Grand National Stand
Canterbury Jockey Club
30-Jul-2015

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Detailed Damage Evaluation

Quantitative Seismic Analysis of Grand National (Public) Stand

Revision 0 – 30-Jul-2015
Prepared for – Canterbury Jockey Club – ABN: N/A

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Client: Canterbury Jockey Club

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Prepared by

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			Name/Position	Signature
0	30-Jul-2015	Draft for comments	Mark Ferfolja Associate Director	

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Executive Summary

AECOM has been engaged by Canterbury Jockey Club (CJC) to carry out a Detailed Damage Evaluation (DDE) of the Grand National Stand (GNS) also known as the Public Stand at Riccarton Racecourse in Christchurch.

This DEE report was prepared as a follow up to AECOM's onsite damage assessment of the building undertaken in March and April 2015 and documented in our Damage Assessment Report (DAR), dated 14 July 2015.

This DDE report documents the pre-earthquake and current seismic capacity of the building, outlines remedial works required to repair damage, and provides concept level strengthening schemes to achieve 34% and 67% of the New Building Standard (NBS) as defined by NZS1170.5:2004 - Earthquake Actions. The report also comments on whether the building is considered to be "dangerous" in the meaning as defined by the Building Act.

Prior to undertaking analysis, AECOM developed a Design Features Report (DFR) which documents key parameters related to methodology of analysis, geometry, loadings, structural modelling, geometric section and material properties.

AECOM has undertaken several, two dimensional Non-Linear Push Over (NLPO) analyses on representative frames in the two orthogonal directions which form the seismic resisting system for the building. An approximation of the global lateral resistance in each direction was calculated by summing the individual frame capacities and the demand was calculated using a spectrum of likely building periods.

AECOM concludes that, all frames when considered individually, have a %NBS less than 34% with typical modes of failure being "soft story" mechanisms, beam sidesway mechanisms and premature shear failure in "short columns". The pre-earthquake capacity of the building as a whole, at the ultimate limit state, under seismic load was assessed as being between 11%NBS and 18%NBS.

It should be noted that the %NBS values noted above are based on potentially non-conservative assumptions, and an optimistic position has been taken by AECOM on matters relating to; bond slip behaviour, adequacy of lap lengths, global torsional effects, reliable beam column joint behaviour, adequacy of confinement reinforcement, second order (P-delta) effects and structural adequacy of the existing roof bracing system. The consequence of this approach is that the actual capacity of the building is likely to be at the lower end of the range provided.

In our opinion, the building is likely to collapse in a moderate earthquake due to several Critical Structural Weaknesses (CSW's) which include an inverted shear wall arrangement on gridline C, the use of plain round bars throughout the building with uncertain / irregular lap lengths, extremely low reinforcement ratios in concrete elements promoting rapid degradation when subjected to cyclic loading and the random / irregular spacing of links in beam and column members.

The building is deemed to be "earthquake prone" when considered in the context of the NZ Building Act 2004 based on the assessed current %NBS seismic capacity being less than 34%NBS, and our opinion that it would be likely to collapse in a moderate earthquake.

AECOM does not consider the building to be a "dangerous building" as defined in "Meaning of dangerous building", Section 121 (1) (a) of the NZ Building Act 2004.

AECOM recommends that the building is strengthened to 67%NBS which is the minimum level of strengthening recommended by the New Zealand Society of Earthquake Engineers (NZSEE). Strengthening to this level will reduce the relative risk of the building from around 20 times to 3 times that of a new building.

AECOM recognizes that it may not always be economical to provide strengthening to 67%NBS. In such instances we suggest that strengthening to a minimum of 34%NBS be undertaken which will reclassify the "earthquake-prone" status of the building and reduce the relative risk (although, to a much lesser degree than in the case of a 67%NBS solution). It is our understanding that the building is required be strengthened to a minimum 34%NBS within certain timeframes imposed by the current legislation. Refer to section 4.2 and Appendix C for more information on proposed strengthening schemes.

In addition to strengthening works, AECOM recommends that repairs of earthquake and non-earthquake related damage are undertaken as detailed in section 4.1 of the report.

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1.0 Introduction

1.1 Overview

AECOM New Zealand Ltd (AECOM) has been engaged by Canterbury Jockey Club (CJC) to carry out a detailed quantitative seismic analysis of the Grand National Stand (GNS) at the Canterbury Jockey Club, Riccarton Park Raceway, 165 Racecourse Road, Christchurch. This report will henceforth be referred to as the Detailed Damage Evaluation (DDE).

This report has been prepared as a follow up to a detailed damage assessment of the building subsequent to the 4 September 2010, 22 February and 13 June 2011 earthquakes and subsequent aftershocks. This sequence of earthquakes will henceforth be referred to as the “Canterbury earthquakes” in this report.

1.2 Related reports

This report should be read in conjunction with the following related reports for the building:

- Damage Assessment Report (DAR), dated 14 July 2015 prepared by AECOM (refer to Appendix A)
- Design Features Report (DFR), dated 29 July 2015 prepared by AECOM (refer to Appendix B)

Refer to DAR for the following information:

- site description,
- site seismic records,
- detailed building description,
- detailed damage assessment of the building,
- floor level and verticality surveys,
- intrusive investigation details,
- material sampling and testing,
- detailed photographical record.

Refer to DFR for the following information:

- scope of the analysis,
- structural layout and load paths,
- soil properties,
- geometric assumptions,
- loading assumptions,
- analysis methodology,
- material properties.

When considered appropriate, some of the information contained in the above mentioned reports has been briefly reproduced in this report.

1.3 Purpose of this report

The purpose of the DDE is to:

- Evaluate the observed condition of the building. This item has been covered in DAR (refer to Appendix A).
- Evaluate the pre and post-earthquake seismic capacity of the building in terms of percentage of new building standard (%NBS, i.e. NZS1170.5:2004-Earthquake Actions).
- Provide indicative repair solutions to the observed damage.

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- Provide recommendations for concept level strengthening schemes to 34%NBS and 67%NBS in the form of marked-up drawings and sketches.

1.4 Building Code requirements

1.4.1 New buildings

The Building Code specifies the current loading code NZS 1170:2002-Structural Design Actions as a means of compliance with the Building Act in terms of the structural strength required for new buildings. Accordingly, the earthquake loading component of this loading code, NZS 1170.5:2004-Earthquake Actions has been used to define the New Building Standard (NBS) in this investigation.

1.4.2 Increase of Christchurch Earthquake Standard

As a result of the recent earthquakes in Canterbury, the seismic hazard factor in the NZ loadings code NZS1170.5 has been increased from 0.22 to 0.3. This change effectively increased the design ultimate seismic loads applied to buildings by 36%. This means that a building designed to meet 100% of NZS1170.5 before this change came in force, would now meet approximately 73%NBS.

1.4.3 Earthquake-Prone Building

The Building Act 2004 and associated regulations define any building which has a seismic capacity of less than or equal to one third of that required for a similar new building (i.e. <34%NBS) and would be likely to collapse in a moderate earthquake causing injury or death to persons in the building or to persons on any other property; and or damage to any other property as an “Earthquake Prone” building.

1.4.4 Earthquake-Risk Building

The New Zealand Society for Earthquake Engineering considers that any building meeting a seismic capacity of at least two thirds of that required for a new building (i e. > 67%NBS) has reached an adequate standard and does not need to be considered as an earthquake risk. Buildings with seismic capacity less than 67%NBS are deemed an “Earthquake Risk” building. The NZSEE strongly recommends every effort be made to achieve improvement to at least 67% NBS. Strengthening a building from 34% NBS to 67% NBS will reduce the relative risk of the building from around 20 times to 3 times that of a new building.

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2.0 Building description and damage status

A brief summary of the building is provided below and in Table 2-1 and Table 2-2 and illustrated in Figure 2-1. Refer to the DFR in Appendix B for a detailed description of the Grand National Stand. The as-built drawings and damage status form part of the DAR included in Appendix A.

The Grand-National Stand is a four storey reinforced concrete structure with timber grandstands, built circa 1920. The lateral load-transfer systems are predominantly moment frames with some shear walls also present throughout the building.

The Grand National Stand is a heritage building and is listed as Group 4 in the Christchurch City Council (CCC) South-West Christchurch Area Plan: Phase 1 Report – European Cultural Heritage.

Table 2-1: Building Summary

Grand National Stand	
Total Length	~ 82 m
Total Width	~ 25 m
Total Height	~ 18.6 m
Importance Level (IL)	3
Number of Stories	5 floor levels 2 grandstands
Total Plan Area (Approximate)	7700m^2

Table 2-2: Level-by-level Building Information

Level	Occupancy	Area	Storey Height
Ground	Workshop & Storage Public Access	1170 m^2 565m^2	0 m (reference level)
First	Public Access	1230 m^2	4 m
Lower Stand	Public Access	825 m^2	4 m – 7.7 m
Second	Public Access	1000 m^2	7.7 m
Third	Public Access	1065 m^2	11.5 m
Upper Stand	Public Access	1080 m^2	12.1 m – 16.4 m
Fourth	Maintenance Access Only	765 m^2	15.6 m
Roof	No Access	~ 2873 m^2	18.6 m

Figure 2-1: Grand National Stand layout

3.0 Structural assessment

3.1 Seismic assessment methodology

Refer to section 5 of the DFR for general information on assessment approach, analysis methodology and a detailed analysis procedure.

The DFR also includes key parameters regarding frame geometries (section 4 and Appendix B of the DFR), section properties used (Appendix A of the DFR) and loading assumptions (section 6 and Appendix C of the DFR).

3.2 Assumptions

In the absence of the original construction drawings or specifications and in order to adopt realistic material and section properties, an extensive programme of intrusive investigations has been completed for the Grand National Stand. The scanning of reinforcement, localized removal of concrete cover and selective material testing allowed AECOM to make calculated assumptions with regard to material properties and sections' reinforcement patterns.

It should be appreciated, that while intrusive investigations refined a number of assumptions, it is impossible to entirely eliminate assumptions which are inherent for this type of assessment.

The following sections outline some of the assumptions made in the analysis which have been broken down into two categories with some of the parameters adopted being potentially conservative while others being potentially optimistic.

AECOM considers that majority of the assumptions made in the analysis are potentially non-conservative. The results of the assessment have been presented as a range of %NBS values and this has been done to capture the uncertainty relating to the assessment parameters such as construction details, actual building period and material strengths. The consequence of using potentially optimistic assumptions is that the buildings actual capacity is likely to be closer to the lower bound value of the assessed %NBS range proposed in section 3.5.

For key parameters (e.g. geometry, material strengths, reinforcement layouts) used in the analysis refer to DFR in Appendix B.

3.2.1 Potentially non-conservative assumptions

The following assumptions adopted are considered to be possibly non-conservative and may contribute to an overestimation of the %NBS seismic capacity of the building:

- It is assumed that existing lap lengths in reinforced concrete columns and beams can develop full capacity of reinforcement bars,
- Effects of bond slip due to round bars being used in reinforced concrete sections have not been considered,
- Concrete encased steel beams are assumed to be adequately anchored in beam-column joints and they are able to develop the full plastic moment capacity of the steel sections,
- Torsional effects due to the eccentricity between the roof and stands mass and the building's centre of rigidity have not been considered in the analysis,
- P-Δ and P-δ effects have not been considered in the analysis,
- The assumed spacing, arrangement and sizes of reinforcement used in the assessment were based on the results of intrusive investigations with the "most typical" arrangements being adopted,
- It has been assumed that the existing primary bracing system within the roof and upper stand can adequately transfer the lateral loads to frame on gridline C,
- Strength and stiffness degradation due to sustained, cyclic seismic loading has not been considered in the analysis,
- Beam-column joints have been assumed to be rigid in the analysis,
- Floor diaphragms have been assumed to be able to distribute the loads between the frames,

- The seismic capacity of the building has been calculated assuming that contributing frames are able to achieve their maximum capacity. This is considered non-conservative as frames achieve maximum base shear at different levels of drift.

3.2.2 Potentially conservative assumptions

The following assumptions adopted are considered to be potentially conservative and may contribute to an underestimation of the %NBS seismic capacity of the building:

- The core area of geometric sections rather than the entire (gross) section area has been used for the capacity calculations of columns,
- A lower-bound concrete strength of 15.3MPa has assumed for all columns and walls,
- Spandrel beams (types 1A and 1B) are assumed to have two longitudinal reinforcement bars in the bottom and no bars in the top.

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3.3 Discussion of results for frames in the North-South direction

3.3.1 Frame on gridline 1

The frame on gridline 1 is regular and symmetrical. The beams and columns between and including levels 0 to 2 are relatively stiff in comparison to top storey (level 3) where significant reduction in sizes of beam and column members occurs.

From modal analysis the elastic period was determined to be 0.36 seconds with the first mode attracting 70% of mass of the structure.

The typical observed mechanism of post-elastic deformation from the four pushover analyses undertaken for this frame is presented in Figure 3-1 and can be summarized as follows:

- Initial moment hinges develop in the level 1 to 3 beams forming beam sidesway mechanism,
- Next a set of hinges develops in the columns at the base of the frame,
- Subsequently hinges form at the top of the columns at level 3,
- At approximately 0.7% drift (100mm) the hinges at the base of the columns reach their ultimate capacity (hinges reach point C on a FEMA load-deformation plot) and the pushover curve drops off,
- At approximately 1.3% drift (200mm) the hinges at the top of the columns at level 3 reach ultimate capacity and the analysis terminates.

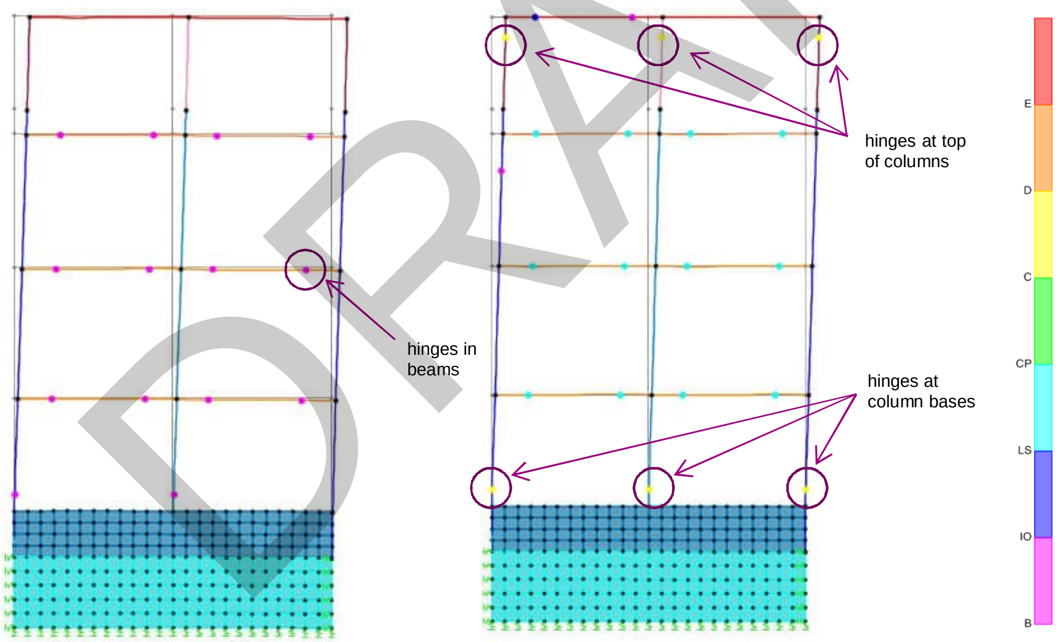

Figure 3-1: Post-elastic deformation of frame on gridline 1 frame at displacements of 10mm and 200mm

The symmetry and regularity of the frame is reflected in the pushover curves which are nearly identical in both directions considered as shown in Figure 3-2. Curves based on the first mode load pattern and the load pattern based on seismic force distribution in accordance with NZS1170.5 are very similar as is expected for a frame with a relatively even mass and stiffness distribution throughout the height.

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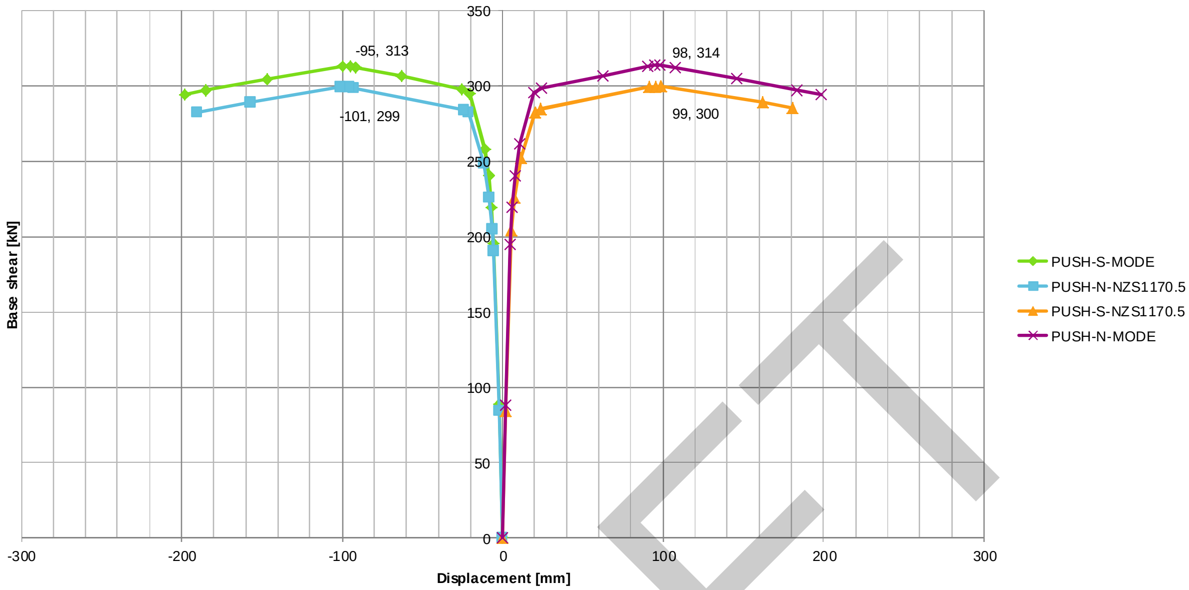

Figure 3-2: Pushover curves for frame on gridline 1

Table 3-1 presents the base shear demand for two considered ductilities, maximum and minimum base shear recorded in the course of the pushover analyses and resulting range of %NBS for the frame.

Table 3-1: Results summary for frame on gridline 1

Seismic demand		Seismic capacity			
Ductiilty μ	Base shear V [kN]	Pushover base shear max [kN]	Pushover base shear min [kN]	%NBS max	%NBS min
1.0	3356	314	299	9%	9%
1.25	2707			12%	11%

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3.3.2 Frame on gridline 2

The frame on gridline 2 is a four storey frame with relatively stiff columns and flexible beams between gridlines C and D. There is an 8.5m high, 15m long shear wall with openings connected to the frame at grid C. As a result there is a significant variability in stiffness between the lower two floors being much stiffer than the upper portion of the frame.

From modal analysis the elastic period was determined to be 0.38 seconds with the first mode (vibration of the upper portion of the frame) attracting only 28% of mass of the structure. The reason for such a low mass participation is the limited mass of the upper frame which contributes to the first mode vibration. The majority of frame mass is concentrated within the shear wall which is not included in the first mode.

The typical mode of failure from the four pushover analyses undertaken for this frame is presented in Figure 3-3. In general a soft storey mechanism occurs on top floor with the hinges forming at top and bottom of the third floor columns with hinges reaching their ultimate capacity at approximately 0.2-0.3% drift (30-50mm).

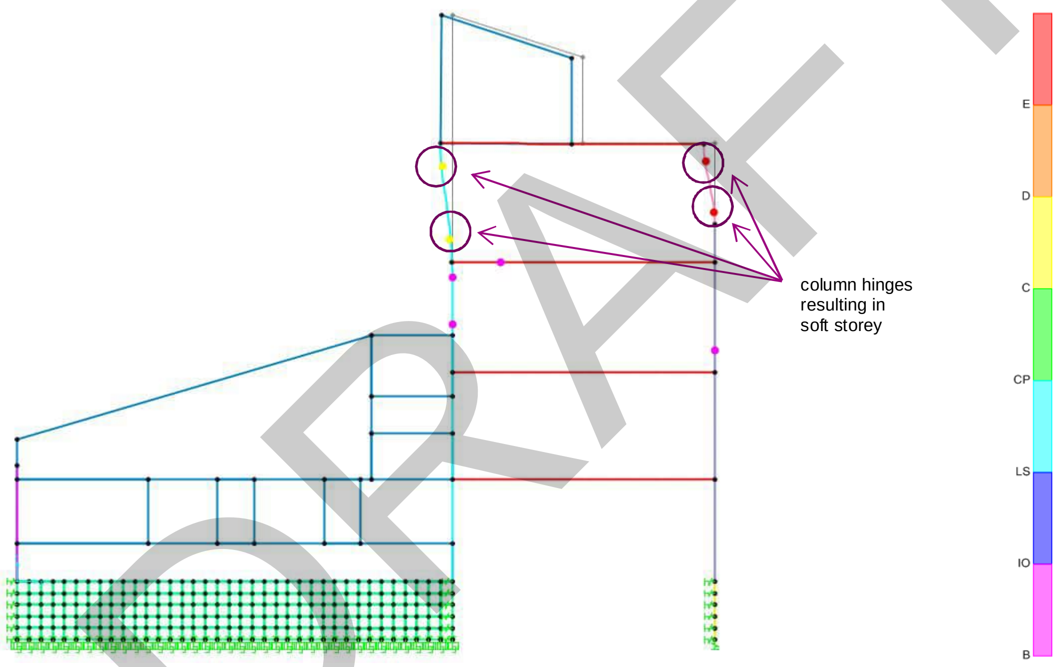

Figure 3-3: Failure mechanism of frame on gridline 2

The pushover curves are shown Figure 3-4. The curves indicate that the frame achieves slightly lower base shear when pushed in the southerly direction. It is also evident that there is a significant difference in curves for frames using modal and NZS 1170.5 distribution load patterns in analyses. The following section explains the reasons for this difference and AECOM's position on which curve represents more realistic capacity of the frame.

The maximum base shear achieved from the frame using the load pattern based on NZS 1170.5 is approximately 60% greater than the base shear obtained from the load pattern based on the frame's first mode. AECOM investigated this difference by comparing the load patterns used in the pushover for the frame. These load patterns are shown in Figure 3-5. It is clear that the first mode load pattern only affects the part of the structure above the shear wall level (above 8.5m) with only minimal load being applied below this level. The NZS 1170.5 load pattern, which is proportional to storey mass, imposes load also on the stiff shear wall. This load is subsequently added to the base shear and is reflected in the pushover curve achieving greater total base shear. With the mode of failure being soft top storey and the capacity of the frame limited by top level columns AECOM considers that the pushover curve based on the modal load pattern best represents the actual case. The maximum base shear that can be resisted by the frame is governed by the minimum load required to cause failure of the top floor and this is best represented using modal load pattern analysis.

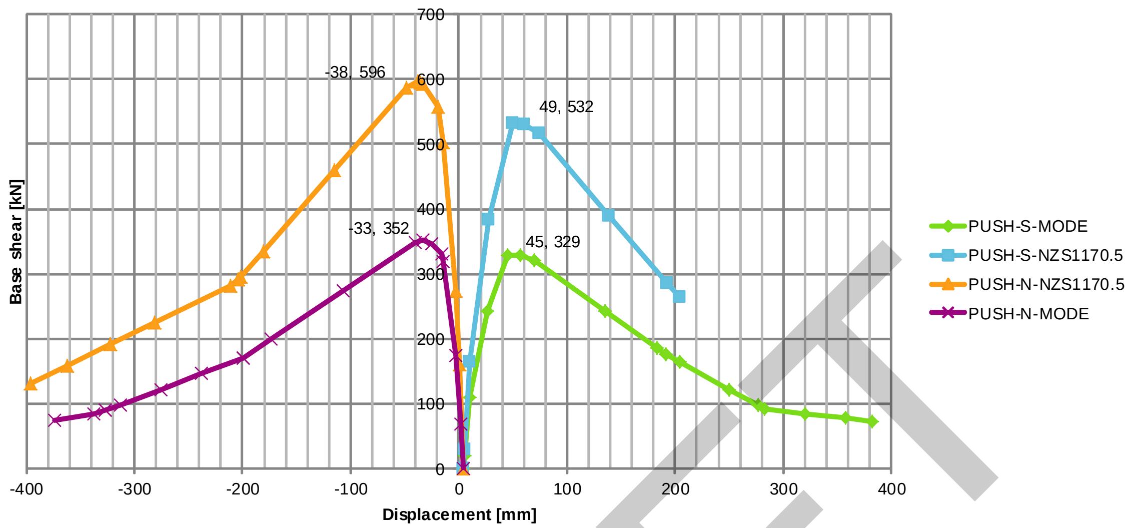

Figure 3-4: Pushover curves for frame on gridline 2

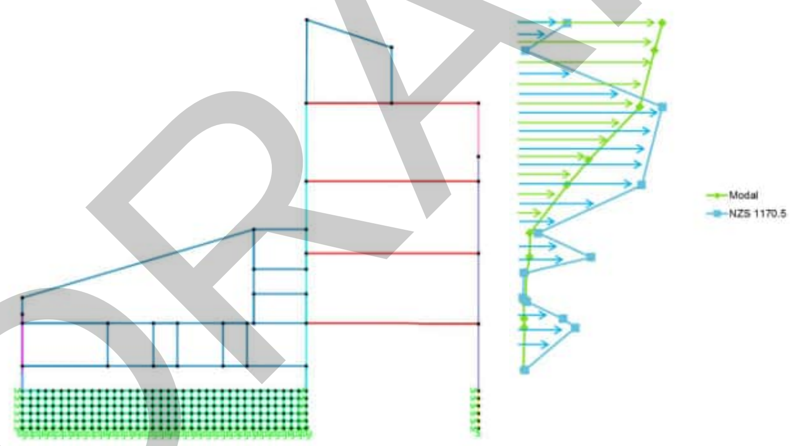

Figure 3-5: Comparison of pushover load patterns based on first mode and NZS 1170.5 for frame on gridline 2

Table 3-2 presents the base shear demand for two considered ductilities, maximum and minimum base shear recorded in the course of the pushover analyses and resulting range of %NBS for the frame.

Table 3-2: Results summary for frame on gridline 2

Seismic demand		Seismic capacity			
Ductiilty µ	Base shear V [kN]	Pushover base shear* max [kN]	Pushover base shear* min [kN]	%NBS max	%NBS min
1.0	4479	532	329	12%	7%
1.25	3612			15%	9%

* Based on pushover in the southerly direction (governing).

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3.3.3 Frame on gridline 4

The frame on gridline 4 represents the most typical arrangement for frames in the north-south direction with 12 of these frames being present across the building length. While the general geometry of the frame is fairly regular in terms of floor to floor heights and beam sizes, the stiffness of the columns is quite different with the internal grid C column having a significantly smaller cross section that the external grid D column. As with all the other frames the perimeter columns have constant cross section up to level 3 where significant reduction in cross sections occurs.

From modal analysis the elastic period was determined to be 1.2 seconds with the first mode attracting 80% of mass of the structure.

For the worst case direction of pushover analysis (in the southerly direction) the observed mode of failure is the development of soft storey mechanism on level 3 as shown in Figure 3-6 with hinges progressively forming at top and bottom of columns on level 3.

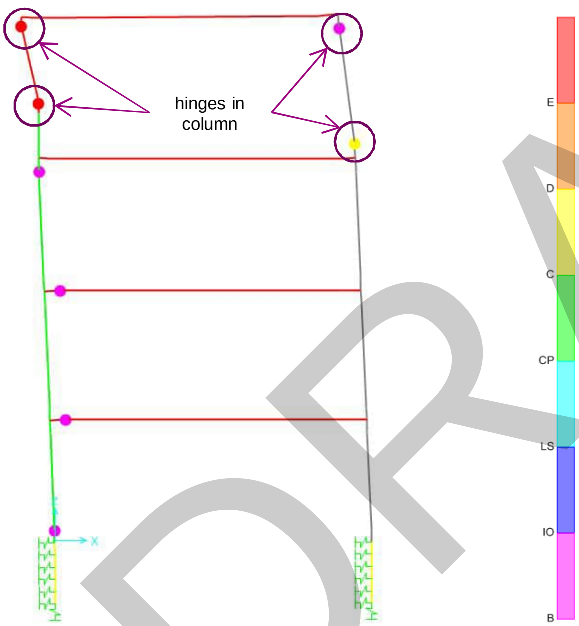

Figure 3-6: Post-elastic deformation of frame on gridline 4 (pushover in the southerly direction)

Due to different columns sizes on gridlines C and D the pushover curves vary, with the pushover in the south direction resulting in a smaller base shear than that reached in the north direction, as shown in Figure 3-7. The shape of the curves is similar for frames with mode-based and NZS 1170.5 loading patterns.

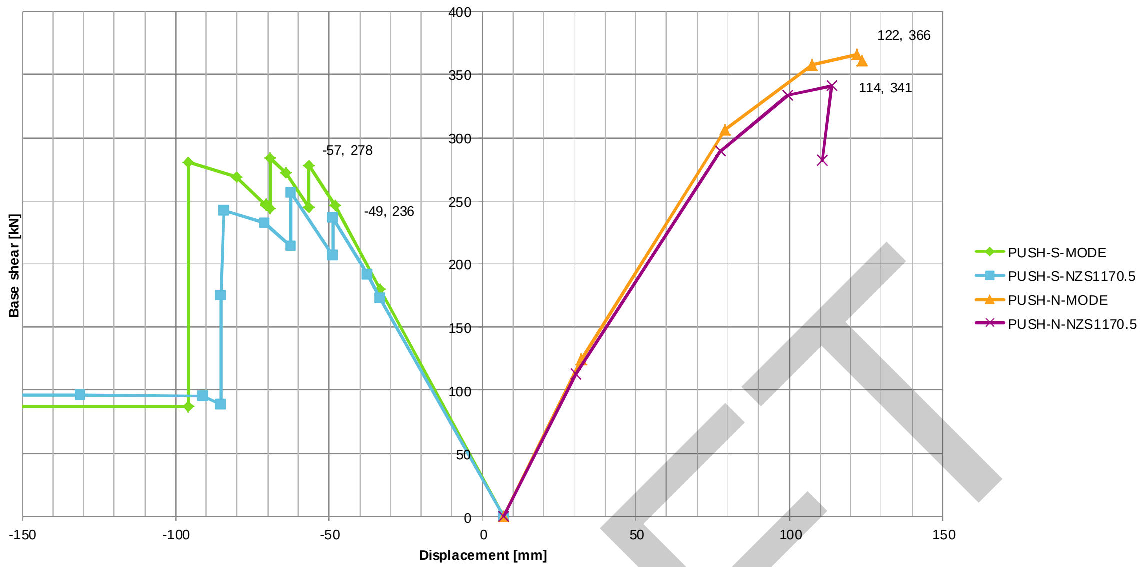

Figure 3-7: Pushover curves for frame on gridline 4

Table 3-3 presents the base shear demand for two considered ductilities, maximum and minimum base shear recorded in the course of the pushover analyses and resulting range of %NBS for the frame.

Table 3-3: Results summary for frame on gridline 4

Seismic demand		Seismic capacity			
Ductiilty μ	Base shear V [kN]	Pushover base shear* max [kN]	min [kN]	%NBS max	min
1.0	1821	278	236	15%	13%
1.25	1469			19%	16%

* Based on pushover in the southerly direction (governing).

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3.3.4 Frame on gridline 13

The frame on gridline 13 is a four storey frame with large stiff columns at grid D and E which reduce in section at the top storey. There are also a few partial height concrete infill walls between gridlines D and E. The column on gridline C and beams between gridlines C and D are relatively more flexible.

From modal analysis the elastic period was determined to be 0.73 seconds with the first mode attracting 72% of mass of the structure.

A typical failure mechanism for the frame is a soft storey at level 3 with the hinges forming at top and bottom of columns (see Figure 3-8). These eventually reach their ultimate capacity at a lateral displacement of approximately 40-50mm when pushed in the southerly direction and 60-70mm for pushover in the northern direction. The column on gridline D attracts a shear force which is in excess of the column's shear capacity resulting in a reduced frame capacity.

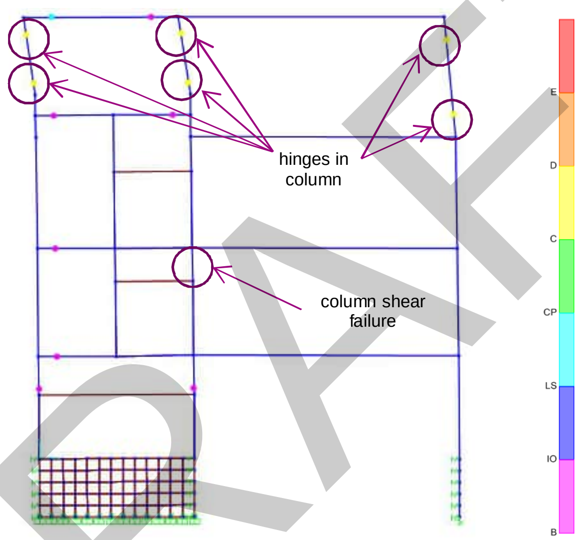

Figure 3-8: Failure mode for the frame on gridline 13

The pushover curves reach similar base shears in each direction as shown in Figure 3-9. It should be noted that column on gridline D (level 1) reaches its shear capacity at a base shear of 595kN in the south direction and 627kN in the north. These values limit the upper bound base shear and this has been indicated on the graph by dashed lines.

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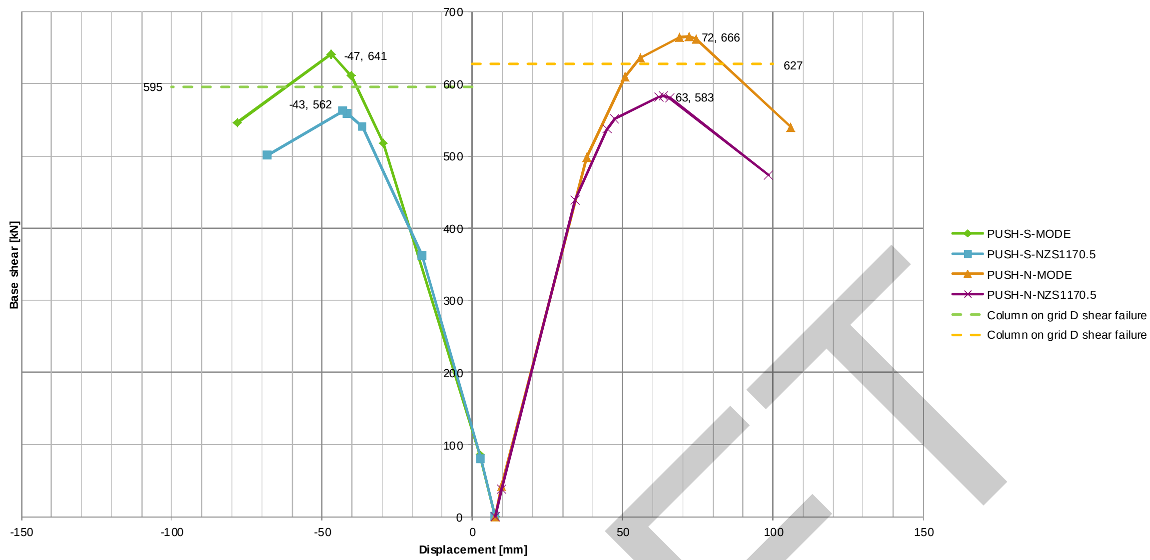

Figure 3-9: Pushover curves for frame on gridline 13

Table 3-4 presents the base shear demand for two considered ductilities, maximum and minimum base shear recorded in the course of the pushover analyses and resulting range of %NBS for the frame.

Table 3-4: Results summary for frame on gridline 13

Seismic demand		Seismic capacity			
Ductiilty μ	Base shear V [kN]	Pushover base shear* max [kN]	Pushover base shear* min [kN]	%NBS max	%NBS min
1.0	2663	595**	562	22%	21%
1.25	2148			28%	26%

* Based on pushover in the southerly direction (governing).

** Approximate base shear at premature shear failure on Grid D column

3.4 Discussion of results for frames in the East-West direction

3.4.1 Frame on gridline C

The frame on gridline C is considered to be a backbone of the building attracting main portion of the seismic mass in the longitudinal (East-West) direction. The layout of walls with its length increasing with height approximates an inverted shear wall arrangement. This results in the stiffness and strength of the frame being at its lowest at level 0. There is a partial height concrete infill wall at level 2 (adjacent to gridline 15) which promotes undesirable “short column effect” behaviour.

From modal analysis the elastic period was determined to be 0.6 seconds with the first mode attracting 93% of mass of the structure.

The non-linear pushover analyses result in multiple hinges developing both in beams and columns at very low levels of drift (0.1-0.2%). The column on grid 15 at level 2 attracts high shear loads particularly when “pushed” in the westerly direction. The column reaches its maximum shear capacity well before the maximum base shear is reached in the pushover analysis. Refer to Figure 3-10 for location of critical columns shear failure.

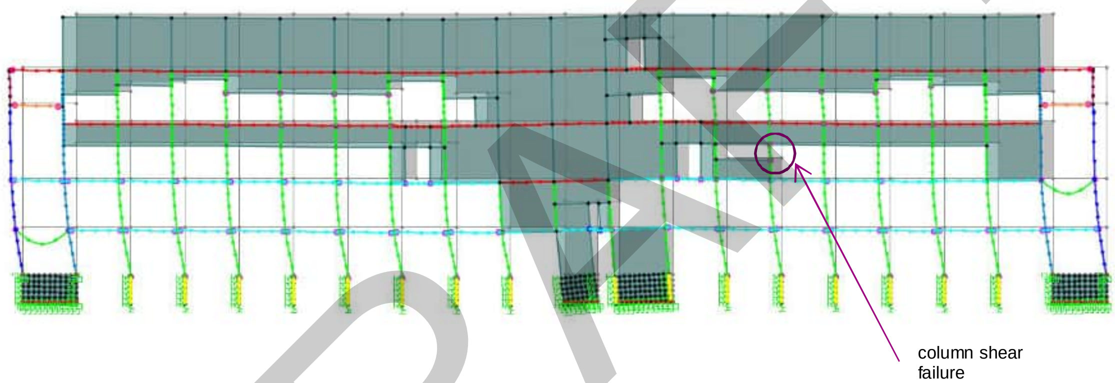

Figure 3-10: Failure mode for frame on gridline C

The pushover curve for the frame is shown in Figure 3-11. While the curve reaches base shears in the order of 5600kN for pushover in the southern direction the premature shear failure of column on gridline 15 on level 2 governs the maximum capacity of the frame. The column reaches its maximum shear capacity at a base shear of approximately 2940kN for the mode based load pattern and 2620kN for the NZS1170.5 load pattern model (both for pushover in the western direction).

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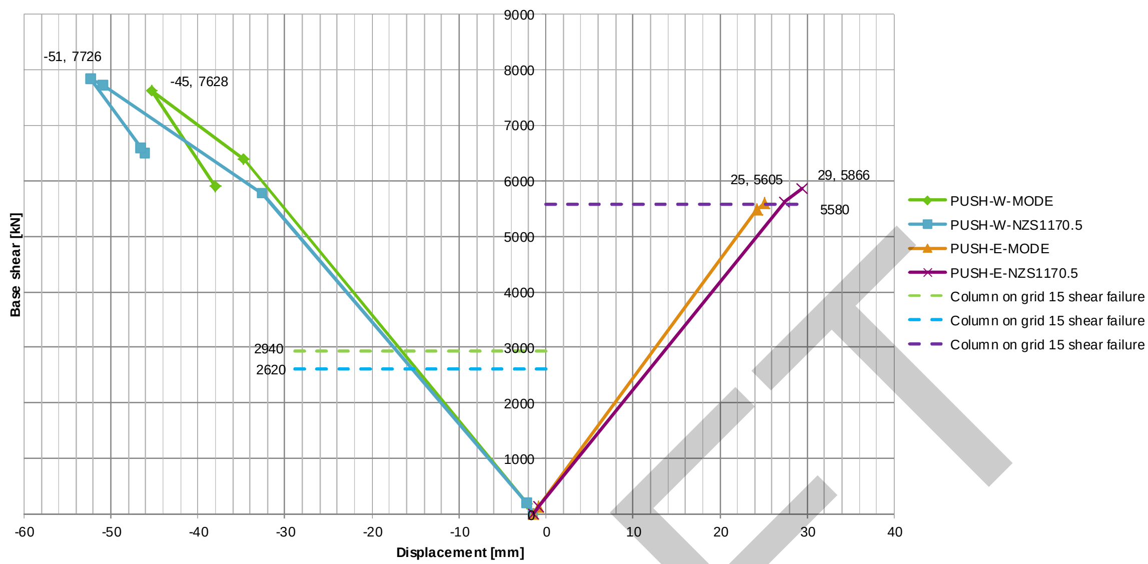

Figure 3-11: Pushover curves for frame on gridline C

Table 3-5 presents the base shear demand for two considered ductilities, maximum and minimum base shear recorded in the course of the pushover analyses and resulting range of %NBS for the frame.

Table 3-5: Results summary for frame on gridline C

Seismic demand		Seismic capacity			
Ductiilty μ	Base shear V [kN]	Pushover base shear* max [kN]	min [kN]	%NBS max	min
1.0	32738	2940**	2620**	9%	8%
1.25	26402			11%	10%

* Based on pushover in the westerly direction (governed by column shear failure).
** Approximate base shear at premature shear failure on Grid 15 column

3.4.2 Frame on gridline D

The frame on gridline D is a four story moment frame located mostly on the exterior face of the building with large stiff columns and deep spandrel beams. There is a relatively flexible section of the frame between gridline 9 and 13 with smaller beams and columns located within the interior of the building. The larger exterior columns become smaller at the top storey which results in the top storey being more flexible.

From modal analysis the elastic period was determined to be 0.36 seconds with the first mode attracting 89% of mass of the structure.

The model develops a beam sway mechanism with the initial hinges forming in the beams and at the base of the columns as shown in Figure 3-12. The columns eventually reach their ultimate capacity at the base at a displacement of 86-88mm or 0.6% drift.

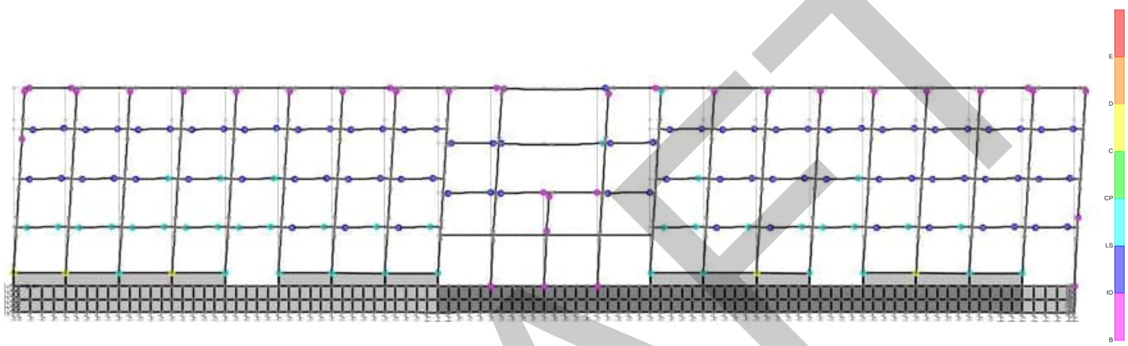

Figure 3-12: Post-elastic deformation of frame on gridline D frame

The pushover curves are similar in each direction, see Figure 3-13, reaching the same displacement and base shear, this is due to the frame being symmetrical and having the same response in each direction.

The mode based load pattern and the load pattern related to mass distribution resulted in similar pushover curves however, the mode based load pattern produced 15% higher base shears than those reached with the NZS1170.5 based load distribution. This is due to the modal load pattern being more linearly distributed along the building's height and the NZS 1170.5 pattern concentrating more load at the upper part of the frame.

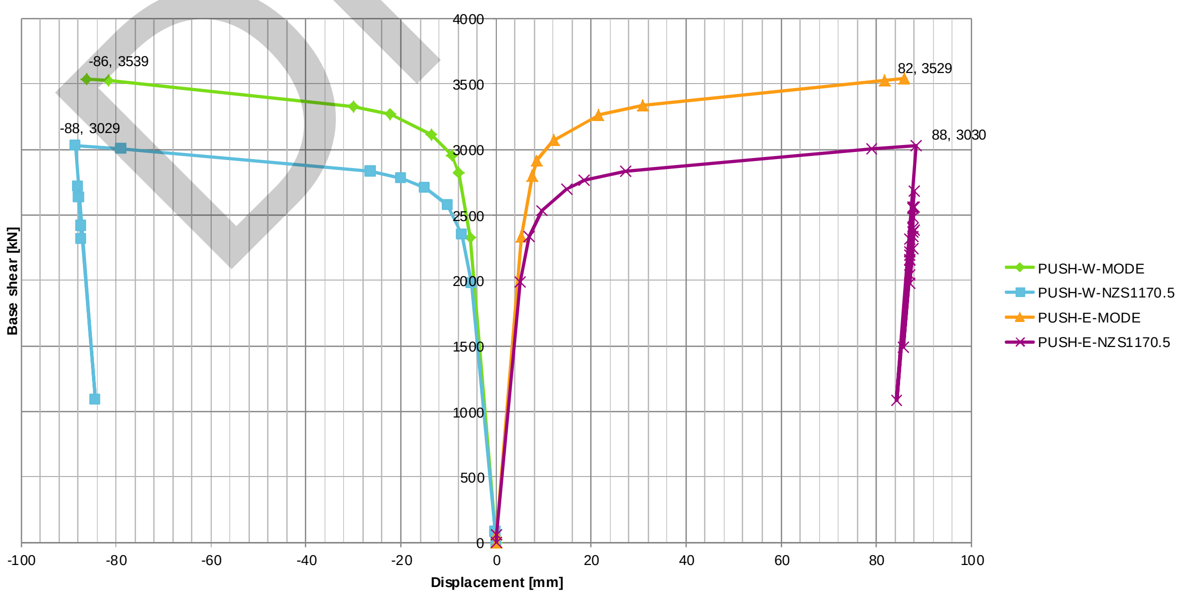

Figure 3-13: Pushover curves for frame on gridline D

Table 3-6 presents the base shear demand for two considered ductilities, maximum and minimum base shear recorded in the course of the pushover analyses and resulting range of %NBS for the frame.

Table 3-6: Results summary for frame on gridline D

Seismic demand		Seismic capacity			
Ductiilty μ	Base shear V [kN]	Pushover base shear max [kN]	min [kN]	%NBS max	min
1.0	26498	3542	3029	13%	11%
1.25	21369			17%	14%

3.4.3 Frame on gridline E

The frame on gridline E is a four storied frame located on the exterior face of the building with stiff columns and deep spandrel beams. Similarly to other exterior frames, the columns become smaller at the top storey which results in the top storey being more flexible.

From modal analysis the elastic period was determined to be 0.46 seconds with 81% of mass participation in the first mode.

The analyses indicate a beam sway mechanism develops in the frame with the initial hinges forming in the beams - see Figure 3-14. At a lateral displacement of approximately 90-100mm (0.6% drift) the hinges at the base of the columns reach their ultimate capacity and the curve drops off and the analysis terminates.

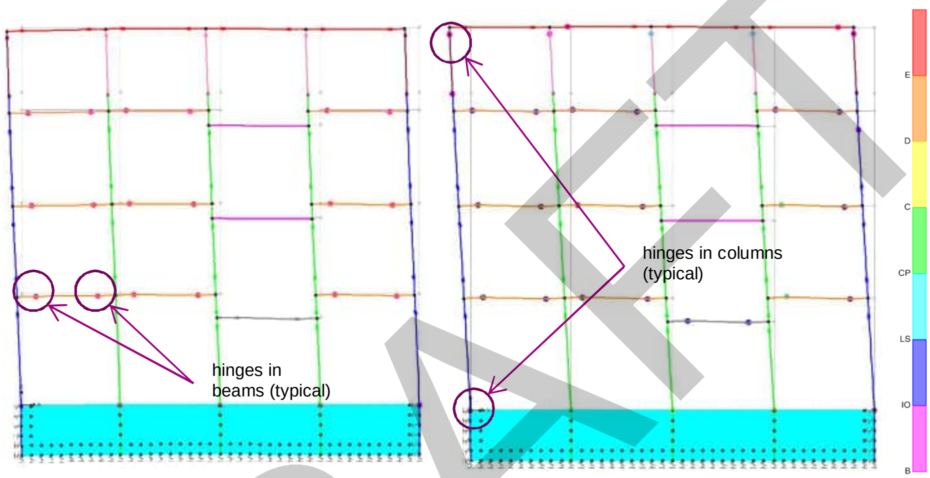

Figure 3-14: Post-elastic deformation of frame on gridline E frame

The pushover curves are similar in each direction, reaching the same displacement and base shear, this is due to the frame being symmetrical and having the same response in each direction. Due to the uniform mass distribution there is not much difference between the mode based load pattern and the load pattern based on NZS 1170.5 distribution.

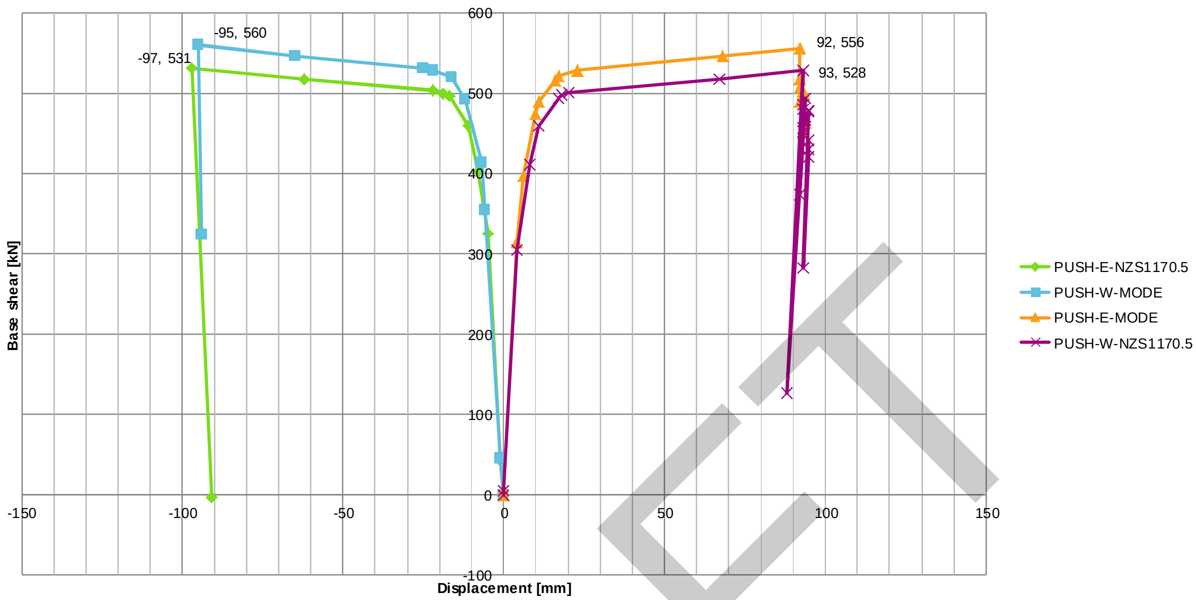

Figure 3-15: Pushover curves for frame on gridline E

Table 3-7 presents the base shear demand for two considered ductilities, maximum and minimum base shear recorded in the course of the pushover analyses and resulting range of %NBS for the frame.

Table 3-7: Results summary for frame on gridline E

Seismic demand		Seismic capacity			
Ductiilty µ	Base shear V [kN]	Pushover base shear max [kN]	Pushover base shear min [kN]	%NBS max	%NBS min
1.0	7748	560	528	7%	7%
1.25	6248			9%	9%

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3.5 Estimate of pre-earthquake seismic capacity of the building

Table 3-8 summarizes seismic capacity ranges for individual frames expressed in terms of percentage of new building standard (%NBS). The table also provides period for each frame and the commentary on modes of failure observed in the pushover analyses. Figure 3-16 is a graphical representation of frame capacities ranges.

In summary none of the frames, when considered independently, exceeded threshold of 34%NBS with the seismic capacities averaging around 13%.

Table 3-8: Summary of results for individual frames

Frame / Grid	Period (s)	% NBS		Failure mode observed in the pushover analysis
		min	max	
1	0.36	9%	12%	Beam sidesway mechanism
2	0.38	7%	15%	Soft storey mechanism at top storey
4	1.16	13%	19%	Soft storey mechanism at top storey
13	0.73	21%	28%	Soft storey mechanism at top storey. Upper-bound base shear limited by column shear failure at level 1.
C	0.61	8%	11%	Column shear failure at level 2
D	0.36	11%	17%	Beam sidesway mechanism
E	0.46	7%	9%	Beam sidesway mechanism

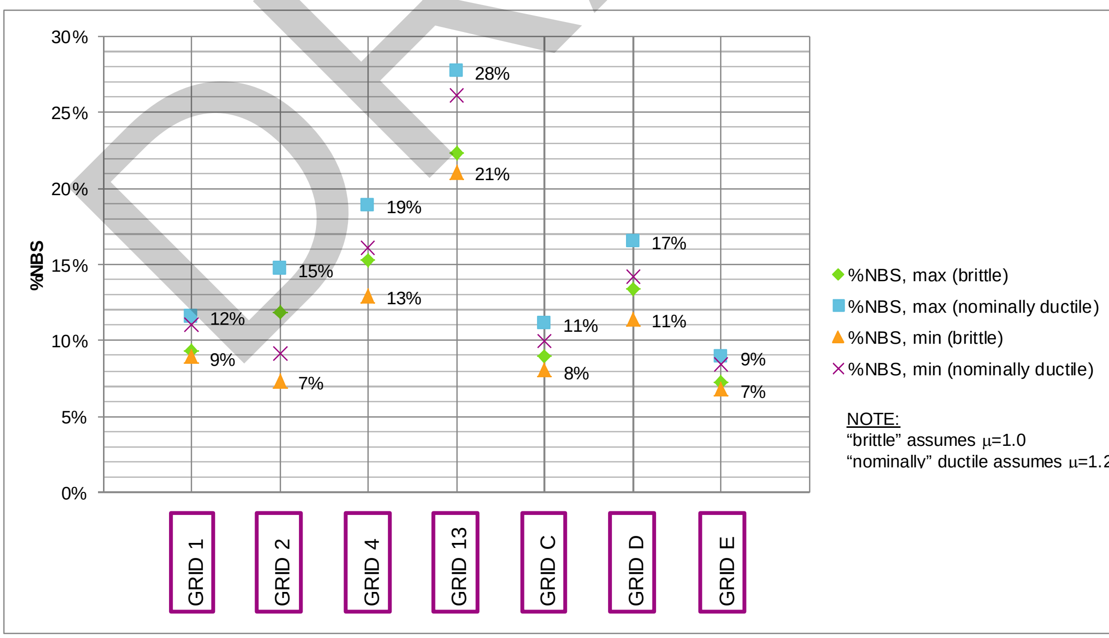

Figure 3-16: Summary of seismic capacities of individual frames

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To rationally convert the capacities of individual frames into the capacity of the entire building and to assess the seismic demand for the building as a whole the following procedure has been adopted:

- Each frame in the building has been approximated by one of the 7 frames analysed as shown in Figure 3-17 and Figure 3-18.
- The seismic capacity of the building was approximated by adding together the individual capacities of relevant frames in the north-south and east-west directions. It is recognized that the maximum base shear for each frame is achieved at different levels of drift. As a consequence the building's capacity is overestimated using this approach.
- The seismic demand on the building as a whole is dependent on the period of the building. AECOM considers that the actual period must fall within the range of periods of the individual frames (0.4-1.2s) with the likely period being between 0.8 and 1.0s.
- The demand for the building has been calculated for a range of periods (0.4-1.2s) with the %NBS for the most likely period indicated in the Figure 3-19 and Figure 3-20.
- AECOM considers that the building's seismic capacity falls into a range given in the Table 3-9.

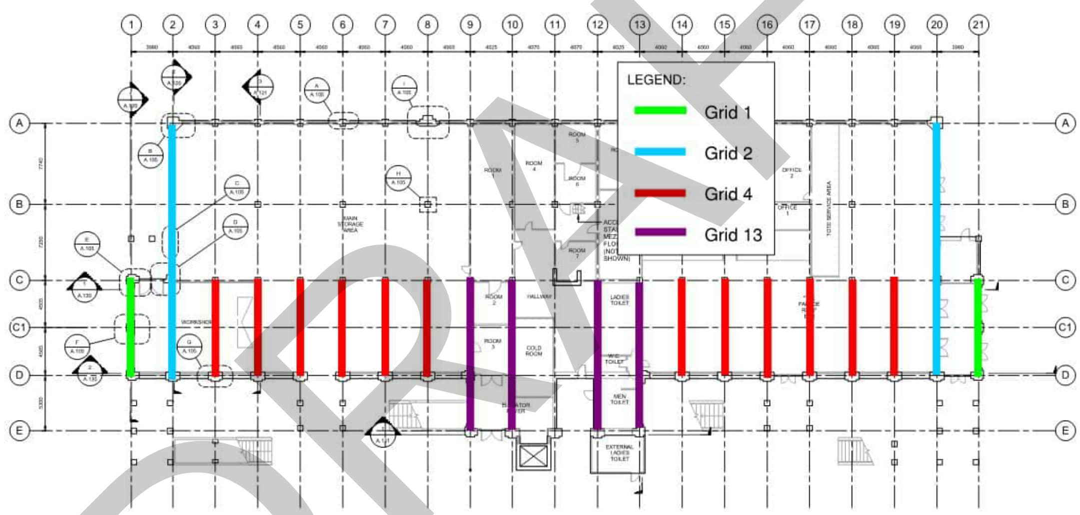

Figure 3-17: Plan of building showing frames in North-South direction and how each was approximated

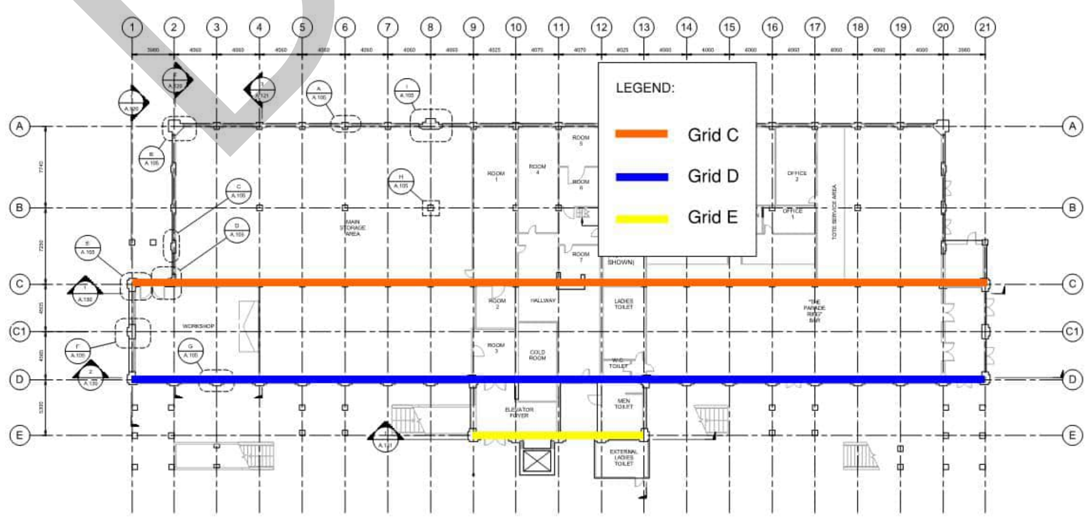

Figure 3-18: Plan of building showing frames in East-West direction and how each was approximated

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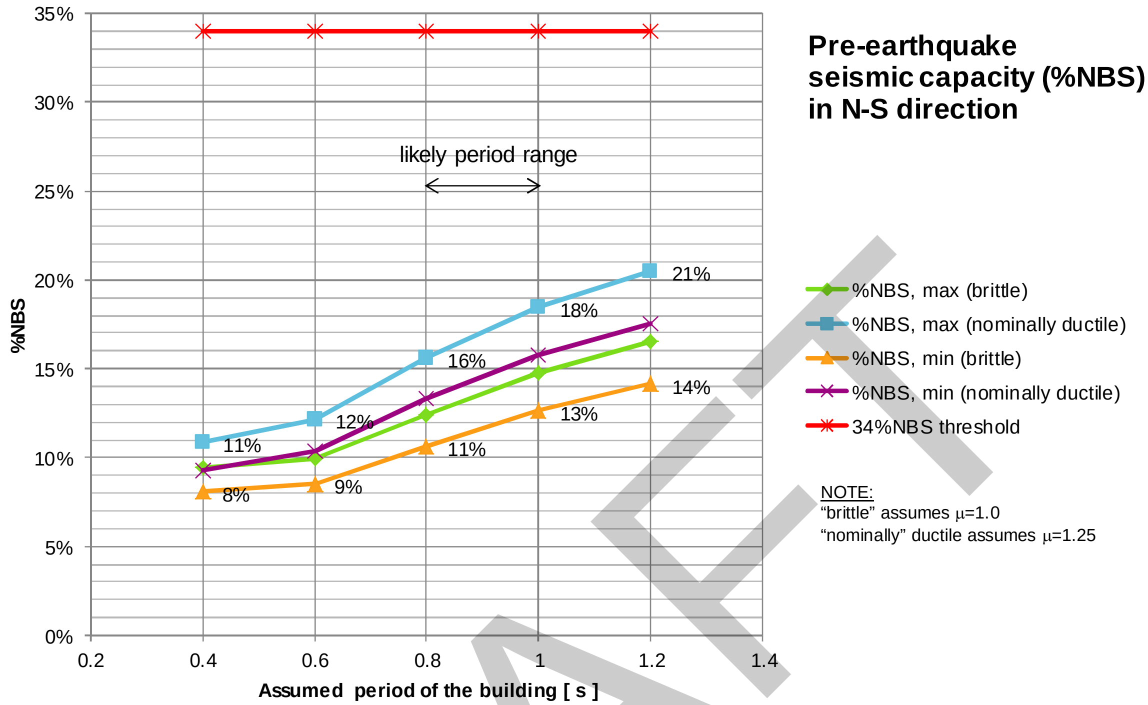

Figure 3-19: Approximated seismic capacity of the building as a whole in North-South direction

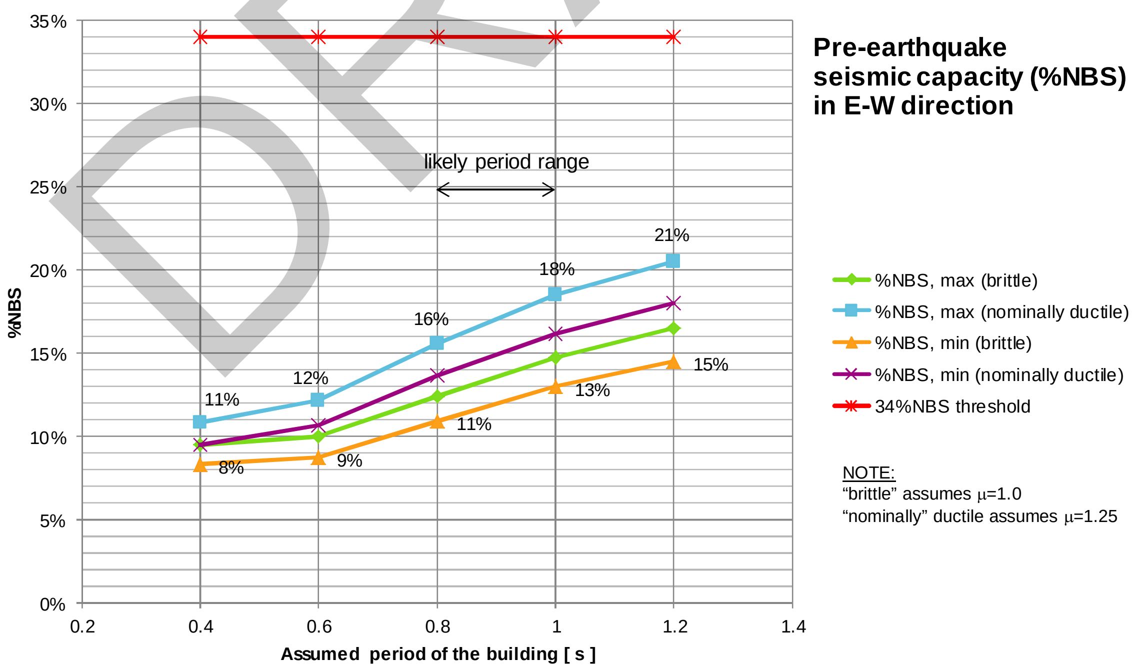

Figure 3-20: Approximated seismic capacity of the building as a whole in East-West direction

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Table 3-9: Pre-earthquake capacity of the building as a whole

Direction	Period [s]	% NBS		Commentary
		min	max	
N-S	0.8-1.0	11%	18%	Lower-bound value of seismic capacity (%NBS) represents the lowest capacity achieved for ductility μ = 1.0; upper-bound value represents greatest capacity achieved assuming ductility μ = 1.25.
E-W	0.8-1.0	11%	18%	

3.6 Estimate of post-earthquake seismic capacity of the building

It should be noted that the building has sustained relatively significant earthquake attributed damage given the level of shaking it was subjected to in the Canterbury earthquakes (in the order of 40 to 50% of the design level earthquake; refer to DAR, section 2.3). As the building had a significant deficiency in seismic capacity based on its pre-earthquake estimate, the post-earthquake capacity would, naturally be less. We note that it would be difficult to quantify the post-earthquake capacity of the building with a sufficient degree of certainty and it would not change the status of the building.

In our opinion the building is likely to collapse in a moderate earthquake for the following reasons:

- The building displays a substantial deficiency in a lateral resisting system despite using potentially conservative assumptions in the assessment,
- The building suffered fairly substantial damage from relatively low levels of shaking during the "Canterbury earthquakes",
- The structural system exhibits a severe vertical irregularity in the form of an "inverted shear wall" arrangement on gridline C,
- The reinforcement ratios in all reinforced elements are extremely low and do not meet minima required by current building codes. As such most of the concrete elements would be treated as unreinforced concrete in the meaning of the current standards,
- The spacing of confining reinforcement is inconsistent with a high degree of variability in spacing observed,
- The use of round reinforcement bars throughout the building and high degree of uncertainty with regards to lap lengths and their effectiveness,
- In general the reinforcement quantity and patterns promote quick degradation of strength and stiffness when subjected to reversible, cyclic loading (e.g. seismic)

As a result the building is deemed to be an "earthquake prone" building according to the NZ Building Act 2004 based on the assessed current %NBS seismic capacity (less than 34%NBS and our opinion that it would be likely to collapse in a moderate earthquake).

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4.0 Remedial work

Repair and concept-level retrofit options recommended herein represent a balanced approach with respect to the following factors:

- achieving a practical repair / retrofit solution at reasonable cost and acceptable level of Building Code compliance,
- maintaining the existing utility value of the facility.

4.1 Repair recommendations

The following repair recommendations summarise methods to return earthquake damaged elements back to their pre-earthquake capacity and serviceability:

- Cracking to concrete beam, column and slab elements in all locations to be repaired by injecting the cracks with an epoxy resin,
- Cracking to the south-east corner of the ground floor slab is to be broken out with new reinforcement to be drilled and epoxied into the existing concrete slab, concrete cast and the remaining slabs stitched together. It is anticipated that upon removal of all floor coverings and wall linings that more significant cracking may be discovered which will also require addressing,
- The cracking to the concrete shear wall on Grid 3 is to be repaired by injecting the cracks with epoxy. The vertical crack running the full height of the shear wall is to be broken out by saw cutting say 0.6m either side of the crack, drilling and epoxying new reinforcement into the existing concrete wall and casting new concrete to stitch the remaining walls together,
- The retaining wall to the north of the structure is to be demolished and replaced. During this process the ancillary buildings and the stairs to the north of the structure will have to be removed. It is likely that they will be able to be removed whole, and potentially reused later. A safe batter will need to be cut into the soil profile to prevent collapse of the retained soil. As a consequence of the retaining wall work, the red concrete podium area to the north of the retaining wall will be affected and likely to require partial replacement,
- The ramps on the southern elevation are extensively damaged with evidence of concrete spalling and historical repair works previously conducted. By observation, it would not appear that a sufficient lateral seismic load resisting system exists. AECOM recommends that the ramps are demolished and replaced, however AECOM acknowledges that the ramps may retain certain heritage values which would need to be considered prior to this recommendation being implemented,
- The stairs on the south elevation are to be retained and repaired, with the cracks to be injected with epoxy,
- The stairs on the east and west elevations have suffered significant damage. AECOM recommends that these stairs are removed and replaced. It is likely that these stairs will need to be removed anyway as a consequence of the replacement of the exterior retaining wall which encloses the building,
- Areas of scabbling and concrete breakout resulting from the intrusive investigations should be repaired using an engineered repair compound or grout.

The following repair recommendations are to repair non-earthquake damaged elements:

- The timber on the lower and upper stand has significant borer damage and wet rot. The timber panelling and bleachers should all be carefully inspected by a specialist and replaced as required. Any timber that is retained and has active borer may affect any newly installed timber,
- The spalled / segregated concrete located predominately on Grid 1 and the shear wall is to be scabbled / broken out and an engineered repair compound or grout is to be plastered onto the surface. In large areas requiring such treatment, a fine mesh and steel "pins" may need to be installed to provide a suitable matrix for such a repair,
- The steel columns supporting the stands display corrosion damage around the collar connection. The paint coating and corrosion is to be removed and the residual steel carefully inspected for loss of section. The existing paint system should be tested for the presence of lead or other potentially hazardous substances prior to removal. Repair will include the reinstatement of an appropriate paint system to protect the steel members,

- The steel in the upper stand roof has significant corrosion damage. The corrosion damage will need to be carefully inspected for loss of section and an appropriate paint system applied. Due to the significant amount of corrosion, repair may also include replacement of some members or connections depending upon the amount of steel section loss,
- The steel cross bracing in the upper stand roof is supported by timber blocking. The timber blocking is not fixed and is falling onto the bird control netting fixed to the underside of the stands. The timber that has fallen onto the net is to be replaced and all timber blocking is to be fixed to the trusses.

4.2 Concept strengthening schemes

Concept strengthening schemes have been developed for the Grand National Stand to achieve 34% NBS and 67%NBS.

The two schemes use similar structural systems of constructing strengthened moment frames in both the north-south and east-west directions at various grids along the structure with the extent of work being greater in 67%NBS solution. Columns and beams are to be enlarged by encasing them with concrete to increase their capacity. To accommodate the strengthened elements the foundations are to be enlarged and new foundation beams are to be installed to connect the internal columns.

The concept strengthening process is set out below and indicative drawings for both the 34% and 67%NBS options are shown in Appendix C.

4.2.1 Foundations

- Excavate 750 – 800 mm wide by 1600mm deep trenches between column lines, exposing the top of existing pad footings,
- Clean face of existing plinths and scabble to expose the reinforcement but no more than 50mm,
- Drill and epoxy H20-200 layers (4 per layer) into existing plinth and foundation beam [refer to details 4 and 5 in drawing C11],
- Place new ground beam cage and column starter bars,
- Cast new ground beams.

4.2.2 Superstructure

- Prop all tributary areas around the columns that are to be modified,
- Scabble all columns to expose existing steel reinforcement but not more than 50mm,
- Scabble sides of beams which are to be encased by 20 – 30mm,
- Remove beam bottom cover,
- Cut 1000 x 200mm slots at 2.0m centres next to beams which are to be encased; retain the existing reinforcement in the floor slab if practically possible,
- Cut all spandrel beams (on the external façade) at column faces; do not cut the internal beam or slab,
- Drill and epoxy columns’ and beams’ connectors; installation of connectors to follow a strict quality assurance process which would be defined prior to commencement of works,
- Install column and beam reinforcement,
- Cast columns and beams.

4.2.3 Stands and roof

- Prepare detailed existing drawings for both stands and roof sufficient to allow for the design of a new bracing system,
- Design a new bracing system to drag loads back to Gridline C at each stand level and roof level,
- Install a new bracing system.

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4.2.4 Additional considerations and risks

- The floor slabs will need to be checked to ensure that they can act as diaphragms to distribute loads to the strengthened moment frames. Carbon fibre strips may need to be added to the slabs,
- Risks to the foundation repair include location of existing services, unforeseen foundation shapes, depth of the water table and unshored construction,
- Access for heavy machinery required to carry out excavation works is restricted at the ground floor level due to existing internal walls of various construction (timber, brick and concrete). Some of the existing infill walls will require demolition prior to enable the installation of the new frames,
- Consideration should be given to temporary and enabling access works for roof and stands in order to allow for installation of new bracing systems,
- Risks to the superstructure include being able to drill and epoxy into existing concrete, limited existing reinforcement and quality of new epoxied reinforcement.

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5.0 Building Consent

A table showing the requirements for consenting of building activity in accordance with Christchurch City Council (CCC) policy is shown below.

This table is indicative (only) and the final requirements are at the discretion of CCC. Further advice should be sought from CCC or a suitably experienced planner, versed in such matters.

Table 5-1: Expected consent requirements

Item	No consent	Exemption from consent	Full consent
Minor crack injection & minor spalling repairs	Yes	-	-
Demolition and replacement of stairs and ramps	-	-	Yes
Demolition and replacement of exterior retaining wall	-	-	Yes
Significant damage repair (local demolition, stitching and recasting of concrete)	-	Yes	-
Implementation of strengthening works to 34% or 67%	-	-	Yes
Repairs / replacement of timber bleachers	-	Yes	-
Structural steel remediation (stripping and painting)	Yes	-	-
Structural steel remediation (replacement, “like for like”)	-	Yes	-

The Grand National Stand is a heritage building and is listed as Group 4 in the Christchurch City Council (CCC); South-West Christchurch Area Plan: Phase 1 Report – European Cultural Heritage. Group 4 structures have the lowest level of heritage protection and the rules governing its protection are detailed in the Damage Assessment Report in Appendix A.

Any alteration of a Group 4 building or the erection of any additional buildings on a site containing a Group 4 building shall be a controlled activity, with the exercise of the Council’s discretion limited to matters concerning the heritage values of the protected building.

Any removal of a Group 4 building shall be a discretionary activity.

An application will need to be made for resource consent for alterations or removal of the building or components. Being Group 4 listed such activities will not require the written consent of other persons and is “non-notifiable”.

6.0 Conclusions and recommendations

6.1 Conclusions

AECOM has undertaken several two dimensional non-linear pushover (NLPO) analyses on representative frames in two orthogonal directions which form the seismic resisting system of the building. The aim of the analysis was to gain a sufficiently accurate estimation of the response of the entire building in an earthquake and estimate its capacity in terms of current building standard (%NBS).

AECOM concludes that, all frames when considered individually, have a %NBS less than 34%. Typical modes of failure are "soft story" mechanism at level 3, beam sidesway mechanism and premature shear failure in "short columns".

An approximation of the global lateral resistance in each direction was found by summing the individual frame capacities. It is recognized that the building's capacity is overestimated using this approach as individual frames are unlikely to achieve full capacity at the same level of drift. The demand has been calculated using a range of structural building periods between 0.4s and 1.2s. These values are considered to be the upper and lower bound periods for the entire building (based on individual frame analysis). This method assumes that the concrete diaphragm is capable of sharing the load between frames. Assessment of the seismic capacity for the building as a whole also results in a %NBS substantially lower than a threshold for potentially earthquake-prone buildings with 11%NBS to 18%NBS achieved.

The seismic capacity was derived by "enveloping" results using:

- lower and upper bound frame capacities for two different load patterns in pushover analyses,
- two different ductilities (μ = 1.0 and 1.25), and
- a range of periods to calculate the global demand.

It should be noted that the %NBS values noted above are based in part on potentially non-conservative assumptions including those related to bond slip behaviour, adequacy of lap lengths, global torsional effects, reliable beam column joint behaviour, adequacy of confinement reinforcement, second order (P-delta) effects and structural adequacy of existing roof bracing system.

It is possible that the capacity of the building pre and post-earthquake remain within the ranges nominated above, however the post-earthquake capacity is likely to be at the lower end of this range.

The building is deemed to be an "earthquake prone" building according to the NZ Building Act 2004 based on the assessed current %NBS seismic capacity (less than 34%NBS and our opinion that it would be likely to collapse in a moderate earthquake). AECOM does not consider the building to be a "dangerous building" as defined in the "Meaning of dangerous building", Section 121 (1) (a) of the NZ Building Act 2004.

Refer to DAR, section 7.2 for conclusions and further comments related to condition and damage assessment of the building.

Structural repair and strengthening works, as described in section 4.0, can improve the %NBS seismic capacity.

6.2 Recommendations

AECOM recommends that the building is strengthen to 67%NBS which is the minimum level of strengthening recommended by the New Zealand Society of Earthquake Engineers (NZSEE). Strengthening to this level is considered to reduce the risk to a reasonable level, taking into account the economic feasibility of strengthening.

However, AECOM recognizes that it may not be economically possible to provide strengthening to 67%NBS in a short term. Therefore, we recommend that strengthening to at least 34%NBS be carried out with a view that in a future further strengthening may take place. This level of strengthening will lift the "earthquake-prone" classification from the building and reduce the relative risk although to a much lesser degree than in the case of 67%NBS solution. It should be note that the strengthening of a building from 34%NBS to 67%NBS will reduce the relative risk of the building from around 20 times to 3 times that of a new building. Concept strengthening schemes have been provided in section 4.2.

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In addition to strengthening works AECOM recommends that the following earthquake-related works are carried out as detailed in section 4.1:

- removal and replacement of retaining wall along northern elevation,
- removal and replacement of external stairs along east and west elevations,
- replacement or strengthening of ramps along southern elevation,
- partial replacement of slab-on-grade at ground floor,
- partial replacement and crack repairs to shear walls,
- further carpet lift to floors and repairs as required (crack injection or partial replacement),
- repairs to intrusive investigation locations,
- crack repairs by epoxy injection in various areas.

Section 4.1 also outlines recommended repairs to non-earthquake related damage such as:

- borer and wet rot to timber bleachers,
- segregated concrete, or
- corrosion to steel elements.

7.0 Disclaimer

1) It should be noted that the remedial measures made in this report do not preclude the possibility of future differential settlement of the building following future significant earthquakes. This settlement will be cumulative and may result in further structural damage, settlement of ground slab and requirement for re-inspection. The requirement for ground improvement should be considered on a cost-benefit basis in accordance with the geotechnical report, taking consideration of cost, time and disruption and likelihood of future damage.
2) This report is for the sole use and benefit of our Client. No other party should rely on this report without the prior written consent of AECOM. AECOM undertakes no duty, nor accepts any responsibility, to any third party who may rely upon or use this report. The basis of AECOM's advice and our responsibility to our Client is set out above and in the terms of engagement with our Client.

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Appendix A

Damage Assessment Report

DRAFT

Damage Assessment Report

Grand National (Public) Stand

Revision 0 – 14-Jul-2015
Prepared for – Canterbury Jockey Club – ABN: N/A

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Damage Assessment Report

Grand National (Public) Stand

Client: Canterbury Jockey Club

ABN: N/A

Prepared by

14-Jul-2015

Job No.: 60332326

AECOM in Australia and New Zealand is certified to the latest version of ISO9001, ISO14001, AS/NZS4801 and OHSAS18001.

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Quality Information

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Date	14-Jul-2015
Prepared by	Matt Clifford, Nik Richter, Olivia Heaslip, Matthew Crake, Claudio Petti and Antonia Corr
Reviewed by	Mark Ferfolja and Mike Lowe

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
0	14-Jul-2015	Draft - For commentary	Craig Oldfield Associate Director - Structural	

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Executive Summary

This report summarises the damage assessment of the Grand National Stand (GNS) also known as the Public Stand undertaken by AECOM NZ at Riccarton Racecourse on behalf of Canterbury Jockey Club (CJC) in March and April 2015.

The purpose of the assessment was to inspect, undertake intrusive and non-intrusive investigations, measure and document the damage sustained by the GNS. AECOM's assessment also included the removal and testing of concrete and rebar samples.

Existing reports and information were used to assist in assessing this building. One of these included a Detailed Engineering Evaluation (DEE) of the GNS completed by Airey Consultants in 2012 which was peer-reviewed by Thornton Tomasetti. As part of this commission AECOM have compared the damage found in the Airey's report with that documented by AECOM. Due to the absence of complete and legible structural drawings, an extension to AECOM's scope included a full site measure of the building and the creation of a 3D structural model of the grandstand.

Riccarton Park is an open and flat site with numerous small buildings and another significant grandstand (the Club Stand) to the East of the GNS.

The grandstand was built circa 1920 and is approximately 82m (long) x 25m (wide) with an approximate plan area of 7700sq m. The structure is essentially divided into two, with a multi-storey concrete frame to the rear and twin level lightweight bleachers to the front (racecourse side). A group of reinforced concrete stairs and ramps provides access to the stand. The GNS internal columns are supported by concrete pad foundations while the exterior perimeter columns and walls are supported by strip foundations bearing onto dense sands and gravels.

The GNS is Group IV Heritage listed with Christchurch City Council (CCC).

To aid in the assessment of the GNS, a grid system was overlaid on the stand with 21 grids labelled numerically running north-south and 5 grids labelled alphabetically running east-west.

The damage observed was extensive and was located within the building itself including the roof, ramps and stairs, and the large retaining wall to the front of the stand. Where accessible, all surfaces were considered including tops and soffits of slabs, vertical surfaces and the interior and exterior of façade elements. Cracking of concrete elements was recorded on drawings with accompanying photographs. In most instances, maximum crack widths, lengths and locations were recorded. The most significant damage was located on the E/W shear wall on Grid C, the ramps and stairs generally behind the grandstand, retaining wall to the front of the grandstand and the ground floor slab.

Observation of any damage to the steel roof frame was limited by difficult access and safety considerations. An Elevating Work Platform (EWP) was used to provide closer inspection of some of the roof and front column elements.

A level survey conducted on all floors was undertaken using a Zip™ level and a verticality survey was undertaken across the entire building on walls and columns using a 1200mm long digital "spirit level". Due to access restrictions, the verticality of the long slender columns at the front of GNS were measured by a specialist surveying sub-contractor. Based on measurements it appears that the GNS has settled in the order of 72mm with a gradual slope from east to west.

Intrusive works involved removing floor and wall linings to provide access to the structure, removing concrete core and rebar samples, localised removal of concrete to expose rebar sizes, cover and reinforcement locations and rebar scanning of concrete undertaken by a specialist sub-contractor. Asbestos linings on various surfaces were removed and treated, prior to intrusive works being undertaken.

Contrary to previous assumptions, the intrusive works found concrete encased steel beams, not reinforced concrete beams, between Grid C and D on all levels. The precise nature of the connection detail between the steel beams and the concrete columns is unknown. The notionally square concrete columns supporting the grandstand are very lightly reinforced using 19mm bars (one in each corner). The intrusive works also found that the reinforcement used in the GNS comprised plain round reinforcing bar and not deformed bar (which is standard, modern, industry practice).

From testing, the concrete compressive strength was determined to be 25.5 MPa for the beams and floors and 15.3 MPa for columns and walls. The low strength for the columns and walls reflects the large sized aggregate

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found in the core samples. The steel reinforcement was sampled to determine the yield stress, tensile strength and ductility. 19 mm bars were found to have a yield stress of 296 MPa, tensile strength of 451 MPa and normal ductility. 7 mm bars were found to have a yield stress of 307 MPa, tensile strength of 451 MPa and high ductility.

Structural steel properties were found in a 1906 “Steel Construction Handbook”. The material properties inferred from this source indicated that the steel would have a yield stress of 202 MPa, tensile strength of 432 MPa and Young’s Modulus of 200 GPa.

To determine the magnitude of design level earthquake the Grand National Stand experienced during the Canterbury earthquake sequence the PEER Ground Motion Database peak spectral acceleration values for Riccarton High School, the closest recording station, were used. Using an expected period range of 0.8 to 1.0 second the Grand National Stand experienced approximately 50% of a current design level earthquake. Therefore, the damage sustained was initiated by an event approximately half the magnitude of the design event and significantly more damage would be expected in a design level event.

As part of this report, the damage assessment completed by Airey Consultants was compared to the findings generated by AECOM. Airey’s damage assessment formed part of their DEE analysis report. Airey presented damage in a general manner over two pages. AECOM catalogued each item of damage individually, and inspected elements by undertaking intrusive works.

AECOM generally agree with, but have identified significantly more, damage than Airey Consultants. Additionally, the key areas of report disagreement include:

- Shear wall on Grid C. Airey’s report omits this item,
- Airey reported that the building is a reinforced concrete frame. AECOM’s intrusive investigation reveals that N/S beams, at all floor levels are in fact steel beams,
- Airey reported that the column reinforcement varies from 25mm to 32mm dia. AECOM’s intrusive investigation reveals that columns are reinforced with 19mm bars,
- Damage to diaphragms. Airey’s conclude there is no diaphragm damage. AECOM disagree, citing the damage assessment,
- Airey’s over riding conclusion is that damage is “…minor, ie, nothing more than hairline cracking…” AECOM disagree with this conclusion as significant damage has been identified during the assessment.

Upon review of the building and our findings AECOM recommends that a full quantitative analysis (e.g. DDE, DSA) be undertaken for the building in order to assess the seismic capacity in terms of percentage of new building standard (%NBS, i.e. NZS1170.5:2004-Earthquake Actions).

1.0 Introduction

1.1 Overview

AECOM New Zealand Ltd has been engaged by the Canterbury Jockey Club Inc. Soc. to undertake a seismic damage assessment of the Grand National (Public) Stand at the Canterbury Jockey Club, Riccarton Park Raceway, 165 Racecourse Road, Sockburn, Christchurch.

An Initial inspection of the Grand National Stand was carried by AECOM structural engineers, Nik Richter and Matt Clifford, on Tuesday 11th March 2015, Wednesday 12th March 2015, and Friday 13th March 2015. These initial inspections were non-intrusive visual inspections only, the main purpose of which was to identify areas for intrusive works and to understand the structural systems. The AECOM report "Intrusive Investigation Report - Grand National (Public) Stand" dated 14 April 2015 documents the initial inspection observations, recommendations and conclusions.

Detailed site inspections were performed by AECOM structural engineers Matt Clifford, Nik Richter, Olivia Heaslip, Claudio Petti and Matthew Crake from the 17th April till 14th May 2015.

This report documents the detailed investigations undertaken by AECOM.

1.2 Purpose / Scope

The scope of the damage assessment report is to document the results of the detailed site investigation. The preparation of the damage assessment involved carrying out desk studies/liaising with Thornton Tomasetti, site investigations and preparing the damage assessment report. The detailed assessment included the following desk study activities:

- Preliminary structural desk study – AECOM reviewed the existing Detailed Engineering Evaluation (DEE) report completed by Airey Consultants Ltd. (dated 20 August 2012), the Thornton Tomasetti Peer Review (dated 18 December 2012), and existing building drawings that are available. Refer to section 1.3 for a list of documents sighted during the initial desk study. The existing drawing sets recovered were incomplete and insufficient to gain a general appreciation of the structure. (As a result it was necessary for AECOM to carry out a dimensional survey of the building.)
- Geotechnical Desk study/Review - AECOM geotechnical engineers carried out a review of existing geotechnical reports and data
- Liaising with Thornton Tomasetti (TT) with regard to the available project information and included TT in the project approach / strategy as foreseen by AECOM
- Liaising with Thornton Tomasetti (TT) with regard to the findings of the detailed site investigation

The following site investigations were undertaken:

- Site familiarisation inspection. AECOM carried out a brief site inspection to become familiar with the site, scale of building(s), access / egress, site contact(s) and Identify potential H&S risks and note these in AECOM's SWMS register
- Performed visual observations and a walk-through of the building to align understanding of drawings with current building layout and verify the existing structural arrangement matches the recovered drawings and note any obvious changes or alteration's to the building
- Identified areas of restricted access and noted these for future reporting
- Developed a programme for future intrusive investigation of structural members. AECOM provided a brief report outlining areas which need to be exposed for detailed inspection. (refer to section 1.3 below)
- Carried out a floor level survey on each floor taking indicative spot levels using a ZIP level and undertook a verticality check on the vertical structural members
- Identified and recorded the building damage, noting whether, in the opinion of the assessing engineer, the damage was caused by the seismic events or by other causes (e.g. installation of services or other alterations to the building, vehicle impacts or general wear and tear). The damage was recorded using

photographs with written descriptions and the locations of the photographs were noted on drawings prepared by AECOM

- Verified, as far as practical, the sizes of structural members and verified the structural arrangement (including reinforcement layout and detailing otherwise concealed in reinforced concrete elements)
- Identified the use of all areas of the building
- Identified any modifications made to the building structure wherever possible
- AECOM determined the principal vertical and lateral load-paths
- AECOM carried out a dimensional survey of the building and prepared as-built drawings.
- AECOM carried out intrusive investigations, directing sub-contractors to expose various structural elements, scan concrete elements, undertake verticality measurements to columns supporting stands and roof as described in the body of this report
- Sampling of concrete and reinforcement to material properties testing
- AECOM geotechnical engineers carried out a shallow intrusive investigation to confirm foundation general arrangements and ground conditions (groundwater level, soil composition, etc.)

The following activities were carried out during the preparation of this damage assessment report:

- Prepared descriptions of the overall structure and the general condition of the building structure and fabric such as cladding, as well as describing the vertical and lateral load resisting systems
- Documented the damage observed. Where possible, the causes of the damage were identified. Photographs and marked up drawings have been utilised to document and present the observed damage
- Provided an opinion with respect to the building damage reported in the Airey Consultants Ltd. DEE report, as to whether their comments and / or assumptions are valid and if not, which are not and why not
- Documented the level, verticality and dimensional surveys carried out by AECOM. This documentation was recorded on drawings prepared by AECOM for the building
- Documented the intrusive investigation carried out on site
- Carried out an assessment of the bearing capacity at selected locations as per the intrusive investigation and provided recommendations regarding further loading
- Carried out an assessment of site seismic records to determine the likely peak ground accelerations experienced at the site
- Documented the materials testing undertaken

1.3 Sources of Information

- Architectural modification drawings. Not dated, but assumed to be circa 1981, by Gleeson Architects.
- Structural, mechanical services, electrical services, and fire services alteration drawings dated 27 July 1981, by Powell Fenwick and Partners Consulting Engineers.
- All drawings were received as scanned images only and AECOM did not view originals. As such these documents served as reference sketches only as dimensions and details were not legible.
- Detailed Engineering Evaluation carried out by Airey Consultants, dated 20 August 2012.
- Initial report carried out by Thornton Tomasetti (TT), dated 18 December, 2012.
- Airey and TT reports were used as sources of information and as aids to AECOM's initial inspections.
- Geotechnical desk study for the Tote Building dated 15 October 2014 by AECOM.
- AECOM Dimensional Survey.
- AECOM visual and intrusive investigations.

- AECOM report scoping intrusive investigation dated 14 April 2015.
- Column verticality & beam level survey report from Staig & Smith dated 1 May 2015.
- Concrete compression test reports from Opus International Consultants Ltd dated 4 May 2015 and 29 May 2015.
- Steel reinforcing test reports from SAI Global dated 28 April 2015, 30 April 2015 and 5 June 2015.
- X-Radar & Ferroscan Investigations from Scancrete.

D R A F T

2.0 Grand National (Public) Stand description

2.1 Site Description

The building is located on the grounds of the Riccarton Park Raceway, which is located at 165 Racecourse Road, Sockburn, approximately 7 km west of the Christchurch CBD, as shown in Figure 1.

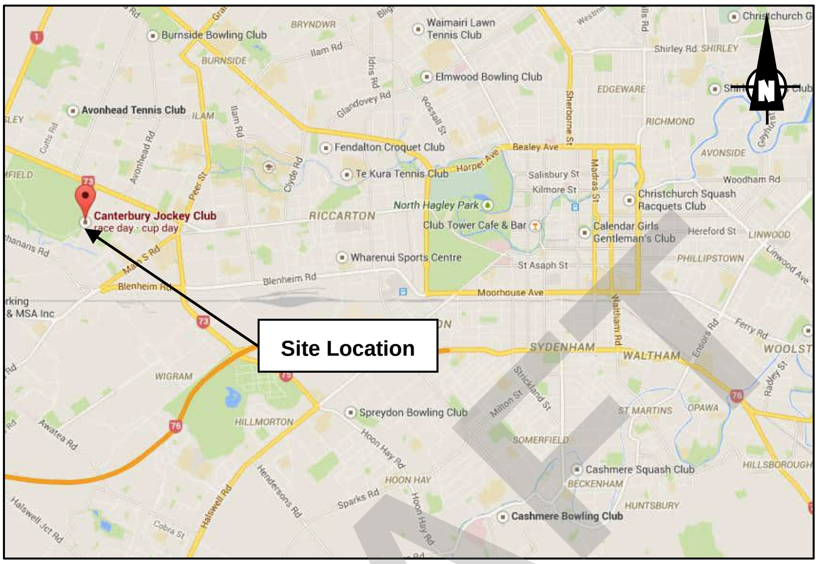

Figure 1: Site Location Plan [1]

This site is generally flat and at the same level as the immediate surrounding area. The building, which will be referred to as the "Grand National Stand", is located on the southern side of the Racecourse, adjacent to and west of the property's other remaining grandstand, the Club (or Administration) Stand. There are several other racecourse buildings in the southwest vicinity of the building as shown in Figure 2. The ground directly to the south of the building is paved in asphalt and the ground directly to the north of the stand is finished with a salmon-coloured concrete plinth, with an integral concrete retaining wall retaining up to 1.8m of ground. The Grand National Stand itself is founded on level ground.

Figure 2: Site Layout Plan [2]

2.2 Geotechnical Appraisal

2.2.1 Desk Study

AECOM has prepared a report following a desk study for the Tote Building (Ref 60332326/1.2, dated 15 October 2014). No site specific investigation was undertaken by AECOM and our report is based on information available on the Christchurch Geotechnical Database (CGDB) [3], the Ministry of Business Innovation and Employment (MBIE) Guidance document [4] and other provided reports associated with the development.

The reader is referred to the above referenced AECOM report for details on the sub surface ground materials, discussion of ground performance and geotechnical design advice.

In accordance with NZS 1170.5:2004 [5], the site is considered to be subsoil Class D.

Additional geotechnical data from the CGD and ECan database that was not available at the time the desk study was received and has been reviewed as part of this assessment and all points are listed in Table 2-1. Locations of the data points and the related records are presented in Appendix H. These investigations were not undertaken by AECOM and, therefore, their accuracy cannot be guaranteed.

Table 2-1:Existing geotechnical data

CGD ID (original reference)	Investigation Type	Depth (m below ground level)	Date	Approximate Distance and Direction from Site	Notes
CPT_54208 (CPT2)	CPT	4.95	24/04/2014	250 m SE	No groundwater recorded.
HA-DCP_54211 (P3 + 4 + A3)	HA-DCP	1.8	16/04/2014	250 m SE	No groundwater recorded.

Notes: CPT = Cone Penetrometer Test
HA-DCP = Hand Auger – Dynamic Cone Penetrometer

Based on the existing geotechnical data, the inferred site geology comprises very stiff silt from surface to between 0.9m to 1.3m, underlain by loose sand with a thickness of 1.3m to 1.8m, which in turn is underlain by very dense gravels up to 12m in thickness, all of which are of the Springston Formation. It should be noted that the summarised ground conditions have been interpreted from investigations undertaken by others, the accuracy of which cannot be guaranteed by AECOM. It should also be noted that alluvial deposits can be laterally variable over short distances. As such, it is likely that ground conditions vary across the footprint of the structure and more generally over the site.

2.2.2 Liquefaction and Lateral Spread Potential

AECOM concluded that land damage due to lateral spread or liquefaction is unlikely due to the low water table and non-liquefiable soil strata supported by a lack a reported signs of liquefaction over the site. It is noted that Canterbury Earthquake Recovery Authority (CERA) has designated all residential land directly adjacent to the Riccarton Racecourse grounds as green zone, technical category 1 (TC1) [6]. Whilst these zonings do not apply to commercial structures, the lack of reported liquefaction ejecta and the lack of ground cracking or major settlement on site would suggest that the site is likely to have similar characteristics as land classified as TC1.

The advice provided by AECOM in the desk top study was provided for qualitative assessment of the geotechnical risks at the site only. Should replacement foundations be required as part of the retrofit works, a site specific geotechnical investigation should be undertaken prior to undertaking detailed design.

2.2.3 Site Investigation

An Engineering Geologist from AECOM undertook a shallow intrusive geotechnical inspection on 25 June 2015 and a further inspection on 2 July 2015. The inspections were completed in the excavations at the base of column C7 and alongside the base of strip footing D7, as referred to in Tables C-7 and C-9. The purpose of the geotechnical investigation was to confirm the dimensions of the footings, confirm the existing ground conditions at the locations of the footings and determine the bearing strength of the ground material supporting column C7 and strip footing D7.

2.2.4 Observations

During the investigation on 25 June 2015, the plinth structure below the level of the floor slab of column C7 was exposed in the excavation; however the footing of the column C7 and strip footing D7 were not exposed. The material exposed in the wall of the excavations comprises organic silt [topsoil], silt, and sandy gravel [fill] which was located around the edge of the column structures. The fill material around the plinth is loosely packed, and at the location of C7 it is approximately 330mm to 380mm wide to a depth of 0.9m below the base of the floor slab (bbs). From a depth of approximately 1.1m bbs to the base of the footing the width of the fill reduced to 300mm. At the north-western side of D7, the width of the fill is approximately 250mm to 400mm.

The excavations were subsequently deepened, and during the investigation on 2 July 2015, the footing of column C7 was exposed in the excavation. Whilst the full depth of the base of the footing for column C7 was not exposed, it is considered likely that it is founded on the natural medium dense silty fine sand.

A concrete strip was exposed at the base of D7, however it is thought that this is not the true footing structure as it is not connected structurally to D7. It is likely that the true footing structure is present at a depth similar to the footing structure for column C7. This concrete strip was founded on the natural fine sand. In addition to the existing material exposed in the excavations, fine silty sand was observed at the base of the excavations.

Selected annotated site photographs with dimensions of the footings are presented in Appendix H. Based on site observations, dimensions of the footings are presented in Table 2-2. Whilst the observed footing at D7 is not considered the true footing, its dimensions have been included for comparison.

Table 2-2: Observed footing geometry

Foundation Element		Depth (mm)	Width (mm)
Concrete Plinth	Column C7	1650	760 – 770
	Strip Footing D7	1150	2600
Concrete Footing	Column C7	130[A]	220 – 240[B]
	Strip Footing D7	200	150 – 380[B]

Notes: A – Full depth of footing not measured
B – Width of footing extending from plinth

2.2.5 Shallow Investigation

One hand auger with hand held shear vane tests and two Dynamic Cone Penetrometer (DCP) tests were completed in the excavation of column C7, and hand held shear vane tests with one DCP test were completed in the excavation of strip footing D7 on 25 June 2015. The hand held shear vane tests were carried out in the wall of the excavations.

To confirm the dimensions of the column footings, an additional DCP test was completed in the excavations of column C7 and strip footing D7 on 2 July 2015. During both investigations, DCPs and the hand auger were carried out in the base of the excavations.

A plan of the investigation locations are presented in Appendix H.

2.2.6 Investigation Results

The shallow AECOM investigation confirms that the near surface material is broadly consistent with the ground model outlined in the AECOM geotechnical desk study. The inferred site geology is summarised in Table 2-3, with depths taken from below the base of the floor slab.

Table 2-3: Inferred site geology

Material Description	Depth from base of floor slab (m bbs)	Thickness (m)
Loosely packed sandy GRAVEL [Non engineered fill][A]	0.0	1.8
Stiff SILT [Topsoil]	0.0	0.2
Stiff to very stiff SILT and sandy SILT [Springston Formation]	0.2	0.9 – 1.1
Medium dense fine SAND and silty SAND [Springston Formation]	1.1 – 1.3	2.0 – 2.3
Very dense GRAVEL [Springston Formation]	3.1 – 3.4	> 12.0

Notes: A - Encountered in HA/DCP01 only

DCP testing by AECOM in the non-engineered fill encountered in the excavation of column C7 indicates it is of low, inconsistent strength to a depth of 2.4m bbs.

2.2.7 Groundwater

The existing geotechnical data indicates a groundwater level of 9.5m below ground level (bgl). Groundwater contours on the CGD indicate that the median depth to groundwater is > 6m bgl. In the absence of site-specific data, it is recommended that a groundwater level of 6.0m bgl is adopted.

2.2.8 Engineering Properties

Engineering properties have been derived for the soils encountered during the AECOM investigation and correlated with values based on experience of similar material and published parameters. The engineering properties are presented in Table 2-4.

Table 2-4: Engineering properties

Name	Depth to top of unit (m)	Average DCP Count (Range) (blows per 100 mm)[A]	Engineering Properties[B]			
			Bulk Unit Weight (kN/m^3)	Undrained Shear Strength (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
Loosely packed sandy GRAVEL [Non engineered fill][A]	0.0	5 (0 - 20)	18	-	0	30
Stiff SILT [Topsoil]	0.0	No data	14	-	0	24
Stiff to very stiff SILT and sandy SILT	0.2	No data	17	100	3	28
Medium dense fine SAND and silty SAND	1.1 – 1.3	No data	19	-	0	32
Very dense GRAVEL	3.1 – 3.4	No data	22	-	-	40

Notes:
A. Based on AECOM DCP data. Maximum depth of DCP is 3.4m bbs.
B. Based on investigation data correlated with experience of similar materials in Christchurch and published parameters.

2.2.9 Assessment

The static and seismic bearing strength of the existing foundations have been assessed using the proprietary software *Loadcap* (version 2014.21.1.662). The assessment assumes only vertical, non-eccentric loads, and uses the engineering properties presented in Table 2-4, and the foundation dimensions presented in Table 2-2. A strength reduction factor of 0.5 has been applied based on B1/VM4 and our general knowledge of the site. Seismic bearing strengths have been calculated using Eurocode 7/8. Results are presented in Table 2-5.

Table 2-5: Bearing strength analysis of existing pad foundation

Foundation	Assumed Founding Depth (m)	Assumed Width (m)	Design Bearing Pressure (kPa)	Design Static Bearing Strength Q_{dbs} (kPa)	Design Seismic Bearing Strength Q_{dbs} (kPa)
Pad footing	1.2	1.2	700	750	560

The assessment on the existing foundations confirms there is marginal bearing strength under static conditions, and under seismic conditions the foundations do not meet current design standards. As a result, the foundations may experience bearing strength related settlements under static and seismic conditions.

An immediate elastic settlement analysis was also conducted.

2.2.10 Conclusion

The results of the preliminary analysis indicate that the measured settlement of the Grand National Stand is considered to be a result of a combination of the following:

- Elastic settlement (with no rebound) of underlying materials in response to higher seismic loading.
- Movement associated with early bearing capacity failure of the foundations due to reduced bearing strength of the ground materials supporting the pad foundations during seismic loads.
- Consolidation of the gravels due to dynamic seismic actions.
- Variation in strength of underlying materials.

Due to the marginal bearing strength, it is strongly recommended that the no additional loads act on the existing foundations. Any additional load will require new foundations, or additional strengthening of the materials supporting the existing footings, such as compaction grouting.

In addition, it should be noted that further settlement of the structure is anticipated following an SLS or ULS design earthquake event.

2.3 Site Seismic Records

2.3.1 Site Performance in the Canterbury Earthquake Sequence

To evaluate the site performance during the Canterbury earthquake sequence, an assessment of the Conditional Peak Ground Acceleration (PGA) [3] against the design level PGA values [4] was undertaken. Full results of the assessment are presented in Appendix E. The process can be summarized as follows:

1. Contours developed to illustrate PGA values experienced in Christchurch during the 2010/2011 Canterbury earthquake sequence [7] were acquired. These are available on the CGDB.
2. The conditional median PGA values were then scaled to the M_w 7.5 design level earthquake event using magnitude scaling factors [8].
3. AECOM then compared the scaled PGA values to the design level PGA values using the methodology described in the MBIE Guidance [4].

For Importance level 2 (IL2) structures, a Serviceability Limit State (SLS) design event is defined as having an annual probability of exceedance of 1/25. For an Ultimate Limit State (ULS) design event the annual probability of exceedance is 1/500. For IL3 structures the SLS and ULS annual probability of exceedance is 1/25 and 1/1000 respectively [5].

MBIE Guidance [4] recommends design level PGA values of 0.13g for annual probability of exceedance of 1/25 (SLS) and 0.35g for annual probability of exceedance of 1/500 (ULS), this guidance explicitly relates to IL2 structures. As the Grand National Stand is an IL3 structure, the Conditional PGA (CPGA) needs to be compared to a 1/1000 design level PGA for ULS. Since the MBIE Guidance does not provide an IL3 ULS level PGA, an inferred value of 0.455g has been used. This was determined by multiplying 0.35g (1/500 design level PGA) by 1.3. This multiplication factor was based on the ratio of return periods of IL3 and IL2 structures as defined in Table 3.3 of NZS1170.5:2004 [5].

According to MBIE Guidance [4], a site can be considered to be ‘sufficiently tested’ to an annual probability of exceedance of 1/25 event if the scaled (to $M_{7.5}$) PGA value exceeds 170% of the SLS (1/25 design level) PGA. In the absence of further guidance it is considered that application of the MBIE assessment procedures is appropriate for this structure. The results (presented in in Appendix E) show that PGA values in the September 2010 event (Event 1) range between an upper bound value of 257%SLS and a lower bound value of 131%SLS. In the February 2011 event (Event 2), the PGA values range between an upper bound value of 214%SLS and a lower bound of 98%SLS. These ranges are for the 68% Confidence interval.

As the entire range of both events is not greater than 170% it is not possible to say conclusively whether or not the site has or has not been ‘sufficiently tested’. The median PGA values for these events are 183%SLS and 145%SLS respectively.

Results show (see Appendix E) that for all seven events the upper bound PGA values are less than a 1/1000 (IL3 ULS) design level event and therefore the site did not experience an equivalent 1/1000 annual probability of exceedance event during the 2010/2011 Canterbury earthquake sequence.

From this analysis we can infer that the site was tested between 75% and 150% of a ‘sufficient level’ in accordance with the MBIE definition, during the Canterbury earthquake sequence. Because of the level of uncertainty in the data used for the assessment, a more precise answer cannot be provided.

2.3.2 Ground Motions in the Canterbury Earthquake Sequence

To determine the ground excitation on this site, the PEER Ground Motion Database [9] earthquake records were used to find the pseudo spectral accelerations (pSa). The closest recording station to the Grand National Stand is at Riccarton High School. Riccarton High School is approximately 1.7 km away. It is considered that, based on the proximity of the station and the similarities in ground conditions, that the records will provide a reasonable indication of the level of ground excitation.

The Riccarton High School recording station has horizontal principal directions of, N86W and S04W. The Grand National Stand has a longitudinal orientation of approximately N53W and a transverse direction of approximately S37W. However, since the ground motion comparison is between pSa and both ULS elastic design coefficient and ULS horizontal design action coefficient, which both are uni-directional; the orientation does not affect the comparison results.

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The ULS elastic design level earthquake derived from NZS1170.5 is expressed as a horizontal site hazard spectrum, C(t). The horizontal design action coefficient also derived from NZS1170.5 uses C(t) and takes into consideration the structural property of ductility, is expressed as $C_d(t)$. Comparison between C(t) and $C_d(t)$ is shown in Appendix E along with the full assumptions used in their calculation.

C(t) and $C_d(t)$ is equivalent to pSa when both are in terms of gravity. C(t) and $C_d(t)$ is plotted against the pSa of the September 2010 and February 2011 events for each of the two principal directions, see Appendix E for graphs of excitation in both directions.

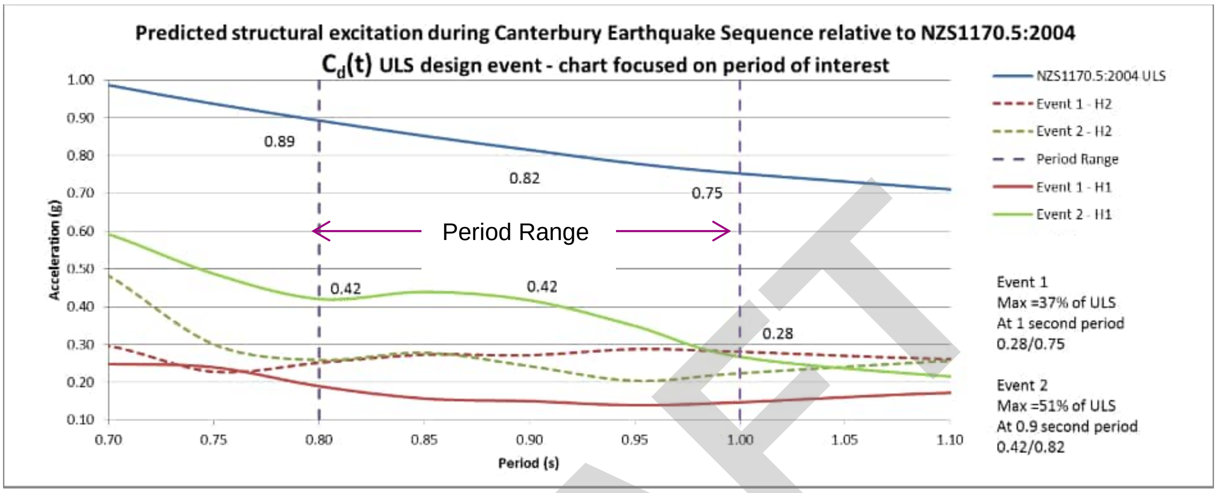

Figure 3: Ground Motion Excitation

A comparison of the plots for the pSa from Riccarton High School for both the September 2010 and February 2011 events against the NZS1170.5 horizontal design coefficient shows that the site did not experience a ULS design level earthquake.

2.3.3 Significance of Damage Observed

During the Canterbury Earthquake Sequence, the Canterbury region and particularly the Christchurch CBD area experienced significant ground motions resulting in PGA values and accelerations in excess of the current NZS1170.5 design level event. This excitation resulted in significant damage. The Grand National Stand at the Riccarton Park site has not experienced a design level earthquake.

It is important therefore to note that the damage observed (detailed in section 3.0 of this report) is due to seismic excitation less than that of a ULS design level (approximately 50%ULS). Therefore significantly more damage could be expected in a future design level ULS earthquake.

2.4 Building Description

2.4.1 General Description

The Grand-National Stand is a reinforced concrete (RC) structure with timber grandstands, built circa 1920. The Grand National Stand is a heritage building and is listed as Group 4 in the Christchurch City Council (CCC) South-West Christchurch Area Plan: Phase 1 Report – European Cultural Heritage [10] [11] [12].

The building is orientated with the long side parallel to the track and 37° off east-west or approximately northwest-by-west (NWbW) to southeast-by-east (SEbE) in direction. For the purpose of reference, site north has been defined as perpendicular to the home straight of the track in the east-west direction. This reference convention is shown in Figure 4.

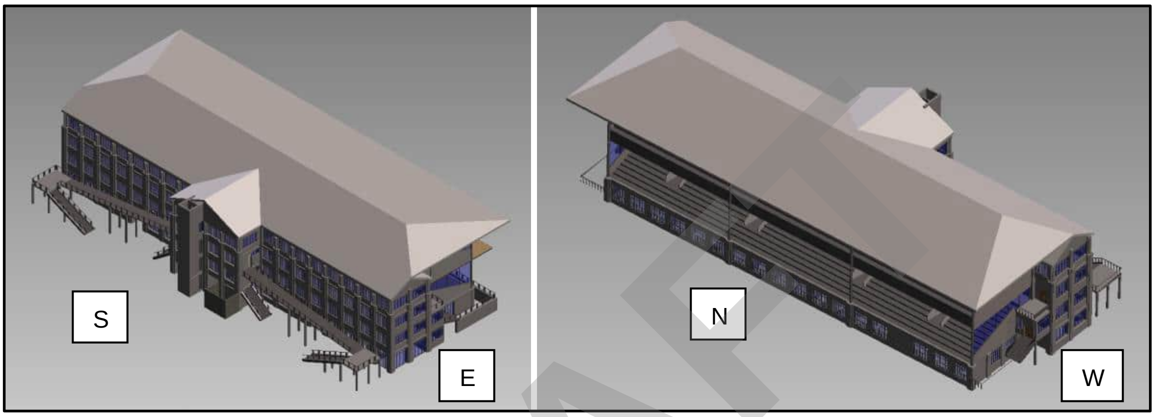

Figure 4 Elevation naming convention at Grand National Stand (GNS)

The structure consists of five above ground stories with two grandstand seating levels and has a footprint of approximately 82m parallel to the racetrack and 25m perpendicular to the racetrack. The main RC structure is generally rectangular on plan, measuring approximately 82m x 9.5m. There is an attached foyer and elevator core area measuring approximately 15.8m (east-west) x 6.5m (north-south) extending out on the southern elevation (see Figure 4). The elevator core is not an original feature.

There are two grandstands on the northern elevation, as shown in Figure 5. Both the (smaller) lower stand and (larger) upper stand are of timber construction. These grandstands sit on a steel support structure composed of trusses, plate girders, columns, and diagonal bracing. Both grandstand areas are approximately 73m long but vary in width and slope. The lower grandstand is narrower and flatter with a seating area of approximately 825m^2. The upper grandstand is steeper and wider than the lower stand and, with a seating area of approximately 1080m^2, is 30% larger than the lower grandstand area.

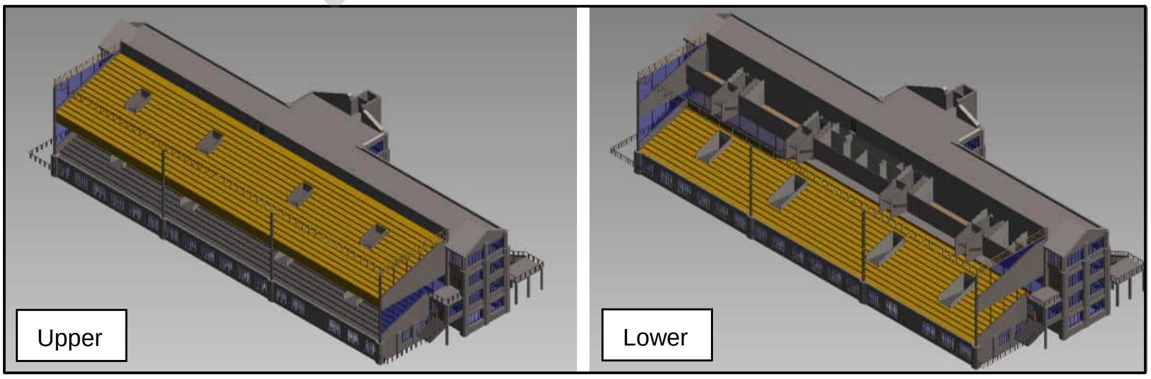

Figure 5 Cutaway showing the grandstand seating areas at GNS

The ground floor consists of a bar (known as ‘The Parade Ring’) at the eastern end of the structure and a storage and workshop area at the western end of the structure. The first, second, and third floors, consist of tote offices, bar areas, café facilities, kitchens, and general public assembly areas. The fourth floor is a maintenance level with no public access.

Access to these upper floors, (first, second, and third) is via several ramps and concrete steps or via an elevator; all located on the south elevation (see Figure 4). Access to the fourth floor is via a service door on the upper stand (see Figure 5) or via the elevator (see Figure 4). The lower stand can be accessed directly from trackside on the northern side and from the first and second stories on the south side. Access to the upper stand is via four sets of stairs on the third floor only.

A brief summary of the building is provided in Table 2-6 and Table 2-7.

Table 2-6: Building Summary

Grand National Stand	
Total Length	~ 82 m
Total Width	~ 25 m
Total Height	~ 18.6 m
Importance Level (IL)	3
Number of Stories	5 floor levels 2 grandstands
Total Plan Area (Approximate)	7700m^2

Table 2-7: Level-by-level Building Information

Level	Occupancy	Area	Storey Height
Ground	Workshop & Storage Public Access	1170 m^2 565m^2	0 m (reference level)
First	Public Access	1230 m^2	4 m
Lower Stand	Public Access	825 m^2	4 m – 7.7 m
Second	Public Access	1000 m^2	7.7 m
Third	Public Access	1065 m^2	11.5 m
Upper Stand	Public Access	1080 m^2	12.145 m – 16.375 m
Fourth	Maintenance Access Only	765 m^2	15.6 m
Roof	No Access	~ 2873 m^2	18.6 m

2.4.2 Structural layout and load paths

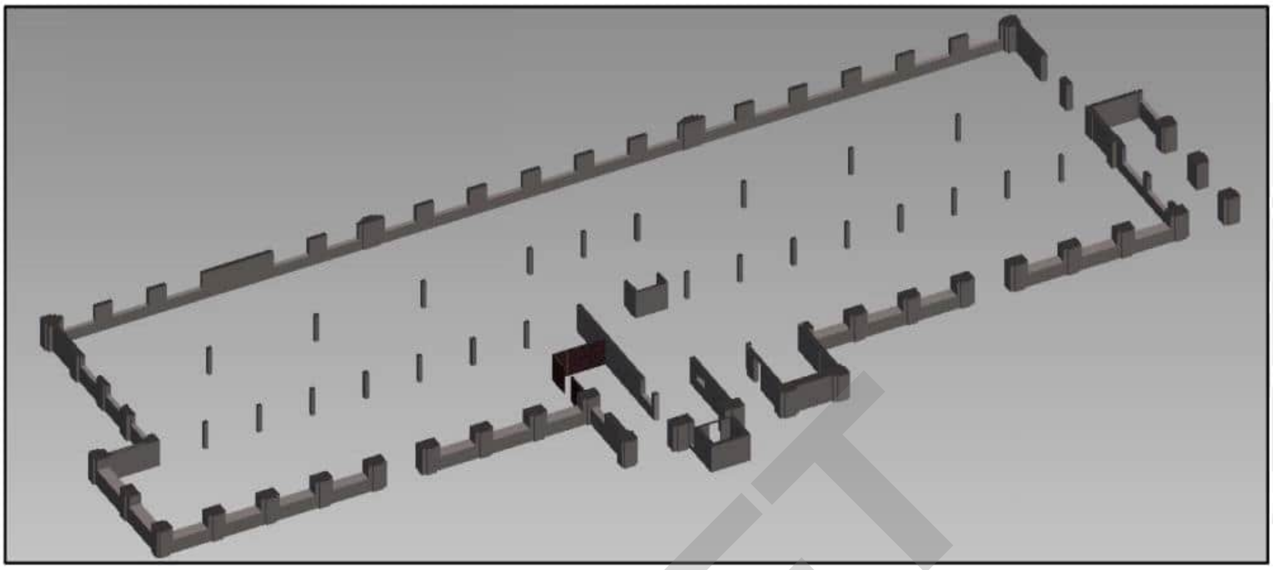

Figure 6 Cutaway showing walls and columns at the ground floor level at GNS

The ground floor plate is of slab on grade construction. The reinforced concrete columns that support the upper floors are supported by pad footings. The gravity loads from the upper levels are transferred to the ground through reinforced concrete columns. At the centre of the ground floor there is one 'u-shaped' shear wall, which will transfer both gravity and lateral loads, as shown in Figure 6. There are also shear walls on grids 2 and 20, which run in the North-South direction. All other walls at ground level are partition walls and are not intended to be load bearing elements. The lateral load-transfer system at ground floor level is a reinforced concrete moment frame system with concrete encased steel beams.

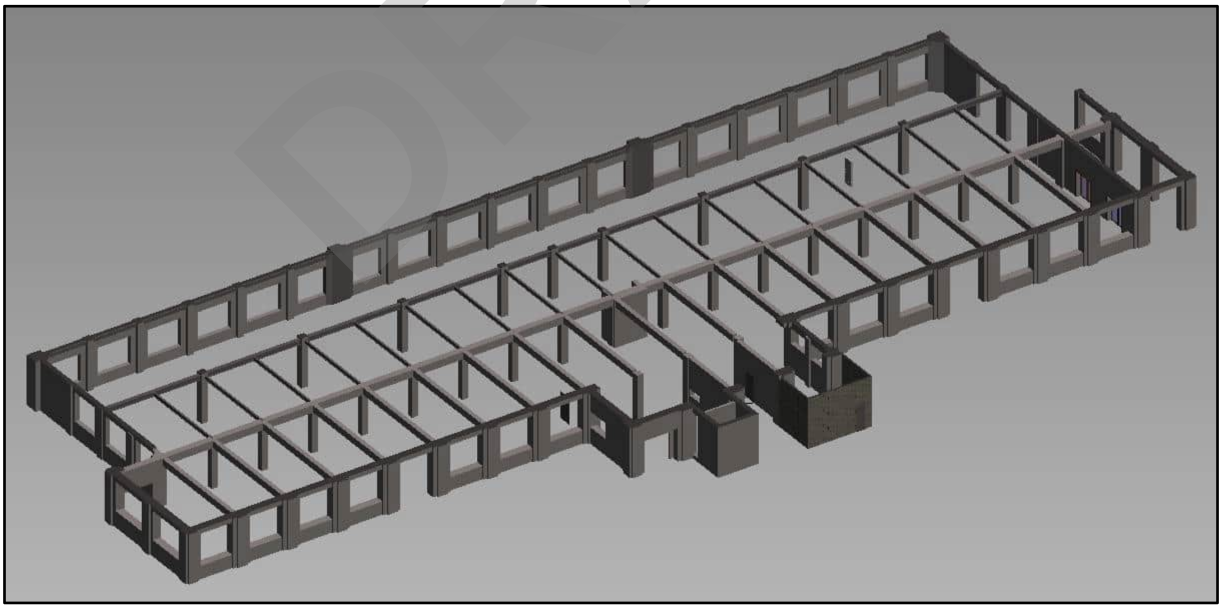

Figure 7 Cutaway showing beams, walls, and columns at the ground floor level at GNS

The first floor is a cast-in-situ reinforced concrete floor which sits on concrete encased steel beams. This floor plate spans in one direction, between beams in the east-west direction, as shown in Figure 7. The gravity loads from the first floor are transferred through this floor plate and beams and eventually to the ground through reinforced concrete columns.

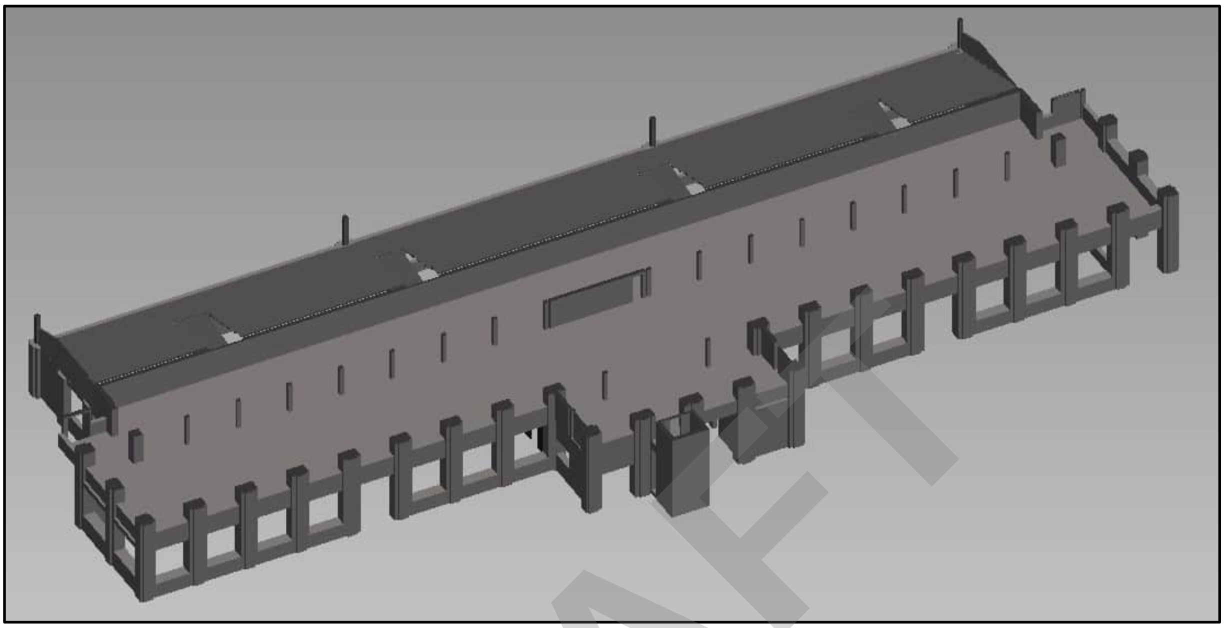

Figure 8 Cutaway showing walls and columns at the first floor level at GNS

The reinforced concrete columns that support the upper floors are present at first floor level. The ground floor 'u-shape' shear wall length extends in the longitudinal direction and the return walls discontinue as shown in Figure 8. The gravity loads from the upper levels are transferred to the ground floor columns through both reinforced concrete columns and the central shear wall. The lateral load-transfer system at first floor level is combination of the reinforced concrete moment frame system, concrete encased steel beams and the longitudinal shear wall. All other internal walls at first floor level are lightweight partition walls and are not intended to be load bearing elements. There is direct access to the lower stand from first floor level via four stepped passageways.

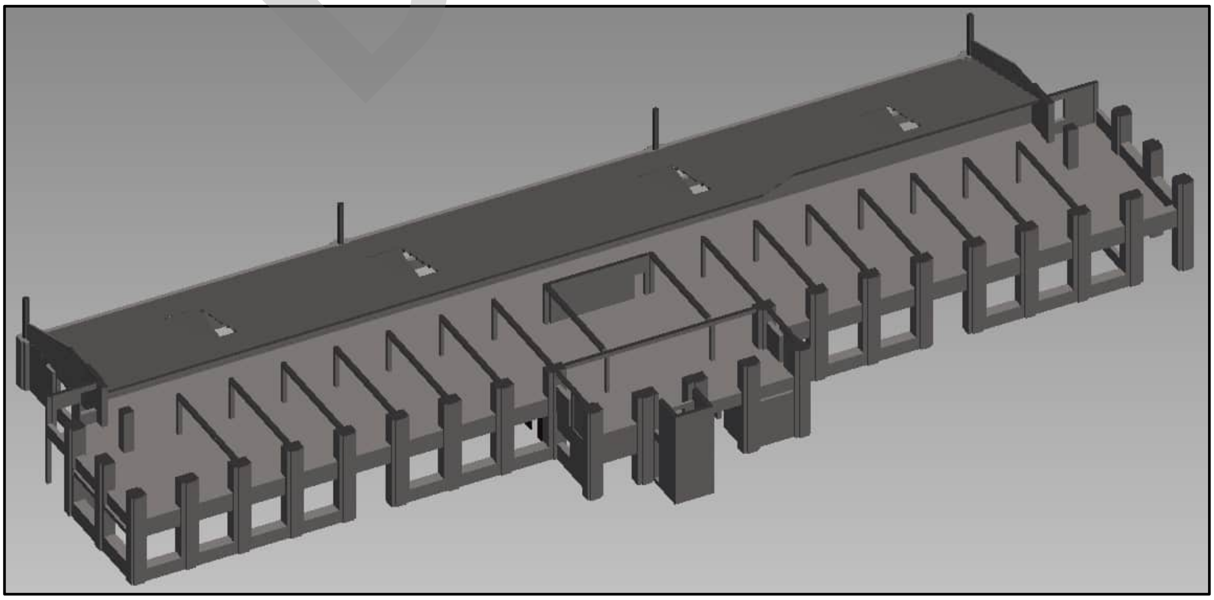

Figure 9 Cutaway showing beams, walls, and columns at the first floor level at GNS

The second floor is a cast-in-situ reinforced concrete floor which sits on concrete encased steel beams. This floor plate spans in one direction, between beams in the east-west direction, in a similar manner to the first floor and this is shown in Figure 9. The occupancy loads from the second floor are transferred through the second floor plate and beams and eventually to the ground through a combination of reinforced concrete columns and the central shear wall. The lower stand is supported directly by steel girders which bear on the ground floor concrete columns. The (north elevation) upper stand supporting circular columns can be seen in Figure 9. These columns do not contribute to the lateral resistance system in the structure and transfer vertical gravity loading only.

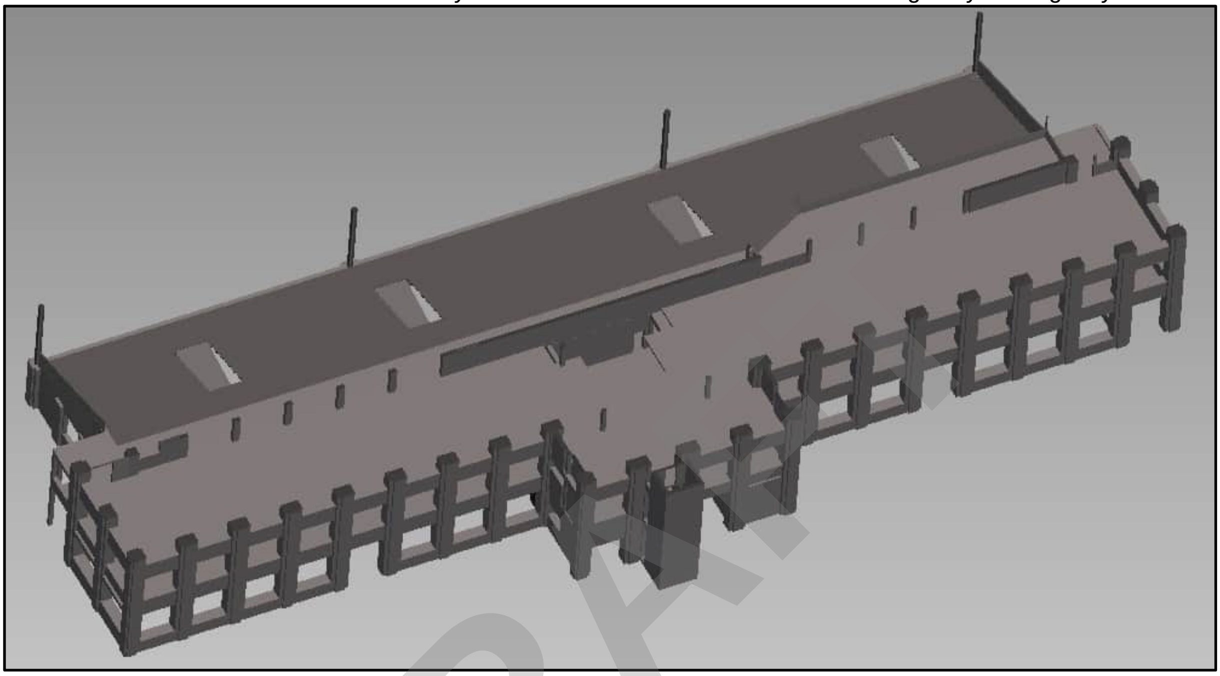

Figure 10 Cutaway showing walls and columns at the second floor level at GNS

The longitudinal shear wall is larger at second floor level than at first floor level, as shown in Figure 10. This shear wall was modified in the early 1980's and is now different from the original 1920's design. The reinforced concrete columns that support the upper floors are present at second floor level. The gravity loads from the upper levels are transferred to the ground floor columns through both reinforced concrete columns and the central shear wall. The lateral load-transfer system at second floor level is a combination of the reinforced concrete moment frame system, concrete encased steel beams and the longitudinal shear wall. All other internal walls at first floor level are lightweight partition walls and are not intended to be load bearing elements. There is direct free-flow access to the top of the lower stand from second floor level. The (north elevation) upper stand supporting circular columns can be further seen in Figure 10.

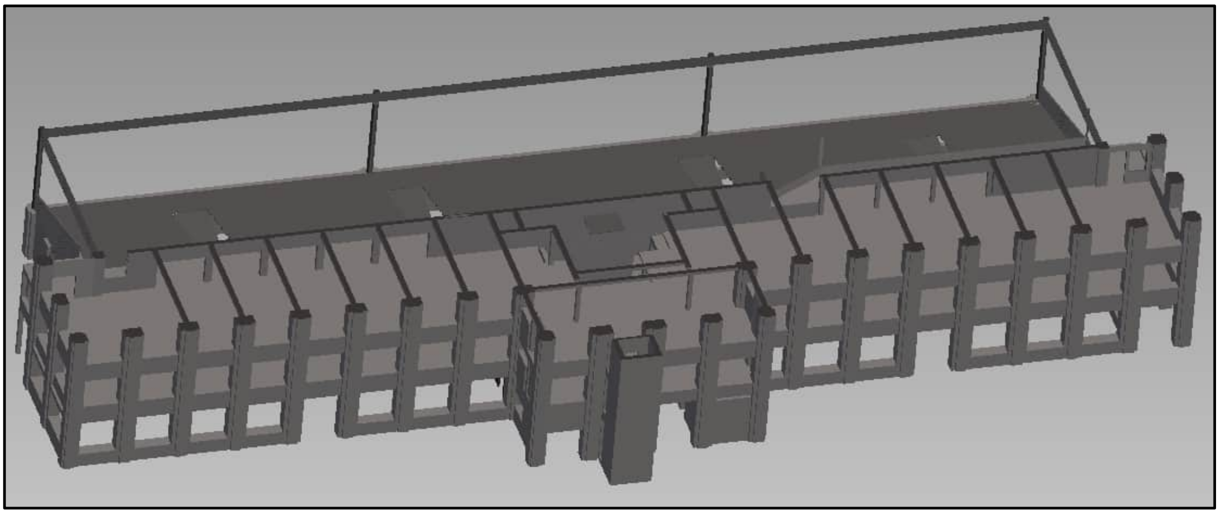

Figure 11 Cutaway showing beams, walls, and columns at the second floor level at GNS

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The third floor is a cast-in-situ reinforced concrete floor which sits on concrete encased steel beams. This floor plate spans in one direction, between beams in the east-west direction, in a similar manner to the second floor and this is shown in Figure 11. The occupancy loads from the third floor are transferred through the third floor plate and beams and eventually to the ground through a combination of reinforced concrete columns and the central shear wall.

The upper stand timber decking and seating is supported on timber joists which span between the top chords of steel trusses located on the numbered grids. These steel trusses span between steel perimeter girders running along grid A and the shear wall on grid C. The steel perimeter girders are fabricated from riveted steel plates and are supported on circular steel columns as shown in Figure 11. A series of six diagonal tension braces in the horizontal plane provide lateral restraint to the perimeter girders in the east-west direction. The bracing is laid out in an XXX pattern. The bracing ties directly into the reinforced concrete frame and is omitted from Figure 11 for clarity.

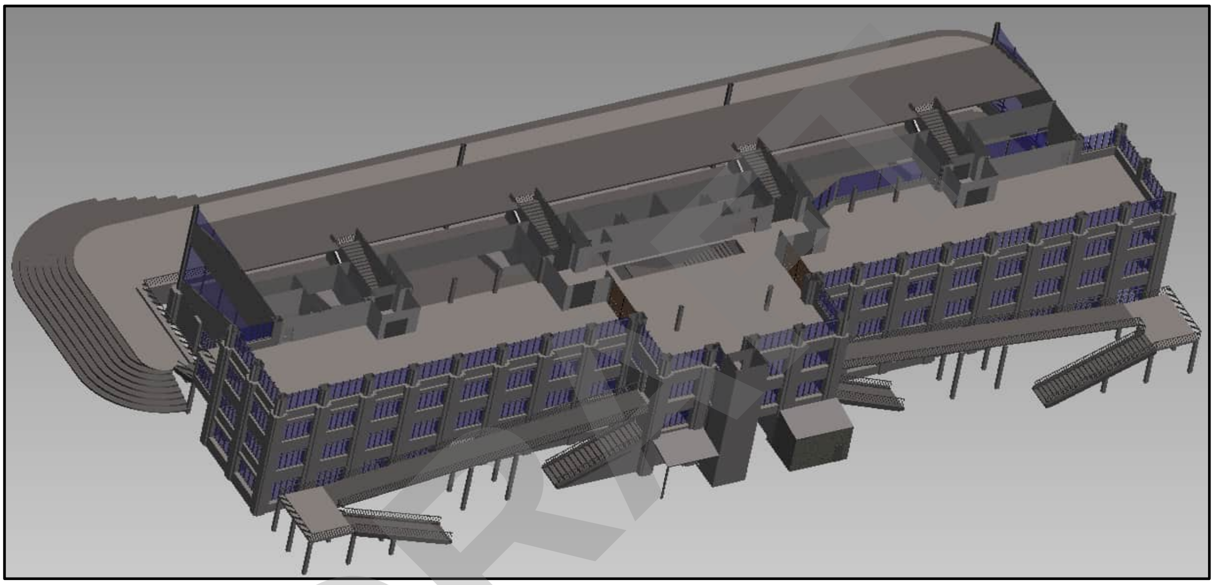

Figure 12 Cutaway showing walls and columns at the third floor level at GNS

The longitudinal shear wall is larger at third floor level than at second floor level, as shown in Figure 12. This shear wall was modified in the early 1980's and is now different from the original 1920's design. In its original layout the shear wall at level 3 ran the full length of the structure, with designed openings for ramps to access the upper stand. Extra openings were cut in this wall in the early 1980's to allow access to new tote and kitchen areas. The reinforced concrete columns that support the upper floors are present at third floor level. The gravity loads from the upper levels are transferred to the ground floor columns through both reinforced concrete columns and the central shear wall. The lateral load-transfer system at third floor level is a combination of the reinforced concrete moment frame system, concrete encased steel beams and the longitudinal shear wall. All other internal walls at third floor level are lightweight partition walls and are not intended to be load bearing elements. There is direct access to the upper stand from third floor level via four stepped passageways, as shown in Figure 13. This is the only public access to the upper stand.

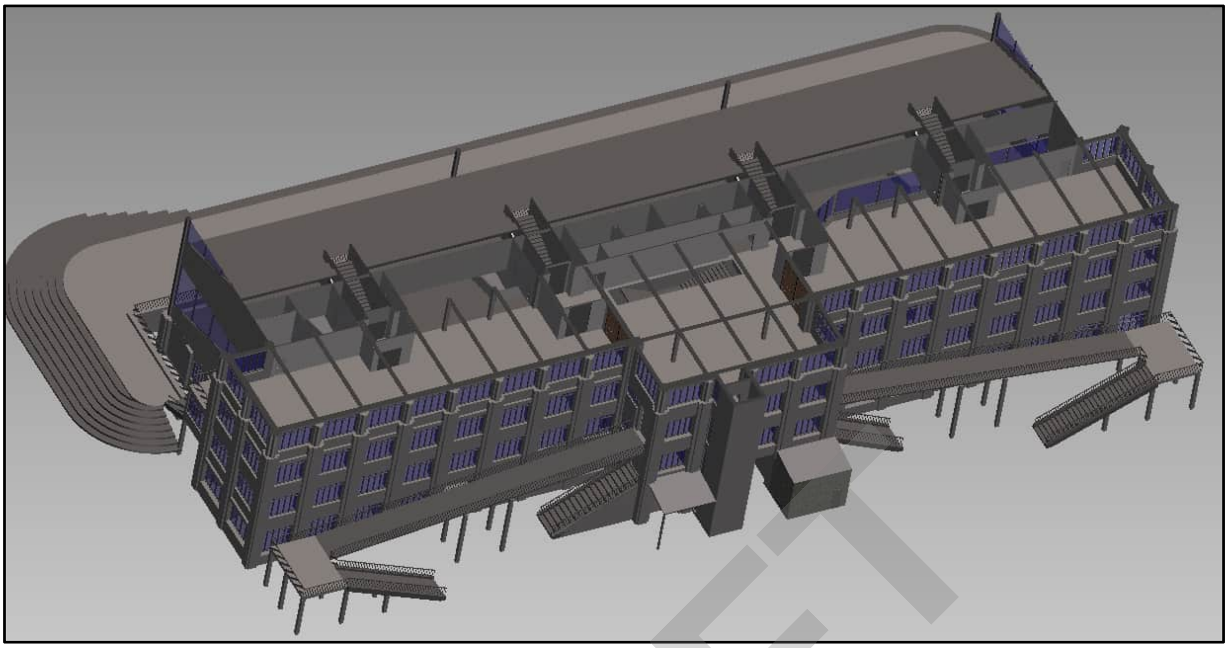

Figure 13 Cutaway showing beams, walls, and columns at the third floor level at GNS

The fourth floor is a cast-in-situ reinforced concrete floor which sits on concrete encased steel beams. This floor plate spans in one direction, between beams in the east-west direction, in a similar manner to the third floor and this is shown in Figure 13. The maintenance access occupancy and storage loads from the fourth floor are transferred through the fourth floor plate and beams and eventually to the ground through a combination of reinforced concrete columns and the central shear wall.

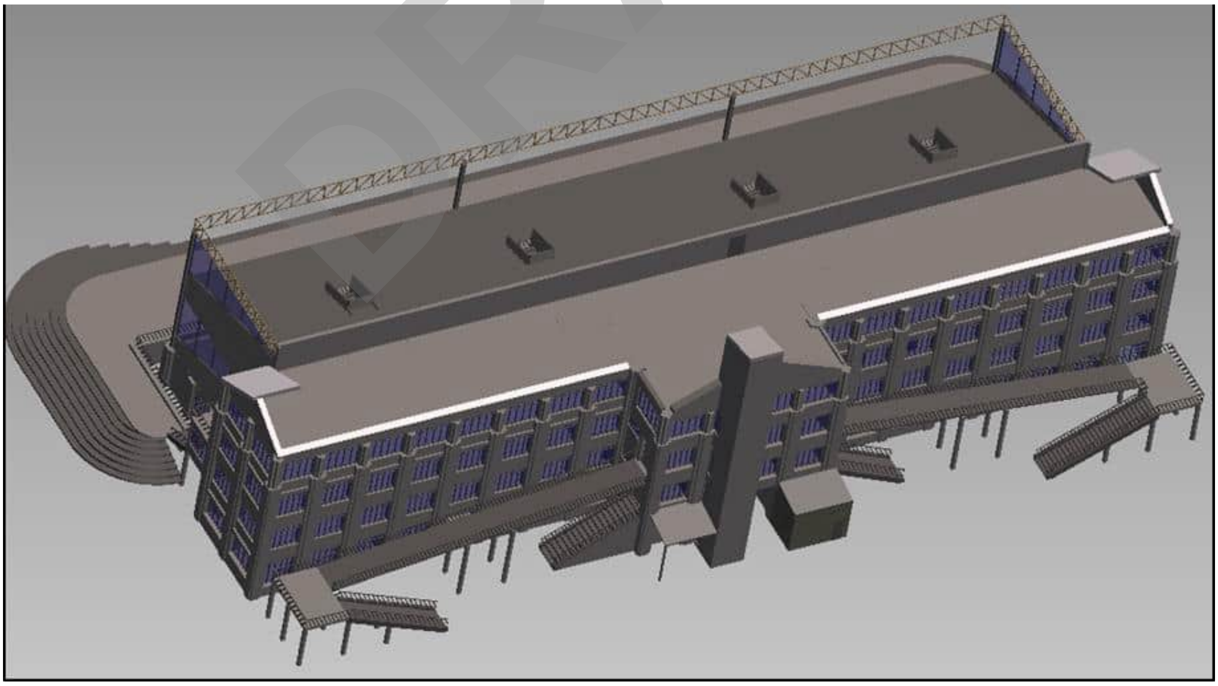

Figure 14 Cutaway showing walls and columns at the fourth floor level at GNS

Between Grid C and D the roof is supported on timber purlins spanning between steel rafter beams fabricated from back to back unequal steel angles. The steel rafter beams are supported by the walls on grid C and D and by three intermediate steel columns fabricated from single equal angle sections. There is no bracing in this section of the roof.

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Between Grid A and C the roof is supported on timber purlins spanning between steel roof trusses located on each numbered grid. The steel roof trusses span between the shear wall on grid C and the steel perimeter trusses on grid A with a cantilevered section beyond grid A. The steel perimeter trusses on grid A are supported by circular steel columns as shown on Figure 14. A series of six diagonal tension braces provide lateral restraint in the east-west direction to the perimeter trusses in a horizontal plane level with the bottom chord of the roof trusses. The bracing is laid out in an XXX pattern and ties directly into the longitudinal reinforced concrete shear wall on grid C as shown in Figure 16 . Between the perimeter truss and the shear wall on grid C the roof relies on the roof sheeting to act as a diaphragm to distribute lateral loads. This diaphragm also restrains the top chord of the roof trusses.

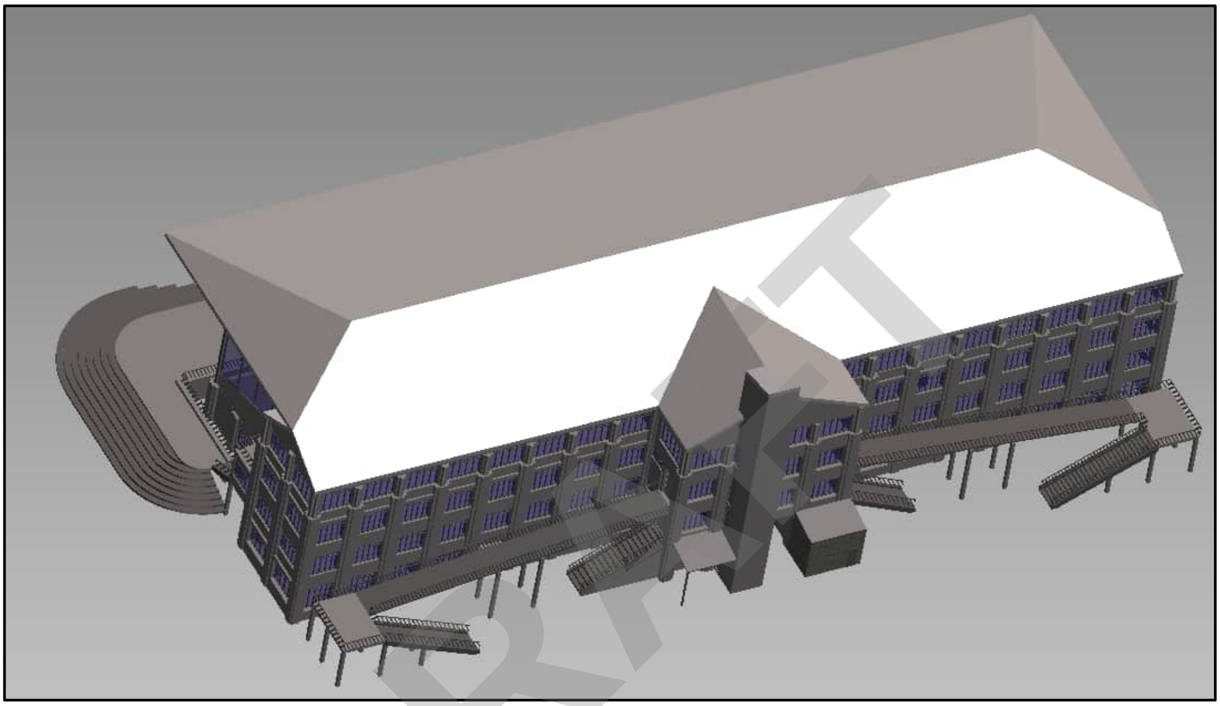

Figure 15 3D model showing roof level at GNS

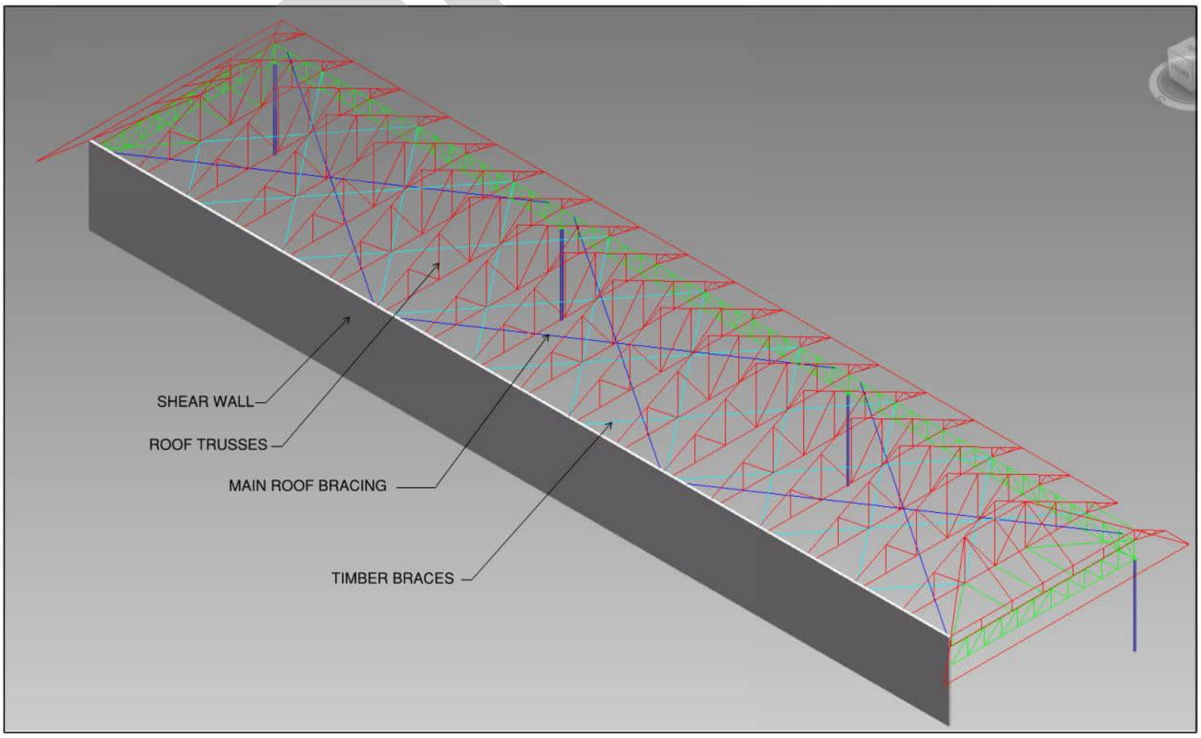

Figure 16: Upper stand roof layout

2.4.3 Historical use of the site

The existing building was constructed circa 1920 and is shown in the earliest historical photograph taken in 1941. Prior to its construction the site housed a timber structure which was destroyed by fire in 1919. Historical aerial photographs taken in 1973 and 1984, show that the lift core was added to the south elevation sometime during this period. Aside from this the stand appears to have had no significant alterations to its overall dimensions since historical aerial photography began in 1941. Photographs of the site are located in Appendix D.

2.4.4 Heritage

The Grand National Stand is a heritage building and is listed as Group 4 in the Christchurch City Council (CCC); South-West Christchurch Area Plan: Phase 1 Report – European Cultural Heritage [10] [11] [12]. Group 4 structures have the lowest level of heritage protection and the rules governing its protection are shown in Appendix F.

Any alteration of a Group 4 building or the erection of any additional buildings on a site containing a Group 4 building shall be a controlled activity, with the exercise of the Council's discretion limited to matters concerning the heritage values of the protected building.

Any removal of a Group 4 building shall be a discretionary activity.

An application will need to be made for resource consent for alterations or removal, but because the building is Group 4 it will not require the written consent of other persons and shall be non-notified.

2.4.5 Foundations

The main RC columns are supported on plinths and the plinths are supported on shallow mass concrete pad footings. The ground floor is a slab-on-grade construction. Thickened footings are present under the exterior wall foundations. See section 2.2 for geotechnical appraisal and drawings A-160 and A-161 for layout.

3.0 Observations

3.1 Damage Summary

The following sections summarise typical damage observed to the superstructure over the course of the investigation.

Refer to Appendix B for further details of damage observed. Photos of the damage and the key plans are included in Appendix A.

Included in Appendix B for each of the damage items is the likely cause of damage. There are five categories for the likely cause of damage as shown in Appendix B. The damage identified generally fell into three categories:

- likely earthquake damage,
- pre-existing damage likely exacerbated by the earthquake,
- possibly existing damage but has been exacerbated by earthquake.

Due to the age of the structure there is existing damage and construction methodologies of that time have resulted in areas of poor construction. Therefore a lot of the damage identified has been made worse by the earthquake but whether it existed before is indeterminate.

3.1.1 Interior

Level 0

Damage includes poorly compacted concrete on columns and beams, vertical and horizontal cracks on walls below windows, and signs of moisture damage to the top of columns and the slab soffit. Significant damage includes a crack up to 2.5mm to the wall beneath the window along grid A at grid 20, a major horizontal crack in the wall along grid 2 (also visible to the exterior face), and a major crack near the beam column joint at C/9.

A section of the carpet in the bar area was lifted and cracks up to 15mm wide were observed to the slab. Minor cracks to the coating on the slab were observed in the other areas.

From grid 1 to 4 there are cracks to the slab soffit in the corners of the bays near grid D. The beams on grid 4 to 6 have cracks underneath and up the sides. There are multiple locations where there is a void for services through the slab soffit and the concrete around the voids has spalled, exposing the reinforcement on the underside of the slab. There is also damage where holes have been drilled into the beams and slab soffit, causing spalling and exposing the reinforcing. Between grid 8 and grid 9 there is insufficient cover to the reinforcing and some reinforcing is visible below the slab. The slab soffit and beams in the bar area are lined with plasterboard and their inspection was not possible.

Level 1

Typical damage includes hairline cracks in the columns on grid D, near the bottom of the windows. There is evidence of moisture on the walls below some windows, vertical cracks in the wall below windows and diagonal cracks propagating from the corner of windows. There is a significant vertical crack up to 25mm between the wall and column at grid D/9 and a similar crack at grid D/12 up to 1.6mm wide and spalling.

A small area of carpet was lifted on level 1 to expose the floor slab. Historical cracks above each beam were observed to the coating, up to 5mm wide on the surface. On the exposed concrete area, significant cracks were observed along grid C up to 10mm wide with 5mm vertical displacement. These cracks are on the interface between the original slab and 1980’s slab extension.

There is moisture damage to the slab soffit around all beam column joints on grid D. There are a number of beams which have minor cracks to the bottom and sides.

Level 2

Damage includes minor cracks in the wall below the window in the lift core on both grid 10 and 11. There is a crack on the central column on grid 1 which continues to the exterior of the column. Between grid D and grid E there is significant damage including vertical cracks in the wall propagating from the window frame to the floor at the grid D column, the crack on grid 9 is 2mm wide and on grid 13 the crack is 0.7mm wide. There are significant cracks in the column between the windows on both grid 9 and grid 13, near grid E. There are a number of horizontal hairline cracks to the columns at various heights.

From grid 1 to grid 13 there are cracks in the floor slab, up to 1.6mm wide, directly above every beam running north to south. Between grid 1 and grid 2 there are diagonal cracks to the floor slab in the corner of the building, around 0.2mm wide. In the stair area there are multiple cracks to the slab. In the area where the carpet was lifted there are cracks up to 0.8mm wide which show evidence of historical repair.

Majority of beams have multiple cracks along their length which are on the bottom of the beams and some continue up the sides. At grid 1 and grid 21 there are cracks in the corner of the slab soffit. The beams under the stairs have cracks to the underside.

There is a 3.5mm wide vertical crack on the exterior face of the shear wall near grid 11. Some of the infill walls have horizontal cracks at mid height and have separated from the columns.

Level 3

Damage includes some horizontal hairline cracks in the columns, particularly near the bottom of windows and vertical cracks below windows up to 3mm wide with 15mm spalling. There is evidence of moisture on some columns and separation of the GIB wall from some window frames. There are significant cracks to the underside of the beam which connects the lift core to grid E.

In the stair area there are multiple cracks in the floor slab coating, up to 10mm wide on the surface. The carpet was removed between grid 1 and 2 which revealed cracks up to 2mm in the corner of the building and up to 1.8mm along grid lines 1 and 2, above the beams. Carpet was also lifted along grid 6, cracks up to 5mm which have been partially filled were observed. Carpet was lifted between grids 20 and 21 and cracks up to 0.6mm were observed at the corner of the building. Cracks up to 0.9mm were observed above the beam on grid 20. Areas of carpet were also removed around the service shafts on grid D at grid 9 and grid 13. Multiple cracks up to 5mm wide were observed in this area, some of which show evidence of historical repair.

The slab soffit and beams are covered in asbestos apart from grid 9 to grid 13 which is covered with plaster; no cracks were visible on this level. There are multiple locations with moisture damage to the beams and slab soffit particularly between grid 10 and grid 12.

The shear wall on level 3 has a 15mm wide vertical crack adjacent to grid 11 which was observed following the removal of GIB at this location. The wall has a horizontal crack at the top which runs the entire length, through a pour line. There is a horizontal crack up to 2.5mm wide around 1m below the top of the wall, which also runs the entire length of the wall. The trusses that extend over the grandstand are cast into the columns. Vertical cracks run from the bottom of the cast beam to the edges of the column. The concrete quality and joining to the shear wall is of poor quality and proper bond is not achieved. Between grid 12 and 13 there is water ingress coming through the cracks.

Level 4

Cracks up to 1.4mm were observed to the floor slab at every gridline above the beams, between the steel columns.

Major damage to the shear wall on level 4 is a significant vertical crack up to 5mm wide on the exterior face at grid 6. There is another significant vertical crack which is 2mm wide on the exterior face at grid 17. Some vertical cracks have also formed on the grid lines. There are multiple areas on the interior face of the wall which have spalling concrete, and the buttress walls have severe spalling over their area. This is likely due to poor construction practice.

The damage to the level 4 shear wall is covered in more detail in section 3.4.

3.1.2 Elevations

North Elevation

Damage along grid A includes poorly compacted concrete on most columns, vertical cracks up to 1.8mm in some walls below the windows and horizontal cracks in the construction joints on some columns. Major damage includes a horizontal crack near the top of the wall from grid 10 to grid 12.

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South Elevation

Typical damage on grid D includes horizontal cracks on the columns, minor cracking and spalling to the render and vertical cracks below windows. There are horizontal cracks from grid 13 to grid 21 above the ground floor windows and also above the first floor windows (on the joint between slab and upstand beam). There are a number of locations which have spalling exposing the reinforcing steel.

The grid E elevation has spalling to the base of some columns, some of which have been repaired. There is horizontal cracking to the walls and columns as well as spalling above the second floor windows.

East Elevation

Along grid 13 there are hairline cracks to the grid E column. There is a separation between the grid D column and the infill walls. There is a vertical crack along the wall below the third floor window which runs from grid D to grid E. There is also cracking around the area where the stair handrail is cast into the wall at the first floor.

There is a significant crack along the wall on grid 20 propagating from grid A to grid B. This crack is also visible on the interior face of the wall. There are hairline cracks and damage to the render on the grid A column.

On grid 21 there are visible cracks in the walls below the windows and horizontal cracks around the grid C column.

West Elevation

Along grid 1 there are multiple horizontal cracks around the grid C column and the central column between grid C and grid D. There is some separation between the walls and the columns. There is a continuous horizontal crack from grid C to grid D above the first floor window and some vertical cracks below the windows.

Along grid 2 there is a significant horizontal crack which starts as hairline (<0.1mm) at grid C and continues to grid A, becoming significantly larger. There are some cracks below the ground floor windows.

There are horizontal cracks along grid 9 at the grid E column and on the wall below the third floor window. There are cracks where the stairs connect to the wall and also a separation between the grid D column and the infill walls.

3.1.3 Stands

The upper stand is constructed out of timber and is showing significant signs of deterioration. All of the timber floors and seating shows signs of borer damage. The flooring is showing signs of wet rot. The timber blocking in the truss system is consistently falling down and being caught by the netting.

The lower stand is constructed out of timber and this is also showing significant signs of deterioration. All of the timber floors and seating shows signs of borer damage. The flooring is showing signs of wet rot. The balustrade along the front which is cast into the concrete wall has cracked the adjacent concrete.

The damage to the grandstand support system is covered in section 3.6.

3.1.4 Ramps and Stairs

Stairs along South Elevation

The western stairs have cracks on the stringers which are up to 20mm wide. There is a 0.4mm vertical crack on one of the columns and spalling at the bottom of the stairs.

On the eastern stairs there is significant spalling to one of the columns and minor damage at the bottom of the stairs where the handrail is cast-in.

Stairs on West Elevation (Grid 1)

These stairs are severely damaged with cracks up to 4mm wide along the stringers, 4mm wide cracks on the underside of the stairs, multiple cracks on the wall under the stairs up to 3.5mm wide and spalling which exposes reinforcing.

D R A F T

Stairs on East Elevation (Grid 21)

These stairs are also severely damaged with extensive cracking along the stringers, which is visible on both the outside and inside face. There is a crack up to 20mm wide with spalling on the slab near the bottom of the stairs with evidence of settlement to the stair side, this crack continues vertically down the wall, up to 10mm wide with lateral displacement. There is a horizontal crack up to 3mm wide on the east face of the wall below the stairs which continues around the retaining wall under the stairs.

Western Ramp

The western ramp has multiple cracks across the width of the ramp, most of which are visible on the top and the bottom of the ramp. There are some vertical cracks in the columns, spalling to the columns exposing the reinforcing and horizontal cracks at the top of some columns. There are two steel angles which have been added to the underside of the platform where it joins to the ramp and to the stairs. Beneath these angles there is a significant crack which spans the length of the platform. On the underside of the platform there is a significant crack running the width of the platform between the ramp and the stairs. The underside of the platform has evidence of moisture damage from water seepage through the cracks.

Eastern Ramp

The eastern ramp has damage similar to the western ramp with multiple cracks across the width, most of which are visible on the top and the bottom of the ramp. There is a column which has had the corner broken off, exposing the reinforcement and horizontal cracks at the tops of the columns. There is significant cracking to the upstand where the stairs are joined to the ramps as well as broken out concrete around where the handrail has been cast-in. As on the western ramp there have been steel angles bolted to the underside of the platform, and a crack beneath these. This crack continues to a vertical crack on the side of the beam, where the ramp joins the platform. A significant crack running the width of the platform was observed to the underside. The underside of the platform has evidence of moisture damage from water seepage through the cracks.

3.1.5 Retaining Wall

The retaining wall has been poured in two sections with the top section being approximately 600mm deep. This has separated from the bottom section which is retaining the mass in front. There are a number of areas of poor concrete with timber and demolition waste cast-in the concrete. There are a number of vertical and horizontal cracks in both the top and bottom sections. The wall has bowed at mid height towards the stand.

The retaining wall damage is covered in detail in section 3.4.

3.1.6 Slab and stairs in front of stand

This slab spans the length of the building in front of the stand. The slab comes out 8m from the retaining wall, and then has steps down to the grass area. There is a crack which runs the whole length of the slab and multiple cracks running the width of the slab, some of which continue through the steps and the retaining wall. The cracks range from hairline to 30mm and some of the cracks have been filled with sealant.

3.1.7 Upper stand roof

The columns are connected to the roof via cast iron collars. At the interface between the two the paint has cracked and rust has developed. A number of the timber blocking supporting the braces has fallen onto the netting. The steel elements have surface rust damage and a timber purlin has broken its connection at one end and fallen.

The roof damage is covered in section 3.7.

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3.2 Floor Level Survey

3.2.1 Summary

AECOM undertook a floor level survey across all levels of the main structure. The complete floor level survey is documented in Appendix A. All references to gridlines and column or beam locations are in relation to Appendix A. AECOM did not use a spirit level to measure floor slopes, and all reference to gradients in the floor plate are approximate and calculated by dividing the level difference between two measured spot levels by the distance between the two measured spot levels.

Table 3-1: Summary of Floor Levels

Level	Differential floor level	Direction of settlement
Ground	72mm	A-14 and A-15 (high) to C1-2 and D-3 (low)
1	42mm	D-11 (high) to C1-20 (low)
2	46mm	C-19 (high) to D-3 (low)
3	40mm	C1-10 and D-19 (high) to C-11 and C1-4 (low)
4	62mm	D-21 (high) to C1-3 (low)

The general settlement trend observed at the Grand National Stand is that the settlement increases towards the western end. This is shown in Figure 17 to Figure 21 with the green trend line showing the grids on the western end have more settlement. Another apparent trend is the mid span deflection or sagging of intermediate concrete beams running in the north south direction. The lower stand follows the trend of the main superstructure and is settling towards the western end. The upper stand is generally level.

The MBIE Guidance for industrial buildings [18] provides some guidance on the maximum allowable floor slopes and allowable differential settlements in moment framed systems. An assessment of the effects of angular rotations of the moment frames due to differential settlement has not been undertaken at this stage and be included in the seismic analysis report.

3.2.2 Ground Level

The floor at ground level is comprised of a concrete slab-on-grade. Thickenings exist in the slab under internal column and perimeter walls in the form of pad footings and strip footings respectively. The settlement pattern at the ground level indicates that the foundation has settled towards the south western corner. There is cracking up to 10mm wide that has opened up in the western end of the Grand National Stand. The reduced levels at ground floor exhibit the most significant settlement of any of the GNS floors, with a maximum differential level measured at ground level of 72mm, with the lowest point measured in the workshop located in the south western corner.

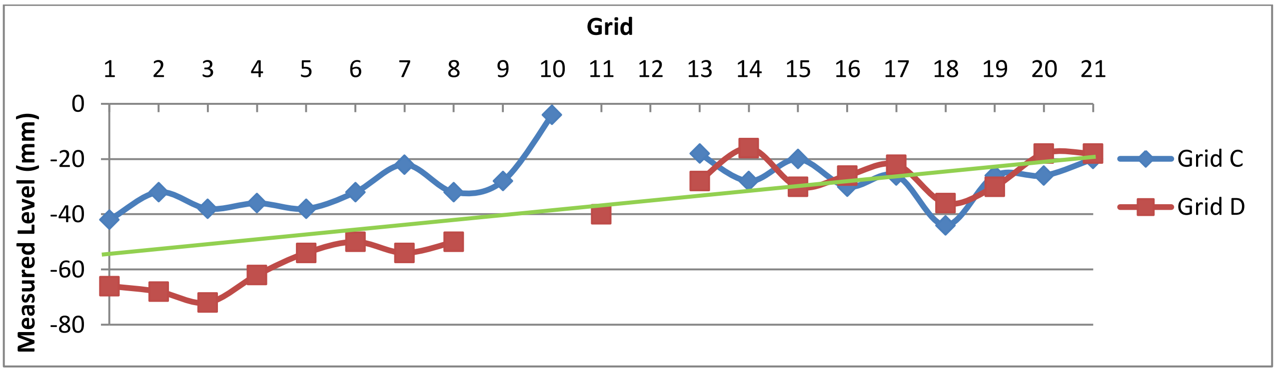

Figure 17: Ground Level Change in Floor Level along Grids

Figure 17 shows that the grids located at the western end are lower than the grids at the eastern end. It is also shows that the measured levels around the perimeter beam wall, grid D, is lower than interior measured levels.

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3.2.3 Level 1

Level 1 is a suspended concrete slab supported by the concrete frame structure consisting. It consists of beam and columns. In the interior, there are concrete columns supporting intermediate concrete beams. The maximum differential level measured is 42mm with the high point in the central core and the lowest point at the western end.

Along grid C the maximum differential settlement between adjacent columns was 13mm and the maximum angular rotation was 0.33%. Along grid D the maximum differential settlement between adjacent columns was 8mm and the maximum angular rotation was 0.20%

The general trend reflects both the west and east ends of the main superstructure settling, with the central core area being the highest point as seen in Figure 18. Local floor level variation exists on level 1. In between grid C and grid D the line known as grid C1 is lower than both grid C and grid D, this is mid span between two columns. The suspended slab is supported at the ends by the exterior concrete frame and intermediate concrete beams running between grid C and grid D. This shows that the intermediate beams have deflected at mid-span.

There is an area between grid 13 and grid 17 which has a 40mm raised timber zone. This raised area had its measured levels reduced to the datum for analysis.

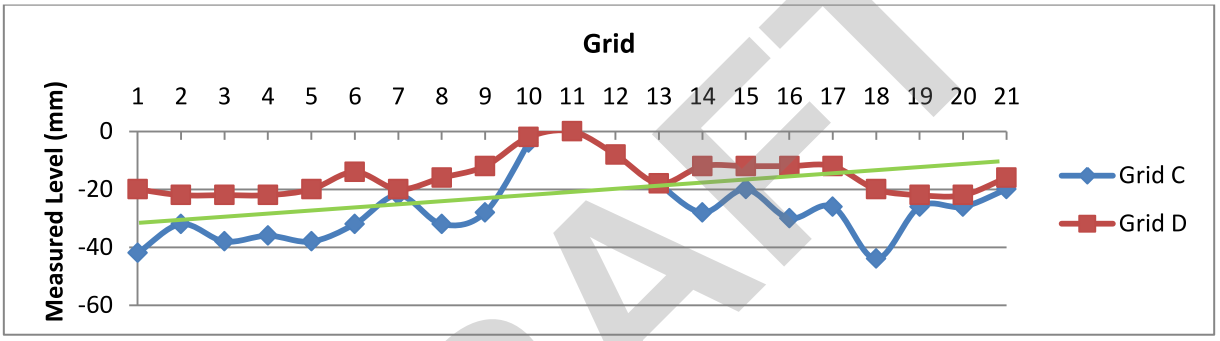

Figure 18: Level 1 Change in Floor Level along Grids

3.2.4 Level 2

Level 2 has the same structural system as level 1. The maximum differential level measured was 46mm with the high point in the Mellay Room and the lowest at the western end.

Along grid C the maximum differential settlement between adjacent columns was 9mm and the maximum angular rotation was 0.28%. Along grid D the maximum differential settlement between adjacent columns was 13mm and the maximum angular rotation was 0.30%

From the data shown in Figure 19 it can be seen that the western end has settled relative to the central core area and eastern end. The local floor variations as seen on level 1 exist on level 2. Grid C1 is lower than both grid C and grid D indicating the intermediate concrete beam has deflected and sagging at mid span.

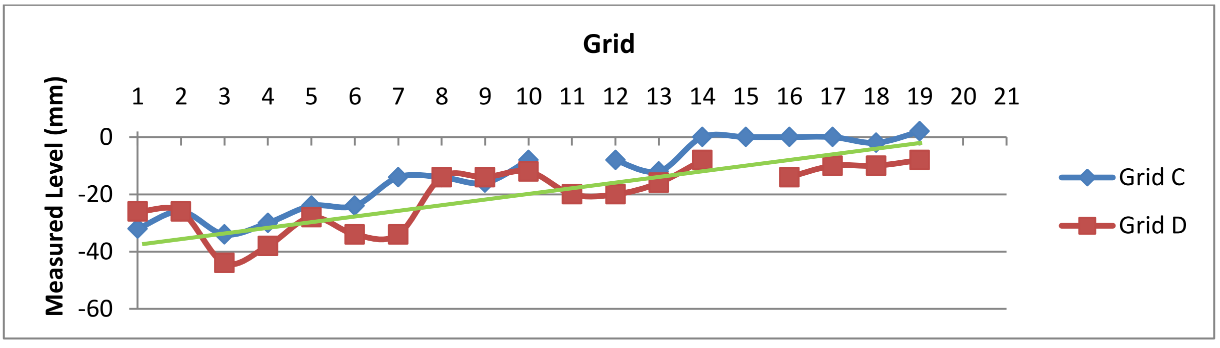

Figure 19: Level 2 Change in Floor Level along Grids

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3.2.5 Level 3

Level 3 has the same structural system as level 1 and 2. The maximum differential level measured is 40mm with the high point in the central core and the lowest towards the western end.

Along grid C the maximum differential settlement between adjacent columns was 7mm and the maximum angular rotation was 0.18%. Along grid D the maximum differential settlement between adjacent columns was 14mm and the maximum angular rotation was 0.35%

From the data shown in Figure 20 it can be seen that the measured levels don't follow a consistent pattern. Some local floor variations are present on level 3. It appears that the western exterior wall has settled but this is far more local than when compared to the previous levels where the whole building trends in that direction. The kitchen area between the upper stand and grid C is lower than the surrounding area and is exhibiting localised settlement. The intermediate beams including the intermediate beams in the central core exhibit mid span deflections.

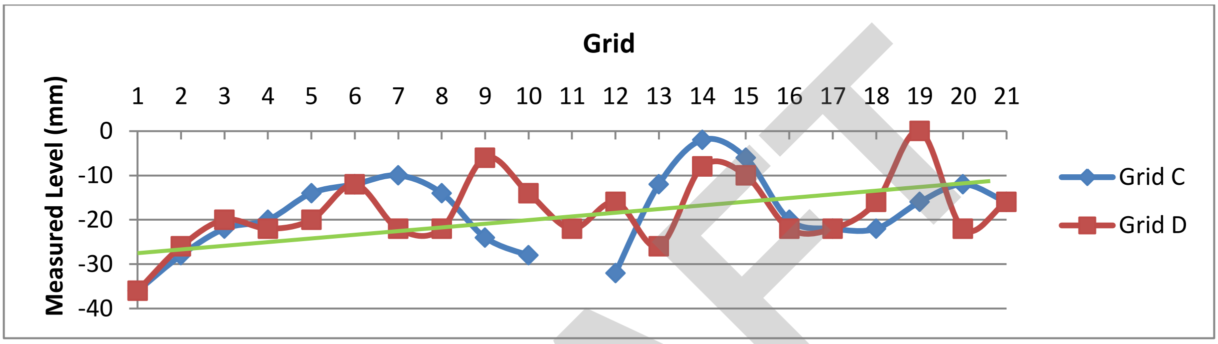

Figure 20: Level 3 Change in Floor Level along Grids

3.2.6 Level 4

Level 4 is a suspended slab supported on grid 1, grid 21, grid D and grid E by the exterior concrete frame. Along grid C it is cast as part of the shear wall. There is a horizontal crack running the length of grid C along the construction joint between the slab and wall. The maximum differential level measured is 62mm with the high point on the eastern end and the lowest in the western end.

Along grid C the maximum differential settlement between adjacent columns was 12mm and the maximum angular rotation was 0.30%. Along grid D the maximum differential settlement between adjacent columns was 9mm and the maximum angular rotation was 0.23%.

There is an overall trend with settlement toward the western end as shown in Figure 21. The same localised settlements of intermediate beams deflecting at mid span exist as shown on the previous levels.

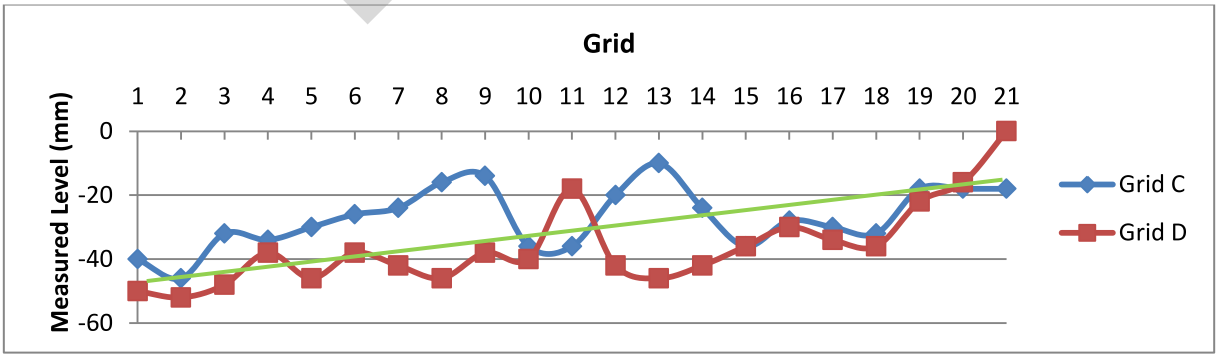

Figure 21: Level 4 Change in Floor Level along Grids

3.2.7 Lower Stand

The lower stand is of timber construction supported on steel beams that are visible from the ground floor. It is tiered in the north south direction. The measured levels for the stands are analysed in an east west direction as it is not tiered in this direction. The general trend is consistent, with the western end of the lower stand settling, following the trend of the main superstructure. Grid A, being the front of the stand, has less variation in measured levels compared to the other lines of the lower stand analysed.

3.2.8 Upper Stand

The upper stand is of timber construction supported on steel trusses that are visible from a void accessed from level 2. It is tiered in the north south direction. The measured levels for the stands are analysed in an east west direction as it is not tiered in this direction. The upper stand is generally level and there is no particular settlement trend.

3.3 Internal Verticality Survey

AECOM undertook a reinforced concrete column and wall verticality survey at each level in the structure. This survey was carried out using a 1200mm digital spirit level. The purpose of the survey was to determine if any trends exist with regards to the lean of the structure that may represent residual drift of the building following the earthquake sequence. The complete frame verticality survey is documented in Appendix A. The columns were surveyed in both the longitudinal (east west) and transverse (north south) direction where accessible and the results are shown in Appendix A and summarised below.

No guidance exists on maximum allowable verticalities in commercial/industrial structures. AECOM considers a gradient of 0.5% as construction tolerance and a gradient of greater than 1.0% as potentially requiring remediation.

In both directions and on all levels there does not appear to be a general trend to the verticality of the internal elements. By using the frame survey in Appendix A and Figure 22 to Figure 25 it is seen that there is no common direction of the verticalities and they appear to be in a range of directions. Table 3-2 and Figure 22 to Figure 25 shows that there is no trend to the magnitude of the verticalities. The number of verticalities above the threshold does not increase or decrease up or down the structure. There are more values in the north south direction above the 0.5% threshold than in the east west direction. This is not considered a trend because they are in both the north and south directions.

There is one value at 1.0%, this is on the ground level and is located at the column at the intersection of grid C and grid 18. It is leaning 1.0% to the south and 0.8% to the west. This is not considered earthquake damage as the surrounding columns have not experienced the same vertical movements and could be attributed to construction workmanship.

There are 37 verticality measurements above the AECOM considered construction tolerance of 0.5%, which represents approximately 10% of all measurements taken. AECOM believe that these verticality measurements are unlikely to be attributed to the earthquake sequence and are rather associated with construction workmanship prevalent at the time of construction. There is also no damage to window and door frames, no broken glass and limited lining damage, which is associated with the verticality of the structure.

Table 3-2: Verticality Summary

Level	Number of measurements taken	Lean above 0.5%			Lean above 1.0%	
		N-S direction	E-W direction	Total	N-S direction	E-W direction
Ground	164	4	7	11	1	0
1	74	2	0	2	0	0
2	79	4	11	15	0	0
3	72	2	6	8	0	0

3.3.1 Ground Level

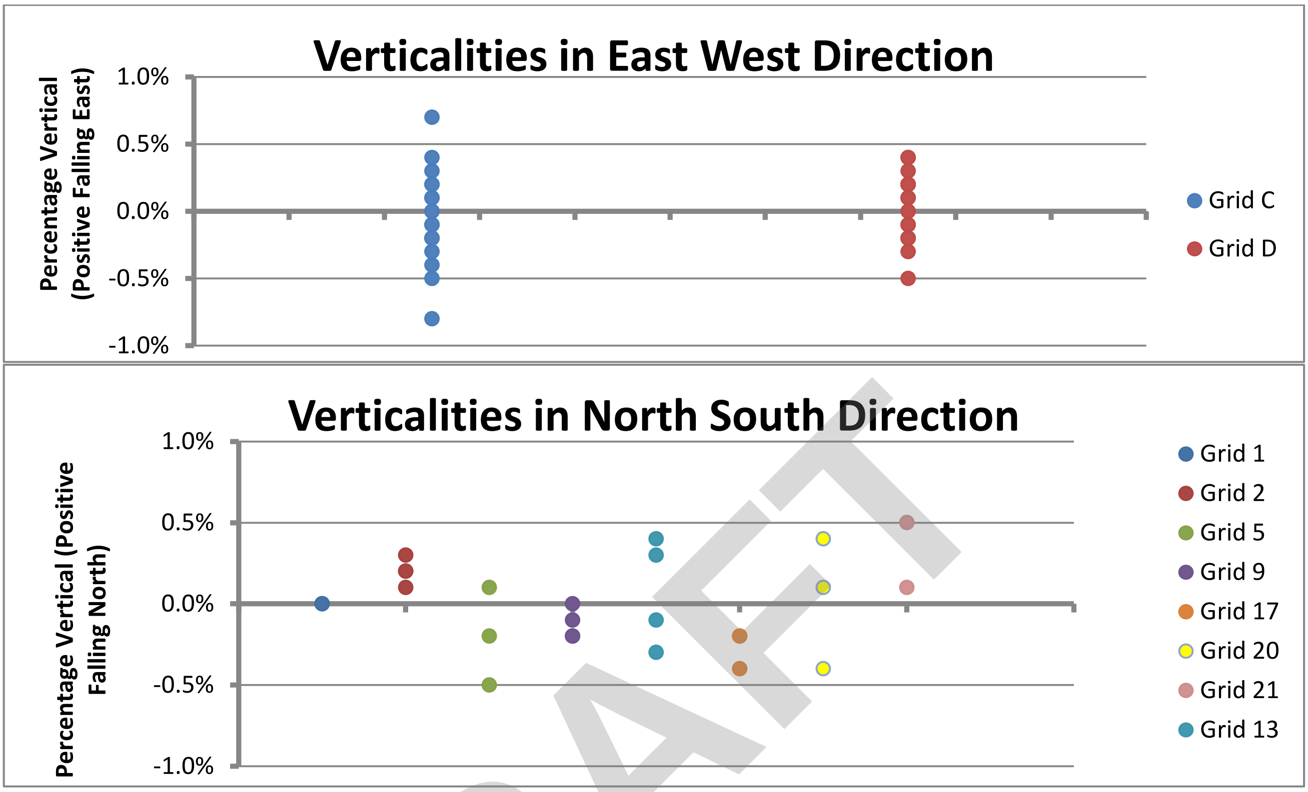

Figure 22: Verticality Trends Ground Level

3.3.2 Level 1

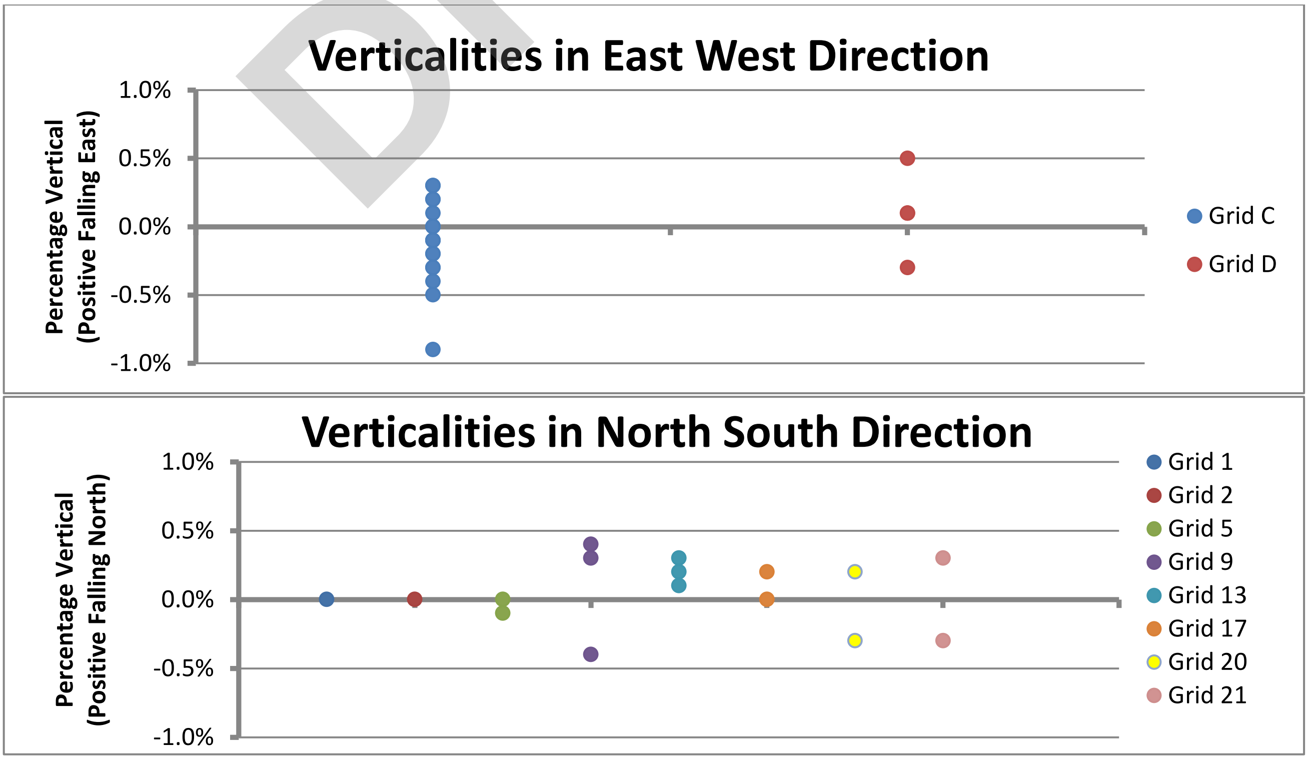

Figure 23: Verticality Trends Level 1

3.3.3 Level 2

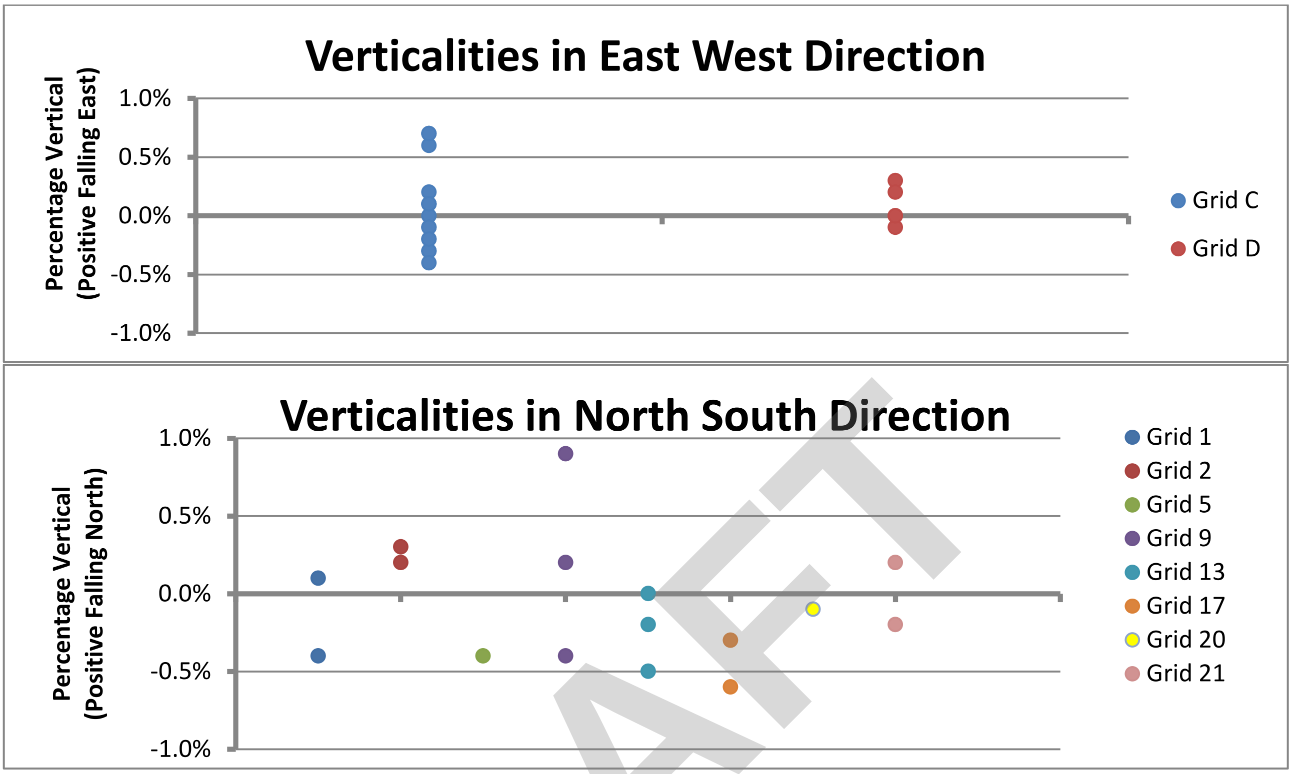

Figure 24: Verticality Trends Level 2

3.3.4 Level 3

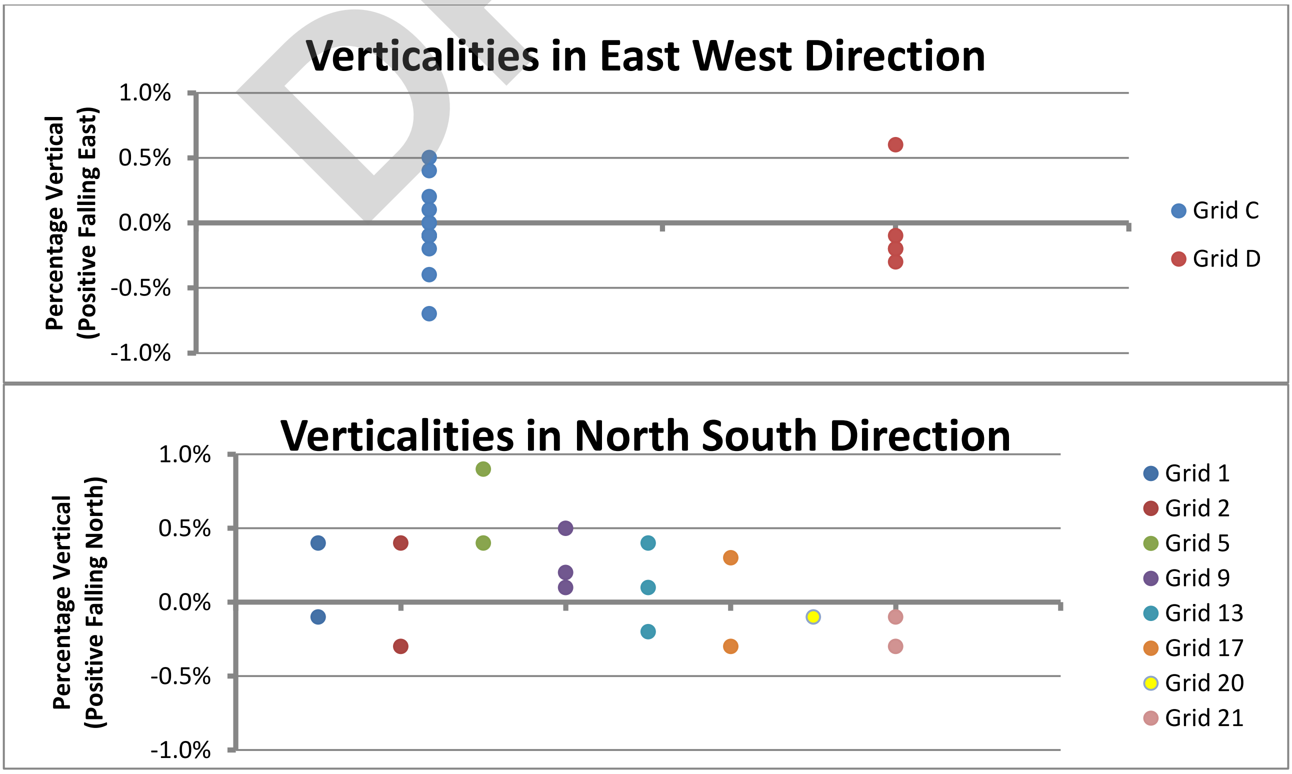

Figure 25: Verticality Trends Level 3

3.4 Retaining Wall

3.4.1 Damage assessment

AECOM carried out a visual inspection of the retaining wall as detailed in Table 3-3.

Table 3-3: Retaining wall damage assessment

Item	Drawing	Detail	Damage Observed
1	A-700	1	9.6m long horizontal crack, approximately 0.6mm in width, occurring 2.2m above ground level and 0.6m below the top of the wall. This crack runs the entire length of the western retaining wall. This crack appears to signify the movement of the retaining wall relative to the slab above it.
2	A-700	1	0.6m long vertical crack, approximately 5mm in width, occurring between 3m and 4m from the southern end of the western retaining wall, the crack begins at the top of the wall and propagates for 600mm before intersecting crack 1 and disappearing.
3	A-700	1	0.6m long vertical crack, approximately 5mm in width, occurring between 7m and 8m from the southern end of the western retaining wall, the crack begins at the top of the wall and propagates for 600mm before intersecting crack 1 and disappearing.
4	A-700	1	2.2m long vertical crack, approximately 6mm-8mm in width, occurring 8m from the southern end of the western retaining wall, the crack begins at the base of the wall and propagates for 2.2mm before intersecting crack 1 and disappearing. Crack 4 is less than 600mm away from crack 3
5	A-700	1	0.6m long vertical crack, approximately 2mm in width, occurring at the intersection between the western and northern retaining wall, the crack begins at the top of the wall and propagates for 600mm before intersecting crack 1 and disappearing.
1 (ctd.)	A-700	2	Crack 1 continues on the northern retaining wall as an 11.96m long horizontal crack beginning at the intersection of the western and northern retaining walls and propagating along the northern retaining wall. This crack is approximately 0.6mm in width, occurring 2.2m above ground level and 0.6m below the top of the wall.
6	A-700	2	0.6m long vertical crack, approximately 1mm to 2mm in width, occurring between 1m and 2m from the western end of the northern retaining wall, the crack begins at the top of the wall and propagates for 600mm before intersecting crack 1 and disappearing.
7	A-700	2	0.6m long vertical crack, approximately 1mm in width, occurring between 3m and 4m from the western end of the northern retaining wall, the crack begins at the top of the wall and propagates for 600mm before intersecting crack 1 and disappearing.
8	A-700	2	0.6m long vertical crack, approximately 1mm – 2mm in width, occurring approximately 5m from the western end of the northern retaining wall, directly adjacent to the fence. The crack begins at the top of the wall and propagates for 600mm before intersecting crack 1 and disappearing.
8a	A-700	2	Damage reference '8a' is an area of spalling measuring 500mm wide by 300high by approximately 40mm deep. This damage occurs at the same point along the wall as crack 8.

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Item	Drawing	Detail	Damage Observed
9	A-700	2	Damage reference ‘9’ is an area of severe spalling occurring over the full height of the wall in a strip 1000mm wide and approximately 40mm deep. This damage occurs at the same point along the wall as crack 8.
10	A-700	2	1.8m long vertical crack, approximately 5mm in width, occurring approximately 8m from the western end of the northern retaining wall, the crack begins at the bottom of the wall and propagates for 1.8m before intersecting crack 1 and disappearing.
1 (ctd.)	A-700	2	0.6m long vertical crack, approximately 0.6mm in width, occurring approximately 12m from the western end of the northern retaining wall. Crack 21 is a horizontal crack that runs for 11.96m before turning at 90° and becoming a 600mm vertical crack and terminating at the top of the wall.
11	A-700	2	Item 11 is a slot, which appears to have been cut or cast into the wall. The slot is 1630mm in height, 230mm wide and 40mm deep. This item may be the remnants of the original construction, such as a stairway or ramp support. This item occurs between 12.5m and 13m from the western end of the northern retaining wall.
12	A-700	2	Item 12 is an ‘L-shaped’ crack propagating from the top right corner of the slot (item 11) extending approximately 250mm in an easterly (horizontal) direction along the wall before changing direction and becoming a vertical crack for its remainder. Overall, the crack is approximately 1.1m long and generally 0.4mm wide.
13	A-700 A-700 A-700	2 2 3	2.6m long vertical crack, approximately 0.5mm in width, occurring between 15m and 16m from the western end of the northern retaining wall. The crack occurs over the full height of the wall. Item 13 includes an area of severe spalling approximately 20m long, beginning at 13.5m from the western end of the northern retaining wall and continuing to 33.5m. The spalling begins at ground level and occurs over approximately 40% of the height of the wall and varies in depth between 50mm and 100mm from the outside face of the wall. There did not appear to be any exposed reinforcement in this area. Some of the aggregate in this region of spalling can be removed by hand.
14	A-700	2	Item 14 is an ‘L-shaped’ crack occurring between 20m and 21m from the western end of the northern retaining wall. The crack begins at the top of the retaining wall as a vertical crack and propagates for 600mm before turning easterly and becoming a horizontal crack for a further 600mm. Overall, the crack is approximately 1.2m long and generally 0.4mm to 0.6mm wide.
15	A-700	2	0.6m long vertical crack, approximately 0.4mm in width, occurring between 23m and 24m from the western end of the northern retaining wall, the crack begins at the top of the wall and propagates for 600mm before disappearing.
16 16a	A-700 A-700	2 2	2.0m long horizontal crack, approximately 0.3mm in width, occurring between 22.5m and 24.5m from the western end of the northern retaining wall. The crack occurs approximately 900mm below the top of the wall. Item 16a is an approximately square area of severe spalling with side 0.45m long, beginning at 22m from the western end of the northern retaining wall and continuing to 22.5m. The spalling is up to 60mm deep, occurs at 900mm below the top of the wall and crack 16 propagates from the bottom right corner of this spalling. There did not appear to be any exposed reinforcement in this area.

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Item	Drawing	Detail	Damage Observed
17	A-700	2	2.6m long vertical crack, approximately 5mm in width, occurring between 24m and 25m from the western end of the northern retaining wall. The crack occurs over the full height of the wall and propagates through the severe spalling noted as item 13 for its lower 1m of height.
18	A-700	2	4.5m long horizontal crack, varying in width from less than 0.1mm to spalling greater than 30mm in width, occurring between 24.5m and 29m from the western end of the northern retaining wall. The crack occurs approximately 600mm below the top of the wall and propagates from the vertical crack 17.
19	A-700	2	0.6m long vertical crack, approximately 0.5mm in width, occurring between 26m and 27m from the western end of the northern retaining wall, the crack begins at the top of the wall and propagates for 600mm before intersecting crack 18 and disappearing.
20	A-700	2	Similar to crack 19: 0.6m long vertical crack, approximately 0.5mm in width, occurring between 28m and 29m from the western end of the northern retaining wall, the crack begins at the top of the wall and propagates for 600mm before intersecting crack 18 and disappearing.
21	A-700	3	2.6m long vertical crack, approximately 3mm in width, occurring approximately 31m from the western end of the northern retaining wall. The crack occurs over the full height of the wall and propagates through the severe spalling noted as item 13 for its lower 1m of height.
22	A-700	3	1.35m long horizontal crack, 0.5mm in width, occurring between 32m and 33.5m from the western end of the northern retaining wall. The crack occurs approximately 600mm below the top of the wall and propagates until it intersects damage items 23 and 23a.
23	A-700	3	0.6m long vertical crack, approximately 0.5mm in width, occurring between 33m and 34m from the western end of the northern retaining wall, the crack begins at the top of the wall and propagates for 600mm before intersecting crack 22 and spalling damage 23a and disappearing.
23a	A-700	3	Item 23a is a region of severe spalling damage, in which stones can readily be removed from the wall by hand. The region is approximately 500mm wide and similar in height. The region begins at the intersection of cracks 22 and 23 respectively, approximately 600mm below the top of the wall.
23 (ctd.)	A-700 A-701	3 4	At the top eastern corner of spalling damage 23a, crack 23 again propagates, but as a horizontal crack extending 38.1m and terminating at the fence approximately 5m from the eastern end of the northern retaining wall. This crack occurs approximately 600m below the top of the wall and varies in width from 3mm at the western end to 10mm at the eastern end with a maximum width of 15mm. The average width of this crack is approximately 10mm.
24	A-700	3	0.6m long vertical crack, approximately 0.2mm in width, occurring between 34m and 35m from the western end of the northern retaining wall, the crack begins at the top of the wall and propagates for 600mm before intersecting crack 23 and disappearing.
25	A-700	3	0.5m long horizontal crack, 2mm in width, occurring approximately 33m from the western end of the northern retaining wall. The crack occurs adjacent to the top corner of the eastern end of spalling damage item 13.

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Item	Drawing	Detail	Damage Observed
26	A-700	3	7m long horizontal crack, 3mm in width, occurring between approximately 35m and 42m from the western end of the northern retaining wall. The crack occurs 900mm below the top of the wall, beginning 300mm below crack 24 and continuing for 7m in an easterly direction along the wall. Upon intersecting vertical crack 28, this horizontal crack turns at a 30° angle and extends up the wall to intersect crack 23 within 600mm to 700mm. crack 23 is approximately 5mm wide at this intersection point. There is a 2mm step crack in the wall at the location of crack 26 i.e. the section of the wall above crack 26 appears to have 'shunted' forward and there is a 2mm to 5mm lip (or overhang) where the wall has fractured.
27	A-700	3	0.6m long vertical crack, approximately 3mm in width, occurring between 36m and 37m from the western end of the northern retaining wall, the crack begins at the top of the wall and propagates for 600mm before intersecting crack 23 and disappearing.
28	A-700	3	1m long vertical crack, approximately 2.5mm in width, occurring approximately 41m from the western end of the northern retaining wall, the crack begins at the top of the wall and propagates for 600mm before intersecting crack 23, a further 300mm before intersecting crack 26 and a final 100mm before disappearing.
29	A-700	3	0.56m long vertical crack, approximately 4mm in width, occurring between 44m and 45m from the western end of the northern retaining wall, the crack begins at the top of the wall and propagates for 560mm before intersecting crack 23 and disappearing. Crack 23 is approximately 10mm wide at this point.
30	A-700	3	0.6m long vertical crack, approximately 0.2mm to 0.5mm in width, occurring between 47m and 48m from the western end of the northern retaining wall, the crack begins at the top of the wall and propagates for 600mm before intersecting crack 23 and disappearing. Crack 23 is approximately 10mm wide at this point.
31	A-700	3	Item 31 is an area of spalling leading the exposure of a horizontal reinforcement bar, occurring 48m from the western end of the northern retaining wall. The exposed piece of reinforcing steel is 300mm long and appears to be approximately 10mm in diameter which would correspond to a 3/8" bar, common at the time of construction of this wall.
32	A-700	3	2.44m long vertical crack, approximately 1mm to 2mm in width, occurring approximately 48m to 49m from the western end of the northern retaining wall. The crack occurs over the full height of the wall and crosses crack 23 approximately 600mm below the top of the wall. Crack 23 is 10mm wide at this point.
33	A-700	3	Damage item 33 is a large t-shaped or inverted triangle shaped area spalling, occurring 600mm below the top of the wall, between 50m and 53m from the western end of the northern retaining wall. See 3/A.700 for exact location of damage.
34	A-700	3	0.6m long vertical crack, approximately 0.5mm in width, occurring between 51m and 52m from the western end of the northern retaining wall, the crack begins at the top of the wall and propagates for 600mm before intersecting crack 23 and disappearing.
35	A-700	3	0.6m long vertical crack, approximately 12mm in width, occurring between 53m and 54m from the western end of the northern retaining wall, the crack begins at the top of the wall and propagates for 600mm before intersecting crack 23 and disappearing.

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Item	Drawing	Detail	Damage Observed
36	A-700	3	1.5m long vertical crack, approximately 1.5mm to 2mm in width, occurring between 54m and 54.5m from the western end of the northern retaining wall, the crack begins approximately 400mm from the top of the wall and propagates for 200mm before intersecting crack 23 and continues a further 1200mm before disappearing. Crack 23 is 12mm wide at this point.
37 37a	A-700 A-700	3 3	0.2m long vertical crack, approximately 3mm to 4mm in width, occurring approximately 57m from the western end of the northern retaining wall, the crack begins 400mm from the top of the wall and propagates for 200mm before intersecting crack 23, which at this point is up to 15mm in width. Upon crossing crack 23, crack 37a propagates for a further 1.7m, but is a much finer crack, circa 0.1mm (or less) in width.
38	A-701	4	1.25m long vertical crack, approximately <0.1mm to 0.2mm in width, occurring between 60m and 61m from the western end of the northern retaining wall, the crack begins at the bottom of the wall and propagates for 1250mm before intersecting crack 23 and disappearing. Crack 23 is 10mm wide at this point.
39	A-701	4	0.57m long vertical crack, approximately 8mm in width, occurring between 68m and 69m from the western end of the northern retaining wall, the crack begins at the top of the wall and propagates for 570mm before intersecting crack 23 and disappearing.
40	A-701	4	Item 40 is a 1.5m long area of spalling occurring along crack 23, between 70m and 71.5m from the western end of the northern retaining wall. The spalling is a continuation of crack 23 and is up to 40mm wide at this point due to the fracturing of the plaster render finish.
41	A-701	4	0.4m long near-vertical crack, approximately 3mm in width, occurring between 71m and 72m from the western end of the northern retaining wall, to the east of the fence. The crack begins at the top of the wall and propagates at approximately 30° to vertical for 400mm before intersecting crack 45 and disappearing.
42	A-701	4	1.4m long vertical crack, approximately 1mm to 4mm in width, occurring between 72m and 73m from the western end of the northern retaining wall, to the east of the fence. The crack begins at the bottom of the wall and propagates for approximately 1200mm before intersecting crack 46 and continuing for a further 200mm through an area of spalling before intersecting crack 45 and disappearing. Crack 46 is 10mm-15mm wide at this point.
43	A-701	4	0.38m long vertical crack, approximately 3mm in width, occurring between 73m and 74m from the western end of the northern retaining wall, to the east of the fence. The crack begins at the top of the wall and propagates for 380mm before intersecting crack 45 and disappearing.
44	A-701	4	0.6m long vertical crack, approximately 3mm – 10mm in width, occurring between 73m and 74m from the western end of the northern retaining wall, to the east of the fence. The crack begins at the top of the wall and propagates for 450mm before intersecting crack 45, the crack continues for a further 150mm before intersecting crack 46 and disappearing.

Item	Drawing	Detail	Damage Observed
45	A-701	4	This crack is approximately 2.6m long and propagates from the eastern fence in an arch pattern to the east before intersecting with crack 46 and disappearing. The crack begins and finishes approximately 600mm below the top of the wall and reaches approximately 300mm below the top of the wall at its peak. Crack 45 is 3mm in width along its entire length. There is significant spalling of render and concrete in the vicinity of crack 45, in the area bounded by crack 45 and crack 46.
46	A-701	4	This crack is approximately 5m long and propagates from the eastern fence to the intersection of the eastern and northern retaining walls. The crack is horizontal and occurs approximately 600mm below the top of the wall. This crack may be an extension of crack23 but the fence obscures observation of this. Crack 46 ranges from 10mm to 20mm in width along its entire length. There is significant spalling of render and concrete in the vicinity of crack 46, particularly in the area bounded by crack 45 and crack 46.
47	A-701	4	0.55m long near-horizontal crack, approximately 3mm in width, occurring at the eastern end of the northern retaining wall at the intersection of the northern and eastern walls. The crack begins as part of crack 46 and the propagates above crack 46 at approximately 30° to horizontal for 550mm before hitting the north/east wall intersection and disappearing.
48	A-701	5	1.4m long horizontal crack, 20mm in width, propagating from the intersection of the eastern and northern retaining walls for approximately 1400mm along the eastern retaining wall before intersecting with spalling (item 50) and disappearing. This crack occurs 600mm below the top of the wall.
49	A-701	5	Area of spalling occurring less than 1m from the northern end of the eastern retaining wall. This spalling does not intersect with any other cracks. See 5/A.701 for exact location of damage.
50	A-701	5	Area of spalling occurring 1m from the northern end of the eastern retaining wall. This spalling is 400mm long and occurs at the intersection of cracks 48, 51, 52, and 53.
51	A-701	5	1.75m long vertical crack, approximately 2mm to 2.5mm in width, occurring between 1m and 2m from the northern end of the eastern retaining wall. The crack begins at the bottom of the wall and propagates for approximately 1750mm before intersecting spalling (item 50) and disappearing.
52	A-701	5	0.6m long vertical crack, approximately 1mm in width, occurring between 1m and 2m from the northern end of the eastern retaining wall. The crack begins at the top of the wall and propagates for 600mm before intersecting crack 53 and disappearing.
53	A-701	5	8.2m long horizontal crack, 10mm in width, propagating in a southerly direction from spalling (item 50), beginning approximately 1.5m from the northern face of the eastern retaining wall and continuing to the mostly southerly point of this wall. This crack occurs 600mm below the top of the wall.
54	A-701	5	0.6m long vertical crack, approximately 2mm in width, occurring between 5m and 6m from the northern end of the eastern retaining wall. The crack begins at the top of the wall and propagates for 600mm before intersecting crack 53 and disappearing.

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Item	Drawing	Detail	Damage Observed
55	A-701	5	0.6m long vertical crack, approximately 2mm in width, occurring approximately 9m from the northern end of the eastern retaining wall. The crack begins at the top of the wall and propagates for 600mm before intersecting crack 53 and disappearing. There is a second arm to this crack that intersects it in a 'Y' pattern, which is 300mm long, giving a total length of crack of 900mm.

3.4.2 Verticality

Further to the damage survey undertaken, AECOM undertook a verticality survey of the u-shaped retaining wall to the north of the Grand National Stand. The survey was carried out using a 1200mm long digital spirit level. The complete wall verticality survey is documented in drawings A-700 and A-701, with all verticality measurements recorded as percentage values off-vertical. Positive values are indicative of the wall sloping away from the observer and negative measurements are indicative of the wall sloping away from the observer. Measurements were taken at 1m intervals along the full length of the wall. High point and low point measurements were taken at every location, the high point measurement taken at the top of the wall and the low point measurement taken near the base of the wall. Where these values agree, only one value is shown on drawings.

Since original drawings are not available, AECOM cannot comment on reinforcement in the wall. However, spalling damage (noted as item 31 in damage assessment, see 3/A-700) reveals the presence of 10mm diameter plain round horizontal reinforcing steel at one location on the northern wall.

It appears from the consistency of verticality measurements recorded, that this retaining wall was constructed with a batter, i.e. the wall was not intended to have a straight vertical front face. For example, the recorded measurements suggest that the actual batter of the eastern wall is between 7.73% and 9.39%, which converts to a 1:10 to 1:13 batter. Discounting outlying measurements at the free end of the eastern wall, the average verticality measurement is in the range of 8.2% to 8.4%, which equates to a slope of approximately 1:12.

AECOM does not have access to the original construction drawings for this wall and thus cannot comment further on the intended design batter; however the achieved batter for the eastern wall appears to be 1:12. Figure 26 shows the spread of verticality measurements for the eastern retaining wall. When all measurements on the northern wall are analysed, the apparent batter is 1:10. Figure 27 shows the spread of verticality measurements for the northern retaining wall.

AECOM has plotted the verticality measurements recorded in the western and northern retaining walls in Figure 26 and Figure 27 respectively. For both walls, the recorded measurements have been plotted against an expected construction tolerance, based on the era of construction, and a series of confidence intervals (CI). The various plotted confidence intervals (64CI, 80CI etc.) are based on an assumed normal distribution (bell curve) of the variance about the mean.

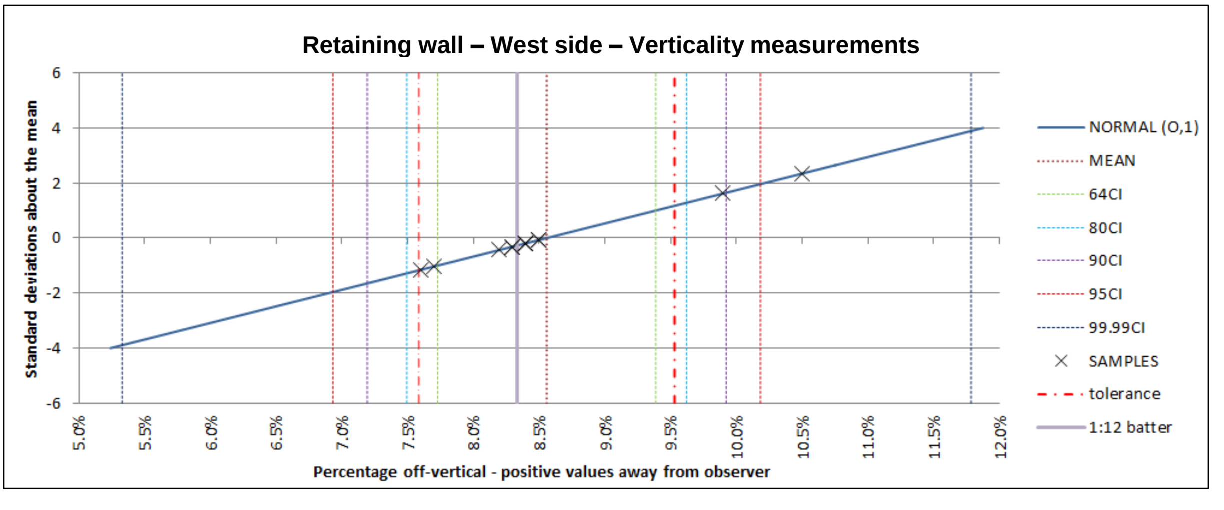

Figure 26: Western retaining wall verticality measurements

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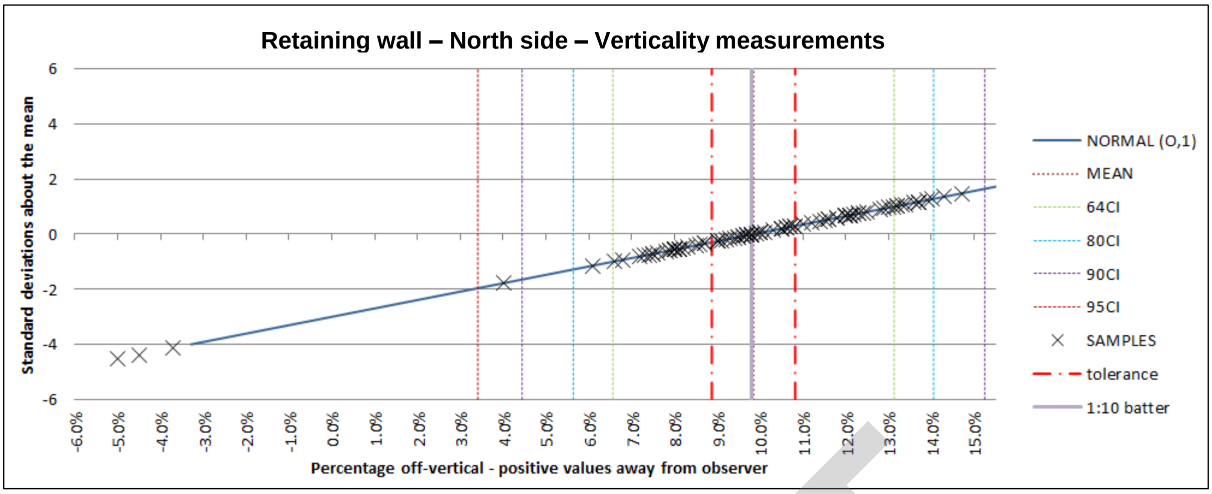

Figure 27: Northern retaining wall verticality measurements

The northern retaining wall is approximately 76m long, and over the eastern 44m of this wall there is a clear division between the low point and high point verticality measurements. The lower point measurements in this zone average out 6.4%, with significant bowing detected and three measurements which show the wall leaning back towards the observer. In the same zone the upper measurements average 12.4%. It is theorized therefore that the wall failed and hinged along a horizontal yield line at the approximate location of the construction joint. It is likely that this was caused by a shear failure in the retaining wall face.

3.4.3 Significance of damage

The retaining wall has suffered serious damage in the Canterbury Earthquake Sequence. Notwithstanding the fact that AECOM cannot rule out that some of the damage recorded, such as spalling, may pre-date the earthquakes, most if not all of the damage can be attributed to or has been exacerbated by earthquake induced loading.. This retaining wall displays significant horizontal separations along its entire length, and discrete vertical cracking which run the full height of the wall. A series of photos showing typical damage to the retaining wall is contained in drawings A-710, A-711, and A-712.

3.5 Level 4 Shear Wall

3.5.1 Damage assessment

AECOM carried out a visual inspection of both the interior and the exterior faces of the shear wall on level 4 as detailed in Table 3-4.The complete wall damage survey is documented in drawings A.424 to A.426.

Note that only cracks that were readily accessible from floor level were measured.

Table 3-4: Shear Wall Damage Assessment

Gridline	Drawing	Section	Damage Observed
C1-C (Grid 2)	A-424	2	Interior side of this buttress wall has severe spalling over most of the area. There are two locations where the rebar is exposed, on the end of the wall at grid C1, and again near grid C.
	A-425	7	Exterior side of this wall has severe spalling over the area.
2-3	A-424	3	On the interior face of the wall there is a horizontal crack (referred to later as main horizontal crack) which runs from grid 2 to grid 11 (36m), around 800mm from the top of the wall. There is severe spalling near the bottom of the wall, which has left concrete overhanging.
	A-426	9	The horizontal crack is reflected on the exterior face of the wall, however on this face the crack runs from grid 2 to grid 20 (72m). On this face the crack was up to 0.2mm. There is a 0.2mm wide vertical crack near grid 2, which begins at the top of the wall and propagates down to the main horizontal crack (0.825m).
3-5	A-424	3	There is a 7m long crack which begins near grid 3 on the main horizontal crack and propagates slightly upwards, meeting the top of the wall near grid 5. There is some spalling around this crack, between grid 3 and 4.
	A-426	9	0.2mm wide vertical crack at grid 4, which starts at the top of the wall and continues for 0.9m, meeting the main horizontal crack. There is a second vertical crack running the full height of the wall at grid 4 (2.4m), which is 0.2mm wide at the base of the wall, reducing to hairline, (<0.1mm) at the top of the wall.
5-6	A-424	3	There have been three 100mm diameter cores taken from this location for concrete compressive strength testing.
	A-426	9	0.1mm crack at grid 5, which runs from the bottom of the wall to the main horizontal crack (1.55m).
6-7	A-424	3	Hole in wall for pipe near grid 6, which has local spalling.
	A-426	9	5mm vertical crack at grid 6 which runs the entire height of the wall (2.4m).
7-9	A-424	3	Crack which begins at the top of the wall at grid 7 runs horizontally to grid 10 (13m). At grid 8 there is an area near the top of the wall where the concrete is chipped.
	A-426	9	Two vertical cracks 0.1mm wide at grid 7 and grid 8 which run from the bottom of wall to the main horizontal crack (1.64m).
9-10	A-425	4	No additional damage.
	A-426	10	0.5mm wide crack running entire height of wall at grid 9 (2.4m).
10-11	A-425	4	Main horizontal crack finishes at grid 11, at the face of the column

Gridline	Drawing	Section	Damage Observed
	A-426	10	At grid 11, adjacent to the column, there is a vertical crack 5mm-8mm wide which runs the height of the wall (2.4m).
11-12	A-425	4	Column on grid 11 has a vertical crack on its side 1.2m long and 3 horizontal cracks on the interior face 0.8m long. Note that there is a gap between the column and the wall. There is spalling to the wall near this gap.
	A-426	10	Column on grid 11 has 4 horizontal cracks along its height, 0.2mm wide, 0.8m long.
12-13	A-425	4	The door to level 4 is between grid 12 and 13. There is spalling to the wall near the top of the door.
	A-426	10	0.2mm wide crack at the top corner of the door which runs to the top of the wall, 0.2m long.
13-14	A-425	4	Three areas of spalling on the upper half of the wall between grid 13 and 14. There is a horizontal crack up to 0.1mm wide which starts between grid 13 and grid 14, and finishes at grid 17 (14m).
	A-426	10	0.9m long vertical crack from the top of the wall at grid 13, up to 0.1mm. 0.18m long horizontal crack near grid 14.
14-15	A-425	4	Near grid 14 a crack develops from the main horizontal crack and continues to grid 17 (11m)
	A-426	10	0.1mm wide crack starts from main horizontal crack near grid 14, and finishes at grid 16, 7.7m long. Vertical crack from top of wall at grid 14 to just below the main horizontal crack, 0.2mm wide, 1.5m long. Another vertical crack at grid 14 starts in the main horizontal crack and continues to the bottom of the wall, 1.5m long, and 2mm wide.
15-16	A-425	5	Two areas of spalling between grid 15 and 16.
	A-426	11	0.2mm wide vertical crack from main horizontal crack to bottom of wall on grid 15 (1.5m).
16-17	A-425	5	Area of spalling near the bottom of the wall near grid 16 and a larger area near the top of the wall at grid 17.
	A-426	11	1mm wide vertical crack from main horizontal crack to bottom of wall on grid 16. 1.5m long.
17-18	A-425	5	At grid 17 there is a vertical crack 1.5m long which extends from the lower horizontal crack, to the bottom of the wall. Horizontal crack starts near top of wall at grid 17 and continues to grid 20, 11m long. Horizontal crack near bottom of wall runs from grid 17 to grid 18 (4m). There is spalling at this crack on grid 17.
	A-426	11	2mm wide vertical crack runs height of wall at grid 17 (2.2m). 0.2mm wide diagonal crack at the bottom of grid 17 0.4m long. 0.1mm wide horizontal crack which starts before grid 17 continues to join the main horizontal crack just past grid 18, 5.2m long.
18-19	A-425	5	Vertical crack near grid 18 from main horizontal crack to bottom of wall (1.8m).
	A-426	11	Vertical crack from the interior face is reflected, 0.1mm wide from main horizontal crack to bottom of wall (1.5m)
19-20	A-425	5	No additional damage.

Gridline	Drawing	Section	Damage Observed
	A-426	11	At grid 20 there is a 0.2mm-2mm wide vertical crack which starts at the top of the wall and finishes at the main horizontal crack (1m).
C-C1 (Grid 20)	A-425	6	The buttress wall has severe spalling to the interior face. Near grid C1 there is a piece of timber which has been cast in the concrete, and some exposed rebar at the bottom of the wall.
	A-425	8	There is an exposed vertical reinforcing bar which is exposed over the full height of the wall. The timber on the interior face is also visible on the exterior face.

It should be noted that the crack referred to as the main horizontal crack which runs the entire length of the wall looks to be on a “cold joint”, where the top part of the wall was poured separately to the bottom part of the wall.

3.5.2 Verticality

Further to the damage survey undertaken, AECOM undertook a verticality survey of the shear wall on level 4. The survey was carried out using a 1200mm long digital spirit level. The complete wall verticality survey is documented in drawings A.424 to A.426, with all verticality measurements recorded as percentage values off-vertical. On the drawings, positive values are indicative of the wall sloping away from the observer and negative measurements are indicative of the wall sloping away from the observer, as shown in the ‘Verticality Measurements Key’ on drawing A.424. Measurements were taken at 1m intervals along the full length of the wall, on both faces. Two measurements were taken at every location, a measurement taken at the top of the wall and a measurement taken near the base of the wall, see Figure 28. Where these values agree, only one value is shown on drawings.

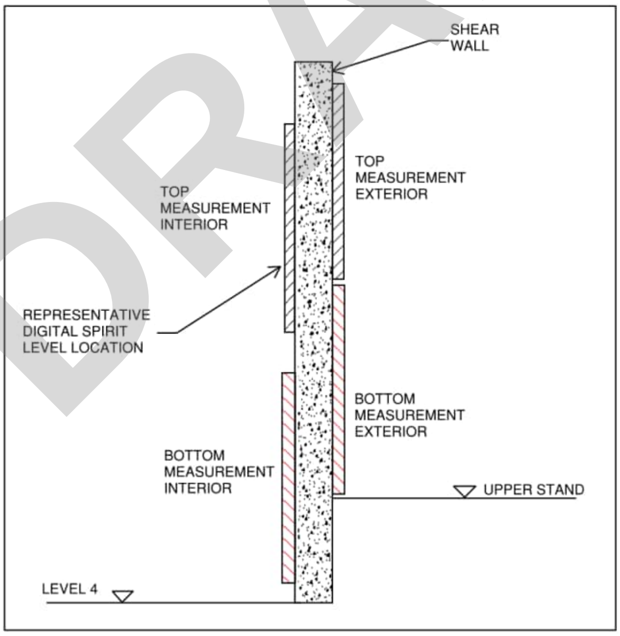

Figure 28: Location of spirit level for each measurement

No guidance exists on maximum allowable verticalities in commercial/industrial structures. AECOM considers a gradient of 0.5% as construction tolerance and a gradient of greater than 1.0% as potentially requiring remediation.

For the purpose of correlating the results the values measured from the exterior face were adjusted to agree with the interior measurements so that all positive values indicate the wall leaning towards the stands (outwards), and all negative values indicate the wall leaning away from the stands (inwards), as shown in Figure 29. The results vary between the interior and exterior measurements, as well as between the top and bottom measurements,

however the general trend shows that the wall is leaning towards the stands, with the overall average being 0.5% outwards, which is generally considered to be within the construction tolerance of the columns and walls.

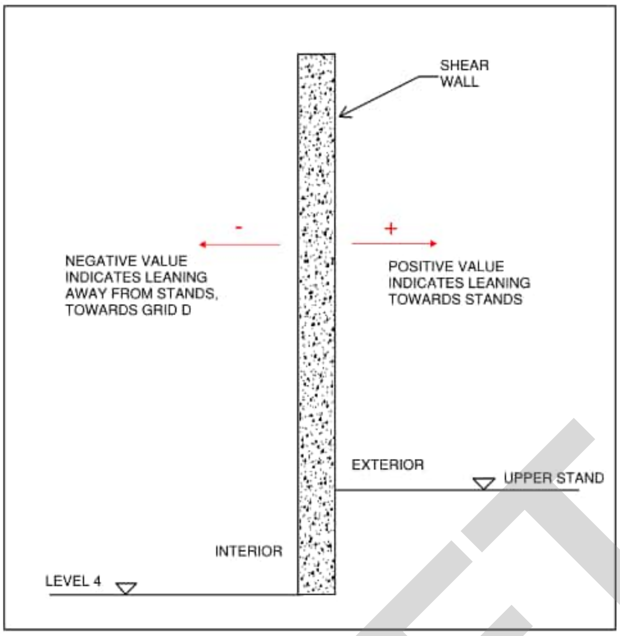

Figure 29: Notation for measurements shown on graphs

Figure 32 and Figure 33 show the verticality measurements taken along the wall, with a 68% confidence interval used as a tolerance range. Variability in measurements taken on either side of the wall at the same grid location indicate that the wall varies in thickness both vertically (over its height) and horizontally (along its length). This suggests poor quality control during construction.

There is a noticeable difference between verticality measurements taken at the top of the wall and measurements taken at the bottom of the wall. This is likely due to hinges forming along a horizontal crack on the cold joint, which is around mid-height, running the entire length of the wall, both on the interior and exterior faces, see Figure 30.

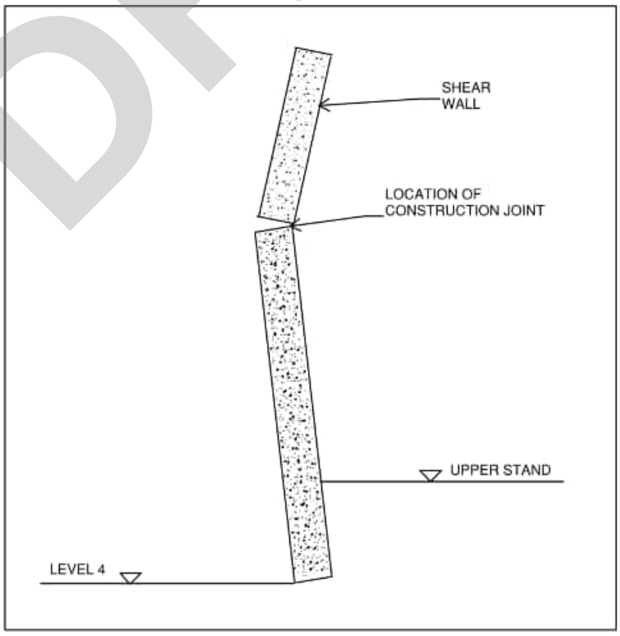

Figure 30: Hinging inferred from verticalities and crack patterns

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There is a significant difference between the top and bottom measurements on the exterior face of the wall between 50m and 57m. At this location there are two horizontal cracks near the middle of the wall, on both faces, so there is evidence to suggest that the wall has hinged at this section, resulting in the top of the wall leaning towards the stands and the bottom of the wall leaning away from the stands, similar to Figure 30. The maximum change between the verticalities measured at the top and at the bottom is 3.5%.

Figure 31 shows the roof framing layout in relation to the shear wall. The main trusses are shown in red and main bracing shown in dark blue. There is additional timber bracing which is shown in light blue.

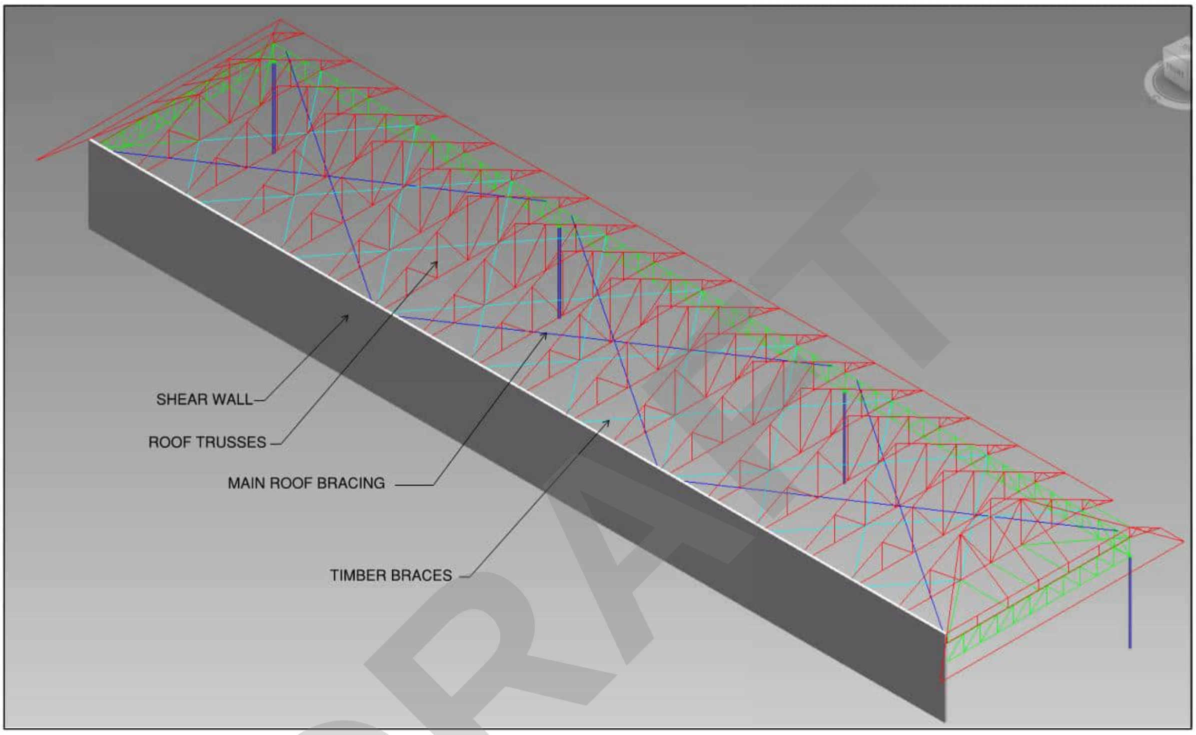

Figure 31: Shear wall and roof framing

It can be seen on Figure 32 that at the locations where the main roof bracing connects to the wall (24m and 48m); the top and bottom measurements are both close to zero. This shows that the wall has not moved at the location where it is restrained. This is not reflected on the interior face due to the column from the roof truss restricting access to the wall and therefore the measurements were taken either side of the column.

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Figure 32 shows the verticality measurements taken on the exterior face of the wall. It can be seen that the measurements taken at the top of the wall are usually more positive than the measurements taken at the bottom of the wall, indicating the hinging mechanism shown in Figure 30. It can also be seen that the measurements taken at the top of the wall follow a pattern with measurements around zero at the restraints and becoming larger between restraints.

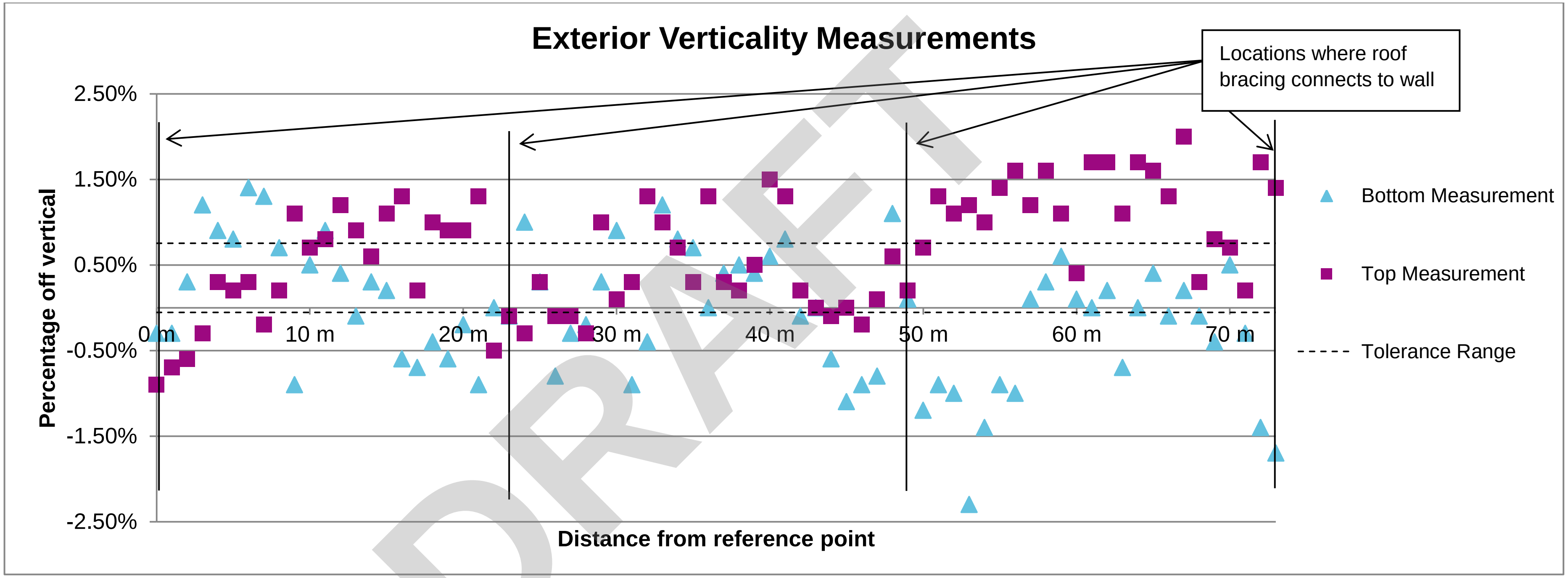

Figure 32: Verticalities of Level 4 Shear Wall from the exterior

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Figure 33 shows the verticality measurements taken on the interior face of the wall. These measurements show less of a pattern and vary more than the exterior face measurements but most measurements indicate the wall is leaning outwards.

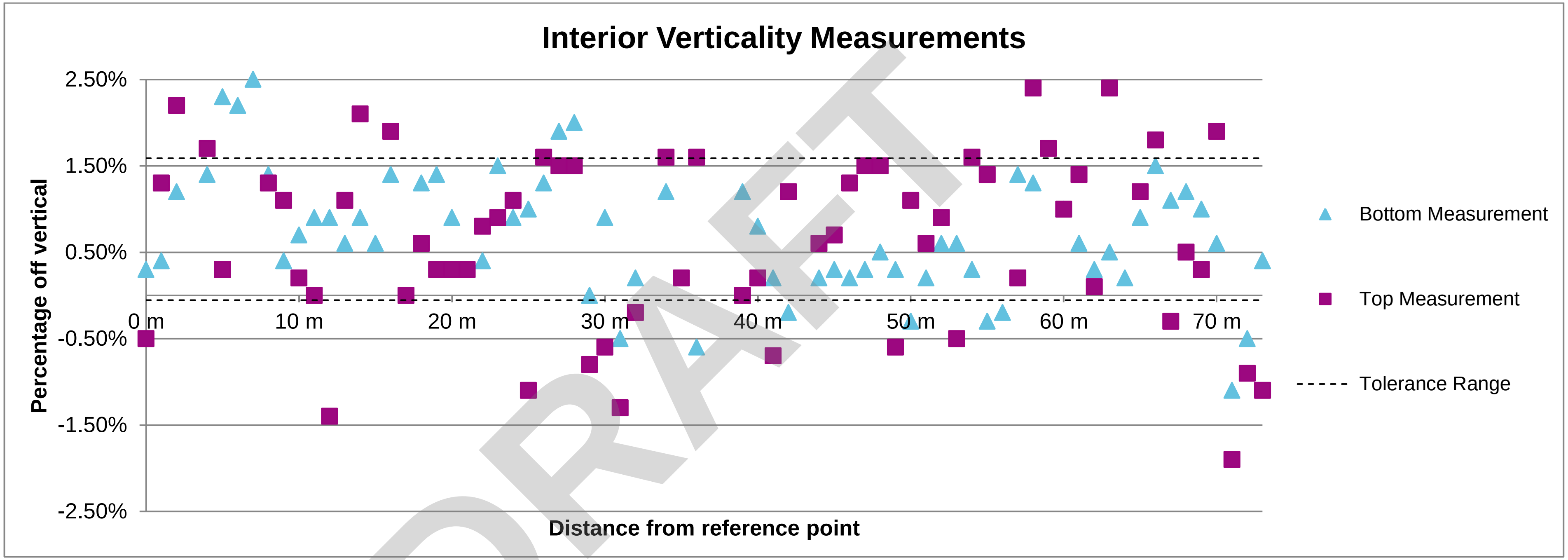

Figure 33: Verticalities of Level 4 Shear Wall from the interior

3.5.3 Crack Pattern

The observed damage can be analysed using yield line theory. The roof trusses are restraining the wall at each grid line, seen in red in Figure 31. As the wall is not well reinforced, these restraints act as pinned connections with the length of wall between each connection acting as individual panels, free to rotate about the points of restraint, as shown in Figure 34. This causes cracks to form at the restraints, and an expected yield line pattern as shown in Figure 35. However, as discussed above, the observed cracking to each panel is on the location of the cold joint. This is likely due to the cold joint being a plane of weakness and therefore the first place a crack will form. This leaves the top and bottom parts of the wall spanning horizontally, with cracks forming at the restraints, see Figure 36. These vertical cracks have occurred on some, but not all of the panels.

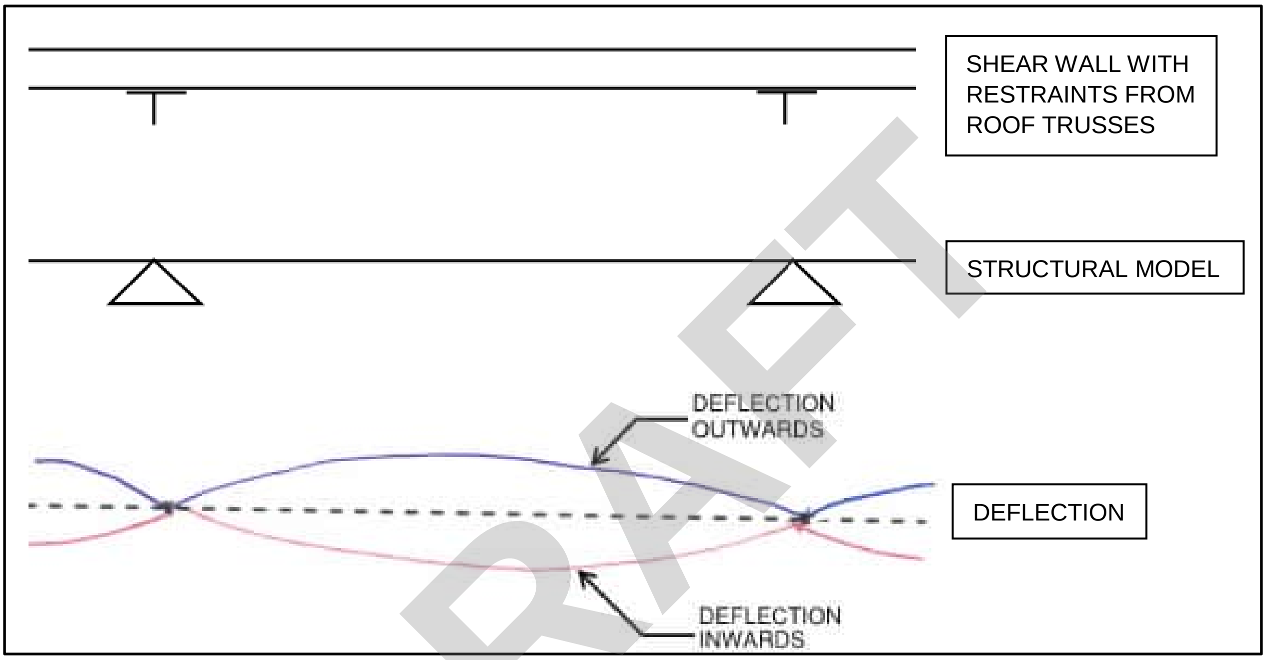

Figure 34: Panel behaviour of a wall element

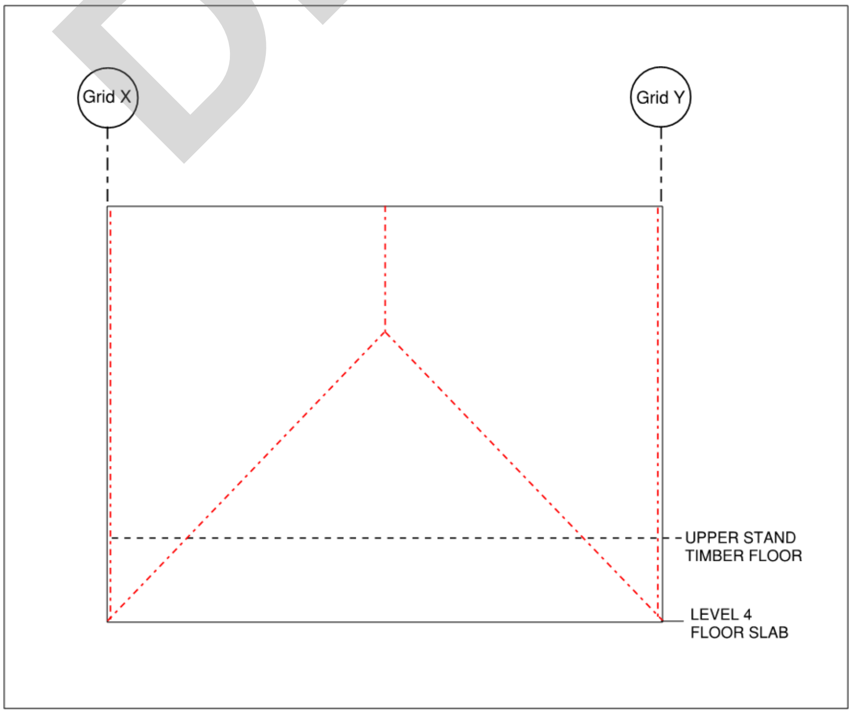

Figure 35: Expected Yield Line Pattern

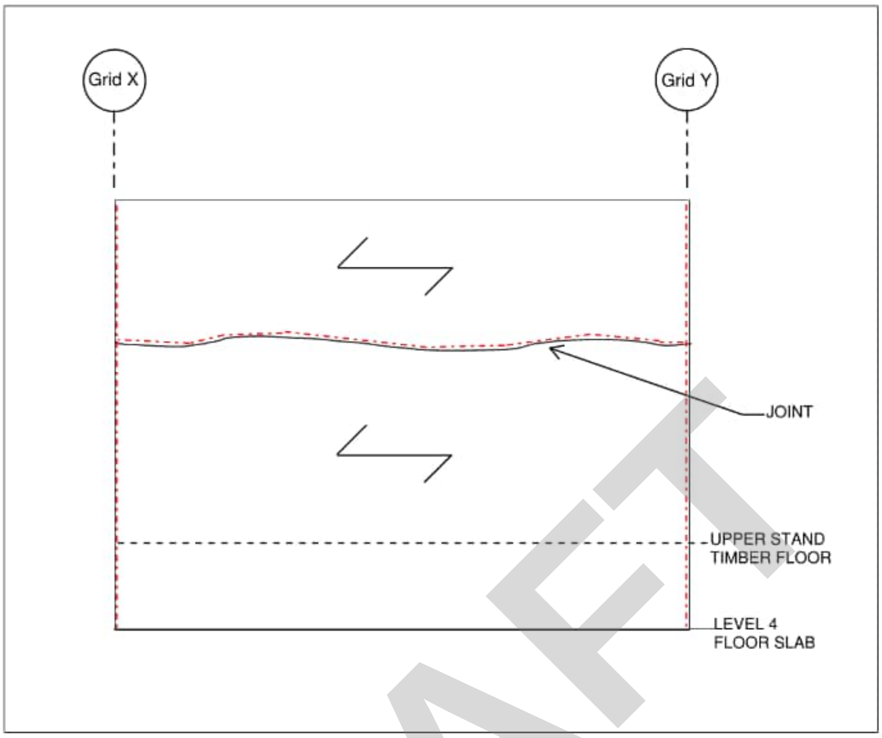

Figure 36: Observed Yield Line Pattern

3.5.4 Summary of damage

The major damage to the shear wall is the significant vertical crack up to 5mm wide on the exterior face at grid 6. There is another significant vertical crack which is 2mm wide on the exterior face at grid 17. Some vertical cracks have also formed on the grid lines.

There are multiple areas on the interior wall which have spalling concrete, and the buttress walls have severe spalling over their area. This is likely due to poor construction practice.

The average verticality of +0.5% shows that the wall is leaning slightly towards the stands; however this is not a significant lean and is within our stated construction tolerance. The difference in verticalities above and below the horizontal cracks signifies that the wall has hinged at the cold joint, and particularly in the area between 50m and 57m (grids 14 to 16) where a second horizontal crack has formed.

3.6 Grandstand Support

AECOM engaged Staig & Smith to conduct a verticality survey of the column and beams along the northern elevation of the structure. There are four columns and three beams supporting the upper stand and four columns and three beams supporting the upper stand roof. See Figure 37 for their locations. The following section summarises Staig & Smith's findings.

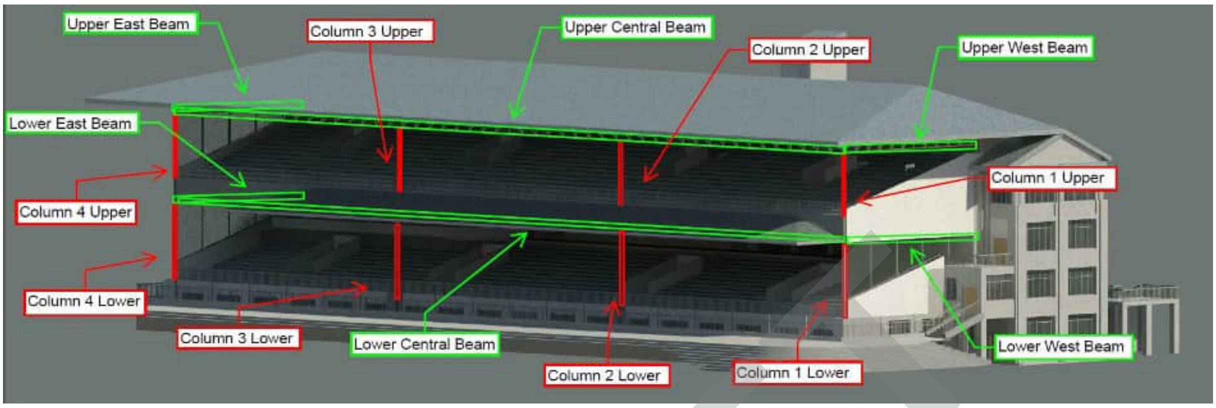

Figure 37: Beam and Column Locations

3.6.1 Columns

The assessment of the columns involved measuring the horizontal displacements of each column at their base (lower stand), upper stand level, the roof level, and additional points along their height. Measurements were taken from two sides, one in the north–south direction and one in the east–west direction. Upper and lower columns were also measured in relation to each other to provide relative results. The accuracy of the survey is ± 3mm.

The maximum deviation from verticality observed in any column was 13mm towards the south on lower Column 2, which is considered to be within construction tolerances. Majority of the other measurements are less than 5mm. This indicates that the columns have remained near vertical. See Figure 38 and Figure 39 for full results, the vertical scale is in metres and the horizontal scale is in millimetres for comparison.

For the east –west direction, east is considered positive and for the north – south direction, north is considered positive

The top of column 3 upper has moved away from plumb in both directions. It is possible that this is due to construction alignment issues or movement during the earthquakes due to a rusty connection, this is currently unknown.

3.6.2 Beams

The assessment of the beams involved measuring the vertical deflections along the beams. Levels were taken to the underside of the beam with an accuracy of ± 5mm. Points were sampled every 2m where possible.

For the lower beams the maximum height difference surveyed along the central beam was 11mm, with a general trend of the beam increasing in height towards the centre-point between columns (midspan of trusses). The maximum deviation along the side beams was 4mm. See Figure 40 for results. A maximum difference of 11mm indicates that the beams have remained relatively stable and level.

The maximum deviation measured for the upper central beam was 42mm and is less than the span/500 serviceability limit state deflection of 48mm, see Figure 40 for results. Heights surveyed showed an increase in heights in between the columns with a maximum at the centre point between columns. The trend of the high points being in between column support may indicate pre-cambering of the beam.

The measurements taken of the western beams at the western end of the structure showed a decrease in height at the south end of the beam towards the south of 35mm. The eastern end beam has a maximum vertical deviation from the front to the back of 6mm. The upper western beam's settlement does follow the trend of the structure settling in that direction, but it would be expected to see the same trend on the lower beam as well. There is localised crack damage in that location as shown in drawing A-426 and photo 4.11 on drawing A-541 that may have contributed to the settlement.

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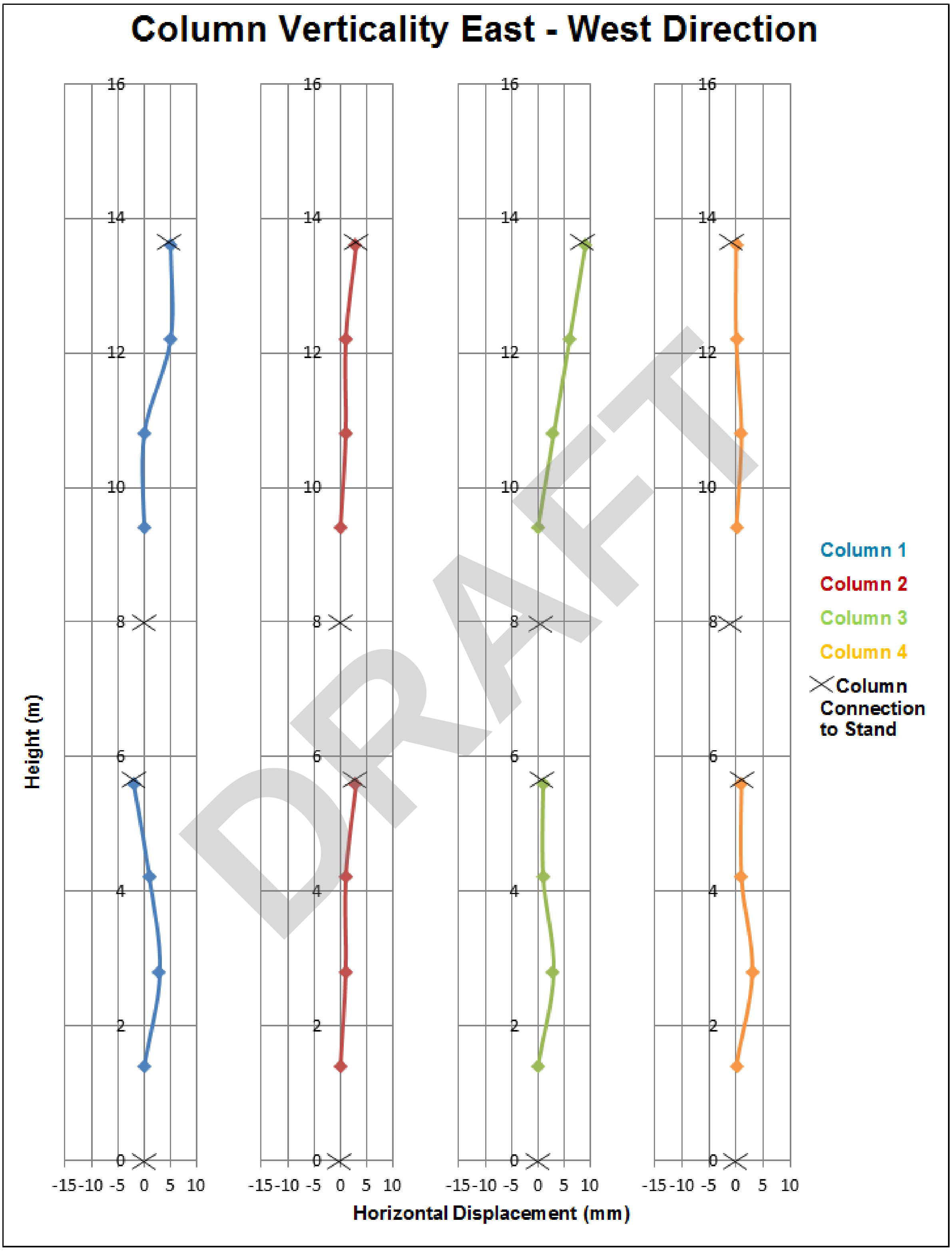

Figure 38: Column East-West Deflections

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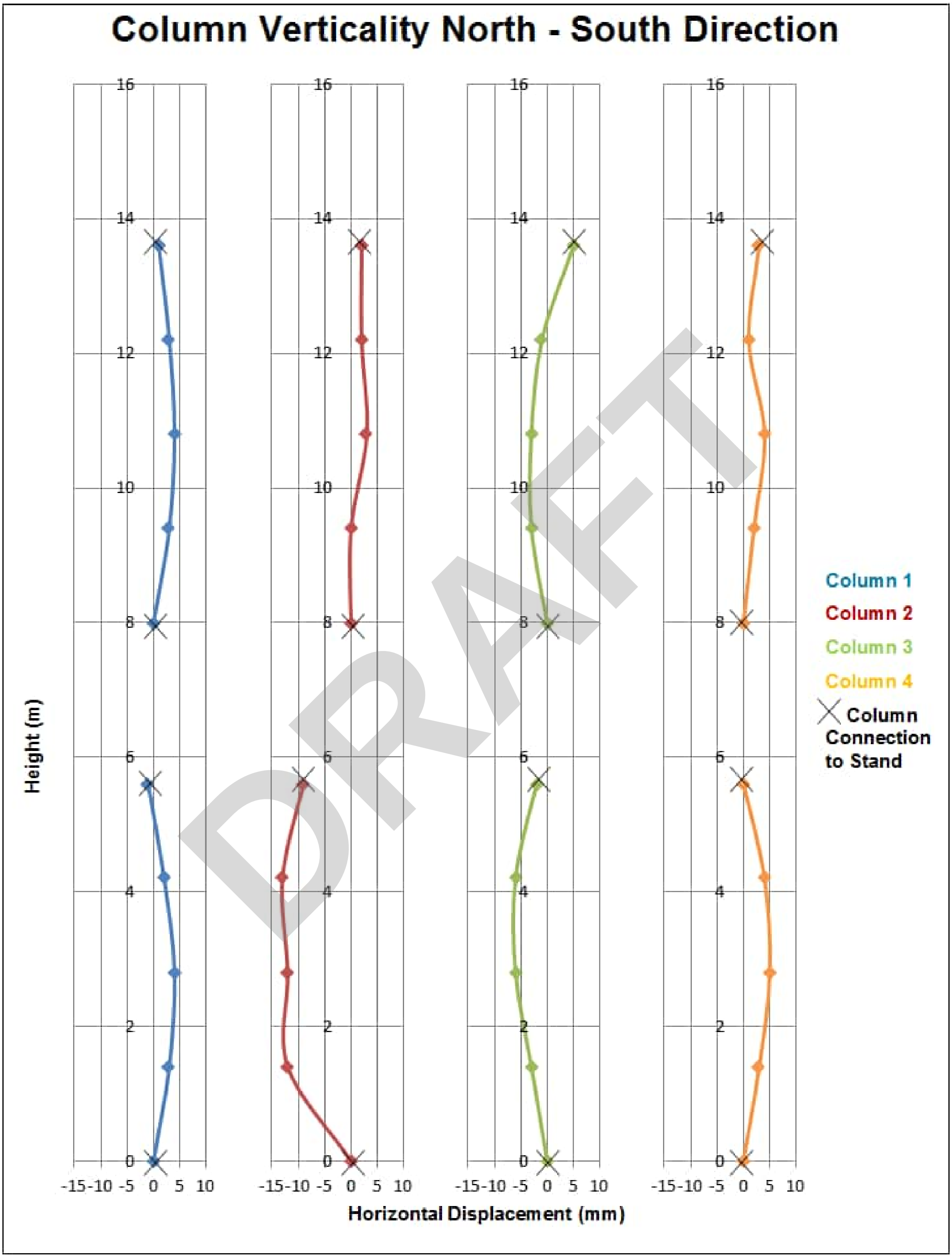

Figure 39: Column North-South Deflections

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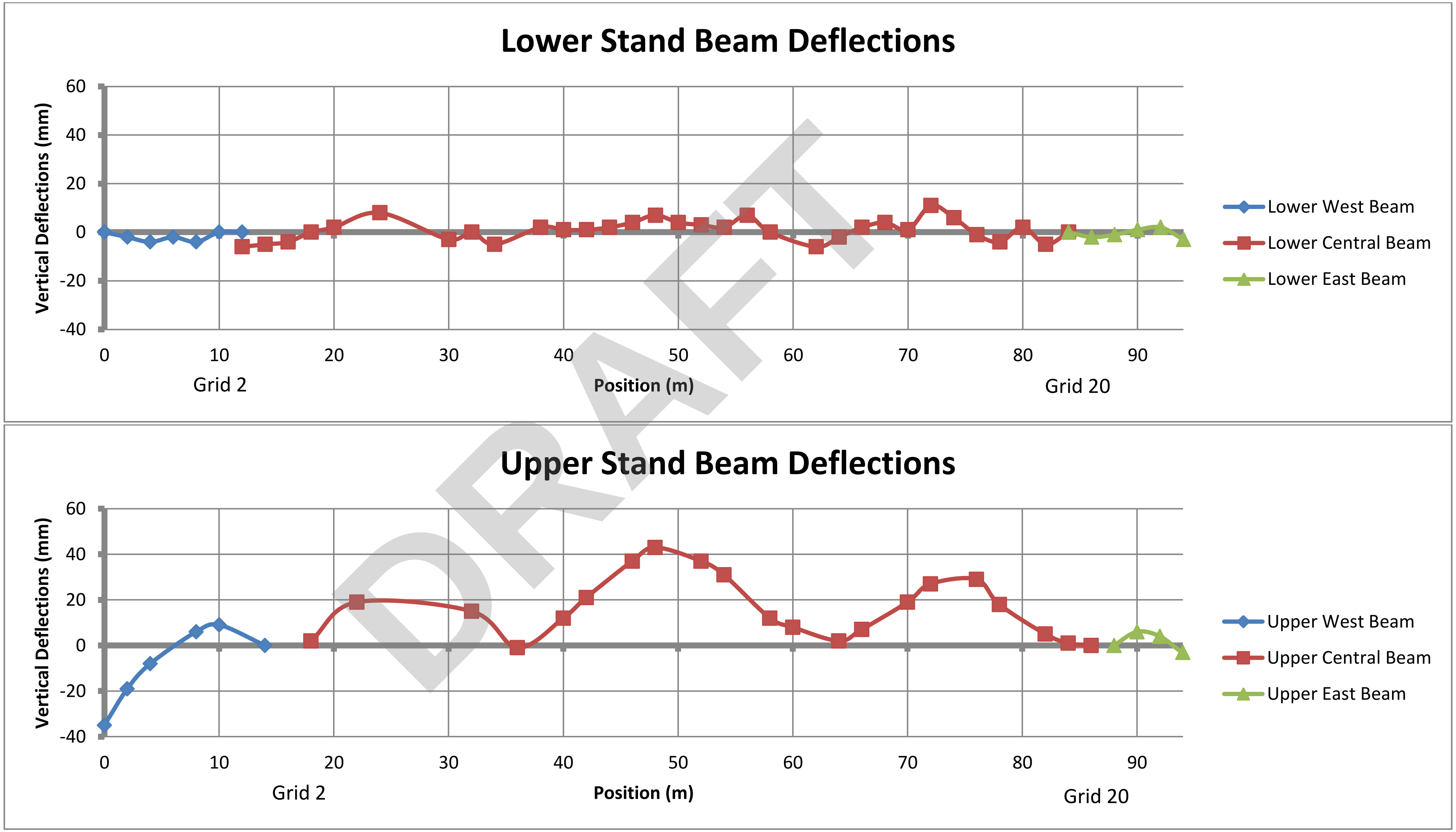

Figure 40: Beam Verticalities

3.7 Roof Assessment

Roof assessment was split into two phases. In the first phase roof members were visually assessed from level 4 slab and from the upper stand level. In the second phase a 26m knuckle boom was used in order to gain closer access to the upper stand roof elements and their connections to the supporting columns.

The knuckle boom was set up on the north side of the Grand National Stand to inspect the steel column connections at grid 8 and 14. To inspect the column connection on grid 2 the knuckle boom was set up to the west of the column and for the column connection on grid 20 it was set up to the east of the column. The concrete steps in front of the grand stand prevented the truck from backing up directly underneath the columns. This reduced the range of the knuckle boom and the columns at grid 8 and 14 had to be inspected from approximately 1 – 2 m away. The knuckle boom was able to access the columns on grid 2 and 20 because they were accessed from the east and west of the column.

The underneath of the roof space has been fitted with netting to prevent birds getting into the roof space. The netting also goes over the central truss spanning over the columns. This meant when investigating and taking photos of the roof space from the knuckle boom two layers of netting obstructed the view, compared to one layer when inspecting from the upper stand.

3.7.1 Column Connection

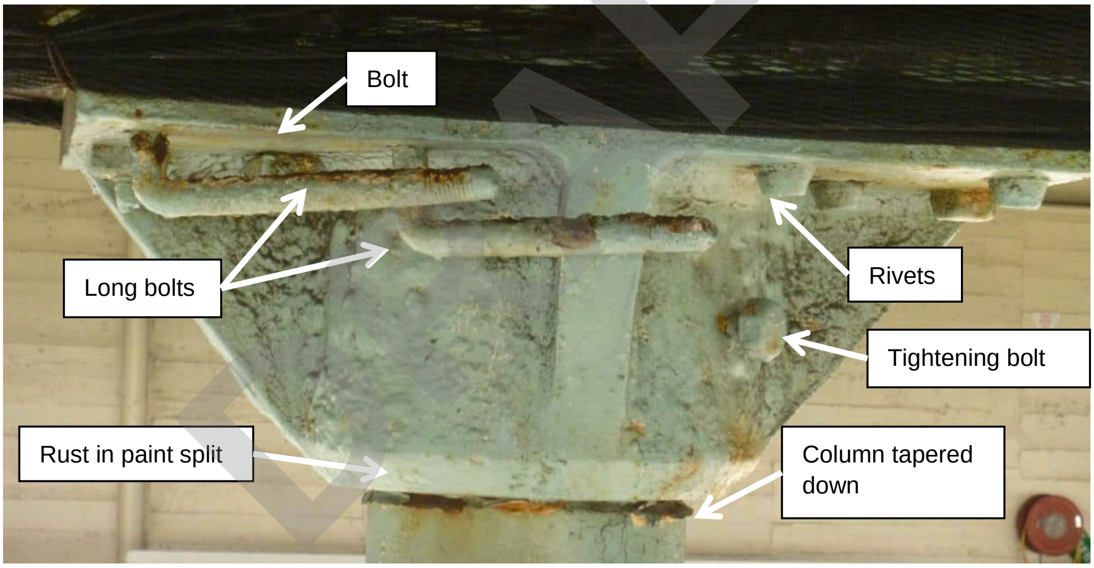

Figure 41: Cast iron collar connection

The steel columns supporting the truss are connected via cast iron collars. The steel columns taper down and appear to sit inside the collars. Both the columns and the collars have been painted and the paint has split at the interface of the connections resulting in the steel rusting.

The long bolts are only evident on the grid 8 column connection and may have been used to align the column during construction. For the remainder of the connections combination of bolts and rivets were used.

A likely failure mechanism of the column is shown in Figure 42. The collar assembly appears to be much stiffer than the column. If the roof displaces laterally and imposes displacement demand on the connection the column is expected to yield at the interface with the collar at its weakest location. The other potential failure mechanism would be rupturing of the rivets and bolts connecting collar to the bottom boom of the truss.

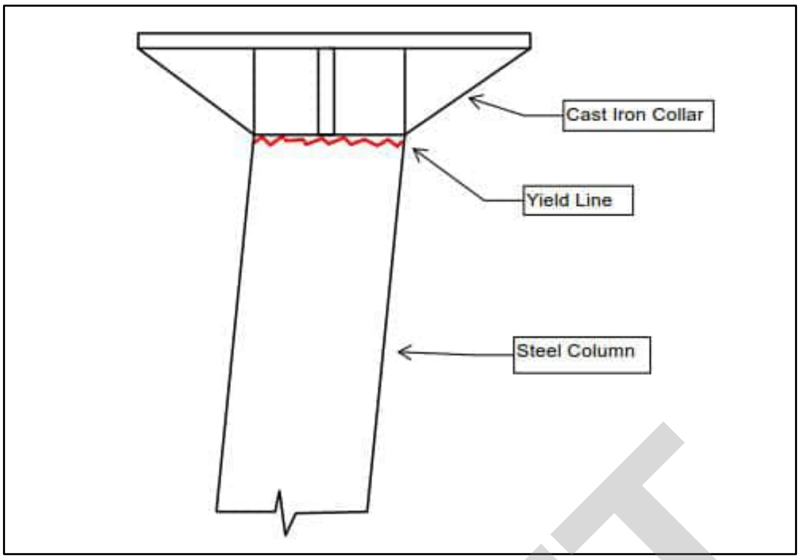

Figure 42: Likely yield mechanism of column

3.7.2 Bracing

The primary steel bracing in the roof consists of three bays of cross bracing as shown in drawing A-440. The bracing consists of round bars that appear to have been flattened at their ends to form splice connections. There are three types of brace bolted connections, splice at mid span, to the shear wall and to the truss. Typical connection details are shown in Figure 43.

The bracing rods run above the trusses and are supported on timber blocking. A number of the timber blocks have moved and fallen on to the netting as shown in photo F.2 and F.3 on drawing A-442. This indicates that the braces have displaced during the earthquake sequence or wind but there does not appear to be any sagging or yielding of the braces.

Splice connection with five bolts

Bracing connection to level 4 shear wall

Figure 43: Bracing connections

3.7.3 Damage Assessment

The roof layout consists of steel columns, steel trusses, steel braces, timber braces, timber purlins and timber joists and is shown in Figure 16. The bottom element of the steel truss running from the grid 20 column to the northern corner of grid 21 has significant rust damage; it is the most exposed element in the roof structure. The remaining steel elements appear to be in good condition apart from surface rust. In one location a loose bolt was observed as shown in photo F.9 on drawing A-442.

At each end of the roof space there is a suspended timber walking platform to an old viewing platform, which does not appear to be operational. Adjacent to this at the western end a timber purlin has been damaged and has fallen with only one end remaining connected. Apart from this and loose timber blocking mentioned in the previous section the timber members appear to be in reasonable condition for their age.

It should be noted that the inspection of the roof was visual in nature and mostly carried out from a relatively significant distance (upper stand level, level 4 slab). A detailed inspection of roof structure is recommended in the course of repair works to ensure that no loose timber blocks exist and that all connections are adequate.

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4.0 Intrusive Investigation

As the original construction drawings are not available and to conduct a thorough comprehensive assessment of individual pieces of damage, intrusive works were completed. This allowed investigation into inaccessible items and gain appreciation of the actual make-up of the main structural elements as well as the sampling of materials. Following the initial site walkover a list of intrusive works were developed and is shown in Tables C1 – C5 in Appendix C with the locations of works shown in drawings A-600 to A-604.

Due to inconclusive reinforcement scanning results from the original investigation further intrusive works were required to the superstructure which involved removal of concrete cover and reinforcement exposure in selected locations. Excavation to determine the foundation configuration was also conducted at a later stage.

4.1 Original Investigation

The original intrusive works involved:

- removing flooring and wall linings to provide access for damage assessment
- taking core samples of the concrete in the shear wall and suspended slab
- breaking out concrete to expose and extract steel reinforcement samples and
- reinforcement scanning.

The flooring and wall linings were removed and access to locked areas of the Grand National Stand were provided before the onsite damage assessment, except for items L0.3 (locked room) and L0.7 where the barrels were not removed to provide access to the room.

The ceiling of the Grand National Stand on various levels has an asbestos coating, which appears to be sprayed on. This had to be removed by a certified asbestos removal company to allow for concrete cores and steel rebar samples to be taken.

Concrete samples were taken by using a core drill to extract core samples in the floor slabs on level 1 to 4. Cores were also taken in the level 3 and 4 shear wall. The cores (in total 25 samples) were drilled the whole way through the slab and shear wall, then wrapped in bubble wrap and delivered to the lab for testing. See section 5.1 for core sampling results.

To extract the reinforcement in the slab, the slab was broken out over the top of beams. This minimised the damage created during the extraction. The reinforcement was identified to run in the east west direction and was at the bottom face of the slab. The material samples (17 no. 500mm long bars) were collected and delivered to the lab for testing and the results are shown in section 5.2.

To determine the reinforcement present in the reinforced concrete elements, for the analysis, reinforcement scanning took place. This occurred on all levels of the Stand at beams, columns, adjacent to beam-column joints and slab. Some of the original scanning locations had to be changed because of utilities blocking a clear path for the scanning equipment. This resulted in opposite sides of the beam or nearby columns being scanned instead. Scanning was also used in conjunction with extracting reinforcement in the slab. The scanning identified the specific locations of the slab so the reinforcement could be broken out and extracted. Two types of scanners were used, the PS200 which as a guidance can scan up to 100mm and gives the size of the reinforcement and the PS1000 which as a guidance can scan up to 300mm and provides a detailed picture of the location of reinforcement. The PS200 scanner was used to scan in all locations except for the level 4 shear wall. The PS1000 was used more sparingly, mainly as a verification of the PS200 results or if the PS200 did not detect any reinforcement. For thorough details on the scanning and the results see section 5.3 and Appendix G.

Reinforcement was exposed at three external (shear walls on east and west elevations and external stairs) and one internal location (adjacent to beam-column joint). The objective was to determine the extent of damage, confirm reinforcement size, spacing and the depth of cover.

4.2 Further Investigation

4.2.1 Superstructure

It was envisaged at the beginning that reinforcement scanning would provide an adequate understanding of the reinforcement present in the structure but the reinforcement scanning results were largely inconclusive. In some locations no reinforcement was detected and in some others the PS200 and PS1000 results did not provide definitive results on the reinforcement. The reasons for the inconclusive results were likely to be attributable to the depth of the concrete cover, steel beams being present rather than reinforcing bars and the non-uniformity of reinforcement throughout the structure. Further investigation was recommended and subsequently carried out:

- Beams and columns had 100mm wide by 900mm long slots cut to a depth of approximately 70-100mm at seven locations (refer to Table C-8)
- Holes were drilled in the beams and columns in order to confirm whether structural steel section were embedded in the concrete elements (four locations)

Subsequently in some locations the slots depths needed to be increased to 120mm as no reinforcement was found at 70-100mm slots.

4.2.2 Foundation exposure

In order to determine the foundation configuration local excavation was carried out at the ground floor level. It was decided to excavate two pits around an internal column, C7, and external column, D7, as shown in Table C-7. The findings of foundation exposure are presented in section 2.2 and inferred foundation layout is shown in drawing A-160 and A-161.

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5.0 Material Testing

5.1 Concrete Sample Testing

5.1.1 Test results

Analysis of 25 concrete test results show a statistically significant difference in the compressive strength of samples taken from horizontal elements (floors) and vertical elements (walls). In the absence of NZ-specific guidance on the assessment of in-situ compressive strength of concrete in existing structures, international best practice has been followed. Therefore, the rules of BS EN 13791:2007 [13] have been adopted. Test results yield the following distinct concrete grades:

Table 5-1: Concrete Grades

Element	Compressive strength fc' (MPa)	Mean specific weight γ_{conc} (kN/m^3)	Material designation
Beams and Floors	25.53	23.261	C25
Columns and walls	15.29	23.110	C15

5.1.2 Concrete properties for analysis

The following concrete characteristics will be used for all analysis, whether carried out by hand or using software, and for all design checks:

Table 5-2: Concrete Properties

Characteristic	C15	C25	Formula (if applicable)	Commentary and Reference
Specific weight (γ_{conc})	23.1 kN/m^3	23.3 kN/m^3	Derived from testing	Mean value of samples adopted
Compressive strength (f_c')	15.3 MPa	25.5 MPa	Derived from testing	Value determined in accordance with BS EN 13791:2007 [13]
Modulus of elasticity (E_c)	19882 MPa	23675 MPa	$E_c = 3320\sqrt{f_c'} + 6900$	cl. 5.2.3 NZS3101:2006 [14]
Modulus of rupture (f_r)	2.35 MPa	3.03 MPa	$f_r = 0.6\,\lambda\,\sqrt{f_c'}$	cl. 5.2.4 NZS3101:2006 [14]
Direct tensile strength (f_{cr})	1.41 MPa	1.82 MPa	$f_{cr} = 0.36\,\sqrt{f_c'}$	cl. 5.2.6 NZS3101:2006 [14]
Poisson's Ratio (v)	0.2	0.2	Codified value	cl. 5.2.7 NZS3101:2006 [14]
Coefficient of thermal expansion (α)	0.000012 /K (12x10^6 /°C)	0.000012 /K (12x10^6 /°C)	Codified value	cl. 5.2.9 NZS3101:2006 [14]
Shear Modulus (Gc)	7952 MPa	9470 MPa	$G_c = 0.4\,E_c$	cl. C7.6.1.3 NZS3101:2006 [14]

5.1.3 Further considerations regarding concrete properties for analysis

AECOM met with the insurer's engineer, Thornton Tomasetti (TT), on Friday 12 June 2015 to discuss the results of the concrete testing.

TT pointed out that the American Concrete Institute's (ACI) guidance suggests that a concrete core must have diameter measuring at least 3 times the nominal size of the aggregate used in the concrete matrix. This limitation is intended to prevent bond failure of individual aggregate unrepresentatively affecting the compressive test results. In the case of the Grand National Stand, aggregate as large as 70mm have been observed in vertical elements such as walls and columns. Much smaller aggregate (circa. 20mm) has been observed in floor slabs and beam. TT contends that in the case of one of the samples taken from the 4th floor shear wall that a 70mm piece of aggregate has caused the premature failure of the sample under compressive testing and thus this sample should be disregarded, based on ACI guidance. AECOM understands that TT suggests that this sample should either be disregarded or validated. This sample showed the lowest compressive strength of the batch.

AECOM accepts the validity of TT's comments regarding ACI guidance. However, there does not seem to be an easy way to conform to this guidance. Since the ratio of diameter to length of a sample must be at least 1:1.5, no code-compliant testing can carried out; aggregate concerns preclude all samples smaller than 210mm, in which case the sample must be at least 315mm long to be in accordance with testing standards. The shear wall is 180mm thick and thus such a sample is not possible. AECOM does not agree with taking a 210mm diameter from the centre of a 540mm load bearing concrete column, on both safety and practicality grounds.

AECOM contends that this sample, far from being unrepresentative, actually underline the vulnerability of the 180mm unreinforced shear wall to premature failure under compressive loading. Given the extremely poor quality of the concrete observed in the vertical elements throughout the structure, AECOM considers it prudent to use the 'lower' bound 15.3MPa throughout the structure for columns and shear walls.

From a pragmatic point of view, AECOM suggests that this structure is likely to achieve a %NBS far below 33%NBS. Based on the analysis of structures built in a similar era in Christchurch, AECOM suggests a %NBS of 10-15% is likely in this structure. The proposed non-linear pushover analysis is not sensitive to changes in concrete strength to such a degree that a change from 15MPa to 24MPa would make any appreciable difference to this 10-15% range prediction. The only area where the difference in concrete strengths would make any significant difference is in the 'hierarchy of failure' and in particular the shear strength of (unconfined) reinforced concrete columns. In this regard, AECOM considers that such a conservative stance on concrete strength in the vertical elements is in-line with the capacity design principle of 'strong column, weak beam', and is the safer approach to take.

AECOM will therefore undertake all non-linear pushover analyses on the basis of the lower bound concrete strengths. Should the %NBS value for the structure turn out to be near the 33%NBS threshold, then a sensitivity analysis can be considered to determine the actual influence of varying the concrete strength and further testing can be considered, ranging from Schmidt Hammer testing to further core samples, in accordance with international best practice.

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5.2 Steel Reinforcement Sample Testing

Preliminary test results show that there is a statistically significant difference in the steel properties of the 'large' diameter and 'small' diameter bars. 13 large diameter samples were tested and 3 small diameter samples were tested. Therefore for the purpose of analysis, two distinct materials have been defined, as follows:

Table 5-3: Reinforcement Steel Grades

Callout	Bar type	Nominal Size	Yield strength (fy)	Tensile strength (fu)	Stress ratio (Rm / Re)	% elongation	Design size (SAP)	Design area (SAP)
R307B	Round	7 mm	307 MPa	340 MPa	1.11	17%	6.8 mm	36.3 mm^2
R296C	Round	19 mm	296 MPa	451 MPa	1.51	20%	19 mm	283.5 mm^2

The reinforcement callout is a three part coding system, (*XYYYZ*) based on EN10080 and NZS3101. This system allows the reinforcing material to be described in terms of type, yield stress, and ductility.

- *X:* bar type – Round (R) or deformed (D)
- *YYY:* bar yield grade - yield strength (fy) of material expressed in MPa
- *Z:* bar ductility grade – example below shown is for 350MPa steel. Grade A, B, or C based on ductility measurements with thresholds defined in accordance with NZS3101:2006.

Note that the standard New Zealand ductility grading L, N, and E have intentionally not been used as although the tested steel may exhibit similar elongation properties to these categories, extensive enough testing has not been carried out to suggest that the tested steel can be accurately classified in accordance with NZS3101:2006.

Table 5-4 sets out the stress ratios and elongation limits used to define each reinforcement steel class:

Table 5-4: Steel Reinforcement Grades

Grade YYYZ	Yield stress fy (MPa)	Stress ratio Rm / Re	Total elongation %	Comment
350A	350[1]	>= 1.03	>= 1.5%	Low ductility – analogous to NZS3101 grade 'L'
350B	350	>= 1.08	>= 5.0%	Normal ductility – analogous to NZS3101 grade 'N'
350C	350	>= 1.15	>= 15%	High ductility – analogous to NZS3101 Seismic grade 'E'

Where a sample exhibits properties which place the sample in a transitional zone between grades, i.e. the stress ratio corresponds to ductility grade B and total elongation corresponds to ductility grade C, then the lower bound conservative ductility grading has been chosen.

[1] yield grade 350 is used as an illustrative example only

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5.3 Steel Reinforcement Scanning

There were no original construction drawings available for the Grand National Stand so the reinforcement used in the concrete elements could not be determined for the analysis. The location and size of the reinforcement is required for the section properties to be inputted into the structural model. To determine the reinforcement the concrete elements were scanned, this was completed on all levels and at a range of beams, columns, slabs and beam column joints with the locations shown in Appendix C.

Two types of scanners were used, the PS200 which as a guidance can scan up to 100mm and gives the size of the reinforcement and the PS1000 which as a guidance can scan up to 300mm and provides a detailed picture of the location of reinforcement. The PS200 scanner was used to scan in all locations except for the level 4 shear wall. The PS1000 was used more sparingly, mainly as a verification of the PS200 results or if the PS200 did not detect any reinforcement. The location where each type of scanner was used is shown in Appendix G.

The results of the scanning have been compiled and calibrated to their specific location and are shown in Appendix G. The PS200 and PS1000 scanning results were viewed in conjunction with each other to develop a better understanding of the reinforcement present.

The results from the scanning turned out to be largely inconclusive. In many instances bar sizes readings were unrealistic; in some locations where reinforcement was expected scanning did not detect any steel. The reasons for this is likely due to the large cover depth to the reinforcement, steel beams being present instead of reinforcing bars and the non-uniformity of the reinforcement.

In order to verify the inconclusive results or to find reinforcement where none was detected further intrusive works to break out the concrete and expose reinforcement was undertaken with the results shown in Appendix C.

5.4 Structural steel

AECOM were furnished with a digital copy of the steel properties tables [15] used in the design of the original structure, circa 1922. AECOM have relied upon this set of tables for all material information pertaining to the structure steel used in the construction of this building. Table 5-5 summarizes the information acquired:

Table 5-5: Structural Steel Characteristics

Characteristic	British units	SI
Specific weight (γ_{steel})	489.6 lbs/ cubic foot	76.936 kN/m^3
Tensile strength (f_u)	28 ton / square inch	432.55 MPa
Elongation at failure	20%	0.2
Max permissible stress (f_b)	7.5 ton / square inch	115.86 MPa
Yield stress (f_y)	13 ton / square inch	202 MPa
Young's Modulus (E)	- Not stated -	200 GPa (assumed) [16]

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6.0 Comparison of Airey's Damage Assessment

Airey Consultants, as part of their Detailed Engineering Evaluation (DEE) undertook a structural assessment of the building and documented damage to the Grand National Stand. A summary of the damaged elements Airey identified is shown in Table 6-1 along with the AECOM's observations on the damage identified.

Table 6-1: Comparison of Airey's Damage Assessment

Element	Airey's Notes	AECOM Observations
Ground conditions	1. *No liquefaction ejecta.* 2. *No lateral spread.* 3. *No signs of settlement.*	1. Agree with Airey's. 2. Agree with Airey's. 3. AECOM performed a floor level survey using a Zip Level, see Appendix A for results. There is a trend of settlement to the western end but the magnitude is relatively low. AECOM agree with Airey's comments.
Foundations	1. *No obvious signs of settlement.*	1. AECOM performed a floor level survey using a Zip Level, see Appendix A for results. There is a trend of settlement to the western end; however the magnitude is relatively low. AECOM agree with Airey's comments.
Roof / Level 4 wall	1. *No obvious movements.* 2. *Concrete wall at top of the seating has historical cracking that is showing minor movement following the recent seismic events.*	1. AECOM have performed a visual inspection of the roof from the upper stand and from elevating working platform. Corrosion and loose timber packers in the roof space noted. 2. Widespread crack damage to shear wall at the top of upper stand also noted.
Overall alignment and verticality	1. *No obvious movements or rotations.*	1. AECOM undertook a verticality survey using a 1.2m digital spirit level. See section 3.2.2 for detailed verticality analysis. The shear wall is leaning significantly north towards the track. The columns throughout the structure appear to have no consistent trend .
Moment frames	1. *No evidence of hinging at base.* 2. *No evidence of hinging at the beam column joint.*	1. Agree with Airey's comments. 2. Agree with Airey's comments.
Shear walls	1. *No shear walls in the building.*	1. Grid C of the stand is a significant shear wall on level 2, 3 and 4 and is a major lateral load resisting system for the building. See section 3.5 for detailed damage assessment of the shear walls. Horizontal and vertical cracks with water ingress through the cracking identified. Significant cracks to ground floor shear walls in grids 2 and 20 observed.
Diaphragms	1. *No evidence of damage to the in-situ concrete floor diaphragms.* 2. *Historical cracking was observed to the surface of the slab on the second floor.*	1. AECOM recommended carpet lifts in multiple locations. Substantial (15mm wide) cracks observed to ground floor slab. Significant cracks observed on level 1 at interface between original

Element	Airey's Notes	AECOM Observations
		slab and 1980's addition. Various other relatively minor cracks on all levels observed.
Stairs	1. *Concrete stairs in the centre of structure are seated on concrete frame of which there is no distress to the seating.*	1. Agree with Airey's comments with respect to internal stairs. Airey's did not comment on external stairs and ramps which suffered significant damage.
Cladding	1. *Only secondary cladding N and S sides of the grandstand and no damage was observed.*	1. Agree with Airey's comments.

Airey in their DEE report made the following general comment about the damage:

> *"The damage observed throughout the building is minor ie: generally nothing more than hairline cracking in some locations and may be partly historical ie: not necessarily originating from seismic damage but possibly from other factors such as shrinkage strains, and likely to have been made more noticeable as a result of seismic displacement of the structure."*

AECOM disagree with the above statement. There are multiple areas within the building which suffered various degrees of damage ranging from widespread and substantial (e.g. shear walls) to minor (columns). Also the stairs, ramps and retaining walls which are all attached to the main building suffered relatively significant damage and do not feature in Airey's report.

It is evident that the building has been damaged by the Canterbury earthquake sequence with some of the historical building defects (such as pre-existing shrinkage cracks or segregation of concrete due to poor construction practice) exacerbated by the events.

We also note that the beams identified in Airey's calculations as beams reinforced with 2no. 25mm bars top and bottom were in fact concrete encased steel beams. Concrete columns which have been assumed by Airey's to be reinforced with 32mm diameter vertical bars and 6mm links were in fact reinforced with 19mm diameter vertical bars and 12mm diameter links.

7.0 Conclusions and Further Comments

7.1 Site

A desktop study indicates that the site has not experienced the design level earthquake in any of the Canterbury earthquake sequence events.

The shallow geotechnical investigation revealed that the columns are set upon relatively small pad footings and the bearing stresses beneath the footing are significant.

7.2 Damage

It is evident that the building has been damaged by the 2010 / 2011 earthquake sequence and subsequent aftershocks. Historical building defects have been exacerbated and the building suffers from some deterioration which is consistent with its age.

Significant cracking to the shear wall on Gridline C has been identified in the course of the investigation. Shear walls on Gridline 2 and 20 experienced crack damage with substantial horizontal cracks observed to both walls. The extent and location of cracking on the interface between the lift core and the main building suggests that the core may have partially detached from the remaining building. Although not earthquake damage, we note numerous rotten timber bleachers in the construction of the both upper and lower stand facing the racecourse. The roof trusses appear to suffer from poor maintenance with corrosion to steel members evident in a number of locations.

External ramps and stairs are significantly damaged due to combination of the above stated factors. In some locations, excessive cracking has led to ingress of water which has subsequently led to spalling of concrete and corrosion of reinforcement. The retaining wall to the north of the building is severely damaged with cracking, spalling and concrete delamination evident.

We note that some areas were affected by segregation of concrete due to construction practice. We also identified excessively large aggregate contained in the concrete elements (e.g. Gridline A frame).

The site survey identified that there have been a number of structural alterations to the original building frame. For example, a lift shaft has been added south of gridline E and a number of shear walls has been removed along Gridline C. The survey identified an undesirable structural form of the shear wall in gridline C with its length increasing with height (i.e. approximating an “inverted” shear wall arrangement“).

We have not assessed secondary components of the building - our inspection was restricted to primary structural elements. Electrical, service connections, sanitary fittings and secondary elements such as windows and fittings were not inspected.

In summary, the most significant damage was located on the E/W shear wall on Grid C, the ramps and stairs generally behind the grandstand, retaining wall to the front of the grandstand and the ground floor slab.

7.3 Intrusive Investigation

In the course of investigation it was not possible to determine the precise make-up of some structural elements (e.g. beam-column joints). We note that the detailing of reinforcement (e.g. laps and development lengths at the node) has a major influence on the ductility, and hence overall performance of the structure.

Intrusive investigations revealed that the amount of reinforcement in the existing concrete columns and beams is considerably less than the current minimum requirements for reinforced structures. The reinforcement appears to be somewhat random in quantity and location with plain round bars being used throughout the building. Also the cover to reinforcement varies significantly. We note that reinforced concrete structures with plain round bars have not been heavily researched, and limited guidance exist on the technical engineering treatment of these elements.

Some beams which were presumed to be constructed of reinforced concrete were in fact concrete encased steel sections.

Lifting of carpets in the bar area at the ground floor exposed significant cracks to the slab-on-grade. Removal of plasterboard to the back of shear wall at level 3 identified a significant vertical crack which continuous throughout the full height of the wall.

7.4 Discussion of Airey Consultants report

AECOM strongly disagree with Airey's summary of damage to the structure being "nothing more than hairline cracking". We identified significantly more damage than purported by Aireys both with regard to damage extent and location.

We also note that the beams identified in Airey's calculations as beams reinforced with 2no. 25mm bars top and bottom were in fact concrete encased steel beams. Concrete columns which have been assumed by Airey's to be reinforced with 32mm diameter vertical bars and 6mm links were in fact reinforced with 19mm diameter vertical bars and 12mm diameter links. We consider these deviations between modelling assumptions and physical representation to be grossly erroneous.

7.5 Further Recommendations

AECOM recommends that a full quantitative analysis (e.g. DDE, DSA) be undertaken for the building in order to assess the seismic capacity in terms of percentage of new building standard (%NBS, i.e. NZS1170.5:2004- Earthquake Actions).

We note that the roof structure was only visually assessed from the upper stand and elevating working platform due to lack of safe access for a more detailed investigation. We recommend that safe access is provided to roof space for closer inspection and assessment of trusses and associated connections.

8.0 Disclaimer

1) Only structural elements readily visible and accessible by reasonable means in accordance with health and safety requirements have been observed. Unless otherwise noted, structural elements hidden by wall linings, ceilings and cladding have not been inspected.

2) Where existing structural documentation is available, it is assumed that all reasonable measures have been taken during construction to erect the building in accordance with these documents. Any reinforcement size/spacing, strength grades and connection details indicated on the existing drawings have been assumed to be correct on-site.

3) The repair and strengthening concepts and information contained in this report are conceptual and are intended for preliminary pricing only. The information in this report is not intended for construction purposes or for the purpose of obtaining building consent (or exemption from consent).

4) It should be noted that the remedial measures made in this report do not preclude the possibility of future differential settlement of the building following future significant earthquakes. This settlement will be cumulative and may result in further structural damage, settlement of ground slab and requirement for re-inspection. The requirement for ground improvement should be considered on a cost-benefit basis in accordance with the geotechnical report, taking consideration of cost, time and disruption and likelihood of future damage.

5) This report is for the sole use and benefit of our Client. No other party should rely on this report without the prior written consent of AECOM. AECOM undertakes no duty, nor accepts any responsibility, to any third party who may rely upon or use this report. The basis of AECOM's advice and our responsibility to our Client is set out above and in the terms of engagement with our Client.

9.0 References

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Appendix A

Drawings

STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

STRUCTURAL DRAWING LIST		
SHEET NUMBER	DRAWING NAME	SHEET NAME
A.001	SITE LOCATION	GENERAL BUILDING INFORMATION
A.100-A.109	AS BUILT DRAWINGS	EXISTING PLANS
A.110-A.119	AS BUILT DRAWINGS	EXISTING ELEVATIONS
A.120-A.129	AS BUILT DRAWINGS	SECTIONS ON GRID 1, GRID 2, GRID 4 AND GRID 13
A.130-A.139	AS BUILT DRAWINGS	SECTIONS ON GRID C AND GRID D
A.140-A.149	AS BUILT DRAWINGS	RETAINING WALL
A.150-A.159	AS BUILT DRAWINGS	EXTERIOR RAMPS, STAIRS AND STEPS
A.160-A.169	AS BUILT DRAWINGS	FOUNDATION PLAN AND ASSUMPTIONS
A.200-A.209	FLOOR LEVELS AND VERTICALITY SURVEY	FLOOR LEVELS
A.300-A.309	FLOOR LEVELS AND VERTICALITY SURVEY	COLUMNS AND WALLS VERTICALITY
A.400-A.409	DAMAGE ASSESSMENTS AND CRACK MAPPING	FLOORS AND CEILINGS DAMAGE ASSESSMENT
A.410-A.419	DAMAGE ASSESSMENTS AND CRACK MAPPING	ELEVATIONS DAMAGE ASSESSMENT
A.420-A.429	DAMAGE ASSESSMENTS AND CRACK MAPPING	N/S FRAMES DAMAGE ASSESSMENT
A.430-A.439	DAMAGE ASSESSMENTS AND CRACK MAPPING	E/W FRAMES DAMAGE ASSESSMENT
A.440-A.449	DAMAGE ASSESSMENTS AND CRACK MAPPING	ROOF DAMAGE ASSESSMENT
A.500-A.509	DAMAGE ASSESSMENT - PHOTOS	GROUND LEVEL
A.510-A.519	DAMAGE ASSESSMENT - PHOTOS	LEVEL 1
A.520-A.529	DAMAGE ASSESSMENT - PHOTOS	LEVEL 2
A.530-A.539	DAMAGE ASSESSMENT - PHOTOS	LEVEL 3
A.540-A.549	DAMAGE ASSESSMENT - PHOTOS	LEVEL 4
A.550-A.559	DAMAGE ASSESSMENT - PHOTOS	ELEVATIONS
A.600-A.609	INTRUSIVE WORKS LOCATIONS AND INITIAL DAMAGE LOCATIONS FOLLOW UP	PLANS
A.700-A.709	RETAINING WALL ASSESSMENT	DAMAGE ASSESSMENT
A.710-A.719	RETAINING WALL ASSESSMENT	PHOTOS
A.800-A.809	EXTERIOR RAMPS, STEPS AND COLUMN SURVEY	DAMAGE ASSESSMENT
A.810-A.819	EXTERIOR RAMPS, STEPS AND COLUMN SURVEY	PHOTOS

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ISO A1 594mm x 841mm

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LOCATION PLAN

Scale: 1 : 10000

SITE PLAN

Scale: 1 : 2000

GENERAL BUILDING INFORMATION

TOTAL FLOOR AREA:	
GROUND FLOOR:	1735 m²
FIRST FLOOR:	1230 m²
LOWER STAND:	825 m²
SECOND FLOOR:	1000 m²
THIRD FLOOR:	1065 m²
UPPER STAND:	1080 m²
FOURTH FLOOR:	765 m²
ROOF:	2873 m²
YEAR OF CONSTRUCTION:	1922
LAND ZONING:	CERA green zone. Land analogous to residential TC1
STORIES:	5 floor levels 2 grandstands
FOUNDATIONS:	Unknown - pending full geotechncial investigation Shallow pads assumed
CLADDING TYPE:	Plaster render and exposed concrete
ROOFING TYPE:	Lightweight roofing. Corrugated sheet metal on steel trusses
WINDOW JOINERY:	Timber
GLAZING TYPE:	Single glazing
WALL LININGS:	Plaster render with some GIB linings
CEILING:	Stippled plaster render. Localised asbestos fiber

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PROJECT

STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT

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ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

GENERAL BUILDING INFORMATION

SHEET NUMBER

60332326-DRG-A-001

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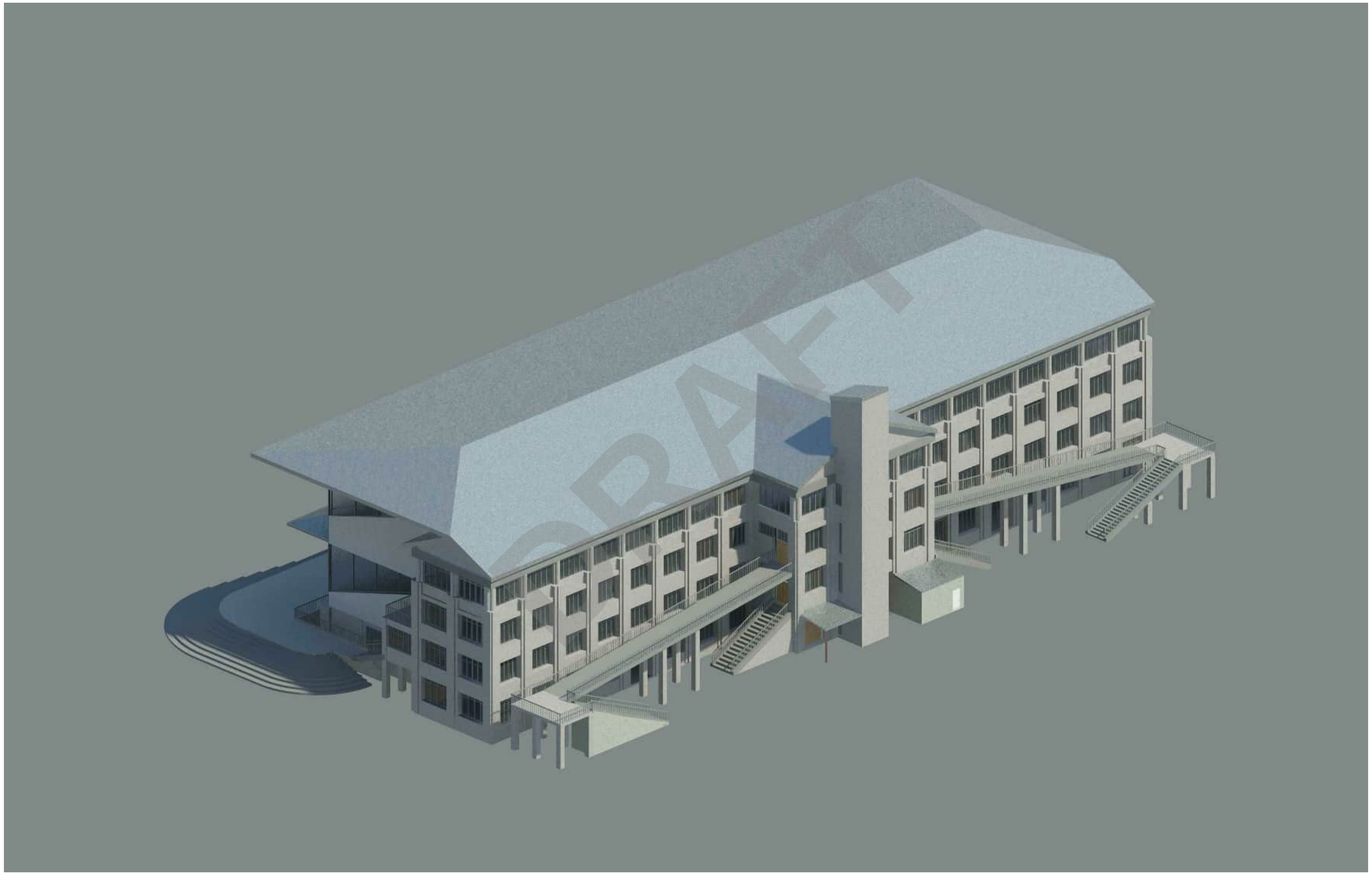

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3D VIEWS

SHEET NUMBER

60332326-DRG-A-002

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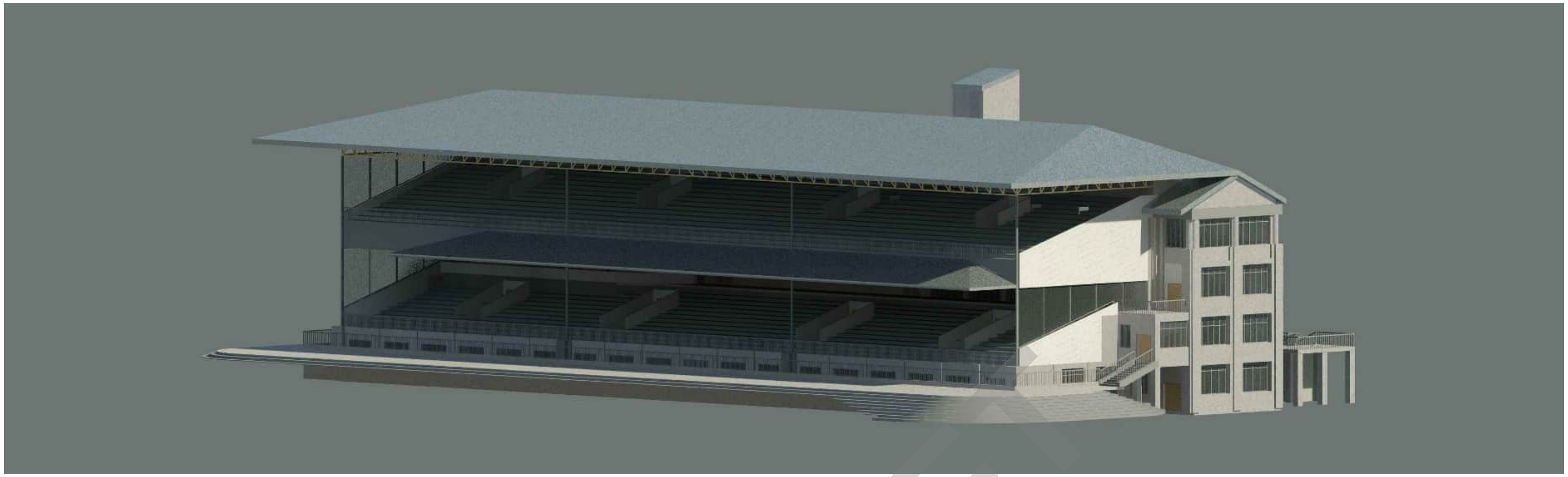

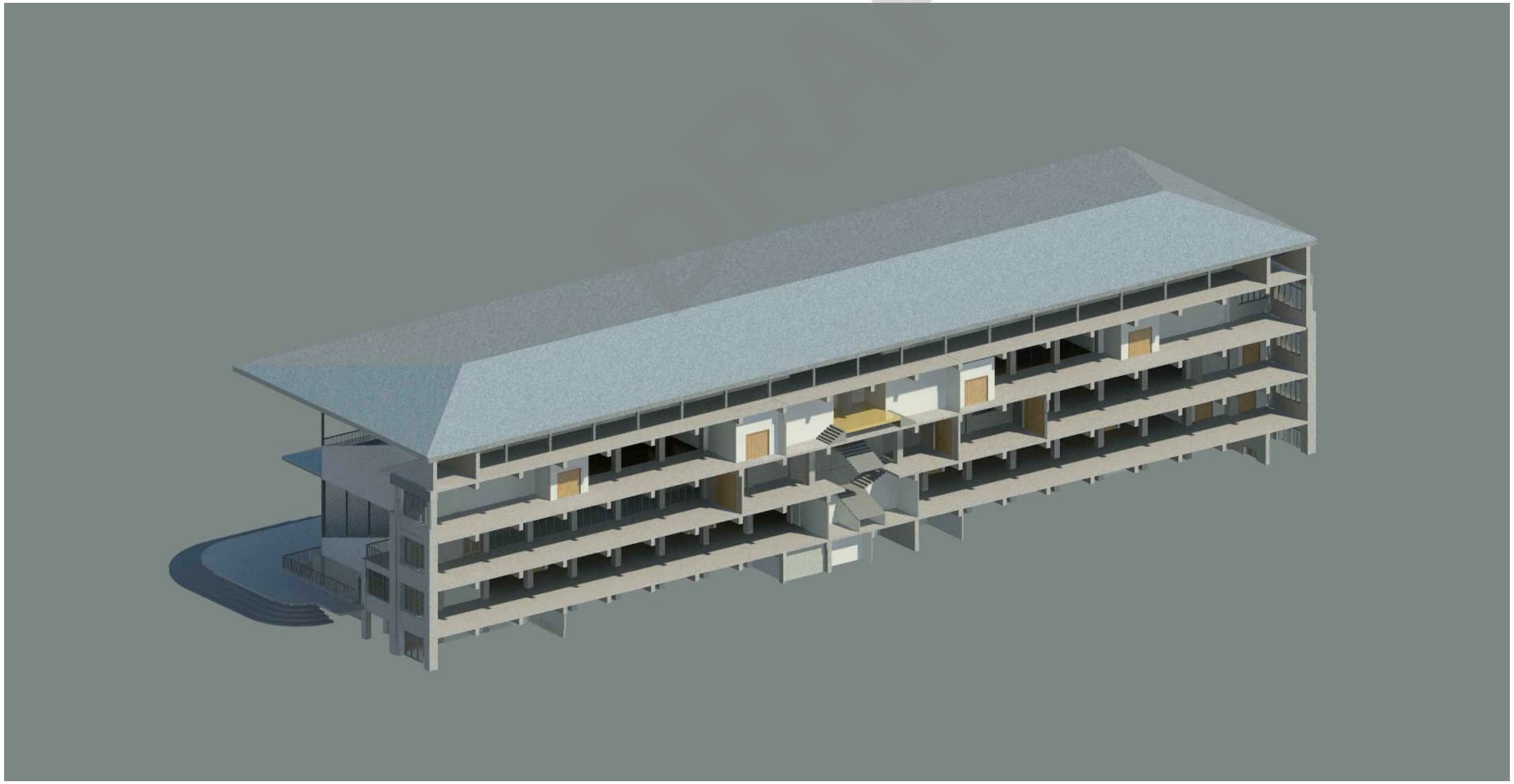

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3D VIEWS

SHEET NUMBER

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ISO A1 594mm x 841mm

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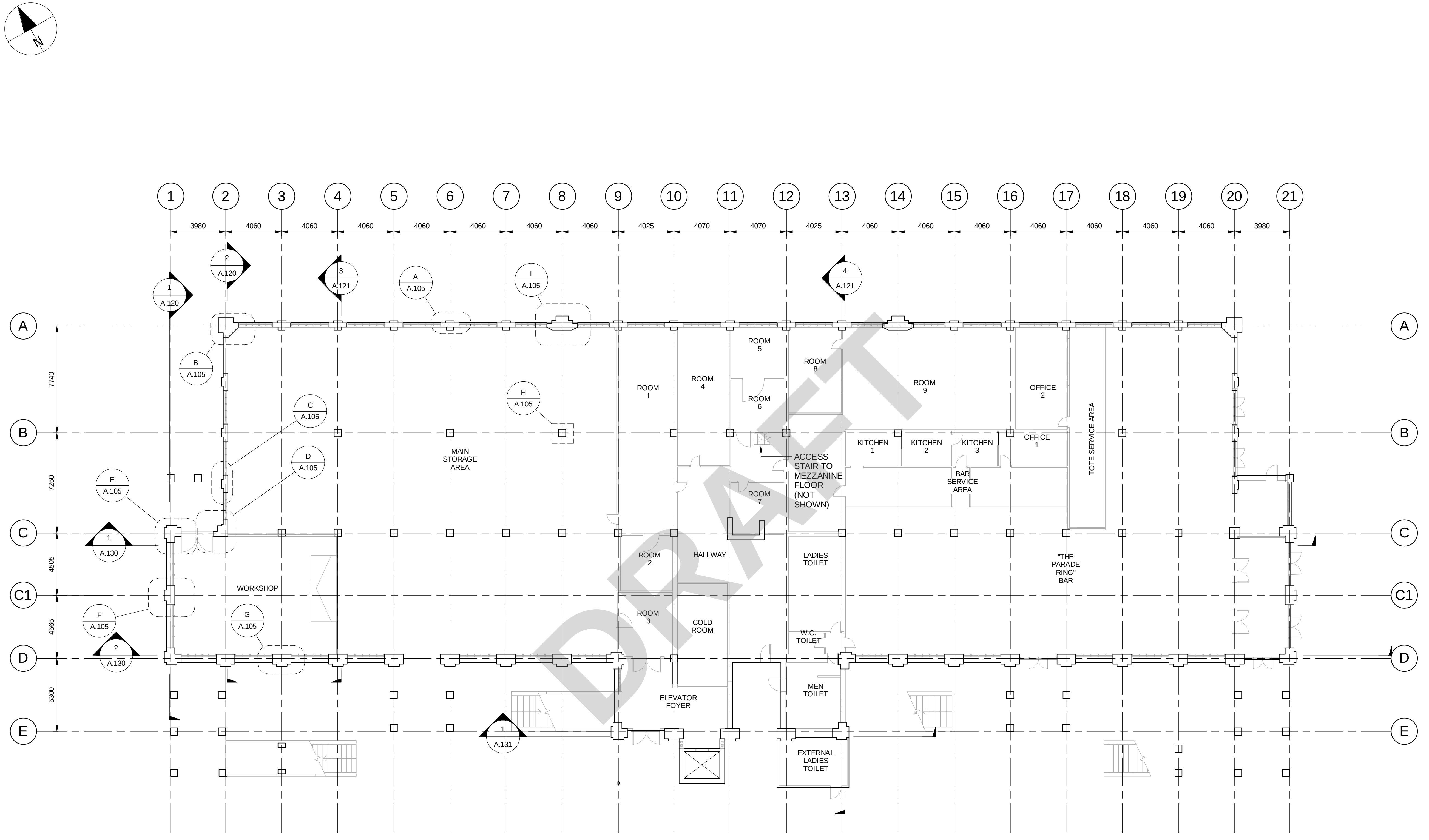

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SHEET TITLE

SUPERSTRUCTURE PLANS LEVEL 0

SHEET NUMBER

60332326-DRG-A-100

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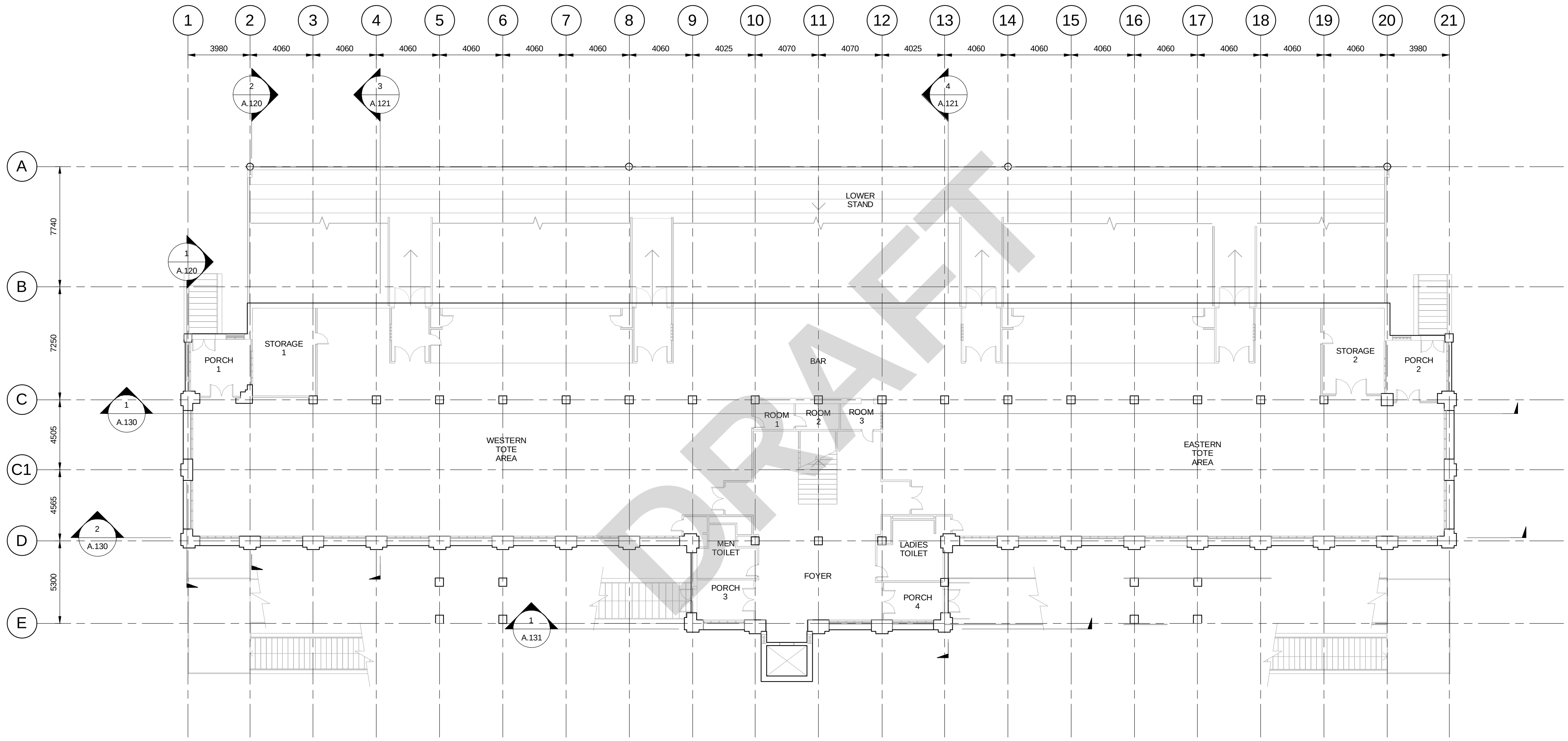

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KEY PLAN

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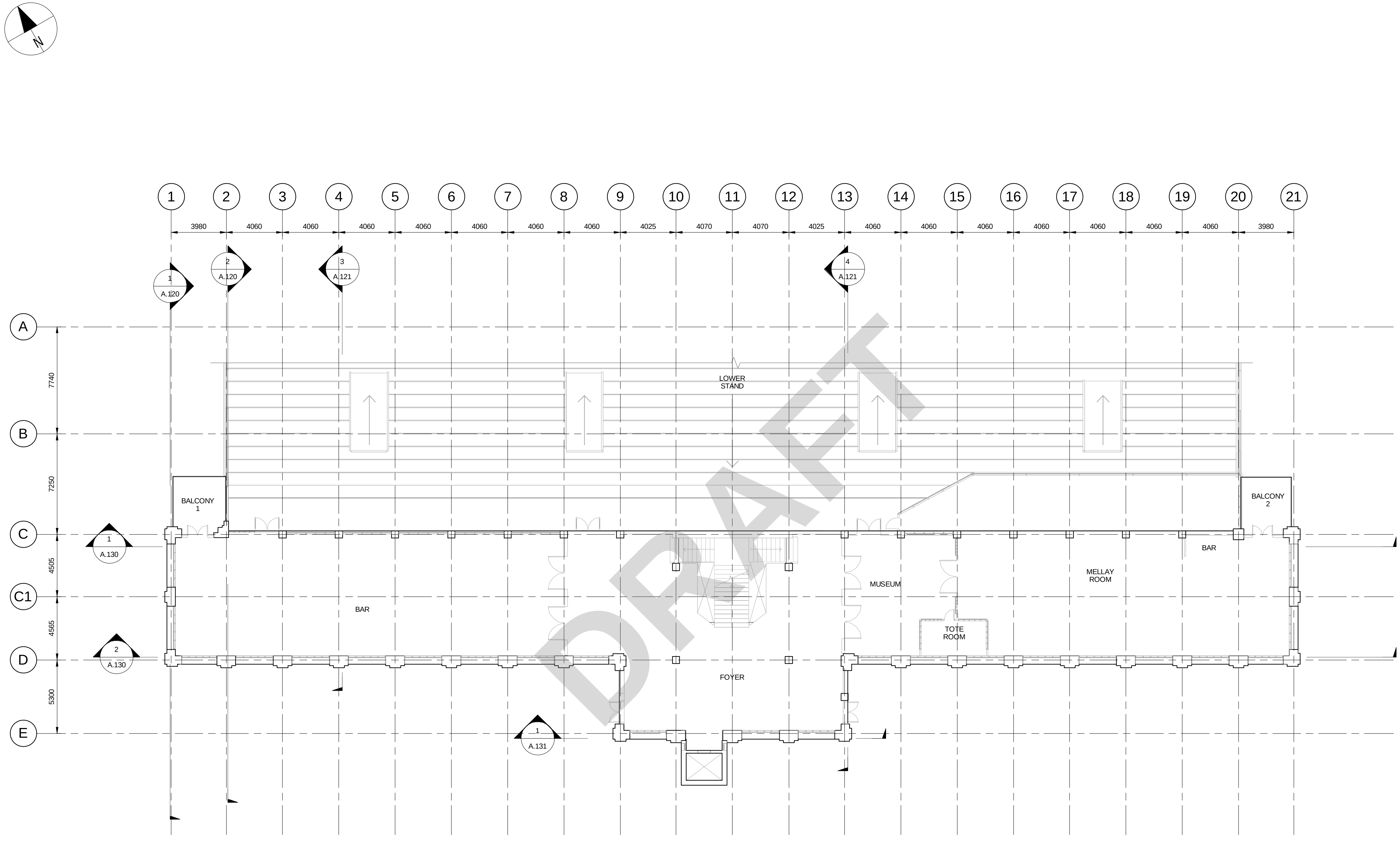
SHEET TITLE

SUPERSTRUCTURE PLANS LEVEL 1

SHEET NUMBER

60332326-DRG-A-101



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STRUCTURAL ASSESSMENT

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT

CANTERBURY JOCKEY CLUB

Prepared for:

CONSULTANT

AECOM New Zealand Limited
2 Hazeldean Rd, Addington
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+64 3 966 6000 tel +64 3 966 6001 fax
www.aecom.com

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
A		

KEY PLAN

PROJECT NUMBER

60332326

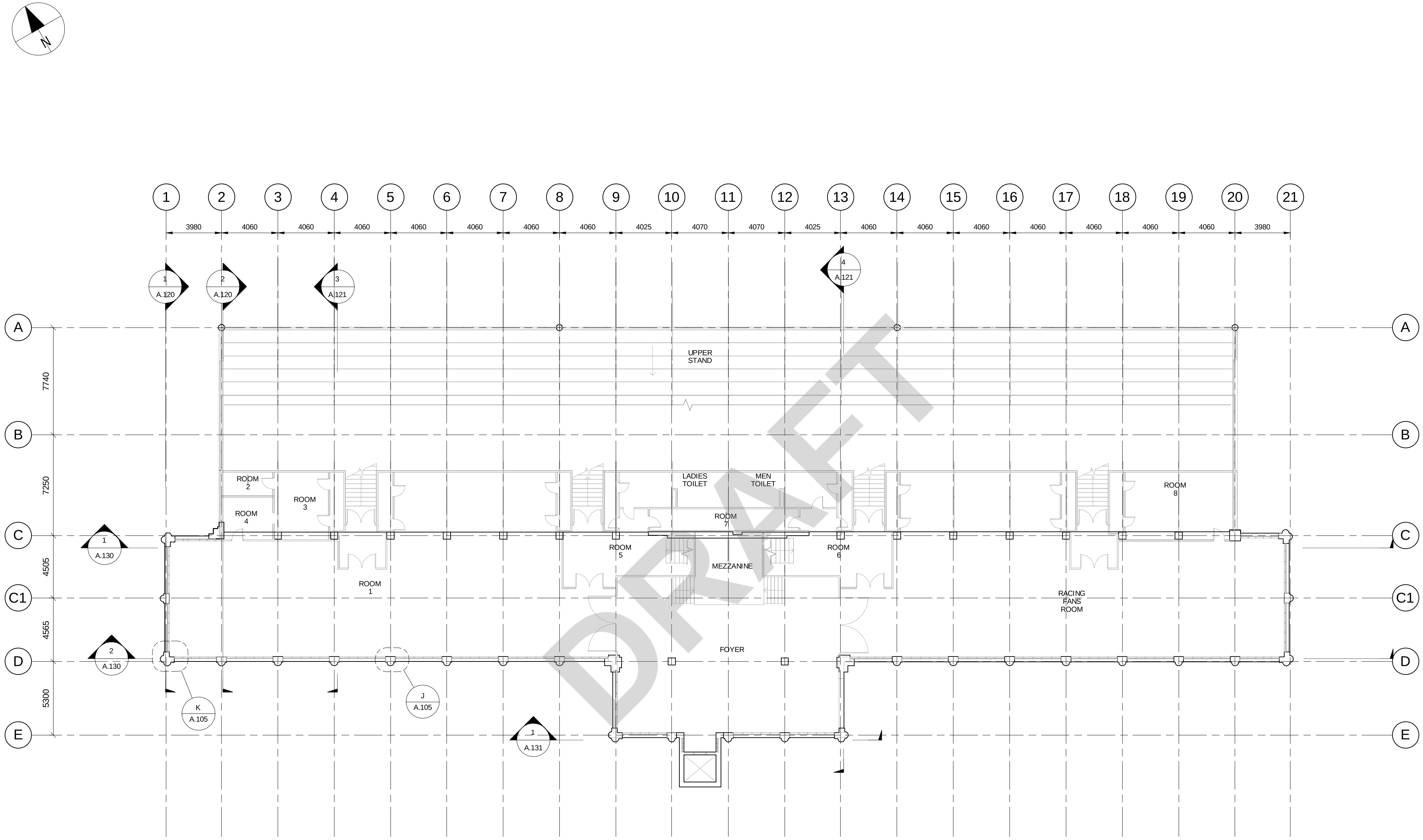
SHEET TITLE

SUPERSTRUCTURE PLANS LEVEL 2

SHEET NUMBER

60332326-DRG-A-102

ISO A1 594mm x 841mm



EXISTING FLOOR 3

Scale: 1 : 150

Last Saved: 8/06/2015 4:47:32 p.m.
Filename: C:\Users\PettiC\Desktop\60332326_MOD_ST_2014_PettiC(Recovery).rvt

This drawing is confidential and shall only be used for the purpose of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM quality assurance system to ISO 9001-2000.

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PROJECT

STRUCTURAL ASSESSMENT

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT

CANTERBURY JOCKEY CLUB

Prepared for:

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ISSUE/REVISION

I/R	DATE	DESCRIPTION
A		

KEY PLAN

PROJECT NUMBER

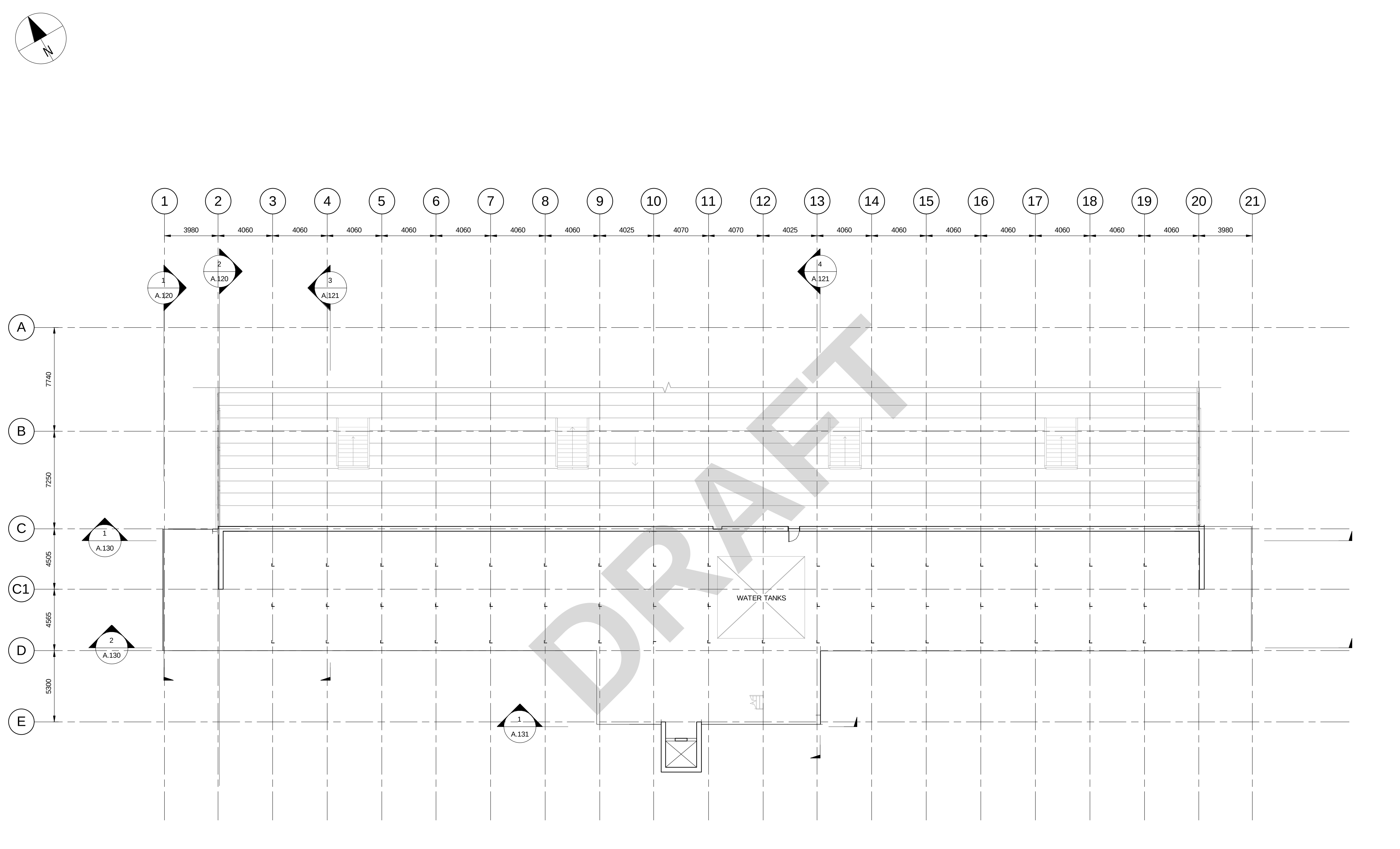
60332326

SHEET TITLE

SUPERSTRUCTURE PLANS
LEVEL 3

SHEET NUMBER

60332326-DRG-A-103



EXISTING FLOOR 4

Scale: 1 : 150

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PROJECT

STRUCTURAL ASSESSMENT

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT

CANTERBURY JOCKEY CLUB

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A		

KEY PLAN

PROJECT NUMBER

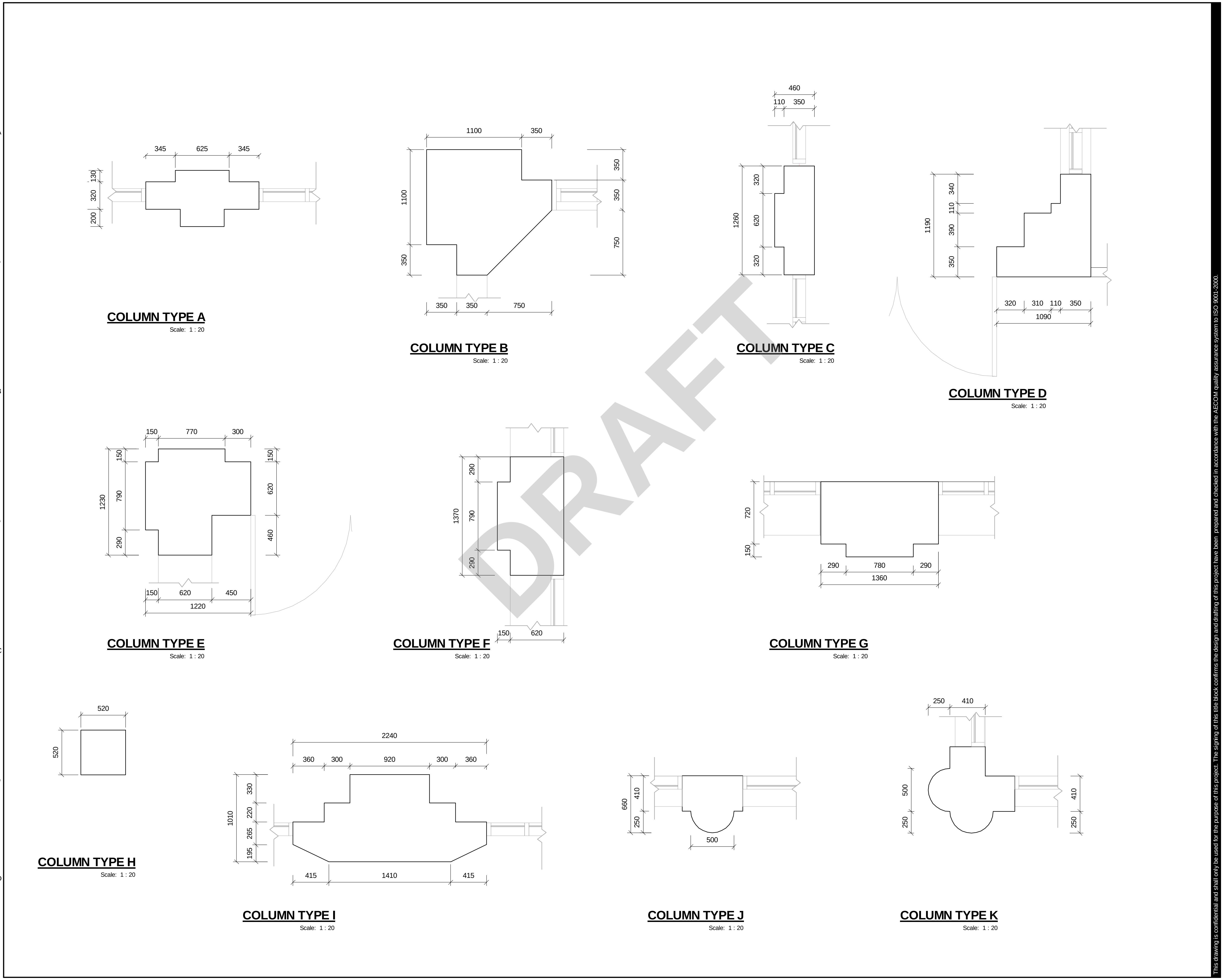
60332326

SHEET TITLE

SUPERSTRUCTURE PLANS

SHEET NUMBER

60332326-DRG-A-104



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STRUCTURAL ASSESSMENT

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT

CANTERBURY JOCKEY CLUB

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I/R	DATE	DESCRIPTION
A		

KEY PLAN

PROJECT NUMBER

60332326

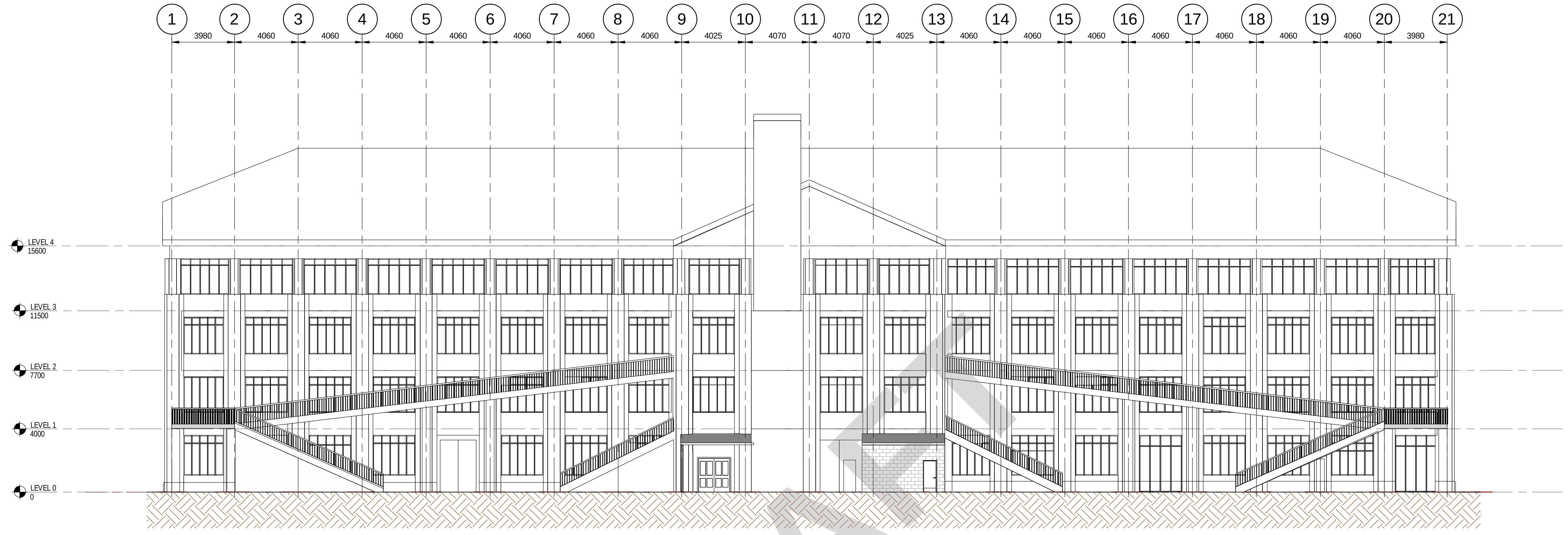
SHEET TITLE

SUPERSTRUCTURE PLANS

SHEET NUMBER

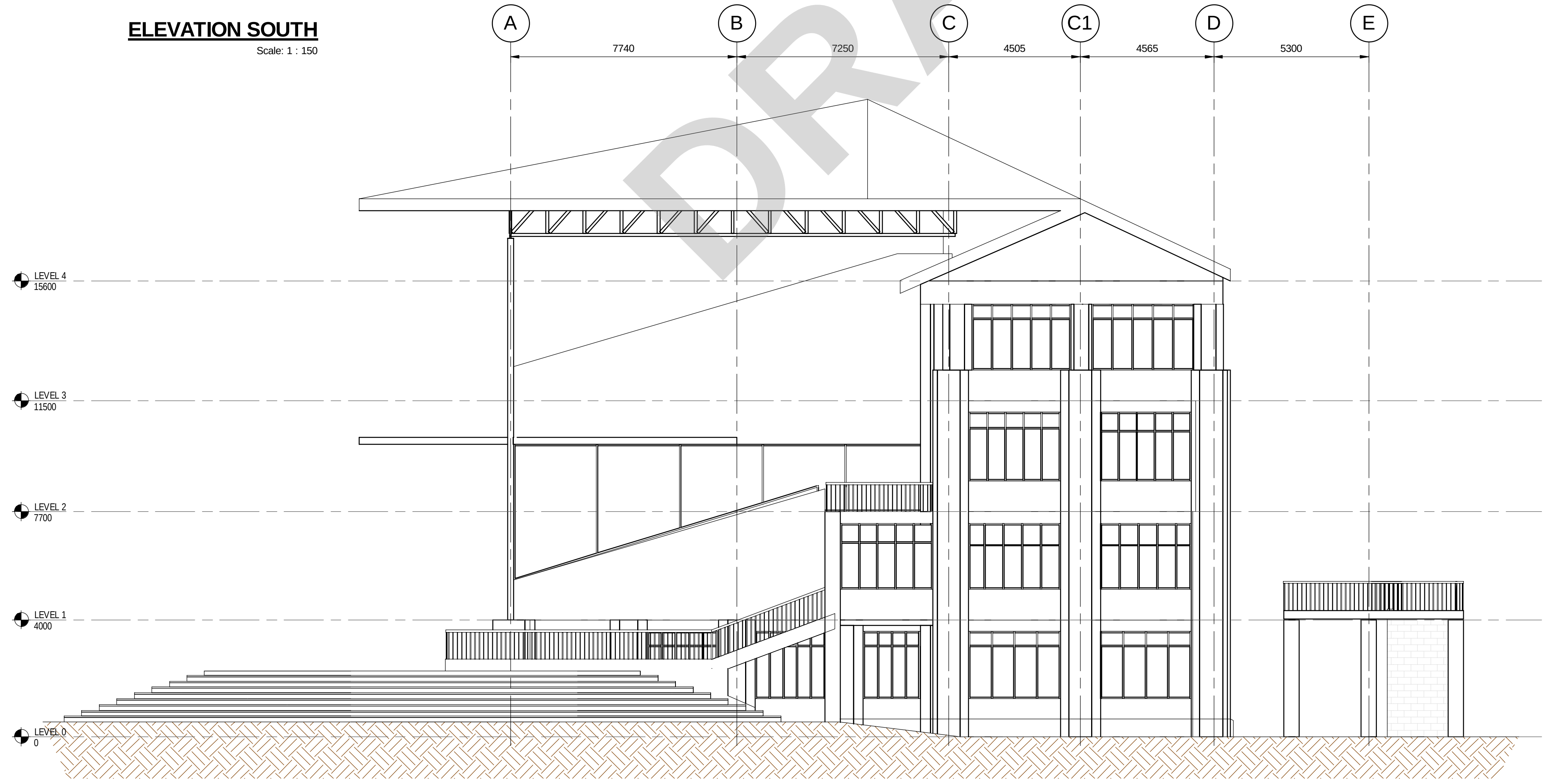
60332326-DRG-A-105

ISO A1 594mm x 841mm



ELEVATION SOUTH

Scale: 1 : 150



ELEVATION WEST

Scale: 1 : 100

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STRUCTURAL ASSESSMENT

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

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ISSUE/REVISION

I/R	DATE	DESCRIPTION
A		

KEY PLAN

PROJECT NUMBER

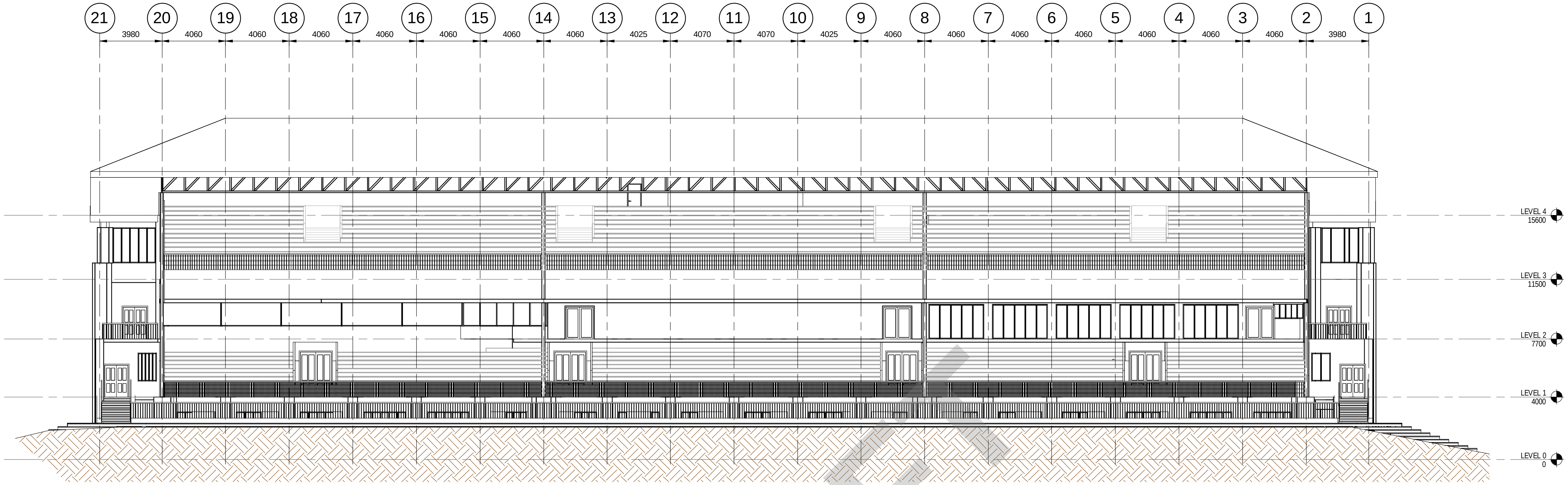
60332326

SHEET TITLE

ELEVATIONS

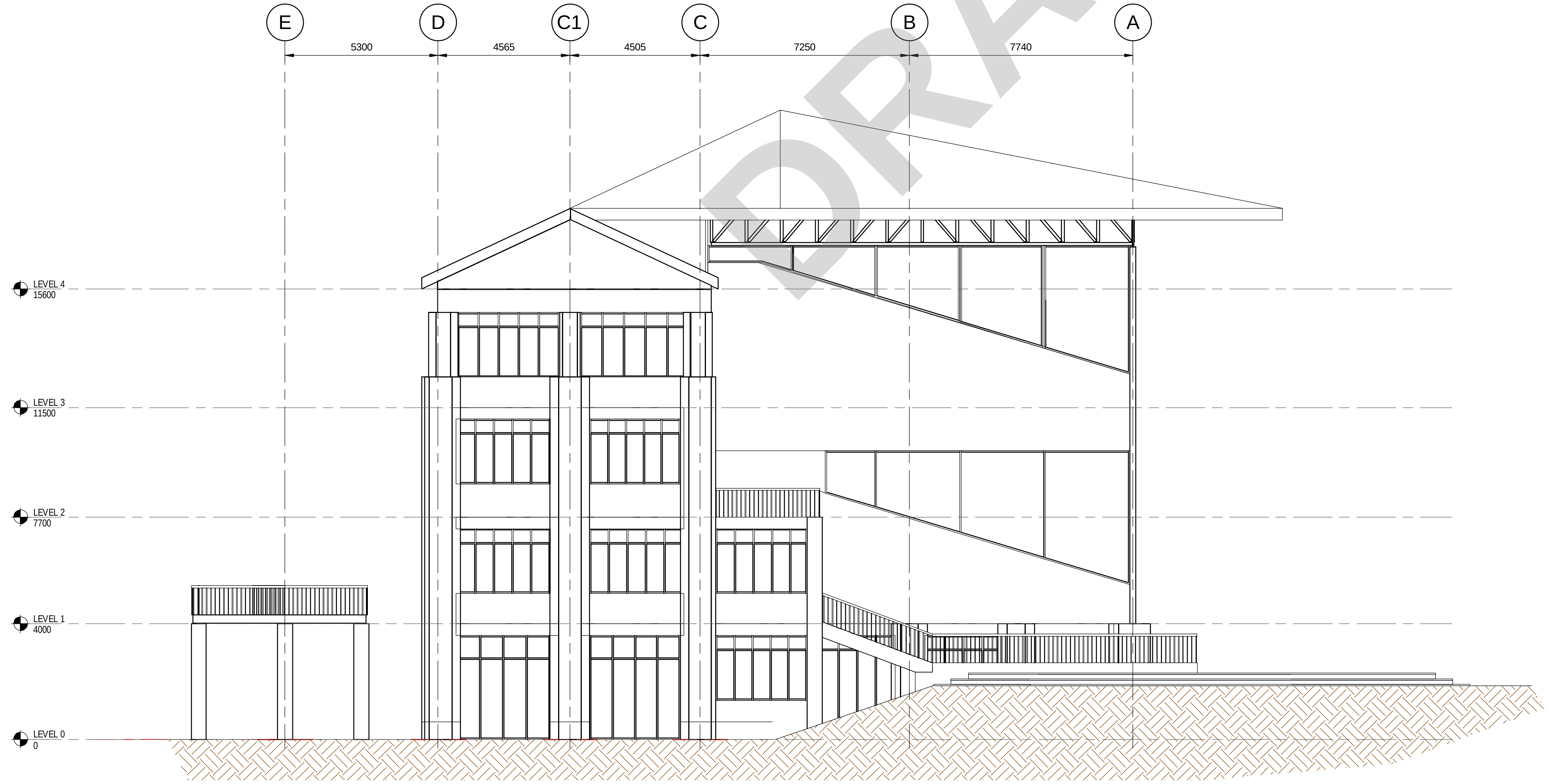
SHEET NUMBER

60332326-DRG-A-110



ELEVATION NORTH

Scale: 1 : 150



ELEVATION EAST

Scale: 1 : 100

DRAFT

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PROJECT

STRUCTURAL ASSESSMENT

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT

CANTERBURY JOCKEY CLUB

Prepared for:

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PROJECT MANAGEMENT INITIALS

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KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

ELEVATIONS

SHEET NUMBER

60332326-DRG-A-111

ISO A1 594mm x 841mm

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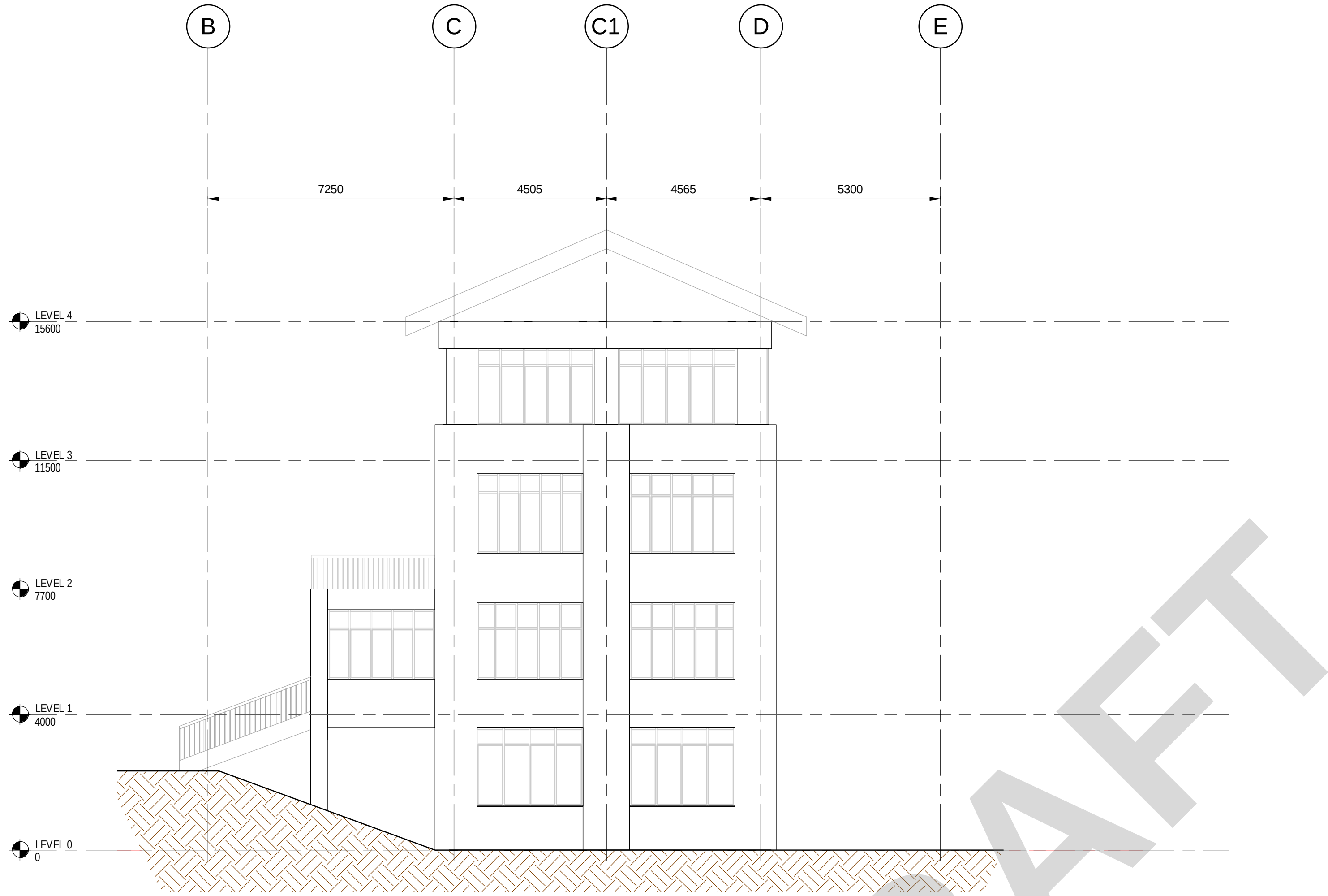
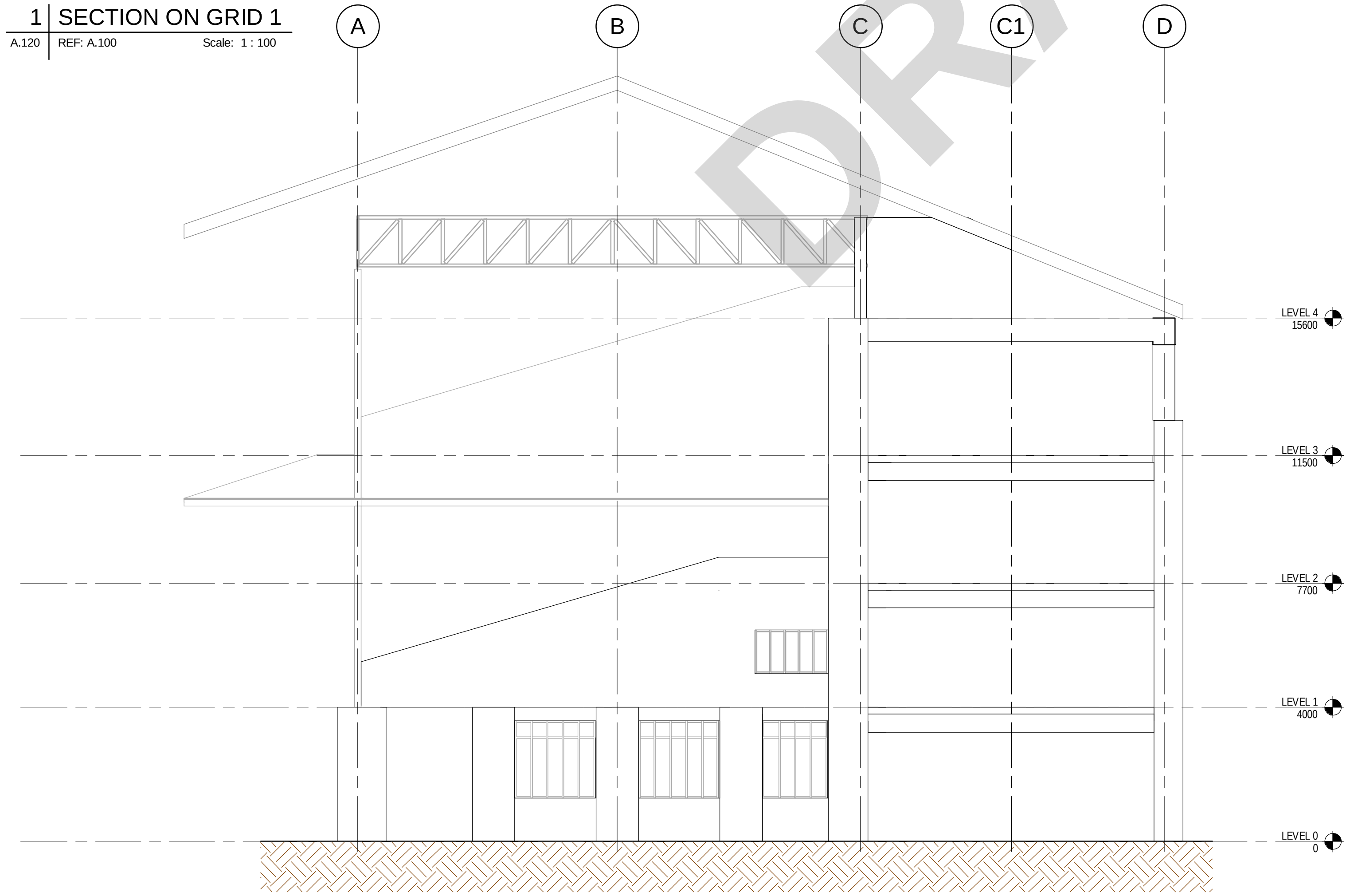


1 SECTION ON GRID 1

A.120 REF: A.100 Scale: 1 : 100



2 SECTION ON GRID 2

A.120 REF: A.100 Scale: 1 : 100

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STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

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PROJECT MANAGEMENT INITIALS

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KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

SECTION N/S SHEET 1

SHEET NUMBER

60332326-DRG-A-120

ISO A1 594mm x 841mm

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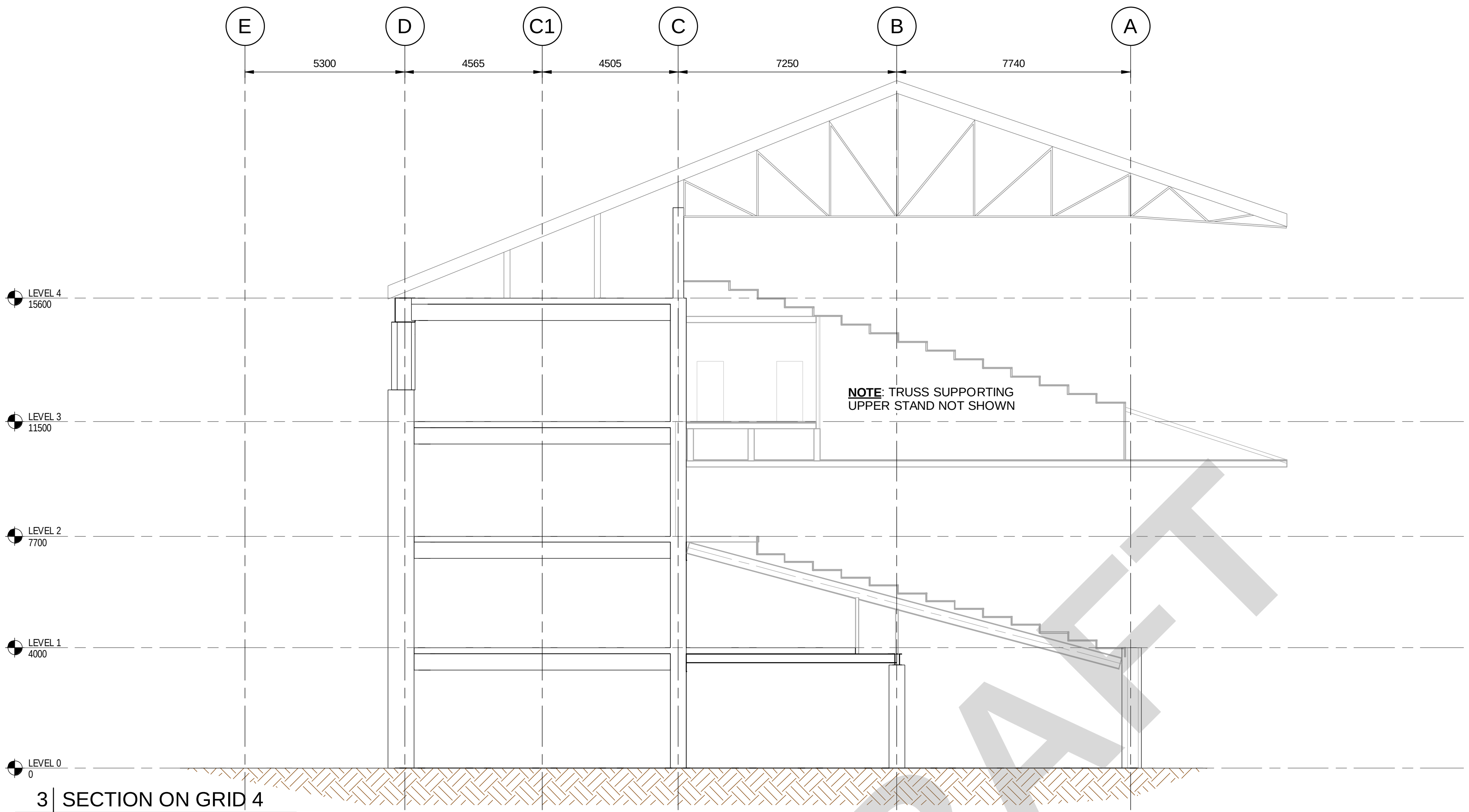
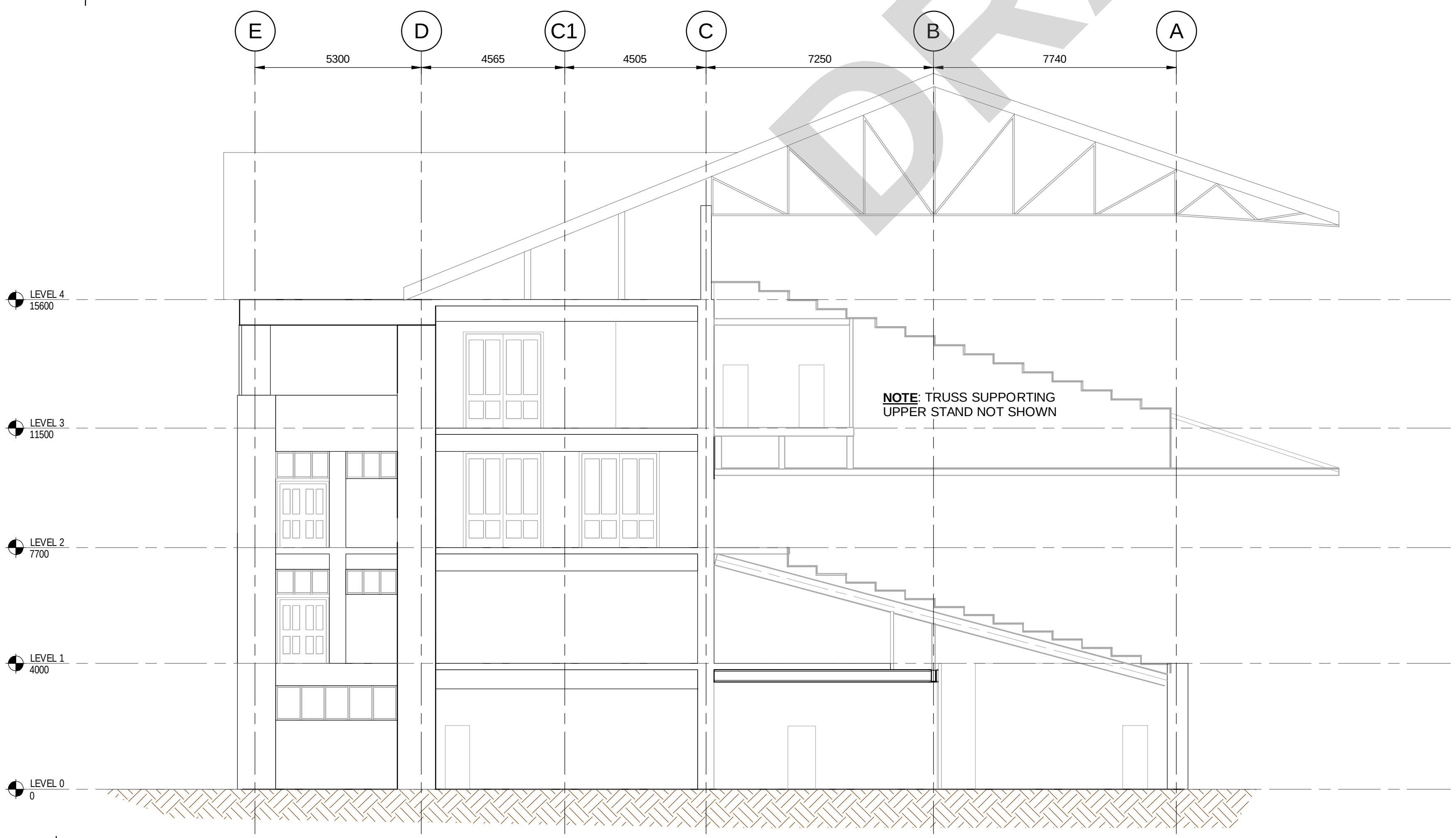
ISO A1 594mm x 841mm



3 SECTION ON GRID 4

A.121 | REF: A.100 | Scale: 1 : 100



4 SECTION ON GRID 13

A.121 | REF: A.100 | Scale: 1 : 100

DRAFT

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Filename: C:\Users\PettiC\Desktop\60332326_MOD_ST_2014_PettiC(Recovery).rvt

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KEY PLAN

PROJECT NUMBER

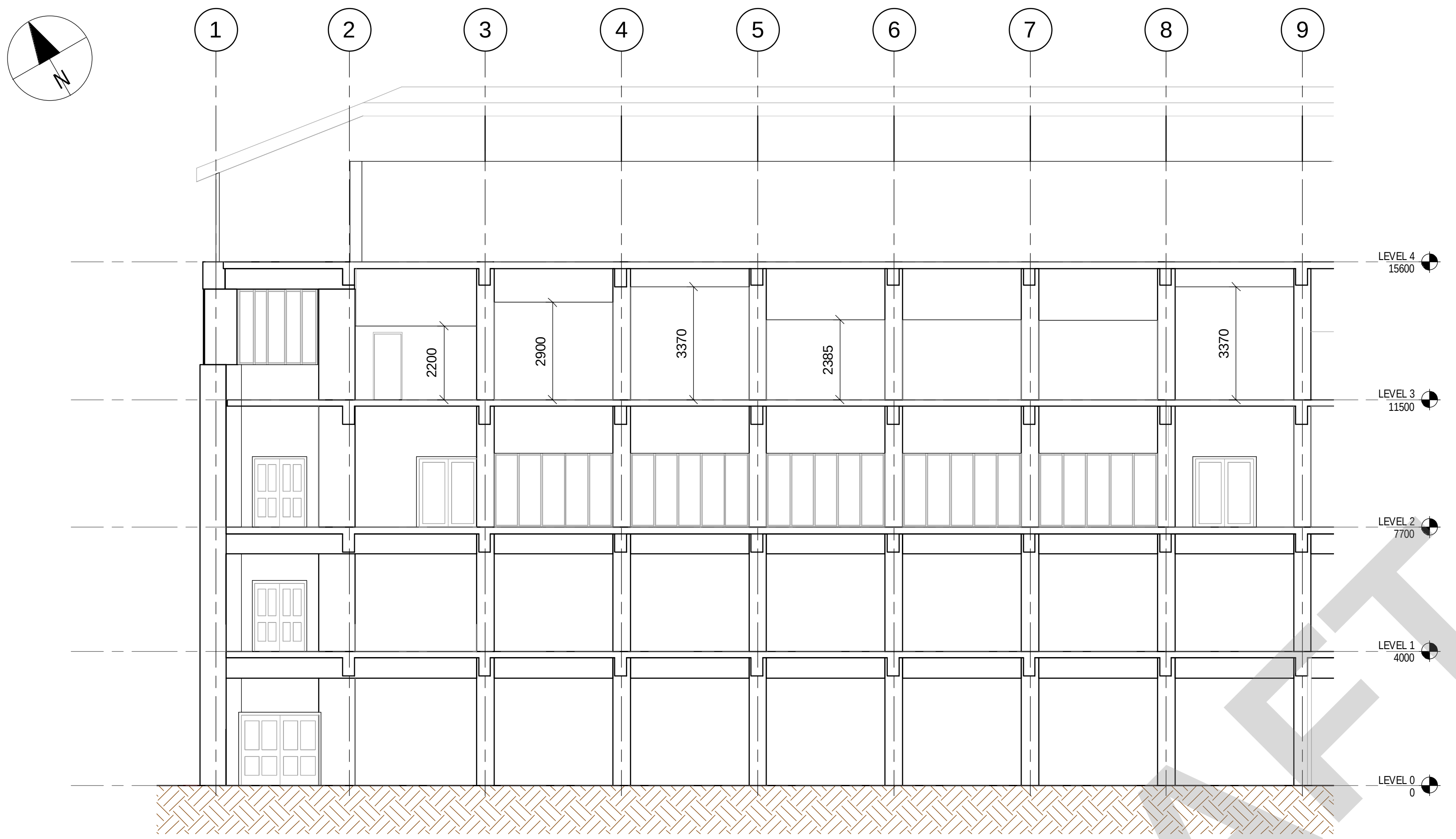
60332326

SHEET TITLE

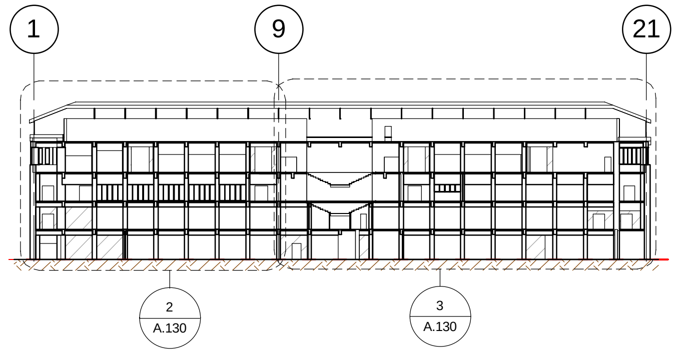
SECTION N/S SHEET 2

SHEET NUMBER

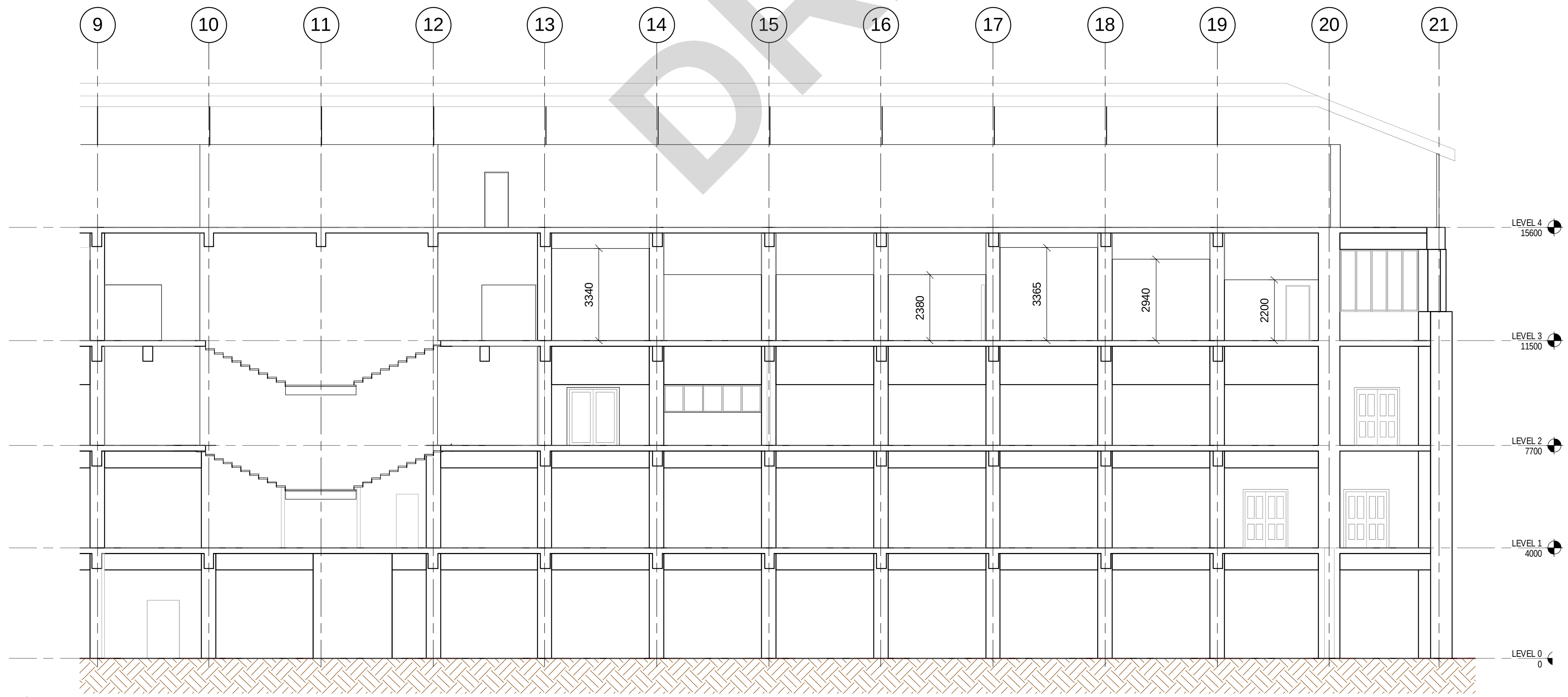
60332326-DRG-A-121



2 | SECTION ON GRID C - GRID 1 TO GRID 9
A.130 | REF: A.130 Scale: 1 : 100



1 | SECTION ON GRID C
A.130 | REF: A.100 Scale: 1 : 500



3 | SECTION ON GRID C - GRID 9 TO 21
A.130 | REF: A.130 Scale: 1 : 100

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PROJECT

STRUCTURAL ASSESSMENT

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

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PROJECT MANAGEMENT INITIALS

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KEY PLAN

PROJECT NUMBER

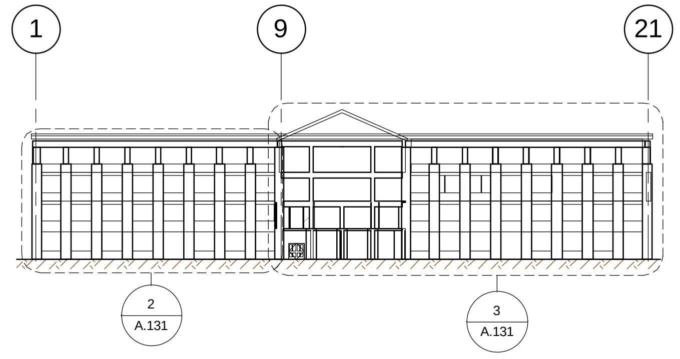
60332326

SHEET TITLE

SECTION E/W SHEET 1

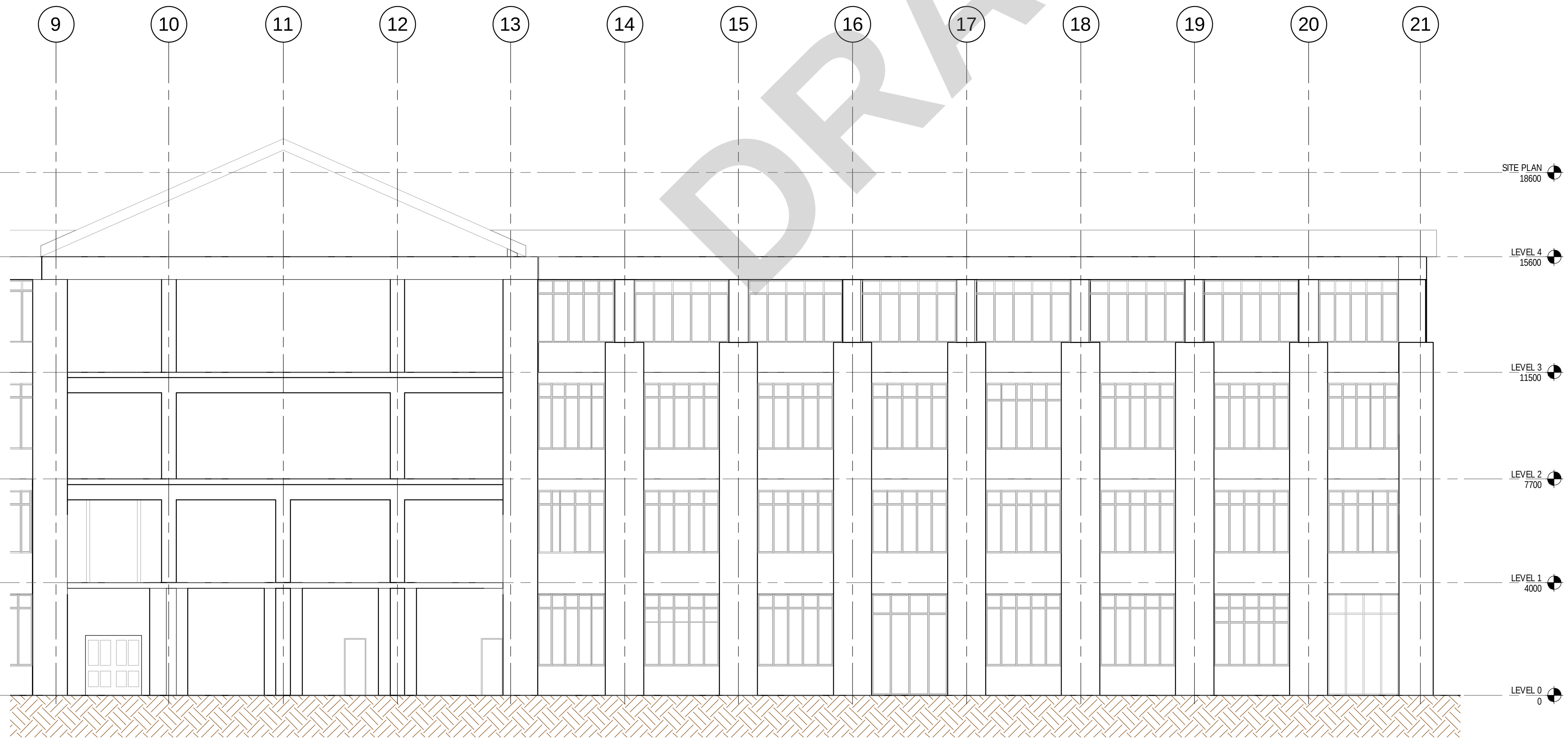
SHEET NUMBER

60332326-DRG-A-130



1 SECTION ON GRID D
A.131 REF: A.100 Scale: 1 : 500

2 SECTION ON GRID D - GRID 1 TO GRID 9
A.131 REF: A.131 Scale: 1 : 100



3 SECTION ON GRID D - GRID 9 TO GRID 21
A.131 REF: A.131 Scale: 1 : 100

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PROJECT

STRUCTURAL ASSESSMENT

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

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PROJECT MANAGEMENT INITIALS

NR	MF	CO
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ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

SECTION E/W SHEET 2

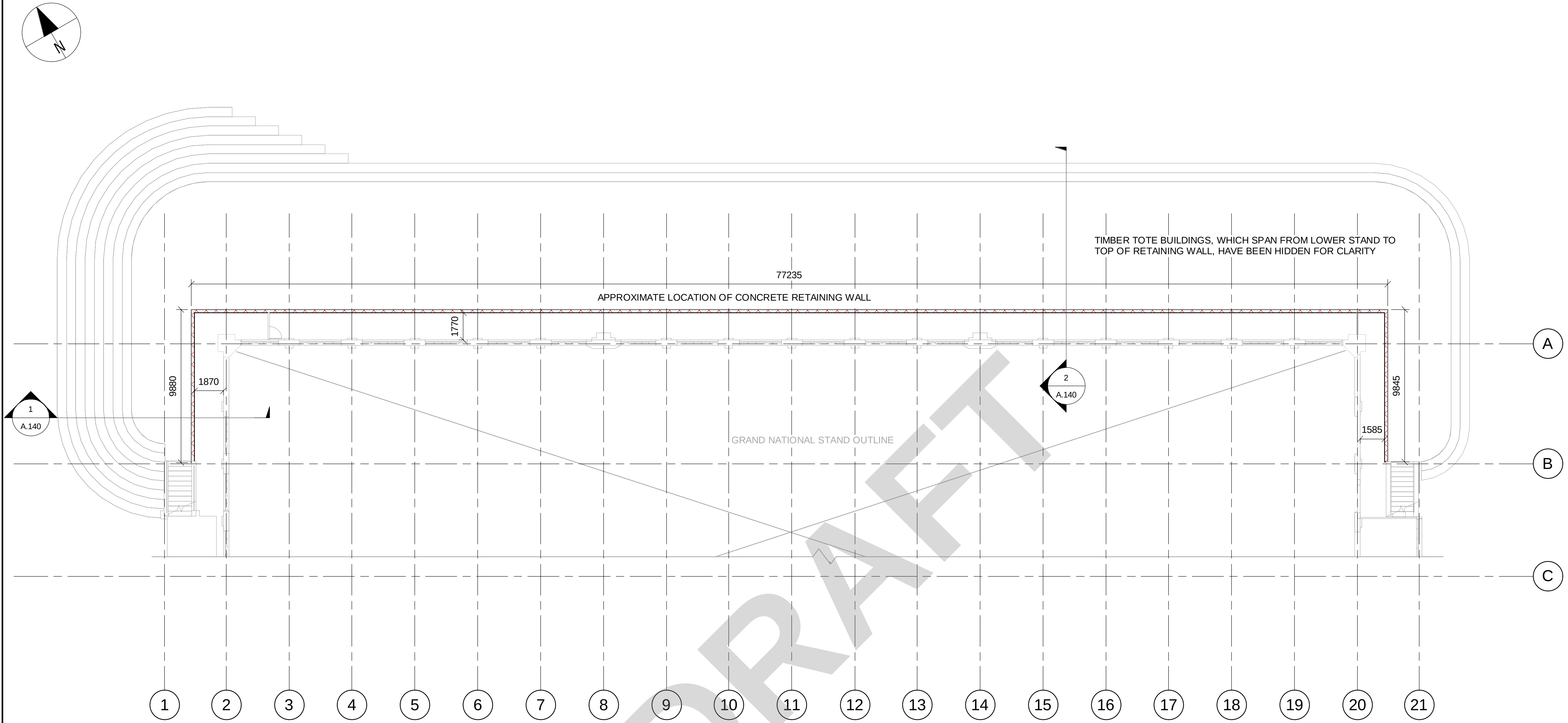
SHEET NUMBER

60332326-DRG-A-131

ISO A1 594mm x 841mm

Last Saved: 10/06/2015 2:37:59 p.m.
Filename: C:\Users\PettiC\Desktop\60332326_MOD_ST_2014_PettiC(Recovery).rvt

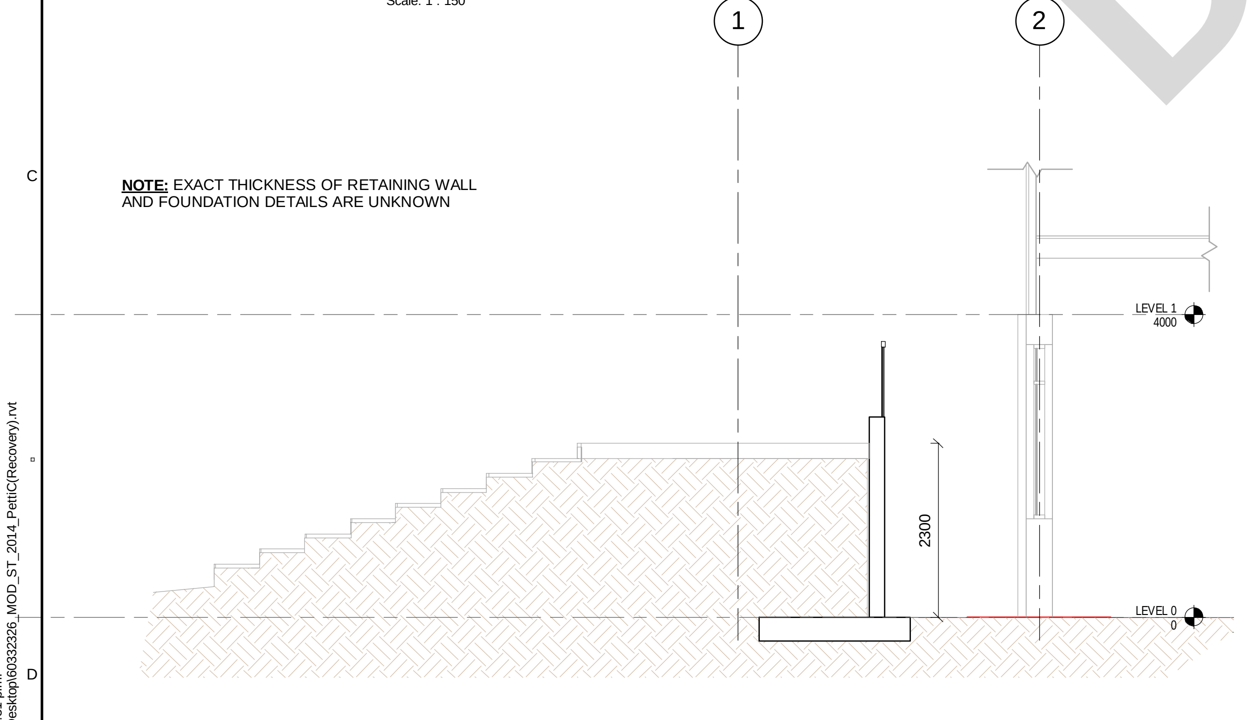
ISO A1 594mm x 841mm



RETAINING WALL - PLAN

Scale: 1 : 150

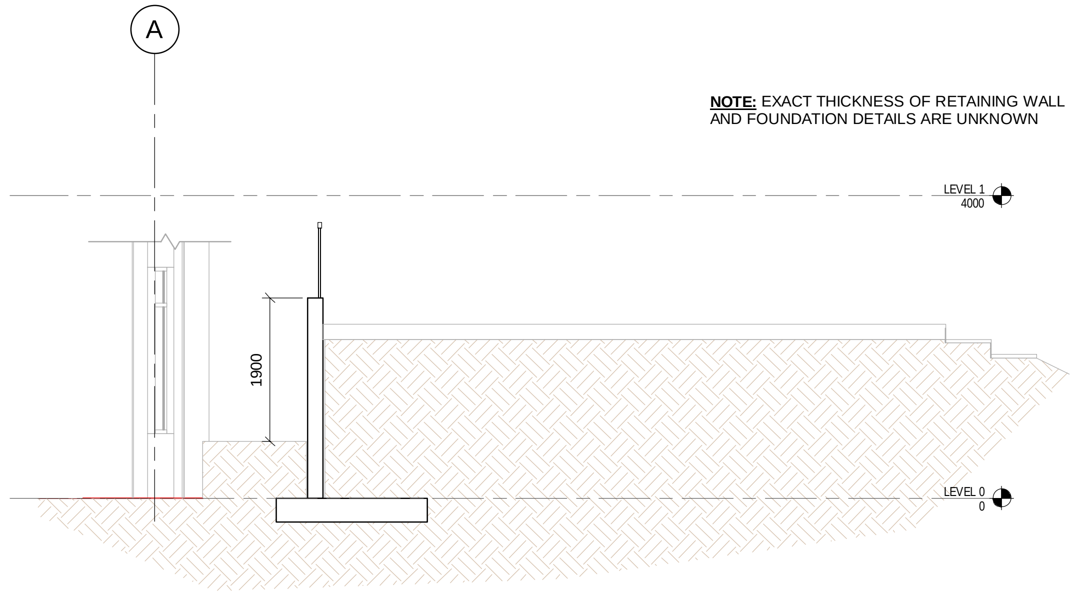
NOTE: EXACT THICKNESS OF RETAINING WALL AND FOUNDATION DETAILS ARE UNKNOWN



WALL SECTION 1

Scale: 1 : 50

NOTE: EXACT THICKNESS OF RETAINING WALL AND FOUNDATION DETAILS ARE UNKNOWN



WALL SECTION 2

Scale: 1 : 50

Last Saved: 5/06/2015 4:07:31 p.m.
Filename: C:\Users\PettiC\Desktop\60332326_MOD_ST_2014_PettiC(Recovery).rvt

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PROJECT

STRUCTURAL ASSESSMENT

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KEY PLAN

PROJECT NUMBER

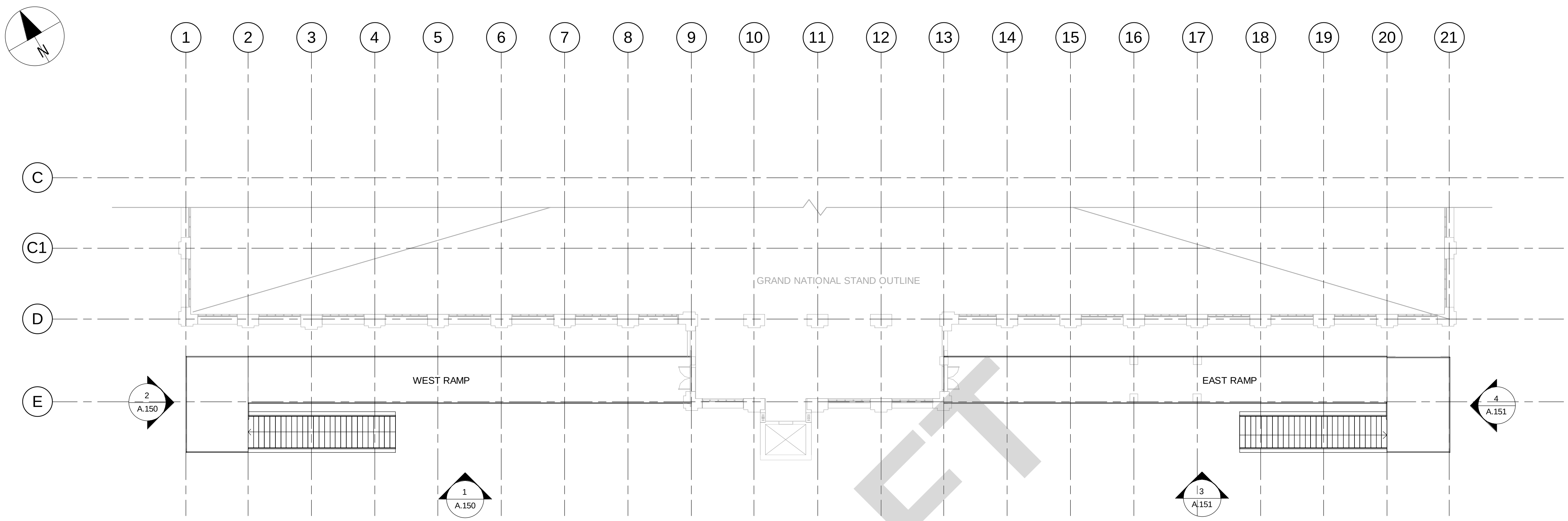
60332326

SHEET TITLE

RETAINING WALL DRAWINGS

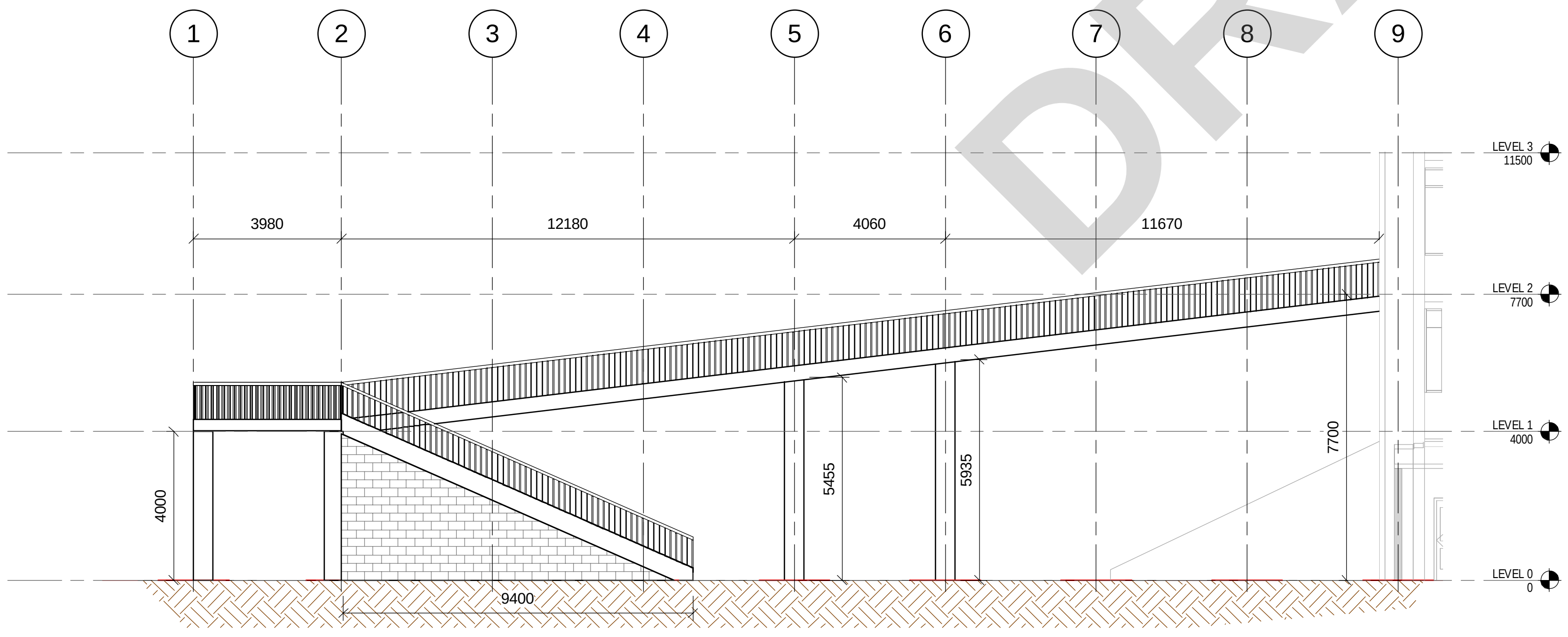
SHEET NUMBER

60332326-DRG-A-140



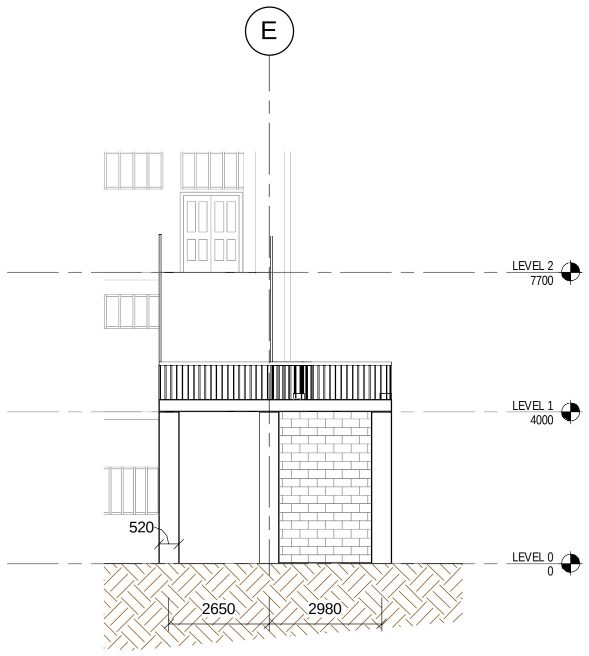
RAMPS LOCATION

Scale: 1 : 150



1 | WEST RAMP - SOUTH ELEVATION

A.150 | REF: A.150 Scale: 1 : 100



2 | WEST RAMP - WEST ELEVATION

A.150 | REF: A.150 Scale: 1 : 100

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PROJECT

STRUCTURAL ASSESSMENT

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ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

RAMPS, STAIRS, AND STEPS AS BUILT. SHEET 1 OF 4

SHEET NUMBER

60332326-DRG-A-150

Last Saved: 10/06/2015 11:33:18 a.m.
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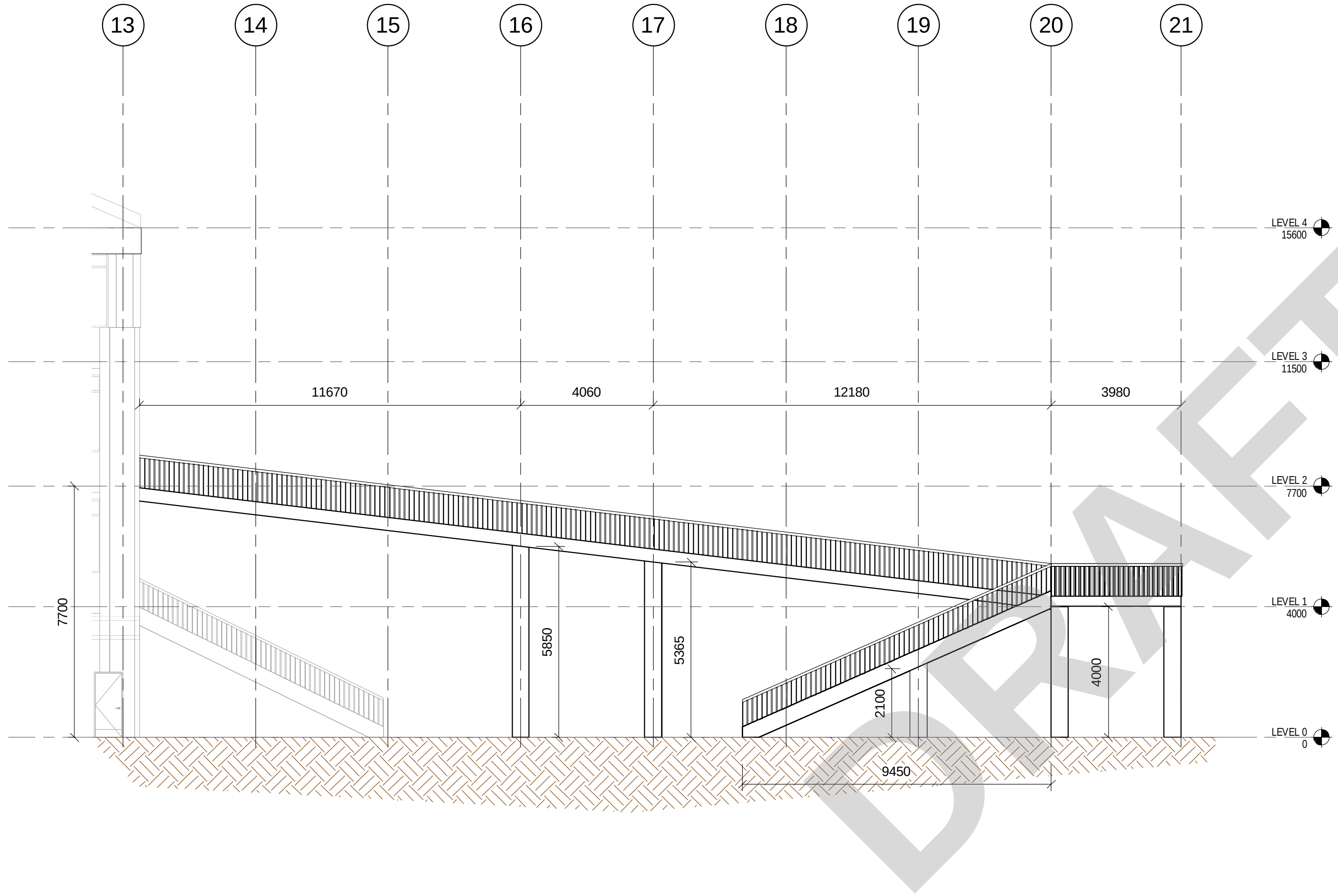
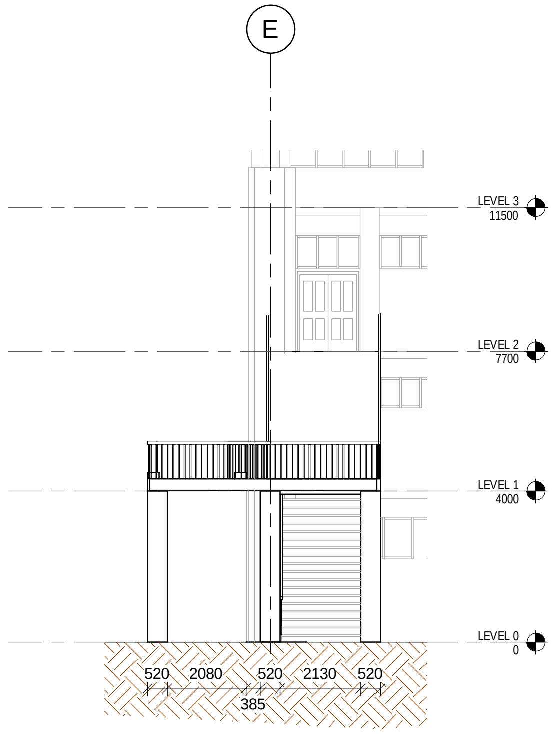


3 EAST RAMP - SOUTH ELEVATION
A.151 REF: A.150 Scale: 1 : 100



4 EAST RAMP - EAST ELEVATION
A.151 REF: A.150 Scale: 1 : 100

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PROJECT

STRUCTURAL ASSESSMENT

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT

CANTERBURY JOCKEY CLUB

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PROJECT MANAGEMENT INITIALS

NR	MF	CO
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ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

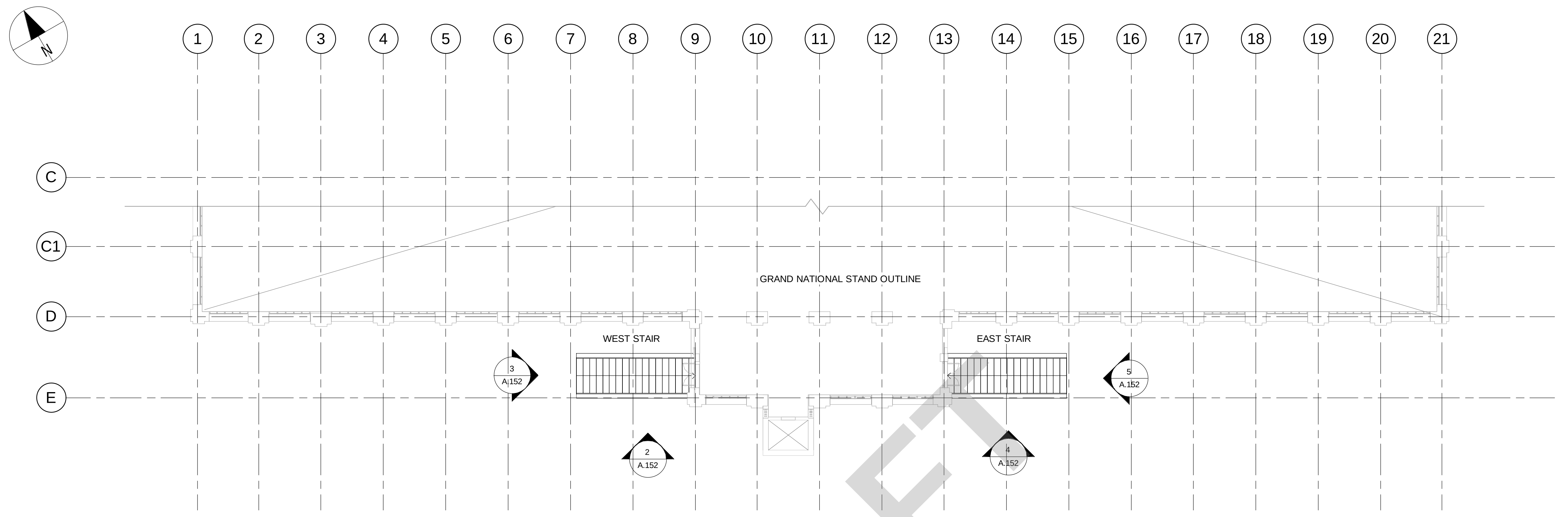
RAMPS, STAIRS, AND STEPS AS BUILT. SHEET 2 OF 4

SHEET NUMBER

60332326-DRG-A-151

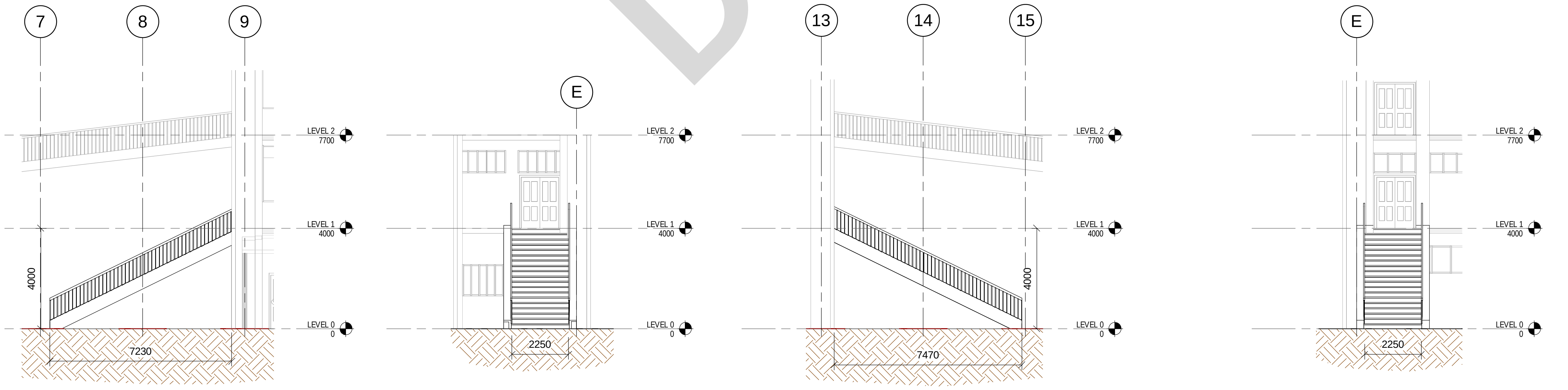
ISO A1 594mm x 841mm

Last Saved: 10/06/2015 11:33:20 a.m.
Filename: C:\Users\PettiC\Desktop\60332326_MOD_ST_2014_PettiC(Recovery).rvt



STAIRS ON SOUTH ELAVATION - LOCATION

Scale: 1 : 150



2 | WEST STAIR - SOUTH ELEVATION
A.152 | REF: A.152 Scale: 1 : 100

3 | WEST STAIR - WEST ELEVATION
A.152 | REF: A.152 Scale: 1 : 100

4 | EAST STAIR - SOUTH ELEVATION
A.152 | REF: A.152 Scale: 1 : 100

5 | EAST STAIR - EAST ELEVATION
A.152 | REF: A.152 Scale: 1 : 100

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KEY PLAN

PROJECT NUMBER

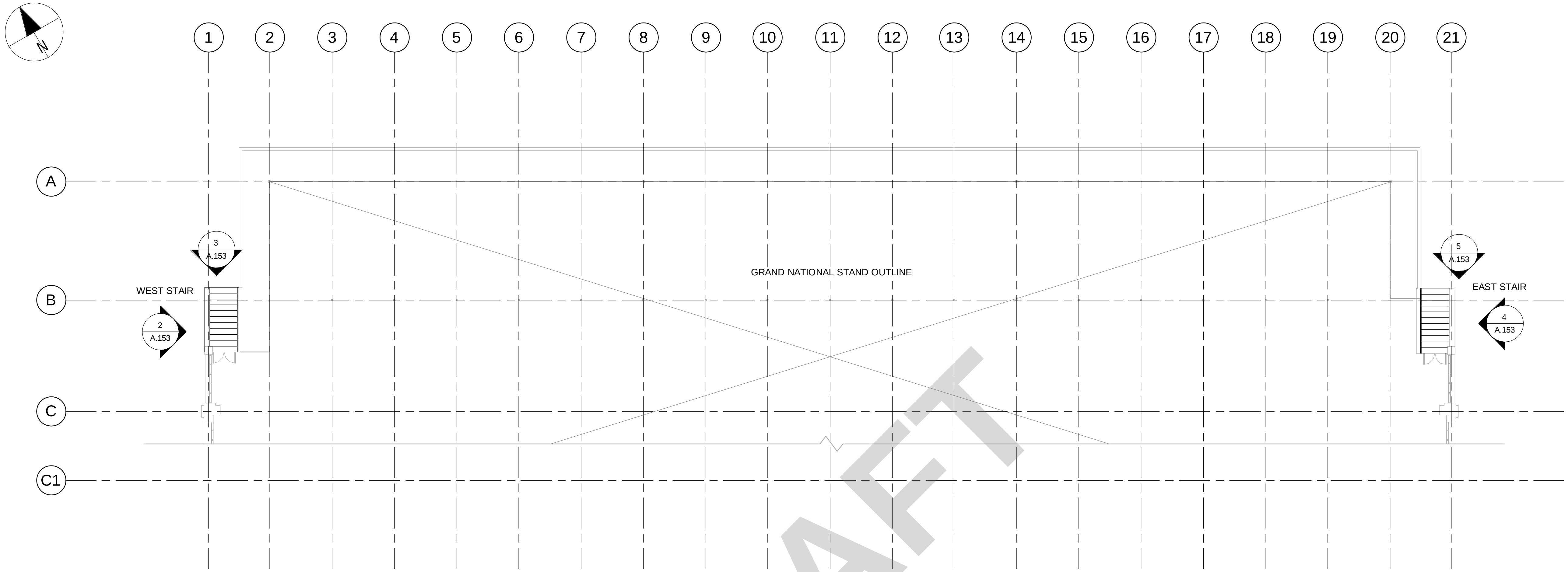
60332326

SHEET TITLE

RAMPS, STAIRS, AND STEPS AS BUILT. SHEET 3 OF 4

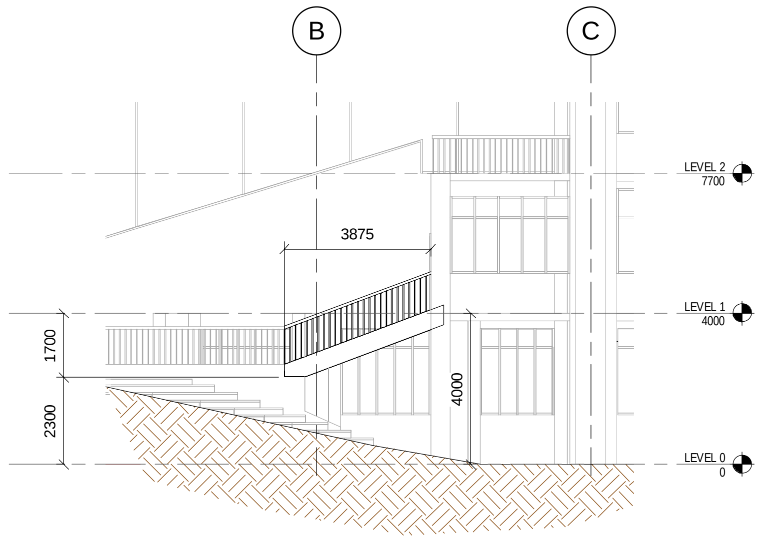
SHEET NUMBER

60332326-DRG-A-152



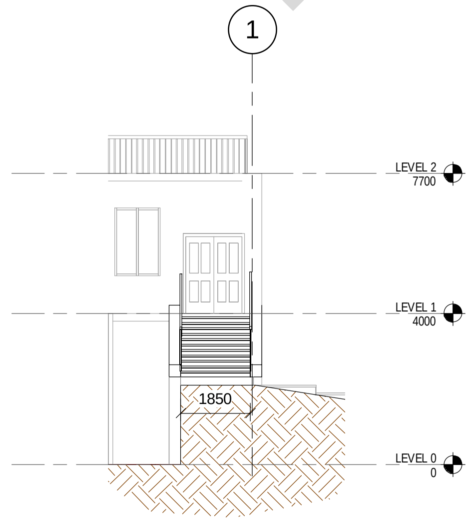
STAIRS ON SIDE ELEVATIONS - LOCATION

Scale: 1 : 150



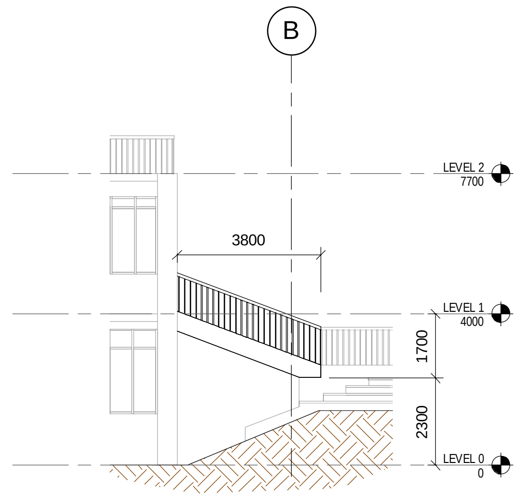
2 WEST SIDE STAIR - WEST ELEVATION

A.153 REF: A.153 Scale: 1 : 100



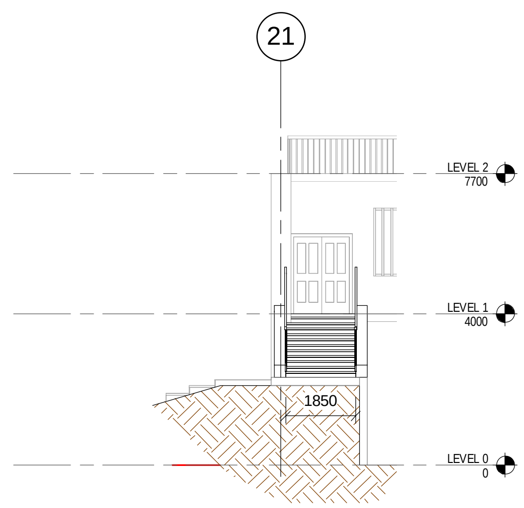
3 WEST SIDE STAIR - NORTH ELEVATION

A.153 REF: A.153 Scale: 1 : 100



4 EAST SIDE STAIR - EAST ELEVATION

A.153 REF: A.153 Scale: 1 : 100



5 EAST SIDE STAIR - NORTH ELEVATION

A.153 REF: A.153 Scale: 1 : 100

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STRUCTURAL ASSESSMENT

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KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

RAMPS, STAIRS, AND STEPS AS BUILT. SHEET 4 OF 4

SHEET NUMBER

60332326-DRG-A-153

ISO A1 594mm x 841mm

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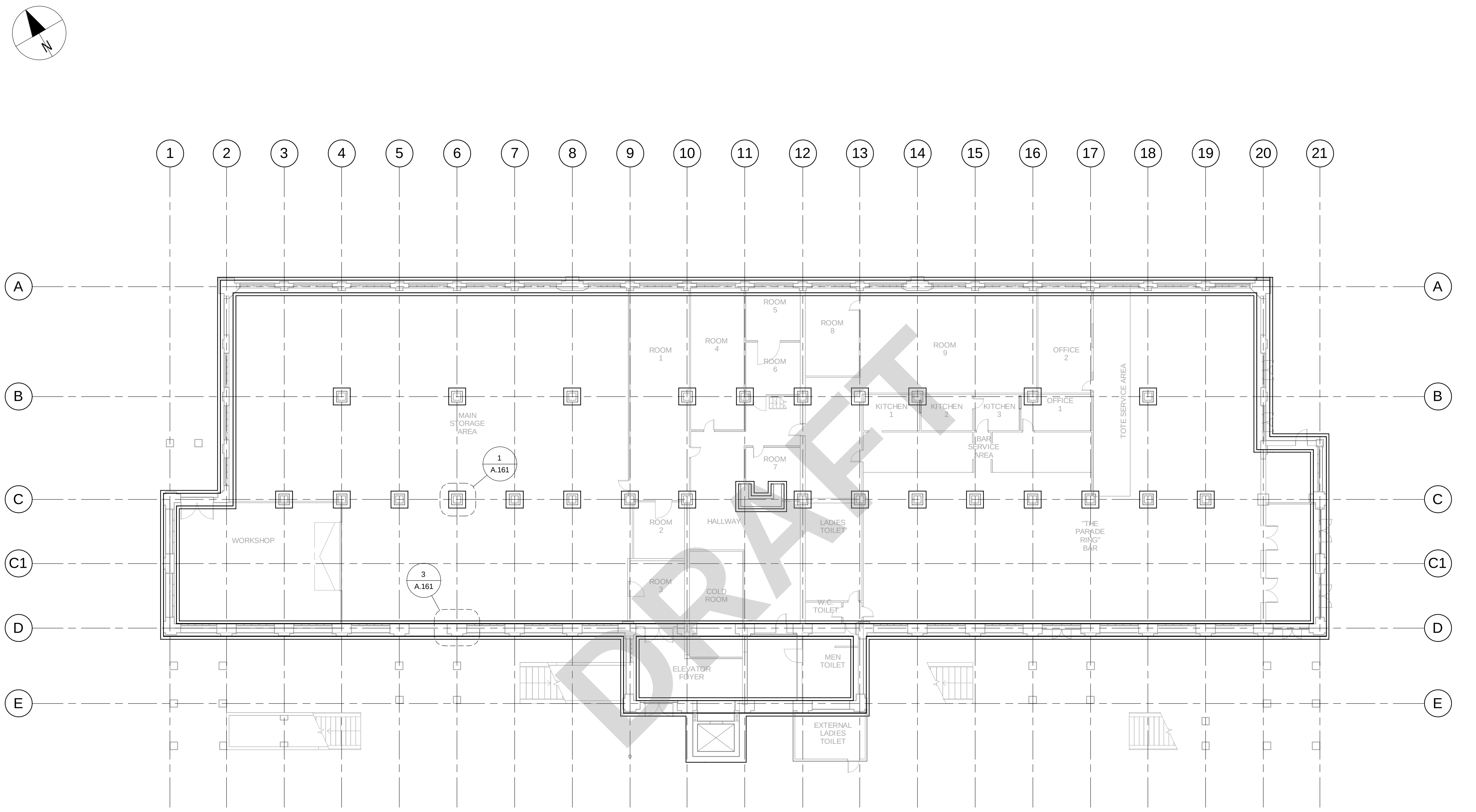

FOUNDATION PLAN (INFERRED FROM LIMITED FOUNDATION EXPOSURE)

Scale: 1 : 150

AECOM

PROJECT

STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT

CANTERBURY JOCKEY CLUB

CONSULTANT

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www.aecom.com

Key

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

INFERRED FOUNDATION PLAN AND SECTIONS

SHEET NUMBER

60332326-DRG-A-160

ISO A1 594mm x 841mm

Last Saved: 3/07/2015 4:40:55 p.m.
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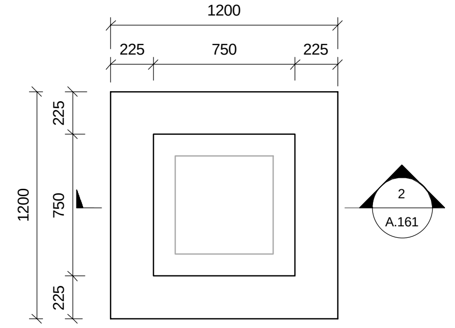
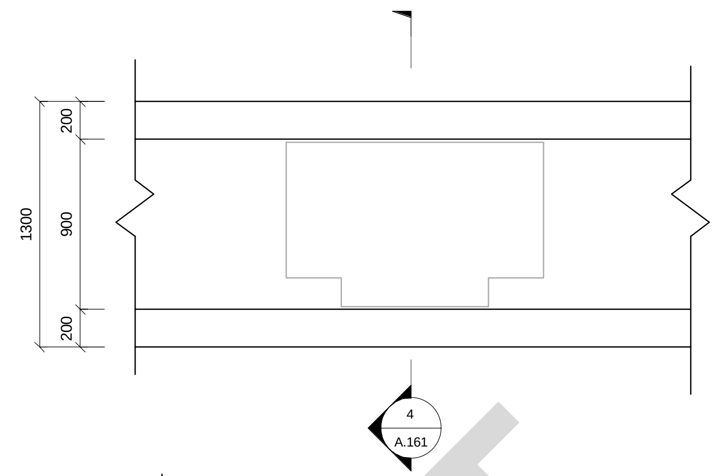
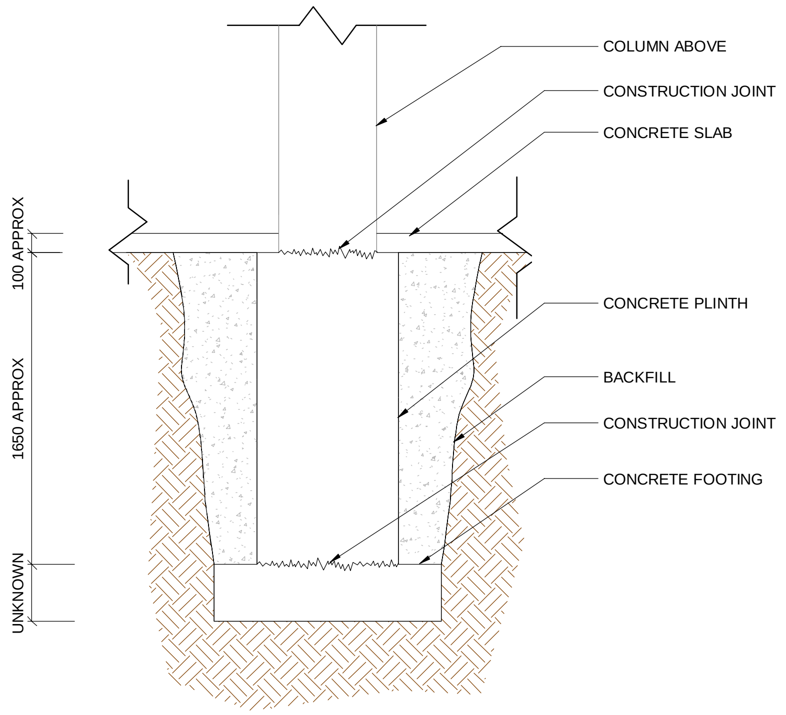


1 TYPICAL COLUMN FOUNDATION - PLAN
A.161 REF: A.160 Scale: 1 : 20



3 TYPICAL WALL FOUNDATION - PLAN
A.161 REF: A.160 Scale: 1 : 20



2 TYPICAL COLUMN FOUNDATION - SECTION
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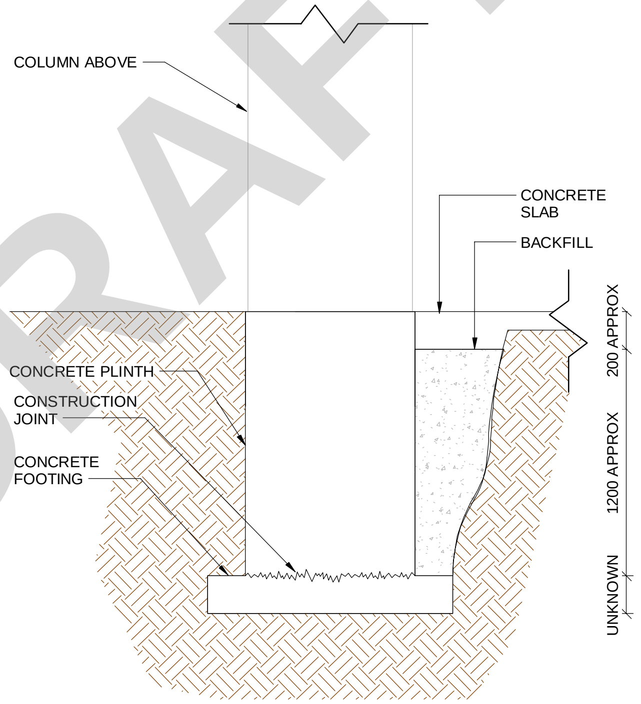

4 TYPICAL WALL FOUNDATION - SECTION
A.161 REF: A.161 Scale: 1 : 20

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KEY PLAN

PROJECT NUMBER

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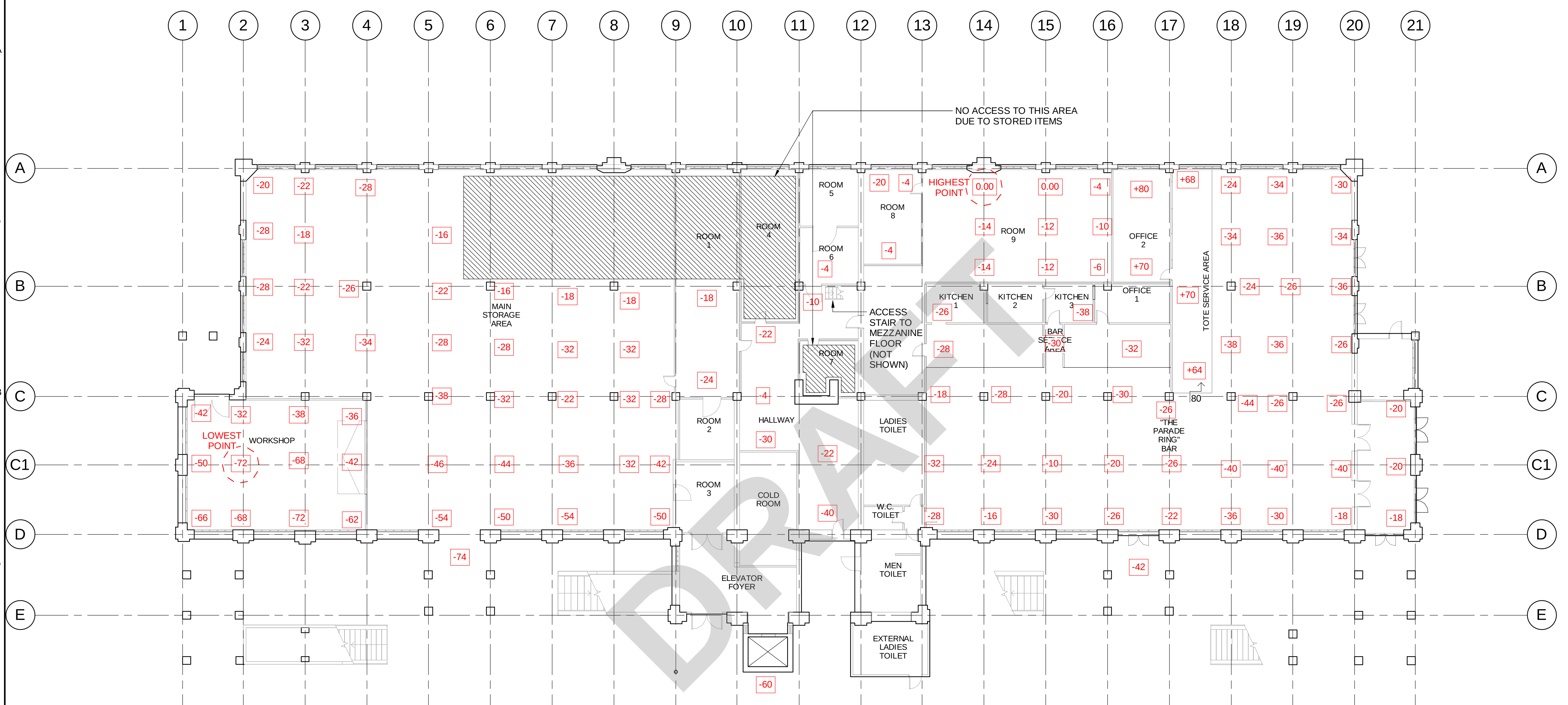
SHEET TITLE

INFERRED FOUNDATION PLAN AND SECTIONS

SHEET NUMBER

60332326-DRG-A-161



FLOOR LEVELS SURVEY - GROUND FLOOR

NOTIONAL DATUM - A14 = 0.000 m

Scale: 1 : 150

NOTE:
FLOOR LEVELS AND WALL VERTICALITIES HAVE BEEN OBTAINED USING NON-PRECISION MEASURING EQUIPMENT. AT TIME OF INSPECTION, OBSTRUCTIONS MAY HAVE RESTRICTED ACCESS TO SOME OF THE FLOOR AREA. AS SUCH, THIS DATA SHALL NOT BE CONSIDERED AS A FULL COMPREHENSIVE SURVEY OF THE FLOOR AND WALL STRUCTURE. IT IS RECOMMENDED THAT A DETAILED SURVEY BE CARRIED OUT BY A RELEVANT CONTRACTOR PRIOR TO COMMENCEMENT OF ANY SITE WORKS.

ISO A1 594mm x 841mm

Last Saved: 22/06/2015 12:01:53 p.m.
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Key

+25 SPOT LEVELS RELATIVE TO DATUM LEVEL (mm)

20 STEP UP (mm)

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

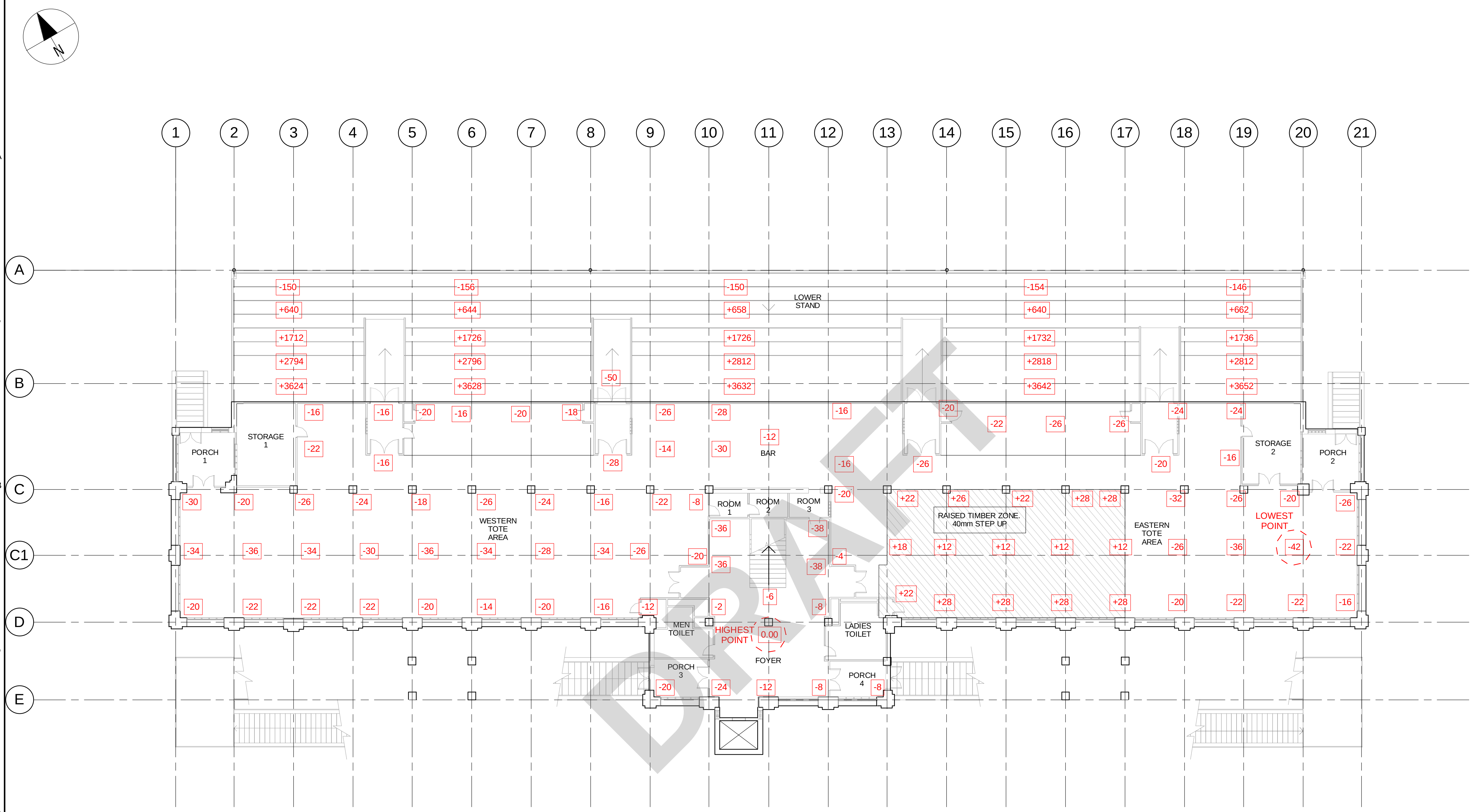
60332326

SHEET TITLE

FLOOR LEVELS SURVEY - LEVEL 0

SHEET NUMBER

60332326-DRG-A-200



FLOOR LEVELS SURVEY - FLOOR 1

NOTIONAL DATUM - D11 = 4.000 m

Scale: 1 : 150

NOTE:
FLOOR LEVELS AND WALL VERTICALITIES HAVE BEEN OBTAINED USING NON-PRECISION MEASURING EQUIPMENT. AT TIME OF INSPECTION, OBSTRUCTIONS MAY HAVE RESTRICTED ACCESS TO SOME OF THE FLOOR AREA. AS SUCH, THIS DATA SHALL NOT BE CONSIDERED AS A FULL COMPREHENSIVE SURVEY OF THE FLOOR AND WALL STRUCTURE. IT IS RECOMMENDED THAT A DETAILED SURVEY BE CARRIED OUT BY A RELEVANT CONTRACTOR PRIOR TO COMMENCEMENT OF ANY SITE WORKS.

PROJECT
STRUCTURAL ASSESSMENT GRAND NATIONAL STAND
CANTERBURY JOCKEY CLUB, CHRISTCHURCH

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Key

+25 SPOT LEVELS RELATIVE TO DATUM LEVEL (mm)

20 STEP UP (mm)

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER
60332326

SHEET TITLE
FLOOR LEVELS SURVEY - LEVEL 1

SHEET NUMBER
60332326-DRG-A-201

ISO A1 594mm x 841mm

Last Saved: 22/06/2015 12:01:55 p.m.
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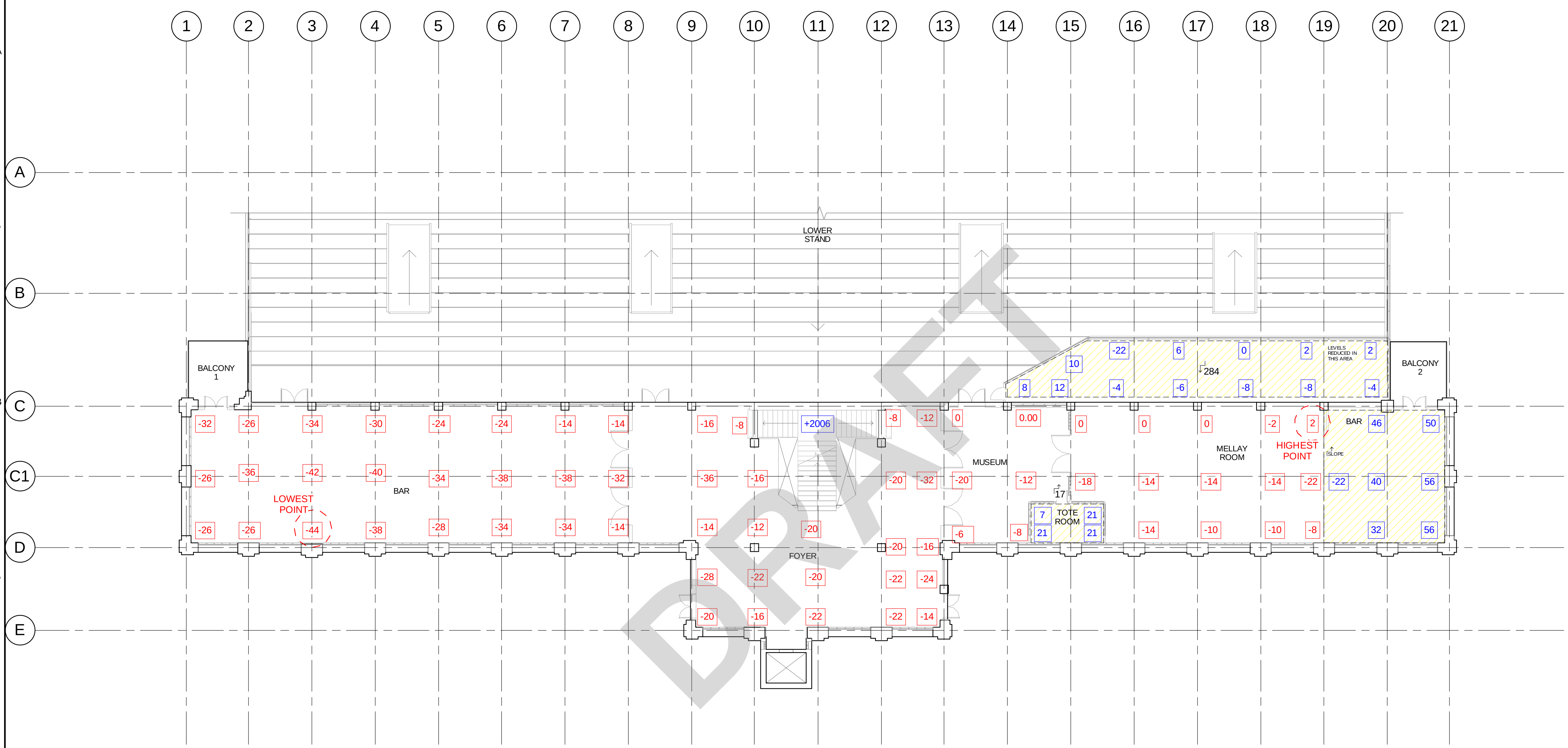

FLOOR LEVELS SURVEY - FLOOR 2

NOTIONAL DATUM - C14 = 7.700 m

Scale: 1 : 150

NOTE:
FLOOR LEVELS AND WALL VERTICALITIES HAVE BEEN OBTAINED USING NON-PRECISION MEASURING EQUIPMENT. AT TIME OF INSPECTION, OBSTRUCTIONS MAY HAVE RESTRICTED ACCESS TO SOME OF THE FLOOR AREA. AS SUCH, THIS DATA SHALL NOT BE CONSIDERED AS A FULL COMPREHENSIVE SURVEY OF THE FLOOR AND WALL STRUCTURE. IT IS RECOMMENDED THAT A DETAILED SURVEY BE CARRIED OUT BY A RELEVANT CONTRACTOR PRIOR TO COMMENCEMENT OF ANY SITE WORKS.

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PROJECT

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Key

+25	SPOT LEVELS RELATIVE TO DATUM LEVEL (mm).
20	STEP MAGINTUDE (mm) AND DIRECTION. ARROW POINTS 'UP'.
+25	SPOT LEVELS RELATIVE TO DATUM LEVEL (mm), TAKEN ON UNDULATING OR SLOPING FLOOR COVERING. LEVELS NOT SEEN AS REPRESENTATIVE OF OVERALL DEFLECTION PATTERN IN FLOOR PLATE.
	AREA OF SLOPING OR UNDUALTING FLOOR COVERING.

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

FLOOR LEVELS SURVEY - LEVEL 2

SHEET NUMBER

60332326-DRG-A-202

ISO A1 594mm x 841mm

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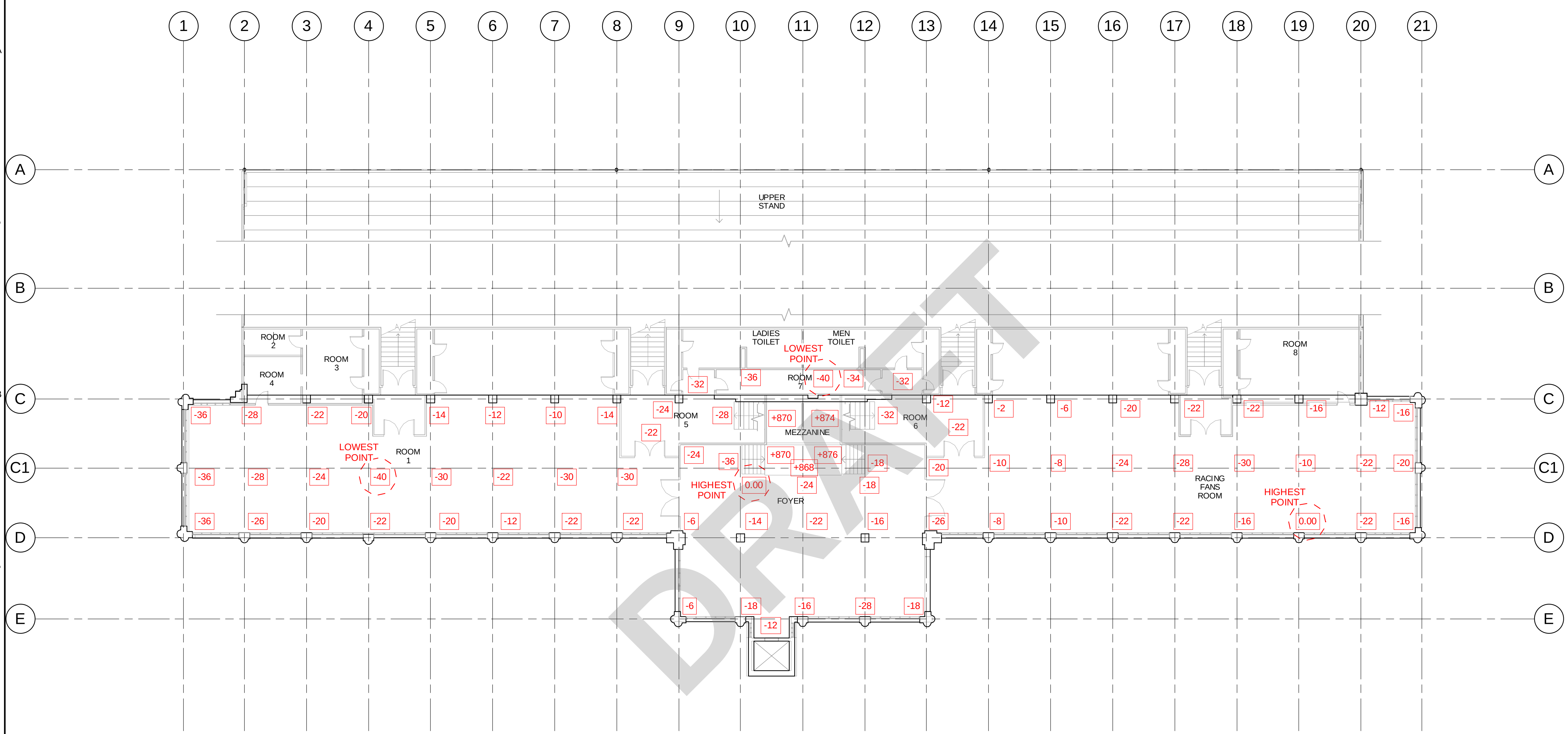

FLOOR LEVELS SURVEY - FLOOR 3

Scale: 1 : 150

NOTIONAL DATUM - D19 = 11.500 m

NOTE:
FLOOR LEVELS AND WALL VERTICALITIES HAVE BEEN OBTAINED USING NON-PRECISION MEASURING EQUIPMENT. AT TIME OF INSPECTION, OBSTRUCTIONS MAY HAVE RESTRICTED ACCESS TO SOME OF THE FLOOR AREA. AS SUCH, THIS DATA SHALL NOT BE CONSIDERED AS A FULL COMPREHENSIVE SURVEY OF THE FLOOR AND WALL STRUCTURE. IT IS RECOMMENDED THAT A DETAILED SURVEY BE CARRIED OUT BY A RELEVANT CONTRACTOR PRIOR TO COMMENCEMENT OF ANY SITE WORKS.

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Key

+25	SPOT LEVELS RELATIVE TO DATUM LEVEL (mm)
20	STEP UP (mm)

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

FLOOR LEVELS SURVEY - LEVEL 3

SHEET NUMBER

60332326-DRG-A-203

ISO A1 594mm x 841mm
Last Saved: 22/06/2015 12:01:57 p.m.
Filename: C:\Users\PettiC\Desktop\60332326_MOD_ST_2014_PettiC(Recovery).rvt

ISO A1 594mm x 841mm

FLOOR LEVELS SURVEY - FLOOR 4

NOTIONAL DATUM - D21 = 15.600 m

Scale: 1 : 150

NOTE:
FLOOR LEVELS AND WALL VERTICALITIES HAVE BEEN OBTAINED USING NON-PRECISION MEASURING EQUIPMENT. AT TIME OF INSPECTION, OBSTRUCTIONS MAY HAVE RESTRICTED ACCESS TO SOME OF THE FLOOR AREA. AS SUCH, THIS DATA SHALL NOT BE CONSIDERED AS A FULL COMPREHENSIVE SURVEY OF THE FLOOR AND WALL STRUCTURE. IT IS RECOMMENDED THAT A DETAILED SURVEY BE CARRIED OUT BY A RELEVANT CONTRACTOR PRIOR TO COMMENCEMENT OF ANY SITE WORKS.

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Key

+25	SPOT LEVELS RELATIVE TO DATUM LEVEL (mm)
20	STEP UP (mm)

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

FLOOR LEVELS SURVEY - LEVEL 4

SHEET NUMBER

60332326-DRG-A-204

Last Saved: 22/06/2015 12:01:57 p.m.
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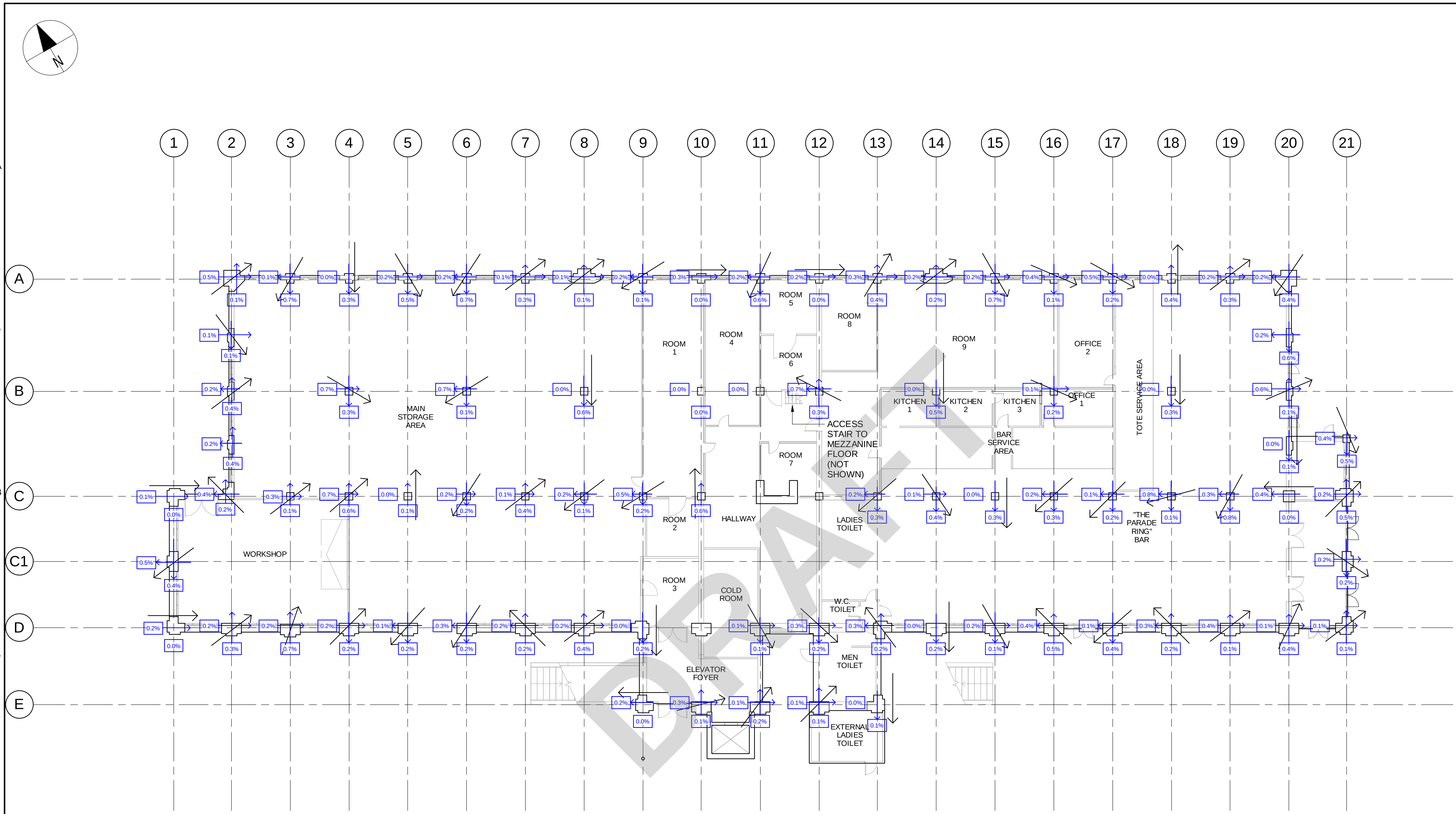
ISO A1 594mm x 841mm



COLUMN AND WALL VERTICALITY SURVEY - GROUND FLOOR

Scale: 1 : 150

NOTE:
FLOOR LEVELS AND WALL VERTICALITIES HAVE BEEN OBTAINED USING NON-PRECISION MEASURING EQUIPMENT. AT TIME OF INSPECTION, OBSTRUCTIONS MAY HAVE RESTRICTED ACCESS TO SOME OF THE FLOOR AREA. AS SUCH, THIS DATA SHALL NOT BE CONSIDERED AS A FULL COMPREHENSIVE SURVEY OF THE FLOOR AND WALL STRUCTURE. IT IS RECOMMENDED THAT A DETAILED SURVEY BE CARRIED OUT BY A RELEVANT CONTRACTOR PRIOR TO COMMENCEMENT OF ANY SITE WORKS.

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Key

0.6% PERCENTAGE AND DIRECTION FOR WALL BEING OUT OF VERTICAL ALIGNEMENT

OVERALL DIRECTION OF COLUMN LEANING

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

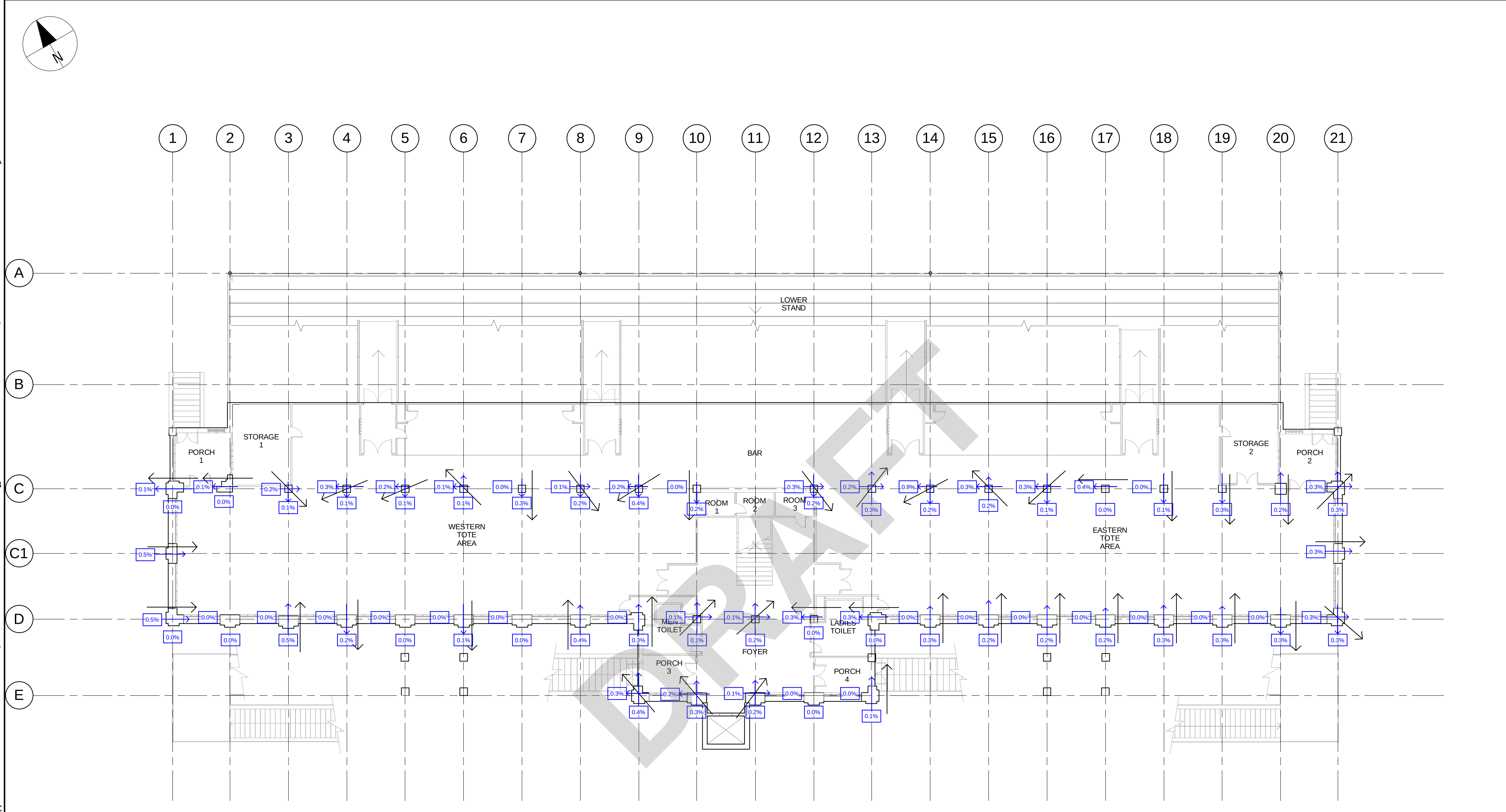
60332326

SHEET TITLE

COLUMN AND WALL VERTICALITY SURVEY - LEVEL 0

SHEET NUMBER

60332326-DRG-A-300



COLUMN AND WALL VERTICALITY SURVEY - FLOOR 1

Scale: 1 : 150

NOTE:
FLOOR LEVELS AND WALL VERTICALITIES HAVE BEEN OBTAINED USING NON-PRECISION MEASURING EQUIPMENT. AT TIME OF INSPECTION, OBSTRUCTIONS MAY HAVE RESTRICTED ACCESS TO SOME OF THE FLOOR AREA. AS SUCH, THIS DATA SHALL NOT BE CONSIDERED AS A FULL COMPREHENSIVE SURVEY OF THE FLOOR AND WALL STRUCTURE. IT IS RECOMMENDED THAT A DETAILED SURVEY BE CARRIED OUT BY A RELEVANT CONTRACTOR PRIOR TO COMMENCEMENT OF ANY SITE WORKS.

ISO A1 594mm x 841mm

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PROJECT

STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

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CONSULTANT

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Key

0.6% — PERCENTAGE AND DIRECTION FOR WALL BEING OUT OF VERTICAL ALIGNEMENT

OVERALL DIRECTION OF COLUMN LEANING

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

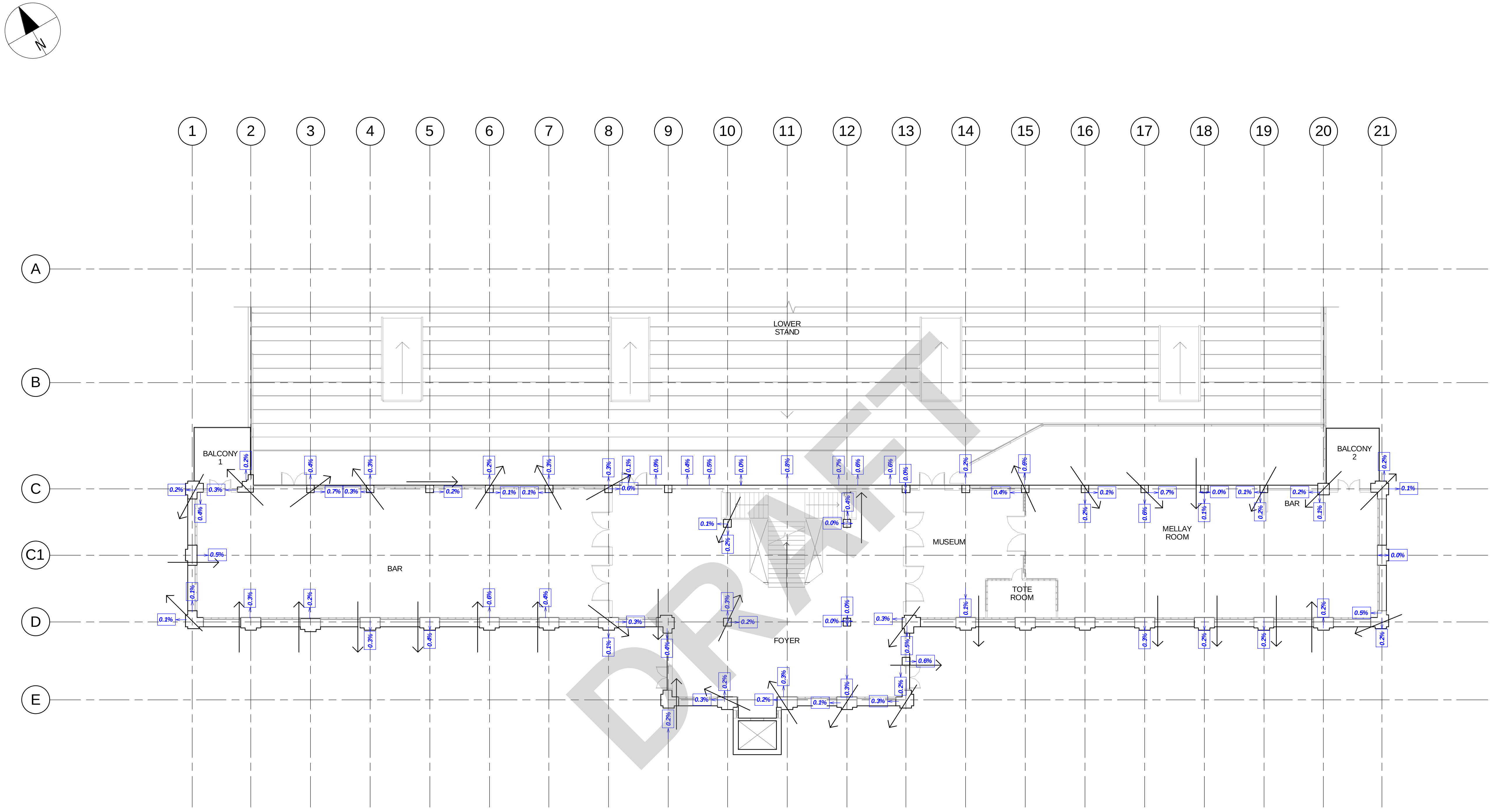
60332326

SHEET TITLE

COLUMN AND WALL VERTICALITY SURVEY - LEVEL 1

SHEET NUMBER

60332326-DRG-A-301



COLUMN AND WALL VERTICALITY SURVEY - FLOOR 2

Scale: 1 : 150

NOTE:
FLOOR LEVELS AND WALL VERTICALITIES HAVE BEEN OBTAINED USING NON-PRECISION MEASURING EQUIPMENT. AT TIME OF INSPECTION, OBSTRUCTIONS MAY HAVE RESTRICTED ACCESS TO SOME OF THE FLOOR AREA. AS SUCH, THIS DATA SHALL NOT BE CONSIDERED AS A FULL COMPREHENSIVE SURVEY OF THE FLOOR AND WALL STRUCTURE. IT IS RECOMMENDED THAT A DETAILED SURVEY BE CARRIED OUT BY A RELEVANT CONTRACTOR PRIOR TO COMMENCEMENT OF ANY SITE WORKS.

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Key

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OVERALL DIRECTION OF COLUMN LEANING

PROJECT MANAGEMENT INITIALS

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ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

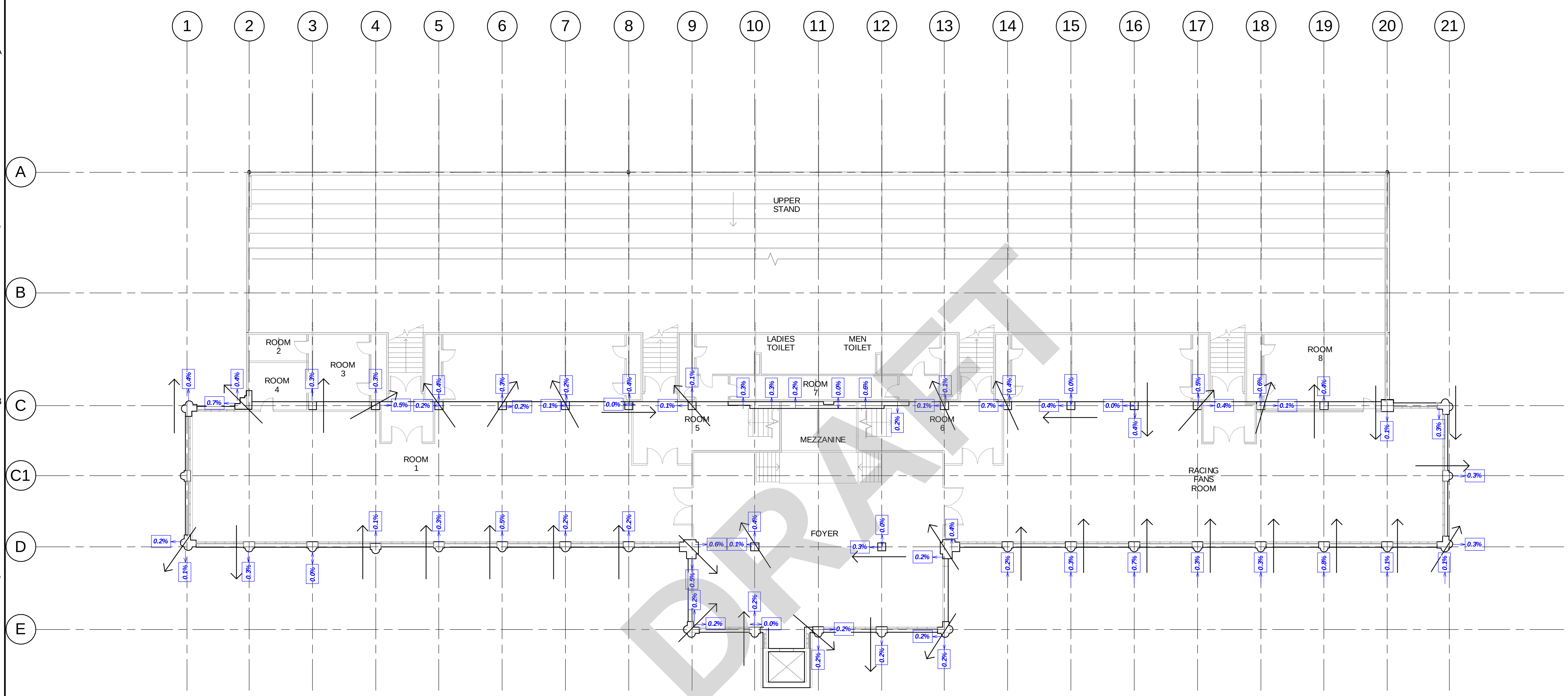
SHEET TITLE

COLUMN AND WALL VERTICALITY SURVEY - LEVEL 2

SHEET NUMBER

60332326-DRG-A-302

ISO A1 594mm x 841mm



COLUMN AND WALL VERTICALITY SURVEY - FLOOR 3

Scale: 1 : 150

NOTE:
FLOOR LEVELS AND WALL VERTICALITIES HAVE BEEN OBTAINED USING NON-PRECISION MEASURING EQUIPMENT. AT TIME OF INSPECTION, OBSTRUCTIONS MAY HAVE RESTRICTED ACCESS TO SOME OF THE FLOOR AREA. AS SUCH, THIS DATA SHALL NOT BE CONSIDERED AS A FULL COMPREHENSIVE SURVEY OF THE FLOOR AND WALL STRUCTURE. IT IS RECOMMENDED THAT A DETAILED SURVEY BE CARRIED OUT BY A RELEVANT CONTRACTOR PRIOR TO COMMENCEMENT OF ANY SITE WORKS.

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Key

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OVERALL DIRECTION OF COLUMN LEANING

PROJECT MANAGEMENT INITIALS

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DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

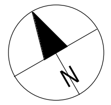
SHEET TITLE

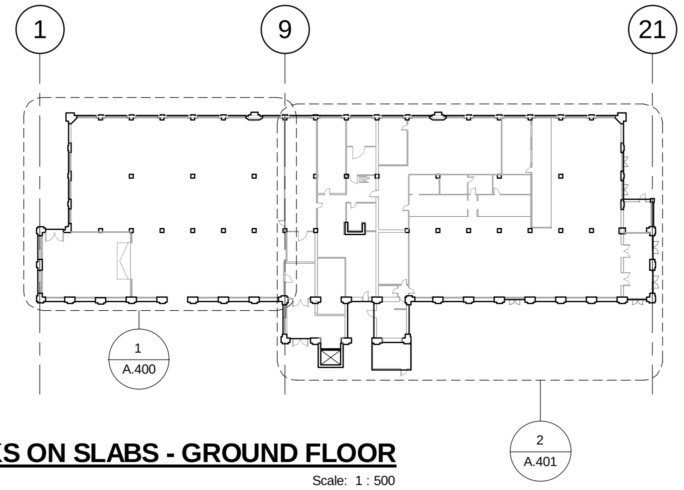
COLUMN AND WALL VERTICALITY SURVEY - LEVEL 3

SHEET NUMBER

60332326-DRG-A-303

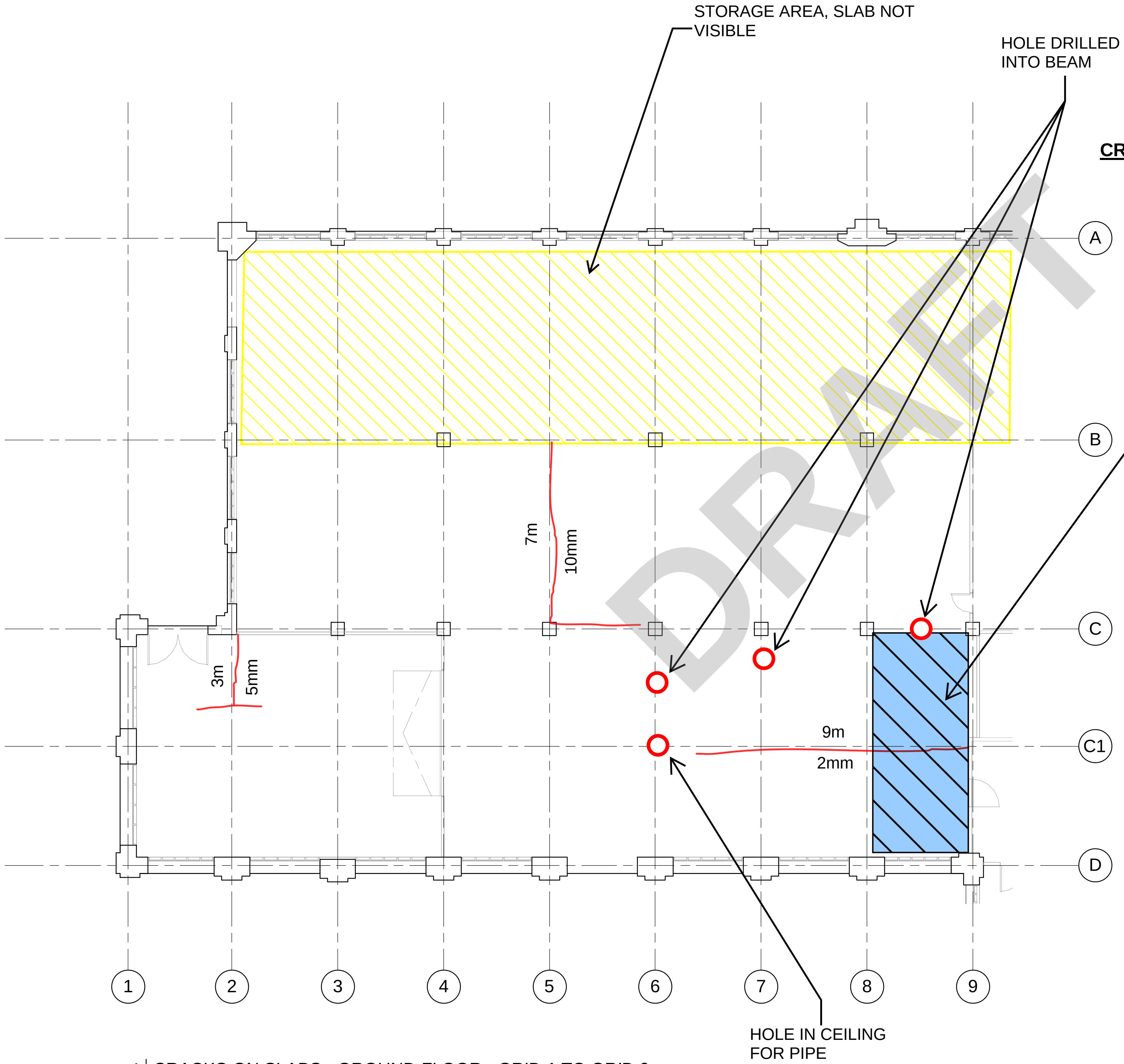
ISO A1 594mm x 841mm





CRACKS ON SLABS - GROUND FLOOR

Scale: 1 : 500



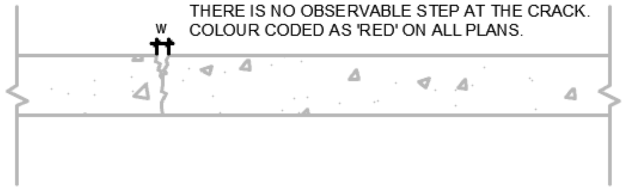
1 | CRACKS ON SLABS - GROUND FLOOR - GRID 1 TO GRID 9

A.400 | REF: A.400 | Scale: 1 : 100

CRACK LEGEND: ALL DRAWINGS A.400 TO A.409

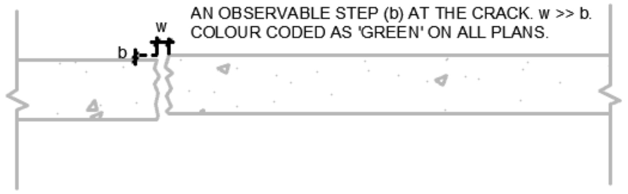
CRACK TYPE 1 - TAPERED FRACTURE

CRACK IS WIDEST AT THE EDGE OF THE ELEMENT (w) AND TAPERS TO HAIRLINE. CRACK MAY OR MAY NOT PENETRATE THE FULL DEPTH OF THE ELEMENT. THERE IS NO OBSERVABLE STEP AT THE CRACK. COLOUR CODED AS 'RED' ON ALL PLANS.



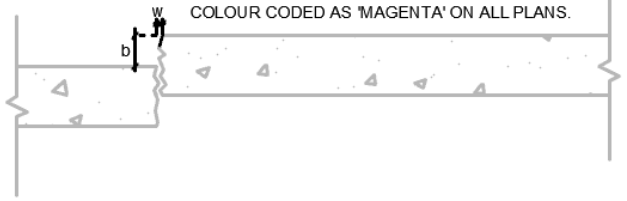
CRACK TYPE 2 - SEPARATION

CRACK IS A CONSTANT WIDTH (w) THROUGHOUT THE FULL DEPTH OF THE ELEMENT. THERE MAY BE AN OBSERVABLE STEP (b) AT THE CRACK. w >> b. COLOUR CODED AS 'GREEN' ON ALL PLANS.



CRACK TYPE 3 - STEP DISLOCATION

THERE IS AN OBSERVABLE STEP (b) AT THE CRACK. THERE MAY BE A SLIGHT SEPARATION (w) AT THE CRACK. b >> w. COLOUR CODED AS 'MAGENTA' ON ALL PLANS.



AECOM

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KEY

- 2.0m — APPROXIMATE LENGTH; 0.4 mm — APPROXIMATE WIDTH; INDICATES CRACK ON TOP OF CONCRETE SLAB
- CRACKS OBSERVED TO THE UNDERSIDE OF SLAB OR BEAM
- AREA NOT ASSESSED (COVERED)

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

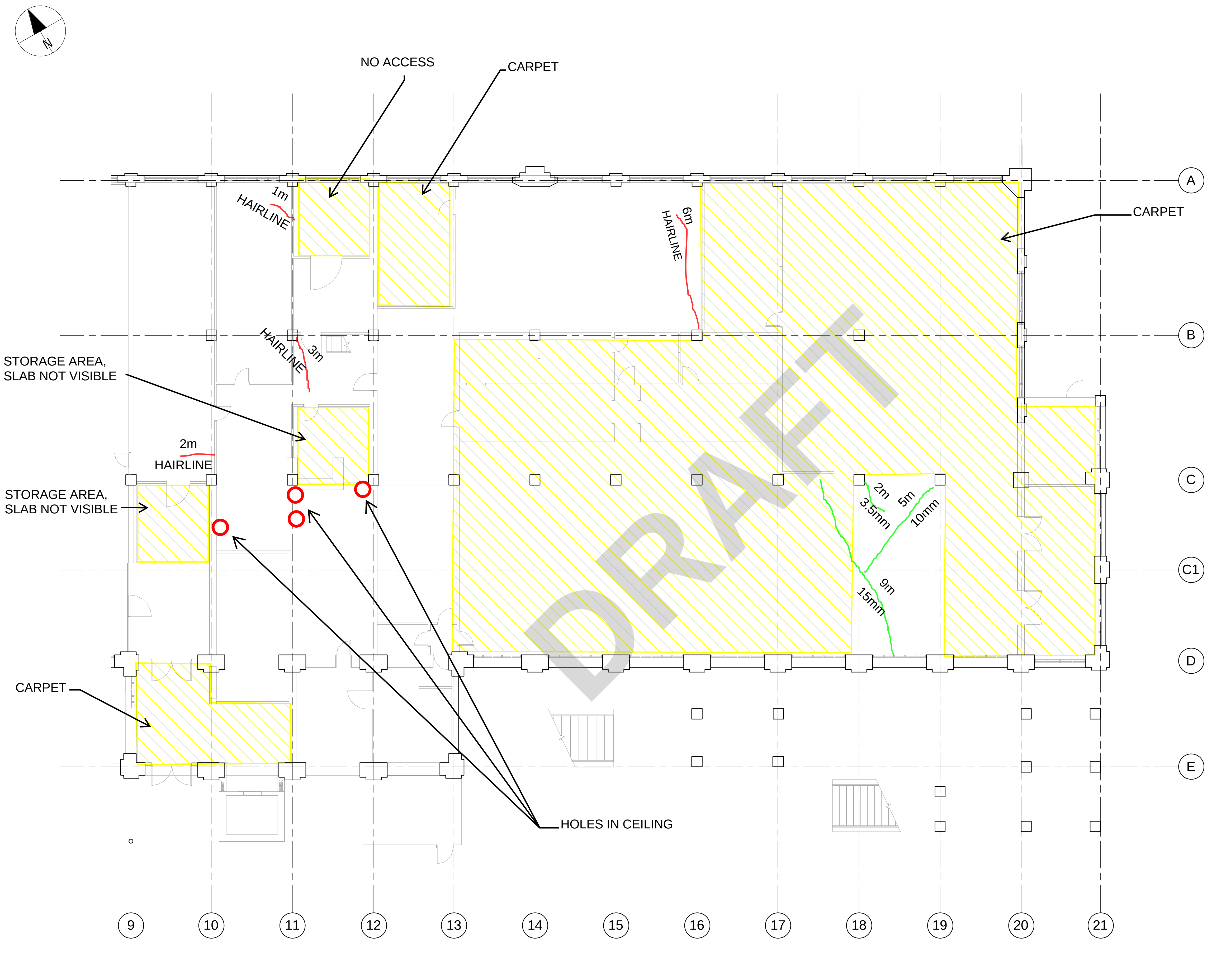
60332326

SHEET TITLE

FLOOR CRACK MAPS - SHEET 1

SHEET NUMBER

60332326-DRG-A-400



2 | CRACKS ON SLABS - GROUND FLOOR - GRID 9 TO GRID 21

A.401 | REF: A.400 Scale: 1 : 100

ISO A1 594mm x 841mm

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www.aecom.com

KEY

2.0m APPROXIMATE LENGTH
INDICATES CRACK ON TOP OF CONCRETE SLAB
0.4 mm APPROXIMATE WIDTH

CRACKS OBSERVED TO THE UNDERSIDE OF SLAB OR BEAM

AREA NOT ASSESSED (COVERED)

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

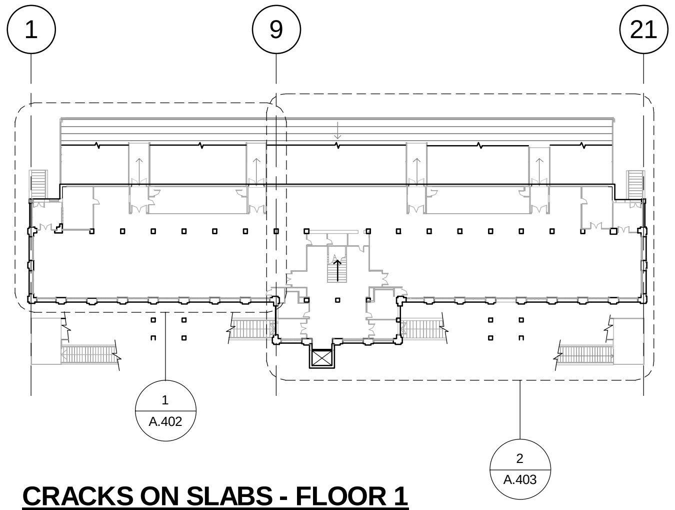
60332326

SHEET TITLE

FLOOR CRACK MAPS - SHEET 2

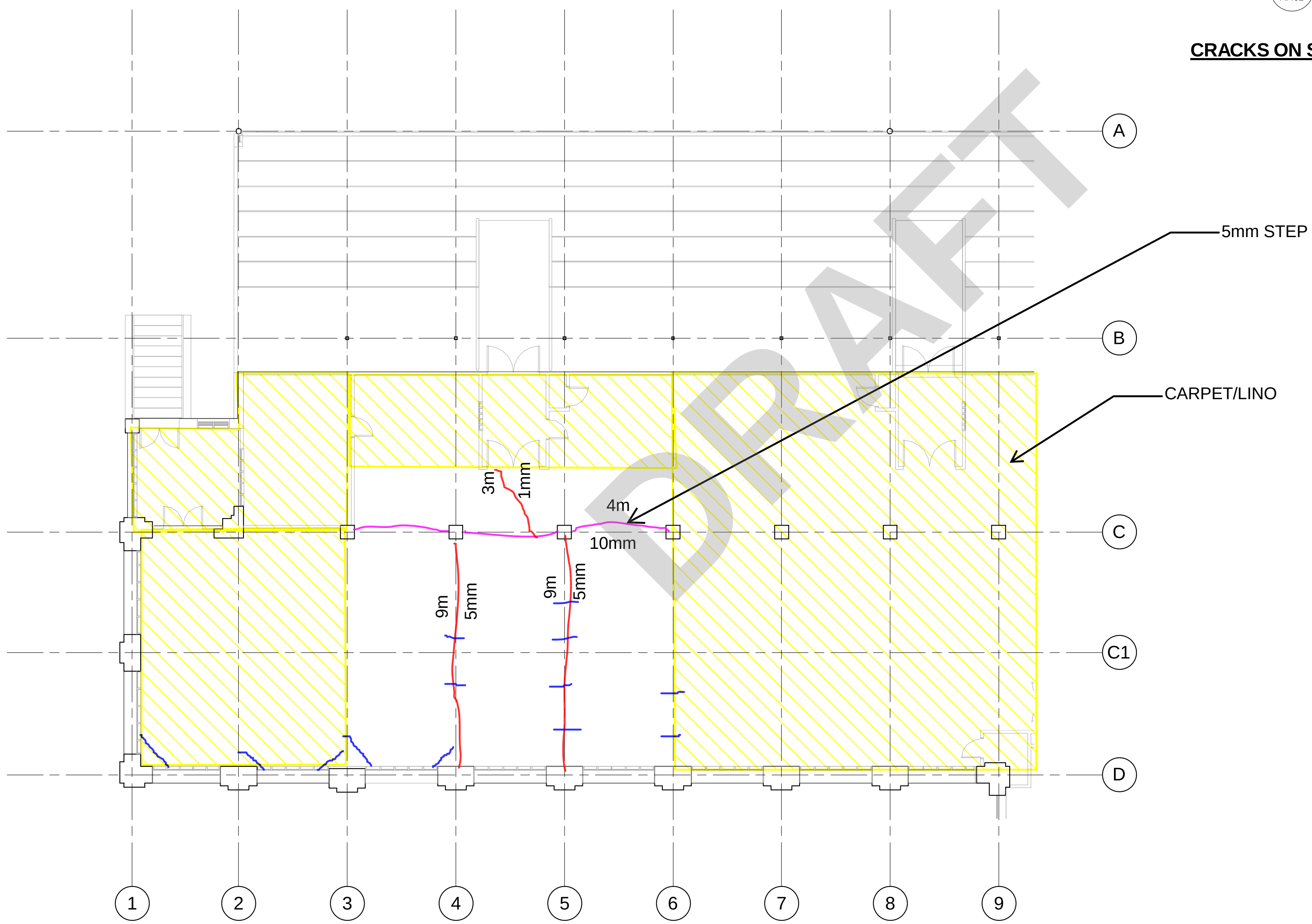
SHEET NUMBER

60332326-DRG-A-401



CRACKS ON SLABS - FLOOR 1

Scale: 1 : 500



1 | CRACKS ON SLABS - FLOOR 1 - GRID 1 TO GRID 9

A.402 | REF: A.402 | Scale: 1 : 100

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PROJECT

STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT

CANTERBURY JOCKEY CLUB

CONSULTANT

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www.aecom.com

KEY

- 2.0m — APPROXIMATE LENGTH; 0.4 mm — APPROXIMATE WIDTH; INDICATES CRACK ON TOP OF CONCRETE SLAB
- CRACKS OBSERVED TO THE UNDERSIDE OF SLAB OR BEAM
- AREA NOT ASSESSED (COVERED)

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

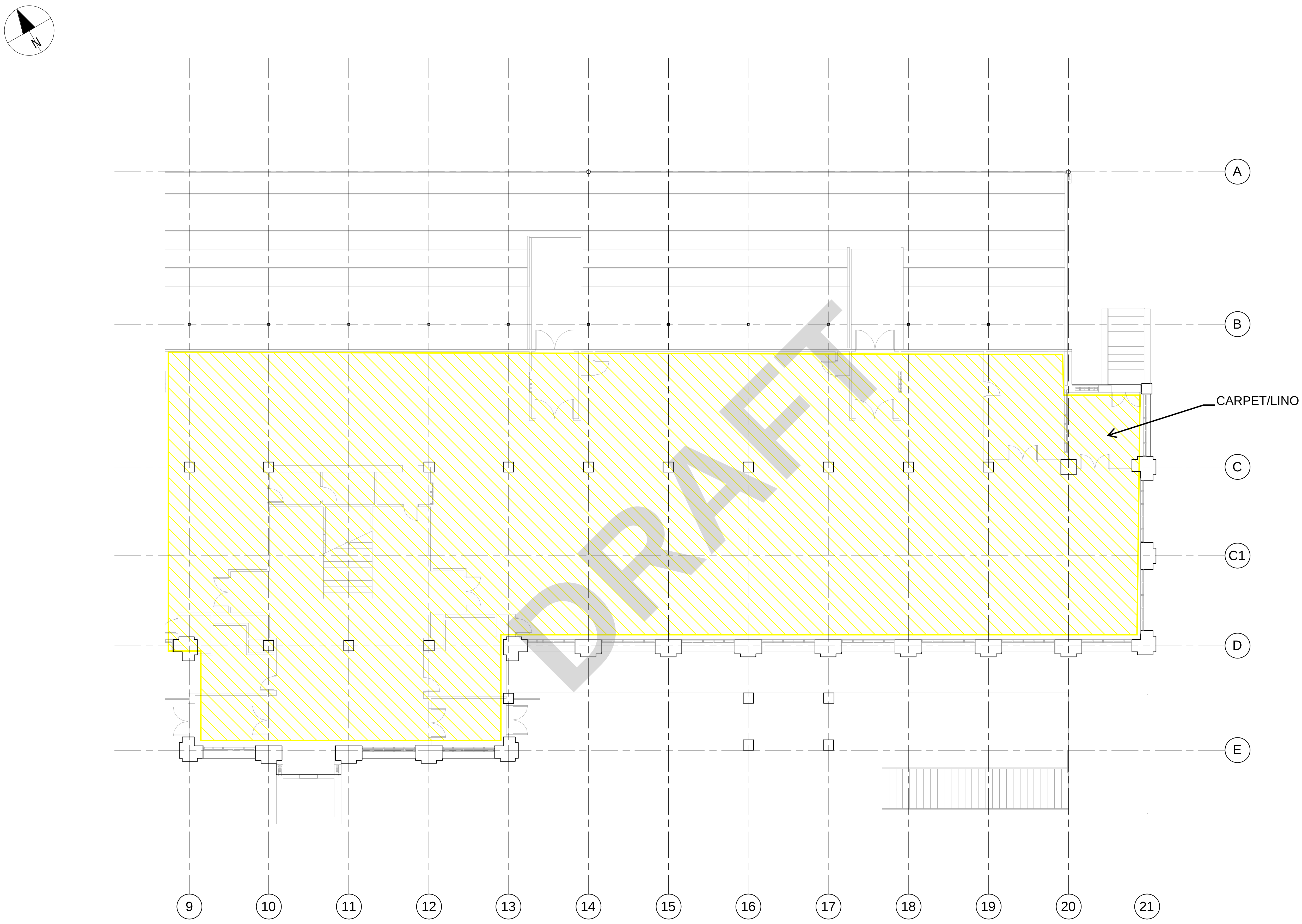
SHEET TITLE

FLOOR CRACK MAPS - SHEET 3

SHEET NUMBER

60332326-DRG-A-402

ISO A1 594mm x 841mm



2 CRACKS ON SLABS - FLOOR 1 - GRID 9 TO GRID 21

A.403 REF: A.402 Scale: 1 : 100

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STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

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KEY

2.0m APPROXIMATE LENGTH
0.4 mm APPROXIMATE WIDTH
INDICATES CRACK ON TOP OF CONCRETE SLAB

CRACKS OBSERVED TO THE UNDERSIDE OF SLAB OR BEAM

AREA NOT ASSESSED (COVERED)

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

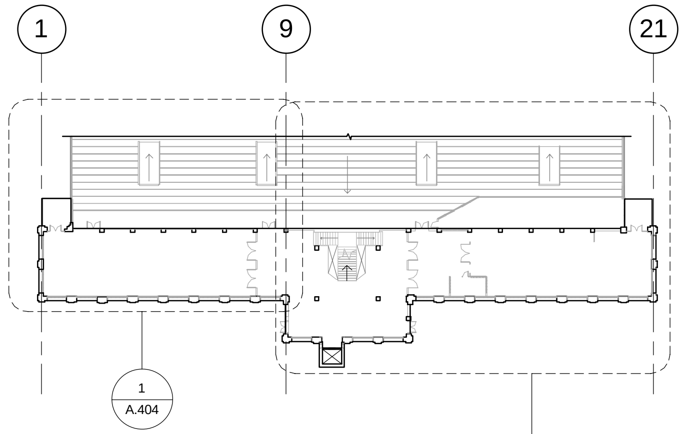
SHEET TITLE

FLOOR CRACK MAPS - SHEET 4

SHEET NUMBER

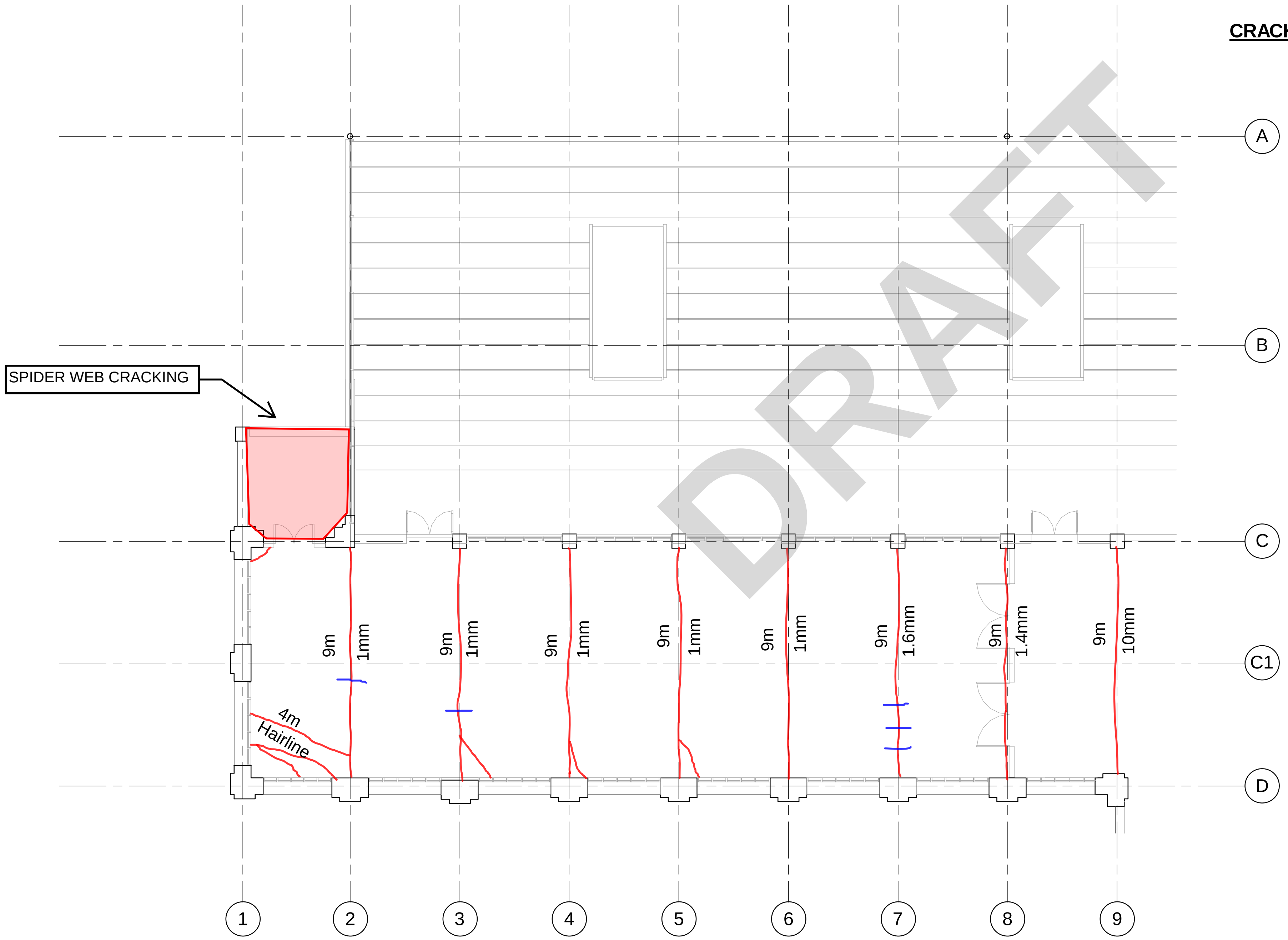
60332326-DRG-A-403

ISO A1 594mm x 841mm



CRACKS ON SLABS - FLOOR 2

Scale: 1 : 500



1 CRACKS ON SLABS - FLOOR 2 - GRID 1 TO GRID 9

A.404 REF: A.404 Scale: 1 : 100

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KEY

2.0m APPROXIMATE LENGTH
INDICATES CRACK ON TOP OF CONCRETE SLAB
0.4 mm APPROXIMATE WIDTH

CRACKS OBSERVED TO THE UNDERSIDE OF SLAB OR BEAM

AREA NOT ASSESSED (COVERED)

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

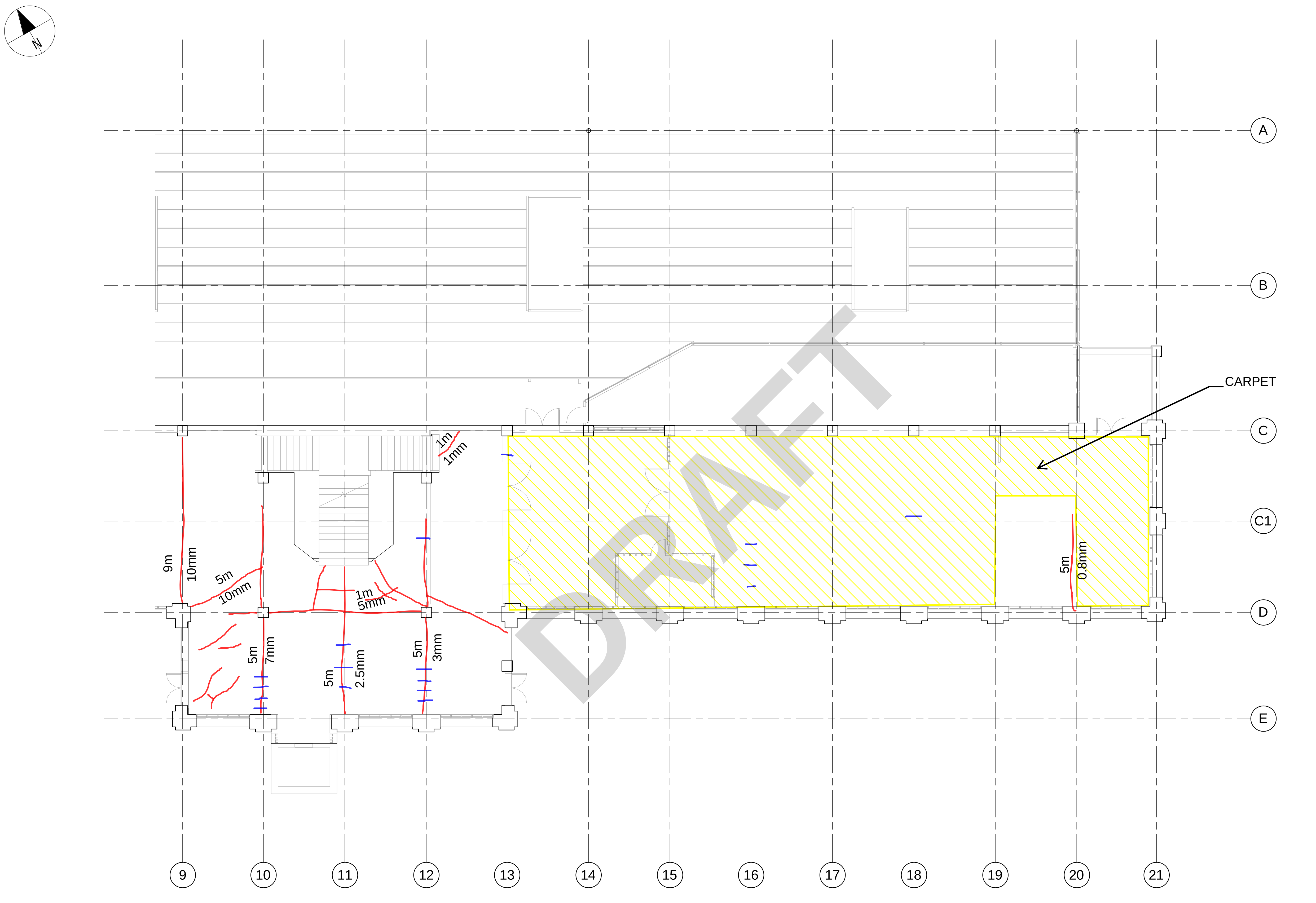
60332326

SHEET TITLE

FLOOR CRACK MAPS - SHEET 5

SHEET NUMBER

60332326-DRG-A-404



2 CRACKS ON SLABS - FLOOR 2 - GRID 9 TO GRID 21

A.405 REF: A.404 Scale: 1 : 100

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KEY

2.0m — APPROXIMATE LENGTH
0.4 mm — APPROXIMATE WIDTH
INDICATES CRACK ON TOP OF CONCRETE SLAB

CRACKS OBSERVED TO THE UNDERSIDE OF SLAB OR BEAM

AREA NOT ASSESSED (COVERED)

PROJECT MANAGEMENT INITIALS

MC	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

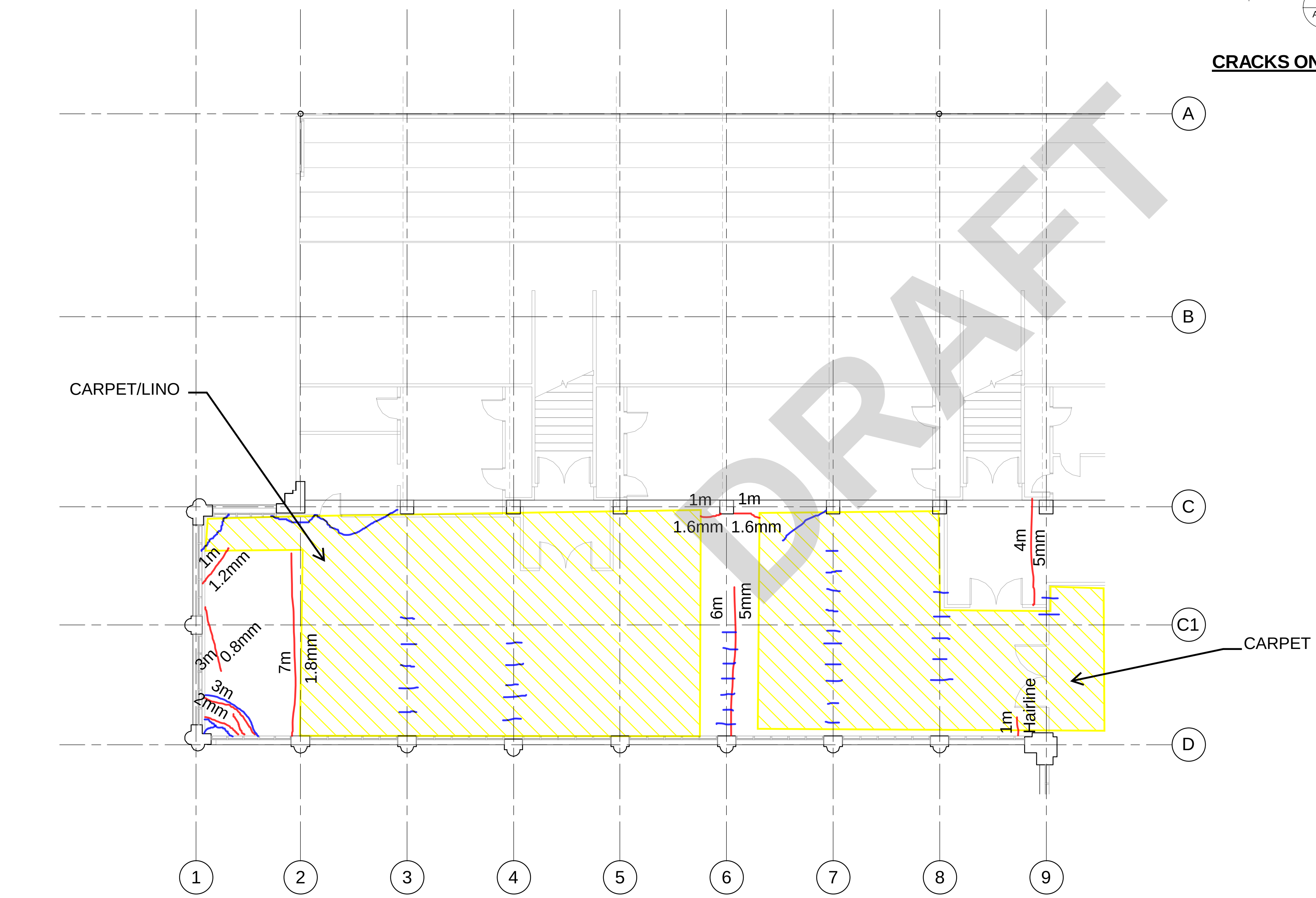
SHEET TITLE

FLOOR CRACK MAPS - SHEET 6

SHEET NUMBER

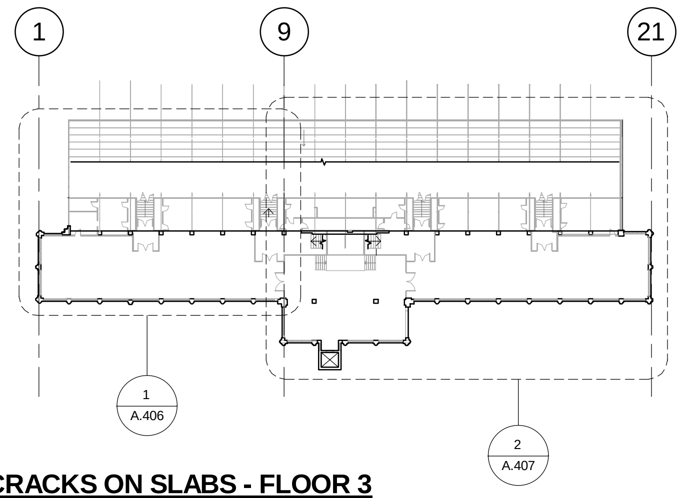
60332326-DRG-A-405

ISO A1 594mm x 841mm



1 CRACKS ON SLABS - FLOOR 3 - GRID 1 TO GRID 9

A.406 REF: A.406 Scale: 1 : 100



CRACKS ON SLABS - FLOOR 3

Scale: 1 : 500

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STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

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KEY

2.0m APPROXIMATE LENGTH
0.4 mm APPROXIMATE WIDTH
INDICATES CRACK ON TOP OF CONCRETE SLAB

CRACKS OBSERVED TO THE UNDERSIDE OF SLAB OR BEAM

AREA NOT ASSESSED (COVERED)

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

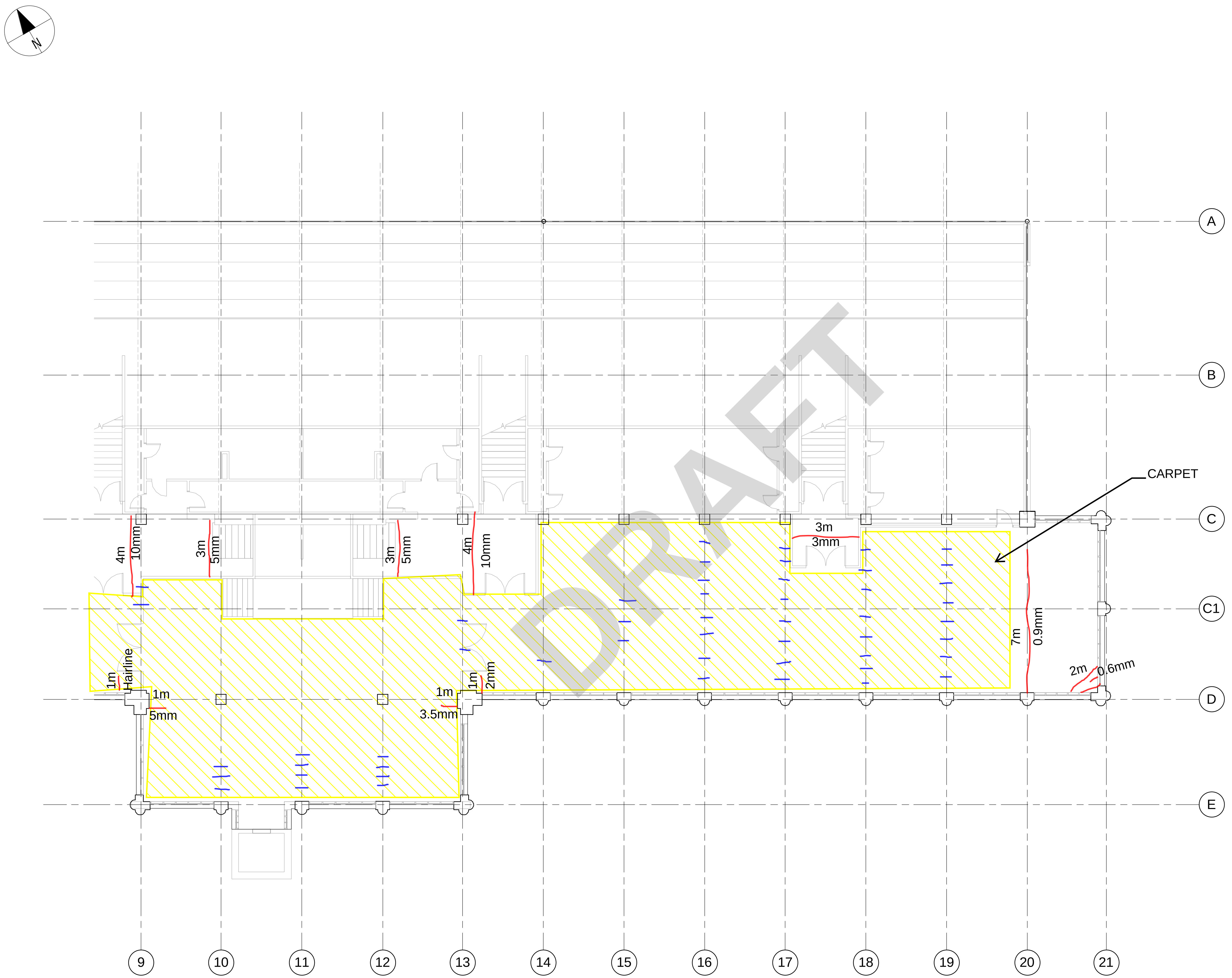
SHEET TITLE

FLOOR CRACK MAPS - SHEET 7

SHEET NUMBER

60332326-DRG-A-406

ISO A1 594mm x 841mm



2 | CRACKS ON SLABS - FLOOR 3 - GRID 9 TO GRID 21

A.407 | REF: A.406 Scale: 1 : 100

ISO A1 594mm x 841mm

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KEY

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- CRACKS OBSERVED TO THE UNDERSIDE OF SLAB OR BEAM
- AREA NOT ASSESSED (COVERED)

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

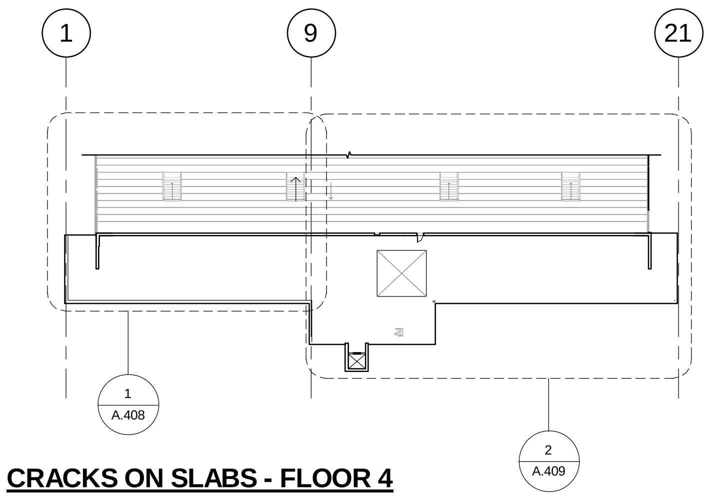
SHEET TITLE

FLOOR CRACK MAPS - SHEET 8

SHEET NUMBER

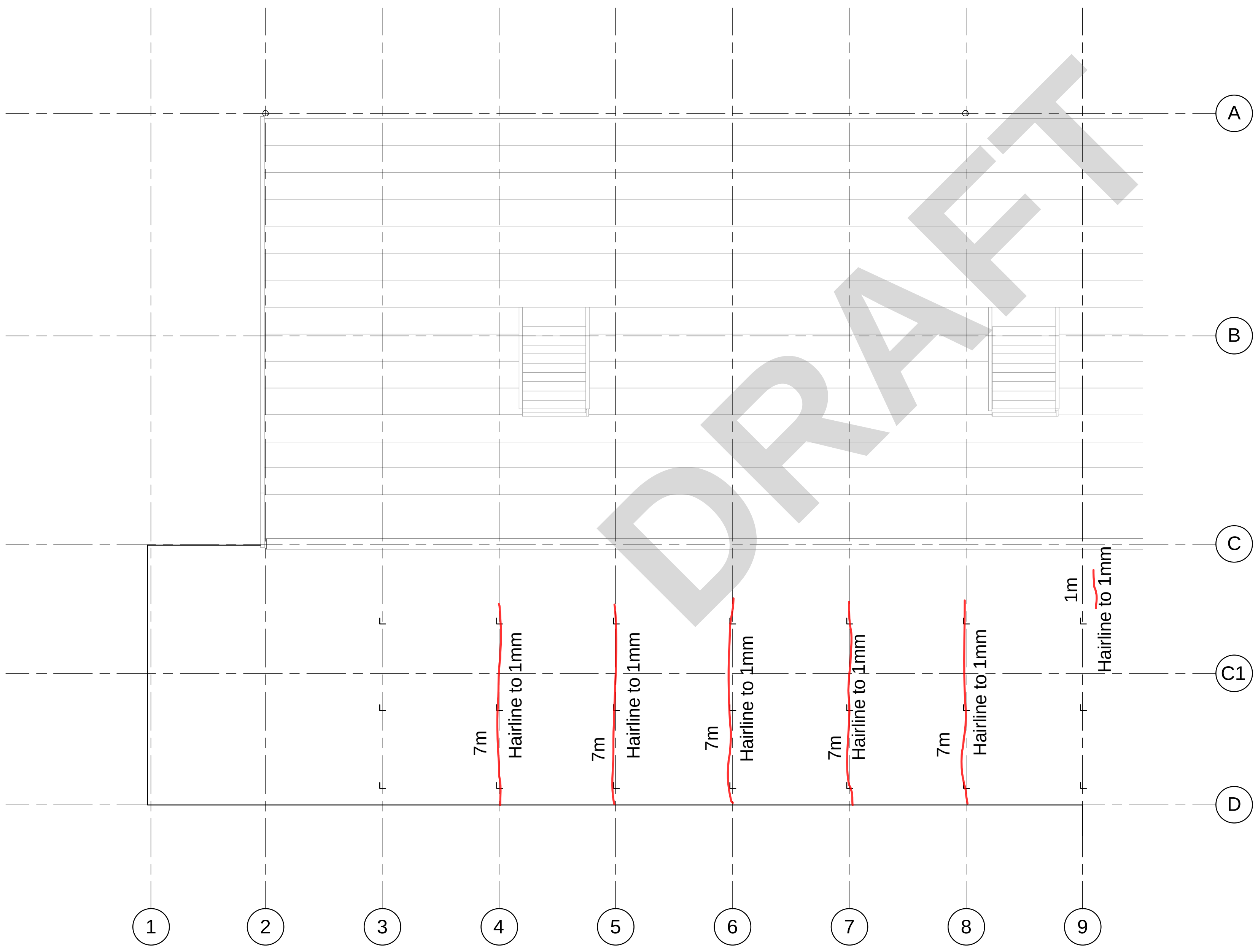
60332326-DRG-A-407

ISO A1 594mm x 841mm



CRACKS ON SLABS - FLOOR 4

Scale: 1 : 500



1 | CRACKS ON SLABS - FLOOR 4 - GRID 1 TO GRID 9

A.408 | REF: A.408 Scale: 1 : 100

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STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

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KEY

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- AREA NOT ASSESSED (COVERED)

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

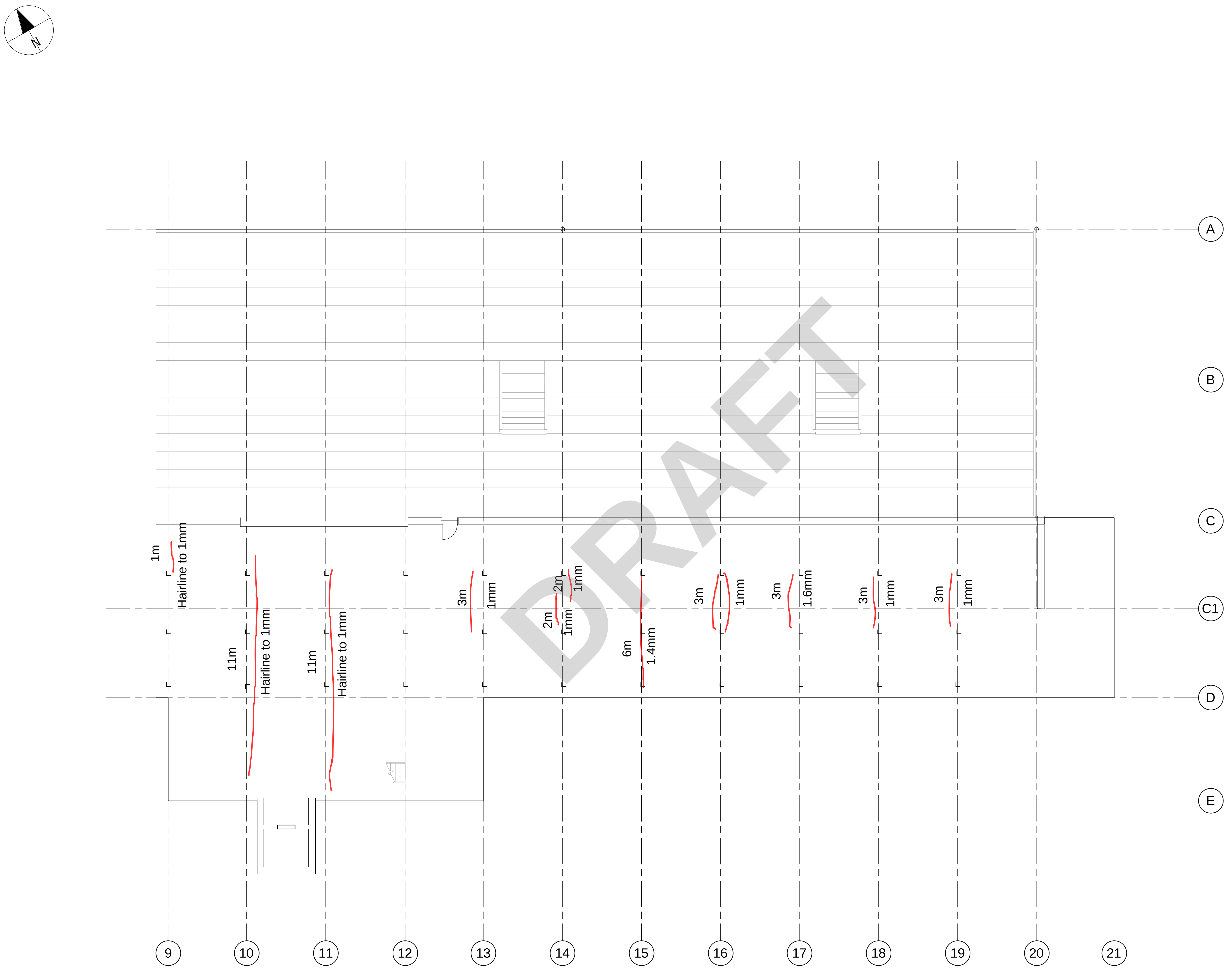
60332326

SHEET TITLE

FLOOR CRACK MAPS - SHEET 9

SHEET NUMBER

60332326-DRG-A-408



2 | CRACKS ON SLABS - FLOOR 4 - GRID 9 TO GRID 21

A.409 | REF: A.408 Scale: 1 : 100

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STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

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KEY

2.0m — APPROXIMATE LENGTH
INDICATES CRACK ON TOP OF CONCRETE SLAB
0.4 mm — APPROXIMATE WIDTH

CRACKS OBSERVED TO THE UNDERSIDE OF SLAB OR BEAM

AREA NOT ASSESSED (COVERED)

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

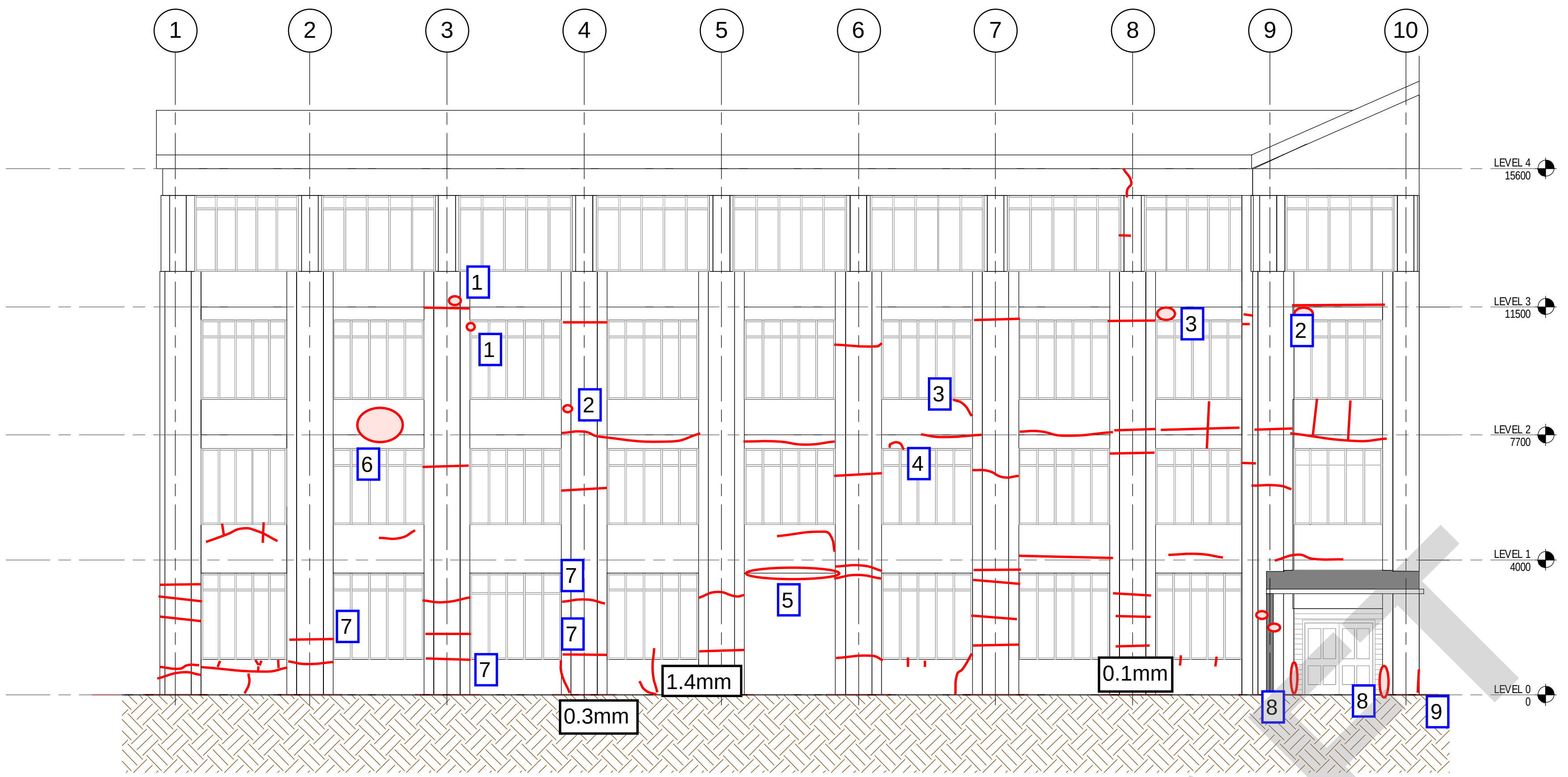
SHEET TITLE

FLOOR CRACK MAPS - SHEET 10

SHEET NUMBER

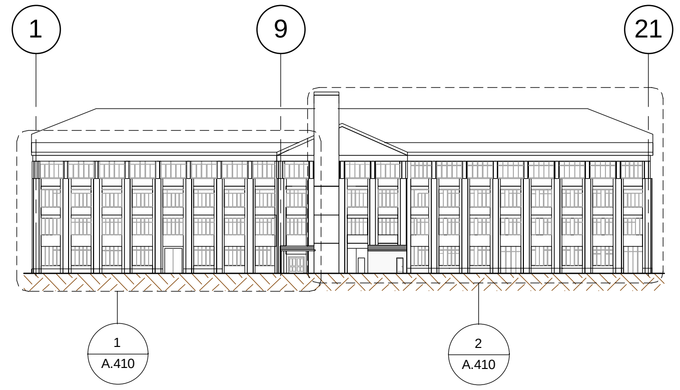
60332326-DRG-A-409

ISO A1 594mm x 841mm



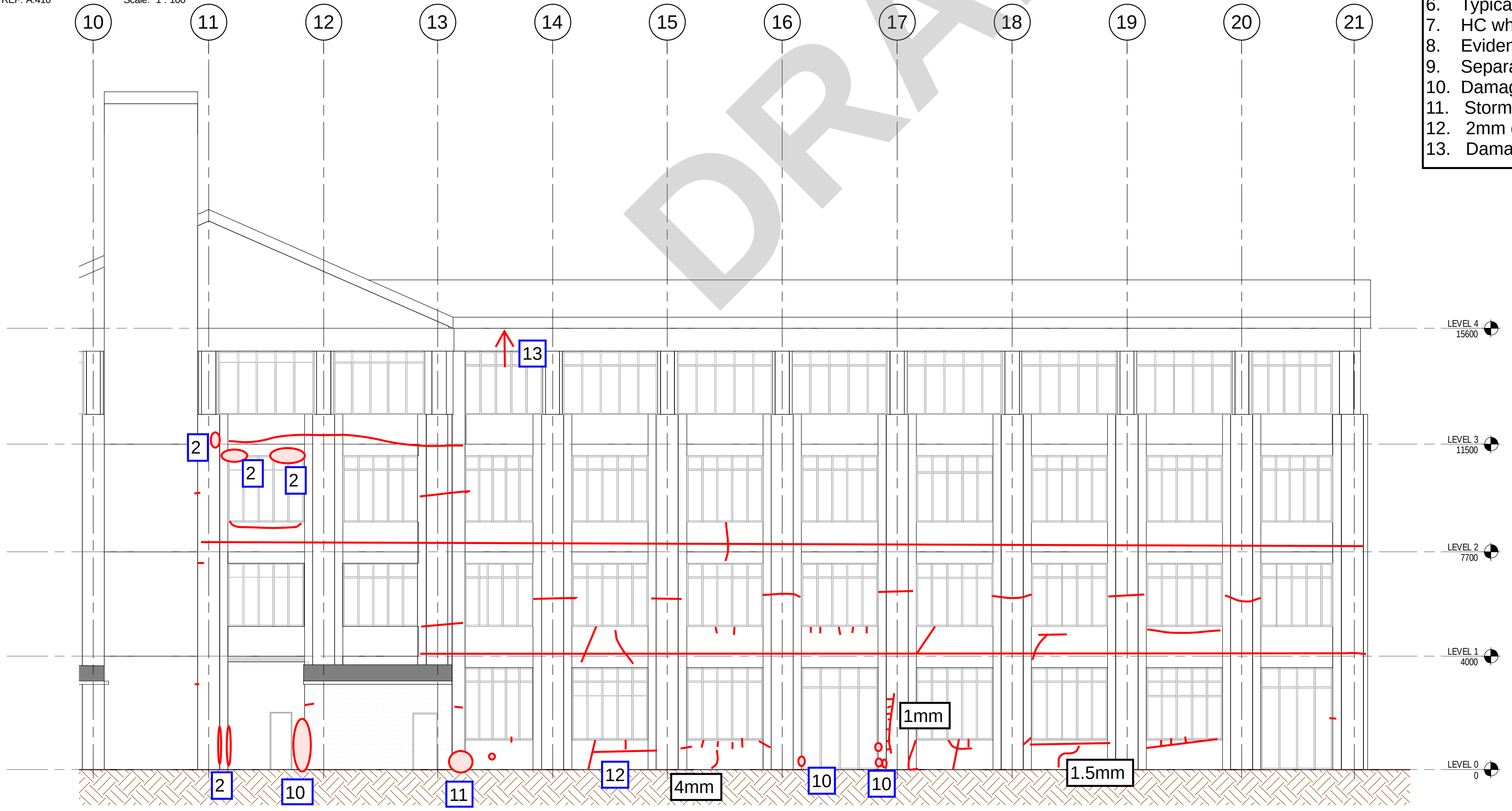
1 DAMAGE ON ELEVATIONS - ELEVATION SOUTH - GRID 1 TO GRID 9

A.410 REF: A.410 Scale: 1 : 100



DAMAGE ON ELEVATIONS - ELEVATION SOUTH

Scale: 1 : 500



2 DAMAGE ON ELEVATIONS - ELEVATION SOUTH - GRID 9 TO GRID 21

A.410 REF: A.410 Scale: 1 : 100

Legend

1. Spalling exposing rebar
2. Spalling
3. Exposed rebar
4. Patch repair
5. Render cracking off
6. Typical cracking to render
7. HC whole way around column
8. Evidence of historical repair
9. Separation between column and wall
10. Damage to the corner
11. Stormwater pipe WD
12. 2mm cracking through window sill
13. Damage to the soffit

Abbreviations Key

HC - Horizontal crack
WD - Water damage

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STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

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PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

Indicates crack observed

PROJECT NUMBER

60332326

SHEET TITLE

ELEVATIONS - DAMAGE SURVEY - SHEET 1

SHEET NUMBER

60332326-DRG-A-410

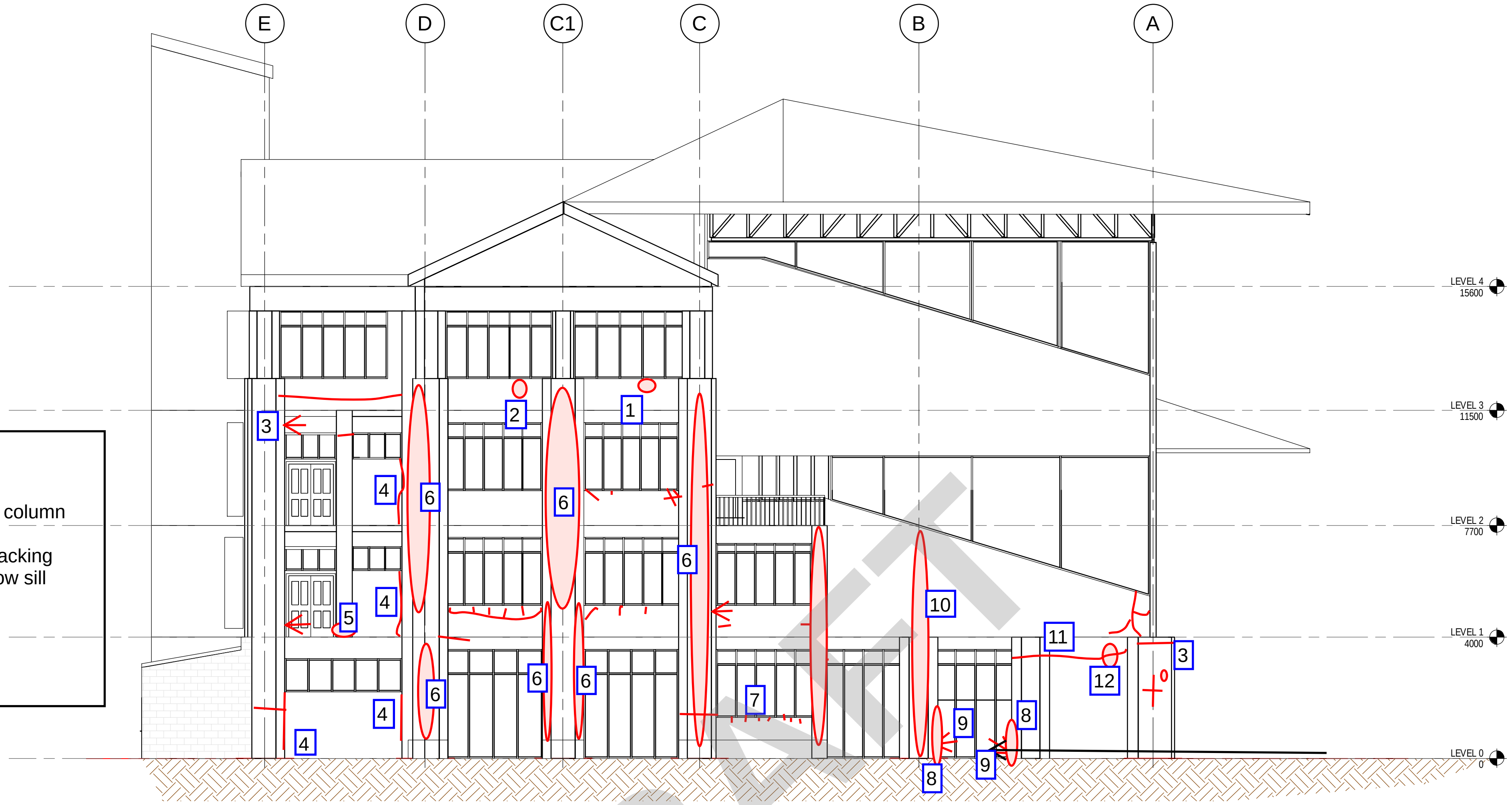
ISO A1 594mm x 841mm

1 2 3 4 5

A B C D

Legend - East Elevation

1. Crack damage
2. Orange stain
3. Spalling
4. Separation between wall and column
5. Cracking around handrail
6. Dark stain with spider web cracking
7. Multiple cracks through window sill
8. Cracked corners
9. Exposed rebar
10. Recess in concrete WD
11. Significant crack inside
12. Broken out



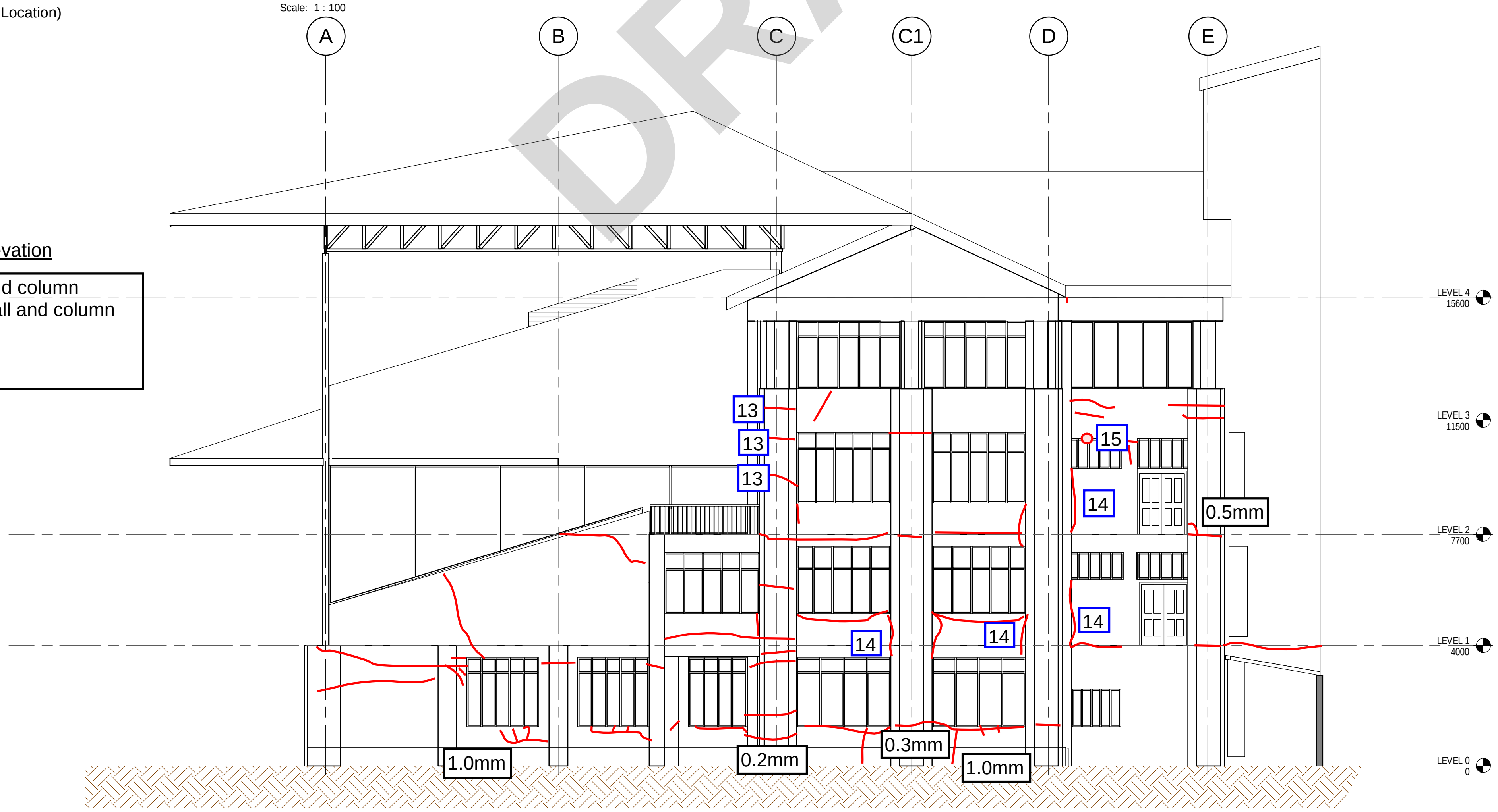
DAMAGE ON ELEVATIONS - ELEVATION EAST

(See A.111 For Location)

Scale: 1 : 100

Legend - West Elevation

13. Crack whole way around column
14. Separation between wall and column
15. Render chipping off



DAMAGE ON ELEVATIONS - ELEVATION WEST

(See A.110 For Location)

Scale: 1 : 100

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STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

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Abbreviations Key

WD - Water damage

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

Indicates crack observed

PROJECT NUMBER

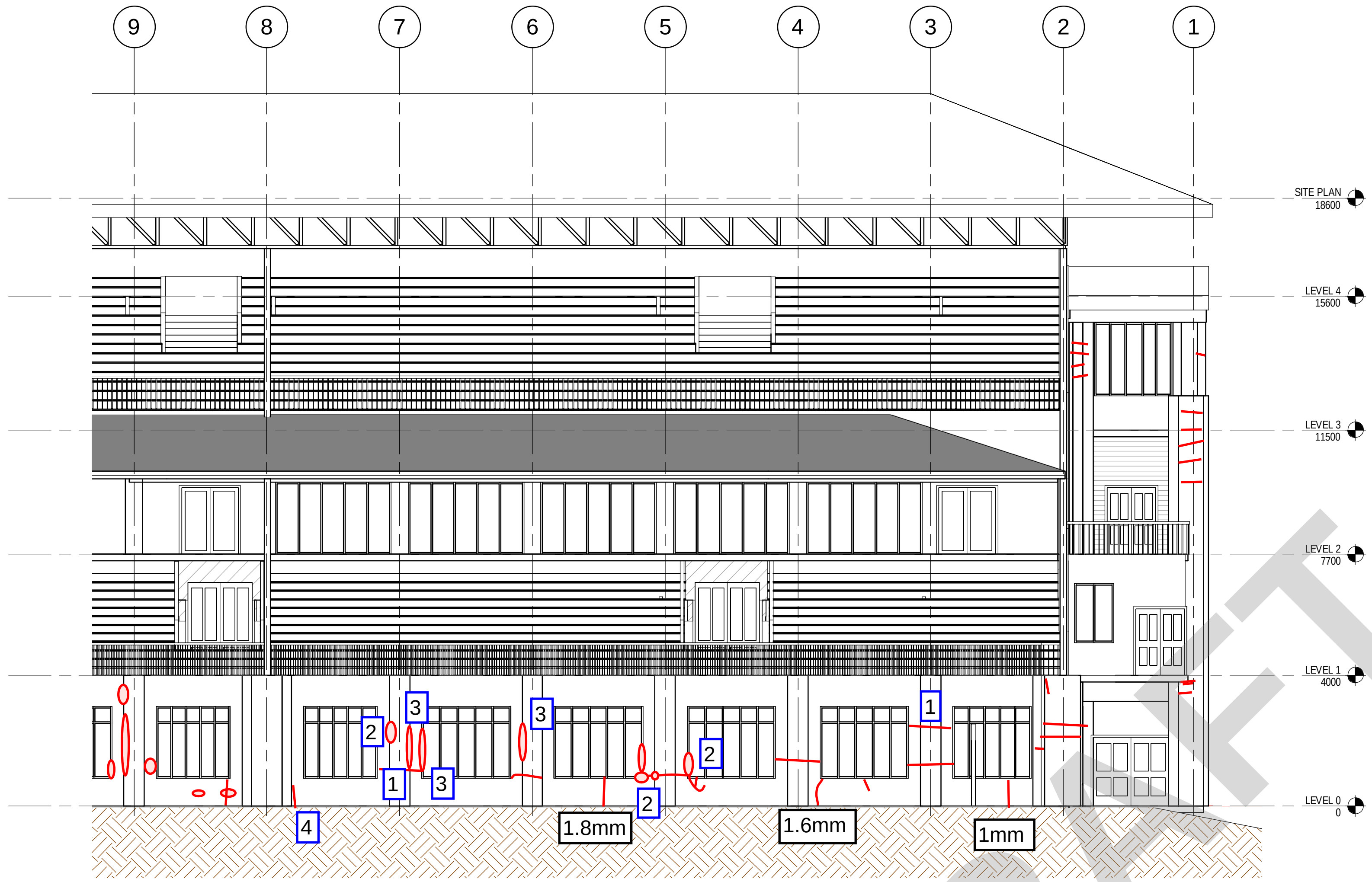
60332326

SHEET TITLE

ELEVATIONS - DAMAGE SURVEY - SHEET 2

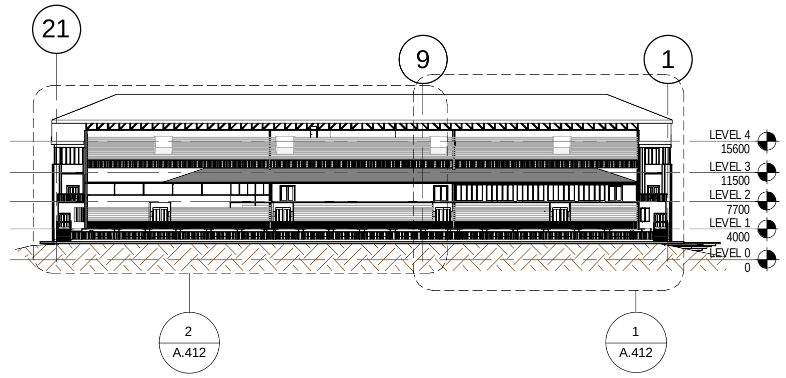
SHEET NUMBER

60332326-DRG-A-411



1 DAMAGE ON ELEVATIONS - ELEVATION NORTH - GRID 1 TO GRID 9

A.412 REF: A.412 Scale: 1 : 100

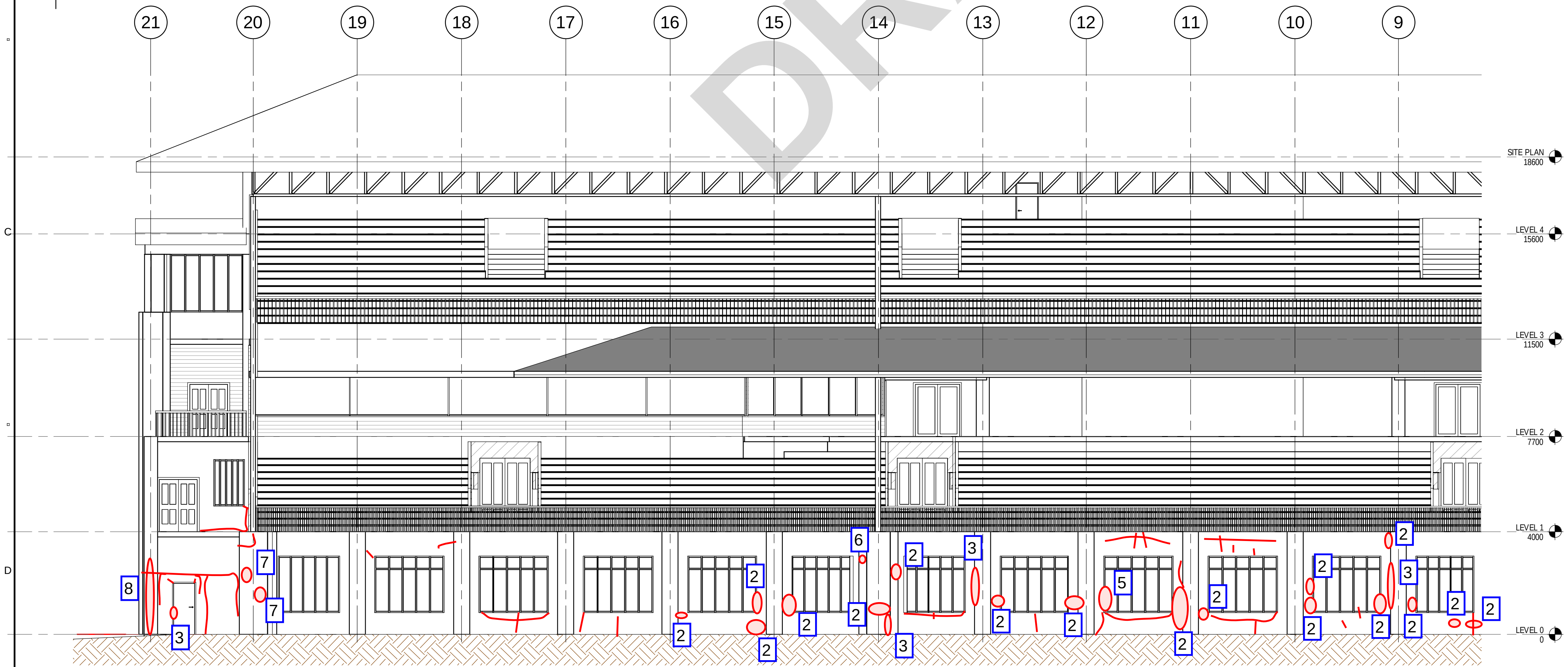


DAMAGE ON ELEVATIONS - ELEVATION NORTH

Scale: 1 : 500

Legend

1. Crack at CJ
2. Poor quality concrete
3. Corner chipped away
4. Separation between wall and column
5. Poor quality concrete rebar exposed
6. Exposed wire
7. Damaged render
8. Dark patches with cracks



2 DAMAGE ON ELEVATIONS - ELEVATION NORTH - GRID 9 TO 21

A.412 REF: A.412 Scale: 1 : 100

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Abbreviations Key

CJ - Construction joint

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

Indicates crack observed

PROJECT NUMBER

60332326

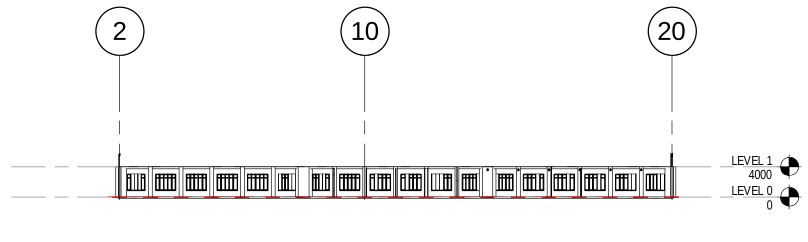
SHEET TITLE

ELEVATIONS - DAMAGE SURVEY - SHEET 3

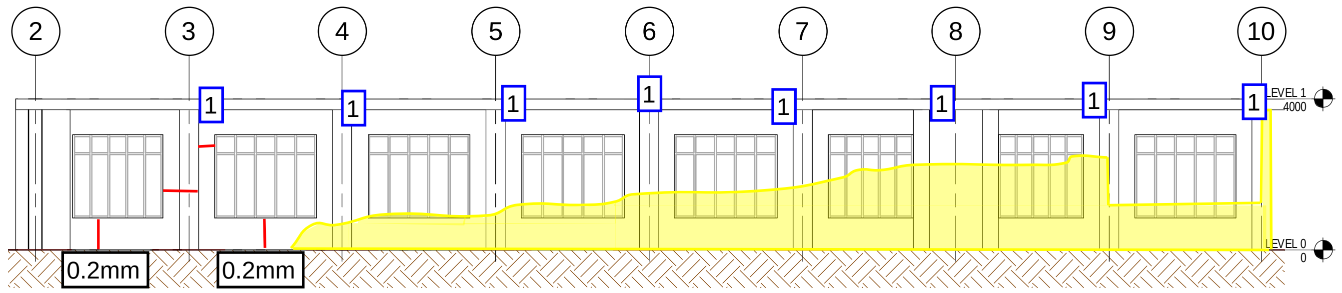
SHEET NUMBER

60332326-DRG-A-412

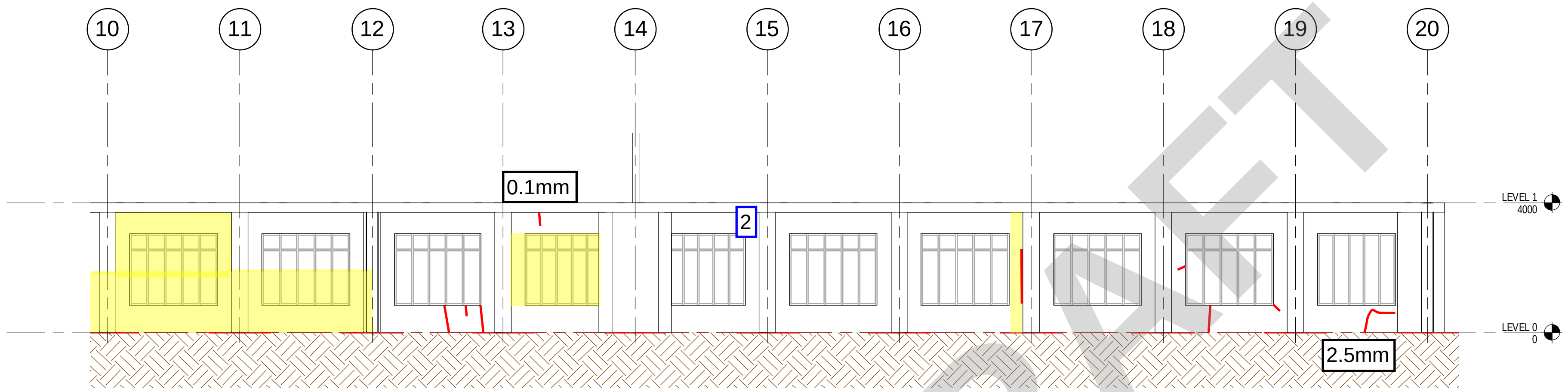
ISO A1 594mm x 841mm



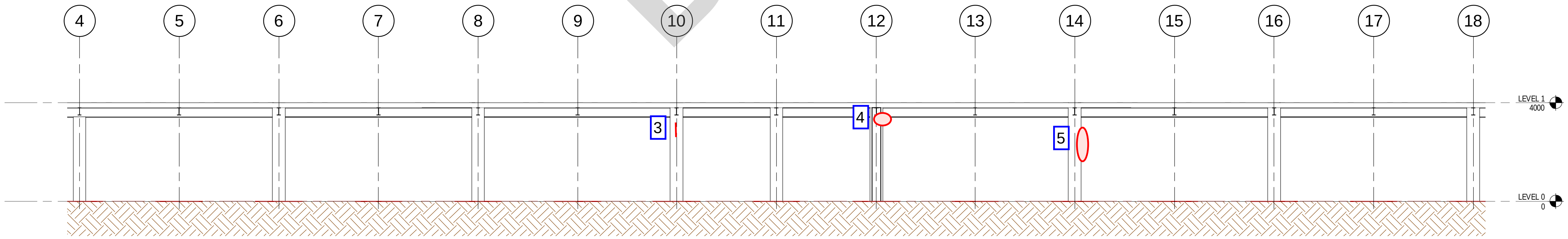
1 SECTION ON GRID A - DAMAGE SURVEY
A.420 REF: A.140 Scale: 1 : 500



2 SECTION ON GRID A - GRID 2 TO GRID 10 - DAMAGE SURVEY
A.420 Scale: 1 : 100



3 SECTION ON GRID A - GRID 10 TO GRID 20 - DAMAGE SURVEY
A.420 Scale: 1 : 100



4 SECTION ON GRID B - DAMAGE SURVEY
A.420 REF: A.140 Scale: 1 : 100

Legend

1. Top of column, poor quality concrete
2. Poor quality concrete on edge
3. Pipe cast in column, cover spalled
4. Spalled at corner
5. Poor compaction of concrete

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Key

Indicates crack observed

Elevation not visible

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

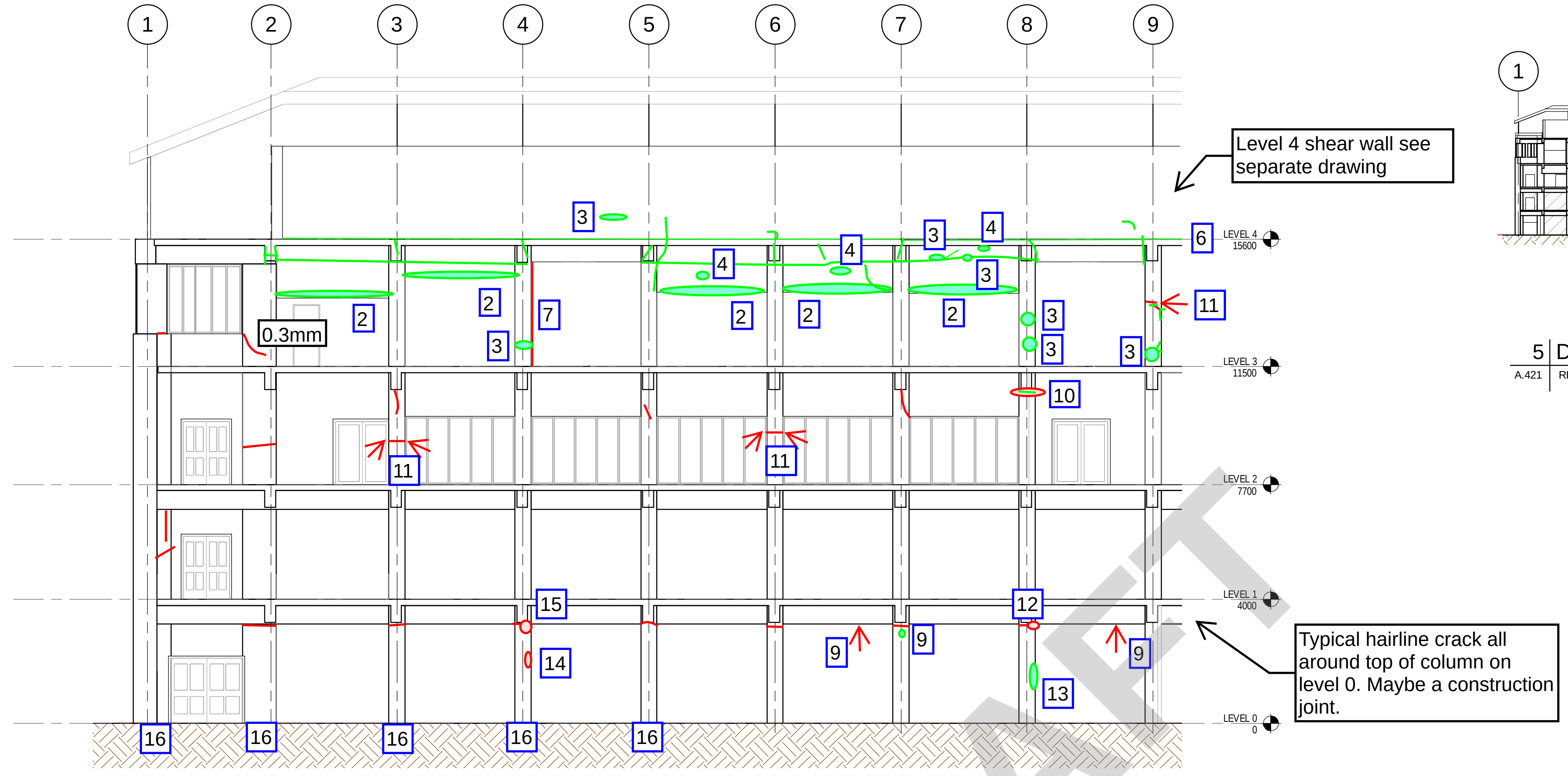
60332326

SHEET TITLE

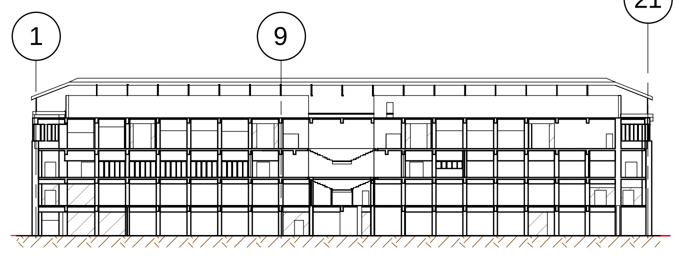
FRAMES AND WALLS DAMAGE SURVEY ON E/W SECTIONS - SHEET 1

SHEET NUMBER

60332326-DRG-A-420



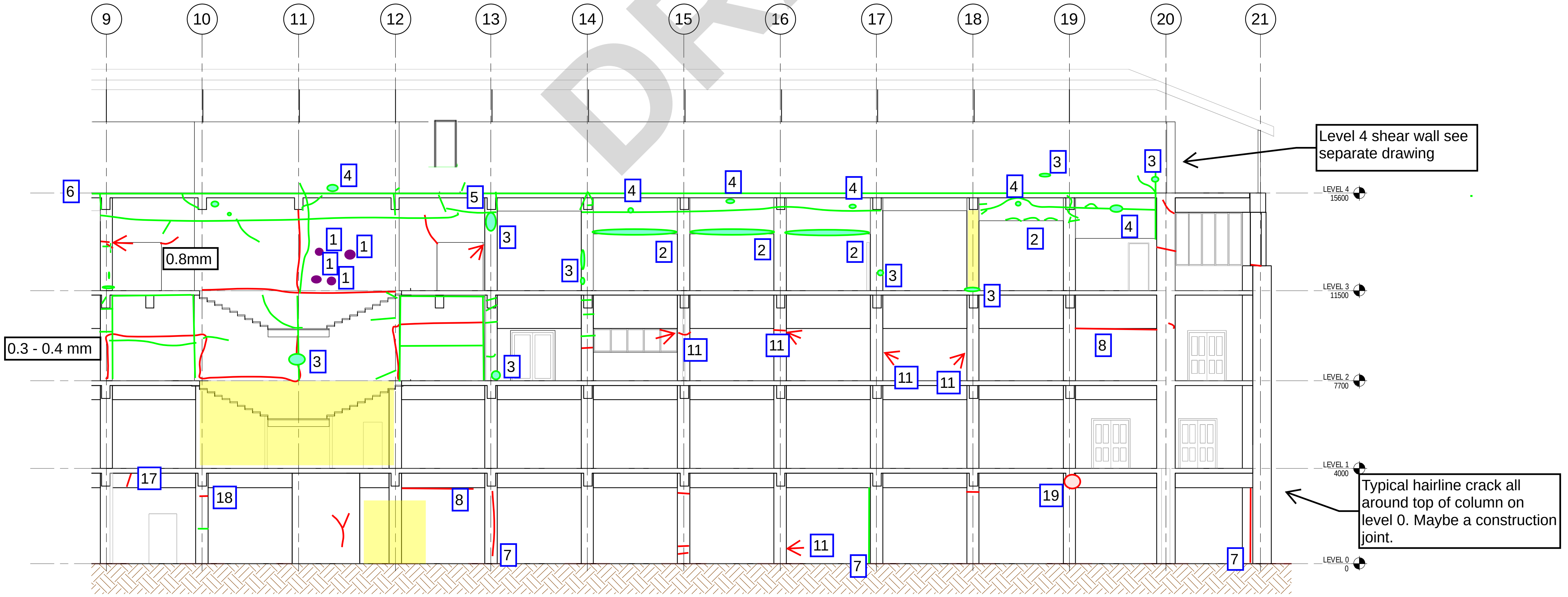
6 | DAMAGE SURVEY - SECTION ON GRID C - GRID 1 TO GRID 9
A.421 Scale: 1 : 100



5 | DAMAGE SURVEY - SECTION ON GRID C
A.421 REF: A.140 Scale: 1 : 500

Legend

1. Core samples
2. Broken out for void opening
3. Spalled concrete
4. Broken out hole with spalling
5. WD through crack
6. Full length crack through CJ
7. Separation between column and wall
8. Separation between beam and wall
9. Drilled hole
10. Plate in column
11. Hairline crack around sides
12. Chipped corner
13. Piece of timber in concrete
14. Broken out
15. Poor compaction
16. Timber boards nailed into column
17. Significant crack
18. Notch in column
19. Minor crack damage



7 | DAMAGE SURVEY - SECTION ON GRID C - GRID 9 TO 21
A.421 Scale: 1 : 100

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STRUCTURAL ASSESSMENT GRAND NATIONAL STAND
CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT
CANTERBURY JOCKEY CLUB

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Key
WD - Water Damage
CJ - Construction Joint
Crack observed visible face
Crack observed opposite face
Elevation not visible

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

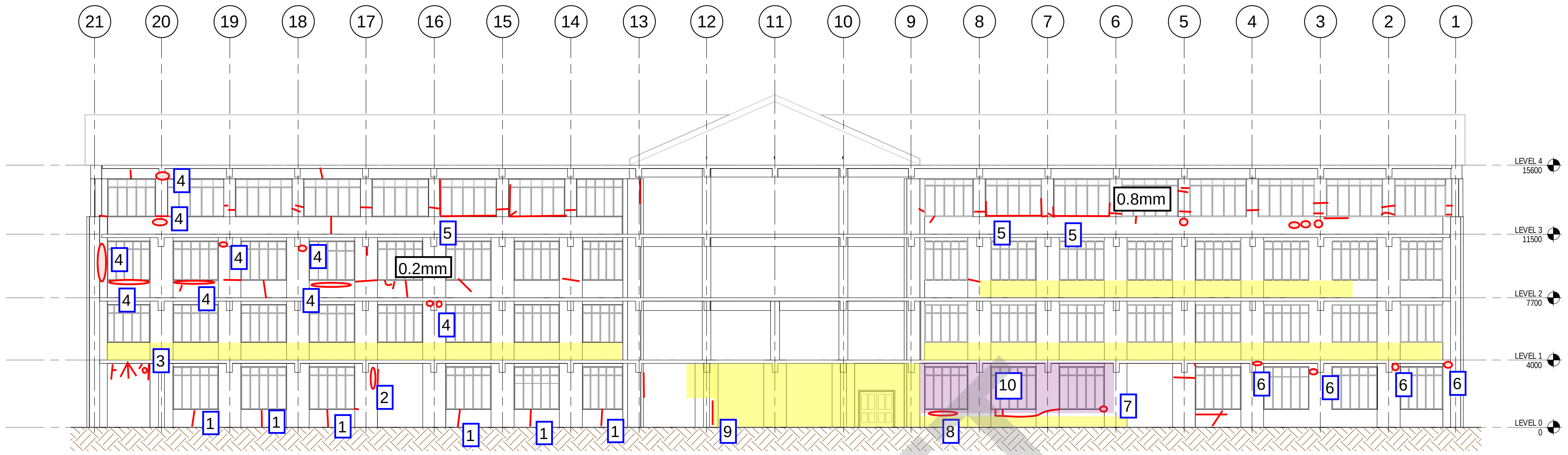
PROJECT NUMBER
60332326

SHEET TITLE
FRAMES AND WALLS DAMAGE SURVEY ON E/W SECTIONS - SHEET 2

SHEET NUMBER
60332326-DRG-A-422

ISO A1 594mm x 841mm

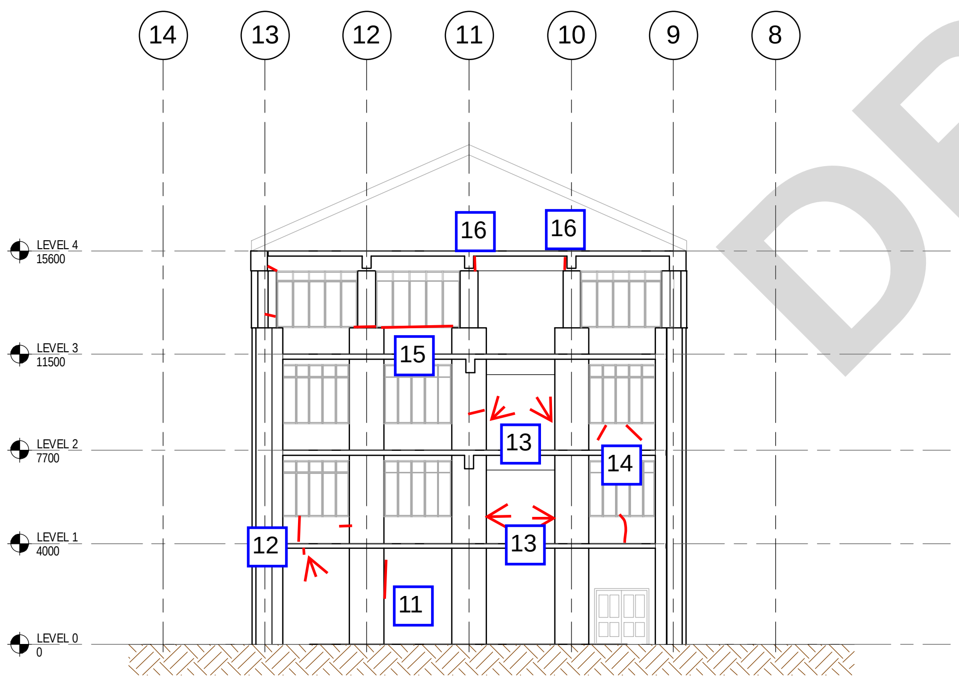
ISO A1 594mm x 841mm



8 | DAMAGE SURVEY - SECTION ON GRID D FROM INTERIOR
A.422 | REF: A.200 Scale: 1 : 150

<u>Legend - Grid D</u>

1. Panels have separated
2. Bubbling paint
3. Separation and WD
4. WD
5. Separation between window and wall
6. Poor quality concrete
7. Broken out
8. Spalling
9. Separation between wall and column
10. Paint peeling off visual inspection limited



9 | DAMAGE SURVEY - SECTION ON GRID E
A.422 | REF: A.200 Scale: 1 : 150

<u>Legend - Grid E</u>

11. Separation between wall and column
12. Crack continues under beam
13. Cracks in return
14. WD
15. Separation between window and wall
16. Separation between beam and lift

DRAFT

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STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

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CLIENT

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CONSULTANT

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<u>Key</u>

WD - Water Damage

Crack observed visible face

Elevation not visible

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

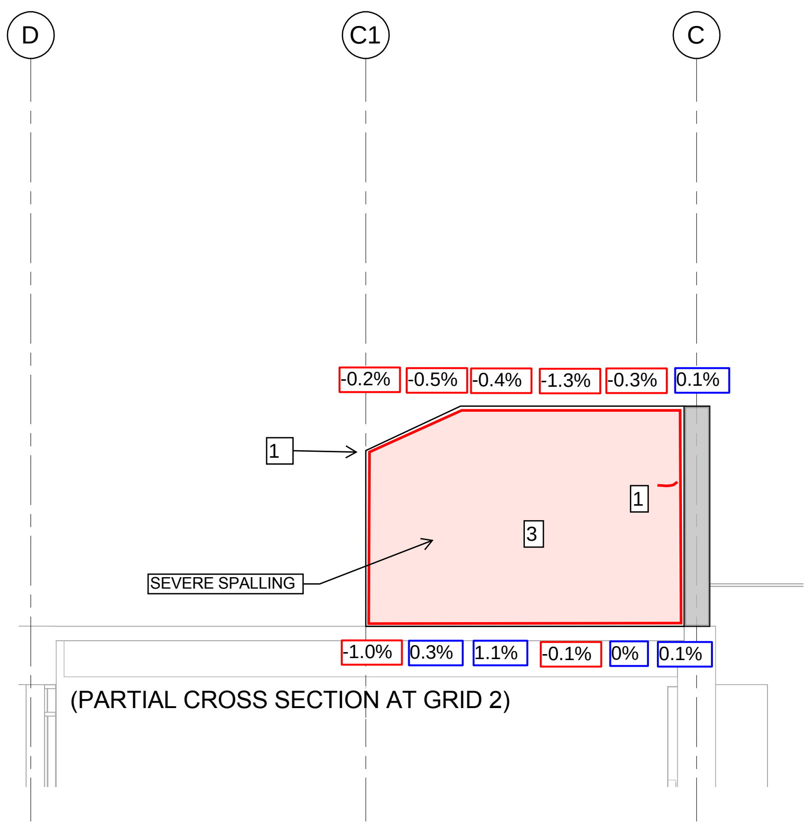
60332326

SHEET TITLE

FRAMES AND WALLS DAMAGE SURVEY ON E/W SECTIONS - SHEET 3

SHEET NUMBER

60332326-DRG-A-423

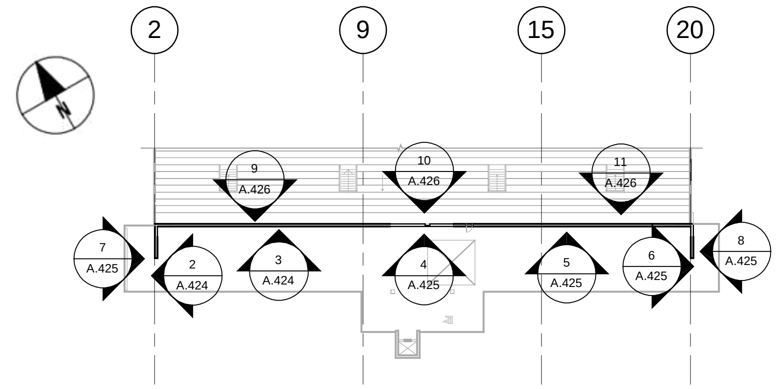


2 | SHEAR WALL - INTERIOR - GRID 2

A.424 REF: A.424 Scale: 1 : 50

Legend

1. Rebar exposed
2. Concrete chipped (small area
3. Concrete spalling (large area)
4. Concrete over hanging
5. HC running full length
6. Crack to concrete
7. Concrete core locations
8. Hole with local spalling



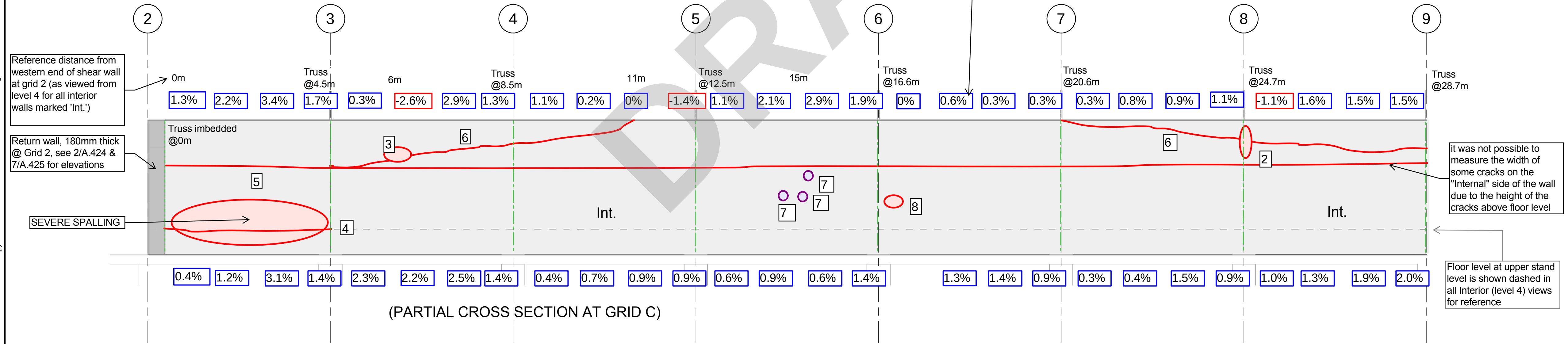
SHEAR WALL ON LEVEL 4 - LOCATION

Scale: 1 : 500

TWO VERTICALITY MEASUREMENTS ARE TAKEN AT 1m INTERVALS ALL ALONG THE WALL, ON BOTH INTERNAL (Int.) AND EXTERNAL (Ext.) FACES.

THE LOWER MEASUREMENT IS CENTRED 600mm ABOVE GROUND LEVEL AND THE UPPER MEASUREMENT IS CENTRED 1800mm ABOVE GROUND LEVEL.

SEE 'VERTICALITY MEASUREMENTS KEY' FOR MORE INFORMATION.



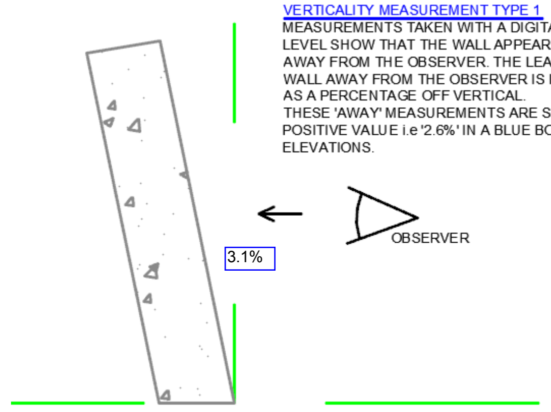
3 | SHEAR WALL - INTERIOR - GRID 2 TO GRID 9

A.424 REF: A.424 Scale: 1 : 50

VERTICALITY MEASUREMENTS KEY

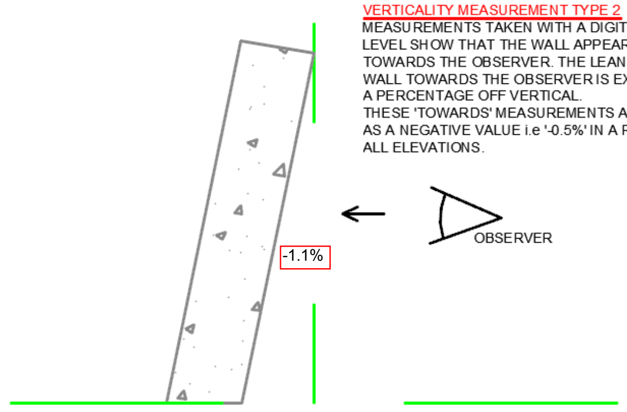
VERTICALITY MEASUREMENT TYPE 1

MEASUREMENTS TAKEN WITH A DIGITAL SPIRIT LEVEL SHOW THAT THE WALL APPEARS TO LEAN AWAY FROM THE OBSERVER. THE LEAN OF THE WALL AWAY FROM THE OBSERVER IS EXPRESSED AS A PERCENTAGE OFF VERTICAL.
THESE 'AWAY' MEASUREMENTS ARE SHOWN AS A POSITIVE VALUE i.e '2.6%' IN A BLUE BOX ON ALL ELEVATIONS.



VERTICALITY MEASUREMENT TYPE 2

MEASUREMENTS TAKEN WITH A DIGITAL SPIRIT LEVEL SHOW THAT THE WALL APPEARS TO LEAN TOWARDS THE OBSERVER. THE LEAN OF THE WALL TOWARDS THE OBSERVER IS EXPRESSED AS A PERCENTAGE OFF VERTICAL.
THESE 'TOWARDS' MEASUREMENTS ARE SHOWN AS A NEGATIVE VALUE i.e '-0.5%' IN A RED BOX ON ALL ELEVATIONS.



Level 4 / Upper stand - Shear wall - Assessment

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CLIENT

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Key

HC Horizontal crack
Crack observed visible face
Int. Wall viewed from level 4
Ext. Wall viewed from upper stand

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

PROJECT NUMBER

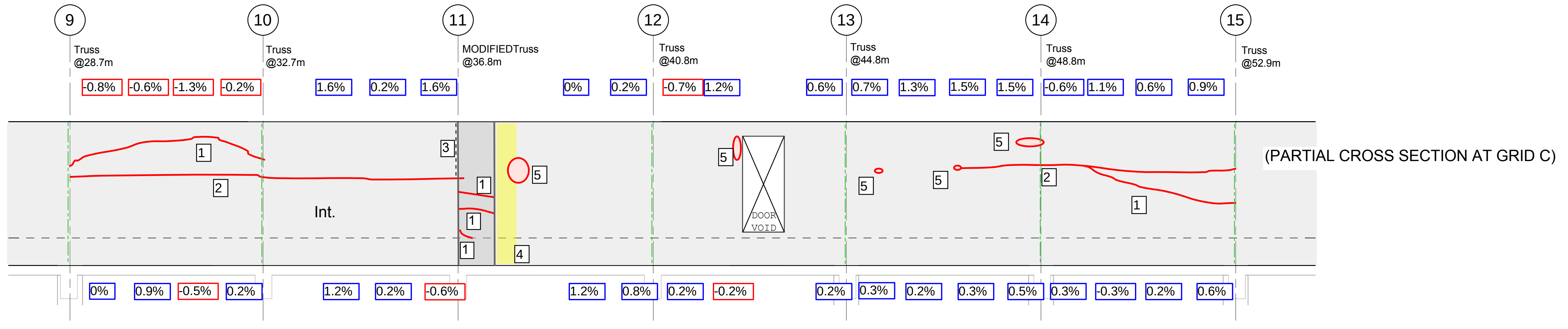
60332326

SHEET TITLE

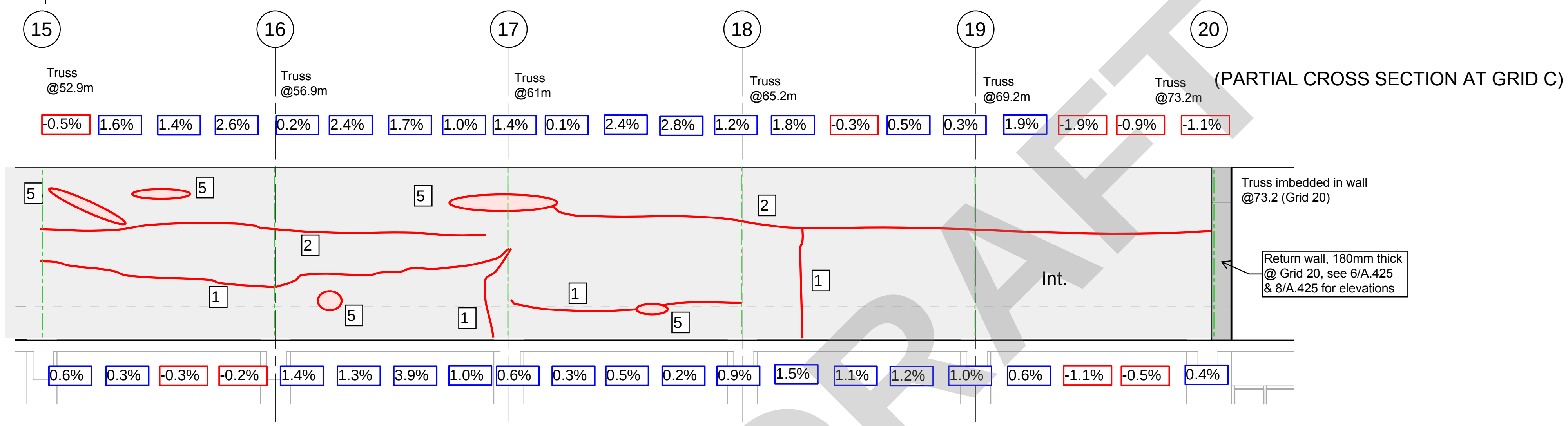
FRAMES AND WALLS DAMAGE SURVEY ON E/W SECTIONS - SHEET 4

SHEET NUMBER

60332326-DRG-A-424



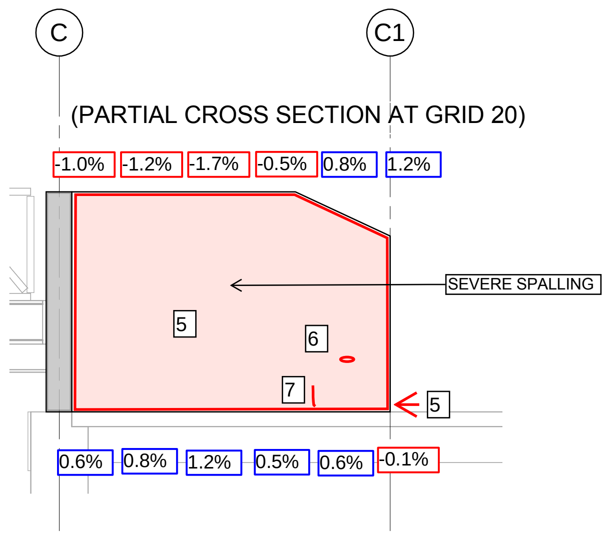
4 | SHEAR WALL - INTERIOR - GRID 9 TO GRID 15
A.425 | REF: A.424 Scale: 1 : 50



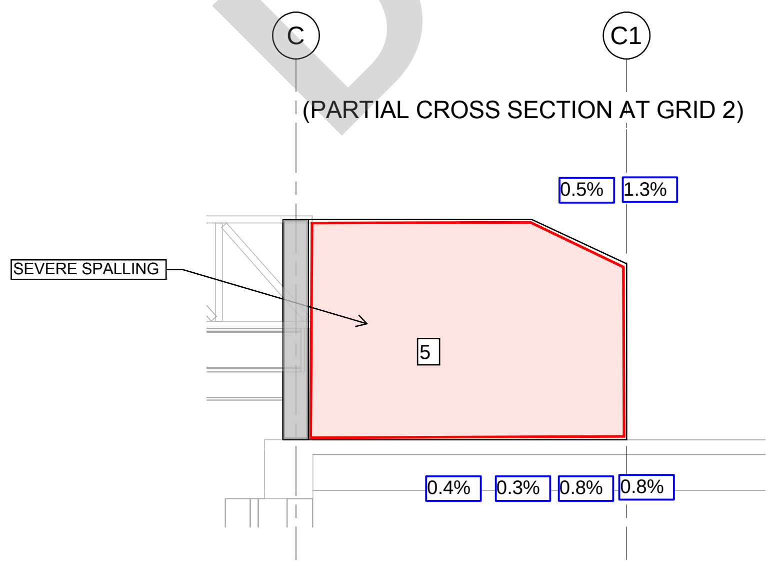
5 | SHEAR WALL - INTERIOR - GRID 15 TO GRID 20
A.425 | REF: A.424 Scale: 1 : 50

Legend

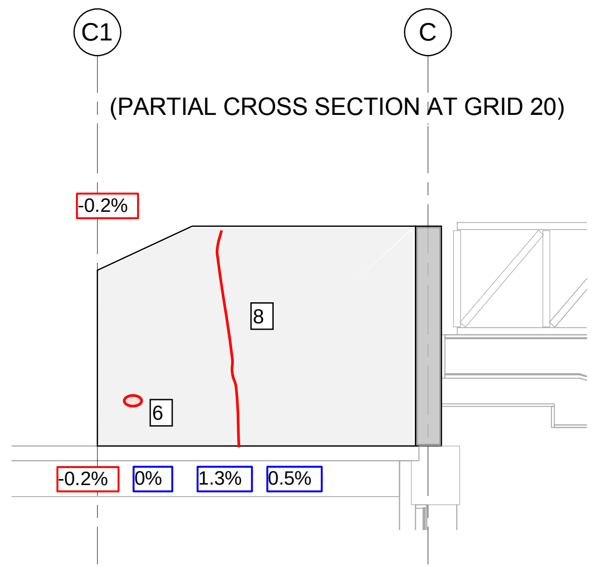
1. Crack to concrete
2. HC to concrete
3. Crack to side of column
4. Void covered by timber
5. Spalling concrete
6. Timber cast in concrete
7. Exposed rebar
8. Exposed steel bar



6 | SHEAR WALL - INTERIOR - GRID 20
A.425 | REF: A.424 Scale: 1 : 50



7 | SHEAR WALL - EXTERIOR - GRID 2
A.425 | REF: A.424 Scale: 1 : 50



8 | SHEAR WALL - EXTERIOR - GRID 20
A.425 | REF: A.424 Scale: 1 : 50

Level 4 / Upper stand - Shear wall - Assessment

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Key

HC Horizontal crack
Crack observed visible face
Int. Wall viewed from level 4
Ext. Wall viewed from upper stand
Elevation not visible - could not be inspected

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

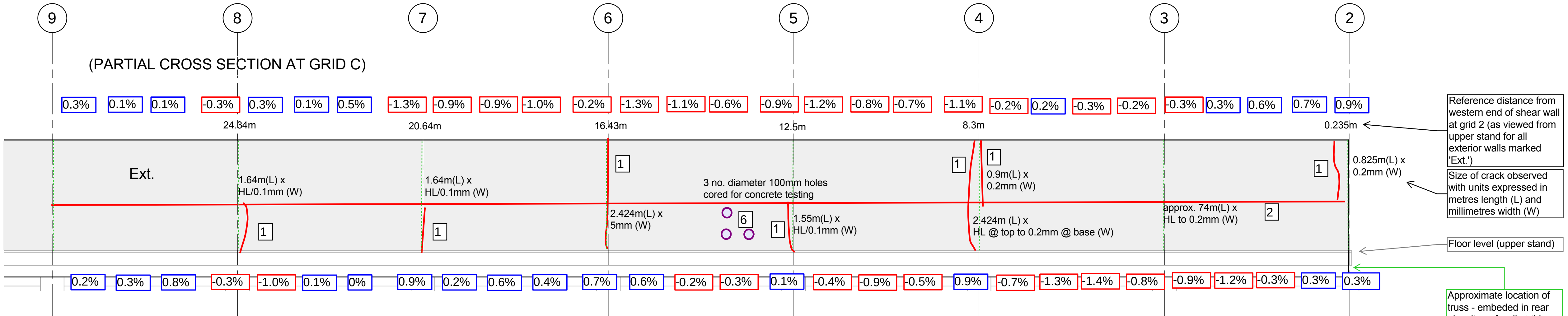
PROJECT NUMBER
60332326

SHEET TITLE
FRAMES AND WALLS DAMAGE SURVEY ON E/W SECTIONS - SHEET 5

SHEET NUMBER
60332326-DRG-A-425

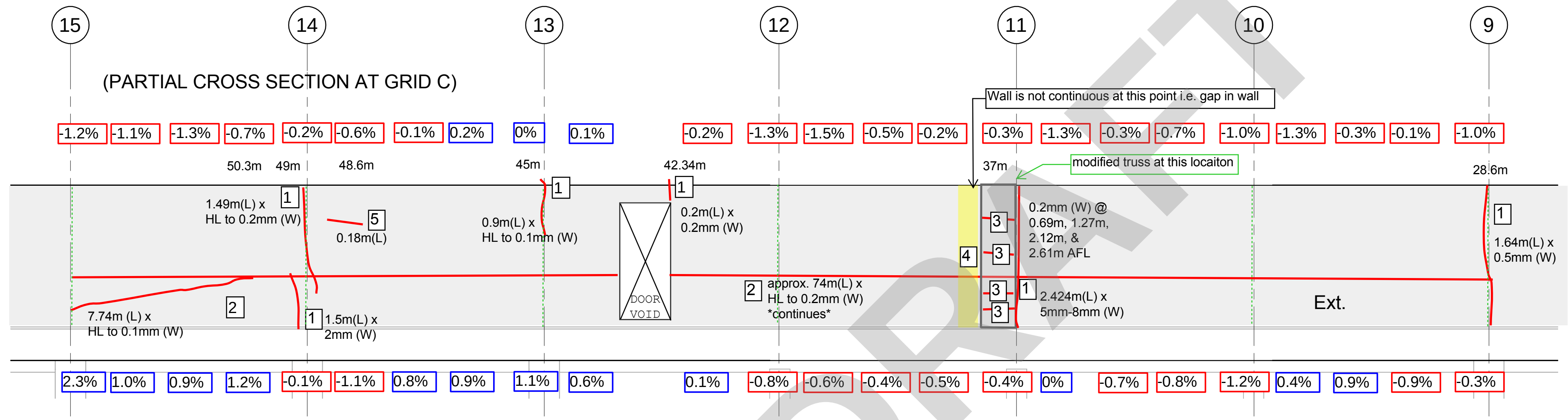
ISO A1 594mm x 841mm

ISO A1 594mm x 841mm



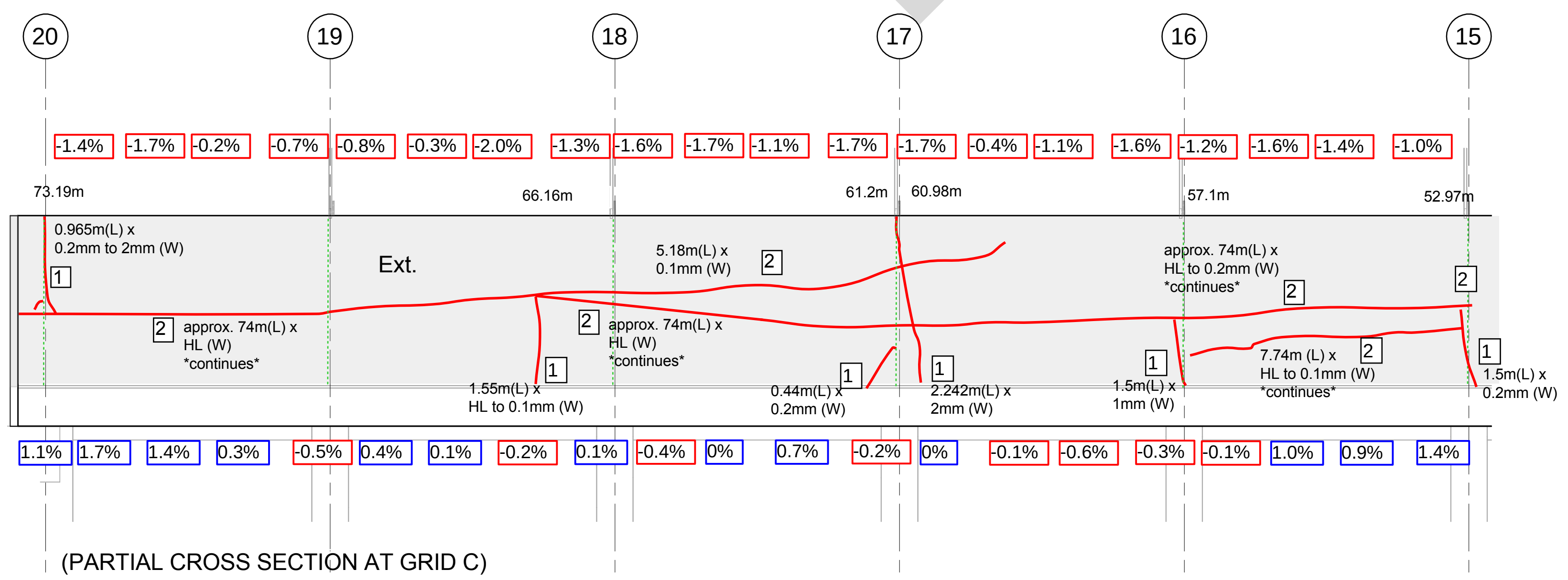
9 | SHEAR WALL - EXTERIOR - GRID 2 TO GRID 9

A.426 REF: A.424 Scale: 1 : 50



10 | SHEAR WALL - EXTERIOR - GRID 9 TO GRID 15

A.426 REF: A.424 Scale: 1 : 50



11 | SHEAR WALL - EXTERIOR - GRID 15 TO GRID 20

A.426 REF: A.424 Scale: 1 : 50

Level 4 / Upper stand - Shear wall - Assessment

DRAFT

Legend

1. VC to concrete
2. HC to concrete
3. HC to column
4. Void covered by timber
5. Exposed rebar (severe spalling)

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Key

HC	Horizontal crack
	Crack observed visible face
Int.	Wall viewed from level 4
Ext.	Wall viewed from upper stand
	Elevation not visible - could not be inspected
VC	Vertical Crack
HL	Hairline crack - less than 0.1mm wide
AFL	Above floor level

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

PROJECT NUMBER

60332326

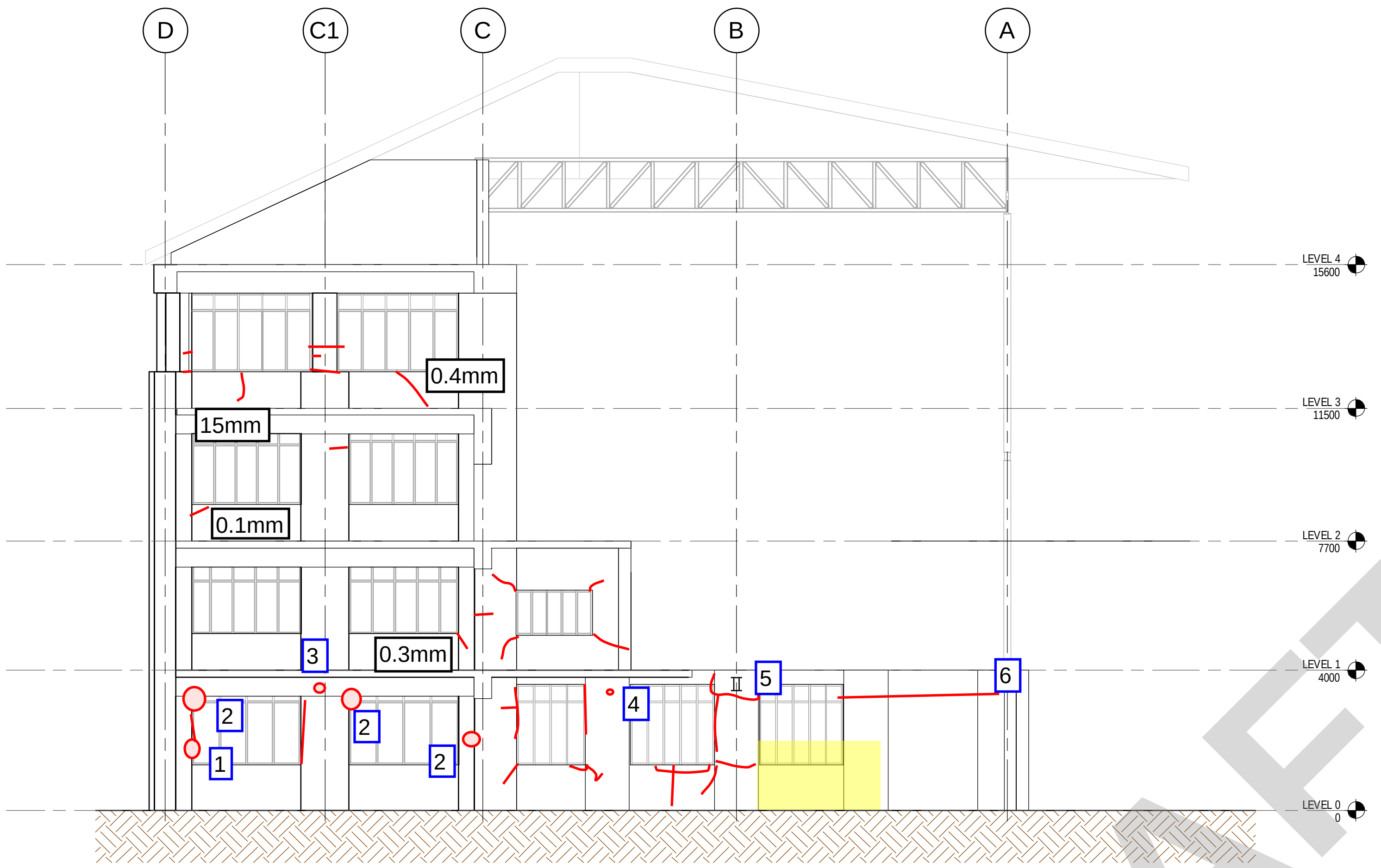
SHEET TITLE

FRAMES AND WALLS DAMAGE SURVEY ON E/W SECTIONS - SHEET 6

SHEET NUMBER

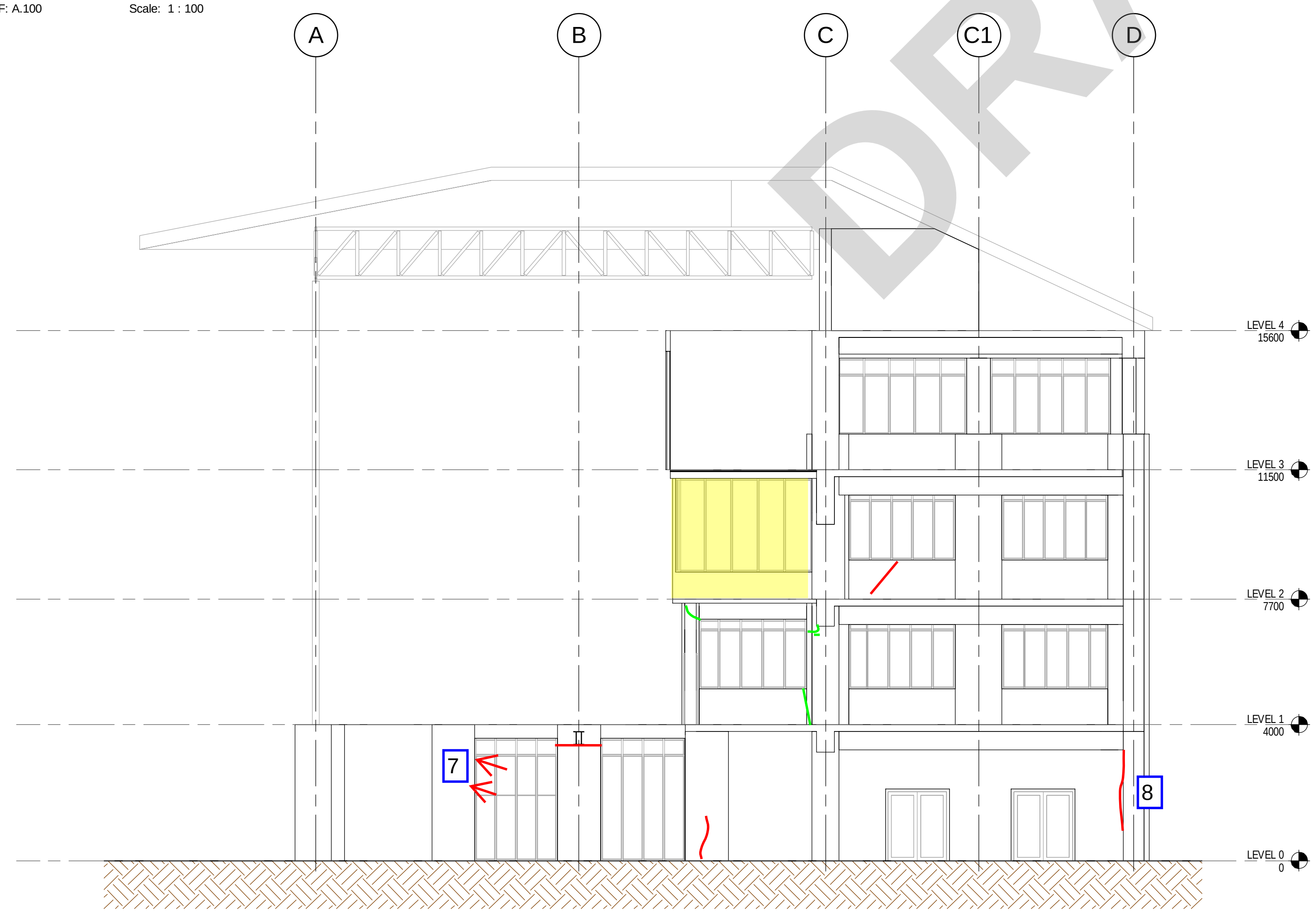
60332326-DRG-A-426

ISO A1 594mm x 841mm



1 DAMAGE SURVEY - SECTION ON GRID 1 - 2

A.430 REF: A.100 Scale: 1 : 100



2 DAMAGE SURVEY - SECTION ON GRID 20 - 21

A.430 REF: A.100 Scale: 1 : 100

DRAFT

Legend

1. Exposed aggregate, separation between column and wall
2. Poor quality concrete
3. Hole, historical pipe location
4. Pipe leaking down wall
5. Crack at CJ
6. Significant crack, visible outside
7. Cracks match up with exterior
8. Separation between column and wall

Key

CJ - Construction Joint

Crack observed visible face

Crack observed opposite face

Elevation not visible

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PROJECT MANAGEMENT INITIALS

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DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

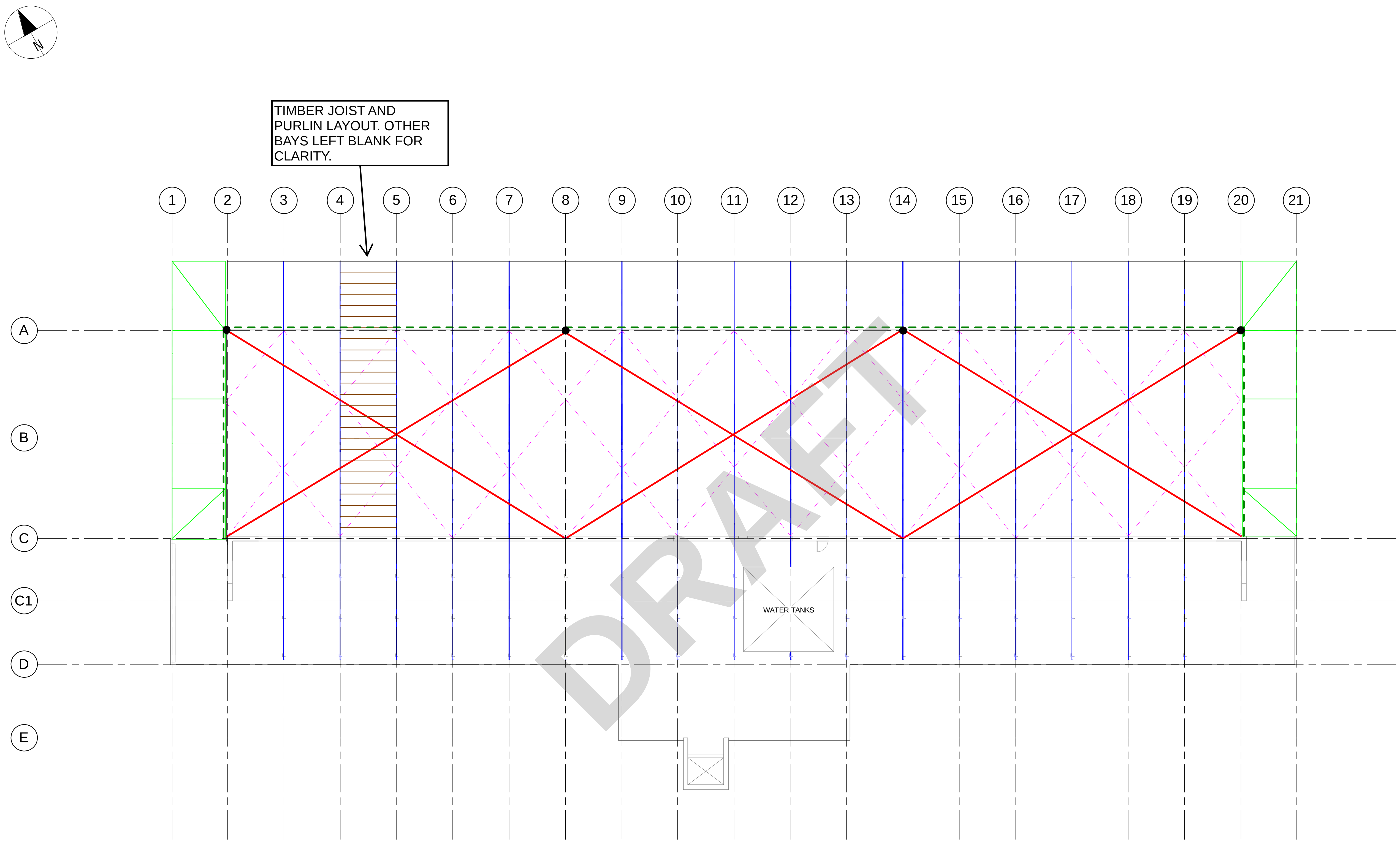
SHEET TITLE

FRAMES AND WALLS DAMAGE SURVEY ON N/S SECTIONS - SHEET 1

SHEET NUMBER

60332326-DRG-A-430

ISO A1 594mm x 841mm



UPPER STAND ROOF - APPROXIMATE LAYOUT

Scale: 1 : 150

MEMBER SCHEDULE	
LINE COLOUR	ELEMENT DESCRIPTION
Blue solid line	STEEL TRUSS
Green solid line	STEEL END TRUSS
Red solid line	STEEL CROSS BRACING
Pink dashed line	TIMBER CROSS BRACING
Brown solid line	TIMBER JOIST AND PURLIN
Green dashed line	PERIMETER STEEL TRUSS

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Key

PROJECT MANAGEMENT INITIALS

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DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

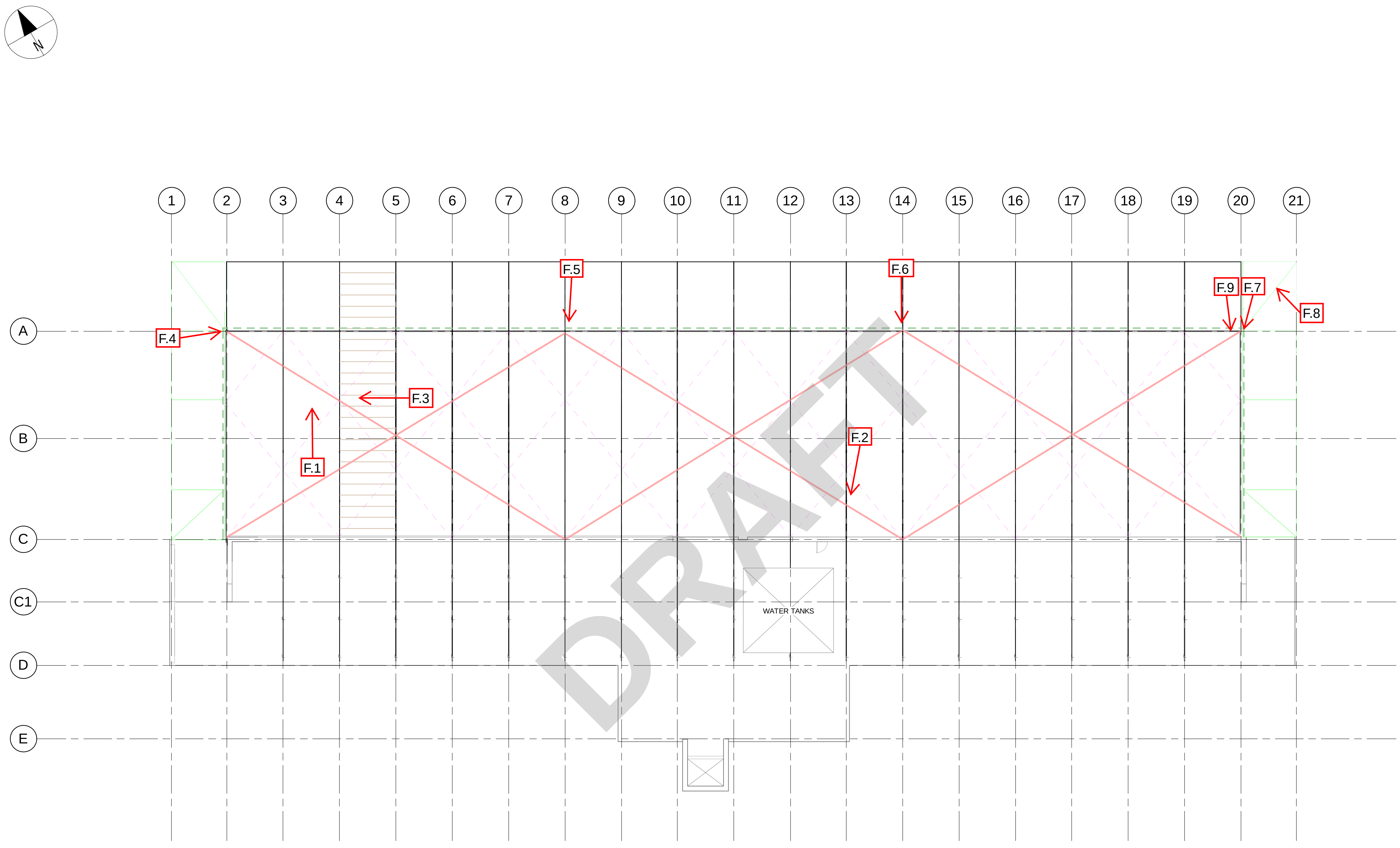
SHEET TITLE

ROOF-SPECIFIC DAMAGE DRAWINGS

SHEET NUMBER

60332326-DRG-A-440

Last Saved: 6/07/2015 11:49:35 a.m.
Filename: C:\Users\PettiC\Desktop\60332326_MOD_ST_2014_PettiC(Recovery).rvt



UPPER STAND ROOF - DAMAGE PHOTO KEYPLAN

Scale: 1 : 150

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STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

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CLIENT

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Key

PROJECT MANAGEMENT INITIALS

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DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

ROOF-SPECIFIC DAMAGE DRAWINGS

SHEET NUMBER

60332326-DRG-A-441

ISO A1 594mm x 841mm
Last Saved: 6/07/2015 11:49:37 a.m.
Filename: C:\Users\PettiC\Desktop\60332326_MOD_ST_2014_PettiC(Recovery).rvt

ISO A1 594mm x 841mm

F.1 A.441 TIMBER PURLIN END CONNECTION FAILED

F.2 A.441 TIMBER BLOCKING SUPPORTING BRACE FALLEN ONTO NET

F.3 A.441 TIMBER BLOCKING SUPPORTING BRACE FALLEN ONTO NET

F.4 A.441 COLUMN COLLAR CONNECTION GRID 2, PAINT SPLIT WITH RUST

F.5 A.441 COLUMN COLLAR CONNECTION GRID 8, PAINT SPLIT WITH RUST

F.6 A.441 COLUMN COLLAR CONNECTION GRID 14, PAINT SPLIT WITH RUST

F.7 A.441 COLUMN COLLAR CONNECTION GRID 20 RUST

F.8 A.441 SIGNIFICANT RUSTING TO GRID 20 TO 21 CORNER TRUSS

F.9 A.441 BRACE CONNECTION TO TRUSS, LOOSE BOLT

Last Saved: 6/07/2015 11:49:38 a.m.
Filename: C:\Users\PettiC\Desktop\60332326_MOD_ST_2014_PettiC(Recovery).rvt

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STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT

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Key

PROJECT MANAGEMENT INITIALS

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DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

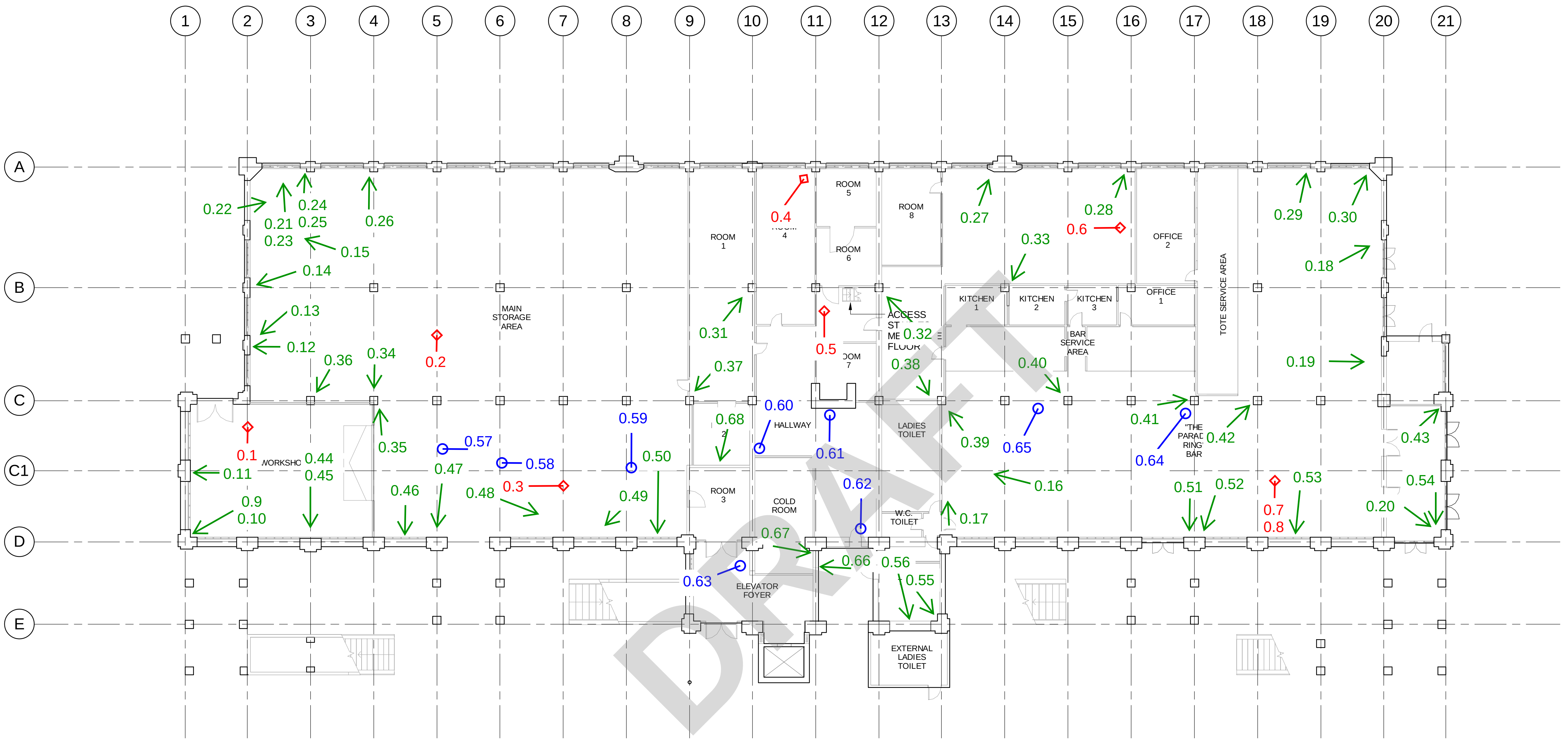
SHEET TITLE

ROOF-SPECIFIC DAMAGE DRAWINGS

SHEET NUMBER

60332326-DRG-A-442

ISO A1 594mm x 841mm



DAMAGE PHOTO KEYPLAN - GROUND LEVEL

Scale: 1 : 150

FOR DAMAGE ASSESSMENT OF SLAB AND CEILING SEE DRG-A-400 TO DRG-A-401

FOR DAMAGE ASSESSMENT OF FRAMES SEE DRG-A-420 TO DRG-A-422

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STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

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KEY

- Slab/floor photo
- Column / wall / frame photo
- Ceiling photo

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DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

GROUND LEVEL - DAMAGE ASSESSMENT - PHOTOS - SHEET 1

SHEET NUMBER

60332326-DRG-A-500

ISO A1 594mm x 841mm

0.1 / A-500 — 1.5mm WIDE CRACK

0.2 / A-500 — DAMAGE TO FLOOR, 10mm WIDE ON SURFACE ONLY

0.3 / A-500 — CRACK IN SLAB, UP TO 2mm WIDE

0.4 / A-500 — MINOR CRACK IN SLAB

0.5 / A-500 — MINOR CRACK TO SURFACE COATING ONLY

0.6 / A-500 — MINOR CRACK TO SURFACE COATING ONLY

0.7 / A-500 — SIGNIFICANT CRACKS IN SLAB WHERE CARPET HAS BEEN PULLED UP

0.8 / A-500 — CRACK UP TO 15mm

0.9 / A-500 — POORLY COMPACTED CONCRETE AROUND WINDOW FRAME AT TOP OF GRID D COLUMN

0.10 / A-500 — POORLY COMPACTED CONCRETE AROUND WINDOW FRAME AT MID-HEIGHT OF GRID D COLUMN

0.11 / A-500 — HISTORICAL HOLE IN TOP OF COLUMN BETWEEN GRID C AND D

0.12 / A-500 — PIPE AT TOP OF COLUMN BETWEEN GRID B AND C, WITH WATER DAMAGE BELOW

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STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

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Key

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ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

GROUND LEVEL - DAMAGE ASSESSMENT - PHOTOS - SHEET 2

SHEET NUMBER

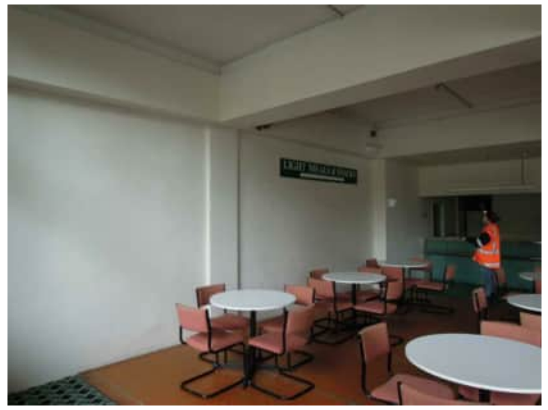
60332326-DRG-A-501

ISO A1 594mm x 841mm

0.13 | A-500 HORIZONTAL CRACK IN WALL BETWEEN GRID B AND C

0.14 | A-500 HORIZONTAL CRACK AT TOP OF WALL AT GRID B IN CONSTRUCTION JOINT, BELOW CAST-IN STEEL BEAM.

0.15 | A-500 HORIZONTAL CRACK TO TOP OF WALL AT GRID A



0.16 | A-500 VIEW OF GRID 13 BETWEEN GRID C AND D

0.17 | A-500 CRACK TO THE PLASTER

0.18 | A-500 CRACKS IN DOOR FRAME BETWEEN GRID A AND B

0.19 | A-500 VERTICAL CRACK IN WALL BETWEEN GRID B AND C

0.20 | A-500 CRACK ABOVE DOOR FRAME AT GRID D

0.21 | A-500 VIEW OF TYPICAL GRID A BAY

0.22 | A-500 VIEW OF GRID 3 TO 9, LIMITED ACCESS DUE TO STORED GOODS BLOCKING WALL

0.23 | A-500 0.2mm VERTICAL CRACK BELOW WINDOW BETWEEN GRID 2 AND 3

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STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

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NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

GROUND LEVEL - DAMAGE ASSESSMENT - PHOTOS - SHEET 3

SHEET NUMBER

60332326-DRG-A-502

ISO A1 594mm x 841mm

0.24 A-500 HAIRLINE HORIZONTAL CRACK AT LOCATION OF CONSTRUCTION JOINT ON GRID 3

0.25 A-500 HAIRLINE HORIZONTAL CRACK NEAR TOP OF WINDOW AT GRID 3

0.26 A-500 TYPICAL POORLY COMPACTED CONCRETE WITH EXPOSED AGGREGATE NEAR TOP OF COLUMNS

0.27 A-500 VERTICAL CRACKS BELOW WINDOW BETWEEN GRID 13 AND 14

0.28 A-500 POORLY COMPACTED CONCRETE ON EDGE OF GRID 16 COLUMN

0.29 A-500 HAIRLINE DIAGONAL CRACK FROM CORNER OF WINDOW BETWEEN GRID 18 AND 19

0.30 A-500 CRACK UP TO 2.5mm BELOW WINDOW ON GRID 20

0.31 A-500 DAMAGE AROUND PIPE CAST INTO COLUMN ON GRID 10

0.32 A-500 DAMAGE TO TOP OF GRID 12 COLUMN

0.33 A-500 POORLY COMPACTED CONCRETE ON GRID 14 COLUMN

0.34 A-500 TYPICAL BEAM AND COLUMN ON GRID C

0.35 A-500 DAMAGE AROUND NAIL WHERE TIMBER PANELS ARE CONNECTED TO THE COLUMNS, OCCURS FROM GRID 2 TO GRID 5

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Key

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

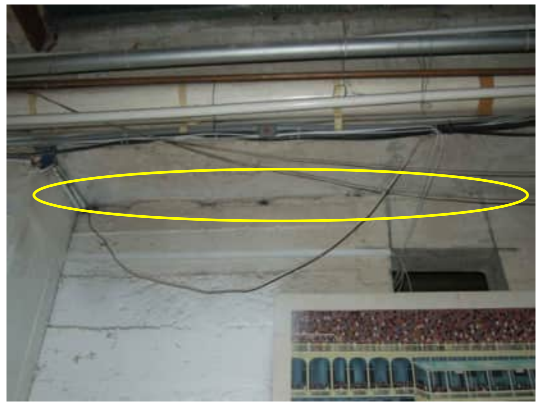
GROUND LEVEL - DAMAGE ASSESSMENT - PHOTOS - SHEET 4

SHEET NUMBER

60332326-DRG-A-503

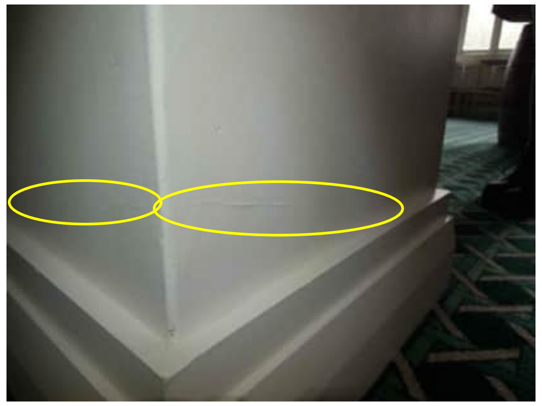
0.36 / A-500 — TYPICAL CRACK NEAR TOP OF COLUMN, ON ALL FACES OF COLUMN

0.37 / A-500 — SIGNIFICANT CRACK TO BEAM NEAR BEAM COLUMN JOINT ON GRID 9



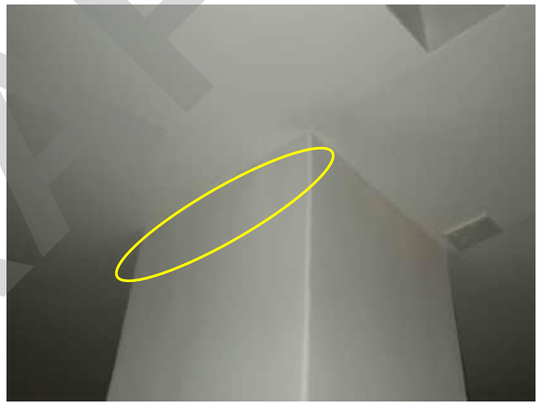
0.38 / A-500 — SEPARATION BETWEEN CONCRETE WALL AND BEAM/COLUMNS BETWEEN GRID 12 AND 13

0.39 / A-500 — SEPARATION BETWEEN GRID 13 COLUMN AND GIB LINED WALL



0.40 / A-500 — HAIRLINE CRACKING TO GIB LINING AROUND BASE OF COLUMN ON GRID 15

0.41 / A-500 — SEPARATION TO GIB LIING BETWEEN GRID 17 COLUMN AND WALL



0.42 / A-500 — HAIRLINE CRACKING TO GIB LINING NEAR TOP OF COLUMN ON GRID 18

0.43 / A-500 — SEPARATION BETWEEN GRID 21 COLUMN AND WALL

0.44 / A-500 — TYPICAL BEAM COLUMN JOINT ON GRID D

0.45 / A-500 — POORLY COMPACTED CONCRETE AT TOP OF COLUMN, TYPICAL BETWEEN GRID 1 AND GRID 4

0.46 / A-500 — HORIZONTAL AND VERTICAL CRACK BELOW WINDOW BETWEEN GRID 4 AND 5

0.47 / A-500 — CRACK IN CONSTRUCTION JOINT ON GRID 5 COLUMN

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PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

GROUND LEVEL - DAMAGE ASSESSMENT - PHOTOS - SHEET 5

SHEET NUMBER

60332326-DRG-A-504

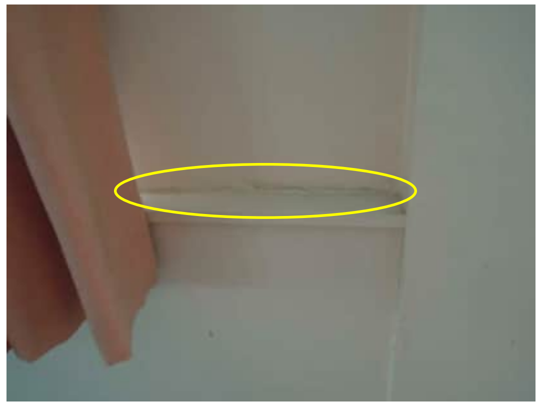
ISO A1 594mm x 841mm

0.48 | A-500 — VIEW OF GRID 6-9, RESTRICTED ACCESS TO LOWER HALF OF WALL DUE TO STORAGE

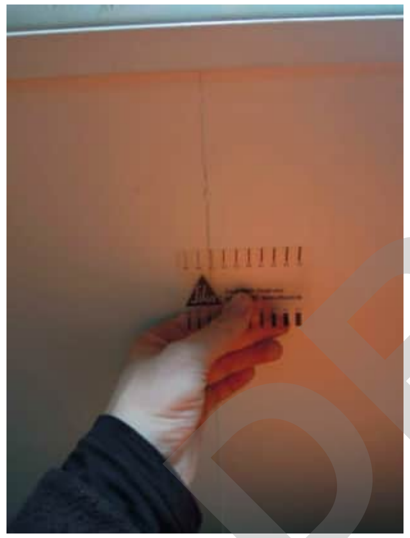
0.49 | A-500 — HORIZONTAL AND VERTICAL CRACK BELOW WINDOW BETWEEN GRID 7 AND 8

0.50 | A-500 — SIGNIFICANT CRACK BELOW WINDOW BETWEEN GRID 8 AND 9

0.51 | A-500 — SIGN OF MOISTURE DAMAGE TO TOP OF COLUMN ON GRID 17, ALSO OCCURS AT GRID 20



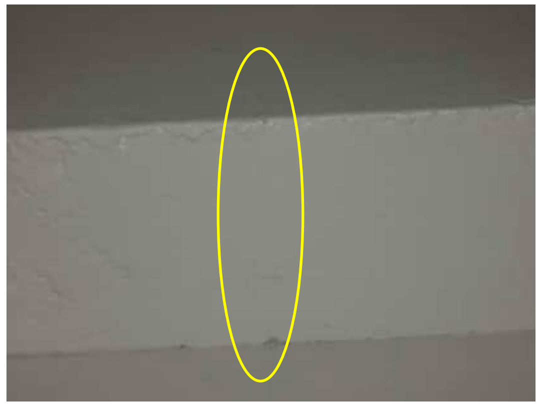
0.52 | A-500 — HORIZONTAL CRACK IN WALL ON GRID 17 IN LINE WITH BOTTOM OF WINDOW



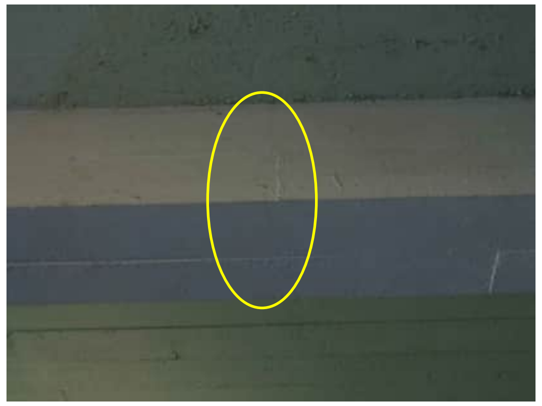
0.53 | A-500 — TYPICAL SEPARATION BETWEEN PLASTER BOARD PANELS, OCCURS FROM GRID 13 TO GRID 20

0.54 | A-500 — CRACKS AT TOP OF GRID 21 COLUMN

0.55 | A-500 — VIEW OF BEAM COLUMN JOINT AT GRID 13



0.56 | A-500 — CRACK TO BEAM BETWEEN GRID 12 AND 13



0.57 | A-500 — VERTICAL CRACK AROUND BEAM ON GRID 4 (GRID 5 AND 6 SIMILAR, ALONG THEIR LENGTH)

0.58 | A-500 — POORLY COMPACTED CONCRETE ALONG BEAM AT GRID 6 (GRID 8 SIMILAR)

0.59 | A-500 — EXPOSED SLAB BOTTOM REINFORCEMENT, IN THE BAY BETWEEN GRID 8 AND GRID 9

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PROJECT NUMBER

60332326

SHEET TITLE

GROUND LEVEL - DAMAGE ASSESSMENT - PHOTOS - SHEET 6

SHEET NUMBER

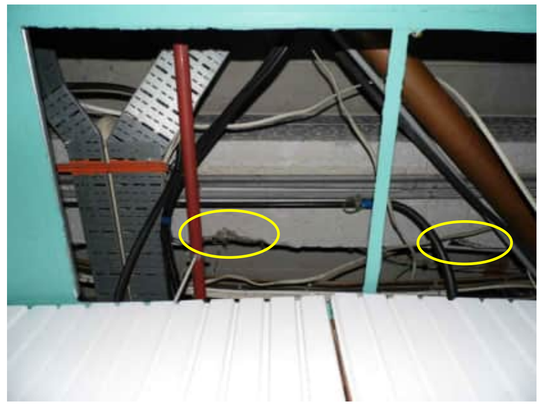
60332326-DRG-A-505

ISO A1 594mm x 841mm

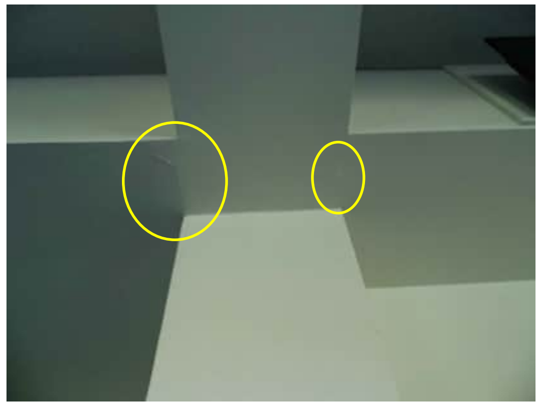
0.60 / A-500 — VOID ON CEILING EXPOSING THE REINFORCING AT GRID 10

0.61 / A-500 — PIPE THROUGH CEILING WITH SPALLING WHICH HAS EXPOSED REINFORCING

0.62 / A-500 — SIGNIFICANT CRACKS IN THE CEILING NEAR GRID 12/D



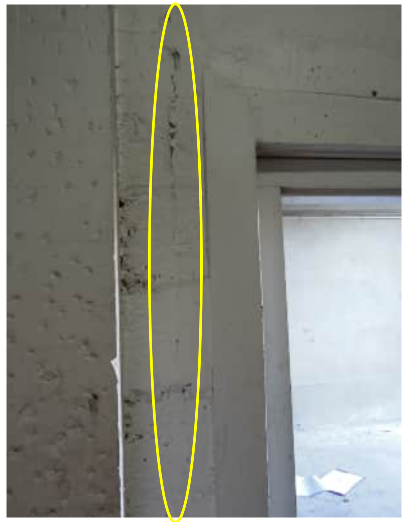
0.63 / A-500 — CORNER OF BEAM ON GRID 10 HAS BROKEN OUT IN TWO LOCATIONS BETWEEN GRID D AND GRID E



0.64 / A-500 — CRACK IN CASING AT BEAM COLUMN JOINT AT GRID 17 (GRID 13, 16 AND 19 SIMILAR)

0.65 / A-500 — TYPICAL BEAM WITH CASING BOWING OUTWARDS

0.66 / A-500 — DIAGONAL CRACK ON EXTERIOR FACE OF CONCRETE WALL



0.67 / A-500 — VERTICAL FULL HEIGHT CRACK IN CONCRETE WALL PANEL ON INTERIOR FACE

0.68 / A-500 — DIAGONAL STEP CRACKING IN RED BRICK INFILL PANEL

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PROJECT NUMBER

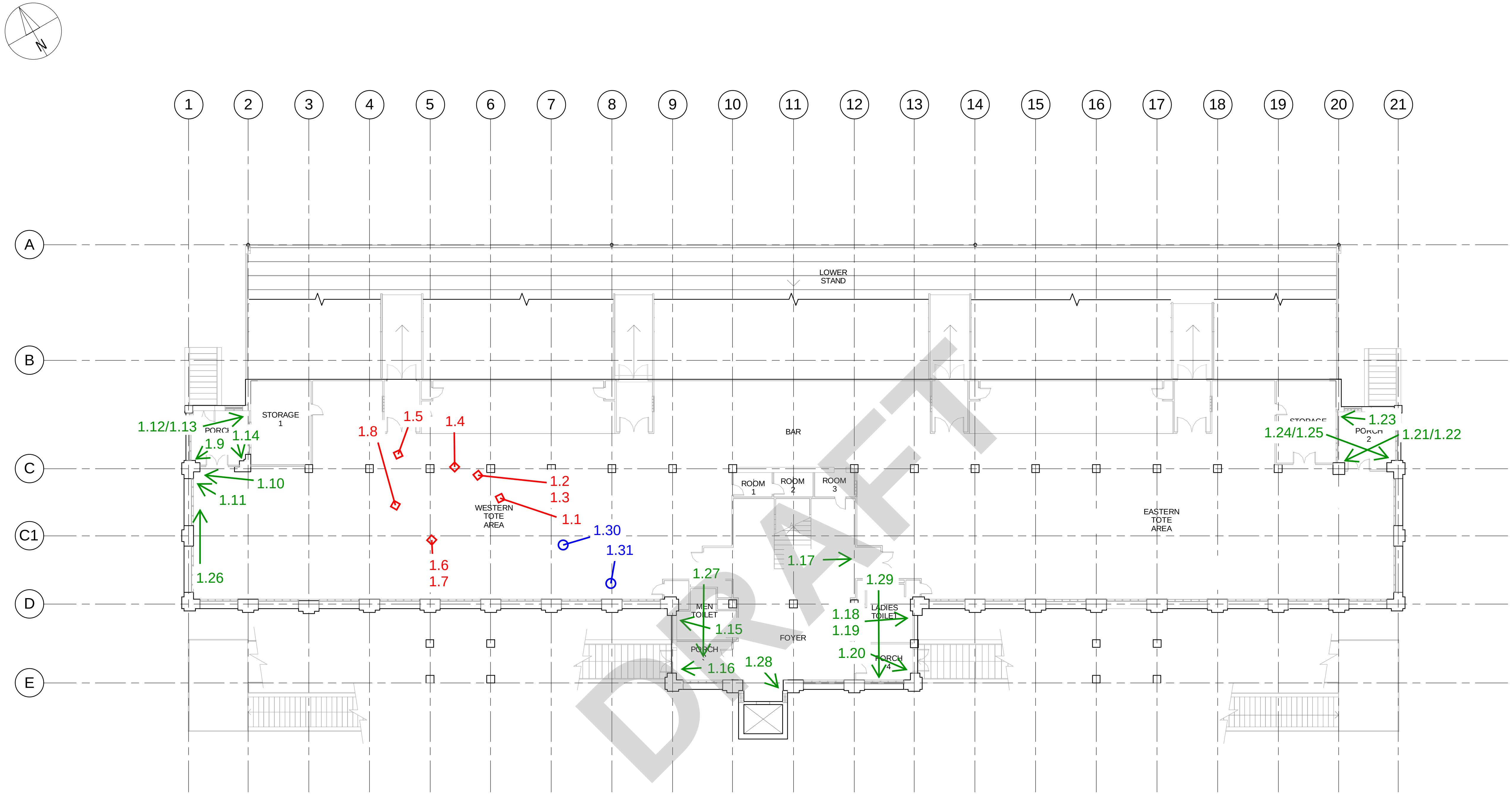
60332326

SHEET TITLE

GROUND LEVEL - DAMAGE ASSESSMENT - PHOTOS - SHEET 7

SHEET NUMBER

60332326-DRG-A-506



FOR DAMAGE ASSESSMENT OF SLAB AND CEILING SEE DRG-A-402 TO DRG-A-403

FOR DAMAGE ASSESSMENT OF FRAMES SEE DRG-A-420 TO DRG-A-422

DAMAGE PHOTO KEYPLAN - FLOOR 1

Scale: 1 : 150

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Slab/floor photo

Column / wall / frame photo

Ceiling photo

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PROJECT NUMBER

60332326

SHEET TITLE

LEVEL 1 - DAMAGE ASSESSMENT - PHOTOS - SHEET 1

SHEET NUMBER

60332326-DRG-A-510

ISO A1 594mm x 841mm

1.1 A-510 VIEW OF EXPOSED SLAB

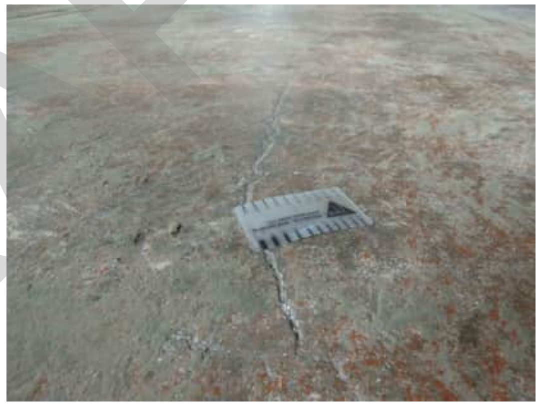
1.2 A-510 LOCATION OF CRACK BETWEEN GRID C COLUMNS

1.3 A-510 CRACK BETWEEN GRID C COLUMNS UP TO 10MM WIDE WITH 5MM VERTICAL DISPLACEMENT

1.4 A-510 SPALLING OF CRACK BETWEEN GRID C COLUMNS

1.5 A-510 CRACK UP TO 1MM PERPENDICULAR TO THE CRACKS BETWEEN GRID C COLUMNS

1.6 A-510 TYPICAL CRACK OVER THE CENTRE OF BEAMS RUNNING BETWEEN GRID C AND GRID D



1.7 A-510 CRACKS ARE UP TO 5MM ON THE SURFACE

1.8 A-510 CRAZED CRACK PATTERN ON SLAB BETWEEN GRID 4 AND 5

1.9 A-510 0.9MM VERTICAL CRACK FROM BOTTOM OF WINDOW IN GRID C COLUMN

1.10 A-510 HAIRLINE HORIZONTAL CRACK AROUND COLUMN AT MID HEIGHT

1.11 A-510 0.3MM DIAGONAL CRACK FROM BOTTOM OF WINDOW IN GRID C COLUMN

1.12 A-510 DIAGONAL CRACK FROM TOP CORNER OF WINDOW IN WALL BETWEEN GRID B AND C

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KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

FIRST LEVEL - DAMAGE ASSESSMENT - PHOTOS - SHEET 2

SHEET NUMBER

60332326-DRG-A-511

ISO A1 594mm x 841mm

1.13 A-510 CRACK FROM BOTTOM CORNER OF WINDOW IN WALL BETWEEN GRID B AND C

1.14 A-510 CRACK FROM BOTTOM CORNER OF WINDOW IN GRID C COLUMN

1.15 A-510 CRACK BETWEEN GRID D COLUMN AND WALL 2-3MM WIDE WITH SPALLING UP TO 25MM ON SURFACE

1.16 A-510 CRACK IN GRID E COLUMN ABOVE WINDOW FRAME

1.17 A-510 HORIZONTAL CRACK ALONG WALL BELOW THE BEAM ABOVE OPENING

1.18 A-510 1.6MM VERTICAL CRACK BETWEEN WALL AND COLUMN AT GRID D

1.19 A-510 SPALLING OF CRACK BETWEEN WALL AND COLUMN AT GRID D

1.20 A-510 CRACK IN WALL NEAR GRID E ABOVE WINDOW FRAME

1.21 A-510 HORIZONTAL CRACK IN GRID C COLUMN 0.5m FROM TOP OF COLUMN. CRACK IN WALL NEAR TOP OF WINDOW FRAME

1.22 A-510 DIAGONAL CRACK FROM BOTTOM CORNER OF WINDOW IN GRID C COLUMN

1.23 A-510 DIAGONAL CRACK FROM TOP CORNER OF WINDOW IN WALL BETWEEN GRID B AND C

1.24 A-510 HORIZONTAL CRACK AROUND GRID C COLUMN 1m FROM FLOOR

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SHEET TITLE

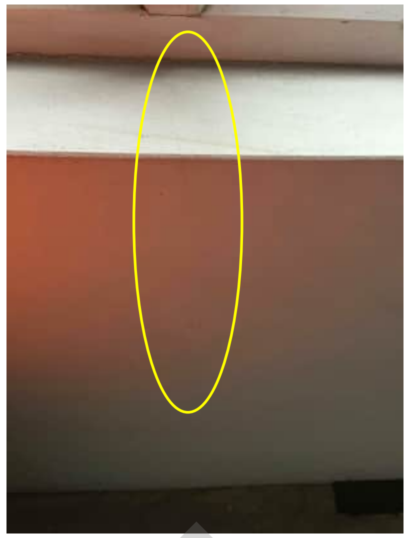
LEVEL 1 - DAMAGE ASSESSMENT - PHOTOS - SHEET 3

SHEET NUMBER

60332326-DRG-A-512

1.25 CRACK IN CORNER OF GRID C COLUMN BELOW WINDOW
A-510

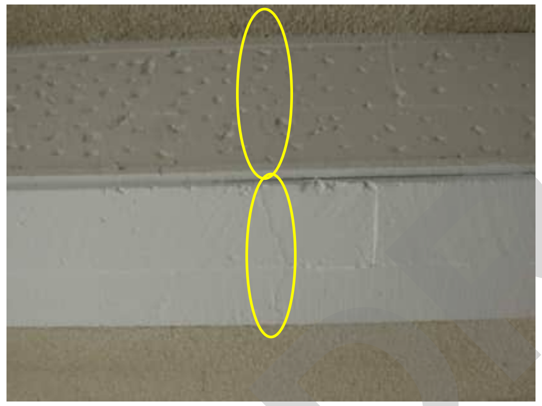
1.26 DAMAGE TO SURFACE BETWEEN GRID 1 COLUMN AND CONCRETE DOOR FRAME
A-510



1.27 HAIRLINE VERTICAL CRACK BELOW WINDOW BETWEEN GRID 9 AND 10
A-510

1.28 VERTICAL CRACK UP TO 0.2mm BELOW WINDOW AT GRID 11 IN LIFT SHAFT EXTENSION
A-510

1.29 HAIRLINE VERTICAL CRACK BELOW WINDOW BETWEEN GRID 12 AND 13
A-510



1.30 EXAMPLE OF A TYPICAL VERTICALCRACK ON THE BOTTOM AND SIDES OF BEAMS
A-510

1.31 TYPICAL MOISTURE DAMAGE TO CEILING AT BEAM COLUMN JOINTS ALONG GRID D
A-510

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KEY PLAN

PROJECT NUMBER

60332326

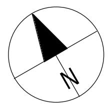
SHEET TITLE

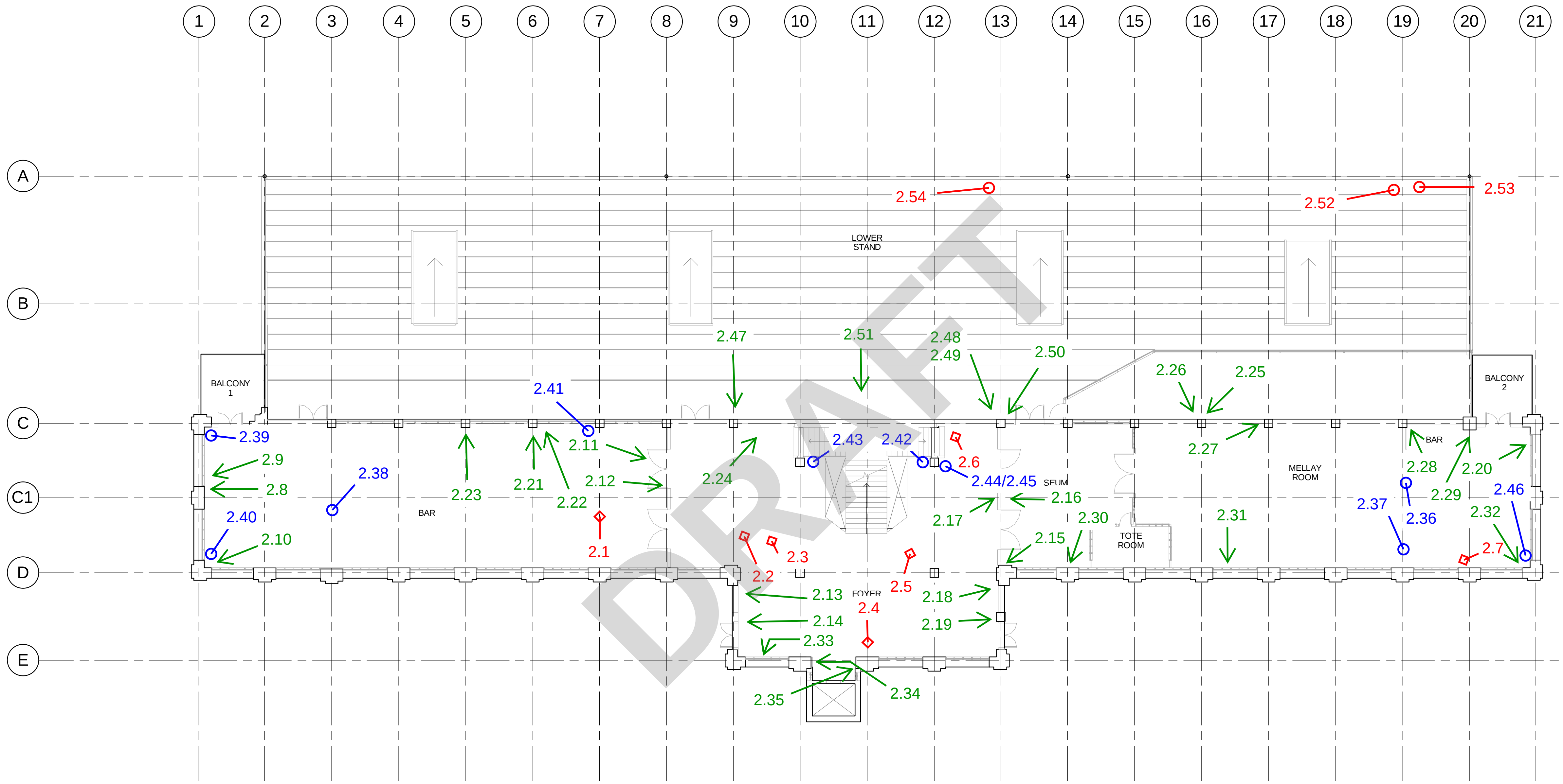
LEVEL 1 - DAMAGE ASSESSMENT - PHOTOS - SHEET 4

SHEET NUMBER

60332326-DRG-A-513

ISO A1 594mm x 841mm





FOR DAMAGE ASSESSMENT OF SLAB AND CEILING SEE DRG-A-404 TO DRG-A-405

FOR DAMAGE ASSESSMENT OF FRAMES SEE DRG-A-420 TO DRG-A-422

DAMAGE PHOTO KEYPLAN - FLOOR 2

Scale: 1 : 150

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KEY

- Slab/floor photo
- Column / wall / frame photo
- Ceiling photo

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ISSUE/REVISION

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KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

LEVEL 2 - DAMAGE ASSESSMENT - PHOTOS - SHEET 1

SHEET NUMBER

60332326-DRG-A-520

ISO A1 594mm x 841mm

2.1 A-520 TYPICAL CRACK ABOVE BEAM ON GRID 7, UP TO 1.6MM TYPICAL FOR GRIDS 2-12

2.2 A-520 CRACK ABOVE BEAM ON GRID 9, UP TO 10MM

2.3 A-520 CRACK RUNNING DIAGONALLY ACROSS SLAB, UP TO 10MM

2.4 A-520 CRACK ABOVE BEAM AT CONSTRUCTION JOINT UP TO 2.5MM

2.5 A-520 CRACKING TO SLAB UP TO 5MM

2.6 A-520 CRACK AT TOP OF STAIRS UP TO 1.6MM

2.7 A-520 PARTIALLY FILLED CRACKS ON SLAB, UP TO 0.8MM

2.8 A-520 CRACK NEAR TOP OF WINDOW ON COLUMN BETWEEN GRID C AND GRID D

2.9 A-520 CRACK NEAR TOP OF WINDOW ON COLUMN BETWEEN GRID C AND GRID D CONTINUES TO EXTERIOR

2.10 A-520 0.1MM DIAGONAL CRACK FROM BOTTOM OF WINDOW AT GRID D

2.11 A-520 CRACKS ABOVE DOOR FRAME IN WALL ALONG GRID 8 BETWEEN GRID C AND GRID D

2.12 A-520 SEPARATION BETWEEN WALL AND BEAM BETWEEN GRID C AND GRID D

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60332326

SHEET TITLE

LEVEL 2 - DAMAGE ASSESSMENT - PHOTOS - SHEET 2

SHEET NUMBER

60332326-DRG-A-521

ISO A1 594mm x 841mm

2.13 A-520 VERTICAL CRACK BETWEEN GRID D COLUMN AND WALL AVERAGE 2MM, UP TO 3.5MM

2.14 A-520 SIGNIFICANT HORIZONTAL CRACK WITH SPALLING ON WALL BETWEEN WINDOWS BETWEEN GRID D AND GRID E

2.15 A-520 SEPARATION BETWEEN GRID D COLUMN AND WALL

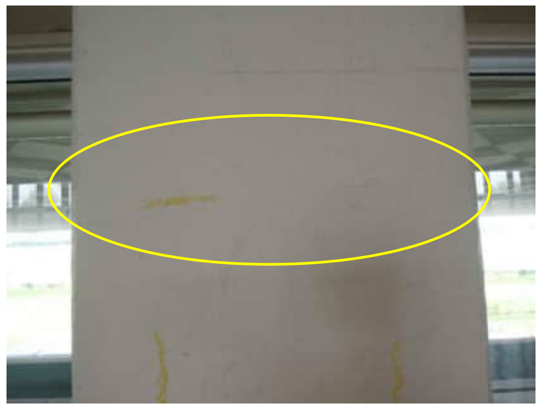
2.16 A-520 CRACK IN WALL BETWEEN GRID C AND GRID D, BETWEEN DOOR FRAMES

2.17 A-520 SEPARATION BETWEEN WALL AND BEAM BETWEEN GRID C AND GRID D

2.18 A-520 0.7MM VERTICAL CRACK BETWEEN GRID D COLUMN AND WALL

2.19 A-520 CRACK BETWEEN WINDOWS BETWEEN GRID D AND GRID E

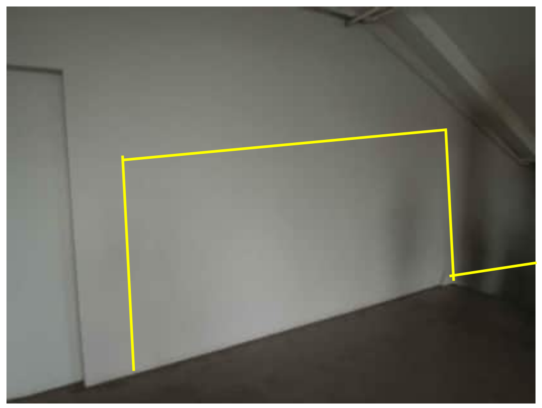
2.20 A-520 HAIRLINE DIAGONAL CRACK BELOW WINDOW NEXT TO GRID C COLUMN



2.21 A-520 HAIRLINE CRACK AROUND GRID 6 COLUMN (GRID 3, 14 AND 15 COLUMNS SIMILAR)

2.22 A-520 HAIRLINE CRACK CONTINUES AROUND GRID 6 COLUMN (GRID 3, 14 AND 15 COLUMNS SIMILAR)

2.23 A-520 VERTICAL CRACK IN BEAM ABOVE GRID 5 COLUMN



2.24 A-520 0.3-0.4mm CRACK IN SHEAR WALL AT LOCATION WHERE WALL THICKENS, BETWEEN GRID 8-9 (GRID 12-13 SIMILAR)

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SHEET TITLE

LEVEL 2 - DAMAGE ASSESSMENT - PHOTOS - SHEET 3

SHEET NUMBER

60332326-DRG-A-522

2.25 A-520 CRACK IN BEAM COLUMN JOINT AT GRID 16

2.26 A-520 CRACK IN BEAM COLUMN JOINT AT GRID 16

2.27 A-520 MULTIPLE HAIRLINE HORIZONTAL CRACKS DOWN SIDE OF COLUMN ON GRID 16 (GRID 17 SIMILAR)

2.28 A-520 CRACK BETWEEN BEAM AND WALL BETWEEN GRID 19 AND 20

2.29 A-520 DIAGONAL CRACK FROM CORNER OF WINDOW IN GRID 20 COLUMN

2.30 A-520 HORIZONTAL HAIRLINE CRACK IN COLUMN AT GRID 14 (GRID 8, 17 AND 19 SIMILAR)

2.31 A-520 0.1-0.2mm WIDE VERTICAL CRACK BELOW WINDOW BETWEEN GRID 16 AND 17

2.32 A-520 CRAZED CRACKS UP WHOLE HEIGHT OF COLUMN AT GRID 21

2.33 A-520 HAIRLINE DIAGONAL CRACK BELOW WINDOW BETWEEN GRID 9 AND 10 WITH SOME MOISTURE SEEPAGE

2.34 A-520 HAIRLINE CRACK BELOW WINDOW IN LIFT SHAFT WALL ON GRID 10

2.35 A-520 HAIRLINE CRACK BELOW WINDOW IN LIFT SHAFT WALL ON GRID 11

2.36 A-520 TYPICAL CRACKS ALONG LENGTH OF BEAM

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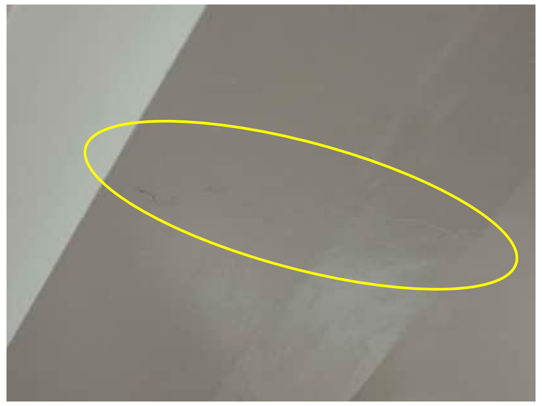
SHEET TITLE

LEVEL 2 - DAMAGE ASSESSMENT - PHOTOS - SHEET 4

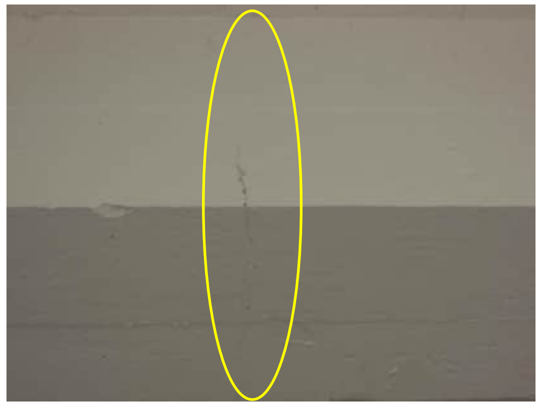
SHEET NUMBER

60332326-DRG-A-523

ISO A1 594mm x 841mm



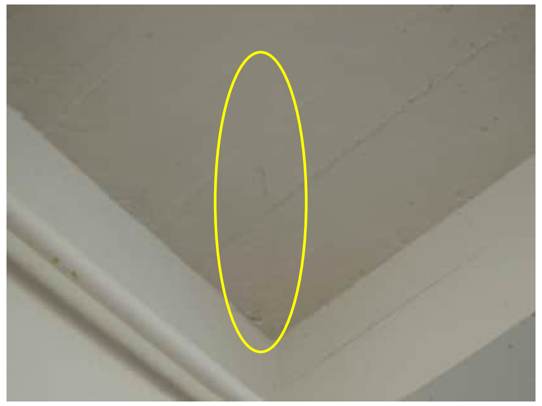
2.37 | A-520 TYPICAL CRACK IN PLASTER FINISH TO BEAM



2.38 | A-520 TYPICAL CRACK IN EXPOSED BEAM

2.39 | A-520 CRACK IN CORNER OF SLAB SOFFIT AT GRID 1/C

2.40 | A-520 CRACK IN CORNER OF SLAB SOFFIT AT GRID 1/D

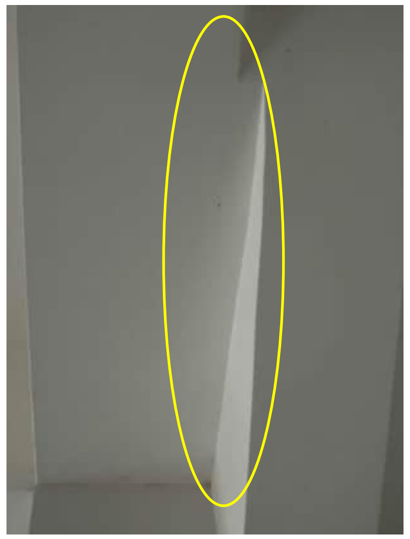


2.41 | A-520 CRACK FROM CORNER OF SLAB SOFFIT AT GRID 7/C

2.42 | A-520 CRACK ON BEAM UNDER STAIRS

2.43 | A-520 PLASTER BREAKING OFF BEAM UNDERNEATH STAIRS

2.44 | A-520 SEPARATION BETWEEN COLUMN AND CEILING AT STAIRS



2.45 | A-520 SEPARATION BETWEEN CEILING AND STAIRS

2.46 | A-520 CRACKING TO PLASTER IN CORNER OF SLAB SOFFIT AT GRID 21/D

2.47 | A-520 CRACKING TO COLUMN AT GRID 9

2.48 | A-520 CRACKING TO COLUMN AT GRID 13 AND ADJACENT SHEAR WALL

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NR	MF	CO
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ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

LEVEL 2 - DAMAGE ASSESSMENT - PHOTOS - SHEET 5

SHEET NUMBER

60332326-DRG-A-524

ISO A1 594mm x 841mm

1 2 3 4 5

A B C D

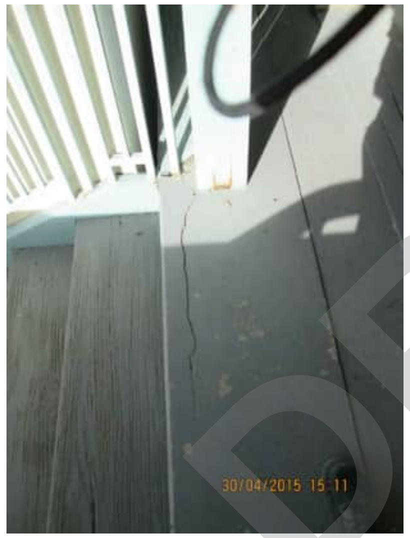
2.49 A-520 CRACKING TO TOP OF COLUMN AT GRID 13

2.50 A-520 CONCRETE SEGREGATION AT THE BOTTOM OF SHEAR WALL

2.51 A-520 VERTICAL 3.5mm WIDE CRACK TO SHEAR WALL

2.52 A-520 LOWER STAND SLAB EDGE CRACKING

2.53 A-520 LOWER STAND DAMAGE TO TIMBER DECKING



2.54 A-520 LOWER STAND SLAB EDGE CRACKING

DRAFT

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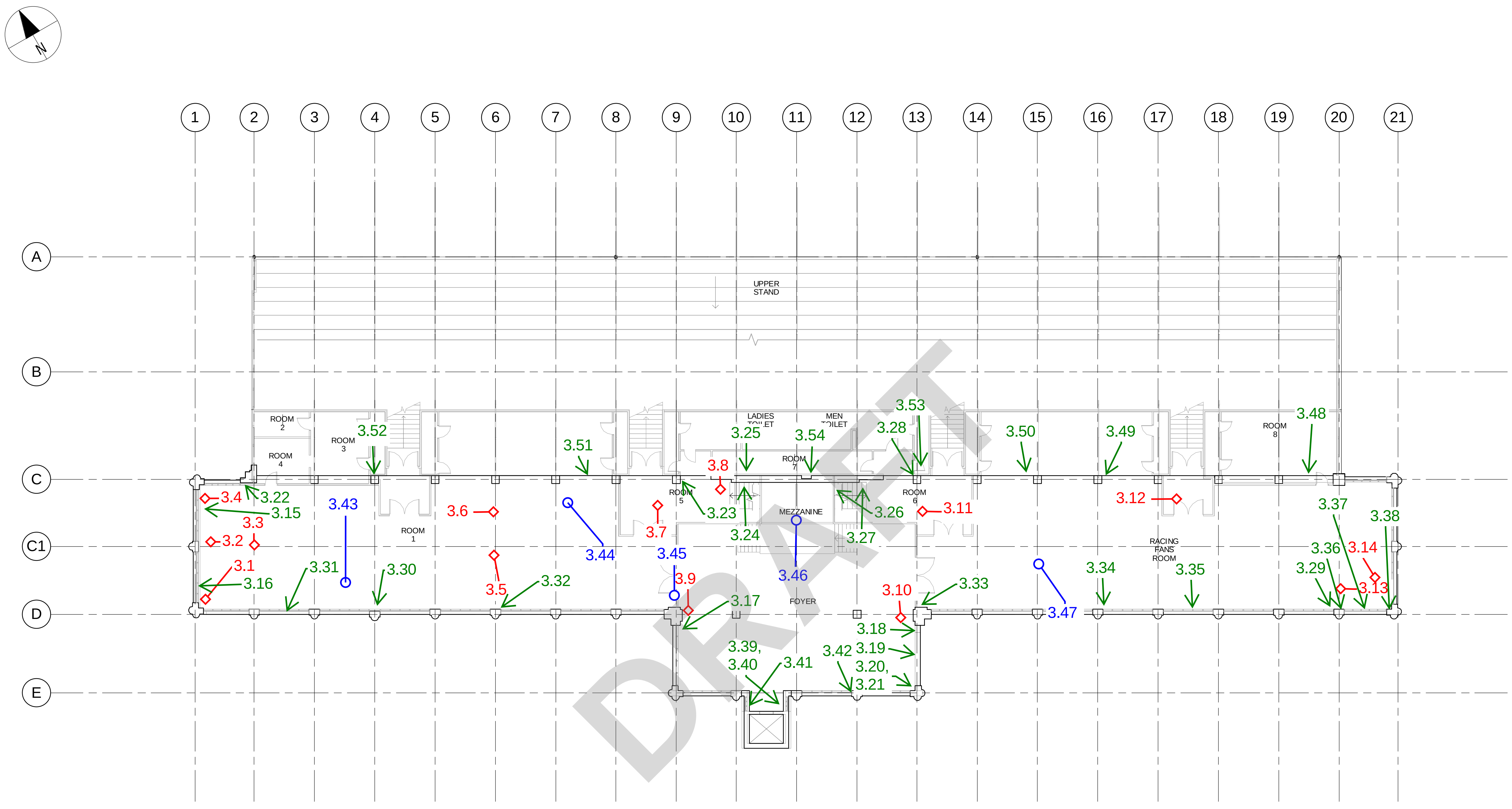
60332326

SHEET TITLE

LEVEL 2 - DAMAGE ASSESSMENT - PHOTOS - SHEET 6

SHEET NUMBER

60332326-DRG-A-525



DAMAGE PHOTO KEYPLAN - FLOOR 3

Scale: 1 : 150

FOR DAMAGE ASSESSMENT OF SLAB AND CEILING SEE DRG-A-406 TO DRG-A-407

FOR DAMAGE ASSESSMENT OF FRAMES SEE DRG-A-420 TO DRG-A-422

ISO A1 594mm x 841mm

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KEY

Slab/floor photo

Column / wall / frame photo

Ceiling photo

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60332326

SHEET TITLE

LEVEL 3 - DAMAGE ASSESSMENT - PHOTOS - SHEET 1

SHEET NUMBER

60332326-DRG-A-530

ISO A1 594mm x 841mm

3.1 A-530 DIAGONAL CRACKS AT CORNER OF BUILDING UP TO 3MM

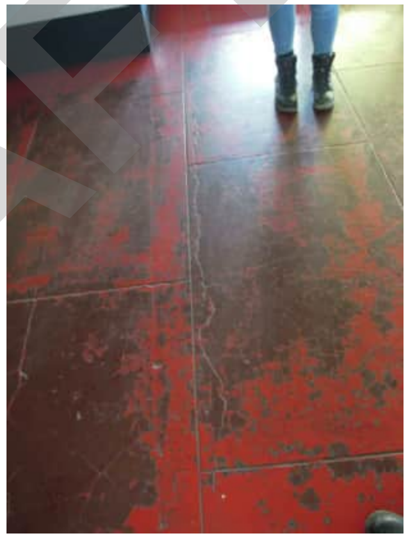
3.2 A-530 CRACK UP TO 0.8MM ALONG GRID 1

3.3 A-530 CRACK ALONG GRID 2 UP TO 1.8MM WIDE

3.4 A-530 DIAGONAL CRACK IN CORNER UP TO 1.2MM

3.5 A-530 CRACK ABOVE GRID 6 BEAM WHICH HAS BEEN PARTIALLY REPAIRED

3.6 A-530 CRACK ABOVE GRID 6 BEAM IS UP TO 5MM WIDE

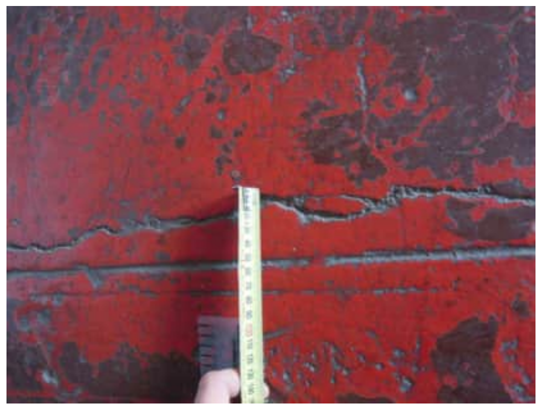


3.7 A-530 CRACK IN COATING, SPALLING UP TO 10MM WIDE AT SURFACE

3.8 A-530 CRACK IN COATING ALONG TOP OF STAIRS SPALLING UP TO 10MM WIDE AT SURFACE

3.9 A-530 CRACK UP TO 5MM WHICH HAS PREVIOUSLY BEEN PARTIALLY REPAIRED

3.10 A-530 CRACK UP TO 2MM WHICH HAS BEEN PREVIOULSY REPAIRED



3.11 A-530 CRACK IN COATING SPALLING UP TO 10MM WIDE AT SURFACE

3.12 A-530 CRACK IN COATING UP TO 3MM WIDE

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SHEET TITLE

LEVEL 3 - DAMAGE ASSESSMENT - PHOTOS - SHEET 2

SHEET NUMBER

60332326-DRG-A-531

ISO A1 594mm x 841mm

3.13 / A-530 — CRACK ALONG GRID 20 UP TO 0.9MM WIDE

3.14 / A-530 — CRACKS IN CORNER UP TO 0.6MM

3.15 / A-530 — VERTICAL CRACK BELOW WINDOW UP TO 0.4MM NEAR GRID C

3.16 / A-530 — 3MM VERTICAL CRACK BELOW WINDOW, CRACK HAS SPALLED UP TO 15MM

3.17 / A-530 — HORIZONTAL HAIRLINE CRACK IN GRID D COLUMN AT BOTTOM OF WINDOW

3.18 / A-530 — HAIRLINE CRACK FROM CORNER OF WINDOW IN GRID D COLUMN

3.19 / A-530 — HAIRLINE CRACK IN WALL BELOW WINDOW BETWEEN GRID D AND E

3.20 / A-530 — HAIRLINE CRACK AROUND 300MM ABOVE BOTTOM WINDOW IN GRID E COLUMN

3.21 / A-530 — HAIRLINE CRACK NEAR TOP OF WINDOW IN GRID E COLUMN

3.22 / A-530 — 0.3MM DIAGONAL CRACK FROM BOTTOM OF WINDOW AT GRID 2 COLUMN

3.23 / A-530 — HAIRLINE HORIZONTAL CRACK 2M UP THE GRID 9 COLUMN

3.24 / A-530 — DIAGONAL HAIRLINE CRACK IN SHEAR WALL FROM CORNER OF DOORWAY AT GRID 10

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SHEET TITLE

LEVEL 3 - DAMAGE ASSESSMENT - PHOTOS - SHEET 3

SHEET NUMBER

60332326-DRG-A-532

3.25 A-530 — 0.8MM DIAGONAL CRACK ON BACK OF SHEAR WALL FROM CORNER OF DOORWAY AT GRID 10

3.26 A-530 — HORIZONTAL HAIRLINE CRACK ALONG SHEAR WALL FROM GRID 10 TO GRID 12

3.27 A-530 — VERTICAL CRACK IN SHEAR WALL ABOVE DOOR OPENING NEAR GRID 12

3.28 A-530 — HORIZONTAL CRACK AROUND SIDE AND BACK OF GRID 13 COLUMN

3.29 A-530 — HORIZONTAL HAIRLINE CRACK ALONG GRID 20 COLUMN AT BOTTOM OF WINDOW (GRID 1, 2, 3 AND 21 SIMILAR)

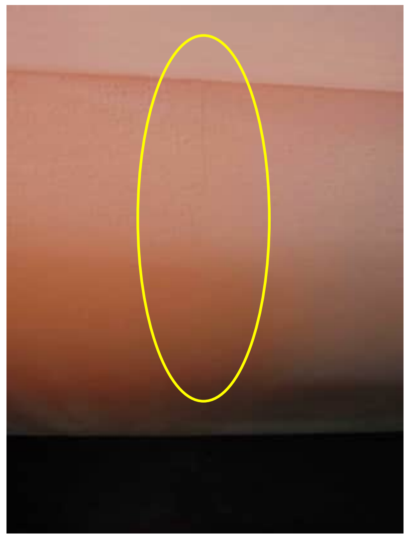
3.30 A-530 — HORIZONTAL HAIRLINE CRACK ALONG GRID 4 COLUMN AROUND 300MM ABOVE BOTTOM OF WINDOW (GRIDS 1-9 AND GRIDS 14-19 SIMILAR)

3.31 A-530 — HORIZONTAL CRACK IN WALL BELOW WINDOW BETWEEN GRID 2 AND GRID 3

3.32 A-530 — SEPARATION OF GIB FROM WINDOW FRAME AND HORIZONTAL CRACK UP TO 0.8MM IN GRID 6 COLUMN

3.33 A-530 — SEPARATION BETWEEN COLUMN AND SERVICE SHAFT AT GRID 13

3.34 A-530 — SEPARATION OF GIB FROM WINDOW FRAME BETWEEN GRID 15 AND 16. GRID 14 TO 15 SIMILAR. THESE WINDOW FRAMES DIFFER FROM OTHERS ALONG THIS WALL



3.35 A-530 — VERTICAL HAIRLINE CRACK BELOW WINDOW BETWEEN GRID 17 AND 18

3.36 A-530 — EVIDENCE OF MOISTURE ON GRID 20 COLUMN. SIMILAR AT GRID 3 AND 5

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60332326

SHEET TITLE

LEVEL 3 - DAMAGE ASSESSMENT - PHOTOS - SHEET 4

SHEET NUMBER

60332326-DRG-A-533

3.37 A-530 VERTICAL CRACK ABOVE WINDOW BETWEEN GRID 20 AND GRID 21

3.38 A-530 0.3MM HORIZONTAL CRACK IN GRID 21 COLUMN FROM CORNER OF WINOW

3.39 A-530 CRACK ON UNDERSIDE OF BEAMS BETWEEN GRID E BEAM AND BEAM FOR THE LIFT SHAFT EXTENSION, NEAR GRID 11

3.40 A-530 CRACK ON UNDERSIDE OF BEAMS BETWEEN GRID E BEAM AND BEAM FOR THE LIFT SHAFT EXTENSION, NEAR GRID 10

3.41 A-530 CRACK ON UNDERSIDE OF BEAMS BETWEEN GRID E BEAM AND BEAM FOR THE LIFT SHAFT EXTENSION, NEAR GRID 11

3.42 A-530 HORIZONTAL HAIRLINE CRACK ON GRID 12 COLUMN AT BOTTOM OF WINDOW

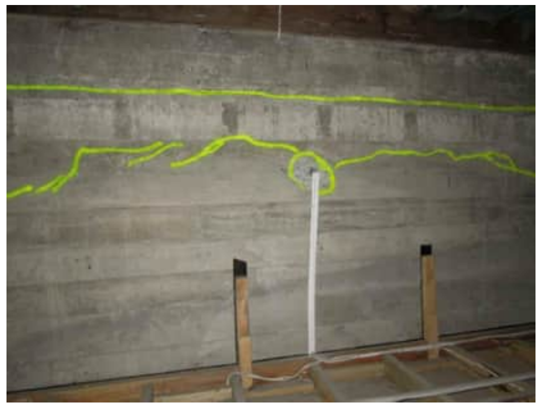
3.43 A-530 HEATER INADEQUATELY CONNECTED TO CEILING – HAZARD

3.44 A-530 MOISTURE DAMAGE TO BEAM AND CEILING AT GRID 7

3.45 A-530 DAMAGE TO GRID 9 BEAM

3.46 A-530 MOISTURE DAMAGE TO CEILING AND BEAM ON GRID 11

3.47 A-530 MOISTURE DAMAGE TO BEAM AND CEILING AT GRID 15



3.48 A-530 HORIZONTAL CRACKS TO SHEAR WALL. UPPER CRACK IS THROUGH POUR LINE. LOWER CRACK IS 0.2 TO 0.5MM WIDE

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SHEET TITLE

LEVEL 3 - DAMAGE ASSESSMENT - PHOTOS - SHEET 5

SHEET NUMBER

60332326-DRG-A-534

ISO A1 594mm x 841mm

1 2 3 4 5

A

3.49
A-530
MULTIPLE CRACKS TO SHEAR WALL. UPPER CRACK IS THROUGH POUR LINE. VERTICAL CRACK UNDER TRUSS IS 1.2MM WIDE. POOR QUALITY CONCRETE IN BEAM AT BOTTOM. MIDDLE HORIZONTAL CRACK IS 1.8 TO 2MM WIDE

3.50
A-530
UPPER CRACK IS THROUGH POUR LINE. POOR QUALITY CONCRETE AT BOTTOM. MIDDLE HORIZONTAL CRACK 0.8 TO 1.6mm WIDE

3.51
A-530
POOR QUALITY CONCRETE ON GRID 4 WITH 2MM WIDE HORIZONTAL CRACK

3.52
A-530
POOR QUALITY CONCRETE BETWEEN TWO VOIDS

B

3.53
A-530
WATER INGRESS DAMAGE AT GRID 13 THROUGH CRACKING AT TOP

3.54
A-530
FULL HEIGHT VERTICAL CRACK UP TO 15MM WIDE

C

D

1 2 3 4 5

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KEY PLAN

PROJECT NUMBER

60332326

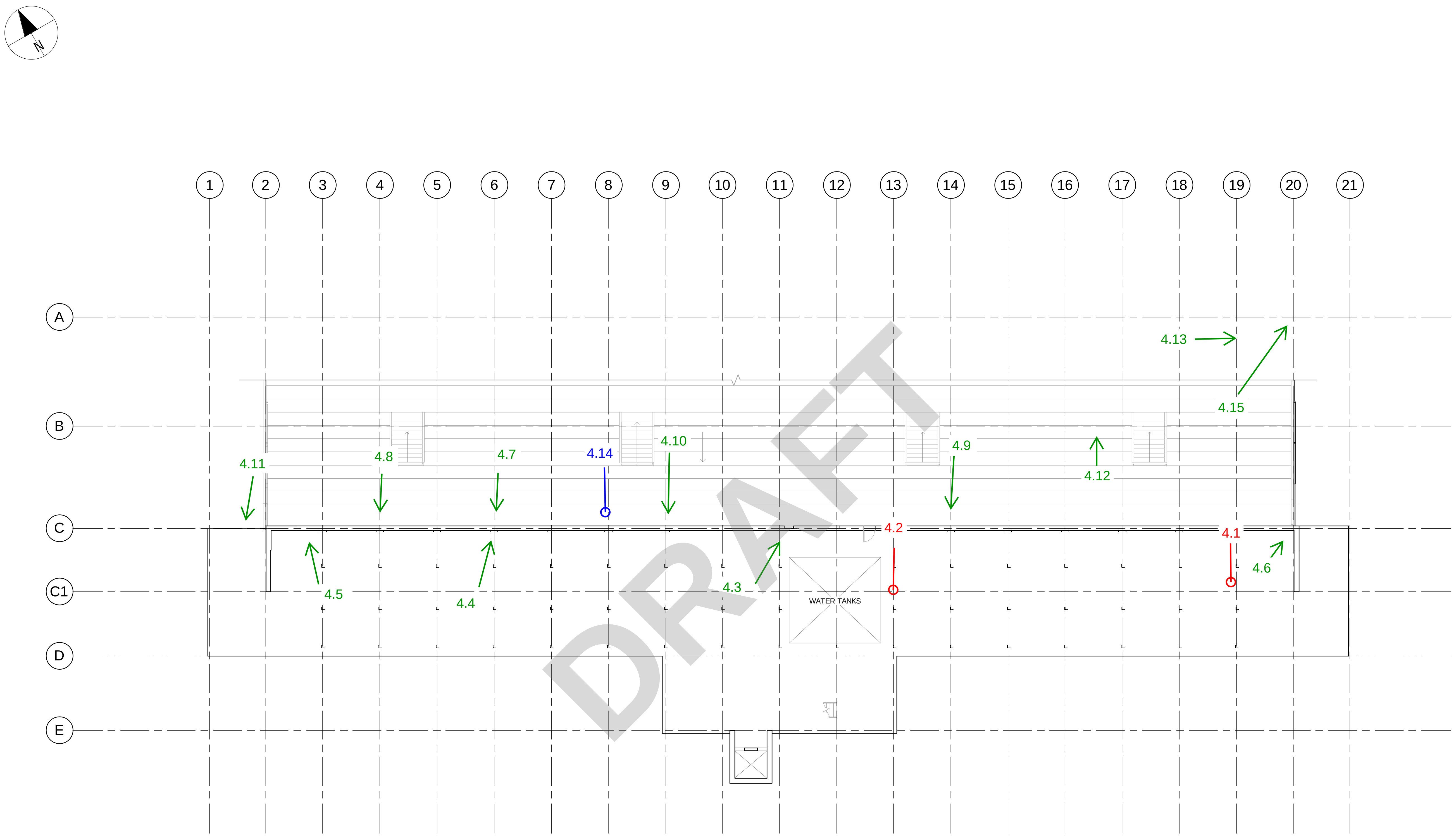
SHEET TITLE

LEVEL 3 - DAMAGE ASSESSMENT - PHOTOS - SHEET 6

SHEET NUMBER

60332326-DRG-A-535

ISO A1 594mm x 841mm



DAMAGE PHOTO KEYPLAN - FLOOR 4

Scale: 1 : 150

FOR DAMAGE ASSESSMENT OF SLAB AND CEILING SEE DRG-A-408 TO DRG-A-409

FOR DAMAGE ASSESSMENT OF FRAMES SEE DRG-A-420 TO DRG-A-422

FOR DAMAGE ASSESSMENT OF SHEAR WALL SEE DRG-A-424 TO DRG-A-426

This drawing is confidential and shall only be used for the purpose of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM quality assurance system to ISO 9001-2000.

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KEY

Slab/floor photo

Column / wall / frame photo

Ceiling photo

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SHEET TITLE

LEVEL 4 - DAMAGE ASSESSMENT - PHOTOS - SHEET 1

SHEET NUMBER

60332326-DRG-A-540

ISO A1 594mm x 841mm

4.1 A-500 TYPICAL CRACK NEAR GRIDLINE BETWEEN STEEL COLUMNS

4.2 A-540 CRACK THROUGH DRAINAGE CHANNEL, UP TO 1.4MM

4.3 A-540 CONCRETE COLUMN HAS SEPARATED FROM THE SHEAR WALL. THE COLUMN HAS MULTIPLE HORIZONTAL CRACKS SHOWING IT HAS BEEN BENT IN FLEXURE

4.4 A-540 CRACK RUNNING FROM THE STEEL COLUMN VERTICALLY

4.5 A-540 POOR QUALITY CONCRETE OVER HANGING THE FLOOR SLAB

4.6 A-540 VERTICAL CRACKS NEAR THE CONNECTION BETWEEN SHEAR WALL AND BUTTRESS. POOR CONCRETE AROUND THE CONNECTION

4.7 A-540 VERTICAL CRACK ON THE EXTERNAL FACE OF THE SHEAR WALL AT GRID 6, RUNNING PARALLEL TO THE STEEL COLUMN ON INTERNAL FACE

4.8 A-540 VERTICAL CRACK ON THE EXTERNAL FACE OF THE SHEAR WALL RUNNING PARALLEL TO THE STEEL COLUMN ON INTERNAL FACE

4.9 A-540 VERTICAL CRACK ON THE EXTERNAL FACE OF THE SHEAR WALL RUNNING PARALLEL TO THE STEEL COLUMN ON INTERNAL FACE

4.10 A-540 VERTICAL CRACK ON THE EXTERNAL FACE OF THE SHEAR WALL RUNNING PARALLEL TO THE STEEL COLUMN ON INTERNAL FACE

4.11 A-540 VIEW OF THE WESTERN WING WALL FROM UPPER STAND SHOWING DAMAGE AROUND CONNECTION OF SHEAR WALL TO BUTTRESS WALL

4.12 A-540 CONDITION OF TIMBER DECKING ON THE UPPER STAND

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60332326

SHEET TITLE

LEVEL 4 - DAMAGE ASSESSMENT - PHOTOS - SHEET 2

SHEET NUMBER

60332326-DRG-A-541

4.13
A-540
CONDITION OF TIMBER DECKING ON THE UPPER STAND

4.14
A-540
LOOSE TIMBER PIECES CAUGHT IN THE PROTECTIVE MESH

4.15
A-540
DAMAGE TO INTERFACE BETWEEN COLUMN AND TIMBER INFILL

ISO A1 594mm x 841mm

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60332326

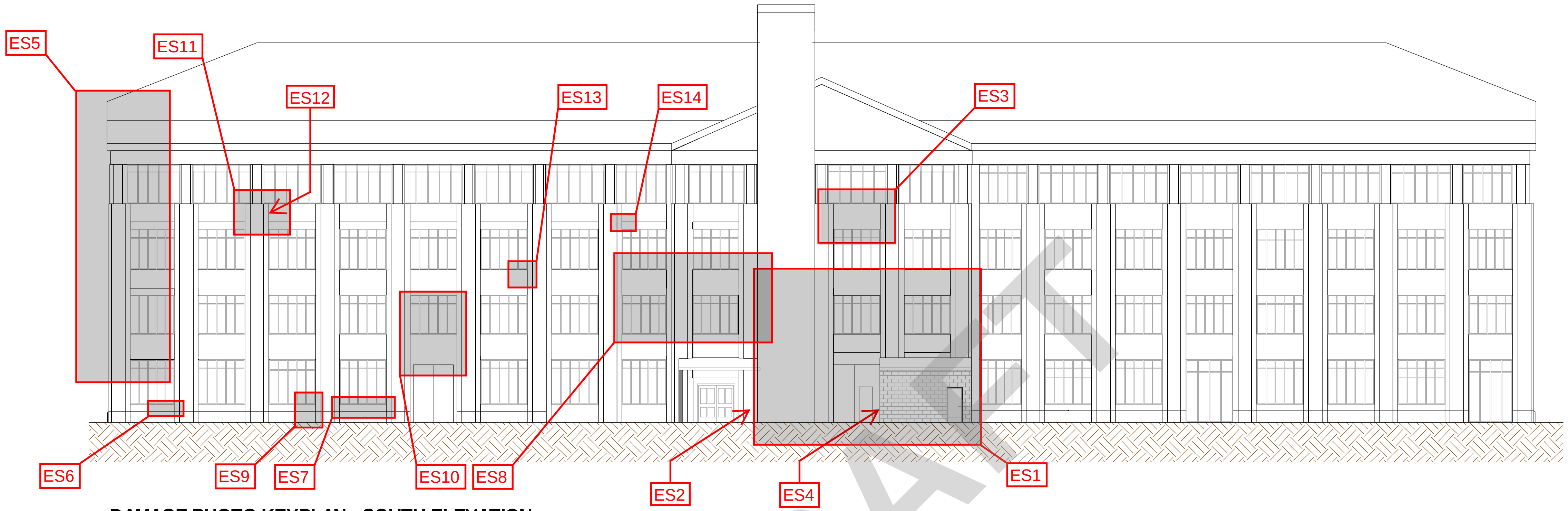
SHEET TITLE

LEVEL 4 - DAMAGE ASSESSMENT - PHOTOS - SHEET 3

SHEET NUMBER

60332326-DRG-A-542

ISO A1 594mm x 841mm



DAMAGE PHOTO KEYPLAN - SOUTH ELEVATION

Scale: 1 : 150

DRAFT

ES1
A-550
HORIZONTAL CRACK ABOVE FIRST FLOOR WINDOWS

ES2
A-550
SEPARATION BETWEEN GRID 10 COLUMN AND LIFT SHAFT EXTENSION

ES3
A-550
DAMAGED RENDER ABOVE SECOND FLOOR WINDOW EXPOSING REINFORCEMENT

ES4
A-550
DAMAGE TO RENDER AT BASE OF GRID 12 COLUMN

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KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

ELEVATIONS - DAMAGE ASSESSMENT - PHOTOS - SHEET 1

SHEET NUMBER

60332326-DRG-A-550

ES5 A-550 TYPICAL CRAZED CRACKING TO RENDER

ES6 A-550 TYPICAL HORIZONTAL CRACK BELOW WINDOW

ES7 A-550 TYPICAL VERTICAL CRACK BELOW WINDOW ON GROUND FLOOR

ES8 A-550 TYPICAL HORIZONTAL CRACK ABOVE WINDOW AND HORIZONTAL CRACK AROUND COLUMN

ES9 A-550 VERTICAL CRACK UP TO 0.3MM FROM CORNER OF WINDOW ON GROUND FLOOR AT GRID 4 COLUMN

ES10 A-550 RENDER HAS BROKEN OFF ABOVE DOOR OPENING BETWEEN GRID 5 AND 6

ES11 A-550 SPALLING NEAR TOP OF GRID 3 COLUMN EXPOSING REINFORCING

ES12 A-550 SPALLING ON SIDE OF GRID 3 COLUMN EXPOSING REINFORCING

ES13 A-550 CRACK EXPOSING REINFORCING BELOW SECOND FLOOR WINDOW AT GRID 7

ES14 A-550 EXPOSED REINFORCING ABOVE SECOND FLOOR WINDOW IN GRID 8

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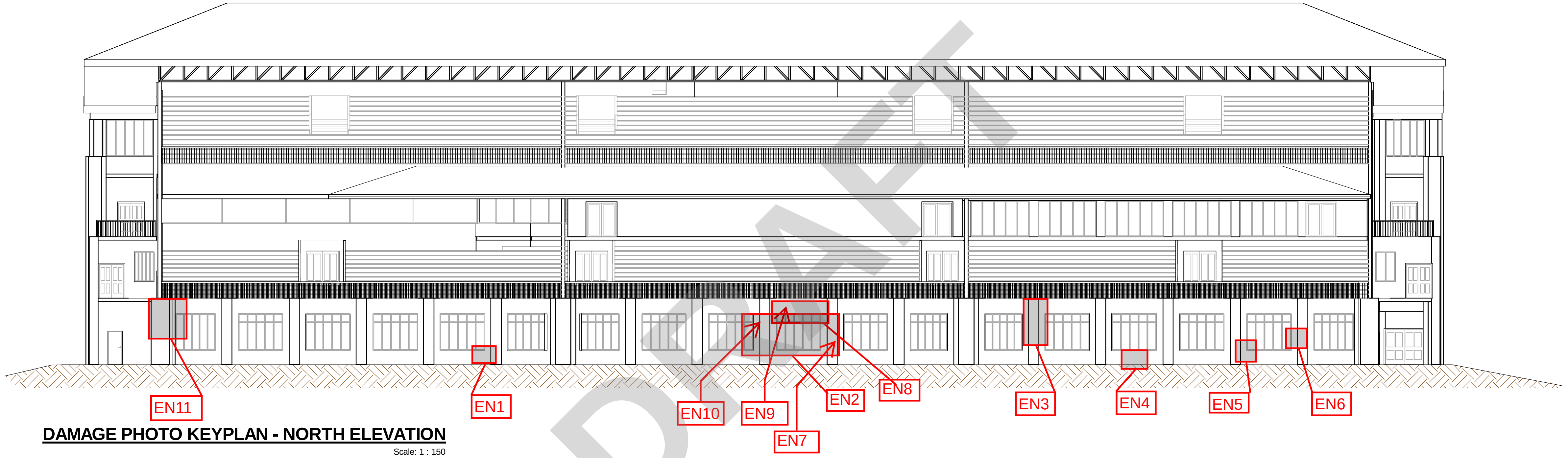
60332326

SHEET TITLE

ELEVATIONS - DAMAGE ASSESSMENT - PHOTOS - SHEET 2

SHEET NUMBER

60332326-DRG-A-551



DAMAGE PHOTO KEYPLAN - NORTH ELEVATION

Scale: 1 : 150

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SHEET TITLE

ELEVATIONS - DAMAGE ASSESSMENT - PHOTOS - SHEET 3

SHEET NUMBER

60332326-DRG-A-552

EN1 A-552 AREA OF SEGREGATED CONCRETE AT BASE OF COLUMN AND WALL

EN2 A-552 AREA OF SEGREGATED CONCRETE ON COLUMN FACE AND SIDES

EN3 A-552 SPALLING TO CORNERS OF COLUMNS

EN4 A-552 VERTICAL CRACK BELOW WINDOW

EN5 A-552 CRACK FROM CORNER OF WINDOW

EN6 A-552 MINOR HORIZONTAL CRACK AT LOCATION OF CONSTRUCTION JOINT

EN7 A-552 CONCRETE SPALLING WITH PROTRUDING STEEL BAR AT CORNER OF GRID 10 COLUMN

EN8 A-552 SIGNIFICANT HORIZONTAL CRACK ALONG TOP OF WALL AROUND 10MM WIDE, AT LOCATION WHERE STAIRS TO STANDS HAVE BEEN CAST INTO THE WALL

EN9 A-552 SIGNIFICANT HORIZONTAL CRACK AND MINOR VERTICAL CRACK ABOVE WINDOW BETWEEN GRID 10 AND 11, AT LOCATION WHERE STAIRS TO STANDS HAVE BEEN CAST INTO THE WALL

EN10 A-552 VERTICAL CRACK UP TO 0.4MM ON SIDE OF COLUMN AT GRID 11

EN11 A-552 HORIZONTAL CRACK AT TOP OF GRID 20 COLUMN

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PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

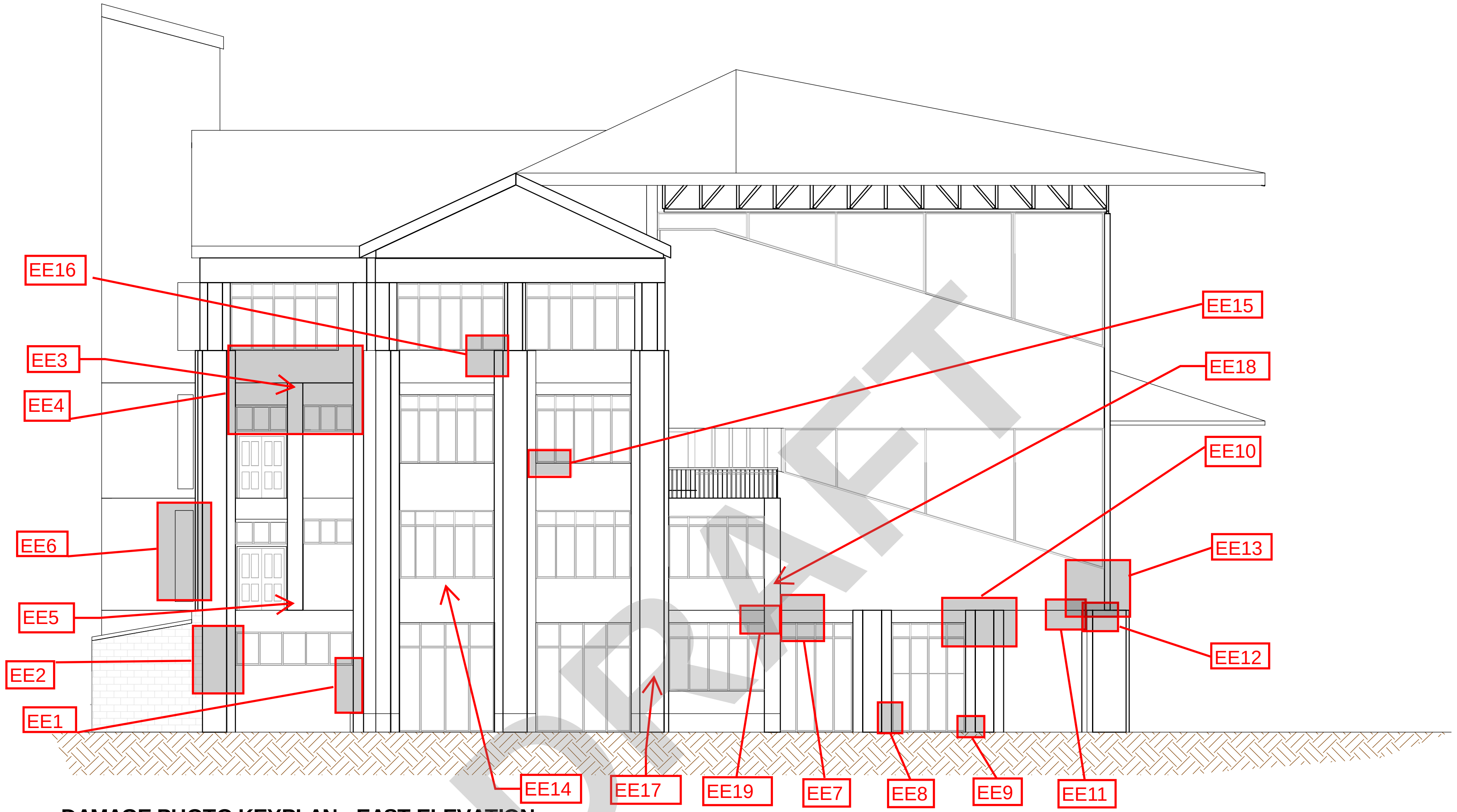
SHEET TITLE

ELEVATIONS - DAMAGE ASSESSMENT - PHOTOS - SHEET 4

SHEET NUMBER

60332326-DRG-A-553

ISO A1 594mm x 841mm



DAMAGE PHOTO KEYPLAN - EAST ELEVATION

Scale: 1 : 100

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KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

ELEVATIONS - DAMAGE ASSESSMENT - PHOTOS - SHEET 5

SHEET NUMBER

60332326-DRG-A-554

Last Saved: 18/06/2015 2:11:04 p.m.
Filename: C:\Users\PettiC\Desktop\60332326_MOD_ST_2014_PettiC(Recovery).rvt

EE1 TYPICAL CRACK BETWEEN GRID D COLUMN AND CONCRETE INFILL WALL
A-554

EE2 HAIRLINE CRACK TO GRID E COLUMN AT GROUND LEVEL
A-554

EE3 HORIZONTAL CRACK AND DIAGONAL CRACKS BETWEEN CENTRAL COLUMN AND THIRD FLOOR WALL
A-554

EE4 HORIZONTAL CRACK ALONG WALL ON THE THIRD FLOOR
A-554

EE5 CRACKING AROUND CAST-IN HANDRAIL AT THE FIRST FLOOR
A-554

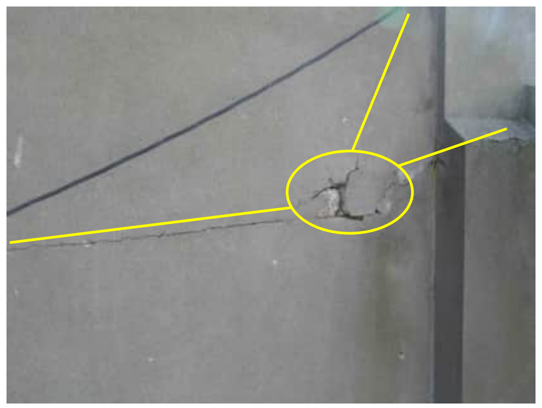
EE6 DAMAGE TO LIFT SHAFT AT CONNECTION TO MAIN BUILIDNG
A-554

EE7 CRACKS AND DAMAGE TO RENDER ON THE GRID C COLUMN
A-554

EE8 DAMAGED CONCRETE AROUND DOOR WITH REINFORCING EXPOSED (WALL APPEARS TO HAVE BEEN CUT TO FORM DOOR)
A-554

EE9 DAMAGED CONCRETE ON OTHER SIDE OF DOOR, REINFORCING IS ALSO EXPOSED (WALL APPEARS TO HAVE BEEN CUT TO FORM DOOR)
A-554

EE10 SIGNIFICANT HORIZONTAL CRACK ALONG WALL
A-554



EE11 CONTINUATION OF CRACK SHOWN IN EE10 WITH SOME ICRETE BREAKING OUT
A-554

EE12 CONTINUATION OF CRACK SHOWN IN EE11 THROUGH GRID A COLUMN
A-554

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I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

ELEVATIONS - DAMAGE ASSESSMENT - PHOTOS - SHEET 6

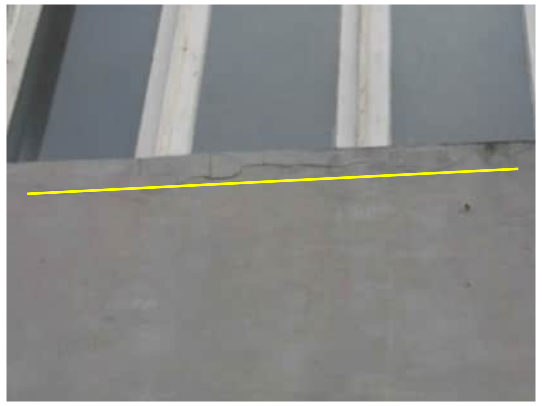
SHEET NUMBER

60332326-DRG-A-555

ISO A1 594mm x 841mm
Last Saved: 18/06/2015 2:11:06 p.m.
Filename: C:\Users\PettiC\Desktop\60332326_MOD_ST_2014_PettiC(Recovery).rvt

ISO A1 594mm x 841mm

EE13 | **A-554** CRACKING TO WALL ABOVE GRID A COLUMN

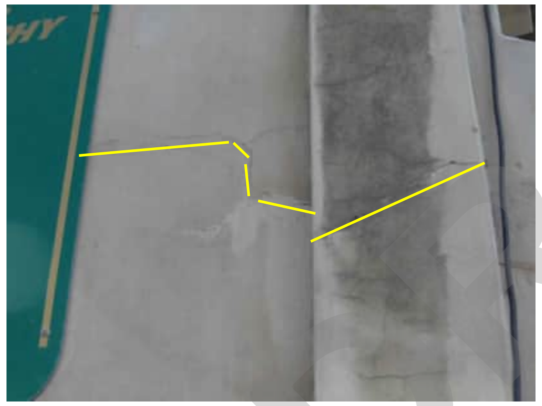


EE14 | **A-554** CRACKS BELOW WINDOW BETWEEN GRID C AND GRID D

EE15 | **A-554** RENDER HAS BROKEN OFF BEHIND SIGN

EE16 | **A-554** EVIDENCE OF RUST BELOW THE THIRD FLOOR WINDOW

EE17 | **A-554** 0.2MM CRACK IN GRID C COLUMN



EE18 | **A-554** HORIZONTAL CRACK IN WALL AND COLUMN BETWEEN GRID B AND C

EE19 | **A-554** HORIZONTAL CRACK IN COLUMN BETWEEN GRID B AND C

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ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

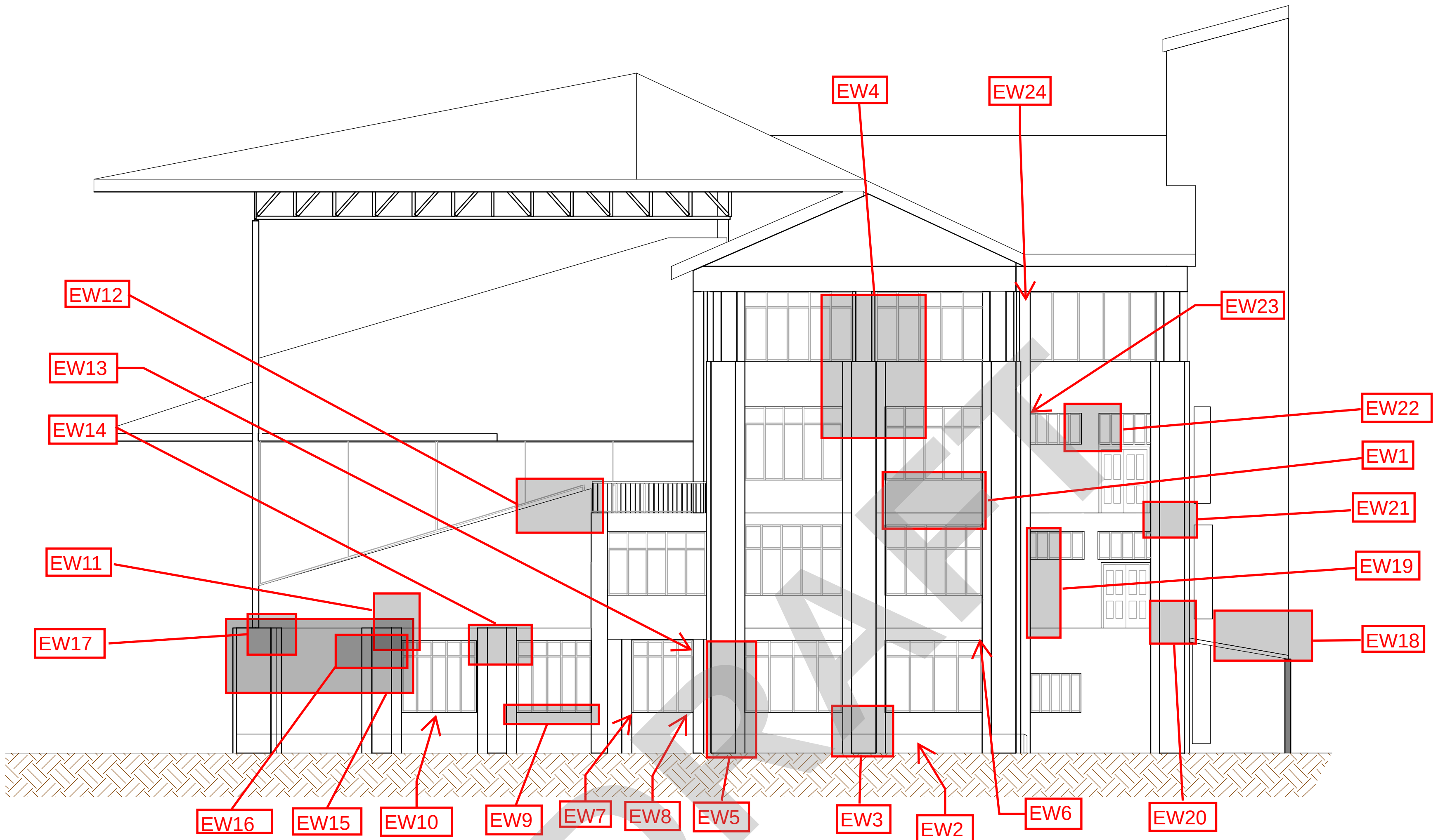
60332326

SHEET TITLE

ELEVATIONS - DAMAGE ASSESSMENT - PHOTOS - SHEET 7

SHEET NUMBER

60332326-DRG-A-556



DAMAGE PHOTO KEYPLAN - WEST ELEVATION

Scale: 1 : 100

Last Saved: 18/06/2015 2:11:10 p.m.
Filename: C:\Users\PettiC\Desktop\60332326_MOD_ST_2014_PettiC(Recovery).rvt

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PROJECT MANAGEMENT INITIALS

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I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

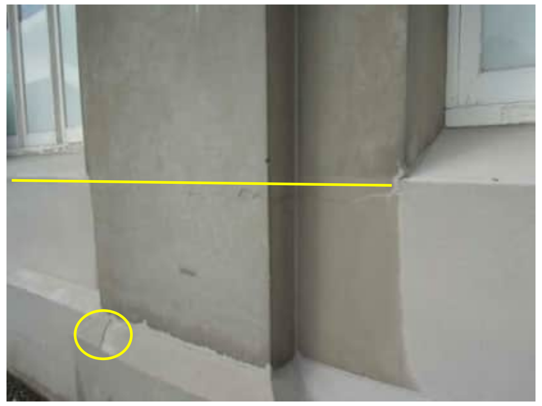
ELEVATIONS - DAMAGE ASSESSMENT - PHOTOS - SHEET 8

SHEET NUMBER

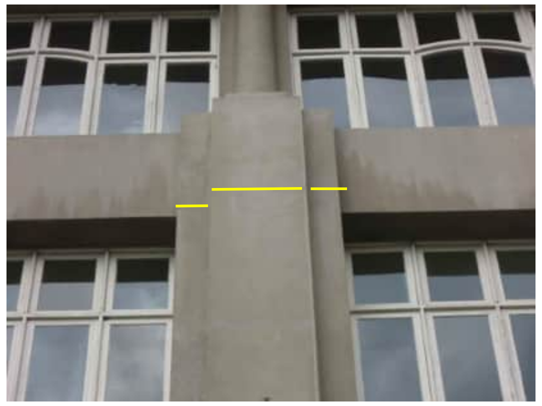
60332326-DRG-A-557

EW1 | **A-557** — SIGNIFICANT CRACK ABOVE FIRST FLOOR WINDOW BETWEEN GRID C AND GRID D

EW2 | **A-557** — 1.0MM VERTICAL CRACK BELOW GROUND FLOOR WINDOW



EW3 | **A-557** — 0.2MM HORIZONTAL CRACK NEAR BASE OF CENTRAL COLUMN



EW4 | **A-557** — HORIZONTAL CRACK ON CENTRAL COLUMN ABOVE SECOND FLOOR WINDOWS

EW5 | **A-557** — 0.2MM HORIZONTAL CRACKS NEAR BASE OF GRID C COLUMN

EW6 | **A-557** — TYPICAL SEPARATION BETWEEN WALLS AND COLUMNS

EW7 | **A-557** — DIAGONAL CRACK BELOW WINDOW ON COLUMN BETWEEN AND GRID C

EW8 | **A-557** — DIAGONAL CRACK BELOW WINDOW ON COLUMN BETWEEN GRID B AND GRID C

EW9 | **A-557** — HORIZONTAL CRACK BELOW WINDOW

EW10 | **A-557** — 1.0MM VERTICAL CRACK BELOW WINDOW

EW11 | **A-557** — VERTICAL CRACK ABOVE GROUND FLOOR WINDOW GRID A AND GRID B

EW12 | **A-557** — HORIZONTAL CRACK IN CONCRETE WALL OF LOWER STAND

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KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

ELEVATIONS - DAMAGE ASSESSMENT - PHOTOS - SHEET 9

SHEET NUMBER

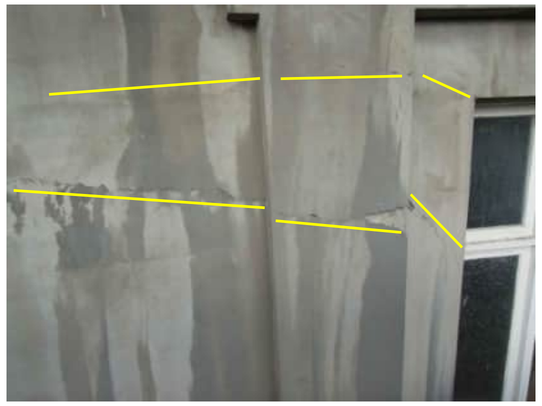
60332326-DRG-A-558

Last Saved: 18/06/2015 2:11:12 p.m.
Filename: C:\Users\PettiC\Desktop\60332326_MOD_ST_2014_PettiC(Recovery).rvt

EW13 A-557 — HORIZONTAL CRACK NEAR CEILING LEVEL OF GROUND FLOOR, ON COLUMN BETWEEN GRID B AND GRID C

EW14 A-557 — HORIZONTAL CRACK NEAR CEILING LEVEL OF GROUND FLOOR ON COLUMN AT GRID B

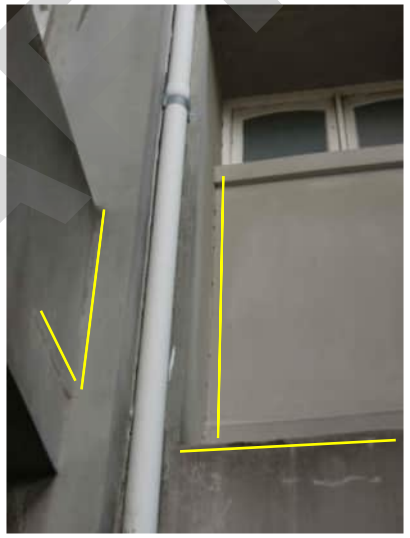
EW15 A-557 — HORIZONTAL CRACK BECOMES WIDER TOWARDS GRID A



EW16 A-557 — HORIZONTAL CRACK AND DAMAGED COLUMN

EW17 A-557 — HORIZONTAL CRACK AT GRID A COLUMN WITH SPALLING AND EVIDENCE OF RUST

EW18 A-557 — CRACK IN LIFT SHAFT NEAR FLOOR LEVEL OF FIRST FLOOR



EW19 A-557 — SEPARATION BETWEEN GRID D COLUMN AND INFILL WALL

EW20 A-557 — HORIZONTAL CRACK AROUND GRID E COLUMN

EW21 A-557 — CRACKING TO GRID E COLUMN NEAR WHERE STAIRS CONNECT AT SECOND FLOOR UP TO 0.5MM

EW22 A-557 — VERTICAL CRACKING TO CENTRAL COLUMN AND SEPARATION BETWEEN THE COLUMN AND THE WALL BETWEEN THE SECOND AND THE THIRD FLOOR

EW23 A-557 — RENDER BREAKING OFF ABOVE SECOND FLOOR WINDOW

EW24 A-557 — CRACKING TO THE SOFFIT AT GRID D

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KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

ELEVATIONS - DAMAGE ASSESSMENT - PHOTOS - SHEET 10

SHEET NUMBER

60332326-DRG-A-559

ISO A1 594mm x 841mm

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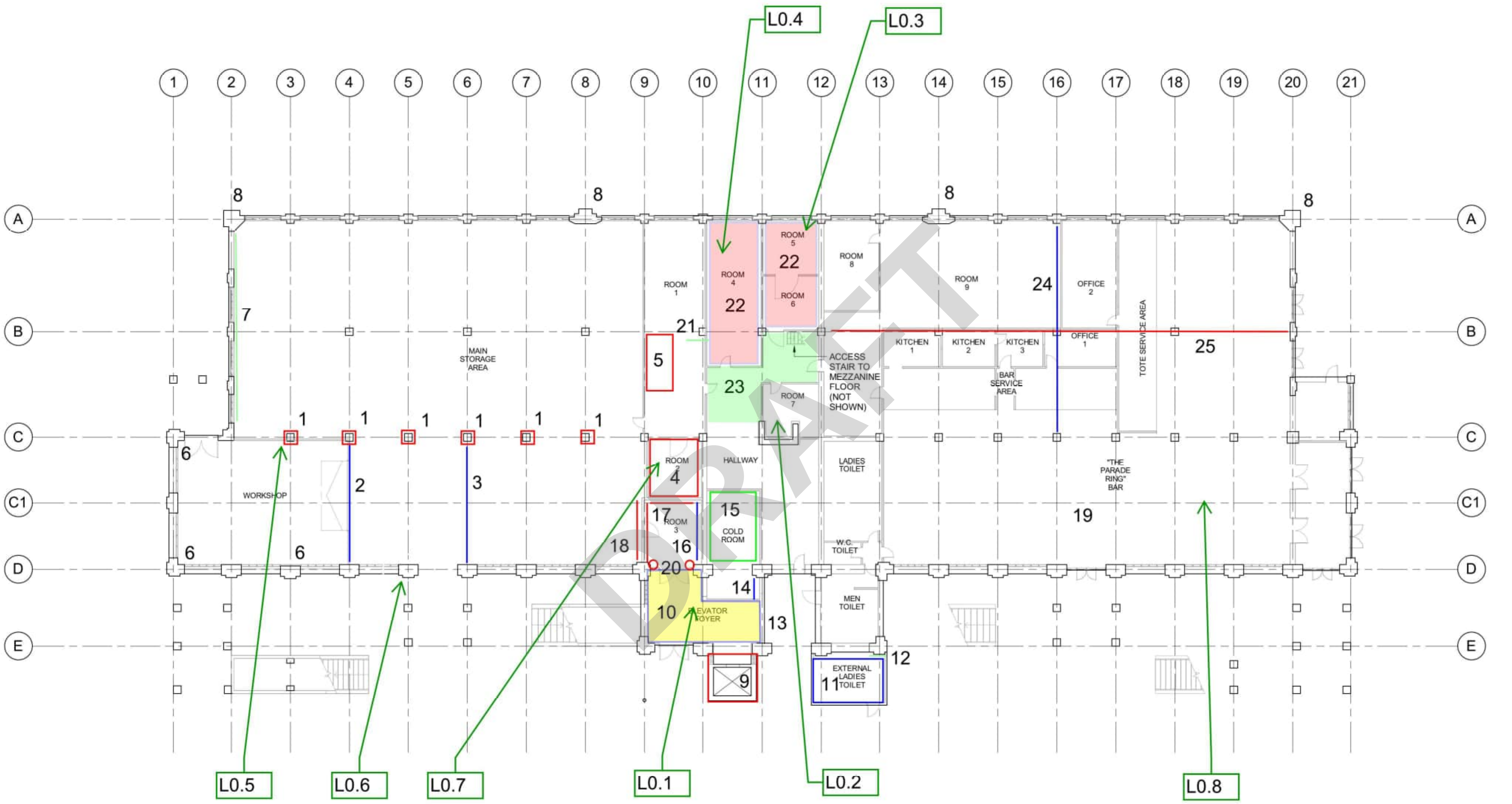
Filename: C:\Users\PettiC\Desktop\60332326_MOD_ST_2014_PettiC(Recovery).rvt



INTRUSIVE ACTIONS AND INITIAL OBSERVATIONS - GROUND FLOOR

Scale: 1 : 150

KEY

Items L0.1 to L0.8 - refer to table C-1 in Appendix C of Damage Assessment Report for commentary.
Items 1 to 25 - refer to table C-6 in Appendix C of Damage Assessment Report for commentary.

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I/R	DATE	DESCRIPTION
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KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

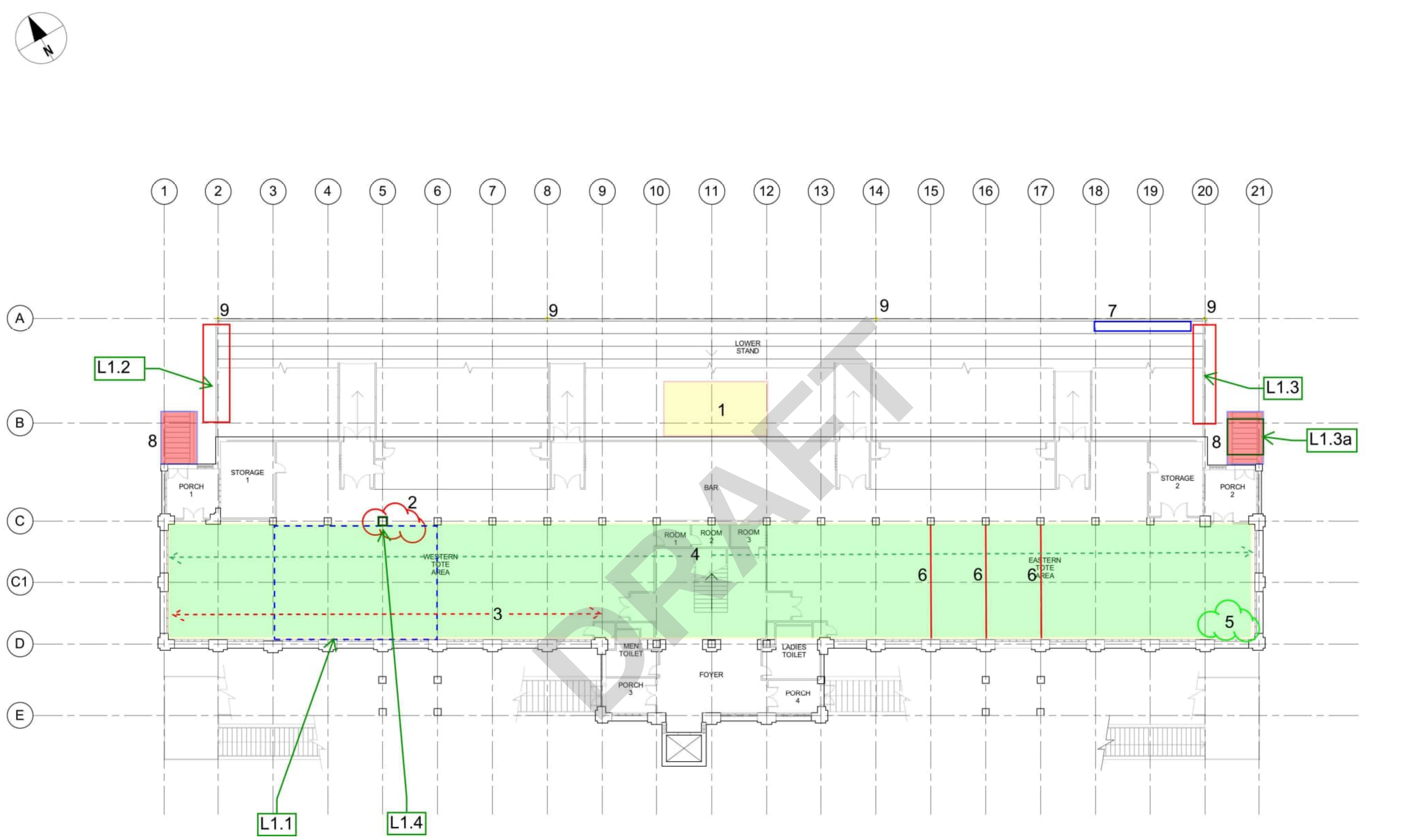
INTRUSIVE ACTIONS AND INITIAL OBSERVATIONS - GROUND FLOOR

SHEET NUMBER

60332326-DRG-A-600

ISO A1 594mm x 841mm

Last Saved: 9/06/2015 2:54:24 p.m.
Filename: C:\Users\PettiC\Desktop\60332326_MOD_ST_2014_PettiC(Recovery).rvt



INTRUSIVE ACTIONS AND INITIAL OBSERVATIONS - FLOOR 1

Scale: 1 : 150

KEY

Items L1.1 to L1.4 - refer to table C-2 in Appendix C of Damage Assessment Report for commentary.
Items 1 to 9 - refer to table C-7 in Appendix C of Damage Assessment Report for commentary.

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KEY PLAN

PROJECT NUMBER

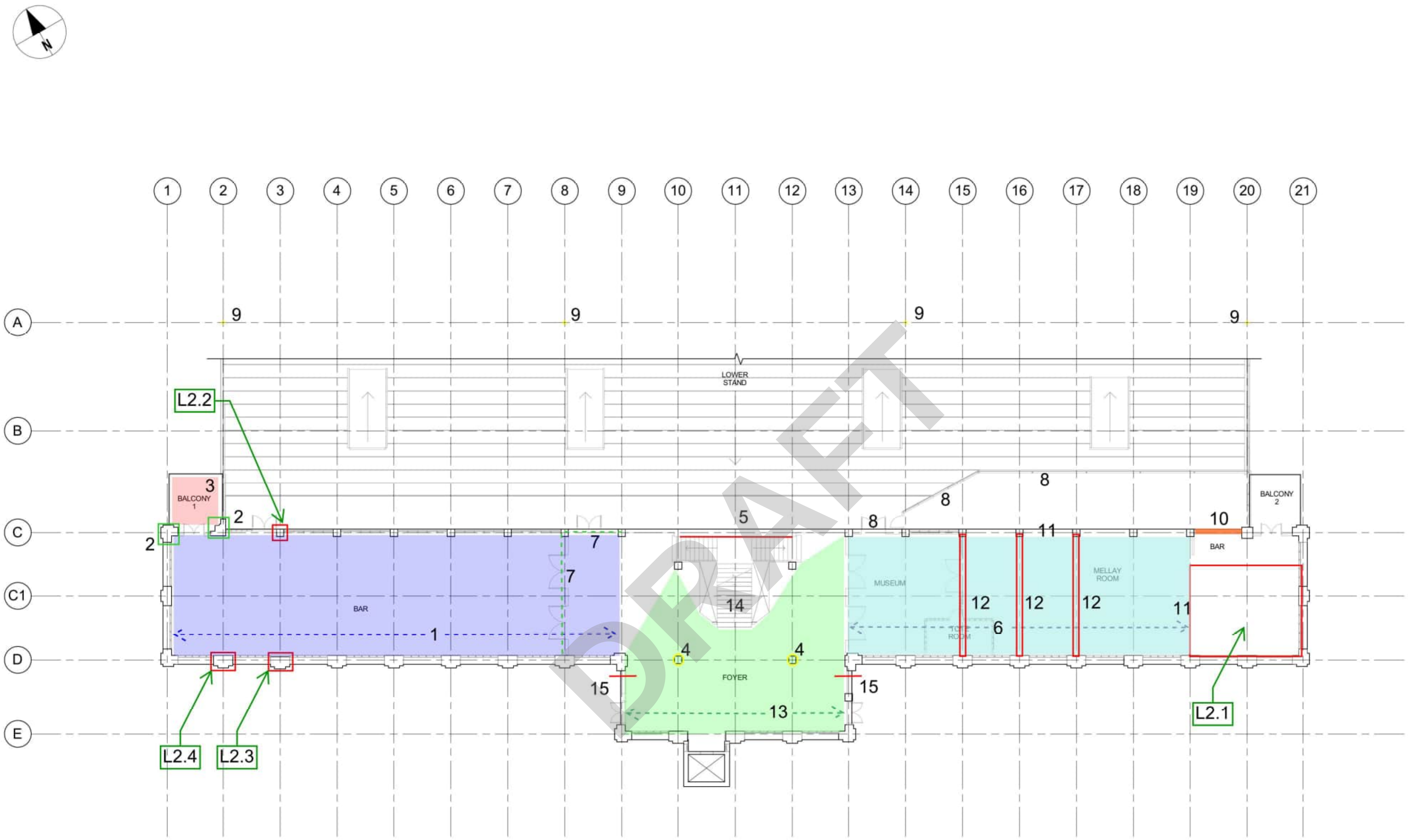
60332326

SHEET TITLE

INTRUSIVE ACTIONS AND INITIAL OBSERVATIONS - FLOOR 1

SHEET NUMBER

60332326-DRG-A-601



INTRUSIVE ACTIONS AND INITIAL OBSERVATIONS - FLOOR 2

Scale: 1 : 150

KEY

Items L2.1 to L2.4 - refer to table C-3 in Appendix C of Damage Assessment Report for commentary.
Items 1 to 15 - refer to table C-8 in Appendix C of Damage Assessment Report for commentary.

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ISSUE/REVISION

I/R	DATE	DESCRIPTION
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KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

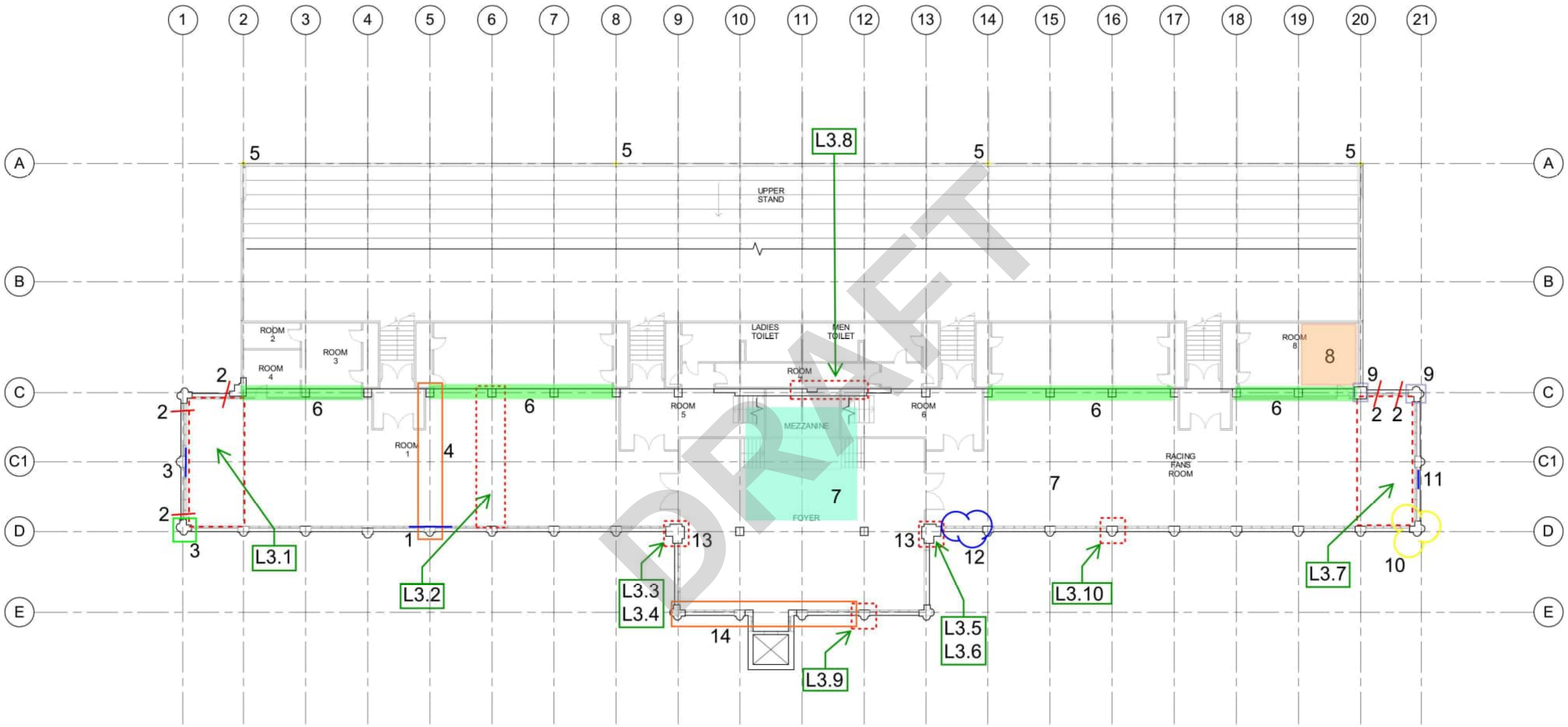
INTRUSIVE ACTIONS AND INITIAL OBSERVATIONS - FLOOR 2

SHEET NUMBER

60332326-DRG-A-602

ISO A1 594mm x 841mm

Last Saved: 9/06/2015 2:54:27 p.m.
Filename: C:\Users\PettiC\Desktop\60332326_MOD_ST_2014_PettiC(Recovery).rvt



INTRUSIVE ACTIONS AND INITIAL OBSERVATIONS - FLOOR 3

Scale: 1 : 150

KEY

Items L3.1 to L3.10 - refer to table C-4 in Appendix C of Damage Assessment Report for commentary.
Items 1 to 14 - refer to table C-9 in Appendix C of Damage Assessment Report for commentary.

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I/R	DATE	DESCRIPTION
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KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

INTRUSIVE ACTIONS AND INITIAL OBSERVATIONS - FLOOR 3

SHEET NUMBER

60332326-DRG-A-603

ISO A1 594mm x 841mm
Last Saved: 9/06/2015 2:54:28 p.m.
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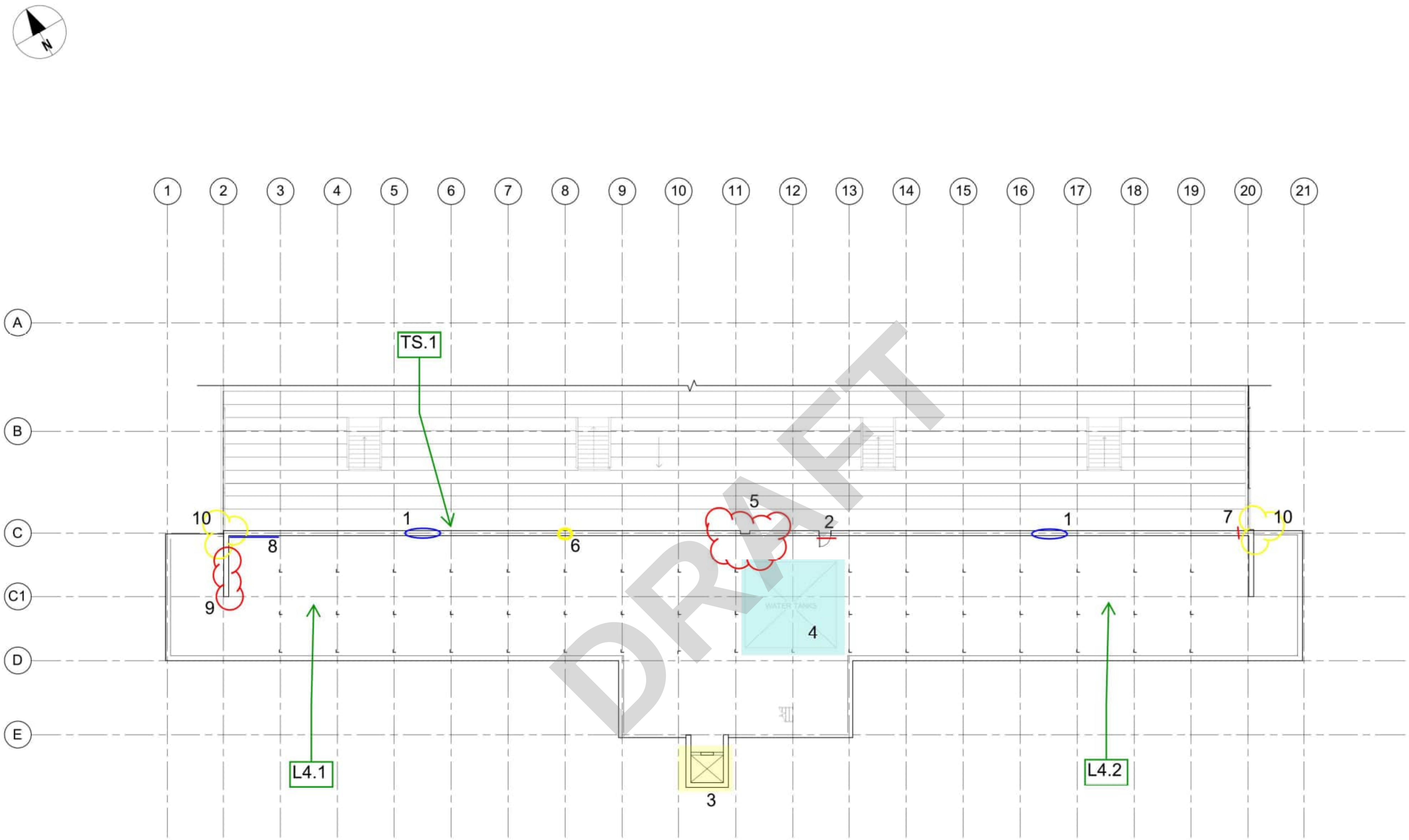
ISO A1 594mm x 841mm



INTRUSIVE ACTIONS AND INITIAL OBSERVATIONS - FLOOR 4

Scale: 1 : 150

KEY

Items L4.1, L4.2, and TS.1 - refer to table C-5 in Appendix C of Damage Assessment Report for commentary.
Items 1 to 10 - refer to table C-10 in Appendix C of Damage Assessment Report for commentary.

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I/R	DATE	DESCRIPTION
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KEY PLAN

PROJECT NUMBER

60332326

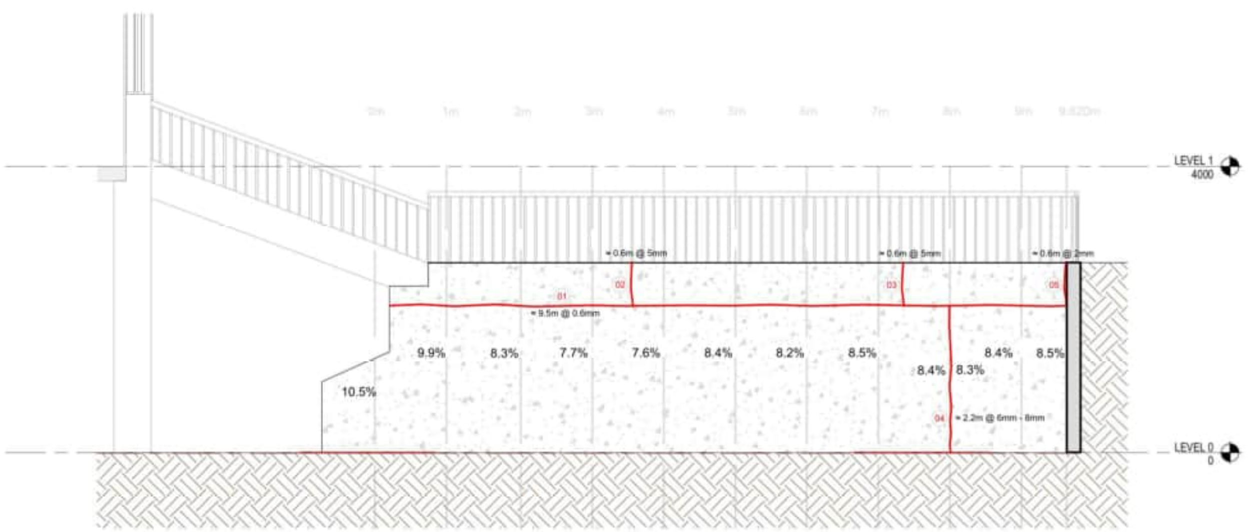
SHEET TITLE

INTRUSIVE ACTIONS AND INITIAL OBSERVATIONS - FLOOR 4

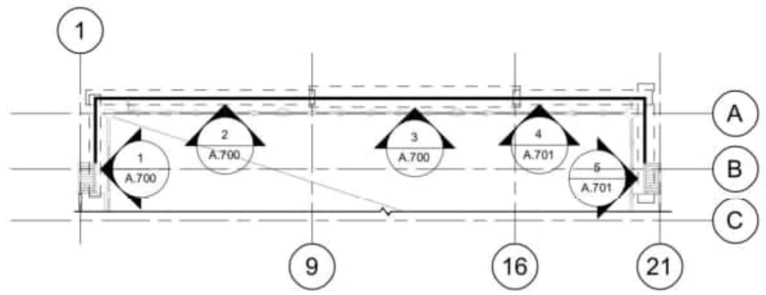
SHEET NUMBER

60332326-DRG-A-604

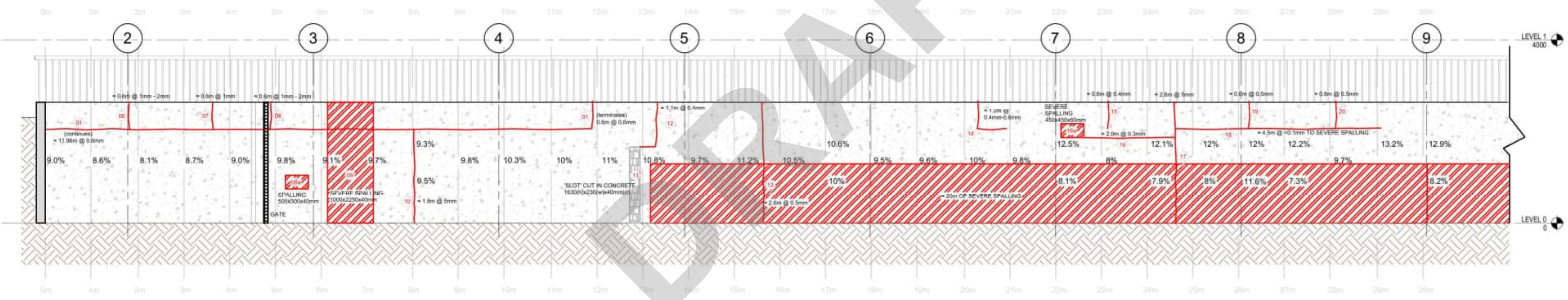
ISO A1 594mm x 841mm



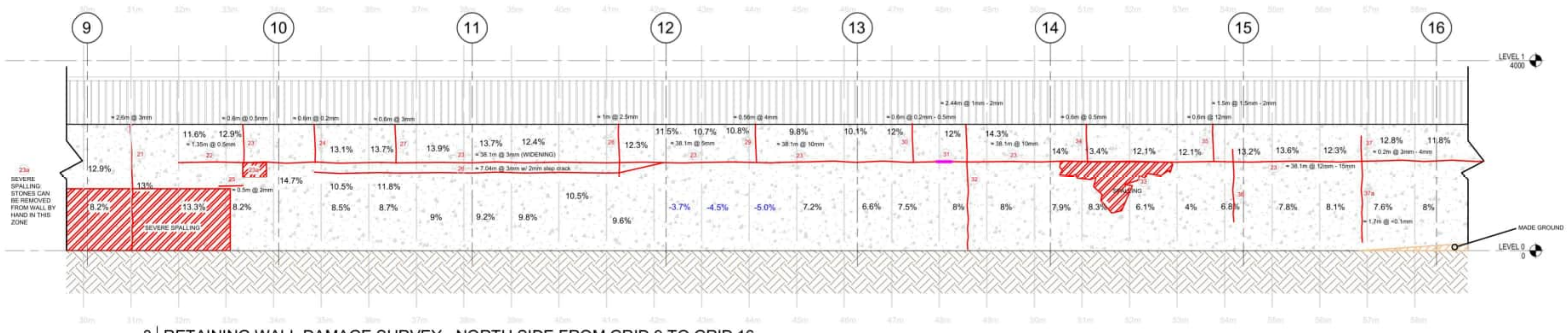
1 RETAINING WALL DAMAGE SURVEY - WEST SIDE
A.700 REF: A.150 Scale: 1 : 50



RETAINING WALL - DAMAGE ASSESSMENT
Scale: 1 : 500



2 RETAINING WALL DAMAGE SURVEY - NORTH SIDE UNTIL GRID 9
A.700 REF: A.153 Scale: 1 : 50



3 RETAINING WALL DAMAGE SURVEY - NORTH SIDE FROM GRID 9 TO GRID 16
A.700 REF: A.153 Scale: 1 : 50

31 (SHOWN IN MAGENTA) 300mm OF EXPOSED HORIZONTAL REINFORCING STEEL, ROUND BAR OBSERVED, APPROX. 10mm DIAMETER BAR - LIKELY 3/8" IMPERIAL BAR SIZE.

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LEGEND
- OBSERVED SPALLING OF CONCRETE WALL
- CRACKING OBSERVED
- 21m APPROXIMATE OBSERVED LENGTH OF CRACK
- @ 0.6mm APPROXIMATE OBSERVED WIDTH OF CRACK
- 01 CRACK DIRECTION AND REFERENCE NUMBER
- -5.0% WALL LEANING TOWARDS OBSERVER
- 0% WALL LEANING AWAY FROM OBSERVER
- 0m CHAINAGE MEASUREMENT ALONG WALL

* FOR FURTHER INFORMATION ON VERTICALITY SURVEY NOTATION SEE 'VERTICALITY MEASUREMENTS KEY' ON DWG A.424

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

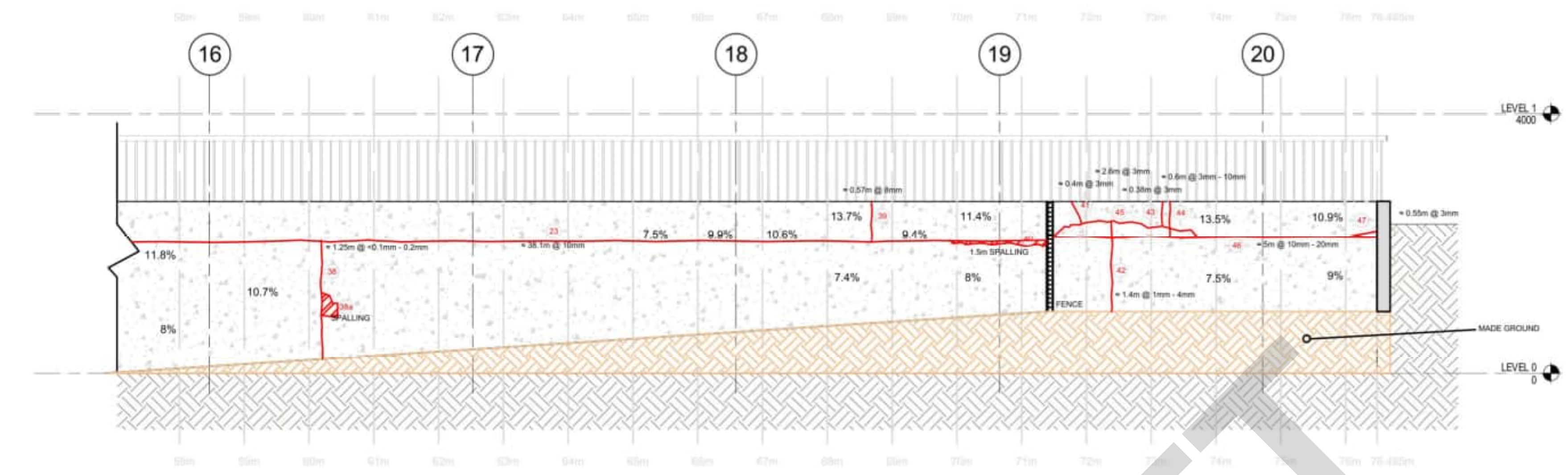
I/R	DATE	DESCRIPTION

PROJECT NUMBER
60332326

SHEET TITLE
RETAINING WALL - DAMAGE ASSESSMENT SHEET 1/2

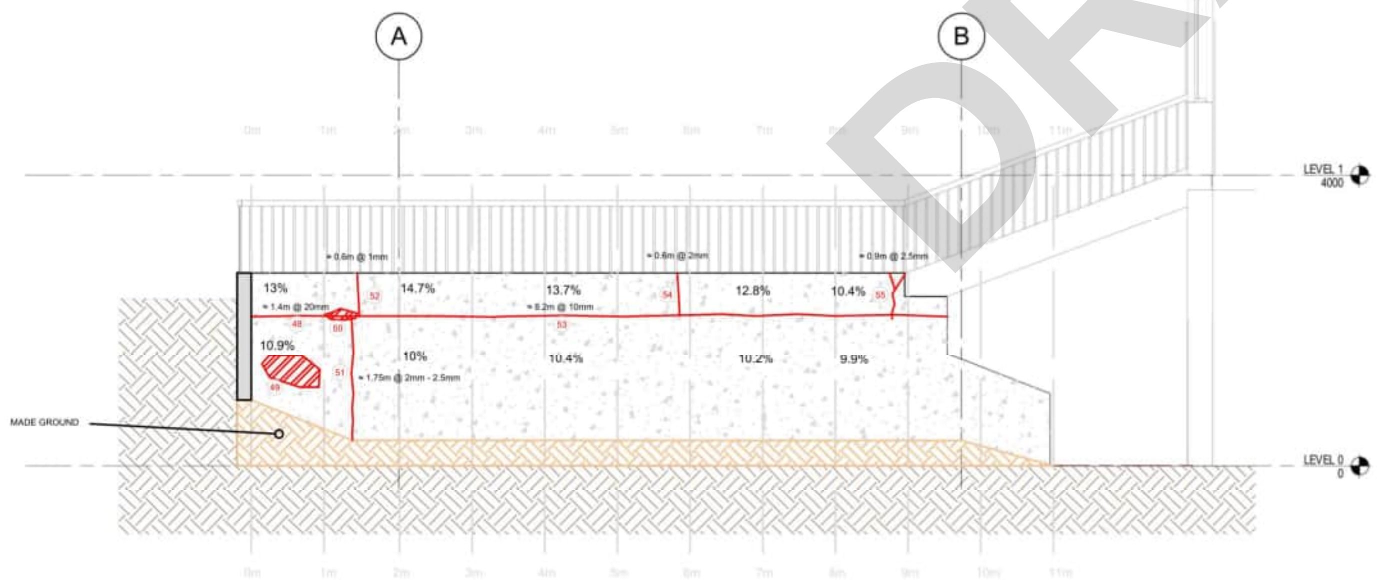
SHEET NUMBER
60332326-DRG-A-700

ISO A1 594mm x 841mm



4 | RETAINING WALL DAMAGE SURVEY - NORTH SIDE - END PART FROM GRID 16

A.701 | REF: A.153 Scale: 1 : 50



5 | RETAINING WALL DAMAGE SURVEY - EAST SIDE

A.701 | REF: A.150 Scale: 1 : 50

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LEGEND

- OBSERVED SPALLING OF CONCRETE WALL
- CRACKING OBSERVED
- 21m APPROXIMATE OBSERVED LENGTH OF CRACK
- @ 0.6mm APPROXIMATE OBSERVED WIDTH OF CRACK
- 01 CRACK DIRECTION AND REFERENCE NUMBER
- -5.0% WALL LEANING TOWARDS OBSERVER
- 8% WALL LEANING AWAY FROM OBSERVER
- 58m CHAINAGE MEASUREMENT ALONG WALL
- * FOR FURTHER INFORMATION ON VERTICALITY SURVEY NOTATION SEE 'VERTICALITY MEASUREMENTS KEY' ON DWG A.424

PROJECT MANAGEMENT INITIALS

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DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

PROJECT NUMBER

60332326

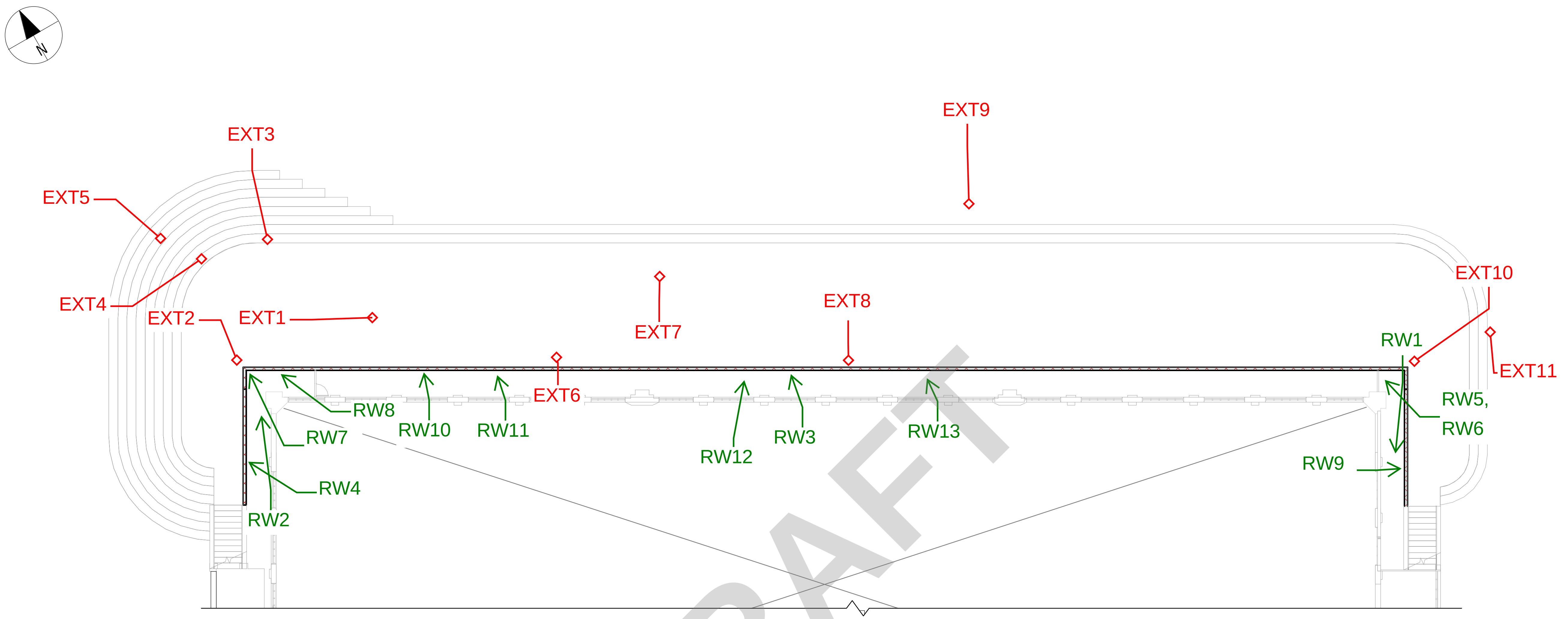
SHEET TITLE

RETAINING WALL - DAMAGE ASSESSMENT SHEET 2/2

SHEET NUMBER

60332326-DRG-A-701

ISO A1 594mm x 841mm



DAMAGE PHOTO KEYPLAN - RETAINING WALL AND CONCRETE STEPS

Scale: 1 : 150

This drawing is confidential and shall only be used for the purpose of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM quality assurance system to ISO 9001-2000.

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STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

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Key

Slab photo

Wall photo

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

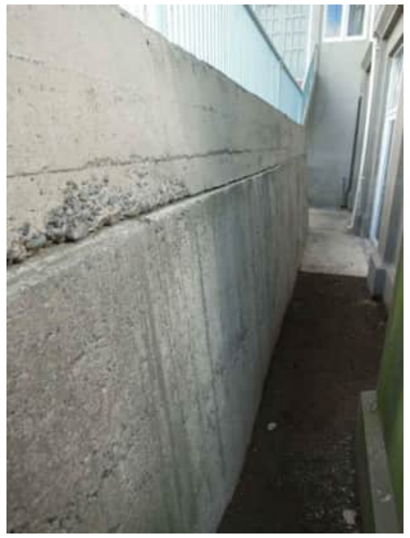
60332326

SHEET TITLE

RETAINING WALL AND EXTERNAL PATIO - DAMAGE ASSESSMENT - PHOTOS - SHEET 1

SHEET NUMBER

60332326-DRG-A-710



RW.1 / A.710 — VIEW OF RETURN OF RETAINING WALL AT EASTERN END, JOINT IS UP TO 10MM

RW.2 / A.710 — VIEW OF RETURN OF RETAINING WALL AT WESTERN END, JOINT IS 0.6MM

RW.3 / A.710 — TYPICAL AREA WITH POORLY COMPACTED CONCRETE

RW.4 / A.710 — TYPICAL CRACK FROM TOP OF WALL TO JOINT, CRACKS RANGE FROM 0.2MM TO 5MM

RW.5 / A.710 — SIGNIFICANT CRACKS UP TO 10MM AND DAMAGE TO RENDER

RW.6 / A.710 — SIGNIFICANT CRACKS BELOW STAIRS UP TO 3MM

RW.7 / A.710 — CRACK IN CORNER OF RETAINING WALL, 2MM WIDE

RW.8 / A.710 — VERTICAL CRACK FROM TOP OF WALL TO JOINT AND A HORIZONTAL CRACK RUNNING THROUGH

RW.9 / A.710 — CRACKS UP TO 2.5MM WHICH HAVE PREVIOUSLY BEEN REPAIRED BUT HAVE REAPPEARED

RW.10 / A.710 — 1.8M LONG VERTICAL CRACK, UP TO 5MM WIDE, STARTING FROM THE BOTTOM OF THE WALL

RW.11 / A.710 — SEVERE CONCRETE SPALLING

RW.12 / A.710 — APPROXIMATELY 600MM LONG VERTICAL CRACK, STARTING FROM THE TOP OF THE WALL, UP TO 3MM WIDE

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I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

RETAINING WALL AND EXTERNAL PATIO - DAMAGE ASSESSMENT - PHOTOS - SHEET 2

SHEET NUMBER

60332326-DRG-A-711

ISO A1 594mm x 841mm

RW.13 SIGNIFICANT HORIZONTAL CRACK AT JOINT AND EXPOSED REINFORCEMENT AT APPROXIMATELY 600MM FROM THE TOP OF THE WALL
A.710

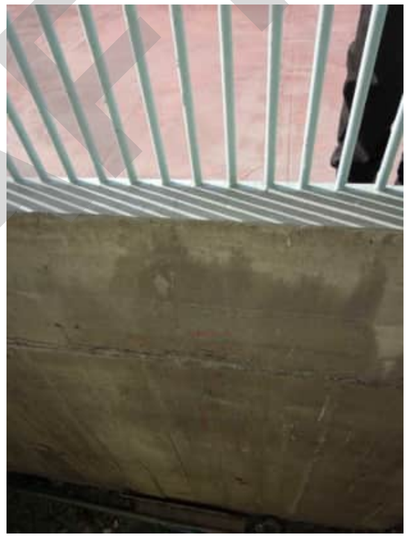
EXT.1 CRACK ALONG ENTIRE LENGTH OF SLAB
A.710

EXT.2 DAMAGE TO TOP OF RETAINING WALL AROUND CAST-IN HANDRAIL
A.710

EXT.3 CRACKS THROUGH STEPS, OCCURS THROUGHOUT
A.710

EXT.4 SEPARATION BETWEEN SLAB AND FIRST STEP UP TO 25MM
A.710

EXT.5 SPALLING DAMAGE TO TOP OF STEP
A.710



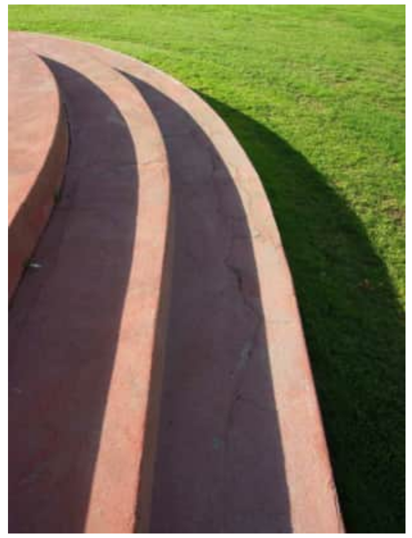
EXT.6 CRACK IN SLAB WHICH CONTINUES THROUGH RETAINING WALL
A.710

EXT.7 TYPICAL CRACK IN JOINT
A.710

EXT.8 CRACK IN SLAB AND RETAINING WALL
A.710

EXT.9 CRACK THROUGH SLAB AND STEPS
A.710

EXT.10 CRACK IN SLAB FROM CORNER OF RETAINING WALL
A.710



EXT.11 CRACK ALONG LOWER STEP
A.710

DRAFT

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I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

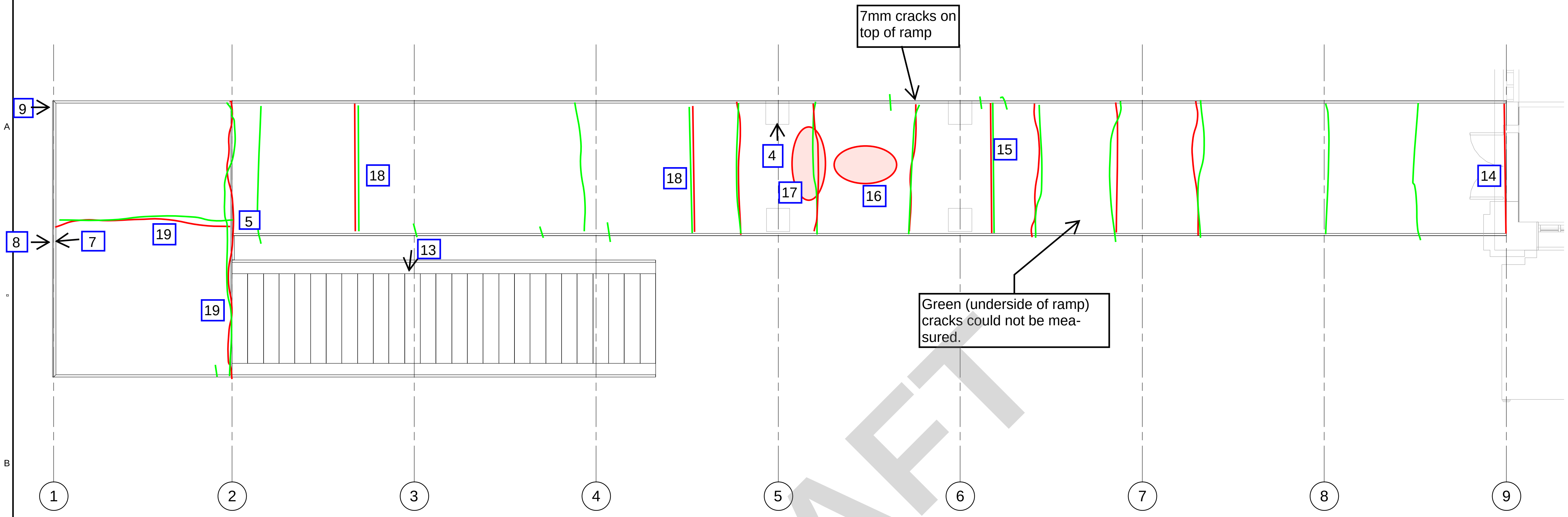
SHEET TITLE

RETAINING WALL AND EXTERNAL PATIO - DAMAGE ASSESSMENT - PHOTOS - SHEET 3

SHEET NUMBER

60332326-DRG-A-712

ISO A1 594mm x 841mm



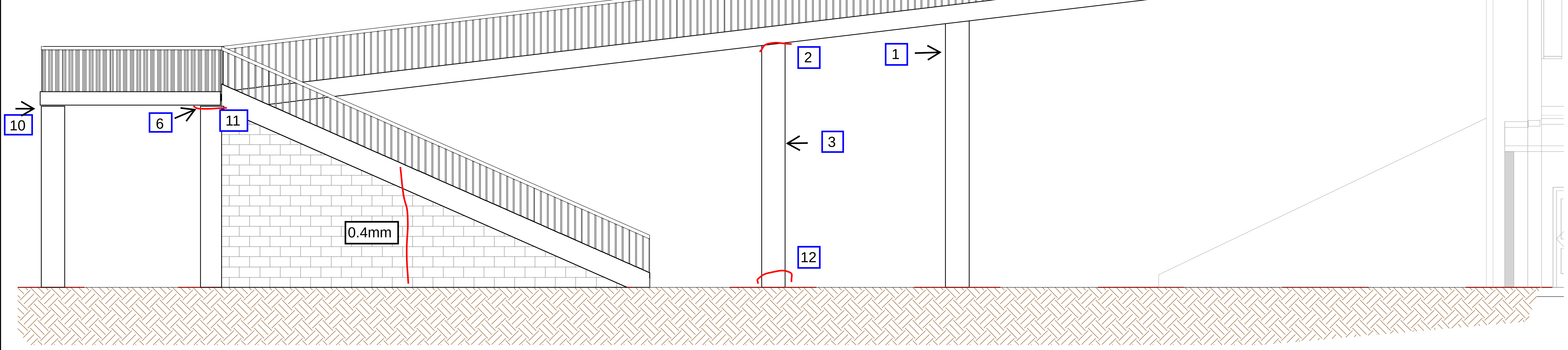
WEST RAMP DAMAGE ASSESSMENT - PLAN

(See A.150 For Location)

Scale: 1 : 50

Legend

1. 0.9mm cracks to west face of column
2. Rebar exposed at the top of column
3. VC 0.4mm east face of column
4. VC 0.3mm south face of column
5. WD, signs of corrosion
6. Steel angle retrofit, crack through slab
7. Cover falling off column
8. HC at top of column
9. HC at beam column joint
10. HC at beam column joint
11. Cracks at beam column joint
12. Spalling at base of column
13. VC 1.2mm, evidence of seepage
14. Crack through CJ
15. 6mm crack filled with filler
16. Hollow sound
17. WD
18. Crack through CJ, leaking
19. Crack that is filled with filler



WEST RAMP DAMAGE ASSESSMENT - ELEVATION

(See A.150 For Location)

Scale: 1 : 50

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Abbreviations Key

VC - Vertical crack
HC - Horizontal crack
WD - Water damage
CJ - Construction joint

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

Indicates crack observed
Face of elevation/top of ramp
Opposite elevation/bottom of ramp

PROJECT NUMBER

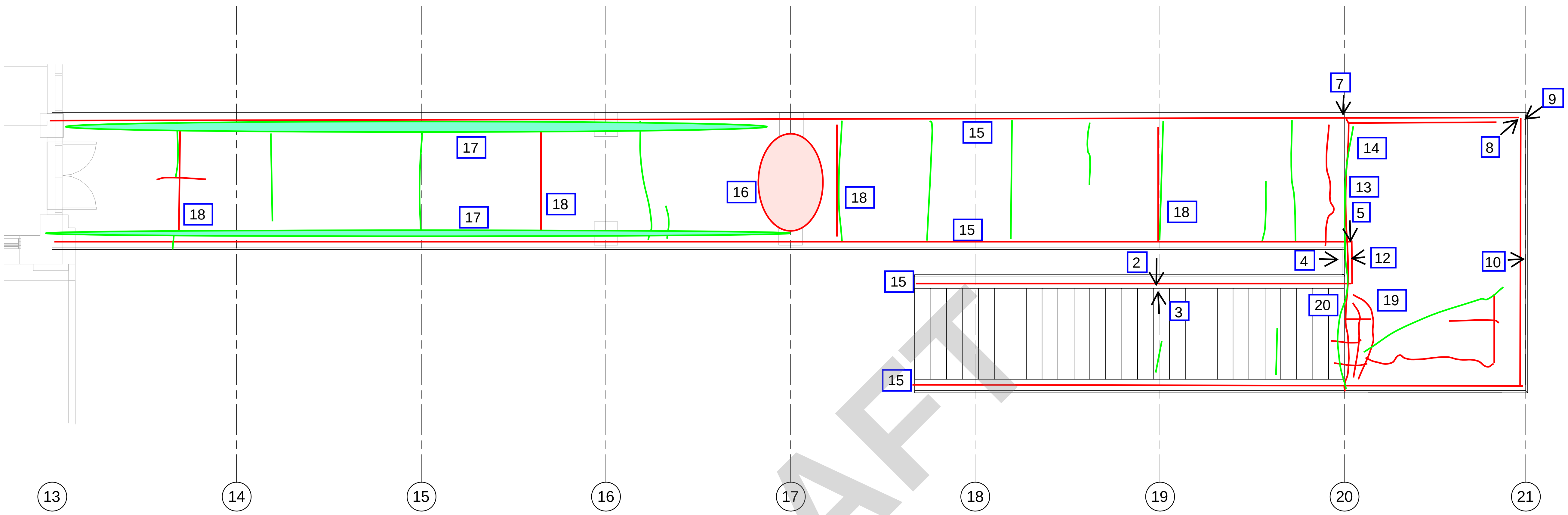
60332326

SHEET TITLE

EXTERIOR RAMPS, STAIRS AND STEPS - DAMAGE SURVEY SHEET 1

SHEET NUMBER

60332326-DRG-A-800



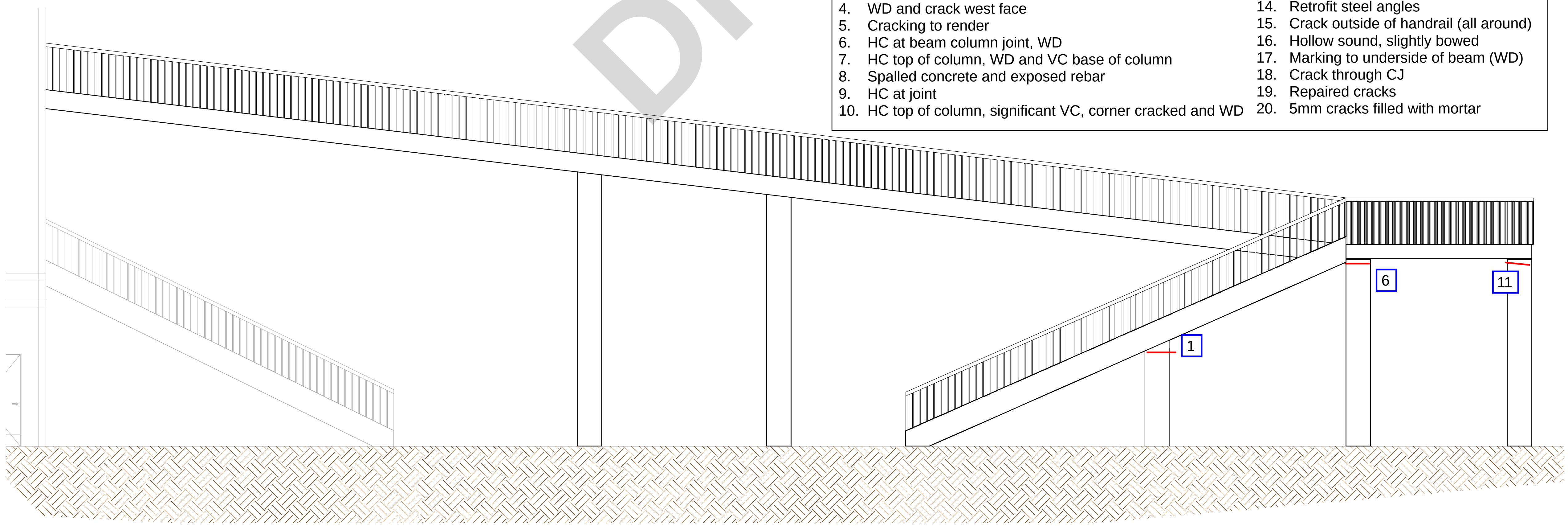
EAST RAMP DAMAGE ASSESSMENT - PLAN

(See A.150 For Location)

Scale: 1 : 50

Legend

1. Crack (0.5mm) whole way round column
2. Crack to top of column on north face
3. WD south face
4. WD and crack west face
5. Cracking to render
6. HC at beam column joint, WD
7. HC top of column, WD and VC base of column
8. Spalled concrete and exposed rebar
9. HC at joint
10. HC top of column, significant VC, corner cracked and WD
11. HC all around the top, VC two faces
12. Spalled concrete around hand rail
13. WD with apparent leaking
14. Retrofit steel angles
15. Crack outside of handrail (all around)
16. Hollow sound, slightly bowed
17. Marking to underside of beam (WD)
18. Crack through CJ
19. Repaired cracks
20. 5mm cracks filled with mortar



EAST RAMP DAMAGE ASSESSMENT - ELEVATION

(See A.150 For Location)

Scale: 1 : 50

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Abbreviations Key

VC - Vertical crack
HC - Horizontal crack
WD - Water damage
CJ - Construction joint

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

Indicates crack observed
Face of elevation/top of ramp
Opposite elevation/bottom of ramp

PROJECT NUMBER

60332326

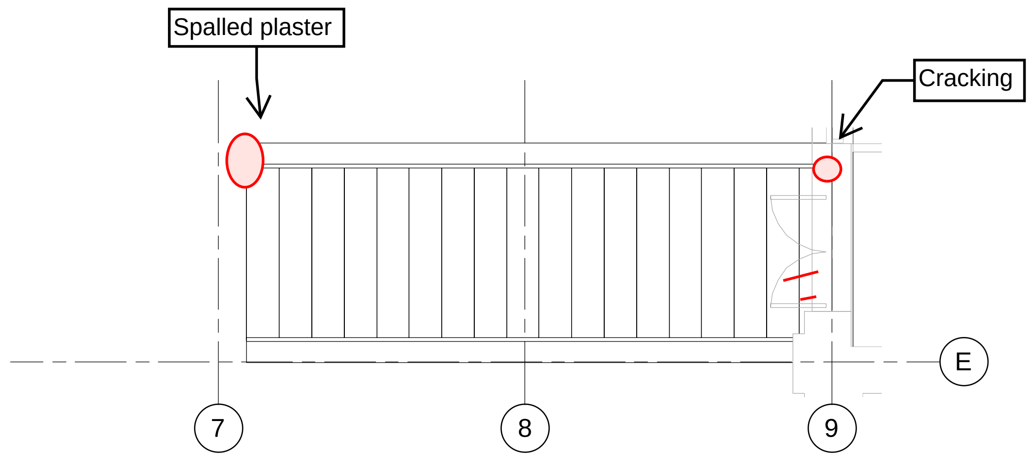
SHEET TITLE

EXTERIOR RAMPS, STAIRS AND STEPS - DAMAGE SURVEY SHEET 2

SHEET NUMBER

60332326-DRG-A-801

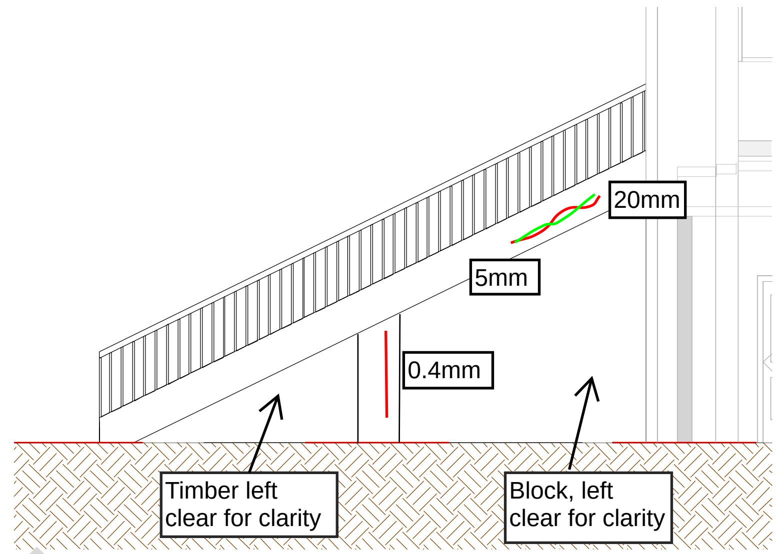
ISO A1 594mm x 841mm



STAIRS ON SOUTH ELAVATION ASSESSMENT - WEST STAIR - PLAN

(See A.152 For Location)

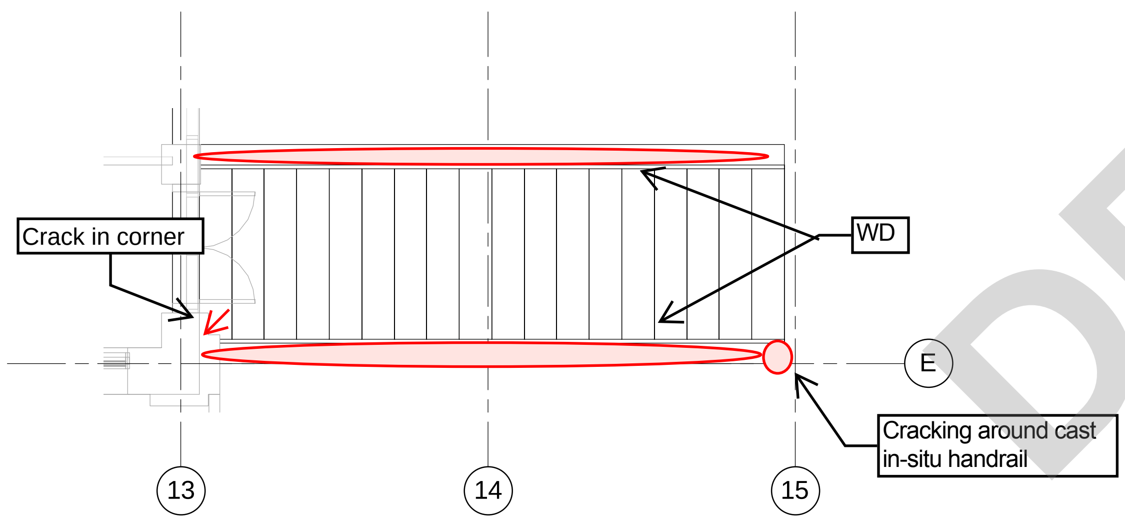
Scale: 1 : 50



STAIRS ON SOUTH ELEVATION ASSESSMENT - WEST STAIR - ELEVATION

(See A.152 For Location)

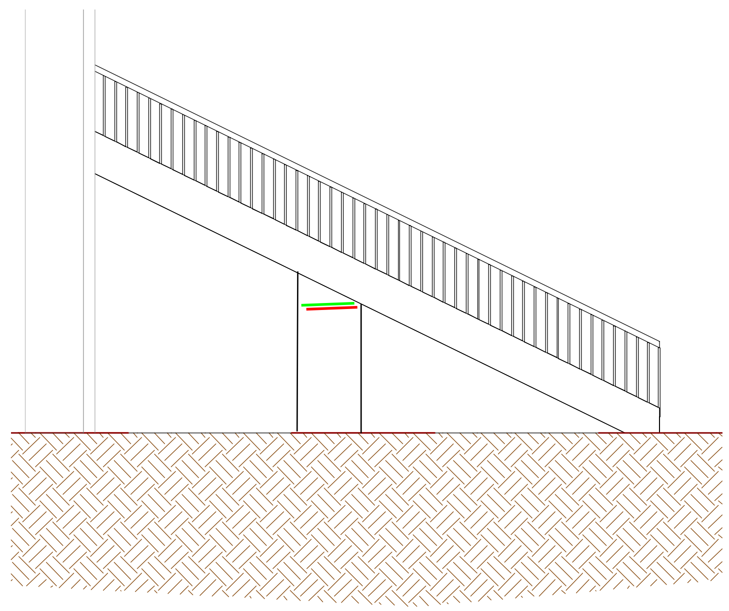
Scale: 1 : 50



STAIRS ON SOUTH ELEVATION - EAST STAIR - PLAN

(See A.152 For Location)

Scale: 1 : 50



STAIRS ON SOUTH ELEVATION - EAST STAIR - ELEVATION

(See A.152 For Location)

Scale: 1 : 50

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Abbreviations Key

VC - Vertical crack
HC - Horizontal crack
WD - Water damage
CJ - Construction joint

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

Indicates crack observed

Face of elevation/top of ramp

Opposite elevation/bottom of ramp

PROJECT NUMBER

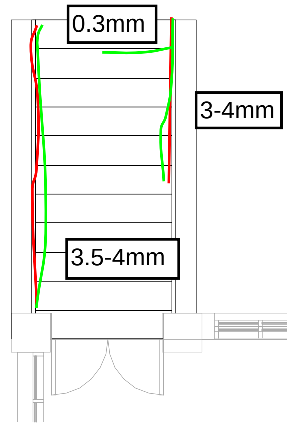
60332326

SHEET TITLE

EXTERIOR RAMPS, STAIRS AND STEPS - DAMAGE SURVEY SHEET 3

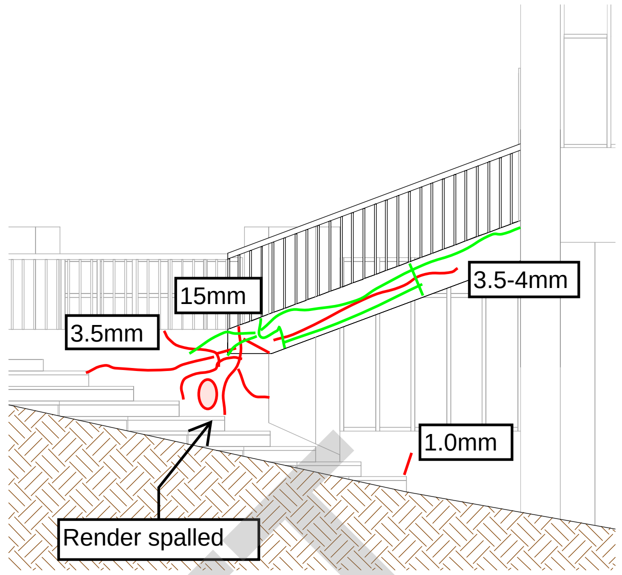
SHEET NUMBER

60332326-DRG-A-802



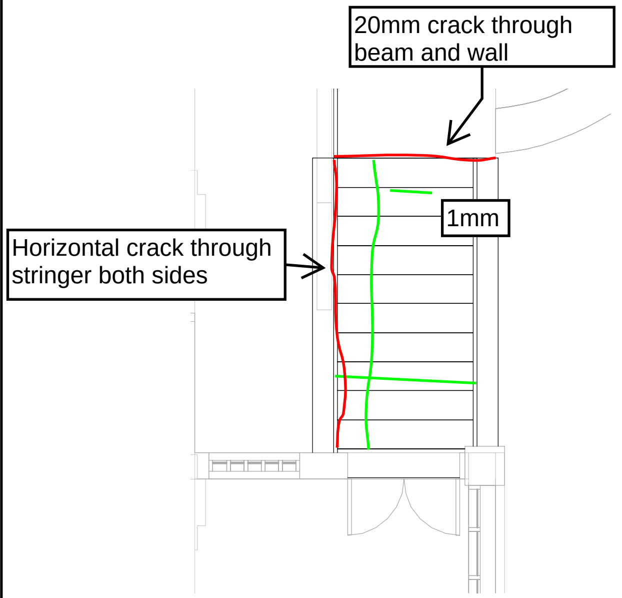
STAIRS ON SIDE ELEVATIONS - WEST STAIR - PLAN

(See A.153 For Location) Scale: 1 : 50



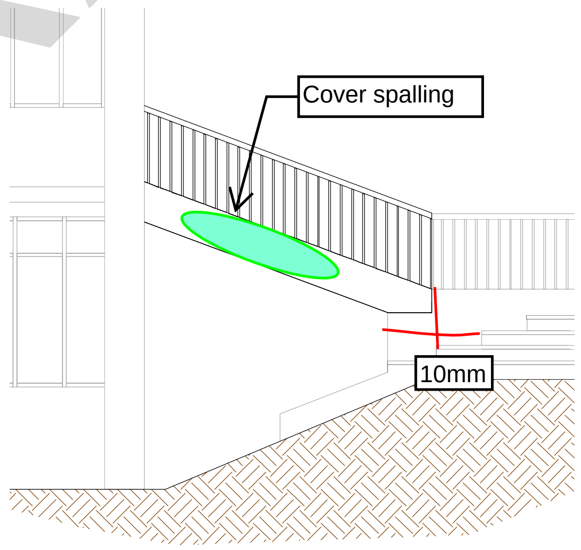
STAIRS ON SIDE ELEVATIONS - WEST STAIR - ELEVATION

(See A.153 For Location) Scale: 1 : 50



STAIRS ON SIDE ELEVATIONS - EAST STAIR - PLAN

(See A.153 For Location) Scale: 1 : 50



STAIRS ON SIDE ELEVATIONS - EAST STAIR - ELEVATION

(See A.153 For Location) Scale: 1 : 50

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Abbreviations Key

VC - Vertical crack
HC - Horizontal crack
WD - Water damage
CJ - Construction joint

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

Indicates crack observed
Face of elevation/top of ramp
Opposite elevation/bottom of ramp

PROJECT NUMBER

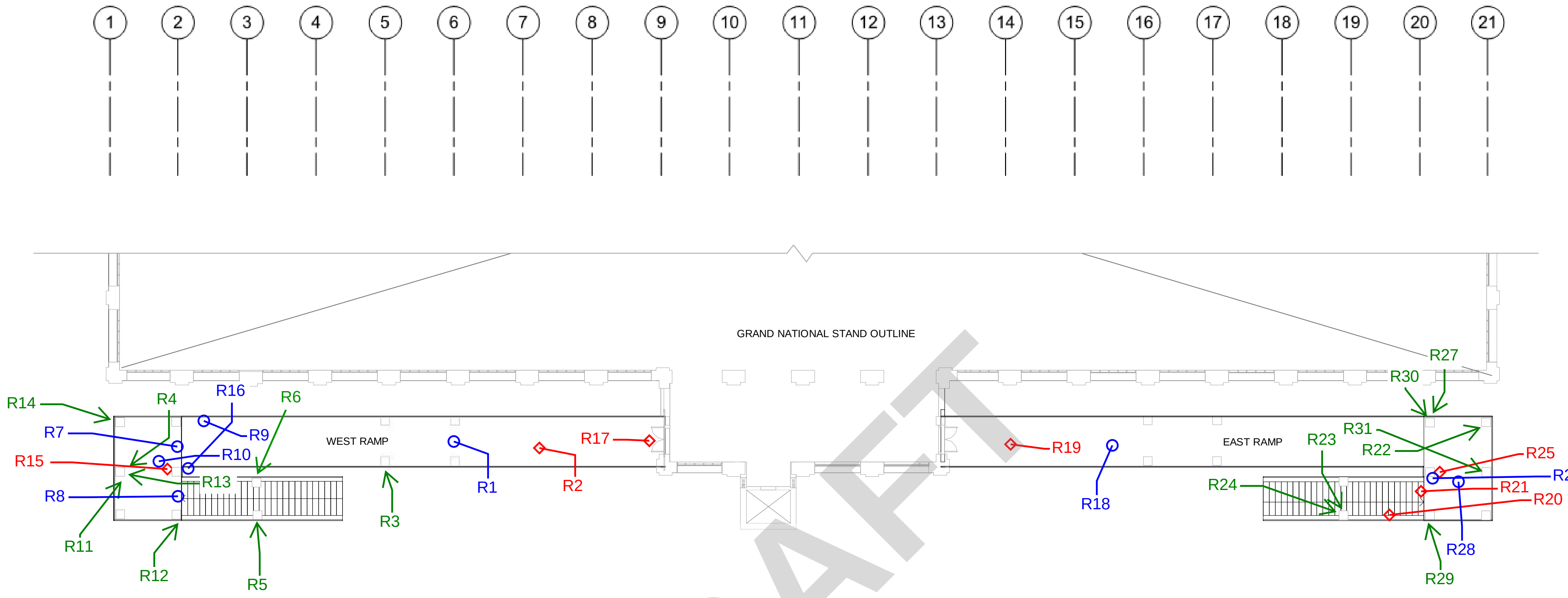
60332326

SHEET TITLE

EXTERIOR RAMPS, STAIRS AND STEPS - DAMAGE SURVEY SHEET 4

SHEET NUMBER

60332326-DRG-A-803



DAMAGE PHOTO KEYPLAN - RAMPS

Scale: 1 : 150

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Key

Photo from top of ramp

Photo of columns and beams

Photo from below ramp

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

RAMPS AND STEPS - DAMAGE ASSESSMENT - PHOTOS - SHEET 1

SHEET NUMBER

60332326-DRG-A-810

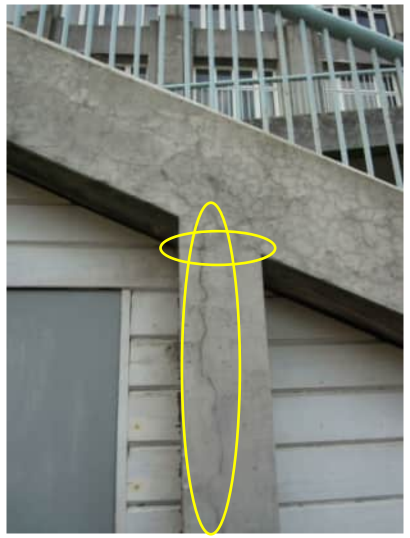
ISO A1 594mm x 841mm

R1 / A-810 TYPICAL CRACKS ON UNDERSIDE OF RAMP

R2 / A-810 TYPICAL CONSTRUCTION JOINT ON TOP SIDE OF RAMP

R3 / A-810 SPALLING EXPOSING THE REINFORCING

R4 / A-810 SPALLING EXPOSING REINFORCING ON THE CORNER OF COLUMN



R5 / A-810 VERTICAL CRACK DOWN COLUMN AND HORIZONTAL CRACK AT JOINT

R6 / A-810 VERTICAL CRACK DOWN COLUMN UP TO 1.2MM

R7 / A-810 SIGNIFICANT CRACK BETWEEN BEAM AND SLAB, BENEATH STEEL ANGLE

R8 / A-810 CRACK CONTINUES TO OTHER SIDE OF PLATFORM

R9 / A-810 HORIZONTAL CRACKS AROUND COLUMNS

R10 / A-810 SIGNIFICANT CRACK THROUGH PLATFORM

R11 / A-810 CORNER BREAKING OFF COLUMN EXPOSING REINFORCING

R12 / A-810 CRACK THROUGH BEAM COLUMN JOINT WHERE STAIRS CONNECT TO PLATFORM

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I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

RAMPS AND STEPS - DAMAGE ASSESSMENT - PHOTOS - SHEET 2

SHEET NUMBER

60332326-DRG-A-811

ISO A1 594mm x 841mm

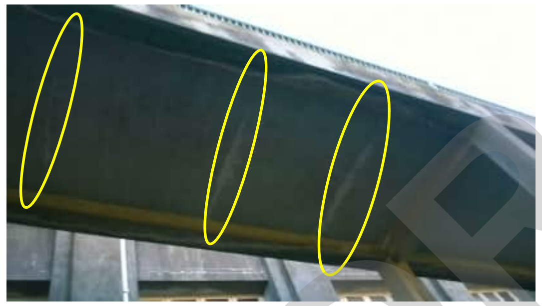
R13 / A-810 — CORNER SPALLING OFF COLUMN

R14 / A-810 — HORIZONTAL CRACK AT TOP OF COLUMN

R15 / A-810 — CRACKING THROUGH LANDING SLAB BETWEEN STAIRS AND RAMP

R16 / A-810 — MULTIPLE CRACKS TO BEAMS AND COLUMNS WHERE RAMPS CONNECTS TO LANDING

R17 / A-810 — CRACK IN SLAB WHERE THE RAMP CONNECTS TO THE BUILDING



R18 / A-810 — TYPICAL CRACKS TO UNDERSIDE OF RAMP

R19 / A-810 — TYPICAL CONSTRUCTION JOINT ON TOP SIDE OF RAMP

R20 / A-810 — CRACK/JOINT ALONGSIDE THE HANDRAIL ON TOP OF STAIR STRINGER

R21 / A-810 — MULTIPLE CRACKS TO LANDING AND STAIRS

R22 / A-810 — CORNER SPALLED OFF COLUMN EXPOSING REINFORCING

R23 / A-810 — CRACK AT TOP OF COLUMN

R24 / A-810 — MULTIPLE CRACKS AT TOP OF COLUMN

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I/R	DATE	DESCRIPTION

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PROJECT NUMBER

60332326

SHEET TITLE

RAMPS AND STEPS - DAMAGE ASSESSMENT - PHOTOS - SHEET 3

SHEET NUMBER

60332326-DRG-A-812

ISO A1 594mm x 841mm

R25 / **A-810** CRACKING TO THE BEAM AND LANDING SLAB BETWEEN THE STAIRS AND RAMP, CONCRETE BROKEN OUT AROUND HANDRAIL

R26 / **A-810** CRACK BETWEEN SLAB AND BEAM UNDER LANDING SLAB. STEEL ANGLES HAVE BEEN FITTED TO SUPPORT SLAB

R27 / **A-810** CRACK SHOWN IN PHOTO R26 CONTINUES THROUGH BEAM TO TOP OF COLUMN. VERTICAL CRACK THROUGH BEAM WHERE RAMP AND LANDING INTERSECT

R28 / **A-810** CRACK ON UNDERSIDE OF LANDING SLAB

R29 / **A-810** CRACKS TO BEAM AND COLUMN

R30 / **A-810** CRACK BETWEEN BEAM AND COLUMN

R31 / **A-810** SIGNIFICANT VERTICAL CRACK NEAR TOP OF COLUMN

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I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

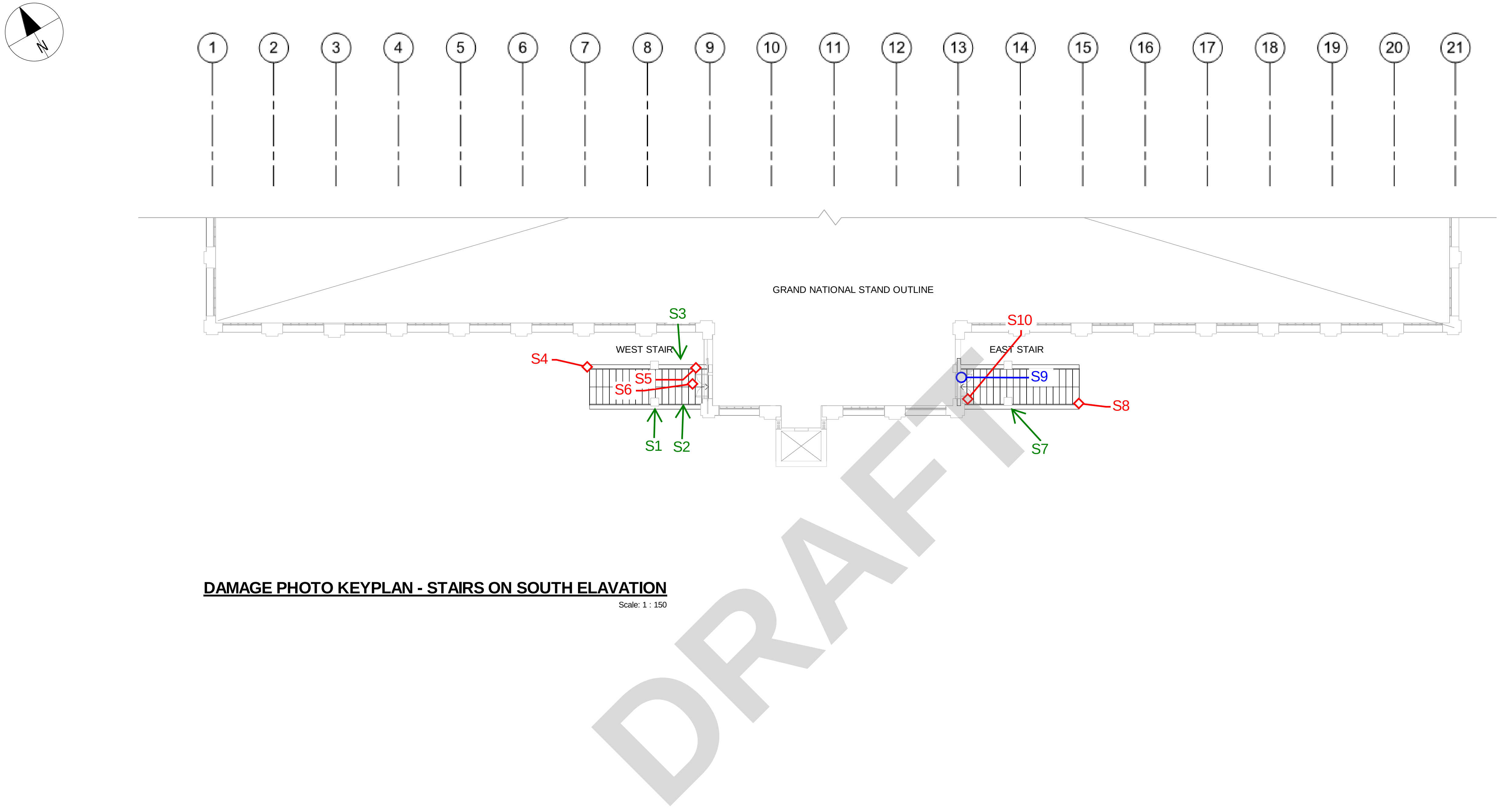
60332326

SHEET TITLE

RAMPS AND STEPS - DAMAGE ASSESSMENT - PHOTOS - SHEET 4

SHEET NUMBER

60332326-DRG-A-813



DAMAGE PHOTO KEYPLAN - STAIRS ON SOUTH ELEVATION

Scale: 1 : 150

ISO A1 594mm x 841mm

AECOM

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Key

Photo from top of ramp

Photo of columns and beams

Photo from below ramp

PROJECT MANAGEMENT INITIALS

NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

RAMPS AND STEPS - DAMAGE ASSESSMENT - PHOTOS - SHEET 5

SHEET NUMBER

60332326-DRG-A-814

ISO A1 594mm x 841mm

S1 CRACKS AT THE TOP OF THE COLUMN UP TO 0.4MM
A-814

S2 CRACK UP TO 20MM ALONG THE SIDE OF THE STRINGER
A-814

S3 CRACK UP TO 5MM ALONG THE OTHER SIDE OF THE STRINGER
A-814

S4 DAMAGE TO THE SURFACE OF THE CONCRETE AT BASE OF THE STRINGER
A-814

S5 CRACK WHERE THE STAIRS CONNECT TO THE BUILDING
A-814

S6 CRACK UP TO 1.6MM IN THE SLAB AT THE TOP OF THE STAIRS
A-814

S7 HAIRLINE HORIZONTAL CRACK AT TOP OF COLUMN AND SPALLING DAMAGE ALONG HEIGHT
A-814

S8 CRACKING AROUND WHERE HANDRAIL IS CAST INTO THE CONCRETE
A-814

S9 SEPARATION BETWEEN UNDERSIDE OF STAIRS AND THE MAIN BUILDING
A-814

S10 CRACKING IN THE CORNER WHERE THE STAIRS CONNECT TO THE MAIN BUILDING
A-814

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KEY PLAN

PROJECT NUMBER

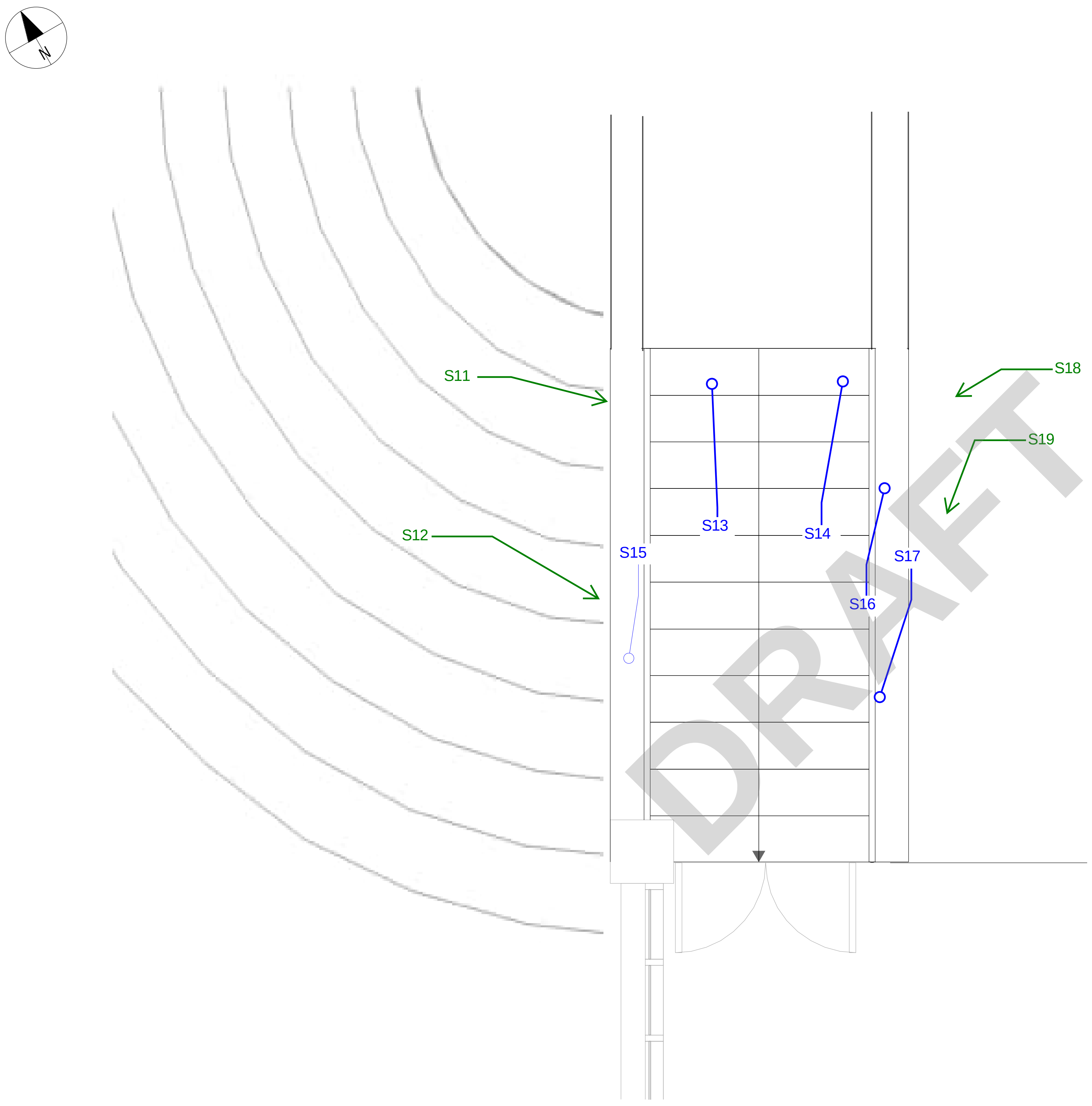
60332326

SHEET TITLE

RAMPS AND STEPS - DAMAGE ASSESSMENT - PHOTOS - SHEET 6

SHEET NUMBER

60332326-DRG-A-815



DAMAGE PHOTO KEYPLAN - STAIRS ON WEST ELEVATION

Scale: 1 : 20

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PROJECT

STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

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Key

- Photo from top of stairs
- Photo from side of stairs
- Photo from below stairs

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60332326

SHEET TITLE

RAMPS AND STEPS - DAMAGE ASSESSMENT - PHOTOS - SHEET 7

SHEET NUMBER

60332326-DRG-A-816

ISO A1 594mm x 841mm

Last Saved: 19/06/2015 3:59:44 p.m.
Filename: C:\Users\richtern\Revit Project Files\60332326_MOD_ST_2014_richtern.rvt

ISO A1 594mm x 841mm

S11 / **A-816** SIGNIFICANT CRACKS ON THE SIDE OF THE STAIRS UP TO 3.5MM WITH RENDER SPALLING OFF

S12 / **A-816** CRACK UP TO 4MM ALONG THE STRINGER

S13 / **A-816** HORIZONTAL CRACK UP TO 0.5MM ON WALL BELOW STAIRS

S14 / **A-816** VERTICAL CRACKS UP TO 0.8MM WIDE ON THE UNDERSIDE OF THE STAIRS AND DOWN THE WALL BELOW THE STAIRS

S15 / **A-816** CRACK ON UNDERSIDE OF STAIRS UP TO 4MM WIDE

S16 / **A-816** CRACK ON UNDERSIDE OF STAIRS UP TO 4MM WIDE

S17 / **A-816** CRACK ON UNDERSIDE OF STAIRS UP TO 4MM WIDE WITH LOCALISED SPALLING TO RENDER

S18 / **A-816** CRACKS UP TO 15MM AT TOP OF WALL WHERE STAIRS BEGIN

S19 / **A-816** CRACKS ALONG STRINGER AS WELL AS POORLY COMPACTED CONCRETE

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PROJECT NUMBER

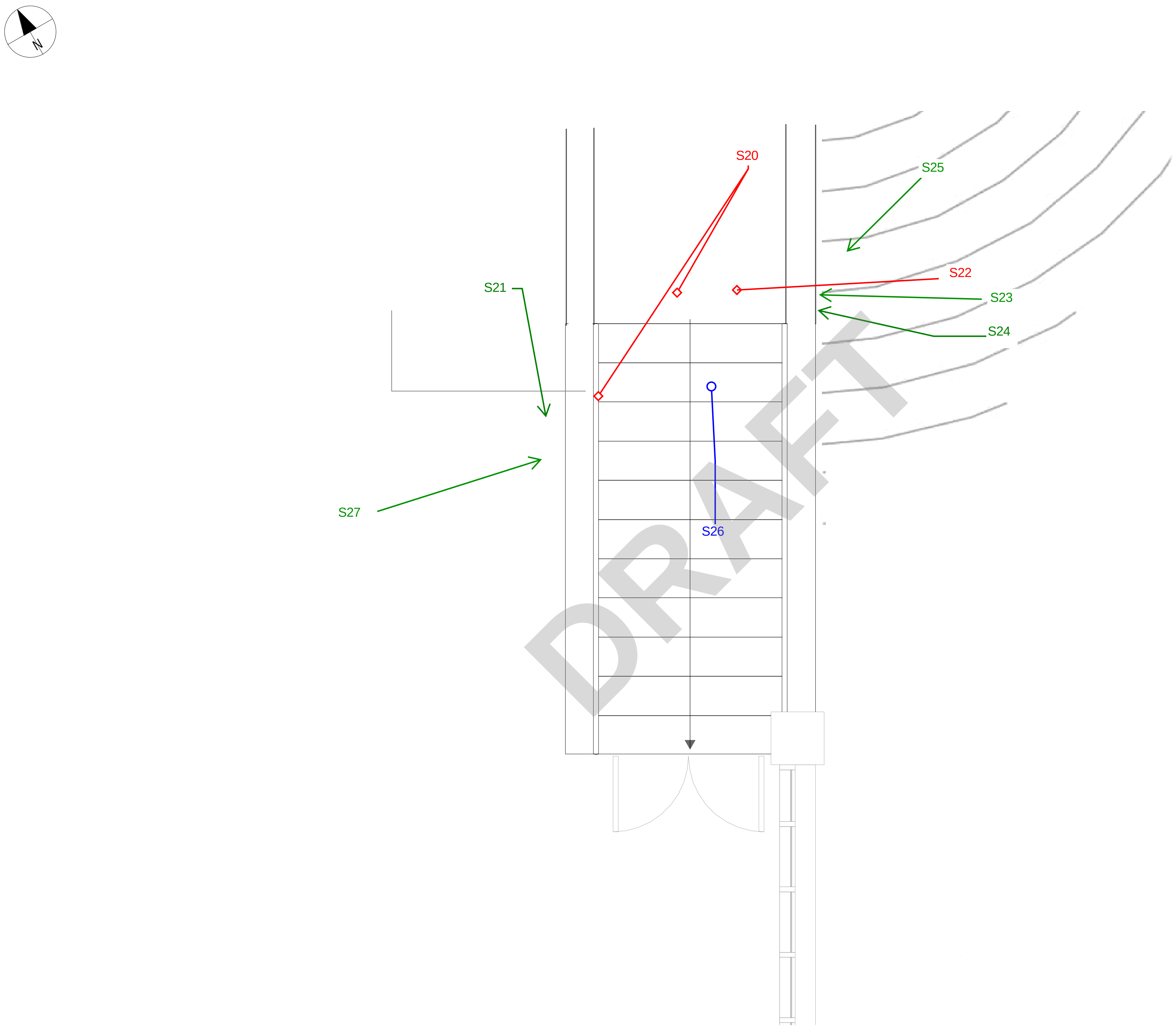
60332326

SHEET TITLE

RAMPS AND STEPS - DAMAGE ASSESSMENT - PHOTOS - SHEET 8

SHEET NUMBER

60332326-DRG-A-817



DAMAGE PHOTO KEYPLAN - STAIRS ON EAST ELEVATION

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Key

Photo from top of stairs

Photo from side of stairs

Photo from below stairs

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PROJECT NUMBER

60332326

SHEET TITLE

RAMPS AND STEPS - DAMAGE ASSESSMENT - PHOTOS - SHEET 9

SHEET NUMBER

60332326-DRG-A-818

ISO A1 594mm x 841mm

S20 A-818
SIGNIFICANT CRACK ALONG STRINGER AND ANOTHER SIGNIFICANT CRACK ACROSS LANDING SLAB AT BOTTOM OF STAIRS

S21 A-818
SIGNIFICANT CRACK ALONG STRINGER SHOWN IN PHOTO S20 IS ALSO VISIBLE ON OUTSIDE OF STAIRS

S22 A-818
SIGNIFICANT CRACK IN LANDING SLAB AT BOTTOM OF STAIRS SHOWN IN PHOTO S20 HAS EVIDENCE OF SETTLEMENT TO THE STAIR SIDE

S23 A-818
SIGNIFICANT CRACK IN LANDING SLAB AT BOTTOM OF STAIRS SHOWN IN PHOTO S22 CONTINUES INTO WALL

S24 A-818
SIGNIFICANT CRACK IN WALL WITH SPALLING UP TO 10MM WIDE

S25 A-818
HORIZONTAL CRACK ALONG WALL AT THE BOTTOM OF THE STAIRS 3MM WIDE

S26 A-818
HORIZONTAL CRACK IN WALL CONTINUES TO THE WALL BENEATH THE STAIRS

S27 A-818
HORIZONTAL CRACK IN WALL CONTINUES TO THE WALL BENEATH THE STAIRS

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CANTERBURY JOCKEY CLUB, CHRISTCHURCH

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SHEET TITLE

RAMPS AND STEPS - DAMAGE ASSESSMENT - PHOTOS - SHEET 10

SHEET NUMBER

60332326-DRG-A-819

Appendix B

Damage Observed

D R A F T

Table of Contents

D R A F T

Introduction

The following section includes descriptions of the damage which was observed during the site investigation. It covers typical damage only and does not describe every individual piece of damage. The damage can be divided into 3 types; earthquake related damage, non-earthquake related damage and historical damage which may have been exacerbated during earthquakes.

The damage is split into five types, this is related to how it was sustained and they are shown below:

A Most likely earthquake damage
B Pre-existing damage but likely to have been exacerbated by the earthquakes
B* Possible pre-existing damage definitely exacerbated by the earthquakes
C Not likely to be earthquake damage
D Cause indeterminate

Interior Frame

Ground Level

Grid A

The structure along grid A consists of a single storied reinforced concrete frame between grid 2 and grid 20.

Access to parts of this wall was restricted due to goods stored against the wall and not having access into some of the rooms. Typical damage includes poorly compacted concrete at the top of the columns and 0.2mm vertical cracks below the windows. Significant damage includes a crack up to 2.5mm under the window at grid 20.

Photo Reference	Sheet Number	Descriptions	Type of damage
0.21	A-502	View of typical grid A bay	-
0.22	A-502	View of grid 3 to 9, limited access due to stored goods blocking wall	-
0.23	A-502	0.2mm vertical crack below window between grid 2 and 3	B
0.24	A-503	Hairline horizontal crack at location of construction joint on grid 3	B
0.25	A-503	Hairline horizontal crack near top of window at grid 3	B
0.26	A-503	Typical poorly compacted concrete with exposed aggregate near top of columns	C
0.27	A-503	Vertical cracks below window between grid 13 and 14	B
0.28	A-503	Poorly compacted concrete on edge of grid 16 column	C
0.29	A-503	Hairline diagonal crack from corner of window near grid 19	A
0.30	A-503	Crack up to 2.5mm below window on grid 20	A

Grid B

The structure along grid B consists of a single story of reinforced concrete columns between grid 2 and grid 20 with a steel double I beam above. This beam is supporting the lower stand.

Grid B columns are generally undamaged. There is some damage to the top of the columns where the concrete has broken out at grid 10 and 12 and poor compaction of concrete on the column at grid 14.

Photo Reference	Sheet Number	Descriptions	Type of damage
0.31	A-503	Damage around pipe cast into column on grid 10	C
0.32	A-503	Damage to top of grid 12 column	C
0.33	A-503	Poorly compacted concrete on grid 14 column	C

D R A F T

Grid C

Grid C structure consists of a 4 storied reinforced concrete frame between grid 1 and grid 21. At level 0 Grid C is a reinforced concrete frame with columns and a beam at ceiling level. There is a large C shaped column at grid 11.

Typical damage includes hairline cracks near the top of the columns at what looks to be a construction joint. Timber panels have been nailed into the columns from grid 2 to grid 5 which has caused localised damage to the concrete around the nails. There is a significant crack in the beam at the grid 9 beam column joint. There is a separation between the columns and the GIB lined walls at grids 13, 17 and 21.

Photo Reference	Sheet Number	Descriptions	Type of damage
0.34	A-503	Typical beam and column on grid C	-
0.35	A-503	Damage around nail where timber panels are connected to the columns, occurs from grid 2 to grid 5	C
0.36	A-504	Crack near top of column, on all faces of column. Typical from grid 2 to grid 8.	B
0.37	A-504	Significant crack to beam near beam column joint on grid 9.	A
0.38	A-504	Separation between concrete wall and beam/columns between grid 12 and 13	B
0.39	A-504	Separation between grid 13 column and GIB lined wall	A
0.40	A-504	Hairline cracking to GIB lining around base of column on grid 15	A
0.41	A-504	Separation in GIB lining between grid 17 column and wall	A
0.42	A-504	Hairline cracking to GIB lining near top of column on grid 18	A
0.43	A-504	Separation to GIB lining between grid 21 column and wall	A

Grid C1

Along grid C1 at level 0 there is a brick infill wall between grid 9 and grid 10.

Photo Reference	Sheet Number	Descriptions	Type of damage
0.68	A-506	Diagonal step cracking in red brick infill panel	A

Grid D

Grid D structure consists of a four storied reinforced concrete frame between grid 1 and grid 21.

Access to the lower half of grid 6 to grid 9 restricted due to good stored in this area. Grid 1 to grid 9 was difficult to assess for cracks because the paint was peeling off in this area. Typical damage includes poorly compacted concrete near the tops of columns, some signs of moisture damage at the top of the columns, some cracking below windows and a visible separation between GIB panels below windows on grids 13-20.

Photo Reference	Sheet Number	Descriptions	Type of damage
0.44	A-504	Typical beam column joint on grid D	-
0.45	A-504	Poorly compacted concrete at top of column, typical between grids 1 and 4.	C
0.46	A-504	Horizontal and vertical crack below window between grid 4 and 5	B
0.47	A-504	Crack in construction joint on grid 5 column	B
0.48	A-505	View of grid 6-9, restricted access to lower half of wall due to storage	-
0.49	A-505	Horizontal and vertical crack below window between grid 7 and 8	B
0.50	A-505	Significant crack below window between grid 8 and 9	B
0.51	A-505	Sign of moisture damage to top of column on grid 17, also occurs at grid 20	C
0.52	A-505	Horizontal crack in wall on grid 17 in line with bottom of window	A
0.53	A-505	Typical separation between plaster board panels, occurs from grid 13 to grid 20	A
0.54	A-505	Cracks at top of grid 21 column	A

Grid E

Grid E structure consists of a four storied reinforced concrete frame between grid 9 and grid 13.

Access to grids 9-11 was restricted due to the frame being covered. Grid 12 and 13 were accessible and a crack to the beam between these grids was visible.

Photo Reference	Sheet Number	Descriptions	Type of damage
0.55	A-505	View of beam column joint at grid 13	-
0.56	A-505	Crack to beam between grid 12 and 13	B

Grid 1

Grid 1 structure consists of a four storied reinforced concrete frame between grid C and D.

Damage includes poorly compacted concrete around the window frames.

Photo Reference	Sheet Number	Descriptions	Type of damage
0.9	A-501	Poorly compacted concrete around window frame at top of grid D column	C
0.10	A-501	Poorly compacted concrete around window frame at mid-height of grid D column	C
0.11	A-501	Historical hole in top of column between grid C and D	C

DRAFT

Grid 2

Grid 2 structure consists of a shear wall from grid A to C, and a four storied reinforced concrete frame from grid C to D.

Damage includes some cracks around the windows with a significant horizontal crack along the grid B column continuing through the grid A column.

Photo Reference	Sheet Number	Descriptions	Type of damage
0.12	A-501	Pipe at top of column between grid B and C, with water damage below	C
0.13	A-502	Horizontal crack in wall between grid B and C	B
0.14	A-502	Horizontal crack at top of wall at grid B in construction joint, below cast-in steel beam	A
0.15	A-502	Horizontal crack to top of wall at grid A	A

Grid 11

Along grid 11 there is a concrete wall from grid D to grid E. The wall panel has some cracks around the openings.

Photo Reference	Sheet Number	Descriptions	Type of damage
0.66	A-506	Diagonal crack on exterior face of concrete wall	A
0.67	A-506	Vertical full height crack in concrete wall panel on interior face	B*

Grid 13

Grid 13 has a GIB lined timber framed wall between grid B and grid D. There is a horizontal crack which runs from grid C to grid D around 1m high which has been previously repaired.

Photo Reference	Sheet Number	Descriptions	Type of damage
0.16	A-502	View of grid 13 between grid C and D	-
0.17	A-502	Crack to plaster	A

Grid 20

Grid 20 structure consists of a shear wall from grid A to C, and a four storied reinforced concrete frame from grid C to D.

There are minor cracks with evidence of moisture in the door frame between grid A and B and a vertical crack in to the wall between grid B and C.

Photo Reference	Sheet Number	Descriptions	Type of damage
0.18	A-502	Cracks in door frame between grid A and B	B
0.19	A-502	Vertical crack in wall between grid B and C	A

Grid 21

Grid 21 structure consists of a four storied reinforced concrete frame between grid C and D and a two storey structure between grid B and C. There is a minor crack above door frame in the grid D column.

Photo Reference	Sheet Number	Descriptions	Type of damage
0.20	A-502	Crack above door frame at grid D	A

DRAFT

Level 1

Grid C

Very little damage from grid 2 to 20. Refer to grid 1, 2, 20 and 21 for further damage.

Photo Reference	Sheet Number	Descriptions	Type of damage
1.26	A-513	Damage to surface between grid 1 column and concrete door frame	C

Grid D

No damage.

Grid E

Vertical cracks below windows between grid E and lift shaft core, up to 0.2mm.

Photo Reference	Sheet Number	Descriptions	Type of damage
1.27	A-513	Hairline vertical crack below window between grid 9 and 10	B
1.28	A-513	Vertical crack up to 0.2mm below window at grid 11 in lift shaft extension	B
1.29	A-513	Hairline vertical crack below window between grid 12 and 13	B

Grid 1

Damage includes diagonal cracks from bottom of windows in column at grid C and horizontal crack around grid C column at mid-height.

Photo Reference	Sheet Number	Descriptions	Type of damage
1.9	A-511	0.9mm vertical crack from bottom of window in grid C column	B*
1.10	A-511	Hairline horizontal crack around grid C column at mid height	A
1.11	A-511	0.3mm diagonal crack from bottom of window in grid C column	A

Grid 2

Diagonal cracks from corners of the window.

Photo Reference	Sheet Number	Descriptions	Type of damage
1.12	A-511	Diagonal crack from top corner of window in wall between grid B and C	A
1.13	A-512	Crack from bottom corner of window in wall between grid B and C	A
1.14	A-512	Crack from bottom corner of window in grid C column	A

Grid 9

Crack in column above window frame at grid E. Significant crack between wall and column at grid D, 2-3mm wide with spalling.

Photo Reference	Sheet Number	Descriptions	Type of damage
1.15	A-512	Crack between grid D column and wall 2-3mm wide with spalling up to 25mm on surface	A
1.16	A-512	Crack in grid E column above window frame	A

Grid 12

Crack in wall below beam.

Photo Reference	Sheet Number	Descriptions	Type of damage
1.17	A-512	Horizontal crack along wall below the beam above opening	A

Grid 13

Damage is similar to that on grid 9. Crack in column above window frame at grid E. Significant crack between wall and column at grid D 1.6mm plus spalling.

Photo Reference	Sheet Number	Descriptions	Type of damage
1.18	A-512	1.6mm vertical crack between wall and column at grid D	A
1.19	A-512	Spalling of crack between wall and column at grid D	A
1.20	A-512	Crack in wall near grid E above corner of window	A

Grid 20

Damage is similar to that on grid 2. Diagonal cracks from corners of window and crack through grid C column.

Photo Reference	Sheet Number	Descriptions	Type of damage
1.21	A-512	Crack in grid C column 0.5m from top of column. Crack in wall near top of window frame.	A
1.22	A-512	Diagonal crack from bottom corner of window in grid C column	A
1.23	A-512	Diagonal crack from top corner of window in wall between grid B and C	A

Grid 21

Damage is similar to that on grid 1. There is a vertical crack from bottom corner of window in grid C column and 0.2mm horizontal crack through grid C column.

Photo Reference	Sheet Number	Descriptions	Type of damage
1.24	A-512	Horizontal crack around grid C column 1m from floor.	A
1.25	A-513	Crack in corner of grid C column below window	B*

Level 2

Grid C

Hairline cracks in some columns. 0.3-0.4mm cracks in shear wall where the wall thickens on other side. Crack between the wall and the beam between grid 19 and 20.

Photo Reference	Sheet Number	Descriptions	Type of damage
2.21	A-522	Hairline crack around grid 6 column. (Grid 3, 14 and 15 columns similar)	B
2.22	A-522	Hairline crack continues around grid 6 column. (Grid 3, 14 and 15 columns similar)	B
2.23	A-522	Vertical crack in beam above grid 5 column	A
2.24	A-522	0.3-0.4mm crack in shear wall at location where wall thickens, between grid 8-9 (grid 12-13 similar)	A
2.25	A-523	Crack in beam column joint at grid 16	A
2.26	A-523	Crack in beam column joint at grid 16	A
2.27	A-523	Multiple hairline horizontal cracks down side of column on grid 16 (grid 17 similar)	A
2.28	A-523	Crack between beam and wall between grid 19 and 20	A
2.29	A-523	Diagonal crack from corner of window in grid 20 column	A

Grid D

Hairline cracks in some columns at bottom of window. Cracks up whole height of column 21. Evidence of moisture below some windows, grid 19-21.

Photo Reference	Sheet Number	Descriptions	Type of damage
2.30	A-523	Horizontal hairline crack in column at bottom of window at grid 14 (grid 8, 17 and 19 similar)	A
2.31	A-523	0.1-0.2mm wide vertical crack below window between grid 16 and 17	A
2.32	A-523	Crazed cracks up whole height of column at grid 21	B

Grid E

Diagonal crack below window between grid 9 and 10. Cracks below window in lift shaft extension, on grid 10 and 11.

Photo Reference	Sheet Number	Descriptions	Type of damage
2.33	A-523	Hairline diagonal crack below window between grid 9 and 10 with some moisture seepage	A
2.34	A-523	Hairline crack below window in lift shaft wall on grid 10	A
2.35	A-523	Hairline crack below window in lift shaft wall on grid 11	A

Grid 1

There is a crack on the central column which continues to the exterior of the column, and a 0.1mm diagonal crack below window near grid D.

Photo Reference	Sheet Number	Descriptions	Type of damage
2.8	A-521	Crack near top of window on column between grid C and grid D	B
2.9	A-521	Crack near top of window on column between grid C and grid D continues to exterior	A
2.10	A-521	0.1mm diagonal crack from bottom of window at grid D	A

Grid 8 and 9

On the wall along grid 8 between grid C and grid D there are some vertical cracks above the doors and a horizontal crack where the wall meets the beam. At the edge of the grid D column there is a 2mm vertical crack from the window frame to the floor. There is a significant crack on grid 9 between the windows in the middle of grid D and grid E.

Photo Reference	Sheet Number	Descriptions	Type of damage
2.11	A-521	Cracks above door frame in wall along grid 8 between grid C and grid D	A
2.12	A-521	Separation between wall and beam between grid C and grid D	B
2.13	A-522	Vertical crack between grid D column and wall average 2mm, up to 3.5mm	A
2.14	A-522	Significant horizontal crack with spalling on wall between windows between grid D and grid E	A

Grid 13

Damage is similar to that on grid 9.

On the wall between grid C and grid D there are some vertical cracks above the doors and a horizontal crack where the wall meets the beam. At the edge of the grid D column there is a 0.7mm vertical crack from the window frame to the floor. There is a significant crack between the windows in the middle of grid D and grid E.

Photo Reference	Sheet Number	Descriptions	Type of damage
2.15	A-522	Separation between grid D column and wall	A
2.16	A-522	Crack in wall between grid C and grid D, between door frames	A
2.17	A-522	Separation between wall and beam between grid C and grid D	A
2.18	A-522	0.7mm vertical crack between grid D column and wall	A
2.19	A-522	Crack between windows between grid D and grid E	A

Grid 21

Hairline diagonal crack below window near grid C.

Photo Reference	Sheet Number	Descriptions	Type of damage
2.20	A-522	Hairline diagonal crack below window next to grid C column	A

D R A F T

Level 3

Grid C

Typical damage includes hairline cracks in the columns and cracks in the shear wall ranging from hairline to 0.8mm wide.

Photo Reference	Sheet Number	Descriptions	Type of damage
3.22	A-532	0.3mm diagonal crack from bottom of window at grid 2 column	A
3.23	A-532	Hairline horizontal crack 2m up the grid 9 column	A
3.24	A-532	Diagonal hairline crack in shear wall from corner or doorway at grid 10	A
3.25	A-533	0.8mm diagonal crack on back of shear wall from corner of doorway at grid 10	A
3.26	A-533	Horizontal hairline crack along shear wall from grid 10 to grid 12	A
3.27	A-533	Vertical crack in shear wall above door opening near grid 12	A
3.28	A-533	Horizontal crack around side and back of grid 13 column	A

Grid D

Typical damage includes hairline horizontal cracks around the columns at the bottom of the windows and 300mm above the bottom of the window. Some evidence of moisture on the columns and separation of the GIB wall from some window frames.

Photo Reference	Sheet Number	Descriptions	Type of damage
3.29	A-533	Horizontal hairline crack along grid 20 column at bottom of window (grid 1, 2, 3 and 21 similar)	A
3.30	A-533	Horizontal hairline crack along grid 4 column around 300mm above bottom of window (grids 1-9 and grids 14-19 similar)	A
3.31	A-533	Horizontal crack in wall below window between grid 2 and grid 3	A
3.32	A-533	Separation of GIB from window frame and horizontal crack up to 0.8mm in grid 6 column	A
3.33	A-533	Separation between column and service shaft at grid 13	A
3.34	A-533	Separation of GIB from window frame between grid 15 and 16. Grid 14 to 15 similar. These window frames differ from others along this wall	B
3.35	A-533	Vertical hairline crack below window between grid 17 and 18	A
3.36	A-533	Evidence of moisture on grid 20 column. Similar at grid 3 and 5.	A
3.37	A-534	Vertical crack above window between grid 20 and grid 21	A
3.38	A-534	0.3mm horizontal crack in grid 21 column from corner of window	A

Grid E

Some horizontal hairline cracks to columns at bottom of windows. Significant cracks where lift shaft extension connects to grid E roof beam.

Photo Reference	Sheet Number	Descriptions	Type of damage
3.39	A-534	Crack on underside of beams between grid E beam and beam for the lift shaft extension, near grid 11	A
3.40	A-534	Crack on underside of beams between grid E beam and beam for the lift shaft extension, near grid 10	A
3.41	A-534	Crack on underside of beams between grid E beam and beam for the lift shaft extension, near grid 11	A
3.42	A-534	Horizontal hairline crack on grid 12 column at bottom of window	A

Grid 1

Some hairline cracks in columns near bottom of window. Vertical cracks below windows one is up to 3mm with 15mm spalling.

Photo Reference	Sheet Number	Descriptions	Type of damage
3.15	A-532	Vertical crack below window up to 0.4mm near grid C	A
3.16	A-532	3mm vertical crack below window near grid D, crack has spalled up to 15mm	A

Grid 9

Hairline cracks in columns near bottom of window.

Photo Reference	Sheet Number	Descriptions	Type of damage
3.17	A-532	Horizontal hairline crack in grid D column at bottom of window	A

Grid 13

Hairline cracks in columns near bottom of window, top of window and in wall below window.

Photo Reference	Sheet Number	Descriptions	Type of damage
3.18	A-532	Hairline crack from corner of window in grid D column	A
3.19	A-532	Hairline crack in wall below window between grid D and E	A
3.20	A-532	Hairline crack around 300mm above bottom window in grid E column	A
3.21	A-532	Hairline crack near top of window in grid E column	A

D R A F T

Floor Slab

Ground Level

Majority of the floor slab on level 0 is exposed concrete with a thin screed coating, however due to some rooms being used for storage the slab was not always visible. A section of the carpet in the bar area was lifted and major cracks up to 15mm wide were observed. Various cracks were observed in the other areas to the coating on the slab including a crack on grid 5 which is up to 10mm wide on the surface only.

Photo Reference	Sheet Number	Descriptions	Type of damage
0.1	A-501	1.5mm wide crack	C
0.2	A-501	Damage to floor, up to 10mm wide on surface only	C
0.3	A-501	Crack in slab, up to 2mm wide	C
0.4	A-501	Minor crack in slab	C
0.5	A-501	Minor crack to surface coating only	C
0.6	A-501	Minor crack to surface coating only	C
0.7	A-501	Significant cracks in slab where carpet has been pulled up	B
0.8	A-501	Crack up to 15mm	B

Level 1

The whole of level 1 is carpeted; however in the area from grid C to grid D, between grids 18 and 19 the carpet was lifted to expose the floor slab. The top of the concrete slab between grid C and grid D has a thin screed coating. The remaining section is exposed concrete. Historical cracks above each beam were observed to the coating, up to 5mm wide on the surface. On the exposed concrete area, major cracks were observed along grid C up to 10mm wide with 5mm vertical displacement.

Photo Reference	Sheet Number	Descriptions	Type of damage
1.1	A-511	View of exposed slab	-
1.2	A-511	Location of crack between grid C columns	B*
1.3	A-511	Crack between grid C columns up to 10mm wide with 5mm vertical displacement	B*
1.4	A-511	Spalling of crack between grid C columns	B*
1.5	A-511	Crack up to 1mm perpendicular to the cracks between grid C columns	B*
1.6	A-511	Typical crack over the centre of beams running between grid C and grid D	B*
1.7	A-511	Cracks are up to 5mm on the surface	B*
1.8	A-511	Crazed crack pattern on slab between grid 4 and 5	C

Level 2

Most of the level 2 slab from grid 1 to grid 13 has been finished with a thin screed coating. Between grids 13 to 21 the slab has been carpeted. From grid 1 to grid 13 there are cracks up to 1.6mm directly above every beam, running from grid C to grid D. Between grid 1 and grid 2 there are some diagonal cracks on the corner of the building, around 0.2mm wide. In the stair area there are multiple cracks both above the beams and also between beams. The carpet was lifted from grid D to C1 between grid 19 and 20. In this area there are cracks up to 0.8mm wide which have been partially filled in.

Photo Reference	Sheet Number	Descriptions	Type of damage
2.1	A-521	Typical crack above beam on grid 7, up to 1.6mm, typical for grids 2-12	B
2.2	A-521	Crack above beam on grid 9, up to 10mm	B
2.3	A-521	Crack running diagonally across slab, up to 10mm	B
2.4	A-521	Crack above beam at construction joint up to 2.5mm	B
2.5	A-521	Cracking to slab up to 5mm	B
2.6	A-521	Crack at top of stairs up to 1.6mm	B
2.7	A-521	Partially filled cracks on slab, up to 0.8mm	B

Level 3

Level 3 is mainly carpeted apart from areas near stairs to level 2 and stairs to the top stand. These areas have a thin screed coating on the floor slab. The carpet was lifted in five areas and the floor slab in each of these areas also had a coating on the concrete. In the stair areas there are multiple cracks in the coating, up to 10mm wide on the surface. The carpet was removed between grid 1 and 2 which revealed cracks up to 2mm in the corner of the building and up to 1.8mm along grid lines 1 and 2 above the beams. Carpet was also lifted along grid 6, exposing cracks up to 5mm which have been previously repaired. Between grid 20 and grid 21 the carpet was lifted and cracks up to 0.6mm were observed at the corner of the building. Cracks up to 0.9mm were observed along grid 20. Areas of carpet were also removed around the service shafts on grid D at grid 9 and grid 13. Multiple cracks up to 5mm wide were observed in this area, some of which have been previously repaired or partially repaired.

Photo Reference	Sheet Number	Descriptions	Type of damage
3.1	A-531	Diagonal cracks at corner of building up to 3mm	B
3.2	A-531	Crack up to 0.8mm along grid 1	B
3.3	A-531	Crack along grid 2 up to 1.8mm wide	B
3.4	A-531	Diagonal crack in corner up to 1.2mm	B
3.5	A-531	Crack above grid 6 beam which has been partially repaired	B
3.6	A-531	Crack above grid 6 beam is up to 5mm wide	B
3.7	A-531	Crack in coating, spalling up to 10mm wide at surface	B
3.8	A-531	Crack in coating along top of stairs spalling up to 10mm wide at surface	B
3.9	A-531	Crack up to 5mm which has previously been partially repaired	B
3.10	A-531	Crack up to 2mm which has been previously repaired	B
3.11	A-531	Crack in coating, spalling up to 10mm wide at surface	B
3.12	A-531	Crack in coating up to 3mm wide	B
3.13	A-532	Crack along grid 20 up to 0.9mm wide	B
3.14	A-532	Cracks in corner up to 0.6mm	B

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Level 4

The level 4 floor slab was exposed apart from areas with tanks and other plant. Cracks up to 1.4mm were observed at every gridline above the beams, mainly between the steel columns.

Photo Reference	Sheet Number	Descriptions	Type of damage
4.1	A-541	Typical crack near gridline between columns	B
4.2	A-541	Crack through drainage channel, up to 1.4mm	B

Ceiling and Beams

Level 0

In the workshop area of level 0 the slab soffits and beams are exposed but painted. In the bar area the beams are lined with plasterboard and the ceiling is coated in asbestos. From grid 1 to 4 there are cracks in the corners of the bays on grid D. The beams on grid 4 to 6 have cracks underneath and up the sides. There are multiple locations where there is a void for services through the ceiling and the concrete around this has spalled, exposing the reinforcement on the underside of the slab. There is also damage where holes have been drilled into the beams and ceiling. There is little visible damage in the bar area apart from cracks in the casing at the beam column joints, and the casing around the beams is bowing outwards in some locations.

Photo Reference	Sheet Number	Descriptions	Type of damage
0.57	A-505	Vertical crack around beam on grid 4 (grid 5 and 6 similar)	B
0.58	A-505	Poorly compacted concrete along beam at grid 6 (grid 8 similar)	A
0.59	A-505	Exposed slab bottom reinforcement, in the bay between grid 8 and grid 9	B
0.60	A-506	Void on ceiling exposing the reinforcing at grid 10	B
0.61	A-506	Pipe through ceiling with spalling which has exposed reinforcing	B
0.62	A-506	Significant cracks in the ceiling near grid 12/D	B
0.63	A-506	Corner of beam on grid 10 has broken out in two locations between grid D and grid E	C
0.64	A-506	Crack in casing at beam column joint at grid 17 (grid 13, 16 and 19 similar)	A
0.65	A-506	Typical beam with casing bowing outwards	C

Level 1

Level 1 has exposed, painted beams and the slab soffit is coated in asbestos apart from in the lift/stair area where the slab soffit and beams have been plastered. There is moisture damage to the ceiling around all beam column joints on grid D. It is unclear where this moisture has come from. There a number of beams which have cracks on the bottom and sides.

Photo Reference	Sheet Number	Descriptions	Type of damage
1.30	A-513	Example of a typical vertical crack on the bottom and sides of beams	A
1.31	A-513	Typical moisture damage to ceiling at beam column joints along grid D	D

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Level 2

Grid 1 to grid 8 has exposed beams and slab soffits which have been painted. In the remaining area the beams and slab soffits have been covered with plaster. Majority of beams have multiple (up to 10) cracks along their length which are on the bottom of the beams and some continue up the sides of the beams. At grid 1 and grid 21 there are cracks in the corner of the slab. The beams supporting the stairs have cracks similar to those on the floor beams.

Photo Reference	Sheet Number	Descriptions	Type of damage
2.36	A-523	Typical cracks along length of beam	A
2.37	A-524	Typical crack in plaster finish to beam	A
2.38	A-524	Typical crack in exposed beam	A
2.39	A-524	Crack in corner of slab soffit at grid 1/C	A
2.40	A-524	Crack in corner of slab soffit at grid 1/D	A
2.41	A-524	Crack from corner of slab soffit at grid 7/C	A
2.42	A-524	Crack on beam under stairs	A
2.43	A-524	Plaster breaking off beam underneath stairs	D
2.44	A-524	Separation between column and ceiling at stairs	A
2.45	A-524	Separation between ceiling and stairs	A
2.46	A-524	Cracking to plaster in corner of slab soffit at grid 21/D	A

Level 3

Level 3 slab soffit and beams are covered in an asbestos coating apart from grid 9 to grid 13 which is covered with plaster. No cracks were visible on this level however there are multiple locations with moisture damage to the beams and ceiling particularly between grid 10 and grid 12.

Photo Reference	Sheet Number	Descriptions	Type of damage
3.43	A-534	Heater inadequately connected to ceiling – hazard	C
3.44	A-534	Moisture damage to beam and ceiling at grid 7	D
3.45	A-534	Damage to grid 9 beam	D
3.46	A-534	Moisture damage to ceiling and beam on grid 11	D
3.47	A-534	Moisture damage to beam and ceiling at grid 15	D

Exterior

South Elevation

Grid E

The grid E south elevation is four stories high from grid 9 to grid 13. Grid 10 to grid 11 contains the lift shaft. There is some spalling to the base of the columns, some of which have been repaired. There is some horizontal cracking to the walls and columns as well as spalling above the second floor windows.

Photo Reference	Sheet Number	Descriptions	Type of damage
ES1	A-550	Horizontal crack above first floor windows	A
ES2	A-550	Separation between grid 10 column and lift shaft extension	A
ES3	A-550	Damaged render above second floor window exposing reinforcement	B
ES4	A-550	Damage to render at base of grid 12 column	C

Grid D

The grid D south elevation is four stories high from grid 1 to grid 9 and from grid 13 to grid 21. Typical damage includes horizontal cracks on the columns, some minor cracking and spalling to the render and some vertical cracks below windows. There are horizontal cracks from grid 13 to grid 21 above the ground floor windows and also the first floor windows.

Photo Reference	Sheet Number	Descriptions	Type of damage
ES5	A-551	Typical crazed cracking to render	C
ES6	A-551	Typical horizontal crack below window	B
ES7	A-551	Typical vertical crack below window on ground floor	A
ES8	A-551	Typical horizontal crack above window and horizontal crack around column	B*
ES9	A-551	Vertical crack up to 0.3mm from corner of window on ground floor at grid 4 column	A
ES10	A-551	Render has broken off above door opening between grid 5 and 6	B
ES11	A-551	Spalling near top of grid 3 column exposing reinforcing	B
ES12	A-551	Spalling on side of grid 3 column exposing reinforcing	B
ES13	A-551	Crack exposing reinforcing below second floor window at grid 7	B
ES14	A-551	Exposed reinforcing above second floor window in grid 8	B

North Elevation

Grid A

The north elevation on grid A is one storey high and runs below the lower grandstand. Parts of the elevation aren't visible due to the grandstand stairs and the small timber buildings in front. Typical damage includes segregated concrete on most columns, vertical cracks up to 1.8mm in some walls below the windows and horizontal cracks in the construction joints on some columns.

Photo Reference	Sheet Number	Descriptions	Type of damage
EN1	A-553	Area of segregated concrete at base of column and wall	C
EN2	A-553	Area of segregated concrete on column face and sides	C
EN3	A-553	Spalling to corners of columns	C
EN4	A-553	Vertical crack below window	A
EN5	A-553	Crack from corner of window	A
EN6	A-553	Minor horizontal crack at location of construction joint	B
EN7	A-553	Concrete spalling with protruding steel bar at corner of grid 10 column	A
EN8	A-553	Significant horizontal crack along top of wall around 10mm wide, at location where stairs to stands have been cast into the wall	B
EN9	A-553	Significant horizontal crack and minor vertical crack above window between grid 10 and 11, at location where stairs to stands have been cast into the wall	B
EN10	A-553	Vertical crack up to 0.4mm on side of column at grid 11	C
EN11	A-553	Horizontal crack at top of grid 20 column	B

East Elevation

Grid 13

The grid 13 east elevation is four stories high from grid D to grid E. There are some hairline cracks on the grid E column. The grid D column has a visible separation between the column and the infill walls. There is a vertical crack along the wall below the third floor window which runs from grid D to grid E. There is also some cracking around where the stairs handrail is cast into the wall at the first floor.

Photo Reference	Sheet Number	Descriptions	Type of damage
EE1	A-555	Typical crack between grid D column and concrete infill wall	B*
EE2	A-555	Hairline crack to grid E column at ground level	A
EE3	A-555	Horizontal and diagonal cracks between central column and third floor wall	A
EE4	A-555	Horizontal crack along wall on the third floor	A
EE5	A-555	Cracking around cast-in handrail at the first floor	B*
EE6	A-555	Damage to lift shaft at connection to main building	A

Grid 20

The grid 20 elevation is one story high from grid A to grid C with a concrete wall above which is the side of the lower stand. There is a significant crack (also on the interior wall) from grid A to grid B. There are some hairline cracks and damage to the render on the grid A column.

Photo Reference	Sheet Number	Descriptions	Type of damage
EE7	A-555	Cracks and damage to render on the grid C column	A
EE8	A-555	Damaged concrete around door with reinforcing exposed (wall appears to have been cut to form door)	C
EE9	A-555	Damaged concrete on other side of door, reinforcing is also exposed (wall appears to have been cut to form door)	C
EE10	A-555	Significant horizontal crack along wall	B*
EE11	A-555	Continuation of crack shown in EE10 with some concrete breaking out	B*
EE12	A-555	Continuation of crack shown in EE11 through grid A column	B*
EE13	A-556	Cracking to wall above grid A column	B*

Grid 21

Grid 21 is four stories from grid C to grid D and two stories from grid C to midway between grid C and grid B. There are visible cracks in the walls below the windows and some horizontal cracks around the grid C column.

Photo Reference	Sheet Number	Descriptions	Type of damage
EE14	A-556	Cracks below window between grid C and grid D	B*
EE15	A-556	Render has broken off behind sign	B*
EE16	A-556	Evidence of rust below the third floor window	C
EE17	A-556	0.2mm crack in grid C column	A
EE18	A-556	Horizontal crack in wall and column between grid B and C	A
EE19	A-556	Horizontal crack in column between grid B and C	A

West Elevation

Grid 1

The grid 1 west elevation is four stories high from grid C to grid D and two stories high from grid C to midway between grid C and grid B. There are multiple horizontal cracks around the grid C column and the column between grid C and grid D. There is some separation between the walls and the columns. There is a continuous horizontal crack from grid C to grid D above the first floor window and some vertical cracks below the windows.

Photo Reference	Sheet Number	Descriptions	Type of damage
EW1	A-558	Significant crack above first floor window between grid C and grid D	A
EW2	A-558	1.0mm vertical crack below ground floor window	A
EW3	A-558	0.2mm horizontal crack near base of column on grid C1	A
EW4	A-558	Horizontal crack on grid C1 column above second floor windows	A
EW5	A-558	0.2mm horizontal cracks near base of grid C column	A
EW6	A-558	Separation between walls and columns	A

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Grid 2

The grid 2 elevation is one story high from grid A to grid C with a concrete wall above which is the side of the lower stand. There is a significant crack which starts as hairline at grid C and gets larger at grid A. There are some cracks below the ground floor windows.

Photo Reference	Sheet Number	Descriptions	Type of damage
EW7	A-558	Diagonal crack below window on column between grid B and grid C	A
EW8	A-558	Diagonal crack below window on column between grid B and grid C	A
EW9	A-558	Horizontal crack below window	B*
EW10	A-558	1.0mm vertical crack below window	A
EW11	A-558	Vertical crack above ground floor window between grid A and grid B	A
EW12	A-558	Horizontal crack in concrete wall of lower stand	B*
EW13	A-559	Horizontal crack near ceiling level of ground floor, on column between grid B and grid C	B*
EW14	A-559	Horizontal crack near ceiling level of ground floor on column at grid B	B*
EW15	A-559	Horizontal crack becomes wider towards grid A	B*
EW16	A-559	Horizontal crack and damaged column	B*
EW17	A-559	Horizontal crack at grid A column with spalling and evidence of rust	B*

Grid 9

Grid 9 is four stories high from grid D to grid E. There are some horizontal cracks on the grid E column and on the wall below the third floor window. There are some cracks where the stairs connect to the wall and also a separation between the grid D column and the infill walls.

Photo Reference	Sheet Number	Descriptions	Type of damage
EW18	A-559	Crack in lift shaft near floor level of first floor	B*
EW19	A-559	Separation between grid D column and infill wall	A
EW20	A-559	Horizontal crack around grid E column	A
EW21	A-559	Cracking to grid E column near where stairs connect at second floor up to 0.5mm	A
EW22	A-559	Vertical cracking to central column and separation between the column and the wall between the second and the third floor	A
EW23	A-559	Render breaking off above second floor window	B*
EW24	A-559	Cracking to the soffit at grid D	A

Ramps and Stairs

Stairs along South Elevation – Western

These stairs connect the ground level to the building at first floor. Below the stairs there is an enclosed area with block walls and weatherboard walls. There are two columns at mid-flight. There are cracks on the stringers up to 20mm wide. There is a 0.4mm vertical crack on one of the columns and some spalling at the bottom of the stairs.

Photo Reference	Sheet Number	Descriptions	Type of damage
S1	A-815	Cracks at the top of a column up to 0.4mm	A
S2	A-815	Crack up to 20mm along the side of a stringer	B*
S3	A-815	Crack up to 5mm along the side of a stringer	B*
S4	A-815	Damage to the surface of the concrete at base of the stringer	C
S5	A-815	Hairline crack where the stairs connect to the building	B*
S6	A-815	Crack up to 1.6mm in the slab at the top of the stairs	B*

Stairs along South Elevation – Eastern

These stairs are similar to the western stairs, connecting the ground level to the building at first floor. There is some damage to the column and minor damage at the bottom of the stairs where the handrail is cast-in.

Photo Reference	Sheet Number	Descriptions	Type of damage
S7	A-815	Hairline horizontal crack at top of column and spalling damage along height	B
S8	A-815	Cracking around where handrail is cast into the concrete	B
S9	A-815	Separation between underside of stairs and the main building	B*
S10	A-815	Cracking in the corner where the stairs connect to the main building	B*

Stairs on West Elevation (Grid 1)

These stairs start on the slab in front of the stands, and connect to the building at first floor between grid 1 and grid 2. The bottom of the stairs is supported by a retaining wall which continues along the entire length of the building. These stairs are significantly damaged including cracks up to 4mm along the stringers, 4mm cracks on the underside of the stairs, multiple cracks on the walls under the stairs up to 3.5mm and some spalling which exposes reinforcement.

Photo Reference	Sheet Number	Descriptions	Type of damage
S11	A-817	Significant cracks on the side of the stairs up to 3.5mm with render spalling off	B*
S12	A-817	Crack up to 4mm along the stringer	B*
S13	A-817	Horizontal crack up to 0.5mm on wall below stairs	B*
S14	A-817	Vertical cracks up to 0.8mm wide on the underside of the stairs and down the wall below the stairs	B*
S15	A-817	Crack on underside of stairs up to 4mm wide	B*
S16	A-817	Crack on underside of stairs up to 4mm wide	B*
S17	A-817	Crack on underside of stairs up to 4mm wide with localised spalling to render	B*
S18	A-817	Cracks up to 15mm at top of wall where stairs begin	B*
S19	A-817	Cracks along stringer as well as poorly compacted concrete	B*

Stairs on East Elevation (Grid 21)

These stairs start on the slab in front of the stands, and connect to the building at first floor between grid 20 and grid 21. These stairs are also significantly damaged with extensive cracking along the stringers, which is visible on both the outside and inside faces. There is a crack up to 20mm wide with spalling on the slab near the bottom of the stairs with evidence of settlement to the stair side, this crack continues vertically down the wall, up to 10mm wide. There is a horizontal crack up to 3mm wide on the east face of the wall below the stairs which continues around the retaining wall under the stairs.

Photo Reference	Sheet Number	Descriptions	Type of damage
S20	A-819	Significant crack along stringer and another significant crack across landing slab at bottom of stairs	B
S21	A-819	Significant crack along stringer shown in photo S20 is also visible on outside of stairs	B*
S22	A-819	Significant crack in landing slab at bottom of stairs shown in photo S20 has evidence of settlement to the stair side	B*
S23	A-819	Significant crack in landing slab at bottom of stairs shown in photo S22 continues into wall	B*
S24	A-819	Significant crack in wall with spalling up to 10mm wide	B*
S25	A-819	Horizontal crack along wall at the bottom of the stairs 3mm wide	B*
S26	A-819	Horizontal crack in wall continues to the wall beneath the stairs	B*
S27	A-819	Horizontal crack in wall continues to the wall beneath the stairs	B*

Western Ramp

The western ramp has multiple cracks across the width of the ramp, most of which are visible on the top and the bottom of the ramp. There are some vertical cracks in the columns, spalling to the columns exposing the reinforcement and horizontal cracks at the top of some columns. There are two steel angles which have been added to the underside of the platform where it joins to the ramp and to the stairs. Beneath these angles there is a significant crack which spans the length of the platform. On the underside of the platform there is another significant crack running the width of the platform between the ramp and the stairs.

Photo Reference	Sheet Number	Descriptions	Type of damage
R1	A-811	Typical cracks on underside of ramp	B
R2	A-811	Typical construction joint on top side of ramp	B
R3	A-811	Spalling exposing the reinforcing	B
R4	A-811	Spalling exposing reinforcing on the corner of column	B
R5	A-811	Vertical crack down column and horizontal crack at joint	B
R6	A-811	Vertical crack down column up to 1.2mm	B
R7	A-811	Significant crack between beam and slab, beneath steel angle	B
R8	A-811	Crack continues to other side of platform	B
R9	A-811	Horizontal cracks around columns	B
R10	A-811	Significant crack through platform	B
R11	A-811	Corner breaking off column exposing reinforcing	B
R12	A-811	Crack through beam column joint where stairs connect to platform	B
R13	A-812	Corner spalling off column	B
R14	A-812	Horizontal crack at top of column	B*

Photo Reference	Sheet Number	Descriptions	Type of damage
R15	A-812	Cracking through landing slab between stairs and ramp	B*
R16	A-812	Multiple cracks to beams and columns where ramps connects to landing	B*
R17	A-812	Crack in slab where the ramp connects to the building	B*

Eastern Ramp

The eastern ramp has damage similar to the western ramp with multiple cracks running transversely across the width, most of which are visible on the top and the bottom of the ramp. There is a column which has had the corner broken off, exposing the reinforcement and some horizontal crack at the tops of the columns. There is significant cracking to the upstand where the stairs are joined to the ramps as well as broken out concrete around where the handrail has been cast-in to the concrete. As on the western ramp there have been steel angles bolted to the underside of the platform, and a crack beneath these. This crack continues to a vertical crack on the side of the beam, where the ramp joins the platform. There is another significant crack running the width of the platform

Photo Reference	Sheet Number	Descriptions	Type of damage
R18	A-812	Typical cracks to underside of ramp	B
R19	A-812	Typical construction joint on top side of ramp	B
R20	A-812	Crack/joint alongside the handrail on top of stair stringer	B
R21	A-812	Multiple cracks to landing and stairs	B
R22	A-812	Corner spalled off column exposing reinforcing	B
R23	A-812	Crack at top of column	A
R24	A-812	Multiple cracks at top of column	A
R25	A-813	Cracking to the beam and landing slab between the stairs and ramp, concrete broken out around handrail	B
R26	A-813	Crack between slab and beam under landing slab. Steel angles have been fitted to support slab	B
R27	A-813	Crack shown in photo R26 continues through beam to top of column. Vertical crack through beam where ramp and landing intersect	A
R28	A-813	Crack on underside of landing slab	B
R29	A-813	Cracks to beam and column	A
R30	A-813	Crack between beam and column	A
R31	A-813	Significant vertical crack near top of column	A

Slab and stairs in front of stand

The slab and stairs in front of the stand are ground bearing and the southern edge is supported by a retaining wall. There is a central crack which runs the whole length of the slab and multiple cracks running transversely across the width of the slab, some of which continue through the steps and the retaining wall. The cracks range from hairline to 30mm wide and some of the cracks have previously been filled with sealant.

Photo Reference	Sheet Number	Descriptions	Type of damage
EXT.1	A-712	Crack along entire length of slab	B
EXT.2	A-712	Damage to top of retaining wall around cast-in handrail	B
EXT.3	A-712	Cracks through steps, occurs throughout	B
EXT.4	A-712	Separation between slab and first step up to 25mm	B
EXT.5	A-712	Spalling damage to top of step	C
EXT.6	A-712	Crack in slab which continues through retaining wall	B
EXT.7	A-712	Typical crack near joint	B
EXT.8	A-712	Crack in slab and retaining wall	B
EXT.9	A-712	Crack through slab and steps	B
EXT.10	A-712	Crack in slab from corner of retaining wall	B
EXT.11	A-712	Crack along lower step	D

D R A F T

Retaining Wall

The retaining wall in front of the stands has been cast in two sections with the non-retaining top section being approximately 600mm deep. The top section has separated from the bottom section. There are a number of areas of poor quality concrete with timber and large pieces of demolition waste in the concrete. The typical cracking is vertical cracks in either the top or bottom section. The wall has bowed at mid height towards the stand.

Photo Reference	Sheet Number	Descriptions	Type of damage
RW.1	A-711	View of return of retaining wall at eastern end, joint is up to 10mm	B
RW.2	A-711	View of return of retaining wall at western end, joint is 0.6mm	B
RW.3	A-711	Typical area with poorly compacted concrete	C
RW.4	A-711	Typical crack from top of wall to joint, cracks range from 0.2mm to 5mm	B
RW.5	A-711	Significant cracks up to 10mm and damage to render	B
RW.6	A-711	Significant cracks below stairs up to 3mm	B
RW.7	A-711	Crack in corner of retaining wall, 2mm wide	B
RW.8	A-711	Vertical crack from top of wall to joint and a horizontal crack running through	B
RW.9	A-711	Cracks up to 2.5mm which have previously been repaired but have reappeared	B
RW.10	A-711	1.8m long vertical crack, up to 5mm wide, starting from the bottom of the wall	B
RW.11	A-711	Severe concrete spalling	C
RW.12	A-711	Approximately 600mm long vertical crack, starting from the top of the wall, up to 3mm wide	B
RW.13	A-712	Significant horizontal crack at joint and exposed reinforcement at approximately 600mm from the top of the wall	D

D R A F T

Shear Walls

Level 2

This shear wall element runs along grid C from grid 8 to grid 14 between level 2 and level 3. There are columns at each grid line and door openings within the panels between grid 8 and 9 and between grid 13 and 14. There are a number of horizontal cracks to the columns at various heights. The panels have horizontal cracks at mid height and have separated from the columns.

Photo Reference	Sheet Number	Descriptions	Type of damage
2.47	A-524	Cracking to column at grid 9	A
2.48	A-524	Cracking to column at grid 13 and adjacent shear wall	A
2.49	A-525	Cracking to top of column at grid 13	A
2.50	A-525	Concrete segregation at the bottom of shear wall	C
2.51	A-525	Vertical 3.5mm wide crack to shear wall	A

Level 3

This shear wall element runs along grid C from grid 2 to grid 20. From grid 9 to grid 13 the wall is full height from level 3 to level 4. Openings have been made in the wall from grid 2 to grid 9 and grid 13 to grid 20, leaving columns on each grid line and beams of varying depths. There is a horizontal crack near the top of the wall which runs the entire length through a pour line. Around mid-height of the panels is a horizontal crack that runs from the corners of the larger voids, up to 2.5mm wide. The trusses that extend over the grandstand are cast into the columns. There are vertical cracks running from the bottom of the cast beam run to the edges of the column. Where the shear wall has had voids broken out a top beam has been cast to create a square surface. The concrete quality and joining to the shear wall is of poor quality and proper bond is not achieved. Between grid 12 and 13 there is water ingress coming through the cracks.

Photo Reference	Sheet Number	Descriptions	Type of damage
3.48	A-534	Horizontal cracks to shear wall. Upper crack is through pour line. Lower crack is 0.2 to 0.5mm wide	B
3.49	A-535	Multiple cracks to shear wall. Upper crack is through pour line. Vertical crack under truss is 1.2mm wide. Poor quality concrete in beam at bottom. Middle horizontal crack is 1.8 to 2mm wide	B
3.50	A-535	Upper crack is through pour line. Poor quality concrete at bottom. Middle horizontal crack 0.8 to 1.6mm wide	B
3.51	A-535	Poor quality concrete on grid 4 with 2mm wide horizontal crack	B
3.52	A-535	Poor quality concrete between two voids	B
3.53	A-535	Water ingress damage at grid 13 through cracking at top	D
3.54	A-535	Full height vertical crack up to 15mm wide	A

Level 4

This shear wall element runs along grid C from grid 2 to grid 20 between level 3 and the roof trusses. There is a door opening between grid 12 and grid 13 and there are buttress walls at each end. The shear wall has undergone significant out of plane loading and has vertical and horizontal cracks. On the external face of the shear wall a hairline horizontal crack runs the entire length of the wall. At the steel column locations the shear wall has cracked vertically, these vary between full height or mid height cracks. Near grid 6 there is a significant vertical crack that continues down to the shear walls on the levels below. On the inside there is a hairline horizontal crack running nearly the full length of the wall. Above this a horizontal crack that follows a pour line along the wall. The central concrete column which acts as ventilation column has multiple significant horizontal cracks and has separated from the shear wall. The two end buttress shear walls have poor concrete that has spalled badly.

Photo Reference	Sheet Number	Descriptions	Type of damage
4.1	A-541	Typical crack near grid line between steel columns	B
4.2	A-541	Crack through drainage channel, up to 1.4mm	B
4.3	A-541	Concrete column has separated from the shear wall. The column has multiple horizontal cracks showing it has been bent in flexure	B*
4.4	A-541	Crack running from the steel column vertically	A
4.5	A-541	Poor quality concrete over hanging the floor slab	C
4.6	A-541	Vertical cracks near the connection between shear wall and buttress. Poor concrete around the connection	A
4.7	A-541	Vertical crack on the external face of the shear wall at grid 6, running parallel to the steel column on internal face	A
4.8	A-541	Vertical crack on the external face of the shear wall running parallel to the steel column on internal face	A
4.9	A-541	Vertical crack on the external face of the shear wall running parallel to the steel column on internal face	A
4.10	A-541	Vertical crack on the external face of the shear wall running parallel to the steel column on internal face	A
4.11	A-541	View of the western wing wall from upper stand showing damage around connection of shear wall to buttress wall	B*

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Stands

Lower

The lower stand flooring and seating is constructed out of timber supported by steel beams and concrete columns. The visible timber is showing significant signs of deterioration. Most of the timber floors and seating shows signs of borer damage. The flooring is showing signs of wet rot. The balustrade along the front which is cast into the concrete wall has cracked the adjacent concrete.

Photo Reference	Sheet Number	Descriptions	Type of damage
2.52	A-525	Lower stand slab edge cracking	B
2.53	A-525	Lower stand damage to the timber decking	C
2.54	A-525	Lower stand slab edge cracking	B

Upper

The upper stand flooring and seating is constructed out of timber supported by a steel truss which is connected into the main reinforced concrete frame. The timber is showing significant signs of deterioration. Most of the timber floors and seating shows signs of borer damage. The flooring is showing signs of wet rot. Some of the timber blocking in the truss system has fallen out and has been and being caught by the anti-bird netting.

Photo Reference	Sheet Number	Descriptions	Type of damage
4.12	A-541	Deterioration of the timber flooring	C
4.13	A-542	Deterioration of the timber flooring and seating	C
4.14	A-542	Loose timber pieces caught in the protective mesh	B*
4.15	A-542	Damage to interface between column and timber infill	A

Appendix C

Intrusive Actions and Initial Observations

Intrusive Actions

Ground Floor (Level 0)

Table C- 1: Intrusive actions at level 0

Item	Intrusive investigation instruction	Follow Up
L0.1	Remove ceiling tiles	Tiles removed. No damage was found.
L0.2	Provide access	Access provided. Area assessed for damage.
L0.3	Provide access	Access has not been provided to room 5 (not assessed for damage). Access provided to room 6 and assessed. Refer plans for location.
L0.4	Provide access	Access provided. Area assessed for damage.
L0.5	Reinforcement scanning at beam-column joint	Column in gridline C3 scanned on northern face. Beam reinforcement scanned on the northern face adjacent to gridline 2 to avoid services. Column scanned on the eastern face at gridline C5. Beam underside scanned in gridline C5-6. See section 5.3 and Appendix G for results.
L0.6	Expose reinforcement at beam-column joint	Concrete exposed at gridline D5 rather than D3 as specified in the intrusive investigation report on client representative request. See section 4.1 for results.
L0.7	Provide access	Access has not been provided (barrels not removed). Area has not been assessed for damage.
L0.8	Carpet lift	Carpet has been lifted between gridline 18 and 19 as opposed to gridline 19 and 20 as specified in the intrusive investigation report. Refer to A-401 for damage assessment of the exposed area.

Level 1

Table C- 2: Intrusive actions at level 1

Item	Intrusive investigation instruction	Follow Up
L1.1	1. Carpet lift 2. Extract three core samples 3. Extract two rebar samples from slab	1. Carpet has been lifted between grid 3 and 6. 2. Cores have been taken. 3. Four rebar samples have been taken. Refer to A-402 for damage assessment of the exposed area. See section 5.1/5.2for results of material testing.

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Item	Intrusive investigation instruction	Follow Up
L1.2	Expose reinforcement at shear wall	Concrete exposed, no vertical reinforcement found, one horizontal reinforcement bar found approximately 12mm. See section 4.1.
L1.3	Expose reinforcement at shear wall	Concrete exposed, no vertical reinforcement found, one horizontal reinforcement bar found approximately 12mm. See section 4.1.
L1.3a	Expose reinforcement at stairs	Concrete exposed, steel beam encased in concrete on the edges of stair. Top of the stair support two vertical 19mm bars. Base of stair in between steel beams a 19mm longitudinal bar in line with support.
L1.4	Scan reinforcement at beam-column joint	Column in gridline C5 scanned on south and east face. Beam reinforcement scanned on the east, south and underside faces. See section 5.3 and Appendix G for results.

Level 2

Table C- 3: Intrusive actions locations at level 2

Item	Intrusive investigation instruction	Follow Up
L2.1	1. Carpet lift 2. Extract three core samples 3. Extract two rebar samples from slab	1. Extent of carpet lift has been reduced to grid 19 to 20 2. Cores have been taken. 3. Rebar samples have been taken. Refer to A-405 for damage assessment of the exposed area. See section 5.1/5.2 for results of material testing.
L2.2	Reinforcement scanning	Column in gridline C3 scanned on south face. Beam reinforcement scanned on the east face and beam/wall scanned on the south face. See section 5.3 and Appendix G for results.
L2.3	Reinforcement scanning	Column in gridline D3 scanned on north face. See section 5.3 and Appendix G for results.
L2.4	Reinforcement scanning	Column in gridline D2 scanned on north face. Beam reinforcement

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Item	Intrusive investigation instruction	Follow Up
		scanned on the north face. See section 5.3 and Appendix G for results.

Level 3

Table C- 4: Intrusive actions locations at level 3

Item	Intrusive investigation instruction	Follow Up
L3.1	1. Carpet lift 2. Extract three core samples 3. Extract one rebar sample from slab	1. Carpet has been lifted between grid line 1 and 2. 2. Cores have been taken. 3. Rebar sample has been taken. Refer to A-406 for damage assessment of the exposed area. See section 5.1/5.2 for results of material testing.
L3.2	Carpet lift	Carpet has been lifted along grid line 6, area assessed for damage and shown in A-406.
L3.3	Carpet lift	Carpet tiles have been lifted around the grid D9 column, area assessed for damage and shown in A-407.
L3.4	Remove plasterboard from service shaft	Plasterboard has been removed around column D9.
L3.5	Carpet lift	Carpet tiles have been lifted around the grid D13 column, area assessed for damage and shown in A-407
L3.6	Remove plasterboard from service shaft	Plasterboard has been removed around column D13.
L3.7	1. Carpet lift 2. Extract three core samples 3. Extract one rebar sample from slab	1. Carpet has been lifted between grid line 1 and 2. 2. Cores have been taken. 3. Rebar sample has been taken. Refer to A-407 for damage assessment of the exposed area. See section 5.1/5.2 for results of material testing.
L3.8	Remove plasterboard from shear wall	Plasterboard has been removed, wall assessed for damage see A-422 for damage assessment. Additionally four cores have been taken for testing.
L3.9	Reinforcement scanning	Column in gridline E12 scanned on north face. Beam along grid 12 reinforcement scanned on the east face and underside. Beam along

Item	Intrusive investigation instruction	Follow Up
		grid E12-13 scanned on the north face. Slab scanned also. See section 5.3 and Appendix G for results.
L3.10	Reinforcement scanning	Column in gridline D16 scanned on north face. Beam along grid 16 reinforcement scanned on the east face and underside. Beam along grid D16-17 scanned on the north face. See section 5.3 and Appendix G for results.

Level 4

Table C- 5: Intrusive actions locations at level 4

Item	Intrusive investigation instruction	Follow Up
L4.1	1. Extract three core samples from the slab. 2. Extract two straight rebar samples.	1. Cores have been taken. 2. Rebar samples have been taken. See section 5.1/5.2 for results of material testing.
L4.2	1. Extract three core samples from the slab. 2. Extract two straight rebar samples.	1. Cores have been taken. 2. Three rebar samples have been taken. See section 5.1/5.2 for results of material testing.
TS.1	1. Expose reinforcement to shear wall 2. Extract three core samples from the slab. 3. Extract two straight rebar samples.	1. Concrete cover has been removed. Reinforcement has been exposed. 2. Cores have been taken. 3. Three rebar samples have been taken. See section 5.1/5.2 for results of material testing.

Further Intrusive Works

Table C- 6: Intrusive actions dated 28th May 2015

Item	Level	Location	Instruction	Follow up
1	0	Column D4	Scabble until reaching reinforcement but not more than 100 mm.	Concrete scabbled to expose 12mm links at 350mm, 180mm and 370mm spacings.

Table C- 7: Intrusive actions dated 19th June 2015

Item	Level	Location	Instruction	Follow up
1	0	Column C7 footing	Excavate pit approximately 2m x 2m.	Excavated a 2.2m x 1.9m pit. Depth of 1.4m with 0.1m slab. 0.77m x 0.76m plinth exposed beneath the column. Didn't expose to base.
2	0	D7 strip footing	Excavate pit approximately 3m x 0.5m	Excavated a 2.6m x 1.35m pit. Depth of excavation 0.95m, no base detected.

Table C- 8: Intrusive actions dated 24th June 2015

Item	Level	Location	Instruction	Follow up
1	0	Beam C2-3	Scabble until reaching reinforcement but not more than 100 mm. 2 slots.	Scabbled concrete. One 19mm bar with 90mm cover to base and 130mm cover to side.
2	1	Beam C3-4	Scabble until reaching reinforcement but not more than 100 mm. 2 slots.	Scabbled concrete. One 19mm bar with 100mm cover to base and 120mm cover to side. Only one vertical slot done.
3	2	Column D2	Scabble until reaching reinforcement but not more than 100 mm. 2 slots.	Scabbled concrete. No reinforcement within 100mm deep vertical slot and 70-80mm deep horizontal slot.
4	2	Beam D2	Scabble until reaching reinforcement but not more than 100 mm. 1 slot.	Scabbled concrete. Exposed flange of a steel beam with 75mm cover from base.
5	3	Column D18	Scabble until reaching reinforcement but not more than 100 mm. 2 slots.	Scabbled concrete. No reinforcement found in slot.
6	2	Beam C3-4	Scabble until reaching reinforcement but not more than 100 mm. 1 slot.	Scabbled concrete. 19mm bar found with 85mm cover to base and 110mm cover to side.
7	2	Column E12	Scabble until reaching reinforcement but not more than 100 mm. 2 slots.	Scabbled concrete. Two 19mm bars 380mm apart with 12mm links at 430mm spacing.

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Table C- 9: Intrusive actions dated 26th June 2015

Item	Level	Location	Instruction	Follow up
1	0	Column C7 footing	Extend the excavation pit.	Excavated 1.9m to the top of footing.
2	0	D7 strip footing	Extend the excavation pit.	Excavated 1.2m to rubble concrete.

Table C- 10: Intrusive actions dated 30th June 2015

Item	Level	Location	Instruction	Follow up
1	0	Beam C2-3	1. Horizontal slot requires to be deepened to approximately 120mm. 2. Drill a hole horizontally (5 to 15mm diameter) in the beam minimum 350mm deep or to refusal.	1. Horizontal slot deepened to 150mm. No steel reinforcement detected in slot. 2. 450mm hole no steel encountered.
2	1	Beam C3-4	1. Cut a slot as indicated with a crayon approximately 120mm. 2. Drill a hole horizontally (5 to 15mm diameter) in the beam minimum 350mm deep or to refusal.	1. Slot was not cut or scabbled. 2. Full width hole did not hit steel.
3	2	Column D2	1. Both slots require to be deepened to approximately 120mm. 2. Drill a hole horizontally (5 to 15mm diameter) in the column minimum 450mm deep or to refusal.	1. Horizontal slot deepened to 110mm. No steel reinforcement encountered. 2. 400mm hole no steel encountered.
5	3	Column D18	1. Both slots require to be deepened to approximately 120mm. 2. Drill a hole horizontally (5 to 15mm diameter) in the column minimum 450mm deep or to refusal.	1. Both slots were not scabbled deeper. 2. Hole was not drilled.

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Initial Observations

Ground Floor (Level 0)

Table C- 11: Initial observations at level 0

Number	Observation	Follow Up
1	Horizontal cracks below beam-column joint, on all faces of column.	See sheet A-420
2	Full depth flexural cracks visible at discrete intervals along length of RC beam	See sheet A-402
3	Deficient workmanship in suspended RC beam. Concrete mix has segregated at mid-span.	See sheet A-402
4	No access to inspect this room. Blue plastic barrels are stacked to roof level.	No access
5	Stair shown on historic plans does not exist.	See sheet A-100
6	Crack damage to columns in workshop area.	See sheet A-423
7	Some cracking damage to wall panels, columns, and window lintels in this area.	See sheet A-430
8	Enlarged perimeter columns in these locations to transfer load from stand supporting circular cast iron columns	See sheet A-100
9	RC elevator shaft here.	See sheet A-100
10	HAZARD. Possible Asbestos ceiling tiles in this area.	No comment
11	Masonry-walled toilet block here. Reinforcement unknown.	No comment
12	Horizontal cracking in RC column, visible inside toilet block.	See sheet A-411
13	Diagonal crack in RC wall panel.	See sheet A-506
14	Vertical full height crack in RC wall panel to the right of the door. Crack #13 visible at this location also - appears to be a full depth crack.	See sheet A-506
15	Cold storage room for beverages - structural walls obscured by insulation panels.	No comment
16	Concrete wall. Likely RC wall, reinforcement unknown.	No comment
17	Red brick infill wall panel, some diagonal step cracking at left edge.	See sheet A-506
18	Red brick infill wall panel, door has been sealed.	See sheet A-423
19	GIB finishes obscure structural elements. No crack damage noted in GIB finishes.	See sheet A-121
20	Large holes and openings cut in RC slab for services. Reinforcement exposed.	See sheet A-503
21	Vertical cracks in concrete walls. Likely RC wall, reinforcement unknown.	See sheet A-503
22	No access to this room - locked door.	No comment
23	This area does not match historical drawings.	See sheet A-100
24	Single RSJ - Approximately. size: 380 deep, 150mm wide, 17mm thick flange	See sheet A-121
25	Double RSJ's, similar size to #24. Cut to span as simply supported members.	See sheet A-121

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Level 1

Table C- 12: Initial observations at level 1

Number	Observation	Follow Up
1	Royal box area shown on historic plans does not exist.	See sheet A-101
2	Severe cracking damage to suspended RC floor slab, >3.5mm in width. Crack is visible where carpet is torn. Crack is likely to be on the interface between the original slab and 1980's additional section below the stand.	See sheet A-402
3	Floor levels appear to undulate under foot throughout this area.	See sheet A-201
4	HAZARD. Plaster finish to underside of ceiling may be Asbestos.	No comment
5	Moisture damage to plaster ceiling finish.	No comment
6	Full depth flexural cracks visible at discrete intervals along length of RC beam.	See sheet A-405
7	Rotten and loose timber decking boards. Trip hazard.	See sheet A-252
8	HAZARD. Significant cracking damage to RC stairs / ramps. Do not use until further notice.	Fenced off See sheet A-803
9	Outline/ position of stand-supporting circular cast iron columns.	See section Appendix A

Level 2

Table C- 13: Initial observations at level 2

Number	Observation	Follow Up
1	Approximate pattern of cracking observed in exposed RC floor slab on western end of structure (marked in blue).	See sheet A-404
2	Crack damage to columns at this location.	See sheet A-422
3	Spider web-like pattern of cracking observed on deck.	See sheet A-404
4	Reinforced concrete columns exist at this location - not shown on historic drawings.	See sheet A-102
5	Horizontal crack across full width of shear wall.	See sheet A-422
6	Carpet in this area, could not detect or map floor cracks as a result.	Area not accessed
7	RC walls here - not shown on historic drawings.	See sheet A-102
8	Lightweight partition walls and glazing panels - not shown on historic drawings.	See sheet A-102
9	Outline/ position of stand-supporting circular cast iron columns.	See section Appendix A
10	Concrete infill wall panel - not shown on historic plans. Likely RC, reinforcement unknown. Horizontal cracking across full width of wall at approximately 2.5m above ground.	See sheet A-422
11	Step up from carpeted area.	See sheet A-202
12	Full depth flexural cracks visible at discrete intervals along length of RC beam.	See sheet A-407
13	Significant cracking in stairwell. Major cracks marked on plan in dark green.	See sheet A-405
14	Full investigation of stair and connection required at detailed stage - cracking noted.	See sheet A-405
15	Full height vertical cracks in concrete wall panels. Likely RC panels, reinforcement unknown. It appears that the area beyond Gridline D has pulled away from the rest.	See sheet A-411

Level 3

Table C- 14: Initial observations at level 3

Number	Observation	Follow Up
1	Patch repair of concrete observed on concrete column at window level.	No comment
2	Vertical cracking (1mm x 1m) in concrete wall members at columns.	See sheet A-430
3	Vertical spalling and cracking of RC column observed on exterior at the SW corner.	See sheet A-411
4	Noticeable bump in carpet and undulation of floor level in this area.	See sheet A-204
5	Outline/ position of stand-supporting circular cast iron columns.	See section Appendix A
6	Evidence to suggest that shear walls have been removed from these areas in a previous retrofit/ modification of the structure. Evidence can be seen from rear.	See sheet A-131
7	Evidence of significant water penetration through concrete ceiling slab. HAZARD plaster ceiling lining may contain Asbestos.	Asbestos removed
8	Damage to timber floor - settles noticeably under foot.	No comment
9	Horizontal cracks at discrete intervals vertically along columns.	See sheet A-422
10	Significant vertical spalling and cracking of RC column observed on exterior at the SE corner. Major vertical cracks in parapet.	See sheet A-411
11	Window does not close properly, indication that frame may have racked.	No comment
12	Severe damage to soffit.	See sheet A-410
13	Timber encasement around columns.	See sheet A-103
14	Cracking damage to concrete wall elements. Elevator core appears to have pulled from main structure at high level.	See sheet A-423

Level 4

Table C- 15: Initial observations at level 4

Number	Observation	Follow Up
1	Door shown on historic drawings does not exist.	See sheet A-131
2	Diagonal vertical at each corner of door opening. Warning ~800mm step from upper stand level down to fourth floor.	See sheet A-426
3	Could not access fourth floor via elevator. Elevator works down only. No damage observed to elevator core, connections to main structure or to roof locally.	No comment
4	Evidence of significant amounts of water ponding under water tanks.	See sheet A-541
5	Concrete column containing ventilation has failed. Cracks up to 30mm visible from fourth floor level.	See sheet A-425
6	Columns are not concrete rectangles as shown in historic plans. All columns are double steel angle sections, inset into the rear of the RC wall. Vertical cracks in exterior of RC wall (up to 5mm in width) line up with the location of these columns. Full crack mapping exercise to follow in detailed stage.	See sheet A-104
7	Cracking to the interior of the RC wall.	See sheet A-425
8	Historic damage to RC wall. Formwork may have failed during concrete pour. Segregation of concrete and bulging of wall at joint in formwork.	See sheet A-424
9	Horizontal cracking of RC 'wing-wall', some spalling and exposed horizontal reinforcing steel. Bars appear to be approximately 2no. 6mm bars at 400mm vertical centres.	See sheet A-424
10	Steel trusses (roof system) connect to RC structure at this point - detailed investigation of roof to follow in detailed stage. Some purlins and other timber members visibly broken from quick inspection.	See section 3.7.

Appendix D

Historic Aerial Photography

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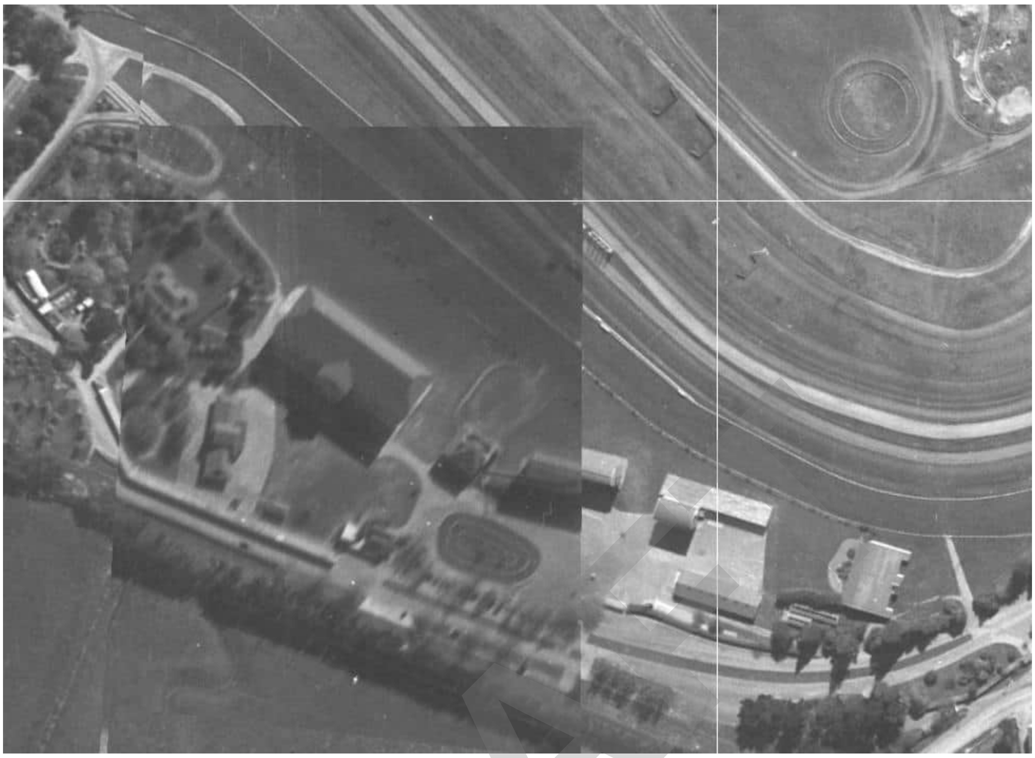
October 14, 1941



May 10, 1955

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October 29, 1965

September 26, 1973

D R A F T

September 28, 1984

November 26, 1994

D R A F T

24 February 2011

2015 [2]

Appendix E

Site Seismic Records

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Site Seismic Records

Table E-1: Peak Ground Acceleration Data and Event Data

Canterbury Jockey Club Grand National Stand	
Design Earthquake (EQ)	**Design Peak Ground Acceleration (PGA)**
Serviceability Limit State (SLS)	0.169
Ultimate Limit State (ULS)	0.455
Event Number	**Date of Event**
1	4-Sep-2010
2	22-Feb-2011
3	16-Apr-2011
4	13-Jun-2011 Foreshock
5	13-Jun-2011
6	23-Dec-2011 Foreshock
7	23-Dec-2011

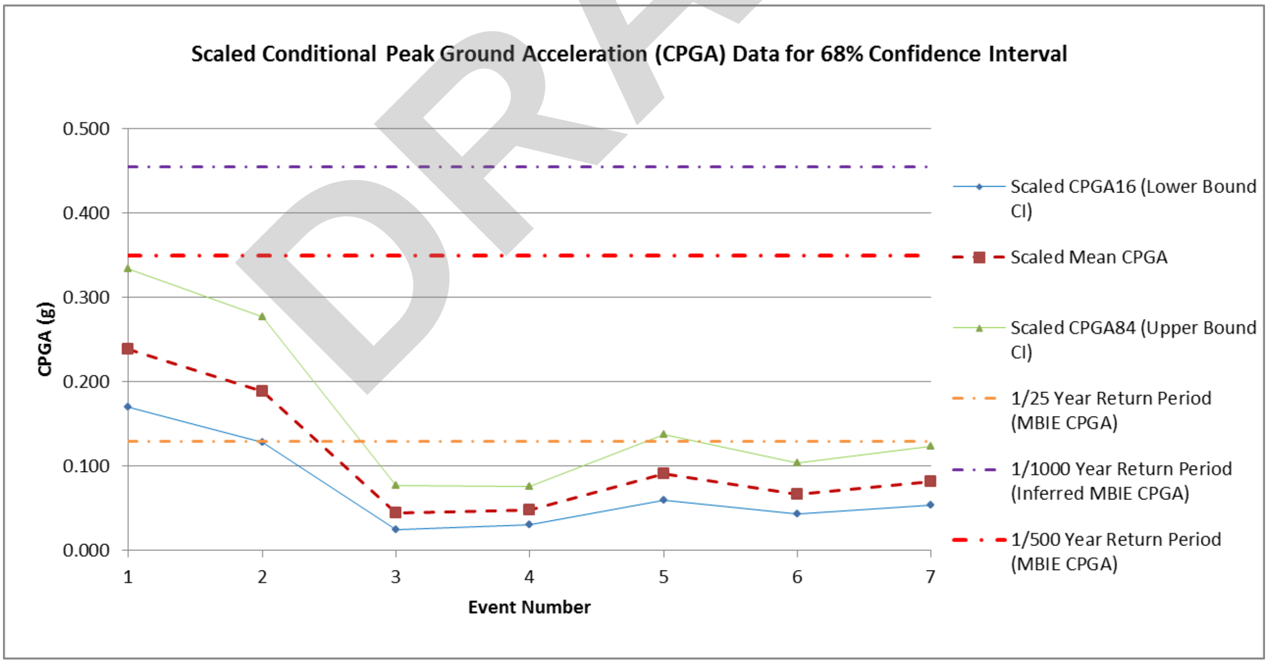

Figure E-1: Conditional Peak Ground Acceleration for Each Event

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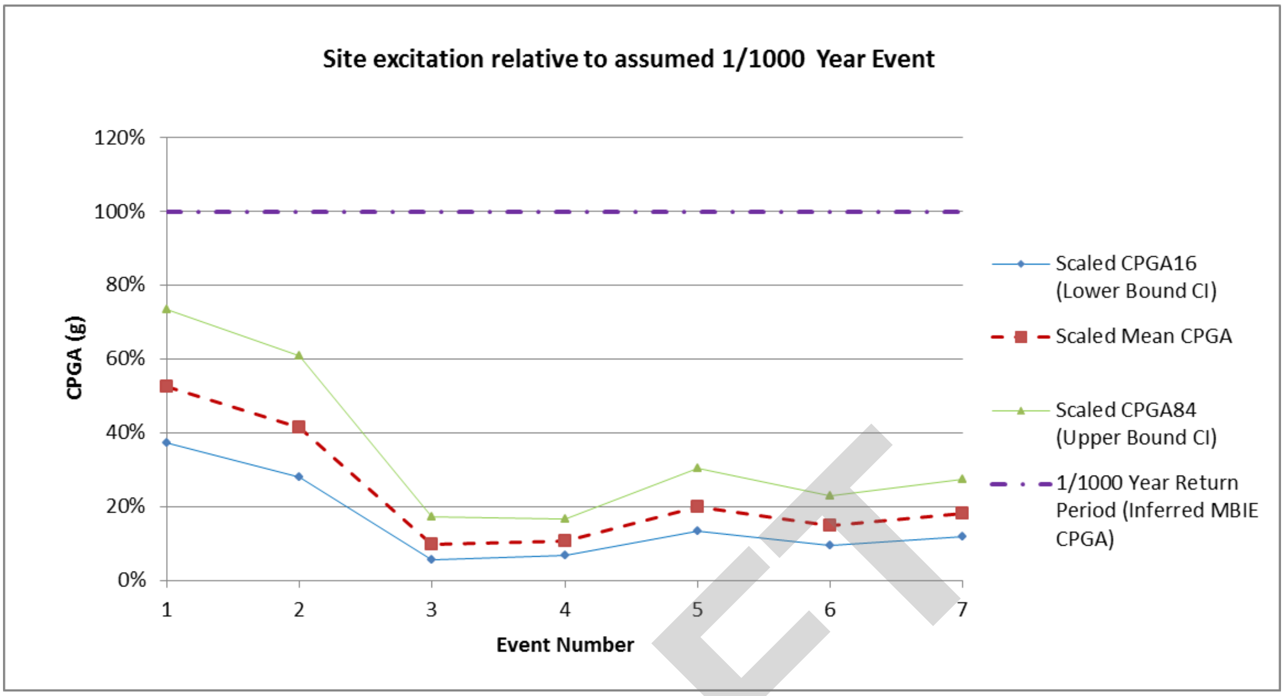

Figure E-2: Conditional Peak Ground Acceleration for Each Event Compared to 1/1000 Year Event

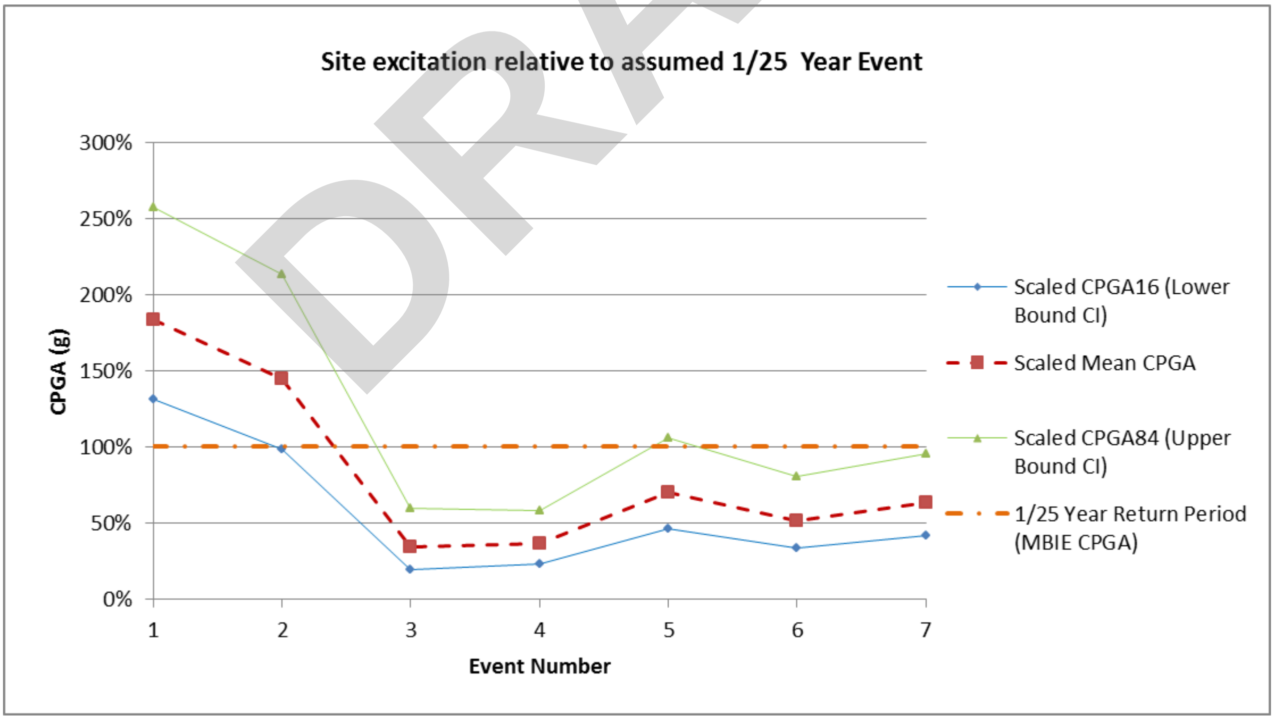

Figure E-3: Conditional Peak Ground Acceleration for Each Event Compared to 1/25 Year Event

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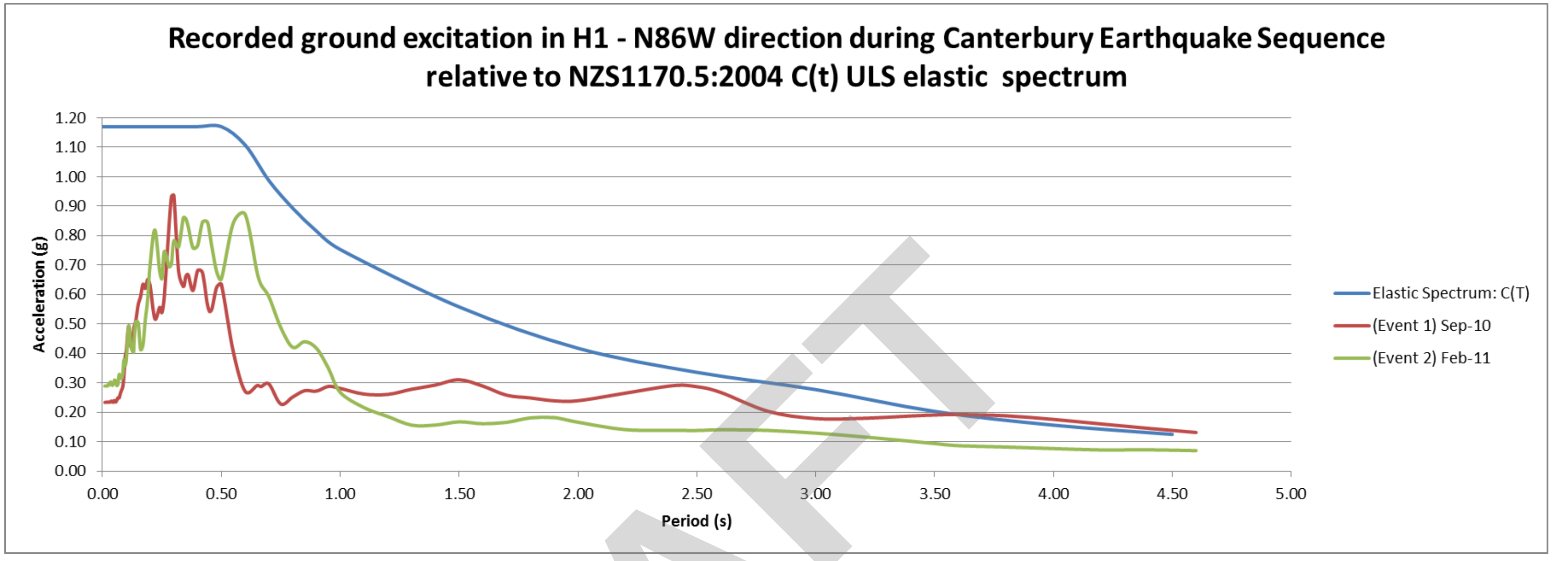

Figure E-4: Ground Motion H1 Direction Compared to Elastic Spectrum

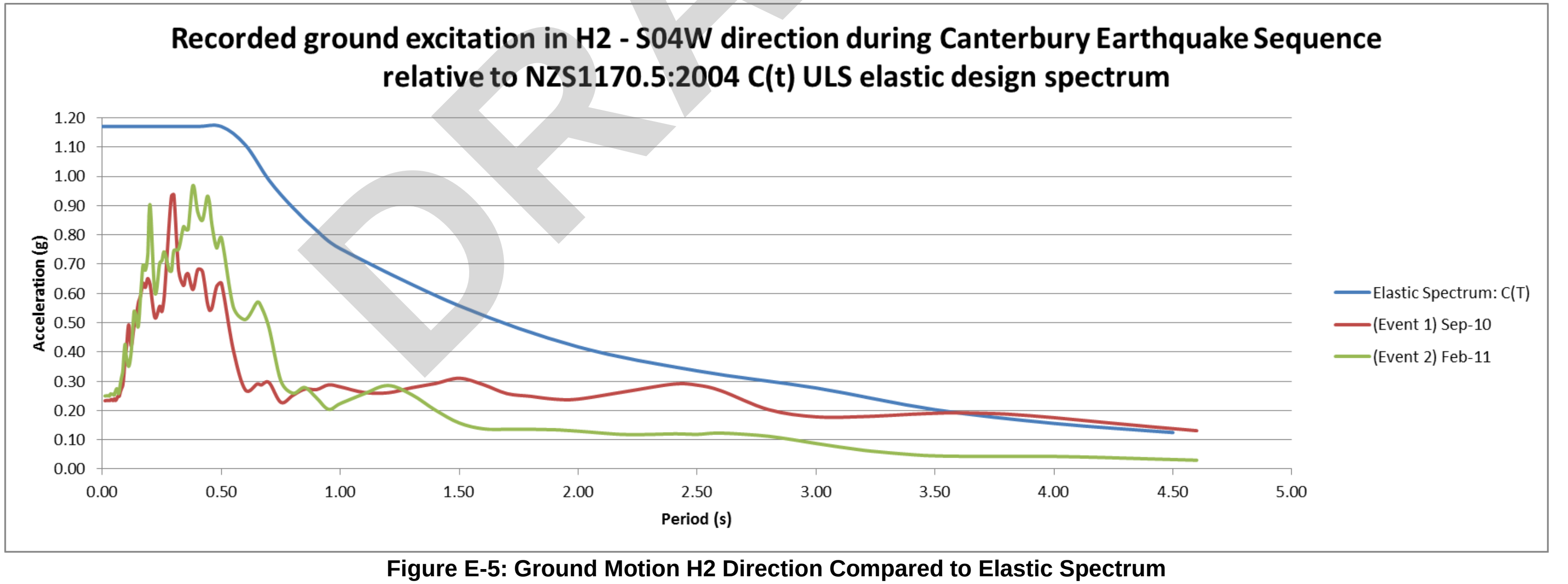

Figure E-5: Ground Motion H2 Direction Compared to Elastic Spectrum

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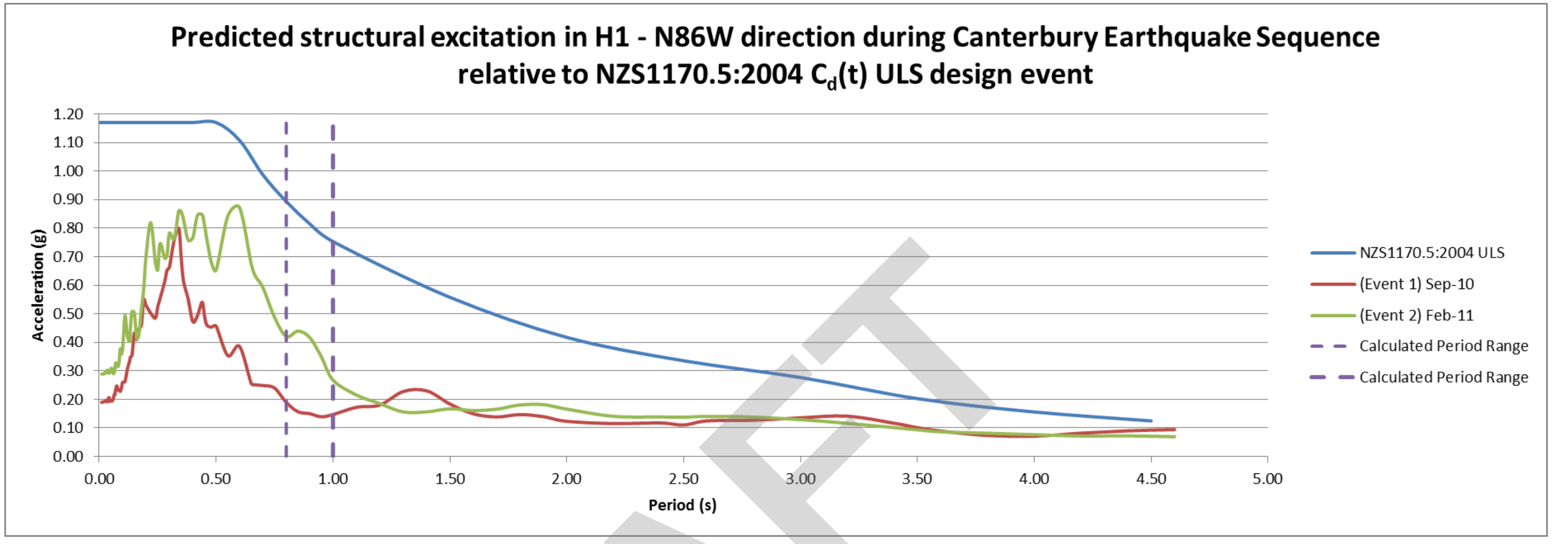

Figure E6: Predicted Structural Excitation H1 Direction Compared to ULS Design Spectrum

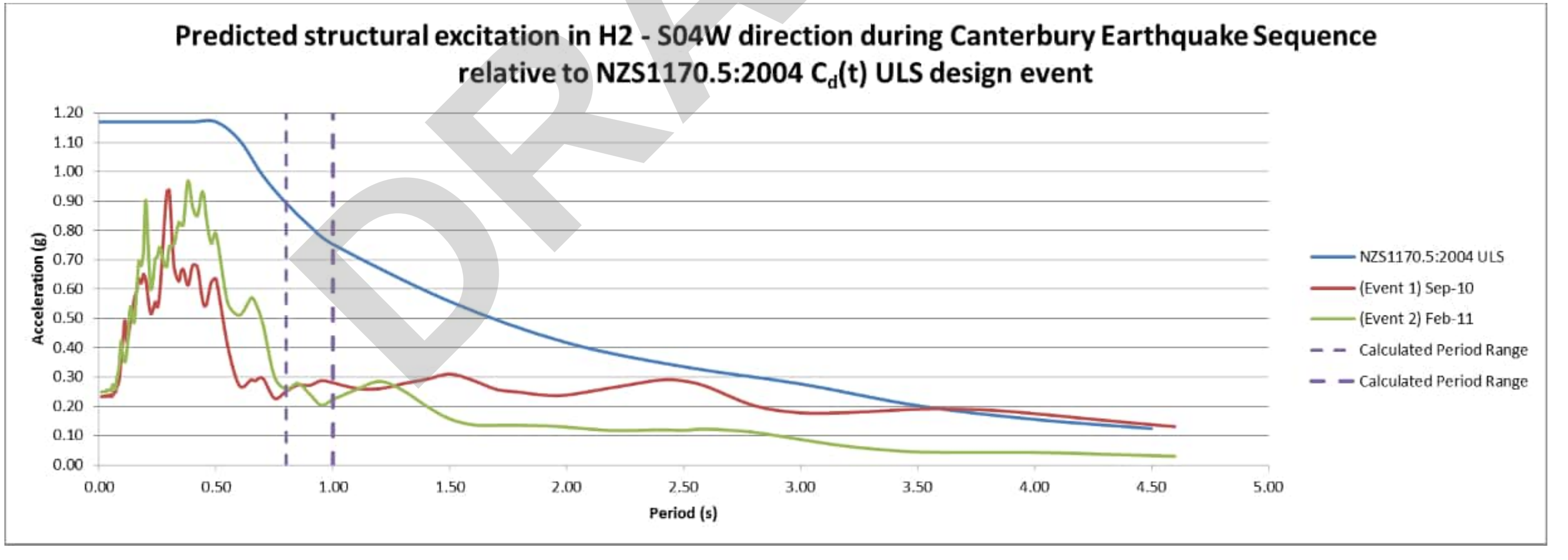

Figure E7: Predicted Structural Excitation H2 Direction Compared to ULS Design Spectrum

Appendix F

CCC City Plan - Heritage Rules

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CCC City Plan - Heritage Rules

	Group 1	*Group 2*	*Group 3*	*Group 4*
Repairs and maintenance	***Permitted***	***Permitted***	***Permitted***	***Permitted***
Reconstruction resulting from the Canterbury earthquakes	***Permitted***	***Permitted***	***Permitted***	***Permitted***
Alterations necessary for the primary purpose of implementing seismic, fire, or access building code upgrades	***Controlled***	***Controlled***	***Permitted***	***Permitted***
Alterations *Includes all other alterations not covered by:* *• repairs and maintenance, and* *• reconstruction or alterations necessary for the primary purpose of implementing seismic, fire, or access building code upgrades (as set out above)*	***Restricted Discretionary***	***Restricted Discretionary***	***Restricted Discretionary - external alterations*** ***Controlled - internal alterations***	***Controlled***
Additional buildings on the site of a listed heritage item	***Restricted Discretionary***	***Restricted Discretionary***	***Controlled***	***Controlled***
New buildings on a site adjoining a site with a listed heritage item	***Restricted Discretionary***	***Restricted Discretionary***	***Controlled***	***Controlled***
Removal	***Restricted Discretionary***	***Restricted Discretionary***	***Restricted Discretionary***	***Restricted Discretionary***
Demolition	***Non-complying***	***Non-complying***	***Discretionary***	***Discretionary***

Appendix G

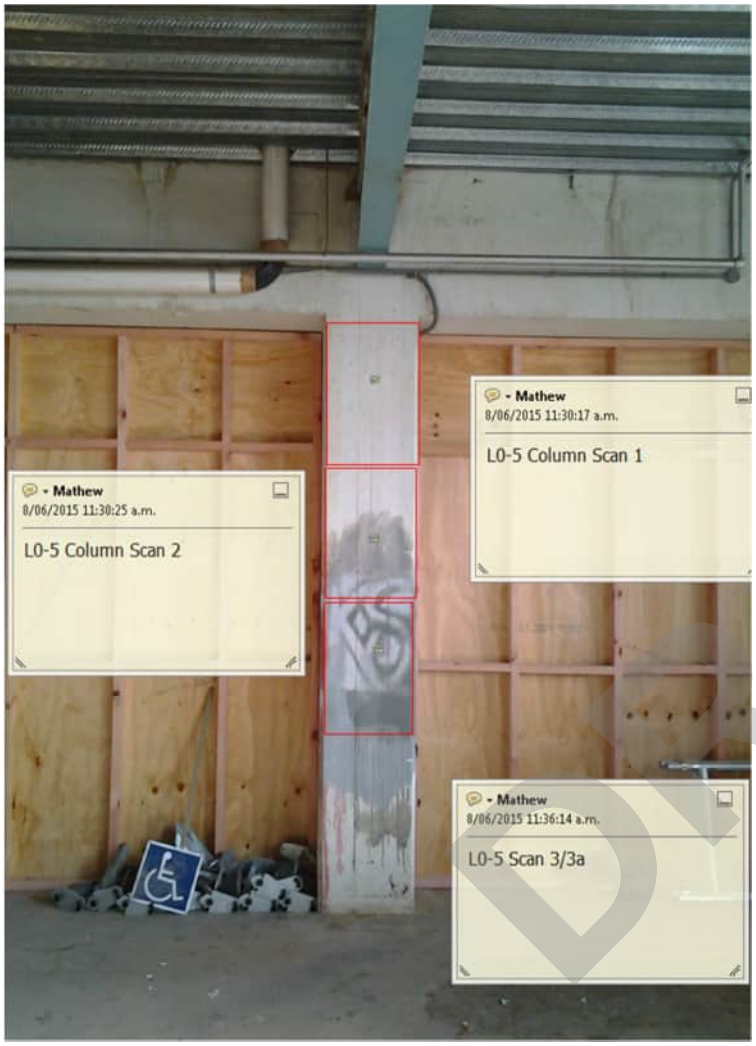
Reinforcement Scanning Results

Scancrete results

Client Name: Canterbury Jockey Club
Project Name: Grand National Stand
Project No: 60332326

No.	Lvl	Item	Scan type		Element	Orientation	GL	Face	Reinforcement		Cover	
			PS200	PS1000					Main	Links	Main	Links
1	0	L0.5	1	-	column	-	C3	north	20-36	12-20 at 100 to 250crs	48-53	38-55
2	0	L0.5	2	-	column	-	C3	north	20	14-20 at 250	52-56	41-56
3	0	L0.5	3	3a	column	-	C3	north	16-20	12-20 at 300	49-63	49-74
4	0	L0.5	4	4a	column	-	C5	east	28-36	6-16 at 300	52-90	52-90
5	0	L0.5	1	1a	beam	east-west	C5-6	underside	3 bars			
6	0	L0.5	1	1a	beam	east-west	C2-3	north	3 bars	no stirrups detected		
7	0	L0.5	-	2a	beam	east-west	C2-3	north	3 bars	no stirrups detected		
8	1	L1.4	1	-	beam	north-south	5	east	20-25	12 at 300		12-26
9	1	L1.4	2	-	beam	north-south	5	east	20-25	12-14 at 325		20-36
10	1	L1.4	1	-	column	-	C5	south	-	links at 300	81-93	56-92
11	1	L1.4	2	2a	column	-	C5	south	-	links at 300	51-78	42-93
12	1	L1.4	3	-	column	-	C5	east	30-36 & 8-10	6-10 at 200/250	85-95	58-59
13	1	L1.4	4	4a	column	-	C5	east	36 & 10-14	6 at 200	84-93	38-74
14	1	L1.4	3	-	beam	east-west	C4-5	south	-	no rebar detected		
15	1	L1.4	4	-	beam	east-west	C4-5	south	-	no rebar detected		
16	1	L1.4	5	5a	beam	east-west	C4-5	underside	16-36	shadowing suggests link		
17	1	L1.4	6	6a	beam	east-west	C4-5	underside	16-36	6 at (600?)		
18	2	L2.2	1	-	beam	north-south	3	east	20-25	1 link within 600	57	8-23
19	2	L2.2	2	-	beam	north-south	3	east	20-25	16 at 250		10-19
20	2	L2.2	1	-	column	-	C3	south	not detected	25-30 bar detected (wall bar)	51-56	
21	2	L2.2	2	-	column	-	C3	south	3 bars - 8-14	14-20 at 350	74-108	72-81
22	2	L2.2	3	3a	column	-	C3	south	3 bars - 10-20	links at 350	74-82	49-108
23	2	L2.2	1	-	beam-wall	east-west	C3-4	south	single 6 at top	no verticals detected		
24	2	L2.2	2	-	beam-wall	east-west	C3-4	south	single 6 at top	no verticals detected		
25	2	L2.2	3	-	beam-wall	east-west	C3-4	south	single 20 at bottom	no verticals detected		
26	2	L2.3	1	-	beam	north-south	3	west	36	12-14 at 250/350	27-76	21-37
27	2	L2.3	2	-	beam	north-south	3	underside	30-36	10-14 at 375	62-65	13-36
28	2	L2.3	1	-	column	-	D3	north				
29	2	L2.3	2	-	column	-	D3	north	36		23-24	
30	2	L2.3	3	-	column	-	D3	north				
31	2	L2.3	4	-	column	-	D3	north	36	6	24-30	
32	2	L2.3	5	-	column	-	D3	north				
33	2	L2.3	-	6	column	-	D3	north	2 bars in column			
34	2	L2.4	-	1	column	-	D2	north	3 bars	links at 200	100-200	
35	2	L2.4	-	2	column	-	D2	north	3 bars	links at 200	100-200	
36	2	L2.4	-	3	beam	east-west	D1-2	north			150	80
37	2	L2.4	4	-	beam	east-west	D1-2	north	25-36	14-16 at ?	121-136	71-84
38	3	L3.9	1	-	beam	east-west	E12-13	north				

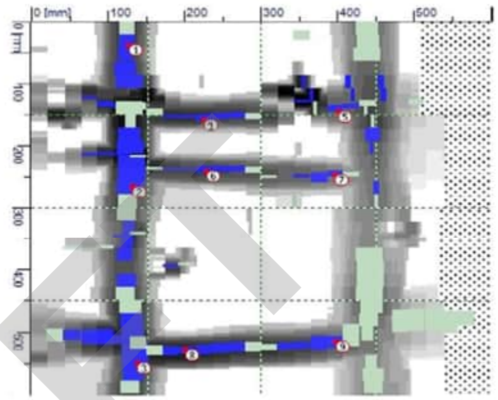
No.	Lvl	Item	Scan type		Element	Orientation	GL	Face	Reinforcement		Cover	
			PS200	PS1000					Main	Links	Main	Links
39	3	L3.9	2	-	beam	east-west	E12-13	north				
40	3	L3.9	1	-	beam	north-south	12	east	angled bar			
41	3	L3.9	2	-	beam	north-south	12	east	angled 30-36	14		
42	3	L3.9	3	-	beam	north-south	12	east				
43	3	L3.9	4	-	beam	north-south	12	underside				
44	3	L3.9	1	-	column	-	E12	north	30-36	8-10	138-146	
45	3	L3.9	2	-	column	-	E12	north			151	
46	3	L3.9	3	-	column	-	E12	north			120	
47	3	L3.9	4	-	column	-	E12	north				
48	3	L3.9	-	5	column	-	E12	north	2 bars in column	no links detected	150-300	
49	3	L3.9	1	-	slab	-	-	-	20 at 300			
50	3	L3.10	1	-	beam	east-west	D16-17	north	36	25-36		
51	3	L3.10	2	-	beam	east-west	D16-17	north	angled 30-36	6		
52	3	L3.10	1	-	beam	north-south	16	east				
53	3	L3.10	2	-	beam	north-south	16	east				
54	3	L3.10	3	-	beam	north-south	16	east		not carried out		
55	3	L3.10	4	-	beam	north-south	16	underside		not carreid out		
56	3	L3.10	1	-	column	-	D16	north				
57	3	L3.10	2	-	column	-	D16	north				
58	3	L3.10	3	-	column	-	D16	north	36	8-10		
59	3	L3.10	4	-	column	-	D16	north	30-36	6		
60	3	L3.10	-	5	column	-	D16	north				
61	4	TS.1	-	1a	shear wall	east-west		north				
62	4	TS.2	-	2a	shear wall	east-west		north				



Home

Imagescan: *L0-5_column_scan_1.XFF*

Date / Time: *2015-04-24 14:58:25* SSN: *16411007* [mm]



Customer: *Canterbury Jockey Club*

Location: *L0-5 Column Scan 1* Operator: *Mathew Le Comte*

Comment:

Annotations 1-3 Vertical bar estimated 20-36mm

Annotations 4-9 Horizontal bar estimated 12-20mm

Marker	x: [mm]	y: [mm]	Comment:
1	123	34	Estimated bar size 20mm, Concrete cover 48mm
2	129	263	Estimated bar size 36mm, Concrete cover 53mm
3	134	547	Estimated bar size 36mm, Concrete cover 50mm
4	222	155	Estimated bar size 12mm, Concrete cover 41mm
5	399	141	Estimated bar size 12mm, Concrete cover 50mm
6	225	237	Estimated bar size 12mm, Concrete cover 42mm
7	395	242	Estimated bar size 10mm, Concrete cover 55mm
8	197	525	Estimated bar size 12mm, Concrete cover 38mm

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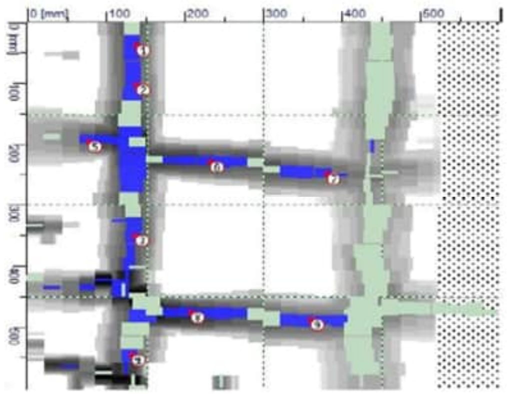
9	396	511	Estimated bar size 20mm, Concrete cover 56mm

Imagescan: *L0-5_column_scan_2.XFF*

Date / Time: *2015-04-24 15:02:52* SSN: *16411007* *[mm]*



Customer: *Canterbury Jockey Club*

Location: *L0-5 Column Scan 2* Operator: *Mathew Le Comte*

Comment:
Annotations 1-4 Vertical bar estimated 20mm
Annotations 5-9 Horizontal bar estimated 14-20mm

Marker	x: [mm]	y: [mm]	Comment:
1	134	34	Estimated bar size 20mm, Concrete cover 53mm
2	134	99	Estimated bar size 20mm, Concrete cover 54mm
3	133	348	Estimated bar size 20mm, Concrete cover 52mm
4	129	542	Estimated bar size 20mm, Concrete cover 56mm
5	74	192	Estimated bar size 14mm, Concrete cover 50mm
6	229	225	Estimated bar size 16mm, Concrete cover 47mm
7	378	245	Estimated bar size 16mm, Concrete cover 54mm
8	204	474	Estimated bar size 16mm, Concrete cover 41mm

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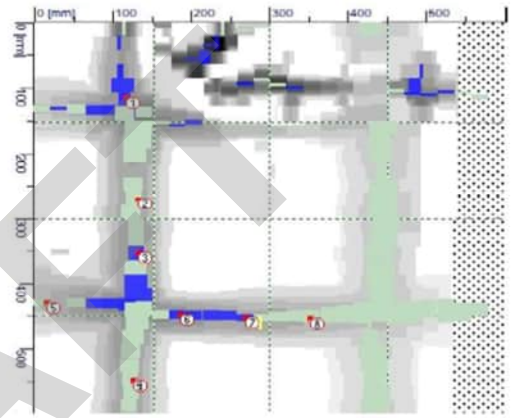
9	356	485	Estimated bar size 20mm, Concrete cover 56mm

Imagescan: *L0-5_column_scan_3.XFF*

Date / Time: *2015-04-24 15:10:57* SSN: *16411007* *[mm]*



Customer: *Canterbury Jockey Club*

Location: *L0-5 Column Scan 3* Operator: *Mathew Le Comte*

Comment:
Annotations 1-4 Vertical bar estimated 16-20mm
Annotations 1-8 Horizontal bar estimated 12-20mm

Marker	x: [mm]	y: [mm]	Comment:
1	112	111	Estimated bar size 16mm, Concrete cover 49mm
2	129	264	Estimated bar size 20mm, Concrete cover 61mm (not verified)
3	127	349	Estimated bar size 20mm, Concrete cover 59mm
4	122	547	Estimated bar size 20mm, Concrete cover 63mm (not verified)
5	12	426	Estimated bar size 12mm, Concrete cover 74mm (not verified)
6	182	445	Estimated bar size 14mm, Concrete cover 49mm
7	264	449	Estimated bar size 12mm, Concrete cover 55mm
8	349	451	Estimated bar size 20mm, Concrete cover 68mm (not verified)

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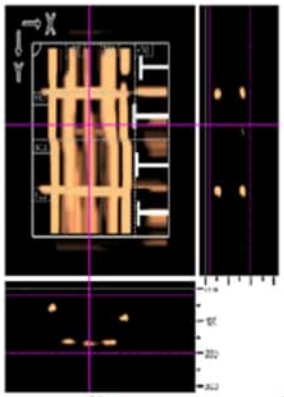
Scan File:	RS_159120003_000889_L0-5_column_scan_3a.hscan
Scan Name:	L0-5 column scan 3a
Date / Time:	2015-04-24 14:18:47
Comment:	-



x: 250 mm   y: 250 mm   z: 20 mm   Thickness: 180 mm
Concrete: 9.0   Method: Standard

Project name:	jockey club level 0	Customer:	-Canterbury Jockey Club
Location:	-L0-5 Column Scan 3a	Object:	-Column
User:	-Mathew Le Comte		
Comment:	-		

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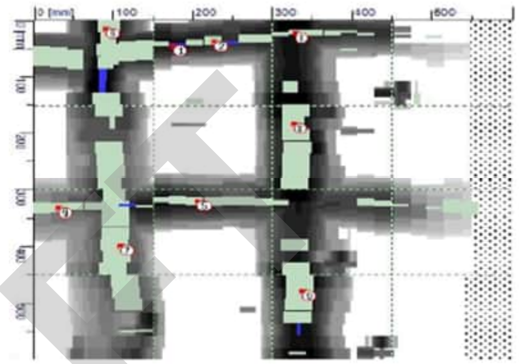
8	349	451	Estimated bar size 20mm, Concrete cover 68mm (not verified)

Imagescan: *L0-5_column_scan_4.XFF*

Date / Time: *2015-04-24 15:32:29* SSN: *16411007* [mm]



Customer: *Canterbury Jockey Club*
Location: *L0-5 Column Scan 4* Operator: *Mathew Le Comte*
Comment:
Annotations 1-5 Horizontal bars estimated 6-16mm
Annotations 6-9 Vertical bars estimated 28-36mm

Marker	x: [mm]	y: [mm]	Comment:
1	173	41	Estimated bar size 6mm, Concrete cover 52mm
2	223	34	Estimated bar size 16mm, Concrete cover 68mm (not verified)
3	325	19	Estimated bar size 10mm, Concrete cover 64mm (not verified)
4	27	332	Estimated bar size 16mm, Concrete cover 90mm (not verified)
5	203	319	Estimated bar size 14mm, Concrete cover 66mm (not verified)
6	88	11	Estimated bar size 28mm, Concrete cover 70mm (not verified)
7	105	396	Estimated bar size 36mm, Concrete cover 88mm (not verified)
8	323	179	Estimated bar size 30mm, Concrete cover 69mm (not verified)
9	336	477	Estimated bar size 36mm, Concrete cover 72mm (not verified)

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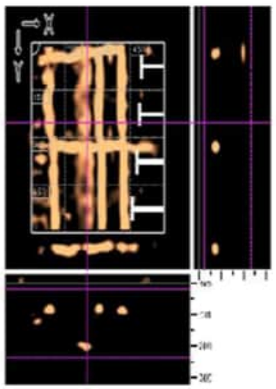
Hilti PROFIS PS 1000 Report

Scan File:	RS_159120003_000890_L0-5_column_scan_4a.hscan
Scan Name:	L0-5 column scan 4a
Date / Time:	2015-04-24 14:38:01
Comment:	-



x: 250 mm y: 250 mm z: 20 mm Thickness: 215 mm
Concrete: 9.0 Method: Standard

Project name:	jockey club level 0	Customer:	-Canterbury Jockey Club
Location:	-L0-5 Column Scan 4a	Object:	-Column
User:	-Mathew Le Comte		
Comment:	-		

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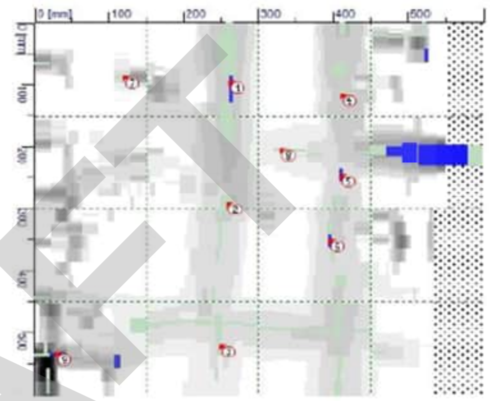
8	323	179	Estimated bar size 30mm, Concrete cover 69mm (not verified)
9	336	477	Estimated bar size 36mm, Concrete cover 72mm (not verified)

Imagescan: ***L0-5_scan_1_under beam.XFF***

Date / Time: *2015-04-24 15:53:51* SSN: *16411007* *[mm]*



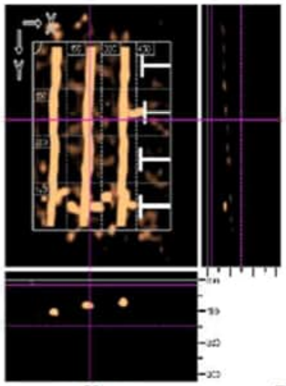
Customer: *Canterbury Jockey Club*
Location: *L0-5 Scan 1 Under Beam* Operator: *Mathew Le Comte*
Comment:
No conclusive results from this image scan

Marker	x: [mm]	y: [mm]	Comment:
1	260	93	Estimated bar size 6mm, Concrete cover 57mm
2	256	290	Estimated bar size 14mm, Concrete cover 75mm (not verified)
3	248	521	Estimated bar size 8mm, Concrete cover 80mm (not verified)
4	411	114	Estimated bar size 8mm, Concrete cover 61mm (not verified)
5	410	245	Estimated bar size 6mm, Concrete cover 57mm
6	395	351	Estimated bar size 6mm, Concrete cover 56mm
7	119	86	Estimated bar size 6mm, Concrete cover 75mm (not verified)
8	330	203	Estimated bar size 6mm, Concrete cover 100mm (not verified)
9	29	533	Estimated bar size 6mm, Concrete cover 28mm

Scancrete results
5

Hilti PROFIS PS 1000 Report

Scan File:	RS_159120003_000891_L0-5_scan_1a_under beam.hscan
Scan Name:	L0-5 scan 1a under beam
Date / Time:	2015-04-24 15:00:43
Comment:	-



x: 250 mm y: 250 mm z: 20 mm Thickness: 125 mm
Concrete: 9.0 Method: Standard

Project name:	jockey club level 0	Customer:	-Canterbury Jockey Club
Location:	-L0-5 Scan 1a Under Beam	Object:	-Beam
User:	-Mathew Le Comte		
Comment:	-		

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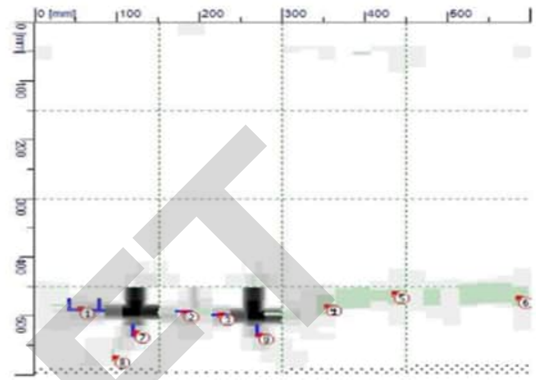
Imagescan: ***L0-5_scan1_beam.XFF***

Date / Time: *2015-04-24 16:24:15* SSN: *16411007* *[mm]*

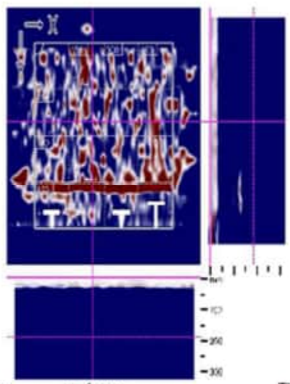


Customer: *Canterbury Jockey Club*
Location: *L0-5 Scan 1 Beam* Operator: *Mathew Le Comte*
Comment:
Scan does not contain conclusive results for the Horizontal bar

Marker	x: [mm]	y: [mm]	Comment:
1	52	486	Estimated bar size 6mm, Concrete cover 60mm
2	178	492	Estimated bar size 6mm, Concrete cover 56mm
3	222	496	Estimated bar size 6mm, Concrete cover 35mm
4	352	481	Estimated bar size 36mm, Concrete cover 128mm (Not verified)
5	434	460	Estimated bar size 28mm, Concrete cover 126mm (Not verified)
6	584	467	Estimated bar size 36mm, Concrete cover 131mm (Not verified)
7	119	526	Estimated bar size 6mm, Concrete cover 41mm
8	95	568	Estimated bar size 6mm, Concrete cover 78mm (not verified)
9	268	530	Estimated bar size 6mm, Concrete cover 39mm

Hilti PROFIS PS 1000 Report

Scan File:	RS_159120003_000892_L0-5_scan1a_beam.hscan
Scan Name:	L0-5 scan1a beam
Date / Time:	2015-04-24 15:21:34
Comment:	-



x: 250 mm y: 250 mm z: -4 mm Thickness: 190 mm
Concrete: 9.0 Method: Advanced

Project name:	jockey club level 0	Customer:	-Canterbury Jockey Club
Location:	-L0-5 Scan 1a Beam	Object:	-Beam
User:	-Mathew Le Comte		
Comment:	-		

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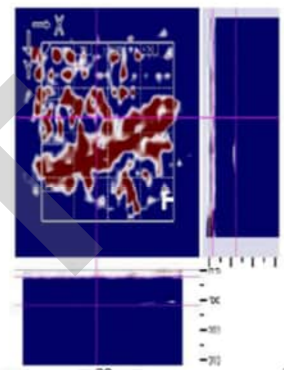
Scan File:	RS_159120003_000893_L0-5_scan 2a_beam.hscan
Scan Name:	L0-5 scan 2a beam
Date / Time:	2015-04-24 15:33:42
Comment:	-



x: 250 mm y: 250 mm z: 20 mm Thickness: 100 mm
Concrete: 9.0 Method: Standard

Project name:	jockey club level 0	Customer:	-Canterbury Jockey Club
Location:	-L0-5 Scan 2a Beam	Object:	-Beam
User:	-Mathew Le Comte		
Comment:	-		

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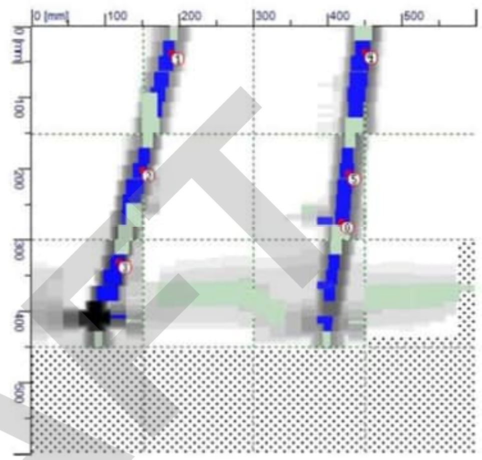
Imagescan: *L1-4_beam_scan_1.XFF*

Date / Time: *2015-04-24 10:58:45* SSN: *16411007* [mm]



Customer: *Canterbury Jockey Club*

Location: *L1-4 Beam Scan 1* Operator: *Mathew Le Comte*

Comment:

Vertical bars estimated 16 20mm

Marker	x: [mm]	y: [mm]	Comment:
1	186	34	Estimated bar size 16mm, Concrete cover 26mm
2	147	197	Estimated bar size 20mm, Concrete cover 19mm
3	114	327	Estimated bar size 20mm, Concrete cover 12mm
4	448	33	Estimated bar size 20mm, Concrete cover 21mm
5	425	203	Estimated bar size 20mm, Concrete cover 22mm
6	416	270	Estimated bar size 20mm, Concrete cover 23mm

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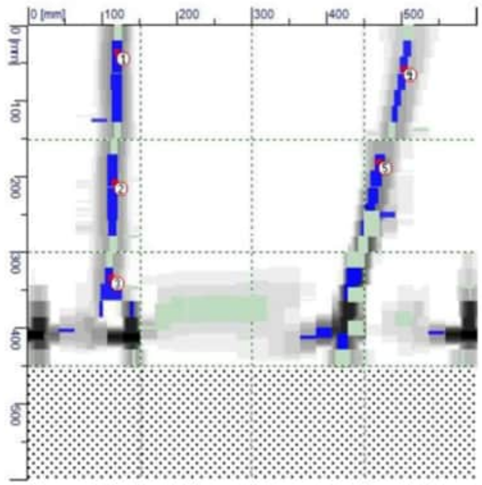
Imagescan: ***L1-4_beam_scan_2.XFF***

Date / Time: *2015-04-24 11:02:23* SSN: *16411007* *[mm]*



Customer: *Canterbury Jockey Club*
Location: *L1-4 Beam Scan 2* Operator: *Mathew Le Comte*
Comment:
Vertical bars estimated 12-14mm

Marker	x: [mm]	y: [mm]	Comment:
1	116	33	Estimated bar size 14mm, Concrete cover 20mm
2	112	204	Estimated bar size 14mm, Concrete cover 24mm
3	108	332	Estimated bar size 12mm, Concrete cover 25mm
4	501	53	Estimated bar size 12mm, Concrete cover 36mm
5	467	177	Estimated bar size 14mm, Concrete cover 23mm

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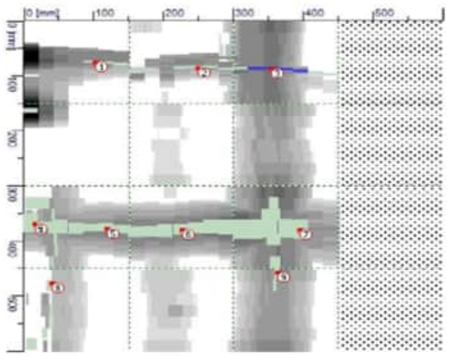
Mathew
8/06/2015 9:13:31 a.m.
L1-4 Column Scan 1
Mathew
8/06/2015 9:13:47 a.m.
L1-4 Column Scan 2/2a


Mathew
8/06/2015 9:15:01 a.m.
L1-4 Column Scan 3
Mathew
8/06/2015 9:15:19 a.m.
L1-4 Column Scan 4/4a

Imagescan: *L1-4_col_scan_1.XFF*

Date / Time: *2015-04-24 10:24:50* SSN: *16411007* *[mm]*



Customer: *Canterbury Jockey Club*
Location: *L1-4 Column Scan 1* Operator: *Mathew Le Comte*
Comment:
Annotations 1-3 Horizontal bar estimated 6mm
Annotations 4-7 Horizontal bar estimated 16-36mm
Annotations 8-9 vertical bars estimated 8mm

Marker	x: [mm]	y: [mm]	Comment:
1	99	73	Estimated bar size 6mm, Concrete cover 67mm (not verified)
2	247	82	Estimated bar size 6mm, Concrete cover 63mm (not verified)
3	352	84	Estimated bar size 6mm, Concrete cover 56mm
4	12	367	Estimated bar size 36mm, Concrete cover 92mm (not verified)
5	116	377	Estimated bar size 16mm, Concrete cover 85mm (not verified)
6	223	378	Estimated bar size 20mm, Concrete cover 82mm (not verified)
7	393	378	Estimated bar size 36mm, Concrete cover 94mm (not verified)
8	37	475	Estimated bar size 8mm, Concrete cover 93mm (not verified)
9	362	455	Estimated bar size 8mm, Concrete cover 81mm (not verified)

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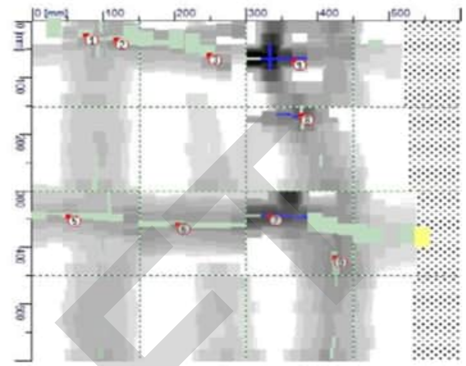
Imagescan: *L1-4_column_scan_2.XFF*

Date / Time: *2015-04-24 10:30:03* SSN: *16411007* *[mm]*



Customer: *Canterbury Jockey Club*
Location: *L1-4 Column Scan 2* Operator: *Mathew Le Comte*
Comment:
Annotations 1-4 Horizontal bar estimated 6-20mm
Annotations 5-7 Horizontal bar estimated 6-8mm
Annotations 8-9 Vertical bar estimated 6-10mm

Marker	x: [mm]	y: [mm]	Comment:
1	73	22	Estimated bar size 16mm, Concrete cover 93mm (not verified)
2	115	30	Estimated bar size 8mm, Concrete cover 79mm (not verified)
3	245	56	Estimated bar size 20mm, Concrete cover 94mm (not verified)
4	364	66	Estimated bar size 6mm, Concrete cover 44mm
5	48	342	Estimated bar size 8mm, Concrete cover 86mm (not verified)
6	200	356	Estimated bar size 8mm, Concrete cover 79mm (not verified)
7	332	341	Estimated bar size 6mm, Concrete cover 42mm
8	375	163	Estimated bar size 6mm, Concrete cover 51mm (not verified)
9	422	416	Estimated bar size 10mm, Concrete cover 78mm (not verified)

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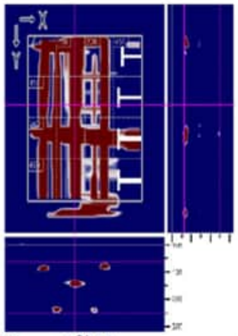
Scan File: RS_159120003_000885_l1_4_col_scan_2a.hscan
Scan Name: L1-4 column scan 2a
Date / Time: 2015-04-24 09:36:48
Comment: -



x: 250 mm y: 250 mm z: 61 mm Thickness: 190 mm
Concrete: 9.0 Method: Standard

Project name:	jockey club level 1	Customer:	-Canterbury Jockey Club
Location:	-L1-4 Column Scan 2a	Object:	-Column
User:	-Mathew Le Comte		
Comment:	-		

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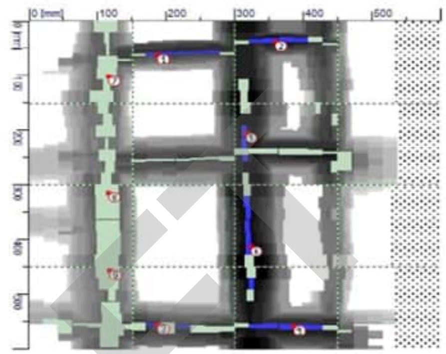
Imagescan: *L1-4_column_scan_3.XFF*

Date / Time: *2015-04-24 10:43:42* SSN: *16411007* [mm]



Customer: *Canterbury Jockey Club*
Location: *L1-4 Column Scan 3* Operator: *Mathew Le Comte*
Comment:
Annotations 1-4 Horizontal bars estimated 6-10mm
Annotations 5-6 Vertical bars estimated 8-10mm
Annotations 7-9 Vertical bar estimated 30-36mm

Marker	x: [mm]	y: [mm]	Comment:
1	184	59	Estimated bar size 6mm, Concrete cover 59mm
2	356	34	Estimated bar size 10mm, Concrete cover 58mm
3	184	553	Estimated bar size 6mm, Concrete cover 59mm
4	384	558	Estimated bar size 10mm, Concrete cover 59mm
5	312	203	Estimated bar size 8mm, Concrete cover 57mm
6	321	411	Estimated bar size 10mm, Concrete cover 55mm
7	112	97	Estimated bar size 30mm, Concrete cover 85mm (not verified)
8	112	311	Estimated bar size 36mm, Concrete cover 87mm (not verified)
9	115	455	Estimated bar size 36mm, Concrete cover 95mm (not verified)

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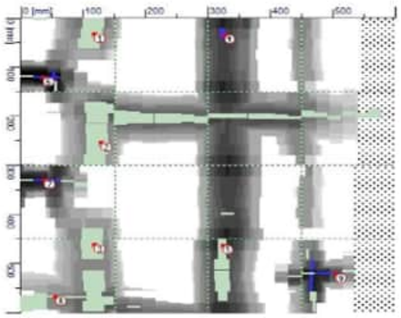
Imagescan: *L1-4_column_scan_4.XFF*

Date / Time: *2015-04-24 10:47:36* SSN: *16411007* [mm]



Customer: *Canterbury Jockey Club*
Location: *L1-4 Column Scan 4* Operator: *Mathew Le Comte*
Comment:
Annotations 1-3 Vertical bar estimated 36mm
Annotations 4-5 Vertical bar estimated 10-14mm
Annotations 6-9 Horizontal bars estimated 6mm

Marker	x: [mm]	y: [mm]	Comment:
1	115	30	Estimated bar size 36mm, Concrete cover 88mm (not verified)
2	125	251	Estimated bar size 36mm, Concrete cover 84mm (not verified)
3	114	460	Estimated bar size 36mm, Concrete cover 93mm (not verified)
4	323	32	Estimated bar size 10mm, Concrete cover 57mm
5	321	462	Estimated bar size 14mm, Concrete cover 58mm (not verified)
6	33	118	Estimated bar size 6mm, Concrete cover 38mm
7	34	329	Estimated bar size 6mm, Concrete cover 44mm
8	52	566	Estimated bar size 6mm, Concrete cover 74mm (not verified)
9	503	519	Estimated bar size 6mm, Concrete cover 56mm

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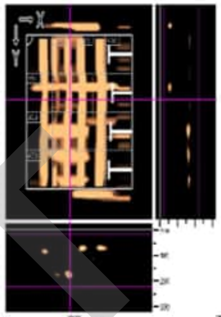
Hilti PROFIS PS 1000 Report

Scan File: RS_159120003_000886_l1_4_col_scan_4a.hscan
Scan Name: L1-4 column scan 4a
Date / Time: 2015-04-24 09:53:02
Comment: -



x: 250 mm y: 250 mm z: 20 mm Thickness: 200 mm
Concrete: 9.0 Method: Standard

Project name: jockey club level 1 Customer: -Canterbury Jockey Club
Location: -L1-4 Column Scan 4a Object: -Column
User: -Mathew Le Comte
Comment: -

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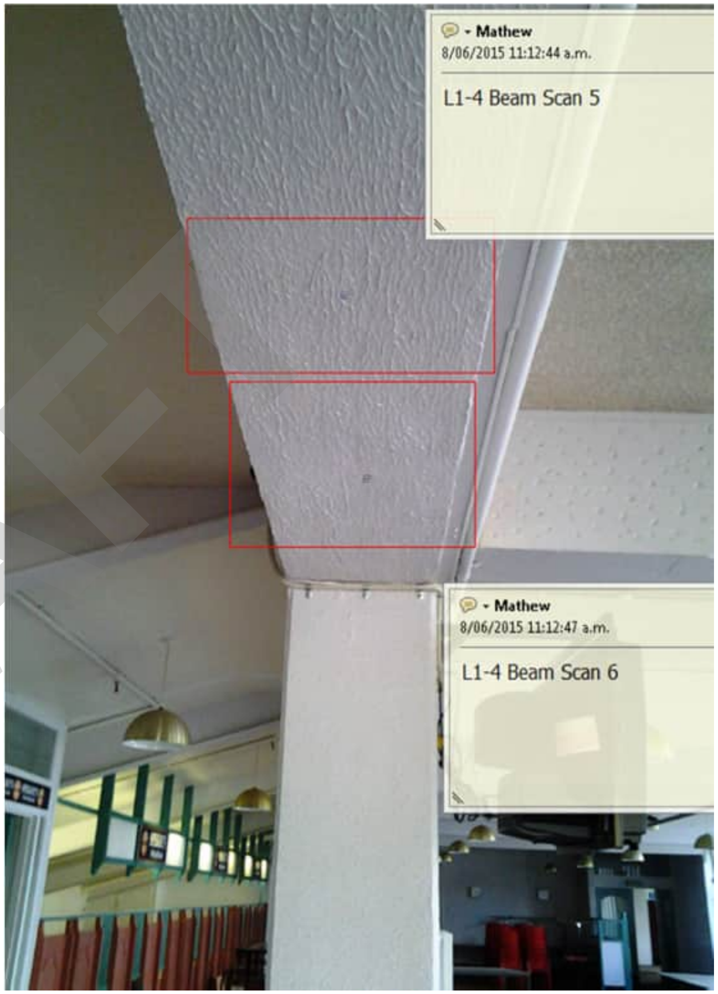
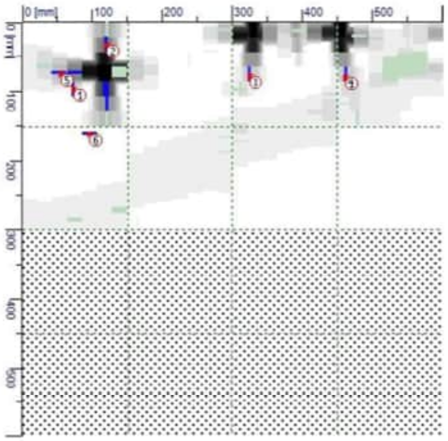
Mathew
8/06/2015 11:12:27 a.m.
L1-4 Beam Scan 3
Mathew
8/06/2015 11:12:30 a.m.
L1-4 Beam Scan 4


Mathew
8/06/2015 11:12:44 a.m.
L1-4 Beam Scan 5
Mathew
8/06/2015 11:12:47 a.m.
L1-4 Beam Scan 6

Imagescan: *L1-4_beam_scan_3.XFF*

Date / Time: *2015-04-24 11:11:49* SSN: *16411007* [mm]



Customer: *Canterbury Jockey Club*

Location: *L1-4 Beam Scan 3* Operator: *Mathew Le Comte*

Comment:
Annotations 1-6 do not indicate continuous re enforcing
Annotations 1-6 estimated 6mm

Marker	x: [mm]	y: [mm]	Comment:
1	70	93	Estimated bar size 6mm, Concrete cover 46mm
2	118	30	Estimated bar size 6mm, Concrete cover 16mm
3	322	75	Estimated bar size 6mm, Concrete cover 47mm
4	460	77	Estimated bar size 6mm, Concrete cover 46mm
5	52	71	Estimated bar size 6mm, Concrete cover 36mm
6	93	159	Estimated bar size 6mm, Concrete cover 26mm

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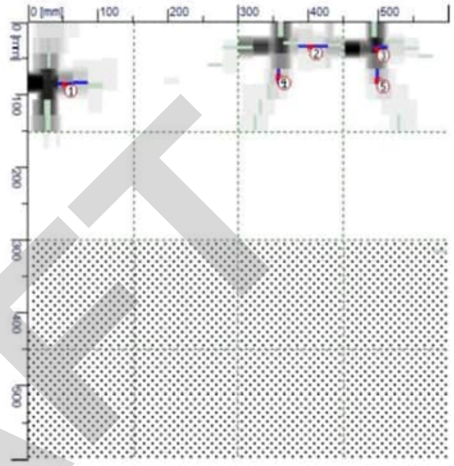
Imagescan: *L1-4_beam_scan_4.XFF*

Date / Time: *2015-04-24 11:15:37* SSN: *16411007* [mm]



Customer: *Canterbury Jockey Club*

Location: *L1-4 Beam Scan 4* Operator: *Mathew Le Comte*

Comment:
Annotations 1-5 do not indicate continuous re enforcing
Annotations 1-5 estimated bar size 6mm

Marker	x: [mm]	y: [mm]	Comment:
1	49	82	Estimated bar size 6mm, Concrete cover 17mm
2	400	32	Estimated bar size 6mm, Concrete cover 55mm
3	496	34	Estimated bar size 6mm, Concrete cover 30mm
4	355	73	Estimated bar size 6mm, Concrete cover 38mm
5	496	77	Estimated bar size 6mm, Concrete cover 35mm

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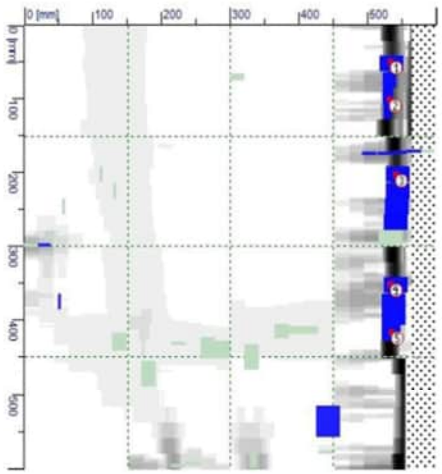
Imagescan: ***L1-4_beam_scan_5.XFF***

Date / Time: *2015-04-24 11:21:50*   SSN: *16411007*   [mm]



Customer: *Canterbury Jockey Club*

Location: *L1-4 Beam Scan 5*   Operator: *Mathew Le Comte*

Comment:
Vertical bar estimated 16-36mm

Marker	x: [mm]	y: [mm]	Comment:
1	532	47	Estimated bar size 36mm, Concrete cover 14mm
2	530	97	Estimated bar size 16mm, Concrete cover 12mm
3	538	199	Estimated bar size 36mm, Concrete cover 11mm
4	532	349	Estimated bar size 36mm, Concrete cover 12mm
5	533	415	Estimated bar size 28mm, Concrete cover 10mm

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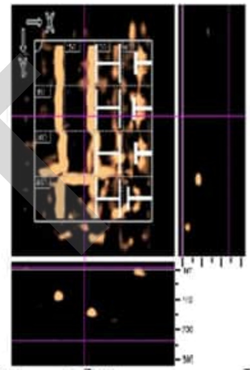
Hilti PROFIS PS 1000 Report

Scan File: RS_159120003_000887_l1_4_beam_scan_5a.hscan
Scan Name: L1-4 beam scan 5a
Date / Time: 2015-04-24 10:31:10
Comment: -



x: 250 mm   y: 250 mm   z: -7 mm   Thickness: 245 mm
Concrete: 9.0   Method: Standard

Project name: jockey club level 1   Customer: -Canterbury Jockey Club
Location: -L1-4 Beam Scan 5a   Object: -Beam
User: -Mathew Le Comte
Comment: -

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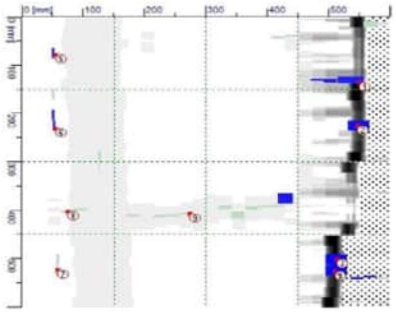
Imagescan: *L1-4_beam_scan_6.XFF*

Date / Time: *2015-04-24 12:23:10* SSN: *16411007* [mm]



Customer: *Canterbury Jockey Club*
Location: *L1-4 Beam Scan 6* Operator: *Mathew Le Comte*
Comment:
Annotations 1-4 vertical bar estimated 16-36mm
Annotations 5-7 Vertical bar estimated 6mm
Annotations 8-9 Horizontal bar estimated 6mm

Marker	x: [mm]	y: [mm]	Comment:
1	548	133	Estimated bar size 16mm, Concrete cover 33mm
2	545	222	Estimated bar size 36mm, Concrete cover 18mm
3	511	499	Estimated bar size 36mm, Concrete cover 12mm
4	508	525	Estimated bar size 36mm, Concrete cover 11mm
5	52	75	Estimated bar size 6mm, Concrete cover 45mm
6	52	227	Estimated bar size 6mm, Concrete cover 48mm
7	55	522	Estimated bar size 6mm, Concrete cover 63mm (not verified)
8	73	401	Estimated bar size 6mm, Concrete cover 108mm (not verified)
9	270	405	Estimated bar size 6mm, Concrete cover 94mm (not verified)

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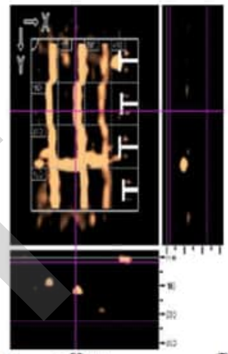
Hilti PROFIS PS 1000 Report

Scan File: RS_159120003_000888_l1_4_beam_scan_6a.hscan
Scan Name: L1-4 beam scan 6a
Date / Time: 2015-04-24 11:29:32
Comment: -



x: 250 mm y: 250 mm z: 20 mm Thickness: 205 mm
Concrete: 9.0 Method: Standard

Project name: jockey club level 1 Customer: -Canterbury Jockey Club
Location: -L1-4 Beam Scan 6a Object: -Beam
User: -Mathew Le Comte
Comment: -

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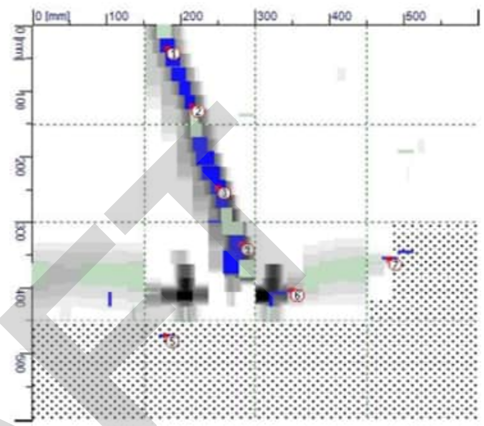
Imagescan: *l2_2_beam_scan_1nort.XFF*

Date / Time: *2015-04-23 12:34:22* SSN: *16411007* *[mm]*



Customer: *Canterbury Jockey Club*
Location: *L2-2 Beam Scan 1* Operator: *Mathew Le Comte*
Comment:
Vertical bar estimated 14-20mm
Horizontal bar estimated 6mm

Marker	x: [mm]	y: [mm]	Comment:
1	178	32	Estimated bar size 20mm, Concrete cover 23mm
2	211	119	Estimated bar size 14mm, Concrete cover 17mm
3	247	244	Estimated bar size 20mm, Concrete cover 14mm
4	278	332	Estimated bar size 20mm, Concrete cover 8mm
5	177	470	Estimated bar size 6mm, Concrete cover 8mm
6	347	401	Estimated bar size 6mm, Concrete cover 30mm
7	478	353	Estimated bar size 6mm, Concrete cover 57mm

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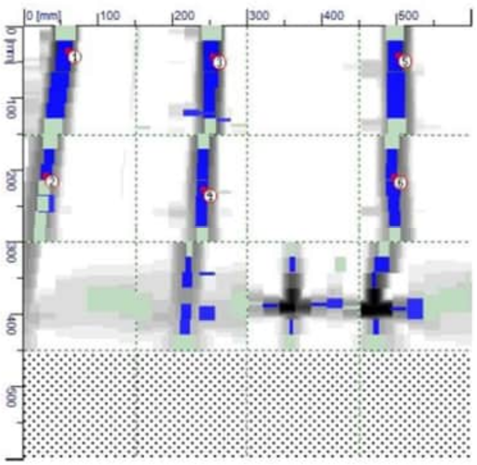
Imagescan: *l2_2_beam_scan_2nort.XFF*

Date / Time: *2015-04-23 12:37:27* SSN: *16411007* [*mm*]



Customer: *Canterbury Jockey Club*

Location: *L2-2 Beam Scan 2* Operator: *Mathew Le Comte*

Comment:
Vertical bars estimated 16-20mm

Marker	x: [mm]	y: [mm]	Comment:
1	56	32	Estimated bar size 20mm, Concrete cover 10mm
2	26	204	Estimated bar size 16mm, Concrete cover 19mm
3	251	38	Estimated bar size 20mm, Concrete cover 11mm
4	238	223	Estimated bar size 16mm, Concrete cover 18mm
5	501	37	Estimated bar size 20mm, Concrete cover 14mm
6	495	205	Estimated bar size 16mm, Concrete cover 19mm

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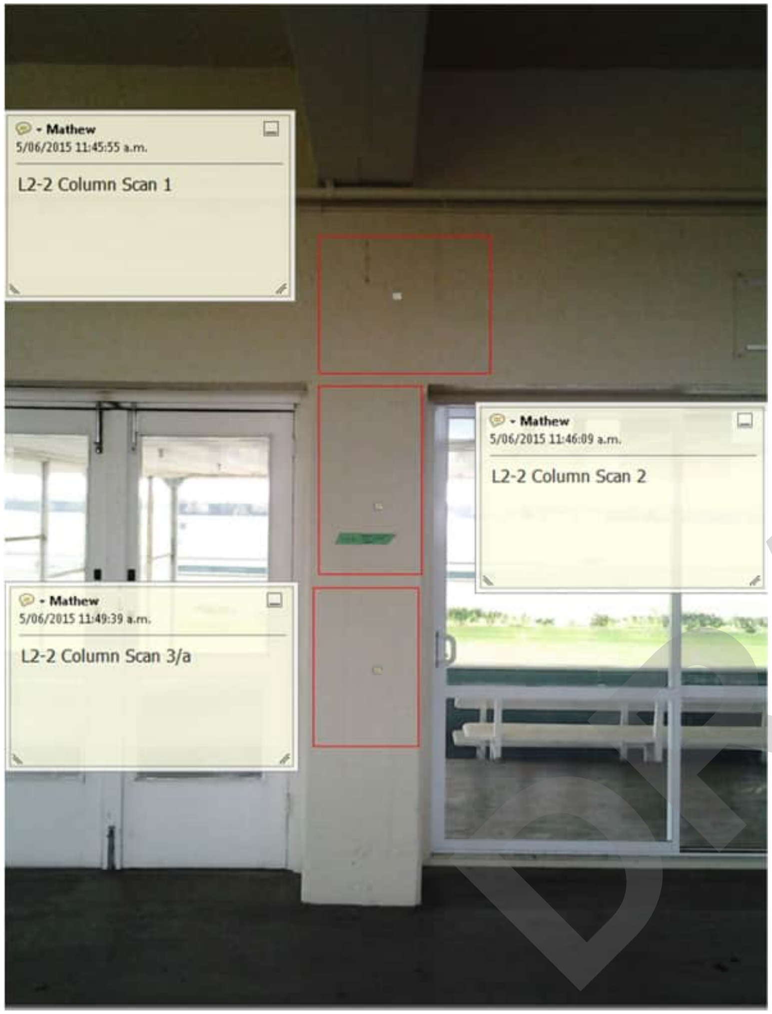
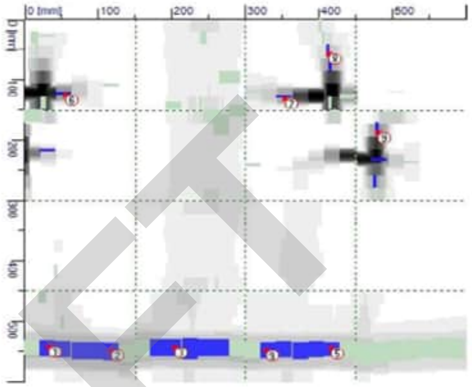


Imagescan: *l2_2_col_scan_1north.XFF*

Date / Time: *2015-04-23 12:08:50* SSN: *16411007* [*mm*]



Customer: *Canterbury Jockey Club*
Location: *L2-2 Column Scan 1* Operator: *Mathew Le Comte*
Comment:
Horizontal bar estimated 25-30mm

Marker	x: [mm]	y: [mm]	Comment:
1	30	540	Estimated bar size 28mm, Concrete cover 53mm
2	115	547	Estimated bar size 30mm, Concrete cover 53mm
3	201	541	Estimated bar size 30mm, Concrete cover 51mm
4	326	547	Estimated bar size 28mm, Concrete cover 53mm
5	415	544	Estimated bar size 25mm, Concrete cover 56mm
6	52	122	Estimated bar size 6mm, Concrete cover 25mm
7	352	129	Estimated bar size 6mm, Concrete cover 29mm
8	411	53	Estimated bar size 6mm, Concrete cover 55mm
9	478	184	Estimated bar size 6mm, Concrete cover 29mm

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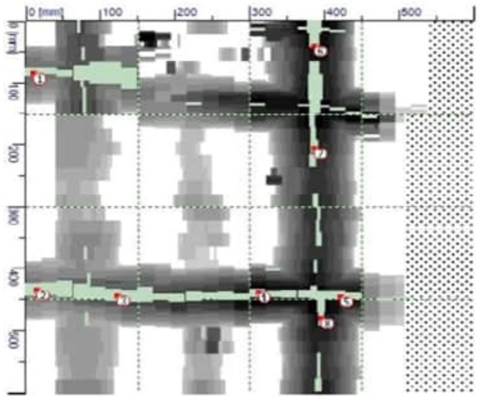
Imagescan: *I2_2_col_scan_2north.XFF*

Date / Time: *2015-04-23 12:12:46* SSN: *16411007* [mm]



Customer: *Canterbury Jockey Club*
Location: *L2-2 Column Scan 2* Operator: *Mathew Le Comte*
Comment:
Horizontal bar estimated 14-20mm
Horizontal bar estimated 8-14mm

Marker	x: [mm]	y: [mm]	Comment:
1	7	81	Estimated bar size 14mm, Concrete cover 99mm (not verified)
2	11	433	Estimated bar size 20mm, Concrete cover 108mm (not verified)
3	119	441	Estimated bar size 20mm, Concrete cover 98mm (not verified)
4	308	436	Estimated bar size 14mm, Concrete cover 74mm (not verified)
5	419	444	Estimated bar size 14mm, Concrete cover 78mm (not verified)
6	384	37	Estimated bar size 14mm, Concrete cover 77mm (not verified)
7	384	203	Estimated bar size 12mm, Concrete cover 81mm (not verified)
8	393	478	Estimated bar size 8mm, Concrete cover 72mm (not verified)

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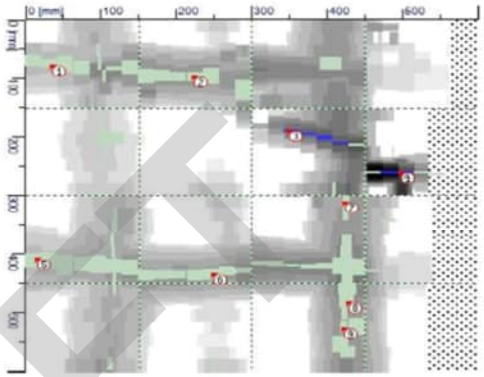
Imagescan: *I2_2_col_scan_3north.XFF*

Date / Time: *2015-04-23 12:19:32* SSN: *16411007* [mm]



Customer: *Canterbury Jockey Club*
Location: *L2-2 Column Scan 3* Operator: *Mathew Le Comte*
Comment:
Horizontal bars estimated 6-25mm
Vertical bar estimated 10-20mm

Marker	x: [mm]	y: [mm]	Comment:
1	33	77	Estimated bar size 16mm, Concrete cover 101mm (not verified)
2	221	95	Estimated bar size 16mm, Concrete cover 80mm (not verified)
3	348	188	Estimated bar size 6mm, Concrete cover 58mm
4	496	259	Estimated bar size 6mm, Concrete cover 49mm
5	12	408	Estimated bar size 25mm, Concrete cover 108mm (not verified)
6	247	434	Estimated bar size 20mm, Concrete cover 87mm (not verified)
7	422	310	Estimated bar size 10mm, Concrete cover 82mm (not verified)
8	426	482	Estimated bar size 20mm, Concrete cover 81mm (not verified)
9	421	526	Estimated bar size 10mm, Concrete cover 74mm (not verified)

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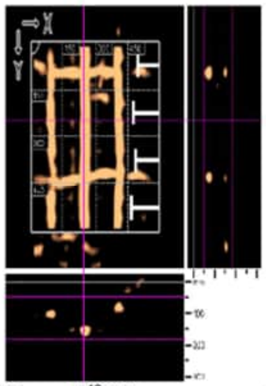
Scan File:	RS_159120003_000877_l2_2_col_scan_3anort.hscan
Scan Name:	l2-2 col scan 3anort
Date / Time:	2015-04-23 11:25:53
Comment:	-



x: 250 mm	y: 250 mm	z: 48 mm	Thickness: 135 mm
Concrete: 9.0		Method: Standard	

Project name:	jockey club level 2	Customer:	-Canterbury Jockey Club
Location:	-Scan 3a Column	Object:	-Column
User:	-Mathew Le Comte		
Comment:	-		

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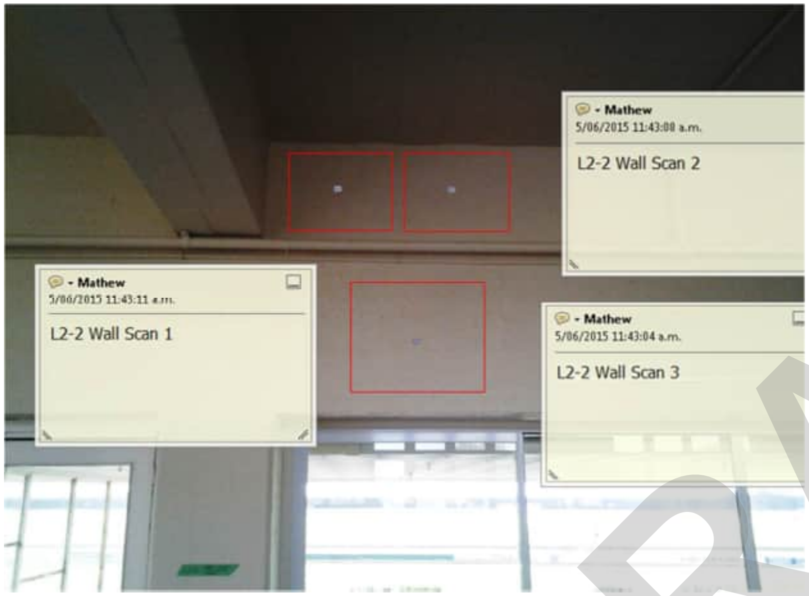
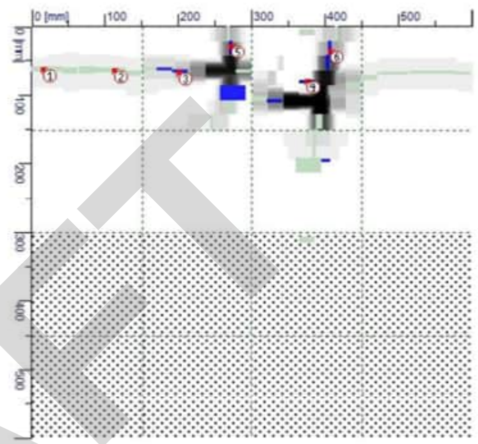


Imagescan: ***l2_2_nwall_scan_1.XFF***

Date / Time: *2015-04-23 12:45:25* SSN: *16411007* *[mm]*



Customer: *Canterbury Jockey Club*
Location: *L2-2 North Wall Scan 1* Operator: *Mathew Le Comte*
Comment:
Horizontal bars estimated 6-8mm
Vertical bars estimated 6mm

Marker	x: [mm]	y: [mm]	Comment:
1	12	60	Estimated bar size 8mm, Concrete cover 72mm (not verified)
2	110	62	Estimated bar size 8mm, Concrete cover 75mm (not verified)
3	197	64	Estimated bar size 6mm, Concrete cover 54mm
4	374	77	Estimated bar size 6mm, Concrete cover 6mm
5	268	25	Estimated bar size 6mm, Concrete cover 15mm
6	405	33	Estimated bar size 6mm, Concrete cover 26mm

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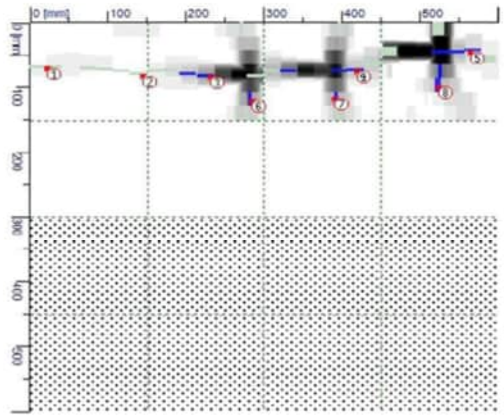
Imagescan: *l2_2_nwall_scan_2.XFF*

Date / Time: *2015-04-23 12:49:27* SSN: *16411007* [*mm*]



Customer: *Canterbury Jockey Club*
Location: *L2-2 North Wall Scan 2* Operator: *Mathew Le Comte*
Comment:
Horizontal bars estimated 6mm
Vertical bars estimated 6-8mm

Marker	x: [mm]	y: [mm]	Comment:
1	19	67	Estimated bar size 6mm, Concrete cover 69mm (not verified)
2	141	79	Estimated bar size 6mm, Concrete cover 69mm (not verified)
3	227	81	Estimated bar size 6mm, Concrete cover 26mm
4	418	73	Estimated bar size 6mm, Concrete cover 39mm
5	563	42	Estimated bar size 6mm, Concrete cover 52mm
6	281	118	Estimated bar size 6mm, Concrete cover 26mm
7	389	115	Estimated bar size 6mm, Concrete cover 33mm
8	522	96	Estimated bar size 8mm, Concrete cover 40mm

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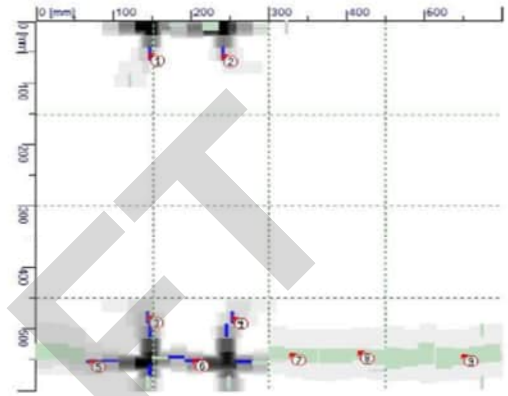
Imagescan: *l2_2_wall_scan_3.XFF*

Date / Time: *2015-04-23 13:09:48* SSN: *16411007* [*mm*]



Customer: *Canterbury Jockey Club*
Location: *L2-2 Wall Scan 3* Operator: *Mathew Le Comte*
Comment:
Vertical bars estimated 6mm
Horizontal bar estimated 6-30mm

Marker	x: [mm]	y: [mm]	Comment:
1	145	52	Estimated bar size 6mm, Concrete cover 43mm
2	238	53	Estimated bar size 6mm, Concrete cover 45mm
3	142	479	Estimated bar size 6mm, Concrete cover 44mm
4	252	481	Estimated bar size 6mm, Concrete cover 47mm
5	68	551	Estimated bar size 6mm, Concrete cover 52mm
6	203	549	Estimated bar size 6mm, Concrete cover 21mm
7	329	540	Estimated bar size 20mm, Concrete cover 83mm (not verified)
8	416	537	Estimated bar size 20mm, Concrete cover 87mm (not verified)
9	549	541	Estimated bar size 30mm, Concrete cover 94mm (not verified)

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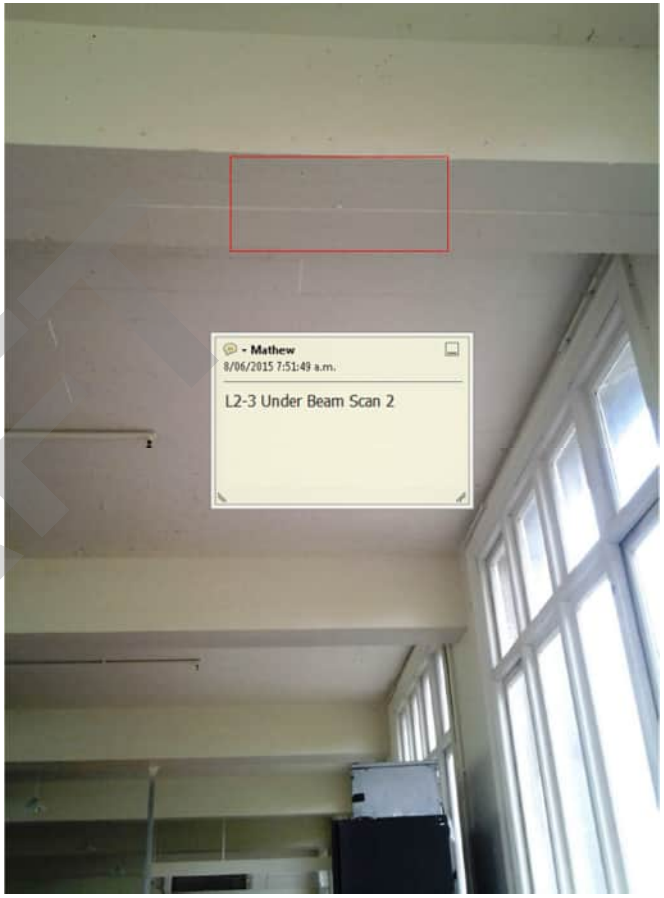
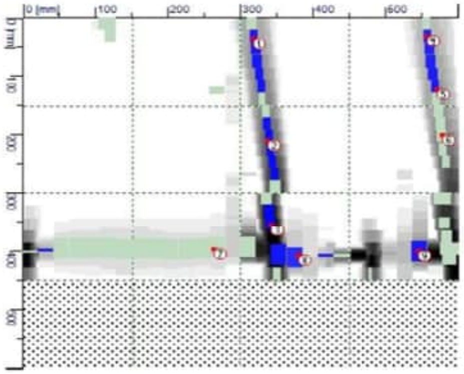
- Mathew
8/06/2015 7:50:07 a.m.
L2-3 Beam Scan 1


- Mathew
8/06/2015 7:51:49 a.m.
L2-3 Under Beam Scan 2

Imagescan: *l2_3_beam_scan_1.XFF*

Date / Time: *2015-04-23 13:40:32* SSN: *16411007* [mm]



Customer: *Canterbury Jockey Club*
Location: *L2-3 Beam Scan 1* Operator: *Mathew Le Comte*
Comment:
Vertical bars estimated 12-14mm
Horizontal bar estimated 36mm

Marker	x: [mm]	y: [mm]	Comment:
1	315	33	Estimated bar size 12mm, Concrete cover 30mm
2	336	207	Estimated bar size 12mm, Concrete cover 16mm
3	340	353	Estimated bar size 14mm, Concrete cover 6mm
4	555	29	Estimated bar size 12mm, Concrete cover 37mm
5	568	119	Estimated bar size 12mm, Concrete cover 29mm
6	577	197	Estimated bar size 14mm, Concrete cover 21mm
7	260	395	Estimated bar size 36mm, Concrete cover 76mm (not verified)
8	378	405	Estimated bar size 36mm, Concrete cover 46mm
9	542	397	Estimated bar size 36mm, Concrete cover 27mm

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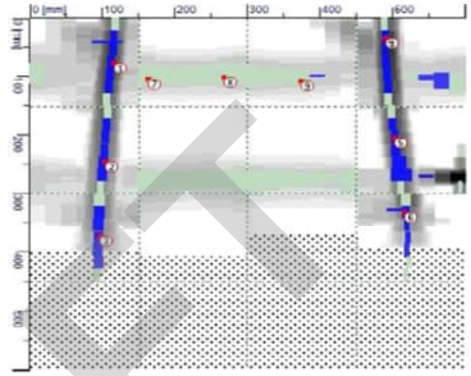
Imagescan: *l2_3_beam_s2_under.XFF*

Date / Time: *2015-04-23 16:53:23* SSN: *16411007* [mm]



Customer: *Canterbury Jockey Club*
Location: *L2-3 Beam Scan 2 Under Beam* Operator: *Mathew Le Comte*
Comment:
Vertical bars estimated 10-14mm
Horizontal bar estimated 30-36mm

Marker	x: [mm]	y: [mm]	Comment:
1	112	74	Estimated bar size 12mm, Concrete cover 15mm
2	100	241	Estimated bar size 14mm, Concrete cover 24mm
3	93	370	Estimated bar size 14mm, Concrete cover 36mm
4	489	32	Estimated bar size 10mm, Concrete cover 13mm
5	501	201	Estimated bar size 12mm, Concrete cover 18mm
6	515	330	Estimated bar size 12mm, Concrete cover 22mm
7	160	101	Estimated bar size 36mm, Concrete cover 62mm (not verified)
8	264	97	Estimated bar size 36mm, Concrete cover 65mm (not verified)
9	373	104	Estimated bar size 30mm, Concrete cover 64mm (not verified)

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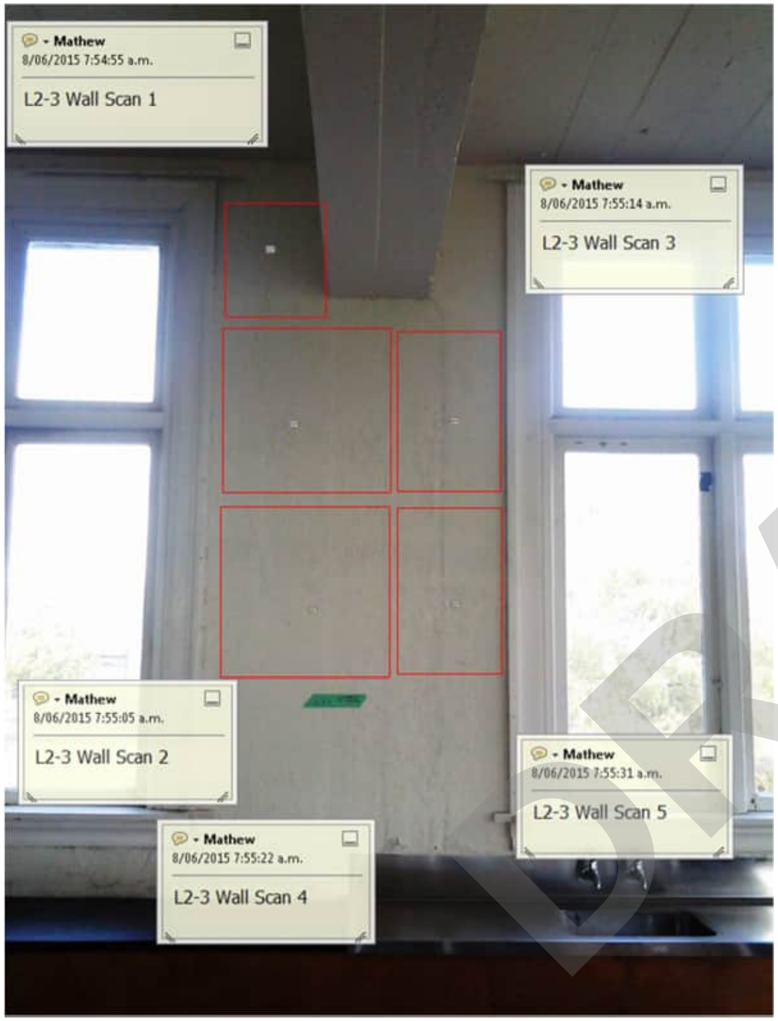
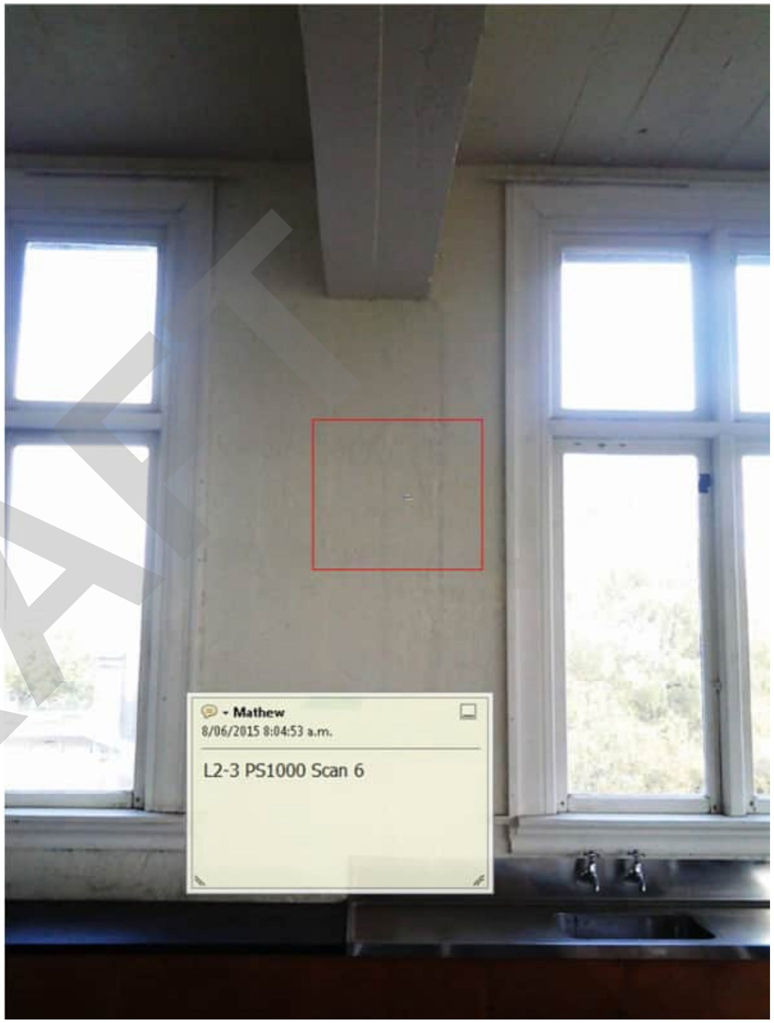
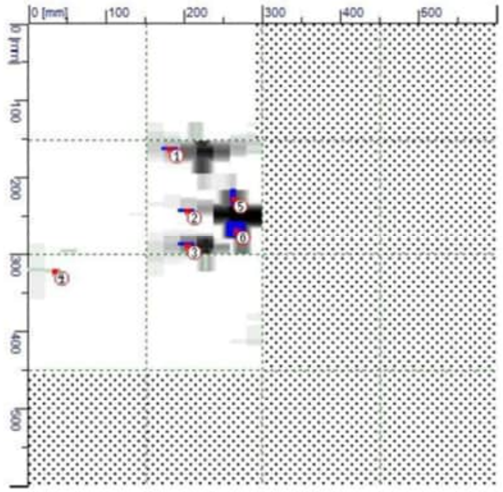

Mathew
8/06/2015 7:54:55 a.m.
L2-3 Wall Scan 1
Mathew
8/06/2015 7:55:14 a.m.
L2-3 Wall Scan 3
Mathew
8/06/2015 7:55:05 a.m.
L2-3 Wall Scan 2
Mathew
8/06/2015 7:55:31 a.m.
L2-3 Wall Scan 5
Mathew
8/06/2015 7:55:22 a.m.
L2-3 Wall Scan 4


Mathew
8/06/2015 8:04:53 a.m.
L2-3 PS1000 Scan 6

Imagescan: *l2_3_wall_scan_1.XFF*

Date / Time: *2015-04-23 13:24:54* SSN: *16411007* *[mm]*



Customer: *Canterbury Jockey Club*
Location: *L2-3 Wall Scan 1* Operator: *Mathew Le Comte*
Comment:

Marker	x: [mm]	y: [mm]	Comment:
1	178	160	Estimated bar size 6mm, Concrete cover 31mm
2	201	240	Estimated bar size 6mm, Concrete cover 21mm
3	200	285	Estimated bar size 6mm, Concrete cover 14mm
4	32	321	Estimated bar size 6mm, Concrete cover 103mm (not verified)
5	260	225	Estimated bar size 8mm, Concrete cover 11mm
6	263	266	Estimated bar size 6mm, Concrete cover 31mm

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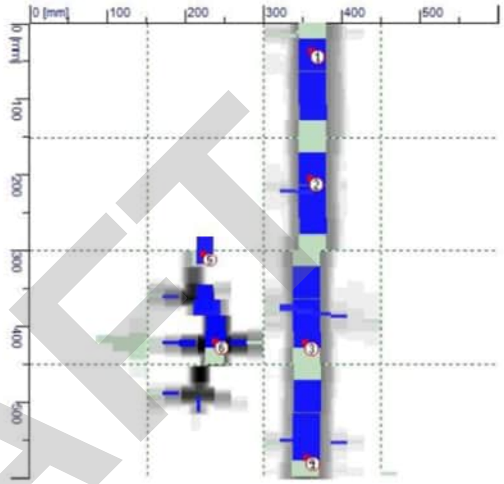
Imagescan: *l2_3_wall_scan_2.XFF*

Date / Time: *2015-04-23 13:30:00* SSN: *16411007* *[mm]*



Customer: *Canterbury Jockey Club*
Location: *L2-3 Wall Scan 2* Operator: *Mathew Le Comte*
Comment:
Annotations 1-4 Vertical bar estimated 36mm

Marker	x: [mm]	y: [mm]	Comment:
1	359	33	Estimated bar size 36mm, Concrete cover 24mm
2	358	201	Estimated bar size 36mm, Concrete cover 23mm
3	351	419	Estimated bar size 36mm, Concrete cover 23mm
4	352	570	Estimated bar size 36mm, Concrete cover 23mm
5	219	300	Estimated bar size 36mm, Concrete cover 29mm
6	234	418	Estimated bar size 28mm, Concrete cover 5mm

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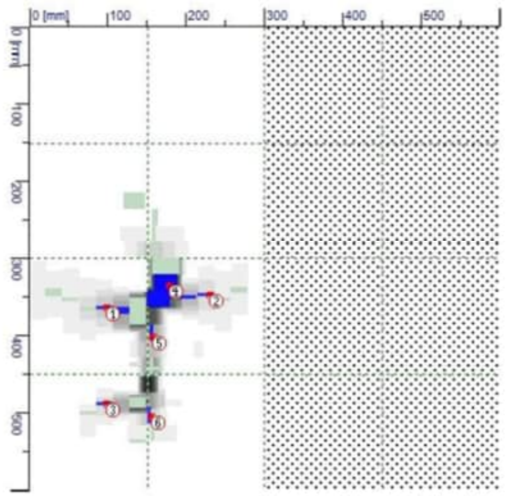
Imagescan: ***l2_3_wall_scan_3.XFF***

Date / Time: *2015-04-23 13:35:14* SSN: *16411007* [mm]



Customer: *Canterbury Jockey Club*
Location: *L2-3 Wall Scan 3* Operator: *Mathew Le Comte*
Comment:

Marker	x: [mm]	y: [mm]	Comment:
1	95	362	Estimated bar size 6mm, Concrete cover 47mm
2	226	345	Estimated bar size 6mm, Concrete cover 57mm
3	95	486	Estimated bar size 6mm, Concrete cover 59mm
4	175	333	Estimated bar size 30mm, Concrete cover 7mm
5	153	399	Estimated bar size 6mm, Concrete cover 28mm
6	152	503	Estimated bar size 6mm, Concrete cover 47mm

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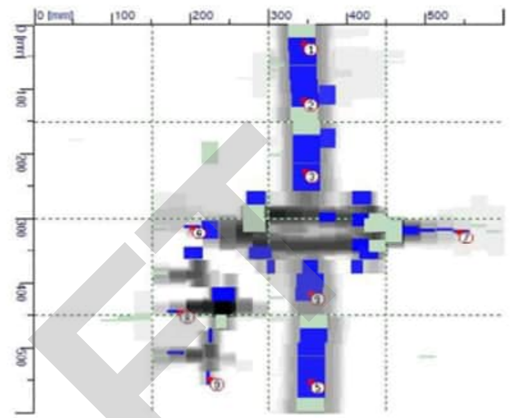
Imagescan: ***l2_3_wall_scan_4.XFF***

Date / Time: *2015-04-23 14:40:06* SSN: *16411007* [mm]



Customer: *Canterbury Jockey Club*
Location: *L2-3 Wall Scan 4* Operator: *Mathew Le Comte*
Comment:
Annotations 1-5 vertical bar estimated 36mm

Marker	x: [mm]	y: [mm]	Comment:
1	344	26	Estimated bar size 36mm, Concrete cover 24mm
2	344	112	Estimated bar size 36mm, Concrete cover 26mm
3	345	223	Estimated bar size 36mm, Concrete cover 26mm
4	352	415	Estimated bar size 36mm, Concrete cover 30mm
5	352	551	Estimated bar size 36mm, Concrete cover 29mm
6	199	311	Estimated bar size 6mm, Concrete cover 24mm
7	541	319	Estimated bar size 6mm, Concrete cover 55mm
8	184	442	Estimated bar size 6mm, Concrete cover 19mm
9	222	547	Estimated bar size 6mm, Concrete cover 31mm

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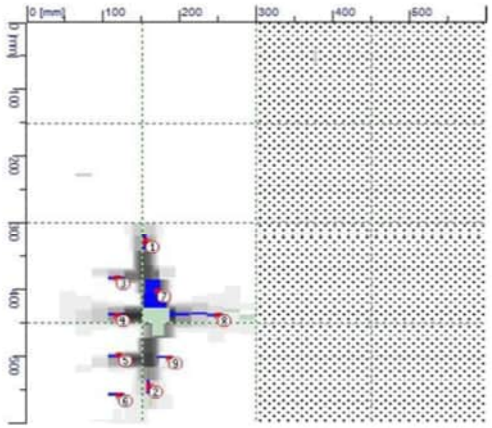
Imagescan: *l2_3_wall_scan_5.XFF*

Date / Time: *2015-04-23 14:43:30* SSN: *16411007* *[mm]*



Customer: *Canterbury Jockey Club*

Location: *L2-3 Wall Scan 5* Operator: *Mathew Le Comte*

Comment:

Marker	x: [mm]	y: [mm]	Comment:
1	152	326	Estimated bar size 6mm, Concrete cover 23mm
2	158	542	Estimated bar size 6mm, Concrete cover 40mm
3	114	381	Estimated bar size 6mm, Concrete cover 18mm
4	115	437	Estimated bar size 6mm, Concrete cover 40mm
5	118	496	Estimated bar size 6mm, Concrete cover 24mm
6	118	556	Estimated bar size 6mm, Concrete cover 41mm
7	167	400	Estimated bar size 20mm, Concrete cover 14mm
8	247	437	Estimated bar size 6mm, Concrete cover 57mm
9	182	500	Estimated bar size 6mm, Concrete cover 34mm

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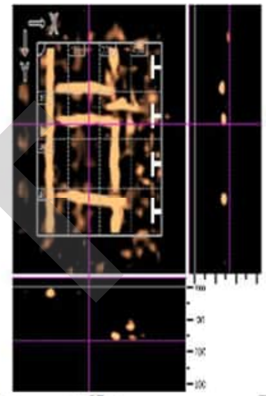
Hilti PROFIS PS 1000 Report

Scan File: RS_159120003_000879_l2_3_wall_scan_6.hscan
Scan Name: l2-3 wall scan 6
Date / Time: 2015-04-23 13:56:00
Comment: -



x: 250 mm y: 250 mm z: -27 mm Thickness: 195 mm
Concrete: 9.0 Method: Standard

Project name: jockey club level 2 Customer: -Canterbury Jockey Club
Location: -L2-3 Wall Scan 6 Object: -Wall
User: -Mathew Le Comte
Comment: -

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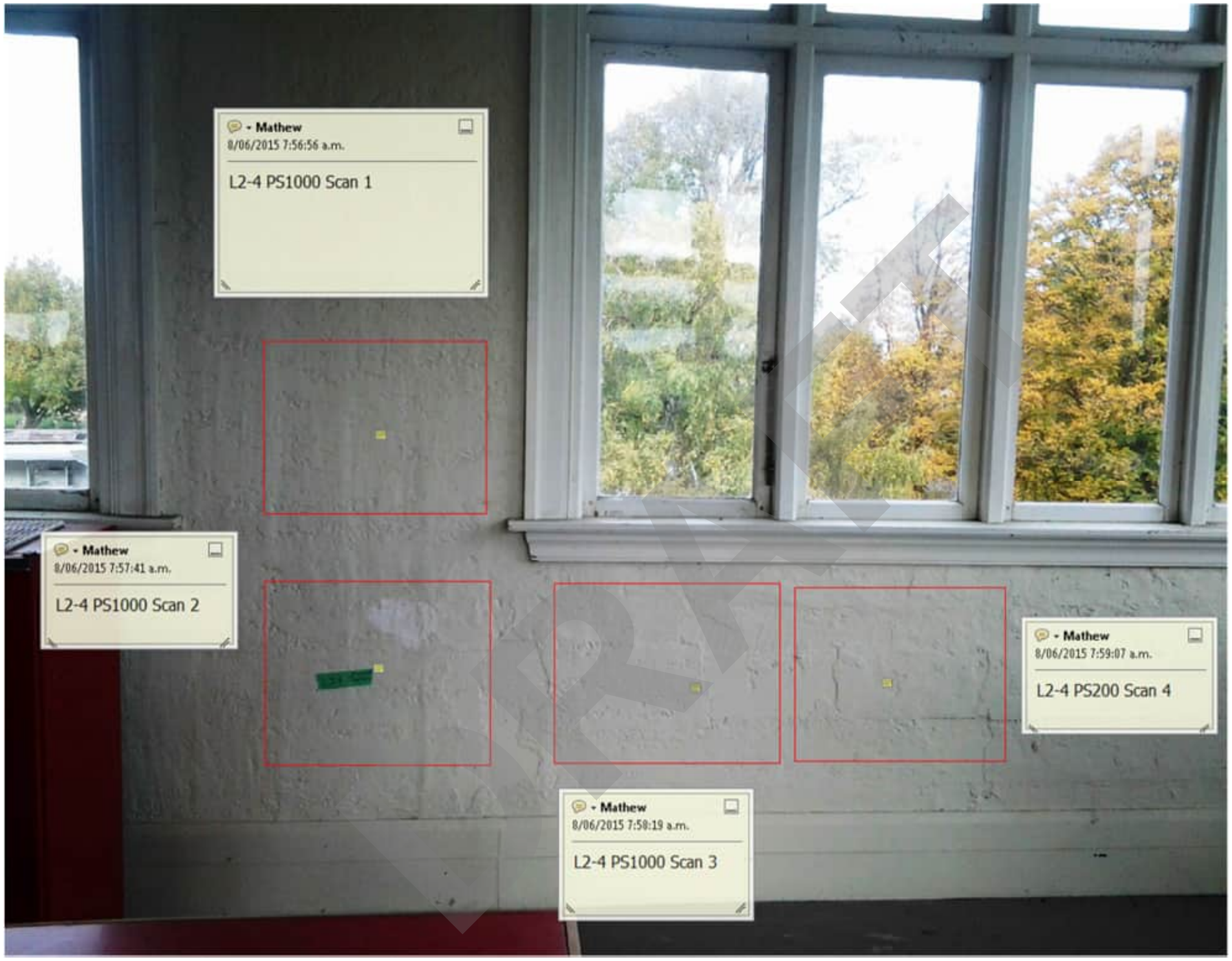
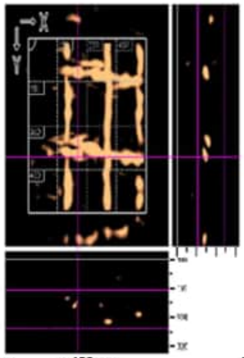

Mathew
8/06/2015 7:56:56 a.m.
L2-4 PS1000 Scan 1
Mathew
8/06/2015 7:57:41 a.m.
L2-4 PS1000 Scan 2
Mathew
8/06/2015 7:59:07 a.m.
L2-4 PS200 Scan 4
Mathew
8/06/2015 7:58:19 a.m.
L2-4 PS1000 Scan 3
DRAFT

Hilti PROFIS PS 1000 Report

Scan File:	RS_159120003_000880_l2_4_wall_scan1.hscan
Scan Name:	l2-4 wall scan1
Date / Time:	2015-04-23 14:07:40
Comment:	-



x: 255 mm	y: 408 mm	z: 106 mm	Thickness: 135 mm
Concrete: 9.0		Method: Advanced	

Project name:	jockey club level 2	Customer:	-Canterbury Jockey Club
Location:	-L2-4 Wall Scan 1	Object:	-Wall
User:	-Mathew Le Comte		
Comment:	-		

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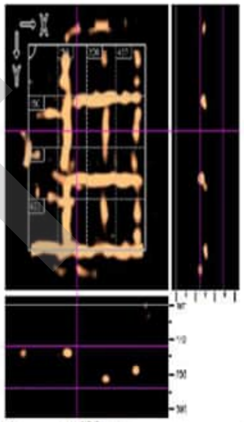
Hilti PROFIS PS 1000 Report

Scan File:	RS_159120003_000881_l2_4_wall_scan_2.hscan
Scan Name:	l2-4 wall scan 2
Date / Time:	2015-04-23 14:16:39
Comment:	-



x: 250 mm	y: 250 mm	z: 120 mm	Thickness: 120 mm
Concrete: 9.0		Method: Standard	

Project name:	jockey club level 2	Customer:	-Canterbury Jockey Club
Location:	-L2-4 Wall Scan 2	Object:	-Wall
User:	-Mathew Le Comte		
Comment:	-		

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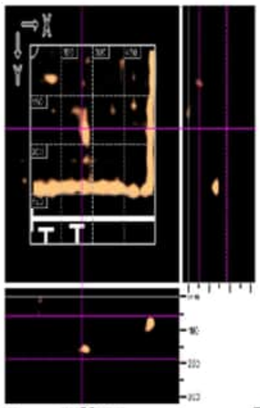
Hilti PROFIS PS 1000 Report

Scan File:	RS_159120003_000882_l2_4_wall_scan_3.hscan
Scan Name:	l2-4 wall scan 3
Date / Time:	2015-04-23 14:25:06
Comment:	-



x: 250 mm   y: 250 mm   z: 56 mm   Thickness: 130 mm
Concrete: 9.0   Method: Standard

Project name:	jockey club level 2	Customer:	-Canterbury Jockey Club
Location:	-L2-4 Wall Scan 3	Object:	-Wall
User:	-Mathew Le Comte		
Comment:	-		

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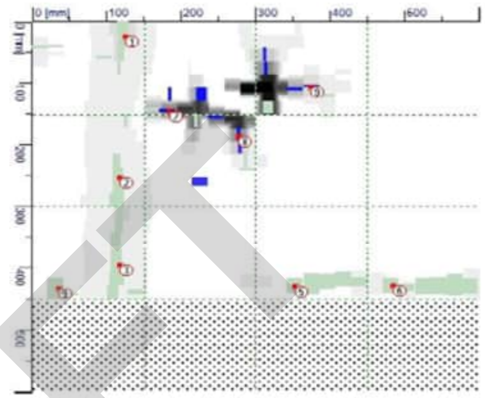
Imagescan: ***l2_4_wall_scan_4.XFF***

Date / Time: *2015-04-23 15:29:55*   SSN: *16411007*   *[mm]*



Customer: *Canterbury Jockey Club*
Location: *L2-4 Wall Scan 4*   Operator: *Mathew Le Comte*
Comment:
Annotations 1-3 Vertical bar estimated 14-16mm
Annotations 4-6 Horizontal bar estimated 25-36mm

Marker	x: [mm]	y: [mm]	Comment:
1	122	21	Estimated bar size 16mm, Concrete cover 71mm (not verified)
2	114	249	Estimated bar size 14mm, Concrete cover 80mm (not verified)
3	114	393	Estimated bar size 16mm, Concrete cover 84mm (not verified)
4	33	432	Estimated bar size 36mm, Concrete cover 136mm (not verified)
5	351	427	Estimated bar size 25mm, Concrete cover 121mm (not verified)
6	482	426	Estimated bar size 25mm, Concrete cover 121mm (not verified)
7	181	141	Estimated bar size 6mm, Concrete cover 16mm
8	274	182	Estimated bar size 6mm, Concrete cover 17mm
9	371	103	Estimated bar size 6mm, Concrete cover 50mm

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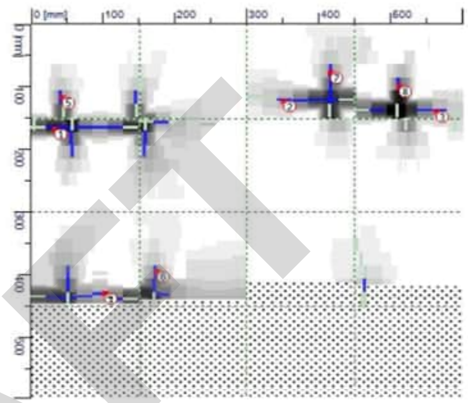
Imagescan: *L3_9_wall_scan_1.XFF*

Date / Time: *2015-04-22 13:03:09* SSN: *16411007* *[mm]*



Customer: *Canterbury Jockey Club*
Location: *L3-9 Wall scan 1* Operator: *Mathew Le Comte*
Comment:
6mm tags found not indicative of continuous re enforcing

Marker	x: [mm]	y: [mm]	Comment:
1	30	164	Estimated bar size 6mm, Concrete cover 15mm
2	349	121	Estimated bar size 6mm, Concrete cover 48mm
3	562	137	Estimated bar size 6mm, Concrete cover 31mm
4	99	429	Estimated bar size 6mm, Concrete cover 51mm
5	40	115	Estimated bar size 6mm, Concrete cover 38mm
6	171	393	Estimated bar size 6mm, Concrete cover 46mm
7	415	75	Estimated bar size 6mm, Concrete cover 47mm
8	510	96	Estimated bar size 6mm, Concrete cover 31mm

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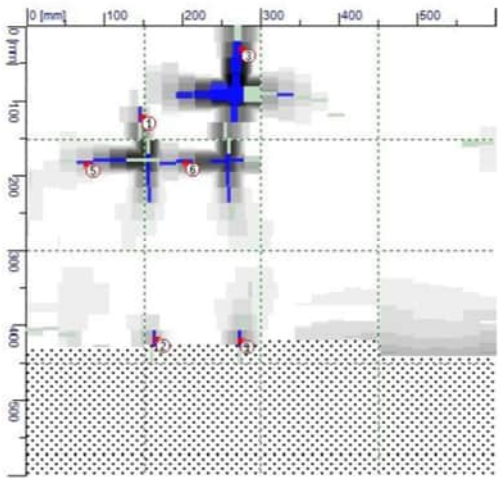
Imagescan: *L3_9_wall_scan_2.XFF*

Date / Time: *2015-04-22 13:06:46* SSN: *16411007* *[mm]*



Customer: *Canterbury Jockey Club*

Location: *L3-9 Wall scan 2* Operator: *Mathew Le Comte*

Comment:

Steel tags found within the wall estimated 6-8mm not indicative of continuous re enforcing

Marker	x: [mm]	y: [mm]	Comment:
1	145	118	Estimated bar size 6mm, Concrete cover 50mm
2	163	416	Estimated bar size 6mm, Concrete cover 51mm
3	271	27	Estimated bar size 12mm, Concrete cover 22mm
4	270	418	Estimated bar size 6mm, Concrete cover 39mm
5	74	181	Estimated bar size 6mm, Concrete cover 56mm
6	201	179	Estimated bar size 6mm, Concrete cover 30mm

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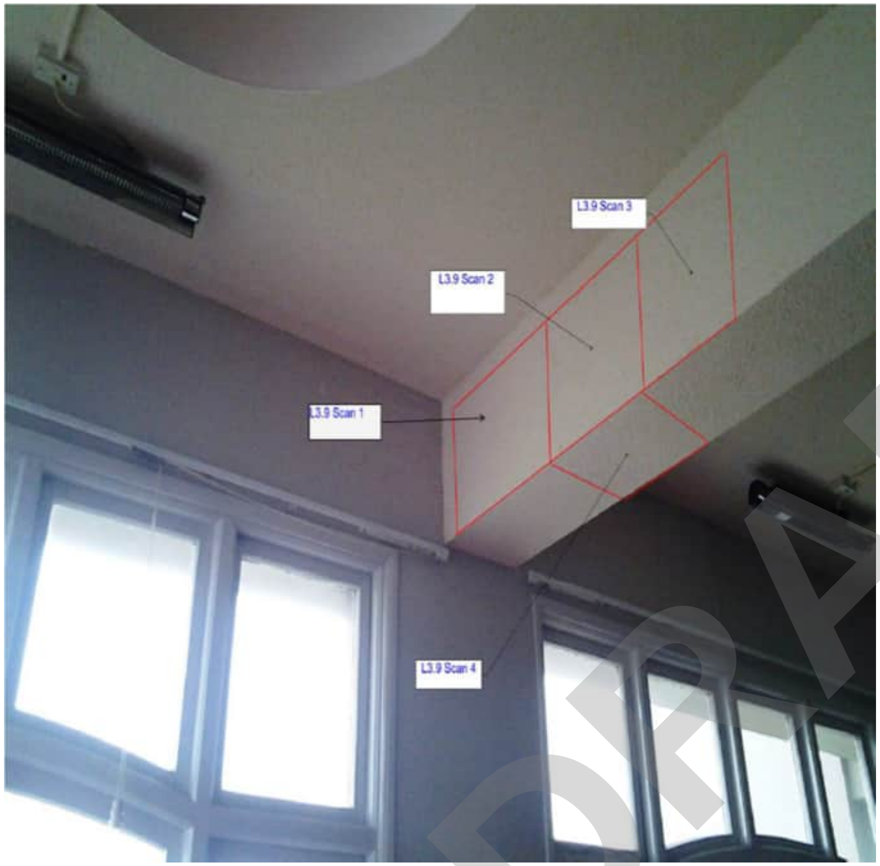
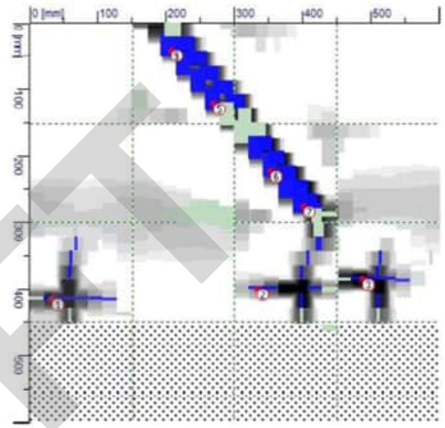


Imagescan: *L3_9_beam_scan_1.XFF*

Date / Time: *2015-04-22 12:54:54* SSN: *16411007* [mm]



Customer: *Canterbury Jockey Club*

Location: *L3-9 Beam Scan 1* Operator: *Mathew Le Comte*

Comment:
Annotations 4-7 showing re enforcing bar on an angle

Marker	x: [mm]	y: [mm]	Comment:
1	30	412	Estimated bar size 6mm, Concrete cover 14mm
2	332	397	Estimated bar size 6mm, Concrete cover 38mm
3	485	382	Estimated bar size 6mm, Concrete cover 9mm
4	204	37	Estimated bar size 36mm, Concrete cover 26mm
5	266	118	Estimated bar size 36mm, Concrete cover 22mm
6	351	219	Estimated bar size 36mm, Concrete cover 24mm
7	399	271	Estimated bar size 36mm, Concrete cover 19mm

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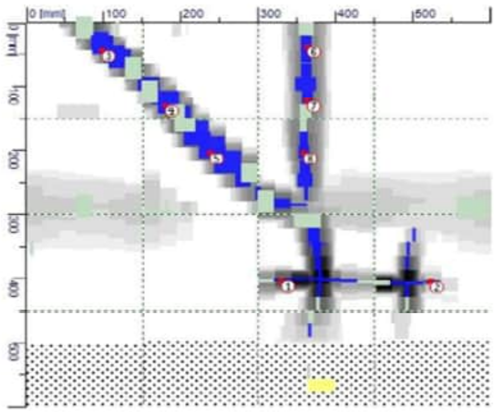
Imagescan: *L3_9_beam_scan_2.XFF*

Date / Time: *2015-04-22 12:59:00* SSN: *16411007* *[mm]*



Customer: *Canterbury Jockey Club*
Location: *L3-9 Beam scan 2* Operator: *Mathew Le Comte*
Comment:
Annotations 3-5 showing angled bar estimated 30-36mm
Annotations 6-8 vertical bar estimated 14mm

Marker	x: [mm]	y: [mm]	Comment:
1	329	401	Estimated bar size 6mm, Concrete cover 19mm
2	521	403	Estimated bar size 6mm, Concrete cover 54mm
3	95	40	Estimated bar size 30mm, Concrete cover 32mm
4	177	126	Estimated bar size 36mm, Concrete cover 34mm
5	234	201	Estimated bar size 36mm, Concrete cover 35mm
6	362	34	Estimated bar size 14mm, Concrete cover 34mm
7	362	119	Estimated bar size 14mm, Concrete cover 32mm
8	358	200	Estimated bar size 14mm, Concrete cover 31mm

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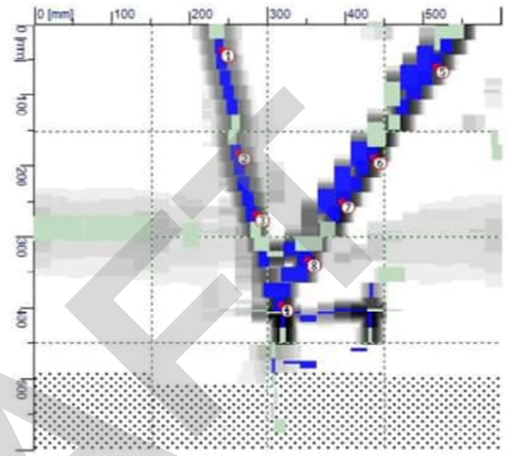
Imagescan: *L3_9_beam_scan_3.XFF*

Date / Time: *2015-04-22 13:11:12* SSN: *16411007* *[mm]*



Customer: *Canterbury Jockey Club*
Location: *L3 9 Beam scan 3* Operator: *Mathew Le Comte*
Comment:

Marker	x: [mm]	y: [mm]	Comment:
1	237	33	Estimated bar size 12mm, Concrete cover 31mm
2	259	178	Estimated bar size 14mm, Concrete cover 27mm
3	281	264	Estimated bar size 16mm, Concrete cover 22mm
4	315	393	Estimated bar size 14mm, Concrete cover 14mm
5	514	55	Estimated bar size 16mm, Concrete cover 18mm
6	434	184	Estimated bar size 16mm, Concrete cover 17mm
7	393	247	Estimated bar size 20mm, Concrete cover 17mm
8	349	330	Estimated bar size 20mm, Concrete cover 15mm

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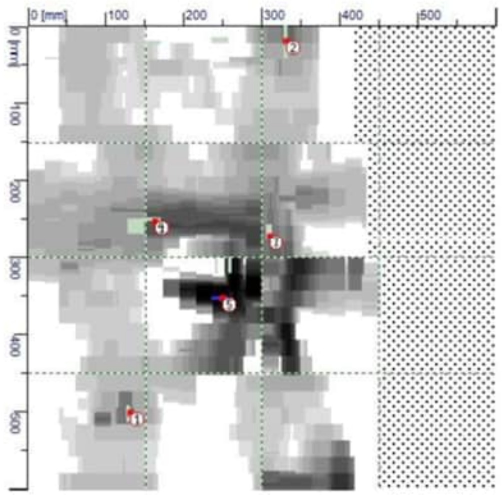
Imagescan: *L3_9_beam_scan_4.XFF*

Date / Time: *2015-04-22 14:24:57* SSN: *16411007* [mm]



Customer: *Canterbury Jockey Club*
Location: *L3-9 Beam scan 4* Operator: *Mathew Le Comte*
Comment:

Marker	x: [mm]	y: [mm]	Comment:
1	127	499	Estimated bar size 6mm, Concrete cover 84mm (not verified)
2	330	16	Estimated bar size 6mm, Concrete cover 81mm (not verified)
3	307	268	Estimated bar size 8mm, Concrete cover 87mm (not verified)
4	160	249	Estimated bar size 6mm, Concrete cover 70mm (not verified)
5	247	351	Estimated bar size 6mm, Concrete cover 48mm

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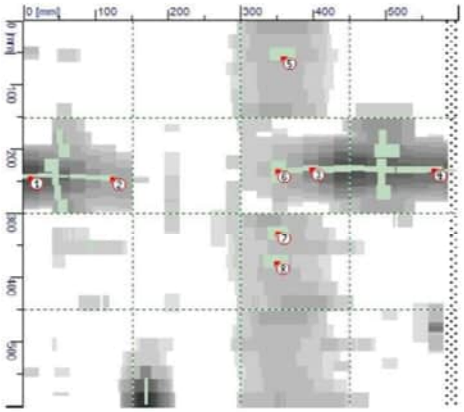
L3.9 Column
Scan 1
L3.9 Column
Scan 2
L3.9 Column
Scan 3
L3.9 Column
Scan 4


L3.9 Column
Scan 5

Imagescan: *L3_9_column_scan_1.XFF*

Date / Time: *2015-04-22 11:16:12* SSN: *16411007* [*mm*]



Customer: *Canterbury Jockey Club*
Location: *L3-9 Vertical column Scan 1* Operator: *Mathew Le Comte*
Comment:
Horizontal bars estimated 8-10mm
Vertical bars estimated 30-36mm

Marker	x: [mm]	y: [mm]	Comment:
1	7	241	Estimated bar size 8mm, Concrete cover 73mm (not verified)
2	121	244	Estimated bar size 10mm, Concrete cover 106mm (not verified)
3	396	229	Estimated bar size 10mm, Concrete cover 94mm (not verified)
4	564	230	Estimated bar size 10mm, Concrete cover 86mm (not verified)
5	356	55	Estimated bar size 36mm, Concrete cover 138mm (not verified)
6	349	232	Estimated bar size 36mm, Concrete cover 140mm (not verified)
7	349	330	Estimated bar size 30mm, Concrete cover 144mm (not verified)
8	348	377	Estimated bar size 36mm, Concrete cover 146mm (not verified)

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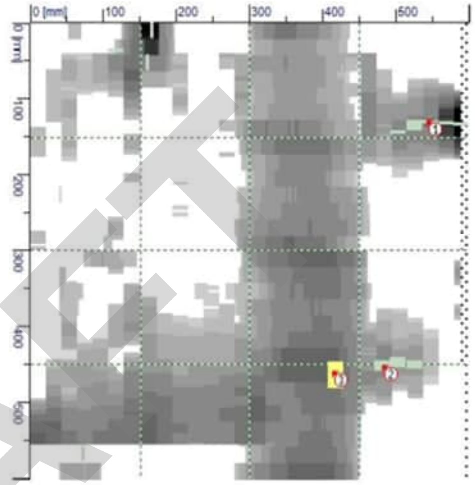
Imagescan: *L3_9_column_scan_2.XFF*

Date / Time: *2015-04-22 11:23:27* SSN: *16411007* [*mm*]



Customer: *Canterbury Jockey Club*
Location: *L3-9 Vertical Column Scan 2* Operator: *Mathew Le Comte*
Comment:
Area scanned does not show clear detections.
Shadowing shows approximate bar locations

Marker	x: [mm]	y: [mm]	Comment:
1	542	127	Estimated bar size 6mm, Concrete cover 98mm (not verified)
2	482	452	Estimated bar size 14mm, Concrete cover 114mm (not verified)
3	415	460	Estimated bar size 36mm, Concrete cover 151mm (not verified)

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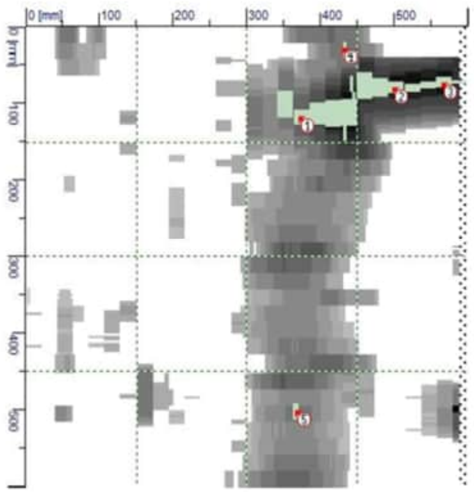
Imagescan: *L3_9_column_scan_3.XFF*

Date / Time: *2015-04-22 11:36:36* SSN: *16411007* *[mm]*



Customer: *Canterbury Jockey Club*

Location: *L3-9 Vertical Column Scan 3* Operator: *Mathew Le Comte*

Comment:

Area scanned does not show clear results

Marker	x: [mm]	y: [mm]	Comment:
1	373	118	Estimated bar size 20mm, Concrete cover 121mm (not verified)
2	499	79	Estimated bar size 16mm, Concrete cover 102mm (not verified)
3	566	74	Estimated bar size 14mm, Concrete cover 99mm (not verified)
4	432	27	Estimated bar size 6mm, Concrete cover 108mm (not verified)
5	367	503	Estimated bar size 8mm, Concrete cover 120mm (not verified)

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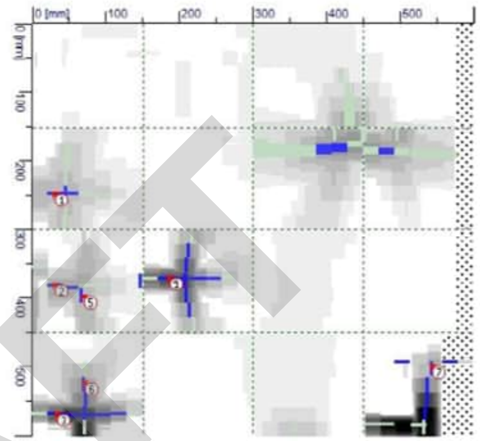
Imagescan: *L3_9_column_scan_4.XFF*

Date / Time: *2015-04-22 11:46:47* SSN: *16411007* *[mm]*



Customer: *Canterbury Jockey Club*

Location: *L3-9 Vertical Column Scan 4* Operator: *Mathew Le Comte*

Comment:

6mm tags found within wall.
This is not indicative of continuous re enforcing

Marker	x: [mm]	y: [mm]	Comment:
1	27	245	Estimated bar size 6mm, Concrete cover 56mm
2	27	379	Estimated bar size 6mm, Concrete cover 59mm
3	32	567	Estimated bar size 6mm, Concrete cover 29mm
4	184	368	Estimated bar size 6mm, Concrete cover 26mm
5	67	396	Estimated bar size 6mm, Concrete cover 56mm
6	68	522	Estimated bar size 6mm, Concrete cover 53mm
7	541	497	Estimated bar size 6mm, Concrete cover 56mm

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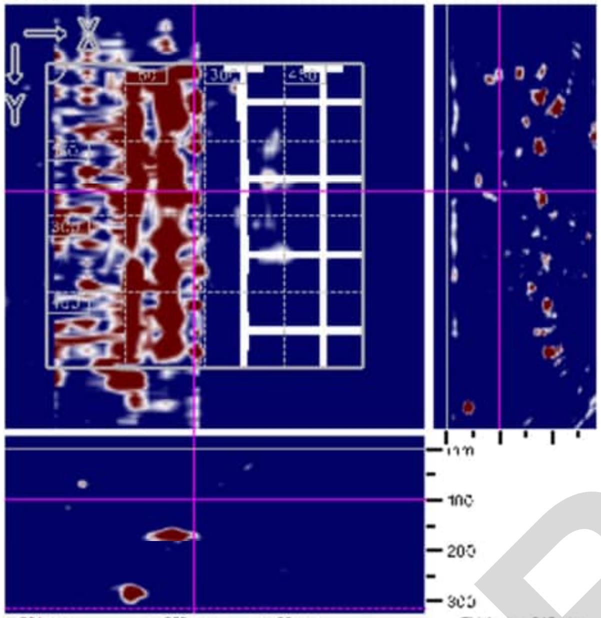
Hilti PROFIS PS 1000 Report

Scan File:	RS_159120003_000883_l3_9_col_scan_5.hscan
Scan Name:	L3-9 col scan 5
Date / Time:	2015-04-23 16:04:41
Comment:	-



x: 281 mm   y: 250 mm   z: 99 mm   Thickness: 215 mm
Concrete: 9.5   Method: Advanced

Project name:	jockey club level3-4	Customer:	-Canterbury Jockey Club
Location:	-L3-9 Column scan 5	Object:	-Column
User:	-Mathew Le Comte		
Comment:	-PS1000 showing 2 x vertical bars at approx. 150/300mm deep in column		

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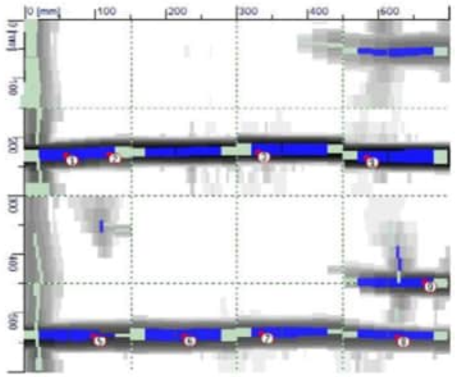
Imagescan: *L3_9_floorceiling_s1.XFF*

Date / Time: *2015-04-22 13:15:40* SSN: *16411007* *[mm]*



Customer: *Canterbury Jockey Club*

Location: *L3-9 Floor scan 1* Operator: *Mathew Le Comte*

Comment:
Scan taken on the underside of floor
Re enforcing in floor estimated 16-20mm

Marker	x: [mm]	y: [mm]	Comment:
1	55	229	Estimated bar size 20mm, Concrete cover 28mm
2	116	225	Estimated bar size 20mm, Concrete cover 28mm
3	329	222	Estimated bar size 20mm, Concrete cover 25mm
4	481	232	Estimated bar size 20mm, Concrete cover 23mm
5	95	537	Estimated bar size 16mm, Concrete cover 31mm
6	222	537	Estimated bar size 20mm, Concrete cover 35mm
7	333	533	Estimated bar size 16mm, Concrete cover 35mm
8	525	538	Estimated bar size 16mm, Concrete cover 36mm
9	563	445	Estimated bar size 16mm, Concrete cover 31mm

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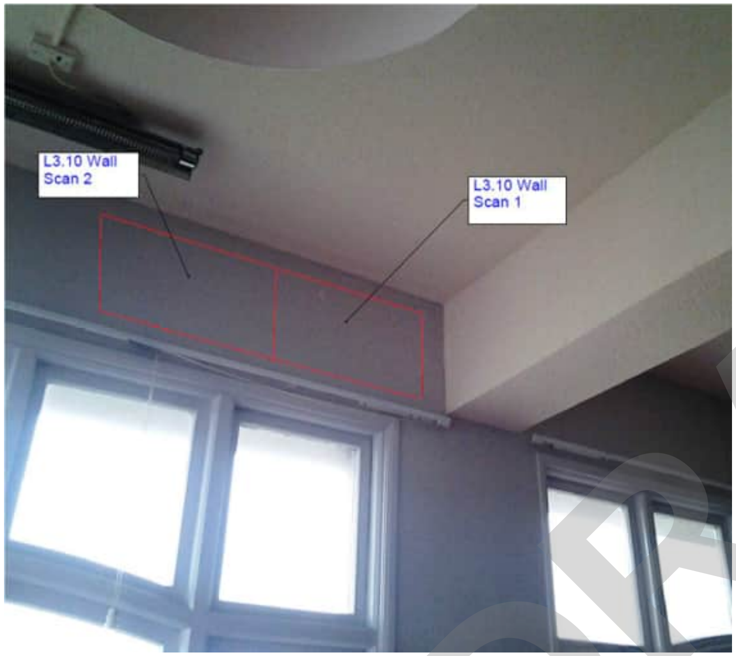
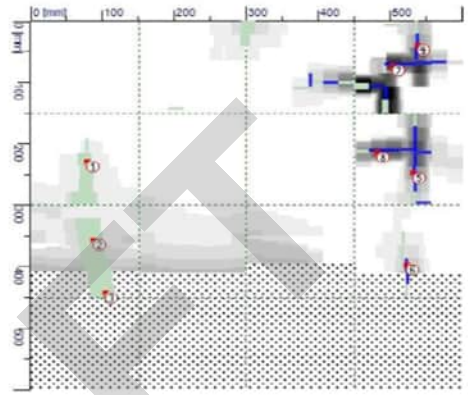


Imagescan: ***L3_10_wall_scan_1.XFF***

Date / Time: *2015-04-22 17:42:46*　　SSN: *16411007*　　*[mm]*



Customer: *Canterbury Jockey Club*
Location: *L3--10 wall scan 1*　　Operator: *Mathew Le Comte*
Comment:
Annotations 1-3 vertical bar estimated 20-36mm
Annotations 4-8 estimated 6mm

Marker	x: [mm]	y: [mm]	Comment:
1	75	225	Estimated bar size 20mm, Concrete cover 107mm (not verified)
2	84	353	Estimated bar size 36mm, Concrete cover 102mm (not verified)
3	101	440	Estimated bar size 36mm, Concrete cover 100mm (not verified)
4	536	36	Estimated bar size 6mm, Concrete cover 37mm
5	530	244	Estimated bar size 6mm, Concrete cover 33mm
6	521	395	Estimated bar size 6mm, Concrete cover 56mm
7	501	68	Estimated bar size 6mm, Concrete cover 13mm
8	479	210	Estimated bar size 6mm, Concrete cover 21mm

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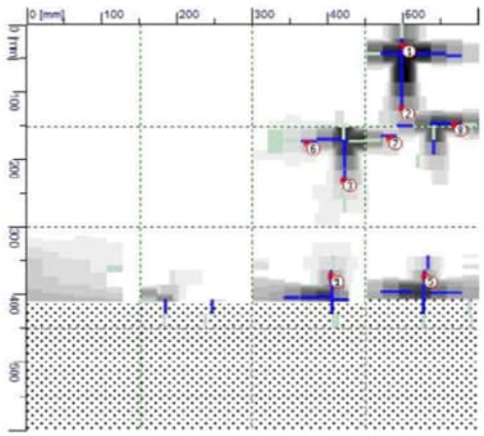
Imagescan: *L3_10_wall_scan_2.XFF*

Date / Time: *2015-04-22 17:46:13* SSN: *16411007* [mm]



Customer: *Canterbury Jockey Club*

Location: *L3-10 wall scan 2* Operator: *Mathew Le Comte*

Comment:

6mm Tags found within wall not indicative of continuous re enforcing

Marker	x: [mm]	y: [mm]	Comment:
1	497	29	Estimated bar size 6mm, Concrete cover 19mm
2	496	121	Estimated bar size 6mm, Concrete cover 33mm
3	419	226	Estimated bar size 6mm, Concrete cover 49mm
4	403	370	Estimated bar size 6mm, Concrete cover 48mm
5	526	370	Estimated bar size 6mm, Concrete cover 40mm
6	370	171	Estimated bar size 6mm, Concrete cover 54mm
7	479	164	Estimated bar size 6mm, Concrete cover 54mm
8	566	145	Estimated bar size 6mm, Concrete cover 19mm

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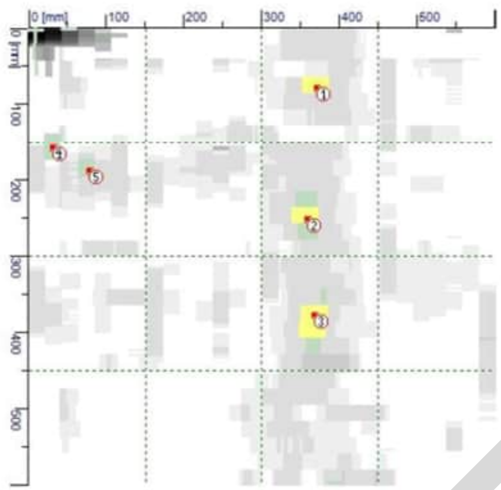
L3.10 Scan 3
L3.10 Scan 2
L3.10 Scan 1
L3.10 Scan 4

Imagescan: *L3_10_scan_1.XFF*

Date / Time: *2015-04-21 09:46:27* SSN: *16411007* *[mm]*



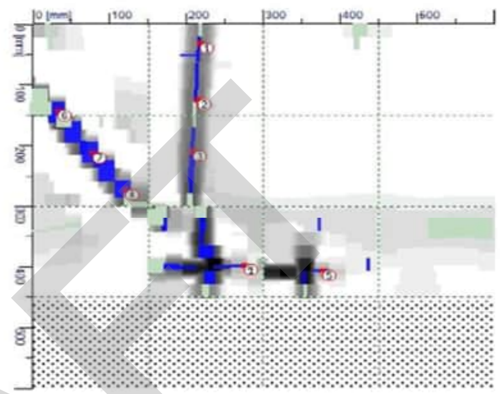
Customer: *Canterbury Jockey Club*
Location: *L3-10 beam scan 1* Operator: *Mathew Le Comte*

Comment:

Annotations 1-3 Vertical bar estimated 36mm
Annotations 4-5 Horizontal bar estimated 25-36mm

Imagescan: *L3_10_beam_scan_2.XFF*

Date / Time: *2015-04-22 18:09:17* SSN: *16411007* *[mm]*



Customer: *Canterbury Jockey Club*
Location: *L3-10 beam scan 2* Operator: *Mathew Le Comte*
Comment:
Annotations 1-3 vertical bar estimated 6mm
Annotations 4-5 Horizontal bar estimated 6mm
Annotations 6-8 angled bar estimated 30-36mm

Marker	x: [mm]	y: [mm]	Comment:
1	215	29	Estimated bar size 6mm, Concrete cover 19mm
2	211	121	Estimated bar size 6mm, Concrete cover 17mm
3	205	205	Estimated bar size 6mm, Concrete cover 15mm
4	271	395	Estimated bar size 6mm, Concrete cover 41mm
5	375	404	Estimated bar size 6mm, Concrete cover 32mm
6	30	138	Estimated bar size 36mm, Concrete cover 24mm
7	75	208	Estimated bar size 36mm, Concrete cover 31mm
8	118	268	Estimated bar size 30mm, Concrete cover 28mm

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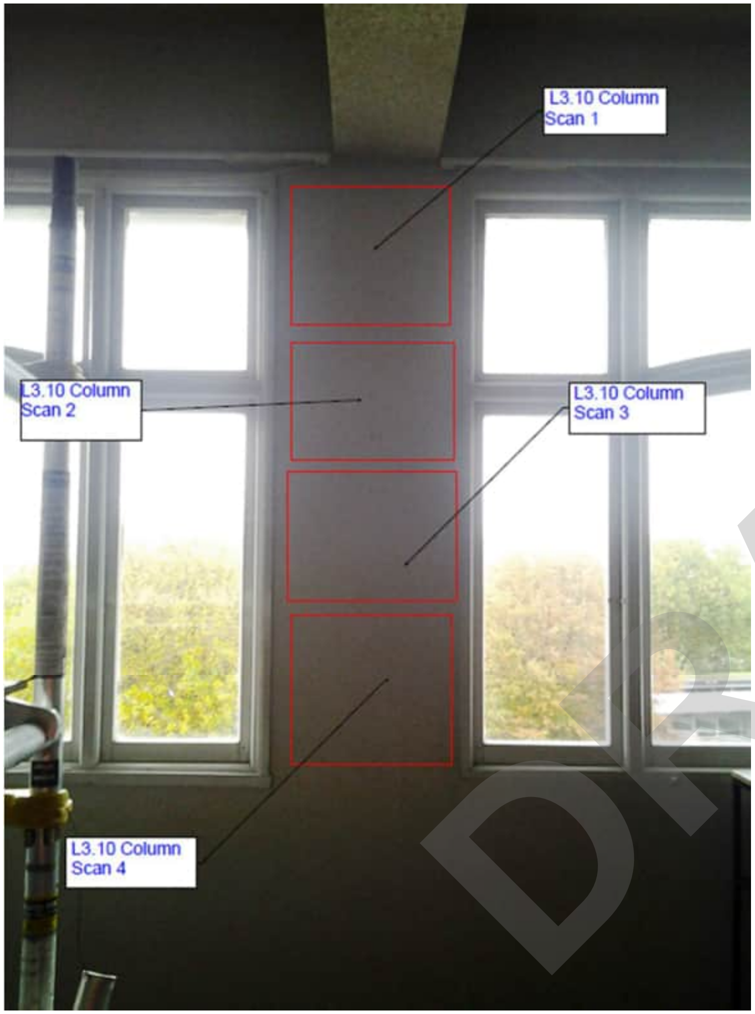
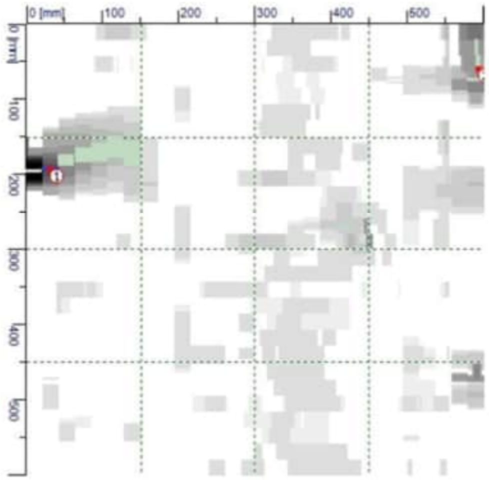

L3.10 Column
Scan 1
L3.10 Column
Scan 2
L3.10 Column
Scan 3
L3.10 Column
Scan 4


L3.10 Column
Scan 5

Imagescan: *L3_10 column_scan_1.XFF*

Date / Time: *2015-04-22 16:27:29* SSN: *16411007* [*mm*]



Customer: *Canterbury Jockey Club*
Location: *L3-10 column scan 1* Operator: *Mathew Le Comte*
Comment:

Marker	x: [mm]	y: [mm]	Comment:
1	29	190	Estimated bar size 6mm, Concrete cover 56mm
2	592	56	Estimated bar size 6mm, Concrete cover 56mm

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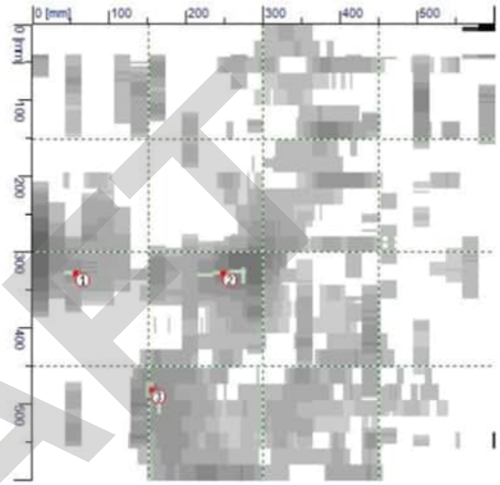
Imagescan: *L3_10_column_scan_2.XFF*

Date / Time: *2015-04-22 17:10:38* SSN: *16411007* [*mm*]



Customer: *Canterbury Jockey Club*
Location: *L3-10 column scan 2* Operator: *Mathew Le Comte*
Comment:
No re enforcing detected within the first 150mm

Marker	x: [mm]	y: [mm]	Comment:
1	53	326	Estimated bar size 6mm, Concrete cover 111mm
2	245	326	Estimated bar size 6mm, Concrete cover 102mm
3	152	479	Estimated bar size 12mm, Concrete cover 134mm

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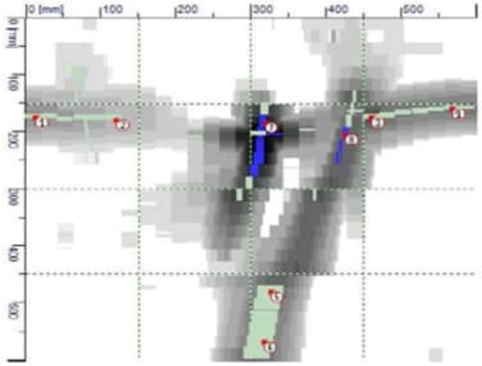
Imagescan: *L3_10_column_scan_3.XFF*

Date / Time: *2015-04-22 17:29:34* SSN: *16411007* [*mm*]



Customer: *Canterbury Jockey Club*
Location: *L3-10 column scan 3* Operator: *Mathew Le Comte*
Comment:
Annotations 1-4 horizontal bar estimated 8-10mm
Annotations 5-6 vertical bar estimated 36mm
Annotations 7-8 vertical bar estimated 8-10mm

Marker	x: [mm]	y: [mm]	Comment:
1	10	171	Estimated bar size 8mm, Concrete cover 80mm (not verified)
2	118	177	Estimated bar size 10mm, Concrete cover 98mm (not verified)
3	459	171	Estimated bar size 10mm, Concrete cover 63mm (not verified)
4	566	158	Estimated bar size 8mm, Concrete cover 70mm (not verified)
5	323	479	Estimated bar size 36mm, Concrete cover 87mm (not verified)
6	315	567	Estimated bar size 36mm, Concrete cover 88mm (not verified)
7	316	181	Estimated bar size 10mm, Concrete cover 49mm
8	423	203	Estimated bar size 8mm, Concrete cover 59mm (not verified)

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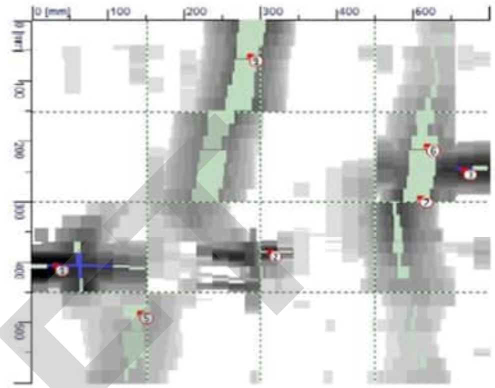
Imagescan: *L3_10_column_scan_4.XFF*

Date / Time: *2015-04-22 17:33:08* SSN: *16411007* [*mm*]



Customer: *Canterbury Jockey Club*
Location: *L3-10 column scan 4* Operator: *Mathew Le Comte*
Comment:
Annotations 1-3 Horizontal bar estimated 6mm
Annotations 4-7 Vertical bars estimated 30-36mm

Marker	x: [mm]	y: [mm]	Comment:
1	29	404	Estimated bar size 6mm, Concrete cover 44mm
2	308	381	Estimated bar size 6mm, Concrete cover 60mm (not verified)
3	564	244	Estimated bar size 6mm, Concrete cover 56mm (not verified)
4	282	55	Estimated bar size 30mm, Concrete cover 89mm (not verified)
5	138	482	Estimated bar size 36mm, Concrete cover 135mm (not verified)
6	516	204	Estimated bar size 36mm, Concrete cover 98mm (not verified)
7	507	290	Estimated bar size 36mm, Concrete cover 84mm (not verified)

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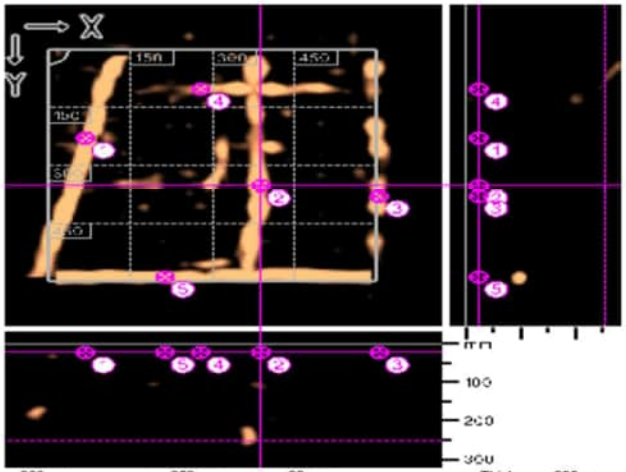
Scan File:	RS_159120003_000884_l3_10_col_scan_5.hscan
Scan Name:	L3-10 column scan 5
Date / Time:	2015-04-23 16:17:09
Comment:	-



x: 389 mm y: 353 mm z: 23 mm Thickness: 230 mm
Concrete: 6.7 Method: Advanced

Project name:	jockey club level3-4	Customer:	-Canterbury Jockey Club
Location:	- L3-10 column scan 5	Object:	-Column
User:	-Mathew Le Comte		
Comment:	-Ps1000 Scan annotations 1-3 showing vertical bars Annotations 4-5 showing horizontal bars		

Marker:	x:		y:		z:		Comment:
1. Annotation	69	mm	229	mm	23	mm	-
2. Annotation	389	mm	353	mm	23	mm	-
3. Annotation	605	mm	380	mm	23	mm	-
4. Annotation	279	mm	102	mm	23	mm	-
5. Annotation	214	mm	590	mm	23	mm	-

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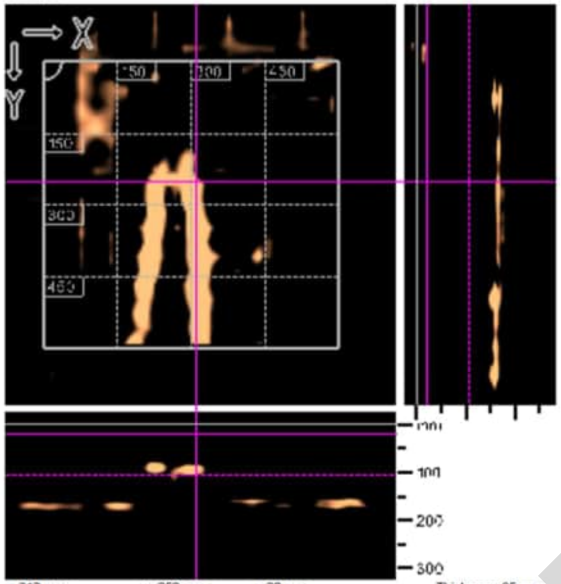
Scan File:	RS_159120003_000869_ts1_scan_1a.hscan
Scan Name:	ts1 scan 1a
Date / Time:	2015-04-20 10:29:59
Comment:	-



x: 313 mm | y: 250 mm | z: 20 mm | Thickness: 85 mm
Concrete: 9.0 | Method: Standard

Project name:	jockey club level3-4	Customer:	-Canterbury Jockey Club
Location:	- TS-1 scan 1a	Object:	-Wall
User:	-Mathew Le Comte		
Comment:	-PS1000 scan showing re enforcing hoop		

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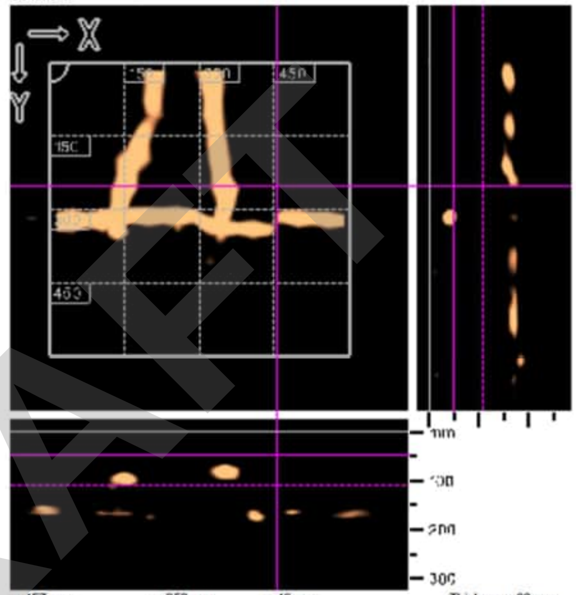
Hilti PROFIS PS 1000 Report

Scan File:	RS_159120003_000870_ts1_scan2a.hscan
Scan Name:	TS-1 scan2a
Date / Time:	2015-04-20 10:38:46
Comment:	-



x: 457 mm | y: 250 mm | z: 49 mm | Thickness: 60 mm
Concrete: 9.0 | Method: Standard

Project name:	jockey club level3-4	Customer:	-Canterbury Jockey Club
Location:	- TS-1 scan2a	Object:	-Wall
User:	-Mathew Le Comte		
Comment:	-PS1000 showing hooped vertical bar and single horizontal bar		

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D R A F T

Appendix H

Geotechnical Investigation

DRAFT

AECOM Geotechnical Investigation

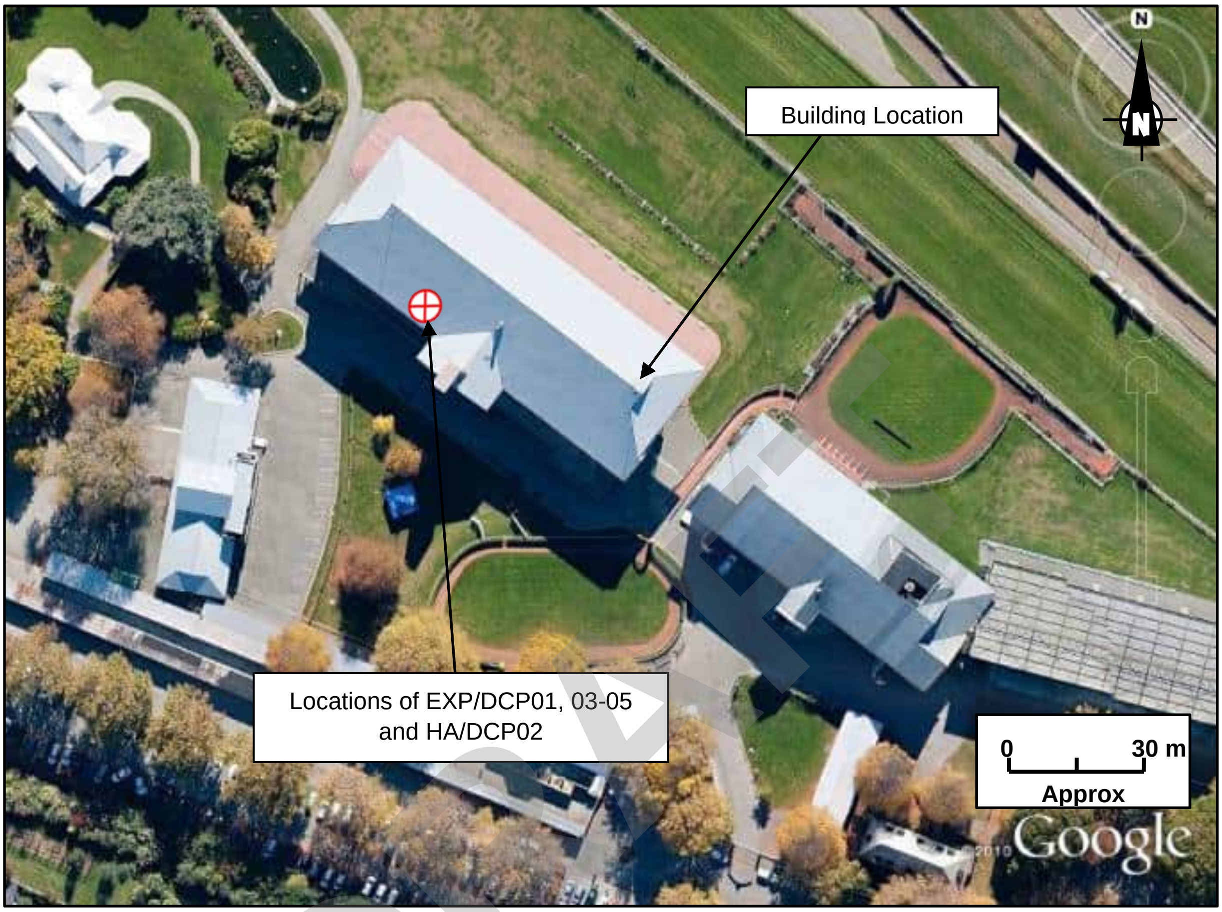

Figure H- 1: Locations of AECOM geotechnical investigation [17]

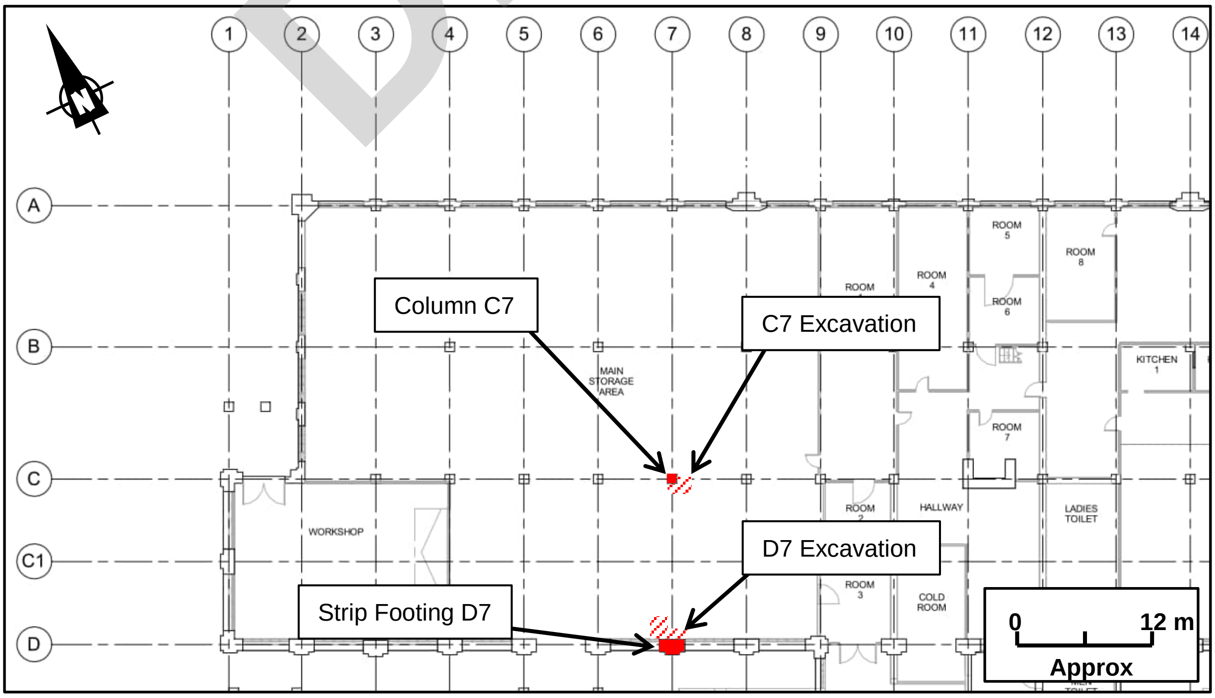

Figure H- 2: AECOM investigation excavations

D R A F T

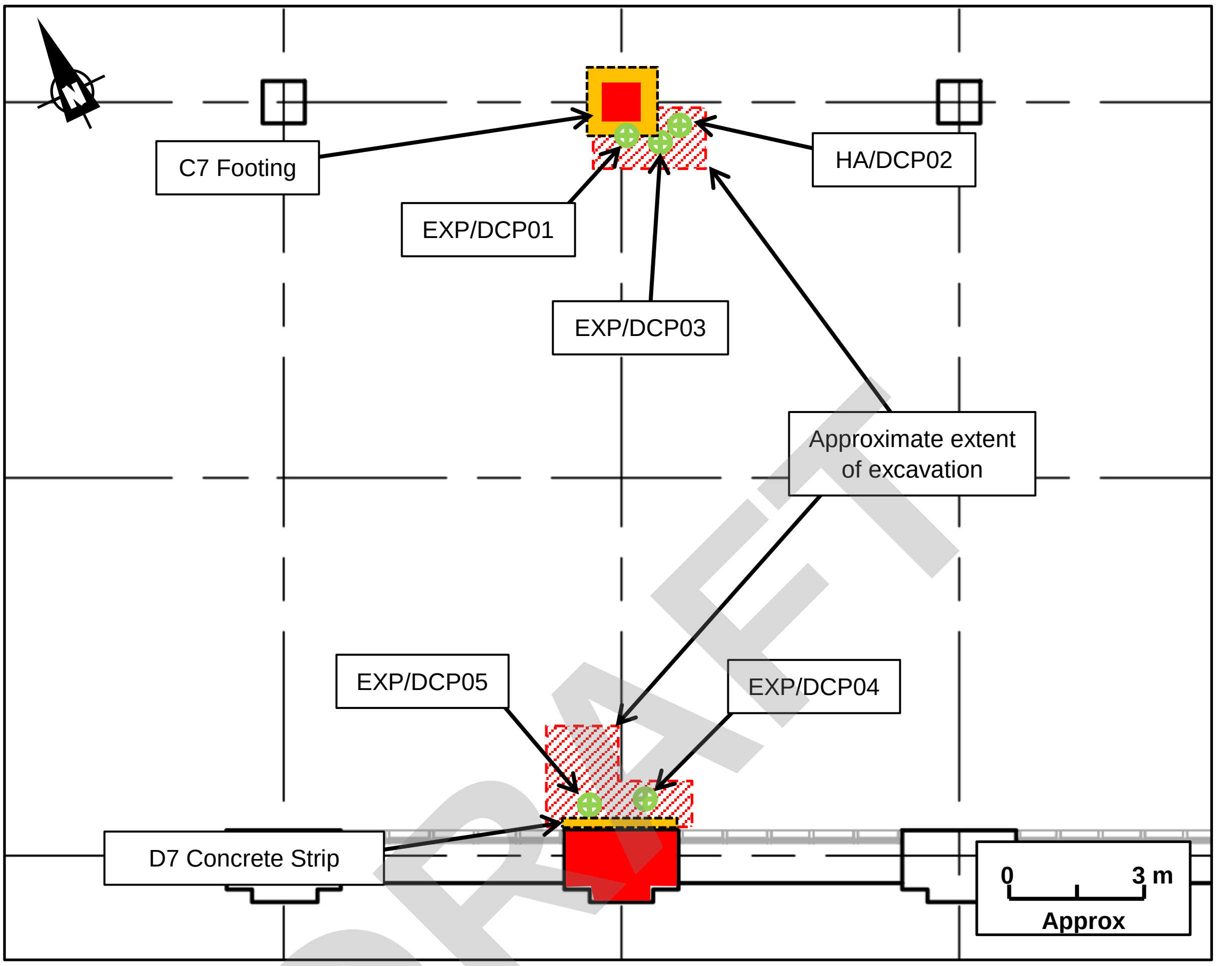

Figure H- 3: AECOM Investigation locations

DRAFT

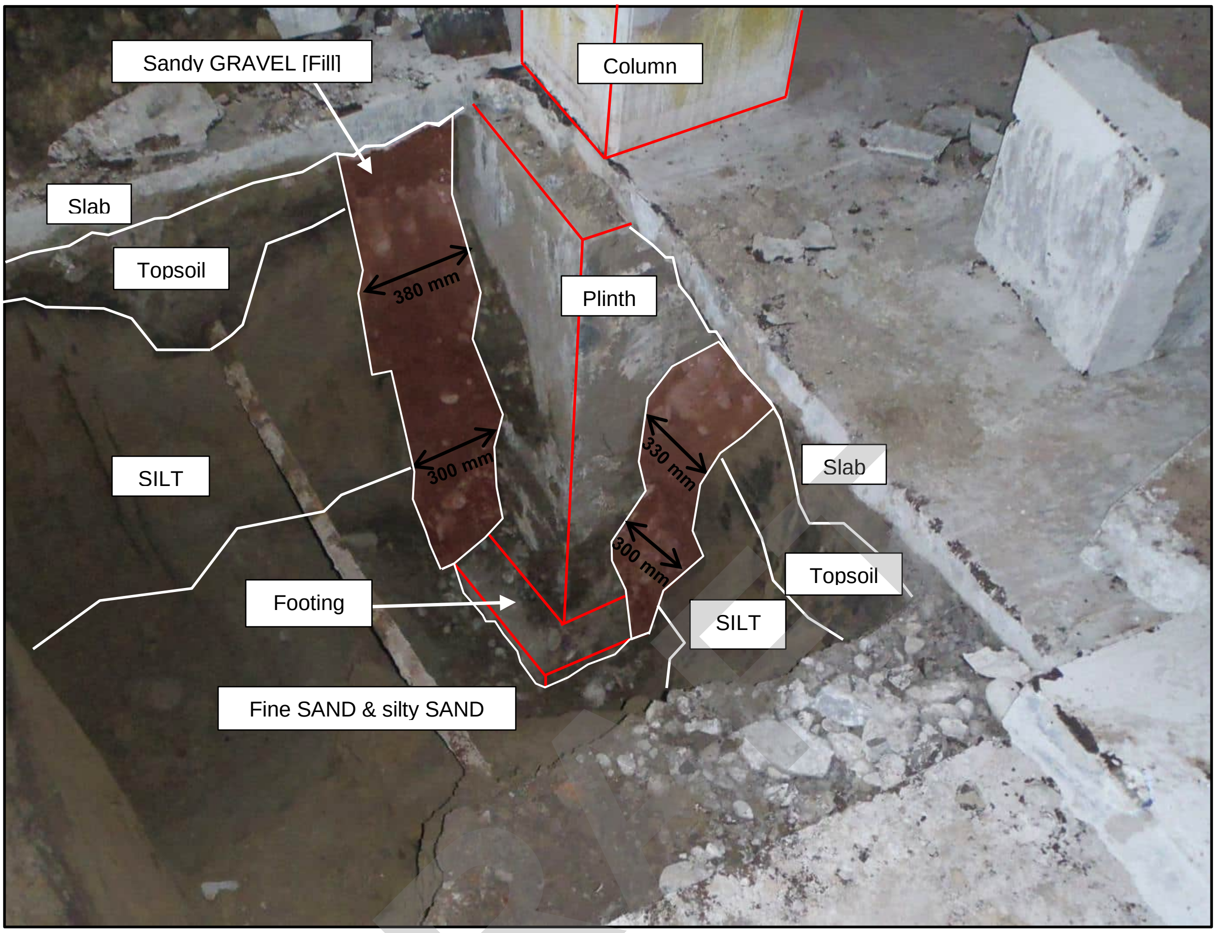

Figure H- 4: Column C7 ground profile facing north-west. All measurements are approximate.

DRAFT

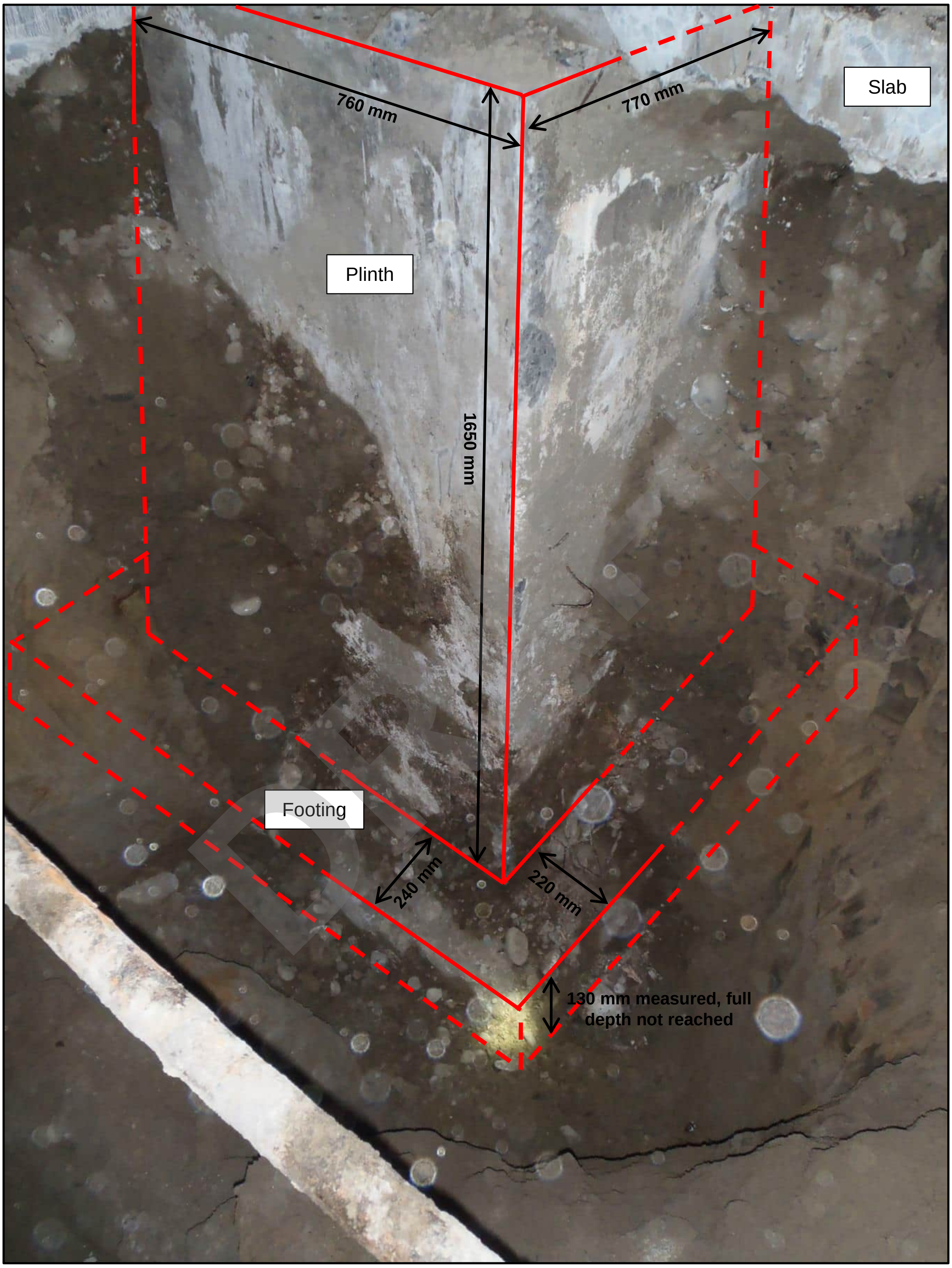

Figure H- 5: Column C7 footing geometry facing north-west. All measurements are approximate.

D R A F T

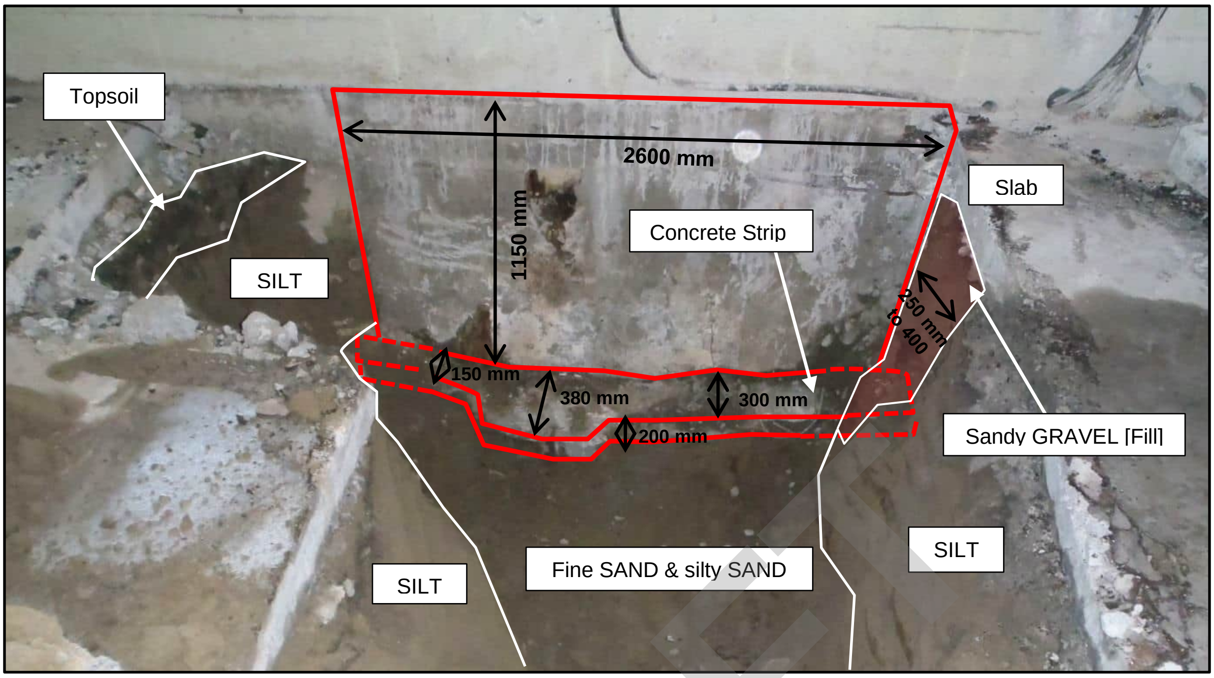

Figure H- 6: Strip Footing D7 ground profile facing south-west. All measurements are approximate.

DRAFT

Additional Existing Geotechnical Data (not completed by AECOM)

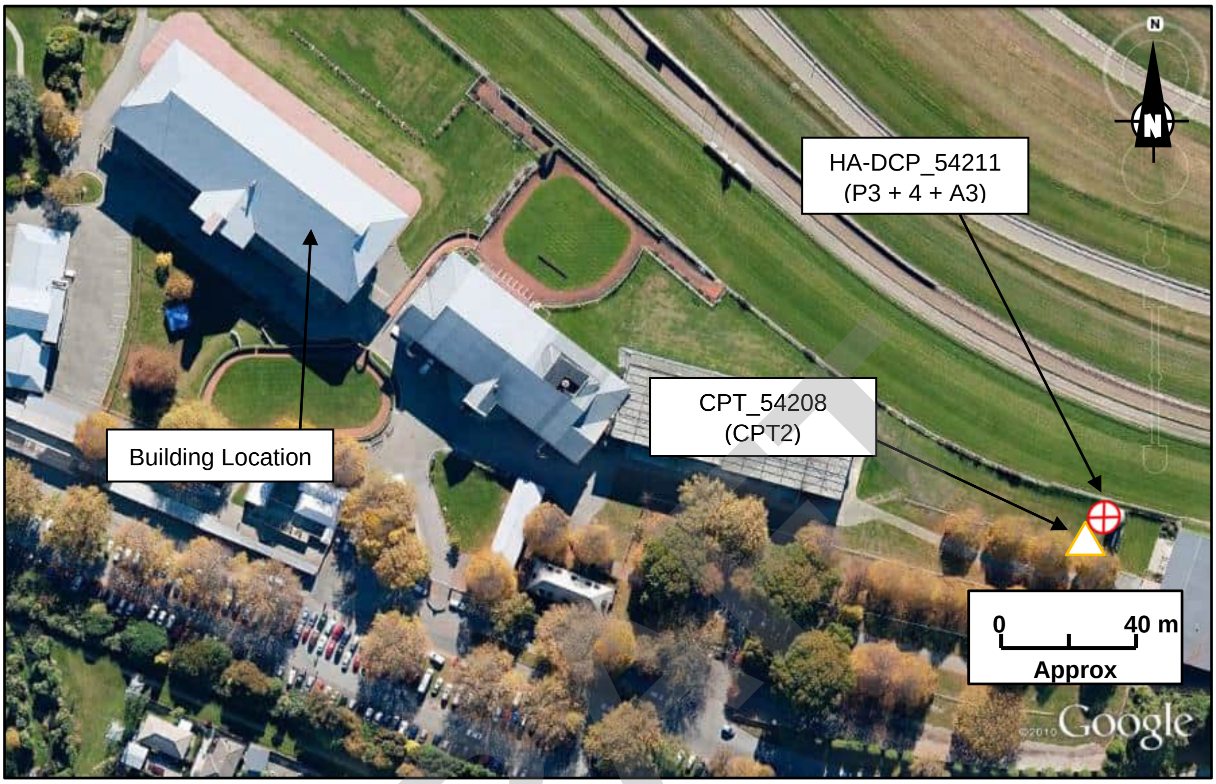

Figure H- 7: Locations of additional geotechnical data [17]

D R A F T

Appendix B

Design Features Report (DFR)

DRAFT

Design Features Report

Grand National (Public) Stand

D R A F T

Design Features Report

Grand National (Public) Stand

Client: Canterbury Jockey Club

Co No.: N/A

Prepared by

AECOM New Zealand Limited
Level 2, 2 Hazeldean Road, Addington, Christchurch 8024, P O Box 710, Christchurch MC, Christchurch 8140, New Zealand
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29-Jul-2015

Job No.: 60332326

AECOM in Australia and New Zealand is certified to the latest version of ISO9001, ISO14001, AS/NZS4801 and OHSAS18001.

Quality Information

Document	Design Features Report
Ref	60332326 p:\603x\60332326\6. draft docs\6.1 reports\03_grand national (public) stand\03.5 design features report\150729 canterbury jockey club dfr.docx
Date	29-Jul-2015
Prepared by	Nik Richter, Matt Clifford, Olivia Heaslip and Matthew Crake
Reviewed by	Mike Lowe

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
	29 July 2015	For Issue	Mark Ferfolja Associate Director	

D R A F T

Table of Contents

D R A F T

1.0 General

1.1 Objective

The Design Features Report (DFR) is a detailed document defining the structure's assessment criteria, key assumptions, methodology of analysis and recording key decisions or outcomes.

It provides commentary to the following matters:

- lateral load resisting systems
- soil properties
- geometrical assumptions
- loading assumptions
- structural modelling assumptions
- methodology of analysis
- material properties
- design standards and industry guidelines used

1.2 Scope

The scope is in line with the Project Change Record (PCR); Register No. PCR_03 Rev.B, dated 1 May 2015 (Phase 4: Visual Damage Assessment and Quantitative Seismic Analysis @ Grand National Stand).

In general terms, the scope of work is as follows:

- Liaise with Thornton Tomasetti (TT) with regard to the structural analysis approach / strategy as foreseen by AECOM,
- Determine building weights and likely live loads acting on the structure; carry out a load take down to estimate the overall building weight.
- Identify significant critical structural weaknesses such as soft stories, strong beam / weak columns etc. which may limit the ductile response of the structure.
- Carry out an assessment of the seismic capacity of all the main structural framing elements excluding secondary structure such as suspended ceilings, balustrades / railings, parapets, chimneys, lightweight cladding such as glazing etc. Refer to Section 8.0 for a list of other items excluded from the analysis.
- Develop multiple 2D analysis models in SAP2000 software for selected frames in two orthogonal directions.
- Perform non-linear pushover analysis for selected frames to assess/verify the seismic response and demand of the structure. The pushover analysis will provide a realistic seismic response and highlight any collapse mechanisms that require attention.
- Carry out an assessment of the seismic capacities of specific critical member connections as deemed necessary.
- Determine seismic capacity of the building in terms of percentage of new building standard (%NBS, i.e. NZS1170.5:2004-Earthquake Actions).
- Liaise with Thornton Tomasetti (TT) with regard to the findings of the structural analysis and assessment of the existing structure.

1.3 Previous reports

This report should be read in conjunction with AECOM's Damage Assessment Report dated 14th July 2015.

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2.0 Building description

2.1 General Description

The Grand-National Stand is a reinforced concrete (RC) structure with concrete encased steel beams, built circa 1920. The grandstands are timber construction, The Grand National Stand is a heritage building and is listed as Group 4 in the Christchurch City Council (CCC) South-West Christchurch Area Plan: Phase 1 Report – European Cultural Heritage [1] [2] [3].

The building is orientated with the long side parallel to the track and 37° off east-west or approximately northwest-by-west (NWbW) to southeast-by-east (SEbE) in direction. For the purpose of reference, site north has been defined as perpendicular to the home straight of the track in the east-west direction. This reference convention is shown in Figure 2-1.

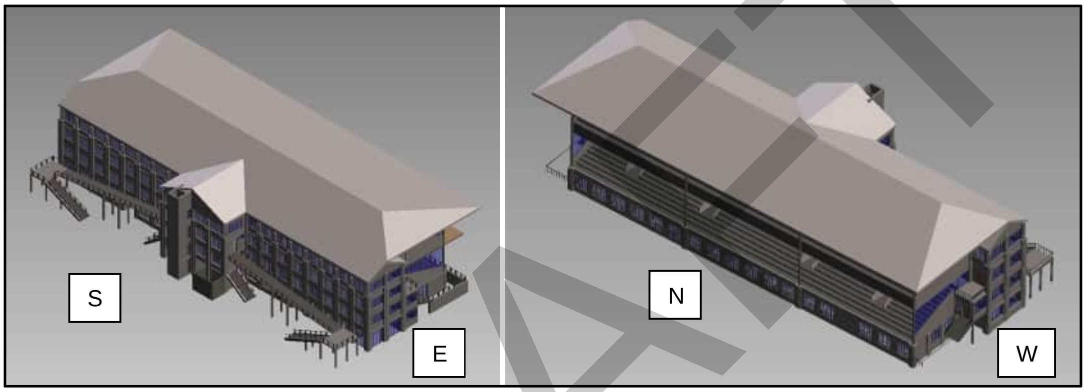

Figure 2-1 Elevation naming convention at Grand National Stand (GNS)

The structure consists of five above ground stories with two grandstand seating levels and has a footprint of approximately 82m parallel to the racetrack and 25m perpendicular to the racetrack. The main RC structure is generally rectangular on plan, measuring approximately 82m x 9.5m. There is an attached foyer and elevator core area measuring approximately 15.8m (east-west) x 6.5m (north-south) extending out on the southern elevation (see Figure 2-1). The elevator core is not an original feature.

There are two grandstand levels on the northern elevation, as shown in Figure 2-2. Both the (smaller) lower stand and (larger) upper stand are of timber construction. These grandstands sit on a steel support structure composed of trusses, plate girders, columns, and diagonal bracing. Both grandstand areas are approximately 73m long but vary in width and slope. The lower grandstand is narrower and flatter with a seating area of approximately 825m^2. The upper grandstand is steeper and wider than the lower stand and, with a seating area of approximately 1080m^2, is 30% larger than the lower grandstand area.

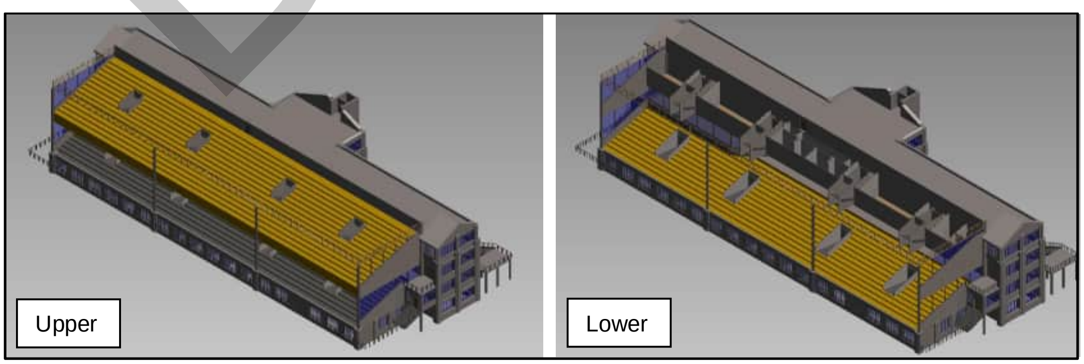

Figure 2-2 Cutaway showing the grandstand seating areas at GNS

The ground floor consists of a bar (known as 'The Parade Ring') at the eastern end of the structure and a storage and workshop area at the western end of the structure. The first, second, and third floors, consist of tote offices, bar areas, café facilities, kitchens, and general public assembly areas. The fourth floor is a maintenance level with no public access.

Access to these upper floors, (first, second, and third) is via several ramps and concrete steps or via an elevator; all located on the south elevation (see Figure 2-1). Access to the fourth floor is via a service door on the upper stand (see Figure 2-2) or via the elevator (see Figure 2-1). The lower stand can be accessed directly from trackside on the northern side and from the first and second stories on the south side. Access to the upper stand is via four sets of stairs on the third floor only.

A brief summary of the building is provided in Table 1 and Table 2.

Table 1: Building Summary

Grand National Stand	
Total Length	~ 82 m
Total Width	~ 25 m
Total Height	~ 18.6 m
Importance Level (IL)	3
Number of Stories	5 floor levels 2 grandstands
Total Plan Area (Approximate)	7700m^2

Table 2: Level-by-level Building Information

Level	Occupancy	Area	Storey Height
Ground	Workshop & Storage Public Access	1170 m^2 565m^2	0 m (reference level)
First	Public Access	1230 m^2	4 m
Lower Stand	Public Access	825 m^2	4 m – 7.7 m
Second	Public Access	1000 m^2	7.7 m
Third	Public Access	1065 m^2	11.5 m
Upper Stand	Public Access	1080 m^2	12.145 m – 16.375 m
Fourth	Maintenance Access Only	765 m^2	15.6 m
Roof	No Access	~ 2873 m^2	18.6 m

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2.2 Structural layout and load paths

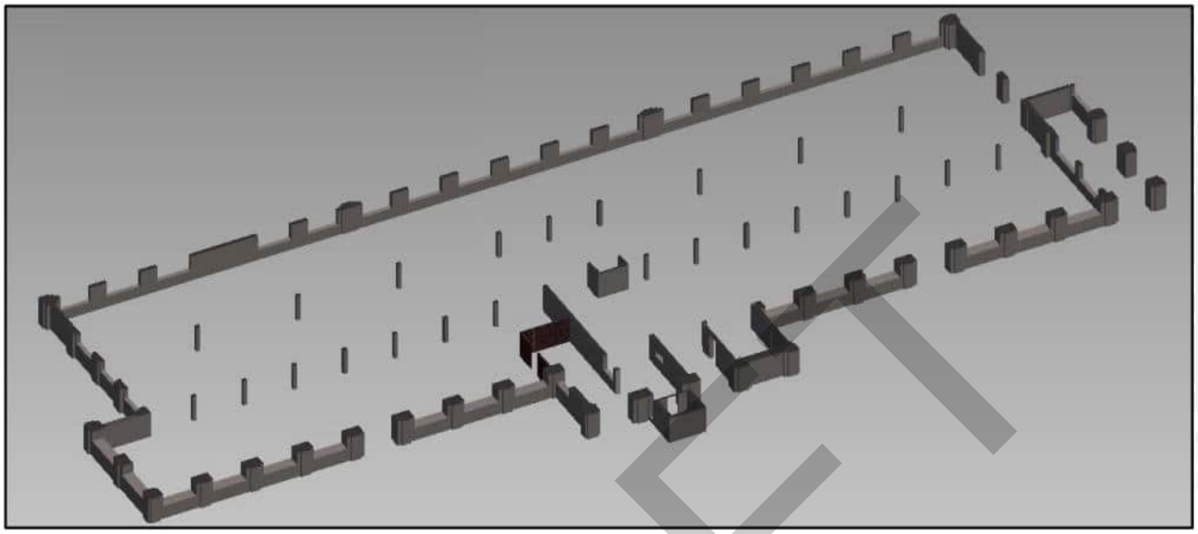

Figure 2-3 Cutaway showing walls and columns at the ground floor level at GNS

The ground floor plate is of slab on grade construction. The reinforced concrete columns that support the upper floors are supported by pad footings. The gravity loads from the upper levels are transferred to the ground through reinforced concrete columns. At the centre of the ground floor there is one ‘u-shaped’ shear wall, which will transfer both gravity and lateral loads, as shown in Figure 2-3. There are also shear walls on grids 2 and 20, which run in the North-South direction. All other walls at ground level are partition walls and are not intended to be load bearing elements. The lateral load-transfer system in the north-south direction is moment frames consisting of reinforced concrete columns and concrete encased steel beams and shear walls on alongside external elevations.

In the east-west direction the lateral load resisting system is comprised of reinforced concrete moment frames and a shear wall.

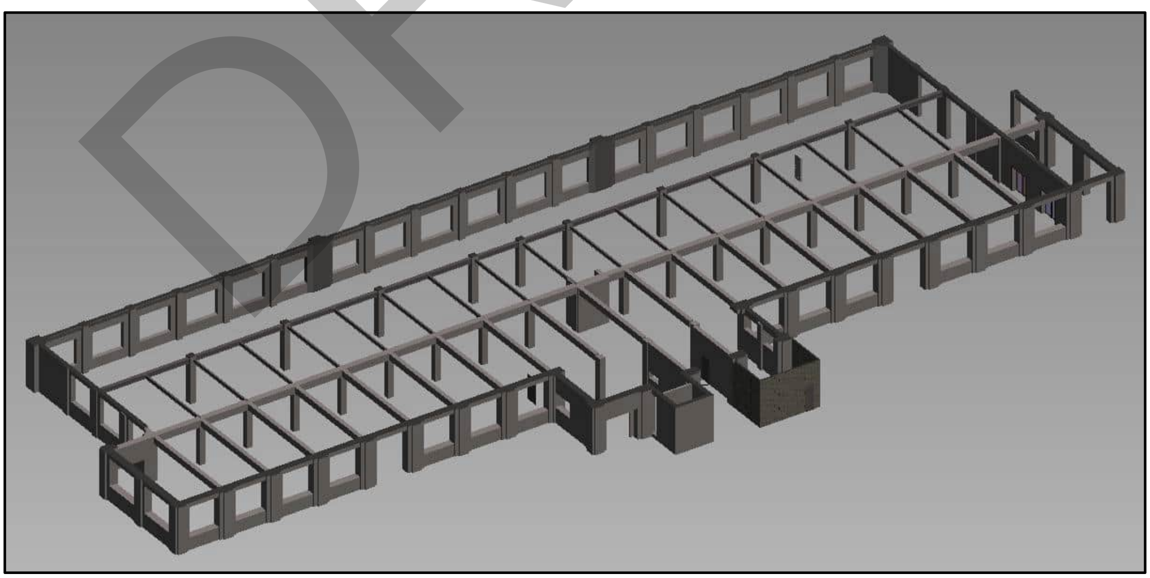

Figure 2-4 Cutaway showing beams, walls, and columns at the ground floor level at GNS

The first floor is a cast-in-situ reinforced concrete floor which sits on concrete encased steel beams. This floor plate spans in the east-west direction, between beams, as shown in Figure 2-4. The gravity loads from the first floor are transferred through this floor plate and beams and eventually to the ground through reinforced concrete columns.

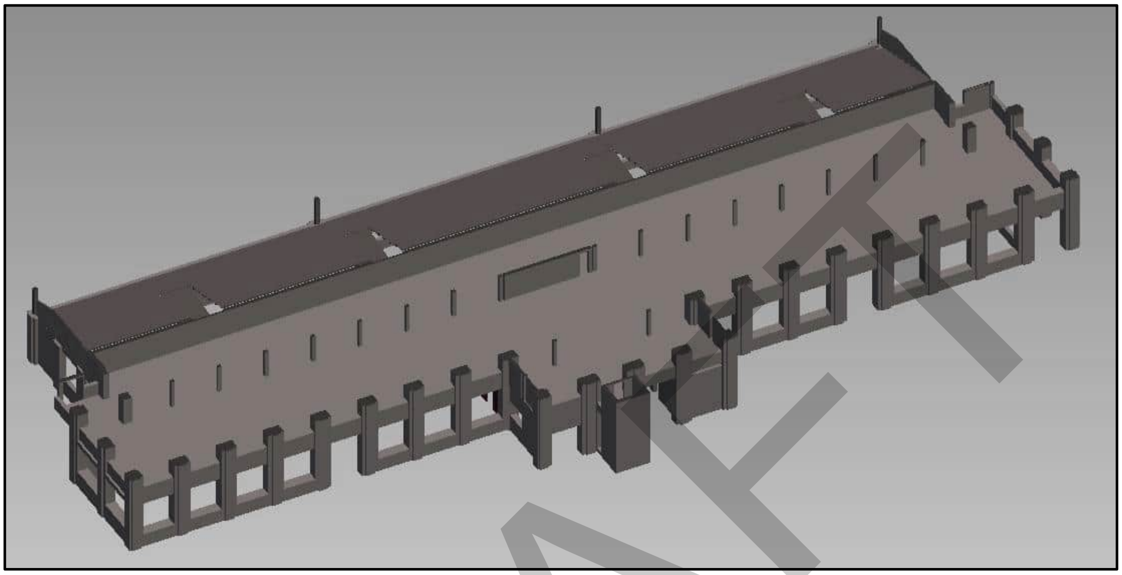

Figure 2-5 Cutaway showing walls and columns at the first floor level at GNS

The reinforced concrete columns that support the upper floors are present at first floor level. The ground floor 'u-shape' shear wall length extends in the longitudinal direction and the return walls discontinue as shown in Figure 2-5. The gravity loads from the upper levels are transferred to the ground floor columns through both reinforced concrete columns and the central shear wall. The lateral load-transfer system at first floor level in the north-south direction is moment frames consisting of reinforced concrete columns and concrete encased steel beams and shear walls alongside elevations. In the east-west direction the lateral load resisting system comprise reinforced concrete moment frames and shear wall. All other internal walls at first floor level are lightweight partition walls and are not intended to be load bearing elements. There is direct access to the lower stand from first floor level via four stepped passageways.

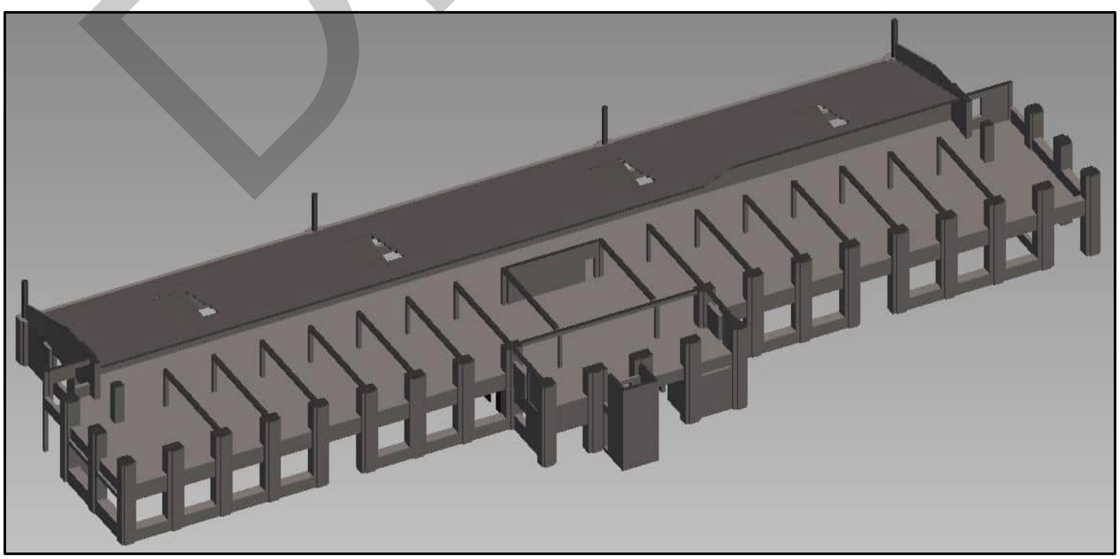

Figure 2-6 Cutaway showing beams, walls, and columns at the first floor level at GNS

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The second floor is a cast-in-situ reinforced concrete floor which sits on concrete encased steel beams. This floor plate spans in the east-west direction, between beams, in a similar manner to the first floor and this is shown in Figure 2-6. The occupancy loads from the second floor are transferred through the second floor plate and beams and eventually to the ground through a combination of reinforced concrete columns and the central shear wall. The lower stand is supported directly by steel girders which bear on concrete columns. The (north elevation) upper stand supporting circular columns can be seen in Figure 2-6. These columns do not contribute to the lateral resistance system in the structure and transfer vertical gravity loading only.

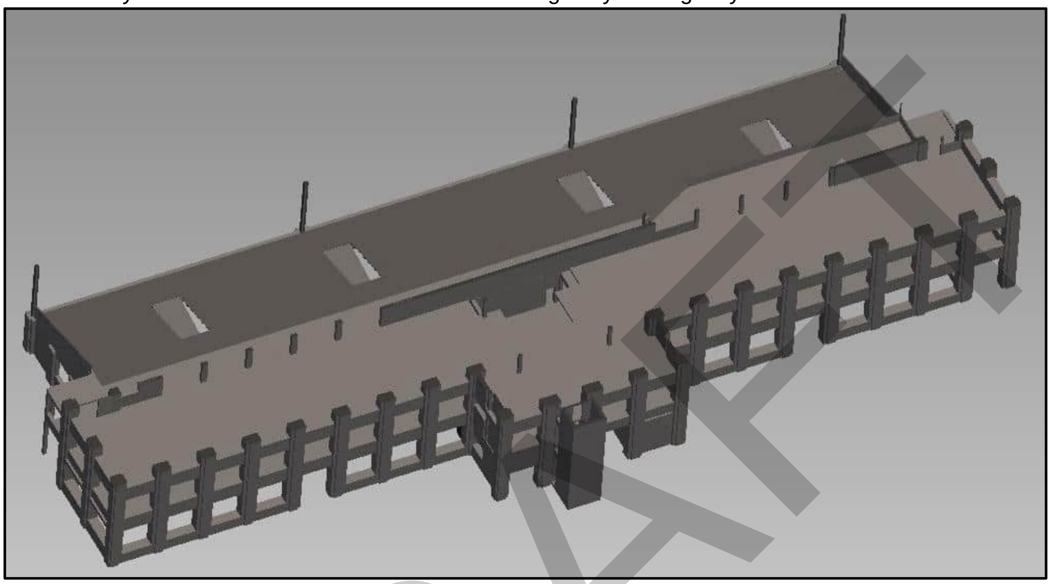

Figure 2-7 Cutaway showing walls and columns at the second floor level at GNS

The longitudinal shear wall on Grid C is larger at second floor level than at first floor level, as shown in Figure 2-7. This shear wall was modified in the early 1980's and is now different from the original 1920's design. The reinforced concrete columns that support the upper floors are present at second floor level. The gravity loads from the upper levels are transferred to the ground floor columns through both reinforced concrete columns and the central shear wall. The lateral load-transfer system at first floor level in the north-south direction is moment frames consisting of reinforced concrete columns and concrete encased steel beams. In the east-west direction the lateral load resisting system is comprised of reinforced concrete moment frames and shear wall. All other internal walls at first floor level are lightweight partition walls and are not intended to be load bearing elements. There is direct free-flow access to the top of the lower stand from second floor level. The (north elevation) upper stand supporting circular columns can be further seen in Figure 2-7.

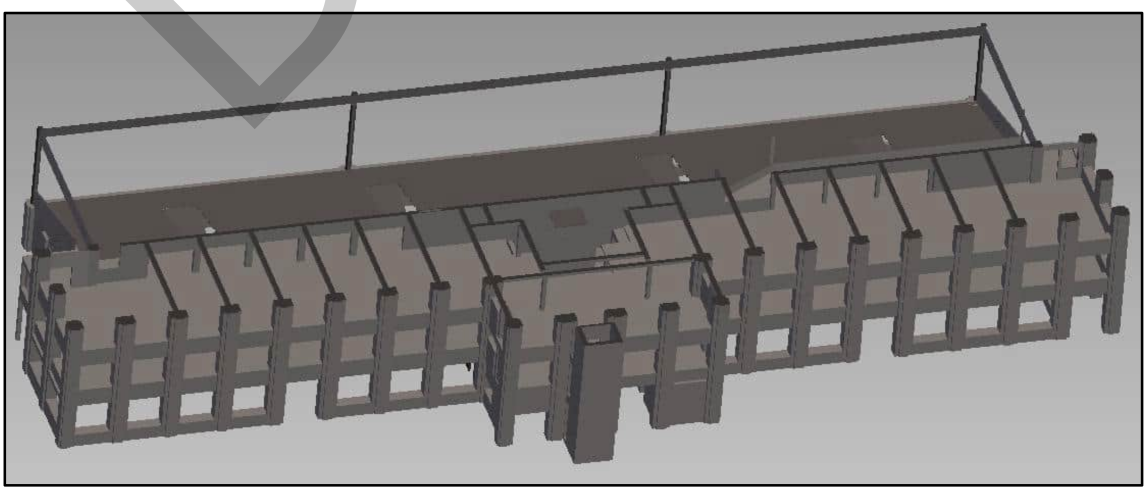

Figure 2-8 Cutaway showing beams, walls, and columns at the second floor level at GNS

The third floor is a cast-in-situ reinforced concrete floor which sits on concrete encased steel beams. This floor plate spans in the east-west direction, between beams, in a similar manner to the second floor and this is shown in Figure 2-8. The occupancy loads from the third floor are transferred through the third floor plate and beams and eventually to the ground through a combination of reinforced concrete columns and the central shear wall.

The upper stand timber decking and seating is supported on timber joists which span between the top chords of steel trusses located on the numbered grids. These steel trusses span between steel perimeter girders running along grid A and the shear wall on grid C. The steel perimeter girders are fabricated from riveted steel plates and are supported on circular steel columns as shown in Figure 2-8. A series of six diagonal tension braces in the horizontal plane provide lateral restraint to the perimeter girders in the east-west direction. The bracing is laid out in an XXX pattern. The bracing ties directly into the reinforced concrete frame and is omitted from Figure 2-8 for clarity.

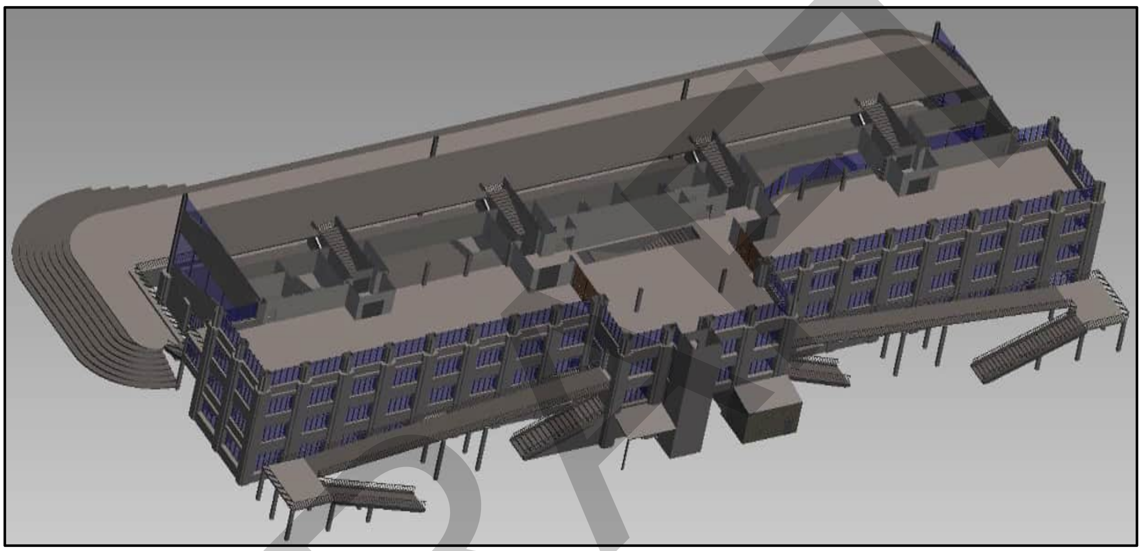

Figure 2-9 Cutaway showing walls and columns at the third floor level at GNS

The longitudinal shear wall on Grid C is larger at third floor level than at second floor level, as shown in Figure 2-9. This shear wall was modified in the early 1980's and is now different from the original 1920's design. In its original layout the shear wall at level 3 ran the full length of the structure, with designed openings for ramps to access the upper stand. Extra openings were cut in this wall in the early 1980's to allow access to new tote and kitchen areas. The reinforced concrete columns that support the upper floors are present at third floor level. The gravity loads from the upper levels are transferred to the ground floor columns through both reinforced concrete columns and the central shear wall. The lateral load-transfer system at first floor level in the north-south direction is moment frames consisting of reinforced concrete columns and concrete encased steel beams. In the east-west direction the lateral load resisting system is comprised of reinforced concrete moment frames and shear wall. All other internal walls at third floor level are lightweight partition walls and are not intended to be load bearing elements. There is direct access to the upper stand from third floor level via four stepped passageways, as shown in Figure 2-10. This is the only public access to the upper stand.

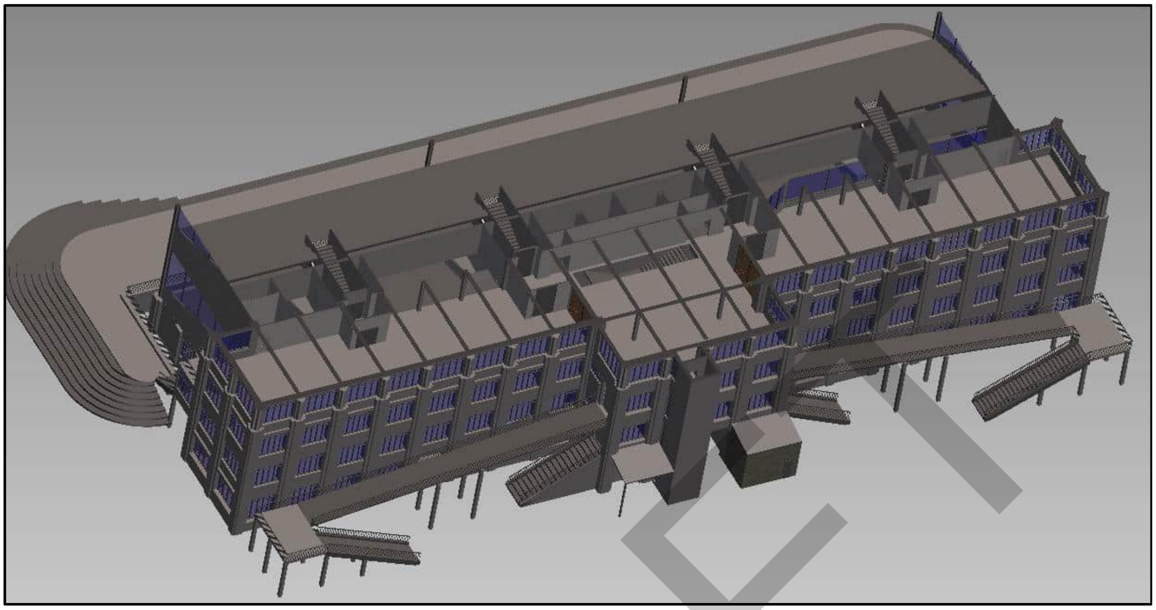

Figure 2-10 Cutaway showing beams, walls, and columns at the third floor level at GNS

The fourth floor is a cast-in-situ reinforced concrete floor which sits on concrete encased steel beams. This floor plate spans in the east-west direction, between beams, in a similar manner to the third floor and this is shown in Figure 2-10. The maintenance access occupancy and storage loads from the fourth floor are transferred through the fourth floor plate and beams and eventually to the ground through a combination of reinforced concrete columns and the central shear wall.

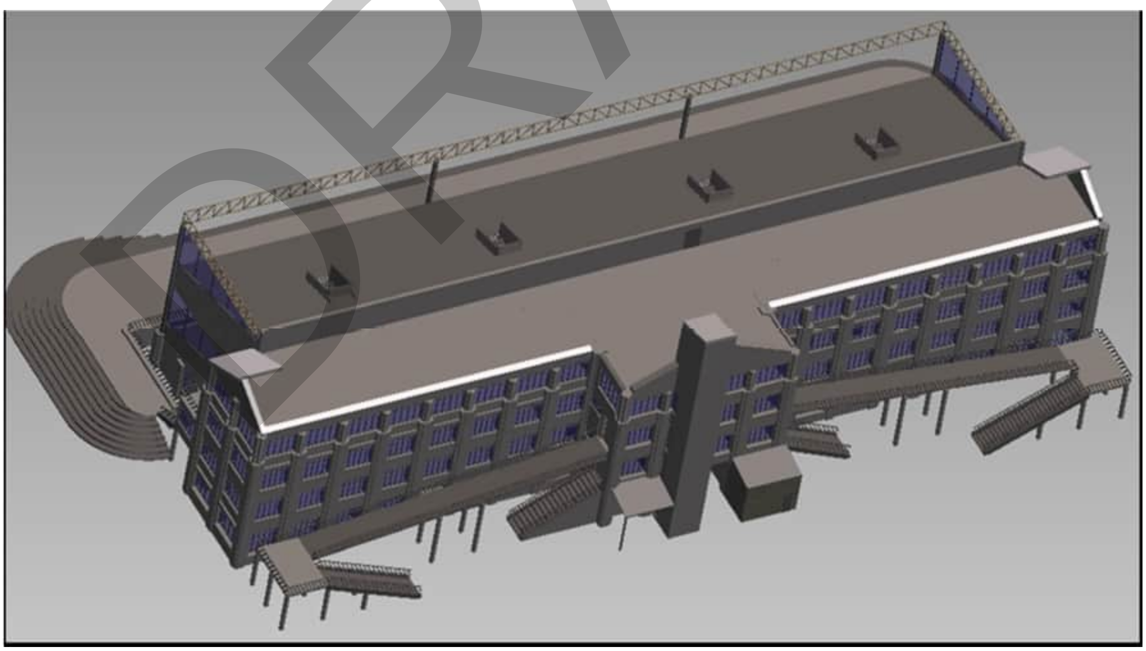

Figure 2-11 Cutaway showing walls and columns at the fourth floor level at GNS

Between Grid C and D the roof is supported on timber purlins spanning between steel rafter beams fabricated from back to back unequal steel angles. The steel rafter beams are supported by the walls on grid C and D and by three intermediate steel columns fabricated from single equal angle sections. There is no bracing in this section of the roof.

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Between Grid A and C the roof is supported on timber purlins spanning between steel roof trusses located on each numbered grid. The steel roof trusses span between the shear wall on grid C and the steel perimeter trusses on grid A with a cantilevered section beyond grid A. The steel perimeter trusses on grid A are supported by circular steel columns as shown on Figure 2-11. A series of six diagonal tension braces provide lateral restraint in the east-west direction to the perimeter trusses in a horizontal plane level with the bottom chord of the roof trusses. The bracing is laid out in an XXX pattern and ties directly into the longitudinal reinforced concrete shear wall on grid C as shown in Figure 2-13 .

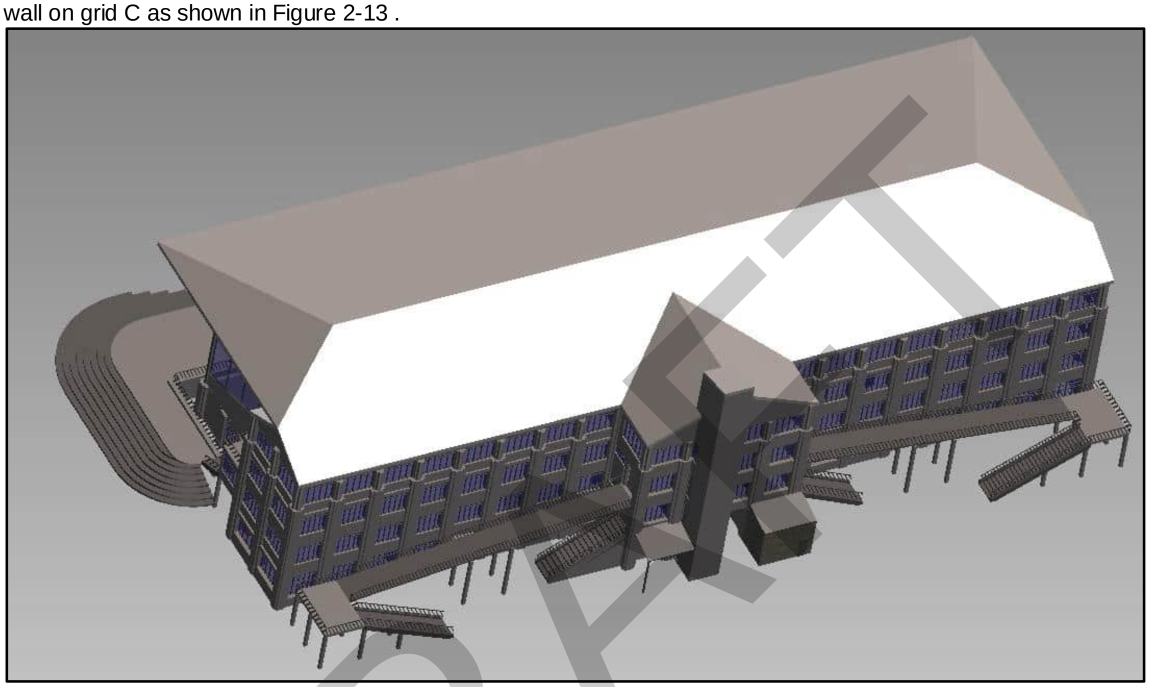

Figure 2-12 3D model showing roof level at GNS

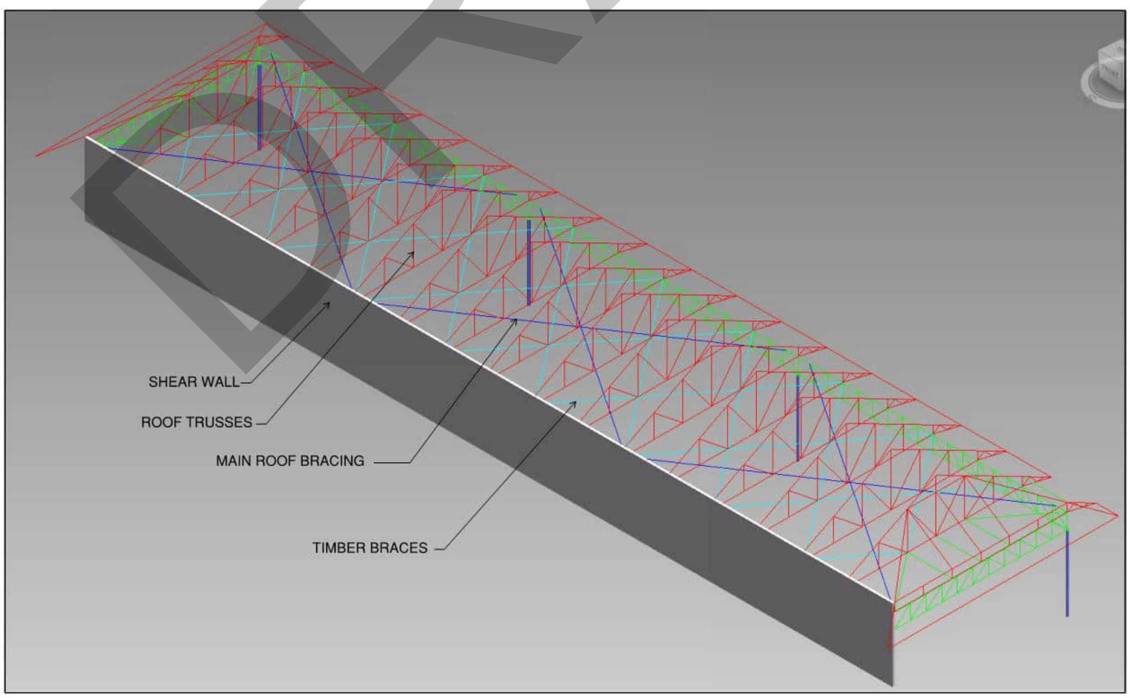

Figure 2-13: Upper stand roof layout

3.0 Soil conditions

3.1 Site Investigation

An Engineering Geologist from AECOM undertook a shallow intrusive geotechnical inspection on 25 June 2015 and a further inspection on 2 July 2015. The inspections were completed in the excavations at the base of column C7 and alongside the base of strip footing D7. The purpose of the geotechnical investigation was to confirm the dimensions of the footings, confirm the existing ground conditions at the locations of the footings and determine the bearing strength of the ground material supporting column C7 and strip footing D7.

3.2 Observations

During the investigation on 25 June 2015, the plinth structure below the level of the floor slab of column C7 was exposed in the excavation; however the footing of the column C7 and strip footing D7 were not exposed. The material exposed in the wall of the excavations comprises organic silt [topsoil], silt, and sandy gravel [fill] which was located around the edge of the column structures. The fill material around the plinth is loosely packed, and at the location of C7 it is approximately 330mm to 380mm wide to a depth of 0.9m below the base of the floor slab (bbs). From a depth of approximately 1.1m bbs to the base of the footing the width of the fill reduced to 300mm. At the north-western side of D7, the width of the fill is approximately 250mm to 400mm.

The excavations were subsequently deepened, and during the investigation on 2 July 2015, the footing of column C7 was exposed in the excavation. Whilst the full depth of the base of the footing for column C7 was not exposed, it is considered likely that it is founded on the natural medium dense silty fine sand. For the purpose of assessing the soil bearing capacity and calculating soil springs AECOM has assumed this to be the case.

A concrete strip was exposed at the base of D7, however it is thought that this is not the true footing structure as it is not connected structurally to D7. It is likely that the true footing structure is present at a depth similar to the footing structure for column C7.

Annotated site photograph of column C7 foundation is shown in Figure 3-1 with dimensions of the footings are presented in Table 3. Whilst the observed footing at D7 is not considered the true footing, its dimensions have been included for comparison.

Table 3: Observed footing geometry

Foundation Element		Depth (mm)	Width (mm)
Concrete Plinth	Column C7	1650	760 – 770
	Strip Footing D7	1150	2600
Concrete Footing	Column C7	130[A]	220 – 240[B]
	Strip Footing D7	200	150 – 380[B]

Notes: A – Full depth of footing not measured
B – Width of footing extending from plinth

Figure 3-1: Column C7 footing annotation

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3.3 Shallow Investigation

One hand auger with hand held shear vane tests and two Dynamic Cone Penetrometer (DCP) tests were completed in the excavation of column C7, and hand held shear vane tests with one DCP test were completed in the excavation of strip footing D7 on 25 June 2015. The hand held shear vane tests were carried out in the wall of the excavations.

To confirm the dimensions of the column footings, an additional DCP test was completed in the excavations of column C7 and strip footing D7 on 2 July 2015. During both investigations, DCPs and the hand auger were carried out in the base of the excavations.

The shallow AECOM investigation confirms that the near surface material is broadly consistent with the ground model outlined in the AECOM geotechnical desk study. The inferred site geology is summarised in Table 4, with depths taken from below the base of the floor slab.

Table 4: Inferred site geology

Material Description	Depth from base of floor slab (m bbs)	Thickness (m)
Loosely packed sandy GRAVEL [Non engineered fill][A]	0.0	1.8
Stiff SILT [Topsoil]	0.0	0.2
Stiff to very stiff SILT and sandy SILT [Springston Formation]	0.2	0.9 – 1.1
Medium dense fine SAND and silty SAND [Springston Formation]	1.1 – 1.3	2.0 – 2.3
Very dense GRAVEL [Springston Formation]	3.1 – 3.4	> 12.0

Notes: A - Encountered in HA/DCP01 only

DCP testing by AECOM in the non-engineered fill encountered in the excavation of column C7 indicates it is of low, inconsistent strength to a depth of 2.4m bbs.

3.4 Soil Springs

The vertical modulus of subgrade reaction used for modelling soil springs was calculated following a method recommended in Bowles [4]. In view of the unknown percentage of settlement associated with elastic compression and liquefaction of fine sand layers within the gravels, a range of subgrade reaction was calculated. The engineering properties shown in Table 5 were used to calculate the recommended vertical modulus of subgrade reaction.

Table 5: Engineering Properties used in Bowles Method

	Engineering Properties						
	Static Stress Strain Modulus (MPa)	Bulk Unit Weight (kN/m^3)	Equivalent Undrained Shear Strength (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Poisson's Ratio	Recommended Vertical Modulus of Subgrade Reaction (MPa)
Fine Silty SAND overlying GRAVEL	25	19	140	0	32	0.3	60

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4.0 Frames geometry

The geometry used for the analytical model for frames in selected gridlines was determined by approximating each frame as a 'stick' model. The following modelling assumptions have been used:

- Beams and columns are represented by line elements on their centre lines.
- Walls are represented by shell elements.
- Potential plastic hinge locations on beams are located at each end of the beam, at the column face, see Figure 4-1.
- Potential plastic hinge locations on columns are assumed to be at each end of the column, at the beam or slab face as applicable, see Figure 4-1.
- Where there are walls between columns, additional potential plastic hinges are located on the line (beam) element at the face of wall openings.
- The foundation conditions have been approximated with multiple vertical and horizontal spring supports and in cases where uplift was expected non-linear gap (compression only) supports were used. The spring stiffness was based on geotechnical recommendations which have assumed that the foundations have been founded on the natural medium dense silty fine sand.

Refer to Appendix B for a graphical representation of geometry used in analytical models for each frame considered.

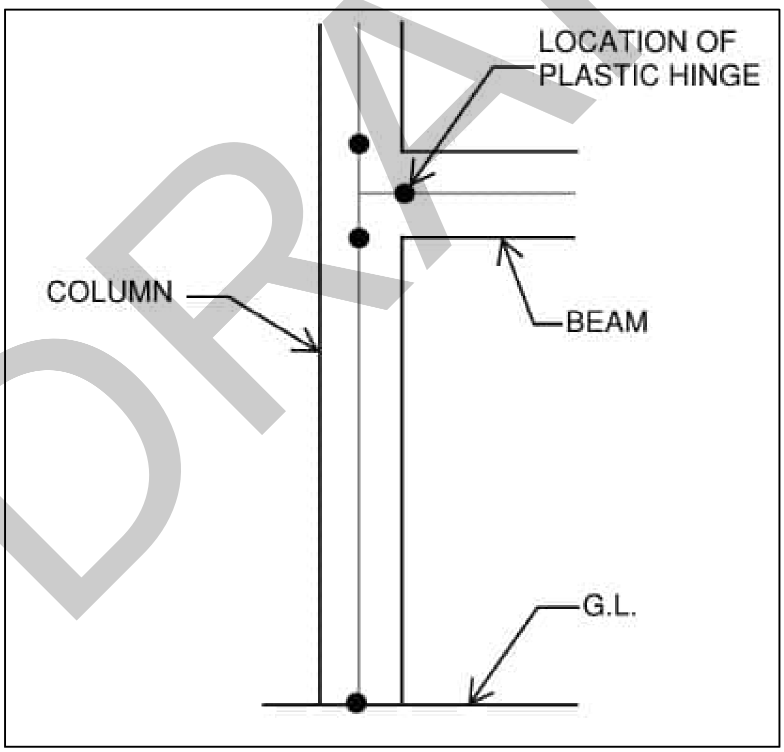

Figure 4-1: Representation of plastic hinge locations

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5.0 Analysis methodology

The building's seismic capacity has been assessed using non-linear pushover analysis (NLPA). NLPA is an analysis technique used to estimate the capacity of a structure beyond its elastic limit up to its ultimate strength in the post-elastic range. It is used to determine how progressive failure in building occurs, and identify the mode of final failure. Refer to section 5.1 for a detailed description of the procedure.

The building was simplified to two-dimensional models (plane frames) of selected parts of the structure which are considered to give a reasonable indication of the building's response in an earthquake.

The following reinforced concrete frames have been selected for the two dimensional nonlinear analysis (refer to Figure 5-1):

- In transverse direction (north-south) frames in gridlines 1, 2, 4 and 13
- In longitudinal direction (east-west) frames in gridline C, D and E

It is considered that the assessment of these frames will provide adequate representation of the seismic response of the entire building. The frames represent typical lateral load resisting systems in two orthogonal directions.

The reinforced concrete frame along gridline A has been omitted from the analysis as the seismic mass resisted by this frame represents only approximately 5% of the seismic mass of the entire structure. As such contribution of this frame to the seismic resistance of the building is not considered significant. By inspection the seismic capacity of the grid A frame will be significantly greater than the overall capacity of the building.

The seismic inertial loads from the roof, lower and upper stands, ramps and stairs have been modelled as lumped seismic masses and added to the appropriate frames. Torsional effects due to the eccentricity of the masses from the roof and upper stand have not been considered in the analysis.

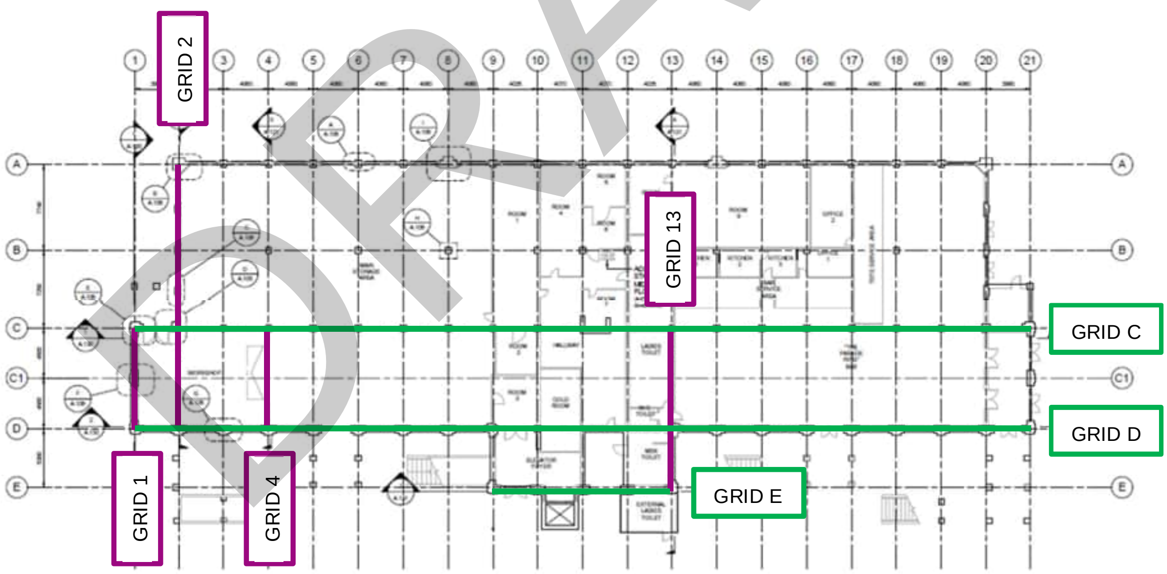


Figure 5-1 Reinforced concrete frames selected for analysis.

5.1 Nonlinear static (pushover) analysis

5.1.1 General

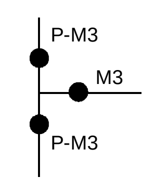
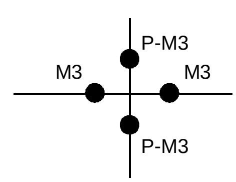
Pushover analysis is a static, nonlinear procedure in which the magnitude of the lateral loading is incrementally and proportionally increased in accordance with a certain predefined pattern (e.g. inverted triangle). With the increase in the magnitude of the loading, weak links and failure modes of the structure are found. The loading is monotonic with the effects of the cyclic behaviour and load reversals being estimated by using a modified monotonic force-deformation criteria and with damping approximations.

The non-linear static push-over analysis was chosen because it can identify the post-elastic failure mechanism and determine the associated strength and deformation capacity of the structure. P-delta effects were not considered in the non-linear push over analyses.

5.1.2 Analysis procedure

Table 6 outlines nonlinear procedure adopted for the assessment of the building. It also provides references and basic assumptions made in the analysis.

Table 6: Nonlinear static analysis procedure

Step	Description	Notes / References
1	**Determine probable member, flexural and shear strengths**	
1.1	Probable flexural strength	NZS 3101: Part 1: 2006, cl. 7.4 for concrete NZS 3404: Part 1: 1997, cl. 5.2 for steel strength reduction factor, ϕ = 1.0 as per NZSEE - Assessment and Improvement of the Structural Performance of Buildings in Earthquakes (NZSEE Guidance) cl. 7.1.1c
1.2	Probable shear strength of beams	NZSEE Guidance, page 7-8, Eq. 7(5) for concrete NZS 3404: Part 1: 1997, cl. 5.11 for steel strength reduction factor, ϕ = 0.85 as per NZSEE - Assessment and Improvement of the Structural Performance of Buildings in Earthquakes (NZSEE Guidance) cl. 7.1.1c
1.3	Determine probable flexural strength of columns for various levels of axial loads	Response-2000 in combination with Excel spreadsheets utilized to plot moment-axial force interaction diagrams to derive columns capacities
1.4	Probable shear strength of columns	NZSEE Guidance, page 7-8, Eq. 7(6) NZS 3101: Part 1: 2006, cl 7.5 strength reduction factor, ϕ = 0.85 as per NZSEE - Assessment and Improvement of the Structural Performance of Buildings in Earthquakes (NZSEE Guidance) cl. 7.1.1c
2	**Nonlinear static pushover analysis using SAP2000**	
2.1	Create models for selected frames	Use geometry as per Appendix B.
2.2	Apply material and section properties as required	Refer to section 8 for detailed information on material properties. Refer to Appendix A for section properties used in the models.
2.3	Define frame hinge properties and assign them to frame elements	Use FEMA 356 interacting frame hinge for columns (P- M3). Use FEMA 356 moment hinge for beams (M3 hinge).  Exterior beam-column joint  Interior beam-column joint

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2.4	Assign restraint conditions	Spring supports to foundation plinths were assigned. In cases where uplift was predicted gap elements (compression only supports) were utilized.
2.5	Define load patterns for pushover analysis	Gravity loads (dead load + 0.3 live load) acting on a structure.
		Two different lateral load patterns were used for pushover case in order to check sensitivity. One load pattern in proportion to the first mode shape and second based on base shear distribution in line with NZS 1170.5. The first mode shape was determined by running a modal analysis on the model initially.
2.6	Define nonlinear static load case	Pre-load the structure with gravity using load control.
		Apply lateral pushover loads under displacement control.
		Select node at top of the structure to monitor displacement.
2.7	Run pushover analysis	
2.8	Review the pushover results	Plot pushover curve.
		Plot deflected shape showing hinge states at various stages.
		Plot internal forces in members at selected stages.
		Export all results to Excel for post-processing.
3	**Assess %NBS of the structure**	
3.1	Individual frames	Assess %NBS on individual frames based on their elastic period and demand.
3.2	Entire building	Assess capacity of the building based on combined capacities of individual frames in two orthogonal directions.
		Assess %NBS of the entire building for the anticipated period range.

6.0 Loading assumptions

6.1 General

The basic loading requirements are given in the table below, along with annual probability of exceedance (APE), which has been determined in accordance with clause 3.3 of AS/ NZS 1170.0.

Applicable design loadings are based on the following criteria:

Table 7: Basic Design Criteria

Description	Criteria
Design working life of building	50 years
Importance category	3
Annual probability of exceedance (ULS)	1/1000 (earthquake)
Annual probability of exceedance (SLS)	1/25 (earthquake)

The design life of 50yrs was used to determine the appropriate loading for the building. AECOM makes no warranty of the actual residual life of this building.

See Appendix C for diagram of each grids loads.

6.2 Dead (permanent) loads

Dead loads are deemed to be all permanently fixed structural materials, and include the self-weight of the structural roof system, walls and floors. Dead loads are calculated from unit material weights and structural component dimensions. Weights of material have been allowed for as follows:

- Reinforced concrete: 25 kN/m3
- Structural steel: 77.5 kN/m3

Table 8 presents typical sizes and associated dead loads for various structural elements within the building. Refer to Appendix A for details of columns and beams.

Table 8: Selected typical weights

Item	Location	Detail		Dead Load [kPa]	Dead load [kN/m]
Roof	-	-	cladding	0.2	-
		-	purlins	0.2	-
		-	trusses / bracing	0.3	-
		-	ceiling / mesh	0.15	-
		Total		<u>0.85</u>	-
Slab	Level 4	-	150mm concrete slab	3.75	-
	Levels 1 to 3	-	200mm (average) concrete slab	5.0	-
Upper stand	-	-	deck/seating	0.2	-
		-	seating plywood/board	0.15	-
		-	joists	0.2	-
		-	trusses/bracing	0.3	-
		-	ceiling	0.3	-
		-	services	0.2	-
		Total		<u>1.35</u>	-
Lower stand	-	-	deck/seating	0.2	-
		-	joists	0.2	-
		-	corrugated board	0.1	-
		-	services	0.2	-

		Total	0.7	-
Shear wall	Level 4, gridline C, typical	200mm concrete wall	5.0	-
	Gridline C, typical	250mm concrete wall	6.3	-
	Level 3, gridline C, locally between gridlines 10 and 12	550mm concrete wall	14	-
Perimeter columns	Type B	approx. 1100x1100mm	-	40
	Type D	approx. 770x770mm	-	21
	Type E	approx. 940x940mm	-	30
	Type F	approx. 620x1370mm	-	24
	Type G	approx. 720x1360mm	-	28
	Type J	approx. 500x660mm	-	10
	Type K	approx. 660x750mm	-	16
	Type L	approx. 200x500mm	-	3
	Type M	approx. 600x600mm	-	9
	Type N	approx. 920x940mm	-	22
Internal columns	Type H	approx. 520x520mm	-	7
Internal beams	Type 3	BSB28 (encased in concrete 540x350mm)	-	5
	Type 4	approx. 500x700mm	-	9
Perimeter beams	Type 1A	approx. 1450x610mm	-	22
	Type 1B	approx. 1300x610mm	-	20
	Type 2	approx. 530x610mm	-	8
	Type 5	approx. 1600x580mm	-	23
	Type 6	approx. 500x580mm	-	7
	Type 7	approx. 540x720mm	-	10

6.3 Imposed loads

Table 9 summarizes all vertical live loads.

Table 9: Imposed loads

Level/Area	Use	Live Load [kPa]
Level 0	Workshop / Public access	5.0
Level 1	Public access	5.0[1]
Level 2	Public access	5.0
Level 3	Public access	5.0
Level 4	Maintenance access only / water tanks	5.0[2]

[1] Area susceptible to overcrowding, refer to table 3.1 (type C5) of AS/NZS1170.1:2002

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Lower stand	Public access	5.0
Upper stand	Public access	5.0
Roof	Maintenance access only	0.25
Stairs	Public access	4.0[3]

6.4 Wind loads

Not undertaken as this assessment is limited to seismic analysis only.

6.5 Snow and ice loads

Not undertaken as this assessment is limited to seismic analysis only.

6.6 Horizontal imposed actions

Horizontal imposed actions due to crowd movement as per clause 3.9 of AS/NZS 1170.1:2002 has not been considered in the analysis as only seismic performance was assessed.

6.7 Seismic loads

The earthquake structural design actions were calculated using AS/NZS 1170.5. The factors used in the calculation of the seismic design coefficient, C_d, are described below:

Table 10: Seismic parameters

Item	ULS	SLS	Comment / Reference
Soil Category	D		Deep or soft soil
Location	Christchurch		
Period, T	0.87s Grid C = 0.62s Grid D = 0.36s Grid E = 0.41s Grid 1 = 0.36s Grid 2 = 0.38s Grid 4 = 1.33s Grid 13 = 0.72s		Based on empirical method A: Refer to NZS 1170.5 Supp 1:2004, clause C.4.1.2.2 h_n = 19.5m Calculated for individual 2d frames based on SAP2000 model including the effect of cracking on the section properties.
Spectral shape factor, $C_h(T)$	Varies between frames		NZS 1170.5: 2004, table 3.1
Hazard Factor, Z	0.3		B1 Building Code (incl. amendment 12, February 2014)
Annual probability of exceedance	1000 years	25 years[1]	Importance level 3 structure, refer table 3.3 in AS/NZS 1170.0:2002

[2] Areas for equipment and plant, refer to table 3.1 (type E) of AS/NZS1170.1:2002
[3] Areas without obstacles for moving people (not subject to wheeled vehicles), refer to table 3.1 (type C3) of AS/NZS1170.1:2002

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Return period factor, R	1.3	0.33[1]	Table 3.5 of AS/NZS 1170.5: 2004 & B1 Building Code (incl. amendment 12, February 2014)
Near fault factor, N(T,D)	1		NZS 1170.5: 2004, table 3.7
Elastic Site Spectra, C(T)	Varies between frames		NZS 1170.5: 2004, Eq. 3.1(1) (Automatically calculated in SAP)
Ductility, μ	1.0 and 1.25		Brittle and nominally ductile structure considered in the analysis
Structural performance factor, S_p	1.0		NZS 1170.5: 2004, cl. 4.4.2
Structural ductility factor, k_μ	Varies between frames		NZS 1170.5: 2004, cl. 5.2.1.1 (Automatically calculated in SAP)
Horizontal design action coefficient, $C_d(T)$	Varies between frames		NZS 1170.5: 2004, cl. 5.2.1.1 (Automatically calculated in SAP)

[1] Assessments of the structure under SLS conditions was not undertaken

7.0 Serviceability criteria

7.1 Seismic deflections

Maximum Allowable: ULS: 2.5% inter-storey in accordance with 7.5.1 of AS/NZS 1170.5:2004

SLS: not applicable as only ultimate limit state considered

7.2 Gravity deflections

Not considered as this assessment is limited to seismic analysis only.

8.0 Limitations

The seismic capacity assessment was limited to the main resisting systems and the following items were not assessed:

- Roof structure
- Bracing in the roof structure
- Trusses supporting the upper stand
- Grid A moment frame
- Ramps and stairs
- Retaining wall

Although they have not been analysed the loads that they impart on the main structure were still considered and applied as lateral seismic mass.

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9.0 Material properties

9.1 Concrete Sample Testing

9.1.1 Test results

Analysis of 25 concrete test results show a statistically significant difference in the compressive strength of samples taken from horizontal elements (floors) and vertical elements (walls). In the absence of NZ-specific guidance on the assessment of in-situ compressive strength of concrete in existing structures, international best practice has been followed. Therefore, the rules of BS EN 13791:2007 [5] have been adopted. Test results yield the following distinct concrete grades:

Table 11: Concrete grades

Element	Compressive strength fc' (MPa)	Mean specific weight γ_{conc} (kN/m^3)	Material designation
Beams and Floors	25.5	23.3	C25
Columns and walls	15.3	23.1	C15

9.1.2 Concrete properties for analysis

The following concrete characteristics will be used for all analysis, whether carried out by hand or using software, and for all design checks:

Table 12: Concrete properties

Characteristic	C15	C25	Formula (if applicable)	Commentary and Reference
Specific weight (γ_{conc})	23.1 kN/m^3	23.3 kN/m^3	Derived from testing	Mean value of samples adopted
Compressive strength (f_c')	15.3 MPa	25.5 MPa	Derived from testing	Value determined in accordance with BS EN 13791:2007 [5]
Modulus of elasticity (E_c)	19900 MPa	23700 MPa	$E_c = 3320\sqrt{f_c'} + 6900$	cl. 5.2.3 NZS3101:2006 [6]
Modulus of rupture (f_r)	2.35 MPa	3.03 MPa	$f_r = 0.6\,\lambda\sqrt{f_c'}$	cl. 5.2.4 NZS3101:2006 [6]
Direct tensile strength (f_{cr})	1.41 MPa	1.82 MPa	$f_{cr} = 0.36\sqrt{f_c'}$	cl. 5.2.6 NZS3101:2006 [6]
Poisson's Ratio (v)	0.2	0.2	Codified value	cl. 5.2.7 NZS3101:2006 [6]
Coefficient of thermal expansion (α)	0.000012 /K (12x10^6 /°C)	0.000012 /K (12x10^6 /°C)	Codified value	cl. 5.2.9 NZS3101:2006 [6]
Shear Modulus (Gc)	7950 MPa	9470 MPa	$G_c = 0.4\,E_c$	cl. C7.6.1.3 NZS3101:2006 [6]

9.1.3 Further considerations regarding concrete properties for analysis

AECOM met with the insurer's engineer, Thornton Tomasetti (TT), on Friday 12 June 2015 to discuss the results of the concrete testing.

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TT pointed out that the American Concrete Institute's (ACI) guidance suggests that a concrete core must have diameter measuring at least 3 times the nominal size of the aggregate used in the concrete matrix. This limitation is intended to prevent bond failure of individual aggregate unrepresentatively affecting the compressive test results. In the case of the Grand National Stand, aggregate as large as 70mm have been observed in vertical elements such as walls and columns. Much smaller aggregate (circa. 20mm) has been observed in floor slabs and beam. TT contends that in the case of one of the samples taken from the 4^{th} floor shear wall that a 70mm piece of aggregate has caused the premature failure of the sample under compressive testing and thus this sample should be disregarded, based on ACI guidance. AECOM understands that TT suggests that this sample should either be disregarded or validated. This sample showed the lowest compressive strength of the batch.

AECOM accepts the validity of TT's comments regarding ACI guidance. However, there does not seem to be an easy way to conform to this guidance. Since the ratio of diameter to length of a sample must be at least 1:1.5, no code-compliant testing can carried out; aggregate concerns preclude all samples smaller than 210mm, in which case the sample must be at least 315mm long to be in accordance with testing standards. The shear wall is 180mm thick and thus such a sample is not possible. AECOM does not agree with taking a 210mm diameter from the centre of a 540mm load bearing concrete column, on both safety and practicality grounds.

AECOM contends that this sample, far from being unrepresentative, actually underline the vulnerability of the 180mm unreinforced shear wall to premature failure under compressive loading. Given the extremely poor quality of the concrete observed in the vertical elements throughout the structure, AECOM considers it prudent to use the 'lower' bound 15.3MPa throughout the structure for columns and shear walls.

AECOM will therefore undertake all non-linear pushover analyses on the basis of the lower bound concrete strengths. Should the %NBS value for the structure turn out to be near the 33%NBS threshold, then a sensitivity analysis can be considered to determine the actual influence of varying the concrete strength and further testing can be considered, ranging from Schmidt Hammer testing to further core samples, in accordance with international best practice.

9.2 Steel Reinforcement Sample Testing

Test results show that there is a statistically significant difference in the steel properties of the 'large' diameter and 'small' diameter bars. 13 large diameter samples were tested and 3 small diameter samples were tested. Therefore for the purpose of analysis, two distinct materials have been defined, as follows:

Table 13: Reinforcement steel grades

Callout	Bar type	Nominal Size	Yield strength (fy)	Tensile strength (fu)	Stress ratio (Rm / Re)	% elongation	Design size (SAP)	Design area (SAP)
R307B	Round	7 mm	307 MPa	340 MPa	1.11	17%	6.8 mm	36.3 mm^2
R296C	Round	19 mm	296 MPa	451 MPa	1.51	20%	19 mm	284 mm^2

The reinforcement callout is a three part coding system, (*XYYYZ*) based on EN10080 and NZS3101. This system allows the reinforcing material to be described in terms of type, yield stress, and ductility.

- *X:* bar type – Round (R) or deformed (D)
- *YYY:* bar yield grade - yield strength (fy) of material expressed in MPa
- *Z:* bar ductility grade – example below shown is for 350MPa steel. Grade A, B, or C based on ductility measurements with thresholds defined in accordance with NZS3101:2006.

Note that the standard New Zealand ductility grading L, N, and E have intentionally not been used as although the tested steel may exhibit similar elongation properties to these categories, insufficient testing has been carried out to suggest that the tested steel can be accurately classified in accordance with NZS3101:2006.

Table 15 sets out the stress ratios and elongation limits used to define each reinforcement steel class:

Table 14: Steel reinforcement grades

Grade YYYZ	Yield stress fy (MPa)	Stress ratio Rm / Re	Total elongation %	Comment
350A	350[4]	>= 1.03	>= 1.5%	Low ductility – analogous to NZS3101 grade 'L'
350B	350	>= 1.08	>= 5.0%	Normal ductility – analogous to NZS3101 grade 'N'
350C	350	>= 1.15	>= 15%	High ductility – analogous to NZS3101 Seismic grade 'E'

Where a sample exhibits properties which place the sample in a transitional zone between grades, i.e. the stress ratio corresponds to ductility grade B and total elongation corresponds to ductility grade C, then the lower bound conservative ductility grading has been chosen.

For the analysis the reinforcement grade R296C, as per Table 13, was used.

[4] yield grade 350 is used as an illustrative example only

9.3 Steel Reinforcement Scanning

There were no original construction drawings available for the Grand National Stand so the reinforcement used in the concrete elements could not be readily determined for the analysis. In order to build a representative analytical model of the structure selected elements were scanned by a specialist subcontractor. A range of beams, columns, walls and slabs were investigated in order to determine reinforcement patterns, reinforcement sizes and cover depth.

Two types of scanners were used, the PS200 which as a guidance can scan up to 100mm and gives the size of the reinforcement and the PS1000 which as a guidance can scan up to 300mm and provides a detailed picture of the location of reinforcement. The PS200 scanner was used to scan in all locations except for the level 4 shear wall. The PS1000 was used more sparingly, mainly as a verification of the PS200 results or if the PS200 did not detect any reinforcement.

It was envisaged that reinforcement scanning would provide an adequate understanding of the reinforcement present in the structure but the results were largely inconclusive. In some locations no reinforcement was detected and in others the PS200 and PS1000 results did not provide definitive results on the reinforcement. The reasons for the inconclusive results were likely to be attributable to the depth of the concrete cover, steel beams being present rather than reinforcing bars and the non-uniformity of the reinforcement arrangements throughout the structure.

In order to verify these results further intrusive works involving removal of concrete cover and exposure of reinforcement was undertaken.

9.4 Structural steel

AECOM were furnished with a digital copy of the steel properties tables [7] used in the design of the original structure, circa 1922. AECOM have relied upon this set of tables for all material information pertaining to the structure steel used in the construction of this building. The following table summarizes the information acquired:

Table 15: Structural steel characteristics

Characteristic	British units	SI
Specific weight (γ_{steel})	490 lbs/ cubic foot	76.9 kN/m^3
tensile strength (f_u)	28 ton / square inch	433 MPa
Elongation at failure	20%	0.2
Max permissible stress (f_b)	7.5 ton / square inch	116 MPa
Estimated Yield Stress (f_y)	13.1 ton / square inch	203 MPa
Young's Modulus (E)	12000 ton / square inch	185 GPa (assumed) [8]

The load capacities quoted in the design manual are based on the assumption of full lateral torsional buckling restraint and therefore it was not necessary to consider pre-yield buckling behaviour or any strength reduction over the numbers quoted. The 1906 structural steel design was based on permissible stress and was not based on limit state theory. Therefore, in order to define an appropriate structural steel for use in the seismic assessment a yield stress needed to be estimated from permissible stress given in the tables. Based on the existing literature [9] a ratio between the yield and permissible stresses for structural steel from 1920's is approximately 1.75. Therefore the yield strength for structural steel was estimated as 203MPa and adopted as probable strength in the analysis.

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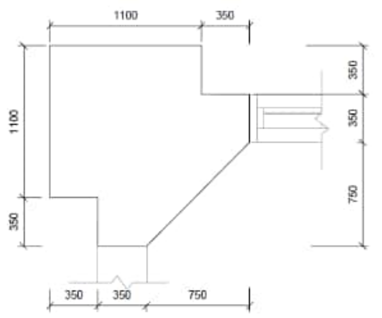
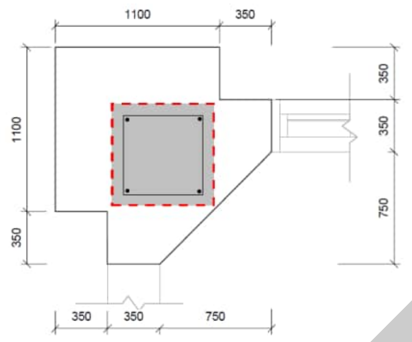
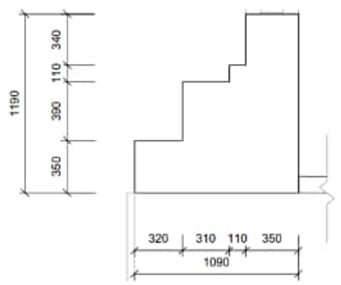
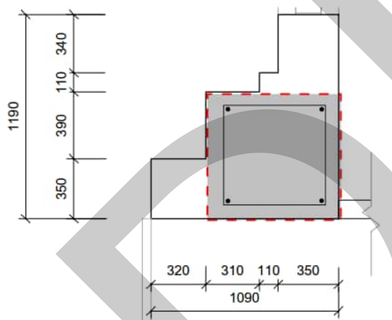
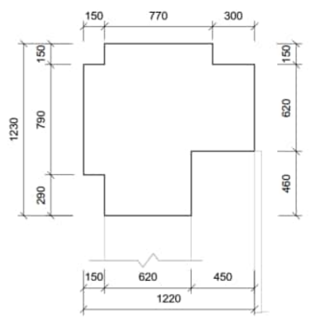
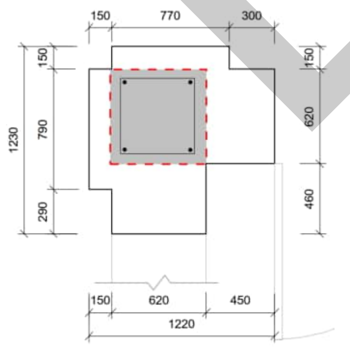
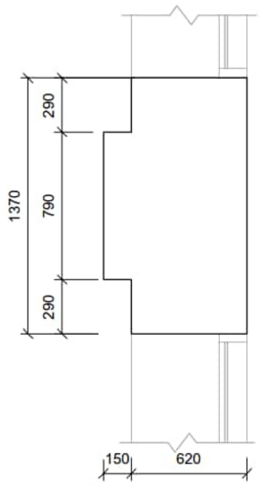
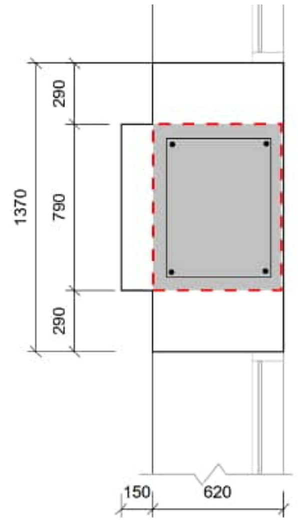
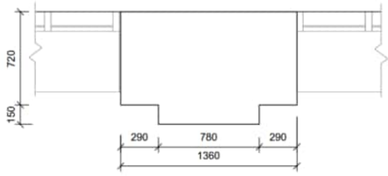
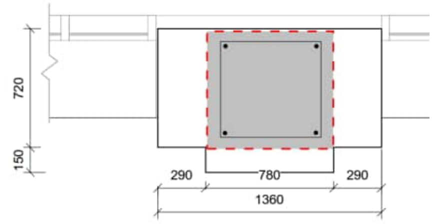
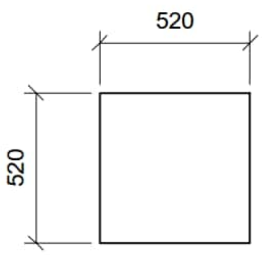
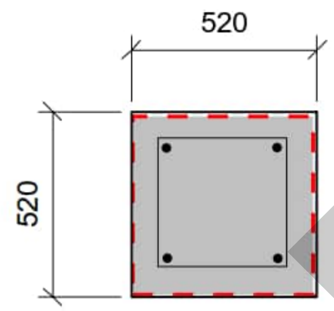
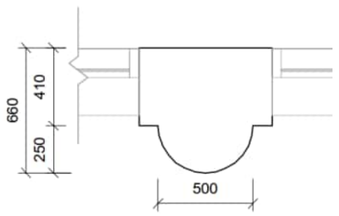
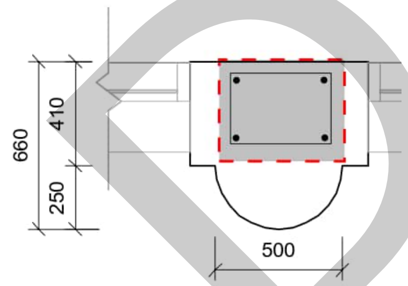
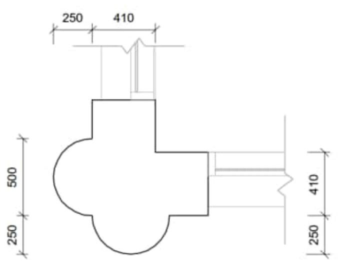
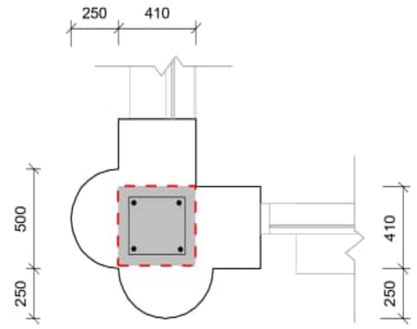
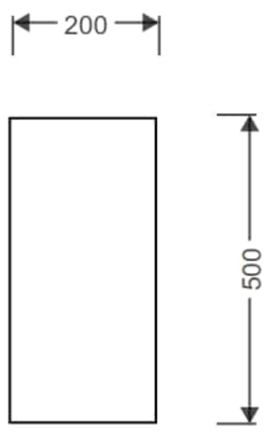
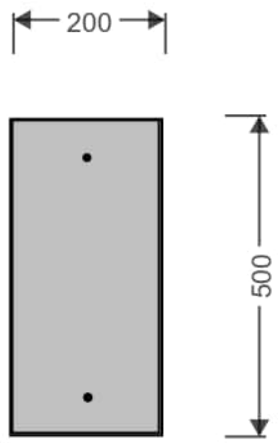
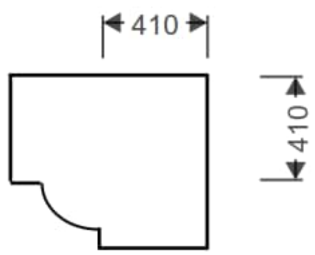
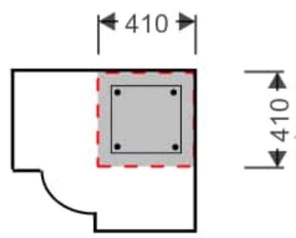
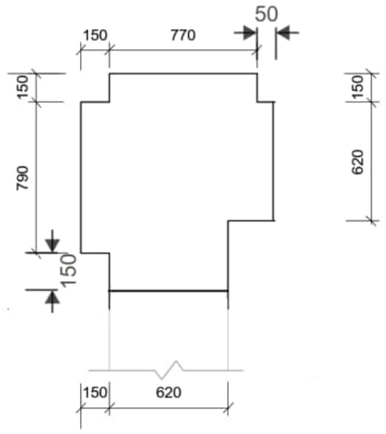
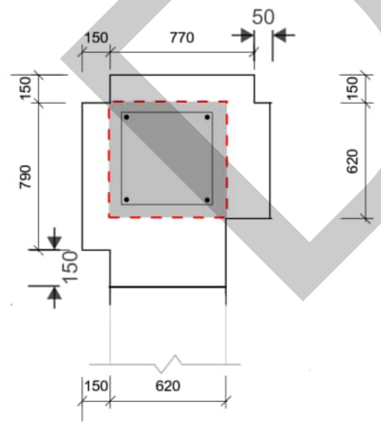
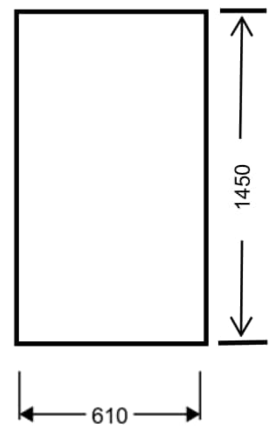
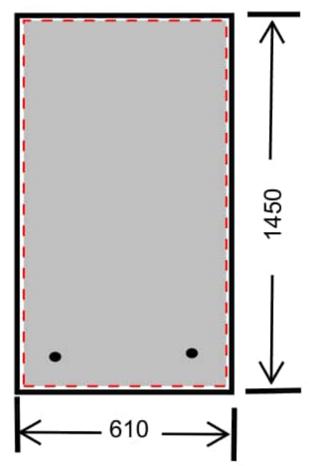
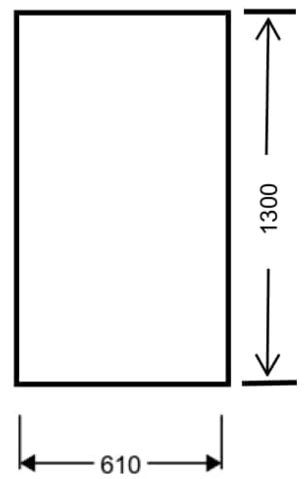
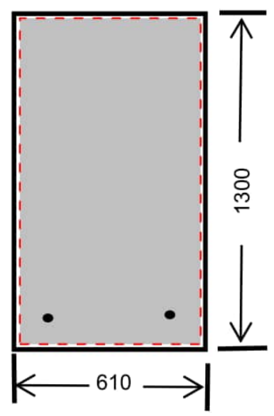
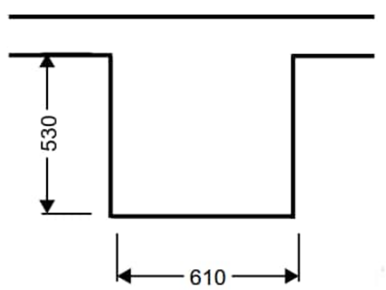
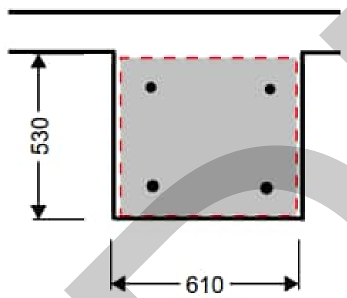
Appendix A

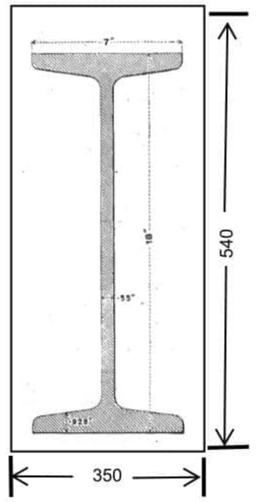
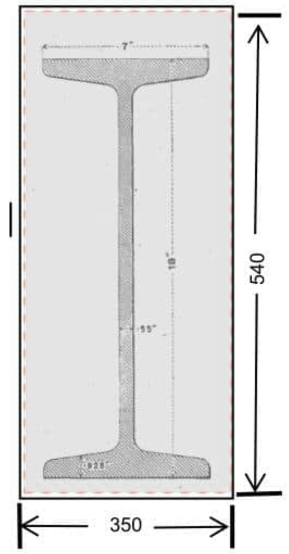
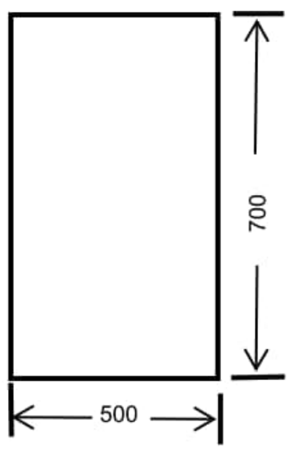
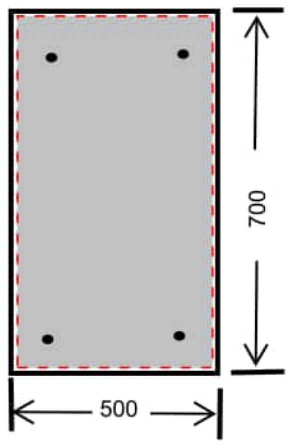
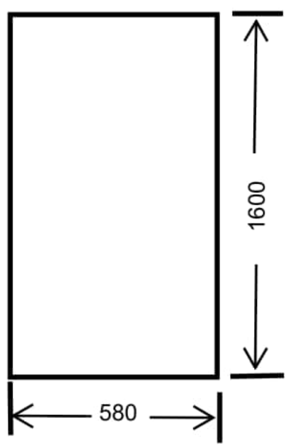
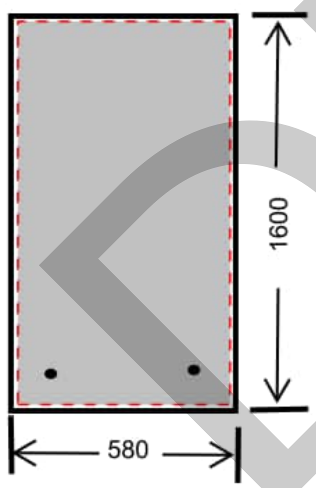
Section summary

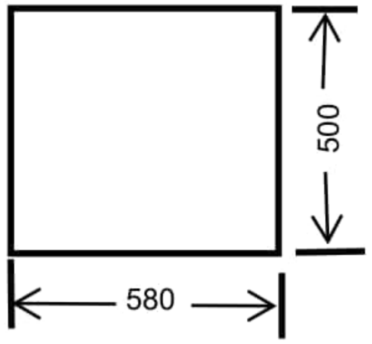
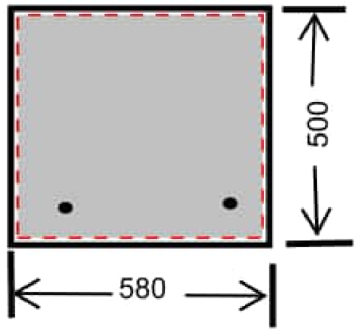
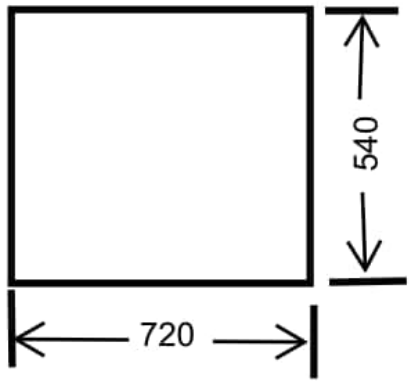
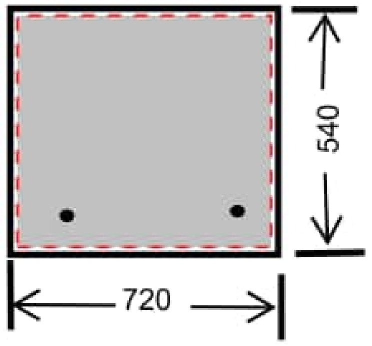
Section type	Section diagram	Section modelled	Section properties	Stiffness modifiers	Material properties	Section capacities estimate		
						Bending, M_n (at axial load N)	Shear, V_n	Axial, N_n
Notes	Section diagram shows the actual size of the element as measured on site. In cases where direct measurements could not be undertaken a section has been inferred from indirect measurements, historical drawings and photos.	Section modelled shows the core area of the element used in the analysis software.	The size of the core is shown along with the cover depth to reinforcement based on intrusive investigation. I_{sec} is the moment of inertia of the entire section. I_{mod} is the moment of inertia of the modelled section. x-x is the moment about the horizontal axis and y-y is the moment about the vertical axis.	The stiffness modifier is the quotient of I_{sec} and I_{mod} multiplied by 0.5 to account for the cracked stiffness of the section. 0.5 (I_{sec} / I_{mod}) This modifier is used in the model to account for the cracked stiffness of the entire section.	Refer to DFR material section for detailed material properties. C15 = 15.3MPa C25 = 25.5MPa R296C = 296MPa Reinforcement layout based on intrusive investigation.	The moment for columns is shown for two axial forces.	The A_c used to determine the shear strength is greater than the modelled core area. Two values of shear strength calculated in accordance with NZS3101 and NZSEE Guidance are shown.	Maximum axial compression force for columns with no moment applied.
Type B Column			750 x 750mm square cover = 100mm $I_{sec\ x\text{-}x} = 2.123 \times 10^{11}\ mm^4$ $I_{mod\ x\text{-}x} = 2.64 \times 10^{10}\ mm^4$	x-x = 4.03	Concrete C15 Rebar R296C 4 no. ϕ19mm bars in the corners ϕ12mm links at 350mm crs.	120kNm (N = 0kN) 261kNm (N=447kN)	428kN (NZS3101) 536kN (NZSEE) A_c=1210000mm^2	8923kN
Type D Column			740 x 770mm rectangle cover = 100mm $I_{sec\ x\text{-}x} = 8.505 \times 10^{10}\ mm^4$ $I_{mod\ x\text{-}x} = 2.6 \times 10^{10}\ mm^4$ $I_{sec\ y\text{-}y} = 7.242 \times 10^{10}\ mm^4$ $I_{mod\ y\text{-}y} = 2.815 \times 10^{10}\ mm^4$	x-x = 1.64 y-y = 1.29	Concrete C15 Rebar R296C 4 no. ϕ19mm bars in the corners ϕ12mm links at 350mm crs.	119kNm (N = 0kN) 512kNm (N=1430kN)	257kN (NZS3101) 307kN (NZSEE) A_c=569800mm^2	9026kN
Type E Column			620x620 mm square cover = 100mm $I_{sec\ x\text{-}x} = 1.217 \times 10^{11}\ mm^4$ $I_{mod\ x\text{-}x} = 1.231 \times 10^{10}\ mm^4$ $I_{sec\ y\text{-}y} = 1.195 \times 10^{11}\ mm^4$ $I_{mod\ y\text{-}y} = 1.23 \times 10^{10}\ mm^4$	x-x = 4.94 y-y = 4.86	Concrete C15 Rebar R296C 4 no. ϕ19mm bars in the corners 4 no. ϕ19mm bars in the corners ϕ12mm links at 350mm crs.	97.1kNm (N = 0kN) 362kNm (N=1290kN)	291kN (NZS3101) 320kN (NZSEE) A_c=663400mm^2	6198kN

Type F Column			790 x 620 mm rectangle cover 100mm $I_{sec\ x\text{-}x} = 1.39\text{x}10^{11}$ mm^4 $I_{mod\ x\text{-}x} = 2.55\text{x}10^{10}$ mm^4 $I_{sec\ y\text{-}y} = 4.29\text{x}10^{10}$ mm^4 $I_{mod\ y\text{-}y} = 1.57\text{x}10^{10}$ mm^4	x-x = 2.73 y-y = 1.37	Concrete C15 Rebar R296C 4 no. ϕ19mm bars in the corners ϕ12mm links at 350mm crs.	126kNm (N = 0kN) 373kNm (N=803kN)	343kN (NZS3101) 421kN (NZSEE) A_c=849400mm^2	7811kN
Type G Column			720x780 mm rectangle cover 100mm $I_{sec\ x\text{-}x} = 6.21\text{x}10^{10}$ mm^4 $I_{mod\ x\text{-}x} = 2.426\text{x}10^{10}$ mm^4 $I_{sec\ y\text{-}y} = 1.57\text{x}10^{11}$ mm^4 $I_{mod\ y\text{-}y} = 2.847\text{x}10^{10}$ mm^4	x-x = 1.28 y-y = 2.76	Concrete C15 Rebar R296C 4 no. ϕ19mm bars in the corners ϕ12mm links at 350mm crs.	115kNm (N = 0kN) 431kNm (N=1148kN)	365kN (NZS3101) 447kN (NZSEE) A_c=979200mm^2	8909kN
Type H Column			520x520 mm square cover 50mm $I_{sec\ x\text{-}x} = 6.09\text{x}10^{9}$ mm^4 $I_{mod\ x\text{-}x} = 6.09\text{x}10^{9}$ mm^4	x-x = 0.5	Concrete C15 Rebar R296C 4 no. ϕ19mm bars in the corners ϕ12mm links at 300mm crs.	79.2kNm (N = 0kN) 296kNm (N=1677kN)	187kN (NZS3101) 208kN (NZSEE) A_c=270400mm^2	4455kN
Type J Column	 Note: Obtained from sources other than site measurement		410x500 mm rectangle cover 100mm $I_{sec\ x\text{-}x} = 1.228\text{x}10^{10}$ mm^4 $I_{mod\ x\text{-}x} = 2.87\text{x}10^{9}$ mm^4 $I_{sec\ y\text{-}y} = 1.90\text{x}10^{10}$ mm^4 $I_{mod\ y\text{-}y} = 4.271\text{x}10^{9}$ mm^4	x-x = 2.14 y-y = 2.23	Concrete C15 Rebar R296C 4 no. ϕ19mm bars in the corners ϕ12mm links at 350mm crs.	60.8kNm (N = 0kN) 97.1kNm (N=290kN)	160kN (NZS3101) 125kN (NZSEE) A_c=246000mm^2	3455kN

Type K Column	 Note: Obtained from sources other than site measurement		410x410 mm square cover 100mm $I_{sec\ x\text{-}x} = 3.83\text{x}10^{10}\ mm^4$ $I_{mod\ x\text{-}x} = 2.355\text{x}10^{9}\ mm^4$	x-x = 8.07	Concrete C15 Rebar R296C 4 no. ϕ19mm bars in the corners ϕ12mm links at 350mm crs.	58.3kNm (N = 0kN) 76.6 kNm (N=155kN)	207 kN (NZS3101) 178 kN (NZSEE) A_c=307500mm^2	3004 kN
Type L Column	 Note: Obtained from sources other than site measurement		500x200 mm rectangle cover 100mm $I_{sec\ x\text{-}x} = 2.08\text{x}10^{9}\ mm^4$ $I_{mod\ x\text{-}x} = 2.08\text{x}10^{9}\ mm^4$	x-x = 0.5	Concrete C15 Rebar R296C 2 no. ϕ19mm	36.5kNm (N = 0kN) 54.2kNm (N=111kN)	108kN (NZS3101) 88.4kN (NZSEE) A_c=100000mm^2	1689kN
Type M Column	 Note: Obtained from sources other than site measurement		410x410 mm square cover 100mm $I_{sec\ x\text{-}x} = 1.237\text{x}10^{10}\ mm^4$ $I_{mod\ x\text{-}x} = 2.355\text{x}10^{9}\ mm^4$	x-x = 2.63	Concrete C15 Rebar R296C 4 no. ϕ19mm bars in the corners ϕ12mm links at 350mm crs.	58.3kNm (N = 0kN) 91.1kNm (N=290kN)	171kN (NZS3101) 129kN (NZSEE) A_c=246000mm^2	2890kN
Type N Column			620x620 mm square cover 100mm $I_{sec\ x\text{-}x} = 8.248\text{x}10^{10}\ mm^4$ $I_{mod\ x\text{-}x} = 1.23\text{x}10^{10}\ mm^4$ $I_{sec\ y\text{-}y} = 6.387\text{x}10^{10}\ mm^4$ $I_{mod\ y\text{-}y} = 1.23\text{x}10^{10}\ mm^4$	x-x = 3.35 y-y = 2.60	Concrete C15 Rebar R296C 4 no. ϕ19mm bars in the corners ϕ12mm links at 350mm crs.	97.1kNm (N = 0kN) 362kNm (N=1290kN)	259kN (NZS3101) 281kN (NZSEE) A_c=558000mm^2	6198kN

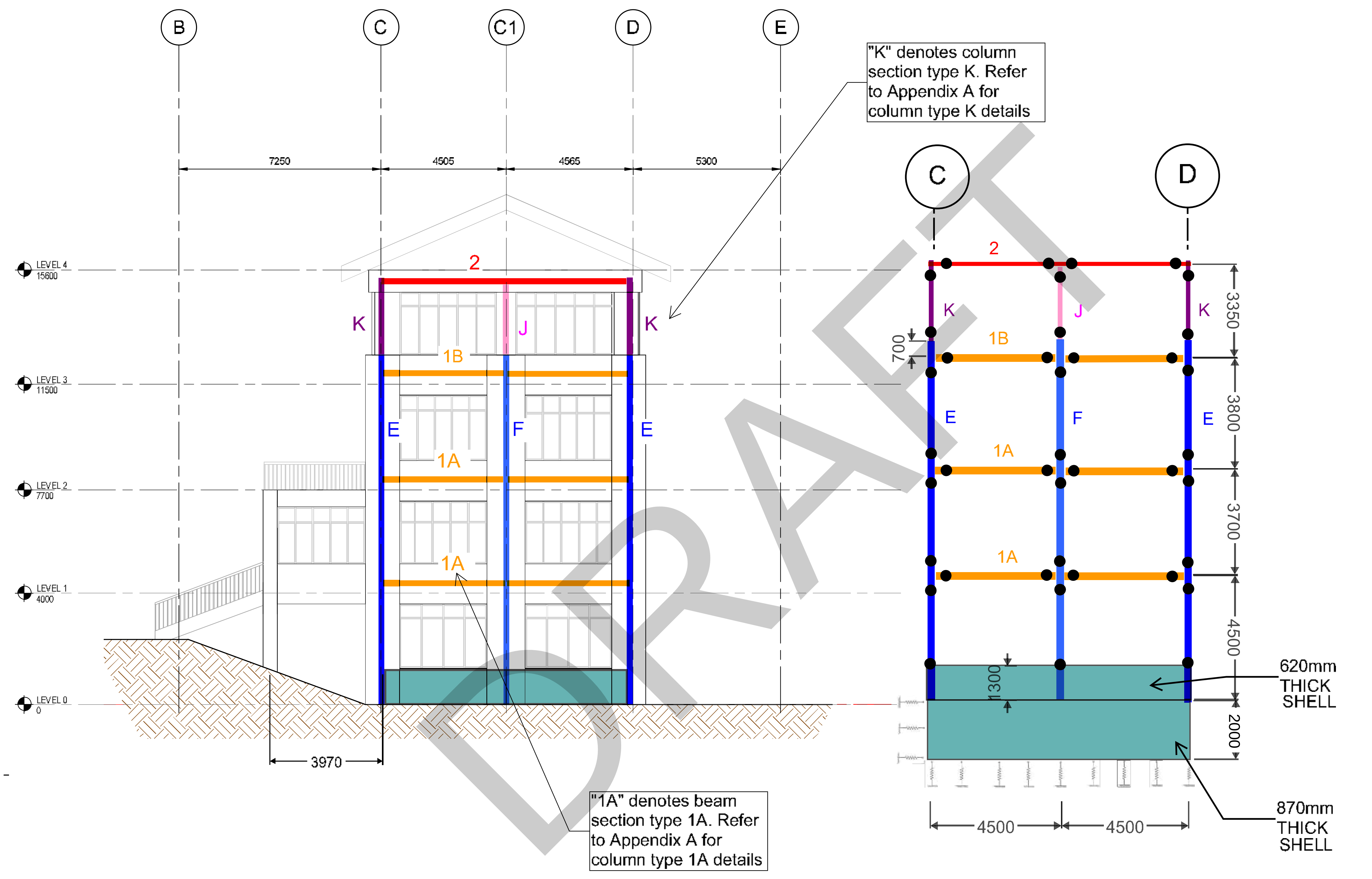
Type 1A Beam			1450x610 mm rectangle cover 100mm $I_{mod} = 1.55x10^{11}$ mm^4	0.5	Concrete C25 Rebar R296C 2 no. ϕ19mm bars bottom	162KNm (NZS3101)	926kN (NZSEE) 512kN (NZS3101)	-
Type 1B Beam	 Note: Obtained from sources other than site measurement		1300x610 mm rectangle cover 100mm $I_{mod} = 1.12x10^{11}$ mm^4	0.5	Concrete C25 Rebar R296C 2 no. ϕ19mm bars bottom	144KNm (NZS3101)	824kN (NZSEE) 460kN (NZS3101)	-
Type 2 Beam			530x610 mm rectangle cover 100mm $I_{mod} = 7.57x10^{9}$ mm^4	0.5	Concrete C25 Rebar R296C 2 no. ϕ19mm bars top 2 no. ϕ19mm bars bottom	111KNm (NZS3101)	295kN (NZSEE) 188kN (NZS3101)	-

Type 3 Beam			Steel section BSB28 encased in 540x350 mm rectangle $I_{sec\ x\text{-}x} = 4.59\text{x}10^9\ mm^4$ $I_{mod\ x\text{-}x} = 4.75\text{x}10^8\ mm^4$ 1920's structural steel beam BSB28 as inferred from intrusive investigation. Beam modelled as steel beam in SAP2000 with stiffness modifier applied to account for concrete surround.	2.14	Concrete C25 203MPa yield strength structural steel	424kNm	893kN	-
Type 4 Beam			700x500 mm rectangle cover 100mm $I_{mod} = 1.43\text{x}10^{10}\ mm^4$	0.5	Concrete C25 Rebar R296C 2 no. ϕ19mm bars top 2 no. ϕ19mm bars bottom	151KNm (NZS3101)	355kN (NZSEE) 229kN (NZS3101)	-
Type 5 Beam	 Note: Obtained from sources other than site measurement		1600x580 mm rectangle cover 100mm $I_{mod} = 1.98\text{x}10^{11}\ mm^4$	0.5	Concrete C25 Rebar R296C 2 no. ϕ19mm bars bottom	180KNm (NZS3101)	991kN (NZSEE) 551kN (NZS3101)	-

Type 6 Beam	 Note: Obtained from sources other than site measurement		500x580 mm rectangle cover 100mm $I_{mod} = 6.04x10^9$ mm^4	0.5	Concrete C25 Rebar R296C 2 no. ϕ19mm bars bottom	48.1KNm (NZS3101)	264kN (NZSEE) 174kN (NZS3101)	-
Type 7 Beam	 Note: Obtained from sources other than site measurement		540x720 mm rectangle cover 100mm $I_{mod} = 9.45x10^9$ mm^4	0.5	Concrete C25 Rebar R296C 2 no. ϕ19mm bars bottom	52.9KNm (NZS3101)	344kN (NZSEE) 206kN (NZS3101)	-

Appendix B

Frames geometry



ELEVATION

ANALYTICAL MODEL

AECOM

PROJECT

STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT

CANTERBURY JOCKEY CLUB

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Key

● POTENTIAL PLASTIC HINGE LOCATION

SPRING SUPPORT

PROJECT MANAGEMENT INITIALS

DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

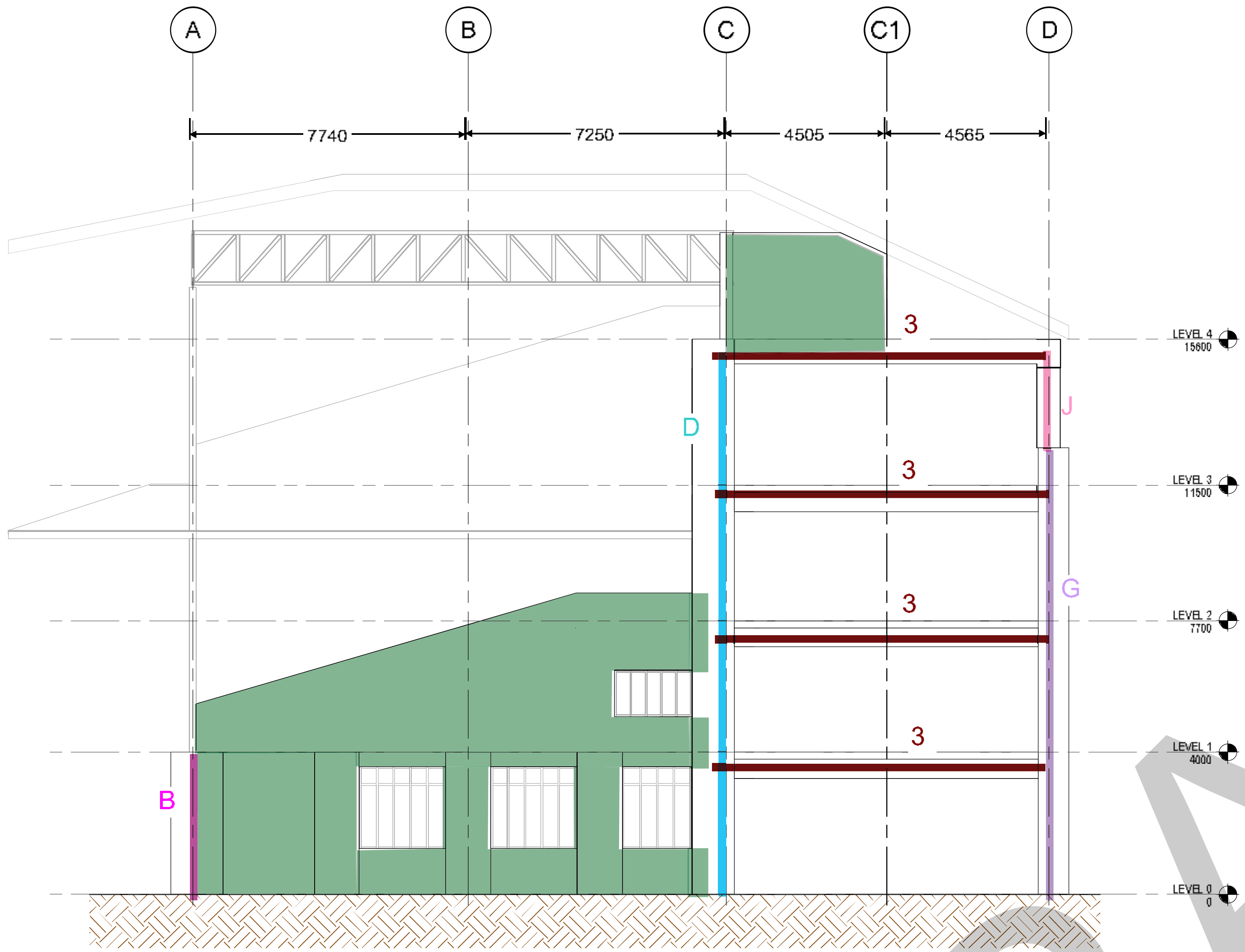
SHEET TITLE

FRAME IN GRID 1 ANALYTICAL MODEL

SHEET NUMBER

B.1

ISO A1 594mm x 841mm



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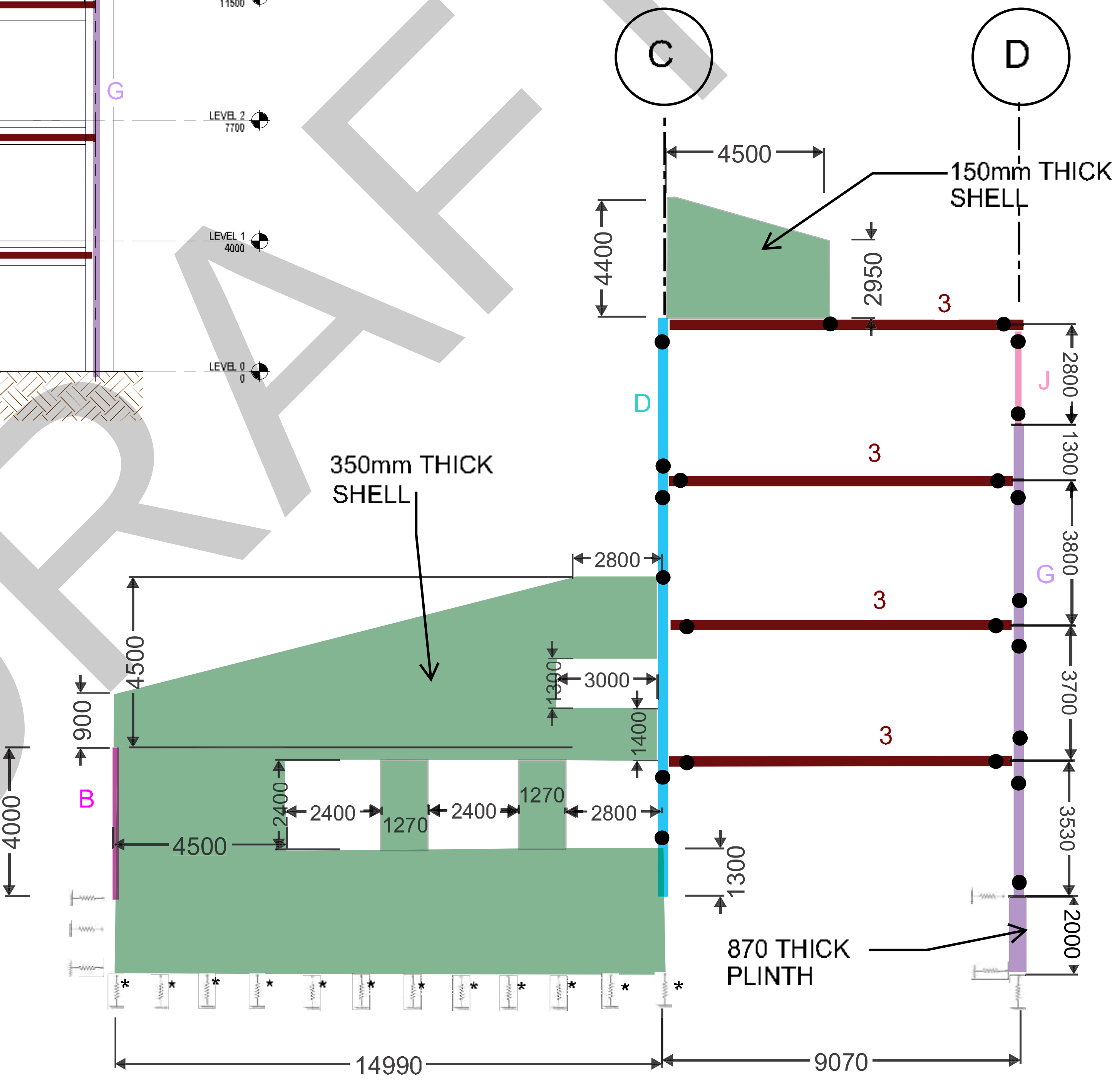

ANALYTICAL MODEL

DRAFT

AECOM

PROJECT

STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT

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● POTENTIAL PLASTIC HINGE LOCATION

SPRING SUPPORT

* SPRING SUPPORT WITH GAP ELEMENT

PROJECT MANAGEMENT INITIALS

DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

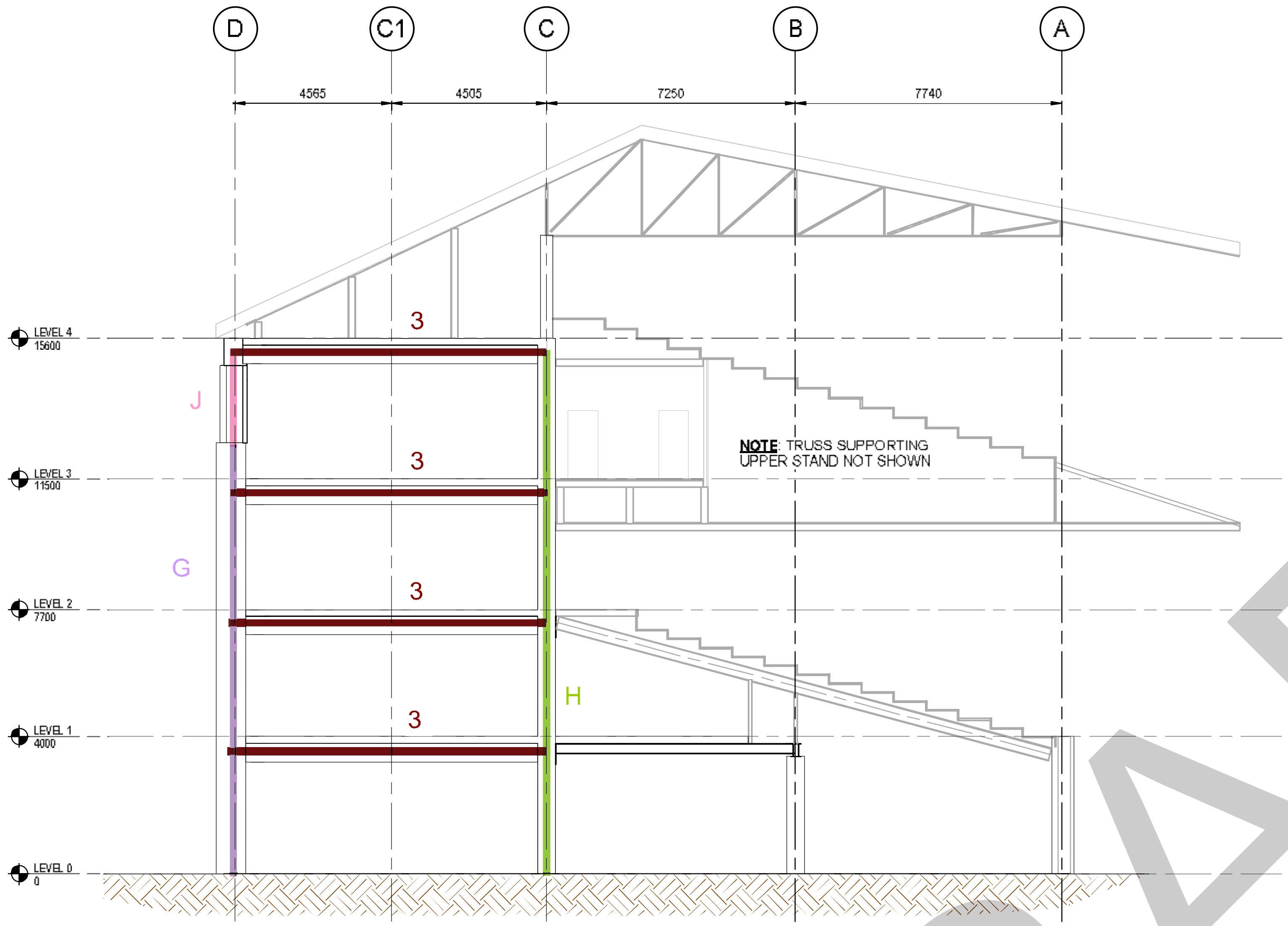
60332326

SHEET TITLE

FRAME IN GRID 2 ANALYTICAL MODEL

SHEET NUMBER

B.2



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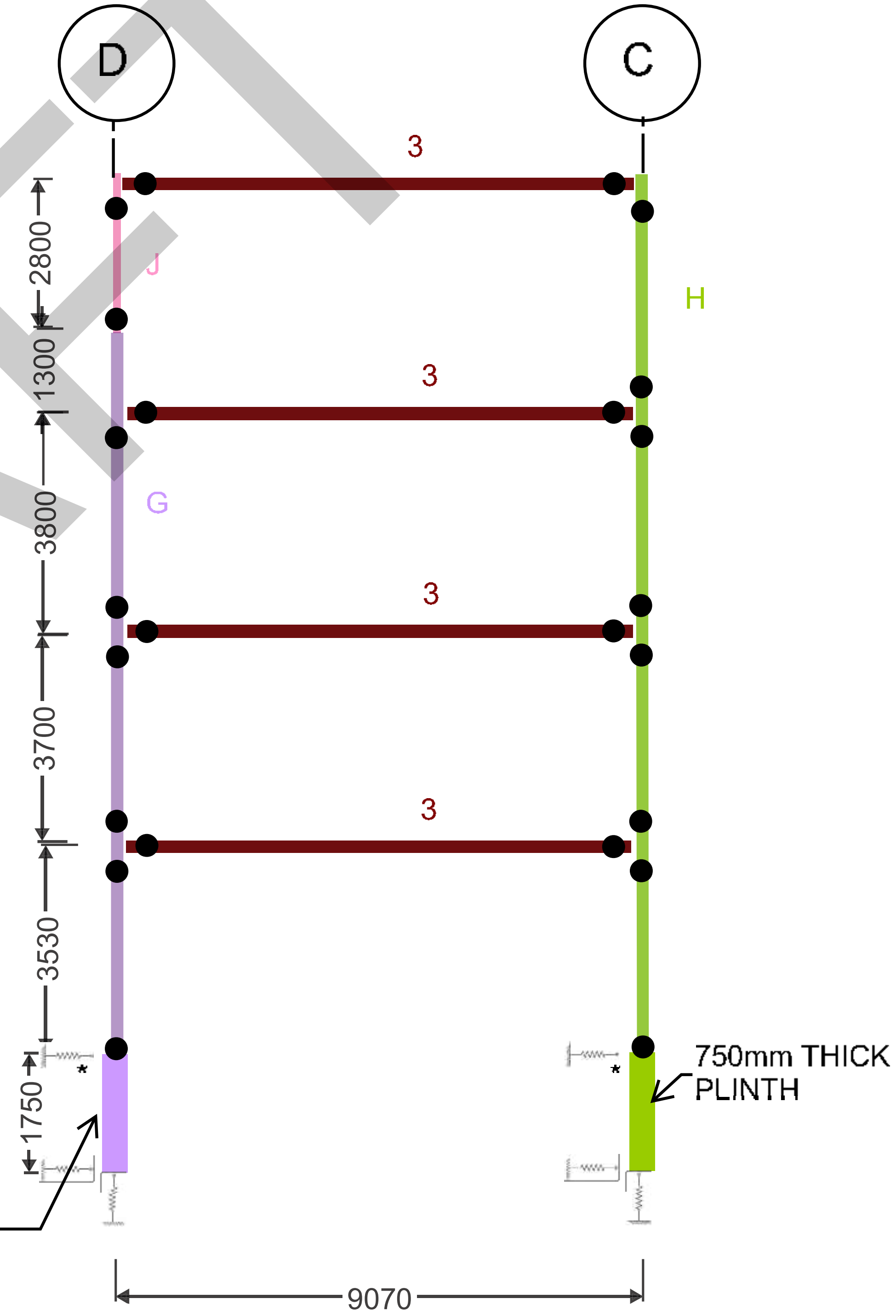

ANALYTICAL MODEL

AECOM

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● POTENTIAL PLASTIC HINGE LOCATION

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PROJECT MANAGEMENT INITIALS

DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

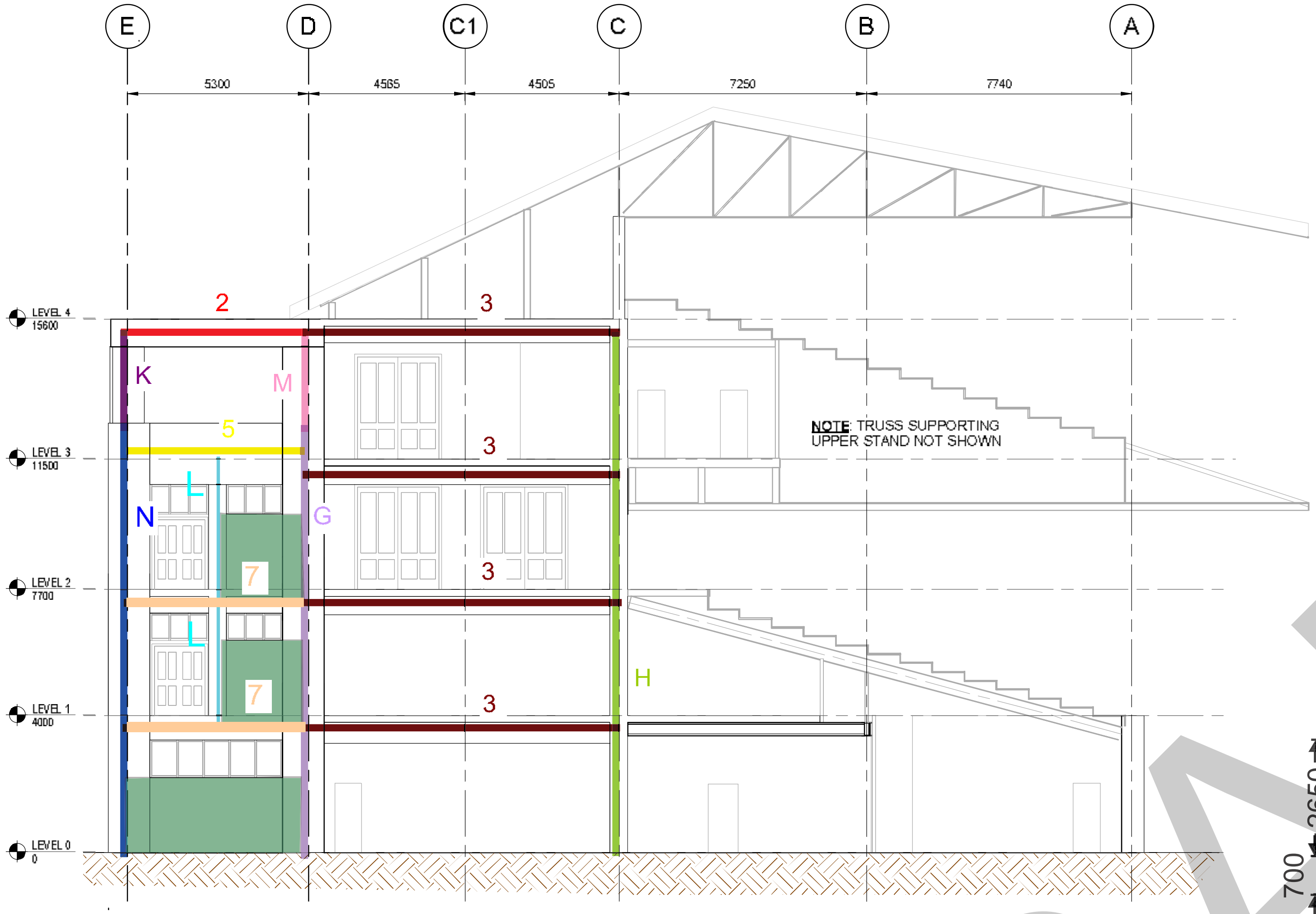
SHEET TITLE

FRAME IN GRID 4 ANALYTICAL MODEL

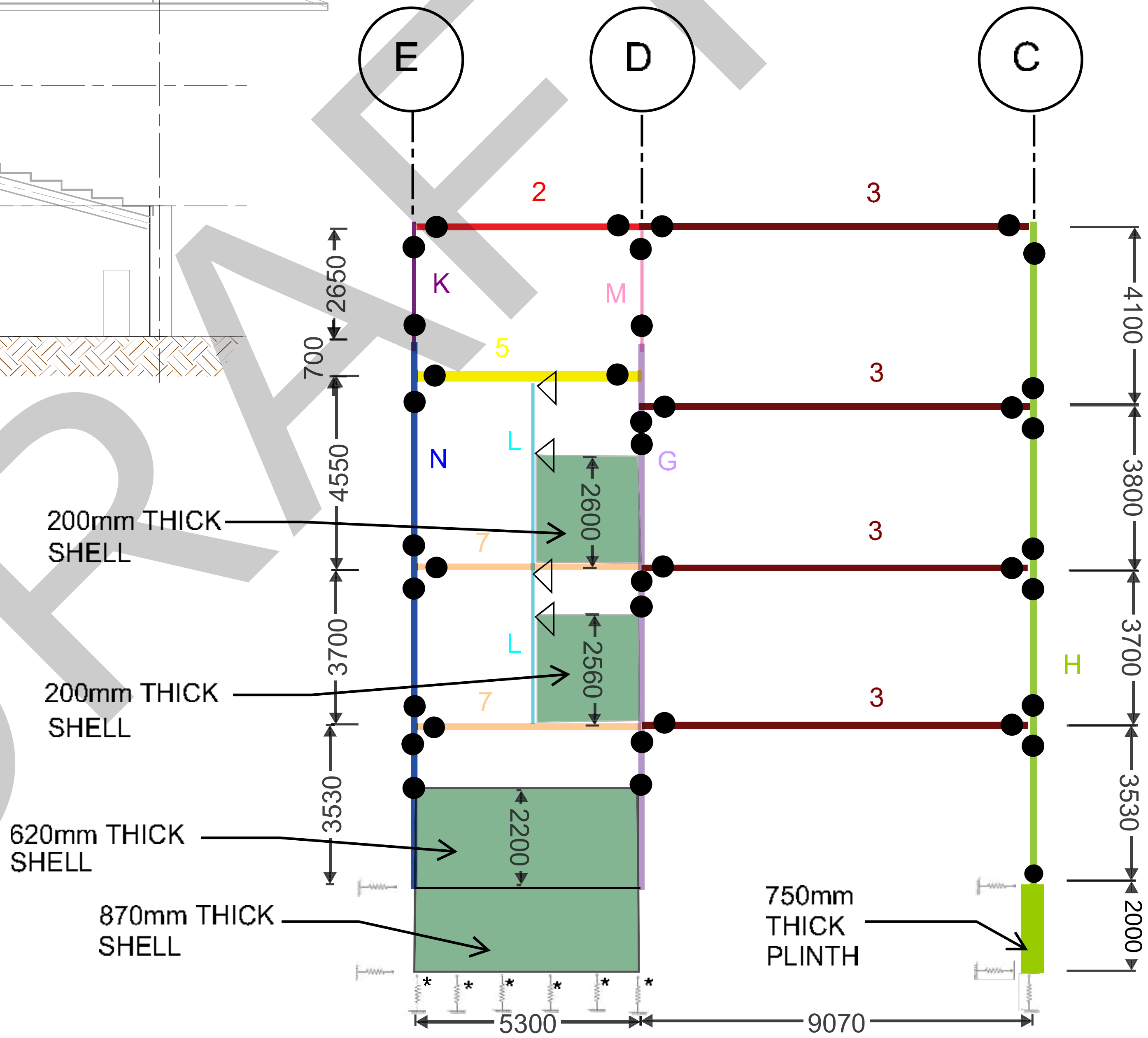
SHEET NUMBER

B.3

ISO A1 594mm x 841mm



ELEVATION



ANALYTICAL MODEL

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PROJECT

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CANTERBURY JOCKEY CLUB, CHRISTCHURCH

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Key

● POTENTIAL PLASTIC HINGE LOCATION

SPRING SUPPORT

* SPRING SUPPORT WITH GAP ELEMENT

PROJECT MANAGEMENT INITIALS

DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

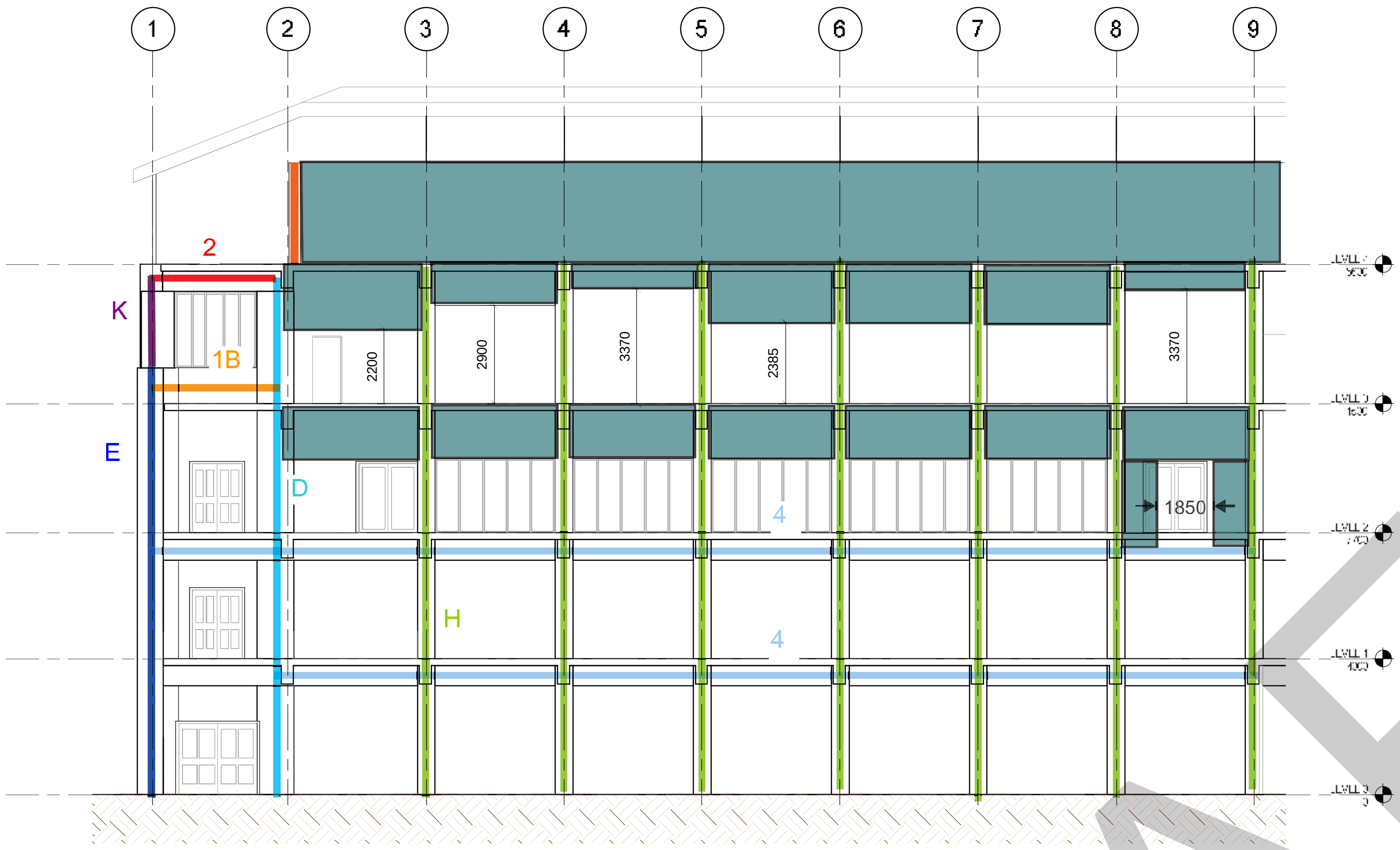
SHEET TITLE

FRAME IN GRID 13 ANALYTICAL MODEL

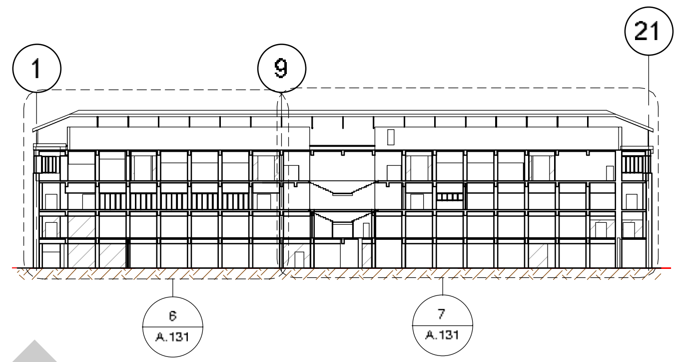
SHEET NUMBER

B.4

ISO A1 594mm x 841mm



6 SECTION ON GRID C - GRID 1 TO GRID 9
A.131 REF: A.131 Scale: 1 : 100



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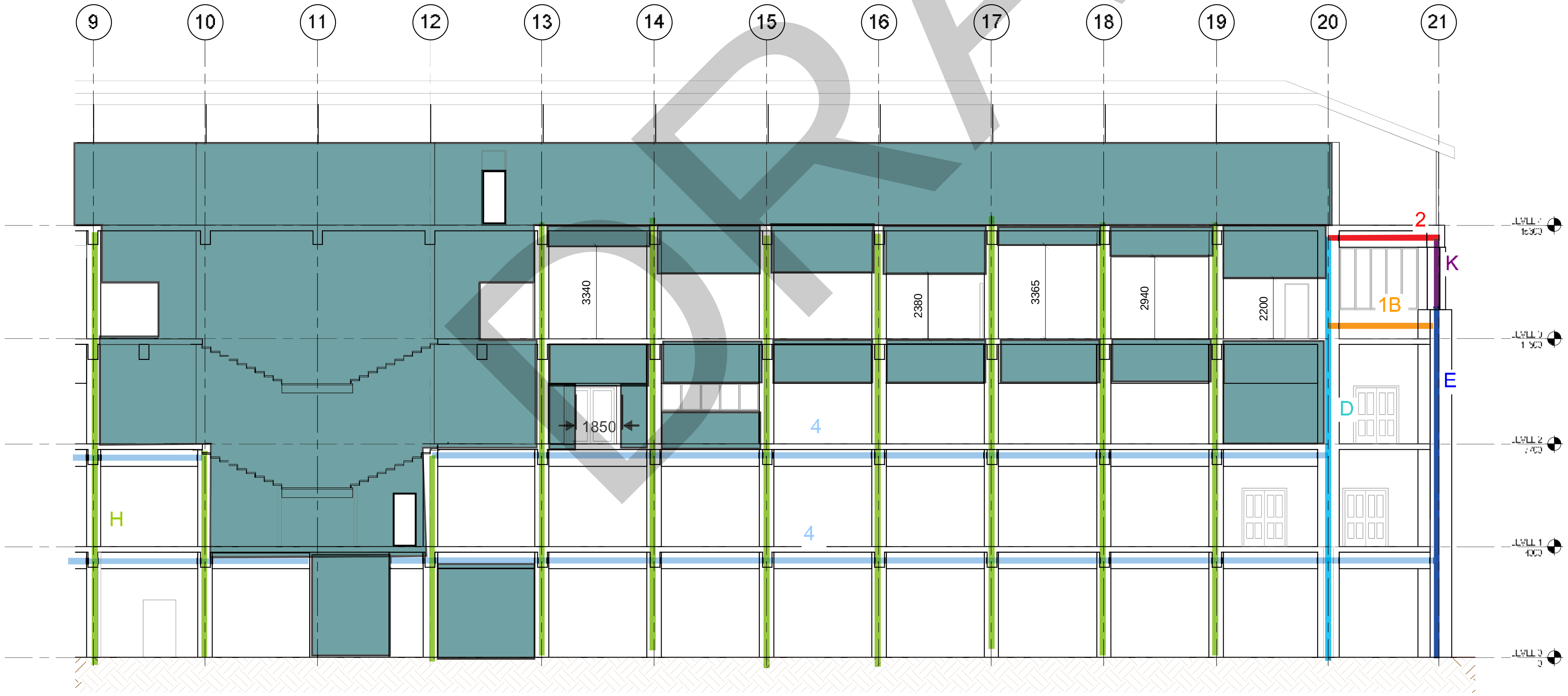

7 SECTION ON GRID C - GRID 9 TO 21
A.131 REF: A.131 Scale: 1 : 100

DRAFT

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Key

SPRING SUPPORT

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NR	MF	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

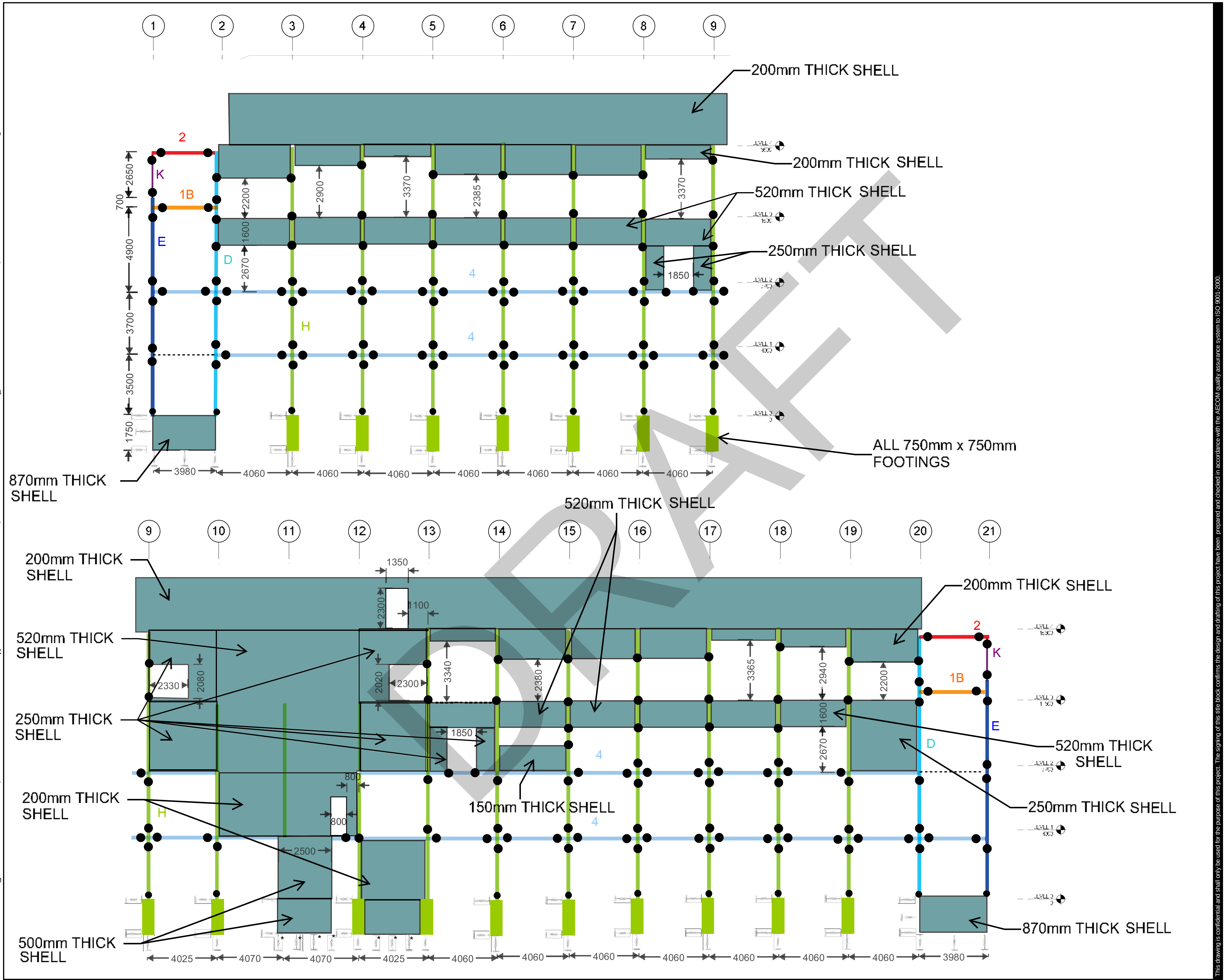
I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER
60332326

SHEET TITLE
FRAME IN GRID C

SHEET NUMBER
B.5



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Key
- ● POTENTIAL PLASTIC HINGE LOCATION
- SPRING SUPPORT
- * SPRING SUPPORT WITH GAP ELEMENT

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ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER
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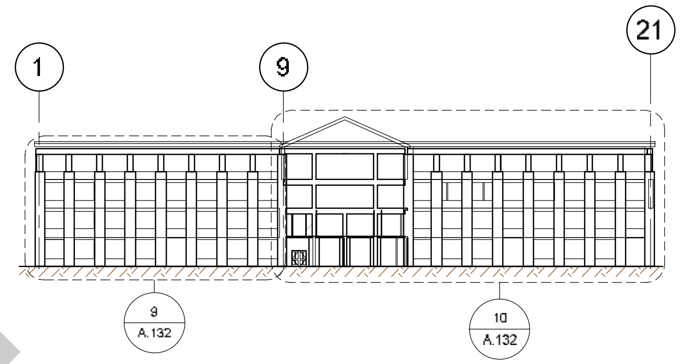
SHEET TITLE
FRAME IN GRID C ANALYTICAL MODEL

SHEET NUMBER
B.6

ISO A1 594mm x 841mm

9 | SECTION ON GRID D - GRID 1 TO GRID 9
A.132 | REF: A.132 Scale: 1 : 100



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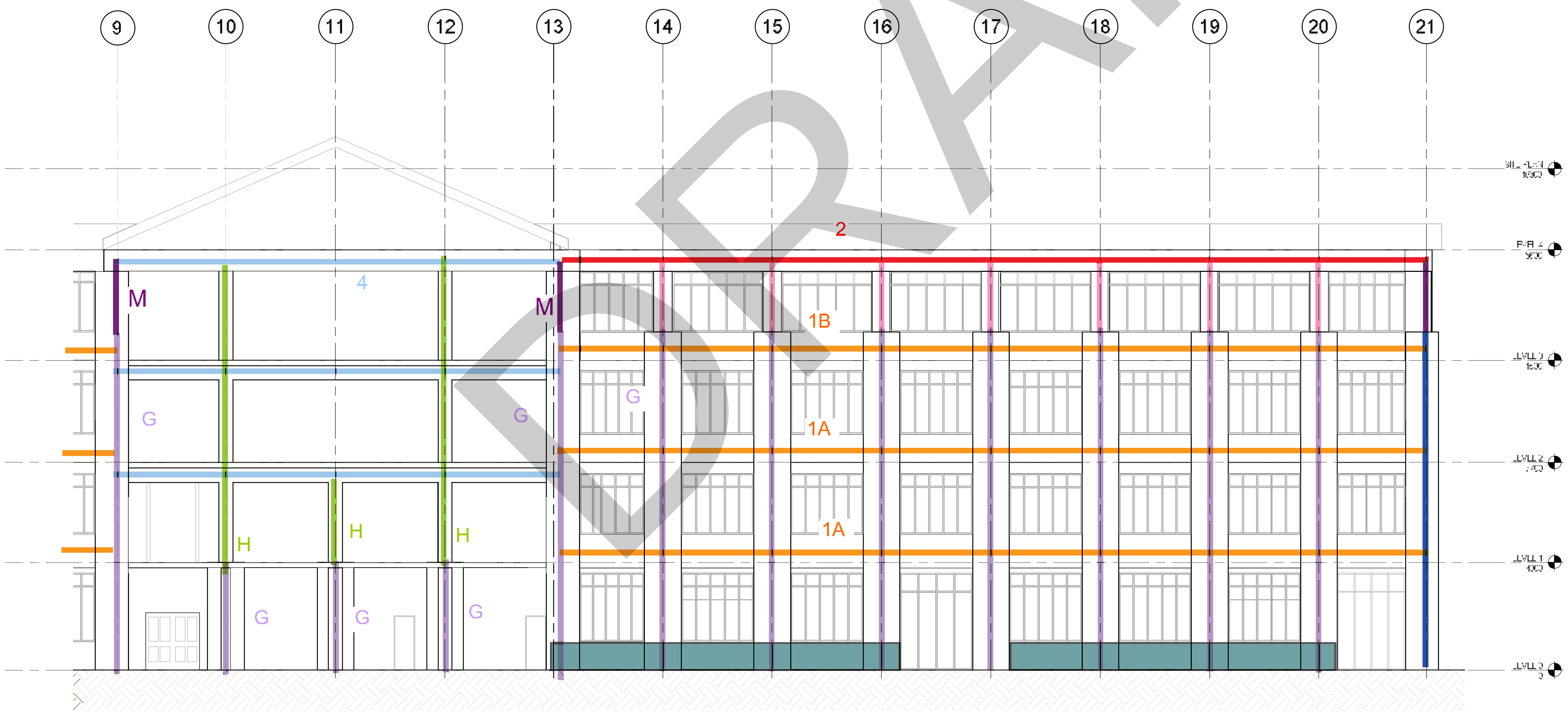

10 | SECTION ON GRID D - GRID 9 TO GRID 21
A.132 | REF: A.132 Scale: 1 : 100

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Key

SPRING SUPPORT

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DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

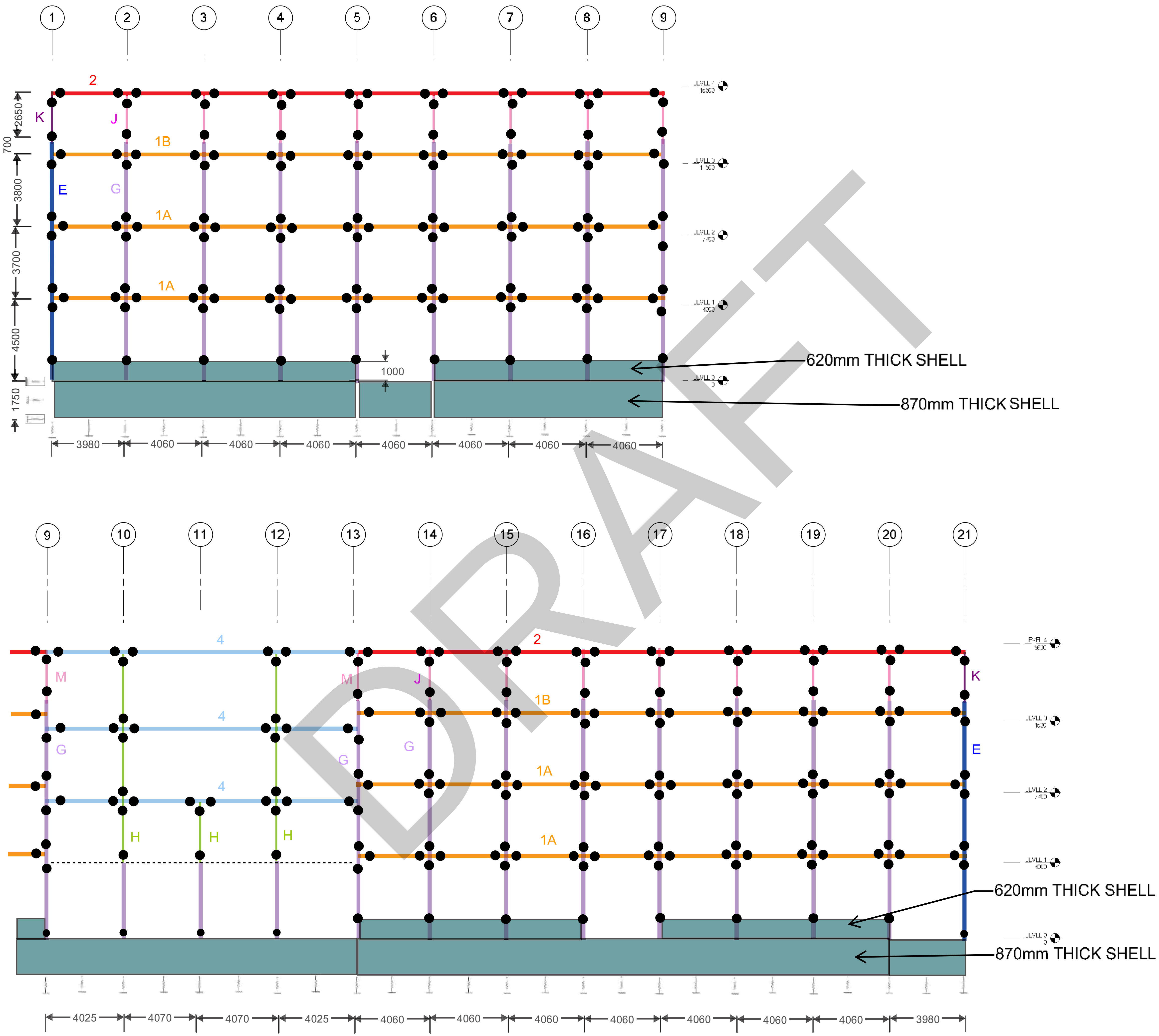
SHEET TITLE

FRAME IN GRID D

SHEET NUMBER

B.7

ISO A1 594mm x 841mm



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Key

● POTENTIAL PLASTIC HINGE LOCATION

SPRING SUPPORT

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I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

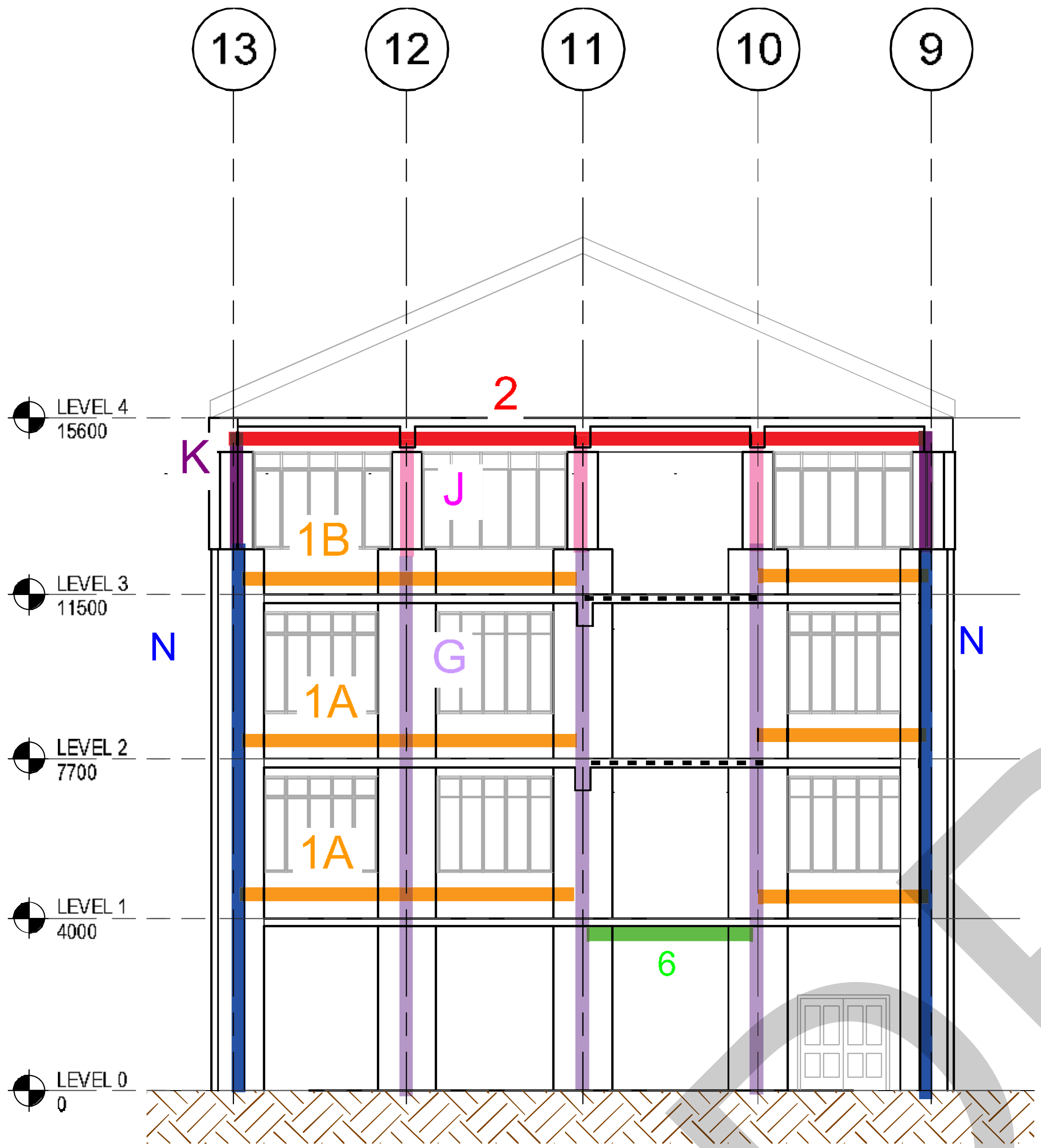
60332326

SHEET TITLE

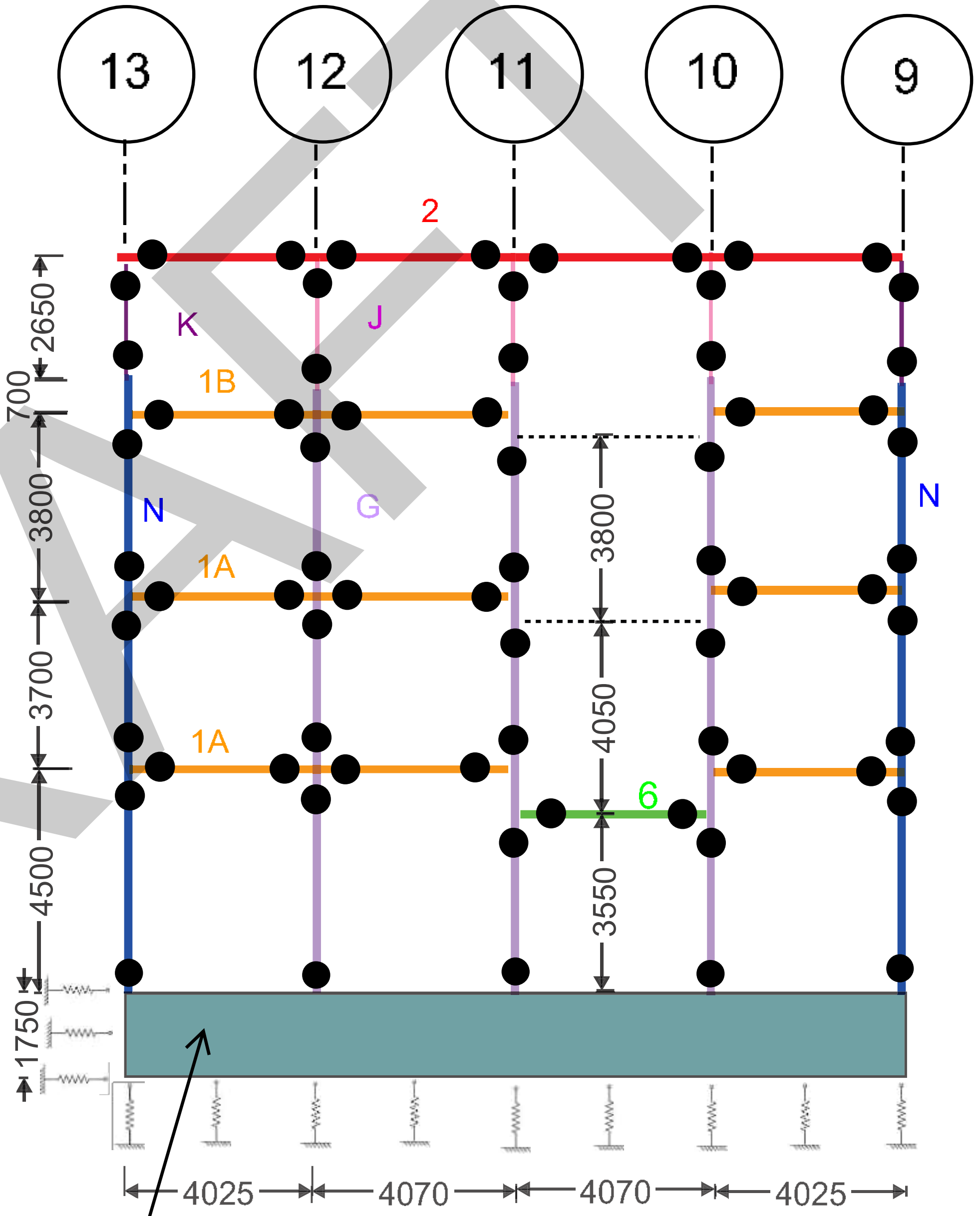
FRAME IN GRID D ANALYTICAL MODEL

SHEET NUMBER

B.8



ELEVATION



ANALYTICAL MODEL

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Key

- POTENTIAL PLASTIC HINGE LOCATION
- SPRING SUPPORT
- SLAB

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KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

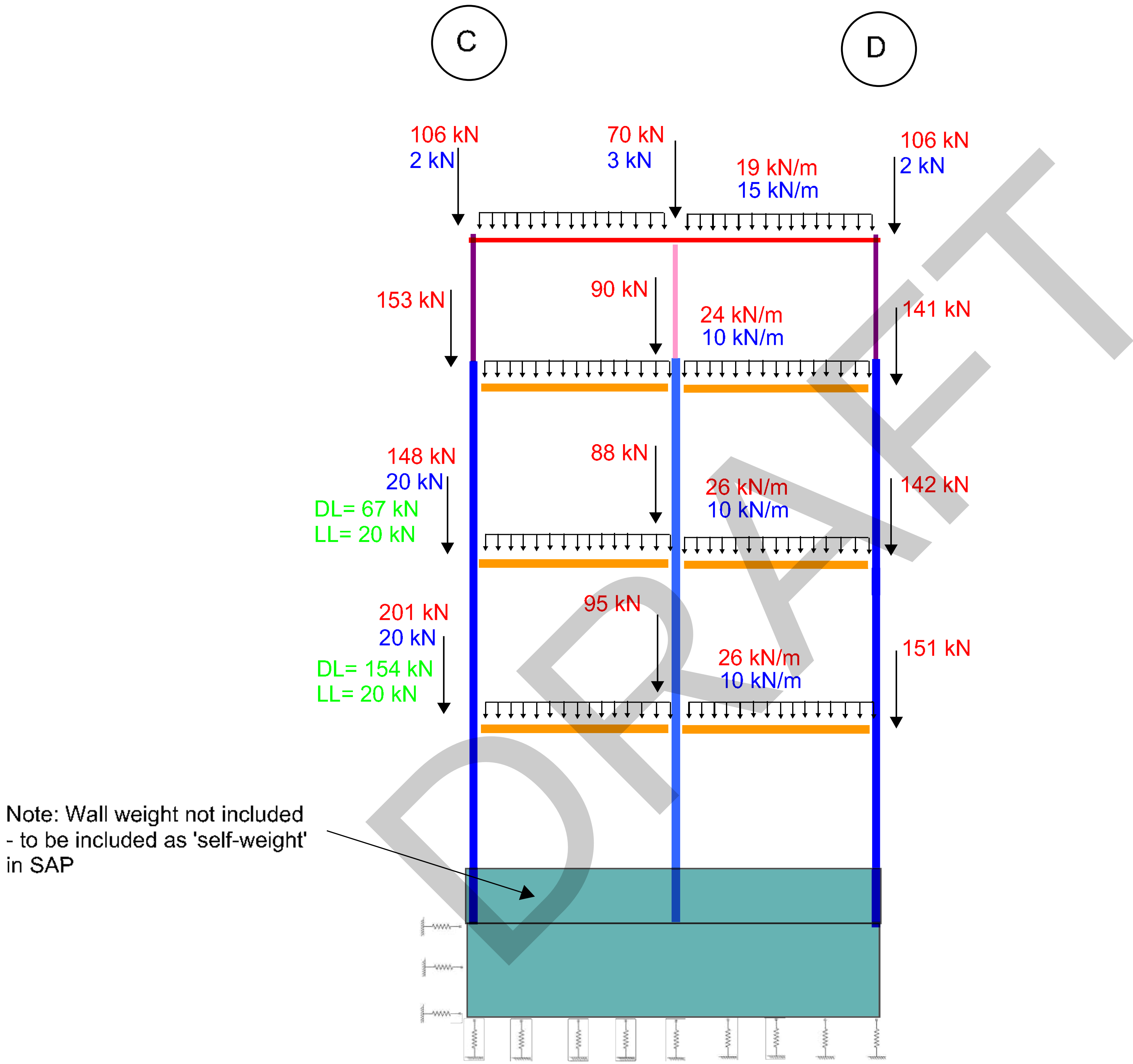
FRAME IN GRID E ANALYTICAL MODEL

SHEET NUMBER

B.9

Appendix C

Frames load diagrams



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DEAD LOAD

LIVE LOAD

ADDITIONAL SEISMIC MASS

PROJECT MANAGEMENT INITIALS

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KEY PLAN

PROJECT NUMBER

60332326

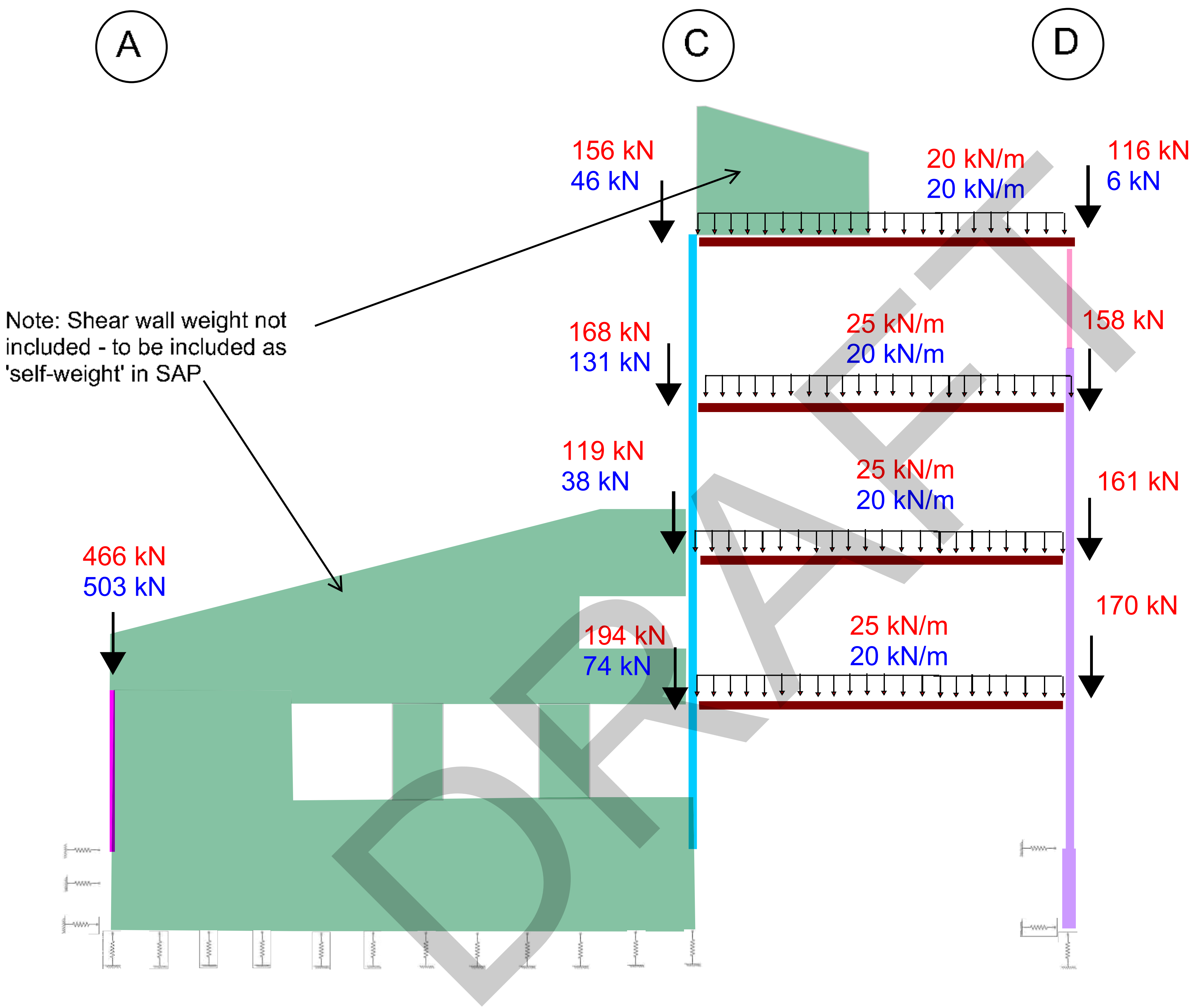
SHEET TITLE

FRAME IN GRID 1 ANALYTICAL MODEL

SHEET NUMBER

C.1

ISO A1 594mm x 841mm



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DEAD LOAD

LIVE LOAD

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KEY PLAN

PROJECT NUMBER

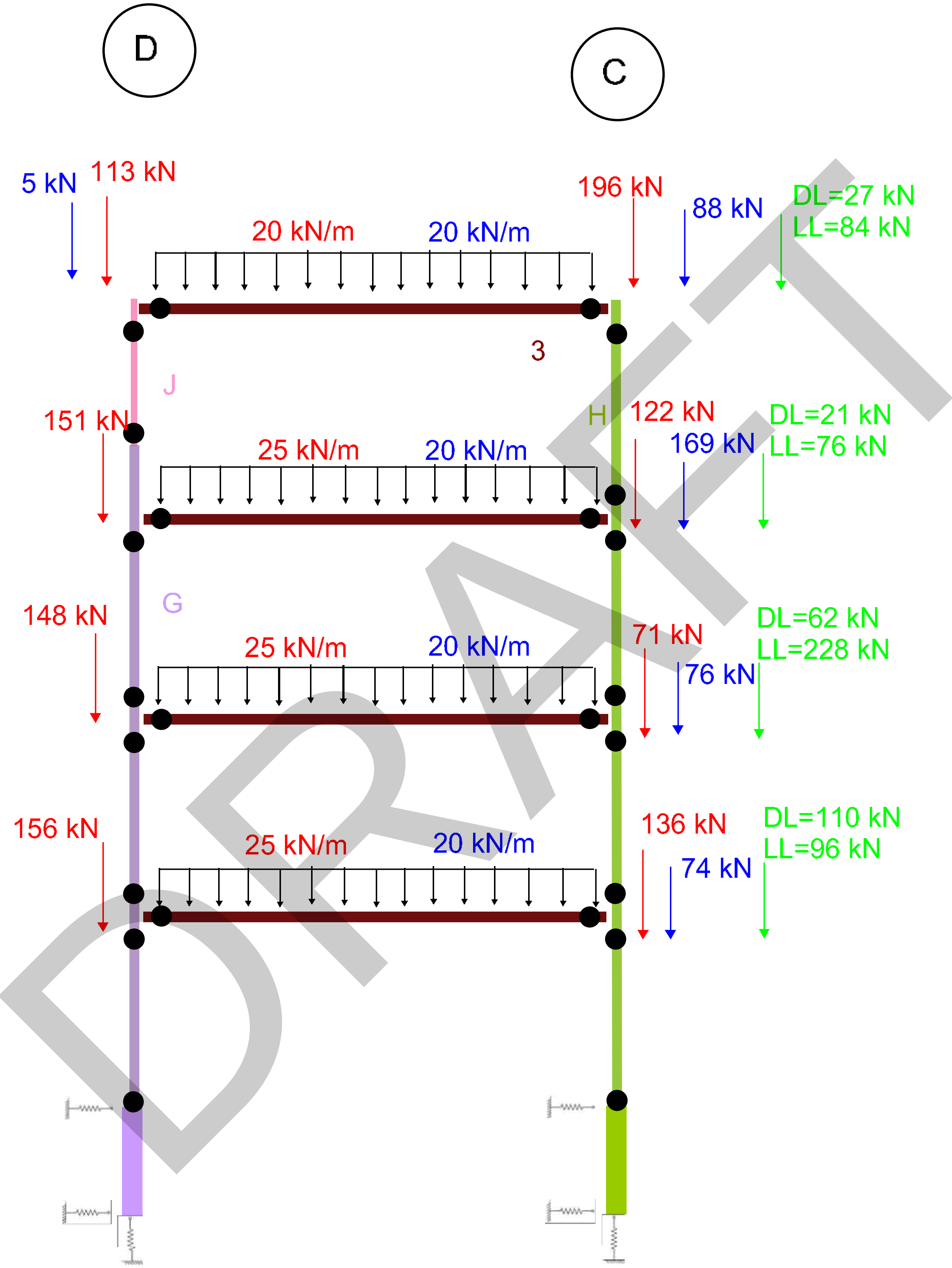
60332326

SHEET TITLE

FRAME IN GRID 2 ANALYTICAL MODEL

SHEET NUMBER

C.2



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LIVE LOAD

DEAD LOAD

ADDITIONAL SEISMIC MASS

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KEY PLAN

PROJECT NUMBER

60332326

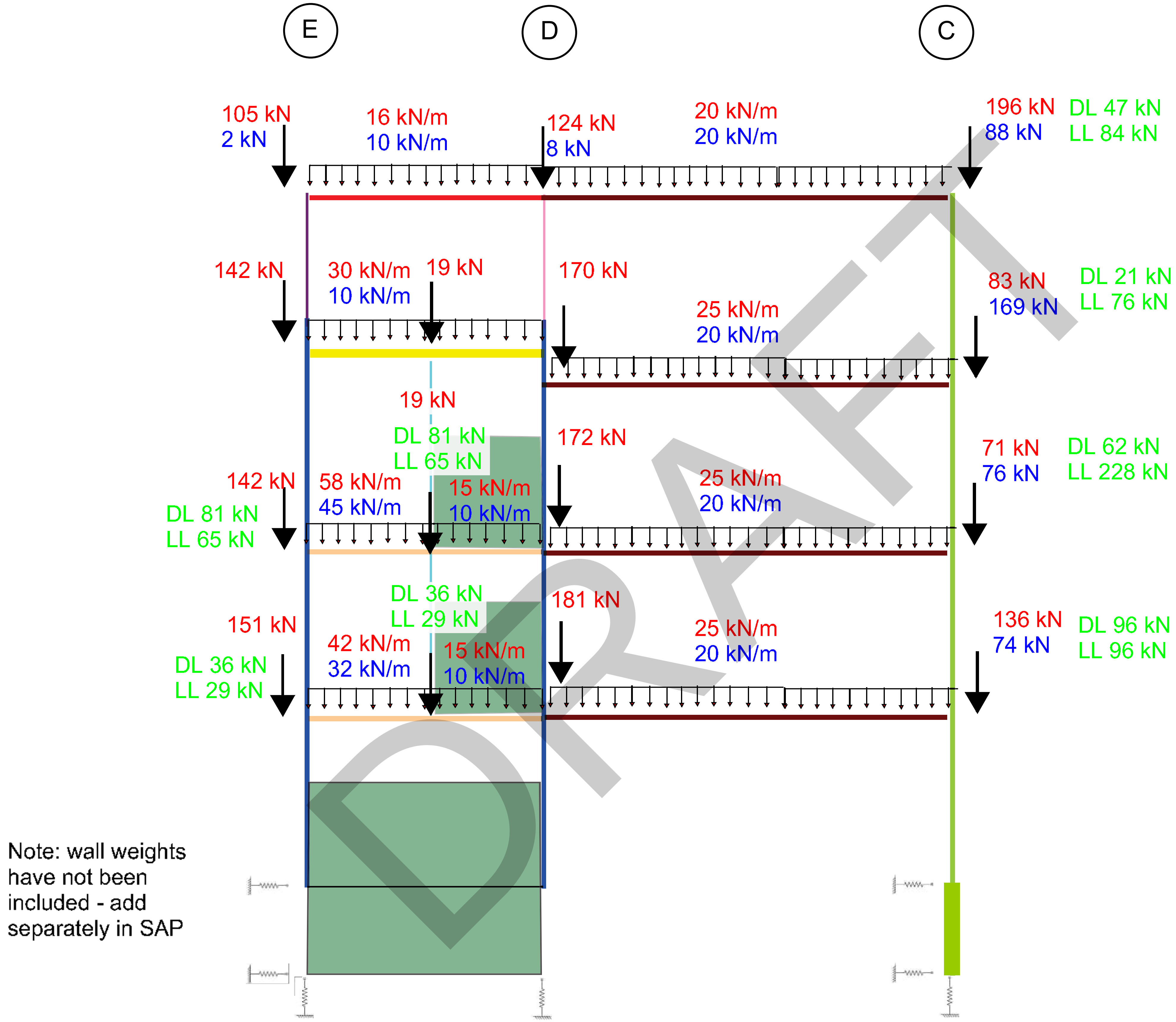
SHEET TITLE

LOADS ON GRID 4

SHEET NUMBER

C.3

ISO A1 594mm x 841mm



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Key

DEAD LOAD

LIVE LOAD

ADDITIONAL SEISMIC WEIGHT

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I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

FRAME IN GRID 13 ANALYTICAL MODEL

SHEET NUMBER

C.4

DEAD LOAD

LIVE LOAD

ADDITIONAL SEISMIC MASS

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PROJECT NUMBER

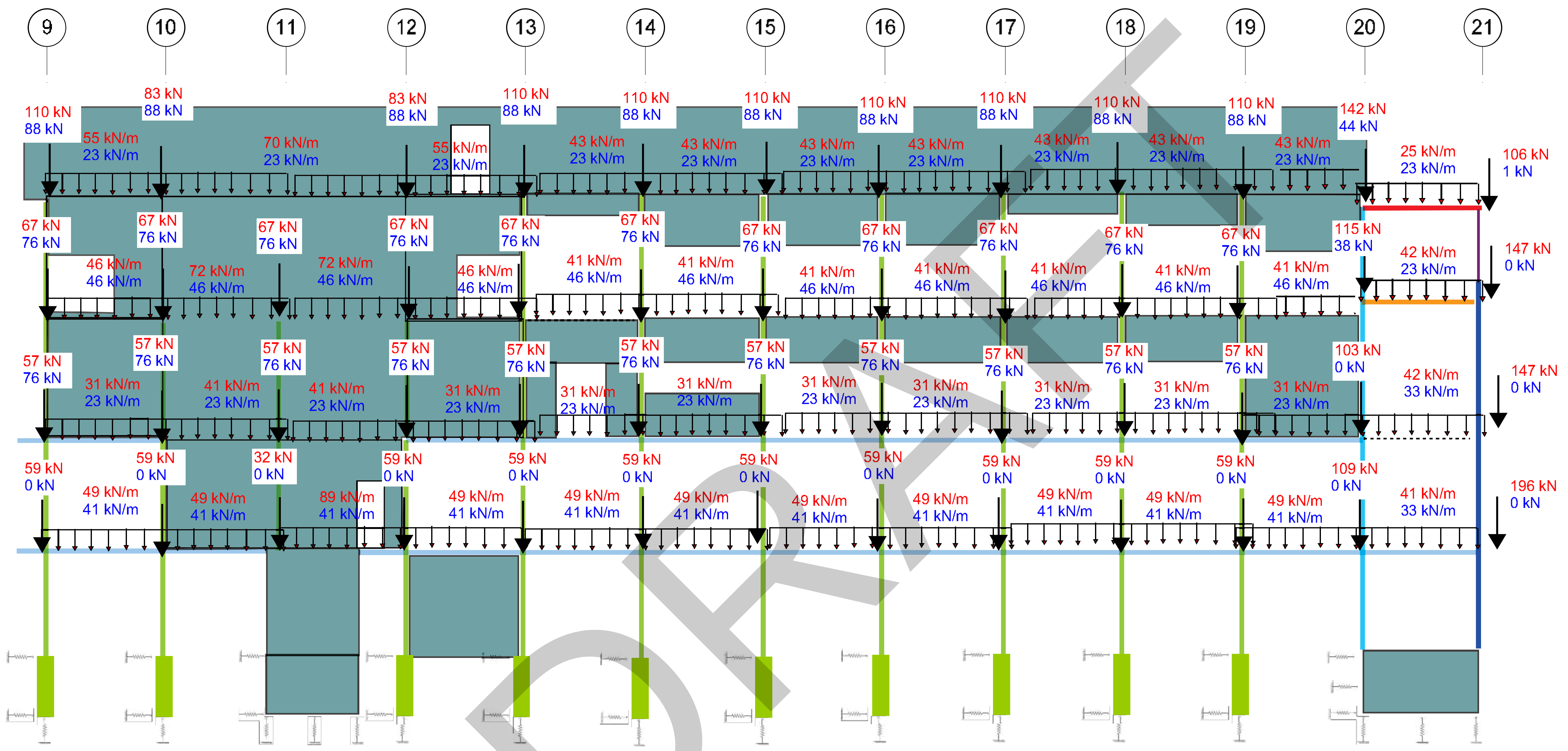
60332326

SHEET TITLE

FRAME IN GRID C ANALYTICAL MODEL

SHEET NUMBER

C.5



DEAD LOAD

LIVE LOAD

ADDITIONAL SEISMIC MASS

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PROJECT NUMBER

60332326

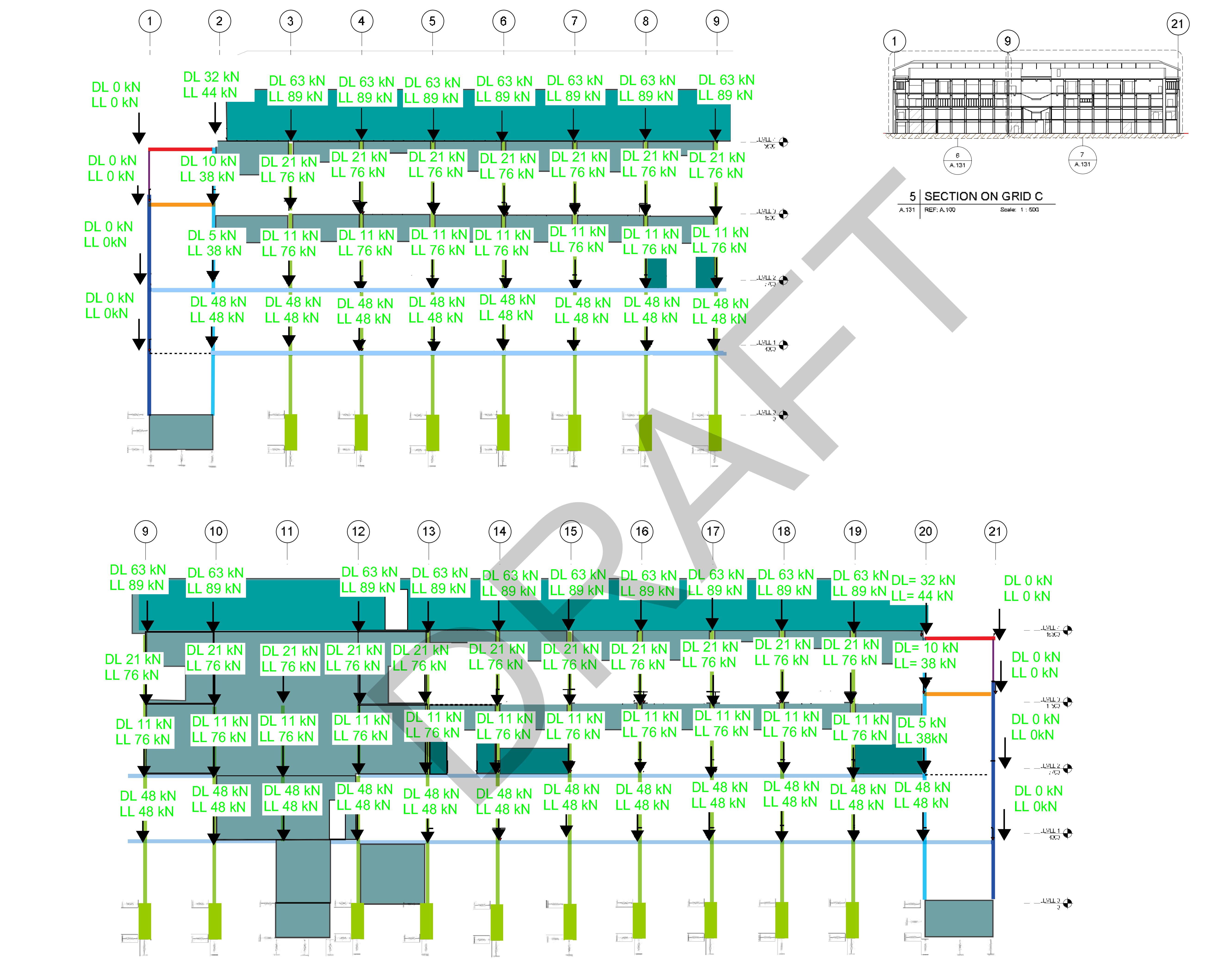
SHEET TITLE

FRAME IN GRID C ANALYTICAL MODEL

SHEET NUMBER

C.6

ISO A1 594mm x 841mm



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LIVE LOAD

ADDITIONAL SEISMIC MASS

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I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

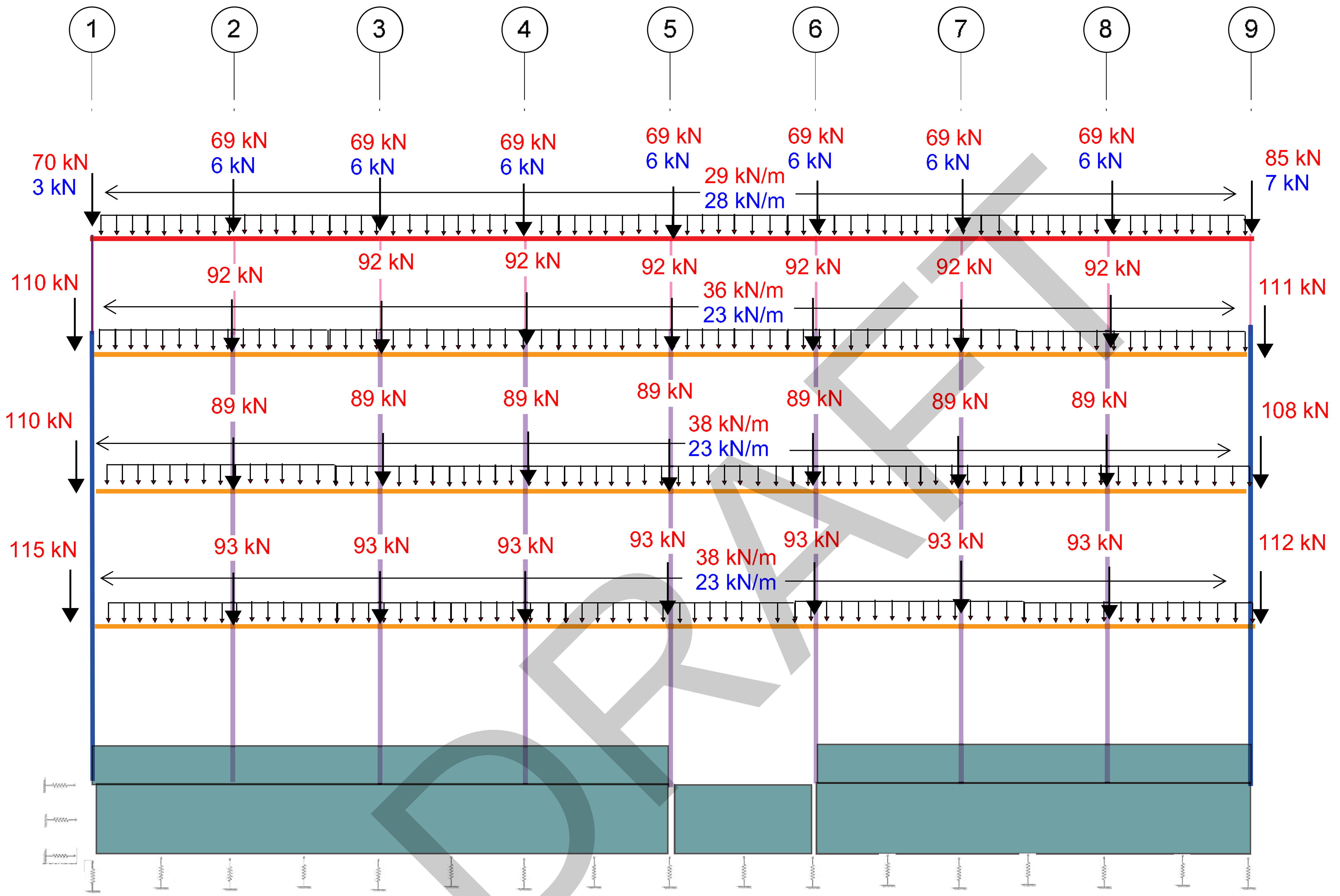
60332326

SHEET TITLE

FRAME IN GRID C ANALYTICAL MODEL

SHEET NUMBER

C.7



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DEAD LOAD

LIVE LOAD

ADDITIONAL SEISMIC MASS

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I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

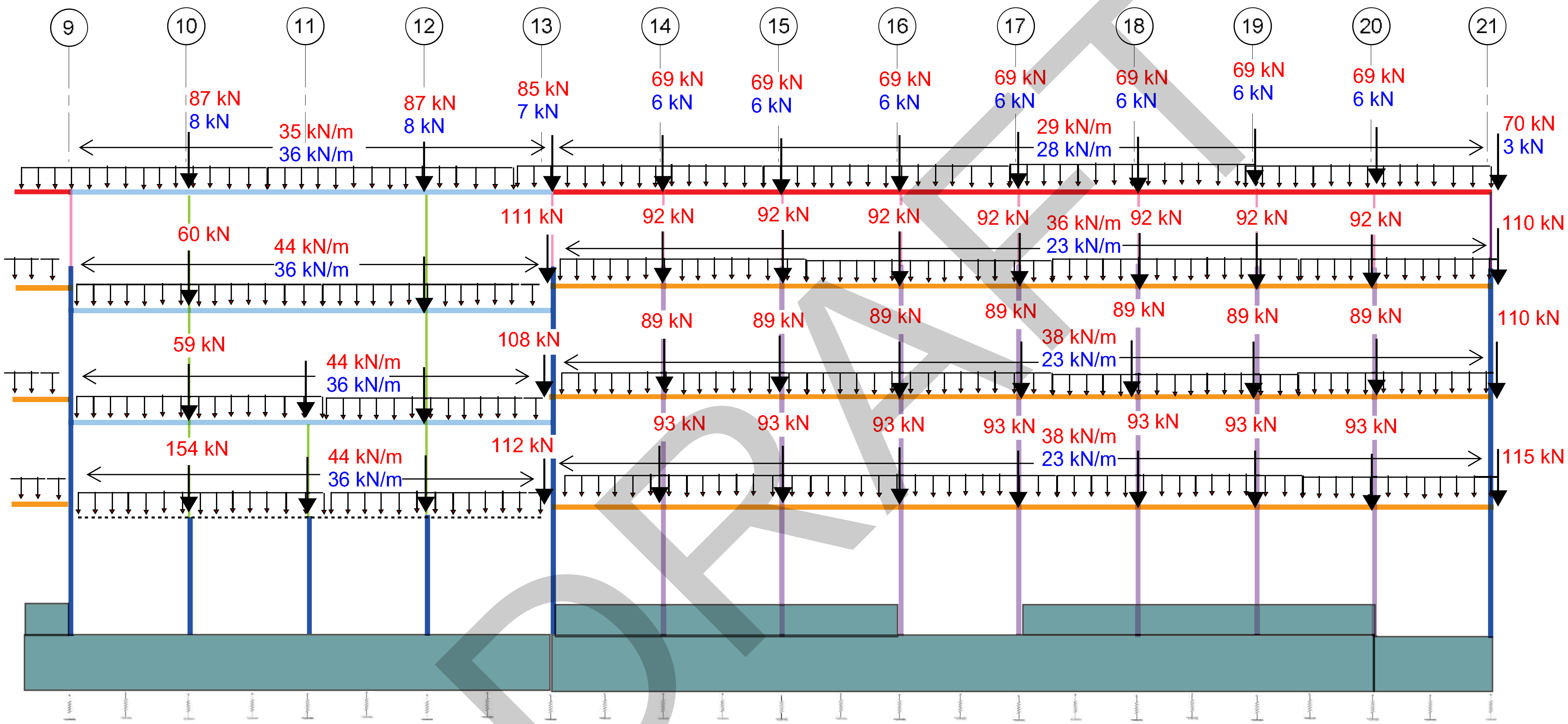
60332326

SHEET TITLE

FRAME IN GRID D ANALYTICAL MODEL

SHEET NUMBER

C.8



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CLIENT

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DEAD LOAD

LIVE LOAD

ADDITIONAL SEISMIC MASS

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I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

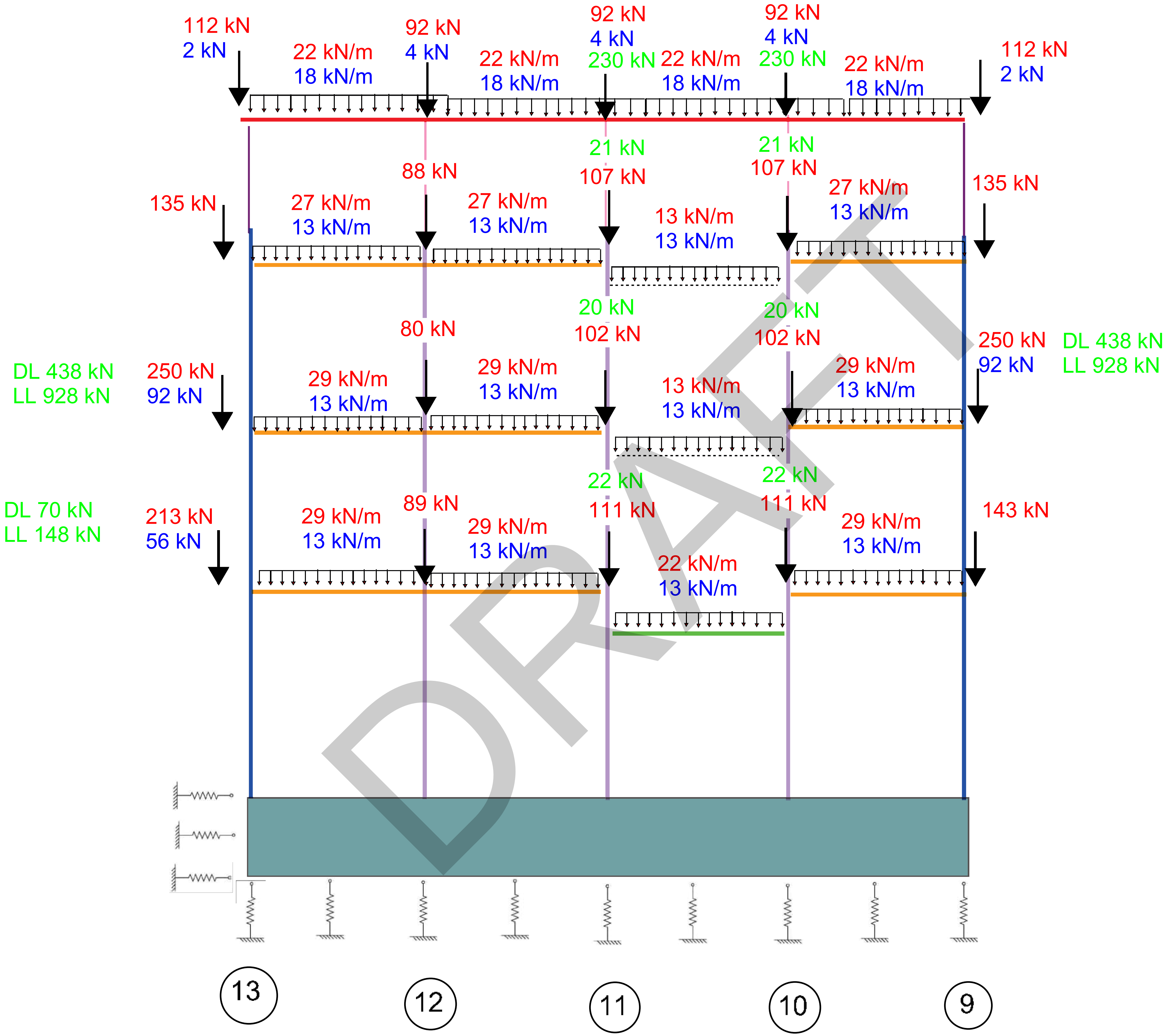
60332326

SHEET TITLE

FRAME IN GRID D ANALYTICAL MODEL

SHEET NUMBER

C.9



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DEAD LOAD

LIVE LOAD

ADDITIONAL SEISMIC MASS

PROJECT MANAGEMENT INITIALS

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ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

FRAME IN GRID E ANALYTICAL MODEL

SHEET NUMBER

C.10

D R A F T

Appendix C

Concept Strengthening Sketches

34%NBS concept strengthening option

EXISTING GROUND FLOOR

Scale: 1 : 150

Foundation works - 1600 x 750mm foundation wall

New columns and beams

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KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

34% Strengthening Plans Ground Level

SHEET NUMBER

60332326-DRG-C1

ISO A1 594mm x 841mm

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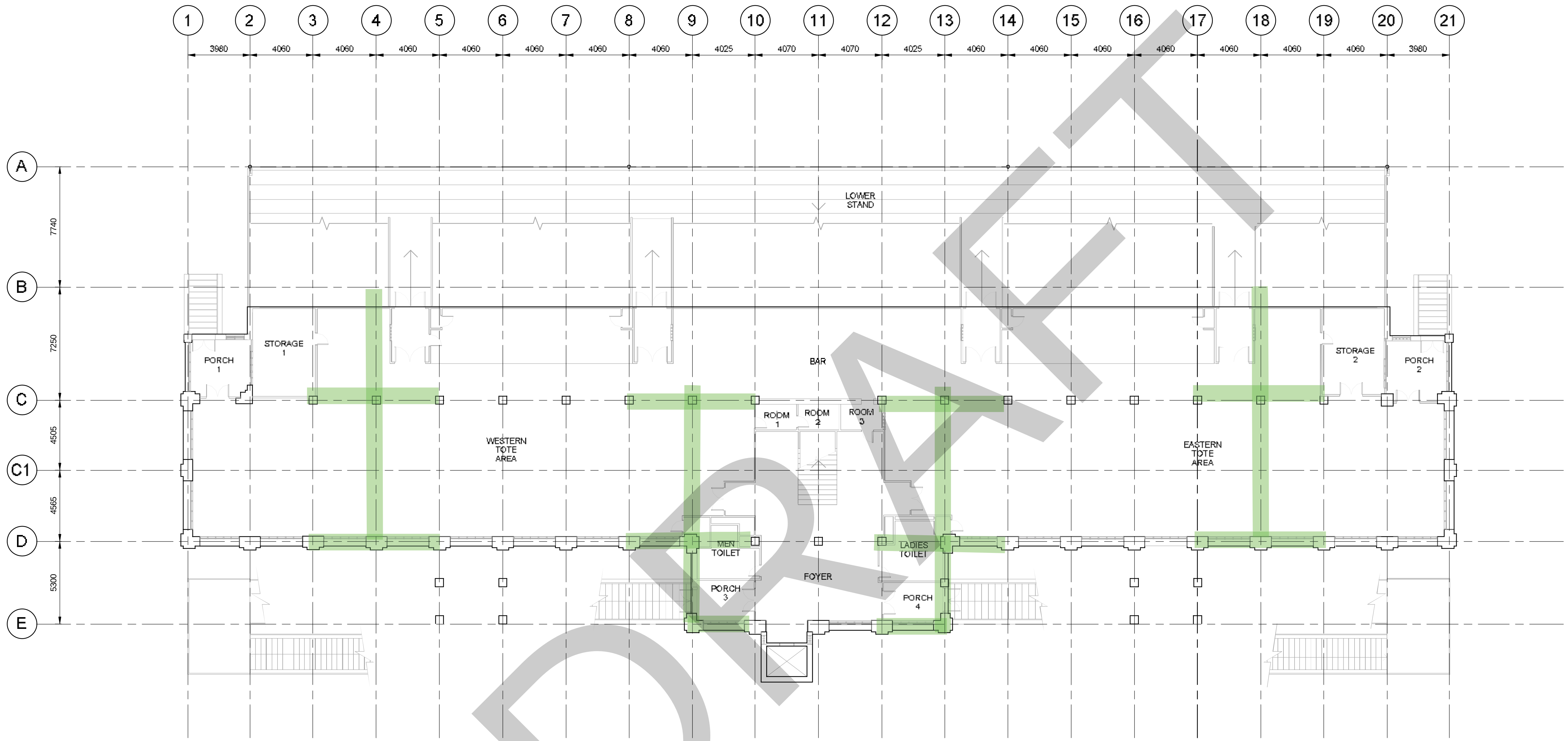
34%NBS concept strengthening option



EXISTING FLOOR 1

Scale: 1 : 150

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KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

34% Strengthening Plans Level 1 to 4

SHEET NUMBER

60332326-DRG-C2

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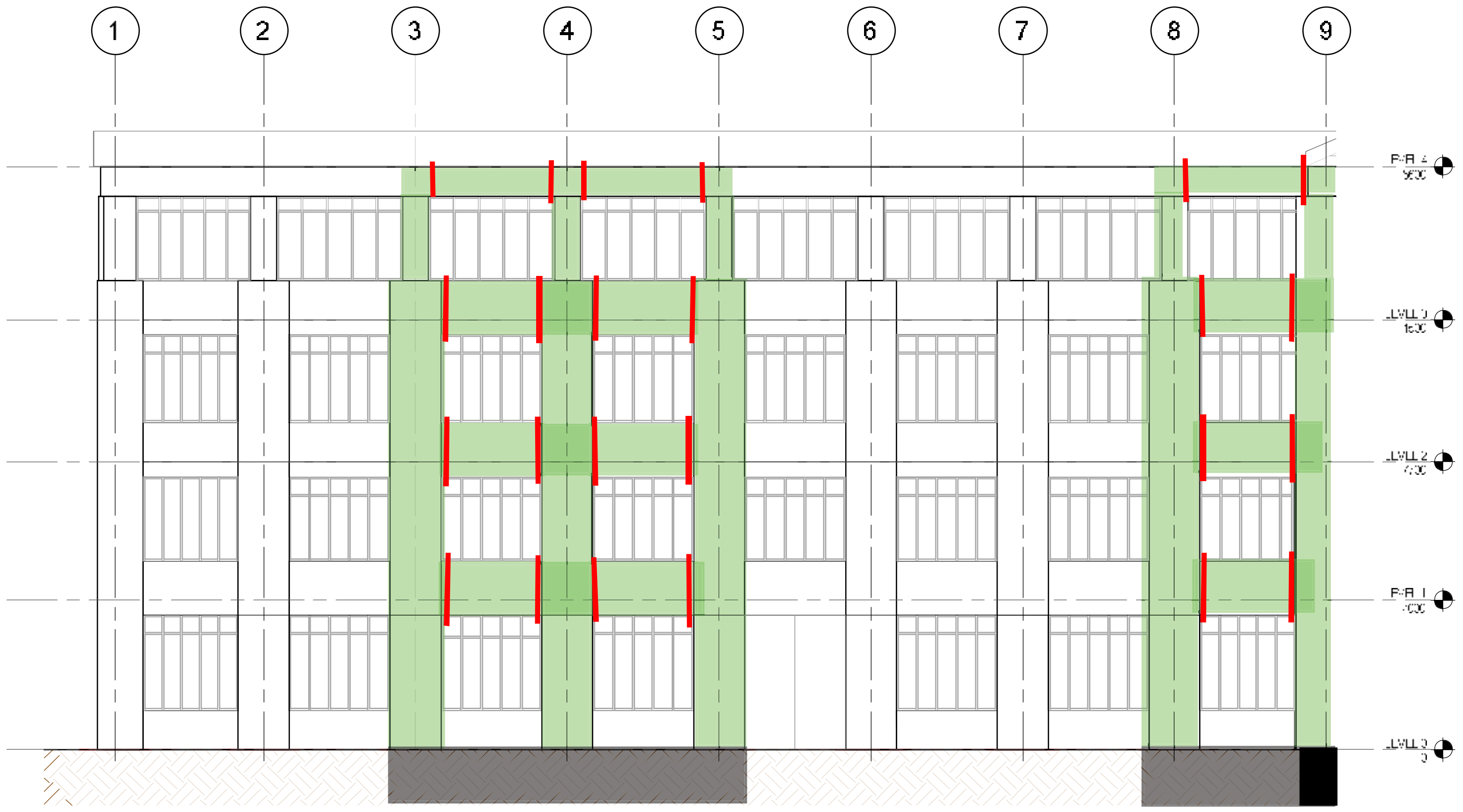

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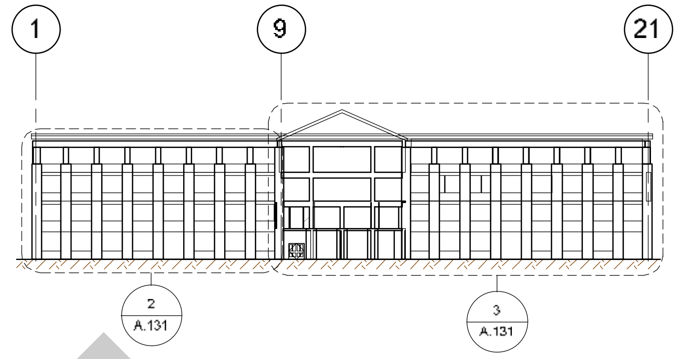


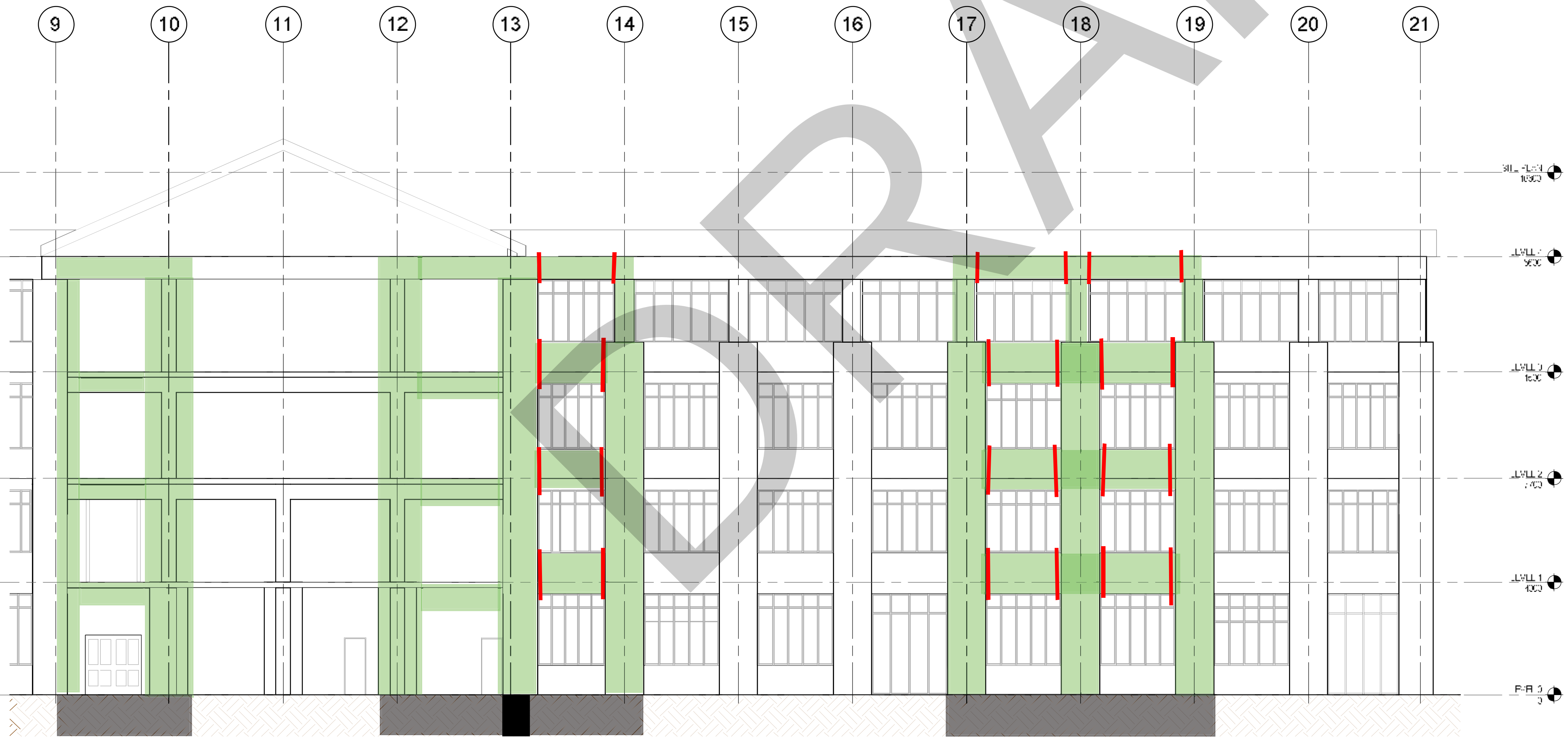
1 SECTION ON GRID D
A.131 REF: A.100 Scale: 1 : 500

34%NBS concept strengthening option

New columns and beams

Cut existing spandrel beam

Foundation wall 1600 x 750mm



3 SECTION ON GRID D - GRID 9 TO GRID 21
A.131 REF: A.131 Scale: 1 : 100

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KEY PLAN

PROJECT NUMBER
60332326

SHEET TITLE
34% Strengthening Plans
Grid D

SHEET NUMBER
60332326-DRG-C3

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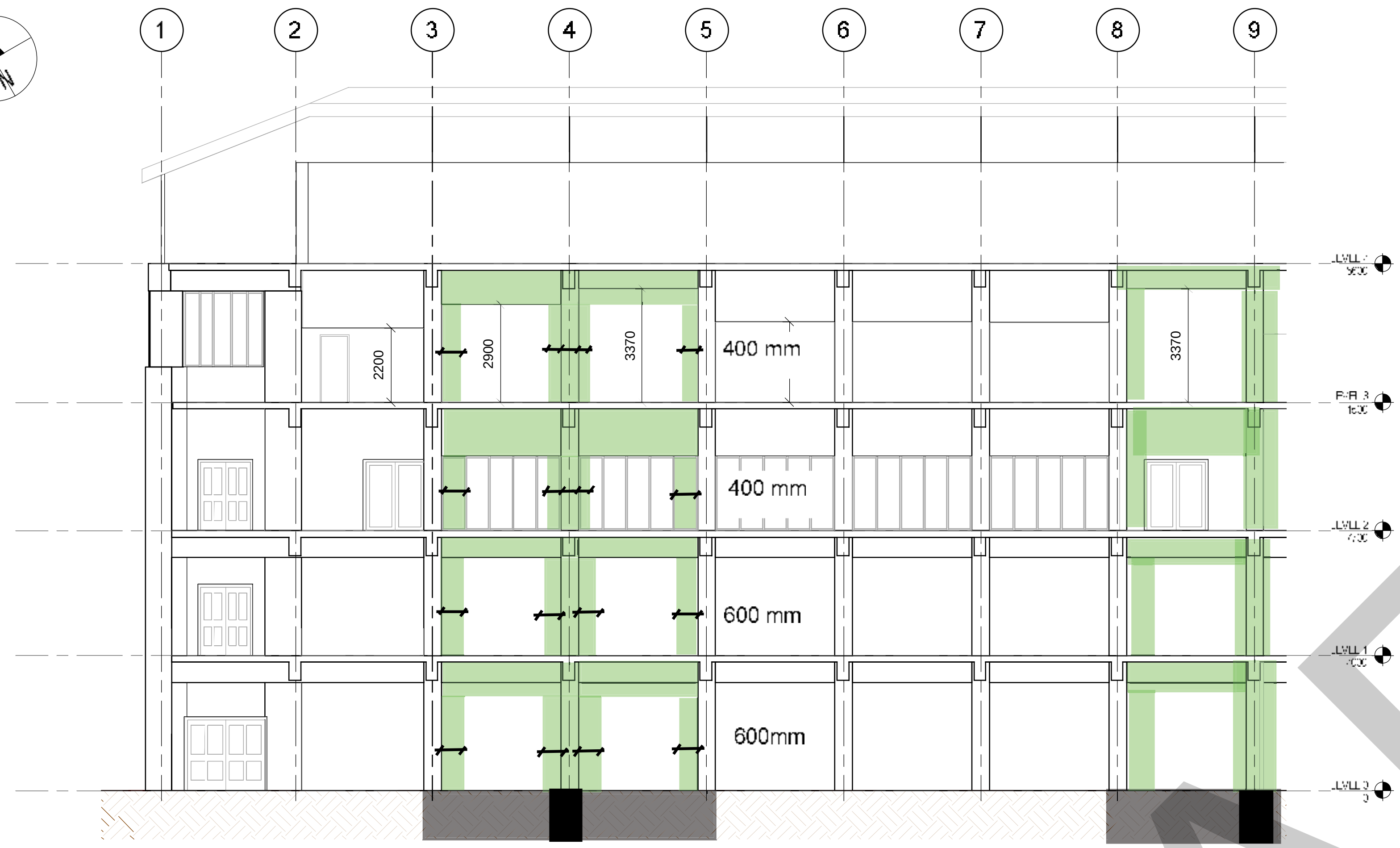

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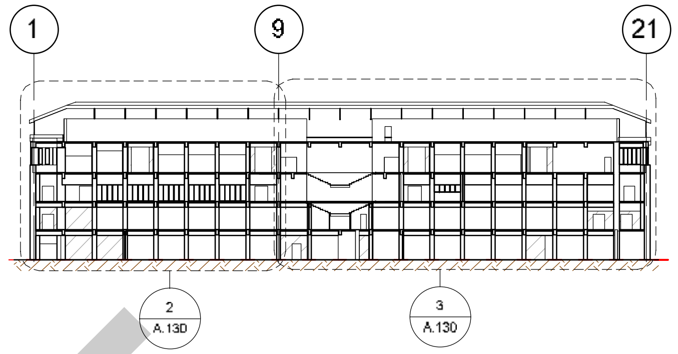
A.130 REF: A.130 Scale: 1 : 100



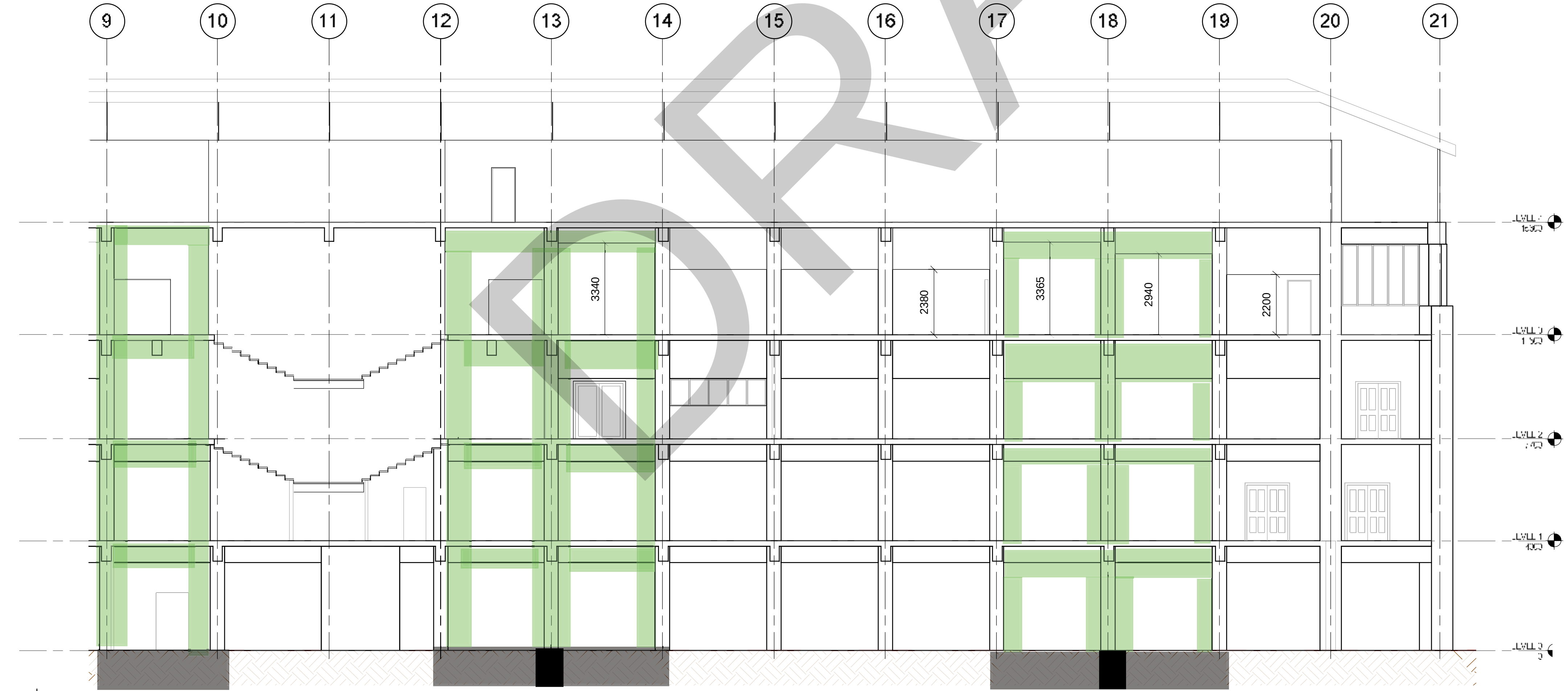
1 SECTION ON GRID C

A.130 REF: A.100 Scale: 1 : 500

34%NBS concept strengthening option

New columns and beams

Foundation wall 1600 x 750mm



3 SECTION ON GRID C - GRID 9 TO 21

A.130 REF: A.130 Scale: 1 : 100

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Prepared for:

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KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

34% Strengthening Plans
Grid C

SHEET NUMBER

60332326-DRG-C4

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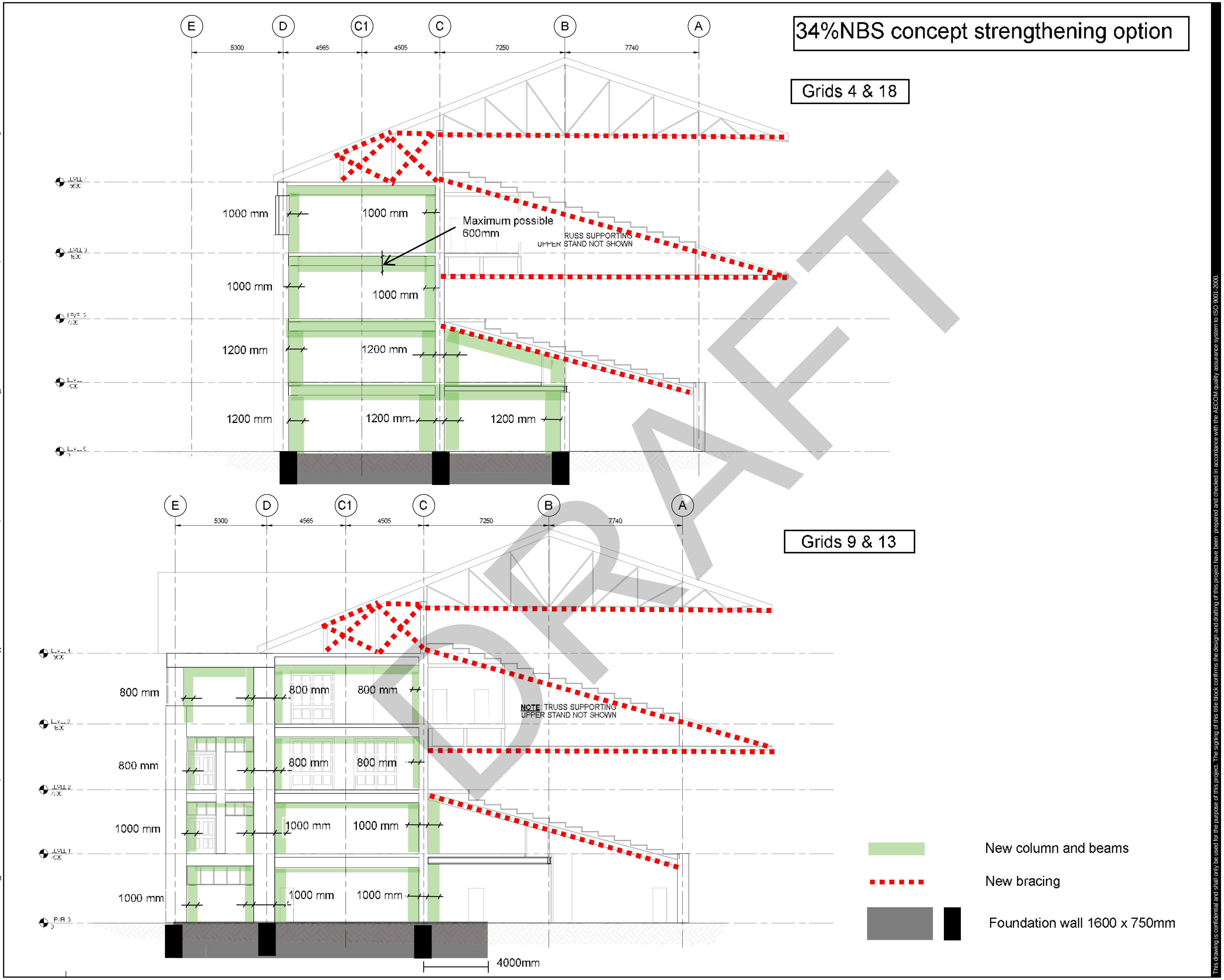

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KEY PLAN

PROJECT NUMBER

60332326

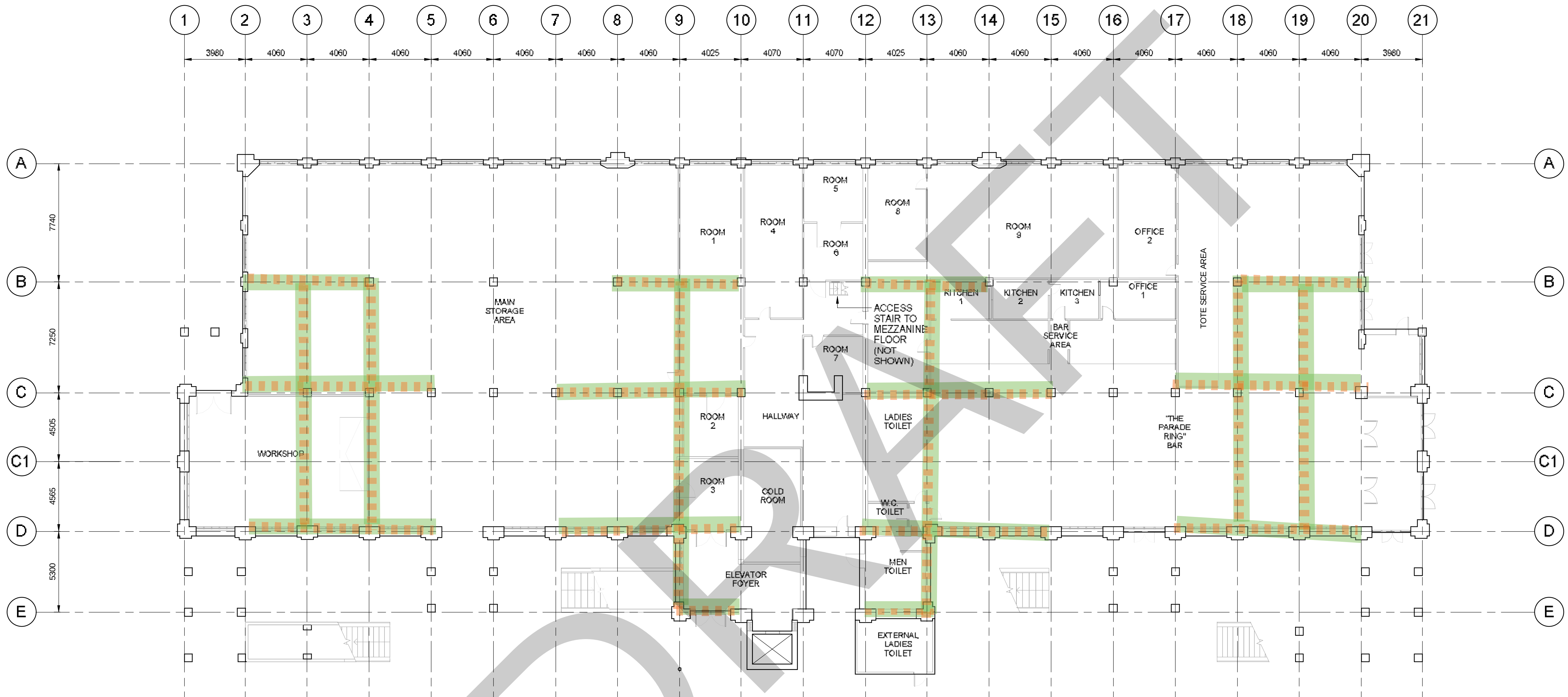
SHEET TITLE

34% Strengthening Plans
Grid 4 & 13

SHEET NUMBER

60332326-DRG-C5

67%NBS concept strengthening option



EXISTING GROUND FLOOR

Scale: 1 : 150

Foundation works - 1800 x 750mm foundation wall

New columns and beams

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PROJECT

STRUCTURAL ASSESSMENT GRAND NATIONAL STAND

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT

CANTERBURY JOCKEY CLUB

CONSULTANT

AECOM New Zealand Limited
2 Hazeldean Rd, Addington
Christchurch, NZ 8024
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www.aecom.com

PROJECT MANAGEMENT INITIALS

CO	MF	CT
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

67% Strengthening Plans Ground Level

SHEET NUMBER

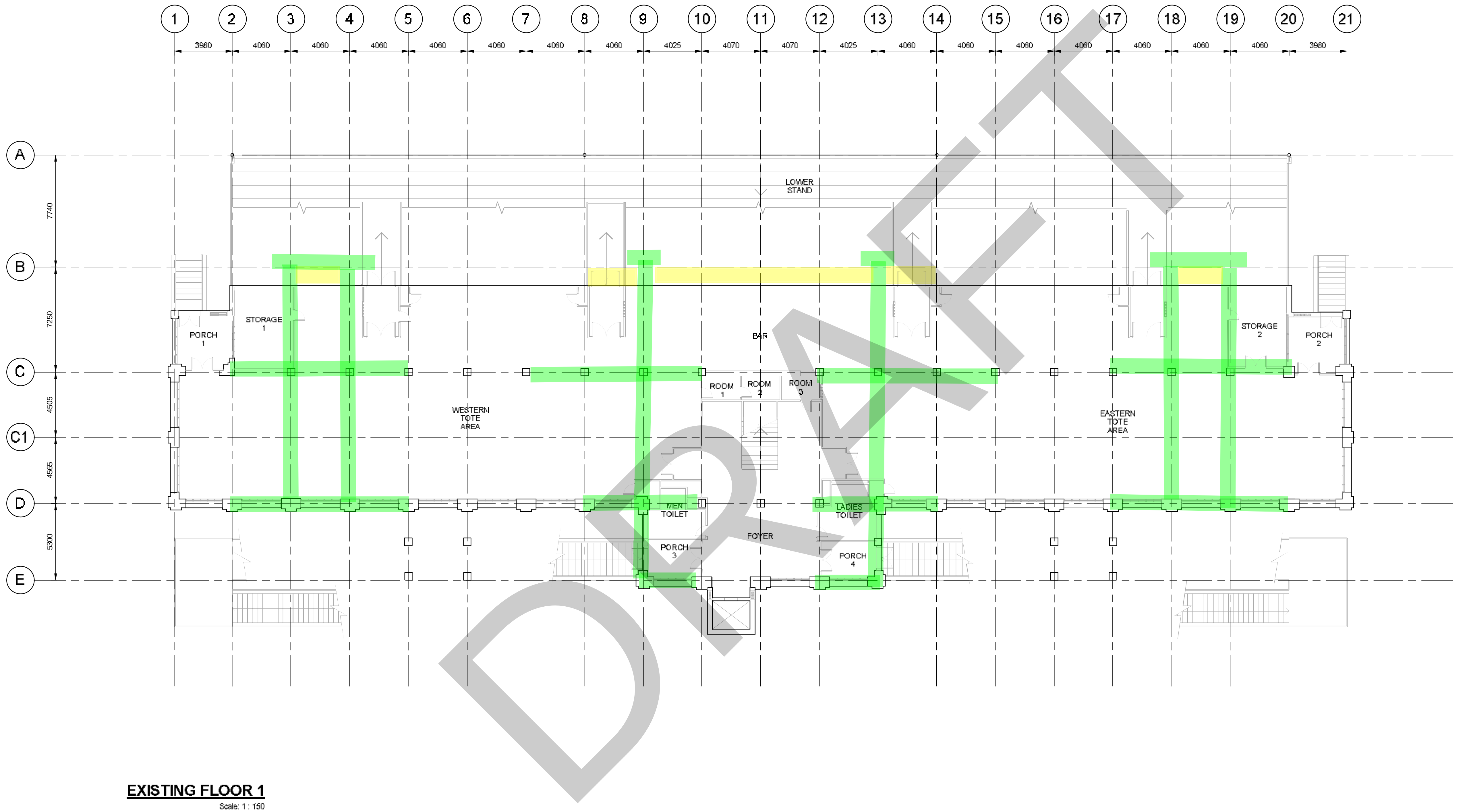
60332326-DRG-C6

ISO A1 594mm x 841mm

Last Saved: 23/07/2015 9:19:57 a.m.
Filename: C:\Users\pettic\Desktop\60332326_MOD_ST_2014_PettiC(Recovery).rvt

ISO A1 594mm x 841mm

67%NBS concept strengthening option



EXISTING FLOOR 1

Scale: 1 : 150

New columns and beams

New slab

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PROJECT NUMBER

60332326

SHEET TITLE

67% Strengthening Plans Level 1 to 4

SHEET NUMBER

60332326-DRG-C7

Last Saved: 23/07/2015 9:19:58 a.m.
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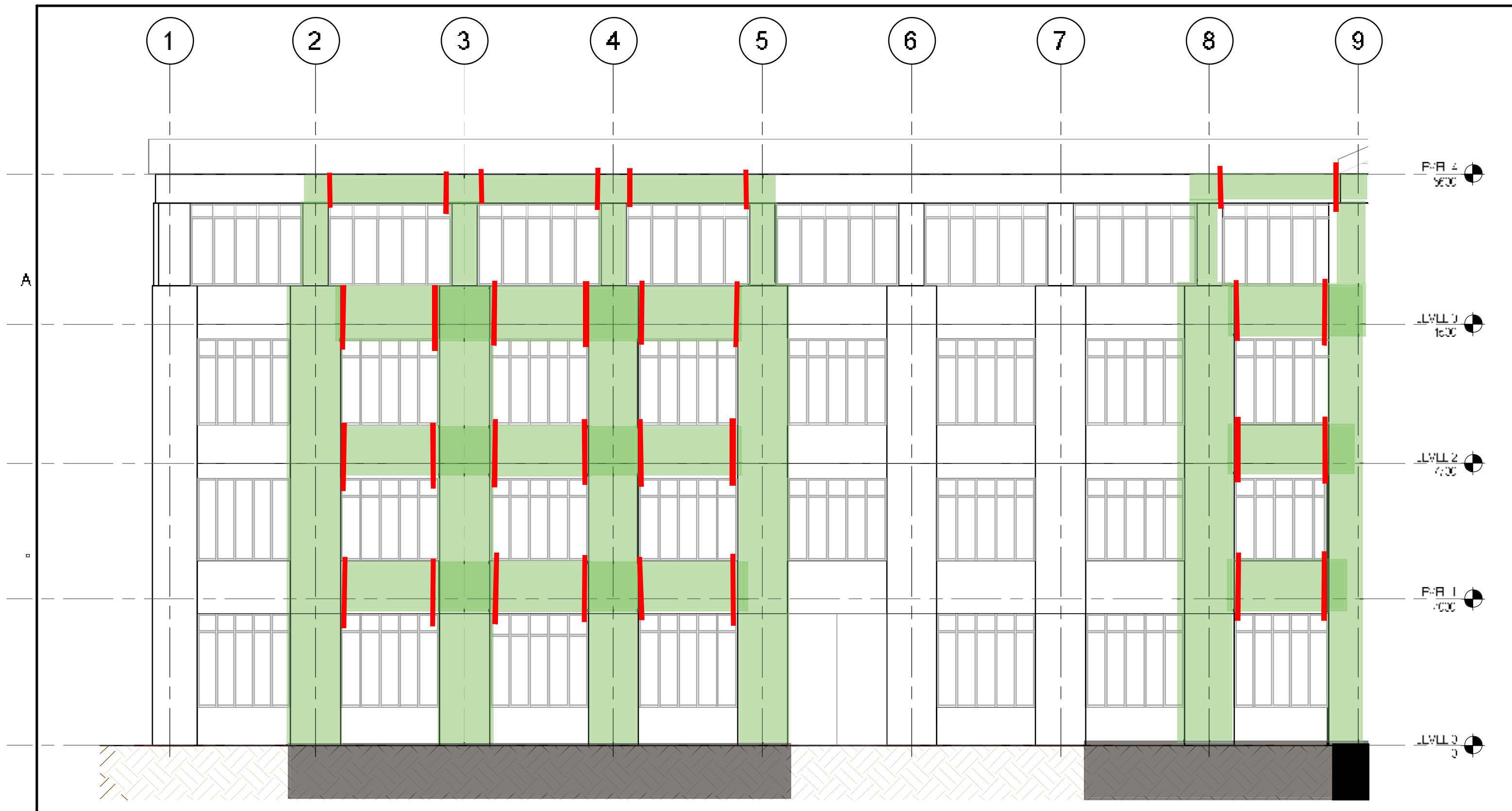
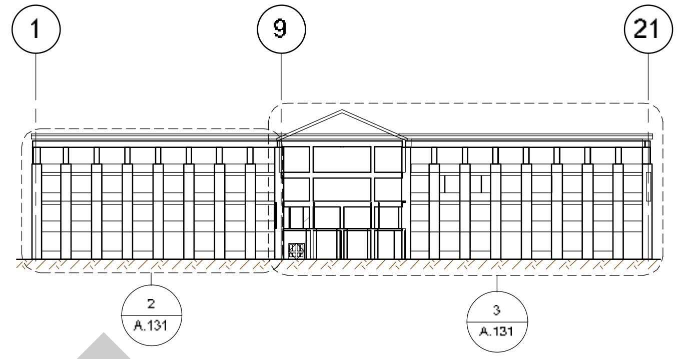


2 | SECTION ON GRID D - GRID 1 TO GRID 9
A.131 | REF: A.131 Scale: 1 : 100



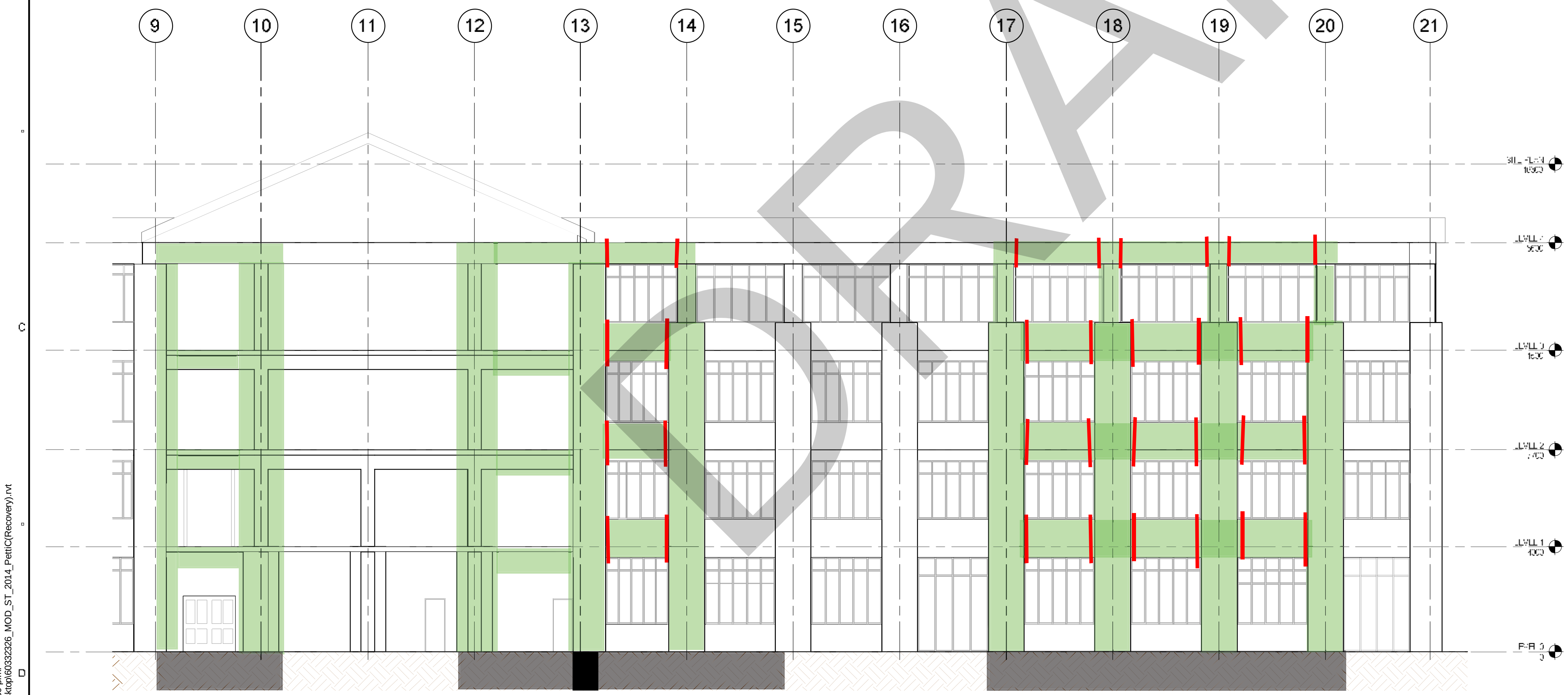
1 | SECTION ON GRID D
A.131 | REF: A.100 Scale: 1 : 500

67%NBS concept strengthening option

New columns and beams

Cut existing spandrel beam

Foundation wall 1800 x 750mm



3 | SECTION ON GRID D - GRID 9 TO GRID 21
A.131 | REF: A.131 Scale: 1 : 100

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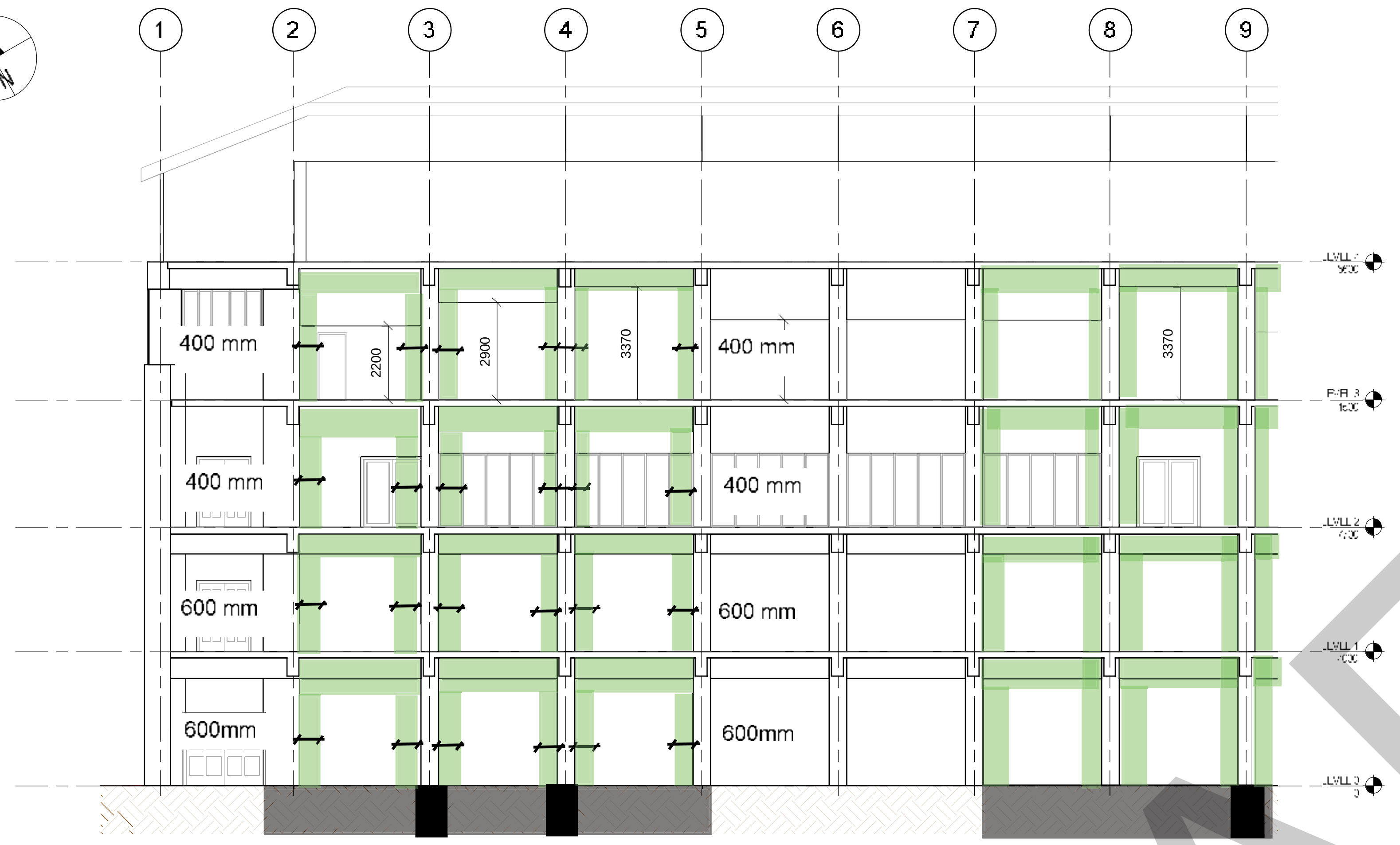
KEY PLAN

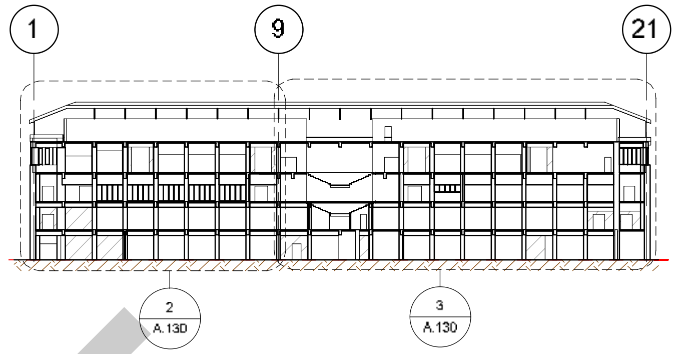
PROJECT NUMBER
60332326

SHEET TITLE
67% Strengthening Plans Grid D

SHEET NUMBER
60332326-DRG-C8



2 | SECTION ON GRID C - GRID 1 TO GRID 9
A.130 | REF: A.130 Scale: 1 : 100



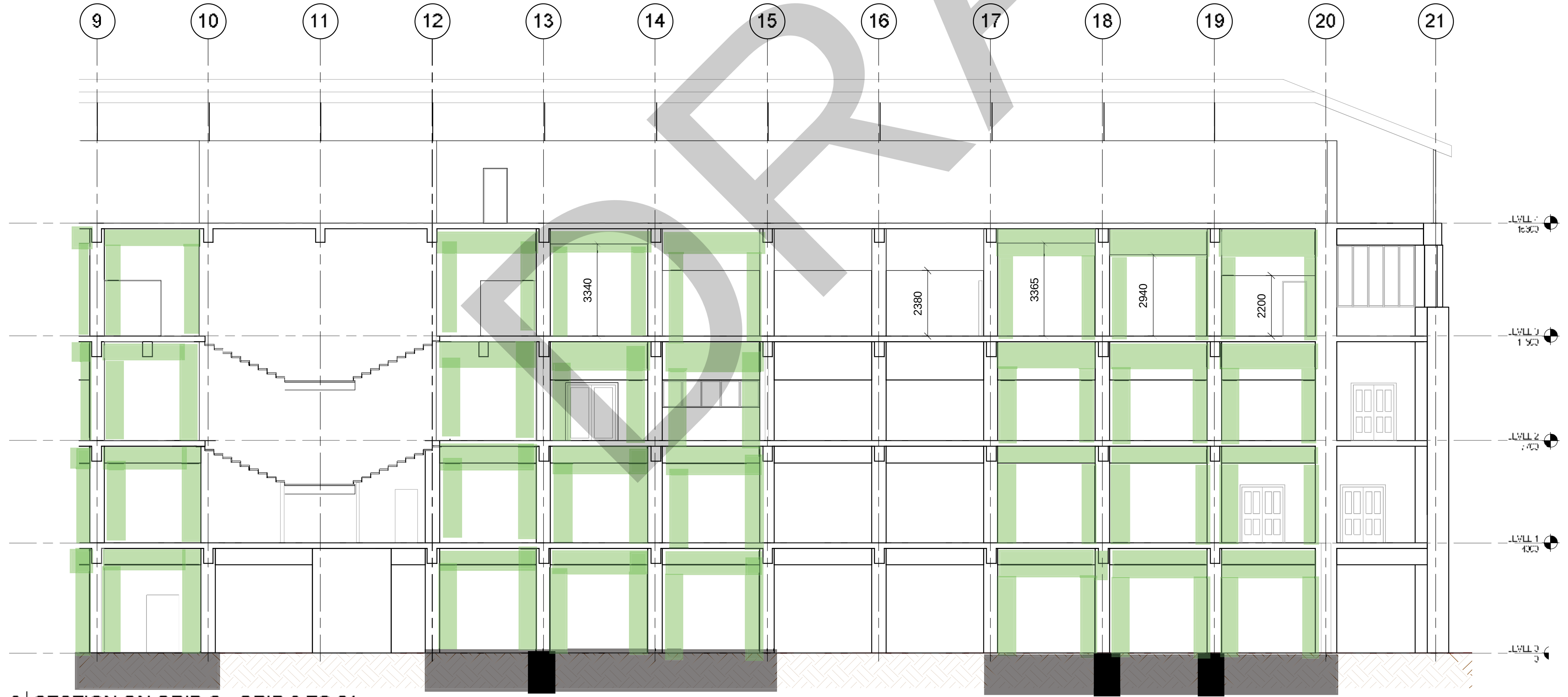
1 | SECTION ON GRID C
A.130 | REF: A.100 Scale: 1 : 600

67%NBS concept strengthening option

New columns and beams

Foundation wall 1800 x 750mm

DRAFT



3 | SECTION ON GRID C - GRID 9 TO 21
A.130 | REF: A.130 Scale: 1 : 100

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KEY PLAN

PROJECT NUMBER

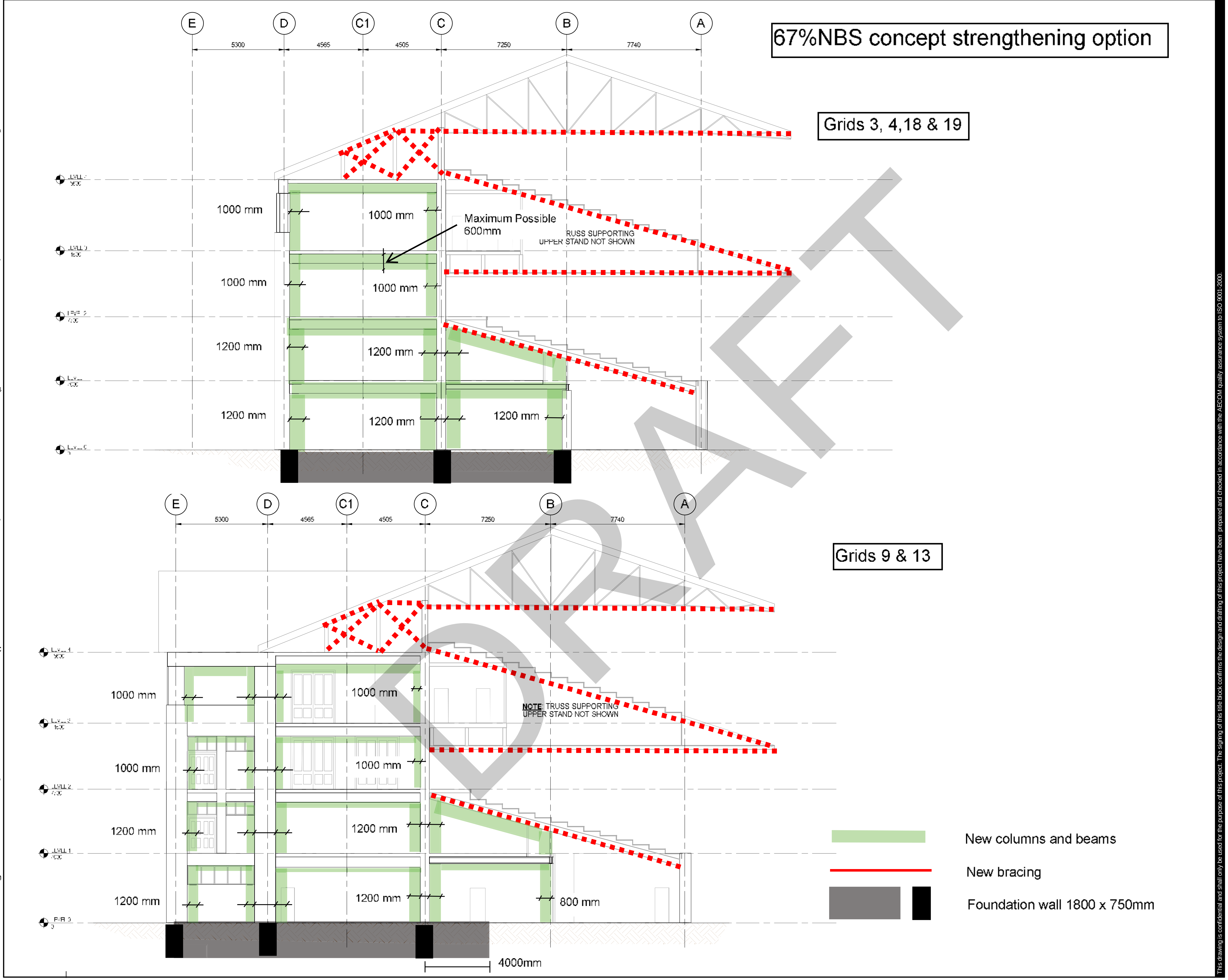
60332326

SHEET TITLE

67% Strengthening Plans
Grid C

SHEET NUMBER

60332326-DRG-C9



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KEY PLAN

PROJECT NUMBER

60332326

SHEET TITLE

67% Strengthening Plans
Grid 3, 4, 9, 13, 18 & 19

SHEET NUMBER

60332326-DRG-C10

ISO A1 594mm x 841mm

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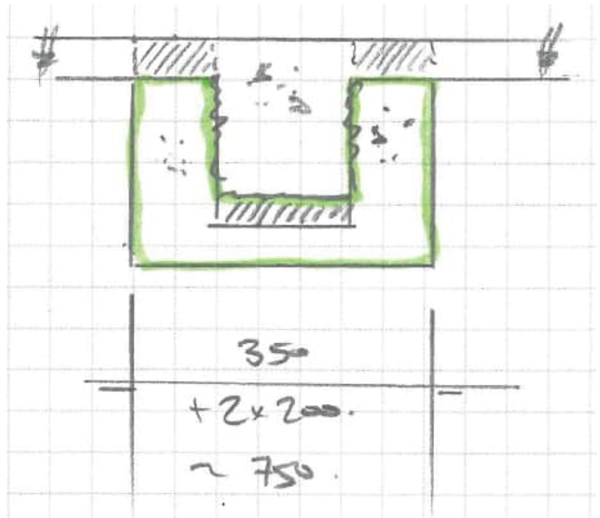
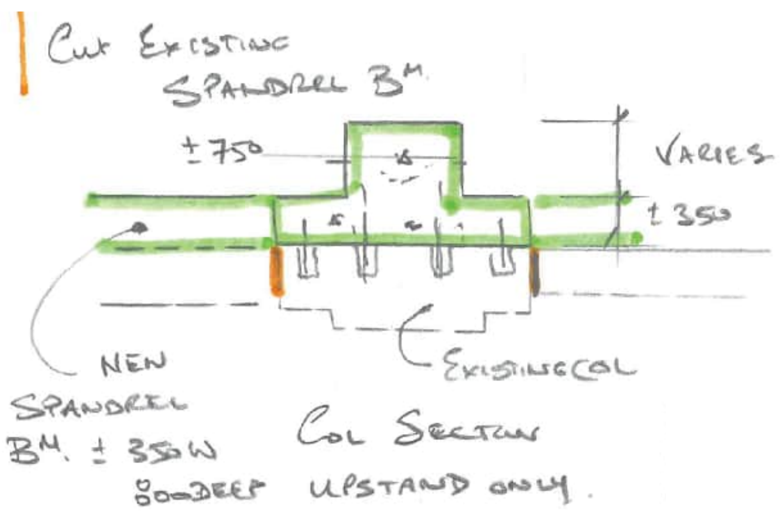
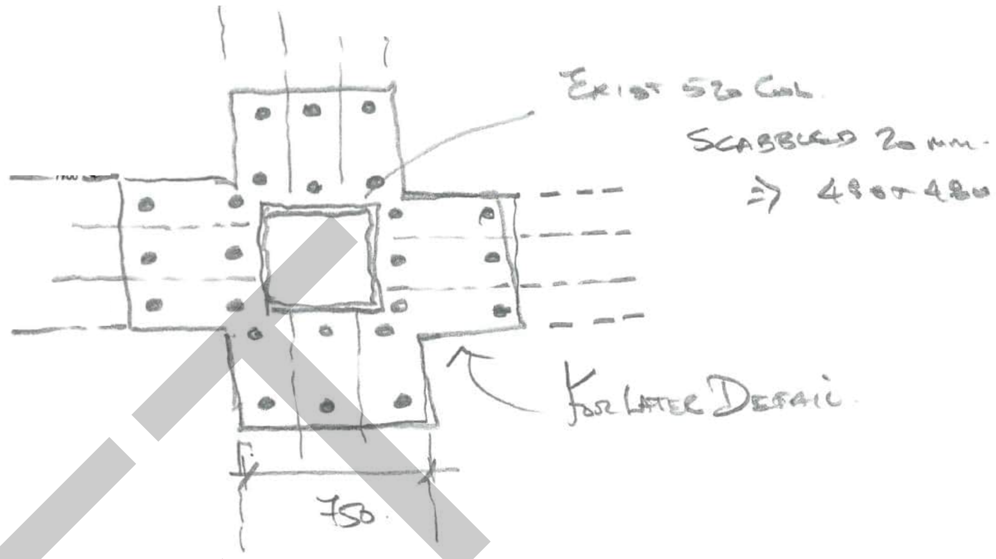
34% and 67%NBS concept strengthening options



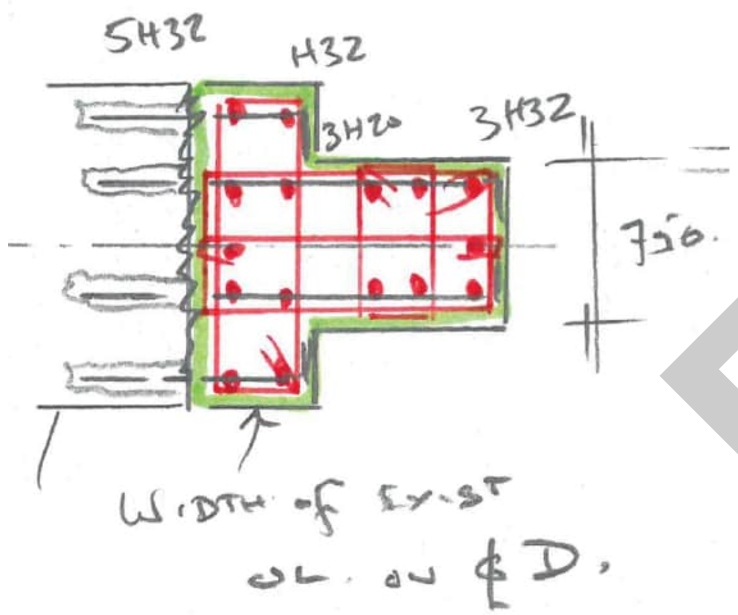
DETAIL 1
Concept beam detail
(N.T.S.)



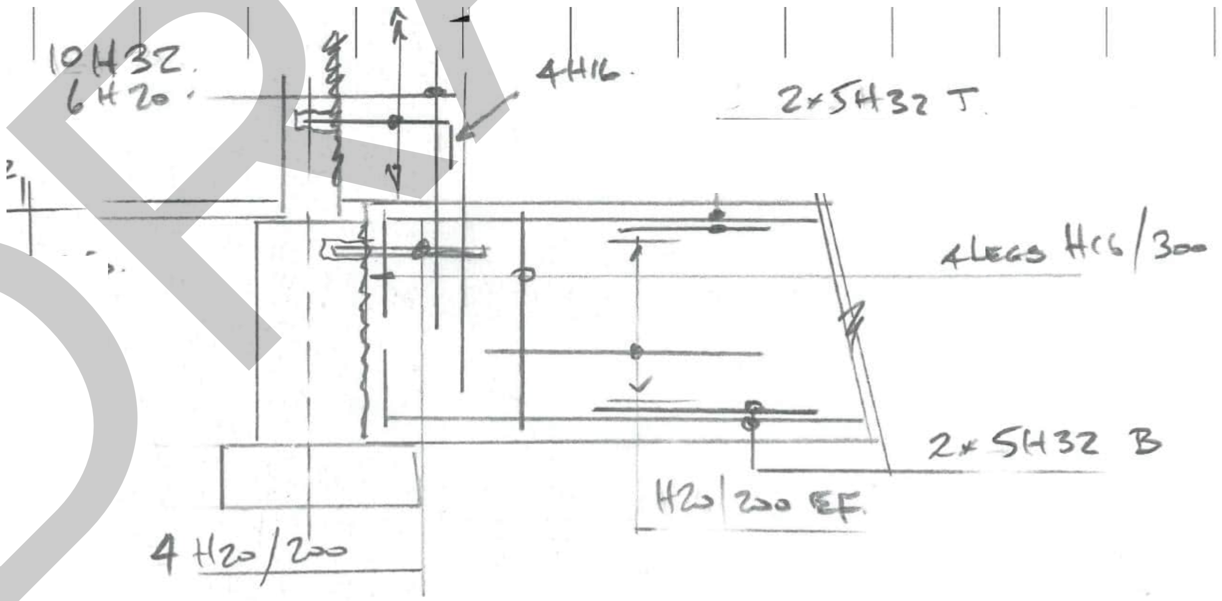
DETAIL 2
Concept column strengthening for external column
(N.T.S.)



DETAIL 3
Concept column strengthening for internal column
(N.T.S.)



DETAIL 4
Section of concept foundation wall and connection to existing plinth
(N.T.S.)



DETAIL 5
Elevation of concept foundation wall and connection to existing plinth
(N.T.S.)

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KEY PLAN

PROJECT NUMBER
60332326

SHEET TITLE
34% & 67% Strengthening Details

SHEET NUMBER
60332326-DRG-C11

ISO A1 594mm x 841mm

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