

CONSTRUCTION METHODOGY FEASIBILTY REPORT

FOR



PROPOSED SEISMIC RETROFIT



ROTORUA museum

Te Whare Taonga o Te Arawa ART | CULTURE | HERITAGE

OUR REF: J000949

SEPTEMBER 2019

PROJECT DETAILS

CLIENT:	ROTORUA LAKES COUNCIL
SITE LOCATION:	GOVERNMENT GARDENS ORUWHATA DRIVE ROTORUA 3046
DESCRIPTION:	SEISMIC STRENGTHENING OF ROTORUA MUSEUM BUILDING
PROJECT NUMBER:	J000949

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SUMMARY REPORT OBJECTIVES

The Construction Methodology Feasibility Report (CMFR) is a detailed document defining a set of construction method statements to be used during the construction of seismic retrofit structure. It summarizes the specific site construction conditions and limitations to be used in the construction phase of the project. The CMFR also outlines the bases of proposed construction techniques that may be applied to construction process and reflects on the safety and practicality of proposed structural design. The CMRF is issued for information to assist all stakeholders in the construction process.

At the development design stage, the CMFR includes structural element descriptions and sample methodologies to construct the design structural members and assemblies and install within the existing structure. In accordance with Construction Industry standards, the developed design drawing set includes sample diagrams and model structural details to demonstrate the proposed construction operations and their sequence. During subsequent Detailed Design stage, the CMFR will be expanded to include increasing the level of detail and adapted to suit successful Contractor's operations.

1. PROJECT INFORMATION

a. SCOPE

The scope of the construction project is in accordance with the Architectural Developed Design drawing set prepared by DPA Architects Ltd.

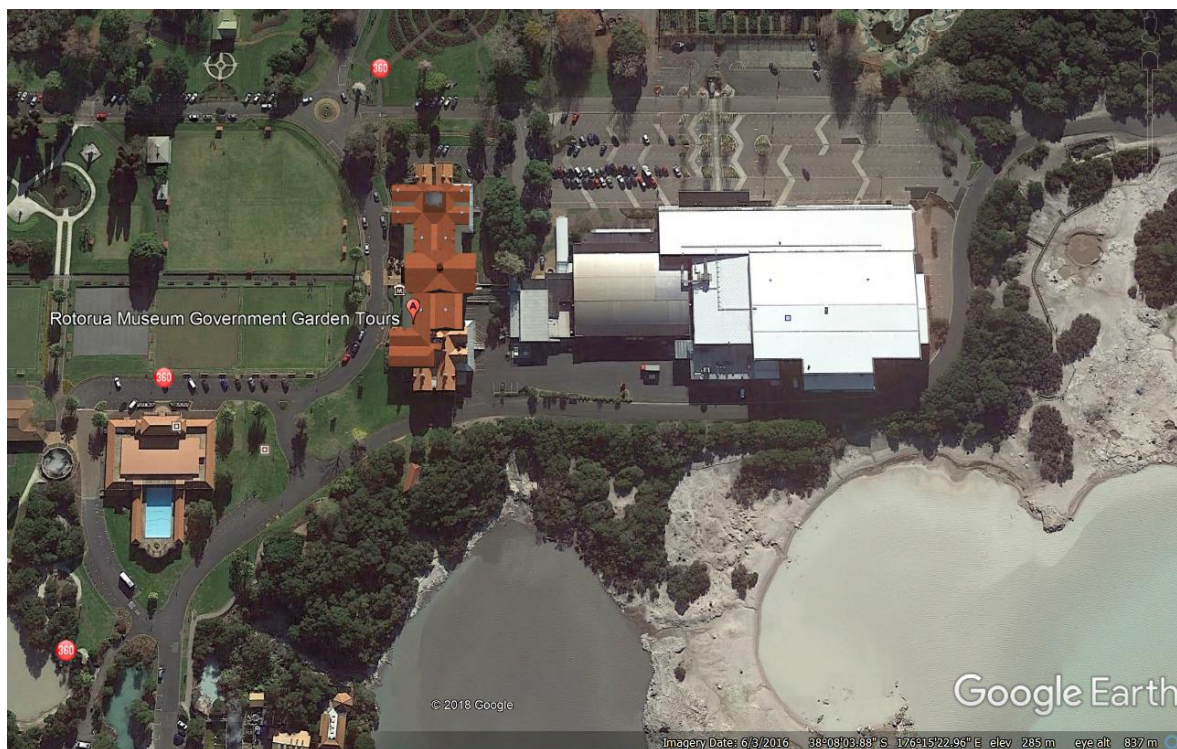
In general, the scope of work is:

- Developed structural Design and Documentation for seismic strengthening of Museum Building in accordance with New Zealand Building Code and Heritage New Zealand Recommendations

b. PROJECT LOCATION

The project site location is Rotorua Museum. The current legal description is Lot 2 SECT 2Blk I Tarawera SD Latitude 38 degrees 8'8"S, Longitude 176 degrees 15'32"E.

Figure 1 - Aerial Photo of Site Location



c. DESIGN LIFE

The standard building structure is designed for a minimum design life of 50 years as recommended by the New Zealand Building Code.

d. IMPORTANCE LEVEL

The proposed structure has been designed as an Importance level 3 (IL3) structure in accordance with NZS1170.0:2002 A2. IL3 refers to "Structures that as a whole may contain people in crowds or contents of high value to the community or pose risks to people in crowds".

2. CONSTRUCTION METHODOLOGY - DETAILED DESCRIPTION

Structural components of Seismic Strengthening Structure are described in detail below:

a. NEW SOUTH WING

Table 2.1 – New South Wing – Method Statement

New South Wing	
Building Element	Description
Strengthening Structural Members	Strengthening system is limited to replacement of the brittle links within the cross-brace assemblies – ground floor and first floor. The bracing structure becomes ductile and with increase resilience. Achieved Seismic Rating – 100% NBS.
Method Statement	Replace Brittle X-Brace Components Construction process should include the following steps: - Develop Health and Safety Plan. - Gradually expose X-bracing elements in sequence approved by the Engineer. - Validate the length of the pre-manufactured X-brace components. - Remove existing bracing rod assemblies. - Replace with new X-brace components. - Restore non-structural elements of the building fabric to architectural detail.
Existing Foundation System	Reinforced concrete strip and pad footings. There are no works proposed at this level.
Strengthened Foundation System	There are no alterations to existing system.

b. **INTERMEDIATE SOUTH WING (TARAWERA GALLERY)**

Table 2.2 – Intermediate South Wing – Method Statement

Intermediate South Wing (Tarawera Gallery)	
Building Element	Description
Strengthening Structural Members	Strengthened Tarawera Gallery structure is designed to act as integral part with the Atrium and Intermediate North Wing and Bath House. Strengthening system has the following components: - Replacement of the brittle links within the cross-brace assemblies – ground floor. The replacement bars are of larger diameter and increased load capacity. The bracing structure becomes ductile and with increase resilience. - Introduce second horizontal steel truss at ceiling level. The roof now acts as flexible diaphragm covering the entire area of this zone. - Introduce two concentrically braces vertical frames supporting common with Atrium transverse concrete wall. - Introduce closely spaced cantilever counterforces partially embedded in the common with atrium transverse concrete wall. These project to basement level. - Achieved Seismic Rating – 80% NBS.
Method Statement	Method Statements are grouped by the bracing element types: Replace Brittle X-Brace Components Construction process should include the following steps: - Develop Health and Safety Plan. - Gradually expose X-bracing elements in sequence approved by the Engineer. - Validate the length of the pre-manufactured X-brace components. - Remove existing bracing rod assemblies. - Replace with new X-brace components. - Restore non-structural elements of the building fabric to architectural detail. Horizontal Steel Truss at Ceiling Level Construction process should include the following steps: - Develop Health and Safety Plan. - Provide Safe Access to ceiling level. - Carefully expose existing steel roof framing as required.

- Validate the length of the pre-manufactured truss components.
- Install new components.
- Restore non-structural elements of the building fabric to architectural detail.

New vertical CBFs supporting common Atrium Wall.

Construction Process should include the following steps:

- Develop Health and Safety Plan.
- Expose contact area with existing Atrium wall.
- Provide safe access to wall face above and below ground floor. Cut out access hatch is required on the south wall.
- Measure and complete cut-outs in existing concrete floor wall and column as necessary. Use light mechanical tools with dust extractors.
- Manufacture CBF in two component types: Type 1-vertical chords with shorth outrigger and Type 2- linear diagonal and horizontal members. Limit the length and weights of the assemblies to 300kg and 3m in length.
- Start incremental CBF construction with installation at basement level first (see foundation preparation below).
- Assemble CBF in full width sections including Type 1 and Type 2 elements. Vertical chords to project above GF finished floor level.
- Connect first (base) section to foundations and concrete wall.
- Assemble second (ground floor to Mezzanine) section above concrete floor.
- Position and connect to base section and concrete wall.
- Assemble third section (Mezzanine to roof).
- Provide safe access to required height.
- Carefully position and connect to second section, mezzanine horizontal diaphragm, roof and concrete wall.
- Connect to base section and concrete wall and existing framing.
- Assemble third section (to roof).
- Provide safe access to required height.
- Carefully position mark required cutouts in the existing timber framing and prepare to receive frame.
- Connect to second section, roof and concrete wall.
- Assemble top bridging section (above Mezzanine windows).
- Provide safe access to required height.
- Position frame, mark required cut outs and prepare to receive frame.
- Carefully position and connect to third sections (north and south), roof and concrete wall.
- Restore non-structural elements of the building fabric to architectural detail.

	Cantilever Counterforces to Atrium Wall Construction process should include the following steps: - Develop Health and Safety Plan. - Provide Safe Access to ceiling level. - Carefully expose Atrium Concrete wall. - Cut out ground floor slab at required locations. - Validate the length of the pre-manufactured UC sections. - Install new counterforces in 3 stages (placing the elements from top) top starting with the base sections. - Restore concrete floor. - Restore non-structural elements of the building fabric to architectural detail.
Strengthened Foundation System	New concrete pads are introduced under the CBF vertical columns. Shallow ground beams integrally connect the new pads with existing perimeter and transverse concrete walls.
Method Statement	New vertical Concrete Pads and Shallow Ground Beams Construction Process should include the following steps: - Develop Health and Safety Plan. Particular attention to be paid to potential release of Sulphur gasses. - Excavate new RC pads, strip footing along Atrium wall and ground beams. - Pour new foundation elements and prepare to receive vertical CBF base section and counterforces base elements. - Top up with concrete to conceal to base connection of the steel chords. - Place nominal soil layer to cover new structural elements in the exhibition areas.
Adjacent Buildings	New South Wing is to the south of Tarawera Gallery. South transverse concrete wall is braced on Tarawera Gallery side. Atrium is to the north. The common transverse wall is braced on both sides.

c. **CENTRAL ATRIUM SECTION**

Table 2.3 – Central Atrium Area – Method Statement

Central Atrium Section	
Building Element	Description
Strengthening Structural Members	Strengthened Atrium structure is designed to act as an integral part with the Tarawera Gallery and Bath House. Strengthening system has the following components: - Introduce two vertical concentrically braced frames (CBF) embedded within perimeter walls to west and east side. These project to the basement level and re chased in the existing concrete perimeter walls. - Introduce two concentrically braces vertical frames supporting common with Tarawera Gallery and Intermediate North Wing concrete walls – one to each side. - Strengthen two existing concrete walls in north-south direction by FRP wrap. - Introduce embedded within the Mezzanine floor steel horizontal steel frame with x-braces. - Reinforce existing ground concrete floor with FRP wrap to top and soffit. - Achieved Seismic Rating – 80% NBS.
Method Statement	Method Statements are grouped by the bracing element types: New vertical CBFs supporting common Tarawera Gallery and Intermediate North Wing Walls. These are located immediately next to existing concrete walls on the west side. Construction Process should include the following steps: - Develop Health and Safety Plan. - Expose contact area with existing Tarawera Gallery and Intermediate North Wing walls. - Provide safe access to wall face above and below ground floor. Cut out access hatch is required on the south wall. - Measure and complete cut-outs in existing concrete floor wall and column as necessary. Use light mechanical tools with dust extractors. - Manufacture CBF in two component types: Type 1-vertical chords with shorth outrigger and Type 2- linear diagonal and horizontal members. Limit the length and weights of the assemblies to 300kg and 3m in length. - Start incremental CBF construction with installation at basement level first (see foundation preparation below).

- Assemble CBF in full width sections including Type 1 and Type 2 elements. Vertical chords to project above GF finished floor level.
- Connect first (base) section to foundations and concrete wall.
- Assemble second (ground floor to Mezzanine) section above concrete floor.
- Position and connect to base section and concrete wall.
- Assemble third section (Mezzanine to roof).
- Provide safe access to required height.
- Carefully position and connect to second section, mezzanine horizontal diaphragm, roof and concrete wall.

New vertical CBFs embedded in the east and west perimeter walls.

Construction Process should include the following steps:

- Develop Health and Safety Plan.
- Expose perimeter wall framing, contact area with existing nib concrete walls.
- Provide safe access to wall face above and below ground floor.
- Measure and complete cut-outs in existing concrete floor and wall as necessary. Use light mechanical tools with dust extractors.
- Manufacture CBF in two component types: Type 1-vertical chords with shorth outrigger and Type 2-linear diagonal and horizontal members. Limit the length and weights of the assemblies to 300kg and 3m in length.
- Start incremental CBF construction with installation at basement level first (see foundation preparation below).
- Assemble CBF in full width sections including Type 1 and Type 2 elements. Vertical SHS chords to project above GF finished floor level.
- Connect first (base) section to foundations, basement concrete wall and nib wall.
- Assemble second (ground floor) section above ground concrete floor.
- Position, mark required cutouts in the existing timber framing and prepare to receive frame.
- Connect to base section and concrete wall and existing framing.
- Assemble third section (to roof).
- Provide safe access to required height.
- Carefully position mark required cutouts in the existing timber framing and prepare to receive frame.
- Connect to second section, roof and concrete wall.
- Assemble top bridging section (above Mezzanine windows).
- Provide safe access to required height.

- Position frame, mark required cut outs and prepare to receive frame.
- Carefully position and connect to third sections (north and south), roof and concrete wall.
- Restore non-structural elements of the building fabric to architectural detail.

Horizontal Steel Truss (diaphragm) at Mezzanine Level

Construction process should include the following steps:

- Develop Health and Safety Plan.
- Carefully remove existing tongue and groove floor lining and expose existing timber floor framing.
- Validate the length of the pre-manufactured diaphragm components.
- Carefully measure required cut its and prepare to receive steel assemblies.
- Install new components.
- Connect to vertical bracing elements and concrete walls to north and south ends.
- Restore non-structural elements of the building fabric to architectural detail.

Strengthen Concrete walls with FRP wraps.

Construction process should include the following steps:

- Develop Health and Safety Plan.
- Carefully expose structural concrete to both faces of the concrete walls and concrete floor at the base of walls.
- Apply FRP wrap to Manufacturer's specifications to either face of the walls.
- Restore non-structural elements of the building fabric to architectural detail.

Strengthen Ground Floor Concrete Slab with FRP wraps.

Floor strengthening to be carried out after the other components of seismic strengthening are completed. Construction process should include the following steps:

- Develop Health and Safety Plan.
- Carefully expose structural concrete to both faces of the concrete floor.
- Apply FRP wrap to Manufacturer's specifications to top and bottom face. Overlap with wall FRP sheets.
- Restore non-structural elements of the building fabric to architectural detail.

Strengthened Foundation System	New concrete pads are introduced under the CBF vertical columns. Complete slab overlay is to cover the basement area.
Method Statement	New vertical Concrete Pads and Shallow Ground Beams Construction Process should include the following steps: - Develop Health and Safety Plan. Particular attention to be paid to potential release of Sulphur gasses. - Excavate new RC pads and ground beams. - Pour new foundation elements and prepare to receive vertical CBF base section. - Upon completion of the bracing lay concrete mat overlay. - Place nominal soil layer to cover new structural elements in the exhibition areas.
Adjacent Buildings	Tarawera Gallery is to the south of Atrium. South transverse concrete wall is braced on both sides. Intermediate North Wing is to the north. The common transverse wall is braced on both sides.

d. **INTERMEDIATE NORTH WING**

Table 2.4 – Method Statement

Intermediate North Wing	
Building Element	Description
Strengthening Structural Members	This area is subjected to significant alterations. Strengthened Intermediate North Wing structure is designed to act as integral part with the Atrium and Tarawera Gallery. Strengthening system has the following components: - Introduce two vertical concentrically braced frames (CBF) embedded within perimeter walls to west and east side. These project to the basement level and re chased in the existing concrete perimeter walls. - Introduce two concentrically braces vertical frames supporting common with Atrium transverse concrete wall. - Introduce closely spaced cantilever counterforces partially embedded in the common with atrium and north wing transverse concrete wall. These project to basement level. - Introduce two new steel portal frames to provide lateral support for the mezzanine over Caffé area. - Strengthen the floor diaphragm in the office with plywood overlay. - Apply Shotcrete overlay to Ground Floor concrete slab soffit. - Achieved Seismic Rating – 80% NBS.
Method Statement	Method Statements are grouped by the bracing element types: New vertical CBFs supporting common Atrium and Bath House Walls. These are located immediately next to existing concrete walls. Construction Process should include the following steps: - Develop Health and Safety Plan. - Expose contact area with existing Atrium and Bath House Wing walls. - Provide safe access to wall face above and below ground floor. Cut out access hatch is required on the south wall. - Measure and complete cut-outs in existing concrete floor wall and column as necessary. Use light mechanical tools with dust extractors. - Manufacture CBF in two component types: Type 1-vertical chords with shorth outrigger and Type 2- linear diagonal and

horizontal members. Limit the length and weights of the assemblies to 300kg and 3m in length.

- Start incremental CBF construction with installation at basement level first (see foundation preparation below).
- Assemble CBF in full width sections including Type 1 and Type 2 elements. Vertical chords to project above GF finished floor level.
- Connect first (base) section to foundations and concrete wall.
- Assemble second (ground floor to Mezzanine) section above concrete floor.
- Position and connect to base section and concrete wall.
- Assemble third section (Mezzanine to roof).
- Provide safe access to required height.
- Carefully position and connect to second section, mezzanine horizontal diaphragm, roof and concrete wall.

New vertical CBFs embedded in the east and west perimeter walls.

Construction Process should include the following steps:

- Develop Health and Safety Plan.
- Expose perimeter wall framing, contact area with existing nib concrete walls.
- Provide safe access to wall face above and below ground floor.
- Measure and complete cut-outs in existing concrete floor and wall as necessary. Use light mechanical tools with dust extractors.
- Manufacture CBF in two component types: Type 1-vertical chords with shorth outrigger and Type 2-linear diagonal and horizontal members. Limit the length and weights of the assemblies to 300kg and 3m in length.
- Start incremental CBF construction with installation at basement level first (see foundation preparation below).
- Assemble CBF in full width sections including Type 1 and Type 2 elements. Vertical SHS chords to project above GF finished floor level.
- Connect first (base) section to foundations, basement concrete wall and nib wall.
- Assemble second (ground floor) section above ground concrete floor.
- Position, mark required cutouts in the existing timber framing and prepare to receive frame.
- Connect to base section and concrete wall and existing framing.
- Assemble third section (to roof).
- Provide safe access to required height.

- Carefully position mark required cutouts in the existing timber framing and prepare to receive frame.
- Connect to second section, roof and concrete wall.
- Assemble top bridging section (above Mezzanine windows).
- Provide safe access to required height.
- Position frame, mark required cut outs and prepare to receive frame.
- Carefully position and connect to third sections (north and south), roof and concrete wall.
- Restore non-structural elements of the building fabric to architectural detail.

Portal Frames to support Café Mezzanine platform.

Construction process should include the following steps:

- Develop Health and Safety Plan.
- Provide safe access to Mezzanine Level.
- Carefully expose floor at requires locations. Provide cut outs as required.
- Install portal legs starting with the base section.
- Connect upper portal sections.
- Restore concrete floor.
- Build timber framed mezzanine platform and connect to the wall bracing elements.
- Restore non-structural elements of the building fabric to architectural detail.

Strengthening Existing Timber Floor (Diaphragm) in the office Area at Mezzanine Level

Construction process should include the following steps:

- Develop Health and Safety Plan.
- Carefully remove floor lining and expose existing timber floor framing.
- Apply structural plywood overlay.
- Connect to vertical bracing elements and concrete walls to south end.
- Restore non-structural elements of the building fabric to architectural detail.

Strengthen Ground Floor Concrete Slab with Shotcrete Overlay.

Floor strengthening to be carried out after the other components of seismic strengthening are completed. Construction process should include the following steps:

- Develop Health and Safety Plan. Particular attention to be paid to potential release of Sulphur gasses.
- Carefully clean structural concrete soffit.

	- Apply Shotcrete Overlay. - Restore ground surface in the display areas as per foundation work description.
Strengthened Foundation System	New concrete pads are introduced under the CBF vertical columns. Shallow ground beams connect new pads with existing perimeter concrete walls.
Method Statement	New vertical Concrete Pads and Shallow Ground Beams Construction Process should include the following steps: - Develop Health and Safety Plan. Particular attention to be paid to potential release of Sulphur gasses. - Excavate new RC pads, strip footing along Atrium wall and ground beams. - Pour new foundation elements and prepare to receive vertical CBF base section and counterforces base elements. - Top up with concrete to conceal to base connection of the steel chords. Place nominal soil layer to cover new structural elements in the exhibition areas.
Adjacent Buildings	Atrium is to the south of Intermediate North Wing. South transverse concrete wall is braced on both sides. North Wing (Bath House) is to the north. The common transverse wall is braced on Intermediate North Wing side.

e. **NORTH WING (BATH HOUSE).**

Table 2.5 – Strengthening Description

NORTH WING (BATH HOUSE)	
Building Element	Description
Strengthening Structural Members	This is a highly sensitive heritage area. Strengthened North Wing structure is designed to act as integral part with the Intermediate North Wing. Strengthening system has the following components: - Introduce two vertical concentrically braced frames (CBF) embedded within perimeter walls to west and east side. These project to the basement level and re-chased in the existing concrete perimeter walls. - Introduce four concentrically braces vertical frames supporting common with New North Wing transverse concrete wall. - Introduce two new concentrically braces vertical frames supporting common with Intermediate North Wing transverse concrete wall. - Introduce horizontal diaphragm (over ceiling line) in the corridor. - Introduce new plant platform to act as effective ceiling diaphragm. - Strengthen ground floor diaphragm with shotcrete overlay to slab soffit. - Achieved Seismic Rating – 80% NBS.
Method Statement	Method Statements are grouped by the bracing element types: New vertical CBFs supporting common Intermediate North Wing and New North Wing Walls. These are located immediately next to existing concrete walls. Construction Process should include the following steps: - Develop Health and Safety Plan. - Expose contact area with existing Atrium and Bath House Wing walls. - Provide safe access to wall face above and below ground floor. Cut out access hatch is required on the south wall. - Measure and complete cut-outs in existing concrete floor wall and column as necessary. Use light mechanical tools with dust extractors. - Manufacture CBF in two component types: Type 1- vertical chords with shorth outrigger and Type 2- linear

diagonal and horizontal members. Limit the length and weights of the assemblies to 300kg and 3m in length.

- Start incremental CBF construction with installation at basement level first (see foundation preparation below).
- Assemble CBF in full width sections including Type 1 and Type 2 elements. Vertical chords to project above GF finished floor level.
- Connect first (base) section to foundations and concrete wall.
- Assemble second (ground floor to Mezzanine) section above concrete floor.
- Position and connect to base section and concrete wall.
- Assemble third section (Mezzanine to roof).
- Provide safe access to required height.
- Carefully position and connect to second section, mezzanine horizontal diaphragm, roof and concrete wall.

New vertical CBFs embedded in the east and west perimeter walls.

Construction Process should include the following steps:

- Develop Health and Safety Plan.
- Expose perimeter wall framing, contact area with existing nib concrete walls.
- Provide safe access to wall face above and below ground floor.
- Measure and complete cut-outs in existing concrete floor and wall as necessary. Use light mechanical tools with dust extractors.
- Manufacture CBF in two component types: Type 1-vertical chords with shorth outrigger and Type 2-linear diagonal and horizontal members. Limit the length and weights of the assemblies to 300kg and 3m in length.
- Start incremental CBF construction with installation at basement level first (see foundation preparation below).
- Assemble CBF in full width sections including Type 1 and Type 2 elements. Vertical SHS chords to project above GF finished floor level.
- Connect first (base) section to foundations, basement concrete wall and nib wall.
- Assemble second (ground floor) section above ground concrete floor.
- Position, mark required cutouts in the existing timber framing and prepare to receive frame.

- Connect to base section and concrete wall and existing framing.
- Assemble third section (to roof).
- Provide safe access to required height.
- Carefully position mark required cutouts in the existing timber framing and prepare to receive frame.
- Connect to second section, roof and concrete wall.
- Assemble top bridging section (above Mezzanine windows).
- Provide safe access to required height.
- Position frame, mark required cut outs and prepare to receive frame.
- Carefully position and connect to third sections (north and south), roof and concrete wall.
- Restore non-structural elements of the building fabric to architectural detail.

Introducing New Ceiling Diaphragm (Horizontal Truss) over corridor.

Construction process should include the following steps:

- Develop Health and Safety Plan.
- Provide Safe Access to ceiling level.
- Carefully expose existing roof framing as required.
- Validate the length of the pre-manufactured truss components.
- Install new components.
- Restore non-structural elements of the building fabric to architectural detail.
-

Introducing New Roof Plant Platform (Horizontal Diaphragm).

Construction process should include the following steps:

- Develop Health and Safety Plan.
- Provide Safe Access to roof level.
- Carefully expose existing roof framing as required.
- Remove redundant timber structural elements as approved by the Engineer.
- Validate the length of the pre-manufactured steel beams and X-brace members.
- Install new components.
- Restore non-structural elements of the building fabric to architectural detail.

	Strengthen Ground Floor Concrete Slab with Shotcrete Overlay. Floor strengthening to be carried out after the other components of seismic strengthening are completed. Construction process should include the following steps: - Develop Health and Safety Plan. Particular attention to be paid to potential release of Sulphur gasses. - Carefully clean structural concrete soffit. - Apply Shotcrete Overlay. Restore ground surface in the display areas as per foundation work description.
Strengthened Foundation System	New concrete pads are introduced under the CBF vertical columns. Shallow ground beams connect new pads with existing perimeter concrete walls.
Method Statement	New vertical Concrete Pads and Shallow Ground Beams Construction Process should include the following steps: - Develop Health and Safety Plan. Particular attention to be paid to potential release of Sulphur gasses. - Excavate new RC pads, strip footing along Atrium wall and ground beams. - Pour new foundation elements and prepare to receive vertical CBF base section and counterforces base elements. - Top up with concrete to conceal to base connection of the steel chords. Place nominal soil layer to cover new structural elements in the exhibition areas.
Adjacent Buildings	Intermediate North Wing is to the south of New North Wing. South transverse concrete wall is braced on both sides. New North Wing is to the north. The common transverse wall is braced on south side.

f. **NEW NORTH WING.**

Table 2.6– Method Statement

NEW NORTH WING	
Building Element	Description
Strengthening Structural Members	Strengthening system has the following components: - Upgrade existing steel framing by introducing x-braces between the steel columns. - Introduce closely spaced cantilever counterforces partially embedded in the common with north wing transverse concrete wall. These project to basement level. - Achieved Seismic Rating – 100% NBS.
Method Statement	Method Statements are grouped by the bracing element types: Introduce New X-Brace Components Construction process should include the following steps: - Develop Health and Safety Plan. - Gradually expose cantilever columns in sequence approved by the Engineer. - Validate the length of the pre-manufactured X-brace components. - Install new X-brace components. - Restore non-structural elements of the building fabric to architectural detail. Cantilever Counterforces to Bath House Wall Construction process should include the following steps: - Develop Health and Safety Plan. - Provide Safe Access to ceiling level. - Carefully expose Atrium Concrete wall. - Cut out ground floor slab at required locations. - Validate the length of the pre-manufactured UC sections. - Install new counterforces in 3 stages (placing the elements from top) top starting with the base sections. - Restore concrete floor. - Restore non-structural elements of the building fabric to architectural detail.

Strengthened Foundation System	Reinforced Concrete Foundation footings. No strengthening works in the basement.
Adjacent Buildings	North Wing is to the north of Bath House. South transverse concrete wall is braced on both sides.

APPENDIX 1

STRUCTURAL ENGINEERING DRAWINGS – DEVELOPED DESIGN