Multi-Objective Optimized Dynamic Design (MOODD)

Despite advances in computational power, it had remained impractical to optimise dynamic design due to the highly nonlinear nature of dynamic analysis. Beca have now developed a means to optimise dynamic design and "tune" the response of a building in a way never before possible, with strict performance criteria focusing on seismic resilience and limiting loss. It is a paradigm shift in the approach to design.

When paired with the right projects – particularly those using damping devices, seismic retrofits, and projects with strict performance criteria, the potential benefits can be significant. Sample viscous damper retrofit projects show that building drifts and accelerations can be reduced, while using significantly fewer viscous dampers than required through traditional design approaches. For the right project, the advantages in partnering with Beca and use of the MOODD process can be significant.

A paradigm shift

Our smart design framework called MOODD is an efficient means to performance based design for seismic and wind. It is a philosophy of developing multiple performance objectives together with the client and designing accordingly.

An efficient way of finding a satisfying design by considering real world complexities:

- 3D multi-degree of freedom buildings
- Bi-directional ground motions
- Near-field and far field records
- Uncertainties in structure, soil and ground motions.

MOODD explicitly considers material usage (in the form of upfront carbon / embodied carbon) and seismic resilience as key design parameters. Life cycle cost design, targeting both embodied carbon and seismic resilience can also be achieved by MOODD.

As a result, MOODD will deliver:

- A design that targets several objectives at the same time: resilience, material usage or carbon impacts.
- A structure that is tested using several dozen ground motions of earthquakes while at the same time acknowledging the complexity of dynamic response.
- In consultation with the client, specific performance targets for the building.
- The best feasible solution chosen from multiple concepts which delivers options possible far beyond conventional design methods.

In summary, MOODD is our clever design solution that provides maximized resilience and material usage with lower carbon options and better economical solutions in mind.

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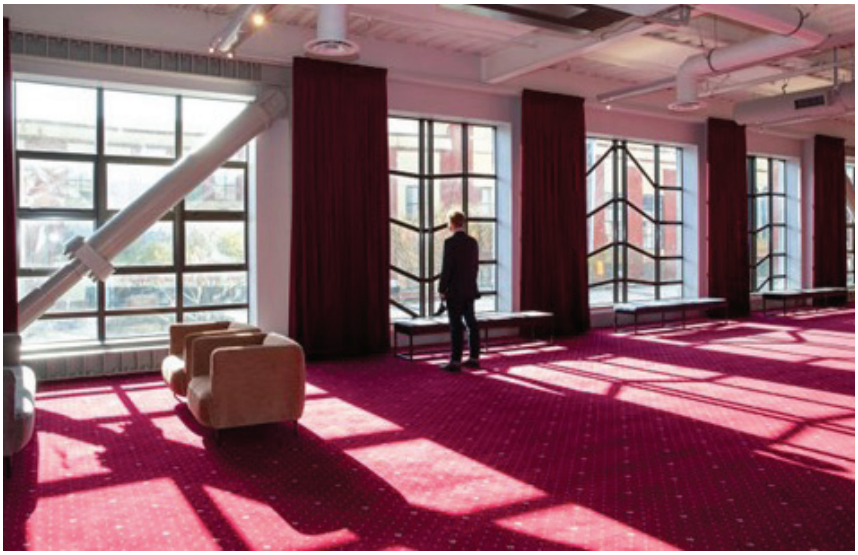

St James Theatre

Location Wellington, New Zealand
Period 2016 – 2023

The project involved the seismic retrofit of two 1912 heritage buildings making up the St James Theatre complex. Implementation of our multi-objective optimized design process allowed us to implement fluid viscous dampers for retrofit of one the buildings. The use of fluid viscous dampers reduced overall retrofit costs and avoided costly foundation upgrades internal to the building.

Awards

- Property Council New Zealand award – best projects 2023

8 Willis Street

Location Wellington, New Zealand
Period 2019 – 2021

Our breakthrough in structural design enabled us to add five floors to the 1980s tower at 8 Willis Street. It already had eight storeys, but we extended the footprint and brought the structure up to market-leading seismic resilience – achieved with just 12 fluid viscous dampers and a minimally invasive structural retrofit.

Awards

- CTBUH structural award 2023 Award of excellence
- IStructE award 2023 short listed

Judges comments

The thoughtful placement of the dampers has maintained open spaces, uninhibited by the structure, unlike other highly resilient seismic retrofits and new builds, where primary structural components tend to dominate the interior.

61 Molesworth Street

Location Wellington, New Zealand
Period December 2022 – Ongoing

This is a 13 storey structure presently under construction. The primary structure consists of a highly resilient damped concrete shear core system. MOODD was used for simultaneous optimization of the design for strength, stiffness and damping, minimizing embodied carbon and achieving a 6* in green star rating and 5* in NABERS rating.

The finished building will have architectural space uninterrupted seismic lateral structure which will makes it feel like a London building in Wellington which has one of the world's highest seismic hazards.