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Status:	Interim Report
Date:	27/07/2018
Revision:	A
Job no:	1444
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Approved by:	James Morgan

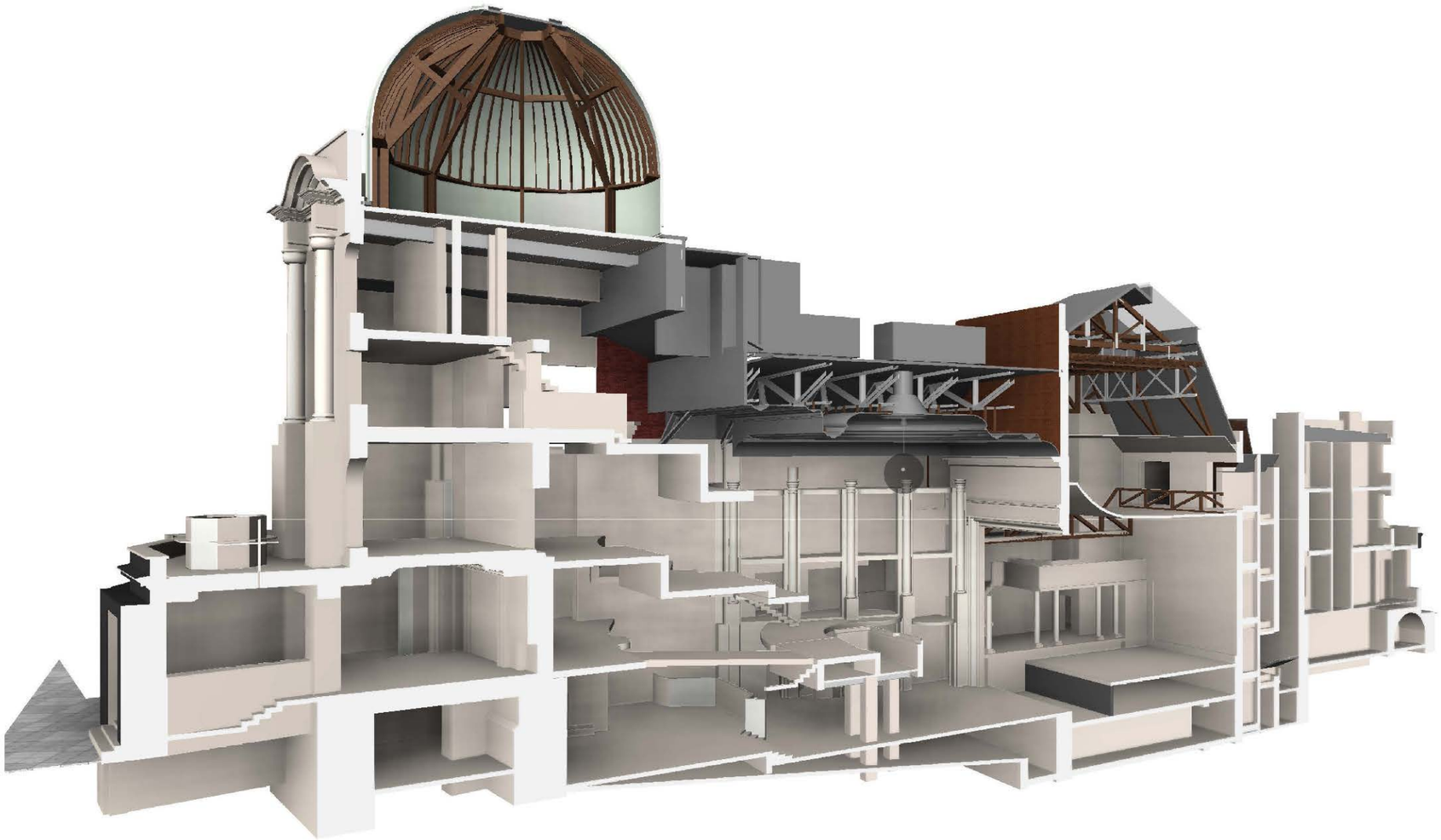
HEYNE TILLETT STEEL

Introduction

HTS undertook a site visit on the 12th June 2018 to inspect the steel truss which supports the dome and the western roof of Koko night club. The truss was found to have suffered from severe corrosion which was possibly caused by water ingress over the life of the building.

Several further inspections have been undertaken on the 17th and 18th July.

This report details the findings of these inspections and recommends further measures which need to be taken immediately.



HEYNE TILLETT STEEL

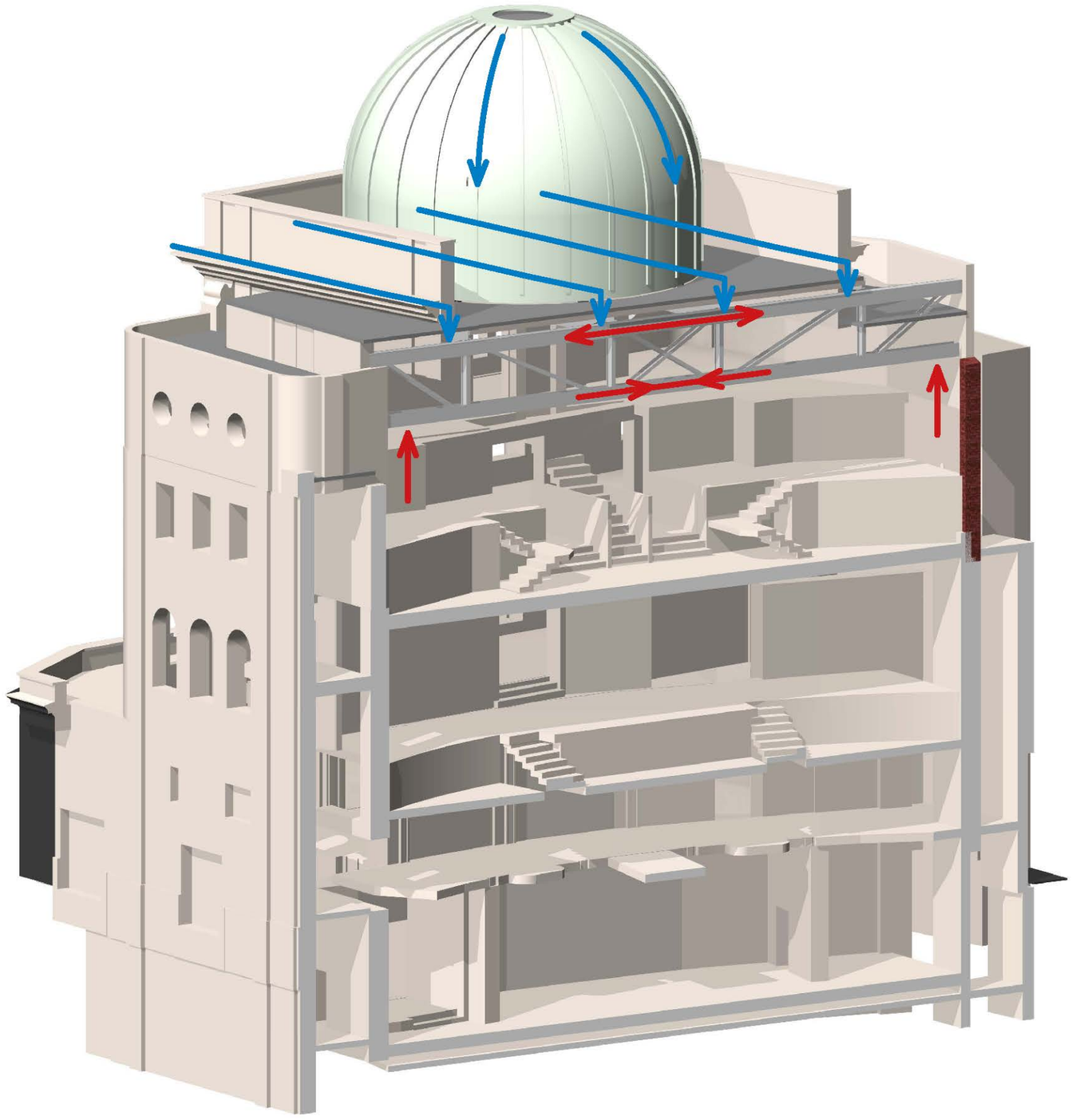
Existing Structure

The existing truss member consists of rolled steel sections riveted together to form a 2.5m deep element with a clear span of 18m across the rear of the auditorium.

The truss is assumed to be supported by the north and south masonry walls of the auditorium. Opening up has not yet been done expose the bearing condition.

The truss supports the western roof above the entrance to Koko, the copper clad dome and a strip of sloped filler joist slab to the plant roof.

The entrance roof appears to be formed of filler joist slab spanning north-south onto four fabricated steel beams and the masonry walls of the auditorium. The domed roof appears to be supported directly on the steel beams and roof slab. Parapets at roof level appear to be formed of 2m tall masonry supported on the steel beams. The four steel beams appear to be supported on the vertical elements of the truss.

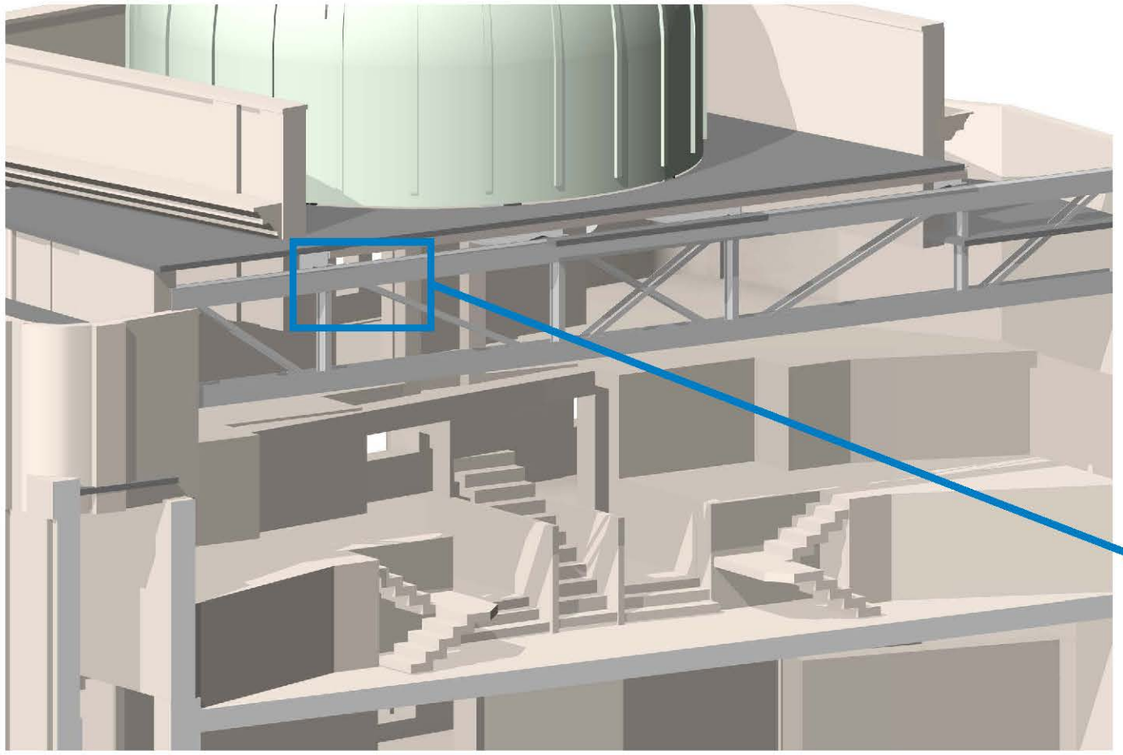


Condition

Severe deterioration/delamination of the truss top chord was observed, likely caused by water ingress during the life of the building. Delamination has caused a reduction in effective steel area which consequently reduce the capacity of the existing truss. In some areas it appears that a significant amount of steel area has been lost to the outer channel that forms the top chord.

A primary area of concern is the connection of the diagonal chord into the top chord. Analysis of the current condition indicates that the diagonal chord carries a tensile force approximately 1000kN (100 tonnes). To give this some context, the diagonal beam is trying to pull away form the corroded top chord with a weight equivalent to 85 VW Golfs.

The concern with this connection it that the section of the top chord that carries this force is very corroded and cannot withstand the applied force. There is also a risk that the corrosion of the connecting rivets may lead them fail under the applied load.



HEYNE TILLETT STEEL

Temporary works

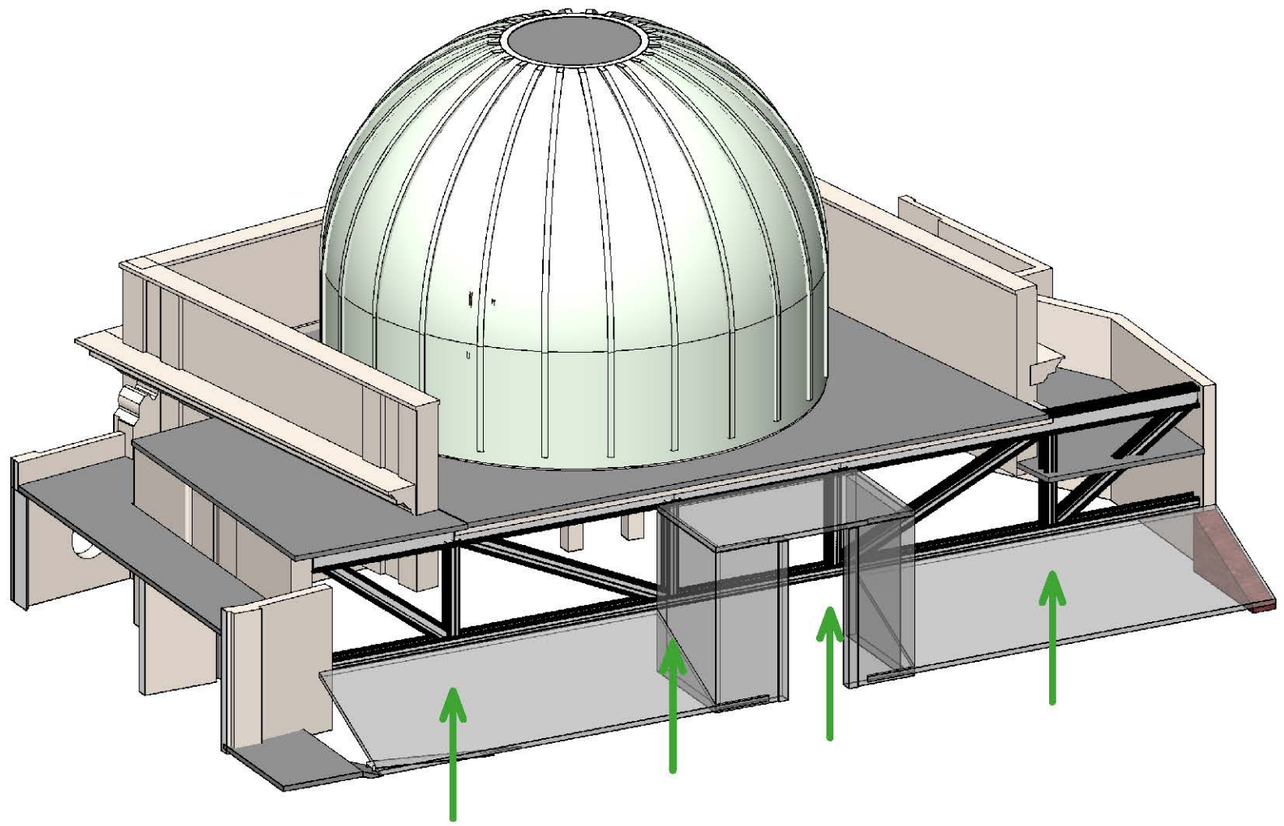
Temporary props have been designed by the temporary works engineer to support all of the loads from the dome and roof. They are aligned to pick up the four beams under the truss. The props extend from roof level through all the floor levels to bear on spread foundations at ground level.

Three temporary options have been reviewed to support the truss until the proposed structure can be installed:

1. The current props stay in the building until the proposed works commence in March 2019
2. A new steel beam is installed on top of the truss to hang truss and support existing loads
3. The truss is refurbished temporarily to support existing loads.

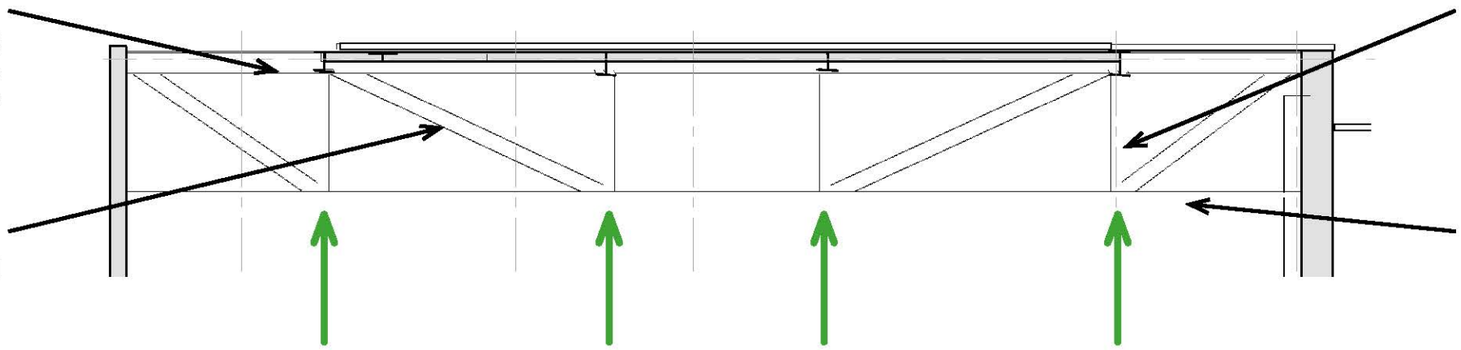
Option 1

Retaining the props is seen as the simplest solution, which avoids any major structural works until the proposed works commence, however, it may be intrusive or obstructive to the venue,



Top chord:
Fabricated steel section from two 13"x3 1/2" PFC sections rivited with steel plates top and bottom. Extremely corroded in sections

Diagonal members:
10"x6" steel I-sections riveted to top and bottom chords



Vertical members:
9"x7" steel I-sections riveted to top and bottom chords

Bottom chord:
10"x6" steel I-section on side. Appears to be supporting sloped filler-joist slab.

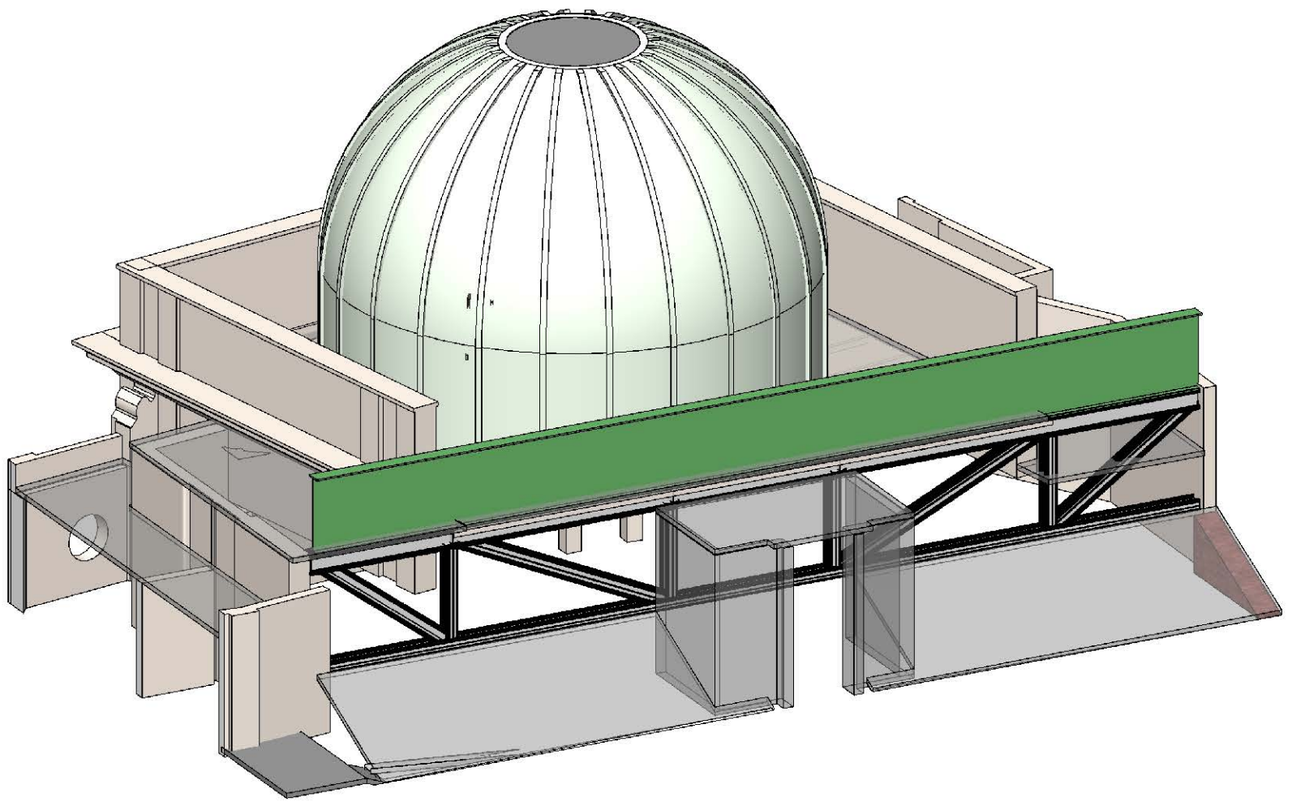
Temporary works

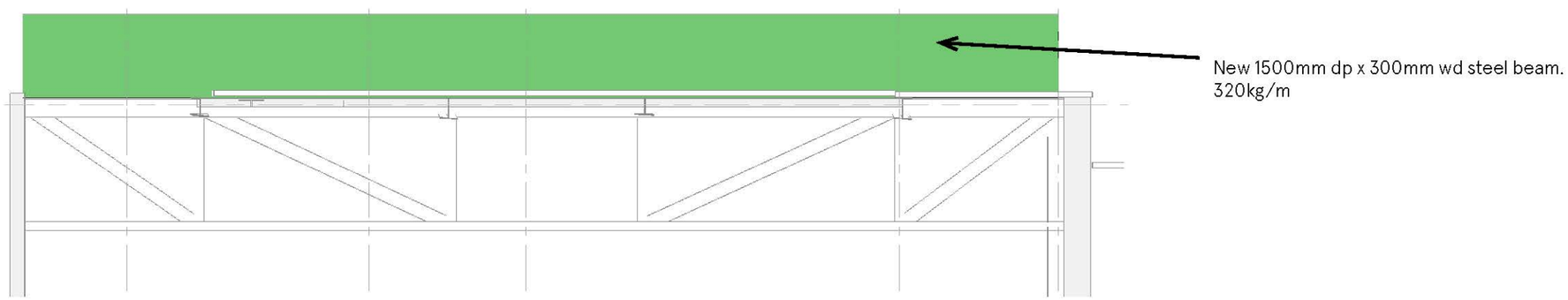
Option 2

A new temporary steel beam can be installed to support the existing truss to allow removal of props. In this case, no works are done to the truss, which is assumed to have no structural function.

The beam would be a 18m long, 1500mm deep x 300mm wide steel section weight approx. 6.5 tonnes.

This option relies on reusing the existing supports of the truss at each end. The beam will require lateral support to the top flange by way of steel ties to the roof slab.





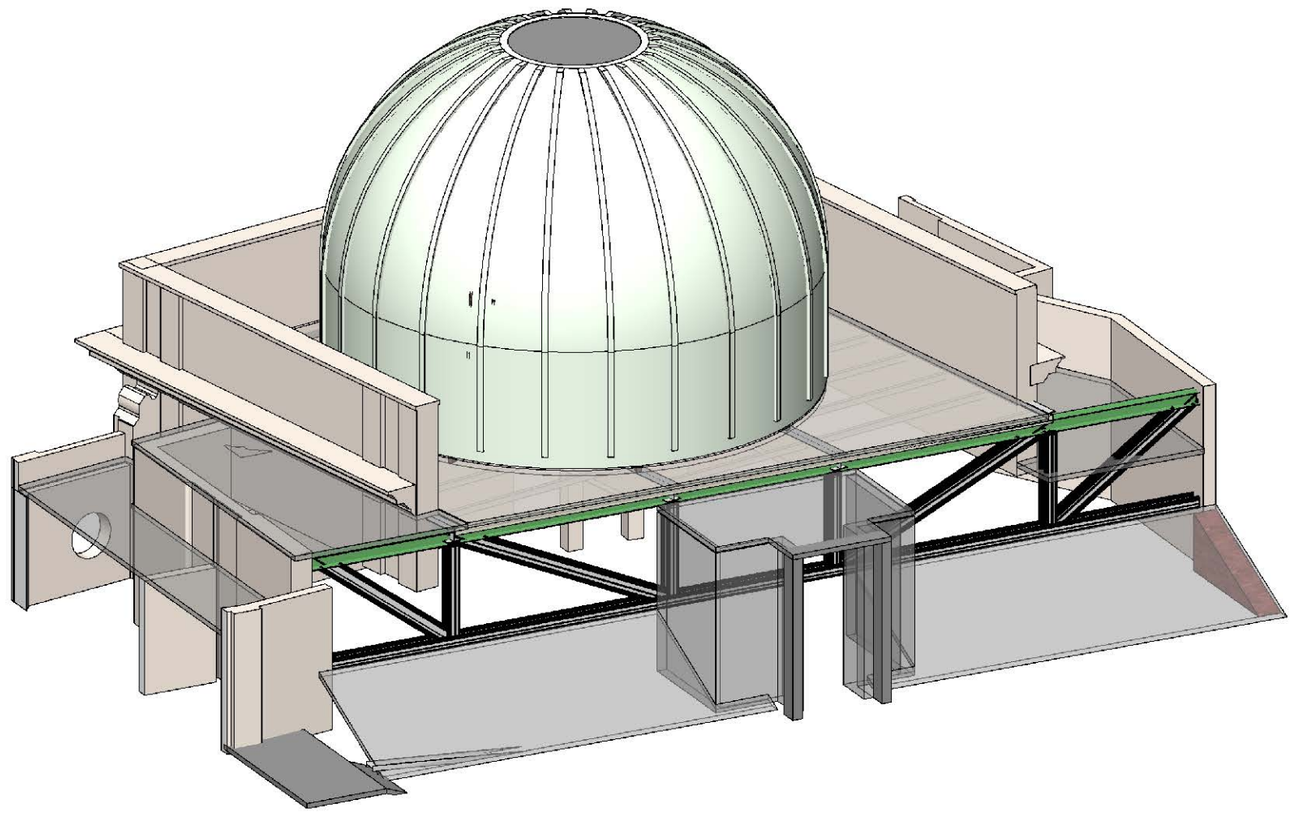
Temporary works

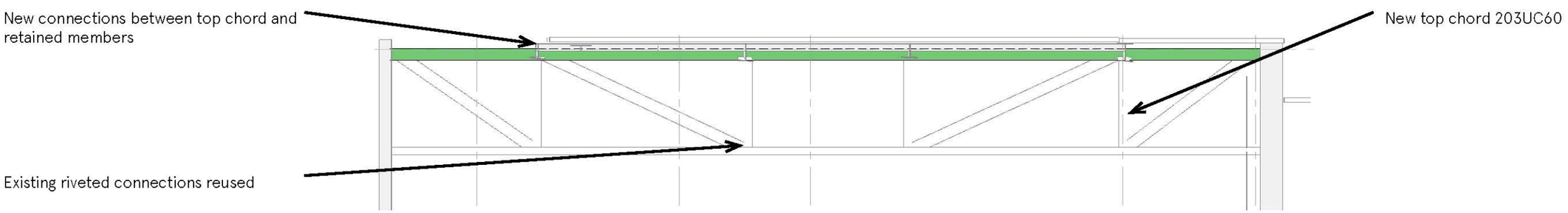
Option 3

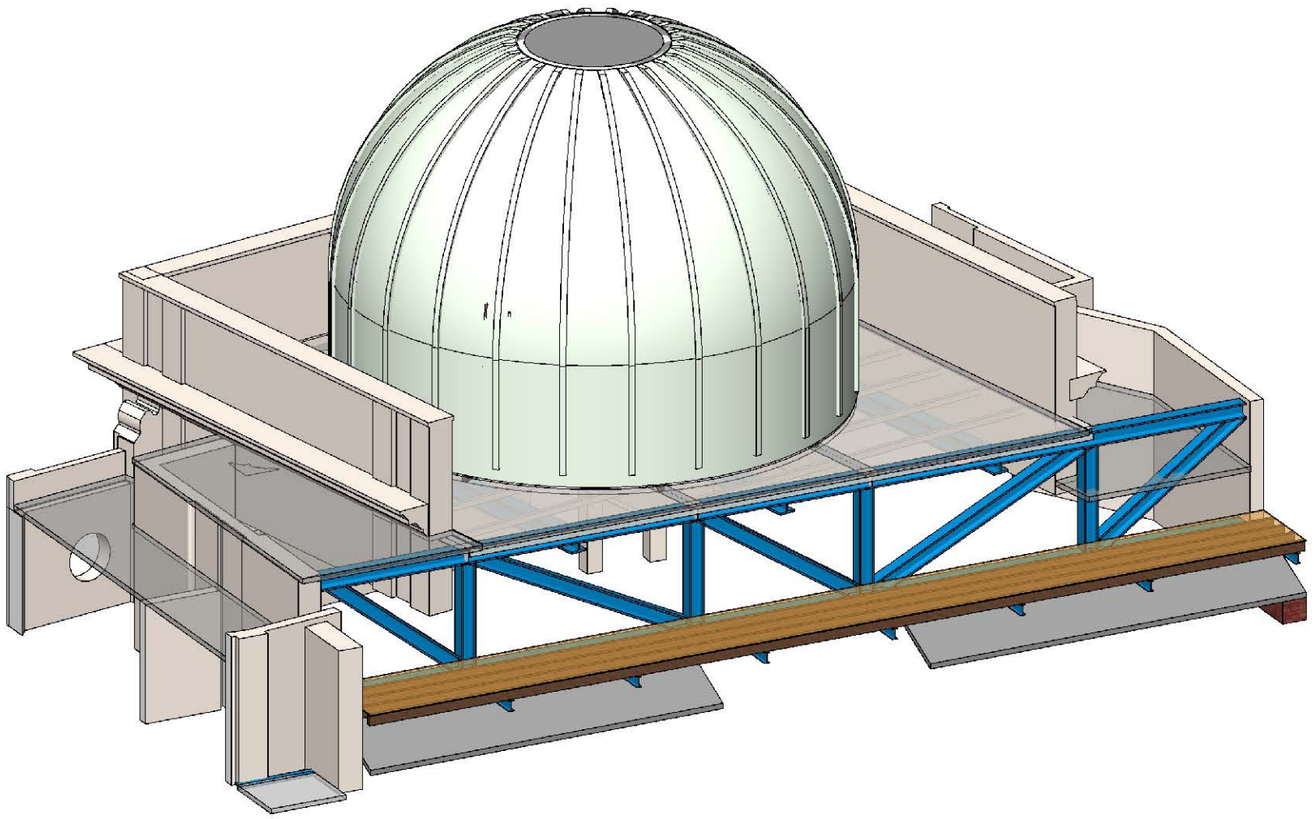
Top chord of the existing truss is replaced with a new steel section. This option is subject to the condition of the bottom chord of the truss, which has not been exposed yet.

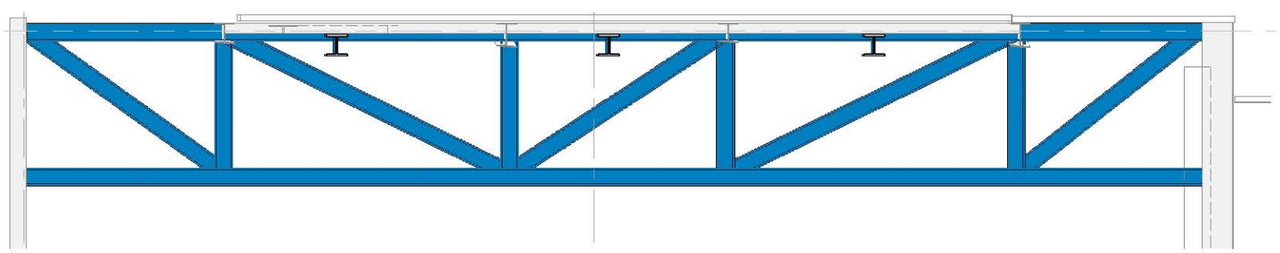
The steel sections could be installed in pieces to avoid cranage.

The new chord would require complex connections to fix the new sections in around the existing vertical and diagonal members. The steel of the truss would require metallurgy testing to verify whether it can be welded for new connections.









Proposed works

Given the quantum of work to strengthen the truss for the semi permanent case, we have looked at what works would be required to the truss to enable it for the permanent works. Nearly all the members and connections have now been exposed, allowing a detailed assessment of each item for the proposed condition.

In the proposed building, the dome is to house a bar and an additional plant deck is to be installed over the truss location. The works will result in a higher super imposed dead and imposed load to the roof and structure below.

The support to the roof must be stiff enough to prevent any discomfort from vibration in the dome bar. This results in a minimum 4.5Hz natural frequency as the design criteria for the support.

Three options have been considered for support of the roof. The options were based upon a 2.5m deep structural zone.

- Enhancement of existing truss to support proposed loads
- Fabricated steel I beam
- Fabricated steel truss

Enhancement of existing truss

HTS has looked at reusing the bottom cord, vertical and diagonal members of the truss in the proposed case. The minor level of corrosion to these members means they could be reused. The load increase on the corroded riveted connections however cannot be justified for the life span of the building.

Strengthening of the truss would involve welding steel plates to all the steel members to enhance their axial capacity. In addition the riveted connections would need to be drilled out and replaced with new welded connections. The in situ working conditions mean that these works would be extremely difficult. Any welding would be subject to the metallurgy of the steels.

Fabricated steel I beam

The fabricated I section was deemed unfeasible as it would require a 30tonne beam for the span. This would be an uneconomical solution that is impractical to install.

Fabricated steel truss

The proposed truss option is a replica of the original truss with 254UC167 sections weighing approx. 700kg/m. The new truss could be installed in sections to reduce cranage.

Next Steps

- Expose the truss internally for the full width so any additional areas of corrosion can be reviewed
- Remove the finishes below the support of the truss to confirm the end conditions and bearing detail

Conclusions

We recommend that the most simple option for works to the truss would be to retain the props in until the proposed works commence in March. Following this the most feasible option would be to replace the corroded truss with a new stronger and stiffer truss.

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