



Memorandum

To	Lynne Armitage (CCC)
Copy	Soon Ong
From	Andrew Davidson
Office	Christchurch
Date	30 May 2023
File/Ref	6-DP536.00
Subject	Christchurch South Library - Temporary Strengthening 67%NBS

Background

The Christchurch South Library suffered significant structural damage during the Christchurch Earthquake Sequence. The subsequent Quantitative Seismic Assessment completed in July 2012 reported that the building had a seismic capacity of around 10 – 20 % New Building Standard (%NBS) based on the building being an Importance Level 3 (IL3) structure, given a potential occupancy of greater than 300 people. The level survey undertaken in July 2012 suggested total vertical settlements in the range of 150mm to 250mm, giving a maximum differential settlement of approximately 100mm.

Temporary strengthening works were completed in 2012 with the primary objective of increasing the seismic capacity of the building to at least 34%NBS (IL3) in order to allow it to be reopened to the public. This work did not involve repairing damage or remediating serviceability issues such as the differential settlement that had occurred. WSP are not aware of any further seismic strengthening work undertaken since 2012. An inspection of the temporary strengthening works was carried out in 2019 to confirm that they were still performing as originally intended.

The scope of this summarised memorandum is to outline the current status of the building and to identify requirements associated with potentially improving the temporary strengthening to achieve a seismic capacity to 67%NBS.

Current Status

The building is currently 34%NBS which is governed by parts of the building that were not previously strengthened when the temporary strengthening was implemented in 2012. The capacity is based on strength for life safety of occupants only and it is likely that damage to the building may occur at lower levels of seismic loading. The appended “Risk Zone Map” (refer Appendix 1) highlights areas of the building where elements of the structure currently achieve a capacity greater than 34%NBS in general due to the previous strengthening. The areas not highlighted are those where further strengthening would be required to achieve a higher building capacity.

Strengthening Target

The current building capacity is 34%NBS which is the minimum required by the Building Act to avoid the need for mandatory strengthening. However, industry best practise is to achieve a minimum of 67%NBS as recommended by the New Zealand Society for Earthquake Engineering (NZSEE).

Table A3.1 in Part A of The Seismic Assessment of Existing Buildings: Technical Guidelines for Engineering Assessments outlines the relative risk for a building compared with a new building based on its %NBS. At 34%NBS the buildings relative risk to occupants is 10x that of a new building whereas at 67%NBS the relative risk is 5x.

The strengthening proposed to achieve 67%NBS is considered temporary as it is not proposed to address building repair or serviceability. Although by the nature of the proposed 67%NBS strengthening there will be some benefit to building serviceability over the current status, such as reduced building drift (movement) during a future seismic event which will contribute to further limiting potential damage.

Effects Following Future Event

A higher building capacity will reduce the impacts of building damage in a future seismic event; however, it is important to note that strengthening proposed is to protect life safety. It is likely that building damage, requiring repair or vacation of the building, will occur at levels of seismic shaking below the level that can be withstood by the building from a strength perspective.

Structural damage following a future seismic event will likely be due to the building drift (movement) and potential lateral spread to the foundations. The duration of potential building closure is difficult to determine because it depends on the extent of structural damage to the building and foundation. However, an improved seismic capacity will reduce the risk of damage requiring vacation of the building.

Strengthening Proposal

The current strengthening proposal appended (refer Appendix 2) is based on improving the lowest rated building elements. The conceptual strengthening was developed to improve the building seismic capacity to 67%NBS (IL3) with the focus on life safety only (i.e., Ultimate Limit State (ULS) design). The building serviceability performance would also improve; however, it will not achieve the same level of performance as the building's strength may imply, when compared to the requirements for a new building. The existing temporary strengthening is retained in this strengthening proposal. The key components of the strengthening are described below:

Longitudinal (East - West direction)

- External Cross Bracing. This is provided where there is a lack of obvious lateral resisting systems, in particular the northern part of the building.
- New steel connections between the roof framing and the precast concrete walls. These connections enable the lateral load at roof level caused by seismic shaking to be transferred to the foundation via the precast concrete walls acting in-plane.

Transverse (North - South direction)

- Strengthening of the steel frames in the corridor zones. The existing building steel frames were designed to allow the columns to pivot at their bases. The proposed strengthening scheme would increase the frames stiffness (improve strength and reduce building movement) by welding steel beams between the bases of adjacent steel columns. The stiffening of the frames does then increase the uplift demand to the foundations. Therefore, ground anchors will be installed to resist these uplift forces.
- External cross bracing is provided where no corridor frames exist.

Intrusive Nature of Proposed Works

The strengthening work will be very intrusive, and it is unlikely that it could practically be completed while the library remains operational. Therefore, temporary closure of the library during the installation is the most likely outcome.

Furthermore, there will be impacts on the internal fabric of the building all of which will require reinstatement. The architectural works associated with the strengthening works are as described at a conceptual level in Appendix 3 attached.

Summary

- This memorandum is intended to provide information to aid in decision making, however it is important to note that it is not an all-inclusive document and there are other considerations that will be required such as potential upgrades to fire and accessibility requirements that may be necessary as a result of the proposed strengthening.
- Strengthening to 67%NBS is consistent with industry practise.
- The proposed temporary strengthening does not address repair or serviceability considerations.
- Structural strengthening has other implications such as impacts on operation during implementation and the need to reinstate architectural fabric.

APPENDIX 1

Christchurch South Library - Risk Zone Map

Current Status 34% NBS (IL3) with 2012 Temporary Strengthening

6 April 2023

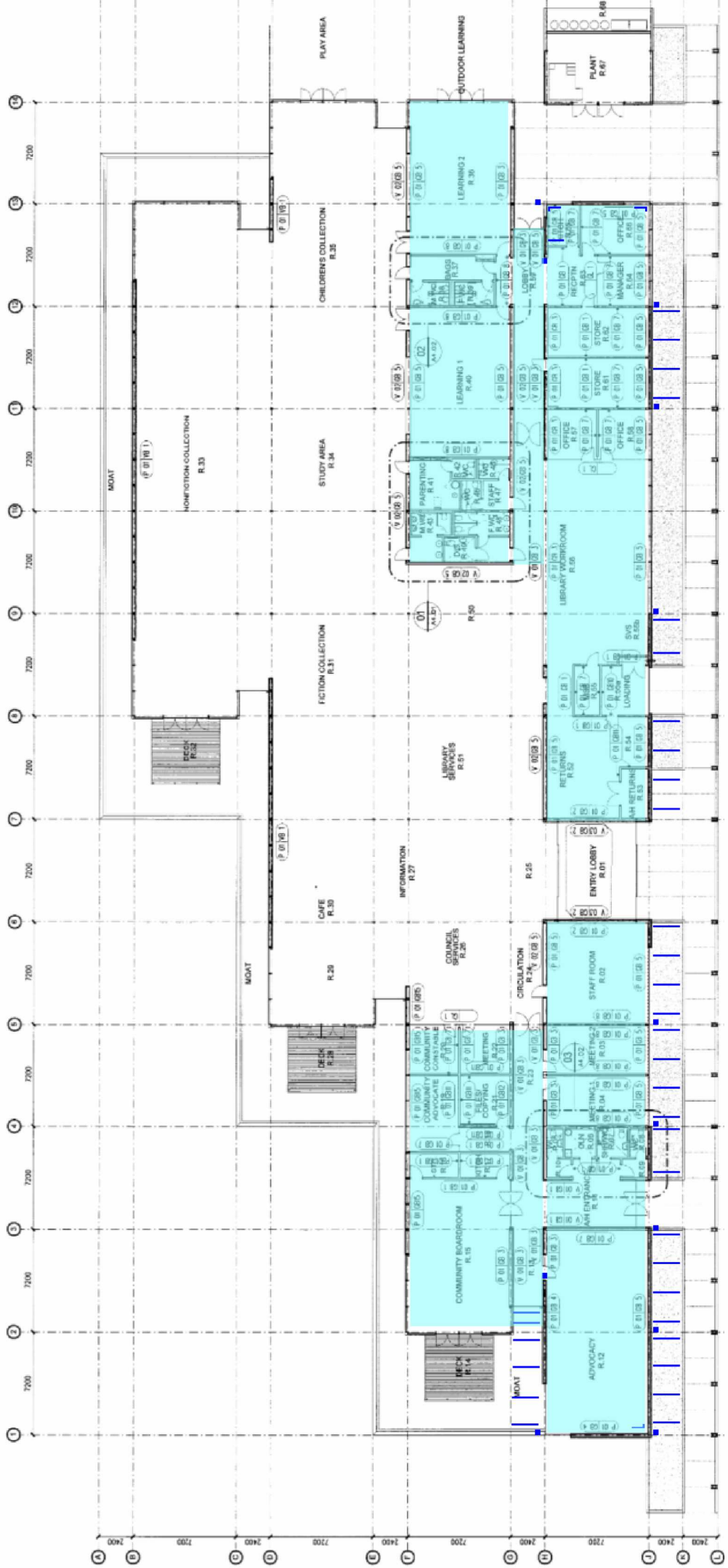
Christchurch South Library - Risk Zone Map

Current Status 34% NBS (IL3) with 2012 Temporary Strengthening

Prepared By : Soon Ong
6 April 2023

LEGEND

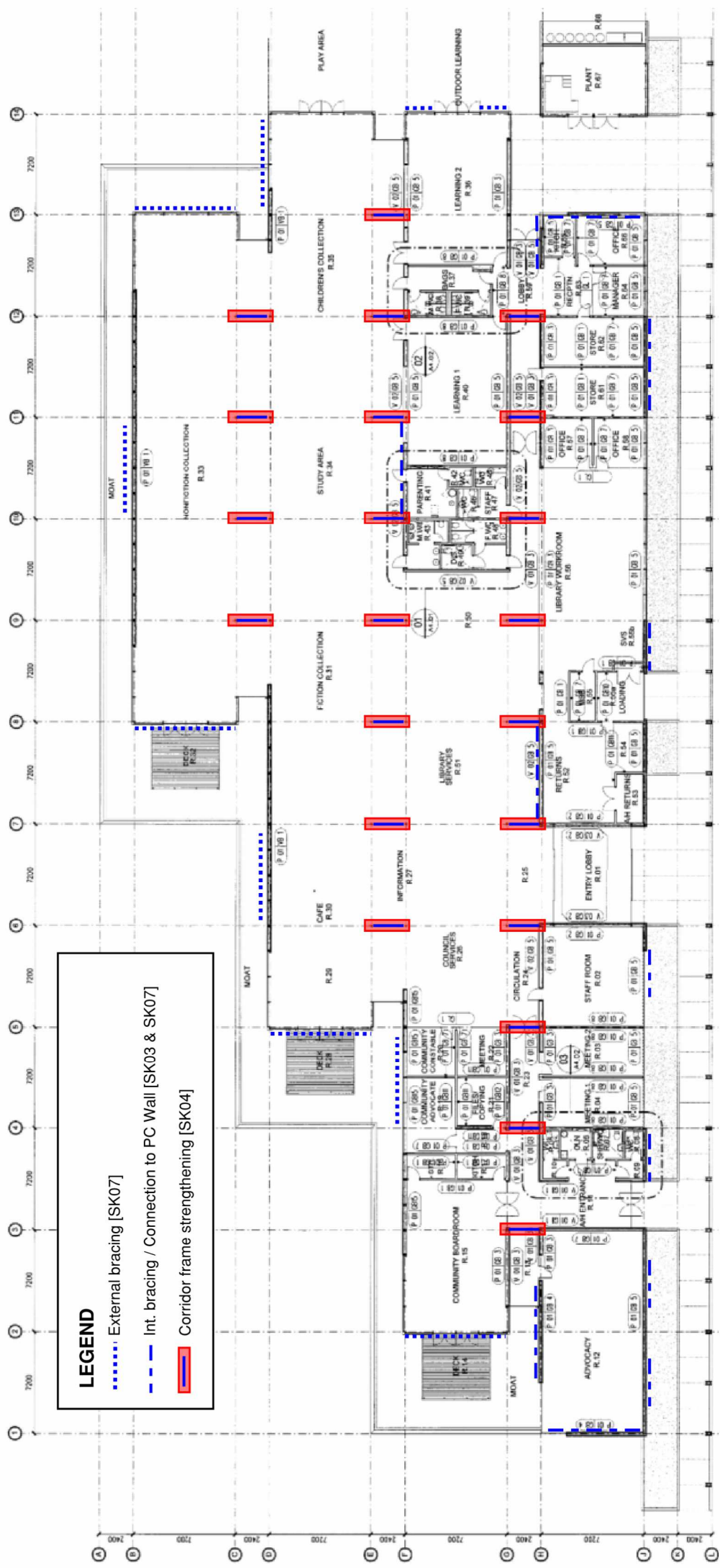
- 34% NBS
- Relatively higher rating of structural elements in these areas




APPENDIX 2

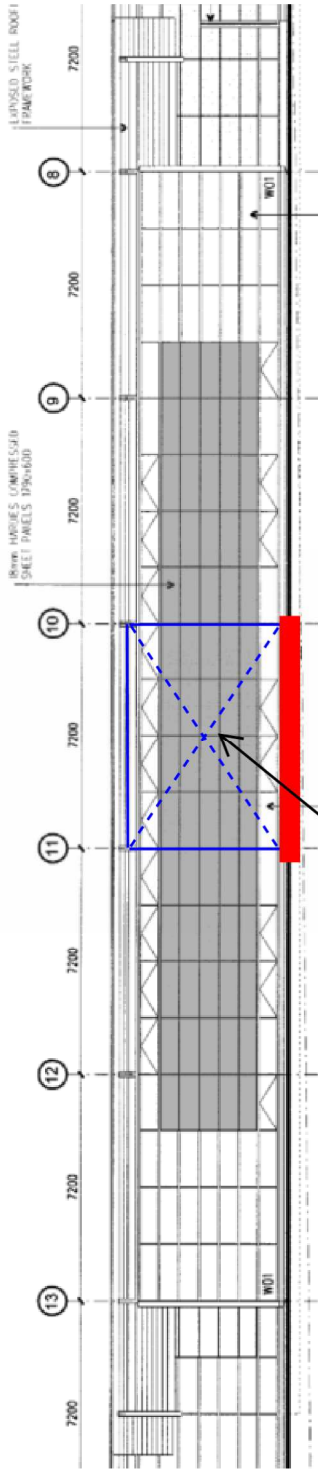
Christchurch South Library – Proposed Concept Strengthening Scheme
67% NBS IL3 (Life Safety)

6 April 2023



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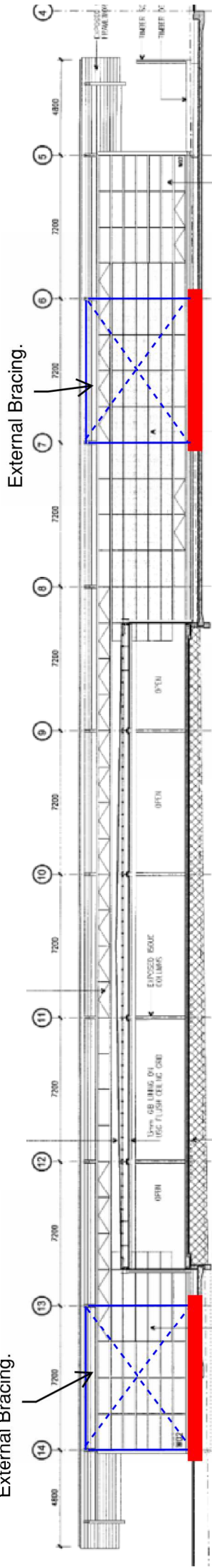
 WSP NZ www.wsp.com/en-NZ	PROJECT: South Library & Service Centre Seismic Advice	JOB No: 6-DP536.00
	DESCRIPTION: Proposed Concept Strengthening Scheme 67%NBS IL3 (Life Safety)	START PAGE No. / REVISION BY: SK01 / REV 1
DESIGNED BY: SLO (Chch)	REVIEWED BY: AD (Chch)	DATE: 06.04.2023



External Bracing. See SK 07 for details

Grid A

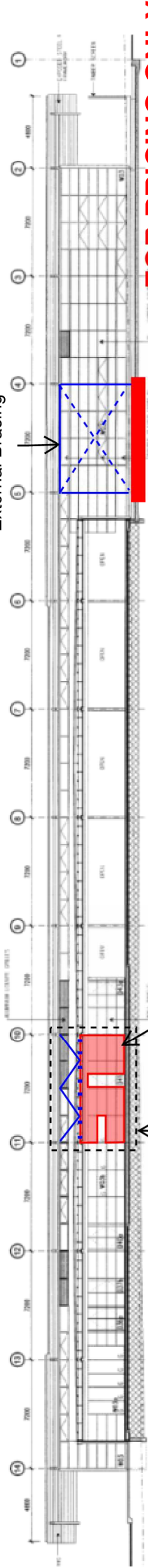
External Bracing.



External Bracing.

Grid D


External Bracing



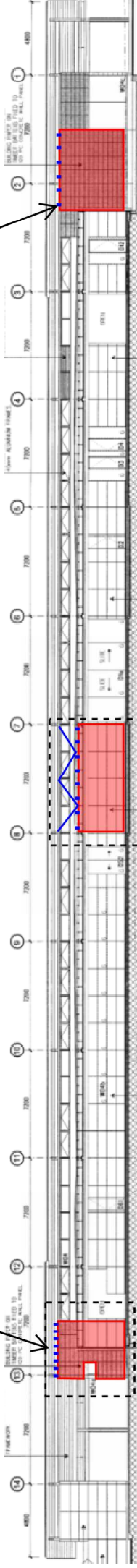
Internal Bracing. See SK 07 for details

Grid F

FOR PRICING ONLY

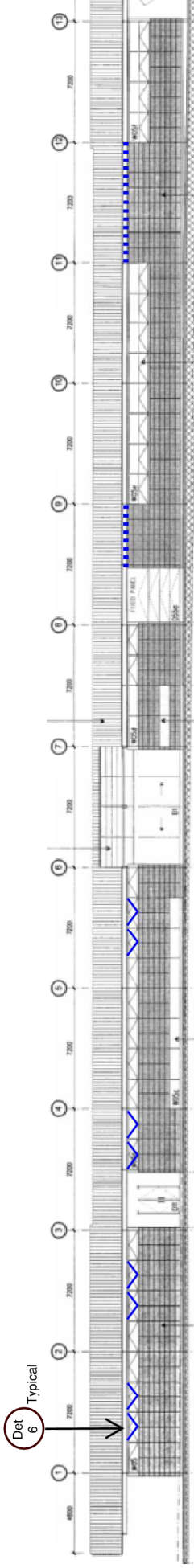
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	DESCRIPTION: Proposed Concept Strengthening Scheme 67%NBS IL3 (Life Safety)	START PAGE No. / REVISION BY: SK02 / REV 1
DESIGNED BY: SLO (Chcht)	DATE: 06.04.2023	APPROVED BY: ...
REVIEWED BY: AD (Chcht)	DATE: 06.04.2023	DATE: ...

Internal Bracing. See SK 07 for details

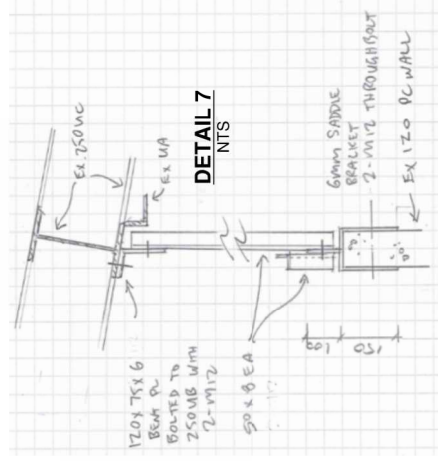
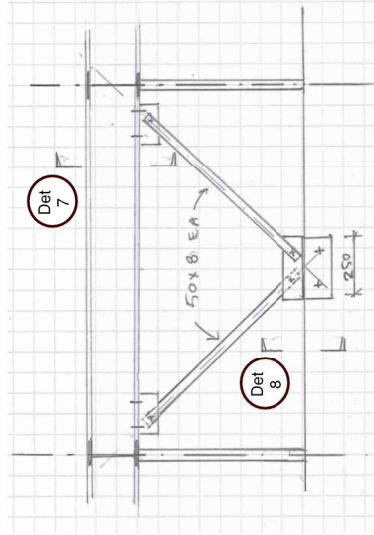


Internal Bracing.
See SK 07 for details

Grid H




Grid J - View from South

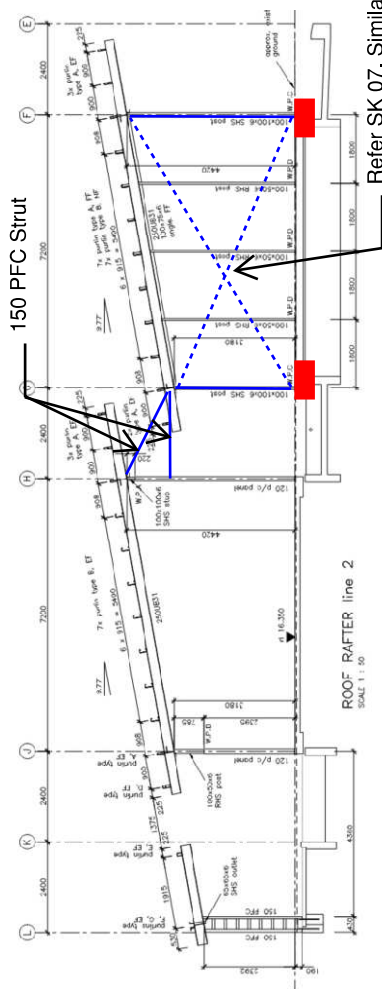


DETAIL 8 NTS

DETAIL 6 NTS

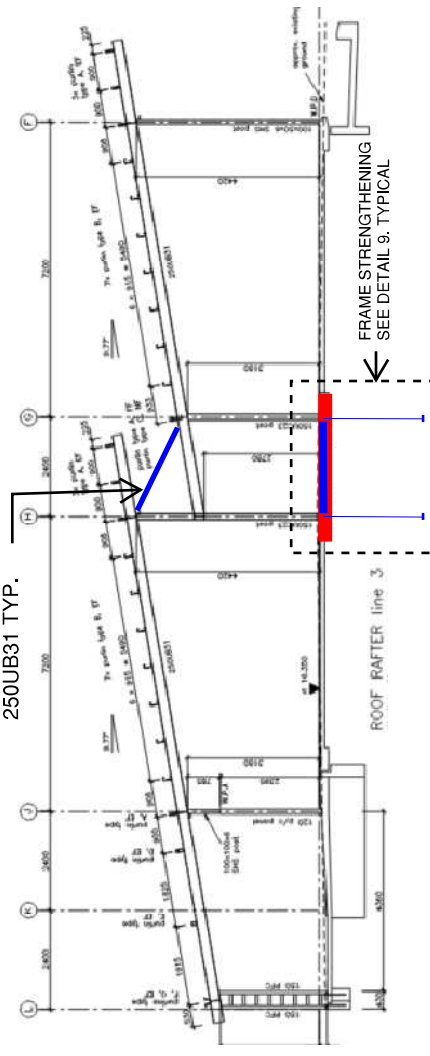
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	DESCRIPTION: Proposed Concept Strengthening Scheme 67%NBS L3 (Life Safety)	START PAGE No. / REVISION BY: SK03 / REV 1
DESIGNED BY: SLO (Chch)	DATE: 06.04.2023	APPROVED BY: ... DATE: ...
REVIEWED BY: AD (Chch)	DATE: 06.04.2023	...



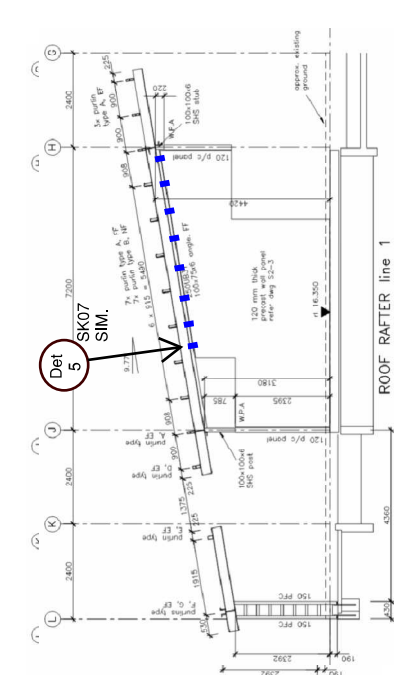
Refer SK 07. Similar

250UB31 TYP.

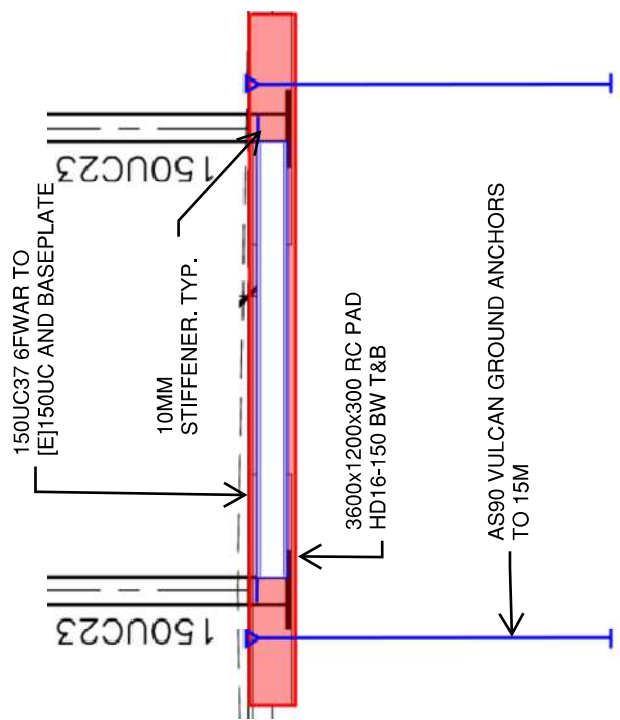


FRAME STRENGTHENING
SEE DETAIL 9. TYPICAL

Grid 4




Det 5

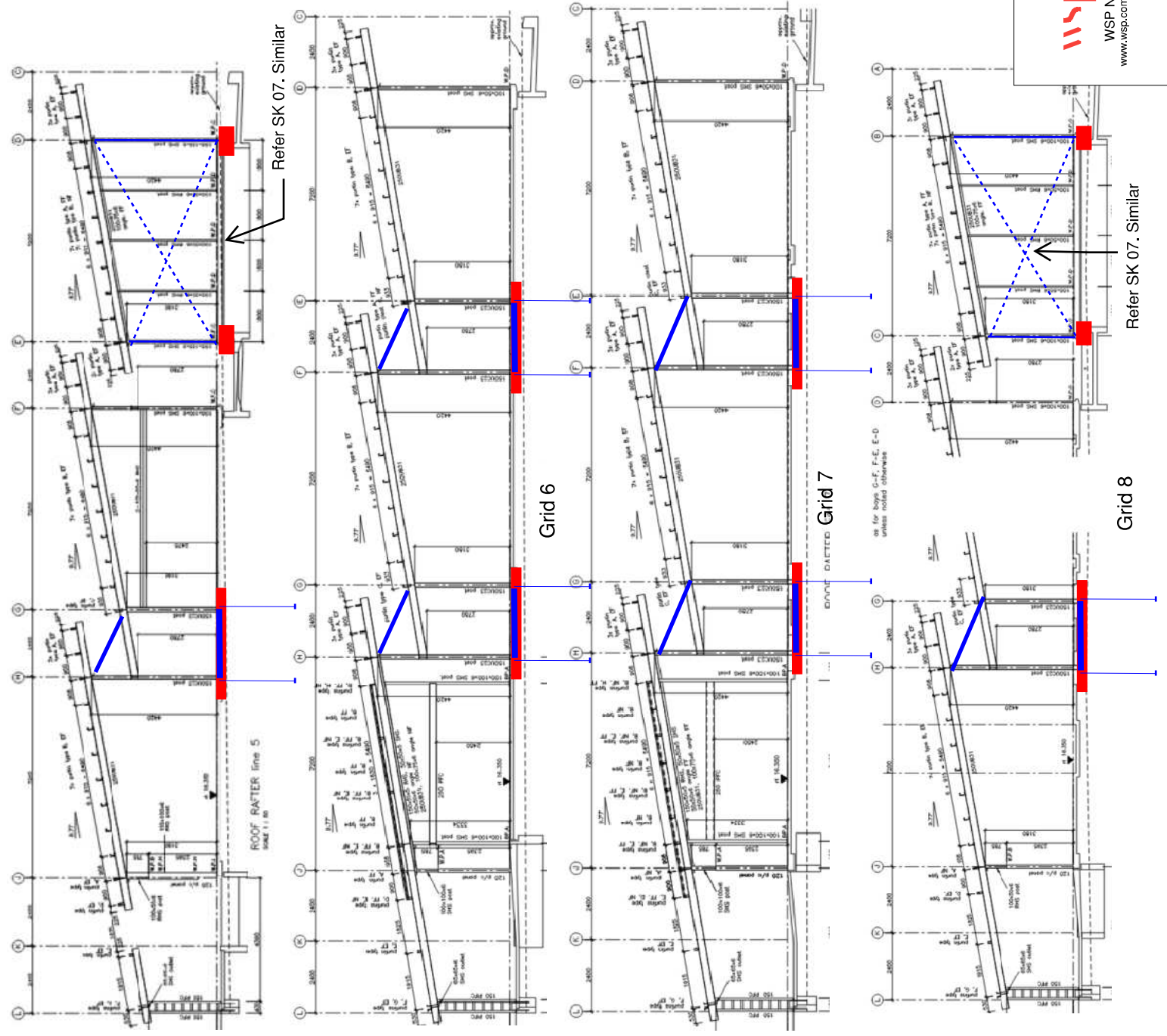


DETAIL 9
NTS

- PROPOSED METHOD OF CONSTRUCTION**
1. REMOVED EXISTING PAD FOUND & CUT BACK SLAB.
 2. INSTALL NEW 150UC37 BASE BEAM
 3. INSERT GROUND ANCHOR RODS
 4. CAST RC PAD
 5. COMPLETE INSTALLATION OF GROUND ANCHORS

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 WSP NZ www.wsp.com/en-nz	PROJECT:	South Library & Service Centre Seismic Advice	JOB NO:	6-DP536.00
	DESCRIPTION:	Proposed Concept Strengthening Scheme 67%NBS IL3 (Life Safety)	START PAGE No. / REVISION BY:	SK04 / REV 1
DESIGNED BY:	DATE:	REVIEWED BY:	DATE:	APPROVED BY:
SLO (Chcht)	06.04.2023	AD (Chcht)	06.04.2023	DATE:
				DATE:

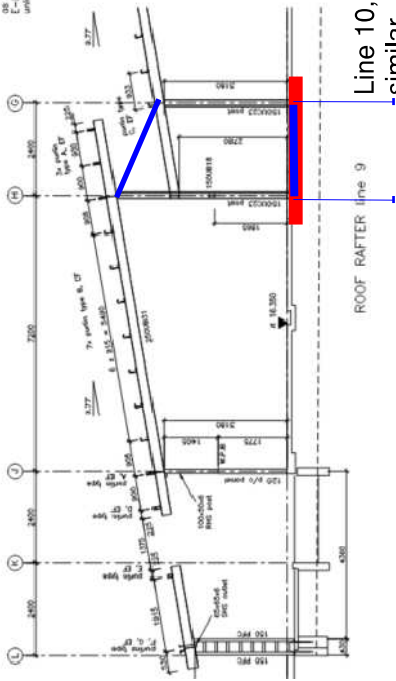


FOR PRICING ONLY

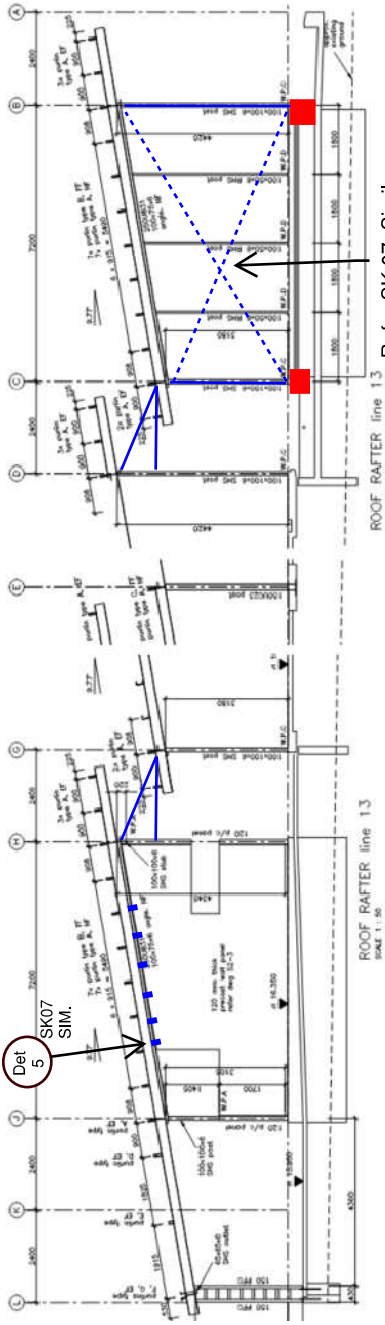
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DESCRIPTION:	Proposed Concept Strengthening Scheme	START PAGE No. / REVISION BY:	SK05 / REV 1
DESIGNED BY:	67%NBS IL3 (Life Safety)	APPROVED BY:	...
DATE:	06.04.2023	DATE:	06.04.2023
REVIEWED BY:	AD (Chcht)	DATE:	...
SLO (Chcht)	06.04.2023	DATE:	...



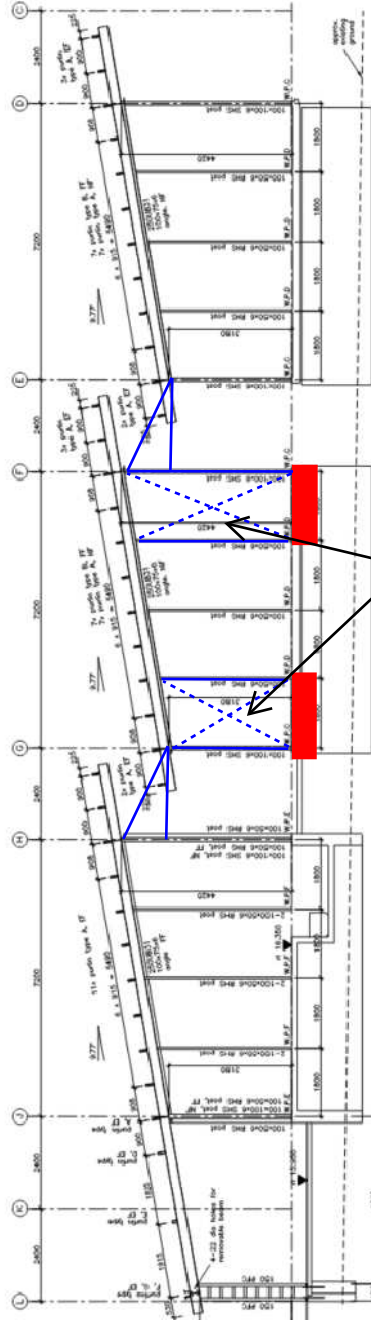
as for bays G-F, F-E, E-D line A, bays S2-S3 unless noted otherwise



Line 10, 11, 12 similar




Refer SK 07. Similar

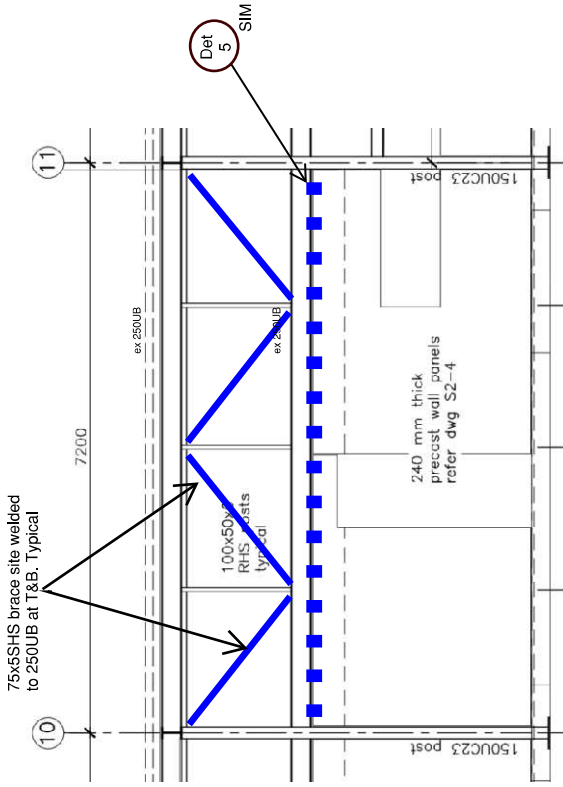


Refer SK 07. Similar

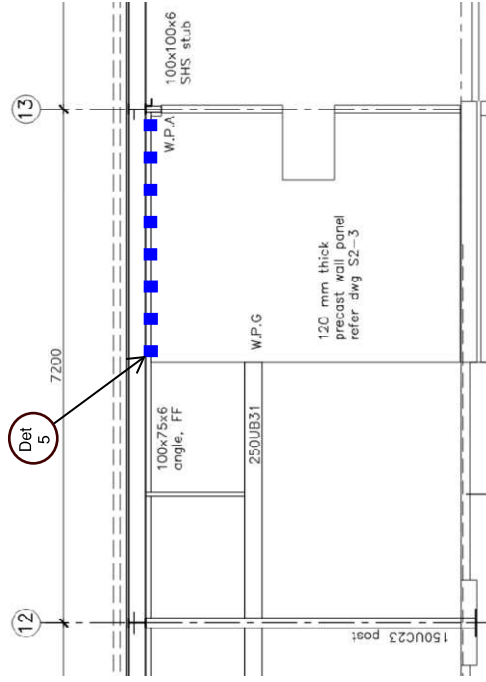
Grid 14

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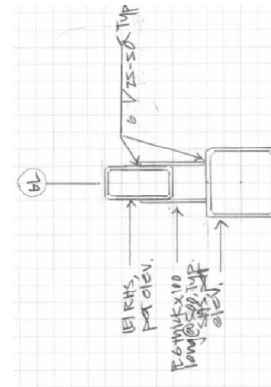
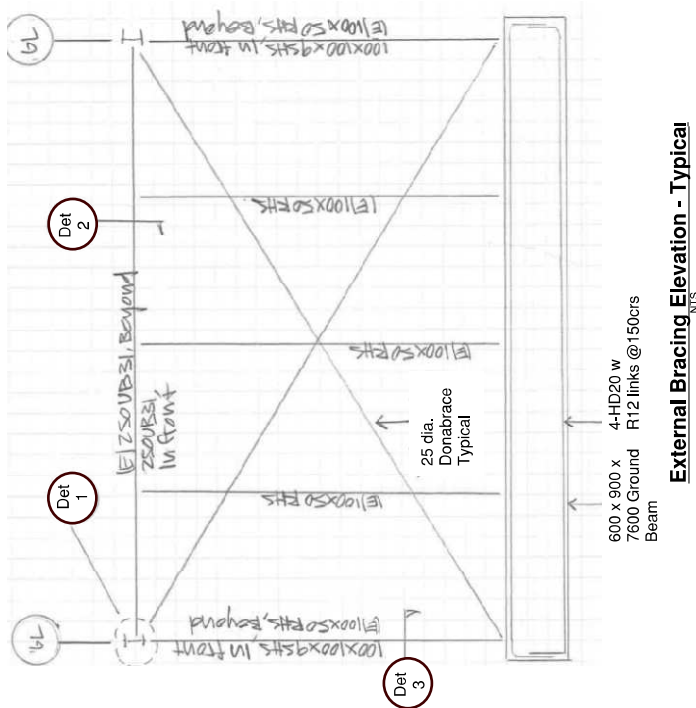
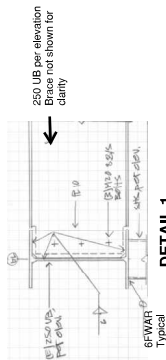
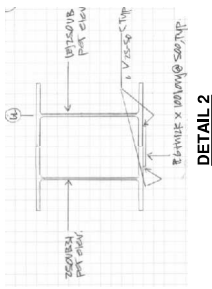
 <p>WSP NZ www.wsp.com/en-nz</p>	PROJECT:	South Library & Service Centre Seismic Advice	JOB No:	6-DP536.00
	DESCRIPTION:	Proposed Concept Strengthening Scheme 67%NBS I3 (Life Safety)	START PAGE No. / REVISION BY:	SK06 / REV 1
DESIGNED BY:	DATE:	06.04.2023	APPROVED BY:	...
REVIEWED BY:	DATE:	06.04.2023	AD (Chch)	...



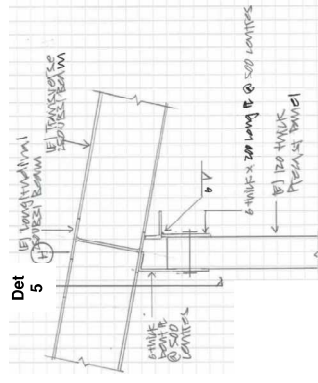
Internal Bracing Elevation (Grid F shown)



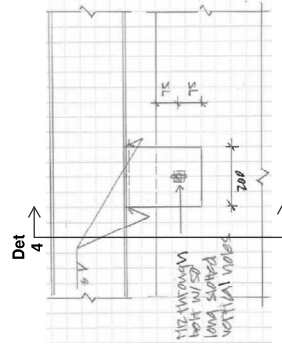
Internal Bracing Elevation (Grid H shown)



DETAIL 3




DETAIL 4



DETAIL 5

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 <p>WSP NZ www.wsp.com/en-NZ</p>	PROJECT:	South Library & Service Centre Seismic Advice	JOB No:	6-DP536.00	
	DESCRIPTION:	Proposed Concept Strengthening Scheme	START PAGE No. / REVISION BY:	SK07 / REV 1	
DESIGNED BY:	SLO (Chch)	DATE:	06.04.2023	APPROVED BY:	...
REVIEWED BY:	AD (Chch)	DATE:	06.04.2023	DATE:	...

APPENDIX 3

Memorandum

Christchurch South Library – Temporary Strengthening 67% NBS Architectural Works

25 May 2023



Memorandum

To	Lynne Armitage (CCC)
Copy	Andrew Davidson, Duncan Bright
From	Cris Brownley
Office	Christchurch
Date	25 May 2023
File/Ref	6-DP536.00-WSP-XX-RP-A-0001
Subject	Christchurch South Library - Temporary Strengthening 67%NBS Architectural Works

Background

WSP memorandum 6-DP536.00-WSP-XX-RP-S-0001 outlines the scope of work required to improve the temporary strengthening of The Christchurch South Library to achieve a seismic capacity of 67% NBS.

This memorandum describes the high-level architectural works associated with the strengthening works. This memorandum has been prepared as a desktop study only with review of existing drawings available and site photography. The full extent of works may not be apparent until a site inspection is undertaken or during construction.

The works described relate to the strengthening works described in 6-DP536.00-WSP-XX-RP-S-0001 and does not cover any other works or repairs required to the building.

External Bracing Strengthening

External bracing required as indicated on 6-DP536.00-SK01, SK02, SK03 and detailed on 6-DP536.00-SK07. Example architectural scope is outlined on drawing A-SK01 and Figure 1 on A-SK04.

It has been assumed that these works can be completed without disruption to external walls, cladding and glazing and that bracing is installed outside the line of the external walls, cladding and glazing.

Areas effected by the works include the external hardstanding, decks, and drainage as a result of the ground beam installation. The works will also impact the waterproofing integrity of the moat design.

There are 4 locations where access doors require adjacent bracing, it is assumed the bracing design will not impede the operation or clear opening width of the doors. Bracing elements will also impact openable glazing in a number of areas. The ventilation strategy for the building will need reviewing to ensure adequate ventilation is available when openable glazing is restricted.

Consideration for future maintenance to cladding and glazing where access is impeded by the bracing design will also be required.

Corridor Frame Strengthening

Internal bracing required as indicated on 6-DP536.00-SK01, SK02, SK03 and detailed on 6-DP536.00-SK07. Example architectural scope is outlined on drawing A-SK02 and Figure 2 on A-SK04.

There are 22 locations of corridor frame strengthening indicated on SK01 throughout the library. The works will be intrusive and require removal of the floor finishes surrounding the strengthening works including the tile and carpet finishes. Due to the extensive nature of areas required it is recommended that all floor finishes are replaced as part of the works to create consistency. We are led to believe there is electric under floor heating throughout the library which will also need repairing or an alternative method of heating may be worth exploring. Slab replacement works are required to install the ground beam required, this will involve replacement of the slab, under slab insulation and waterproofing.

If floor finishes are to be retained generally, then protection will be required while works are carried out to allow for equipment access and from damage.

Several walls will need to be demolished for access to the strengthening works as set out on A-SK02. This will include replacement of wall framing, finishes and fixtures including gib, timber wall panelling internal glazing and doors. Fixed furniture such as wall hung cupboards and fixed benching and desks will also need removing and reinstalling where possible or replacing where required.

Access to the works may require removal and reinstatement of doors and glazing including the main entry doors. Access requirements are to be developed with construction methodology.

A number of WCs are affected by the works (R.05, R.38, R.43, R.48 and R.47) Floor wastes, basins, toilets and SVPs will need to be removed and replaced. Where spaces have floor wastes, floor finishes will need replacing and falls to drains recreating.

Roof penetrations are required where bracing between adjacent roofs; works will include replacing long run roofing and flashing to weather seal, as well as potential interruption to services adjacent to these works (condenser units and high wall units).

Internal Bracing & Connection to PC Wall

Internal bracing and connections between precast walls and the structural beams are indicated on 6-DP536.00-SK01, SK02, SK03, SK04 and SK06 and detailed on 6-DP536.00-SK07. Example architectural scope is outlined on drawing A-SK03 and Figure 2 on A-SK04.

Ceilings, partitions including framing and linings, glazing heads, cills and jambs adjacent to the works will need replacing where access is required internally including removal of existing and replacement once strengthening complete.

Consideration should also be taken for additional thermal breaks created in the envelope, additional insulation may be required to these areas to prevent additional heat loss and condensation issues.

It has been assumed the structural works can be completed without disrupting the external glazing units, but units will likely need to be removed during works for access.

Other Works to be Considered

The strengthening works will require a building consent and therefore trigger the rules for alterations to existing buildings. These works will need to retain the minimum levels of existing compliance as well as meeting current regulations for 'Means of escape from fire' (clauses C3.4, C4, C6, D1, F6, F7, F8.) and 'Access and facilities for persons with disabilities' (clauses D1, D2, F7, F8, G1, G2, G3, G5, G9, G12.) on a 'as nearly as is reasonably practicable' (ANARP) basis. For the scope of these works to be determined a full gap analysis would be required.

Examples of where the building no longer complies with 'means of escape from fire' include more recent surface spread of flame ratings required for internal finishes including the timber panelling which may need treating or replacing to comply. Fire services access will also need reviewing with warning systems and escape signage.

Compliance with clause H1 - Energy Efficiency will be required to meet the previously consented requirements where replacement of a small part of the building envelope should simply ensure the overall thermal resistance of a building is not diminished. The strengthening works may increase thermal breaks in the envelope which should be addressed through additional insulation and considered detailing of the altered envelope.

Summary

- This memorandum is intended to provide information to aid in decision making, however it is important to note that it is not an all-inclusive document and there are other considerations that will be required such as potential upgrades to fire and accessibility requirements that may be necessary because of the proposed strengthening.
- The proposed temporary strengthening does not address repair or serviceability considerations.
- This memorandum outlines the high-level architectural works associated with the strengthening works and includes demolition and replacement of areas of flooring (including tile and carpet floor finishes, slab, below slab insulation and waterproofing), internal walls (including framing, gip, timber panel finishes, internal glazing and associated fixtures and fittings; basins, toilets, drainage works and timber joinery) and roofing at bracing junctions. Ceilings, internal and external walls will require repairing where internal bracing has been proposed. External works include replacement of external hard standing and decks with any associated waterproofing of moat design.
- Additional gap analysis for escape from fire and access is required to determine the total scope of works required for the strengthening works.

Minimum external areas effected by bracing works including external hard standing, decks and slabs.

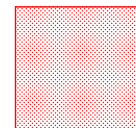
Summary
External works include replacement of external hard standing and decks with any associated waterproofing of moat design.


External Bracing Strengthening



FLOOR PLAN

 WSP NZ www.wsp.com/en-nz	PROJECT:		South Library & Service Centre Seismic Advice		JOB No:	6-DP536.00
	DESCRIPTION:		Proposed Concept Strengthening Scheme 67%NBS IL3 Architectural Review - External Bracing Strengthening		START PAGE No. / REVISION BY:	
DESIGNED BY:	DATE:	REVIEWED BY:	DATE:	APPROVED BY:	DATE:	
CB	28.04.2023	DB	28.04.2023	

 Minimum area of floors and ceilings to be removed and reinstated to allow access for strengthening work

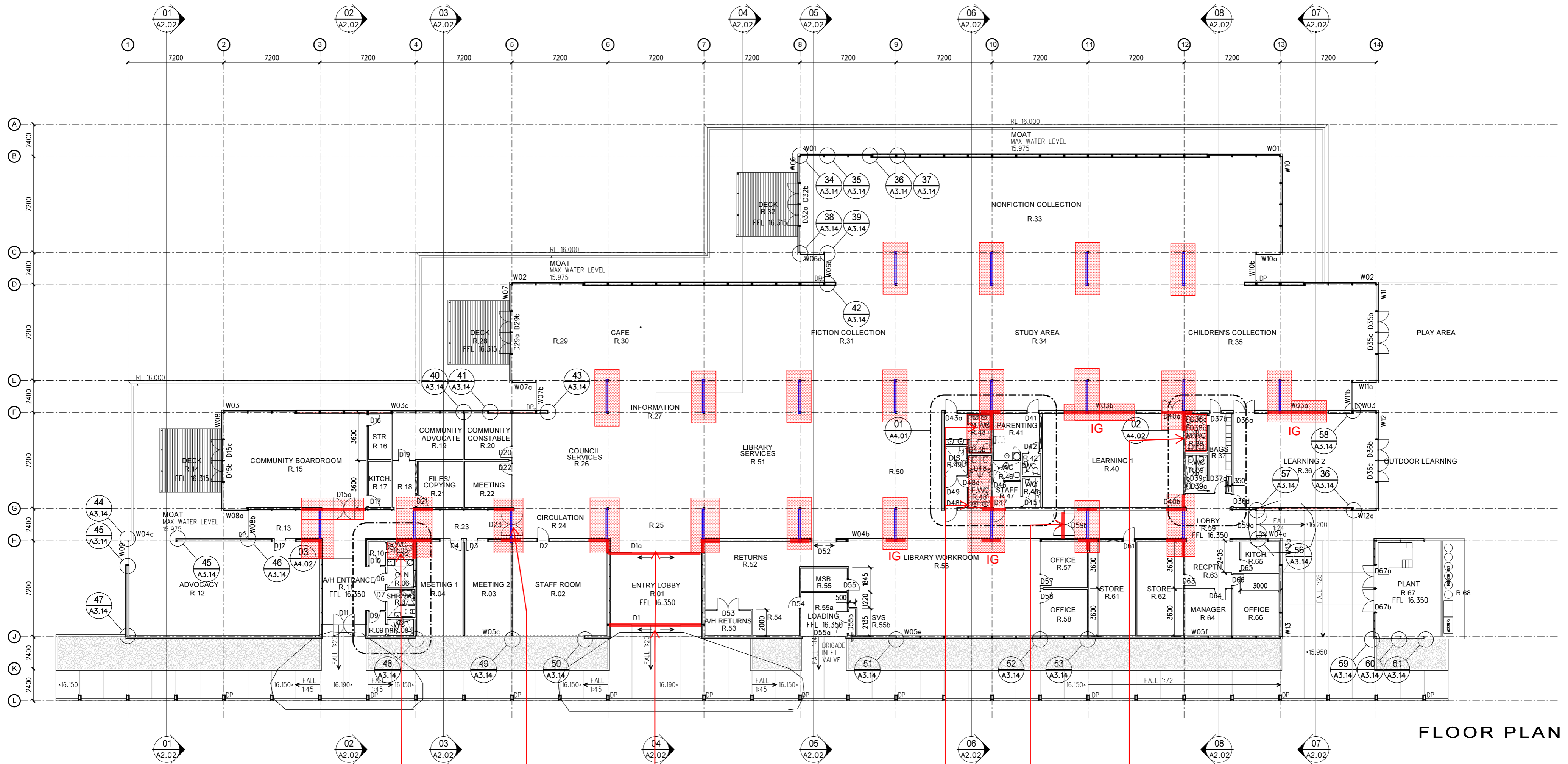
 Walls & doors to be removed for access to works

 Corridor frame strengthening

IG Areas of internal glazing affected by works

Summary

Works include demolition and replacement of areas of flooring (including tile and carpet floor finishes, slab, below slab insulation and waterproofing), internal walls (including framing, gib, timber panel finishes, internal glazing and associated fixtures and fittings; basins, toilets, drainage works and timber joinery) and roofing at bracing junctions.



FLOOR PLAN

WC affected by works


Removal of doors for access to works

Potential temporary removal of entrance glazed doors for access to works

WC Basins and floor drainage affected by works

Removal of doors for access to works

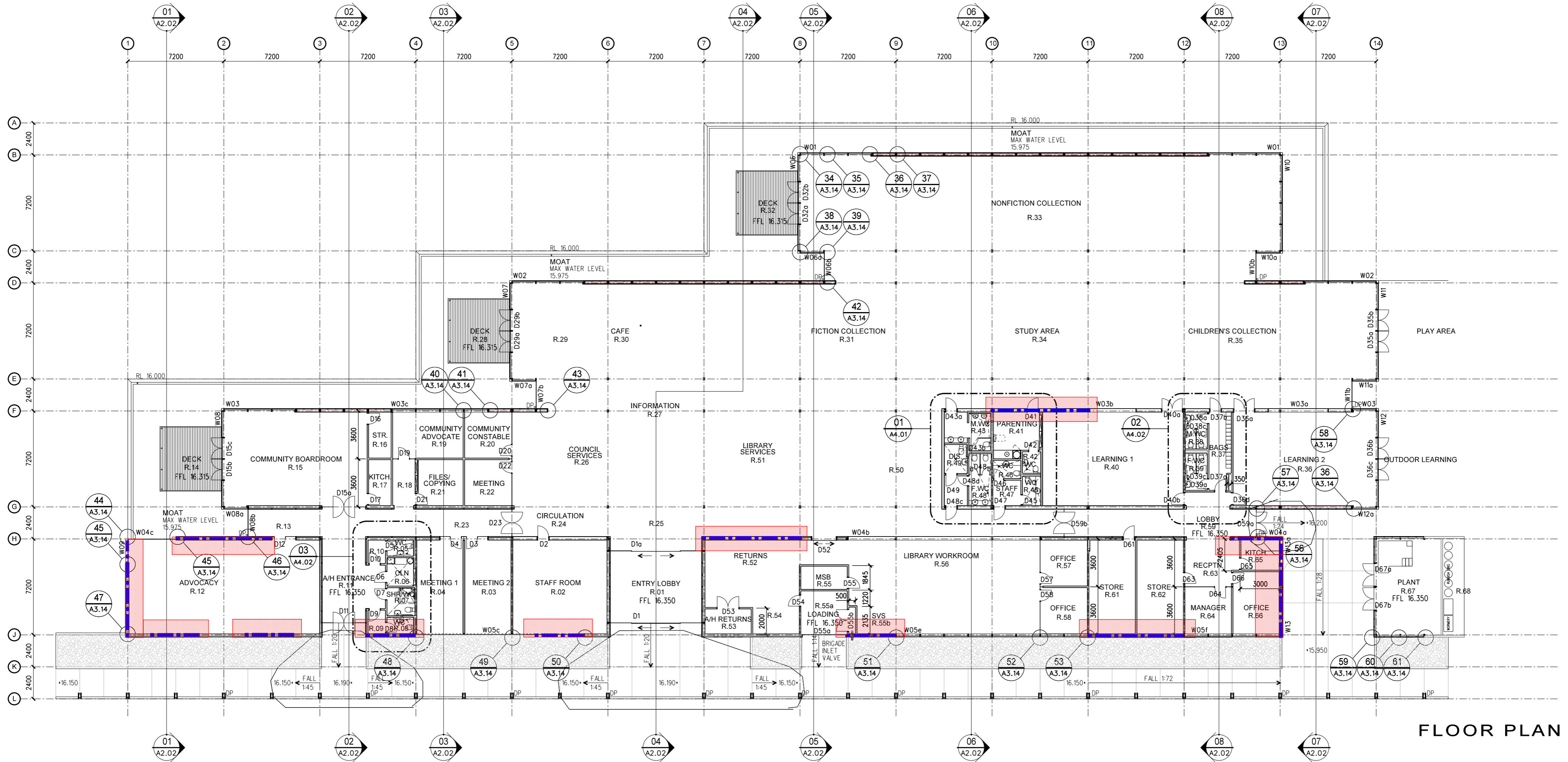
WC Basins and floor drainage affected by works

		PROJECT: South Library & Service Centre Seismic Advice		JOB No: 6-DP536.00	
DESIGNED BY: CB		DATE: 28.04.2023		REVIEWED BY: DB	
DATE: 28.04.2023		DATE: 28.04.2023		APPROVED BY: ...	
DESCRIPTION: Proposed Concept Strengthening Scheme 67%NBS IL3 Architectural Review - Corridor Frame Strengthening		START PAGE No. / REVISION BY: A-SK02 / REV 1		DATE: ...	


Minimum areas affected by bracing and connection works including internal ceilings, internal walls and glazing reveals.

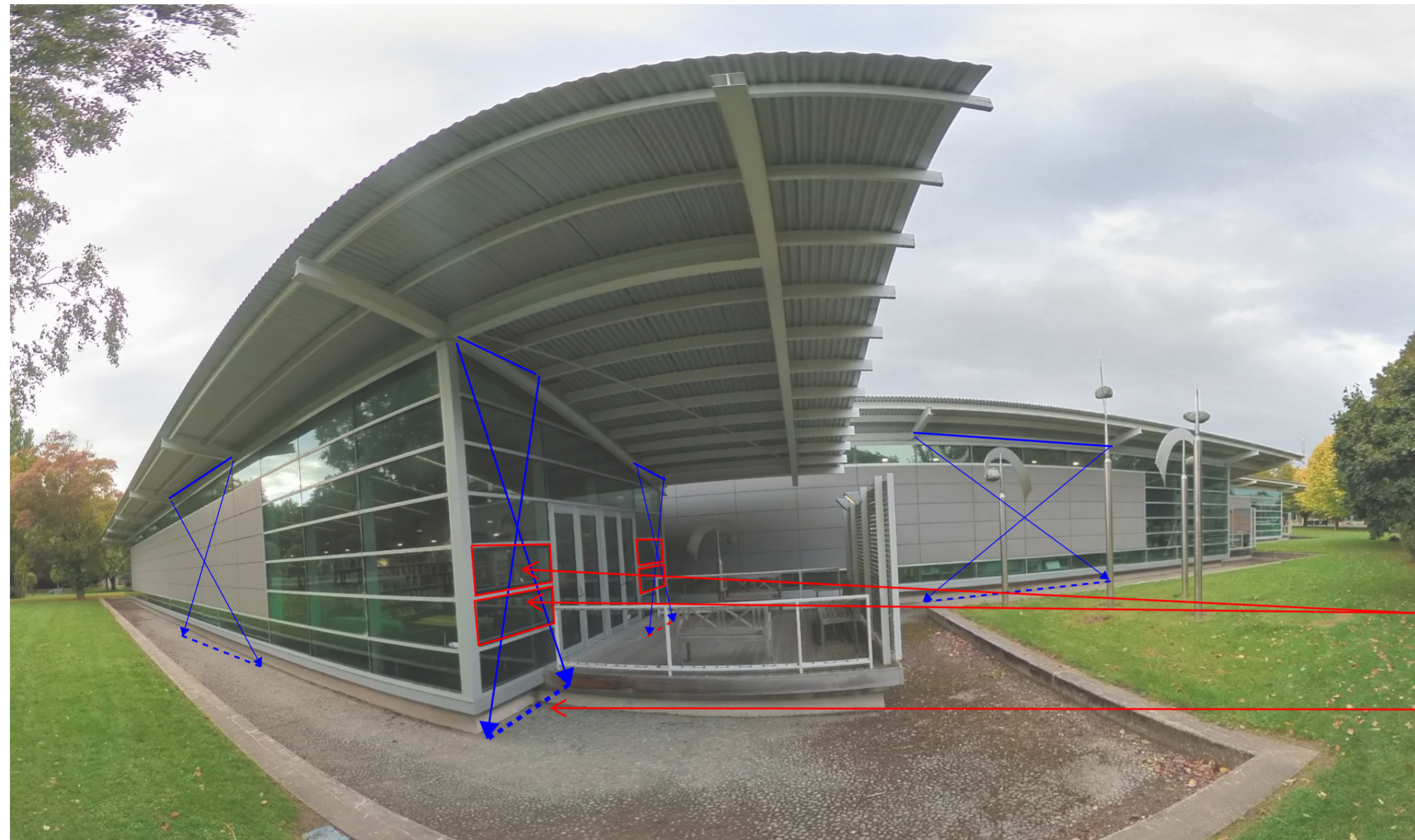
Summary
 Ceilings, internal and external walls will require repairing where internal bracing has been proposed. Additional works to mitigate increased thermal breaks may also be required.

Internal Bracing / Connection to PC Wall



FLOOR PLAN

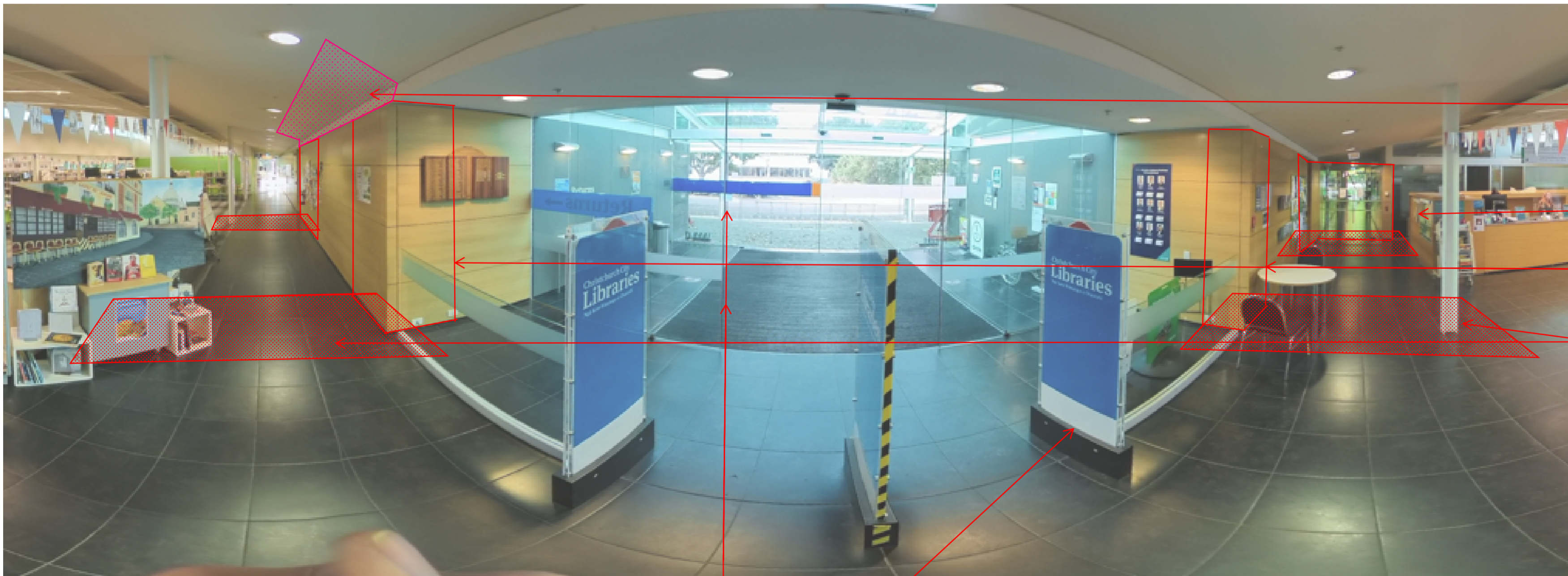
		PROJECT: South Library & Service Centre Seismic Advice		JOB No: 6-DP536.00	
DESCRIPTION: Proposed Concept Strengthening Scheme 67%NBS IL3 Architectural Review - Internal Bracing / Connection to PC Wall		DESIGNED BY: CB		START PAGE No. / REVISION BY: A-SK03 / REV 1	
DATE: 28.04.2023	REVIEWED BY: DB	DATE: 28.04.2023	APPROVED BY: ...	DATE:



Operable glazing impeded by bracing in multiple locations.

Deck to be removed and reinstated for access to ground beam works. Extent of deck reduced by extent of bracing.

FIGURE 1



Ceiling area to be opened for internal bracing and replaced for internal bracing design installation.

Fixed joinery effected by strengthening works. Removed and instated if possible or replacement required.

Approximate minimum area of walls and wall finishes to be removed and replaced

Approximate minimum area of flooring, slab, insulation and waterproofing required to be removed and replaced with works.

Entry barriers and entry glazed doors to be removed and reinstated for equipment access for strengthening works

FIGURE 2

 WSP NZ www.wsp.com/en-NZ	PROJECT: South Library & Service Centre Seismic Advice				JOB No: 6-DP536.00	
	DESCRIPTION: Proposed Concept Strengthening Scheme 67%NBS IL3 Architectural Review - Example Photograph Mark-Ups of Works					
	DESIGNED BY: CB	DATE: 28.04.2023	REVIEWED BY: DB	DATE: 28.04.2023	APPROVED BY: ...	DATE: ...