Example of research paper on the ctv building collapse in christchurch

Environment, Disaster

Introduction

Over years, engineers strive to construct structures that have conventional designs and are capable of fulfilling the designed jobs effectively and safely. Even with all these design factors adhered to, accidents and unexpected loads caused by things like earthquakes, explosions, tornados, moving machine impacts and many other things make a well constructed building suffer damages. Because of such unforeseen accidents and abnormal loads are capable of causing many damage and loss of lives, engineers should provide an effective structural integrity to structures. Structural integrity could be achieved through proper judgment and sharing of ideas and opinions on how to come up with a strong building capable of resisting external forces. On the other hand, architectures and engineers working on a building depend on building codes that feature all the requirements in the design of any structure. However, building codes were generated many years ago and fail to specify all the challenges faced by engineers and architectures today (Chudley & Greeno, 2004). According to Hyland (2012), building codes provide a set of specific structural requirements that provide reinforcement details of cast-in-place beams, slabs, and precise structures. This essay aims at investigating the structural integrity (professional and personal ethics) that led to the collapse of CTV building after the Christchurch earthquake. The CTV building acted as the headquarters of Canterbury Television and many other companies. The CTV building collapsed on February 2011 after a massive earthquake hit Christchurch in New Zealand. The department of Building and Housing formed in 1994 plays a significance role in helping with this analysis. This essay will follow the

following format.

- Introduction
- Discussion
- Events leading to the collapse of the building and events following
- Different roles involved in the design processes
- Different roles involved in the approval and building process
- A discussion of IPENZ’s role
- People who made the building collapse
- Safety measures put in place and how they were not implemented
- Conclusion

Discussion

Events leading to the collapse of the building and events following

A 6. 3 magnitude earthquake took place on February 2011 at 1251HRS shaking Christchurch in New Zealand and its surrounding area. This massive earthquake destroyed many properties in the Central Business District of Christchurch, Eastern and Southern suburbs, Port hills and Lyttelton. During the earthquake, only the north shear wall collapsed causing an enormous fire that also contributed to live losses. One hundred and fifteen people lost their lives and left others with severe injuries following the disaster. The design of the CTV building could not hold the ground shaking forces that led to its collapse. In addition, the building designers used old building codes and failed to embrace the new codes that could have sustained the earth shaking forces. On the other hand, incompetence and several design flaws have been the main reason why the CTV building could not withstand a 6. 3 magnitude

earthquake.

After the accident, a royal commission of inquiry was formed to investigate the main factors that led to the collapse of the CTV building. All witnesses were called upon to testify what they saw to assist in the investigations. The most crucial factors considered in the analysis of the causes of the collapse of the building were whether the building was code-compliance and the competence of engineers assigned the work of design and construction. The commission released their findings in December 2012 that stated that the building was not up to the standards and was not liable for approval. Several changes were brought into the construction industry after the Hawke earthquake involving the use of ductile designs, as opposed to un-ductile designs. The proposed ductile designs involve using joints that are capable of constructing buildings that can survive earthquakes and other ground movements. The original design of the CTV building indicated it had six levels with the ground floor taking the label of level one (The Department of Building and Housing, 2012).

Different roles involved in the design process

David Harding of Alan Reay Consultants Ltd undertook the design and construction of CTV building in Christchurch, New Zealand. The original design comprised of a strip and pad footing laying on sand, silt and gravel. The ground structure was to consist of a shear wall protected gravity load system. The shear walls were capable of giving the building enough resistance to lateral loads in case of an earthquake. The commission of inquiry found out that the CTV building project should not have been

approved because David Harding had insufficient expertise in the construction industry and did not follow the design correctly. In addition, the constructor had not constructed a six-storey building in the past that made him lost on all the designs causing the building to collapse after a 6. 3 magnitude earthquake. Engineers involved in the construction work designed columns to handle gravity loads assuming that the shear walls would counter lateral deflections on the columns (Hyland and Smith, 2012). The building codes require that every part of a building should have all its elements capable of standing and repelling all seismic movements and forces. Ductility design proposed would have prevented all these misfortunes because building designs should present safety to occupants even when seismic forces are stronger than the strength of the building (Aysan, 1995). On the other hand, seismic performance ensures that designers construct a building with enough ductility and load bearing elements. The seismic building codes require that engineers meet certain requirements in order to maintain the correct level of ductility during construction work. The construction company hired to build the CTV building failed to take into consideration the relationship between beams and columns with reinforced concrete and the axial load levels, transverse reinforcement, and concrete strength. According to Chopra and Goel (1999), regions experiencing high seismic loads do not use precast concrete in construction and instead use ductile links that improve a building’s strength. The investigation after the collapse of the VCTV building indicated that engineers did not put the above factors into consideration and ended up construction the building full of

engineering and design flaws that made it collapse after the earthquake (The Department of Building and Housing, 2012).

Different roles involved in the approval and building process with supporting evidence

Approval process

The Canterbury earthquake royal commission investigating the collapse of CTV building condemned its design and argued that the building should not have been approved. The Royal Commission saw many flaws in the building of the CTV structure and could not understand why the government had given a go ahead to the constructors. In addition, the system used to give the building approval was not genuine because the person given the work of overseeing the building construction was not proficient enough in the building industry. Moreover, the approval department did not carry out enough investigation on David competences because the commission revealed that he was working beyond his competence. David faced minimal supervision from his seniors because they believed in his productivity because they had misplaced confidence on his building capabilities (Canterbury Earthquakes Royal Commission, 2012).

On the other hand, the Department for Building and Construction in New Zealand issued an unlawful permit to approve the construction of CTV building because the design failed to comply with the CCC's Building Bylaws. Finally, the construction manager was reportedly absent from his duties showing that he did not adequately supervise the construction. In addition, he used fake Engineering certificates using false names of a retired engineer (Department of Building and housing, 2012; 5).

Building process

The construction of CTV building was liable to many collapse scenarios as identified from building remnants examined after the collapse using different structural analysis. Column failure was identified as the main factor that caused the building to collapse among other causes. Non-ductile columns were used in the building process that were prone to failure in case of massive seismic forces. In addition, the floor slabs constructed were of low quality and could not resist lateral movements of the building. The concrete used was of low strength as the evaluation indicated and was affected by high vertical acceleration (Canterbury Earthquakes Royal Commission, 2012). Moreover, geometrically irregular structures were discovered from the building remnants indicating that the building designers did not carry out enough structural analysis process. The actual displacement capacity of gravity-load bearing columns was designed using the earlier design codes introduced before 1995. All buildings that were constructed before the year 1995 used non-ductile columns that were vulnerable to seismic forces. Finally, the person given the work of building the structure did not follow all design features described on the original design instead, he used his own designs (Department of Building and Housing, 2012; 8-9).

The IPENZ’s role

IPENZ stands the Institution of Professional Engineers New Zealand. IPENZ undertook the role of investigating the main engineering flaws present in the CTV Building that led to its collapse. However, the Christchurch engineer whose firm was given the tender to construct the building tried with all

means to stop IPENZ from undertaking its investigations. IPENZ is a known body in New Zealand, and its findings would play a significant role in determining what design and construction features lacked in the building that made it collapse under a 6. 3 magnitude earthquake. IPENZ investigated about Reay's engineering activities and collaborated with friends and families of these killed and injured in the accident in order to collect more evidences. In addition, IPENZ with the help of its chief executive, Andrew, seeks to determine the validity of Engineer David Harding from Reay Construction Ltd in building a six-storey building without any prior experience on the same. Reay Construction management went ahead and left the building unsupervised even with David's limited ability in building and construction.

The report written by the Royal Commission of inquiry following the CTV building collapse indicated that IPENZ played its role perfectly and came up with many engineering flaws observed in the construction of the CTV building. One of the IPENZ's vital role was to determine the compliance of the building to the general New Zealand engineering standard. The findings written in the Royal Commission report shows that the design used in constructing CTV building lacked a number of key aspects (Department of Building and Housing, 2012).

Who was responsible for the collapse of CTV building?

The report derived by the Royal Commission of Enquiry to the Department of Building and Housing gave many evidences of a number of parties believed to have contributed to the accident that killed many innocent citizens. The

first party believed to be responsible for the collapse of CTV building is the Reay construction Firm. According to One News (2012), the engineering firm that took the contract f building the CTV building bears the responsibility of making design flaws. Reay Construction Ltd was given the responsibility of building CTV house and provided with a well designed layout of the building. The firm did not follow the design features and instead, employed incompetent contractor, David, who could not understand what the design required. In addition, the firm was reluctant to carry out onsite supervision and employed a lazy supervisor who did not attend to his duties effectively (Department of Building and Housing, 2012).

Secondly, the person given the responsibility of undertaking the construction work, David, was also responsible for the collapse of CTV building. According to the Department of Building and Housing report with the help of IPENZ, David was not a qualified engineer. David took the duty of leading the construction of a high-class building without any valid engineering knowledge and experience leading to a structure that could not resists minimal seismic loads. In addition, David accepted the contract knowing that he was no competent enough to carry out his duties effectively. His lack of experience, engineering knowledge and competence in the construction industry made him responsible for the collapse of CTV building in Christchurch, New Zealand (Department of building and Housing, 2012).

Safe guards in place and how they were/were not enforced

The New Zealand construction industry had put in place several construction rules that were to be followed by all contractors. Firstly, the area is prone to

seismic forces hence, all buildings must be constructed in a manner that the resist any lateral movement taking place underground. The construction of CTV building did not follow this safety guidance because the engineers failed to construct a building with enough ductility and load bearing elements. In addition, after the collapse, the IPENZ suggested that all buildings to use the construction work designed columns to handle gravity loads assuming that the shear walls would counter lateral deflections on the columns. These safe guards have been adhered to as no such case has ever occurred again since 2011.

Secondly, the safe guard provides that all buildings should have adequate of floor to shear wall. All buildings constructed in New Zealand after the year 1992 must meet this requirement. The engineers constructing CTV building ignored to put shear walls and instead constructed flat slabs to act as force bearing elements. Moreover, the building had no clearance requirements for non-structural components capable of affecting its structural requirements. The engineers of CTV building did not have an adequate level of involvement that led to its collapse.

Conclusion

What led to the collapse of CTV building in Christchurch? The following question has been answered from the findings of this essay. From the research, two things contributed to the collapse of CTV building. Firstly, the New Zealand government approved an incompetent firm to carry out the construction of CTV building and ended up building a structure that was not in accordance to the original design. Secondly, the supervisors and leading

engineers hired to lead in the construction process were not proficient and had not prior expertise in the construction of a six-storey building.

References

Aysan, Y. (1995). Developing building for safety programmes: guidelines for organizing safe

building improvement programmes in disaster-prone areas. London: Intermediate Technology Publications.

Chopra, A. K., & Goel, R. K. (1999). Capacity-demand-diagram methods for estimating seismic

deformation of inelastic structures: SDF systems. Berkeley: Pacific Earthquake Engineering Research Center.

Chudley, R., & Greeno, R. (2004). Building construction handbook (5th ed.). Oxford: Elsevier

Butterworth-Heinemann.

Canterbury Earthquakes Royal Commission. (2012), Final Report Canterbury Television

Building', Royal Commission, New Zealand, Vol. 6 p. 1.

Performance of Buildings in Christchurch–Final Report. Retrieved from: http://www. dbh. govt. nz/UserFiles/File/Reports/quake-dbh-cti-final-report. pdf

Hyland, C. (2012). CTV building collapse investigation for Department of Building and Housing,

25th January 2012. Christchurch, N. Z.: Dept. of Building and Housing.

Hyland, C. and Smith, A. (2012). CTV Collapse Investigation for Department

of Building and

Housing 25 January 2012. Wellington, New Zealand: Department of Building and Housing.

McSaveney, E. (2012). 'Earthquakes - Building for earthquake resistance', Te Ara- he

Encyclopedia of New Zealand. Retrieved from: http://www. TeAra. govt. nz/en/earthquakes/page-4

One News. (2012). Engineers blamed for CTV collapse. Retrieved from: http://tvnz. co. nz/national-news/engineers-blamed-ctv-collapse-5064618

The Department of Building and Housing. (2012). Structural performance of Christchurch CBD

buildings in the 22 February 2011 aftershock: covering Canterbury Television Building, Pyne Gould Corporation Building, Hotel Grand Chancellor Building, Forsyth Barr Building. (2012). Wellington, N. Z.: Dept.