

Design note

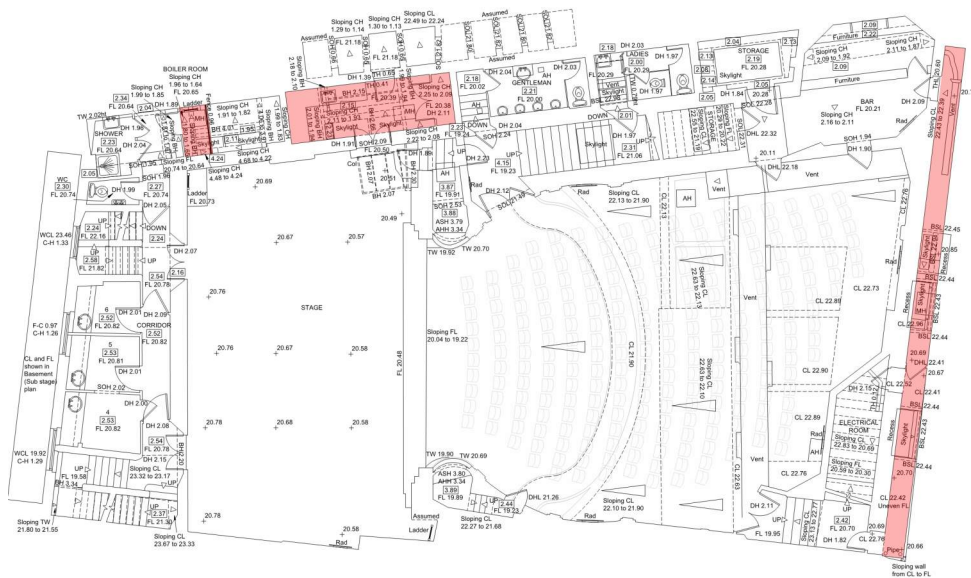
Project	Date	By	Reference
Ambassadors Theatre, London	2 Mar 2023	RR	5208_DN_001

Title
Structural design philosophy, remedial works overhead pavement support

Introduction

This design note discusses the overhead pavement support at basement level and the structural design philosophy adopted for the Ambassadors Theatre in West Street, London. The existing structure has been found to be in a poor condition and remedial works are proposed to ensure the longevity of the building.

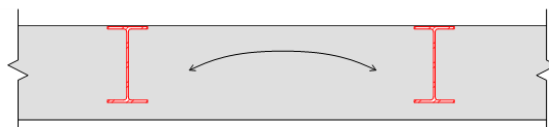
This note refers to the areas at the stalls level (basement) in red below.



Stalls level (basement) survey drawing showing the areas considered in red.

Existing Structure

The existing overhead structure - supporting the pavement and skylights - is of a filler-joist construction, which was typically used in the era when the Ambassadors Theatre was constructed (1913). A filler-joist floor consists of steel beams, at relatively close centres (~600mm in this case), with an unreinforced concrete slab spanning between them and taking support of the bottom flanges. The bottom flange of the steel beams was fully encased in concrete as this provided a certain degree of fire protection.

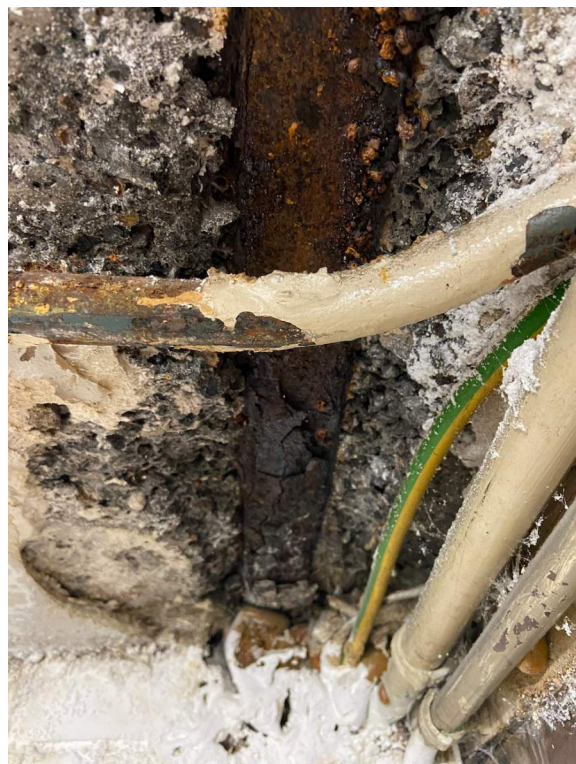


Cross section of a filler joist floor with the steel beams shown in red and the unreinforced concrete spanning in between.

Additionally, steel trimmer beams are present around the skylight openings: these form the 'opening' to let the light in as this is where the structure steps up typically. These steel beams were originally encased in concrete as well, for reasons of fire protection.

Condition of Existing Structure

The existing structure has been inspected from below - the top is covered by the pavement and its build-up and this was not dug up - to understand it's current condition. What became apparent was that the concrete cover on the bottom flange had completely spalled, which was due to the corrosion expansion of the steel beams: when steel corrodes its volume increases up to a factor of ten. The steel beams had suffered from various levels of corrosion: certain areas only had surface corrosion, whereas other areas (typically near the supports) had completely delaminated and could be removed by hand. Hence, the structural integrity of the steel beams - and thereby the floor as a whole - had been compromised and can't be relied on anymore.



*Left photo: the concrete encasing around the bottom flange had spalled, due to corrosion expansion.
Right photo: the corrosion was quite severe in certain locations, with delamination of the steel.*

The cause of the corrosion is water ingress, in combination with the lack of ventilation (as the steel is encased in concrete). This might have been further exacerbated by the the clinker concrete typically used in those days: when the clinker concrete gets wet it creates a strong acidity which affects the steel.

With regards to the steel trimmer beams around the skylights, similar deterioration was found: the concrete originally encasing the steel had spalled nearly completely, due to the corrosion expansion, and had exposed the soffit and sides of the beams. The steel was in an equally poor condition: serious delamination was visible at the top and bottom flanges and the web had been affected too. As a consequence, the steel trimmer beams need remedial works as well.



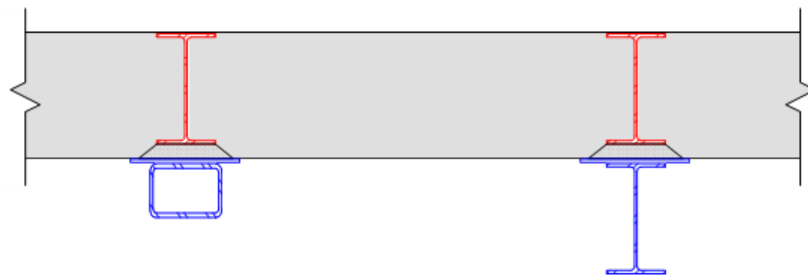


*Left photo: the concrete encasing around the trimming steel beams had spalled, due to corrosion expansion.
Right photo: delamination was severe in certain locations, in particular on the top and bottom flange.*

Remedial Works

The structural design philosophy for the remedial works sets out to make the structure safe again whilst balancing this with practical restraints. Removing the existing steel beams would result in digging up the pavement and extensive temporary works as the slabs also prop the external retaining walls. As a consequence, new steel beams are proposed which sit below the existing ones, taking over their support function. Putting these beams in place with a significant level of corrosion protection (by galvanising) will ensure the correct level of support is achieved again. Also, the insertion of the steel beams could be reversed at a later date if it is ever decided to replace the full slab overhead.

The new steel beams will be as shallow as possible, not to affect the headroom too much. Depending on the extent of the spalled concrete, steel top plates will be introduced to provide sufficient support width. The area where the concrete is lost will be infilled with grout.



Principle of remedial works: providing new steel beams below the existing ones to take over the support function: new steel sections can be UB-sections (shown right) or reduced depth sections (shown left) where headroom is an issue.



With regards to the boiler room, a small portion of the existing filler-joist floor is removed completely: the structure for this is also in a really poor condition - both the steel and the concrete - and its removal is simplified as this is a suspended floor without anything above. Adding remedial works would lead to a reduced headroom in an already confined space and it would be difficult to deal with the safety risk of the spalling concrete (falling on people working below).



Left photo: small portion of the boiler room floor seen from stalls level. Right photo: existing structure seen from below, showing the significant corrosion and subsequent spalling of the concrete.



New opening in existing masonry wall:
- 2no precast plank lintels over 100w x 140dp, with 150mm bearing at each end.
- Opening to be created in two stages: one half leaf removed & lintel installed first, followed by the other half leaf



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This drawing is to be read in conjunction with all other relevant contract documents and other consultants information.

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Work only to figured dimensions. If in doubt, ask.

Unless noted otherwise, all dimensions in millimeters, all levels in meters.

All levels and dimensions to be checked on site by persons carrying out the work. Please report any discrepancies to Momentum.

NOTES

1. All drawings are based on a measured survey by Maltby Surveys Ltd, dated May 2019
2. Existing structure shown is based on limited opening up works: the contractor is to notify Momentum immediately if the existing structure deviates from the drawings.
3. For fire rating and protection refer to Architect's drawings / fire consultant.
4. Material grades:
 - Steel S355 JO (hot-formed) U.N.O.
 - Bolt and anchors 8.8
 - Grout: 5-star grout
5. New steelwork for pavement support to be galvanised to 140 microns.
6. All temporary works by contractor.
7. Contractor to assess CDM risks and subsequent potential restrictions in relation to confined spaces on site.
8. Allow for local concrete repair - in accordance with BS EN 1504 - where concrete has spalled.
9. For waterproofing refer to Architect's drawings.
10. Make allowance for some of the electrical servers to be temporarily relocated.
11. Steel-to-steel connection design by contractor.
12. Contractor to take site dimensions before producing shop drawings / fabrication starts

Rev	Date	By	Description
P01	02.03.23	rmh	Planning Issue

NOT FOR CONSTRUCTION

Date	Scale	Format
Mar '23	1:50	A1
Drawn	Reviewed	Approved
rmh	RR	RR

Work Stage & Reason For Issue
For Planning

Architect
citizens design bureau

Client
Ambassador Theatre Group (ATG)

Project Number & Title
5208
Ambassador Theatre

Sheet Number & Title
0099
GA Plan.
Sub Stage Layout
Phase 2

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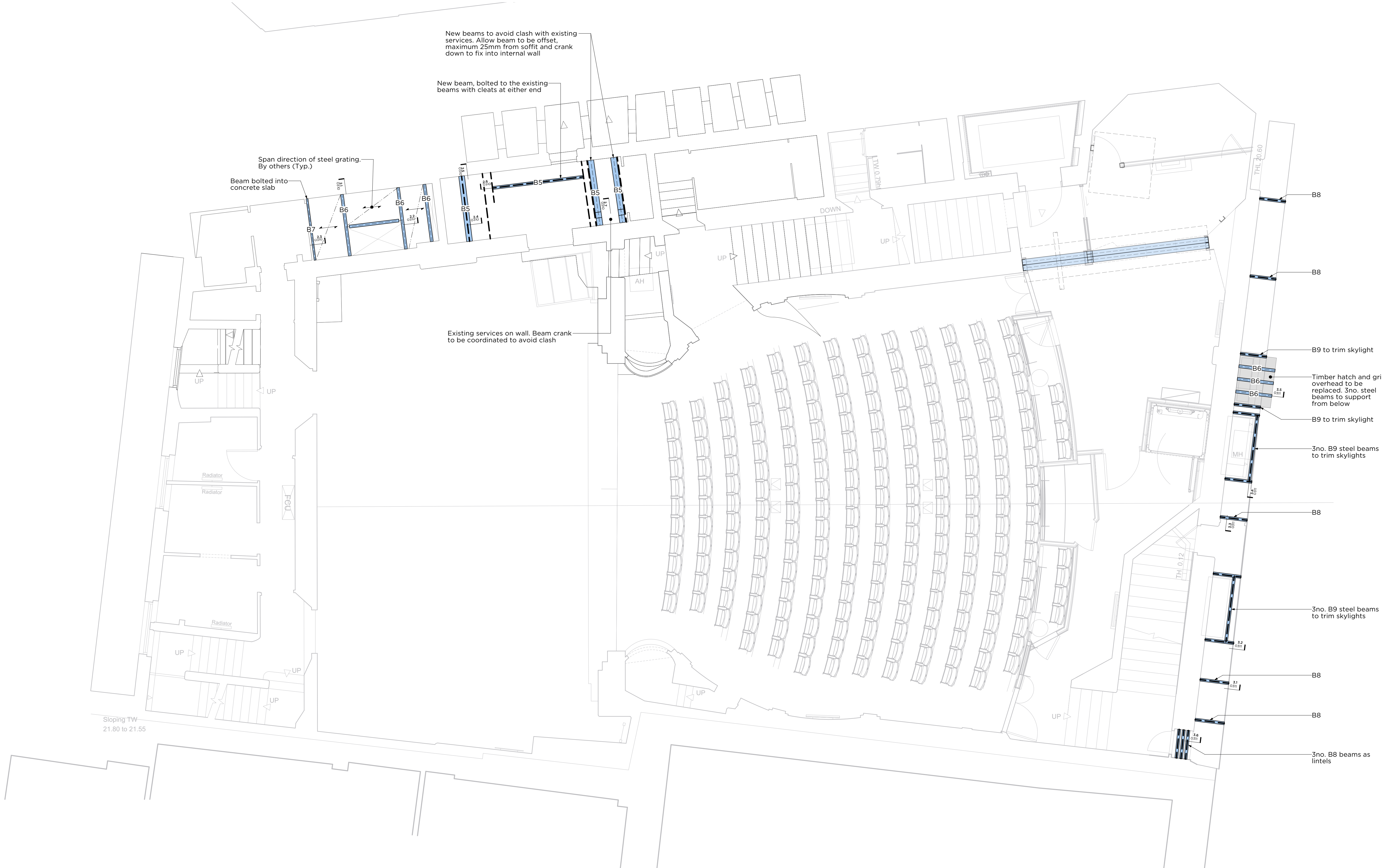
Document Reference
5208-MOM-XX-XX-DR-S-0099
P01

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Existing steel beam

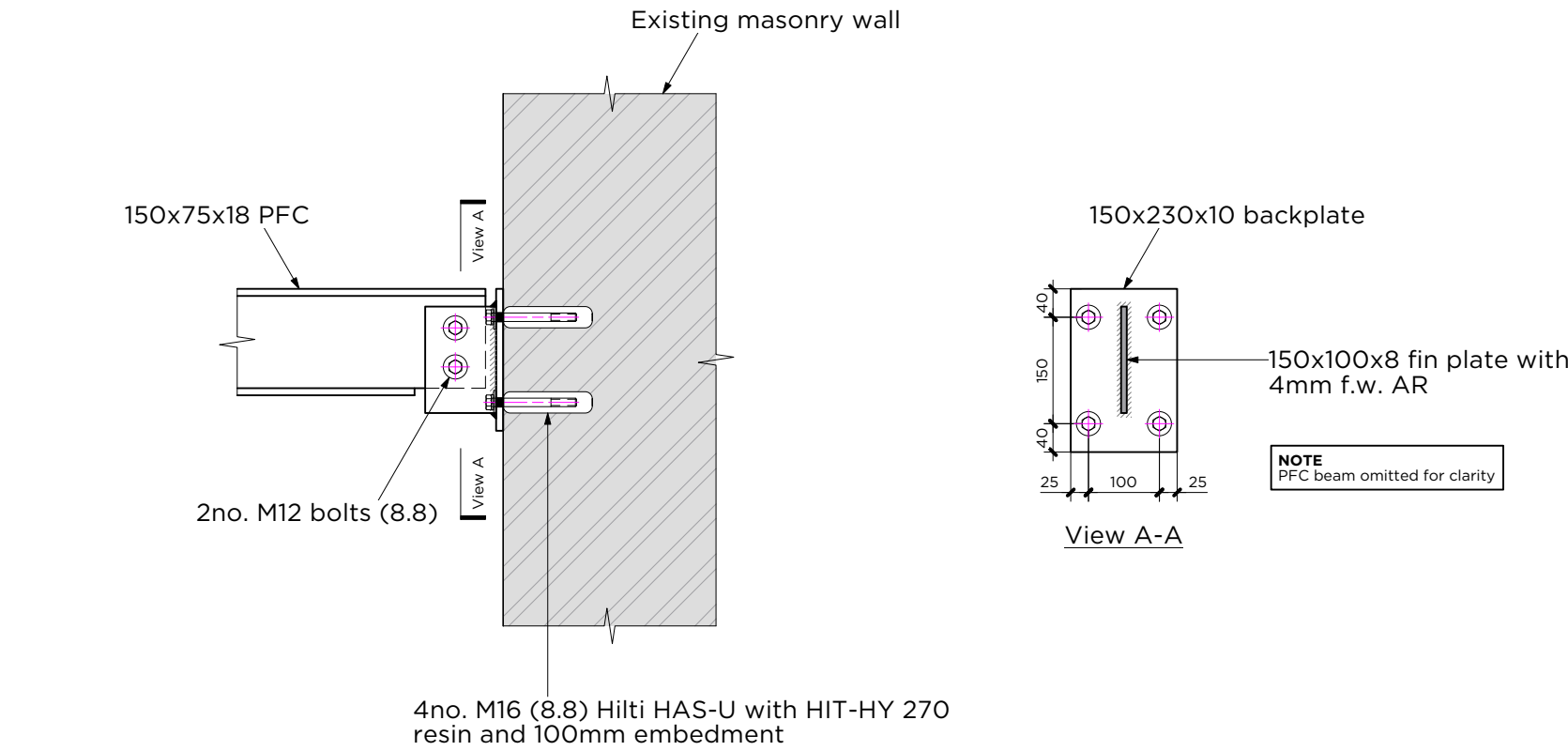
Proposed steel beam

Document Reference
5208-MOM-XX-XX-DR-S-0110
P01

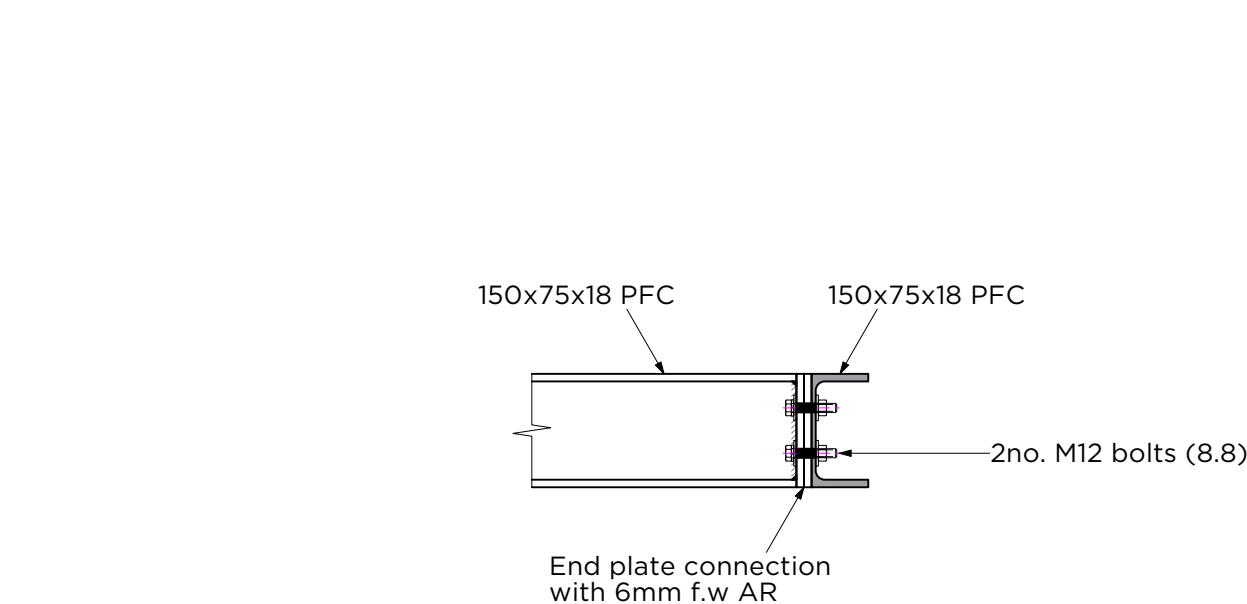


GA Plan - Basement Layout - Phase 2

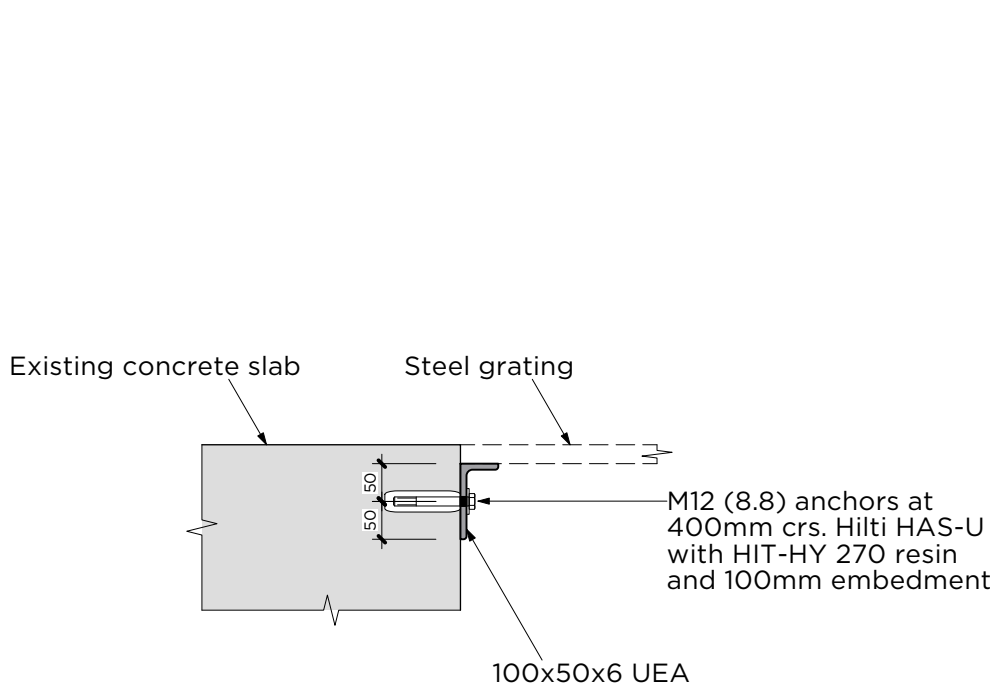




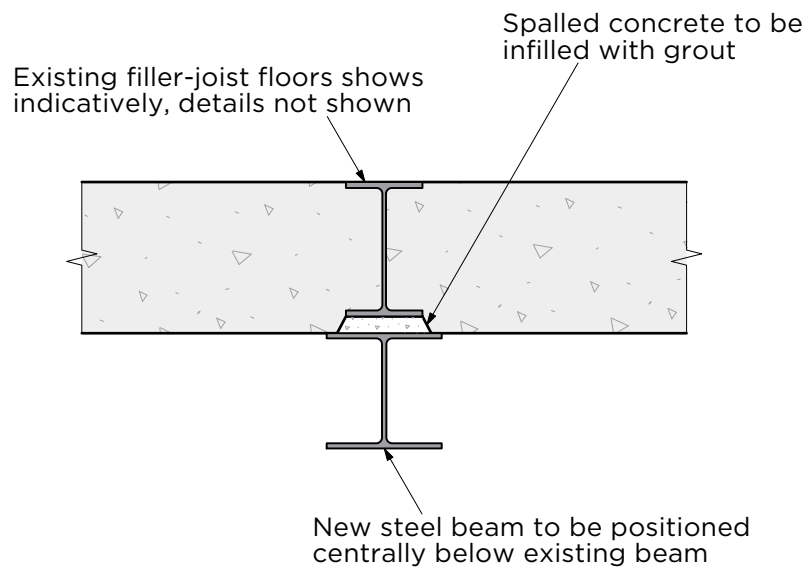
2.1 Detail - PFC to existing masonry
O110 Scale at A1 - 1:10



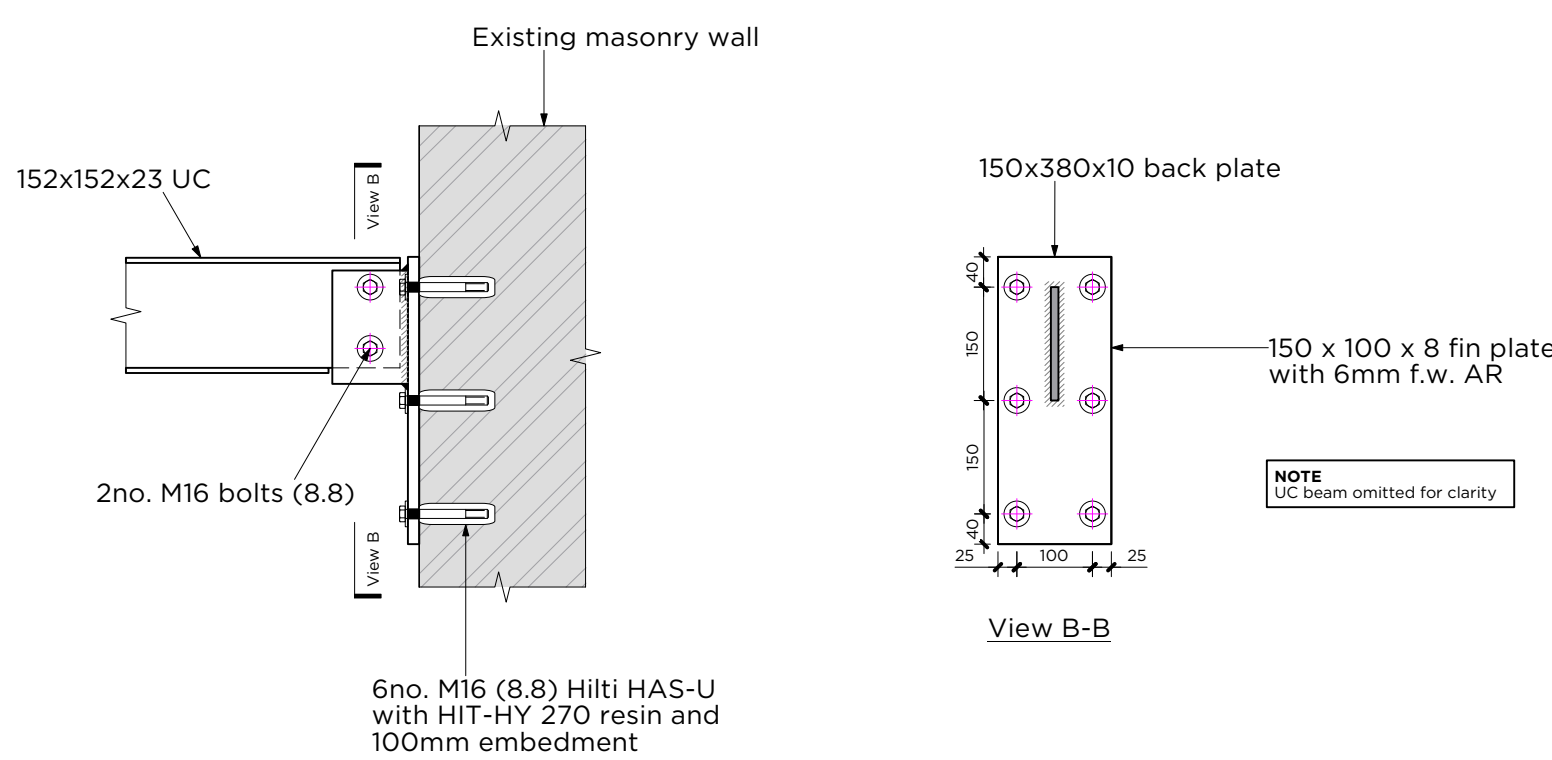
2.2 Detail - PFC to PFC
O110 Scale at A1 - 1:10



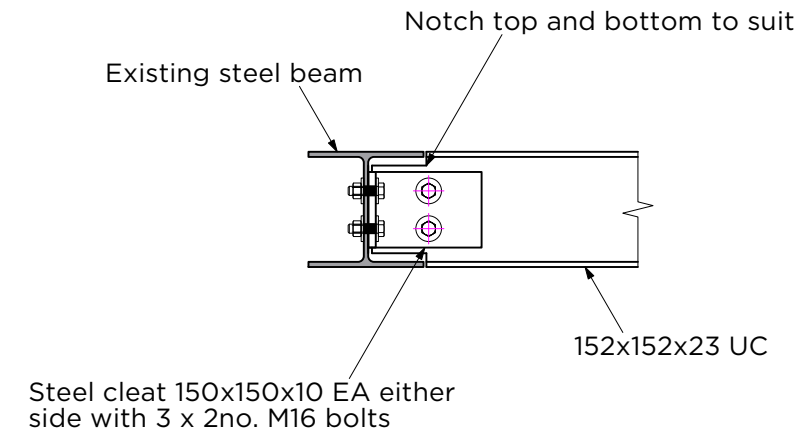
2.3 Detail - PFC to existing slab
O110 Scale at A1 - 1:10



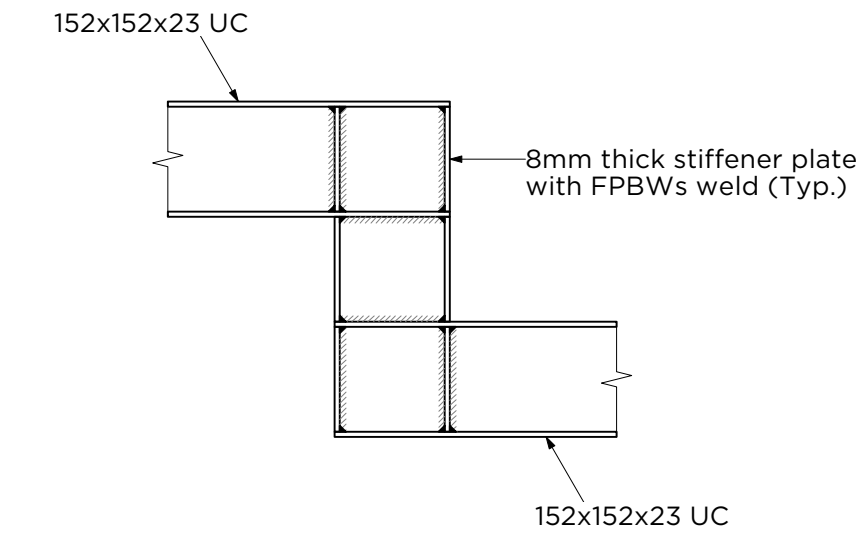
2.4 Detail - UC beam supporting existing filler joist floor
O110 Scale at A1 - 1:10



2.5 Detail - UC to existing masonry
O110 Scale at A1 - 1:10



2.6 Detail - UC to existing beam
O110 Scale at A1 - 1:10



2.7 Detail - UC cranked beam
O110 Scale at A1 - 1:10

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Work Stage & Reason For Issue
For Planning

Architect
citizens design bureau

Client
Ambassador Theatre Group (ATG)

Project Number & Title
5208
Ambassador Theatre

Sheet Number & Title
0310
GA Details.
Basement Details
Phase 2
Sheet 1

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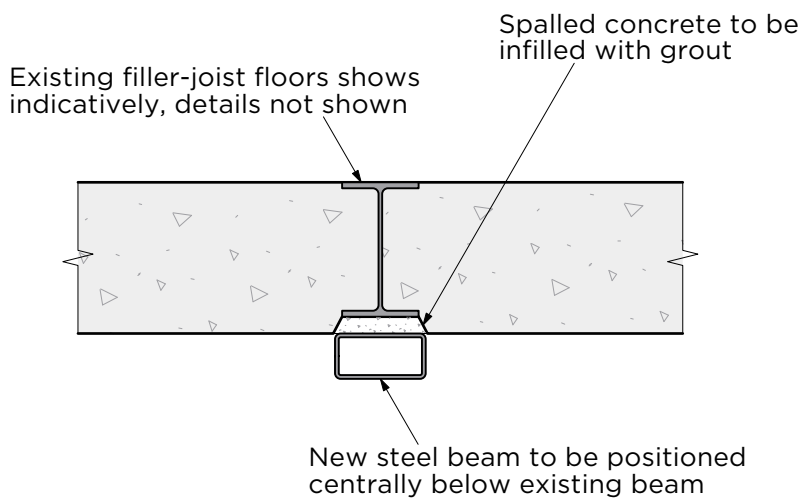
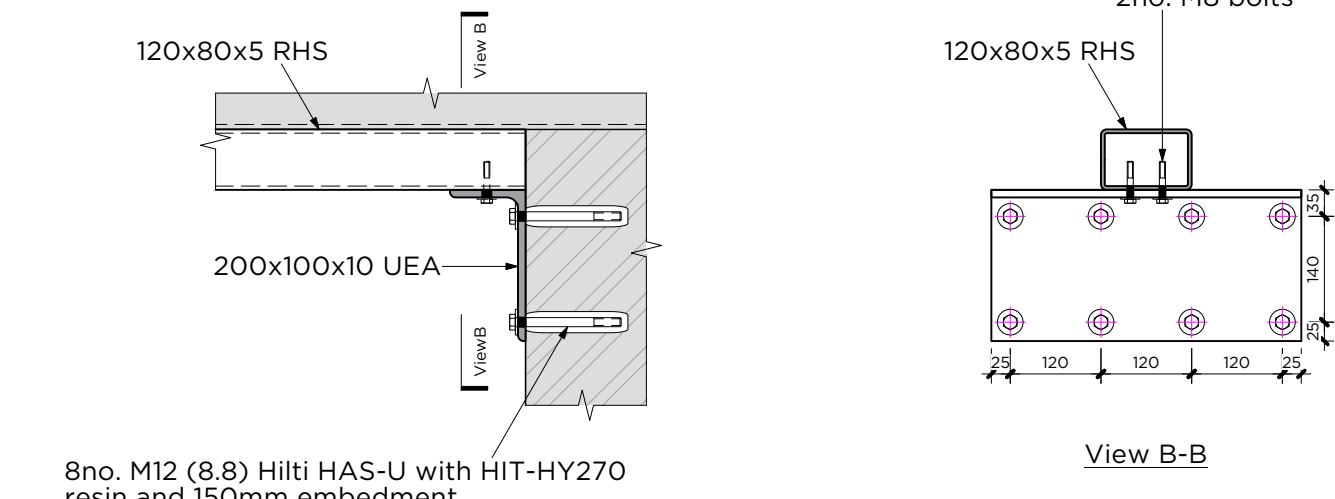
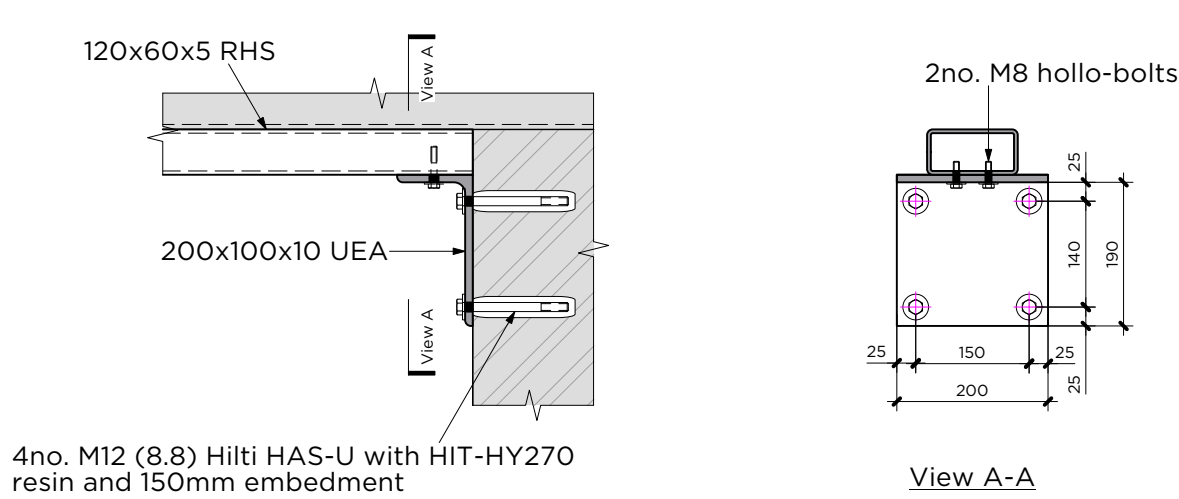
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3.1 Detail - RHS to existing masonry

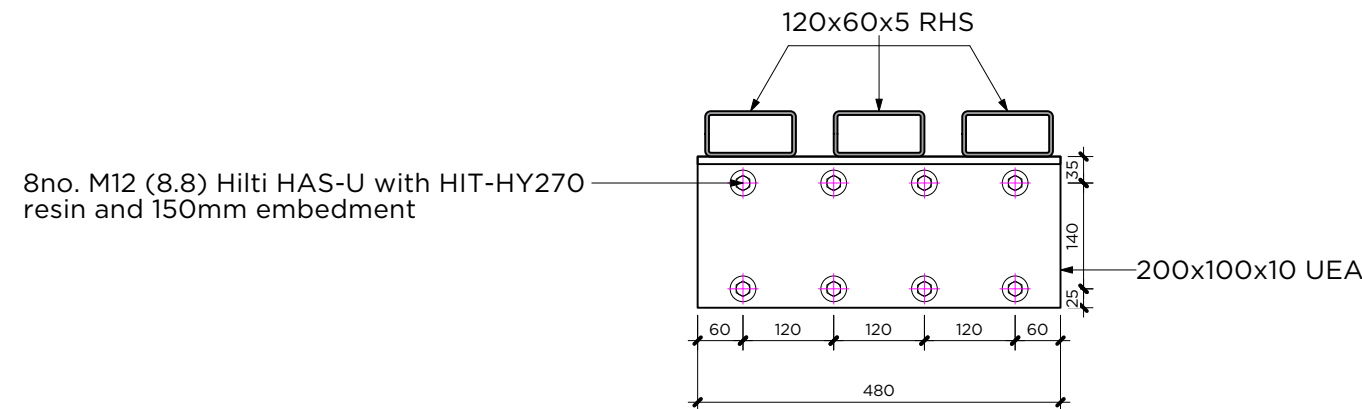
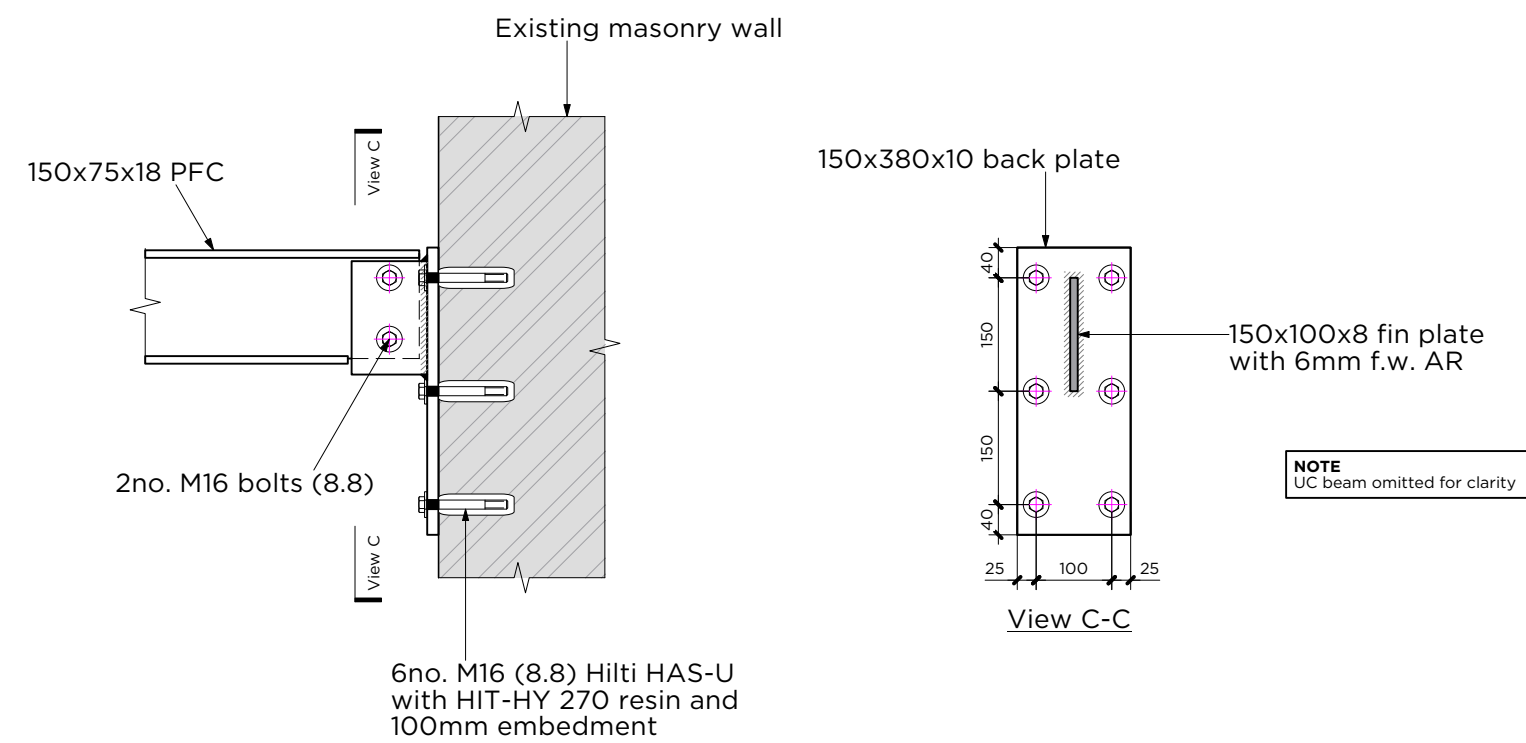
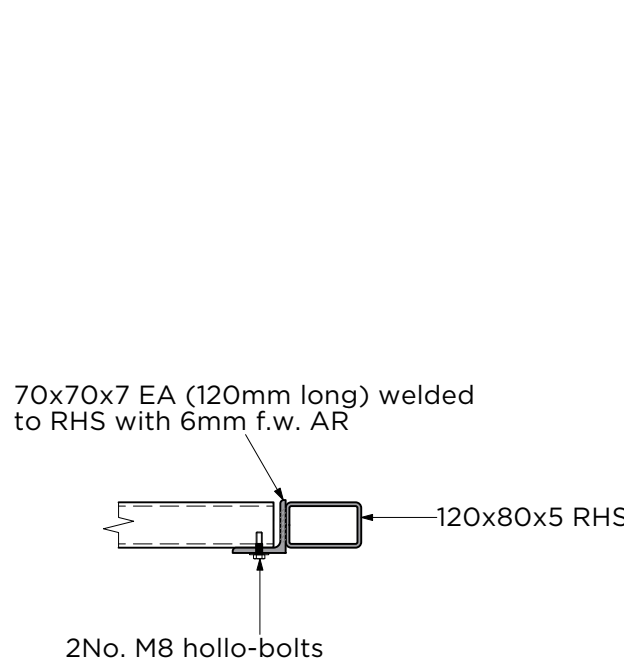
O110 Scale at A1 - 1:10

3.2 Detail - RHS to existing masonry

O110 Scale at A1 - 1:10

3.3 Detail - RHS beam supporting existing filler joist floor

O110 Scale at A1 - 1:10



3.4 Detail - RHS supporting RHS

O110 Scale at A1 - 1:10

3.5 Detail - PFC to existing masonry

O110 Scale at A1 - 1:10

3.6 Detail - RHS lintels

O110 Scale at A1 - 1:10

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Date	Scale	Format
Mar '23	1:10	A1
Drawn	Reviewed	Approved
rmh	RR	RR
Work Stage & Reason For Issue		
For Planning		

Architect
citizens design bureau

Client
Ambassador Theatre
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Project Number & Title
5208
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Sheet Number & Title
0311
GA Details.
Basement Details
Phase 2
Sheet 2

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P01