Network protection without compromise – Deconstruction of 91 Hereford Street for Telecom

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ABSTRACT: Telecom's former main Christchurch Exchange building suffered considerable damage to its architectural finishes and building services in the 22 February 2011 earthquake. In the early 1990's the building was converted from its former primary use as the Canterbury region's Central Exchange building to an office building for Telecom staff. This transition occurred after Telecom constructed a new and immediately adjacent Exchange building. Through migration of the Exchange from the old to the new building, a number of engineering services were configured to be common to both buildings including fire detection, fire suppression, incoming fire hydrant, reserve artesian water supply, a reserve water storage tank to supply the evaporative cooling towers should mains water be lost, physical security encompassing access control, CCTV and security alarms, mains power supply, diesel fuel supply, emergency generator power supply and a major underground cable tunnel that hosted every copper wire and fibre cable for the Canterbury region. After the decision was made to deconstruct the former Exchange building strategic measures were put in place to ensure that no customer service outages would result from the deconstruction process – Network Protection without Compromise became the project mantra. This required the specification of protective works and the development of a deconstruction methodology to ensure that deconstruction could proceed without putting the network at risk and to allow for the safe and controlled removal of hazardous materials. The deconstruction process also presented an opportunity for Telecom to rationalise its infrastructure provisions for its site in a customised space using some remaining parts of the existing structure and simultaneously regenerate the majority of the deconstructed site for the medium term by providing an inner city public park area prior to Telecom making any long term decisions regarding the use of the property.

1 INTRODUCTION

Telecom and its predecessor organisation, the New Zealand Post Office, has been operating buildings in the Christchurch CBD in the vicinity of the Cathedral Square since the 1870s when Christchurch was a young colonial town. The current main Exchange building (referred to as 109 Hereford St), was completed in the early 1990s and replaced the former main Exchange building (referred to as 91 Hereford St) which had been built in the late 1930s (refer Figure 1 showing location of buildings). The modern Exchange building, 109 Hereford St, is Telecom's second most critical facility in New Zealand (second to the main Auckland Exchange building). The entire South Island mobile and landline telephone networks are supported by the equipment inside 109 Hereford St building, therefore its non-stop operation is critical to the New Zealand telecommunications network.

The Christchurch earthquakes proved how essential mobile phone services are in an emergency, not just for the public to contact family, but for the emergency services to communicate with each other. It is worthy to note that Telecom's 109 Hereford St main Exchange building maintained non-stop mobile and landline services throughout all the Christchurch earthquakes.

The 91 Hereford St former Exchange building was converted to an office building when the 109 Hereford St Exchange building came into operation in the early 1990s. 91 Hereford St housed approximately 500 staff at the time of the 22 February 2011 Christchurch earthquake. The 91 Hereford St building housed essential services used to support the on-going operation of the 109 Hereford St building - including two stand-by power generators; an artesian bore pump and water storage tank to provide back-up water supply for the 109 Hereford St building evaporative cooling systems; and a back-up fire hydrant diesel powered pump system and back-up water supply for fire fighting requirements for both buildings.

The 91 Hereford St building suffered a reasonable degree of damage from the February 2011 earthquake event and after several engineering and architectural evaluations was deemed uneconomical to repair. This paper will look at the challenges faced in the overall deconstruction process and the integration required between a number of stakeholders to facilitate the deconstruction process.

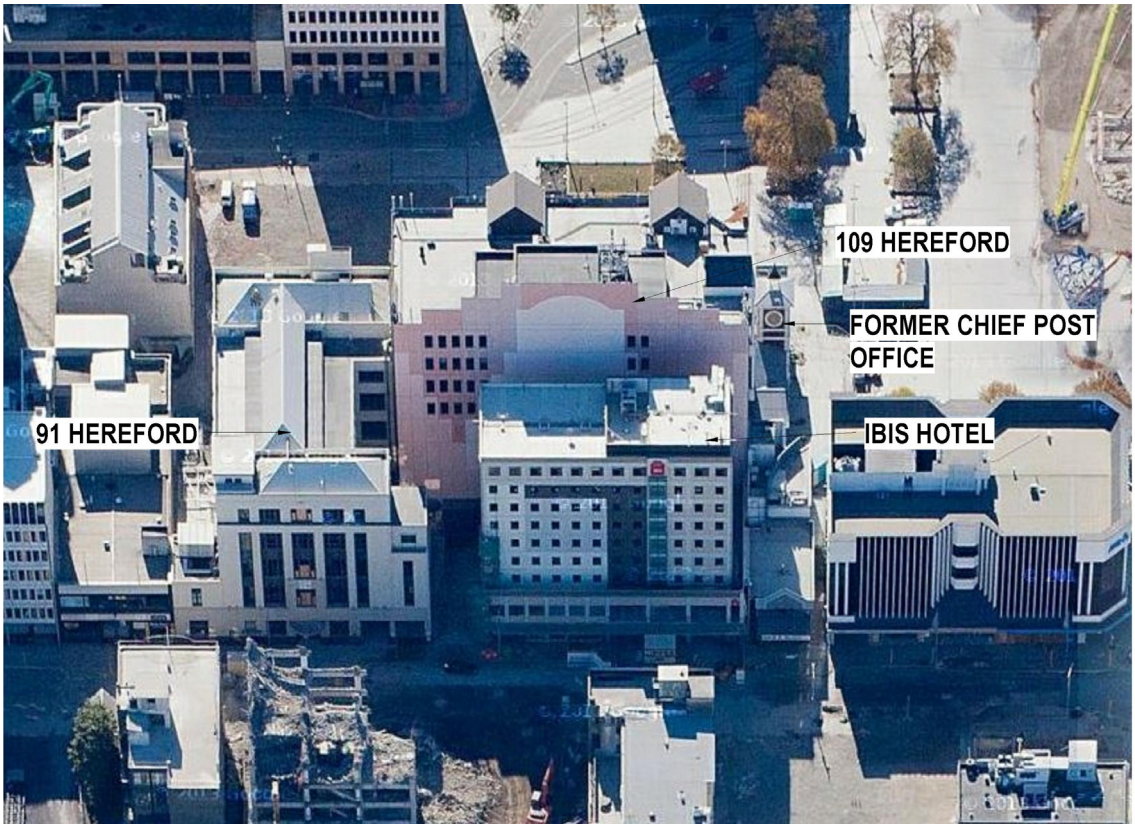

Figure 1. Location of Buildings

2 BUILDING DESCRIPTION

The 91 Hereford St building was a six level steel framed building, including a basement level. Construction of the building commenced in the late 1930s and the building opened in 1941. An annexe to the west was built in the 1960s. The structural steel beams and columns were connected by riveting, the prevalent method at the time, and subsequently encased in concrete. The concrete slabs were in-situ reinforced concrete, averaging 175mm to 200mm thick. The building typically featured a heavy cavity masonry façade on the majority of elevations penetrated by windows to provide natural light. The foundations for the building were a combination of strip footings for the external walls and pads to support the internal columns. The majority of the roof area consisted of lightweight corrugate cladding supported on structural steel truss framing.

3 SEISMIC ASSESSMENT AND OTHER BUILDING CONSIDERATIONS

3.1 Damage Assessment

The building suffered a reasonable degree of damage to its façade, architectural fit-out and building services as a result of the 22 February 2011 earthquake. This included the following:

- Leaning masonry boiler chimney – this was removed from the building soon after the 22 February event
- Substantial collapse at two upper floors of suspended ceiling in the upper parts of the building which resulted in damage to the building services components on those floors
- Extensive cracking and damage to the masonry façade on the north and west elevations of building
- Extensive cracking to masonry in the stairwells
- Significant damage to the toilets and plumbing services

The visual examinations that took place immediately following the 22 February 2011 earthquake event indicated that there was no obvious damage to the primary structural frame. Figure 2 provides some representative examples of observed earthquake damage.

Figure 2. Examples of damage to the 91 Hereford St Building

3.2 Detailed Seismic Analysis

To give a better degree of accuracy of the building's seismic capacity a detailed seismic analysis was undertaken. This included developing a three dimensional model to simulate the building's response to earthquake actions using ETABS software. Member capacities for the primary structural frames acting as moment resisting frames were computed. These sections, in particular the column members, were complex due to their compound nature of having several separate sections encased within concrete. A nominal 10% enhancement of the section capacity was incorporated to allow for the beneficial effects of the concrete encasement. Figure 3 provides an image of the ETABS model developed to analyse the building.

The assessment confirmed that the primary structural frames could be considered very resilient in terms of their seismic capacities. Analysis of the results indicated that the building exceeded an 80% NBS capacity when considered as an Importance Level 2 building. The key deficiency of the building was the brittle nature of the facades.

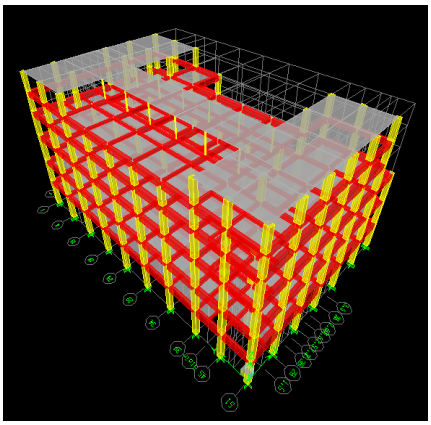

Figure 3. Image of ETABS model developed to analyse the building

3.3 Intrusive Testing of Structure

Invasive testing of a representative number of beam and column joints was undertaken to determine if the riveted connections at the beam and column joints had suffered any damage. This involved scabbling the cover concrete to reveal the beam and column joints. The invasive testing of selected beam and column joints indicated no signs of damage and further demonstrated the overall resilience of the structural system.

3.4 Heritage Considerations

The building had a Group 4 Heritage classification as listed in the Christchurch City Plan administered by the by the Christchurch City Council. The building had no heritage listing with the New Zealand Historic Places Trust.

3.5 Overall Building Assessment

Taking account of the damage to the external facades, the architectural fit-out, the building services systems and the need to upgrade aspects of the building to meet current code requirements under the Building Act the building was deemed uneconomical to repair.

If the building was to be preserved no seismic strengthening would have been considered necessary. The primary requirement would have been replacement of the damaged façades with a new façade system that would provide better seismic and thermal performance. The secondary requirements were replacement of fire and mechanical services, the interior fit-out, and upgrades to meet current code requirements in regard to stairwells, lifts, disabled access and emergency egress.

4 DECONSTRUCTION INITIATION

4.1 Risk Management

Upon Telecom confirming the decision to proceed with deconstruction a workshop was convened to identify and address risk considerations. The primary objective surrounding all decisions and actions during the deconstruction phase was to “Protect the Network Without Compromise”, taking account of its proximity to the current main 109 Hereford St Exchange building. The workshop was attended by a wide range of stakeholders including:

- Telecom, the client
- Chorus, the network owner and operator

- Facility managers for the main Exchange building including maintenance providers for the stand-by power systems and the building services systems
- Christchurch City Council and Orion to provide advice on local utilities
- Engineering, architectural and project management consultants

A comprehensive risk register was developed that would be the base document for the on-going project and this was regularly referred to or challenged as the deconstruction phase progressed. The risk management process identified a number of critical elements that would need protective measures in place to ensure the potential for risk was minimised and these were detailed in a specific deconstruction specification developed for the project. Part of the deconstruction initiation included a survey undertaken by specialist consultants to advise on the existence of hazardous materials throughout the building, the primary concern being the existence of Asbestos material.

4.2 **Deconstruction Specification**

The critical items that required protection during the deconstruction phase included the following:

- Underground cable tunnel hosting every copper wire and fibre cable for the Canterbury region
- Orion substation adjacent to the 91 Hereford St Building
- Artesian borewell head, pump and pipework
- Underground diesel tanks providing fuel for the two stand-by Engine Alternators
- A third containerised external EA
- On-going immediate access to the existing EA enclosure (should mains power be lost from the grid and the EA's activated to support the adjacent 109 Hereford St Exchange building).

Specification documents, including detailed drawings, were developed and included in the deconstruction tender documentation to ensure protective measures were deployed. Figure 4 provides an example of the detailed documentation that was developed to provide guidance on the protective measure requirements and staging. After a market tender process and several interviews with the short listed tenderers the contract was awarded to Fletcher Construction January 2013.

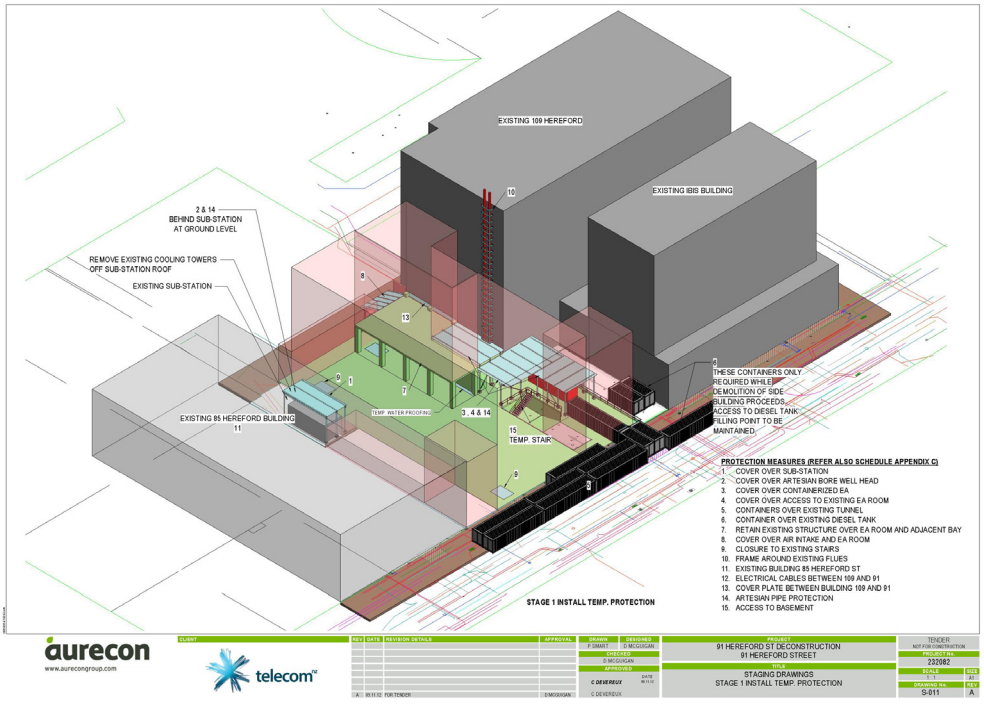

Figure 4. Example of deconstruction specification documentation confirming protective measures

4.3 **Other Deconstruction Considerations**

Deconstruction of the 91 Hereford St building presented an opportunity to reconfigure and improve the resilience of the stand-by power systems for the main 109 Hereford St exchange building. An additional temporary third containerised Engine-Alternator (EA) had previously been located adjacent to the permanent enclosure housing the two permanent EAs which were physically located inside part of the 91 Hereford St building. The temporary EA was to provide additional redundancy to the two primary permanent EAs, albeit the temporary containerised EA could only be initiated by a manual start process. To remove the need for this temporary containerised EA part of the ground floor structure of 91 Hereford St was to be retained to form an extension to the existing EA enclosure and house a third permanent EA.

A feasibility study was undertaken to review the implications of relocating the two permanent EAs into the 109 Hereford St building to simplify and de-risk some of the deconstruction aspects but this proved to be too complex and costly and would have entailed significant periods where little, if any, EA support was available to 109 Hereford St. Consequently it was abandoned in favour of retaining and enhancing the EA configuration in its current location.

This decision then determined the retention of the existing ground floor concrete slab of 91 Hereford St, and the basement car park and foundations. Further engineering analysis determined that the retained components provided a solid foundation for any future new building that also removed the significant risk of damage to the underground cable tunnel, foundations of Telecom's 109 Hereford St main Exchange building and a neighbouring building that would otherwise have been of concern when digging out the substantial foundations to 91 Hereford St.

Consideration was also given to what would be done to the largely vacant site after the completion of deconstruction. A concept scheme was developed, entitled the 'Telecom Green', that intends to provide an inner city public park area until any future long term use of the site is determined. The Telecom Green space will generally consist of a landscaped area with seating and lighting and potential art works or murals.

5 **DECONSTRUCTION PHASE**

5.1 **Set-up and 'Soft Strip' Commencement**

Upon Fletcher Construction being awarded the deconstruction contract for 91 Hereford St, further workshops were held with the Contractor, its sub-contractors and other relevant parties to review the risk items for the project and develop an appropriate deconstruction methodology to take account of the site constraints and incorporate the specific protective measures required. Subsequently a detailed methodology, as required by CERA for the deconstruction of any significant buildings, was developed and issued to CERA for approval. The 'soft-strip' and installation of protective works commenced in February 2013.

Site access was facilitated by the use of a vacant site to the north of 91 Hereford St where a heavy crawler crane could be located to facilitate the 'cut and crane' technique that was necessary for removing the primary structural elements. This method was essential in order to minimise dust levels, minimise the risk of vibration damage to Telecom's critical operational network hardware in 109 Hereford St and to minimise the risk of damage to adjacent facilities.

5.2 **Primary Deconstruction Challenges**

Despite the initial hazardous substances survey, deconstruction work uncovered a hidden and trapped layer of potentially friable (ability to become airborne) layer of asbestos insulation material. This was trapped between the solid sarking timber roof structure and the corrugated iron roof. The discovery of this layer and its extent necessitated a significant effort to contain the asbestos layer during the deconstruction phase. Effectively the entire building's roof had to be encapsulated. A temporary truss structure was erected over the building's roof to which plastic wrap was fixed. Internal walls were

built at the roof level to section off areas of the top floor of the building so that decontamination of different areas of the roof could be prioritised. Strict access measures were in place and a mobile shower was provided at the upper level of the building to allow the specialist removal team to clean themselves after completing work shifts. A 'negative pressure' environment was created to assist with preventing Asbestos material escaping to the external environment. External air quality sampling equipment was installed in several locations to ensure the continual integrity of the encapsulation. These samples were tested every day and provided an ongoing assurance that there was no leakage of any asbestos material or fibres.

The discovery and subsequent management of the asbestos added significant cost to the project and delayed the completion of the deconstruction by approximately five months, taking it to eleven months in total. The measures undertaken to contain and manage the asbestos removal were considered to be industry leading and received favourable praise from Department of Labour and CERA representatives.

5.3 **'Hard' Deconstruction**

The 'hard' deconstruction phase was able to commence after removal and disposal of the asbestos had been completed. Final approval of the deconstruction methodology was required from CERA before commencing works and this was duly obtained.

Concrete slab areas were generally broken up by a small mechanical digger and dropped onto the floor below to expose the beams. A 'cut and crane' technique was then used to remove the beam and column elements of the primary structure. This involved breaking away the concrete cover encasing beams and columns to expose the structural steel. The beams and columns were then supported prior to being cut and, once cut, immediately lifted to a work area to the north of the site to be further broken up. The scabbled concrete was transported to designated landfill areas and the steel sent for recycling.

At ground floor level the columns were cut flush with the ground floor slab to allow a water proof trafficable membrane to be applied over the existing slab. The installation of the membrane will also facilitate the future 'Telecom Green' public space.

Fortnightly site meetings were held between the relevant stakeholders, including the client, to review progress and manage risk throughout the deconstruction process. Telecom also appointed a representative who had a daily presence on site and whose role was to ensure that the agreed deconstruction methodology was followed rigorously and that protection measures were effective. The engineering representative attending the daily pre-work site meetings and was fully conversant with the planned daily activities. They could assess the ever changing daily risk to "Network Protection Without Compromise" and advise the deconstruction team of anything that could pose an unusual risk.

Figure 5 shows a selection of pictures taken during the deconstruction phase including the 91 Hereford Street building at the commencement of deconstruction and the site at the conclusion of deconstruction.

5.4 **Health and Safety**

Several minor incidents were reported during the deconstruction phase but none of a serious nature.

However, it was with much sadness that one of the Fletcher sub-contractor staff passed away whilst on-site for non-work related health reasons and our condolences are extended to his family, friends and colleagues. This unfortunate event impacted the deconstruction crew so work was halted for 24 hours, then resumed at a slow pace for several days to allow the crew to come to terms with their loss, and to have time to regain their total focus on the task at hand. The risk of an accident through emotional distraction was mitigated.

Figure 5. Representative images during deconstruction phase including images of the building at the commencement of deconstruction and the site at the completion

5.5 Survey Monitoring of Site

A baseline survey was undertaken before deconstruction commenced with datum points set on the surrounding buildings and on the 91 Hereford St ground floor slab. Regular monitoring by surveyors was undertaken to determine whether the deconstruction of 91 Hereford St was having any impact on the adjacent buildings and whether the retained 91 Hereford St basement would rise as a result of the removal of the superstructure. Calculations indicated that the combined weight of the retained basement and the ground floor slab prevent the basement from rising and the monitoring results showed negligible movement of the basement.

6 CONCLUSIONS AND LESSONS LEARNT

The successful deconstruction of 91 Hereford St was an excellent example of the collaboration and integration of a number of stakeholders who deployed sound engineering expertise to deconstruct the former main Christchurch Exchange Building with no compromise to the operational Telecom network. Extensive efforts were made by all parties to address potential risk matters by the development and maintenance of a comprehensive risk register.

Significant time and effort was required to address and agree the methodology for not only the safe deconstruction of 91 Hereford St but also the containment, management and disposal of unanticipated hazardous materials discovered during the process. The method developed to address the disposal of the unexpected asbestos material was considered industry leading and best practice by Department of Labour and CERA representatives. None of the project team considered doing anything other than ‘best practise’.

Deconstruction techniques for significant buildings damaged by the Christchurch earthquakes are becoming increasingly complex, even more so when taking account of the need to encapsulate and dispose of hazardous materials during the deconstruction process. This complicated and completed project proves that with the right focus on planning, preparation, protection and determination it can be achieved to the highest standards.