1. Existing Structure

A conditions survey of the auditorium roof was conducted by Cooper & Withycombe in July 2020.

The survey identified that the auditorium roof structure is comprised of timber roof joists bearing on a series of laminated timber beam of approx. 900mm depth that span across the full width of the auditorium.

Timber posts around the perimeter of the auditorium support these laminated timber beams. A concrete ring beam subsequently supports the timber posts.

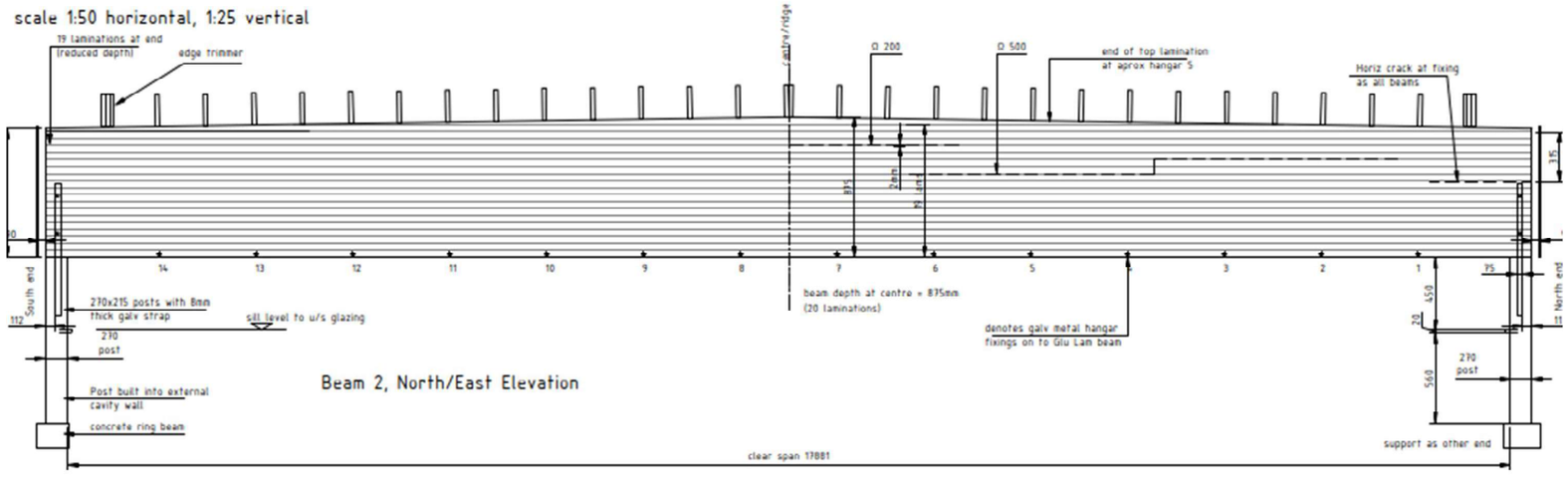
The laminated timber beams exhibit signs of checking / delamination. However, the report concludes that these beams could be reused provided these defects are remediated.

The proposed development is expected to involve an increase in applied roof loading, which has been found to exceed the capacity of the existing laminated beams. The intention for the structural design is to explore means of retaining and strengthening these timber beams with minimal structural interference. Architectural drivers, particualr with respect to the aesthetics, also play a role in the derivation of these strengthening options.

2. Design Criteria for Strengthening

New structural elements will be designed to modern building code. However, the code offers some flexibility in designing for the vertical deflection of the timber beams.

Vertical deflection limits will be limited by the existing deflection with an allowance uplift of 10-20%. This is based on the assumption that the existing timber beams deflected permissibly under the existing loading. There may be particular deflection limits required for the overhead lighting rig system / plant equipment. This will need to be accounted for in the design of the strengthening options.



Existing laminated timber beam and its defects. Extracted from: Auditorium Ceiling Inspection Report, Cooper & Whitycombe (July 2020)

Option 1 - Retrofit Truss

1. Overview

This option relies on the retention of the existing laminated timber beams with new cables and / or steel members fixed to the underside face to form a truss structure.

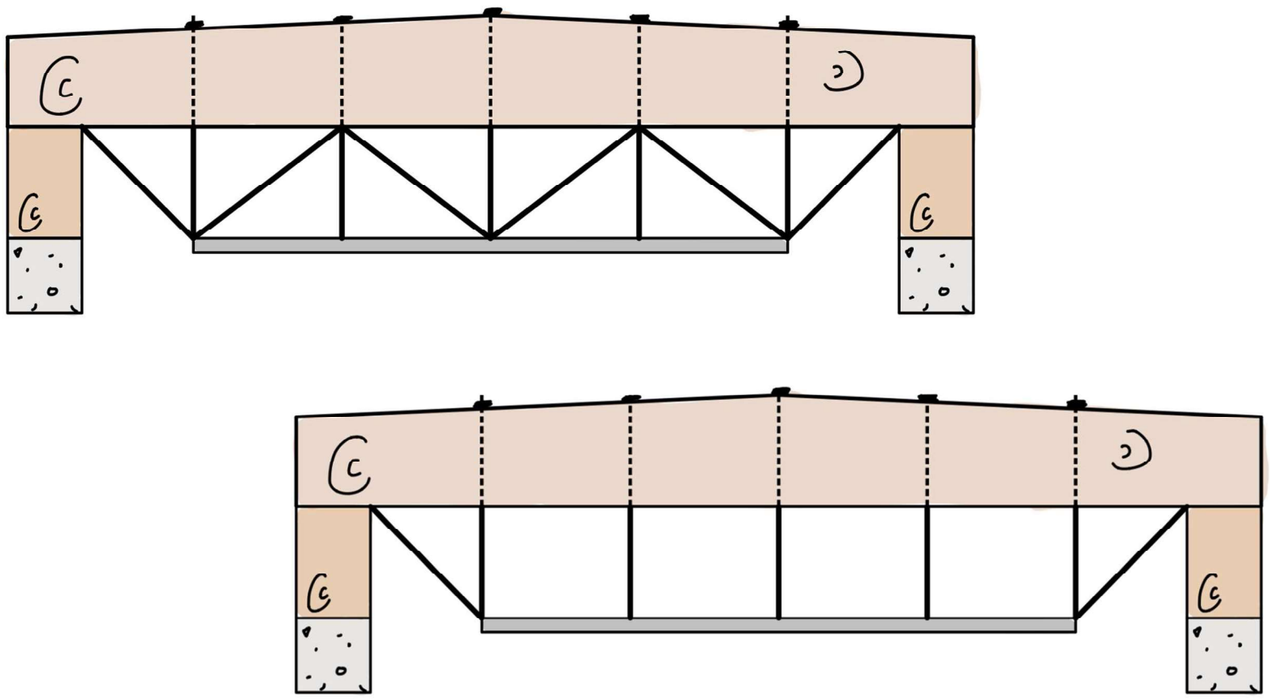
2. Pros

- Retention of existing laminated beams reduces need for temporary works in propping roof structure or, alternatively, eliminates occurance of open roof during construction
- Sustainability credentials of retaining existing structure
- Potential cost benefit in retaining existing structure
- Laminated beam will behave more efficiently, potentially allowing for future additional loads
- Existing timber posts supporting laminated beams can be retained

3. Cons

- Remedial works will required to bring laminated beams to reusable condition. Extent of remedial works is not clear at this stage.
- Fixing of truss elements to laminated beams will be complex and require careful detailing
- Design of truss is constrained by strength capacity and dimensions of existing laminated beam which may result in a considerably deep truss which, in turn, will mean a loss in clear height in the space

North Surrey Sport & Ice Complex



Option 2 – Propped Struts

1. Overview

This will involve the retention of the existing laminated roof beams with the introduction of immediate supports in the form of steel struts. Steel struts will be supported by the existing concrete ring beam.

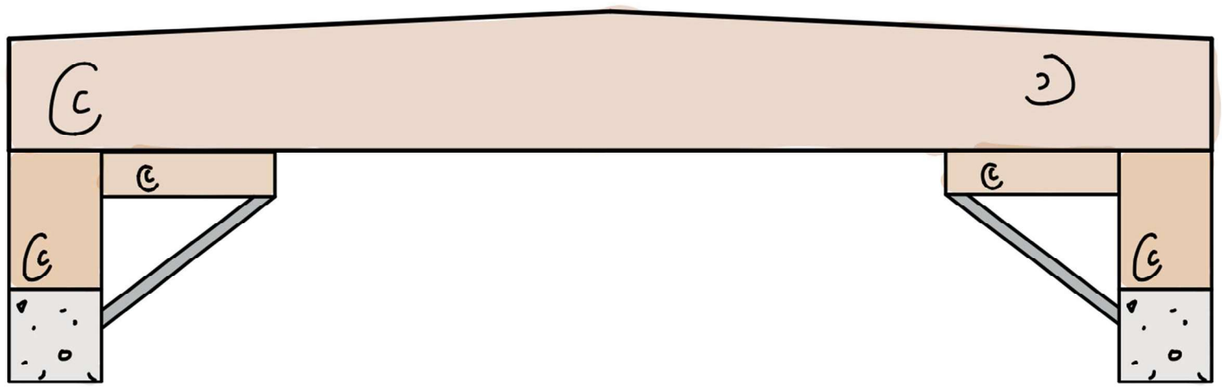
2. Pros

- Retention of existing laminated beams reduces need for temporary works in propping roof structure or, alternatively, eliminates occurance of open roof during construction
- Sustainability credentials of retaining existing structure
- Potential cost benefit in retaining existing structure
- Existing timber posts supporting laminated beams can be retained
- Clear height of auditorium space will not be compromised with only minor interference along perimeter of space
- Steel struts are likely to be thin, discrete elements with minimal visual impact on the space

3. Cons

- Positioning of intermediate supports constrained by position of concrete ring beam below laminated beam. Since this is only approx. 1m below the underside of the laminated beam, intermediate supports will be positioned close to the edge of the beam. This leaves a long unsupported beam span which will still need to work hard to resist the applied loading.
- Concrete ring beam will now be required to resist additional horizontal loading from the struts. Should strengthening of the concrete ring beam be required, this may be complex.
- Remedial works will required to bring laminated beams to reusable condition. Extent of remedial works is not clear at this stage.

Linnaeus University, Växjö, Sweden



Option 3 – New Steel Trusses

1. Overview

This option involves entirely new roof structure i.e. the removal of the laminated timber beams. To achieve the clear span required in the auditorium space, steel trusses would be installed at equal spacings across the roof.

2. Pros

- The cost and risks of remedial works would not be required with this option
- Design will not need to be excessively conservative since there are less unknowns associated with new elements as there would be with retained existing structures.
- Greater flexibility in layout of trusses to suit layout of overhead lighting rig system / plant equipment
- Design will not be constrained by strength capacity of laminated glulam beam. This is likely to mean shallower trusses in comparison to Option 1 and, in turn, less compromise in the clear height of the auditorium space

3. Cons

- Arguably, there is a loss of material efficiency associated with not utilising the existing laminated beams which are deemed suitable for reuse.
- New steel columns will be required to support trusses on the existing concrete ring beam