

ROTORUA MUSEUM SEISMIC STRENGTHENING & REFURBISHMENT CONCEPT DESIGN REPORT

MAY 2018



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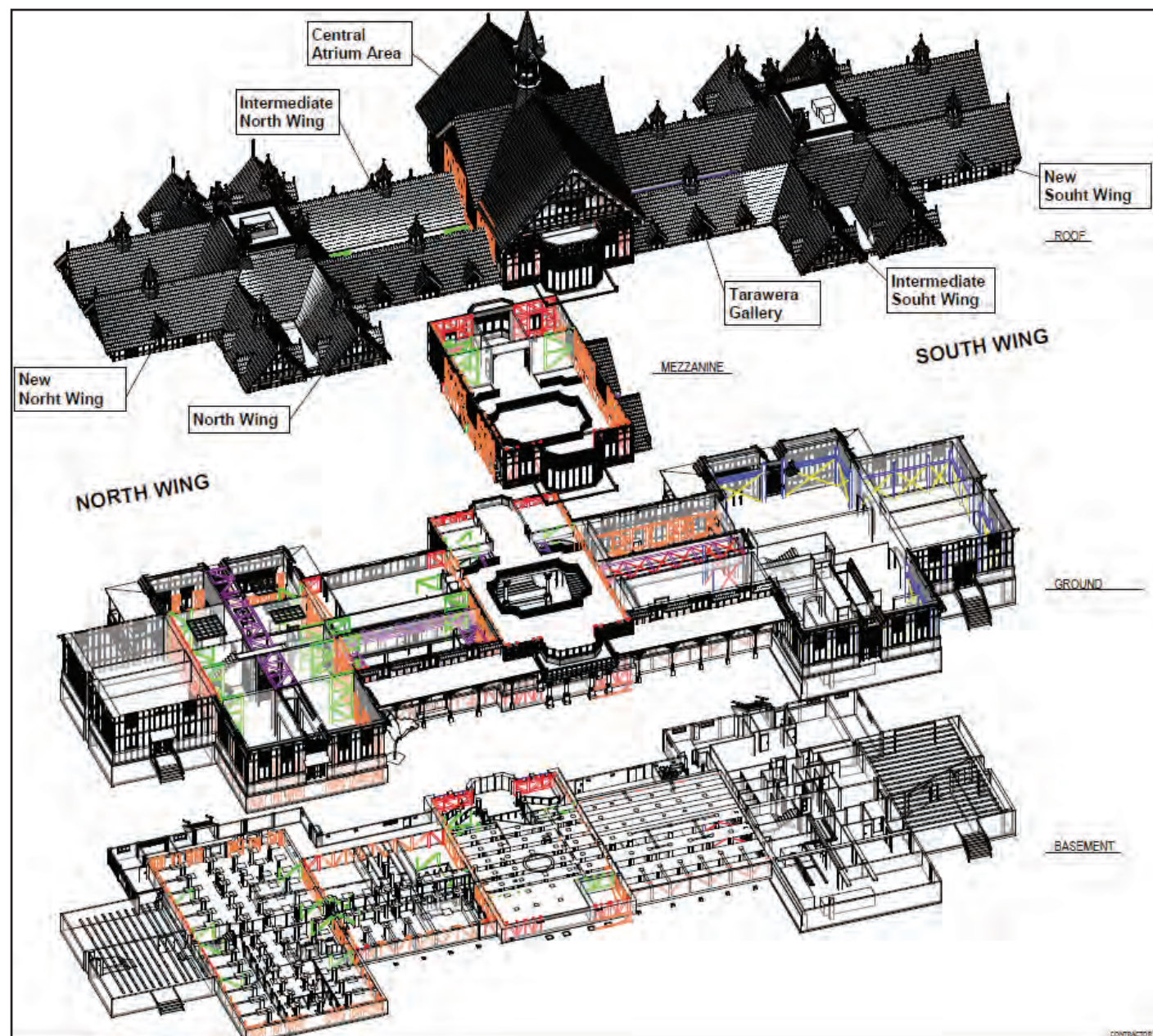
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1.1 - Project Background

The Rotorua Museum was identified as having a high risk of sustaining significant earthquake damage as the buildings structure was assessed to be lower than 33% of the building code New Building Standard in an Initial Seismic Evaluation completed as part of Rotorua Lakes Councils Earthquake Prone Building Policy.

As a result of this Earthquake Prone status, RLC commenced the Seismic Strengthening project to identify and address all problems with the Rotorua Museum building in November 2016. This project commenced with a number of consultants providing a range of services including architectural design, structural engineering, geotechnical engineering, digital surveying and conservation architecture.

1.2 - Building History

- 1902, plans completed by Dr Arthur Stanley Wohlmann and BS Corlett
- 1908, construction completed by W Hutchinson and opened as a Bath House
- Original plans not realized due to budget constraints.
- 1911, 1983 and 1986 saw extensions completed to the North and South Wings
- 1963, building transferred to Rotorua City Council
- 1965, Tudor Towers restaurant and night club opens in Bath House
- 1969, City of Rotorua Museum opened in South Wing
- 1985, Building is classified "B" by New Zealand Historic Places Trust.
- 1987, Te Arawa gallery opens in South Wing
- 1990, 1993 Tudor Towers closed and building restoration commences with Conservation Plan
- 1997, taking the Cure exhibition opens in re-developed North Wing
- 2006, North Wing viewing platform reinstated after removal in 1930's.
- 2008, North Wing extension completed
- 2011, South Wing extension completed, achieving the original designed floor plan



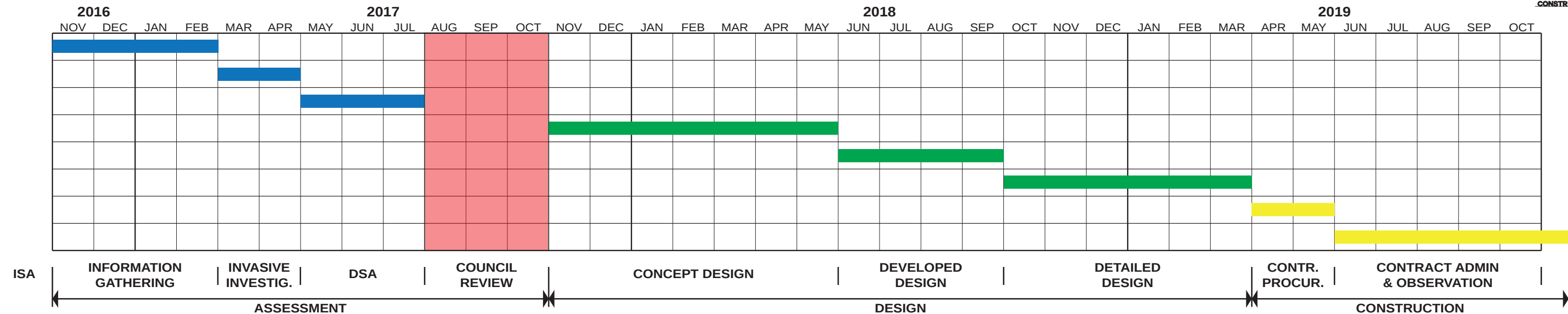
1.3 - Building Design

- Designed in the English Renaissance architectural style as a mixed revival.
- Heavily influenced by the Tudor style with elements of Elizabethan and Jacobean styles
- Overall footprint 105 m long x 37 m wide and approx. 23 m high at the Great Hall Apex
- Classic Elizabethan E-shaped floor plan
- Central Great Hall, two storey with a double height 1st floor
- Double parallel gallery wings extending North and South
- North-South Galleries intersected with double parallel gallery wings extending East and West
- Two roof level viewing platforms at gallery intersections.
- Constructed in Tudor style half-timbered walls on concrete foundations & floors
- Timber framed roof with heavy Marseille roof tiles



1.4 - TDC

Thompson Design & Construction were engaged in November 2016 to provide Preliminary Architectural Design Services including Information Gathering and Concept Design.



2.1 - Initial Seismic Assessment (ISA)

An Initial Seismic Assessment (ISA) provides a broad indication of the expected performance of a building taking into account its type and age of construction, local seismicity, ground conditions and usage. This assessment was carried out by engineers engaged by RLC and determined that the museum building fell well below the minimum 33% New Building Standard (NBS) rating.

With a NBS below 33% the museum was classified as an Earthquake Prone Building (EPB) requiring urgent action to identify and address all structural weaknesses to raise the buildings NBS rating to a higher level required by its status as a significant public building. RLC commenced the Seismic Strengthening project in August 2016 with a detailed survey of the existing building including a highly detailed 3d digital scan and resultant digital model.

Following the Kaikoura Earthquake in November 2016, new cracks were discovered and existing monitored cracks had expanded in ceilings, walls and floors. This sudden increase in crack activity following the seismic event was a great cause for concern as it indicated severe underlying structural weaknesses. As a result the museum was closed to the public and the Seismic Strengthening project was made more urgent requiring immediate engagement of structural engineers.

2.2 - Information Gathering

The project team commenced an in-depth process of compiling and analysing all information on the existing museum building. This process included:

- A highly detailed digital scan of the entire existing building to produce a 3-dimensional digital model to be used as an accurate base off which all subsequent design would work
- Comprehensive review of all existing documentation held on the RLC property file including existing plans, specifications, building consents and other notes
- Detailed assessment of building by structural engineers including review of documentation crack mapping, floor load capacity tests, data comparison
- Detailed assessment of underlying soil conditions by geotechnical engineers based on previous testing, reports and geotechnical engineering
- A detailed plan for testing locations and processes was completed by all consultants to provide an overview of the proposed Invasive Investigation

2.3 - Invasive Investigation

The Invasive Investigation process sought to analyse in accurate detail the exact type, age and condition of various elements of the construction of the museum building. This process involved a wide range of tests and reports by numerous consultants, including:

- Core samples of existing concrete floors and walls
- Removal of linings to inspect existing structural members and connections
- Various soil tests by geotechnical engineers including cone penetrometer and bore holes
- Sampling and testing of timber framing to assess decay of structural timber elements

This process was closely monitored by Heritage NZ and a conservation architect to ensure any damage to the heritage fabric was minimized and mitigated during testing. Testing plans were submitted to Heritage NZ for approval prior to commencement and regular reporting was completed during Invasive Investigations.



2.4 - Detailed Seismic Assessment (DSA)

With an accurate picture of the existing building now established through Information gathering and Invasive Investigations, the structural engineers commenced a Detailed Seismic Assessment of the museum building.

Critical information on the museum buildings structure including layout, sizing, connection details, construction type and condition were all compiled and analysed by a team of structural engineers. The structure was digitally modelled and a series of highly accurate tests were conducted to assess the structural strength of the existing building against current code New Building Standards. These tests produced an in-depth report into the seismic strength of the overall building as well as identifying the individual structural weaknesses.

These results were compiled into a DSA Report including a list of possible solutions to address all the structural weaknesses in order to strengthen the overall building structure to achieve a higher NBS percentage rating. These possible solutions were categorized into four separate options for progressing the Seismic Strengthening project. These options were presented to RLC for review and to have the four options discussed and ultimately decided upon.

2.5 - Concept Design

With the four Seismic Strengthening options entailing vastly different solution proposals, the project team had to await confirmation of a chosen option before progressing with conceptual planning. With the option to retain as much of the existing building as possible while applying structural retrofit solutions and a fit-for-purpose refurbish-ment the project team commenced concept design.

The Concept Design phase comprised of two simultaneous processes structural and architectural design. Structural engineers set about designing a concept for applying various structural retrofit works to the existing building to improve the overall seismic strength. This structural design concept had to be constantly reviewed and approved by Heritage NZ to ensure any structural retrofit works were appropriate and sympathetic to the heritage values inherent in the Category 1 Historic Building.

Simultaneously with the structural concept, the design team completed an architectural design concept that has been developed in constant consultation with RLC to meet a wide range of requirements including Building Code, Usability, Operations, Maintenance, Cultural and Heritage.

2.6 - Developed Design

With an approved concept design these preliminary plans will be refined and further developed to provide a set of documentation including drawings and an outline specification that identifies and coordinates all of the elements of the building, including structural elements, building services, mechanical services, materials and finishes.

Key Tasks

- Further refine the design brief including mechanical and exhibition requirements
- Obtain developed design input from other consultants including mechanical and fire engineers
- Select and size mechanical plant to achieve performance criteria including duct runs and risers
- Review and evaluate other consultants input against architectural design and integrate with developed plans
- Prepare drawings based on approved concept design including more detailed floor plans, elevations and cross sections
- Prepare internal spatial drawings including finishes schedule for Heritage review.
- Produce sketch details of typical and critical construction details and review with RLC, structural engineers and Heritage NZ
- Prepare a Developed Design Report to report on the design refinement, constraints and assumptions, schedule of materials and finishes, mechanical/plant/service design, evaluate input by other consultants and to summarize the Developed Design direction moving into Detailed Design.

Deliverables

- Developed Design Drawings
- Outline Specification
- Developed Design Report

2.7 - Detailed Design

Upon approval from RLC to proceed with the detailed design, the architect will lead the coordination of the design team to establish working drawings for the project. At the completion of the Detailed Design phase of the project, the primary deliverable will be a set of tender and building consent issue documentation. The detailed design documentation will include a completely integrated set of design documents including drawings, specifications and a coordinated 3D Model.

During the detailed design phase the design team will facilitate early engagement with RLC building consent officers to assist in the preparation and processing of building consent documentation to ensure accuracy and efficiency. The architect will consult RLC to identify and agree a preferred contractor procurement methodology. The design team will also produce a detailed Works Programme to identifying the staging and process of completing the proposed works

Deliverables

- Detailed Design Drawings
- Schedules (Steel, Services, and Finishes etc.)
- Complete Project Specification
- Performance Specification (On-Site Contractor Design Decisions)
- Building Consent Application
- Confirmed Method of Procurement
- Conditions of Contract

2.8 – Contractor Procurement

A comprehensive set of documentation will be prepared for submission for tender to form the basis for negotiations with tenderers to select a contractor. Contract documents will be prepared for signing by the RLC and selected Contractor. Key deliverables and their associated tasks include:

- Construction Contract, form of contract, special conditions
- Tenderer Pre-Selection, advise on pre-selection methods and select tenderers
- Tender Documents, consultant docs, insurances, bond, liquidated damages, consent requirements, contractor coordination, and invitation letter
- Tender, assist call to tender, monitor process, receive tenders and check for compliance and report
- Contractor Programme, obtain and review the preliminary programme for the Contract Works

2.9 Contract Admin & Observation

The project is constructed through to a stage of Practical Completion that allows RLC to occupy and use the museum. Administration of the construction contract is undertaken by the architect including Observa-tion of the Contract Works to verify that the construction is generally in accordance with the architect's documents. Observation is a critical part of the architect's service, and is required to complement site supervision undertaken on a continuous basis by the contractor. Tasks include:

- Review contractor's insurance information
- Convene meetings with contractor, RLC and other consultants
- Document amendments for construction
- Additional documentation for construction as required
- Contract directions and variations
- Coordinate other consultants with sub-contractors
- Monitor contractor compliance with legislative requirements
- Review work completed and materials for compliance with project documentation
- Assess and advise contractor payment claims and variations
- Monitor contractors progress against programme and review extensions
- Assess and issue Practical Completion and Defect Notices
- Review as-built documentation and monitor for compliance with consent conditions

3.1 - Structural Design Concept

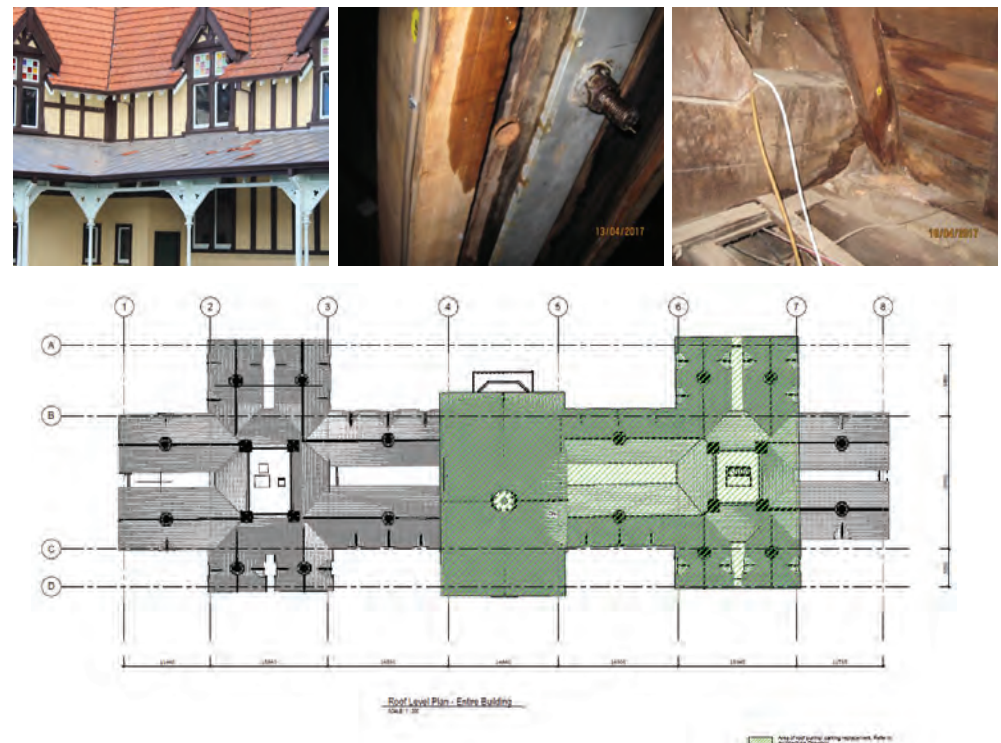
3.1.2 – Roof

Issue
Terracotta Marseille roof tiles are separating and cracking causing severe leaking. Tile damage is significant in some areas and multiple tiles have fallen from the roof. Leaking has caused widespread moisture damage to both structural and service elements of the building. If moisture damage continues to roof framing elements the timber decay will cause severe structural weakness.

Solution
Substantial repair or replacement of the roof tiles is required to prevent any further decay of timber framing elements. Replacement of the existing heavy clay roof tiles with a lightweight alternative will also reduce the seismic demand on the overall structure and will reduce the scale and complexity of structural upgrade works required in supporting structure. Removal of the existing roof tile will also allow structural works in the roof space to be carried out more easily.

Issue
Native timber roof framing and t&g roof sarking has decayed due to continuous leaking of the roof tiles. Decay extends to the structural fixings between different framing elements. Decayed roof framing timbers (beams and rafters) no longer provide sufficient structural strength. Deteriorated fixings and connections have weakened global structure. T&g sarking decay has reduced capacity as a structural diaphragm.

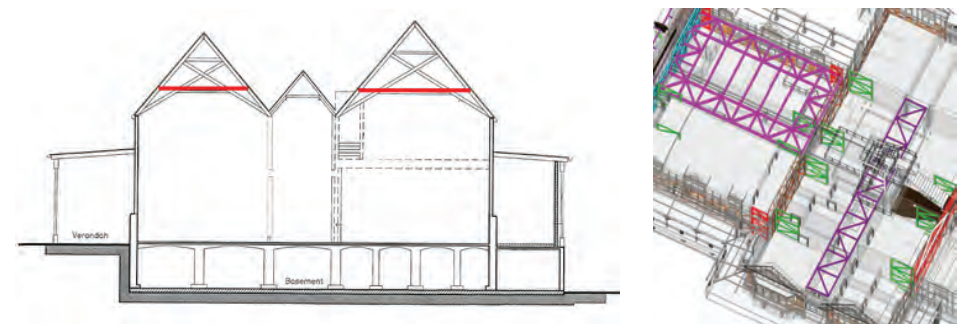
Solution
Replace severely decayed roof framing (beams and rafters) and repair or strengthen those that can be. Install new structural fixings (steel plates, bolts and nails) between elements. Replace sarking in areas required with structural ply.



3.1.3 – Ceiling Diaphragm

Issue
The current global structure lacks an effective ceiling diaphragm to tie together the separate structural walls into a single cohesive structure. The exiting timber sarking is too far decayed and at too steep a pitch to provide an effective diaphragm. Without an effective diaphragm the global structure is weak in the horizontal plane against lateral forces by seismic loading.

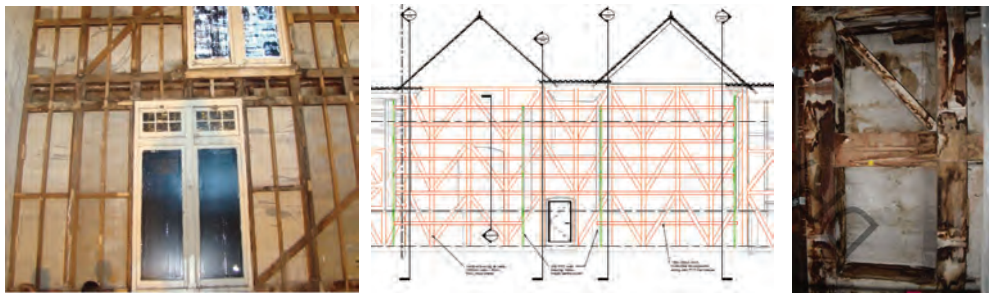
Solution
Install horizontal steel cross bracing in roof the space to create a structural diaphragm above the ceiling joists. The roof tiles and sarking will need to be removed to allow installation of these braces.



3.1.4 – Timber Wall Framing

Issue
Shear capacity of Mortise and Tenon joints in native timber wall framing elements are not sufficient for the seismic demand. These walls may fail under in plane seismic loading. Periodic leaking between wall framing, panels and windows/doors has caused decay to native timber wall framing elements.

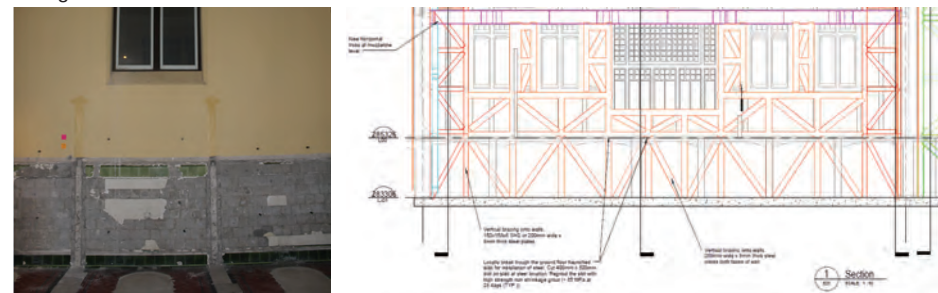
Solution
Increase in plane shear capacity of timber framed walls by installing steel brace frames. Replace severely decayed wall framing elements.



3.1.5 – Concrete Nib Walls

Issue
The unreinforced concrete nib walls, upon which timber wall framing is founded, is weak against out of plane forces. Nib walls may fail under excessive deflection caused by out of plane seismic loading. This will lead to catastrophic failure of timber wall framing above and supported roof structure.

Solution
Strengthen unreinforced concrete nib walls against out of plane loading. Install structural steel plate frames continuously over timber wall framing, concrete nib walls and down into foundation walls and footings.



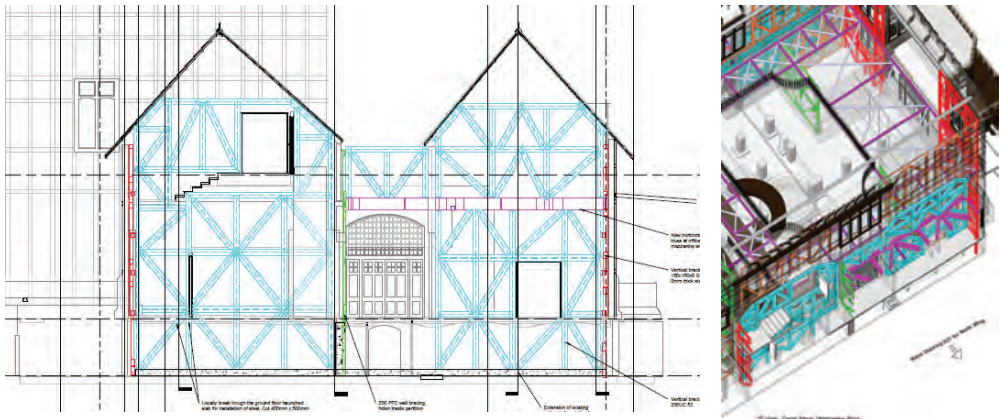
3.1.6 – Full Height Concrete Gable End Walls

Issue
Four of the original five full height unreinforced concrete gable end walls constructed in 1906 remain and are severely weak against out of plane flexural forces caused by seismic loading.

These walls may suffer overturning failure under excessive deflection caused by out of plane seismic loading. This will lead to catastrophic failure and collapse of the walls and supported roof structure. Collapse of these 12+m high walls will cause critical damage to adjacent building elements.

Solution
These walls are the most significant structural weakness in the building and require immediate replacement or strengthening works.

Strengthen the walls with steel brace frames bolted to the concrete walls. Strengthen lower perpendicular adjacent walls and their connection to the full height concrete walls to provide lateral support against overturning. Create structural diaphragm out of existing mezzanine floor by installing steel bracing to floor framing and replacing timber T&G flooring with structural plywood sheet flooring.

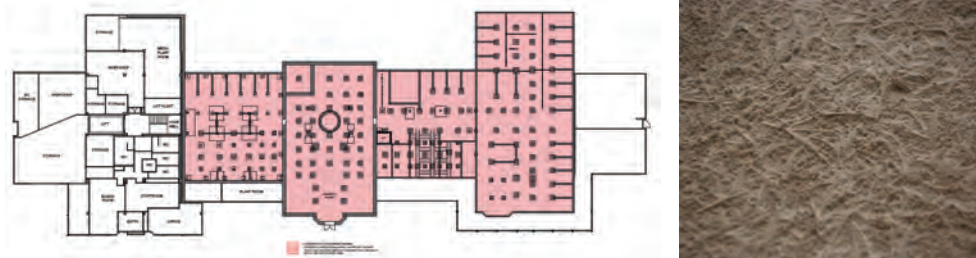


3.1.7 – Suspended Concrete Floor

Issue
Suspended unreinforced concrete floor slab is weak against out of plane flexural forces caused by vertical loads. These include gravitational dead loads under its own weight, movement of supporting walls and piles and also live loading from temporary traffic and permanent fixtures.

Over time these vertical loads have caused significant cracking of the suspended concrete floor slab. As these loads continue, cracking has increased exponentially as the various cracks compound to create structural weakness. Although the suspended concrete floor slab is unreinforced the friction between aggregates within the concrete has provided sufficient strength to the floor preventing failure so far.

Solution
Fill larger cracks with an epoxy resin that bonds either side of the crack. Spray the underside of the floor slab with glass fibre reinforced concrete approx. 100mm thick. This will provide tensile strength to the underside of the slab reducing sagging and further cracking and preventing failure of the slab.

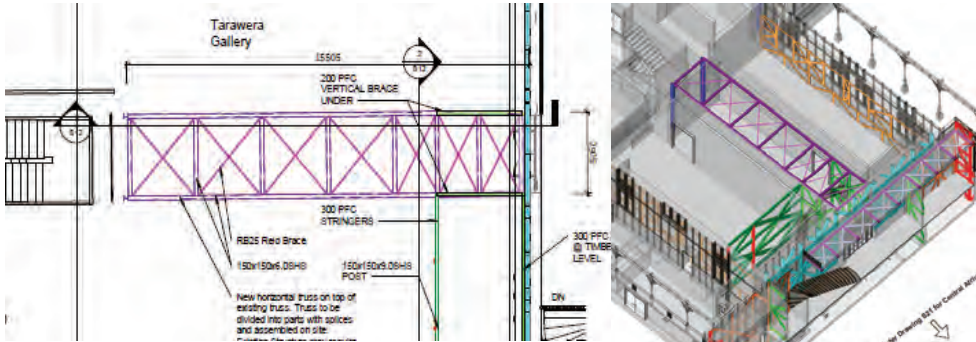


3.1.8 – Tarawera Gallery Steel

Issue
Upper horizontal steel truss, omitted from final design and not installed in construction as required by structural calculations in roof space above central hallway of Tarawera Gallery.

Central steel portal in the Tarawera Gallery likely to experience excessive deflection under seismic event leading to failure.

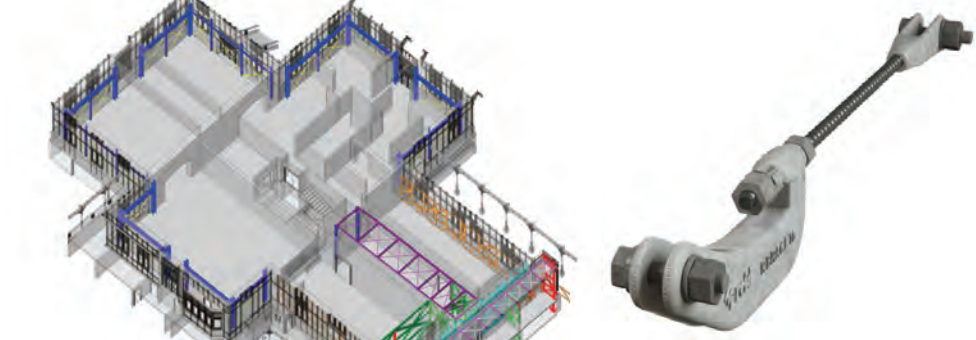
Solution
Install new horizontal steel truss above existing lower steel truss comprised of steel struts and braces, installed in parts for ease of construction in roof space above Pukaki.



3.1.9 – Reid Bar Braces

Issue
Steel brackets connecting diagonal reid-bar braces to base of structural steel framing are too rigid and will become brittle under stress from seismic loads.

Solution
Replace brackets with a more ductile steel bracket. Requires removing wallinings to access. Not heritage value.



3.2 - Architectural Design Concept

3.2.1 – Access & Egress

Issue

The current layout of the original bath house section is not suitable for the current operation of the museum. Multiple bottlenecks occur with visitor foot traffic at a number of single access-egress points. The one way access route along the central hallway of the Intermediate North Wing often becomes congested with visitors. Café visitors, museum patrons and visitors waiting to enter the theatre space all share the same tight space.

Solution

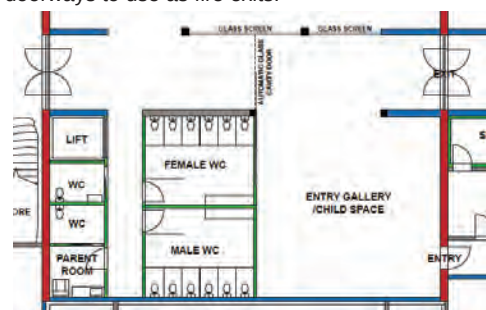
Open up a second access point to the North Wing galleries by reinstating the existing door near the honeymoon suite. This will reduce bottlenecks at the current single access point door. Remove the current theatre space and open it up to the central hallway. This will reduce visitors blocking the hallway and create additional waiting/gallery space.

Issue

The current Fire Exit layout does not provide sufficient final escape points for the escape route path lengths.

Solution

Reinstate original external doorways to use as fire exits.



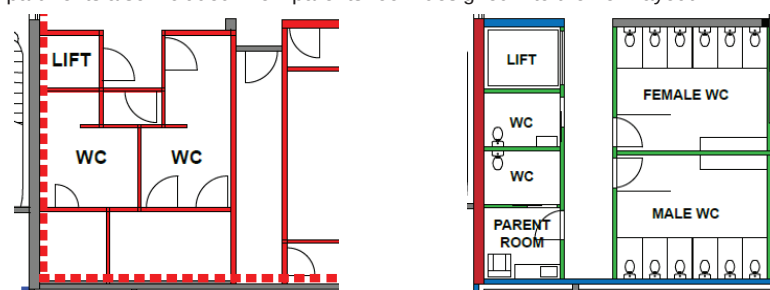
3.2.2 – Sanitary Facilities

Issue

The current number of toilets is insufficient for the museum occupancy load under code requirements. There is also insufficient accessible toilet facilities. There is currently no parent room space for private changing and feeding of infants.

Solution

Re-design and construct the toilet facility space to include 6 male and 6 female toilet pans. 2 accessible toilet compartments also included. New parents room designed into the new layout.



3.2.3 – New Accessible Lifts

Issue

The current lift does not meet accessibility requirements and is not operational, limiting public access to the first floor.

Solution

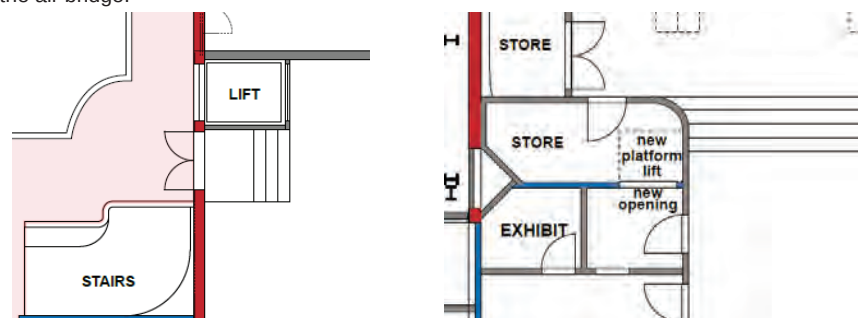
Install a new accessible size lift in the existing lift shaft with some widening required.

Issue

With the proposed air bridge providing covered access to the Energy Events Centre as an additional education/exhibition space, wheelchair accessibility is required to the split level floor at the eastern end of the grand hall.

Solution

Install a new wheelchair platform lift inside the storage space to provide access to a split level landing and on to the air bridge.



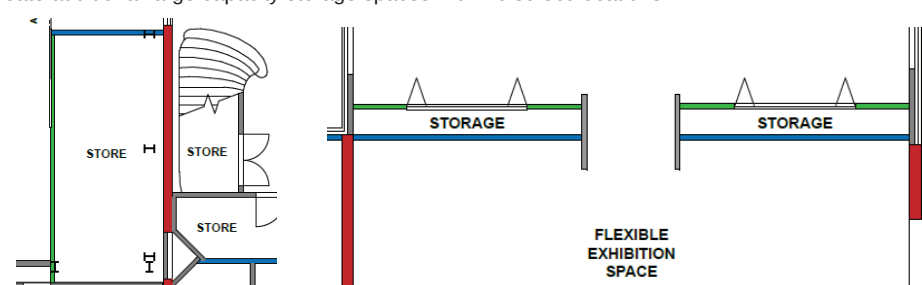
3.2.4 – Storage

Issue

There is a lack of exhibition storage space in the central and northern areas of the museum building, with the primary storage space in the south end basement.

Solution

Create additional large capacity storage spaces within discreet locations.



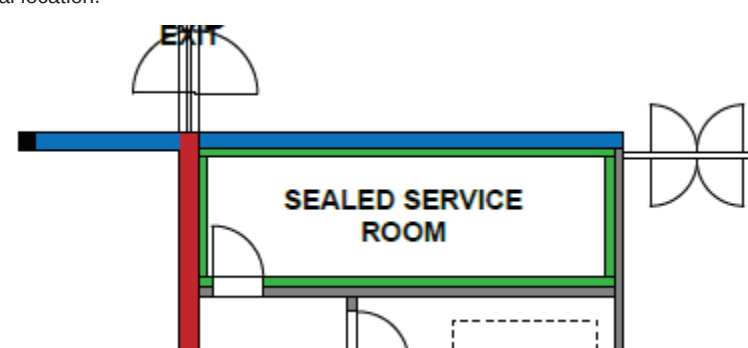
3.2.5 – Service Room

Issue

There is currently no sealed scrubbed air service and mechanical room to service the central and north areas of the museum. The current room has a highly corrosive sulphuric environment.

Solution

Construct a new completely sealed and air scrubbed service room within an existing interior space in a discreet central location.



3.2.6 – Access Control

Issue

There is currently no suitable access control system to restrict visitor access to paid sections of the south and north end galleries and exhibitions.

Solution

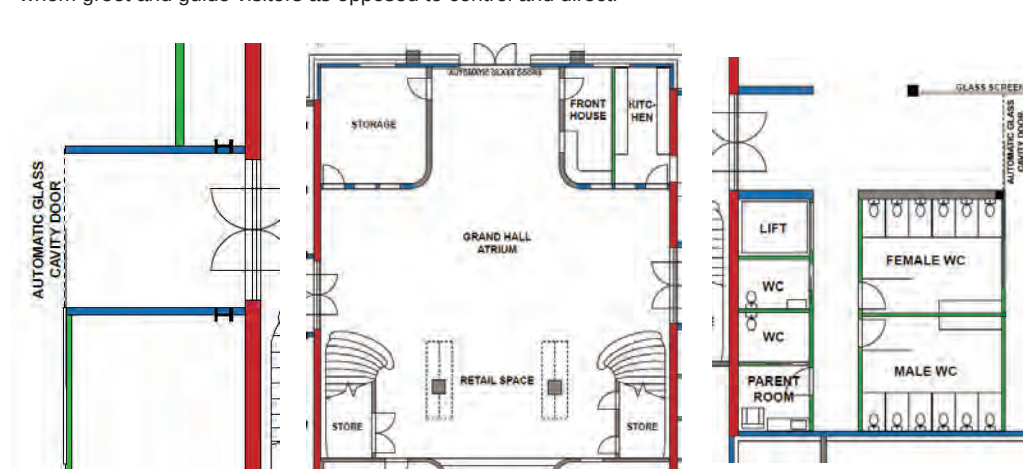
Install new automatic glass doors, controlled by visitor bracelets, to restrict access to the north and south gallery and exhibition spaces. Locate the north wing automatic doors in a location that still allows visitor access to the café and toilet from the central atrium.

Issue

The current reception layout within the central atrium is too traditional and does not suit the future modern museum operations and visitor experience. The central reception desk is outdated and too formal and detracts from the grand scale of the central atrium space as a meeting space.

Solution

Remove the formal central reception desk and develop an open plan entry space with information kiosks provided in spaces adjacent to the atrium. Employ a more modern technological flexible informal visitor/staff interface system. This could be in the form of portable ticketing devices held by reception staff whom greet and guide visitors as opposed to control and direct.



3.2.7 – Café Redevelopment

Issue

As the café is currently a full height space and a new structural diaphragm is required at mid-height an exposed steel truss system will detract from the user experience of the café space.

Solution

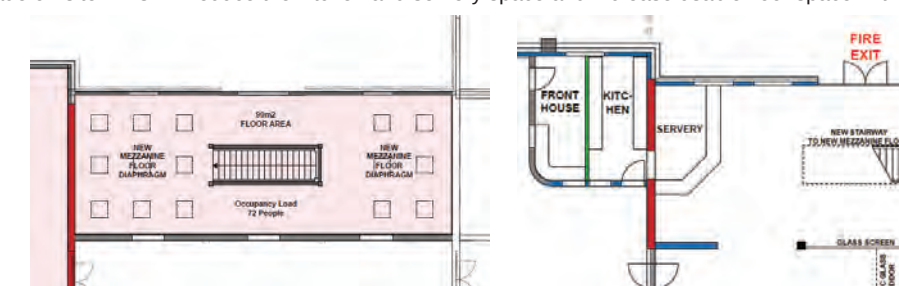
Utilize the required mid-height diaphragm as an opportunity to reinstate the mezzanine floor that existed above the café in the 60's. This will create additional space for 50 people.

Issue

The current full sized commercial kitchen is oversized for the planned future operation of the café. The plant, mechanical and service requirements for this sized kitchen is detrimental to the surrounding fabric of the museum building.

Solution

Reduce the size, scale and complexity of the kitchen space to a mid-sized kitchen for preparation of food made off-site. This will reduce the kitchen and servery space and increase usable floor space in the café.



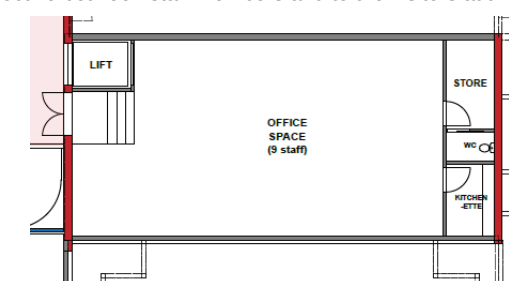
3.2.8 – Office Space

Issue

Staff office spaces are currently spread across the museum, in disjointed small pockets of office spaces. With the majority of staff focused in the south end basement there is a disconnection from the front of house operations.

Solution

Redevelop the current first floor education space into a new office space for staff. This provides a work space that is more connective between staff members and to the visitors at the front of house.



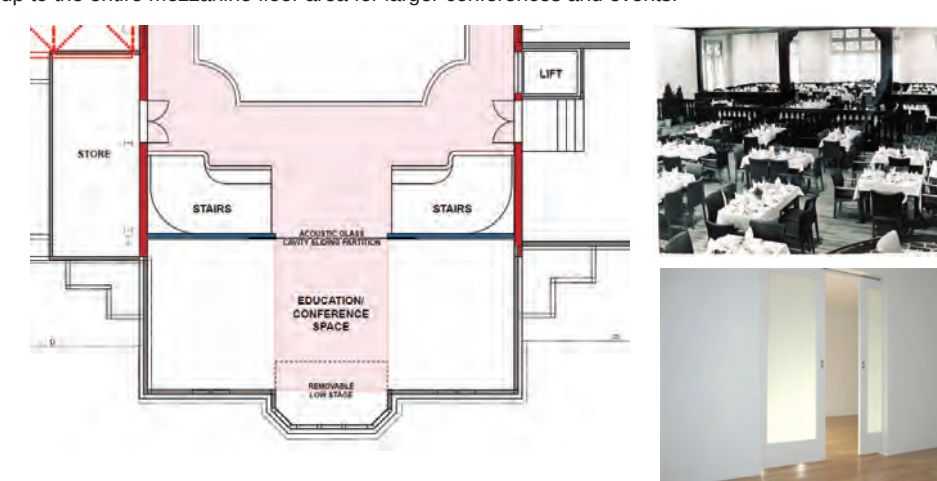
3.2.9 – Education/Conference Space

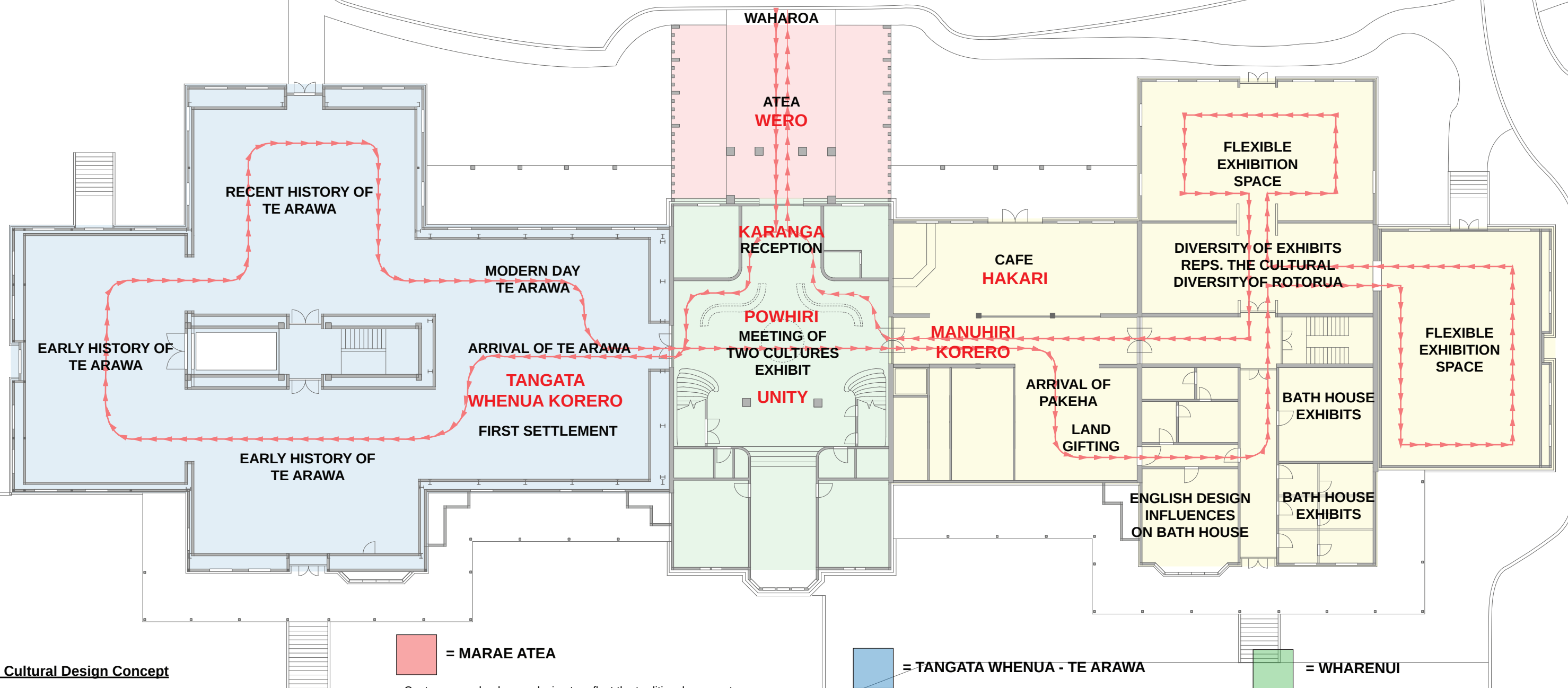
Issue

The current education space is too small and restrictive and feels hidden at the back of house with little connection to the rest of the museum.

Solution

Open up the small, underutilized rooms at the east end of the central halls first floor, into a single large open plan education and conference space. This layout is similar to the Tudor Towers restaurant that operated from 1965 to 1990, and the structure was originally altered to suit this plan. Install soundproof cavity slider glass partition walls to allow this space to be closed off for small to medium groups or opened up to the entire mezzanine floor area for larger conferences and events.





3.3 - Cultural Design Concept

The Rotorua Museum provides the perfect opportunity to tell the story of and celebrate the reciprocal relationship between Te Arawa as Tangata Whenua and Pakeha settlers that has grown from tentative beginnings and flourished over 100 plus years. From the arrival of Pakeha to the Fenton Agreement in the 1880's to the modern day Te Arawa Partnership "Te Tatau o Te Arawa" the Rotorua District has continually been shaped by a distinct biculturalism with a strong importance placed on Te Arawa as Tangata Whenua.

This cultural design concept seeks to utilize the function of the museum as housing the stories of our district to narrate this unique relationship between two very distinct cultures. This concept designs the visitor experience of the museum as a sequential narrative that tells the story of the meeting of two cultures from the perspective of a traditional powhiri experience with the museum as a metaphorical marae complex.

Visitors are welcomed through the atea with a wero (challenge) and simultaneously called onto the marae complex with the karanga (first voice). Visitors now move into the powhiri process initiated by the tangata whenua welcoming manuhiri and telling their story. The manuhiri then reply by acknowledging the mihi and telling their story and where they come from. The process is then complete by a hakari, where the sharing of food negates the tapu surrounding the manuhiri and powhiri process and the people become one.

- Contemporary landscape design to reflect the traditional marae atea space
- A row of timber posts creates a palisade that flanks either side of the marae atea entry space. These posts are interspersed with 8 carved poupuu and maihi structures. These 8 carved figures represent Nga Pumanawa E Waru, the eight beating hearts of Te Arawa, 8 key ancestors in the whakapapa of all Te Arawa.
- This marae atea recreates the traditional powhiri experience in a contemporary way. Visitors are forced to enter the museum through the marae atea space and to acknowledge and respect Te Arawa as tangata whenua. The dominant size and scale of the carved structures recreate the feeling of confrontation and being measured by the tangata whenua as friend or foe.



WAHAROA/ATEA CONCEPT

- Visitors encouraged to begin visit through Tangata Whenua exhibits
- Galleries exhibiting the history of Te Arawa as Tangata Whenua
- Progression through gallery space follows a timeline from stories of Hawaiki to arrival in Aotearoa, through the history of Te Arawa ending with modern history.
- This gives visitors a deep understanding of the history of Te Arawa as tangata whenua

- Galleries exhibiting the history of Pakeha as manuhiri.
- Progression through gallery space follows a timeline from the various original homelands of Pakeha and how their migration to Aotearoa started through the history of the multiple Pakeha cultures in Aotearoa with emphasis on Rotorua ending in the modern history of Pakeha in Rotorua.
- This gives visitors a strong understanding of where how and who Pakeha have lived in New Zealand.

- The traditional whareniui has always been used as a ceremonial meeting house where Tangata Whenua and Manuhiri meet to discuss the topic of that day. Once the formal welcoming Powhiri had concluded that the visitors are peaceful guests they were welcomed inside the whareniui to continue discussions in a more relaxed friendly environment.
- In this context the museum central atrium becomes the whareniui space exhibiting, commemorating and celebrating the relationship and partnership between Pakeha and Te Arawa.
- The atrium becomes not only an entry space but also an exhibition space that narrates the coming together of both cultures. When first entering the atrium the exhibit will have an element of mystery that can only be understood and demystified once visitors have moved through both sides of the museums and gained a good understanding of both cultures. Upon re-entering the atrium space after moving through both sides, visitors are now able to understand the partnership exhibit in the atrium as they would now have a good understanding of both sides of the story.

CONCEPT DESIGN PLANS - TDC - 07/05/18

C01 - GROUND FLOOR DEMOLITION PLAN

C02 - FIRST FLOOR DEMOLITION PLAN

C03 - BASEMENT STRUCTURAL PLAN

C04 - GROUND FLOOR STRUCTURAL PLAN

C05 - GROUND FLOOR RESTORATION PLAN

C06 - FIRST FLOOR RESTORATION PLAN

C07 - GROUND FLOOR REBUILD PLAN

C08 - FIRST FLOOR REBUILD PLAN

