City of Greater Geraldton

The Rocks Building

Structural Condition Survey and Concept Report

REP-001

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Appendices

1 Introduction

Arup has been requested by the City of Greater Geraldton to undertake a structural engineering review of The Rocks building located at 108 Marine Terrace in Geraldton in Western Australia.

Figure 1: The Rocks building

The structure of The Rocks building (hereafter referred to as 'the building') is a single storey masonry building. The roof consists of two different styles, with timber trusses spanning between the side masonry walls in the front (south eastern end) of the building. The roof at the rear (north western end) of the building consists of steel trusses spanning between the side masonry walls. Timber purlins span between the trusses with a lightweight steel roof covering the entire building. The building is approximately 37 metres long by 12 metres wide. The maximum height of the building is approximately 6.3 metres. Sketches showing a plan layout and sections of the building are included in Appendix A.

The scope of the work has been summarised in Section 2 of this report.

2 Basis of Review

This survey was undertaken by Arup to provide the City of Greater Geraldton a report highlighting which elements of the building could be removed to allow the building to be converted into a public thoroughfare to link Marine Terrace with the Geraldton foreshore. This assessment has been based on the visual observations by Arup from areas that were readily accessible by foot during the site inspection.

Arup understand that there are no existing structural or architectural drawings of the building and therefore we have not been able to reference these as part of this report.

No testing of in-situ materials has been performed in the course of preparing this report. Similarly, no furnishings, finishes or fixtures were removed to expose the structural elements.

3 Structural Inspection

Arup undertook a visual inspection of the structure of the building on 17th and 18th January 2018. The following are observations made during this inspection.

The figures referenced in this section are included in Appendix B.

3.1 Overall Building

From the inspection, it appears that there has been at least one (possibly two) extensions to the original building. These have been made to extend the building to the north-west towards Foreshore Drive. These extensions are visible in the roof and masonry walls of the building and will be discussed further in the relevant sections of the report.

3.2 Foundations

The foundations were not made visible to Arup during the site inspection, however it is assumed they will be shallow footings bearing on compacted sand. Arup observed no evidence suggesting structural distress in the foundations of the building.

3.3 Ground Level

At the front of the building (within the existing shop front area), the ground level is covered with carpet, however, when walking through the shop front, it would appear that the substructure is timber. A corner of carpet was attempted to be removed near the entrance, which showed what appeared to be a plywood substructure. It is assumed that this section of the building is part of the original building.

The ground level in the back half of the building is constructed from concrete to create a slab on ground. It is likely that the interface between the timber and corner floors is the location of one of the extensions of the existing building. Where visible, Arup observed no evidence suggesting structural distress in the ground slab.

There is no step between the timber and concrete floors, however there is a minor ramp in the timber floor at the current entrance to the building.

Photographs of the internal spaces can be seen in Figure 2 to Figure 12.

3.4 Walls

There are several different wall types within the building. These will be discussed separately.

3.4.1 Masonry Walls

The building is supported by masonry walls along it's long axis. It is understood that the wall on the south-west side of the wall is a party wall supporting both the building and the adjacent property at 110 Marine Terrace. Along the length of this wall are a number of masonry piers (approximately 500mm long) which coincide with the roof truss locations. It is therefore assumed that the loads from the roof trusses is transferred directly down these piers. These piers can be seen in Figure 2.

On the other side of the building, there is a gap between the building and the adjacent property at 106 Marine Terrace and therefore the masonry wall is only supporting the roof of the building. There are no masonry piers visible in the front section of the building (as seen in Figure 5), however there are two piers in the rear section of the building, once again at the locations of the roof trusses. It is assumed that the section of wall with piers is a later extension. One of the piers can be seen in Figure 11. Arup surmised that there are masonry piers on the outside of the building (in the gap between the building and adjacent property) which will be used to support the roof trusses.

On the northern side of the building, there are a number of masonry walls which form a room. This area is seen in Figure 8. Finally, there is a masonry wall spanning across the width of the building, as seen in Figure 10 and Figure 11. This wall is located towards the rear of the building and is assumed to have once been the end of the building, prior to an extension. None of these walls extend up to the roof line, or support the roof structure and therefore can be removed.

There is also a kitchen and toilet at the very rear of the building. These areas can be seen in Figure 13. It is understood that this area will be demolished as part of the modifications of the building.

Typically, where visible, the masonry walls appear to be in good condition. The one exception to this is at the rear of the building. On the south-west corner, there is significant cracking of the masonry wall. This can be seen in Figure 14 and

Figure 15. Depending on the proposed modifications to the building, these cracks may need to be repaired as part of the works.

3.4.2 Lightweight Walls

Within the footprint of the building are a number of lightweight walls. These walls are non-structural and therefore can be removed. Arup note that one dividing wall at the rear of the building was highlighted as containing asbestos in the Asbestos Survey and therefore this should be removed by a licensed and trained individual in accordance with the Occupational Safety and Health Act 1984, the Occupational Safety and Health Regulations 1996, part 9 of the Code of Practice for the Safe Removal of Asbestos – 2nd Edition and the code of practice for the Management and Control of Asbestos in Workplaces.

3.4.3 Marine Terrace Shop Front

The Marine Terrace Shop Front consists of a glazed shop front with a lightweight canopy and masonry parapet, which can be seen in Figure 1. The condition of the masonry parapet is unknown as this area in the roof space was not safely accessible, however the area below the tin ceiling can be seen in Figure 16.

The parapet and canopy are supported on two steel columns, which are currently located on either side of the entrance doorways. One of the column heads can be seen in Figure 17.

3.5 Roof Structure

The roof of the building consists of timber purlins spanning between trusses, which span the entire width of the building to the perimeter masonry walls. The roof trusses in the front of the building are timber trusses (possibly jarrah) whereas the trusses in the rear of the building are steel. Sketches showing the layout of the roof can be seen in Appendix A.

There are five timber trusses in the front of the building. These are constructed from 190x90mm timber sections in the top chords of the truss and 290x90mm timber sections of the bottom chords of the truss. The internal elements could not be measured as safe access to these elements could not be made. The timber trusses can be seen in Figure 18 and Figure 19.

There are an additional four steel trusses in the rear of the building. These are constructed from steel circular hollow sections welded together to form the truss. The top chords of the truss are constructed from 89mm diameter tubes, the bottom chords are constructed from 60mm diameter tubes and the diagonals within the truss are constructed from 33mm diameter tubes. The wall thicknesses of these tubes could not be determined during the inspection. The steel trusses can be seen in Figure 20 to Figure 23.

The purlins supporting the lightweight steel roof consist of 170 x 50mm timber sections. From the ground level, the purlins appeared to be in good condition, with no signs of rot or termites. Additionally, the roof sheeting appears to be in good condition.

4 Future Investigations

The following are items which should be investigated as part of the next phase of the project. These items will ensure that structural integrity of the building is not compromised when the building is modified.

1. Floor construction type of the front part of the building should be verified. Currently the floor construction type at the front of the building is assumed to be timber, however this should be confirmed in the next phase of the project. If the floor system is a suspended timber floor, the capacity of the floor system will need to be determined as the design load is likely to increase due to the change in building usage.
2. Confirm that the masonry wall on the north-eastern side of the building (adjacent to 106 Marine Terrace) has masonry piers built in the gap between the two buildings.
3. Further investigation should be made into how the building parapet and canopy is supported. This can be done by removing a section of the pressed tin ceiling to allow access into the roof space adjacent to the shop front. Further investigation will determine if any strengthening works is required to the parapet or canopy.
4. The full dimensions of both the steel and timber roof trusses should be determined so that a complete structural review can be undertaken of the trusses to determine their structural adequacy for the new wind loads. This would include full measurements of the section sizes and geometry of both steel and timber trusses, and determination of the wall thicknesses of the steel truss elements.
5. Determination of the roof truss tie down details to the masonry walls to ensure these are suitable for the new wind loads.
6. Review of the building by a suitably qualified person to determine the condition of the timber elements and any areas of rot or termite damage (if any).

5 Concept Options

From the visual inspection undertaken, the City of Greater Geraldton's plan to open the building up to provide a public thoroughfare between the Geraldton foreshore and Marine Terrace appears to be feasible.

The glazing of the shop front and the masonry below the glazing can be removed to open up the Marine Terrace entrance way to the thoroughfare provided the investigation into how the parapet and canopy are supported are undertaken. Furthermore, the steel columns, currently on either side of the shop front entrance way are to remain.

The light-weight stud wall between the current newsagency shop front and back of house area can be demolished as can the lightweight wall divide the side

passageway and back of house area. Please note however that this wall is likely to contain asbestos and therefore needs to be removed using the appropriate safety measures.

The internal masonry walls that form the internal room and separate the back of house area and storage area are currently not supporting the roof of the building and therefore can also be demolished. Furthermore, the toilet block/kitchen area at the rear of the building can also be demolished, however the end masonry wall of the building is currently supporting the roof and can't be removed at this stage.

There are a number of options which could be adopted to allow this wall to be removed. The current roof could be removed between the end wall and the first steel truss or alternatively, new structural steel beams and columns could be added to support the roof prior to the wall being demolished.

These options will also be dependent on the landscape architecture's scheme developed for the site, and therefore will need to be further progressed during the next stage of the project.

5.1 Wind Loads

Due to the age of the building, it is unlikely that the building would have been designed to codified wind loads. However, as the building is proposed to be significantly modified, the remaining building structure will need to be reviewed for wind loading from the current Australian Standards (AS/NZS1170.2).

Please note that Arup have assumed that the building is defined as an Importance Level 2 building in accordance with the Building Code of Australia (BCA) for this exercise, however during the next stage of the project, this should be confirmed by a BCA Consultant.

The following is a summary of the assumed wind load parameters to AS/NZS1170.2:

- Annual Probability of Exceedance 1:5000
- Wind Region: B
- Ultimate Limit State Wind, Vuls 57m/s
- Serv. Limit State Wind. Vsls 39m/s
- Terrain Category TC2 (NW/SE direction)
  TC3 (NE/SW direction)

From these values, the wind pressures on the roof of the current building, and the building assumed both ends are open has been calculated. The wind load in the upwards direction (trying to suck the roof off the masonry walls) increased by approximately 39% and in the downwards direction (pushing the roof down), the wind load increased by 33% percent. These loads have been summarised in the table below.

	Up Wind Pressure	Down Wind Pressure
Current Building	-1.07kPa	0.45kPa
Building with NW and SE ends open	-1.49kPa	0.60kPa

5.2 Steel Truss Review

To determine the effects of the increased wind pressure, a steel truss has been reviewed to determine the structural adequacy of the current design. The steel truss has been used in this review as there is more information known in terms of geometry and section size than the timber truss. A sensitivity study has been conducted on the steel trusses as the wall thicknesses are unknown.

Based on the new wind loads discussed in Section 5.1, the steel truss has been reviewed against the current Australian Steel Structures code, AS4100. The truss was broken up into three different elements, the top truss chord, bottom truss chord and diagonals. Each element has checked individually.

Top Truss Chord:

The top truss chord is constructed from a steel 89mm diameter circular hollow section. The wall thickness is unknown. However, all readily available wall thicknesses have sufficient structural capacity to resist the applied loads.

Bottom Truss Chord:

The bottom truss chord is constructed from a steel 48mm diameter circular hollow section. The wall thickness is unknown. There is no 48mm diameter circular hollow section which has sufficient capacity to resist the increased loads on the truss without additional restraint being provided to the bottom chord for buckling. This could be achieved by tying the bottom chords of the steel trusses together horizontally and providing lateral bracing to the longitudinal masonry walls. This can be seen as the green and pink elements in the markup in Appendix C.

Diagonals:

The diagonal elements (spanning between the top and bottom truss chords) are constructed from a steel 33mm diameter circular hollow section. The wall thickness is unknown. Typically, however, all readily available wall thicknesses have sufficient capacity to resist the applied loads.

The exception to this is the central upright, which spans between the bottom truss chord and the highest point to the top truss chord. This section does not have enough capacity for the increased wind loads without strengthening works. This could be achieved by bracing the centre of the upright in both directions to the primary structure. This can be seen as the red elements in the markup in Appendix C.

Arup note that the truss review undertaken has been a high-level review, and pending a more detailed review (with additional information such as the correct

member wall thickness of the elements), additional strengthening may be required which hasn't be highlighted in this section. Additionally, strengthening works may be required to the timber trusses based on a review of those elements in the next stage of the project.

Furthermore, this review has been undertaken without any input from the landscape architects and their scheme for the space may change the strengthening works provided.

5.3 Other Considerations

There are a number of other considerations which need to be considered in the next phase of the project to ensure the modifications to the building do not affect the long term structural adequacy of the building.

Corrosion Protection:

Due to the proximity of the building to the ocean, there is a high risk of corrosion of steel elements due to salt spray. This is further increased as the building will be opened up and therefore salt spray will be able to directly settle on the steel elements. It is likely that all structural steel elements including, but not limited to, the steel trusses, front columns, tie-downs and any steel connection plates within the truss will need to be re-painted in a suitable corrosion protection paint.

Furthermore, a review should be undertaken into the timber structural elements to ensure that there will be no deterioration of the timber due to the opening of the building and proximity of the ocean.

Connection of Roof Sheeting:

The existing fixings between the roof sheeting and the timber purlins should be reviewed to ensure structural adequacy of these connections for the increased wind loads on the sheeting.

Roof Tie Downs:

The existing tie-downs of the steel and timber trusses to the masonry walls shown be reviewed to ensure structural adequacy of the tie-downs for the increased uplift wind loads on the roof.

6 Conclusions

In conclusion, Arup have undertaken a high-level review of the Rocks Building at 108 Marine Terrace, Geraldton to determine which elements could be removed to create a thoroughfare between the Geraldton foreshore and Marine Terrace. Based on the information obtained during an inspection of the building, held on the 17th and 18th January 2018, Arup have concluded that:

- The internal masonry and lightweight walls are not supporting the roof and can be removed.

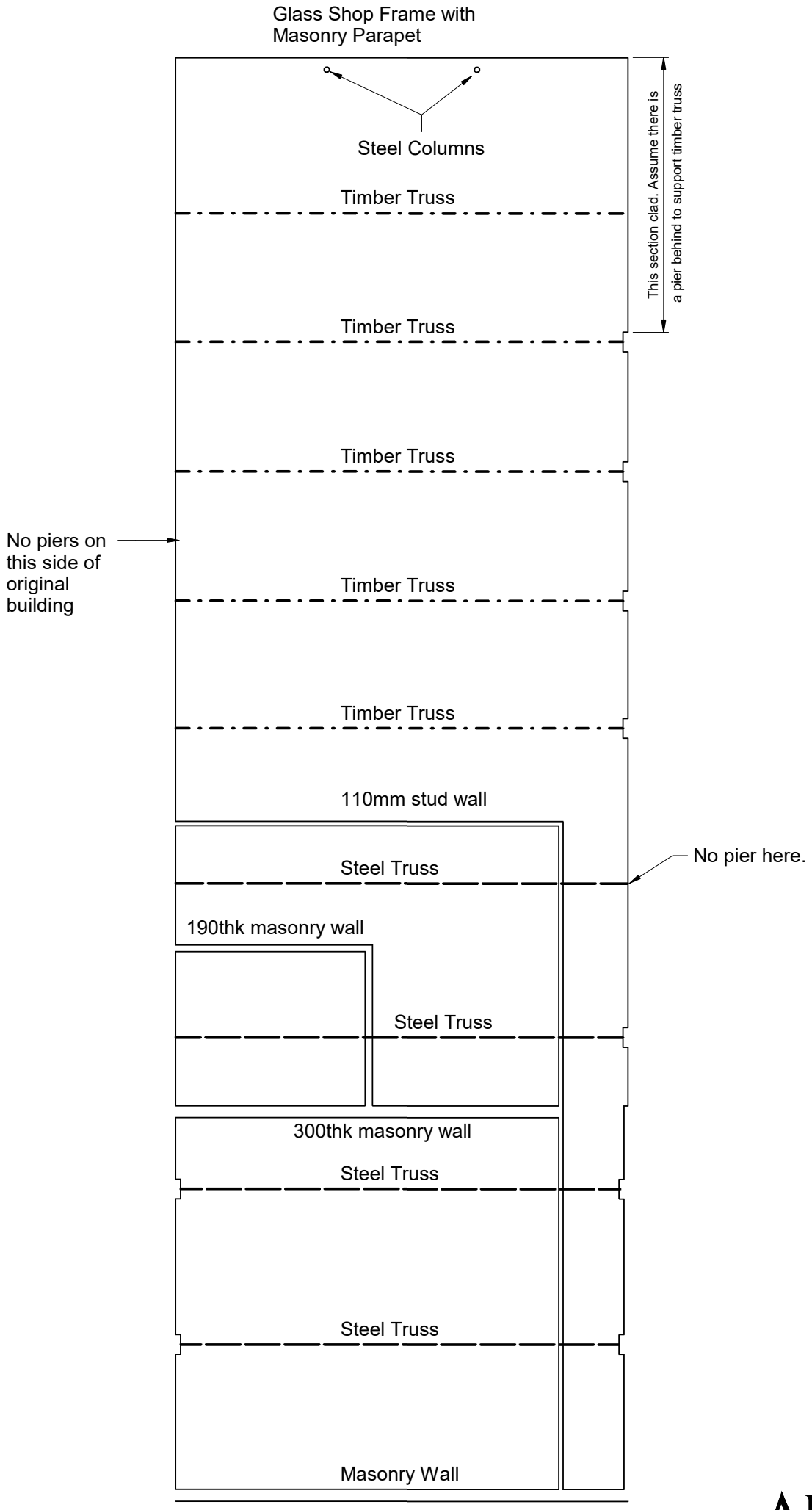
- The support of the parapet and canopy on Marine Terrace should be investigated prior to the removal of the shop front glazing and masonry wall below it.
- The rear wall is currently supporting the roof and therefore additional support will be required or the last bay of roof be removed, prior to the demolition of this wall.
- The toilet and kitchen block at the rear of the building can be demolished.

As part of the review, Arup have highlighted a number of items which should be further investigated in the next stage of the project. These are noted in Section 5.

Arup have also undertaken a high-level review of the Australian Wind Loading Code, AS/NZS1170.2, to determine the effect on opening the building up will have on the wind loading applied to the roof. It is noted that the findings of this review show that the wind pressures will increase on the building and therefore strengthening works may be required to the existing steel and timber trusses.

Appendix A

Sketches of the Building



Current Building Plan

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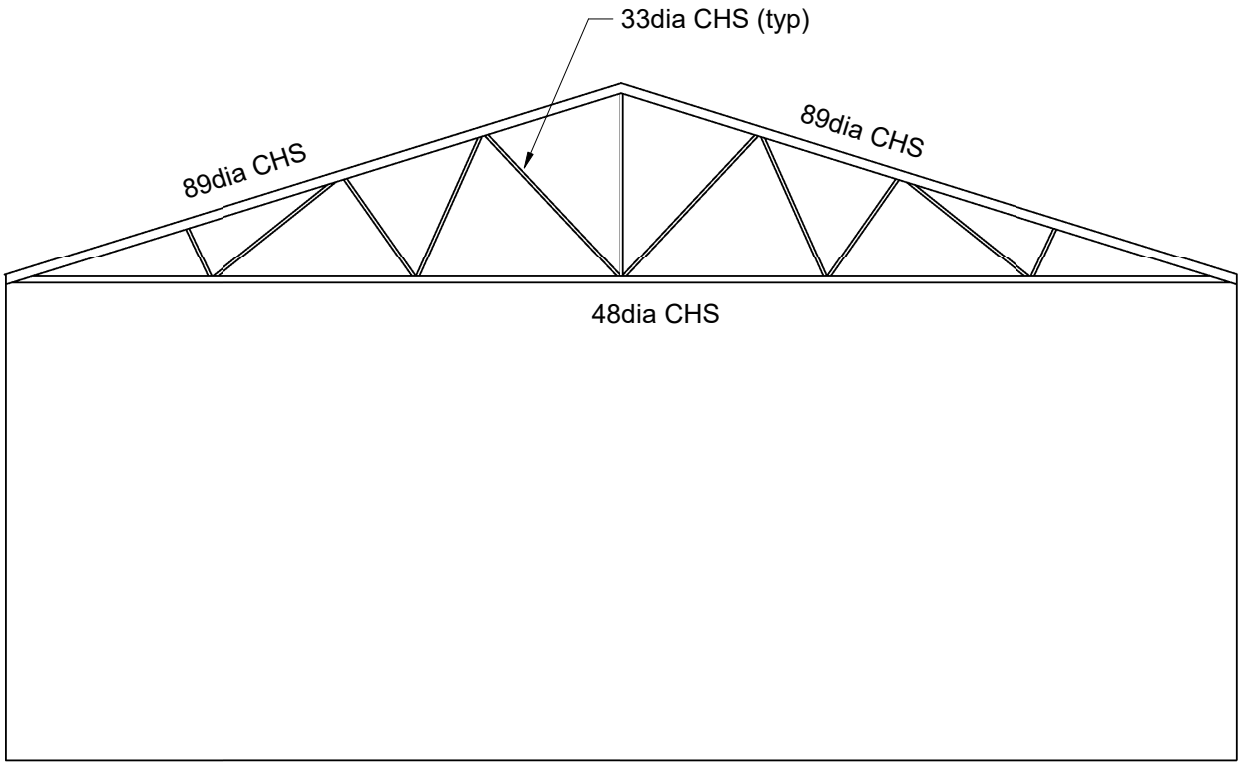
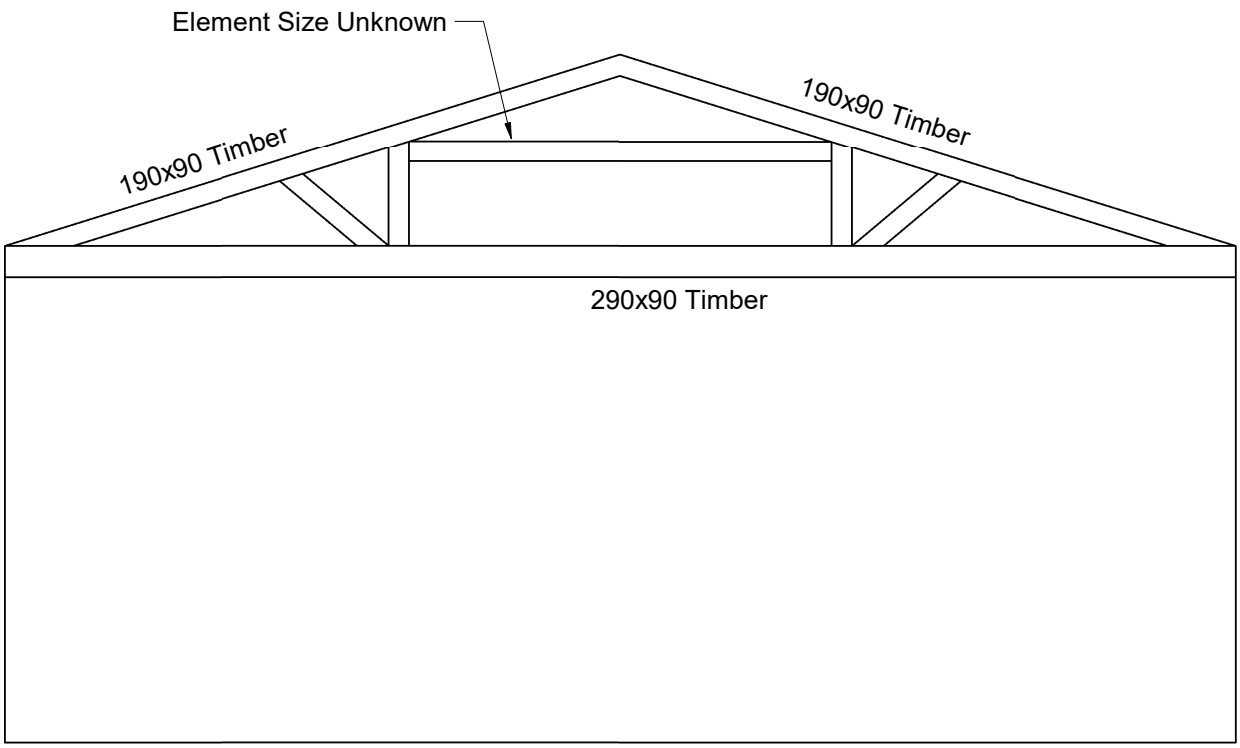
Sketch SKS-001
Drawn by BJK



Steel Truss Elevation



Timber Truss Elevation

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Sketch SKS-002
Drawn by BJK

Appendix B

Site Photographs

Figure 2: View of front space of building looking west

Figure 3: View of front space of building looking south

Figure 4: View of front space of building looking east

Figure 5: View of front space of building looking north

Figure 6: View of central space of building looking west

Figure 7: View of central space of building looking south

Figure 8: View of central space of building looking north

Figure 9: View of rear space of building looking west

Figure 10: View of rear space of building looking south

Figure 11: View of rear space of building looking east

Figure 12: View of rear space of building looking north

Figure 13: View of rear of building

Figure 14: Extent of cracking of masonry wall on western corner of building

Figure 15: Closeup of cracking of masonry wall on western corner of building

Figure 16: Shop front between plasterboard ceiling and tin ceiling

Figure 17: Column head supporting shop front

Figure 18: Overall view of timber roof truss

Figure 19: Close-up of Timber Truss

Figure 20: Steel truss from ground level

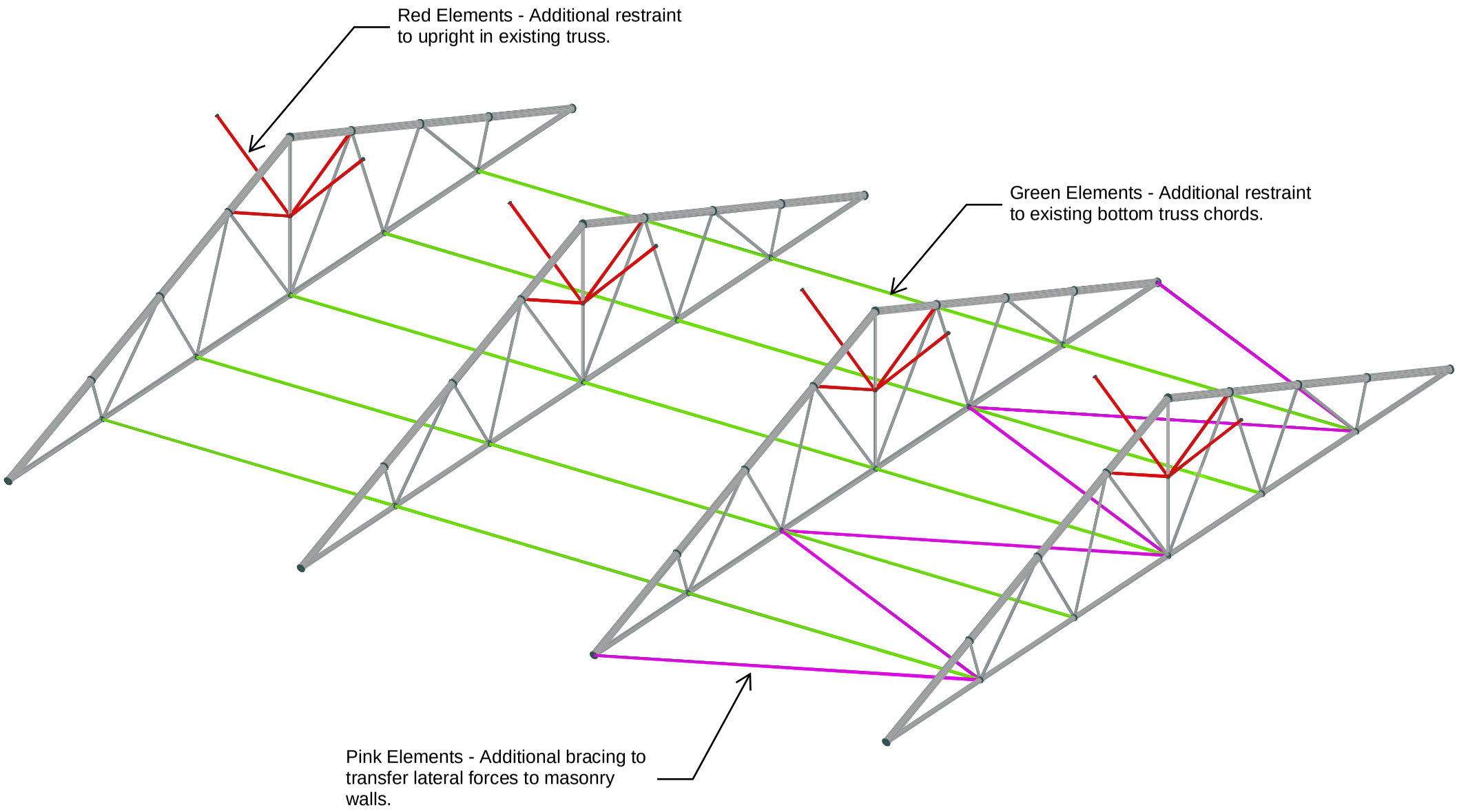
Figure 21: Steel truss from ground level

Figure 22: Closeout of steel truss

Figure 23: Closeout of steel truss

Appendix C

Truss Review



Possible Strengthing Works to Steel Trusses