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National Grandstand
Canterbury Jockey Club

165 Racecourse Road, Sockburn

Christchurch

JOB No.: 1910036
DATE: 18 November 2021
ISSUE: 1

ENGINEERING SERVICES

Seismic Upgrade – Impact Assessment on Existing Building Fabric

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Title	Seismic Upgrade – Impact on Existing Building Fabric
Client	Canterbury Jockey Club
Filename	1910036_CJC_Report_1_First Issue 211118
Version	1
Status	First Issue
Date	18 November 2021
Project Number	1910036

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Approved By	Name: Nik George	Signature:	

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1 EXECUTIVE SUMMARY

The GNS is considered to be 'Earthquake Prone' when considered in the context of the New Zealand Building Act 2004. We concur with the AECOM assessment previously undertaken that the building is likely to collapse in a moderate earthquake due to several critical structural weaknesses.

Kirk Roberts Consulting Engineers (KRCE) strongly recommends that the building is upgraded to a minimum of 67%NBS (as recommended by the New Zealand Society for Earthquake Engineering (NZSEE)) and would suggest a target of 100%NBS is more appropriate in order for the building to be used again as a grandstand for public use. This report considers what would be required to bring the GNS up to 34%NBS solution, a 67%NBS solution and a 100%NBS solution.

In compiling this report, we have referred in the majority to the comparable 34%NBS and 67%NBS Concept Strengthening solutions detailed in the AECOM report 'Detailed Damage Evaluation: Quantitative Seismic Analysis of Grand National Stand (the AECOM Report). The 34%NBS solution was later superseded by the report; Grand National Stand – Retrofit Scheme to 34%NBS (the Retrofit Scheme). Reports and Concept Designs were produced for the purpose of the insurance claim dated 2011 – 2020. The Retrofit Scheme is more onerous than the AECOM Report but has no comparable 67%NBS solution. It is our view that our report is conservative in assessing the impact that any seismic upgrade will have on the heritage value of the GNS. The Concept design and analysis presented in the AECOM Reports remain relevant as they incorporate all significant amendments to the Design Standards made subsequent to the Canterbury Earthquake sequence.

All of the proposed Concept Seismic Upgrade schemes considered in this report will significantly impact on the original (and heritage) fabric of the building as summarised below:

- The South façade will require partial demolition around existing concrete columns to facilitate the installation of new reinforced concrete columns and beams.
- For the 34%NBS solution more than 40% of spandrel panels will need to be demolished. This figure is expected to rise to 60% for a solution targeting >67%NBS.
- Large parts of the floor slabs will need to be demolished to allow installation of drag bars and tie reinforcement to restrain the lift core during seismic loading.
- The access ramps will need to be demolished and replaced with a new compliant solution.
- The gable walls will require extensive repair and/or partial demolition and replacement.

In addition to the existing structure the existing fixtures and fittings will be greatly impacted by the seismic upgrade.

- For a 34%NBS solution approximately 40% of the window frames in the South Elevation will have to be removed and replaced with smaller units to accommodate the increase in column sizes along this gridline. This figure is expected to rise to 60% for a solution targeting >67%NBS.
- Internal wall and ceiling linings will need to be removed and replaced to allow installation of new reinforced concrete columns and beams.

Further to this the fabric of the building has deteriorated. The extent of which is to be confirmed by specialists.

- Timber has signs of wet rot and borer infestation. This may require extensive replacement of bleachers and timber framing.
- Steelwork supporting the grandstand roof has is corroded and may require replacement.

The Grand National Stand requires an extensive seismic upgrade and significant earthquake repairs. The building fabric is deteriorating with corrosion, wet rot and borer infestation. To rectify the defects will require large scale demolition and the removal of significant fixtures and fittings. Although the building can be upgraded to an acceptable seismic performance level and restored to a functional use in our opinion it will be effectively a new building with little original (and heritage) fabric retained.

2 INTRODUCTION

Kirk Roberts Consulting Engineers (KRCE) have been engaged by the Canterbury Jockey Club (CJC) to provide a structural report indicating the proposed conceptual structural upgrades and the impact they will have on the existing building fabric of the Grand National Stand (GNS) at Riccarton Racecourse.

The GNS is a heritage building and is classified as "Highly Significant" in the Christchurch District Plan Schedule of Significant Historic Heritage. But is not listed on the Heritage New Zealand Pouhere Taonga list of Heritage places.

The GNS incurred damage during the Canterbury Earthquake sequence of 2010-2011 and has subsequently been the subject of detailed structural inspections and analyses. This report is written to provide a high-level illustration of the possible seismic upgrade options and the implications of these on the existing building fabric. It draws information and data from previous reports (refer to Section 6 for references) prepared in relation to the insurance claim for the GNS to provide a conclusion and impact assessment.

KRCE have reviewed these various past reports and used the data within these to confirm that the building is, in their opinion, considered to be Earthquake Prone as defined by the Building Act and would require a significant seismic upgrade to increase the performance to be greater than 33%NBS (noting that anything below 33%NBS is considered to be earthquake prone) and even more so to achieve a target >67%NBS as recommended by the New Zealand Society for Earthquake Engineering (NZSEE). In addition, it is likely that some statutory upgrades would also be required as part of the Building Consent process to undertake the seismic works but these are not considered in detail within this report.

We strongly recommend that the building is upgraded to a minimum of 67%NBS and would suggest a target of 100%NBS is more appropriate. We therefore provide comment on what, in our opinion, would be the impact of a 67%NBS solution, and for completeness also consider the minimum 34%NBS and 100% NBS solutions. We note that this is an opinion based on a qualitative assessment of the various past reports already prepared and extrapolation based on our experience in seismic upgrades.

3 EXISTING BUILDING SEISMIC PERFORMANCE

The seismic performance of the building has been extensively assessed along with structural analytical modelling presented in previous reports (refer Section 6 – References) which KRCE have independently reviewed and used to inform this report. It is not the intention of this report to repeat the detail of these reports but to provide a summary of the findings, to provide some background context and to provide an assessment on the impact that the seismic strengthening would have on the existing building fabric.

3.1 Building Description

The GNS is a racecourse grandstand built circa 1920. It is a four-storey building with two levels of terraced seating facing the racecourse. The structure is comprised of concrete walls at each end and concrete frames to the interior supporting concrete floors, and the stands are constructed of steel beams, steel columns and timber flooring. Intrusive investigations undertaken and recorded in previous reports[1] have found that the interior frames are formed from a steel I-beam cast in concrete with the beam fixed into reinforced concrete columns. The roof is constructed of timber rafters and is braced with tension only cross bracing. No original drawings are available, but it appears that several additions were made to the structure including the construction of a lift core, and construction of the external stairs and ramps to the rear of the building. Both of these additions are of concrete construction, and it is unclear as to when these were made to the GNS building. The overall plan of the GNS is shown in Figure 1.

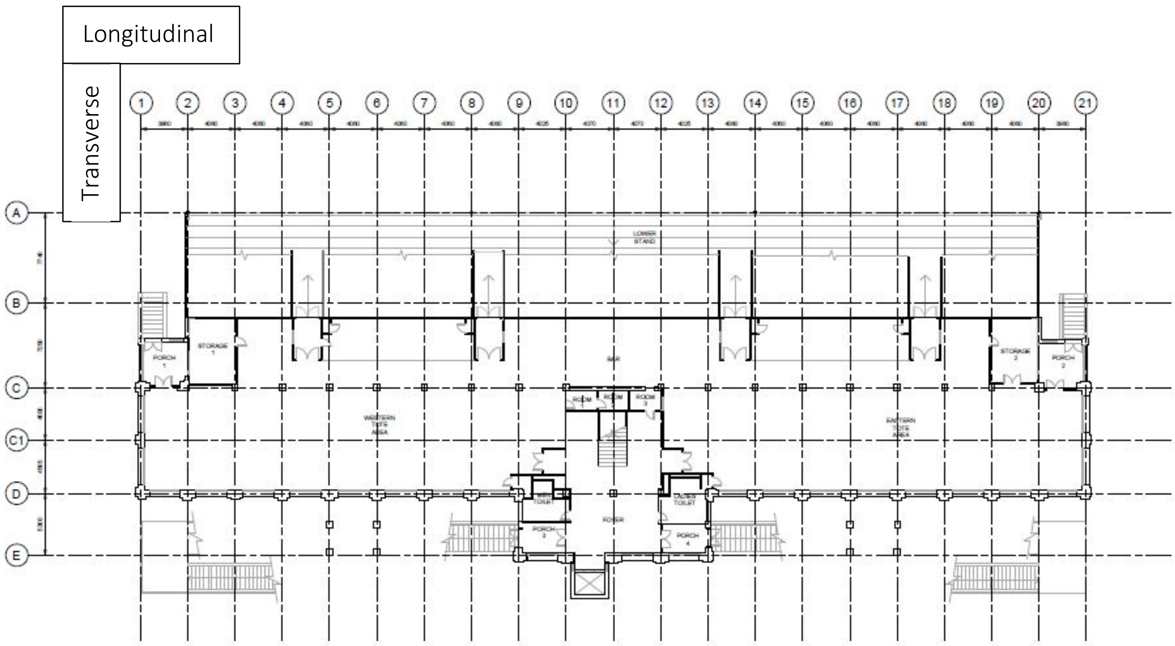


Figure 1: Overall Plan of GNS

1: Report #2: AECOM - Intrusive Investigation Report: Grand National (Public) Stand

3.2 Seismic Performance

The AECOM 'Detailed Damage Evaluation' report considers each longitudinal and lateral building 'frame' in turn and presents a seismic capacity as a percentage when measured against the New Building Standard (XX%NBS) along with the likely failure mode. A summary of the findings is tabulated below.

Frame	%NBS (min)	Failure Mode
1	9%	Beam sidesway mechanism
2	7%	Soft storey mechanism at top level
4	13%	Soft storey mechanism at top level
13	21%	Soft storey mechanism at top storey. Upper-bound base shear limited by column shear failure at level 1
C	8%	Column shear failure at level 2
D	11%	Beam sidesway mechanism
E	7%	Beam sidesway mechanism

Table 1: Summary of Seismic performance (Courtesy of AECOM)

Section 133AB of the Building Act provides that:

A building or a part of a building is earthquake prone if, having regard to the condition of the building or part and to the ground on which the building is built, and because of the construction of the building or part –

(a) The building or part will have its ultimate limit capacity exceeded in a moderate earthquake; and
(b) If the building or part were to collapse, the collapse would cause-
    i. injury or death to persons in or near the building or any other property; or
    ii. damage to any other property

Under the Building Act, a building can be considered Earthquake prone if its seismic capacity is calculated to be less than 33% of the New Building Standard (%NBS).

Although structural analysis can identify the seismic performance of a building, whether a building or a part of a building is classified as 'earthquake prone' is determined by the territorial authority in whose district the building is situated.

Whilst KRCE have not validated the seismic performance results in detail, in considering the above we concur with the overall view of the previous reports that the building is considered to be earthquake prone (<33%NBS). KRCE concur with the recommendations of the New Zealand Society of Earthquake Engineering in that the GNS should be strengthened to a target value of >67%NBS, particularly in light of the public use and potential occupancy level of the building.

It should also be noted that results tabulated above (noting the reports was prepared in 2015) represent a theoretical pre-earthquake capacity and they do not allow for any degradation or reduction in capacity due to damage incurred during the Canterbury Earthquake Sequence. Given the nature of the building it is difficult to quantify the reduction in capacity due to the earthquake damage incurred and given the already low seismic performance, the reduction of capacity by 10% or 20% is not considered meaningful or material to the outcome i.e. even if undamaged, the building is considered earthquake prone. Any consideration of damage and corresponding reduction in performance will only make it more earthquake prone.

4 SEISMIC UPGRADE PROPOSALS

4.1.1 Background

The New Zealand Society for Earthquake Engineering (NZSEE) states the aim of structural performance improvement should be to achieve as near as reasonably practicable to 100%NBS but strongly recommends that a minimum of 67%NBS is attained. This would provide a significant improvement over the current <15%NBS performance of the building as illustrated in the table below developed by NZSEE.

%NBS	Alpha rating	Approx. risk relative to new building	Life-Safety Risk Description
> 100	A+	Less than or comparable to	Low Risk
80 – 100	A	1 – 2 times greater	Low Risk
67 – 79	B	2 – 5 times greater	Low to Medium Risk
34 – 66	C	5 – 10 times greater	Medium Risk
20 - <34	D	10 – 25 times greater	High Risk
<20	E	25 times greater	Very High Risk

Table 2: NZSEE Seismic Performance

The GNS has little inherent lateral capacity in its superstructure to use as the basis for a seismic upgrade in either the longitudinal or transverse directions. It will therefore require the provision of extensive new structural frames to provide the lateral capacity required under seismic loading and new foundations to support this primary structural support. The installation of these new structural elements to achieve any level of seismic upgrade will require significant demolition of the existing building and will permanently alter the aesthetics of the building form.

In considering the impact the proposed seismic upgrade will have on the heritage fabric of the building we have considered the following options:

- Seismic Upgrade to 34%NBS – *Minimum required under Building Act*
- Seismic Upgrade to 67%NBS – *Minimum seismic performance standard both KRCE and NZSEE recommend.*
- Seismic Upgrade to 100%NBS – *Ideal Target of seismic performance standard*

4.1.2 References

In compiling this report, we refer to the following Concept Strengthening options prepared by AECOM listed below:

- Detailed Damage Evaluation *DRAFT* – 30 July 2015 (Report 1)
- Grand National Stand – Conceptual Retrofit Scheme to 34%NBS *DRAFT* – 22 April 2016 (Report 2)

Report 1 (Appendix C) contains an early Concept scheme for both 34%NBS and 67%NBS solutions. In Report 2 (Appendix B) the 34%NBS solution has been further developed for costing purposes and as required for the insurance claim purposes but has no comparative 67%NBS solution.

For the purposes of this report, we will use the earlier 34%NBS and 67%NBS solution presented in Report 1 but note that the 34%NBS scheme was further developed and resulted in a more onerous solution than the earlier scheme. We fully expect the comparative 67%NBS solution, had it been further developed in the same way, would also have resulted in a more onerous solution. Therefore, the information presented in this report is very likely to be a conservative view on the level of disruption and damage and/or replacement of the building fabric.

4.2 SEISMIC UPGRADE TO 34%NBS

As defined by the Building Act, the minimum seismic performance of a building is 34%NBS. With this threshold in mind the previous reports focussed on a seismic upgrade to 34%NBS as was required for the specific purpose of the GNS insurance claim.

4.2.1 Foundations

The existing foundations will require an upgrade to support the increase in forces imparted from the new frames. To install the new foundations large parts of the existing ground floor slab will need to be removed and replaced. Not only will this remove the original fabric but demolition around existing foundations carries inherent risk to the stability of the building that will need to be mitigated for works to proceed. This is likely to include extensive temporary propping of the primary structure to allow a safe working methodology. The new foundations required for this option are shown on the extract plan in Figure 2.

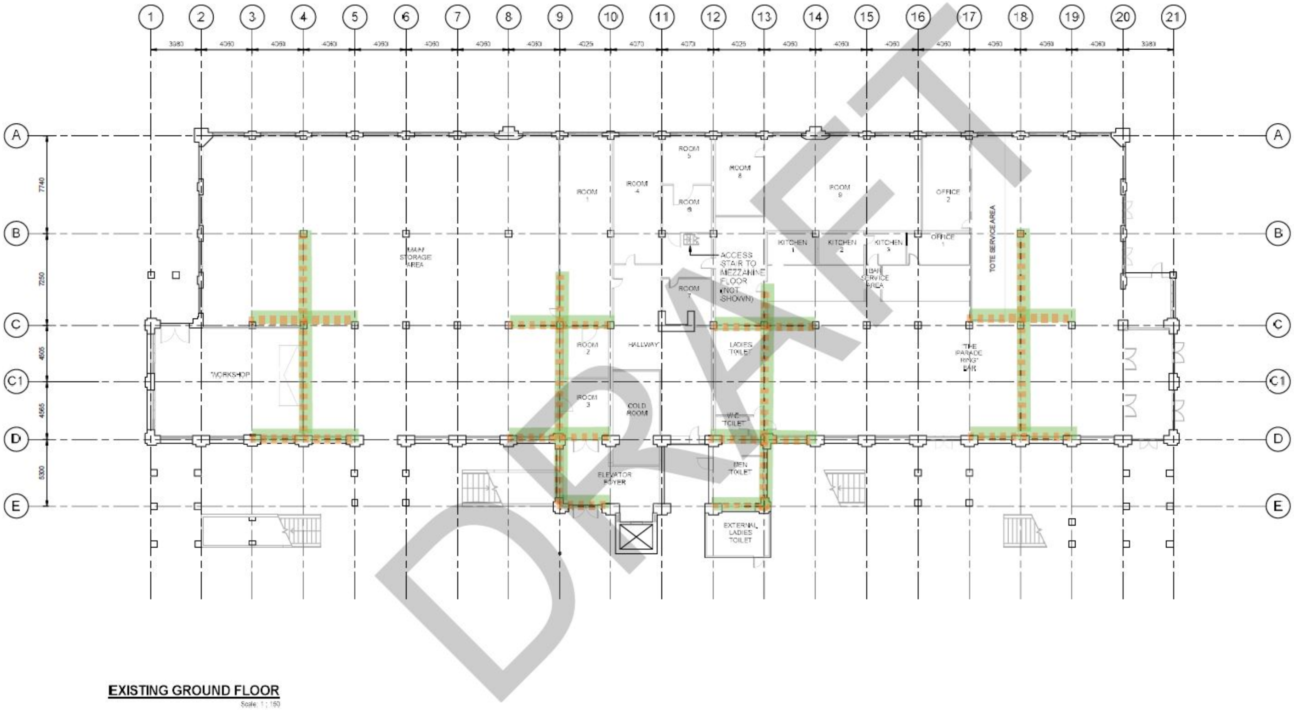


Figure 2: Extract from plan showing proposed new foundations (shaded in green) (AECOM 60332326-DRG-C1)

4.2.2 Transverse Frames

The proposed 34%NBS scheme sees the introduction of new transverse frames consisting of reinforced concrete columns and beams on 4 of the 21 gridlines. The new columns will be 1000mm to 1200mm in addition to the existing column as shown in Figure 9. The installation of these new columns and beams will require; the removal of existing internal finishes, removal of existing window frames and the loss of existing façade details on the external face. Once complete the building will require painting to provide a uniform finish to both external and internal walls.

It should be noted that the scheme presented in Report 2 increased the external column size to 1300mm.

In conjunction with the reinforced concrete frames within the building the seating and roof structure will need tying back to this new frame structure. It is envisaged 32mm diameter Reid brace (or similar) will be used as shown in Figures 4 & 5. It should also be noted that plan bracing of similar type will be provided to each of the levels shown for the full length of the building to transfer lateral loads back to the main concrete frames.

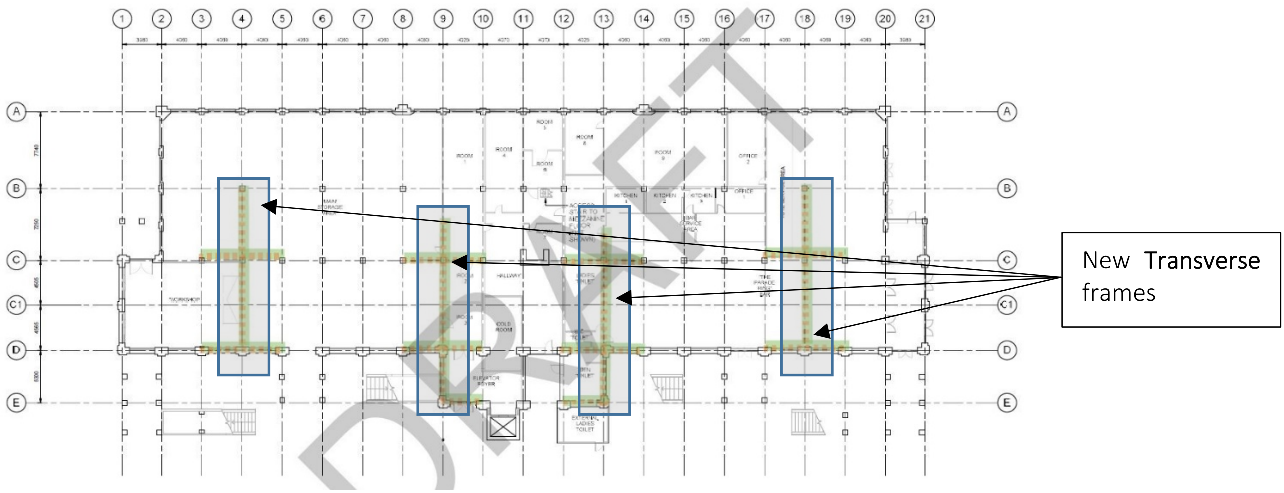


Figure 3: Extract from plan showing proposed new transverse frames (AECOM 60332326-DRG-C2)

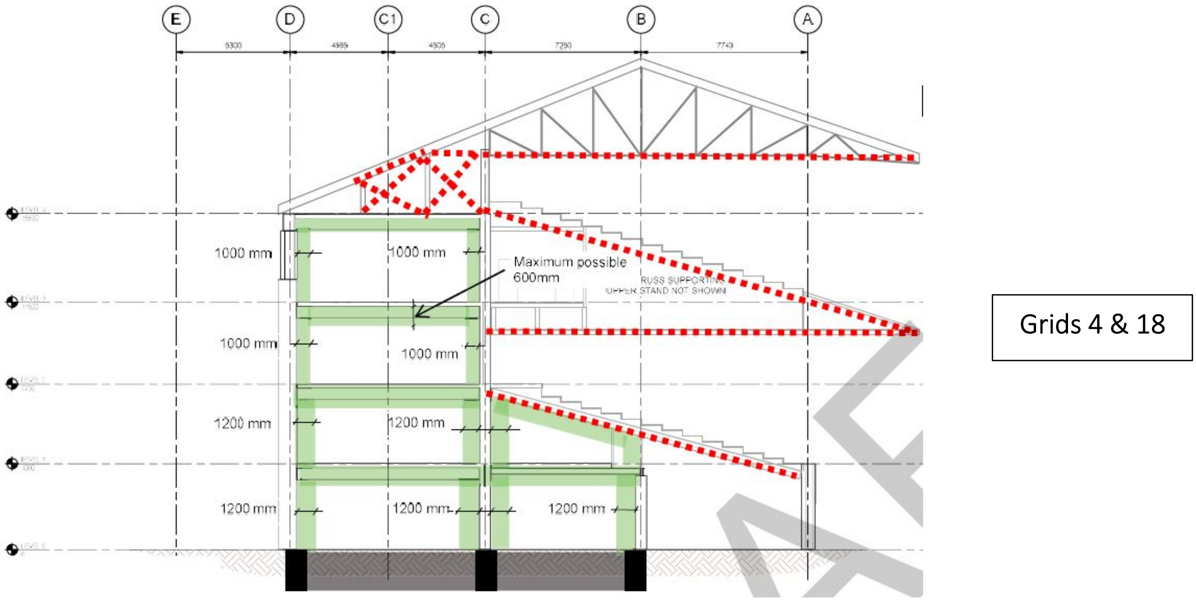


Figure 4: Typical Section on Gridlines 4 & 18 showing new columns, beams (shaded green) and Reid brace ties (dashed red) (AECOM 60332326-DRG-C5)

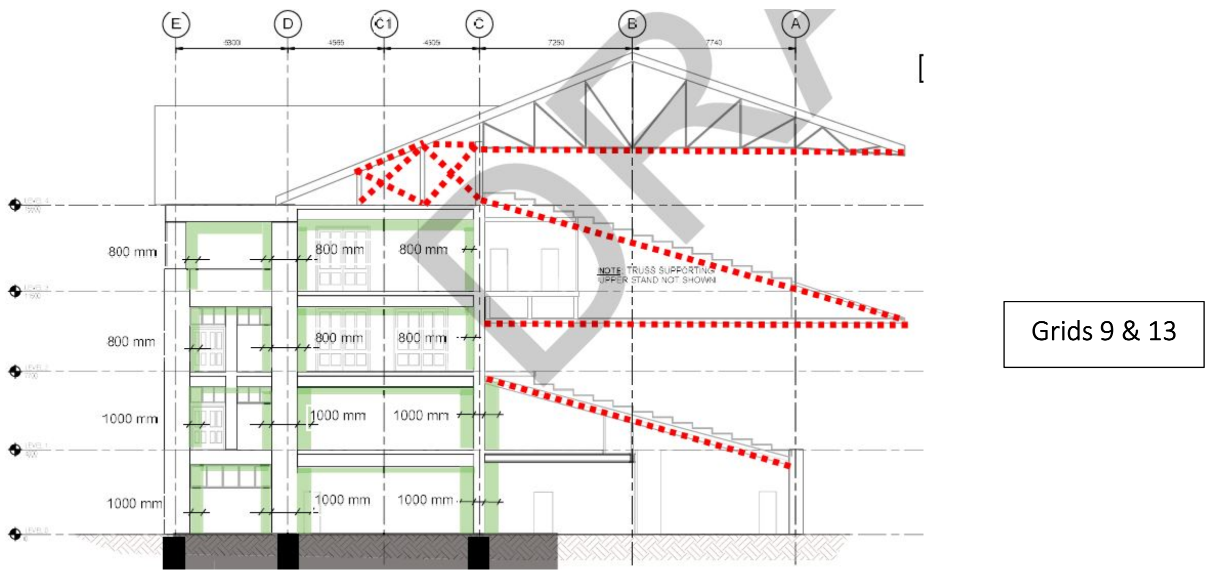


Figure 5: Typical Section on Gridlines 9 & 13 showing new columns, beams (shaded green) and Reid brace ties (dashed red) (AECOM 60332326-DRG-C5)

The new transverse frames significantly impact the internal finishes and amenity value of the space. See Figures 6 and 7 for a before and after representation. It should be noted that the pictures do not capture the loss of natural light that will occur in these areas with the introduction of new longitudinal frames.

Figure 6: Members lounge as existing

Figure 7: Members lounge with representation of proposed seismic upgrade

4.2.3 Longitudinal Frames

New longitudinal frames are to be installed on both Gridline C and D as shown in Figures 8 & 9 and 10 & 11 below.

The new columns are to be positively fixed into the existing columns and so will require extensive demolition of the façade (on grid D) and the internal walls (on grid C). In addition to this, to avoid the detrimental transfer of moments and forces into the spandrel panels in future seismic events, they will need to be cut free from the new columns to prevent possible cracking. A mastic sealant will be applied in the new joint and with painting may have some minor effects on the aesthetics.

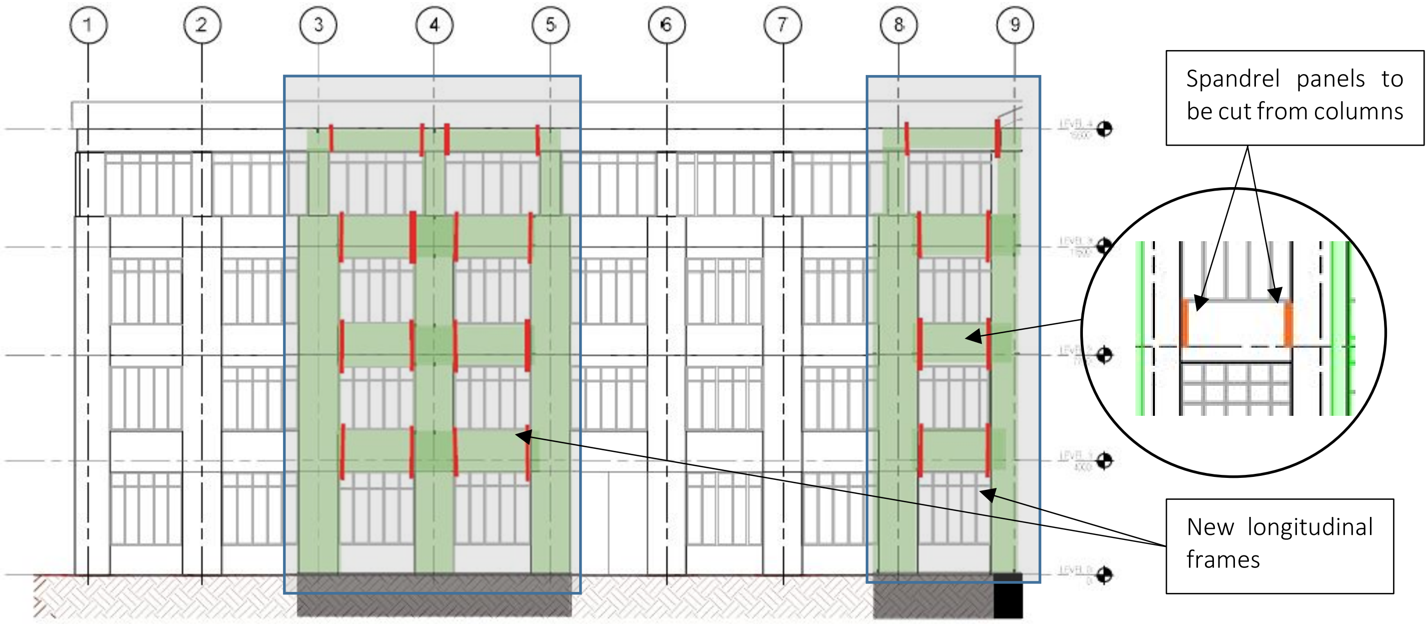


Figure 8: Elevation on Gridline D showing new longitudinal frames (shaded green) and disconnection of spandrel panels (marked in red) (AECOM 60332326-DRG-C3)

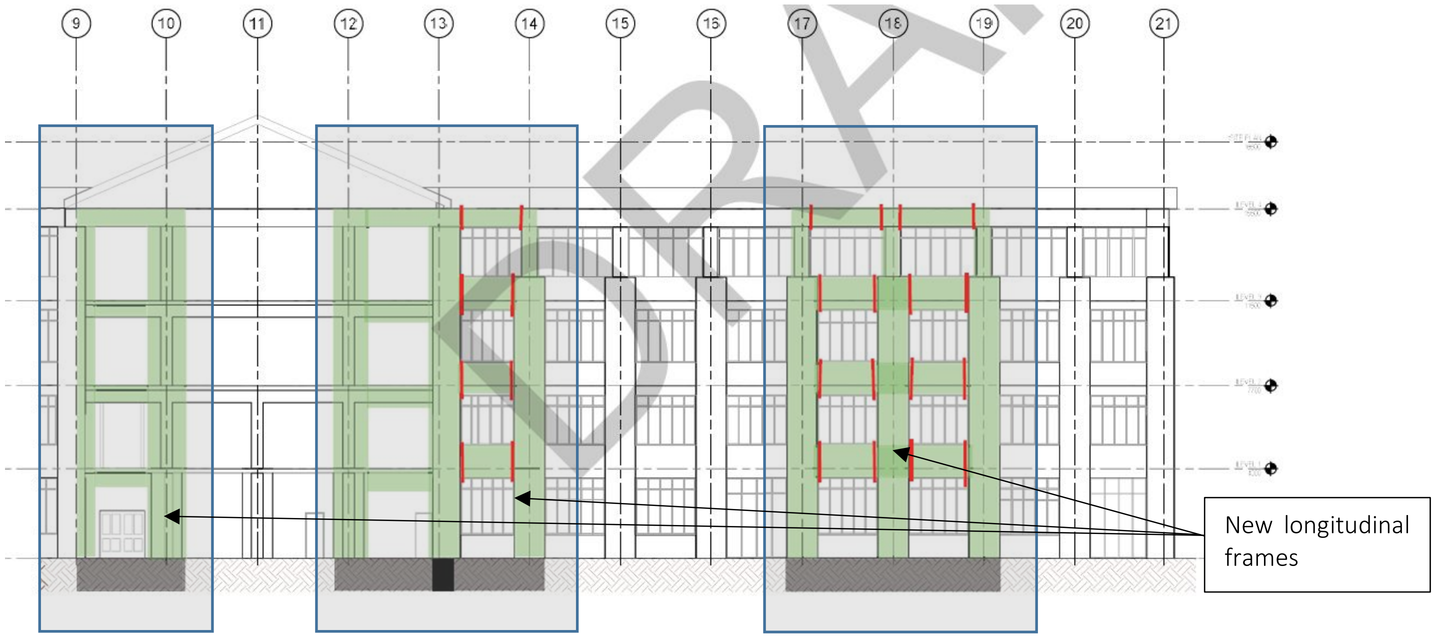


Figure 9: Elevation on Gridline D showing new longitudinal frames (shaded green and disconnection of spandrel panels (marked in red) (AECOM 60332326-DRG-C3)

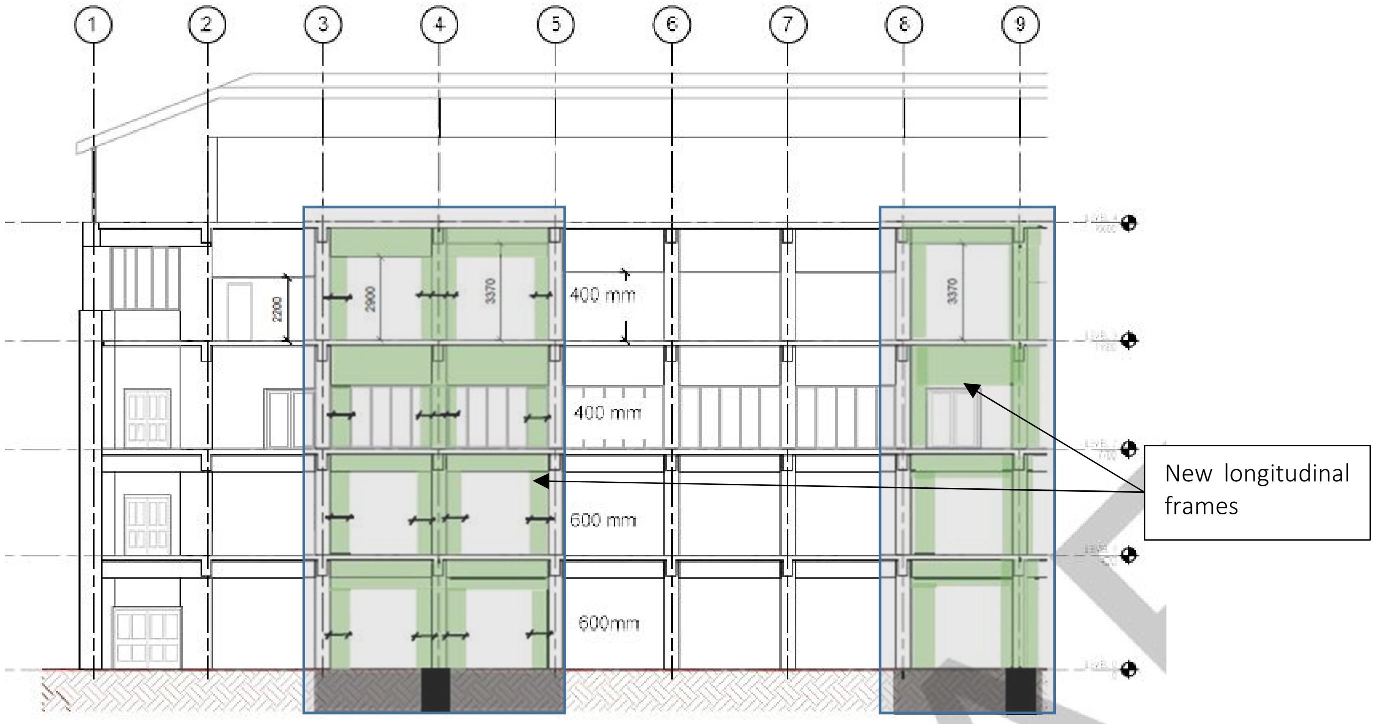


Figure 10: Elevation on Gridline C showing new longitudinal frames (shaded green) and disconnection of spandrel panels (marked in red) (AECOM 60332326-DRG-C4)

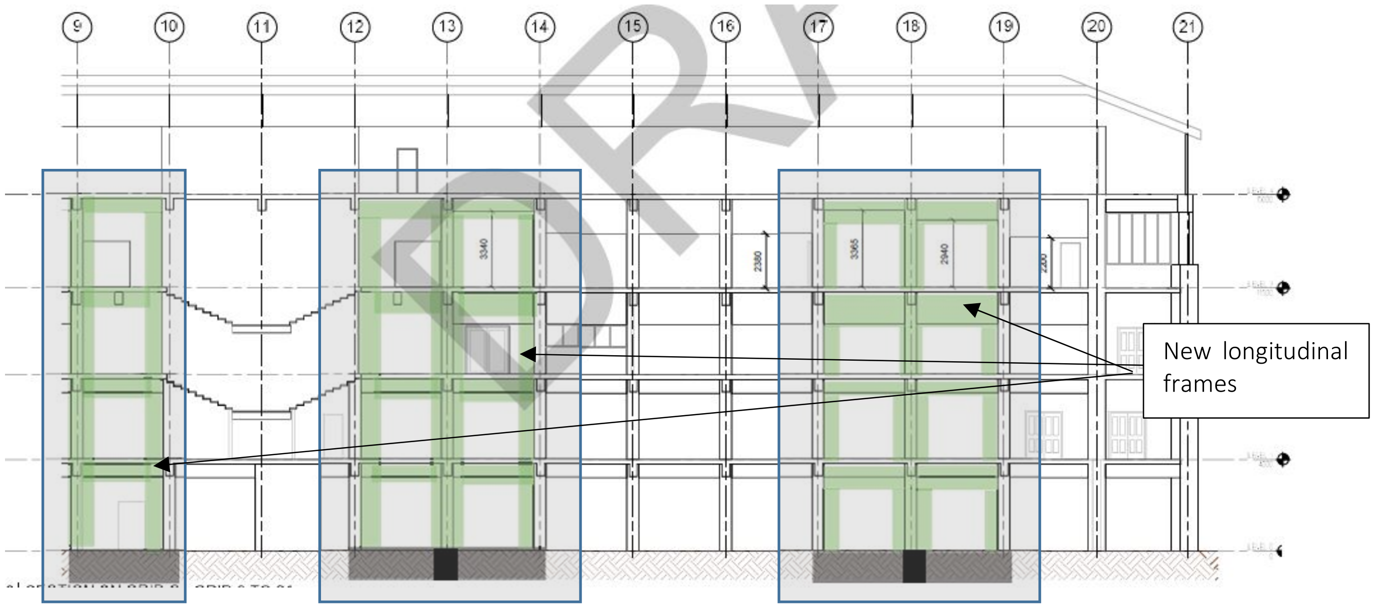


Figure 11: Elevation on Gridline C showing new longitudinal frames (shaded green) and disconnection of spandrel panels (marked in red) (AECOM 60332326-DRG-C4)

The longitudinal frames are a significant size and will reduce the amenity of the building. Figure 12 shows the outside face of the new frame, including columns and beams (discussed further below) on the external façade.

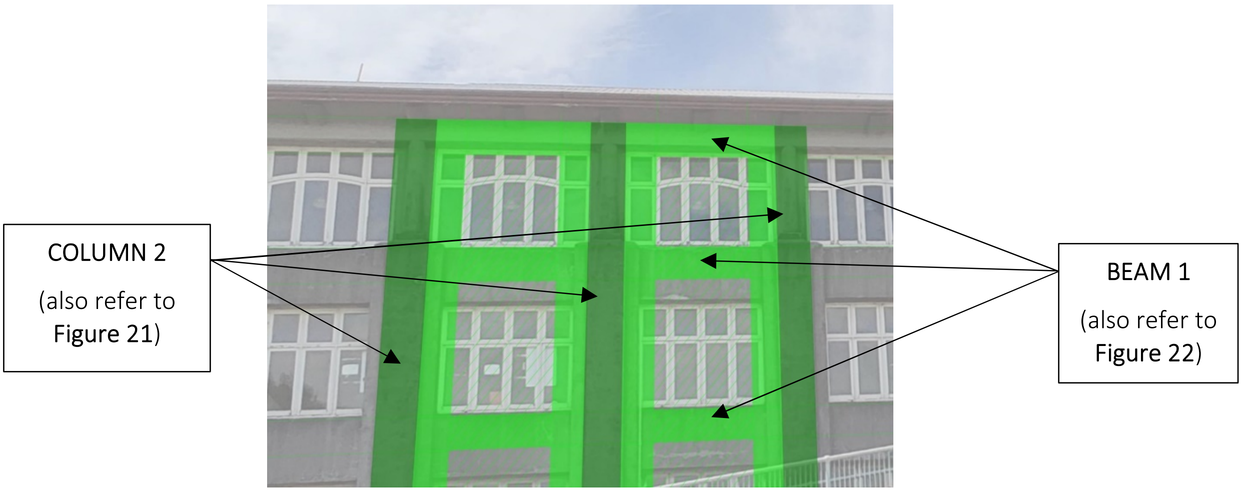


Figure 12: Close-up on impact new frame has on existing elevation (Grid D - Grids 3, 4 and 5)

The new structure will also reduce the window openings, notwithstanding the potential Building Code issues of reinstalling the original (and non-compliant) windows, they will no longer physically fit into the opening so will need to be replaced. To maintain a similar appearance, it would be beneficial to maintain the window pane geometry and so reduce the size by a full pane module on each side. Whilst this may maintain some aesthetic continuity it is not only a loss of original heritage building fabric but will be significantly detrimental to the symmetrical geometric nature of the facade as a whole. The alternative is to replace all windows with a similar size to retain the symmetrical nature at the further cost of original heritage building fabric.

It should be noted that, for the 34%NBS solution, over 40% of the windows will be removed and replaced to allow installation of the seismic upgrade. It is further noted that the reduction in size of the windows will result in a further loss of natural light within the building.

4.3 SEISMIC UPGRADE TO 67%NBS

The NZSEE states the aim of structural performance improvement should be to achieve as near as reasonably practicable to 100%NBS. If this is not practicable, the NZSEE strongly recommends that a minimum target of 67%NBS is attained.

Although it would be preferable to target 100%NBS for the GNS, it is more realistic to target >67%NBS. This is the recommended preferred option by KRCE and is the minimum recommended option by NZSEE. Seismic upgrade of the GNS to 67%NBS would greatly reduce the risk to life, whilst minimising costs and the loss of original heritage building fabric.

4.3.1 Foundations

The proposed solution for localised strengthening of foundations for 34%NBS is expected to remain valid. However, the number of foundations to which the detail relates will need to be increased to accommodate the new reinforced concrete frames required for this solution (as set out below). This is a much more extensive upgrade than the 34%NBS solution outlined above and will not only remove more of the original fabric, but will increase the risk/cost/time of demolition. This is likely to include extensive temporary propping of the primary structure to allow a safe working methodology.

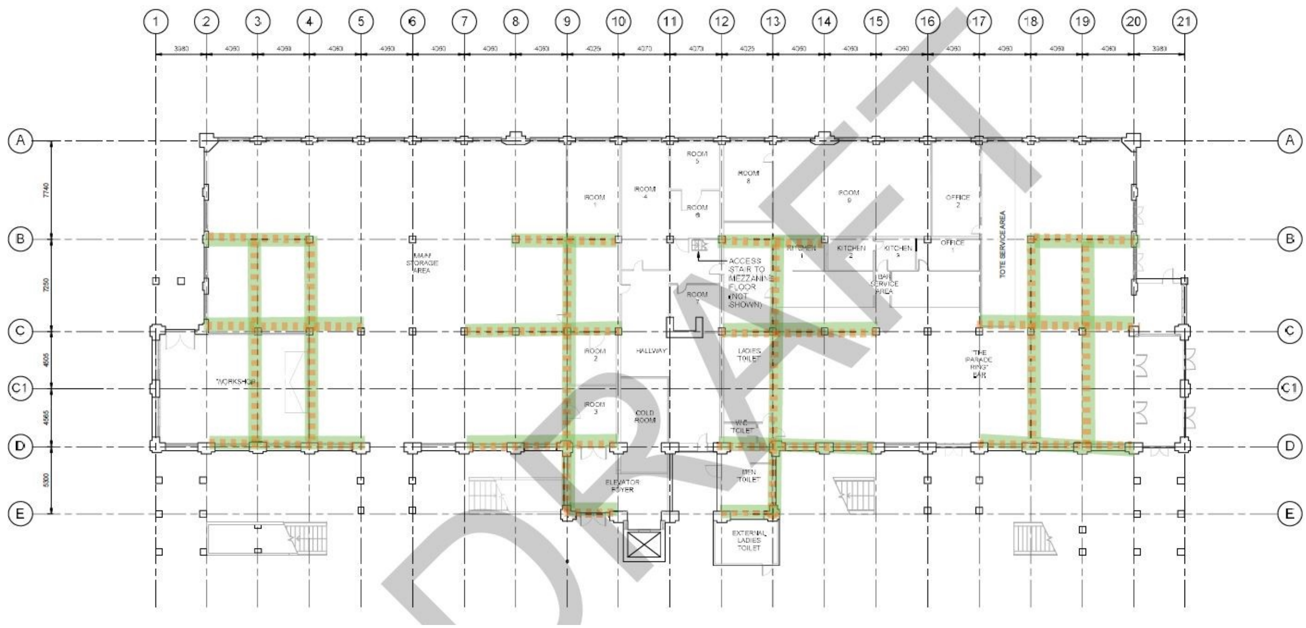


Figure 13: Extract from plan showing proposed new foundations (AECOM 60332326-DRG-C6)

4.3.2 Transverse Frames

The proposed 67%NBS scheme sees the introduction of additional new transverse frames consisting of reinforced concrete columns and beams on 6 of the 21 gridlines (rather than 4 as required for the 34%NBS solution). The new columns will be 1000mm to 1200mm in addition to the existing column as shown in Figure 21. The installation of these new columns and beams will require; the removal of existing internal finishes, removal of existing window frames and the loss of existing façade details on the external face. Once complete, the building will require painting to provide a uniform finish to both external and internal walls.

It should be noted that the scheme presented in Report 2 increased the external column size to 1300mm.

In conjunction with the reinforced concrete frames within the building, the seating and roof structure will need tying back to this new frame structure. It is envisaged 32mm diameter Reid brace (or similar) will be used as shown in Figures 15 & 16. It should also be noted that plan bracing of similar type will be provided to each of the levels shown for the full length of the building to transfer lateral loads back the main concrete frames.

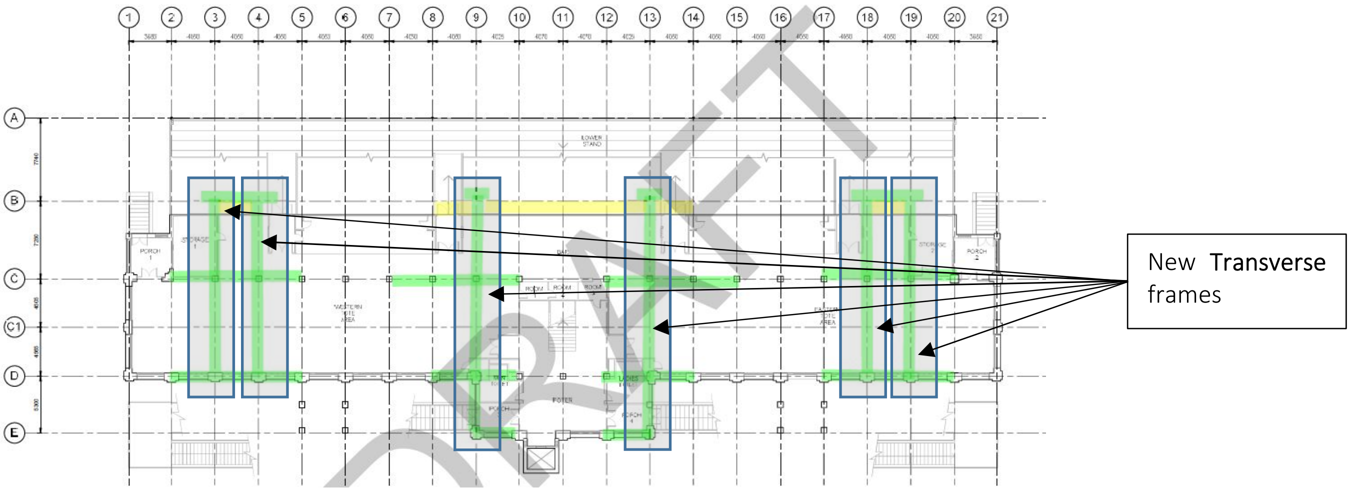


Figure 14: Extract from plan showing proposed new transverse frames (AECOM 60332326-DRG-C7)

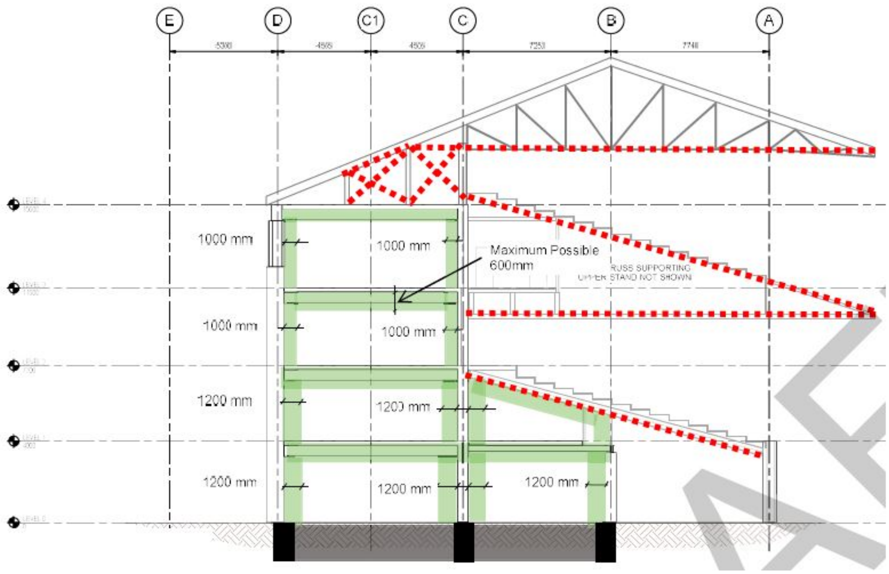


Figure 15: Typical Section on Gridlines 4 & 18 showing new columns, beams (shaded green) and Reid brace ties (dashed red) (AECOM 60332326-DRG-C10)

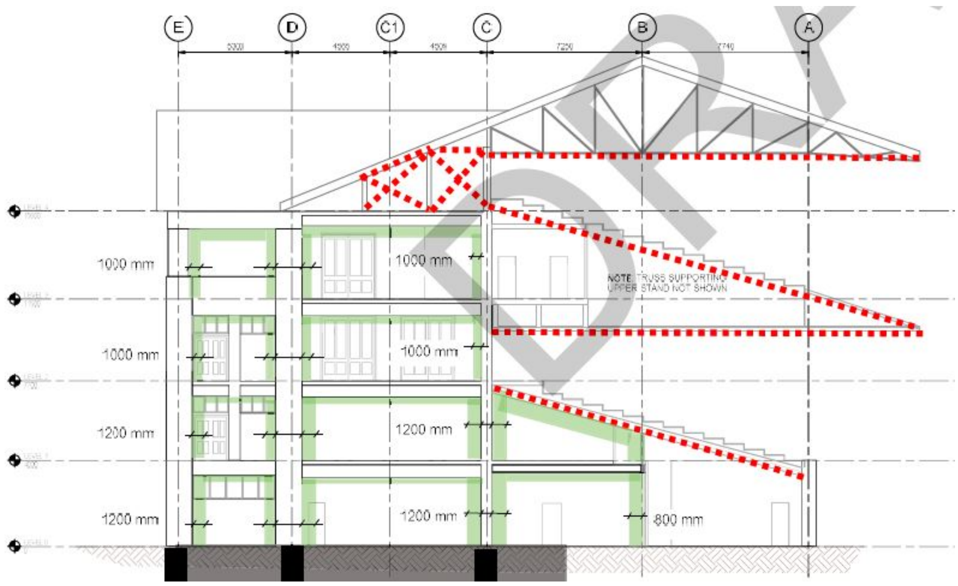


Figure 16: Typical Section on Gridlines 4 & 18 showing new columns and beams (shaded green) and Reid brace ties (dashed red) (AECOM 60332326-DRG-C10)

4.3.3 Longitudinal Frames

New longitudinal frames are to be installed on both Gridline C, D (as shown in Figures 17 & 18 and 19 & 20) and Gridlines B and E (not shown in Figures).

As with the 34%NBS solution, the spandrel panels will need to be separated from the building to avoid the detrimental induced forces and moments they will attract.

As shown the introduction of sufficient frames to provide 67%NBS capacity will require significant demolition and introduction of new structures that will severely impact the heritage fabric of the building. It is envisaged >50% of spandrel panels and windows will be affected by the installation of new longitudinal frames. The new columns and beams are installed in the same way as the 34%NBS solution.

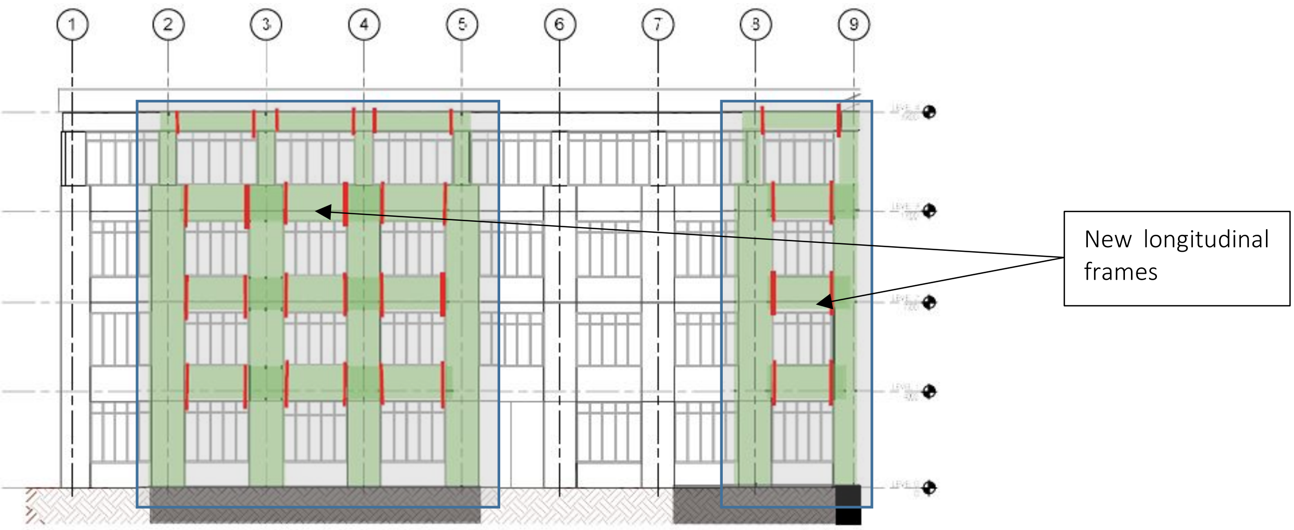


Figure 17: Elevation on Gridline D showing new longitudinal frames (shaded in green) and disconnection of spandrel panels (marked in red) (AECOM 60332326-DRG-C8)

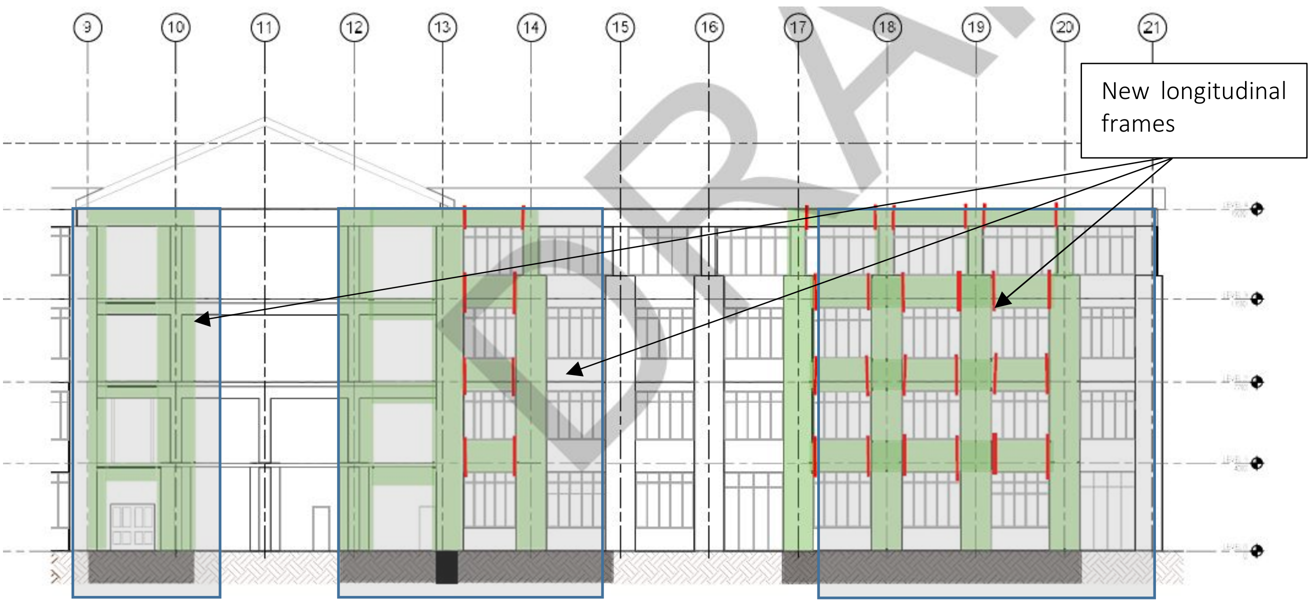


Figure 18: Elevation on Gridline D showing new longitudinal frames (shaded in green) and disconnection of spandrel panels (marked in red) (AECOM 60332326-DRG-C8)

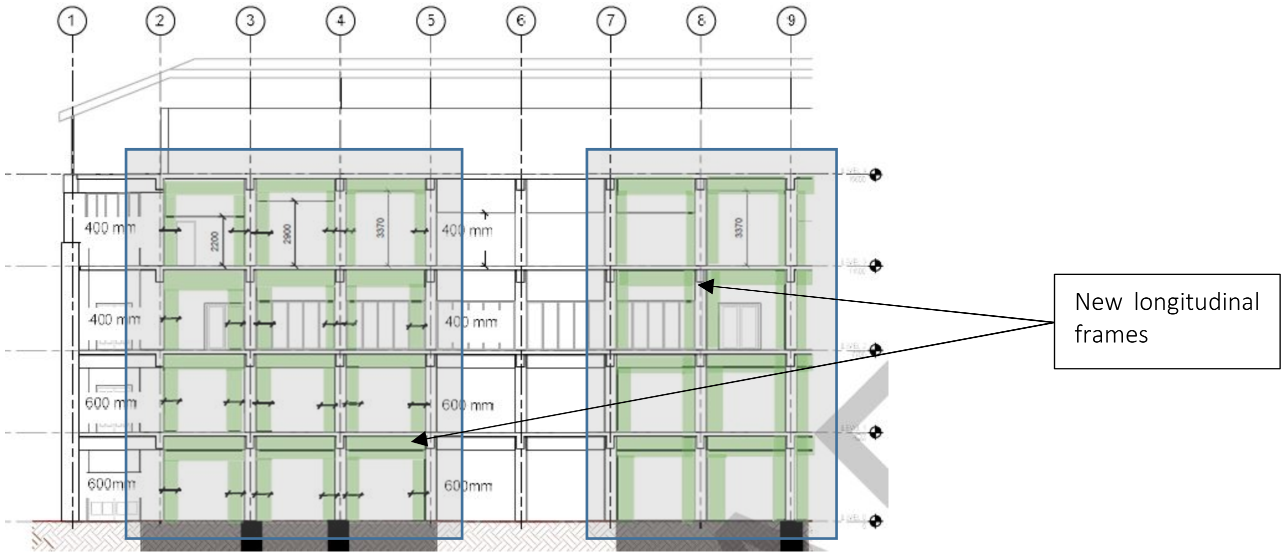


Figure 19: Elevation on Gridline C showing new longitudinal frames (shaded in green) and disconnection of spandrel panels (marked in red) (AECOM 60332326-DRG-C8)

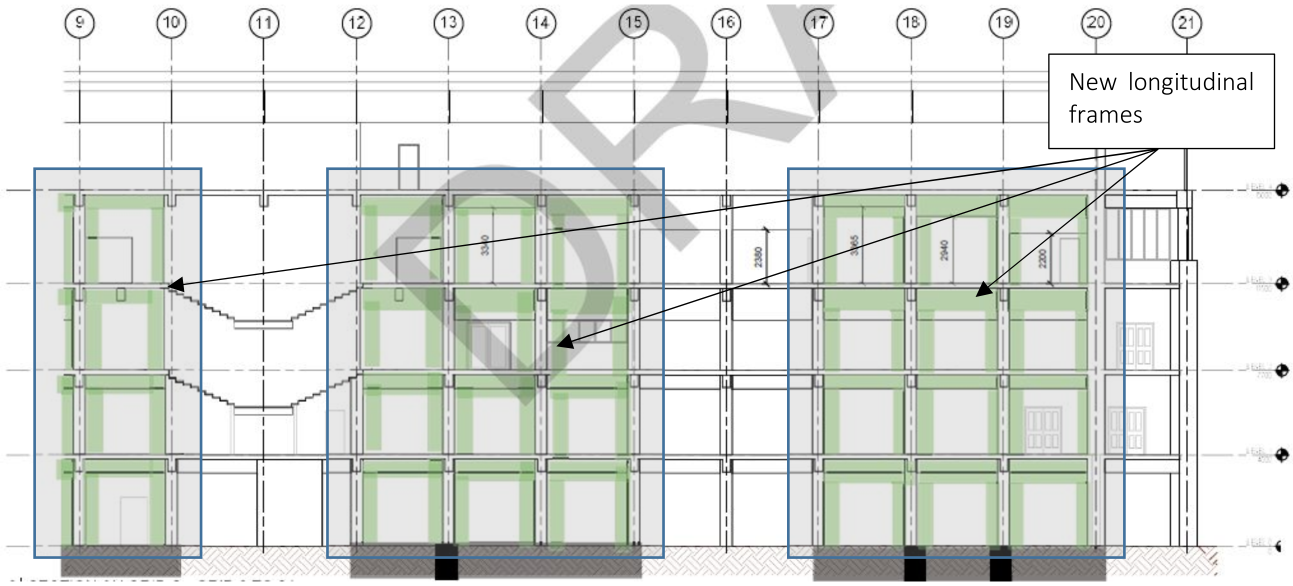


Figure 20: Elevation on Gridline C showing new longitudinal frames (shaded in green) and disconnection of spandrel panels (marked in red) (AECOM 60332326-DRG-C8)

Again, the new structure will also reduce the window openings such that the original windows will need to be replaced, as is the case with 34%NBS option above but to a greater extent casing a loss of original heritage building fabric and natural light.

4.4 SEISMIC UPGRADE TO 100%NBS

Achieving 100%NBS retrospectively for any building is a significant challenge that will see costs escalate rapidly as the solution approaches 100%NBS. This is amplified for an old building and will inevitably see much of the building fabric altered or removed to allow the installation of an essentially whole new lateral structure and foundations.

Whilst we have not undertaken a detailed analysis or design for a 100%NBS solution, based on the solutions (34%NBS and 67%NBS) produced to date it is likely that every transverse frame will need a new reinforced concrete frame installing at every bay and a longitudinal frame will need to be introduced for the full elevation along gridline D, C and B.

The introduction of a transverse frame at every bay will require associated upgrades to foundations at each location.

It is likely that the grandstand roof and bleacher seating will require significant replacement or upgrades that have not been covered in this report or those produced by AECOM.

In summary, a target 100%NBS solution will require a full design and is likely to produce a solution that requires the replacement or upgrade of every part of the building. It must also be understood that even with extensive upgrades, it may be that the target value may not even be achievable and, in any case, will dramatically impact the original (and heritage) fabric of the building.

4.5 GENERAL SEISMIC UPGRADES AND TYPICAL DETAILS REQUIRED REGARDLESS OF TARGET %NBS

The building has inherent issue that require upgrades regardless of the target %NBS. These are covered in this section along with typical details required, such as beams and columns, that form the new frames in both the transverse and longitudinal directions for both 34%NBS and 67%NBS upgrade options.

4.5.1 Beam and Column Details

The beam and columns presented in this section are taken from Report 2 as they represent the later design methodology. Whilst this provides somewhat of a hybrid conceptual design it is deemed to reflect a more accurate view of the work required.

To ensure full connection of the new columns to the existing concrete they will need positive fixing to the existing columns. This will require either drilling for reinforcing bars to be epoxy fixed or have post tensioned system installed as shown in Figure 21 below. Each methodology will have a significant impact on the existing building fabric and overall aesthetic of the building for several reasons as listed below:

- The original columns are completely encapsulated by the new structure and no longer visible.
- The column size and form are significantly altered producing a different aesthetic from the original intent.
- The column sizes will be a mix of old and new which removes the current symmetrical nature of the building.
- The surrounding wall, floor, window frames, spandrel panels and ceilings will need to be demolished and replaced to make way for the new columns.

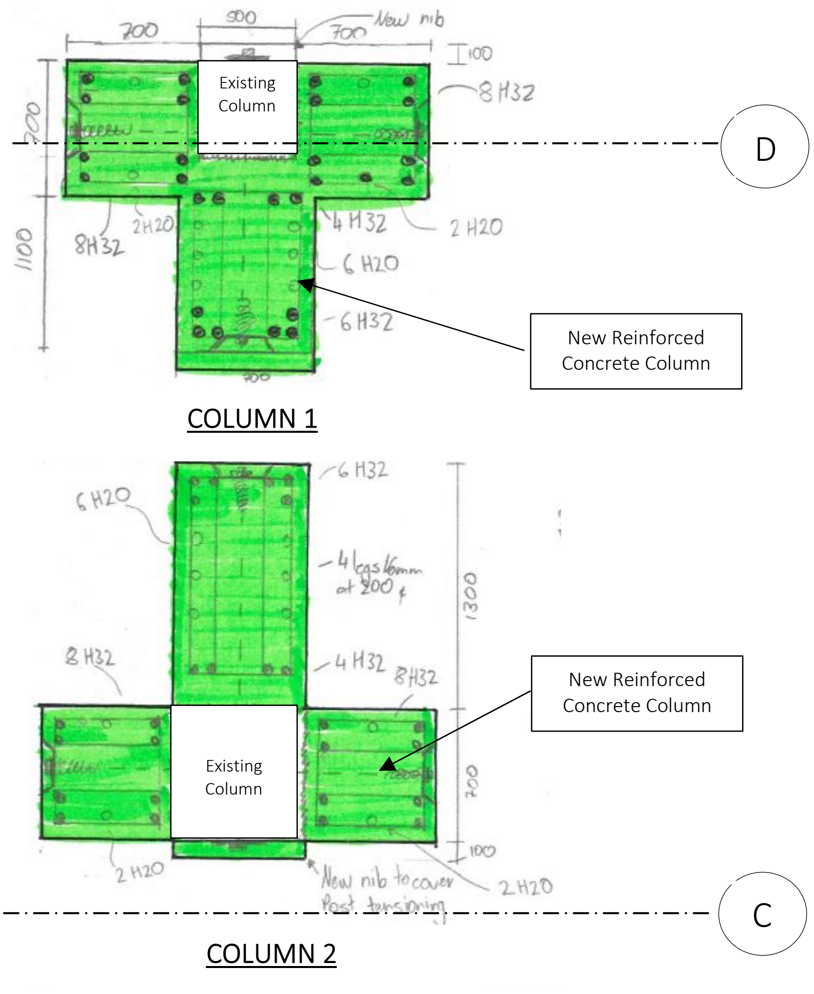


Figure 21: Proposed new column (shaded in green) showing attachment to existing column.

New longitudinal beams will be installed into the existing wall line for both the 34%NBS and 67%NBS solution. This will require the local demolition of the spandrel panel and reinforced concrete floor to allow installation of the new reinforced concrete beam. (Beam 1)

New transverse beams will be introduced for both the 34%NBS and 67%NMBS solution by removing the existing concrete encasement of the existing steel floor beams and local demolition of the existing reinforced concrete floor and replacing with a new reinforced concrete encasement. (Beam 2)

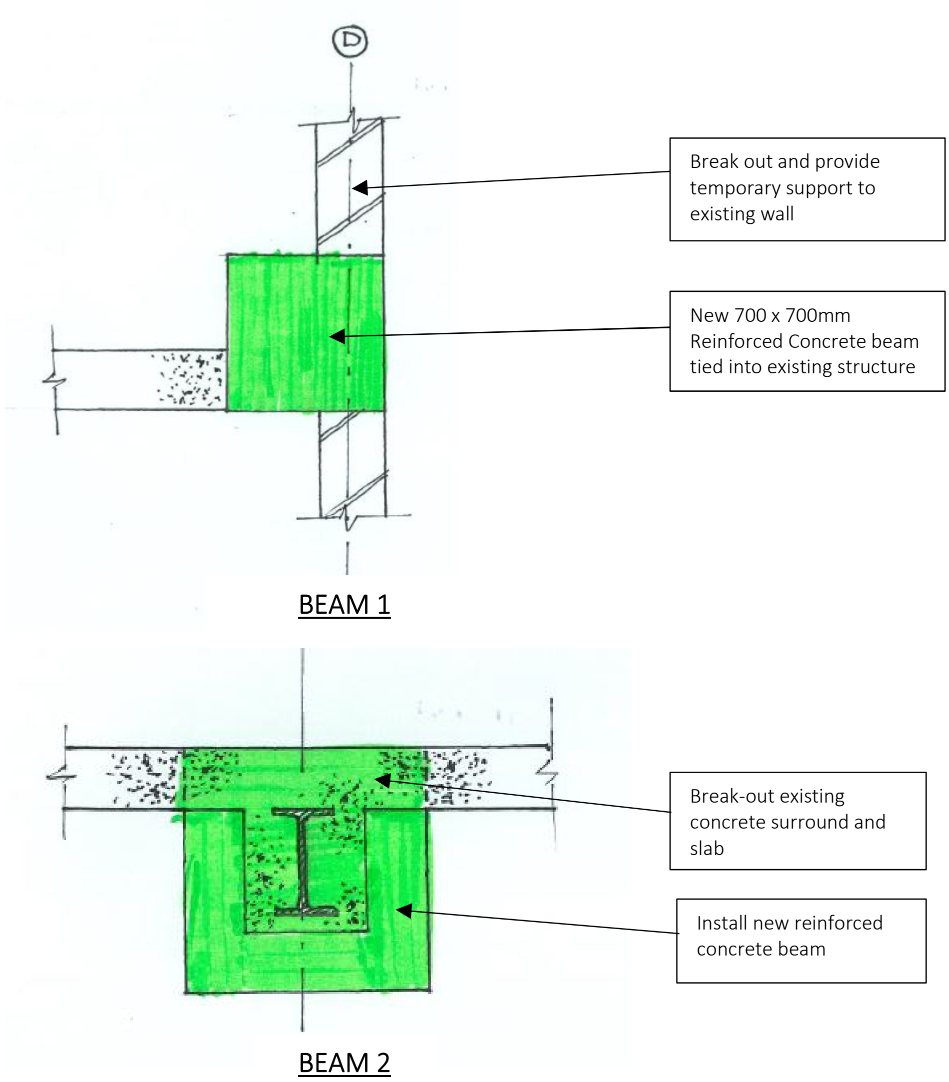


Figure 22: New Reinforced Concrete Beams (Beam 1- Longitudinal and Beam 2 - Transverse)

4.5.2 Lift Core

The beams connecting the lift core are vulnerable to shear failures and they provide restraint to the top of the lift core which acts as a cantilever. The significant mass of the lift core needs to be restrained by tying the lift into the floor diaphragm. This is achieved by 'drag bar' arrangement that is physically fixed into the lift shaft at each floor and embedded into the reinforced concrete floor, at each floor level. It is envisaged two drag bars and 3 carbon strips are required to each side of the lift shaft (4 drag bars and 6 carbon fibre strips at each of the four storey levels) to transfer this load into the floor slab.

The drag bars can be retrofitted directly to the concrete with minimal demolition but the carbon fibre strips will require removal of the top 50mm of concrete to allow placement of the strips into the cover zone. The slab in this area will therefore appear as new construction. This is required at 4 levels.

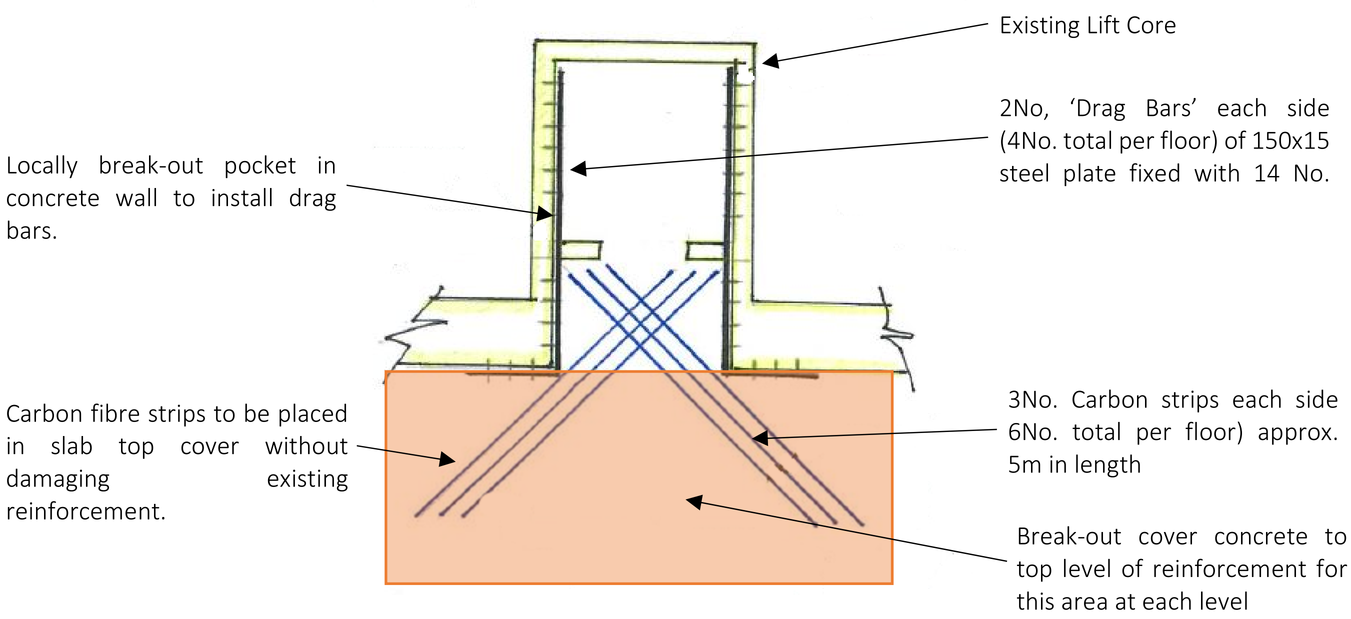


Figure 23: Lift Shaft Structural Tie Details – Typical level

4.5.3 Floor Diaphragm action

At the time of writing the previous reports, we were utilising the reinforced concrete slabs as structural diaphragms to transfer lateral load into the new frames. Subsequent intrusive investigation of the floor reinforcement found that the reinforcing bars were not continuous over the supporting beams. The ability to act as a full diaphragm is therefore compromised. This would need rectifying for both the 34%NBS and 67%NBS solutions. To those areas we are not installing any transverse or longitudinal beams, we will need to tie the existing floor into the perimeter wall. This can be achieved by either breaking out the concrete over the floor beams and installing required reinforcement, or by providing an alternative solution utilising the edge beams. This would require either breaking out the slab and installing reinforcing bars into the edge beam (Option 1) or fixing a steel angle to the underside of the slab to attain full connection (Option 2). Both methodologies will be disruptive and compromise the existing fabric of the building.

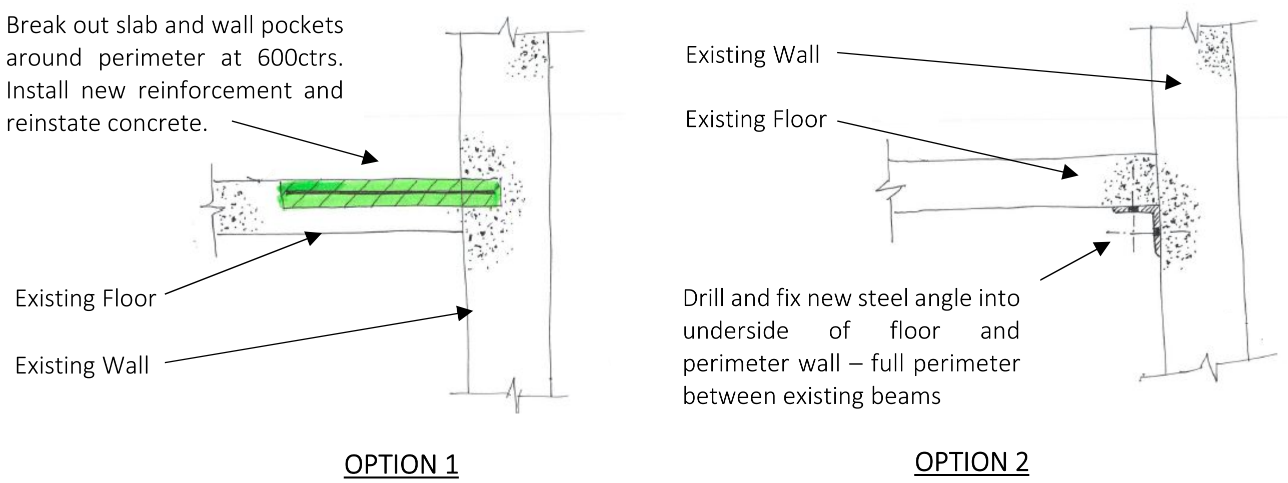


Figure 24: Edge connection details

4.6 Retaining Wall

The retaining wall to the North of the building is damaged and will require demolition and replacement. It may be possible to remove ancillary buildings, such as Tote, betting kiosks and stairs with the intention to reinstate them once the works are complete, but it should be accepted that some damage will occur and at least partial replacement of some items will be required. The red concrete podium area will also require at least partial removal to allow installation of the new retaining wall. It is unlikely a new concrete podium will match the existing colour so it may all have to be replaced.

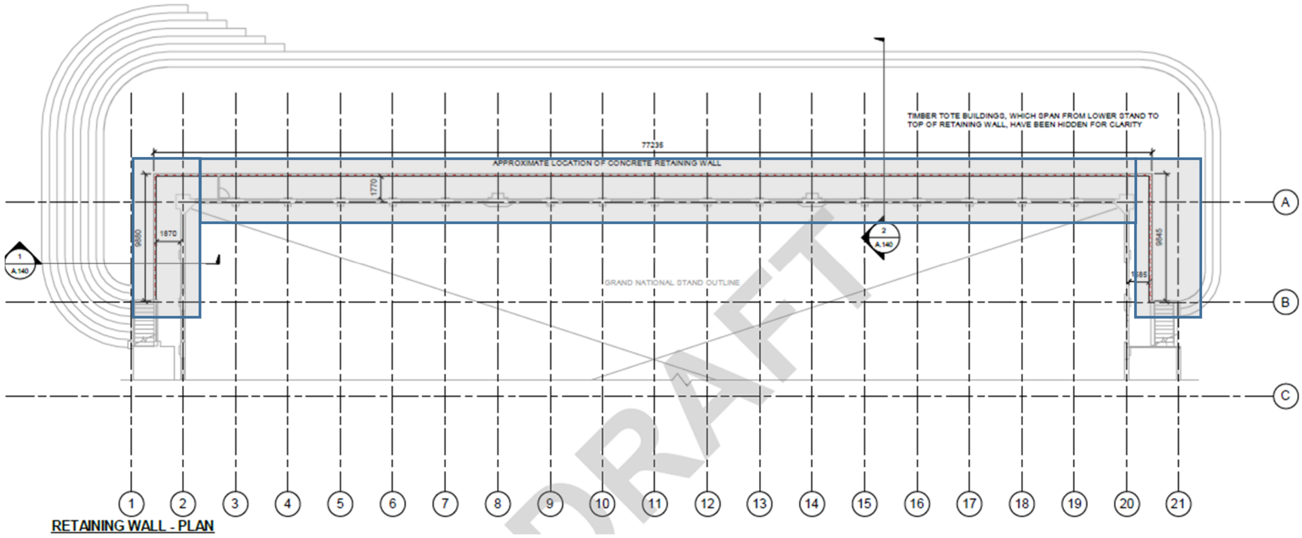


Figure 25: Retaining wall location plan

4.7 Access Ramps

The access ramps are damaged and will require repair and a seismic upgrade for both 34%NBS and 67%NBS solutions. However, any solution to upgrade the ramps is likely to be so extensive it is not considered feasible to strengthen the current structure and it is instead considered more practical to demolish and replace.

In any case, the existing ramps would not meet the accessibility requirement of an ***Accessible Route*** as defined in the New Zealand Building Code for the following reasons:

- Accessible ramps are limited to slope of 1:12. The current ramps have a slope section of approx. 1:7. Not only does this exceed the Accessible ramp limitation but even if it were classified as a Service Ramp it would still require footholds complying with Figure 8 and Table 4 of Acceptable Solution which they do not have.
- The existing ramps transfer to steps for the lower section. As drawn the stairs are at a pitch of 24°. Section 4.0 of D1/AS1 states that *stairs with a pitch line less than 23° do not permit a person to use the stair with an acceptable gait. Dangerous falls occur where the rhythm of movement is broken.* The ramps are therefore very close to minimum pitch but may gain compliance but not when considered as Accessible entry and egress.
- Table 5 and Figure 9 of the Building Code prescribe the landing geometry and limit the maximum height rise between landings to 750mm. The existing GNS access ramp has a maximum height rise of >3,700mm which greatly exceeds the reasonable maximum level difference for a person to negotiate in a wheelchair.

(Ref: MBIE – Acceptable Solutions and Verification Methods: D1 Access Routes)

It is therefore possible that, even with a repair, the ramp and stairway will not receive a Code Compliance Certificate unless another, compliant, accessible route was provided for.

At this stage it is not possible to determine the form a replacement ramp would take as it would require an up-to-date fire and accessibility report and careful consideration of ramp geometry. Suffice to say that any historical interest would be removed with the demolition of the existing ramps.

Further to this the seismic upgrade to the columns either side of the door openings are likely to reduce the opening width to not much greater than a single entry/exit door. This may have implications on fire egress over and above the compliance of the ramp geometry so a full fire assessment is likely to be required.

Figure 26: Access ramps (shown in red) to be demolished and replaced. Note – building is symmetrical – both ramps need to be replaced.

5 REPAIR WORKS

In addition to the seismic upgrade (34%NBS and 67%NBS) the building does require some earthquake repair works and general maintenance. The repair works below are as reported by AECOM in their report of 30 July 2015.

Generally, all walls need to be repaired for cracking and repainted both internally and externally.

5.1 Gable Walls

The gable walls at each end of the building have significant cracking and will require extensive repair. The seismic upgrade will remove the requirement for these walls to act as shear walls, so a simpler repair can be implemented. This will involve partial demolition to allow the installation of the new columns at this location. Subsequent to these works, they will require painting to obscure the remedial works from sight.

5.2 Stairs

The stairs on the south elevation can be retained and repaired with epoxy injection. If concrete is left exposed this will be a visible repair.

The stairs on the East and West elevations are damaged and will require replacement. Even if they could be repaired, it is likely that the works to demolish and replace the retaining wall will require their removal.

5.3 Timberworks

The timber on the lower and upper stands is reported to have significant borer damage and wet rot. The timber panelling and bleachers should be inspected by a timber specialist and replaced as required.

This advice was reported in July 2015. It is likely that this issue will have been further exacerbated since that time.

5.4 Steelworks

The steel in the upper stand columns supporting the upper stand display corrosion damage around the collar connection. They will need to have the paint coating removed and be inspected for loss of section.

The steel in the upper stand roof displays corrosion damage which will need to be carefully inspected and assessed. The corrosion reported is significant and it is likely that at least some members and/or connections will need to be replaced.

This advice was reported in July 2015. It is likely that this issue will have been further exacerbated since that time.

5.5 Window Frames

The window frames in the gable elevations are in an advanced dilapidated state and will require replacement as shown in Figure 27.

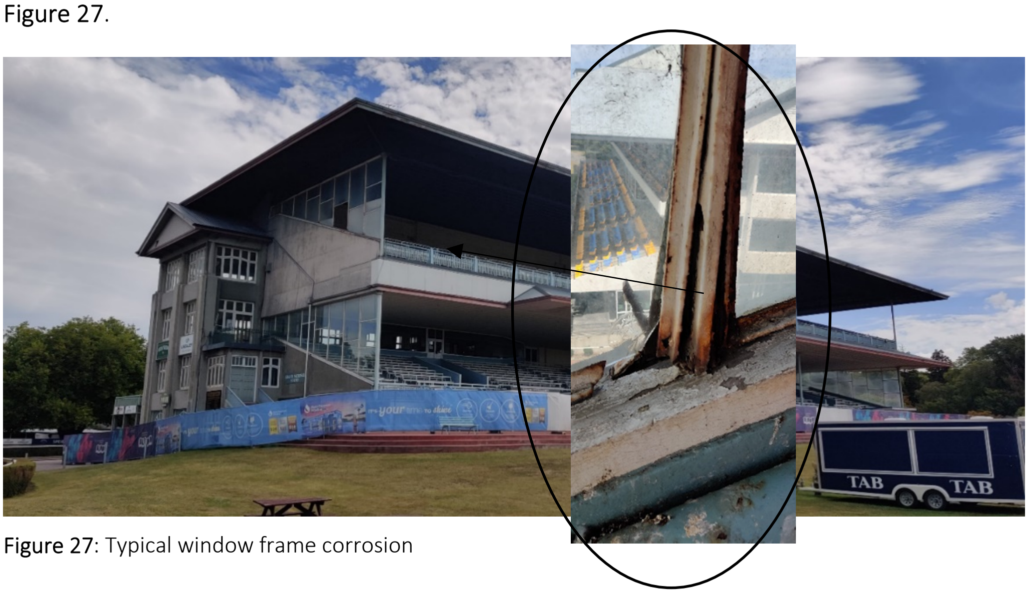


Figure 27: Typical window frame corrosion

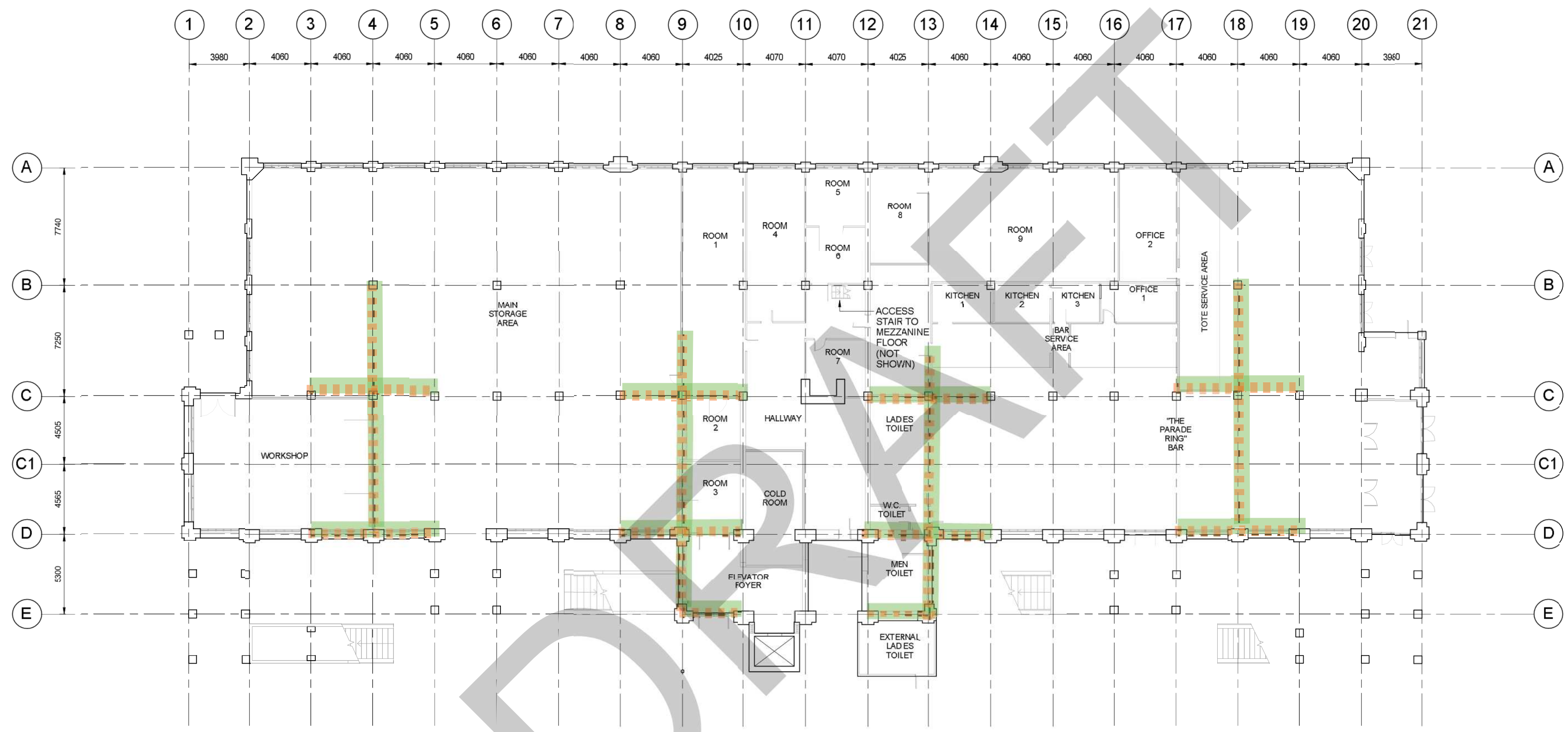
6 REFERENCES

No.	Company	Report Title	Date	Issue
1	AECOM	Grand National Stand – Detailed Damage Evaluation: 3D Response Spectrum, 3D Non-linear Pushover and Vertical Analysis	27/1/15	Draft
2	AECOM	Intrusive Investigation Report: Grand National (Public) Stand	14/4/15	1
3	AECOM	Damage Assessment Report: Grand National (Public) Stand	14/7/15	Draft
4	AECOM	Detailed Damage Evaluation (Quantitative Seismic Analysis of Grand National (Public) Stand	30/7/15	Draft
5	AECOM	Grand National Stand – Conceptual Retrofit Scheme to 34%NBS: Design Features Report	22/4/16	Draft

Table 2: References

Appendix A AECOM Concept Strengthening Sketches (34%NBS & 67%NBS)

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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60332326

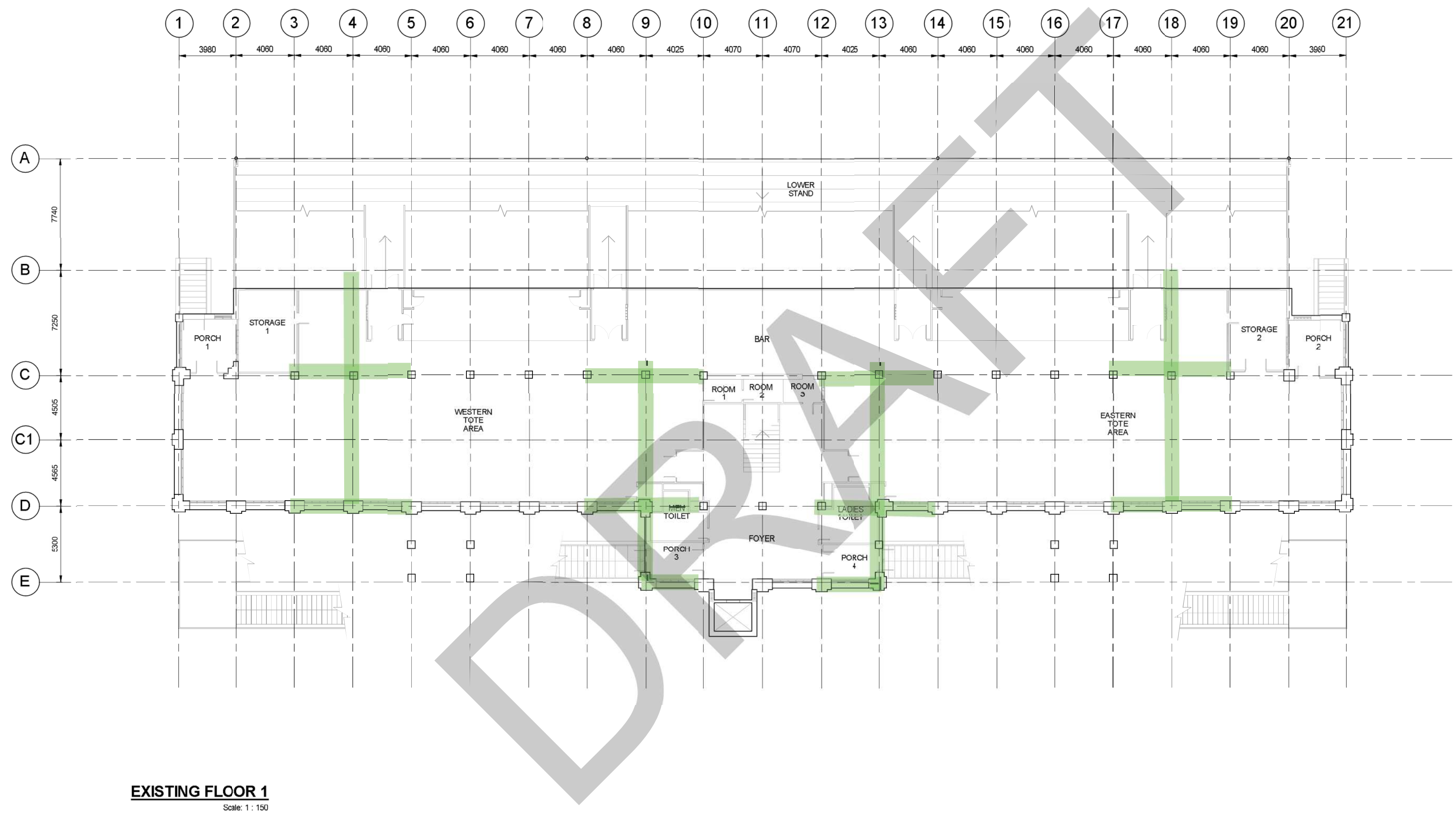
SHEET TITLE

34% Strengthening Plans Ground Level

SHEET NUMBER

60332326-DRG-C1

34%NBS concept strengthening option



EXISTING FLOOR 1

Scale: 1 : 150

New columns and beams

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34% Strengthening Plans
Level 1 to 4

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60332326-DRG-C2

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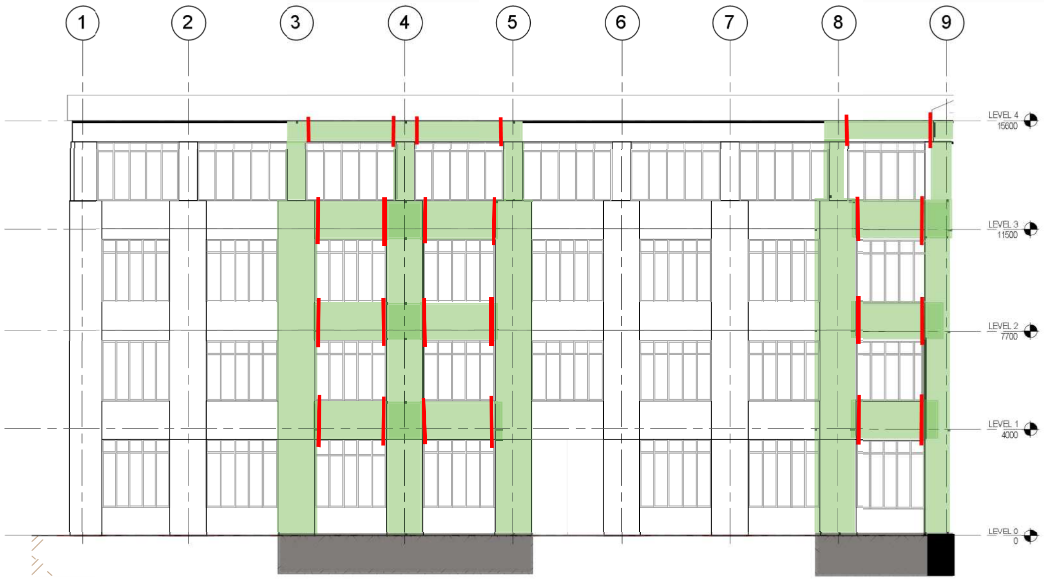

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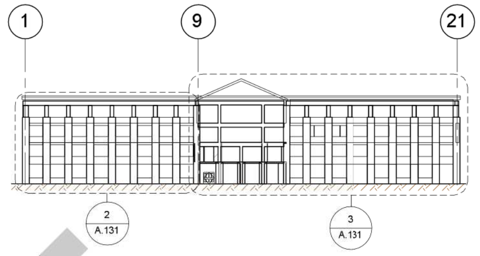

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34%NBS concept strengthening option

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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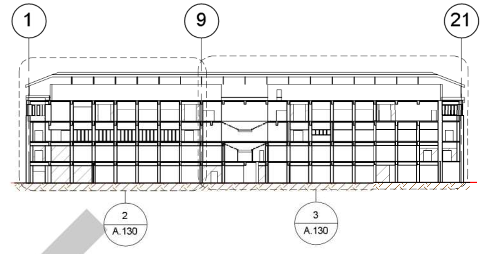

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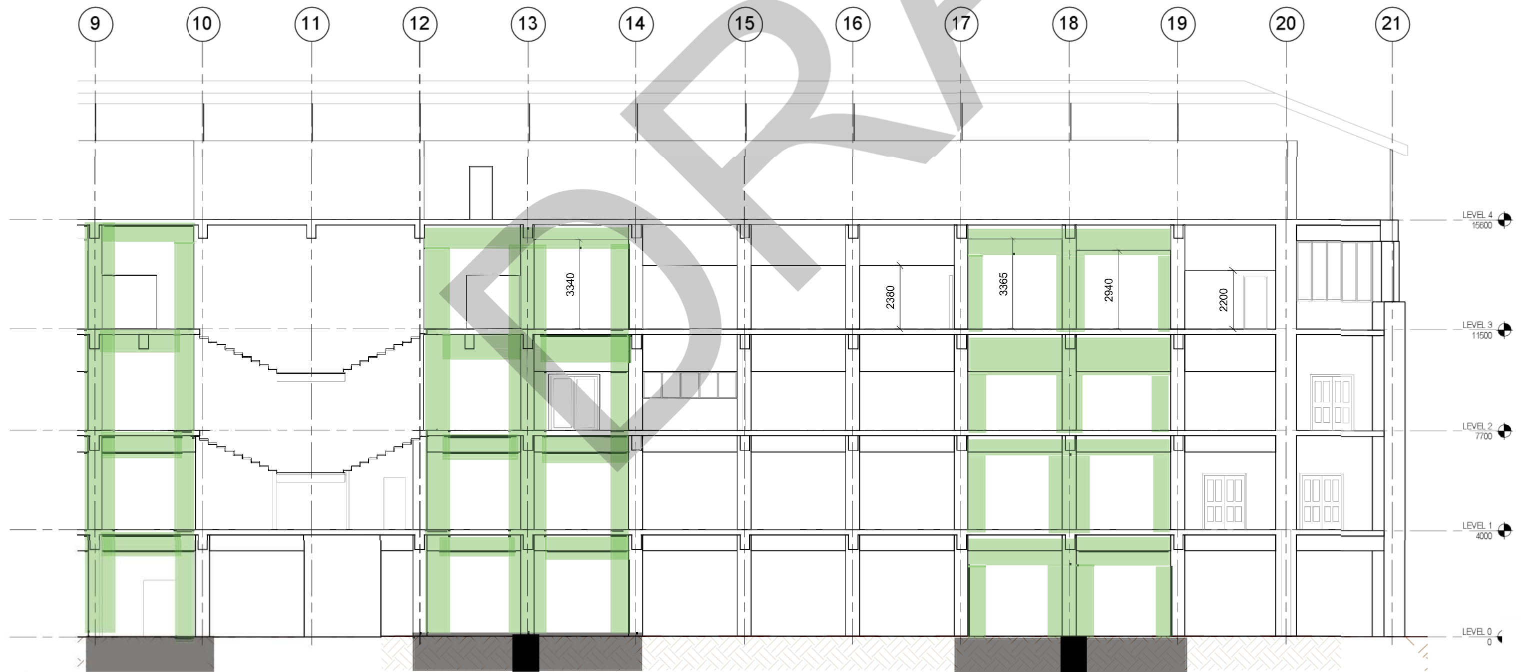
34%NBS concept strengthening option

New columns and beams

Foundation wall 1600 x 750mm



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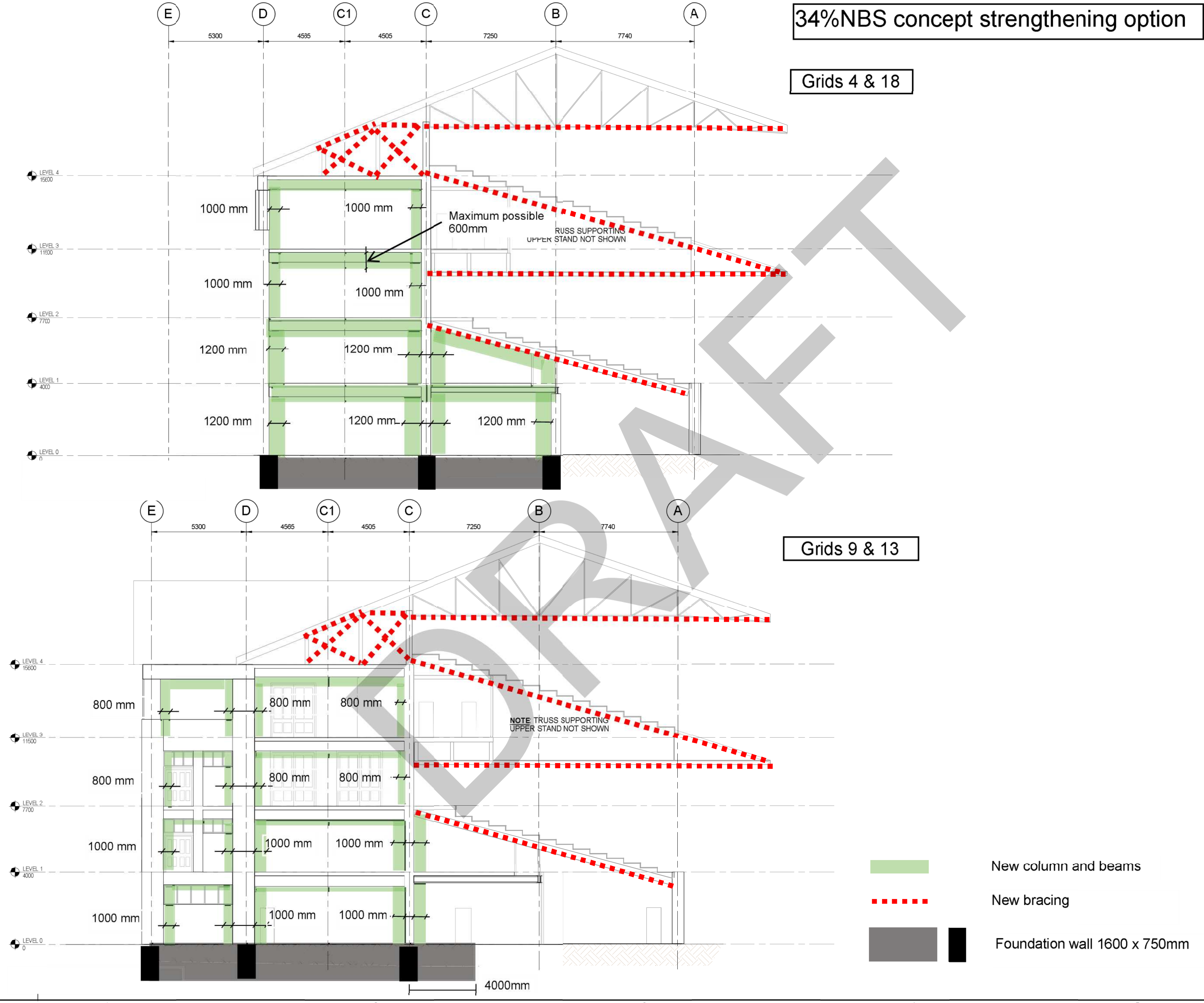
34%NBS concept strengthening option



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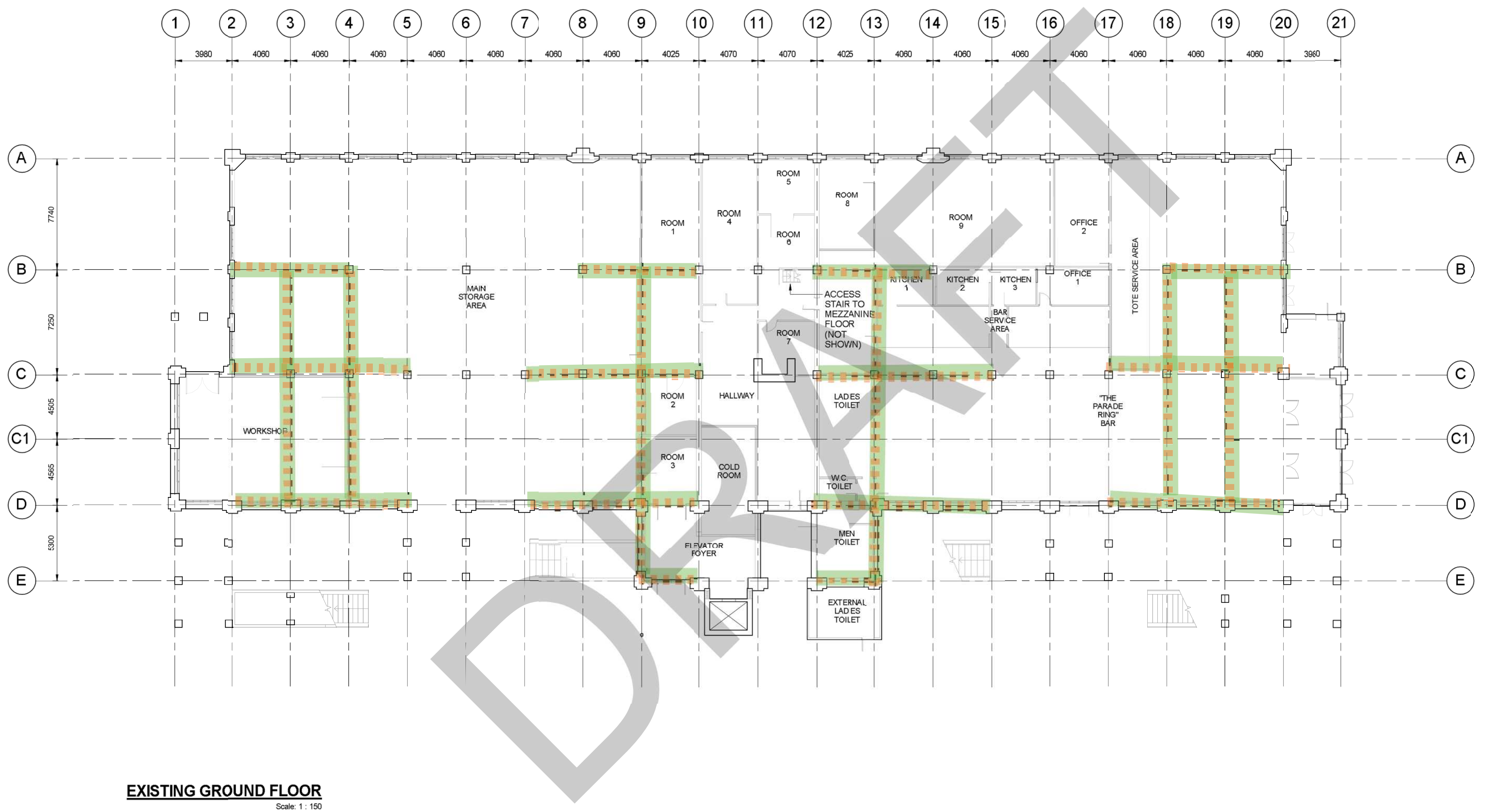
67%NBS concept strengthening option



EXISTING GROUND FLOOR

Scale: 1 : 150

Foundation works - 1800 x 750mm foundation wall

New columns and beams

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Ground Level

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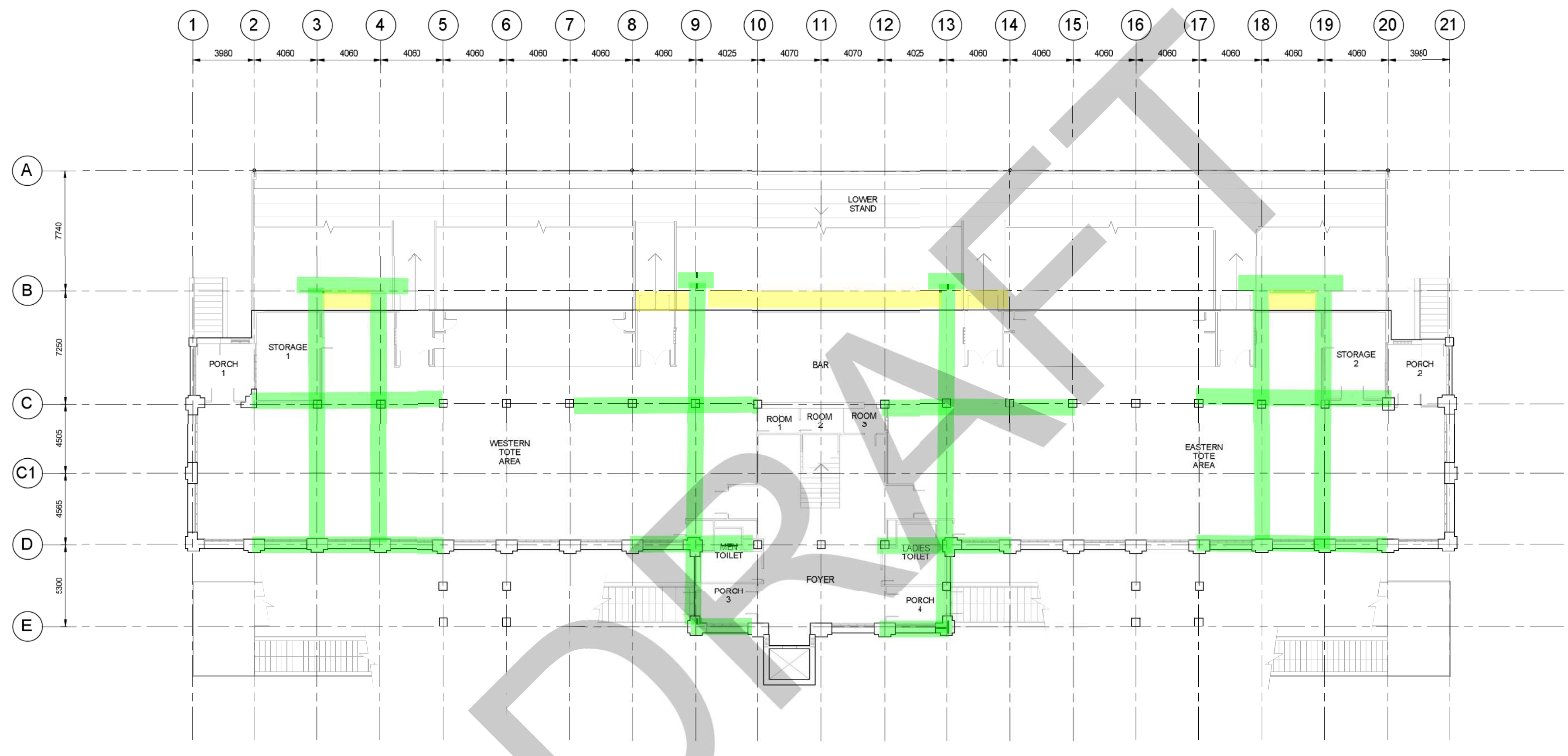

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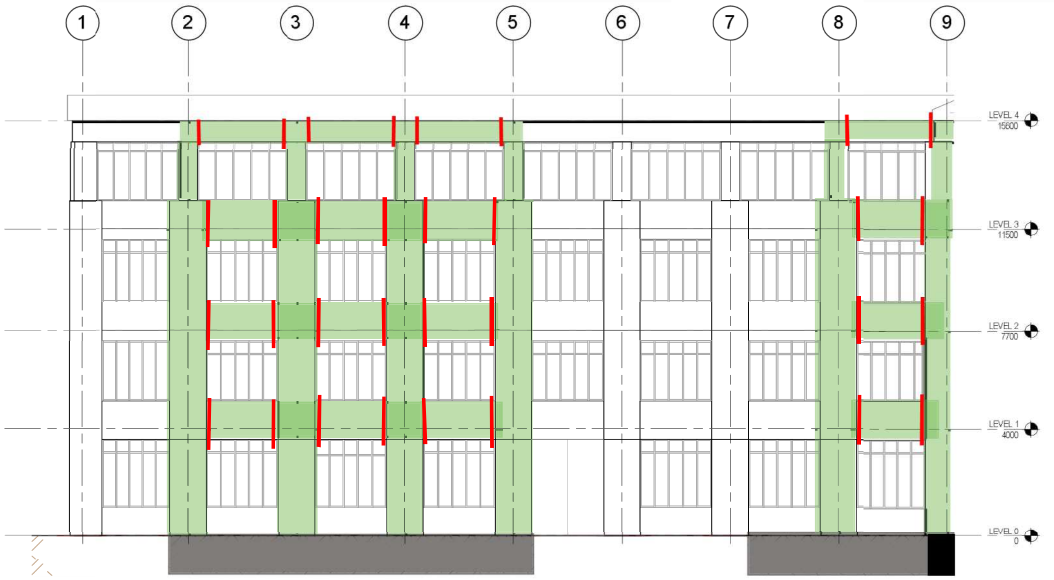

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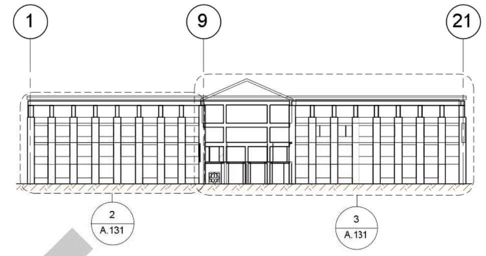

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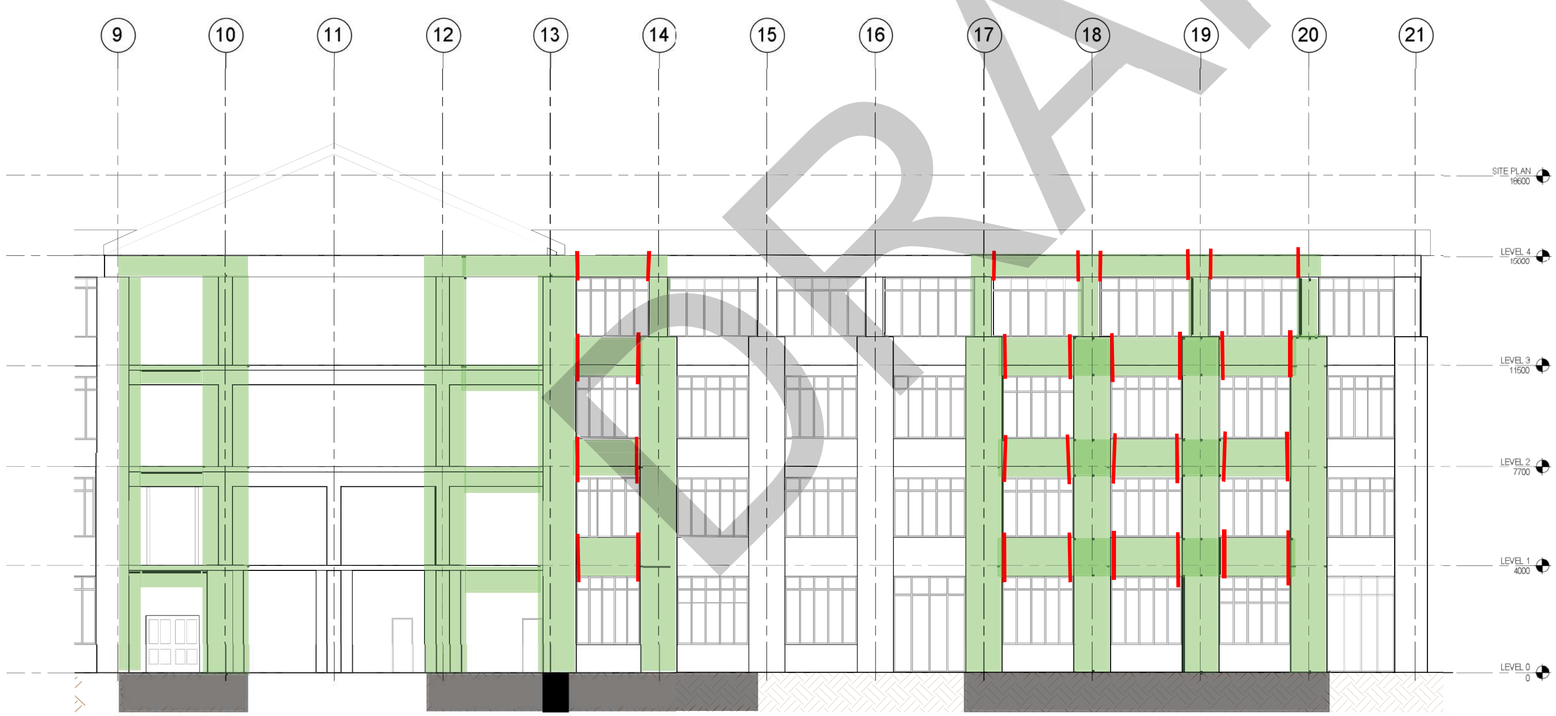
67%NBS concept strengthening option

New columns and beams

Cut existing spandrel beam

Foundation wall 1800 x 750mm



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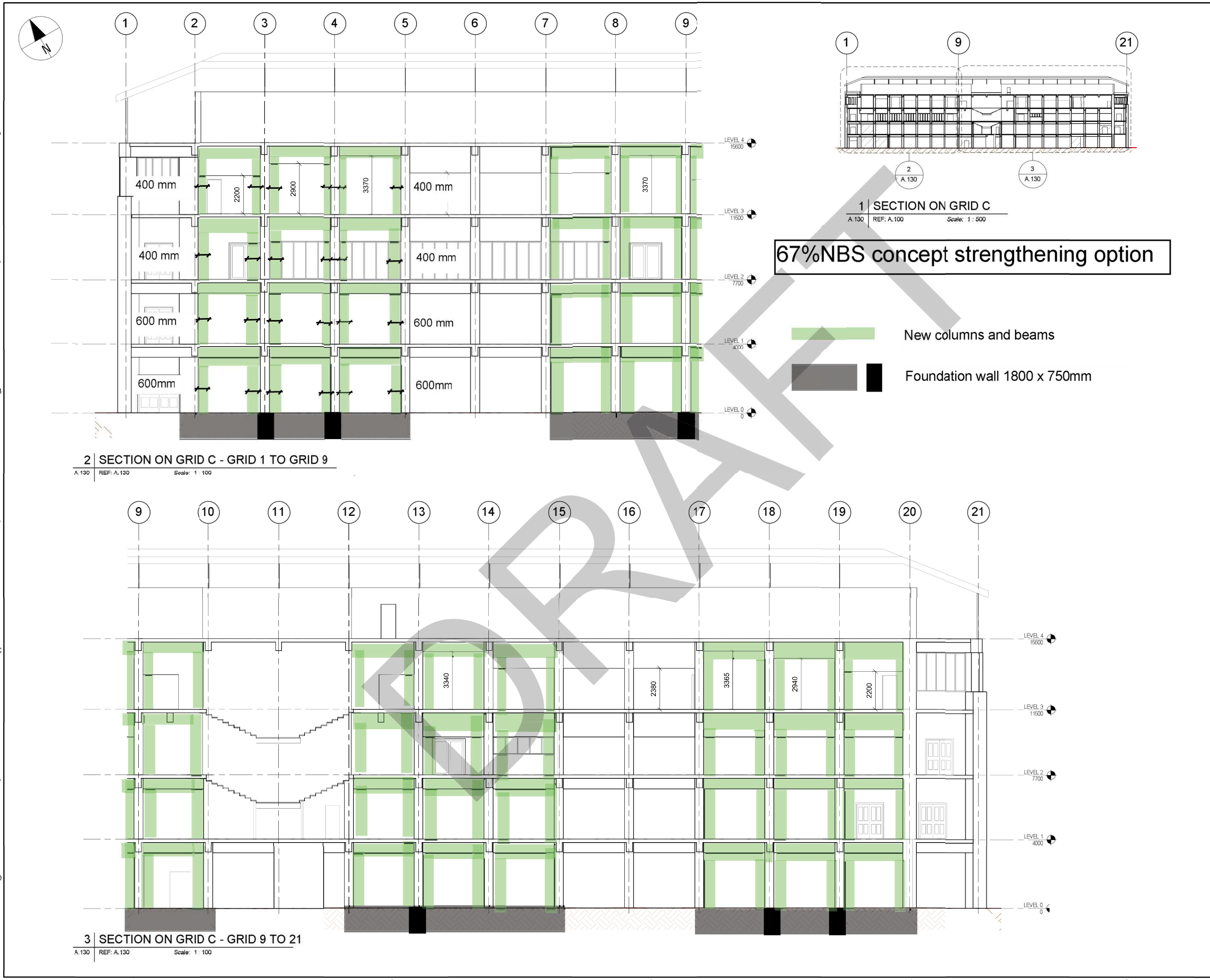

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67% Strengthening Plans Grid C

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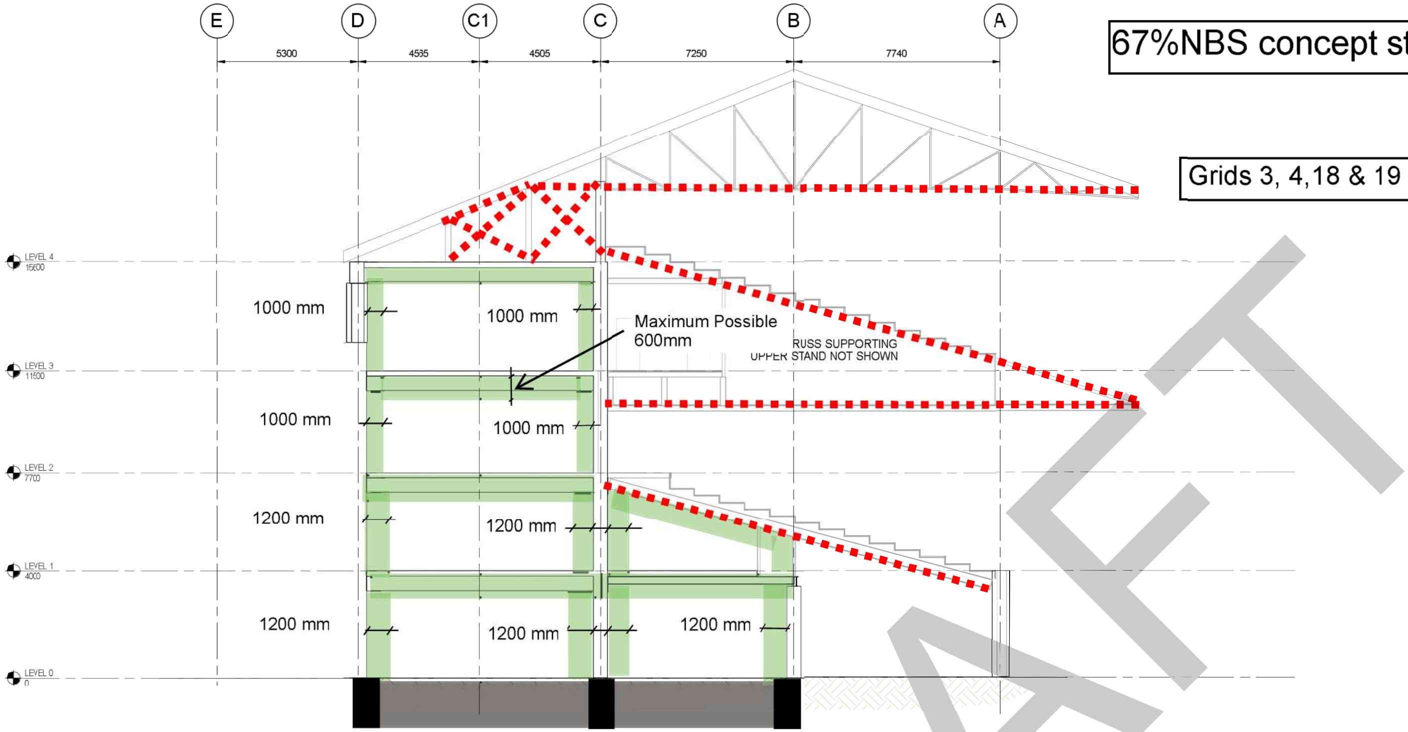
67%NBS concept strengthening option

Grids 3, 4,18 & 19



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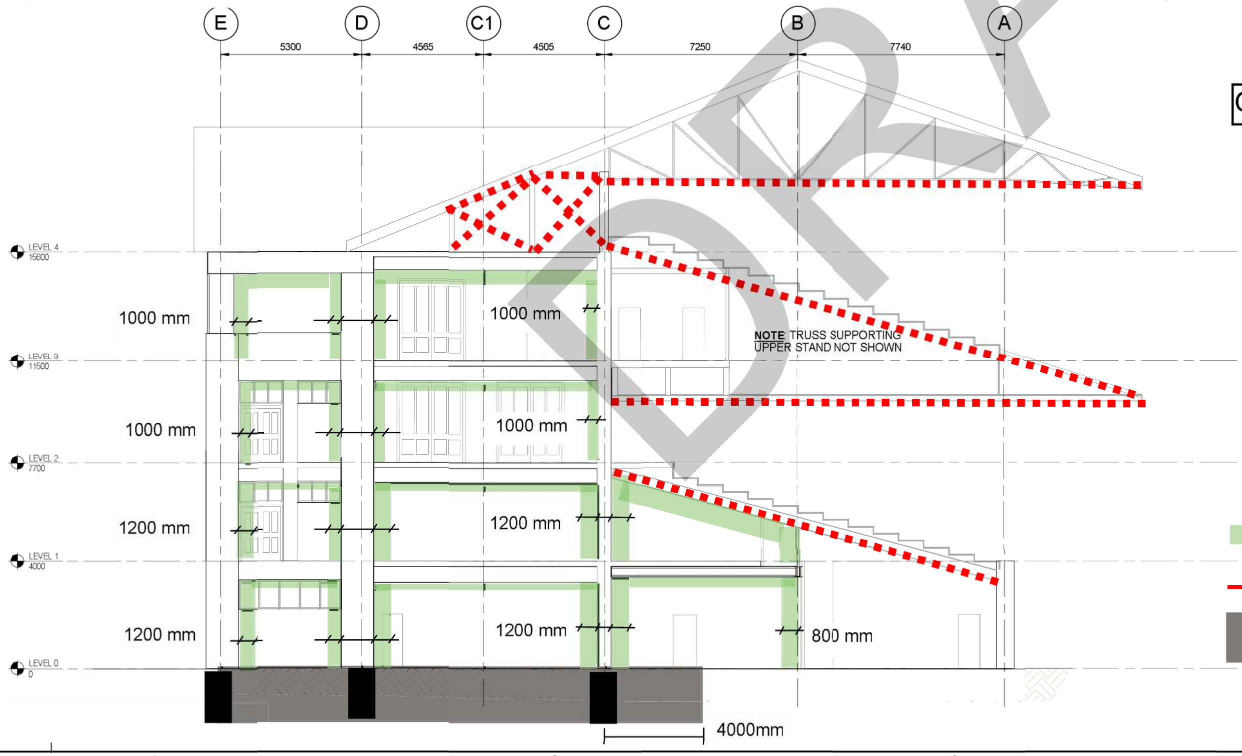

New columns and beams

New bracing

Foundation wall 1800 x 750mm

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Grid 3, 4, 9, 13, 18 & 19

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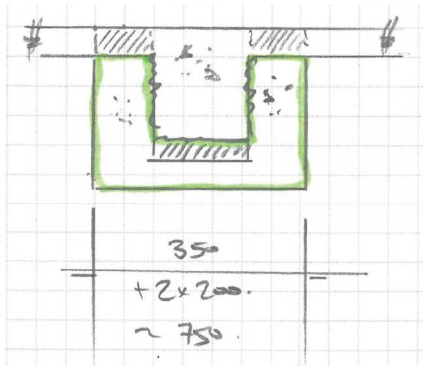
34% and 67%NBS concept strengthening options



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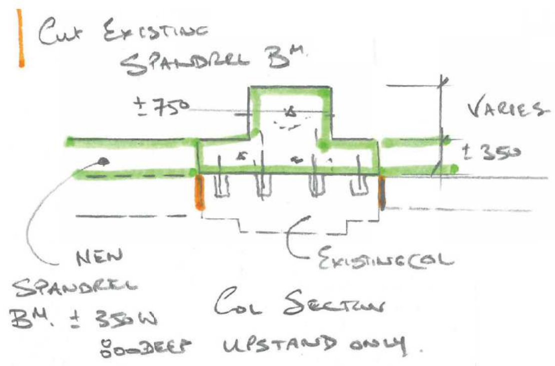

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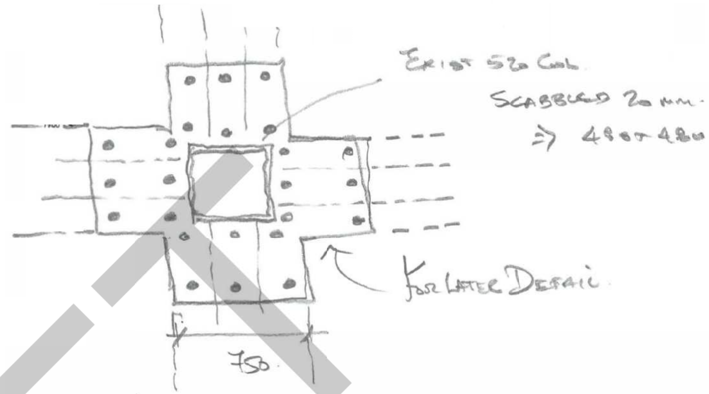

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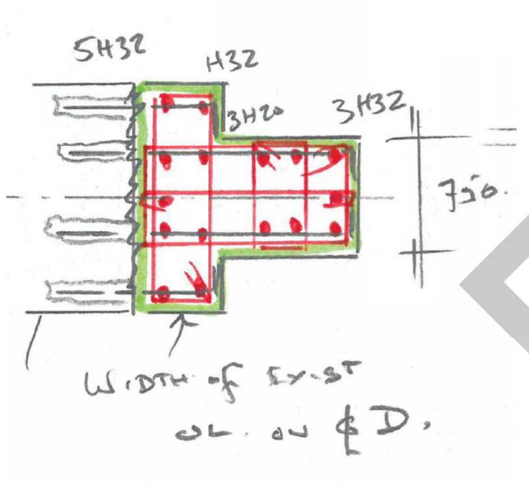
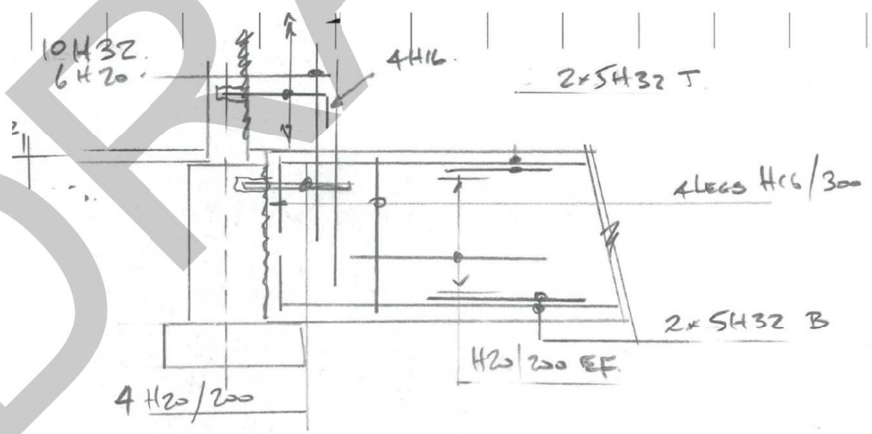


DETAIL 4
Section of concept foundation
wall and connection to existing
plinth
(N.T.S.)



DETAIL 5
Elevation of concept foundation
wall and connection to existing
plinth
(N.T.S.)

AECOM

PROJECT
STRUCTURAL ASSESSMENT GRAND NATIONAL STAND
CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT
CANTERBURY JOCKEY CLUB

CONSULTANT
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Christchurch, NZ 8024
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PROJECT MANAGEMENT INITIALS

CO	MF	CT
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION

KEY PLAN

PROJECT NUMBER
60332326

SHEET TITLE
34% & 67% Strengthening Details

SHEET NUMBER
60332326-DRG-C11

ISO A1 594mm x 841mm
Last Saved: 1/07/2015 11:02:17 a.m.
Filename: C:\Users\PettiC\Desktop\60332326_MOD_ST_2014_PettiC(Recovery).rvt

Appendix B AECOM Concept Retrofit Scheme Drawings (34%NBS)

GRAND NATIONAL STAND

STRUCTURAL SKETCH LIST

DRG-101 DEMOLITION PLAN - LEVEL 0
DRG-102 DEMOLITION PLAN - LEVEL 1 TO 3
DRG-103 DEMOLITION PLAN - LEVEL 4
DRG-104 PROPPING LAYOUT - SHEET 1
DRG-105 PROPPING LAYOUT - SHEET 2
DRG-201 SHEAR FAILURE REMEDIATION. SHEET 1. LIFT CORE
DRG-202 SHEAR FAILURE REMEDIATION. SHEET 2
DRG-301 NEW FOUNDATION LAYOUT
DRG-302 NEW COLUMN LAYOUT. LEVEL 0 TO 4
DRG-501 SECTION - SHEET 1. GRIDLINE D
DRG-502 SECTION - SHEET 2. GRIDLINE C
DRG-503 SECTION - SHEET 3. TRANSVERSE SECTION
DRG-601 DETAILS - SHEET 1
DRG-602 DETAILS - SHEET 2
DRG-603 DETAILS - SHEET 3

FOR PRICING ONLY

GRAND NATIONAL STAND CONCEPTUAL RETROFIT SCHEME TO 34%NBS

CANTERBURY JOCKEY CLUB, RICCARTON PARK, RACECOURSE ROAD, CHRISTCHURCH

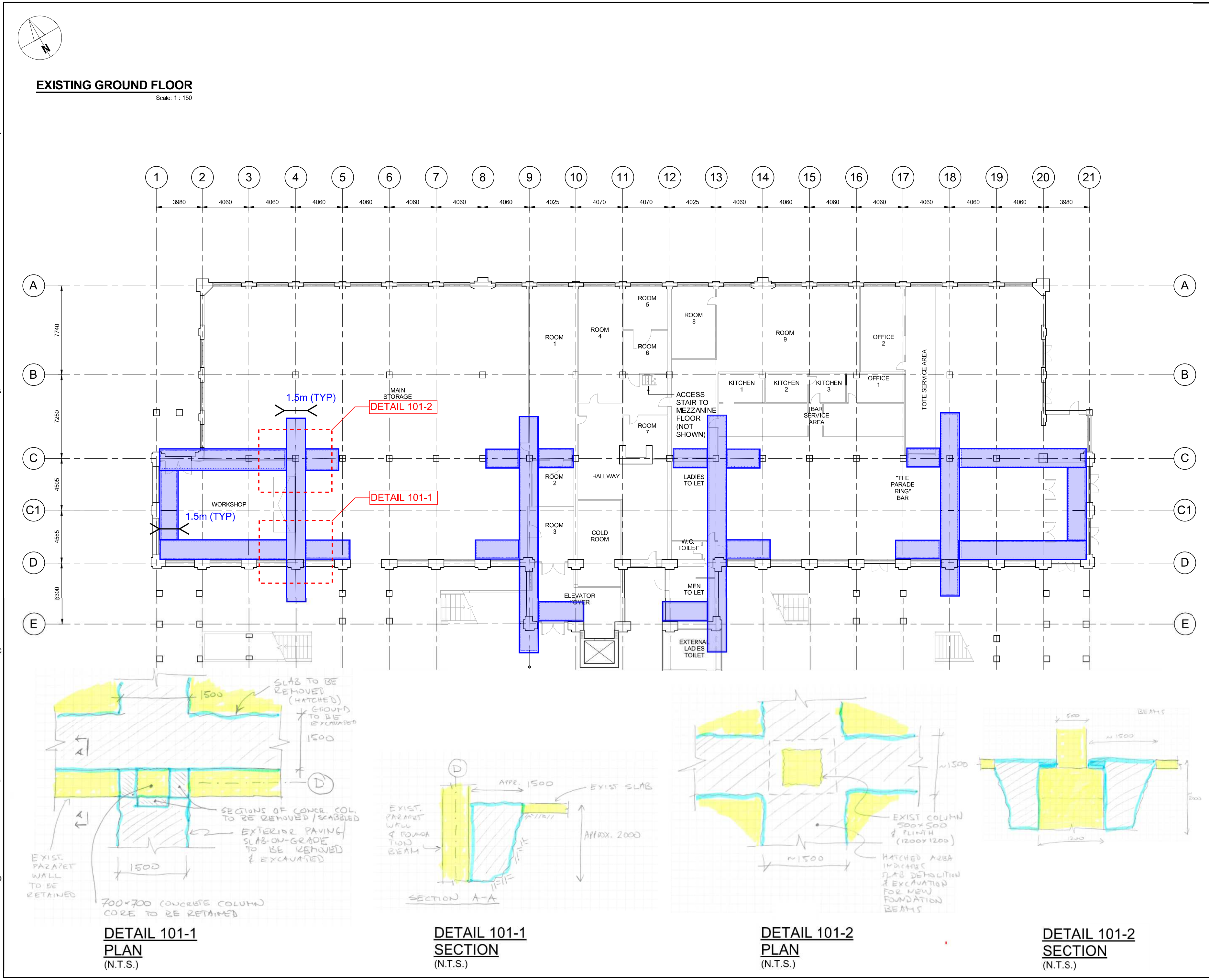
Issued for pricing 18/04/2016

ISSUE/REVISION

I/R	DATE	DESCRIPTION
A	22/04/2016	ISSUED FOR PRICING
-	18/04/2016	ISSUED FOR PRICING

AECOM

60439900



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GRAND NATIONAL STAND CONCEPTUAL RETROFIT SCHEME

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT

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CONSULTANT

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Key

AREAS TO DEMOLISH

PROJECT MANAGEMENT INITIALS

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A	22/4/2016	ISSUED FOR PRICING
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KEY PLAN

PROJECT NUMBER

60439900

SHEET TITLE

DEMOLITION PLAN - LEVEL 0

SHEET NUMBER

60439900 DRG-101

ISO A1 594mm x 841mm
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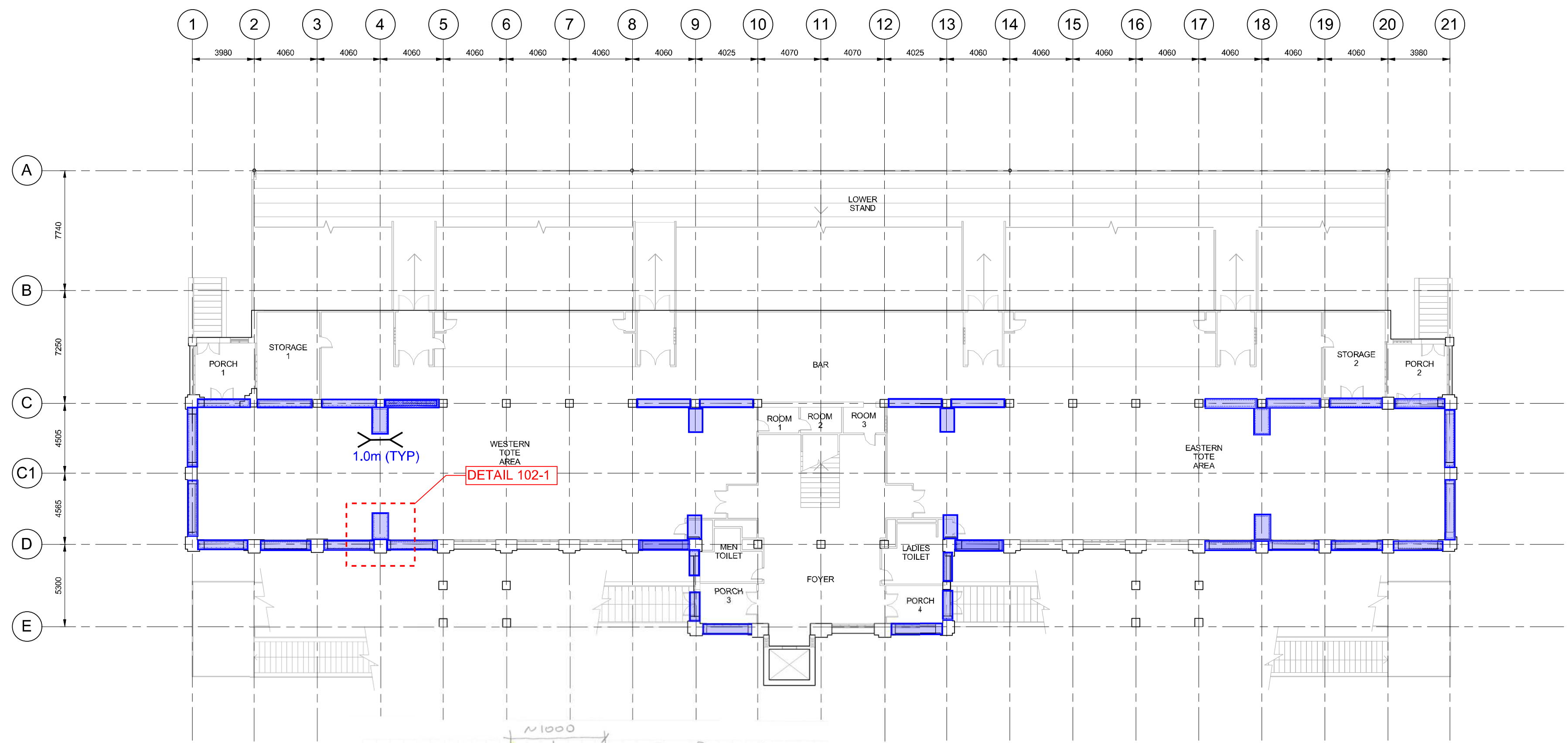
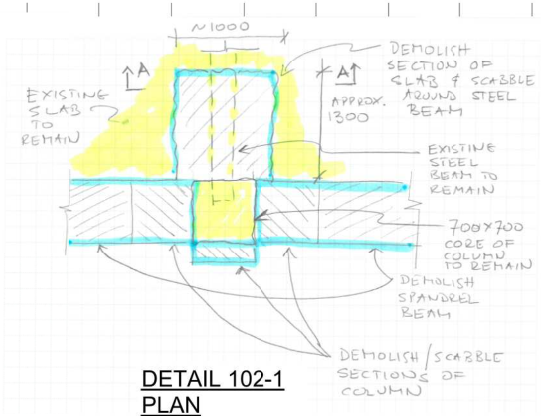


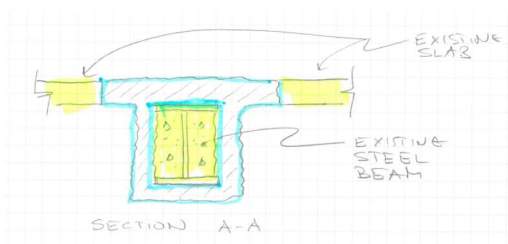
EXISTING FLOOR 1

Scale: 1 : 150

DETAILS ALSO APPLICABLE TO FLOOR 2 AND 3



DETAIL 102-1
PLAN
(N.T.S.)



DETAIL 102-1
SECTION
(N.T.S.)

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GRAND NATIONAL STAND CONCEPTUAL RETROFIT SCHEME
CANTERBURY JOCKEY CLUB, CHRISTCHURCH

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KEY PLAN

PROJECT NUMBER
60439900

SHEET TITLE
DEMOLITION PLAN - LEVEL 1 TO 3

SHEET NUMBER
60439900-DRG-102

ISO A1 594mm x 841mm

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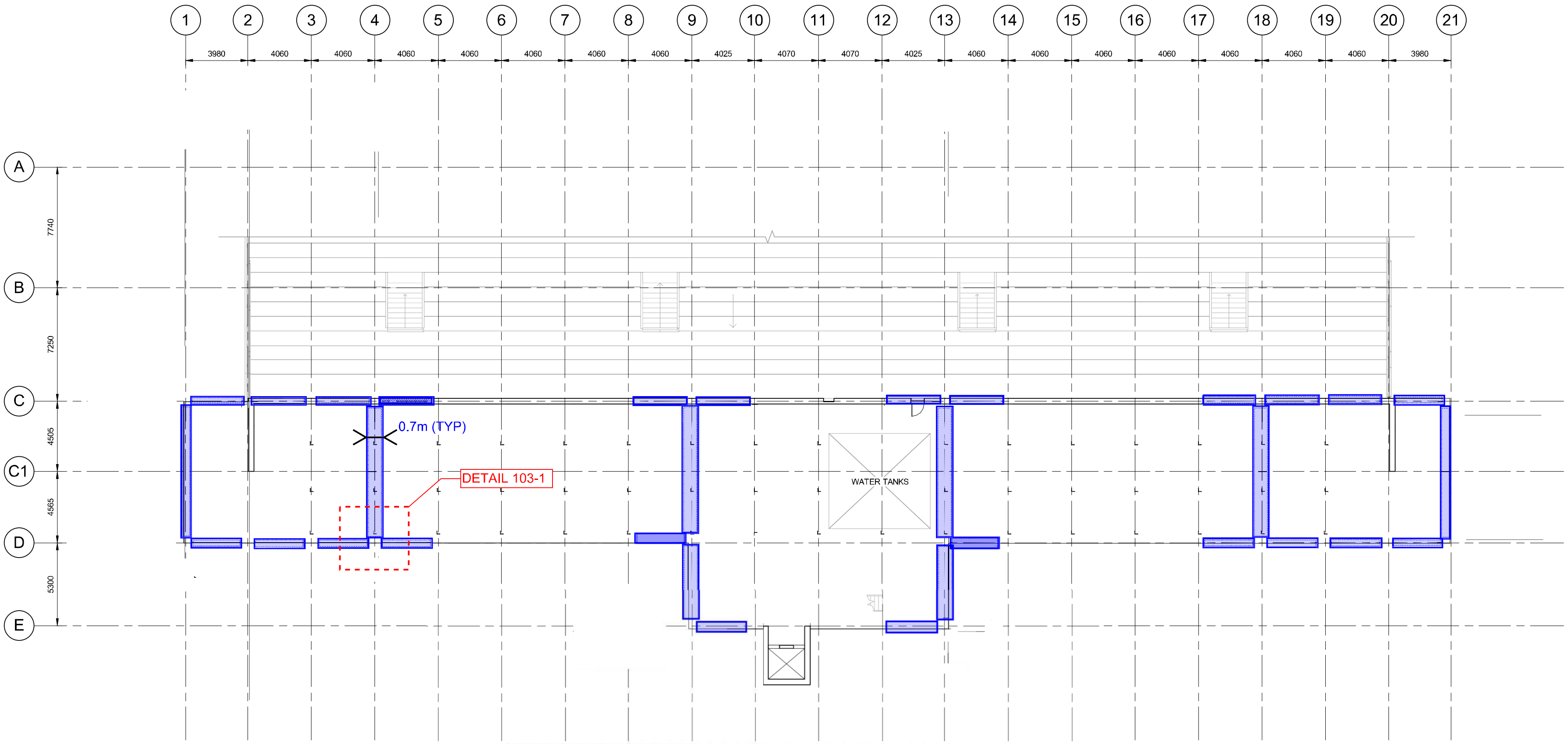
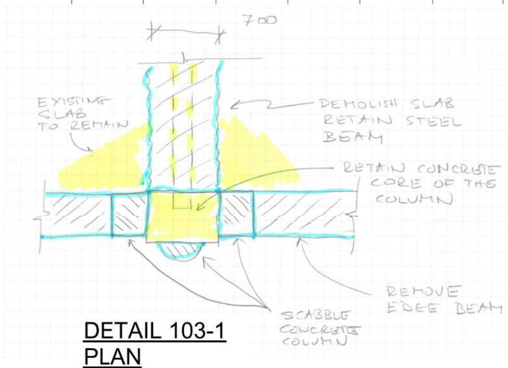


EXISTING FLOOR 4

Scale: 1 : 150



DETAIL 103-1 PLAN

(N.T.S.)

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GRAND NATIONAL STAND CONCEPTUAL RETROFIT SCHEME

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT

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Prepared for:

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DESIGNER	CHECKED	APPROVED

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I/R	DATE	DESCRIPTION
A	18/4/2016	ISSUED FOR PRICING

KEY PLAN

PROJECT NUMBER

60439900

SHEET TITLE

DEMOLITION PLAN - LEVEL 4

SHEET NUMBER

60439900-DRG-103

ISO A1 594mm x 841mm

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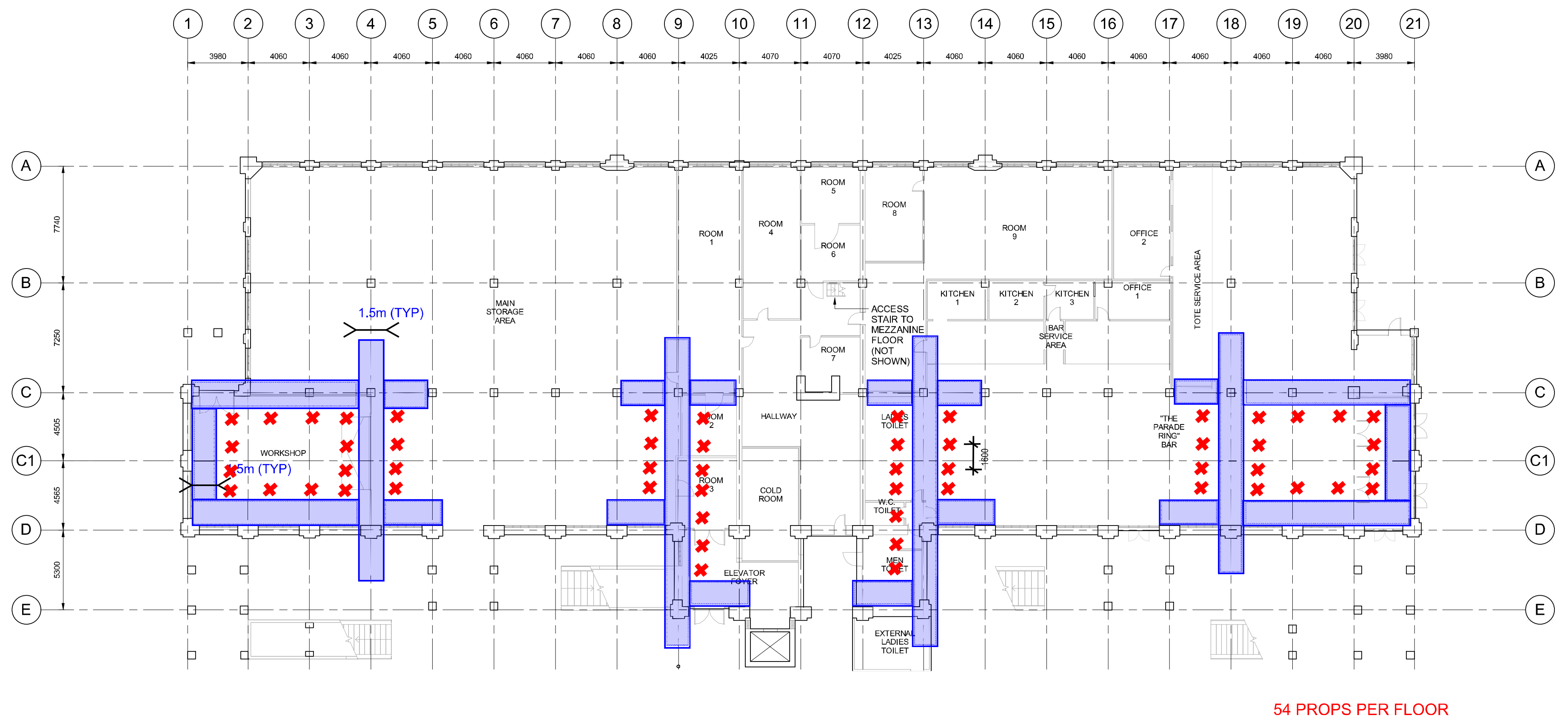
EXISTING GROUND FLOOR

Scale: 1 : 150



PROJECT

GRAND NATIONAL STAND CONCEPTUAL RETROFIT SCHEME

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT

CANTERBURY JOCKEY CLUB

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Key

AREAS TO DEMOLISH

PROP LOCATION

PROJECT MANAGEMENT INITIALS

MC	NR	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
A	22/4/2016	ISSUED FOR PRICING
-	18/4/2016	ISSUED FOR PRICING

KEY PLAN

PROJECT NUMBER

60439900

SHEET TITLE

PROPPING LAYOUT - SHEET 1

SHEET NUMBER

60439900 DRG-104

ISO A1 594mm x 841mm

Last Saved: 23/07/2015 9:19:57 a.m.
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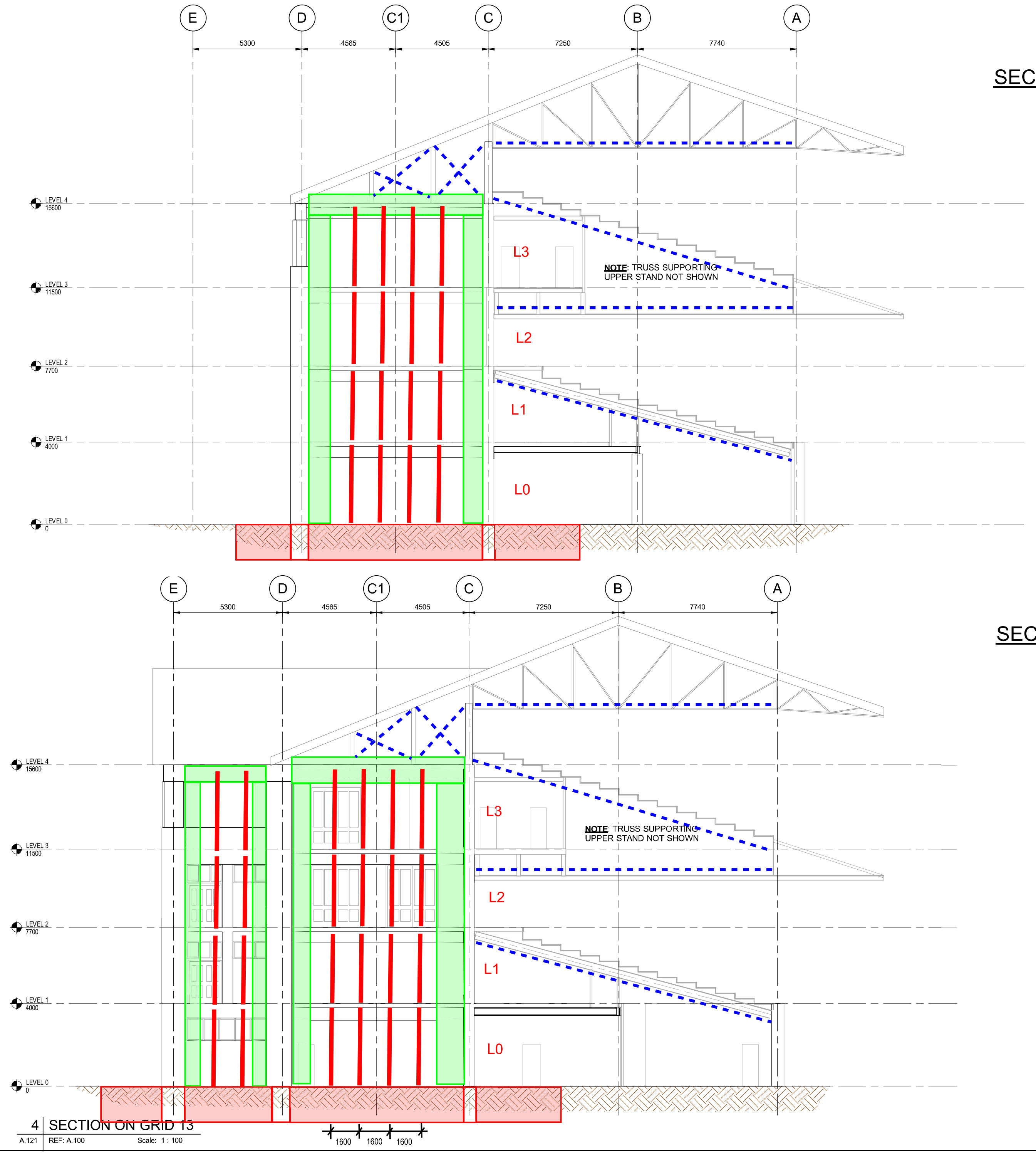
SECTION ON GRIDS 4 & 18



SECTION ON GRIDS 9 & 13

4 SECTION ON GRID 13

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

PROP	SAFE WORKING LOAD (SWL) UNFACTORED
L0	100 kN
L1	75 kN
L2	50 kN
L3	25 kN

AECOM

PROJECT

GRAND NATIONAL STAND CONCEPTUAL RETROFIT SCHEME

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT

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NEW FOUNDATION BEAM

NEW "SUPER COLUMNS" AND BEAMS

NEW TENSION BRACING 32mm REID BRACE

PROP LOCATION

PROJECT MANAGEMENT INITIALS

MC	NR	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
A	22/4/2016	ISSUED FOR PRICING
-	18/4/2016	ISSUED FOR PRICING

KEY PLAN

PROJECT NUMBER

60439900

SHEET TITLE

PROPPING LAYOUT - SHEET 2

SHEET NUMBER

60439900-DRG-105

ISO A1 594mm x 841mm

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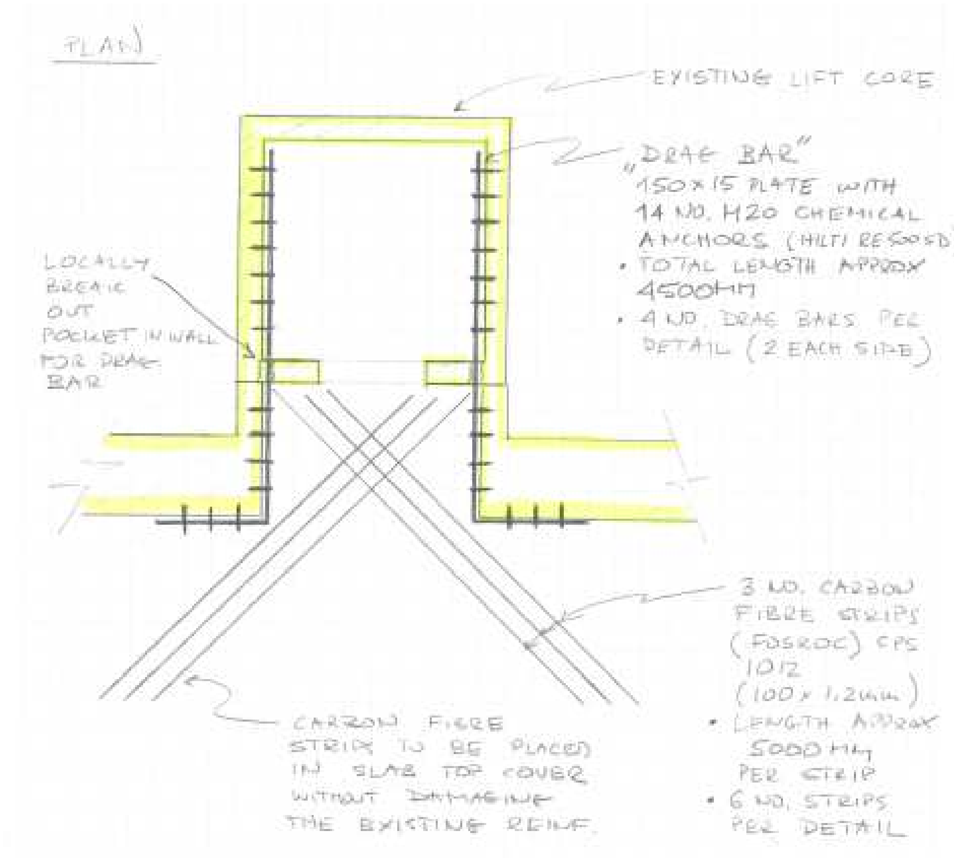
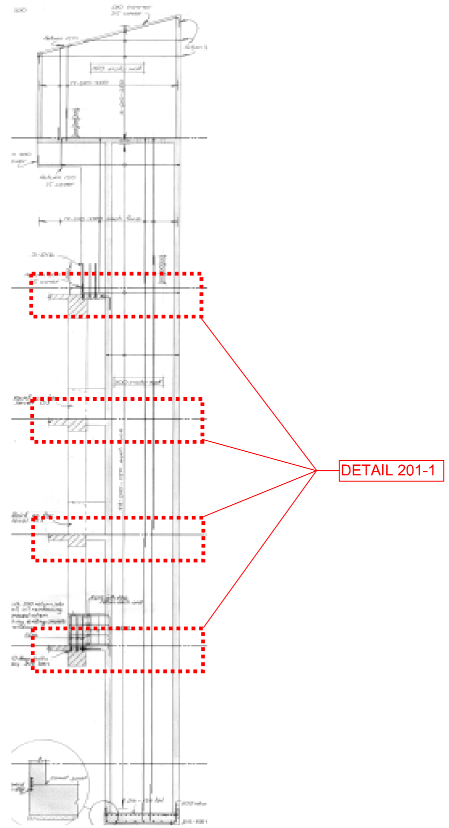


DETAIL 201-1
Conceptual retrofit for liftcore shaft
4no. locations in total (level 1 to 4)
(N.T.S.)



LIFT CORE
DETAIL 201-1 locations

(N.T.S.)

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GRAND NATIONAL STAND CONCEPTUAL RETROFIT SCHEME
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PROJECT MANAGEMENT INITIALS

NR	CO	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
-	18/4/2016	ISSUED FOR PRICING

KEY PLAN

PROJECT NUMBER
60439900

SHEET TITLE
SHEAR FAILURE REMEDIATION
SHEET 1
LIFT CORE

SHEET NUMBER
60439900-DRG-201

ISO A1 594mm x 841mm
Last Saved: 1/07/2015 11:02:17 a.m.
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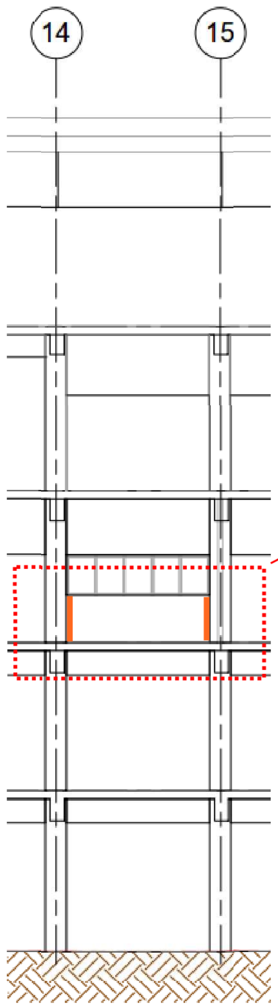
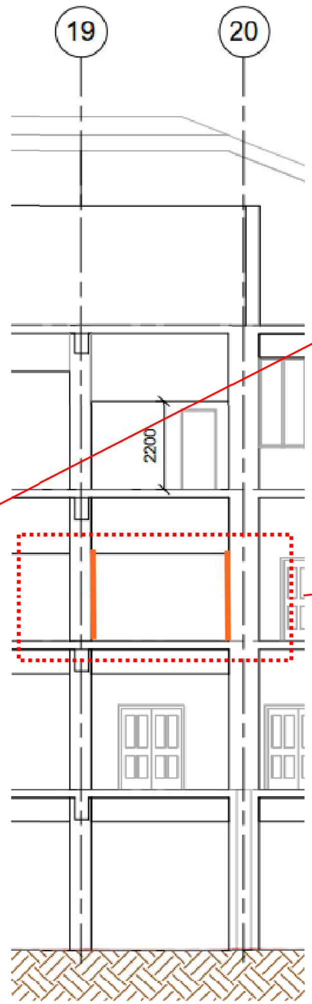


SECTION ON GRID C (14-15)
Cut slots in the parapet beam
adjacent to the columns
Level 2
(N.T.S.)



SECTION ON GRID C (19-20)
Cut slots in the infill wall
adjacent to the columns.
Provide brackety for out-of-plane loads
Level 2
(N.T.S.)

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.

AECOM

PROJECT
GRAND NATIONAL STAND CONCEPTUAL RETROFIT SCHEME
CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT
CANTERBURY JOCKEY CLUB

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PROJECT MANAGEMENT INITIALS

NR	MF	CT
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
-	18/4/2016	ISSUED FOR PRICING

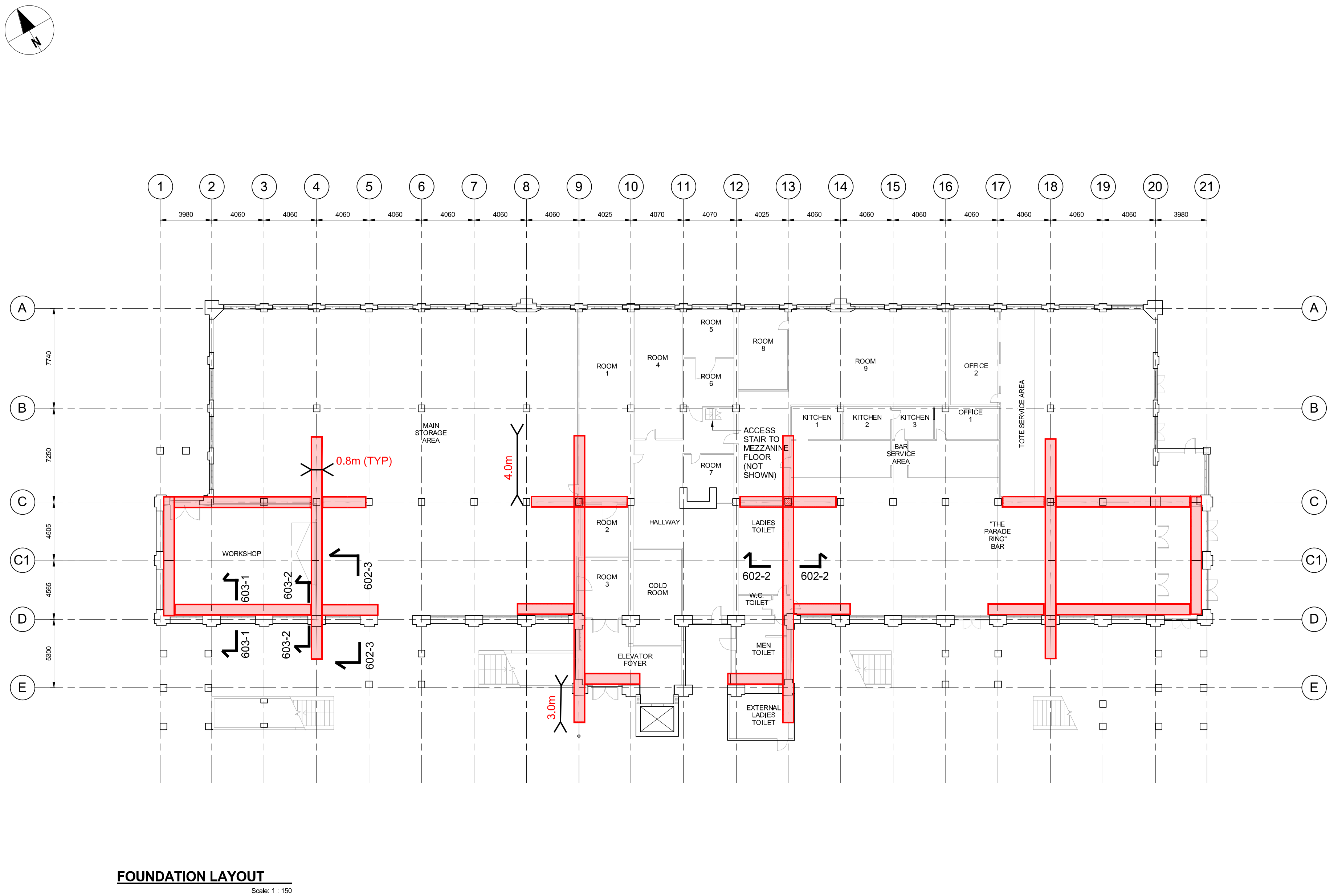
KEY PLAN

PROJECT NUMBER
60439900

SHEET TITLE
SHEAR FAILURE REMEDIATION SHEET 2

SHEET NUMBER
60439900-DRG-202

ISO A1 594mm x 841mm
Last Saved: 1/07/2015 11:02:17 a.m.
Filename: C:\Users\PettiC\Desktop\60332226_MOD_ST_2014_PettiC(Recovery).rvt



FOUNDATION LAYOUT

Scale: 1 : 150

AECOM

PROJECT

GRAND NATIONAL STAND CONCEPTUAL RETROFIT SCHEME

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT

CANTERBURY JOCKEY CLUB

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Key

NEW FOUNDATION BEAM

NOTES

REFER TO DRAWINGS 602 AND 603 FOR FOUNDATION DETAILS.

PROJECT MANAGEMENT INITIALS

MC	NR	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
-	18/4/2016	ISSUED FOR PRICING

KEY PLAN

PROJECT NUMBER

60439900

SHEET TITLE

NEW FOUNDATION LAYOUT

SHEET NUMBER

60439900-DRG-301

ISO A1 594mm x 841mm

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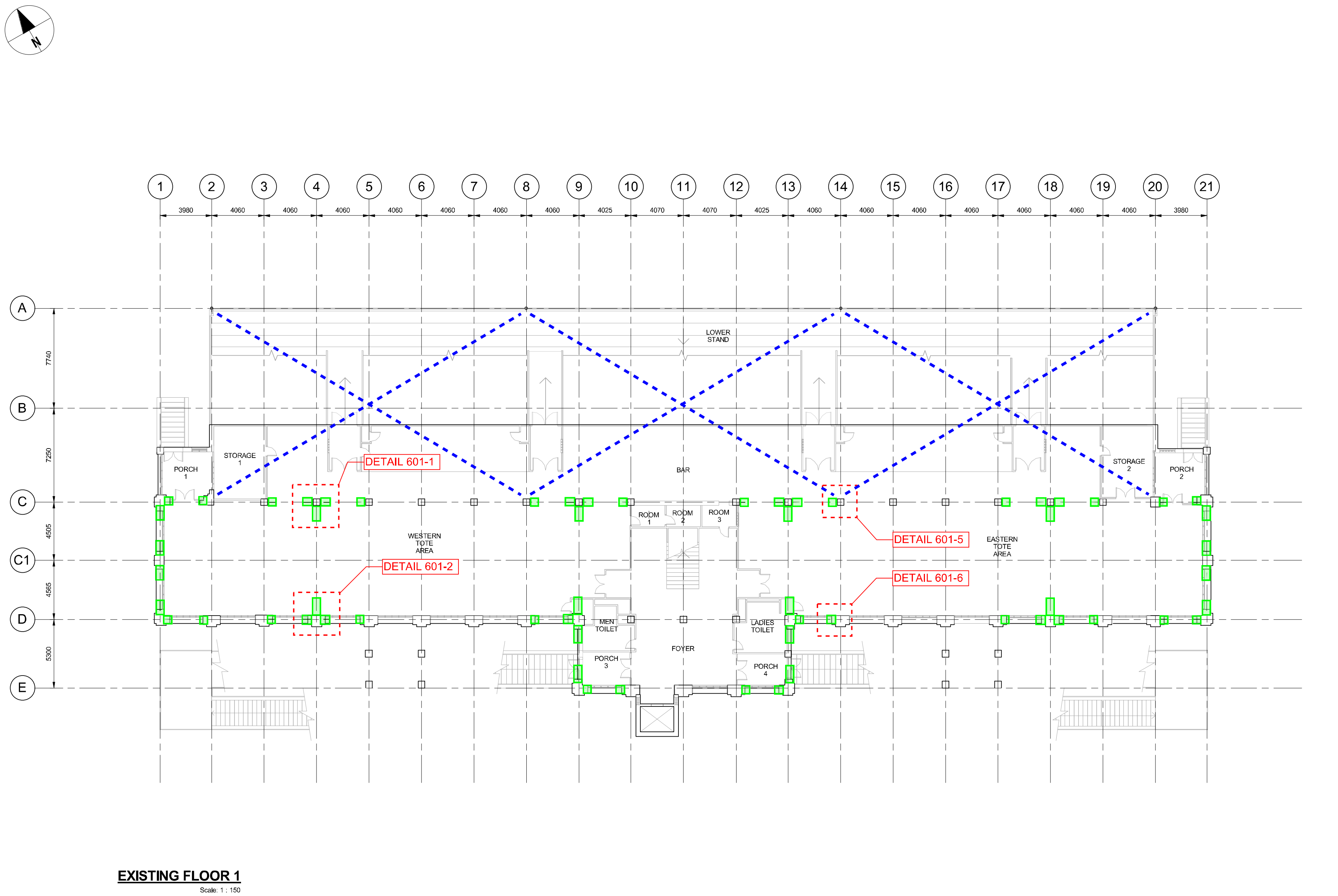

EXISTING FLOOR 1

Scale: 1 : 150

AECOM

PROJECT

GRAND NATIONAL STAND CONCEPTUAL RETROFIT SCHEME

CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT

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CONSULTANT

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NEW "SUPER COLUMNS"

NEW TENSION BRACING 32mm REID BRACE (4 LEVELS OF BRACING)

NOTES

REFER TO DRAWING 601 FOR COLUMN DETAILS.

PROJECT MANAGEMENT INITIALS

MC	NR	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
-	18/4/2016	ISSUED FOR PRICING

KEY PLAN

PROJECT NUMBER

60439900

SHEET TITLE

NEW COLUMN LAYOUT LEVEL 0 TO 4

SHEET NUMBER

60439900-DRG-302

ISO A1 594mm x 841mm

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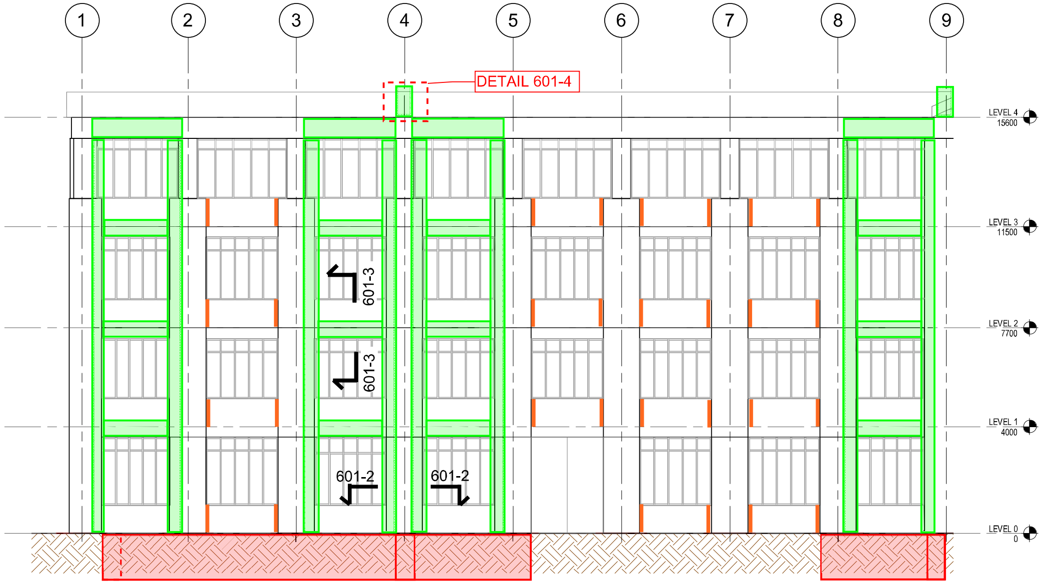
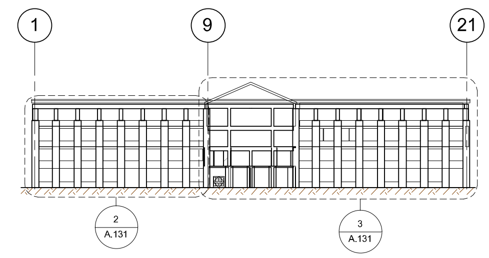


2 SECTION ON GRID D - GRID 1 TO GRID 9
A.131 REF: A.131 Scale: 1 : 100



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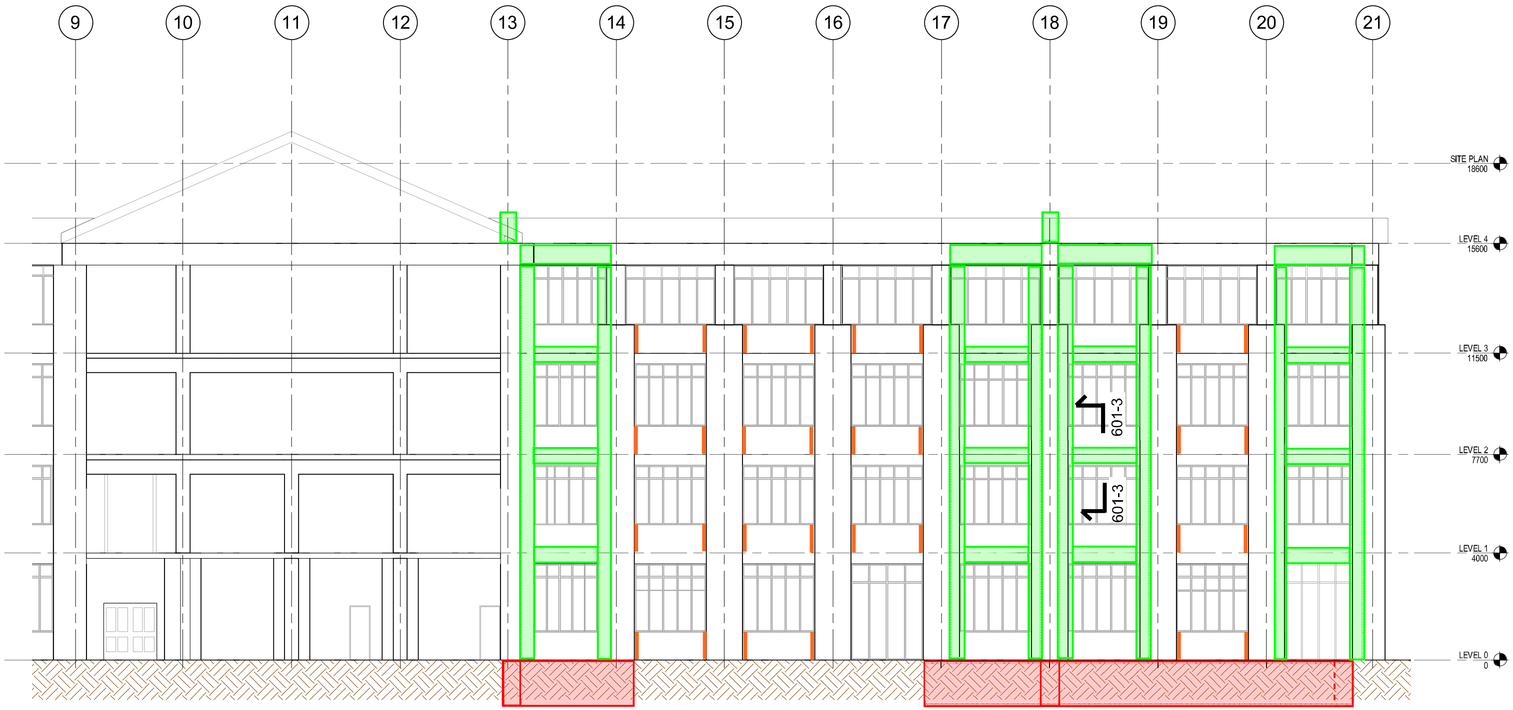
A.131 REF: A.100 Scale: 1 : 500



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

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GRAND NATIONAL STAND CONCEPTUAL RETROFIT SCHEME

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NEW FOUNDATION BEAM

NEW "SUPER COLUMNS" AND BEAMS

SAW CUTS TO ALL SPANDREL BEAMS ADJACENT TO COLUMNS

NOTES

REFER TO DRAWINGS 601 AND 602 FOR COLUMNS AND BEAMS DETAILS.

PROJECT MANAGEMENT INITIALS

MC	NR	CO
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ISSUE/REVISION

I/R	DATE	DESCRIPTION
-	18/4/2016	ISSUED FOR PRICING

KEY PLAN

PROJECT NUMBER

60439900

SHEET TITLE

SECTION - SHEET 1 GRIDLINE D

SHEET NUMBER

60439900-DRG-501

ISO A1 594mm x 841mm
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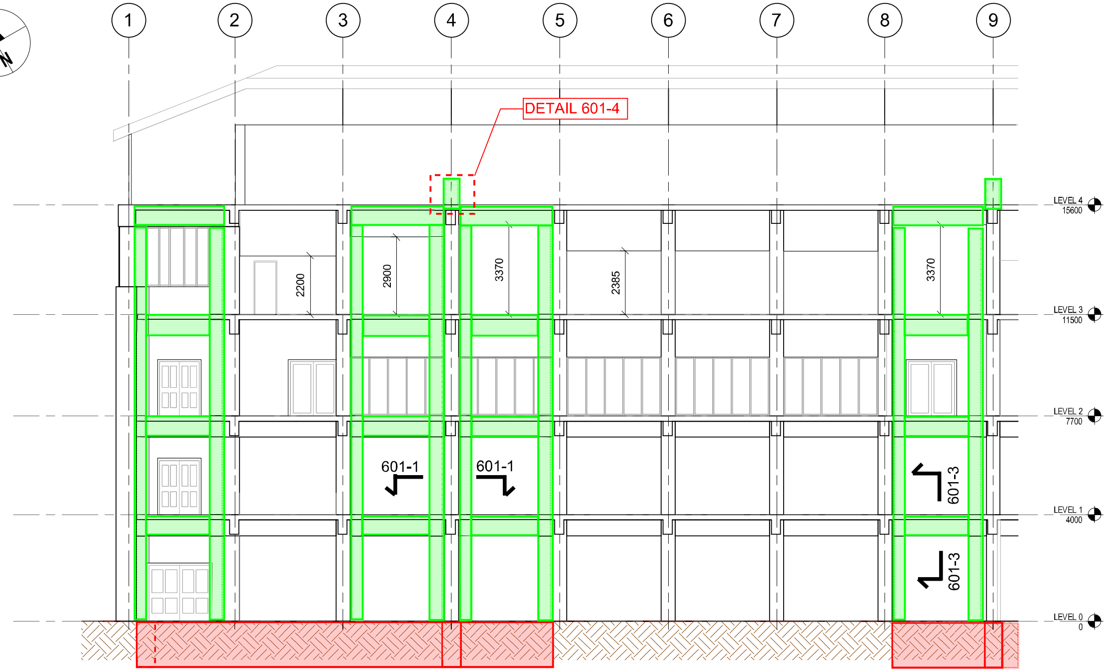

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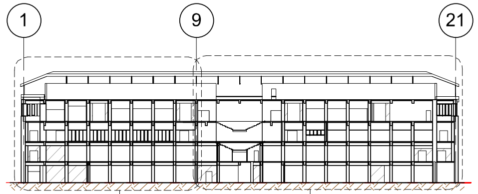

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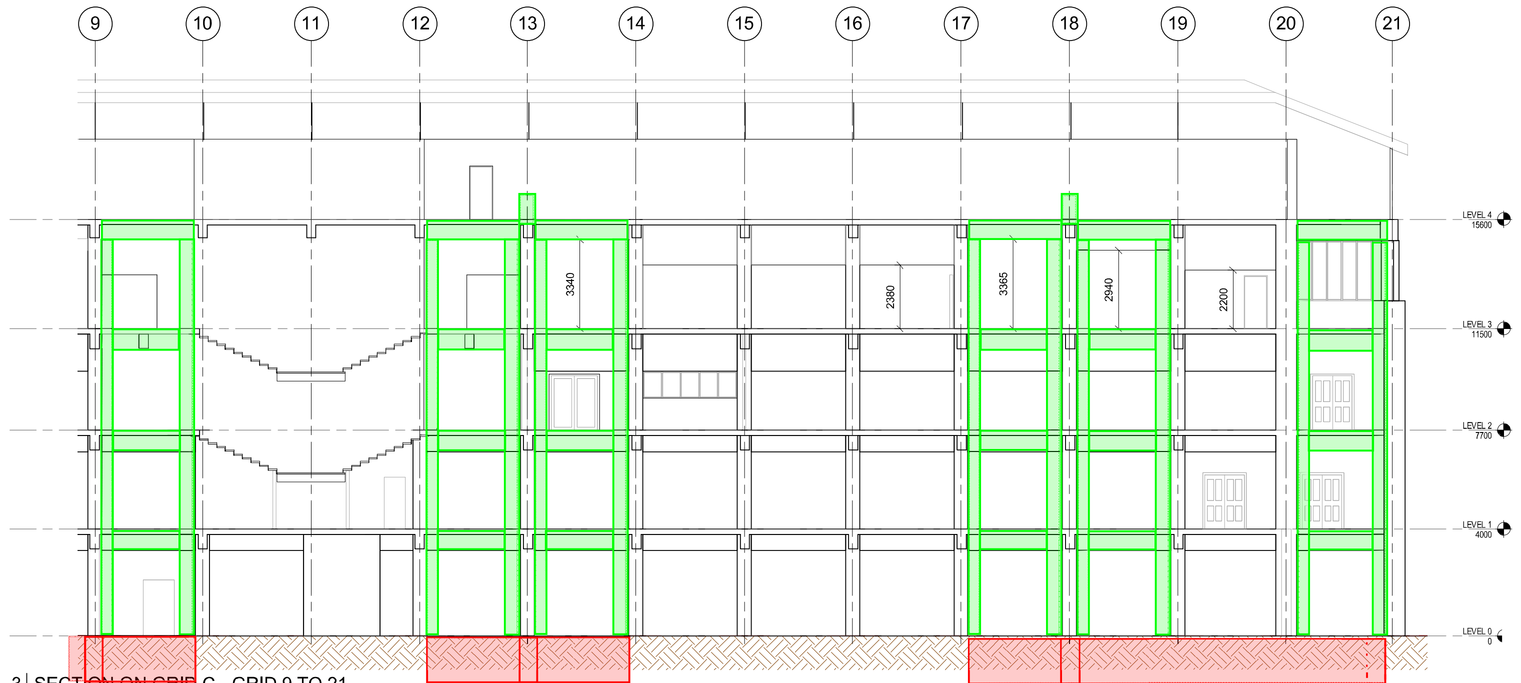

3 SECTION ON GRID C - GRID 9 TO 21
A.130 REF: A.130 Scale: 1 : 100

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GRAND NATIONAL STAND CONCEPTUAL RETROFIT SCHEME
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Prepared for:

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NEW FOUNDATION BEAM
NEW "SUPER COLUMNS" AND BEAMS
SAW CUTS TO ALL SPANDREL BEAMS ADJACENT TO COLUMNS

NOTES
REFER TO DRAWINGS 601, 602 AND 603 FOR COLUMNS AND BEAMS DETAILS.

PROJECT MANAGEMENT INITIALS

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DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

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-	18/4/2016	ISSUED FOR PRICING

KEY PLAN

PROJECT NUMBER
60439900
SHEET TITLE
SECTION - SHEET 2
GRIDLINE C
SHEET NUMBER
60439900-DRG-502

ISO A1 594mm x 841mm
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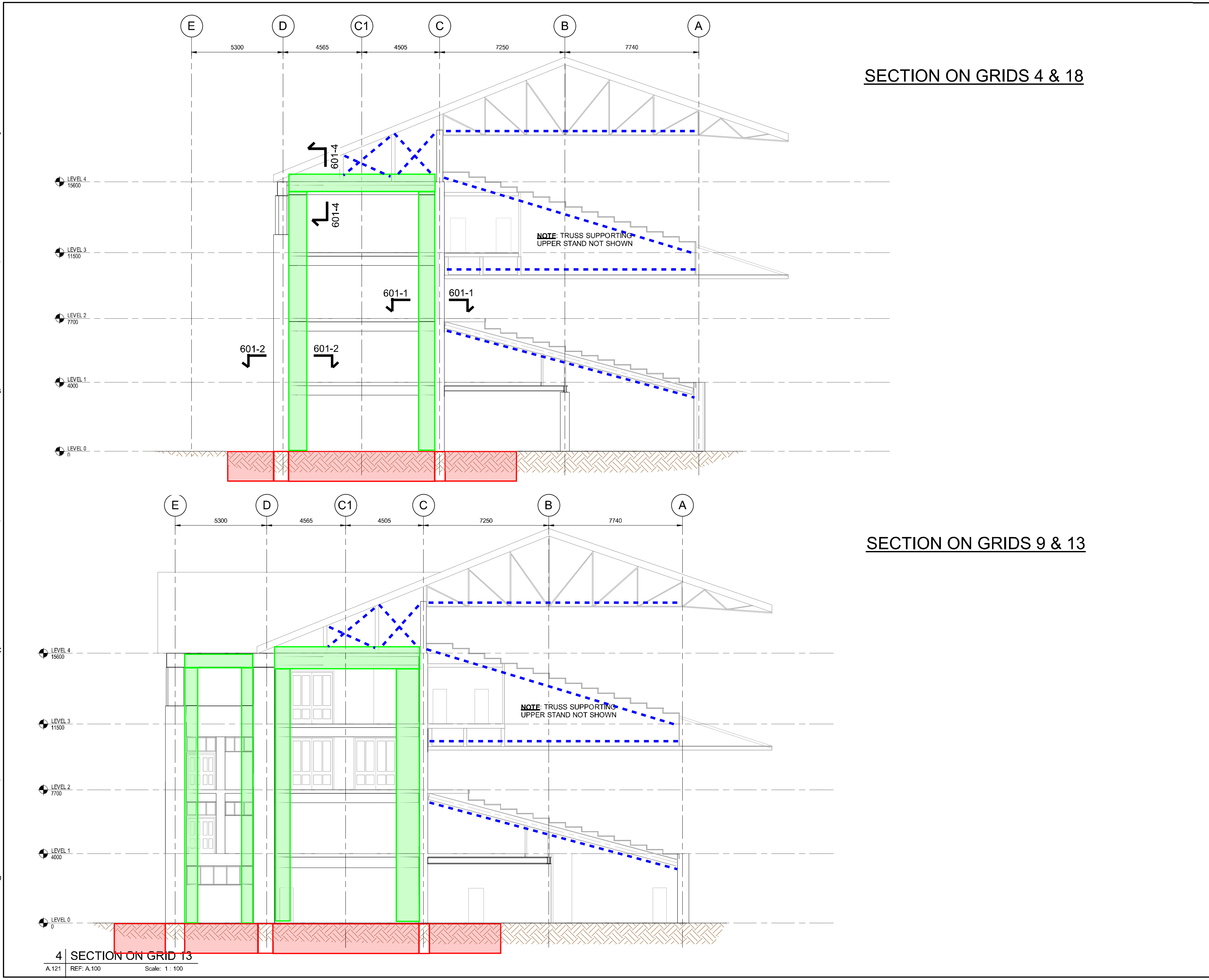

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PROJECT

GRAND NATIONAL STAND CONCEPTUAL RETROFIT SCHEME

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CONSULTANT

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NEW FOUNDATION BEAM

NEW "SUPER COLUMNS" AND BEAMS

NEW TENSION BRACING 32mm REID BRACE

NOTES

REFER TO DRAWINGS 601, 602 AND 603 FOR COLUMNS AND BEAMS DETAILS.

PROJECT MANAGEMENT INITIALS

MC	NR	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
-	18/4/2016	ISSUED FOR PRICING

KEY PLAN

PROJECT NUMBER

60439900

SHEET TITLE

SECTION - SHEET 3
TRANSVERSE SECTION

SHEET NUMBER

60439900-DRG-503

ISO A1 594mm x 841mm
Last Saved: 1/07/2015 11:02:17 a.m.
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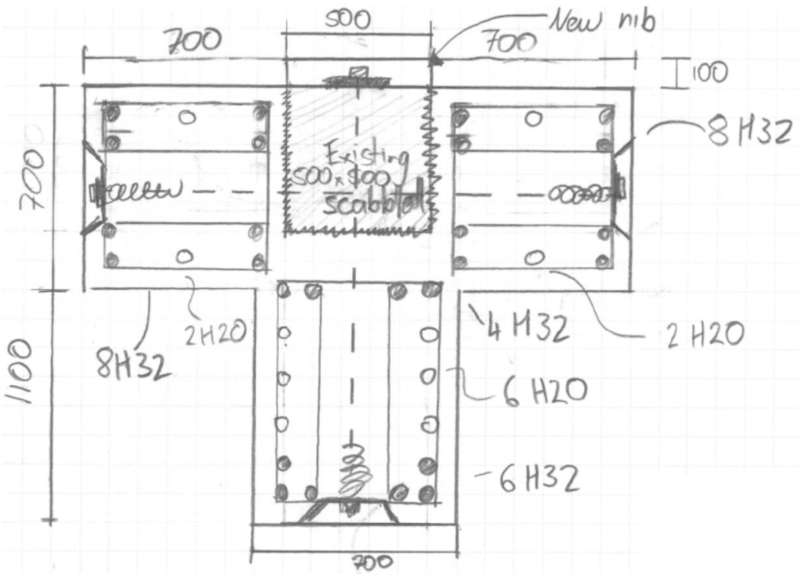
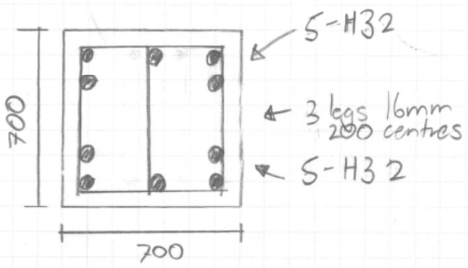
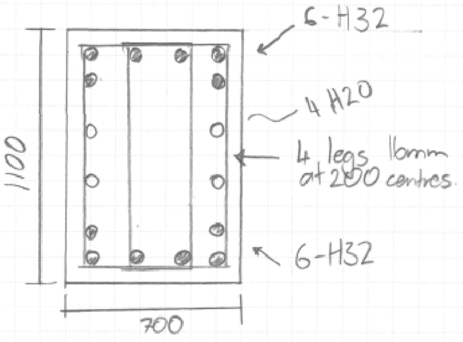


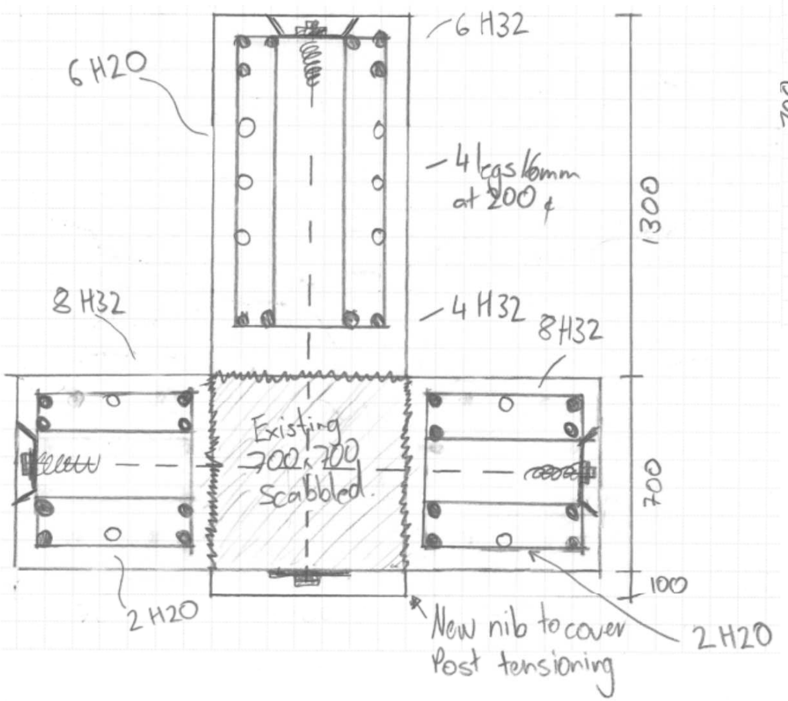
DETAIL 601-1
COLUMN ON GRIDS C-4,C-9,C-13,C-18
(N.T.S.)



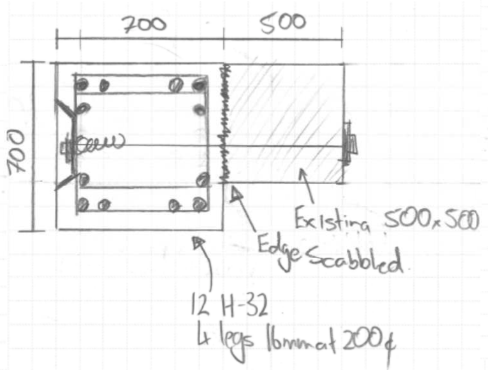
DETAIL 601-3
BEAM ON GRIDS C & D
(N.T.S.)



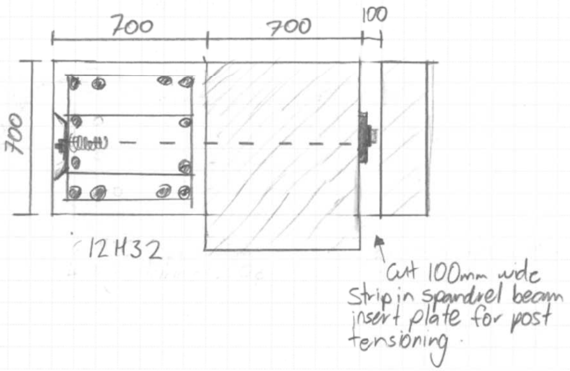
DETAIL 601-4
BEAM ON GRIDS 4, 9, 13 AND 18
LEVEL 4 ONLY (TRANSVERSE)
(N.T.S.)



DETAIL 601-2
COLUMN ON GRIDS D-4,D-9,D-13,D-18
(N.T.S.)



DETAIL 601-5
COLUMN ON GRIDS C-2, C-3, C-5,
C-8, C-10, C-12, C-14, C-17, C-19, C-20
(N.T.S.)



DETAIL 601-6
COLUMN ON GRIDS D-2, D-3, D-5,
D-8, D-14, D-17, D-19, D-20
(N.T.S.)

AECOM

PROJECT
GRAND NATIONAL STAND CONCEPTUAL RETROFIT SCHEME
CANTERBURY JOCKEY CLUB, CHRISTCHURCH

CLIENT
CANTERBURY JOCKEY CLUB

CONSULTANT
AECOM New Zealand Limited
2 Hazeldean Rd, Addington
Christchurch, NZ 8024
+64 3 966 6000 tel +64 3 966 6001 fax
www.aecom.com

NOTES:
1. ALL BARS TO BE COUPLED. USE ANCON BT COUPLERS OR SIMILAR. NO LAPPED SPLICES TO BE USED.

2. COUPLERS TO BE STAGGERED ALONG THE HEIGHT.

3. REINFORCEMENT BARS BARS 500MPa

4. REFER TO 602-1 FOR POST-TENSIONING DETAIL.

PROJECT MANAGEMENT INITIALS

MC	NR	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
A	22/4/2016	ISSUED FOR PRICING
-	18/4/2016	ISSUED FOR PRICING

KEY PLAN

PROJECT NUMBER
60439900

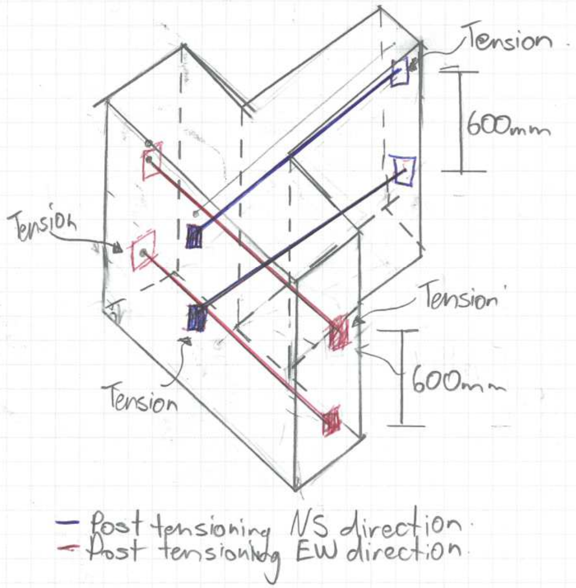
SHEET TITLE
DETAILS - SHEET 1

SHEET NUMBER
60439900-DRG-601

ISO A1 594mm x 841mm
Last Saved: 1/07/2015 11:02:17 a.m.
Filename: C:\Users\PettiC\Desktop\60332326_MOD_ST_2014_PettiC(Recovery).rvt

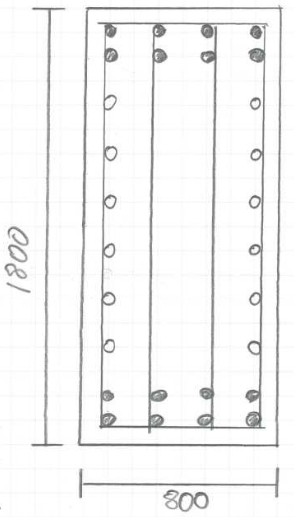
Post-Tensioning

- See details for columns with Post tensioning
- Macalloy 1030 Post tensioning Bars 40mm
- 600mm centres
- Alternating tensioning end
- Column Gridline D/4,9,18,13 C/4,18,9,13, post tensioned both directions, as per detail.
- Corner column Gridline D/1,9,13,21 C/1,9,13,21 tensioned both directions
- Remaining columns post-tensioned one direction



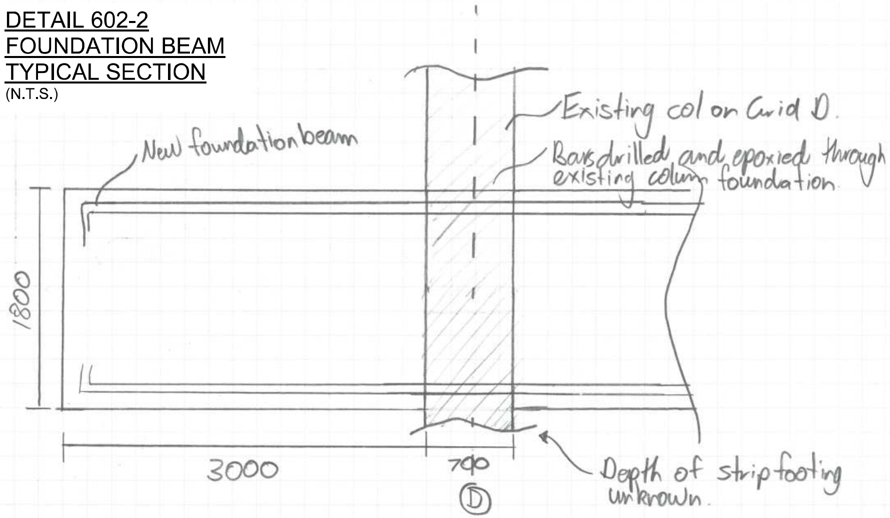
DETAIL 602-1
POST-TENSIONING OF COLUMNS
(N.T.S.)

Foundation Beam Typical



8 H32 Top & Bottom
6 H20 each side
4 legs 20mm at 200¢

DETAIL 602-2
FOUNDATION BEAM
TYPICAL SECTION
(N.T.S.)



DETAIL 602-3
FOUNDATION BEAM
EXTENSION BEYONS BUILDINGS FOOTPRINT
(N.T.S.)

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PROJECT MANAGEMENT INITIALS

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DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
-	18/4/2016	ISSUED FOR PRICING

KEY PLAN

PROJECT NUMBER
60439900

SHEET TITLE
DETAILS - SHEET 2

SHEET NUMBER
60439900-DRG-602

ISO A1 594mm x 841mm

Last Saved: 1/07/2015 11:02:17 a.m.
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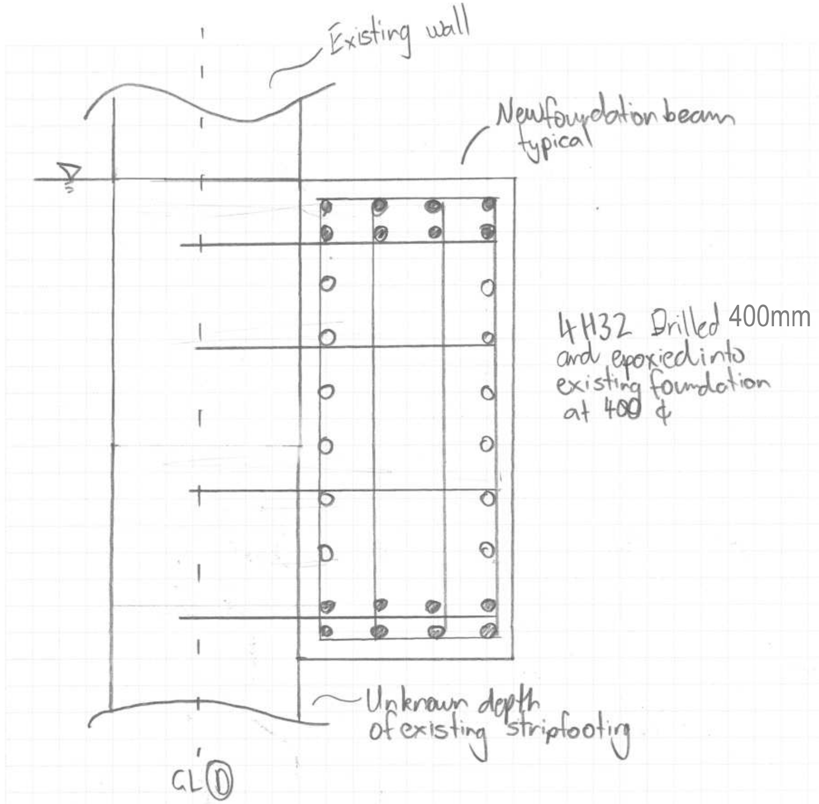
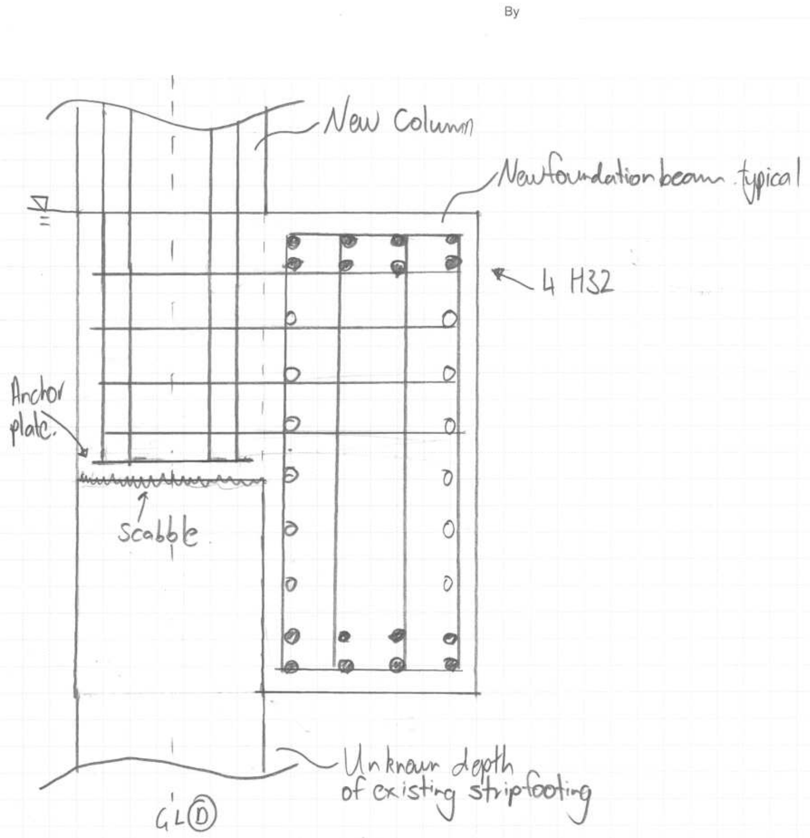


DETAIL 603-1
NEW FOUNDATION BEAM TO EXISTING
SECTION BETWEEN COLUMNS
(N.T.S.)



DETAIL 603-2
NEW FOUNDATION BEAM TO EXISTING
SECTION @ COLUMN LOCATION
(N.T.S.)

By

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PROJECT MANAGEMENT INITIALS

MC	NR	CO
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
-	18/4/2016	ISSUED FOR PRICING

KEY PLAN

PROJECT NUMBER
60439900

SHEET TITLE
DETAILS - SHEET 3

SHEET NUMBER
60439900-DRG- 603

ISO A1 594mm x 841mm

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