SEISMIC VULNERABILITY ASSESSMENT OF IRREGULAR REINFORCED CONCRETE BUILDINGS IN AUSTRALIA

bushfire&natural HAZARDSCRC

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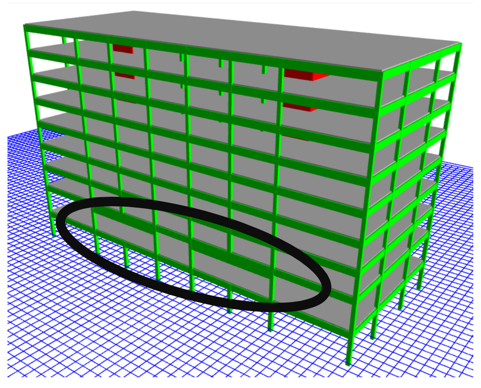
SEISMIC DESIGN AND ASSESSMENT OF IRREGULAR REINFORCED CONCRETE BUILDINGS IN THE REGIONS OF LOW TO MODERATE SEISMICITY SUCH AS AUSTRALIA IS INVESTIGATED THIS POSTER.

1. INTRODUCTION

Reinforced concrete buildings constitute a significant proportion of constructions in Australia. Many existing buildings in Australia and other low to moderate seismic regions have been designed with little to no consideration of ductile detailing. The majority of these buildings also possess irregularities which can exacerbate their vulnerability in an earthquake.

2. STUDIES BASED ON LINEAR RESPONSE

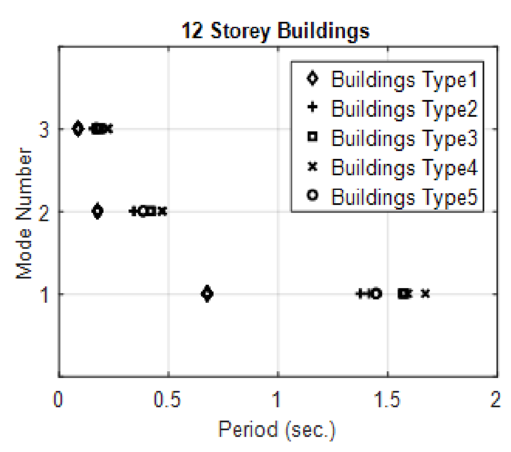
Seismic response of 75 buildings with various locations and extent of irregularities in elevation was evaluated.



A building to be assessed

2.1 Irregular buildings behaviour

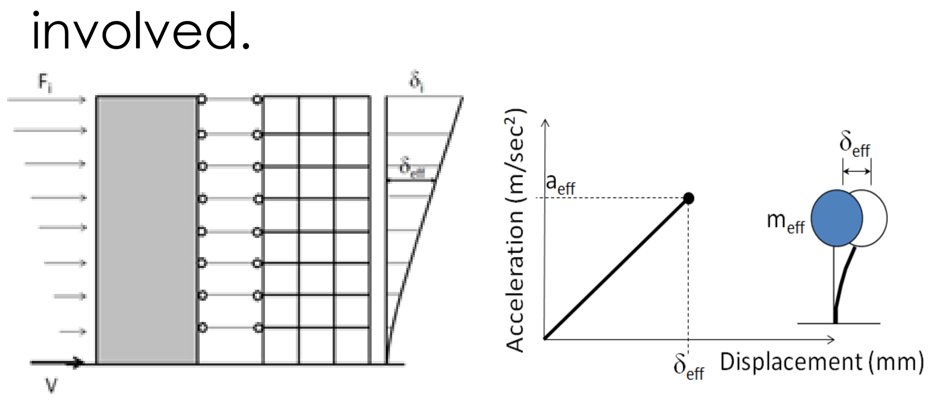
Comparison between the seismic response of vertical regular and vertical irregular buildings have shown that discontinuities in columns within the building do not result in soft-storey mechanism.



Periods of the modes of vibration of buildings

2.2 Generalised lateral force method (GLFM) of analysis

Seismic design codes of practice require the use of dynamic analyses for irregular buildings. However, dynamic analyses can be computationally expensive and require expert judgment, especially as far as three-dimensionally modelling is involved.



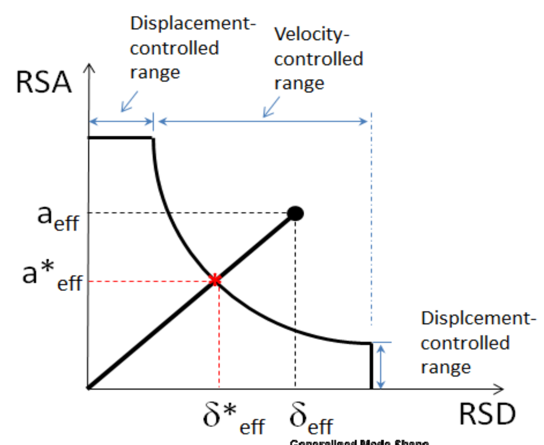
2.3 GLFM for torsionally balanced (TB) buildings

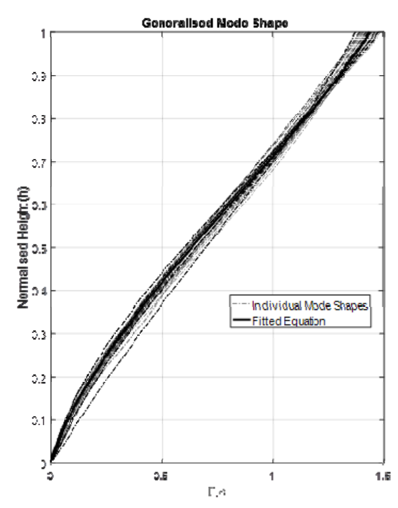
Using the suggested generalised mode shapes, a simple method were developed to estimate the displacement profile of taller buildings.

$$\delta_{eff} = \frac{\sum m_i\delta_i^2}{\sum m_i\delta_i}$$

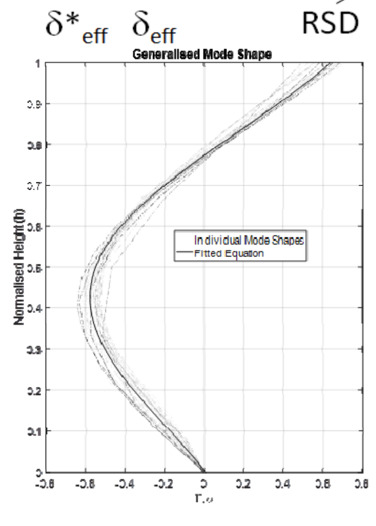
$$m_{eff} = \frac{(\sum m_i\delta_i)^2}{\sum m_i\delta_i^2}$$

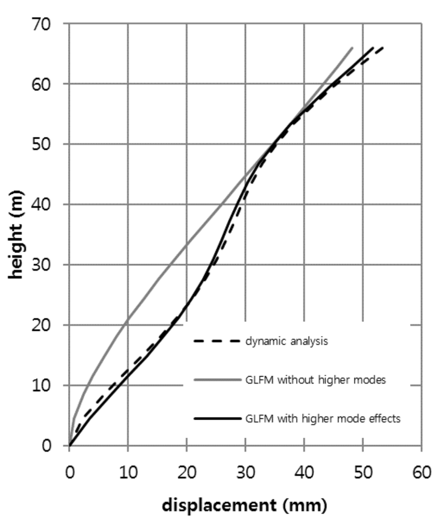
$$a_{eff} = \frac{V}{m_{eff}}$$





Generic mode shapes of first and second modes

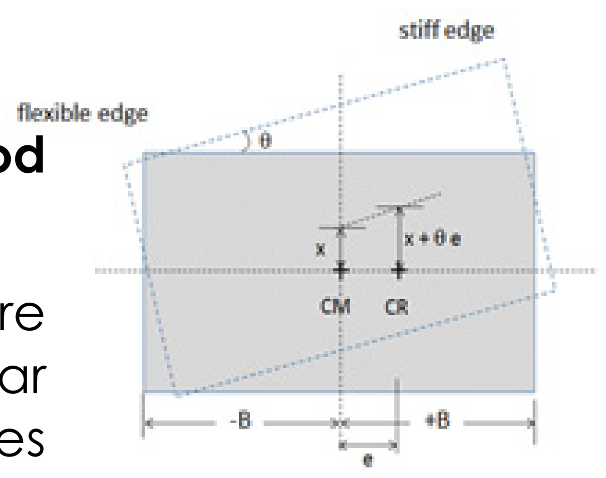


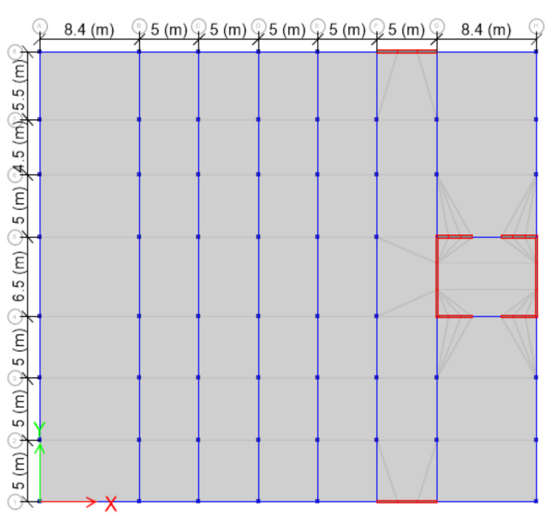


Comparison of the displacement profiles based on the proposed GLFM and dynamic method

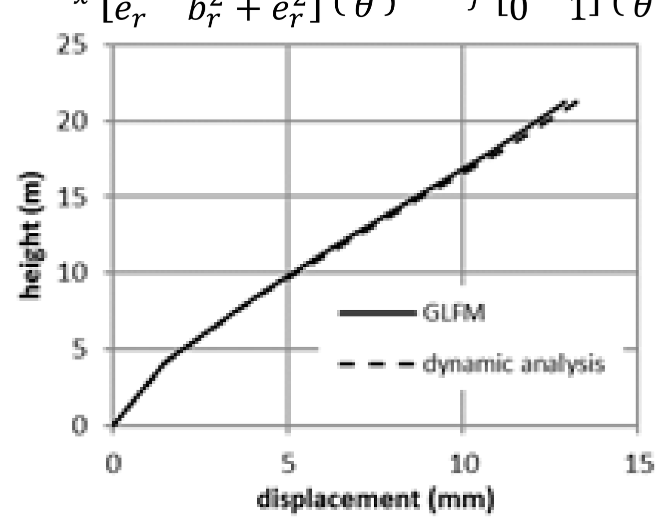
2.3 GLFM for torsionally Unbalanced (TU) buildings

The simplified method has been extended to account for the effects of torsion due to plan asymmetry.





$$\omega_x^2\begin{bmatrix}1 & e_r\\ e_r & b_r^2+e_r^2\end{bmatrix}\begin{Bmatrix}x_r\\ \theta\end{Bmatrix} - \Omega_j^2\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}\begin{Bmatrix}x_r\\ \theta\end{Bmatrix} = \begin{Bmatrix}0\\ 0\end{Bmatrix}$$



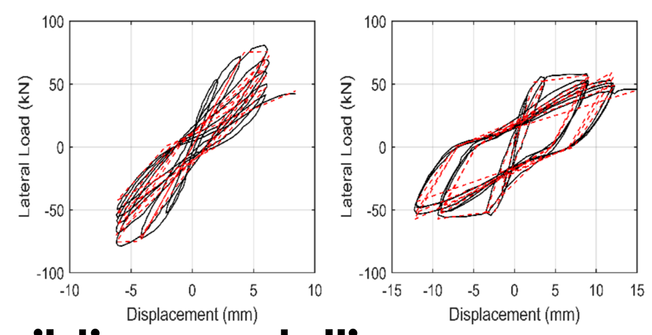
Comparison of the displacement profiles based on the proposed and dynamic method

3. STUDIES BASED ON NONLINEAR RESPONSE

Ductility and failure behaviour of multi-storey buildings featuring discontinuities is investigated.

3.1. Component modelling

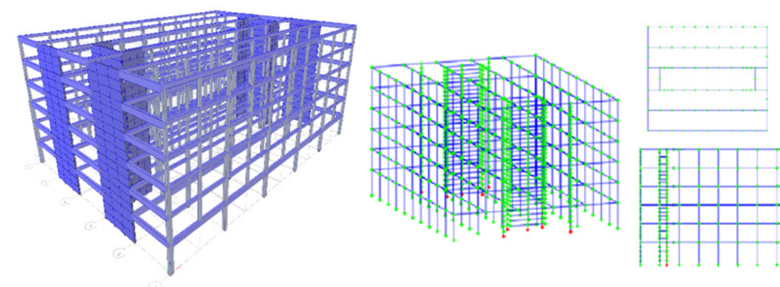
A systematic analytical modelling technique for the simulation of limited-ductile beam-column elements is proposed.

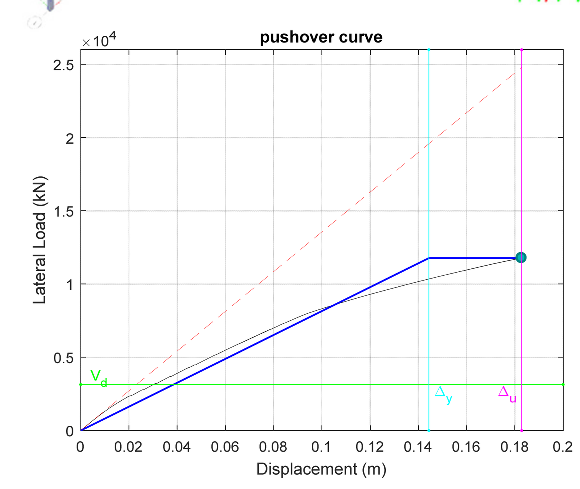


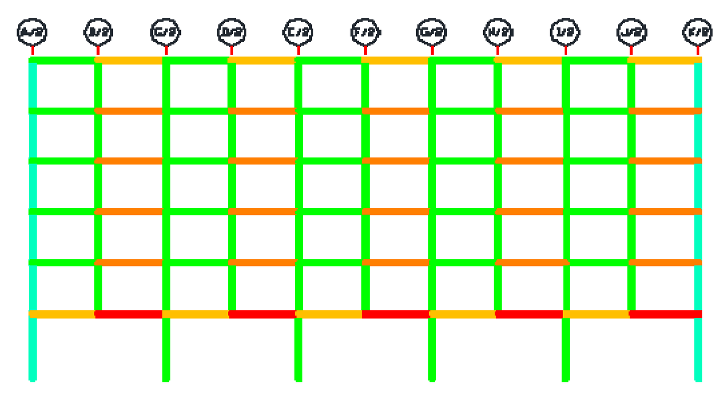
3.2. Building modelling

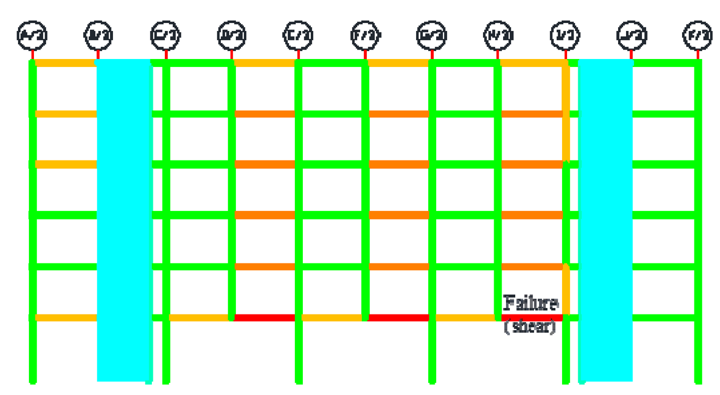
Using the proposed technique, OpenSEES finite element package employed to build 3D case study models.

3.3. Observed mechanisms









Shear failure in the transfer beam occurs prior to the point that structure reaches the calculated target displacement for some cases.

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