



## FORSYTH BARR BLDG STAIRS FAILURE

Comments by  
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**Expert Panel: Chaired by Sherwyn Williams (lawyer), and including representatives of Consulting Structural Engineers, Architects, Building Officials, Seismologists, Geotechnical Engineers, Academics.**

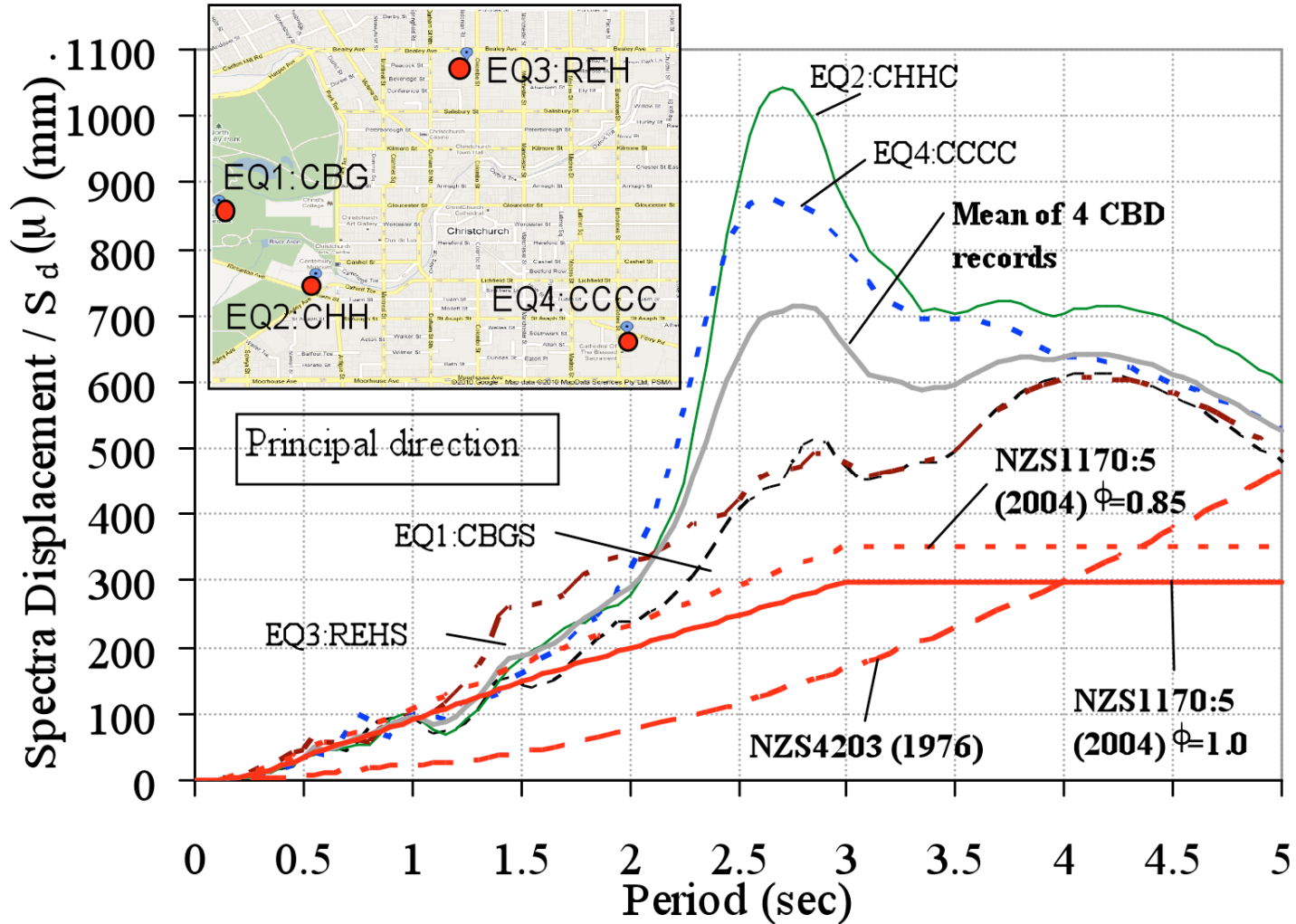
**Role: Assist and review work by Consulting Engineers appointed by DBH investigating collapse or damage to four buildings (PGC, FB, HGC and CTV), and to provide a report to DBH summarizing the consultants reports, and placing them in a wider context.**

## CONCLUSIONS OF EXPERT PANEL REPORT

- General endorsement of conclusions of BECA report
- Seismic Gap satisfied 1988 requirements, but was inadequate for intensity of Feb 22, 2012 earthquake
- Seismic gap of 30mm closed during the earthquake, damaging the the stairs, which shortened as a consequence, causing unseating when the direction of shaking reversed.
- The seismic gap provided would not have satisfied 2011 requirements (by about 20%).
- It is expected that a number of similar stairs in other buildings may be at risk in future earthquakes.
- A DBH Advisory Note should be issued warning about potential problems with the detail used in FB. (Note retrofit to improve safety would not be expensive)
- More conservative seismic gap details should be required for future building designs to ensure safety of egress in seismic events larger than the design level.

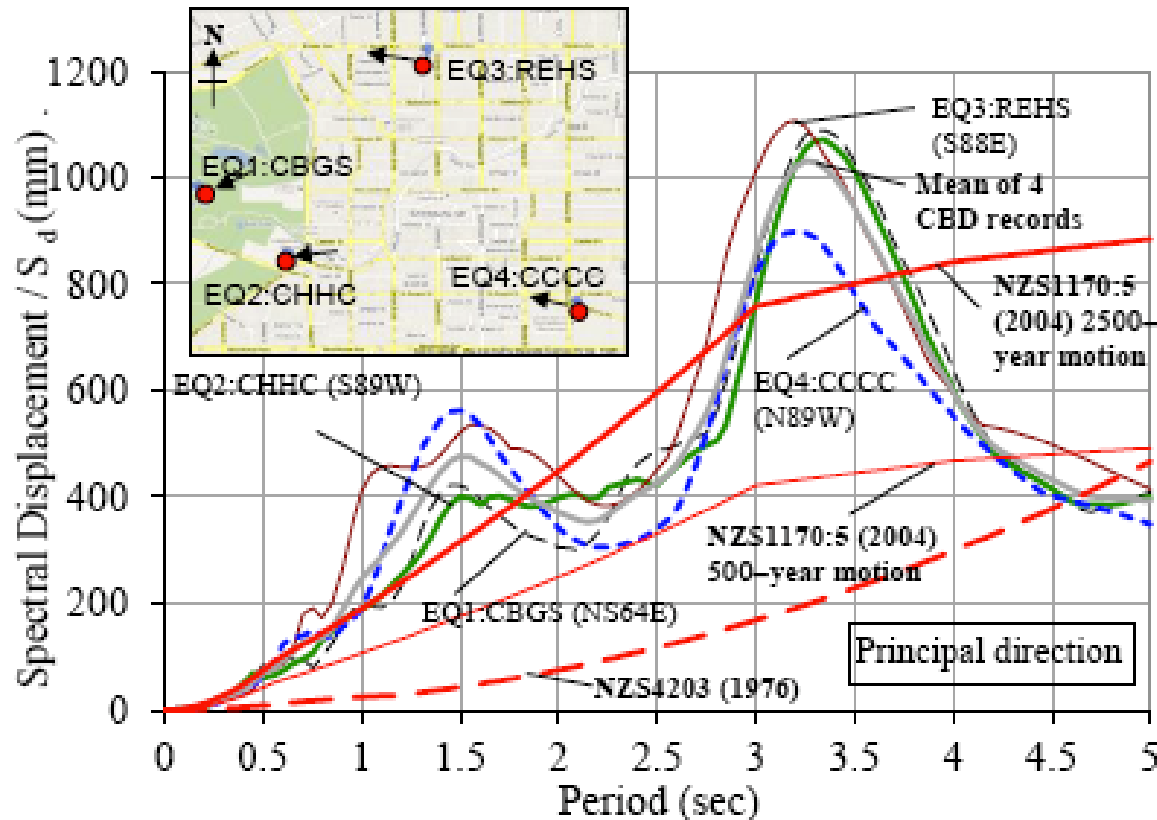
## ADDITIONAL PERSONAL OBSERVATIONS:

Influence of earthquake record

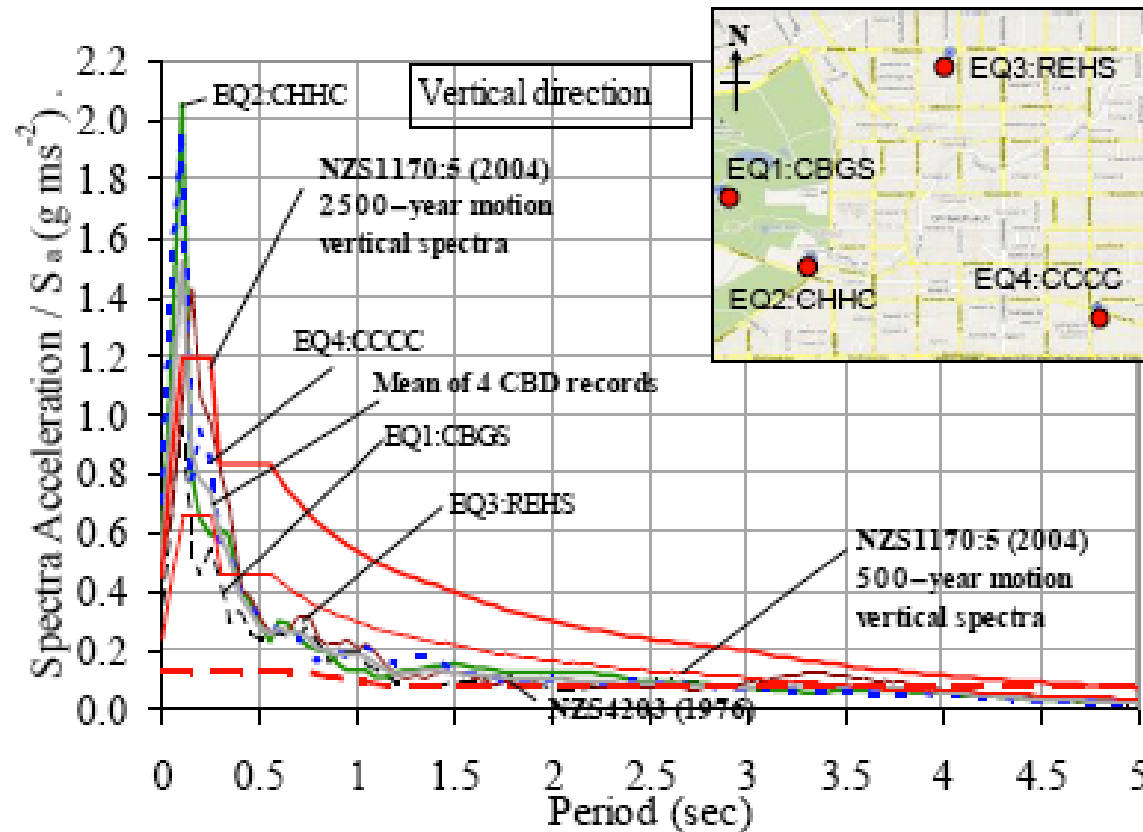


## HORIZONTAL DISPLACEMENT RESPONSE SPECTRA FOR CBD IN SEPT 4 EARTHQUAKE

# Significant displacement demand



# Vertical acceleration



## ISSUES REQUIRING FURTHER DISCUSSION

- Conclusions of BECA report are based on Elastic Time History Analyses. Calculations indicate that beam ductility demand would have been up to  $\mu = 3$ , indicating significant non-linear response. Results would have been more robust if NTHA had been used.
- Only one record (REHS) was used in the analysis. As a consequence the drift demands cannot be considered definitive.
- The possible bracing effect of the stairs acting as diagonal struts after closure of the seismic gap was not modelled
- The unloading stiffness of the damaged stairs after inelastic action following gap closure was too high, probably exaggerating the residual axial shortening of the stairs.
- If debris reduced effectiveness of the seismic gap, then damage, including an increase in the size of the seismic gap should have been apparent after Sept 4 (34mm closure vs 45mm in Feb 22)