STRUCTURAL ASSESSMENT OF

OPERATIONAL SUPPORT BUILDING AT CHARTWELL FIRE STATION

70 Crosby Road, Hamilton

Structural Assessment incorporating Detailed Seismic Assessment (DSA), Wind Loading Assessment (WLA), Snow Loading Assessment (SLA) & Visual Ground Assessment (VGA) prepared by Arnold & Johnstone 2015 Ltd for Fire and Emergency New Zealand (FENZ)

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1. Introduction

Fire and Emergency New Zealand (FENZ) have engaged Arnold & Johnstone 2015 Ltd to complete a structural assessment of the Operational Support Building at Chartwell Fire Station, located at 70 Crosby Road, Hamilton.

FENZ have requested that the following items are investigated as part of the structural assessment:

- The seismic capacity of the structure. This was achieved by completing a Detailed Seismic Assessment (DSA) and reporting the percentage of New Building Standard (*%NBS*) values for Importance Levels IL2, IL3 & IL4.
- The lateral capacity and vertical capacity of the structure for wind loading. This was achieved by completing a Wind Loading Assessment (WLA) and reporting the percentage of New Building Standard (*%NBS*) values for Importance Levels IL2, IL3 & IL4.
- Vertical load carrying capacity of the structure for snow loading. Snow loading is not applicable for this Fire Station. A Snow Loading Assessment (SLA) has not been undertaken as part of this scope of work.
- Identification and explanation of the Critical Structural Weakness (CSW) and other Structural Weaknesses (SW's) for each of the assessments conducted.
- A Visual Ground Assessment (VGA) aimed at identifying any evidence of excessive ground moisture levels or subsidence that may lead to potential settlement of the structure.

No known previous seismic assessments, desktop studies or geotechnical testing have been performed on this building.

This report summarises the findings of our structural assessment in relation to the bullet points above.

We completed localised intrusive investigations on the concrete block walls to determine whether the block walls were hollow or filled with grout, as well as the size and spacing of any reinforcing in the block walls. We did not undertake any geotechnical testing.

2. Building Description

The building description is based on a visual inspection completed on 12 January 2023 and the available drawings obtained from FENZ and Hamilton City Council's property file. Refer to Figure 1 for the layout of the Operational Support Building. Refer to Appendix C for drawings available for this assessment.

Date of Design/Construction	The original building was constructed circa 1978 and was a single storey stand-alone structure. The building can be split into three areas that are tied together. The central area is Appliance Bay 01, the western area is Appliance Bay 02 and the annex structure that wraps around the eastern and southern areas of the building is the Storeroom/Office area. Refer to Figure 1. A lightweight carport structure was constructed in another part of the site circa 1980 and moved to the west of the original building circa 1990. The carport structure is not physically connected to the original building and there is an approx. 100mm seismic gap between the two buildings.
Gross Floor Area	**Original Building:** Approximate floor area: 510m^2 **Carport:** Approximate floor area: 110m^2
Foundation System	**Original Building:** The building has a concrete slab on-grade with concrete footing beams around the perimeter. There are additional thickenings at portal locations, block wall locations and between Appliance Bay 01 and Appliance Bay 02. **Carport:** The building has concrete pad footings beneath the columns on the front (northern) elevation with concrete footing beams around the eastern, western and southern perimeter elevations.
Wall/Cladding System	**Original Building:** A combination of concrete block and timber-framed walls. The external wall cladding is predominantly concrete block with corrugated polycarbonate cladding to the high-level stud framing above the block walls around Appliance Bay 01. The external wall between Appliance Bay 02 and the Carport is clad in fibrolite. **Carport:** Timber-framed walls on the side and rear elevations with fibrolite cladding. The front elevation is open.

Roof System	**Original Building:** The roof consists of lightweight roof cladding supported on timber rafters spanning between the steel portal frames in Appliance Bays 01 and 02, and the concrete block walls in the Storeroom/Office area. **Carport:** The roof consists of lightweight corrugated steel roof cladding supported on timber rafters spanning between steel portal frames.
Lateral Load Resisting System – Longitudinal direction (refer Figure 1 for direction)	**Original Building:** Appliance Bay 01 – Lateral loads are transferred via steel cross bracing in the roof to the concrete block wall on the rear of the appliance bay and the portal columns on the front elevation cantilevering about their weak axis. Appliance Bay 02 – Lateral loads are resisted by steel portal frames at regular centres. Storeroom/Office Area – The concrete block walls rest tributary width lateral loads. **Carport:** Lateral loads are transferred via steel cross bracing in the roof to steel rod cross bracing on the rear wall.
Lateral Load Resisting System – Transverse direction (refer Figure 1 for direction)	**Original Building:** Appliance Bay 01 - Lateral loads are resisted by steel portal frames at regular centres. Appliance Bay 02 – Lateral loads are transferred via steel cross bracing in the roof to the timber framed walls on the appliance bay side elevations. Storeroom/Office Area – The concrete block walls resist tributary width lateral loads. **Carport:** Lateral loads are resisted by steel portal frames at regular centres.
Site Subsoils and Liquefaction	We have not observed any geotechnical records for this site. We have adopted the site to be Soil Class D which is representative of deep or soft soils in accordance with NZS1170.5:2004 and is the likely subsoil Class for the majority of the Hamilton area.

Table 1 - Building Description

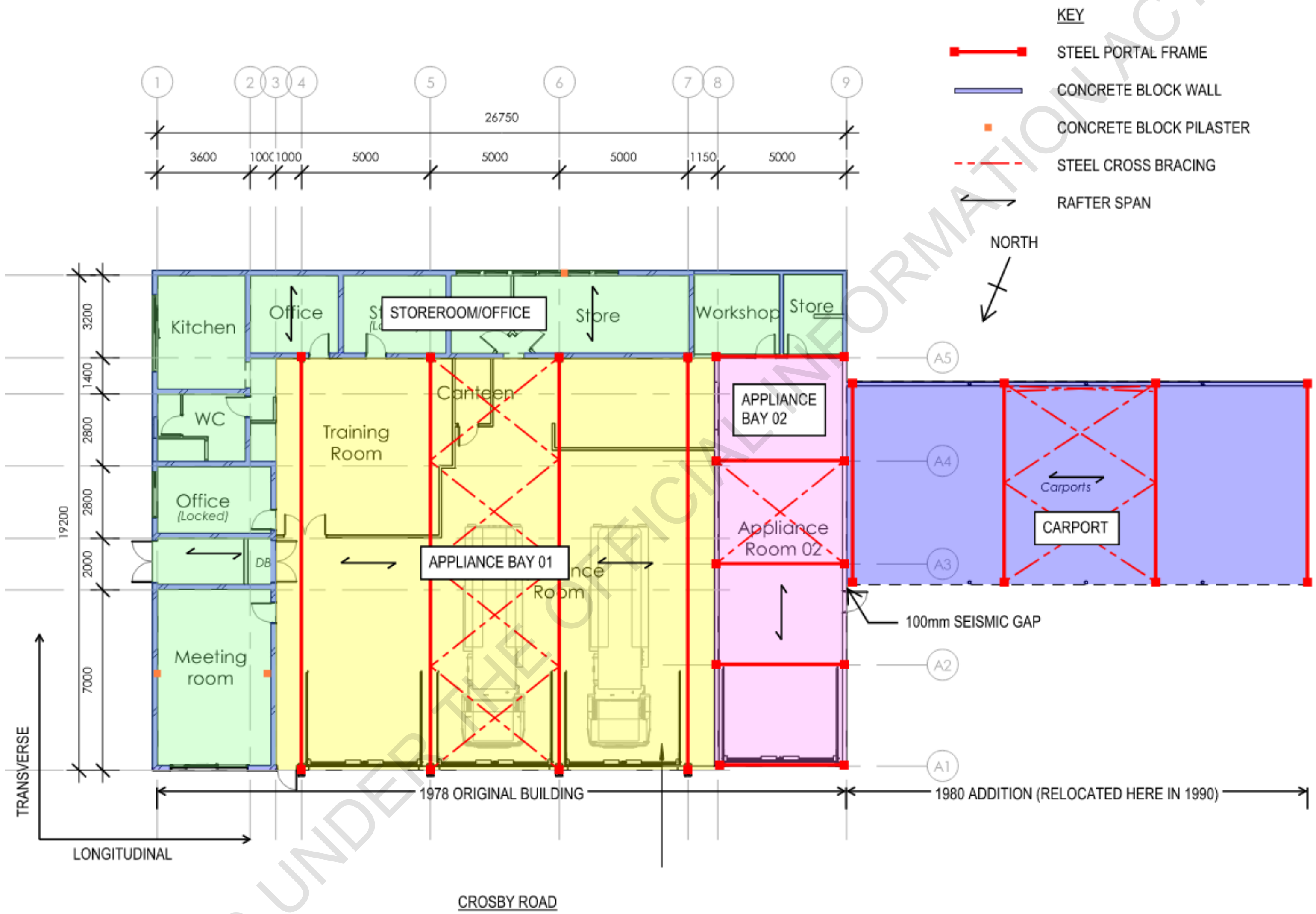


Figure 1: Floor Plan of the Operational Support Building at Chartwell Fire Station and loading directions

Detailed Seismic Assessment (DSA)

2.1 DSA Methodology

This assessment has been undertaken in accordance with the MBIE Seismic Assessment of Existing Buildings Guidelines (2017) and NZS1170.5:2004.

Parameter	Value
Design Working Life	50 years
Importance Level	IL2, IL3 and IL4
Return Period Factor - R	IL2 – 1.0, IL3 – 1.3 and IL4 – 1.8
Site Subsoil Classification	Subsoil Class D (deep soil sites) in accordance with NZS1170.5:2004
Period - T (seconds)	**Appliance Bay 01** $T \leq 0.4$ seconds in the longitudinal direction $T = 0.5$ seconds in the transverse direction **Appliance Bay 02:** $T = 0.5$ seconds in the longitudinal direction $T \leq 0.4$ seconds in the transverse direction **Storeroom/Office:** $T \leq 0.4$ seconds in both directions **Carport:** $T \leq 0.4$ seconds in the longitudinal direction $T = 0.6$ seconds in the transverse direction
Hazard Factor - Z	Z = 0.16 – Hamilton
Near Fault Factor - N	N = 1.0
Structural Ductility Factor and performance factor - μ & S_p	Steel Portals frames - $\mu = 1.25$ & $S_p = 0.9$ Steel Cross Bracing - $\mu = 1.25$ & $S_p = 0.9$ Timber framed walls - $\mu = 2.0$ & $S_p = 0.7$ Cantilevered Columns - $\mu = 1.25$ & $S_p = 0.9$ Concrete Block walls - $\mu = 1.25$ & $S_p = 0.925$

Table 2 - DSA Methodology

2.2 DSA Results

Our assessment concludes the building has the following Percentage of New Building Standard (*%NBS*) earthquake scores, indicated in Table 3. Our DSA is focussed on the primary structural elements resisting earthquake shaking and does not include secondary and non-structural elements. When assessing an IL4 structure the seismic assessment guidelines do not consider how earthquake-induced damage would affect operational requirements. When designing a new IL4 structure, additional design requirements (SLS2) must be met to provide confidence that the building will be able to maintain operational continuity following a ULS event. The general guidance from the Seismic Assessment Guidelines is "*Not withstanding the focus on life-safety, it is recommended that an IL4 building should either attain 67%NBS (IL4) rating as a minimum and fully satisfy SLS2 requirements, or be redesigned".*

Importance Level	*%NBS*
IL 2	E = 25*%NBS* (IL2)
IL 3	E =20*%NBS* (IL3)
IL 4	E = 15*%NBS* (IL4)

Table 3 - DSA Results for the Operational Support Building

The following table summarises the *%NBS* scores for the various lateral load resisting elements for each area of the building. Refer also to Appendix B.

Element	Direction	*%NBS* (IL2)	*%NBS* (IL3)	*%NBS* (IL4)	Commentary with regards to IL 4 capacities
Appliance Bay 01 Steel Portal Frames	Transverse	100%	100%	100%	The steel portal frames over Appliance Bay 01 are expected to have sufficient capacity to resist IL4 seismic loads.
Appliance Bay 01 Cantilevered Columns	Longitudinal	25%	20%	15%	In the longitudinal direction, the portal columns on the front elevation of the building must cantilever approximately 4.5m about their weak axis to resist tributary width lateral loads. The column base plate holding down rods have insufficient tensile capacity to resist IL4 seismic loads. We note the 360UB44 columns bending about their weak axis achieve approximately 50%NBS under IL4 seismic loads.
Concrete Block Walls	In-Plane	100%	100%	100%	The concrete block walls throughout the building are expected to have sufficient capacity to resist IL4 in-plane seismic loads. The walls carry tributary width loads.

Concrete Block Walls	Out-of-Plane	45%	35%	25%	The top of the concrete block walls throughout the building are restrained by a bond beam which must span up to 9m between return walls to resist out-of-plane loads. This is based on only one bar being present in the bond beam. This bond beam has insufficient flexural capacity to resist IL4 seismic loads.
Appliance Bay 01 High Level Timber-Framed Walls	Longitudinal	100%	80%	60%	Lateral loads in the longitudinal direction are transferred from the roof cross bracing to the concrete block walls on the rear elevation of the main appliance bay via cantilevering action of the 360UB44 columns about their weak axis.
Appliance Bay 01 Roof Cross Bracing	Longitudinal	100%	100%	100%	The equal angle steel cross bracing at roof level is expected to have sufficient capacity to transfer IL4 seismic loads to the lateral load resisting systems in the longitudinal direction.
Timber-Framed Walls around Training Room	Both	100%	100%	100%	The timber-framed walls around the training room in the original building are lined with Gib. The walls are expected to have sufficient capacity to withstand the IL4 seismic loads from the lower ceiling structure above the training room.
Appliance Bay 02 Steel Portal Frames	Longitudinal	100%	100%	100%	The steel portal frames over Appliance Bay 02 are expected to have sufficient capacity to resist IL4 seismic loads.
Appliance Bay 02 Timber-Framed Walls	Transverse	100%	100%	100%	The timber-framed walls on the appliance bay side elevations are lined with fibrolite cladding. The walls are expected to have sufficient capacity to resist IL4 seismic loads.
Appliance Bay 01 Roof Cross Bracing	Transverse	100%	100%	100%	The steel rod cross bracing at roof level is expected to have sufficient capacity to transfer IL4 seismic loads to the lateral load resisting systems in the transverse direction.

Carport Steel Portal Frames	Transverse	100%	95%	70%	Lateral loads in the transverse direction are resisted by four bays of steel portal frames. The central bays also resist a torsional force couple due to the eccentricity resulting from the carport being open at the front. Limited by the 2.5% limit, which is exceeded under IL4 seismic loads.
Carport Wall Cross Bracing	Longitudinal	90%	70%	50%	Lateral loads in the longitudinal direction are resisted by steel rod cross bracing on the rear elevation. The portal legs bounding the cross-bracing act as tension/compression chords. The bracing system is limited by the capacity of the holding down bolts cast into the concrete footing beam below to resist uplift demands from the chords. We note the capacity of the rods in tension achieve approximately 65%NBS under IL4 seismic loads.
Carport Roof Cross Bracing	Longitudinal	100%	100%	90%	The steel rod cross bracing at roof level transfers lateral loads in the longitudinal direction to the wall cross bracing on the rear elevation. Limited by the capacity of the R10 rod bracing in tension.

Table 4 - Elements assessed as part of DSA

During our site visit we observed some cabinets throughout the building. We recommend these items, and any other large or heavy items are restrained to prevent them toppling over in a significant earthquake.

No geotechnical investigations or geotechnical desktop study has been completed as part of this assessment. We have assumed that there is no significant ground deformations or liquefaction on the site. To confirm the seismic scores, and overall building seismic rating, a geotechnical desk top assessment is recommended.

DSA Critical Structural Weakness (CSW) and Structural Weaknesses (SW's)

Based on our assessment and the scores reported in Table 4, the Critical Structural Weakness (CSW) and Structural Weaknesses (SW's) of the building's lateral load resisting system under earthquake loading are:

1. The CSW is the capacity of the steel portal columns on the front elevation of the main appliance bay to withstand lateral loads in the longitudinal direction. The 360UB44 columns must cantilever approximately 4.5m about their weak axis to resist lateral loads. The column base plates have been detailed as nominally pinned connections, with 2-M20 hooked rods cast into the footing beams below. The hooked rods have insufficient tension capacity to resist the demands resulting from cantilever action of the out of plane columns. Under IL4 seismic loading, the capacity of this connection is likely to be exceeded causing the columns to become more flexible and resulting in loss of support to the roof structure, becoming a life safety risk to occupants of the building.

2. The SW are any elements that have scored less than 100*%NBS*. Refer Table 4.

The structural weaknesses and justification for the assigned *%NBS* scores is discussed below.

<u>Appliance Bay 01 – Longitudinal Direction</u>

In Appliance Bay 01, lateral loads are transferred in the longitudinal direction to the portal columns on the front elevation and the concrete block walls on the rear elevation via the high-level timber wall framing.

The portal columns are formed of 360UB44 members encased in a 460mm long x 270mm wide concrete column. On the front elevation of the main appliance bay, the portal columns must cantilever approximately 4.5m from the foundations about their weak axis to resist lateral loads. The columns are not detailed for cantilever action, with the column base plates comprising 2-M20 hooked rods cast into the footing beams below. The rods have a small lever arm resulting in a large tension demand on the rods from the moment demands at the base of the columns. The rods have insufficient tension capacity to resist IL4 seismic demands. Under seismic loading, the capacity of this connection is likely to be exceeded causing the columns to become more flexible and resulting in the loss of support to the roof structure, becoming a life safety risk to occupants of the building.

We have assessed the seismic rating of the cantilevered columns to be 15%NBS (IL4), limited by the capacity of the hold down rods. We note the flexural capacity of the UB columns bending about their weak axis is also insufficient to resist IL4 seismic demands. These have been assessed as having a seismic rating of 50%NBS (IL4).

<u>Out-of-Plane Performance of Concrete Block Walls</u>

The southern and eastern perimeter walls around the main appliance bay are formed of 3m high concrete block walls below high-level timber framing spanning to the roof above. The annex structure that wraps around the southern and eastern elevations of the building to form the storerooms/offices area is also formed of 2.4m high external and internal concrete block walls.

There was no information on the available drawings that confirmed the reinforcement in the block walls or whether the block walls were hollow or solid-filled. Intrusive investigations completed on the block walls including scanning of the reinforcement and localised concrete breakouts confirmed the walls are typically reinforced with a deformed 12mm bar at 600mm centres vertically and horizontally. The walls are partially grouted at reinforcement locations. A deformed 16mm bar is present in the bond beam to restrain the top of the wall.

Under out-of-plane seismic loading, the concrete block walls span vertically between the floor slab and the bond beam at the top of the wall. The bond beam must then span horizontally to transfer lateral loads to the return walls. At two locations, the span of the bond beam is broken up with reinforced concrete block pilasters approximately half way between return walls. It is likely the original design intended for these pilasters to cantilever from their foundations to support the end of bond beam however the thickenings beneath the pilasters do not have sufficient overturning capacity for this cantilever action to occur, and the bond beam must therefore span up to 9m to the adjacent return wall. The lightly reinforced bond beam has insufficient flexural capacity to resist the IL4 seismic demands from this large span. The block walls support the ends of the roof rafters. Loss of restraint to the top of the block walls will cause these walls to become more flexible, potentially resulting in the loss of support to the roof structure which may collapse, becoming a life safety risk to occupants of the building.

We have assessed the seismic rating of the concrete block walls for out-of-plane loading to be 25%NBS (IL4).

Carport Wall Cross Bracing

Lateral loads in the longitudinal direction are resisted by one bay of steel rod cross bracing on the rear perimeter wall elevation. The rods are welded to the inside flange of the carport portal columns, with the columns acting as the tension/compression chords in the bracing system. The bracing system is limited by the capacity of the 2-M16 hooked rods cast into the footings below to resist uplift demands from the tension/compression chords. Under seismic loading, the capacity of this connection is likely to be exceeded causing failure of the bracing system and the building to become more flexible. This could result in loss of support to the roof structure and become a life safety risk.

We have assessed the seismic rating of the cross bracing as 50%NBS (IL4), limited by the capacity of the hold down rods. We note the tension capacity of the diagonal rod cross braces is also insufficient to resist IL4 seismic demands. These have been assessed as having a seismic rating of 65%NBS (IL4).

Pounding Between Original Building and Carport

There is no physical connection between the original building and the adjacent carport building and the buildings are separated by a seismic gap of approximately 100mm. This gap is expected to be sufficient to accommodate the differential inter-storey drifts between the two structures in an IL4 seismic event and the effects of pounding are considered insignificant. There may be some potential for localised movement and damage to the cladding, but we do not consider this to be a life safety risk.

Meaning of *%NBS*

The Building Code requires that newly built *Post-Disaster Structures* falling under category IL4 with a design working life of 50 years have "Ultimate Limit State" (ULS) strengths to meet a 1 in 2500-year earthquake demand. For *major structures (affecting crowds)* falling under category IL3 the demand drops to a 1 in 1000-year earthquake and for *normal structures* under category IL2, a 1 in 500-year earthquake. These are the 100%*NBS* levels assumed throughout this assessment.

At the Ultimate Limit State, substantial damage is allowed, such as irrecoverable displacement or cracking, so long as there is a margin against collapse and appropriately low life-safety risk. The focus of the assessment using the Seismic Assessment Guidelines, is on life-safety of those occupying and those immediately outside the building rather than building damage and reparability considerations or business interruption.

Buildings are generally required by legislation to have a design working life of 50 years. The chance of a 1 in 2500-year (IL4) event being exceeded in any 50-year period is approximately 2%.

The following table by the New Zealand Society for Earthquake Engineering (NZSEE) provides the basis of a proposed grading system for existing buildings, as one way of interpreting the *%NBS* building score. It can be seen that Earthquake Prone buildings (*%NBS* less than 33%) have more than 10 times the risk of collapse than a similar new building. For buildings that are a potential Earthquake Risk (67%>*%NBS*>33%), the risk of collapse is 5 to 10 times greater than that of an equivalent new building. Broad descriptions of the life-safety risk can be assigned to these Building Grades accordingly.

Relative Earthquake Risk

Building Grade	Percentage of New Building Strength (*%NBS*)	Approx. Risk Relative to a New Building	Risk Description
A+	>100	≤1	low risk
A	80 to 100	1 or 2 times	low risk
B	67 to 79	2 or 5 times	low or medium risk
C	34 to 66	5 to 10 times	medium risk
D	20 to 33	10 to 25 times	high risk
E	<20	more than 25 times	very high risk

Table 5 - Relative Earthquake Risk [Source: NZSEE]

3. Wind Loadings Assessment (WLA)

3.1 WLA Methodology

We have assessed the current capacity of the building under wind loading based on the Australian & New Zealand Standard AS/NZS1170.2:2021 – *Structural Design Actions, Part 2: Wind Actions* using the following parameters.

Parameter	**Value**
Wind Region	NZ1 in accordance with AS/NZS1170.2:2021
Importance Level	IL2, IL3 and IL4
Event Return Period (Years)	IL 2 – 500 years, IL 3 – 1000 years and IL 4 – 2500 years
Regional Wind Speed - V_R (m/s)	V_R = 45 m/s for IL2 V_R = 46 m/s for IL3 V_R = 47 m/s for IL4
Wind Direction Multiplier - M_d	M_d = 0.90 (North) M_d = 0.90 (South) M_d = 1.00 (West) M_d = 0.95 (East)
Terrain Category	Terrain Category 2.5 with a few trees or isolated obstructions in all wind directions.
Reference height on the structure above the average local ground level – z (m)	Z = 5.0m
Terrain/Height Multiplier – $M_{z,cat}$	$M_{z,cat}$ = 0.87
Shielding Multiplier – M_s	M_s = 1.0
Topographic Multiplier – M_t	M_t = 1.0
Site Wind Speed – $V_{sit,\beta}$ = V_R*M_d*($M_{z,cat}$*M_s*M_t) (m/s)	$V_{sit,\beta}$ = 39.2m/s at IL2 $V_{sit,\beta}$ = 40.0m/s at IL3 $V_{sit,\beta}$ = 40.9m/s at IL4
Aerodynamic Shape Factor – C_{fig}	$C_{p,e}$ = 0.7 windward wall

	$C_{p,e}$ = -0.5 leeward wall $C_{p,e}$ = -0.9, 0.2 roof $C_{p,e}$ = -0.65 side wall $C_{p,i}$ = -0.3, 0.2 internal wind pressure K_a = 1.0 $K_{c,e}$ = 1.0 K_l = 2.0 for rafters on roof edges only K_p = 1.0 non-permeable cladding
Dynamic Response Factor – C_{dyn}	C_{dyn} = 1.0
Design Wind Pressures – p (kPa)	p = 0.92 kPa x C_{fig} for IL2 p = 0.96 kPa x C_{fig} for IL3 P = 1.00 kPa x C_{fig} for IL4

Table 6 - WLA Methodology

3.2 WLA Results

Our assessment has found that the building has the following Percentage of New Building Standard (*%NBS*) values for wind loading. Our wind loading assessment is focussed on the primary structural elements resisting the wind loading. The assessment does not include secondary elements such as roof and wall cladding.

Importance Level	***%NBS***
IL 2	W = 37*%NBS* (IL2)
IL 3	W = 35*%NBS* (IL3)
IL 4	W = 34*%NBS* (IL4)

Table 7 - WLA Results

The following table summarises the *%NBS* capacities for the various lateral and vertical load resisting elements based on our wind loading assessment:

Element	**Direction**	***%NBS* (IL2)**	***%NBS* (IL3)**	***%NBS* (IL4)**	**Commentary with regards to IL 4 capacities**
Appliance Bay 01 Roof Rafters	Both	71%	68%	65%	Limited by the flexural capacity of the timber roof rafters to span between the steel portal frames to resist IL4 wind demands
Annex Roof Rafters	Both	100%	100%	100%	The roof rafters in the annex are expected to have sufficient capacity to span between the concrete block walls to resist IL4 wind demands
Appliance Bay 01 Roof Cross Bracing	Longitudinal	100%	100%	100%	The roof cross bracing is expected to have sufficient capacity to transfer IL4 longitudinal wind demands.
Appliance Bay 01 Cantilevered Columns	Longitudinal	37%	35%	34%	The column base plate holding down rods have insufficient tensile capacity to resist IL4 wind loads resulting from the cantilever action of the columns.
Appliance Bay 01 High Level Timber-Framed Walls	Longitudinal	78%	75%	72%	Limited by the capacity of the wall sheeting to transfer IL4 wind loads to the concrete block wall below.
Appliance Bay 01 Steel Portal Frames	Transverse	100%	100%	100%	The steel portal frames over Appliance Bay 01 are expected to have sufficient capacity to resist IL4 wind loads.

Concrete Block Walls	In-Plane	100%	100%	100%	The concrete block walls throughout the building are expected to have sufficient capacity to resist IL4 wind loads.
Appliance Bay 02 Roof Cross Bracing	Transverse	100%	100%	100%	The roof cross bracing is expected to have sufficient capacity to transfer IL4 transverse wind demands.
Appliance Bay 02 Timber-Framed Walls	Transverse	100%	100%	100%	The lined timber-framed walls on the perimeter of Appliance Bay 02 are expected to have sufficient capacity to resist IL4 wind demands.
Appliance Bay 02 Portal Frames	Longitudinal	100%	100%	100%	The steel portal frames are expected to have sufficient capacity to resist IL4 wind demands.
Carport Roof Rafters	Both	71%	68%	65%	Limited by the flexural capacity of the timber roof rafters to span between the steel portal frames to resist IL4 wind demands.
Carport Girts	Both	44%	42%	40%	Limited by the flexural capacity of the timber girts to span between the steel portal frames to resist IL4 wind demands.
Carport Roof Cross Bracing	Longitudinal	100%	100%	100%	The roof cross bracing is expected to have sufficient capacity to transfer IL4 longitudinal wind demands.
Carport Wall Cross Bracing	Longitudinal	71%	68%	65%	Limited by the capacity of the holding down rods to resist uplift demands from the wall bracing system.
Carport Portal Frames	Transverse	71%	68%	65%	Limited by the flexural capacity of the portal columns to resist IL4 wind demands

Table 8 - Elements assessed as part of WLA

3.3 WLA Critical Structural Weakness (CSW) and Structural Weaknesses (SW's)

Based on our assessment and the scores presented in Table 8, the Critical Structural Weakness (CSW) and Structural Weaknesses (SW's) of this building's lateral load resisting system for wind loading are listed below.

1. The CSW is the capacity of the steel portal columns on the front elevation of the main appliance bay to withstand wind loads in the longitudinal direction. The 360UB44 columns must cantilever approximately 4.5m about their weak axis to resist wind loads. The column base plates have been detailed as nominally pinned connections, with 2-M20 hooked rods cast into the footing beams below. The hooked rods have insufficient tension capacity to resist the demands resulting from cantilever action of the out of plane columns. Under IL4 wind loading, the capacity of this connection is likely to be exceeded causing the columns to become more flexible and resulting in loss of support to the roof structure, becoming a life safety risk to occupants of the building.
2. The SW are any elements that have scored less than 100*%NBS*. Refer Table 8.

The structural weaknesses and justification for the assigned *%NBS* scores is discussed below and as described in Section 2.3.

<u>Original Building</u>

The primary lateral load resisting systems are the steel portal frames and the concrete block walls. These are expected to have sufficient capacity to resist 100%NBS IL4 wind demands.

The cantilevered columns on the front elevation is the CSW for the building, as described above.

The rafters over Appliance Bay 01 have been assessed for wind uplift. The edge rafters, which are defined as the rafters within 2m of the edge and the rafters in the end bays, have been assessed using a local pressure factor of 2.0. These rafters have been assessed as scoring 65%NBS (IL4). The rafters away from the edge were assessed as scoring 100%NBS (IL4).

<u>Carport</u>

The primary lateral load resisting systems are the wall cross bracing and portal frames. These have been assessed as scoring 65%NBS (IL4). Refer to Table 8 and also to Section 2.3 for further commentary on these items.

The rafters and girts have been assessed for wind loads with a local pressure factor of 2.0, and have been assessed as scoring 65%NBS and 40%NBS (IL4) respectively.

4. Snow Loadings Assessment (SLA)

In accordance with the Australian & New Zealand Standard AS/NZS1170.3:2003 – *Structural Design Actions, Part 3: Snow and Ice Actions,* Hamilton is outside of the Snow Regions with no significant snow below 1200m. A snow loading assessment has not been completed for the Operational Support Building.

5. Visual Ground Assessment (VGA)

We visited the site on 12 January 2023. During this site visit, we observed the following general ground conditions at the site. Refer Figure 2 for an indication of the area around the Operational Support Building.

1) The Operational Support Building is located generally on flat ground and surrounded by residential buildings. The rear (south) of the building backs onto the car park for Porritt Stadium.
2) A gully is located on the south western side of the site. Historically, gully areas have often been filled to allow further flat ground for development. No settlement or movement of the ground in the vicinity of the building was noted.
3) There is another building on the property (Chartwell Fire Station). The area surrounding the Operational Support Building is generally paved with concrete with some small grassed areas. No notable settlement was observed on site.
4) Storm water run-off appears to flow to catch pits in the paved area to the north of the building. No ponding issues were noted during our site visit.

Figure 2: Photo of the Operational Support Building

6. Summary of Assessment Results

The following table summarises the results from the assessments we have conducted for FENZ of the Operational Support Building at Chartwell Fire Station located at 70 Crosby Road, Hamilton.

Assessment	*%NBS* (IL2)	*%NBS* (IL3)	*%NBS* (IL4)	Critical Structural Weakness (CSW)
Detailed Seismic Assessment (DSA)	25%	20%	15%	The CSW is the capacity of the steel portal columns on the front elevation of the main appliance bay to withstand seismic loads in the longitudinal direction. The column base plates have been detailed as nominally pinned connections, with 2-M20 hooked rods cast into the footing beams below. The hooked rods have insufficient tension capacity to resist the demands resulting from cantilever action of the out of plane columns
Wind Loading Assessment (WLA)	37%	35%	34%	The CSW is the capacity of the steel portal columns on the front elevation of the main appliance bay to withstand wind loads in the longitudinal direction
Snow Loading Assessment (SLA)	N/A	N/A	N/A	Hamilton is not in a snow zone
Visual Ground Assessment (VGA)	N/A	N/A	N/A	The building is generally in a good condition

Table 9 - Summary of Assessment Results

7. Estimated Difficulty of Strengthening

FENZ has a key long-term objective to 'bring facilities in high-risk areas up to a seismic resilience standard of a minimum of 67%*NBS* IL4'. While it is outside the scope of this report to provide full strengthening options for each CSW or SW found at this site, the following section should assist FENZ in prioritising further investigation into strengthening work by providing them with an estimation of the difficulty of strengthening this particular building.

When assessing their entire rural portfolio, the *estimated difficulty of strengthening* will provide FENZ with another parameter by which to compare their rural properties and prioritise future works. The estimation provided gives a rough overall view of how difficult strengthening this building to 67*%NBS* (IL4) is perceived to be. The particular *difficulty of strengthening* category which this structure falls under is not necessarily directly related to the *%NBS* values listed in Section 6. For example, a building which is currently at 40*%NBS* (IL4) could be very easily brought up to 67*%NBS* (IL4) by simply removing a non-structural element such as a parapet. In another case, a building which currently sits at 60*%NBS* (IL4) may be very difficult to bring up to 67*%NBS* (IL4) due to the fact that the CSW is the out-of-plane capacity of a concrete block wall. In order to bring this structure above 67*%NBS* (IL4), new footings, steel posts and steel transoms may need to be installed at regular centres, over a large area of the external block walls.

The particular categories selected for each of the three assessments conducted; earthquake, wind and snow, have been selected using engineering judgement and through drawing on prior experience in strengthening design. The table shown overleaf provides a brief description of each of the five categories.

Strengthening the Operational Support Building to greater than 67%*NBS* (IL4) for seismic and wind loading is expected to require intermediate strengthening works due to the number and nature of the elements that require strengthening.

Category	Description of Category
A	No strengthening required, currently >67%*NBS* (IL4)
B	Minor strengthening work required e.g. Seismic/Wind – replace a small number (<3) of existing linings to internal timber-framed walls or remove a non-structural element such as an unreinforced masonry parapet e.g. Snow – replace a small number (<3) of understrength elements such as a timber lintel
C	Intermediate strengthening work required e.g. Seismic/Wind – new portal frame and concrete footings to provide additional lateral bracing e.g. Snow – replace existing understrength roof purlins over Office area
D	Major strengthening work required (extensive strengthening work to a large portion of the structure requiring major disruption to operation) e.g. Seismic – remove large portion of exterior unreinforced masonry veneer and re-clad, install numerous portal frames and replace numerous internal wall linings e.g. Wind – replace and re-line a large number of timber-framed walls throughout the structure and install new portal frames with concrete footings e.g. Snow – remove nail-plate truss roof structure over Appliance Bay area and replace with new timber-framed trusses
E	Demolition Recommended In attempting to attain 67%*NBS* (IL4) the amount and nature of strengthening work at this site is so extensive, costly and time-consuming that we would recommend demolishing the existing building and re-building a new structure

Table 10 - Description of Strengthening Categories

The following table shows the categories selected for each of the assessments conducted:

Assessment Type	Category Selected
Seismic	C
Wind	C
Snow	N/A

Table 11 - Estimated Difficulty of Strengthening

Author

pp 9(2)a [redacted]

Nicholas McLean BE(Hons) MEngNZ
Structural Engineer

Reviewer 9(2)a [redacted]

Gavin Douglas BE(Hons) MEngNZ
Senior Structural Engineer

Approver 9(2)a [redacted]

Raman Forbes BE(Hons) CMEngNZ, CPEng
Director

Appendix A – Relevant Site Photographs

Photo 1 – Front (north) elevation of the Operational Support Building

Photo 2 – Rear (south) elevation

Photo 3 – Front elevation of carport

Photo 4 – Internal view of Appliance Bay 01

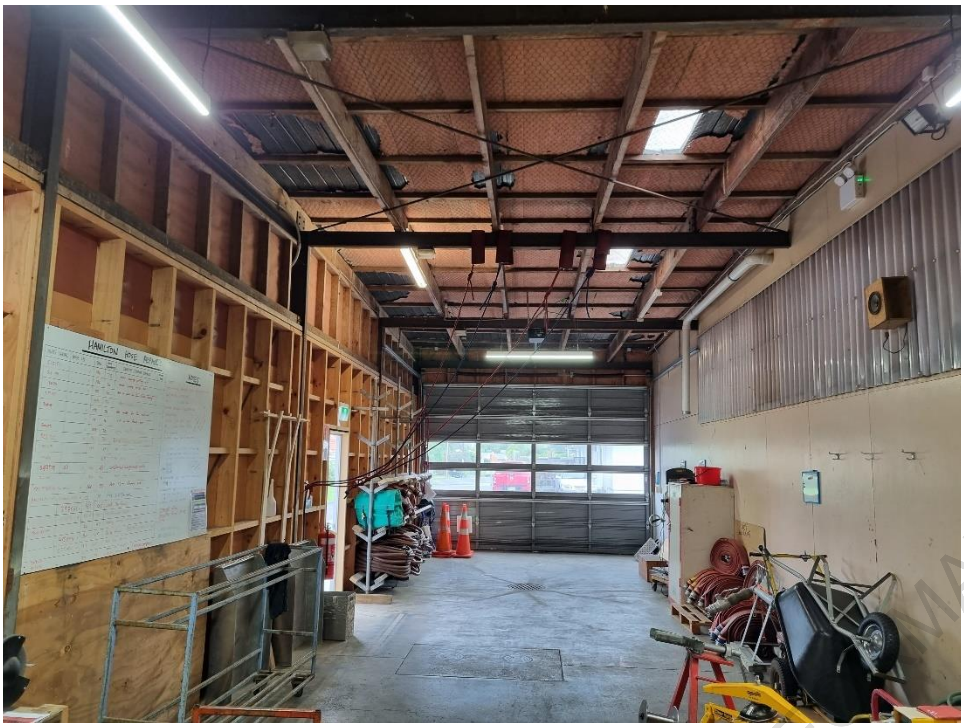


Photo 5 – Internal view of Appliance Bay 02

Photo 6 – Internal view of the Training Room

Appendix B – Mark-Up Sketch of Lateral Load Resisting System

Floor plan showing the locations of the primary lateral load resisting system and seismic scores for IL4 levels of shaking.

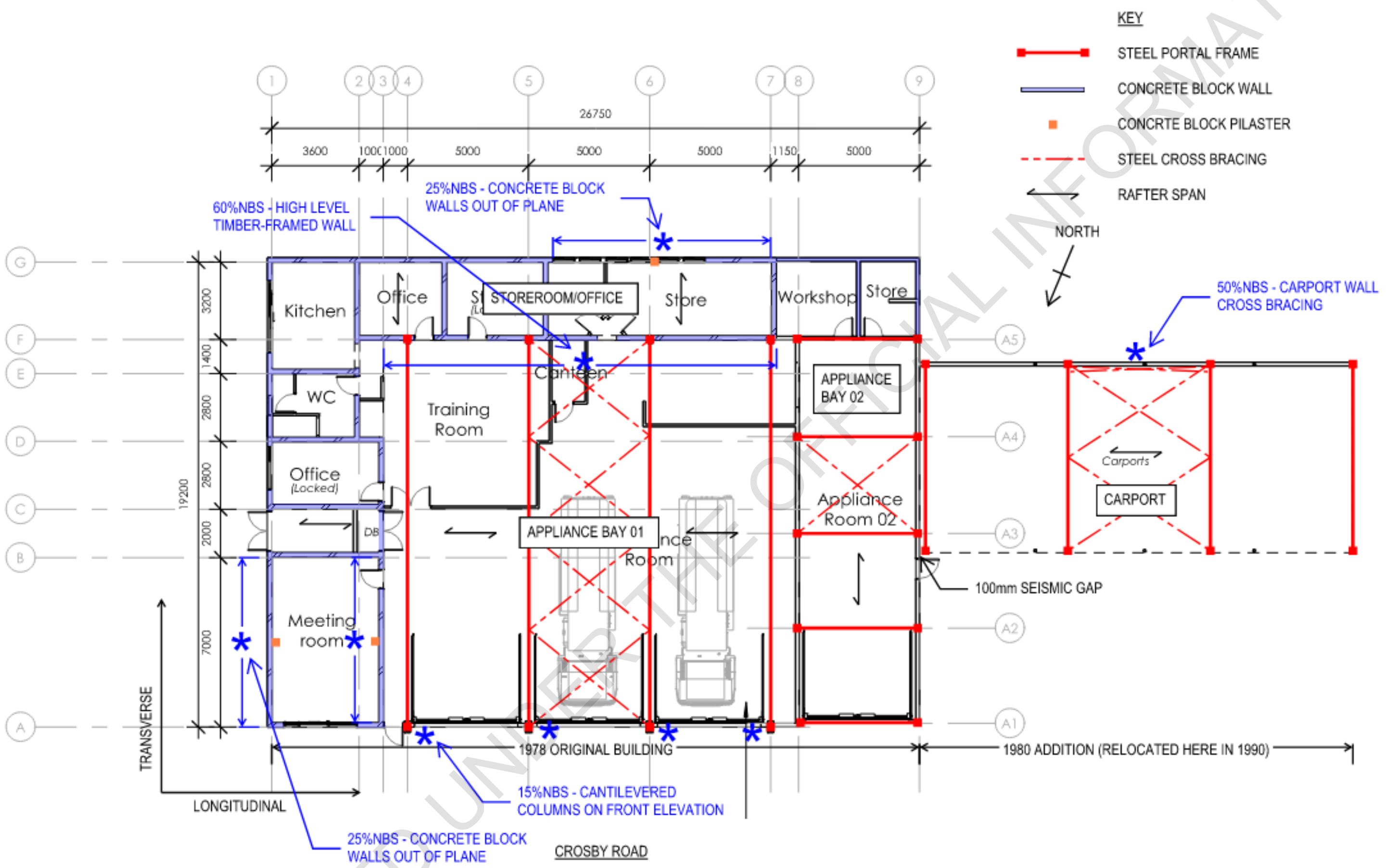


Figure 3: Floor plan showing IL4 seismic scores

Floor plan showing the locations of the primary lateral load resisting system and wind scores for IL4 levels of shaking.

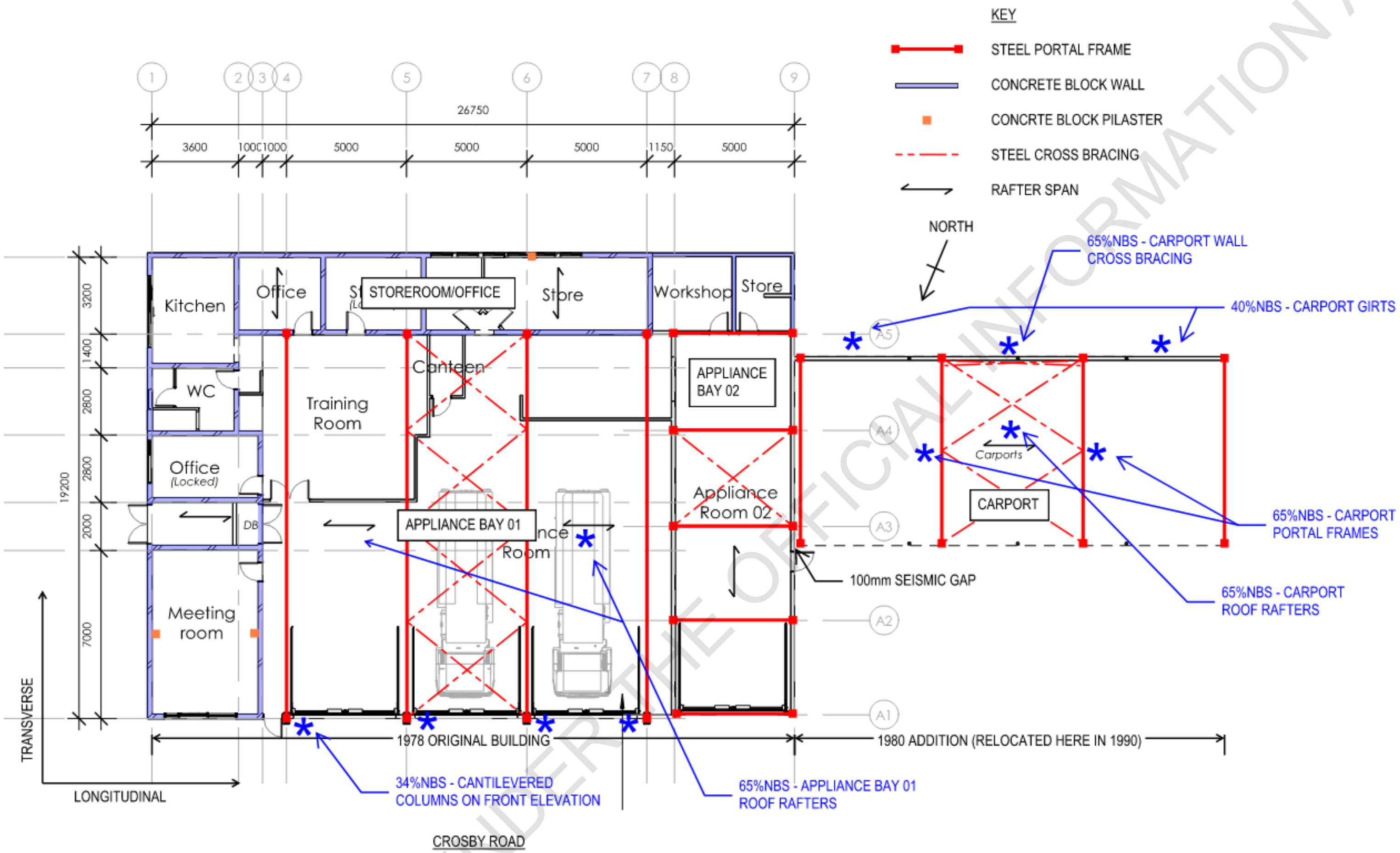
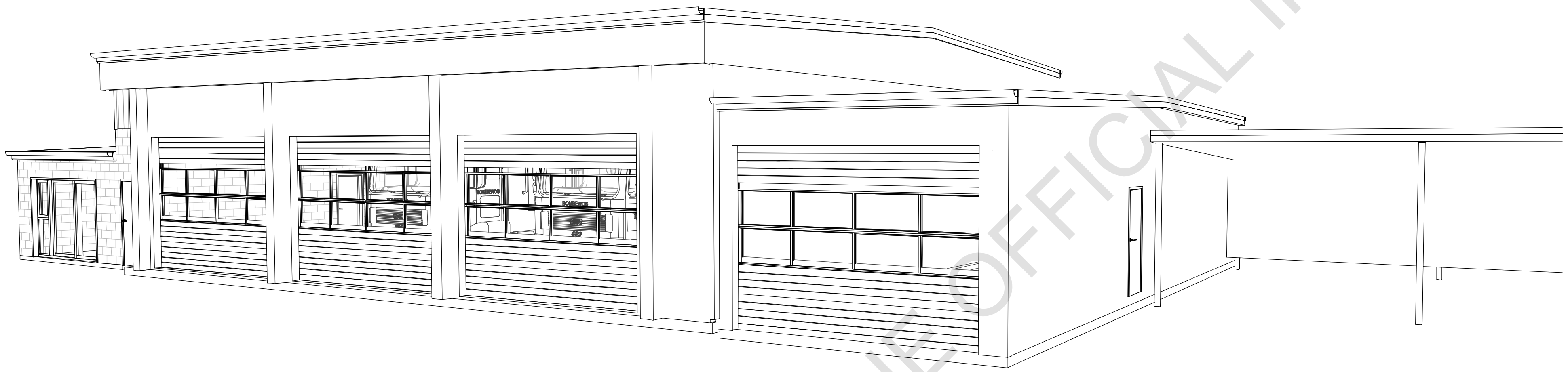


Figure 4: Floor plan showing IL4 wind scores

CHARTWELL FIRE STATION
WAIKATO OPERATIONAL SUPPORT BUILDING
Fire Alarm Upgrade

Project Drawing Index		
Sheet Number	Sheet Name	Current Revision
A0.00	Drawing Schedule & Location Plan	1
A0.10	Standard Notation & Keynotes	1
A1.00	Location and Site Plan	1
A2.00	Existing Floor Plan	1
A4.00	Existing External Elevations	1



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Project:
Chartwell Fire Station - Waikato Volunteer Operational Support Building

Client:
Fire and Emergency NZ

Drawing Title:
Drawing Schedule & Location Plan

CAD File: Autodesk Docs://C895 Chartwell Fire Station/C895 Chartwell Fire Station 1.rvt

REV.	DATE	REVISION DETAILS
1	26.05.22	Building Consent / Tender Issue

Scale: @ A3	Date: 01/01/19	Drawn: FC
	Designed: DLA	Checked: KC
Job No: M806	Drawing No: A0.00	Revision No: 1

General Notes:

1. The Architectural drawings shall be read in conjunction with the associated specifications and conditions of contract. The drawings shall also be read in conjunction with all Structural, Services, & Civil documentation, and all other project drawings. Any discrepancies shall be referred to the Architect for resolution.

2. Do not scale from these drawings, use figured dimensions only. Verify all dimensions with Structural, Services, Civil and all other project drawings prior to construction commencing. Refer all discrepancies to the Architect for resolution.

3. Substitution for, or ammendment to the specified details or materials shall not be carried out with out prior approval of the Architect.

4. All work shall be carried out strictly in accordance with the New Zealand Building Code, Local Territorial Authority Requirements, OSH Requirements & Regulations, and any other Statutory Requirements that may be applicable to this project.

5. All work shall be of best trade practice.

Abbreviations:

AD	Above Datum
AP	Access Panel
APPR	Approved
BM	Benchmark
C/C	Centre to Centre
CL	Centre Line
CTRS	Centres
CODE	Building Code
CONC	Concrete
COS	Check on Site
CORR	Corrugated
CB	Coach Bolt
CS	Coach Screw
CSK	Countersunk
CHS	Circular Hollow Section
CJ	Construction Joint
CP	Cesspit
DRG	Drawing
DWG	Drawing
DIA	Diameter
DIAG	Diagonal
DHS	Dimond Hi-Span (metal Purlin)
DIM	Dimension
DPC	Damp Proof Course
DPM	Damp Proof Membrane
DB	Distribution Board
DP	Downpipe
D4S	Dressed Four Sides
EJ	Expansion Joint
FHR	Fire Hose Reel
FG	Fixed Glass
GT	Gulley Trap
HD	Hold Down Bolt
HDG	Hot Dipped Galvanised
HOR	Horizontal
ID	Inside Diameter
IL	Invert Level
IB	Inspection Bend
IJ	Inspection Junction
KW	Kilowatt
L	Litre
MS	Mild Steel
MAX	Maximum
MIN	Minimum
MM	Millimetre
M	Metre
NB	Nominal Bore
NTS	Not to Scale
NZS	New Zealand Standard
O/A	Overall
O/H	Overhead
OD	Outside Diameter
O/F	Overflow
PC	Precast Concrete
PFC	Parallel Flange Channel
R	Radius
RAD	Radiata
RHS	Rectangular Hollow Section
REF	Reference
RC	Reinforced Concrete
ROW	Right of Way
RL	Reduced Level
RO	Rough Opening (refer to detail)
SC	Sawcut Joint
S.S	Stainless Steel
S.S.S	Satin Stainless Steel
SED	Small End diameter
SK	Sketch
SPEC	Specification
SHT	Sheet
SCHED	Schedule
SHS	Square Hollow Section
SP	Soil Pipe
SQ/M	Square Metre
TFC	Tapered Flange Channel
TYP	Typical
TGV	Tongue, Groove & Vee Joint
TV	Terminal Vent
U/S	Underside
UB	Universal Beam
UC	Universal Column
VER	Vertical
W	Watt
WT	Wall Thickness

Drawing Annotation:

Drawing Numbering

A2.05
- A — Discipline (i.e A is for Architect)
- 2 — Series (100, 200, 300 etc)
- 05 — Sheet Number (0-99)

Series Numbering

A0.00	Drawing Schedule, Locality Plan, General Notation
A1.00	Site Drawings
A2.00	Plans
A3.00	Finishes Plans
A4.00	Elevations
A5.00	Cross Sections
A6.00	Enlarged Plans / Room Elevations
A7.00	Door & Window Schedules
A8.00	Construction Details
A9.00	Interior Details

Doors and Windows

Refer to floor plans & door & window schedules for rough opening sizes, finishes, hardware & furniture.

Door Numbers

D0.01
Type A

D = Door
0 = Level 0
01 = Door Number 1

Type A = Door Type - refer Schedule

Window Numbers

W1.05
Type B

W = Window
1 = Level 1
05 = Window Number 5

Type B = Window Type - refer Schedule

Space Numbering

1.03
Kitchen

1 = Level Number
03 = Space Number
Kitchen = Space Name

Wall Finishes Type Keys

WF1

WF1 = Wall Finish Type Tag
Refer to Legend

Floor Finishes Type Keys

FF1

FF1 = Floor Finish Type Tag
Refer to Legend

Ceiling Finishes Type Keys

CF1
2500

CF1 = Ceiling Finish Type Tag
2500 = Height above RL
Refer to Legend

Reference Symbols:

A
A5.00

A
Letter for Section or Detail Reference

A5.00
Drawing Sheet Reference the section or Detail is on

3
A8.00

3
Number of Detail Reference

A8.00
Drawing Sheet Reference the Detail called out is on

1
A4.00

1
Number for Elevation Reference

A4.00
Drawing Sheet Reference the Elevation is on

Expression of Levels:

RL 2500	Reduced Levels shown on sections, elevations & details
RL 2500	Levels shown in plan
FFL 2500	Finished floor level For areas with carpet, vinyl, tiles fixed directly to substrate and paint finishes
SL 2500	Substrate level For concrete work, SL represents Top of Slab. Refer to details for screed levels
FCL 2500	Finished Ceiling level For areas with solid lined ceilings, suspended tile ceilings etc.

North Arrows:

True north

N
Project north

True North
The actual Real World Orientation of where North lies

Project North
North for this particular project rotated off True North axis to allow drawings to be drawn at right angles to the page

Keynote Tags:

1.1ABC

1.1 = CBI Classification
ABC = Element Abbreviation
Refer to Keynote Legend

Project Specific Legend:

Keynote Legend (All)

Key Value	Keynote Text

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Project:
Chartwell Fire Station - Waikato Volunteer Operational Support Building

Client:
FIRE EMERGENCY NEW ZEALAND
Fire and Emergency NZ

Drawing Title:
Standard Notation & Keynotes

CAD File: Autodesk Docs://C895 Chartwell Fire Station/C895 Chartwell Fire Station 1.rvt

REV.	DATE	REVISION DETAILS
1	26.05.22	Building Consent / Tender Issue

Scale: 1 : 50 @ A3
Date: 06/09/15
Drawn: FC
Designed: DLA
Checked: KC
Job No: M806
Drawing No: A0.10
Revision No: 1

2 Existing Site Plan

A4.00

1 : 500

Project north

True north

Site Notes:

This drawing shall be read in conjunction with all other drawings & specifications.

All work shall be strictly in accordance with the New Zealand Building Code, Local Territorial Authority Requirements, OSH Requirements & Regulations, and any other Statutory Requirements that may be applicable to this project.

All work shall be of best trade practice.

Supply & install all materials, fixtures, fittings, & surface finishes strictly in accordance with the manufacturers specifications and recommendations.

Do not scale from this drawing. Use only figured dimensions. The Contractor shall verify all dimensions on site, and report any discrepancies to the Architect before commencing work.

Contractor to confirm location of power, water supply etc on site before commencing work.

Make good to any damage to existing property and site features arising from construction activities or failure to protect. Reinstate and make good demolition damage to adjoining properties, existing work, services, or property.

Carefully dismantle and store safely all salvage items where directed; for removal, use on the site, or until completion of the works.

Site Information:

Address:	70 Crosby Road, Chartwell, Hamilton
Lot:	Lot 1
DP number:	DPS 57445
Exposure Zone:	Zone B
Earthquake Zone:	Zone 1
Wind Zone:	**HIGH**

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Project: Chartwell Fire Station - Waikato Volunteer Operational Support Building

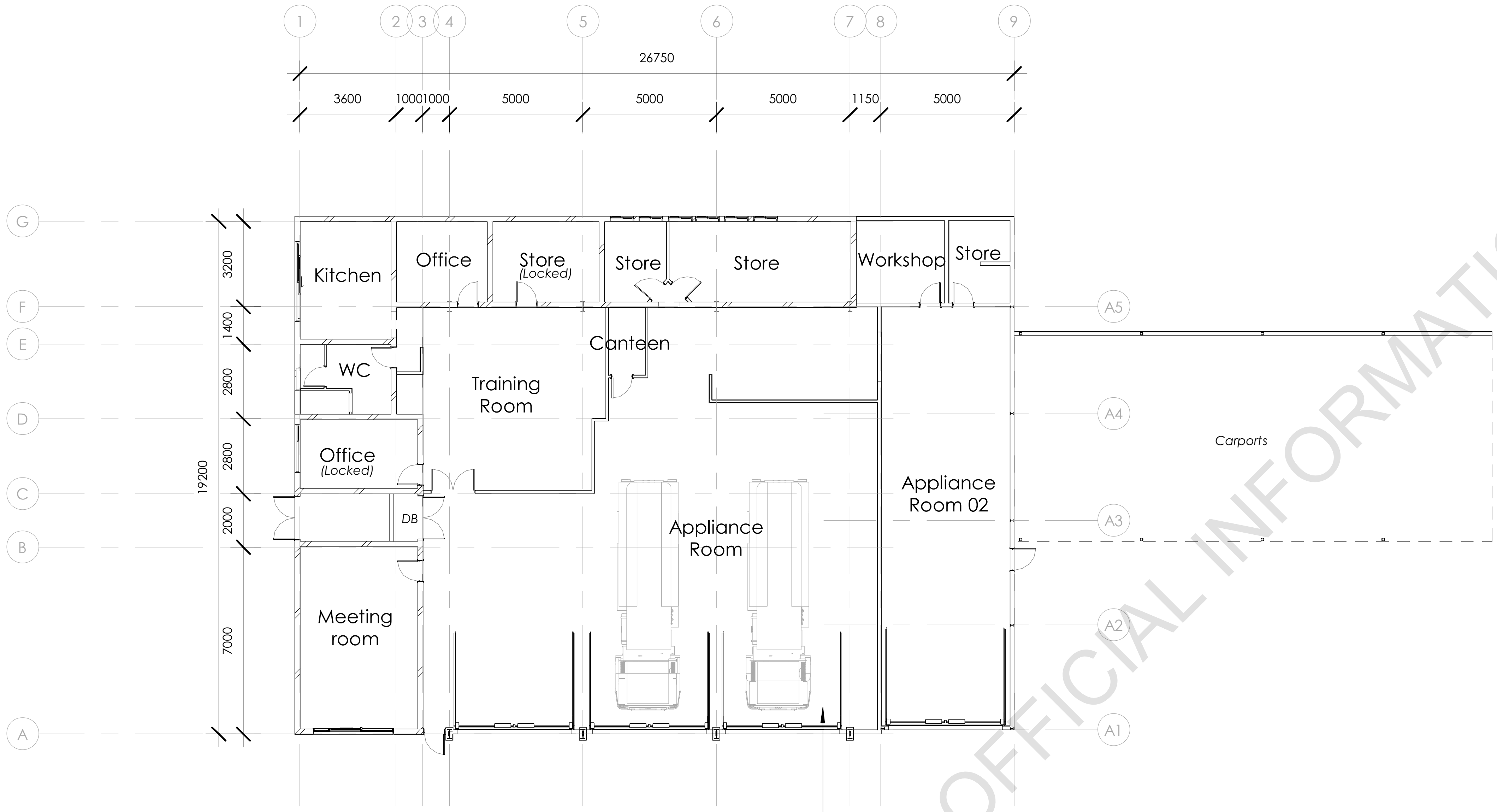
Client: Fire and Emergency NZ

Drawing Title: Location and Site Plan

CAD File: Autodesk Docs://C895 Chartwell Fire Station/C895 Chartwell Fire Station 1.rvt

REV.	DATE	REVISION DETAILS
1	26.05.22	Building Consent / Tender Issue

Scale:	Date:	Drawn:
As indicated @ A3	04/20/17	FC
	Designed: DLA	Checked: KC
Job No: M806	Drawing No: A1.00	Revision No: 1



Install a Type 3 automatic fire alarm and emergency lighting system throughout the Waikato Volunteer Operational Support building

1 | A4.00

Existing Floor Plan

1 : 200

Demolition Notes:

Protect existing services and parts of service systems that are to remain in place during the execution of the works. Provide temporary caps or covers to prevent the ingress of dust and other contaminants into the systems, ducts, pipes etc.

Make good all damage to existing roads, footpaths, grounds or other services, caused in carrying out the contract works.

Protect retained parts of existing buildings, the site and site structures, trees and shrubs. Take care in the cutting away and stripping out to reduce the amount of making good.

Support and brace the existing structure during the cutting of new openings or the replacement of structural parts. Prevent debris from overloading any part of the structure. Do not remove supports until the new work is strong enough to support the existing structure. Ensure all work remains structurally stable and sound.

Make good all existing and new surfaces affected by the demolition and new work.

Reinstate and make good demolition damage to adjoining properties, existing work, services, or property.

Demolition Plan shall be read in conjunction with Altered Floor Plan.

Contractor to disconnect and remove all redundant services (electrical / plumbing etc) as required.

Existing Floor Area 514m2

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Project:
Chartwell Fire Station - Waikato Volunteer Operational Support Building

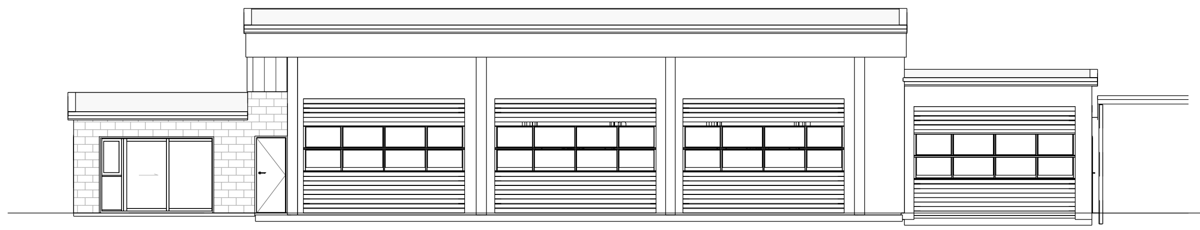
Client:
FIRE EMERGENCY NEW ZEALAND
Fire and Emergency NZ

Drawing Title:
Existing Floor Plan

CAD File: Autodesk Docs://C895 Chartwell Fire Station/C895 Chartwell Fire Station 1.rvt

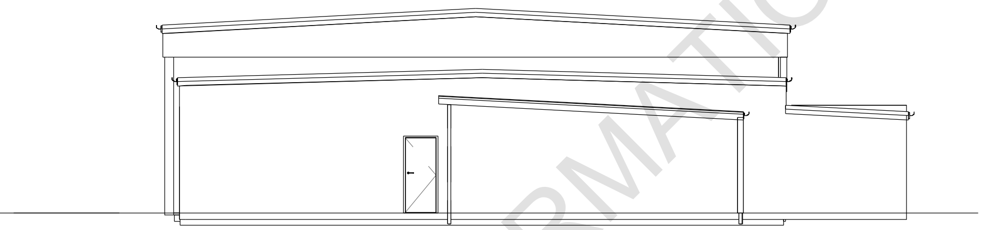
REV.	DATE	REVISION DETAILS
1	26.05.22	Building Consent / Tender Issue

Scale:	Date:	Drawn:
As indicated @ A3	09/03/17	FC
	Designed: DLA	Checked: KC
Job No: M806	Drawing No: A2.00	Revision No: 1



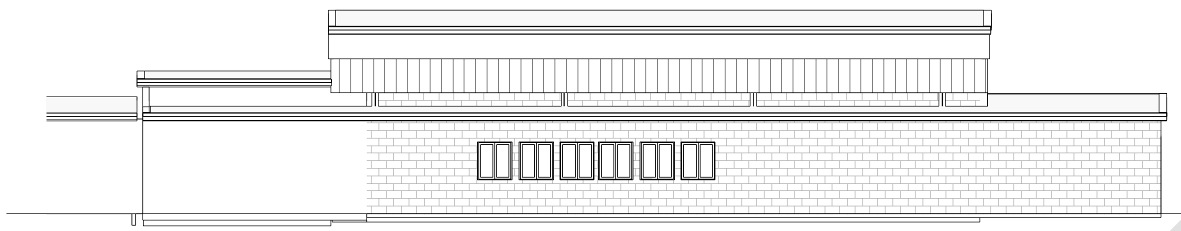
1 External Elevation - Front

1 : 200



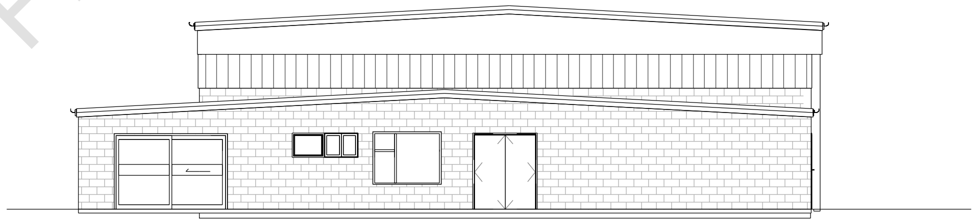
2 External Elevation - Side 1

1 : 200



4 External Elevation- Back

1 : 200



3 External Elevation - Side 2

1 : 200

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Project:

Chartwell Fire Station - Waikato Volunteer Operational Support Building

Client:

FIRE EMERGENCY NEW ZEALAND

Fire and Emergency NZ

Drawing Title:

Existing External Elevations

CAD File: Autodesk Docs://C895 Chartwell Fire Station/C895 Chartwell Fire Station 1.rvt

REV.	DATE	REVISION DETAILS
1	26.05.22	Building Consent / Tender Issue

Scale: 1 : 200 @ A3

Date: 09/03/17

Drawn: FC

Designed: DLA

Checked: KC

Job No: M806

Drawing No: A4.00

Revision No: 1

Hamilton Volunteers Supporting Docs

Out of scope

[redacted]

The photos below shows the cladding to be replaced, indicated by the red arrows, and the lower roof proposed for replacement and re-pitching, indicated by the green arrow.

The photos below show examples of the existing roof framing in the areas proposed to be raised and re-pitched. These roofs are lightweight timber structures bolted between the block walls. The proposed solution will follow a similar construction method but at a higher level, with an increased pitch, and the roof structure extended over the external block walls to eliminated water ingress when gutters overflow.

Medium Business Case

Hamilton Volunteers Upgrade Project

Executive Summary

Out of scope

[redacted]

With the building now approaching 50 years old, several components have reached end of life and require remediation. There are multiple weathertightness issues affecting sections of the roof and exterior cladding. The lower roof areas require full replacement due to poor condition and inadequate falls. Ceiling heights in these areas are also below the minimum requirements of the New Zealand Building Code, at only 2.3m.

The building has additionally been assessed as earthquake prone, with a seismic rating of 15% NBS (IL4). While proposed legislative changes may mean the building is no longer technically classified as earthquake prone, the underlying structural deficiencies would remain and continue to affect resilience. Many of these structural issues are interconnected with other required works such as roof remediation and appliance bay structure, making an integrated approach both practical and cost-effective.

After evaluating options, the preferred approach is to undertake a single upgrade project addressing weathertightness, structural strengthening, and improved ablutions. The project will deliver:

- Roofing and exterior upgrades to ensure weathertightness and long-term asset performance.
- Structural strengthening to improve building resilience.
- Refurbished, inclusive ablutions that meet gender-neutral requirements, support transitional zoning, and accommodate increased brigade membership.

The preferred option—**Option 3: Integrated Upgrade Project**—has a total estimated cost of **$967,000**.

A full open-market procurement process will be undertaken via GETS to ensure transparency, competition, and value for investment.

This project is essential to future-proofing the Hamilton Volunteer Fire Brigade's facility, safeguarding personnel, and supporting the brigade's ability to deliver high-quality emergency response services into the future.

The Strategic Case – The Case for Change

Background and Context

The Hamilton Volunteer Fire Brigade is located within the Chartwell Composite Fire Station in Hamilton. While operating from the same site as career staff, the volunteers occupy a separate building – an arrangement that is uncommon among composite stations.

The volunteer facility was originally constructed in 1978 for appliance servicing and was repurposed as a fire station in 2002, at which point the brigade began operating from the building.

While it has served as a functional base for the past 23 years, the facility is no longer suited to the brigade's growing operational needs. What began as a small operational support unit has evolved into a multi-discipline brigade providing both urban and rural firefighting services.

Out of scope

[redacted]

The Case for Change

Current Situation and Challenges

The existing station is no longer fit-for-purpose and is increasingly unable to support safe, effective, and sustainable operations. Key issues include:

- **Ageing roof and cladding**: Roofing and cladding materials are nearing end of life, resulting in weathertightness failures, water ingress, and progressive asset deterioration.
- **Insufficient post-seismic event resilience**: The building is earthquake prone, and its current structural resilience increases the risk station will remain functional following a major earthquake, undermining emergency response capability.
- **Outdated and non-inclusive facilities**: Ablutions do not support inclusivity or transitional zoning, increasing the risk of carcinogen exposure and creating health and safety concerns.

These deficiencies compromise operational capability, pose risks to personnel, and negatively affect volunteer morale, satisfaction, and retention.

Strategic Drivers/ Reason for the Investment

The investment is driven by the need to:

- Protect the health, safety, and wellbeing of personnel through a safe, compliant, and resilient facility.
- Achieve regulatory compliance including seismic resilience and Building Code requirements.
- Support operational capability and future readiness for a growing and increasingly diverse volunteer brigade.
- Ensure responsible asset stewardship by addressing end-of-life components and preventing further deterioration.
- Provide inclusive, modern facilities that support workforce sustainability and participation.
- Maintain service continuity and community resilience through ensuring the brigade can reliably deliver emergency response services.

Why the Problem Needs to be Solved Now

Timely investment is essential because:

- Health and safety risks are escalating as structural and weathertightness issues worsen.
- Seismic vulnerability creates an operational resilience risk in a post-seismic event if .
- Asset deterioration is increasing the likelihood of more extensive and costly remediation if delayed.
- Operational pressures are growing, with current facilities unable to support brigade size, inclusivity needs, or modern operational requirements.
- Integrated remediation is more cost-effective now, as structural, weathertightness, and functional issues are interconnected.
- Service continuity is at risk if the building becomes partially or fully unusable.

Investment Objectives/ Strategic Fit

The investment objectives are aligned with Fire and Emergency New Zealand's National Strategy:

	Investment Objective	Measure of Success/ Strategic Alignment
IO1	Provide a resilient, functional emergency response facility	Safe, Effective, and Resilient Operations
IO2	Meet minimum statutory and organisational standards	Supporting Our People
IO3	Efficient and sustainable asset management and lifecycle planning	Strong Business Foundations

Existing Arrangements and Business Needs

Current state and existing arrangements	Future State and Business Needs
Lack of seismic resilience	Strengthened structure meeting IL4 standards
Aged roofing and cladding	Weathertight facility
Inadequate ablutions	Inclusive, accessible facilities
Water ingress and damage	Improved drainage and waterproofing
Operational inefficiencies	Fit-for-purpose layout and facilities

Risks, Constraints, and Dependencies

Description	Likelihood (H, M, L)	Consequence (H, M, L)	Mitigation Strategy	Residual (H, M, L)
Cost escalation due to inflation or scope changes	L	M	Sufficient contingency included in project.	M
Contractor availability and capacity	L	M	Pre-qualification and open tender process via GETS.	L
Health and safety incidents during project	M	M	Adherence to H&S policies, SSSPs, and regular audits.	L
Operational disruption during project	M	H	Detailed coordination with brigade and work scheduling.	M
Regulatory delays (e.g., consents, approvals)	L	M	Early engagement with regulatory bodies and compliance reviews.	L

The Economic Case – Options to Address the Problem

Options Considered

The following options were identified and developed to address the identified problems:

Option	Description
Option 1: Do Nothing (Status Quo)	No change to current situation – all issues remain unresolved, including weathertightness failures, post-seismic resilience limitations, and non-inclusive facilities.
Option 2: Minimum Compliance Upgrade	Address only the most critical compliance issues, such as structural strengthening for post-seismic event resilience and essential weathertightness repairs. No improvements to functionality, inclusivity, or internal layouts will be made however.
Option 3: Integrated Upgrade (Preferred)	Undertake structural strengthening and full weathertightness remediation, plus targeted internal upgrades to improve ablutions, hygiene zoning, and basic functionality.

Assessment of Options

Investment Objectives and Critical Success Factors

Each option was assessed against the following criteria:

- Investment Objectives (as set out in the Strategic Case), and
- The Better Business Case Critical Success Factors.

The Critical Success factors are:

Critical Success Factors	Broad Description of critical success factors
Strategic fit and business needs	How well the option meets the agreed investment objectives, related business needs and service requirements, and integrates with other strategies, programmes, and projects.
Potential value for money	How well the option optimises value for money i.e., striking a balance between the benefits, costs, and risks.
Supplier capacity and capability	How well the option matches the ability of potential suppliers to deliver the required services and is likely to result in a sustainable arrangement that optimises value for money.
Potential affordability	How well the option can be met from available funding and matches other funding constraints.
Potential achievability	How well the option is likely to be delivered given the organisation's ability to respond to the changes required and match the level of available skills required for successful delivery.

Summary of Assessment

	Option 1: Do Nothing	Option 2: Minimum Compliance Upgrade	Option 3: Integrated Upgrade (Preferred)
Investment Objectives			
Provide a resilient, functional emergency response facility	**No**	**Partial**	**Yes**
Meet minimum statutory and organisational standards	**No**	**Partial**	**Yes**
Efficient and sustainable asset management/ lifecycle planning	**No**	**Partial**	**Yes**
Critical Success Factors			
Strategic fit and business needs	**No**	**Partial**	**Yes**
Potential value for money	**No**	**Partial**	**Yes**
Supplier capacity and capability	**Yes**	**Yes**	**Yes**
Potential affordability	**Yes**	**Yes**	**Yes**
Potential achievability	**Yes**	**Yes**	**Yes**

Out of scope

[redacted]

The facility is approaching 50 years of age, so a 25-year whole-of-life assessment has been applied on the basis that the building will be nearing the end of its useful life at that point and further decisions about replacement will be required. No net present value for refurbishment has been included in the whole-of-life cost calculations for this reason. Maintenance and operating cost inflation has been assumed at 3%, and a discount rate of 4% has been applied to the whole-of-life cost assessment.

Preferred Option Justification and Comparative Analysis

Preferred Option: Option 3 – Integrated Upgrade

Option 3: the Integrated Upgrade is the preferred option because it provides the most comprehensive, sustainable, and strategically aligned solution to the challenges facing the Hamilton Volunteer Fire Brigade station. Unlike the other options considered, this option addresses all critical deficiencies in a coordinated way, ensuring the facility is safe, resilient, and fit-for-purpose for current and future operational needs.

The Integrated Upgrade delivers full structural strengthening, ensuring the station can remain functional following a major seismic event and continue to support emergency response when the community is most vulnerable. It also includes complete weathertightness remediation, preventing further deterioration of the building fabric and protecting the asset from ongoing water ingress and damage.

In addition, this option provides modern, inclusive ablutions and improved internal layouts, supporting transitional zoning, reducing carcinogen exposure risks, and meeting the expectations of a contemporary volunteer workforce. These improvements directly enhance firefighter wellbeing, operational flow, and the brigade’s ability to attract and retain volunteers.

Option 3 is the only option that fully aligns with the investment objectives by improving resilience, meeting statutory and organisational standards, and supporting long-term operational effectiveness. While it requires a higher upfront investment than partial upgrades, it offers the strongest whole-of-life value by avoiding repeated disruption, reducing future maintenance costs, and ensuring the station remains functional and compliant for decades to come.

For these reasons, the Integrated Upgrade represents the most prudent, future-focused, and strategically sound investment.

[redacted]

Out of scope