

Project: Detailed Seismic Assessment Report of Upper Hutt Civic Building

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SEISMIC ASSESSMENT OF UPPER HUTT CIVIC CENTRE

Executive Summary

Presented here is the seismic assessment of Upper Hutt Civic Centre, which is the city council building, in order to (1). Establish the seismic status of the building at its existing condition if the building is used as a building of importance level 2; and (2). Establish the seismic status of the building at its existing condition if the building is used as a building of importance level 4, which is a building with special post-disaster functions.

Upper Hutt Civic Centre is a rectangular four storey reinforced concrete (RC) wall-frame building constructed in 1967. The dimensions of the building are 34 meters in length, 18 meters in width, and 13.4 meters in height. The building is regular in both directions. At the centre of the building, there is a strong spine element, which is the penetrated RC wall box of full building height. Surround of the RC wall box are reinforced concrete frames, which provide significant moment resistance for the overturning and also act as lateral load resisting systems. The suspended floors and the basement are reinforced concrete floors, and every suspended floor is a mixture of in-situ concrete floor and precast floor with in-situ topping. For the roof, it has got light framing with corrugated metal roofing.

Seismic assessment of Upper Hutt Civic Centre is conducted separately for longitudinal direction and transverse direction, in accordance with the recommendations of the New Zealand Society for Earthquake Engineering (NZSEE) guideline for the assessment of seismic performance of existing buildings dated in 2006. In this assessment, the building classification of being importance level 2 or importance level 4 is based on NZS1170.0:2002, "Structural Design Actions - General Principles". The assessment has considered the lateral load resisting systems to be reinforced concrete wall-frame (Dual) structure. The subsoil class was assumed as "D" as per NZS1170.5:2004, which is the current seismic loading code.

Our assessment concludes the followings:

(1). That the seismic performance of reinforced concrete walls, which are the dominant lateral load resisting systems, would be the preferred ductile flexural mode;

(2). The subject building is expected to have greater seismic resistance in the building's long direction, when compared with that in the building's short direction;

(3) For both directions, our assessment has concluded that the overall seismic rating of the subject building at its existing condition meets 100% New Building Standard (NBS) if the building is considered as a building of importance level 2; and

(4). *If the subject building is used as a building with special post-disaster functions, namely a building of importance level 4, the overall seismic rating of the subject building at its existing condition is 85%NBS, which is limited by the seismic rating in the building's short direction.*

1 Background

We were commissioned by Upper Hutt City Council to conduct a detailed seismic assessment to establish the likely seismic rating of the existing building "Upper Hutt Civic Centre", according to the New Building Standards (NBS). The subject building is currently used as the office building for Upper Hutt City Council.

2 Limitations

This report should be used by Upper Hutt City Council only. Angela Liu should be consulted if any questions arise regarding the interpretation or completeness of our study and report.

3 Description of the Subject Building

One set of structural design drawings was obtained from Upper Hutt City Council. Site visits have confirmed that the existing building is a reasonable representative of the original design drawings.

Upper Hutt Civic Centre is a regular 4 storey rectangular shaped building of about 34 m long, 18 m wide and 13.4 meters high. The building was originally designed in 1967 and the seismic loading code used for the original design was likely to be Chapter 8 of 1965 Code. The lateral seismic load resisting systems are reinforced concrete wall-frame structures in both directions. At the centre of the building, there is a strong spine element, which is the penetrated RC wall box of full building height. The RC wall box has a width, which is about 15% of the total building width, and a length, which is about two thirds (67%) of the total building length. The surround of the RC wall box are reinforced concrete frames in both directions. The RC frames in the short direction of the building also act as lateral load resisting systems, however the more important is that the RC frames provide significant overturning moment resistance in the short direction.

For the floors, the suspended floors and the basement are reinforced concrete floors and the suspended floors are a mixture of in-situ concrete floor and precast floor with 75mm in-situ topping at each level. For the roof, it has got light framing with corrugated metal roofing.

4 Seismic Assessment of Upper Hutt Civic Centre at Its Existing Condition

4.1 Methodology

The subject building, "Upper Hutt Civic Centre" is assessed according to the New Zealand Society for Earthquake Engineering (NZSEE) Guideline 2006 "Assessment and Improvement of the Structural Performance of Buildings in Earthquakes", which was developed for the assessment of seismic performance of existing buildings.

4.2 Assumptions of Probable Material Properties

As stated clearly in NZSEE guideline, probable material strengths, rather than the specified material strengths, should be used when assessing the seismic performance of existing buildings. In accordance with the recommendations in the NZSEE guideline 2006, the probable strength of reinforcing bars is about 1.15 times the specified strength and the compressive strength of concrete is likely to be in the order of 1.5 times of the specified concrete compressive strength.

The specified concrete compressive strength in the original design was 20MPa. In this assessment, we used the concrete compressive strength of 30 MPa and we assumed that the strength of reinforcing bars in the RC beams and columns was $f_y = 275$ MPa, as recommended by NZSEE guideline for the buildings in 1960s.

4.3 Subsoil Classification

For the subsoil classification, our assessment has assumed subsoil class "D" to AS/NZS1170.5:2004.

4.4 Building Ductility

In deriving the seismic actions, a limited ductility of 3 was assumed for either direction. This is reasonable because our assessment has shown that the RC walls will be expected to fail in a ductile manner and the RC walls have a deformation capability for a ductility of at least 3.

4.5 Seismic Assessment

Seismic assessment of Upper Hutt Civic Centre is conducted separately for longitudinal direction and transverse direction, in accordance with the recommendations of the New Zealand Society for Earthquake Engineering (NZSEE) guideline for the assessment of seismic performance of existing buildings dated in 2006. In this assessment, the building is classified as a building of Importance level 2 as per NZS1170.0: 2002, "Structural

Design Action-General Principles". The assessment in short direction, which is the longitudinal direction, has considered the lateral load resisting systems as reinforced concrete wall-frame (Dual) structure. The assessment in long direction, which is the transverse direction, has considered the lateral load resisting systems as reinforced concrete wall structure by ignoring the contribution of RC frames to the seismic resistance.

The subsoil class was assumed as "D" as per NZS1170.5:2004, which is the current seismic loading code. The fundamental period was assumed to be 0.4 s, and this is realistic for a four storey RC wall-frame building.

For the existing RC walls, we have assessed both their probably flexural moment capacities and their probable shear capacities. Our assessment concludes (1). That the seismic failure mechanism of reinforced concrete walls, which are the dominant lateral load resisting systems, would be the preferred ductile flexural mode; and the assumed building ductility of 3 can be achieved; (2). The overall seismic rating of the subject building at its existing condition meets 100% New Building Standard (NBS) in both directions. The subject building is expected to have greater seismic resistance in the building's long direction, when compared with that in the building's short direction.

5 Conclusions

The Upper Hutt Civic Centre is a 4 storey regular RC wall-frame structure and the building is currently used as the office building for Upper Hutt City Council.

The seismic assessment conducted for the subject building has demonstrated that the overall seismic performance of the building is expected to be in a ductile manner, which is the preferred seismic failure mechanism. The subject building is expected to have greater seismic resistance in the building's long direction, when compared with that in the building's short direction.

For both directions, our assessment has concluded that the overall seismic rating of the subject building at its existing condition meets 100% New Building Standard (NBS) if the subject building is considered as a building of importance level 2.

However if the building is considered as a building of importance level 4, which refers to the buildings with special post-disaster functions, the overall seismic rating of the subject building at its existing condition meets 85% New Building Standard (NBS). The overall seismic rating of the existing building is limited by the seismic resistance of the building in its short direction.

References

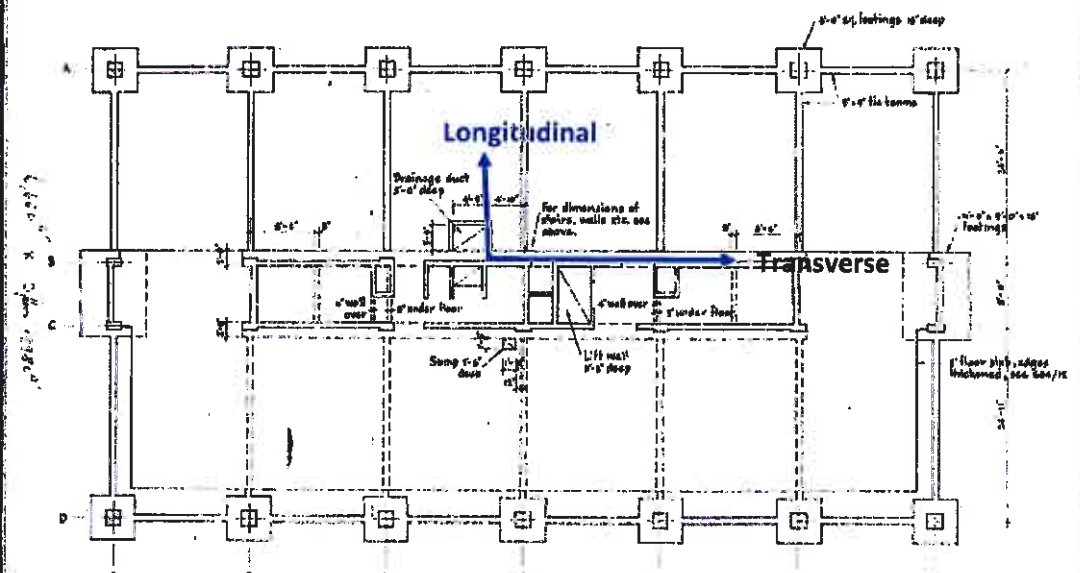
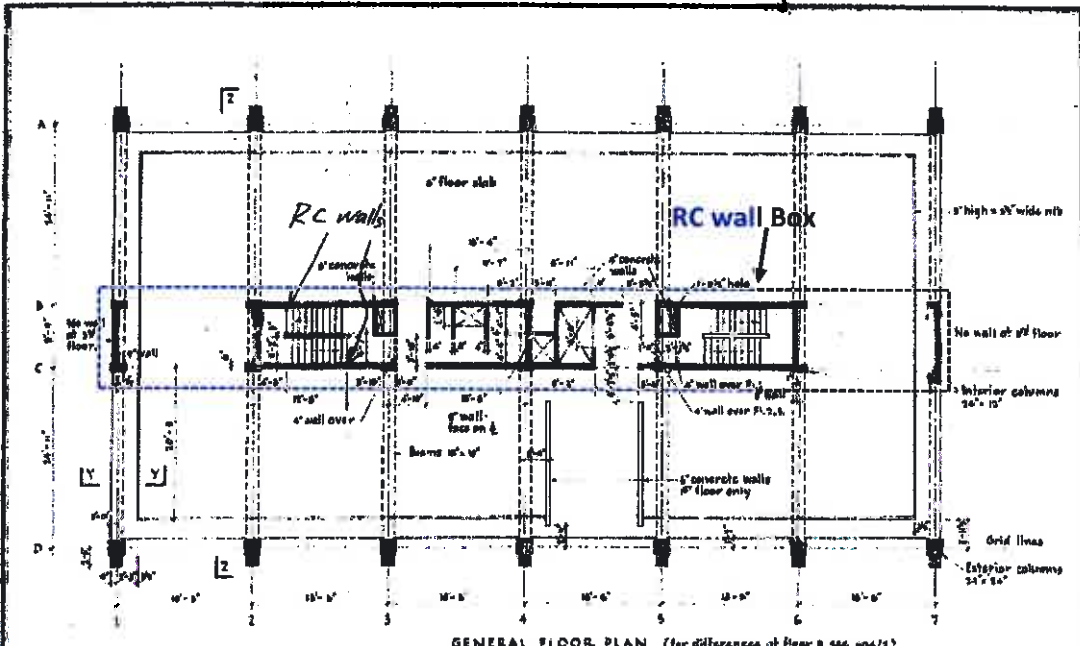
New Zealand Building Act, 2004

NZS 1170.0:2002, Structural Design Actions Part 0 – General Principles, Standards New Zealand.

NZS 1170.5:2004, Structural Design Actions Part 5 – Earthquake Actions, Standards New Zealand.

NZSEE, 2006, Assessment and Improvement of the Structural Performance of Buildings in Earthquake, Recommendations of an NZSEE Study Group on Earthquake Risk, prepared for the Department of Building and Housing, June 2006.

Appendix A



604/1	GABITES AND BEARD	HOLLINGS & FERNER	UPPER HUTT CIVIC CENTRE	DESIGN	SCALE
	ARCHITECTS AND TOWN PLANNING CONSULTANTS P.O. BOX 518 WELLINGTON	CONSULTING CIVIL & STRUCTURAL ENGINEERS P.O. BOX 9045 WELLINGTON.	CITY COUNCIL BUILDING EIGHTH SCALE PLANS	NO. 100 DATE CHECKED BY	1/4" = 1'-0" 1/4" = 1'-0" 1/4" = 1'-0" 1/4" = 1'-0"

