Seismic Low Damage Technologies for Bridges in New Zealand

From Research to Practice

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NHRP
Natural Hazards Research Platform

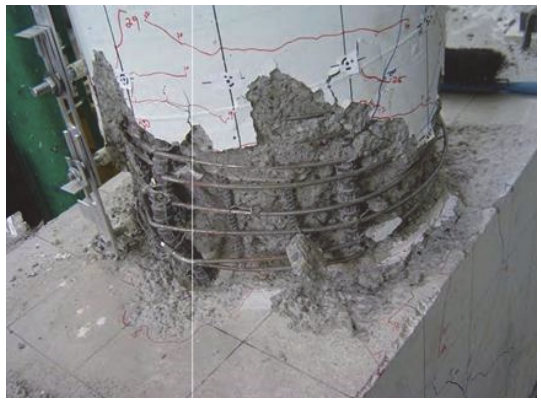
Presentation Outline

- Introduction to low damage connections for bridge substructures
- Research at the University of Canterbury
- Application to a bridge in Christchurch, New Zealand

Conventional approach

Ductile plastic hinging in concrete

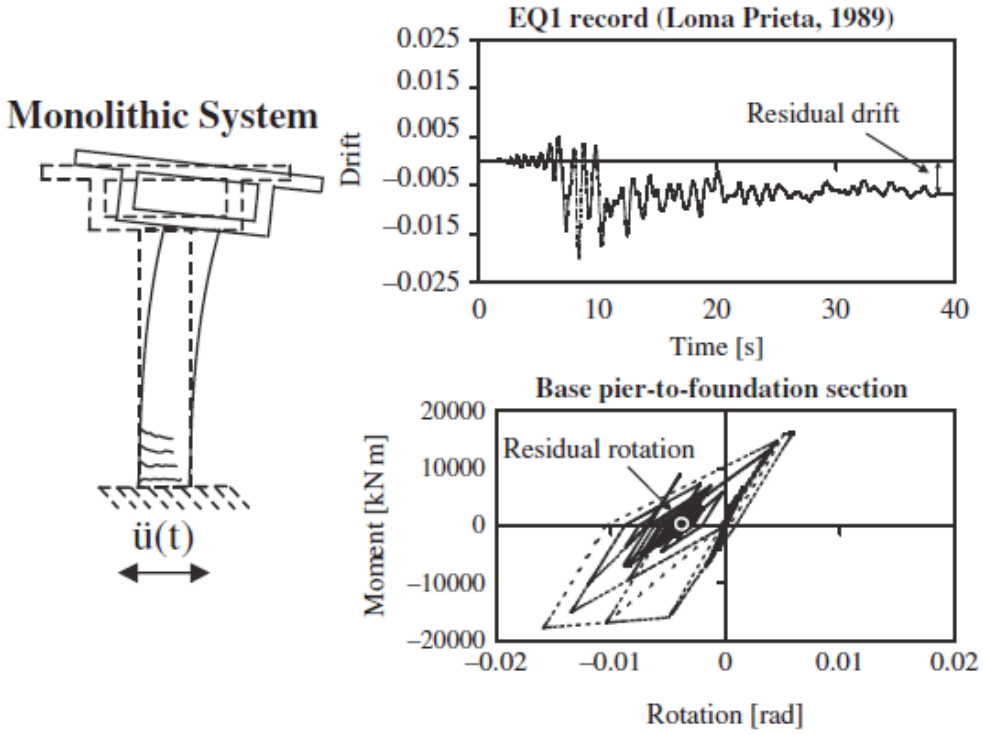
- Economical
- Good ductility
- Damage and residual deformation in large seismic events
- Post-earthquake inspection, assessment and repair

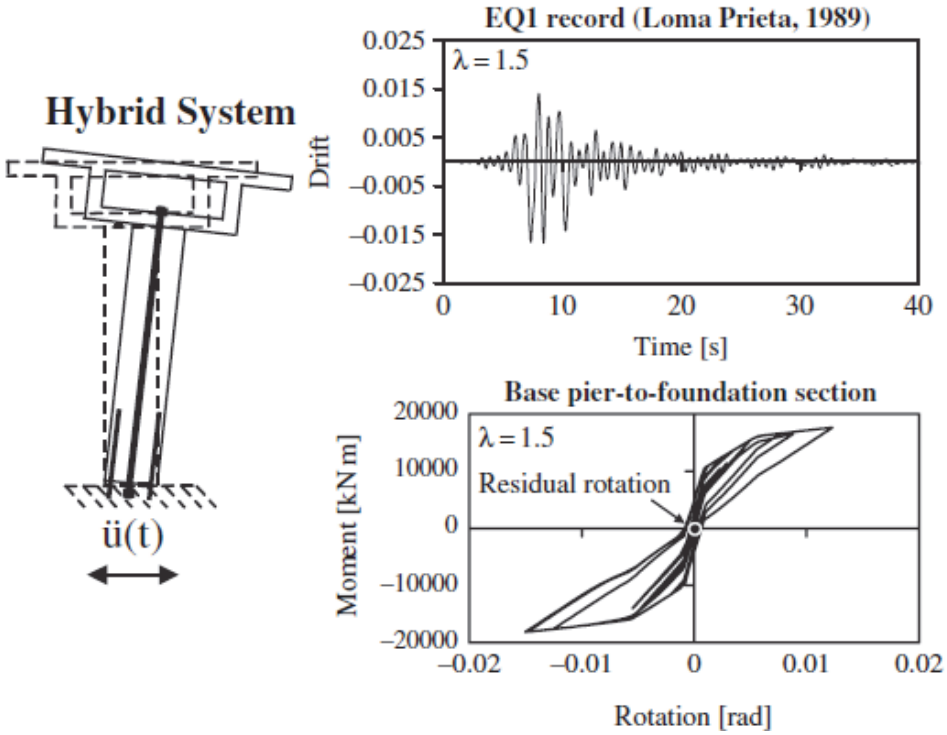


Focus is shifting towards:

- Accelerating bridge construction
- Improving seismic performance
- Reducing post-earthquake costs associated with repair

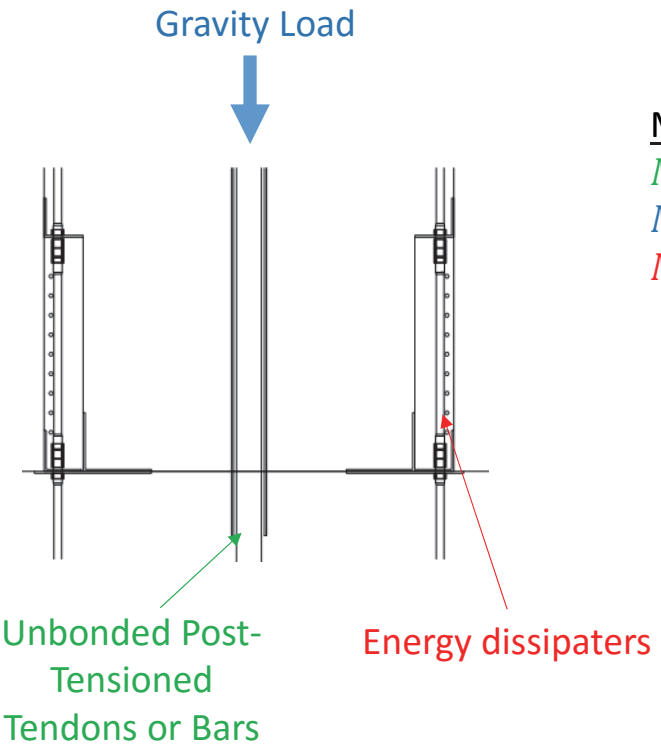
Dissipative Controlled Rocking (DCR) / Hybrid Connections





Innovations in bridge design and construction → Research at UC → Application to a bridge

Dissipative Controlled Rocking / Hybrid Connections



Moment contributions

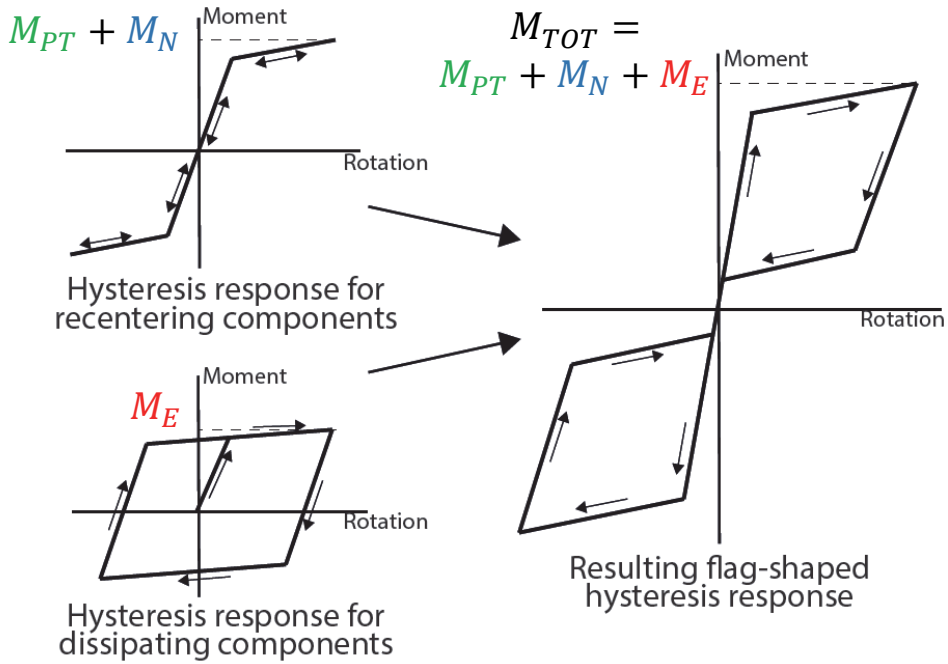
M_{PT} - *Post Tensioning*

M_N - *Gravity Load*

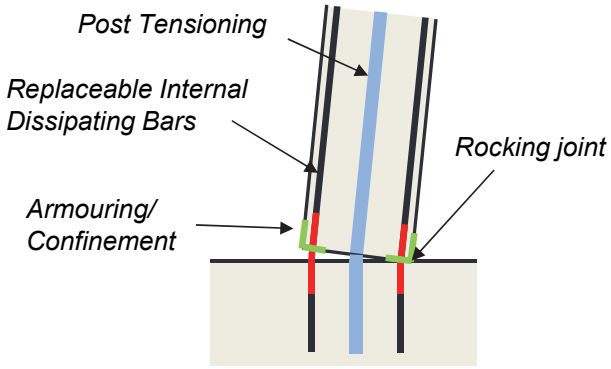
M_E - *Energy Dissipation*

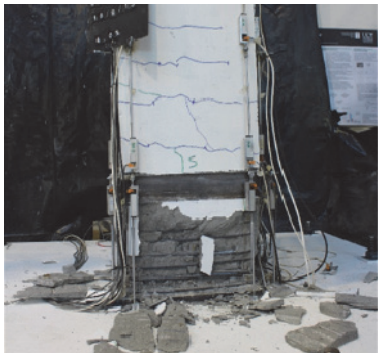
Recentering ratio

$$\lambda = \frac{M_{PT} + M_N}{M_E}$$

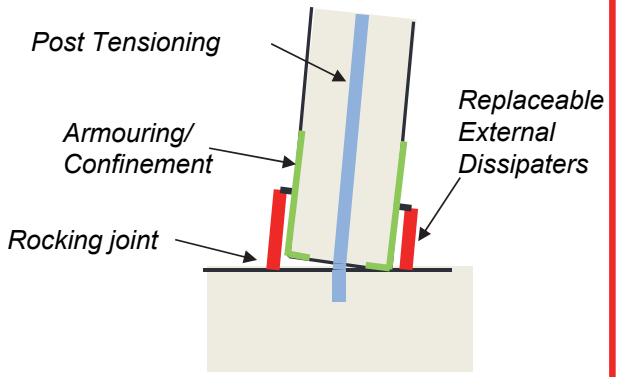


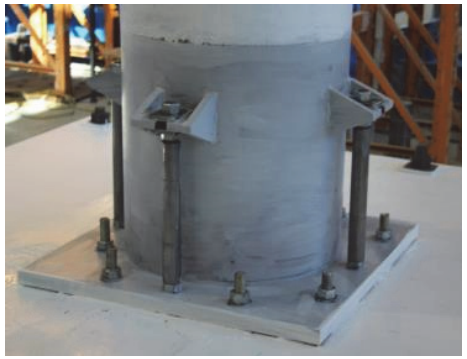
Research at the University of Canterbury





Hybrid Controlled Damage





Hybrid Low Damage

- Cost-effective, pre-determined repair methodologies
- Minimise the need for post-earthquake assessment of residual strength and ductility

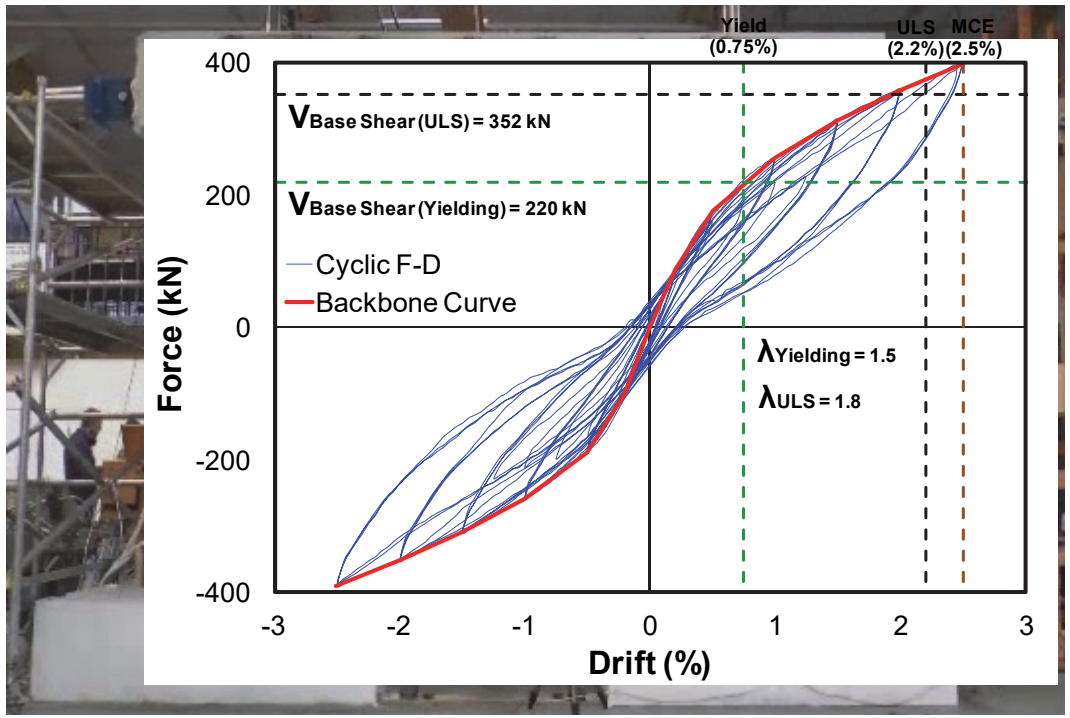
Slide 6

SW2 Could cut this slide and just jump straight into the range of low damage connecitons we tested. No need to talk about emulative here.
Sam White, 6/18/2016

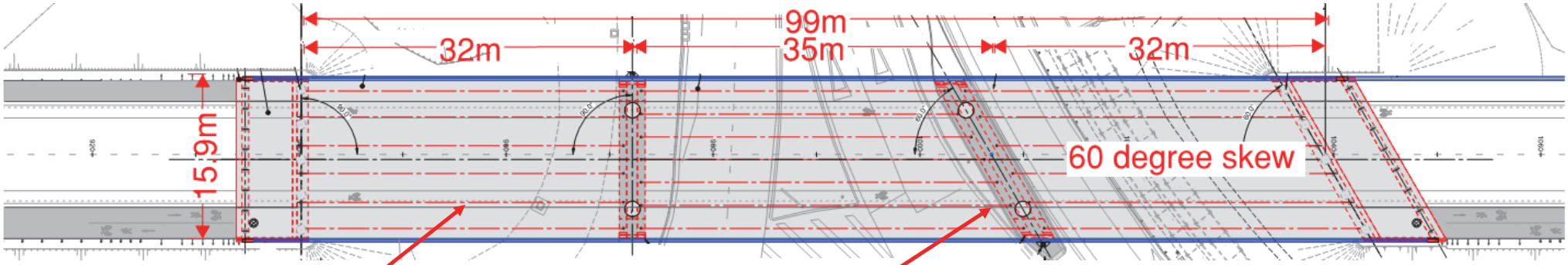
Innovations in bridge design and construction → Research at UC → Application to a bridge

Testing of Low Damage Connections

Testing of Low Damage Connections



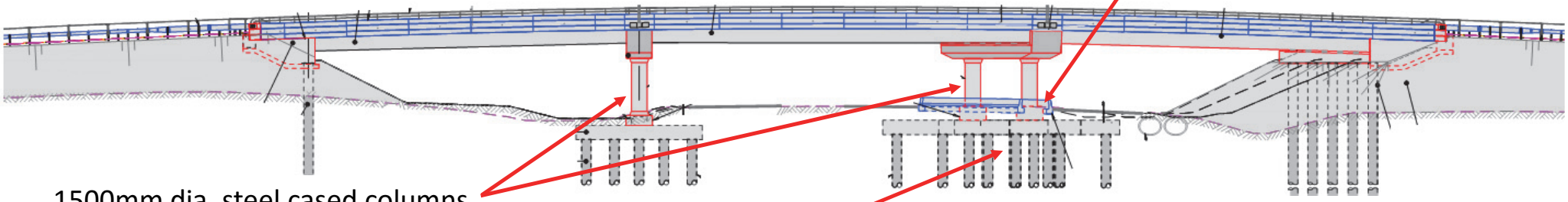
Wigram-Magdala Bridge



1525mm deep Super-tee beams with 200mm thick slab

In-situ pier headstocks

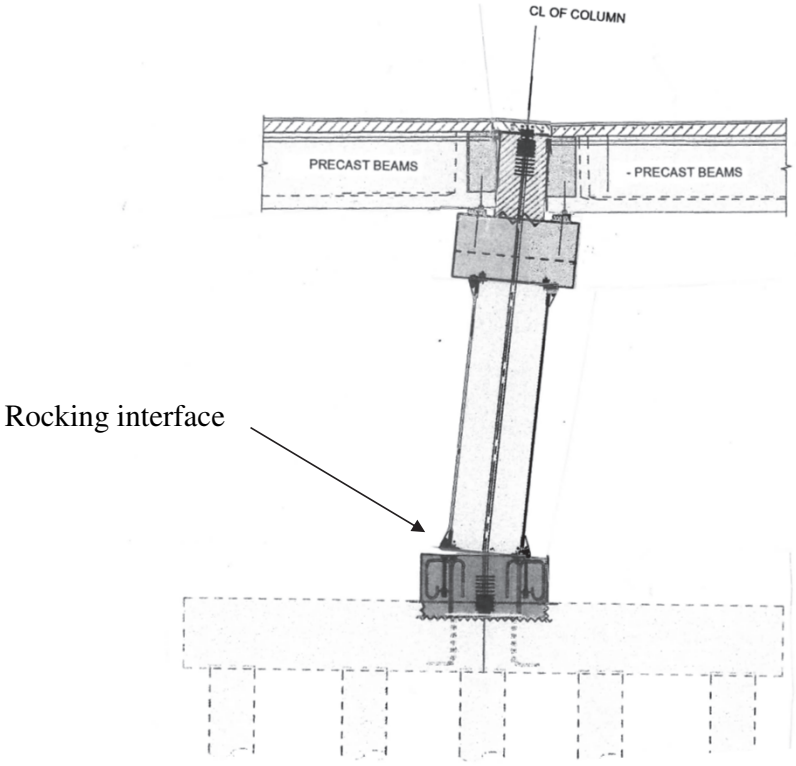
Concrete plinths

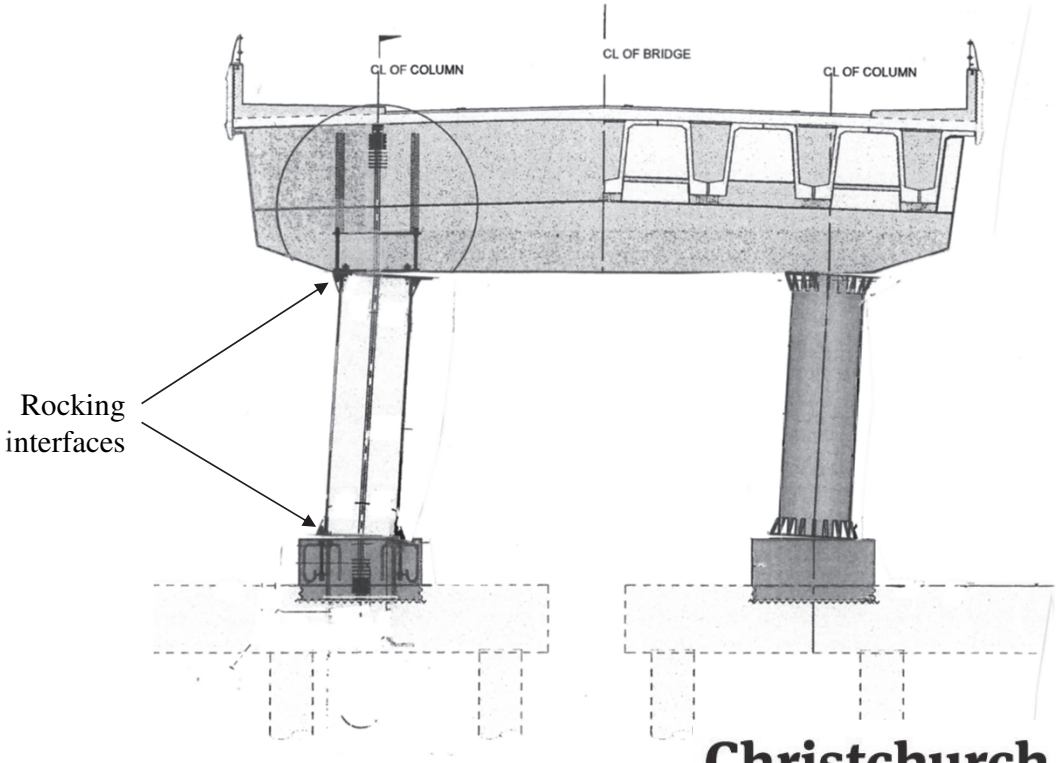


1500mm dia. steel cased columns with low damage connections

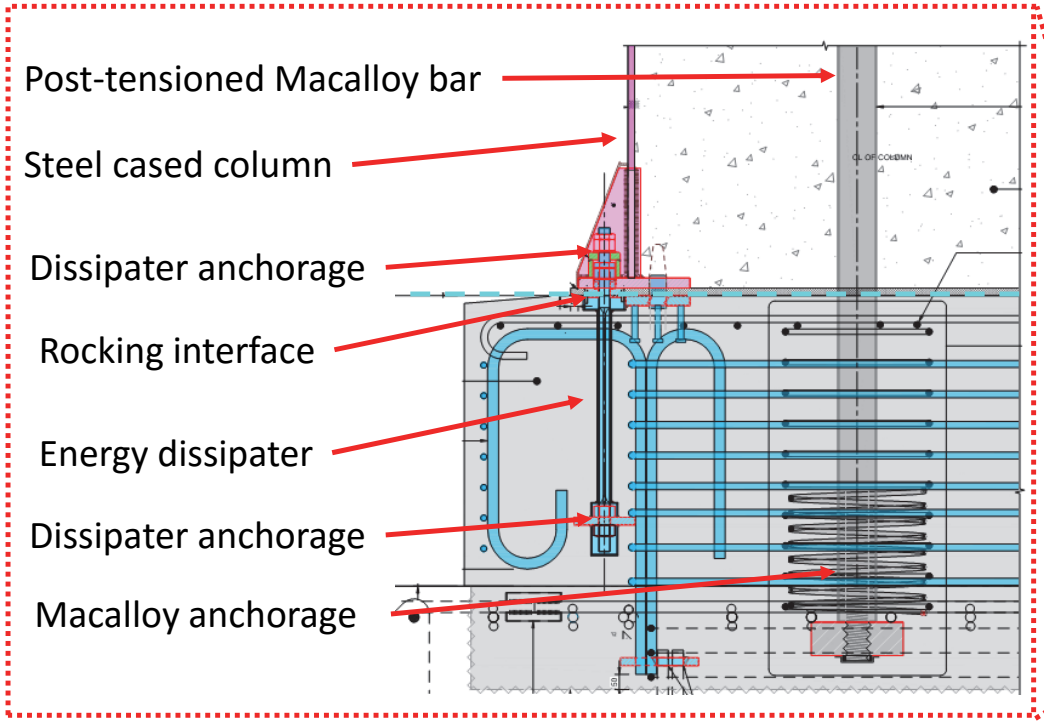
900mm dia piles

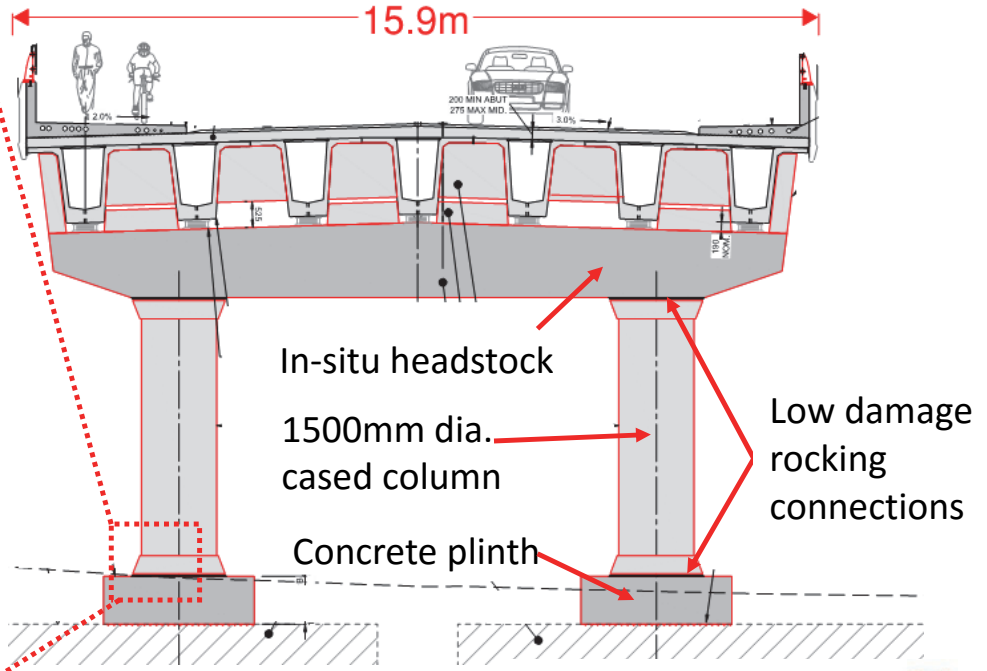
Low-Damage Joint Detail



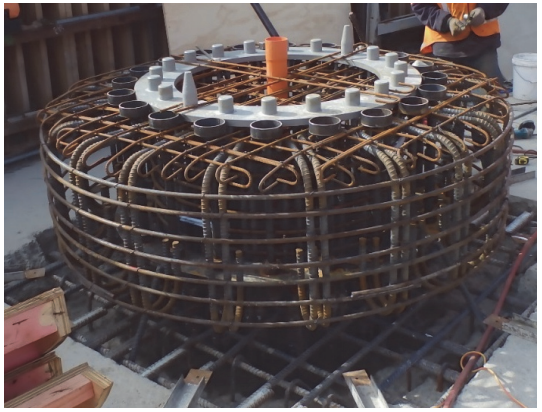


Low-Damage Joint Detail





Construction Photos



Construction Photos

Construction Photos

Conclusion

- Testing and application of low damage connections highlighted a number of issues and challenges
- Low damage connections will continue to improve with further testing and application
- It is expected that low damage connections will offer a competitive alternative to conventional methods of construction

Thank you for your attention

Any questions?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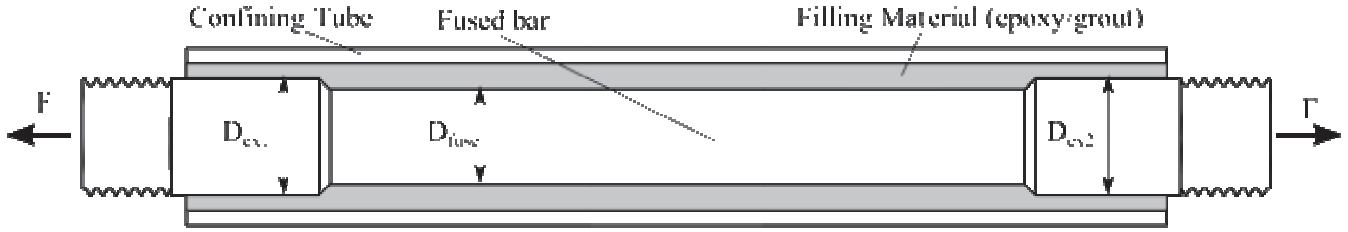
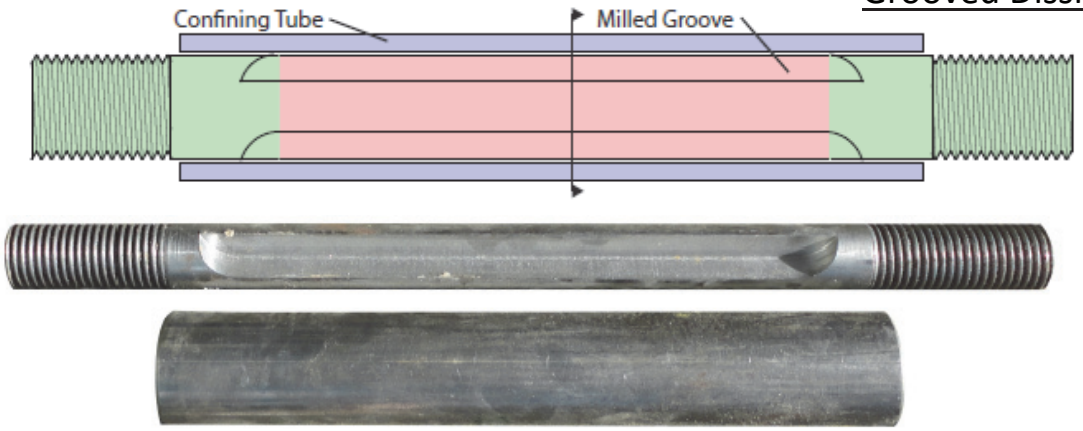
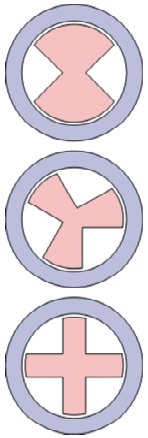
Energy Dissipaters

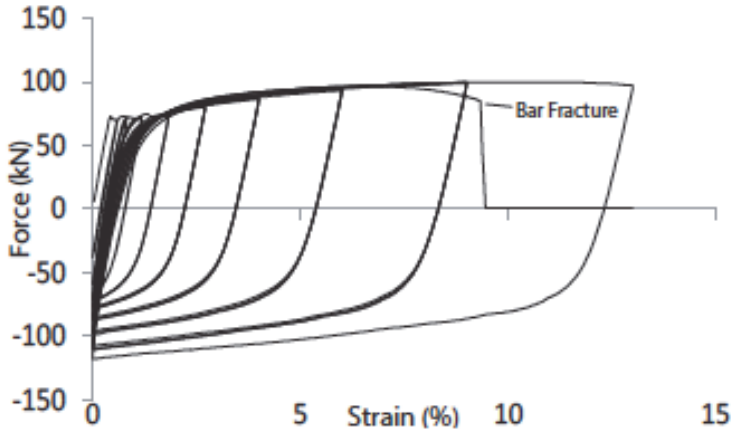
'Mini Buckling Restrained Brace (BRB)'



Grooved Dissipaters







Slide 18

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