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28 July 2015

Job No.: 141111

Barry Redmond
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RE: 229 WEST STREET, ASHBURTON – DETAILED SEISMIC ASSESSEMENT

Dear Barry

As requested we have inspected the building at 229 West Street Ashburton to assess its seismic capacity. The purpose of the assessment is to review the available seismic force-resisting systems, compare the calculated capacities with the currently required by the New Zealand Building Code (% NBS), identify the potential critical structural weaknesses that will need to be remediated in order to strengthen the building and propose a strengthening scheme to comply with NZBC for a change of use of the building.

Building Description

The building is generally constructed in 2 parts. The front two storey, original part, of the building was thought to have been constructed in the late 1880's. It was generally constructed of light weight roofing on timber purlins, curved laminated timber rafters with steel ties, on timber posts. The first floor (mezzanine) is constructed of timber flooring on timber joists and beams, supported on timber posts. We note that the floor does not extend the full width of the building, out to the block walls.
Drawings show that the West Street facade was altered in the mid 1960's with the wall demolished below the first floor level with a new reinforced concrete frame constructed with brick infill along with new doors and windows. A new reinforced concrete block wall was also constructed on the south west wall to the front part of the building. Further additions to the north east were completed in the 1990's with the addition of a single storey office area.

The construction date of the building to the rear is unknown. This single storey building is generally constructed of steel roofing on timber purlins, timber trusses to the central part and lean-to timber rafters each side, supported by timber posts. Drawings and council records indicate that side and rear concrete reinforced block walls (in part with glazing above) were constructed in the late 1960's/early 1970's. This includes an addition to the remainder of the south west block wall of the original front building. The rear (north west) gable wall has steel cladding/corrugated polycarbonate cladding on timber framing above the block wall. The drawings show that these block walls have been constructed on an existing concrete foundation with vertical reinforcement bars drilled into the foundation a small amount.

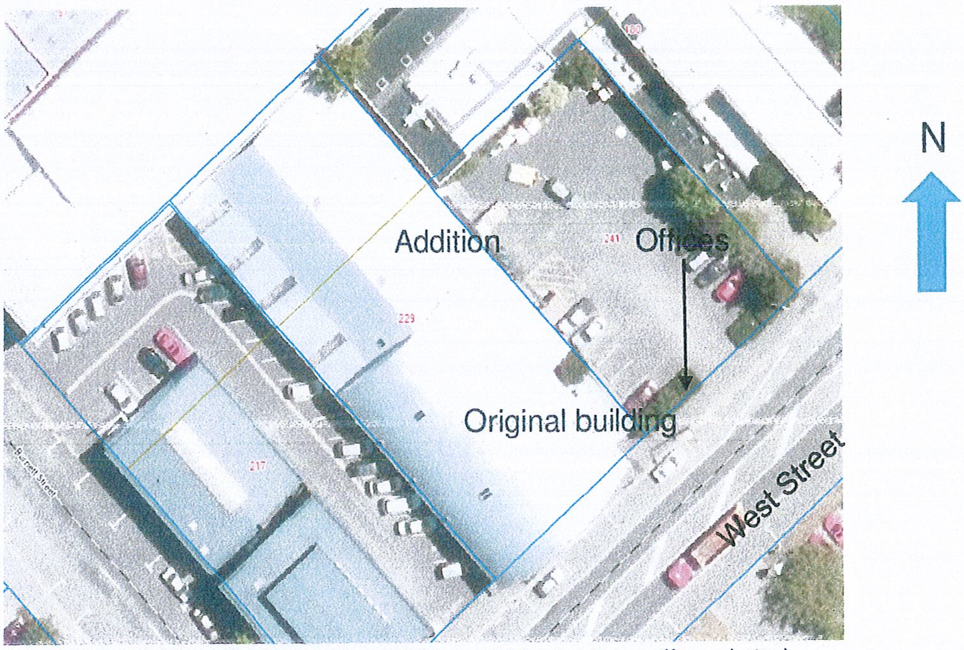

Photo 1: Plan View (Source – Ashburton District Council's website)

Photo 2: West street facade

Building Condition

There have been some roof members and posts replaced/strengthened in the rear part of the building and others that need remediation.

The block side walls appear to be in good condition with only minor cracking observed. At the junction of the south west side wall and the north west gable end wall the rear wall has displaced outwards at the top by about 10mm. This suggests that there is no tie between the side and rear walls.

It was observed that some of the timber members (posts, joists, framing) have been damaged over the time by borer. The posts to the rear part of the building have a lot of borer as do some of the mezzanine floor joists (about 1/3 of the joists appear to be affected). Wall framing to the front of the building along with some roof framing is also affected.
No allowance has been made for the reduction of the capacity of these members in our structural calculations for the detailed seismic assessment.

Lateral Force-Resisting Systems and Seismic Strength

Longitudinal Direction (south east - north west)

Front part of building

The drawings show that the south west block wall to the front part of the building is well connected to its foundations. The block wall further along was built on the existing foundation with only a nominal connection of the wall to the foundations. Being a relatively long length of wall it will have reasonable in plane strength. However the rear part of the wall has windows above so no effective connection to transfer lateral load from the roof to the wall.

Additionally, the first floor (mezzanine) does not extend out to the longitudinal block walls to transfer lateral load to these walls. The timber posts adjacent to the block walls supporting the floor do not appear to have connections to the wall.

The internal partition walls generally do not extend to the first floor structure so have little contribution to the seismic strength.

A potential source of lateral load resistance is for the timber poles to cantilever from their base. We have assumed that the middle timber posts (300 x 300 mm) are embedded into 600x600x600 mm foundation pads and calculated overturning capacity of the assumed system. The lateral seismic capacity of the front part of building in the longitudinal direction is approximately 17% NBS based on the above assumption. The stated assumption is based on a reasonable construction practice and subject to verification.

In reality, the corrugated iron roofing is likely acting as a diaphragm to transfer some load to the block walls. However, the roofing is a non-structural component and cannot be relied upon to act as a diaphragm.

Rear part of building

There are block walls along each side of the building which the drawings indicate are partially reinforced. The drawings show a nominal connection of the block walls to the foundations to the rear building where the walls were constructed on existing foundations. Being a relatively long length of wall, it will have reasonable in plane strength but minimal connection and structure to transfer the loads to the walls.

Additionally, the current roof structure of the building does not allow forces transfer as no horizontal bracing is present. Due to this, and for the purpose of the detailed seismic assessment, we have excluded weight of the block walls from the seismic force.

A potential source of lateral load resistance is for the timber poles to cantilever from their base. We have assumed that the timber posts have fixed base connections with two steel plates extending from foundation and bolted to the post with two 12 dia bolts for this system. The lateral seismic capacity of the rear part of building in the longitudinal direction is approximately 20% NBS based on the above assumption. It was also assumed that the foundations have overturning capacity to, at least, match the capacity of base connections.

Photo 3: Windows above south west block wall

Photo 4: Windows above north east block wall

Photo 5: Post connection at base

Transverse Direction (south west - north east)

Front part of building

Lateral force-resisting system of the front part of building comprises timber floor structure supported by timber posts with timber knee braces. We have assumed that the curved laminated timber rafters have sufficient capacity to transfer the roof seismic loads to the mezzanine floor beams. The longitudinal block walls do not appear to be tied to the adjacent timber posts, which limits strength of the wall.

The calculated lateral seismic capacity of the front part of building in the transverse direction is approximately 30% NBS.

Rear part of building

Lateral force-resisting system of the rear part of building comprises timber trusses supported by timber posts with timber knee braces. It was noticed that several braces have been removed over the time, reducing the lateral capacity of the building. We have assumed that the connection capacity of the knee braces match the compression capacity of the braces.

The rear (north west) block wall does not extend up to the roof level. The timber framed wall structure above does not have a system to transfer the seismic forces from the roof to the block wall.

The calculated lateral seismic capacity of the rear part of building in the transverse direction is approximately 7% NBS.

Photo 6: Front part of building (mezzanine)

Photo 7: Front part of building (ground floor)

Photo 8: Rear part of building (addition)

Walls in out-of-plane direction (face loading)

The majority of the block walls have been built on existing foundations with nominal connections to the foundations. The walls generally do not extend up to the roof level and have no effective restraint along the top.

A potential source of face load resistance for these walls is the stabilising weight of the block walls. The calculated out-of-plane seismic capacity of the walls is approximately 14% NBS.

The south west block wall at the front building appears to have adequate connection to the foundation and tie along the top with the calculated out of plane capacity 97% NBS for this portion of the wall.

Other considerations

We also note that the block walls adjacent to the boundary have minimal post fire face load strength and stability, as well as fire resistance with respect to prevention of fire spread to neighbouring property as the lightweight wall above the north west block wall is unrated and the south west block wall has glazing.

Seismic strengthening or major alteration of the building may trigger the New Zealand Building Act provisions requiring the building to comply as nearly as is reasonably practicable with the current building code provisions regarding means of escape from fire and access / facilities for persons with disabilities.

In case of change the use of the building, the Building Act requires the buildings to comply as nearly as practicable with every provision on the building code that relates to means of escape from fire, protection of other property, sanitary facilities, structural performance, fire-rating performance and access / facilities for persons with disabilities. In this case, the required seismic strengthening level of the building is as close to 100% NBS as practicable. The side block walls would need strengthening or replacement for post fire stability and protection of neighbouring properties. The rear wall would need to be replaced.

Strengthening scope and cost

We have completed structural calculations for the seismic strengthening of the building. Refer to Appendix A for strengthening scheme and details. The seismic strengthening scope includes the following critical structural weaknesses identified during our assessment:

Front part of the building

- Bracing of first floor roof structure
- Longitudinal bracing walls or braced frames on new foundations that extend from the ground floor to first floor level
- Connection of the first floor structure to the longitudinal south west block wall.
- Face load support for the block walls – concrete or concrete block columns on posthole foundations.
- Transverse bracing walls or braced frames, including new foundations, from ground floor to first floor level. Alternatively at the more open rear area use portal frames so the use of the space is not compromised with walls or braces.
- Strengthen the connection of the front facade concrete frame to the first floor structure.

Rear part of building

- Bracing of the roof structure for both longitudinal and transverse direction loading
- Face load support for the side wall and rear wall block walls –concrete or concrete block columns on posthole foundations.
- Longitudinal and transverse portal frames on new foundations (not braced frames which would compromise the use of the space).

Harrisons Quantity Surveyors have been engaged to provide a cost estimate for the proposed strengthening measures. The overall cost of strengthening of the building was estimated at $856k. We note that this does not include replacement of the borer damaged mezzanine floor joists.

Summary

There are minimal seismic load resisting systems available in both the longitudinal and transverse directions to both parts of the building with the estimated minimum calculated seismic capacity 7% NBS, which renders the building earthquake prone. The building generally has a calculated capacity of about 15-30% NBS.

Our assessment shows that the buildings have consistently low capacity in both directions (including block walls in the out-of-plane direction). Therefore, significant strengthening works will be required to lift the seismic strength of the buildings to a reasonable level.

The proposed strengthening is attached in Appendix A. The cost of the proposed strengthening was estimated by Harrisons Quantity Surveyors at $856k.

If you require any further information or explanation please contact us.

Yours sincerely,
TM CONSULTANTS LIMITED

TRM Gwatkin

<u>**Attachments**</u>
Appendix A. Proposed strengthening sketches

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CONCEPT STRENGTHENING

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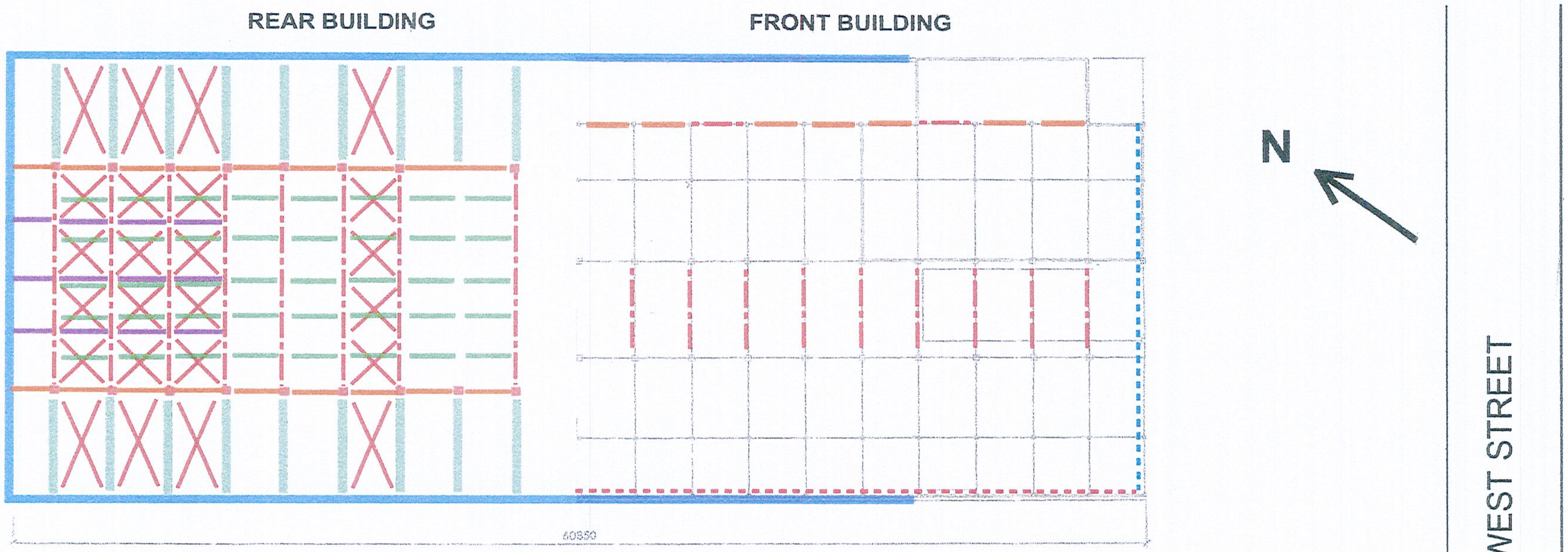

BUILDING PLAN

APPROXIMATELY 30% OF MEZZANINE FLOOR JOISTS NEED TO BE REPLACED DUE TO BORER DAMAGE

LEGEND:

- NEW 300x90 LVL11 RAFTERS.
- NEW 20 SERIES BLOCK WALLS ON NEW FOUNDATIONS. REFER TO SK-1 FOR SIDE WALLS AND SK-2 FOR GABLE WALL.
- NEW STEEL POSTS & PORTAL FRAMES. REFER TO SK-3 FOR REAR BUILDING AND SK-4 FOR FRONT BUILDING.
- NEW CROSS-BRACING BETWEEN TRUSS TOP CHORDS (50x3 FLAT STEEL).
- NEW CROSS-BRACING BETWEEN RAFTERS (65x5 FLAT STEEL).
- NEW CONNECTIONS BETWEEN FRONT FRAME AND MEZZANINE FLOOR. REFER TO SK-5.
- NEW CONNECTIONS BETWEEN TIMBER POSTS AND BLOCK WALL. REFER TO SK-6.
- NEW 89x89x5 SHS STRUTS BETWEEN TRUSS TOP CHORDS.
- NEW 89x89x5 SHS STRUTS BETWEEN NEW PORTALS (REAR BUILDING) AND BETWEEN MEZZANINE FLOOR BEAMS (FRONT BUILDING).
- NEW 90x90 RADIATA PINE STRUTS BETWEEN TRUSS BOTTOM CHORDS.

A.1

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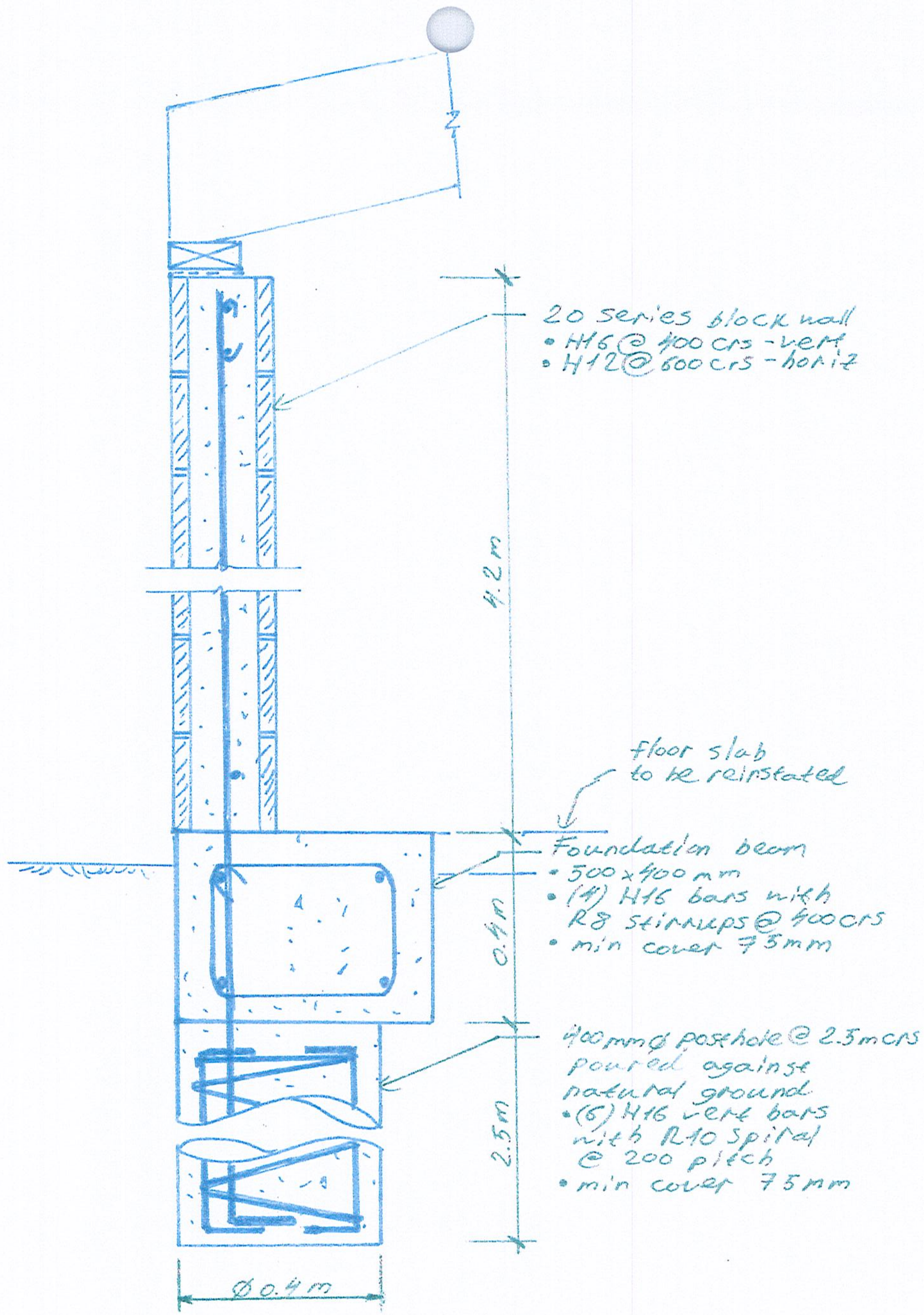

SK-1 (SIDE BLOCKWALLS)

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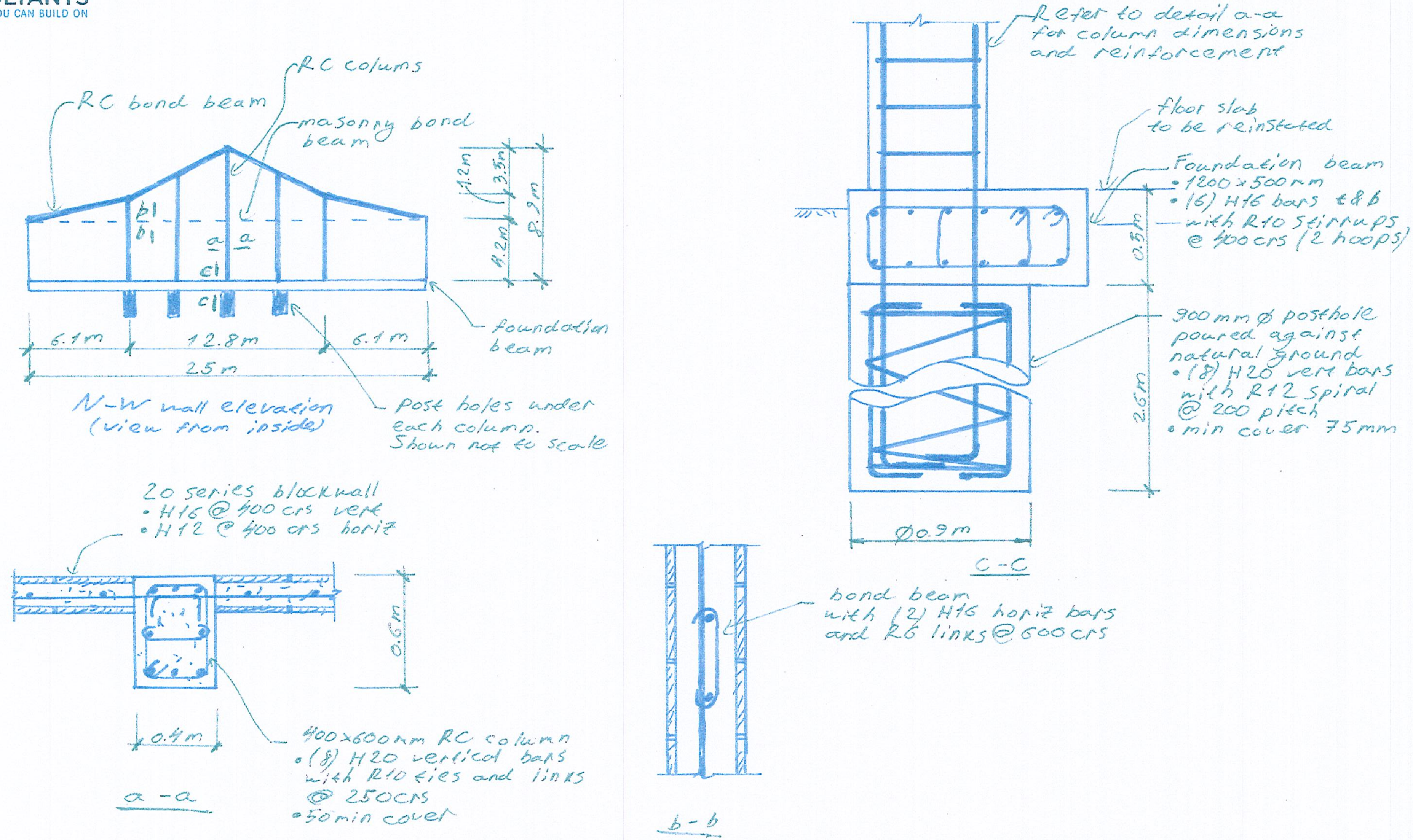

SK-2 (GABLE BLOCKWALL)

A.3

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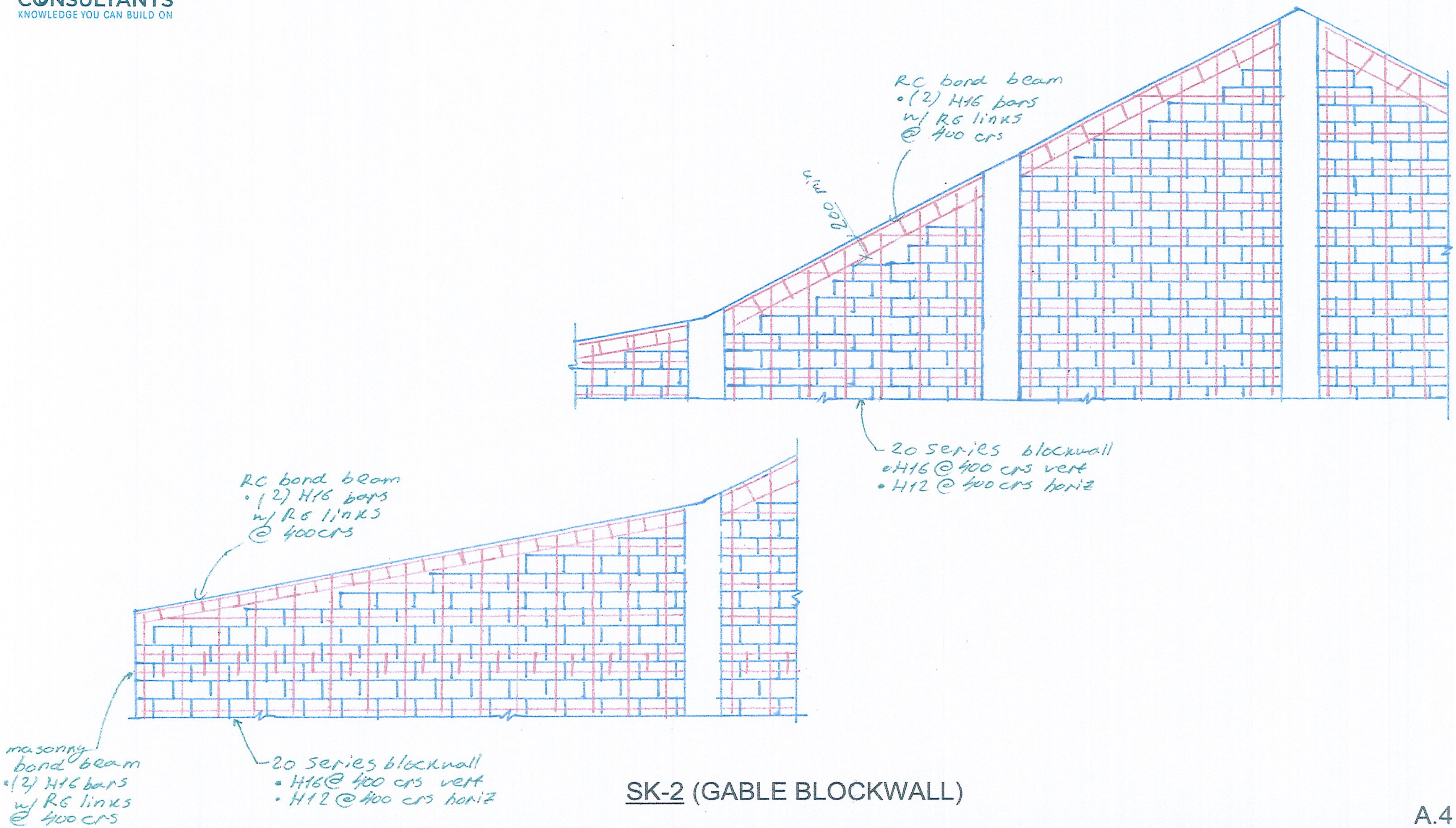

SK-2 (GABLE BLOCKWALL)

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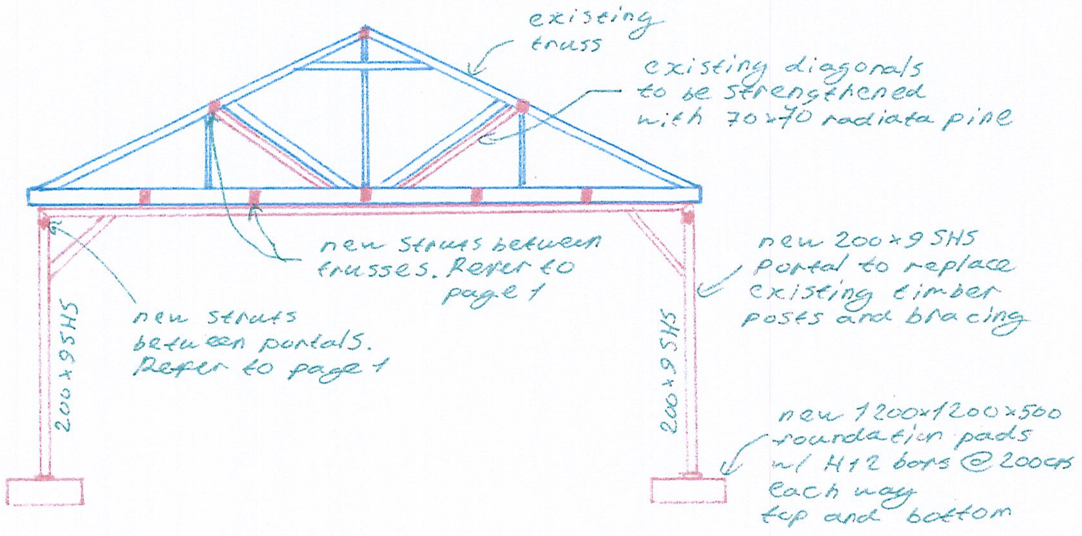

SK-3

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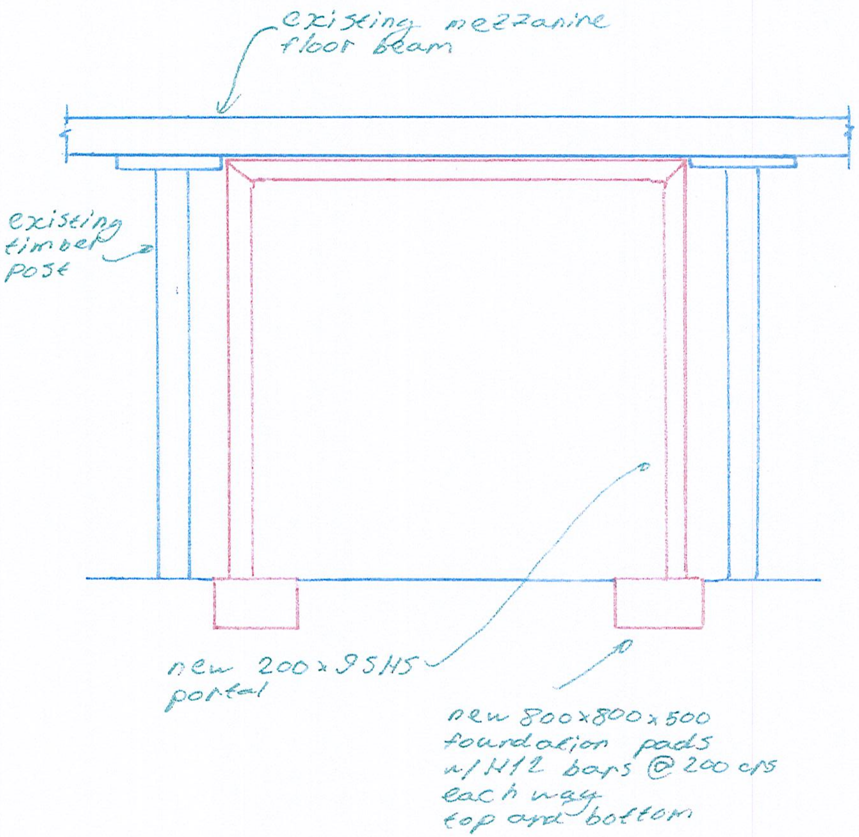
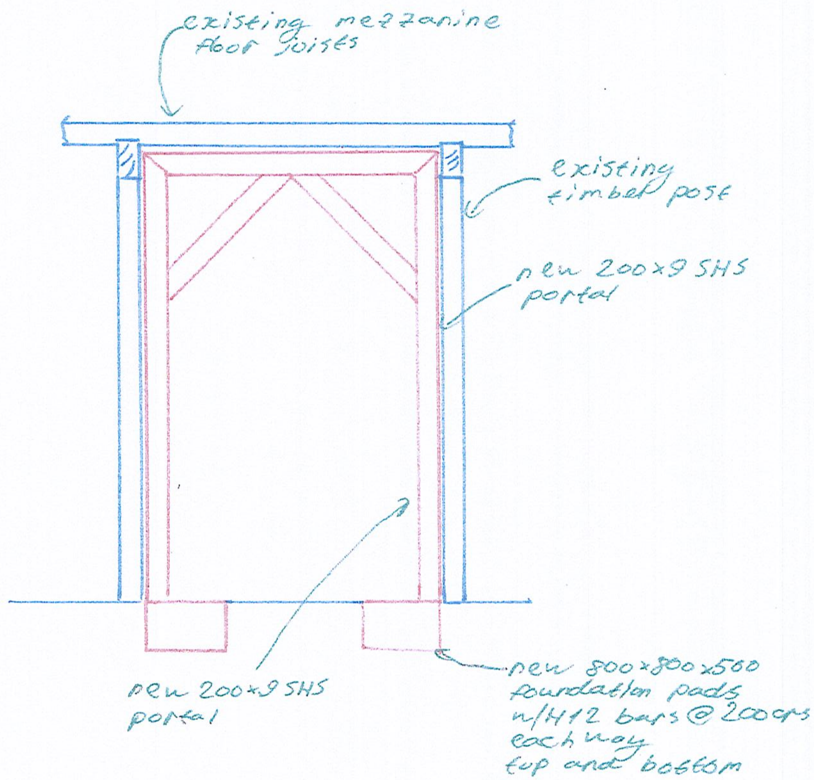


PORTAL ACROSS



PORTAL ALONG

SK-4

A.6

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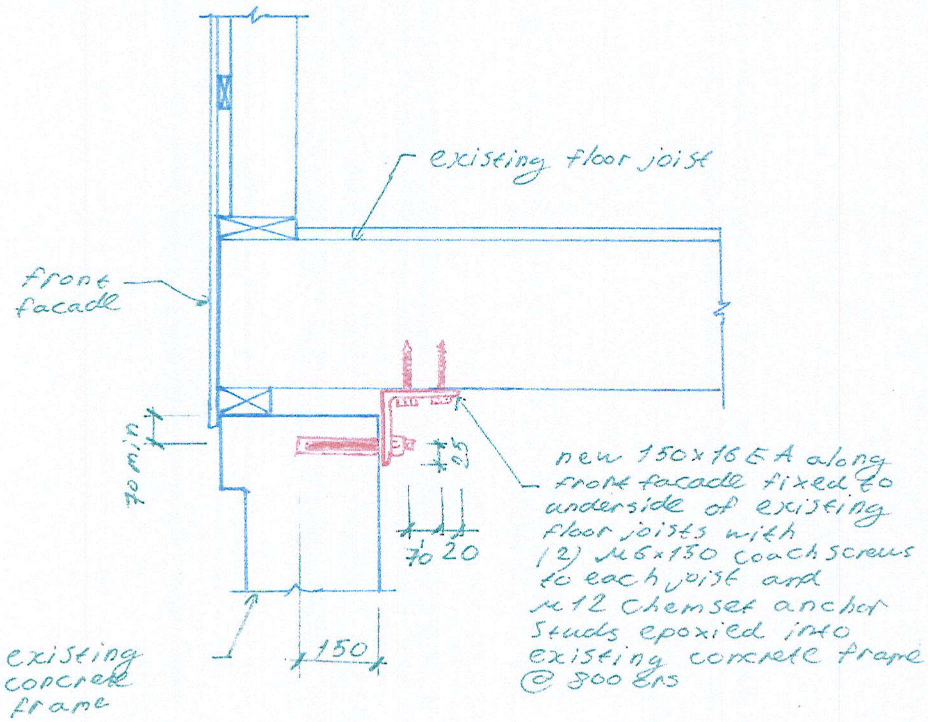
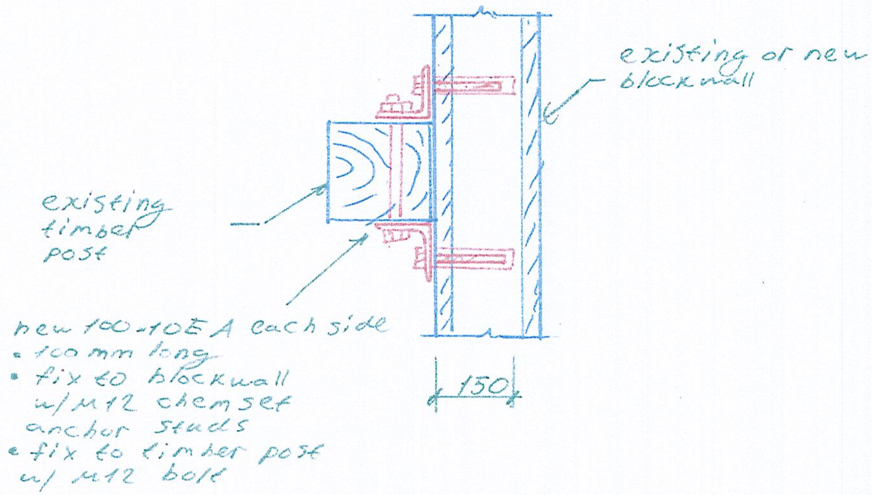


SK-5

(FRONT FRAME CONNECTION DETAIL)



SK-6

(TIMBER POST TO BLOCKWALL CONNECTION DETAIL)