Numerical modelling of micropiles

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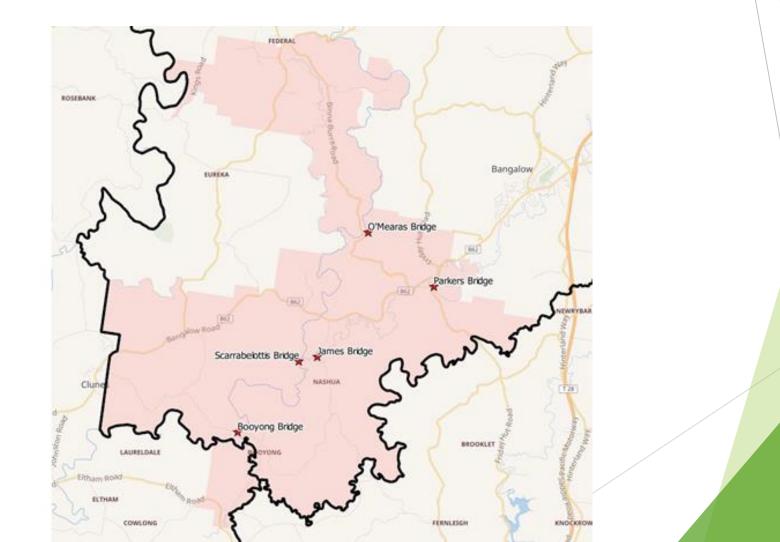


Numerical modelling of micropiles

- 5 timber bridges needed replacement
- Byron Shire in northern coastal New South Wales
- About 85 km south of here



Bridge locations





Typical bridges





Typical bridges

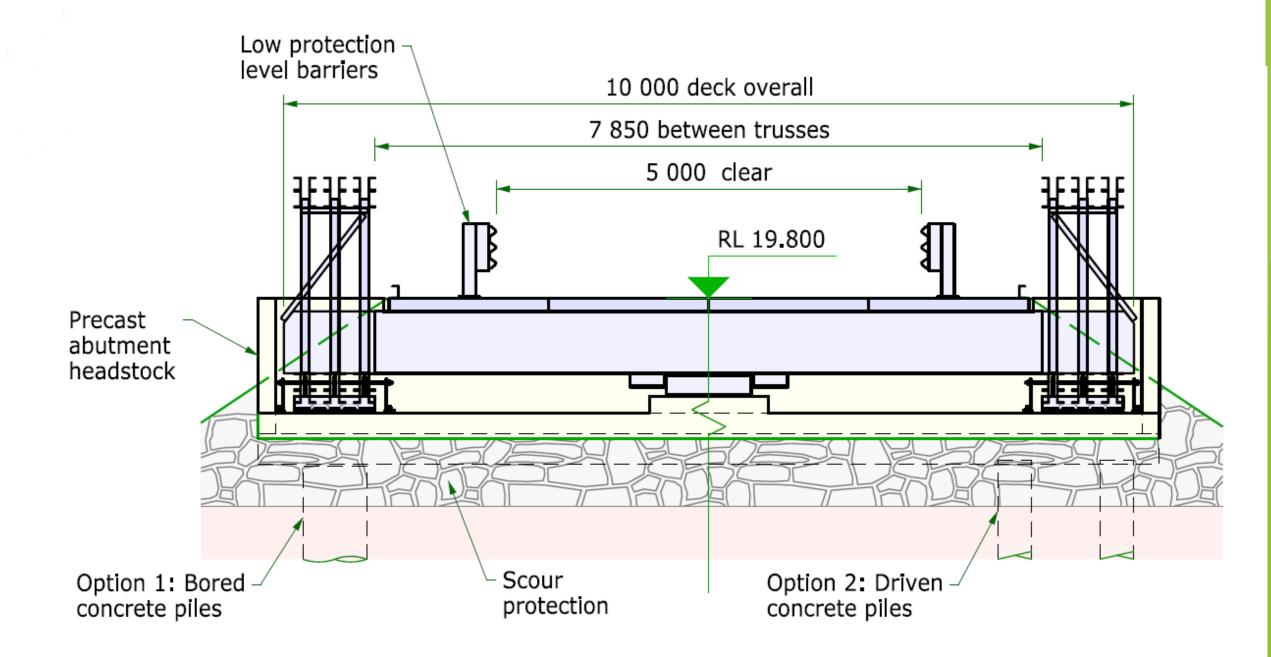






The replacement bridges





Load combinations

Load case	Load combination
1	1.1 x Permanent effects +2 x Live Load + 1.8 x Braking load + 1 x Stream force at deck level
2	Permanent effects + 1 x Live Load + 1 x Braking Load + 1.3 x Stream force at deck level
3	Permanent effects + Ultimate stream forces (1:2000 AEP flood)
4	0.9 x Permanent effects +0 x Live Load + 1.8 x Braking load + 1 x Stream force at deck level with scour
5	0.9 x Permanent effects + 0 x Live Load + 1 x Braking Load + 1.3 x Stream force at deck level with scour
6	0.9 x Permanent effects + Ultimate stream forces (1:2000 AEP flood) with scour



Peer review of design

- Requirement for independent review
- Not easily achieved with use of computer programs
- Decision to carry out fully independent review using same load data but alternative software
- Designer had used GROUP16 for analysis of group effects under headstocks
- This uses p-y curves to model vertical and lateral loading behaviour
- Review used PIGLET, which is based on a continuum model, fully modelling pile-soil-pile interaction
- Also used PLAXIS 2D to model displacements at SLS



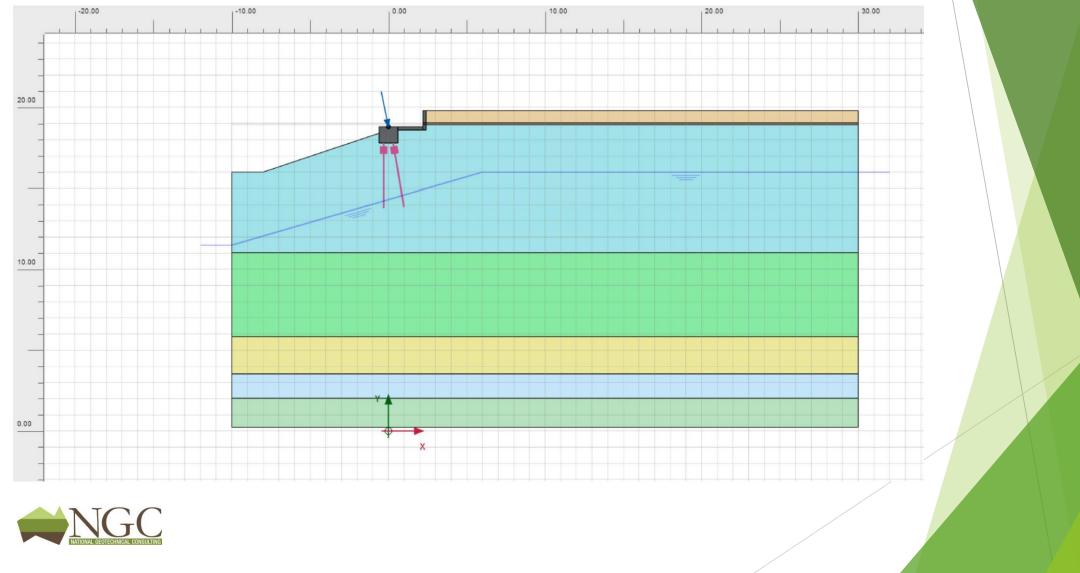
PIGLET analysis results

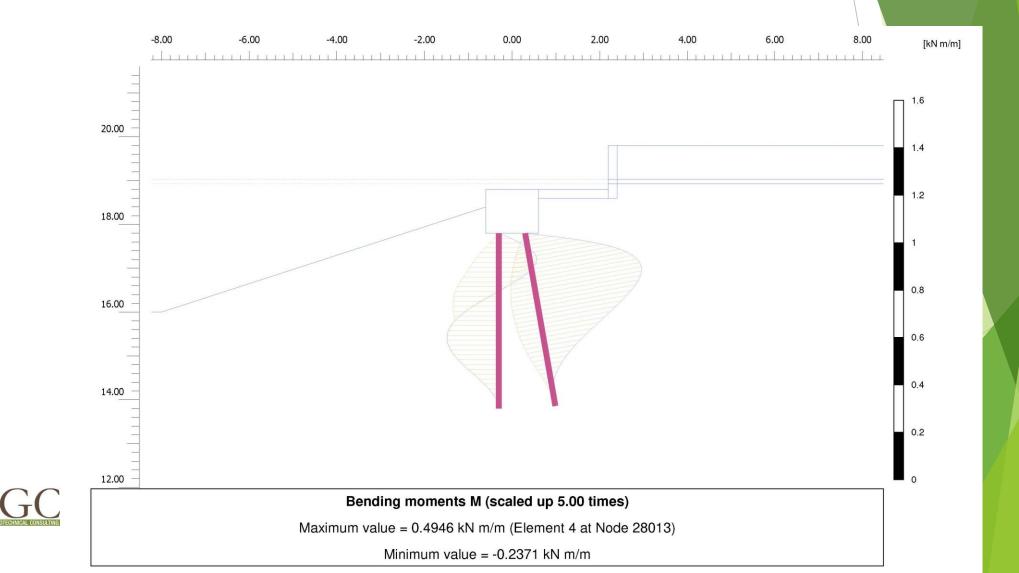
																Left abu	utment															
		No scour															Scour															
	Max	Pile	Load	Min	Pile	Load	Max	Moment	Res	Pile	Load	Max	Moment	Res	Pile	Load	Max	Pile	Load	Min	Pile	Load	Max	Moment	Res	Pile	Load	Max	Moment	Res	Pile	Load
	pile		Case	pile		Case	moment	(y to z)	Moment		Case	moment	(x to z)	Moment		Case	pile		Case	pile		Case	moment	(y to z)	Moment		Case	moment	(x to z)	Moment		Case
	load			load			(x to z)					(y to z)					load			load			(x to z)					(y to z)				
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O'Meara's Bridge	281.9	3	1	-115.	8 13	6	-23.9	-12.26	26.9	19	4	4 -42.3	3.89	42.5		2 3	351.2	2 3	1	-199.	5 13	6 6	-37.56	-19.02	42.1	19	9 4	-54.5	10.6	55.5	2	. 3
Scarrabelotti's Bridge	326.2	5	1	-44.	6 12	. 4	-19.5	-5.4	20.2	15	4	4 -23.2	2.2	23.3		2 3	530.3	3 5	5 1	-171.6	5 12	2 4	-39.6	-12.4	41.5	15	5 4	-35.34	8.55	36.4	2	. 3
Parker's Bridge	439.4	5	1	-119.	8 12	. 4	-32.1	-7.9	33.1	15	4	4 -27.8	5.5	28.3		2 3	552.4	1 5	5 1	-192.8	3 12	2 4	-45.6	-10.8	46.9	15	5 4	-34.9	-9.9	36.3	2	. 3
James' Bridge	332.3	5	1	-87.	7 12	. 4	-28.5	-6.1	29.1	15	4	4 -28.98	3.1	29.1		2 3	450.2	2 5	5 1	-165.9	12	2 4	-44.8	-10	45.9	15	5 4	-37.5	6.8	38.1	2	. 3
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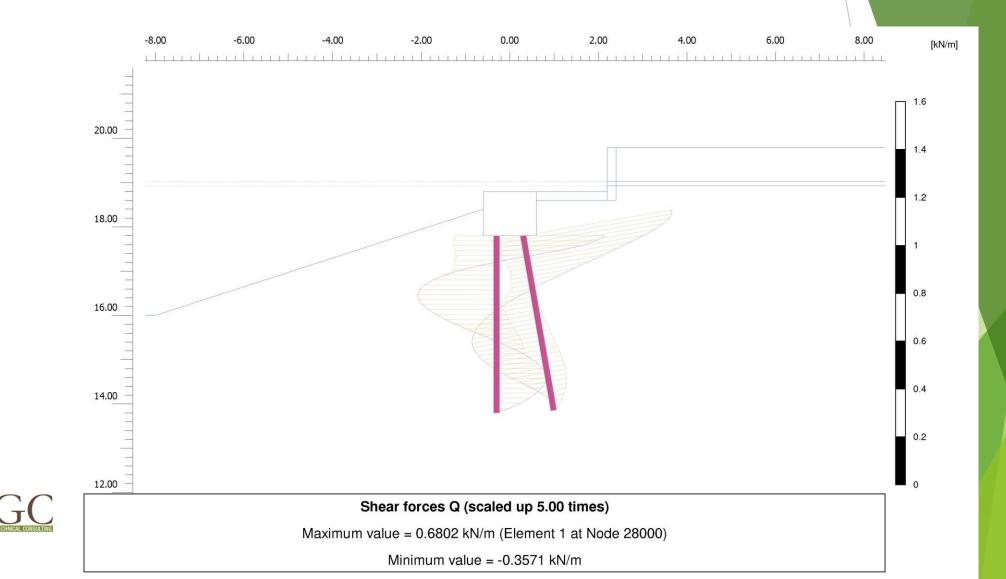
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Max	Pile	Load	Min	Pile	Load	Max	Moment	Res	Pile	Load	Max	Moment	Res	Pile	Load	Max	Pile	Load	Min	Pile	Load	Max	Moment	Res	Pile	Load	Max	Moment	Res	Pile	Load
pile		Case	pile		Case	moment	(y to z)	Moment		Case	moment	(x to z)	Moment		Case	pile		Case	pile		Case	moment	(y to z)	Moment		Case	moment	(x to z)	Moment		Case
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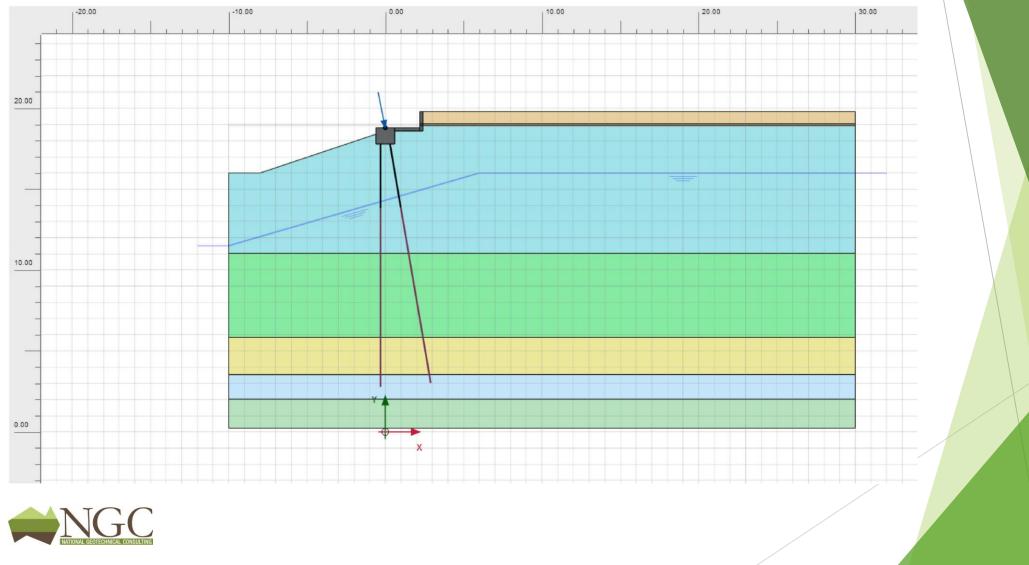
- Only PLAXIS 2D available, so analysed longitudinal and transverse sections
- Able to model piles as embedded beam elements
- Cannot model step change in stiffness, as cannot connect embedded beams end to end
- Modelled in two stages:
 - Upper part with high stiffness to model bending moments and shear forces
 - Lower part with appropriate stiffness connected to headstock with elastic "anchor" to model axial forces in micropile, and movement
- Also modelled factor of safety

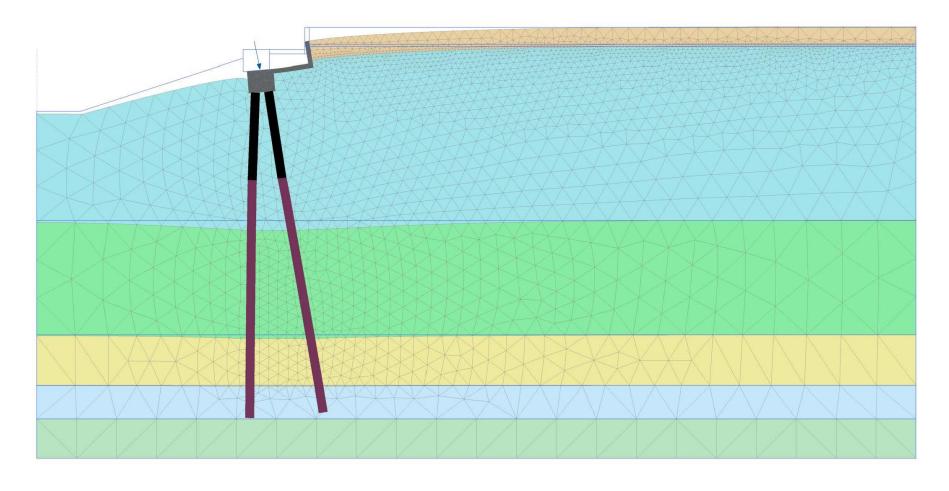




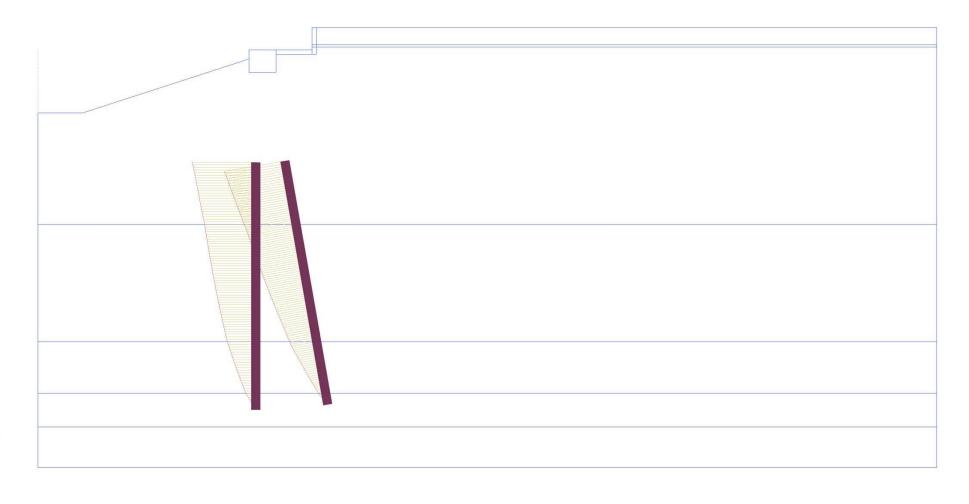






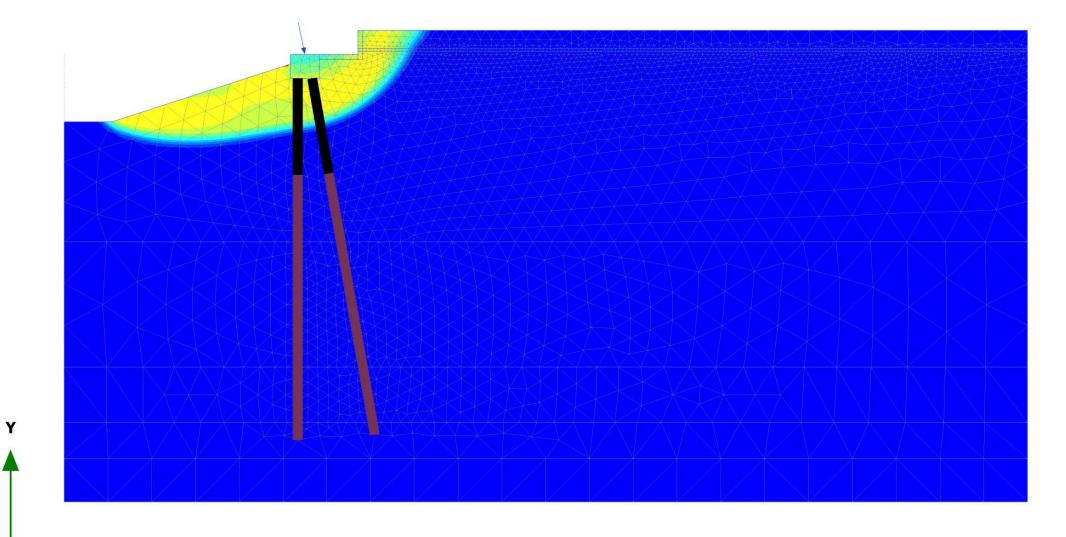


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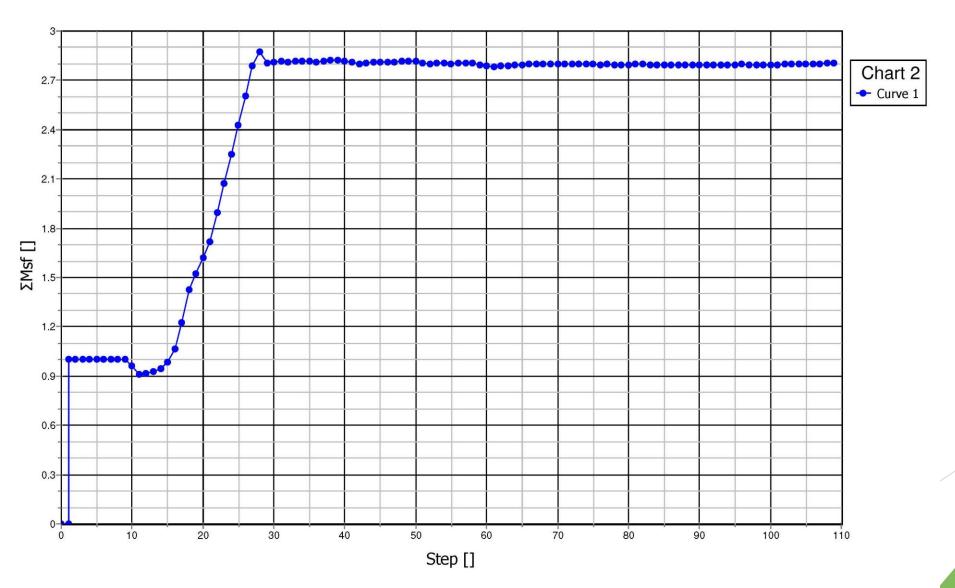


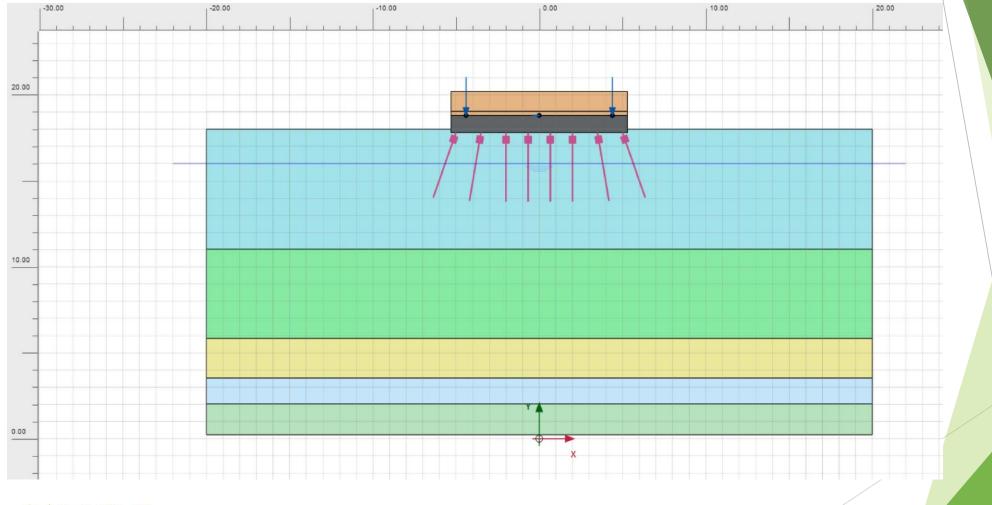
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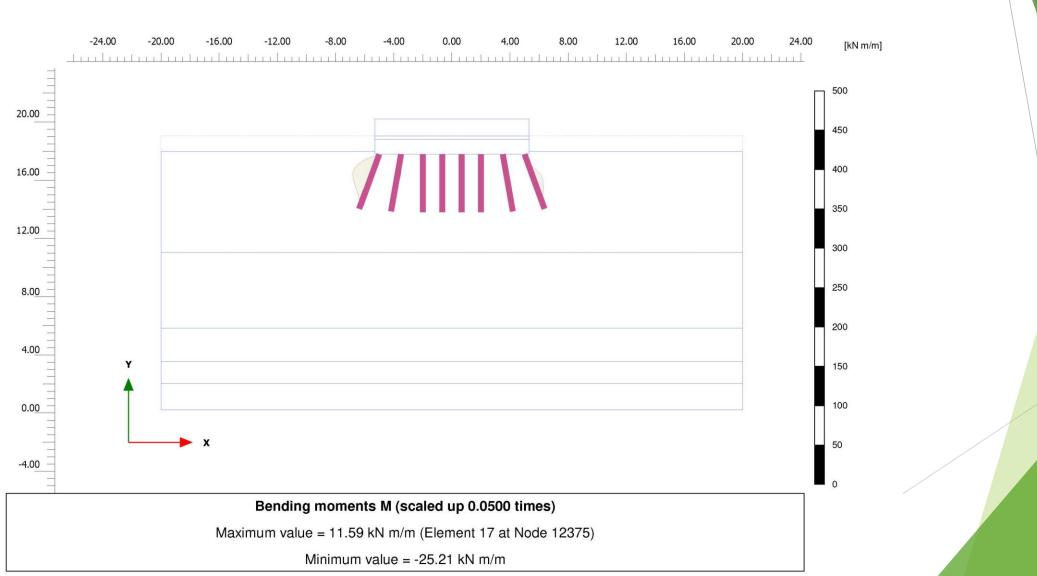


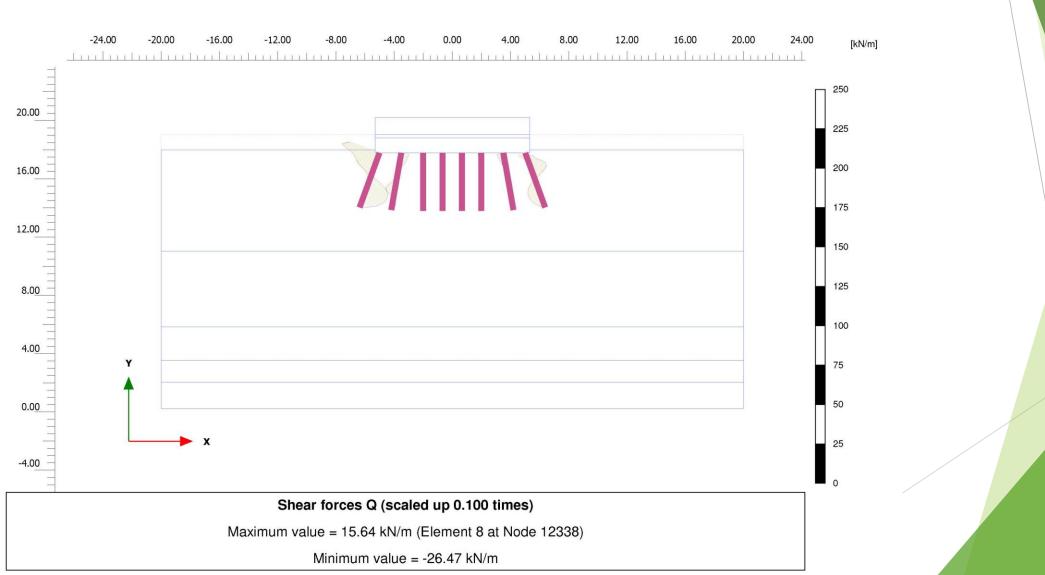
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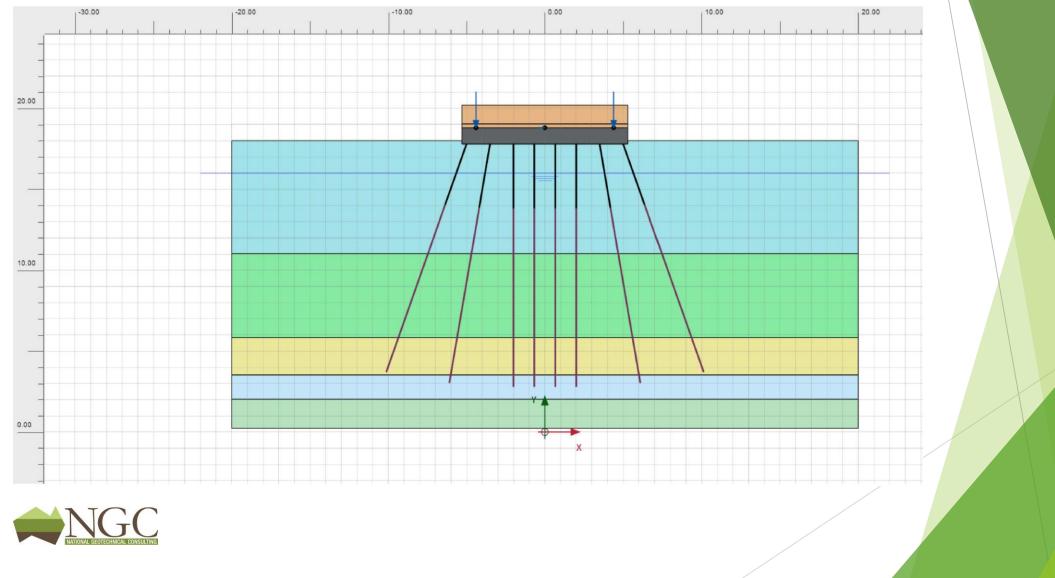


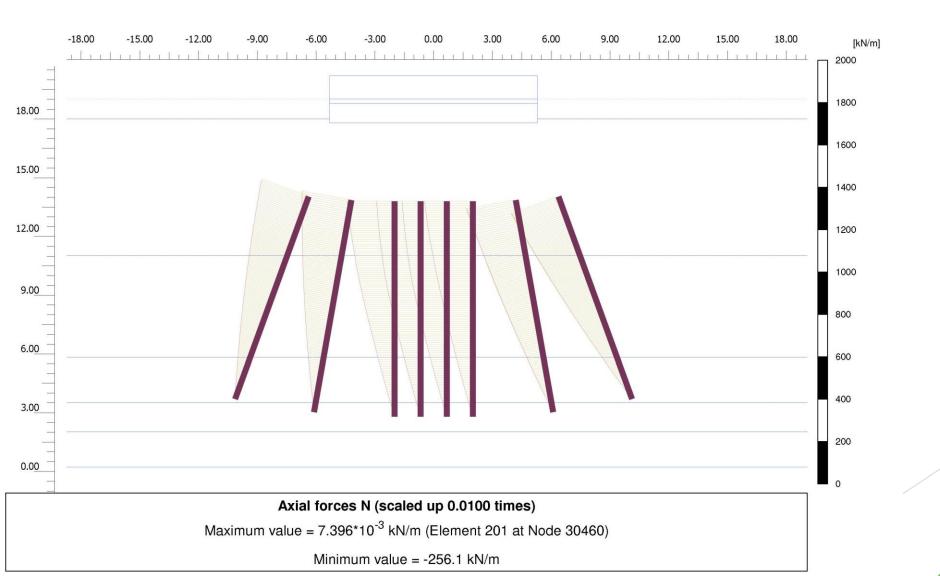


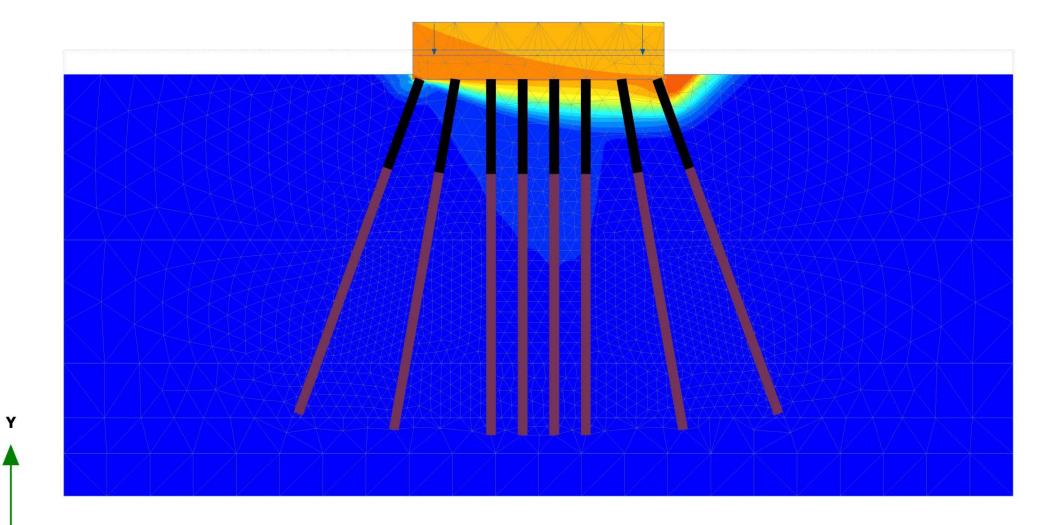




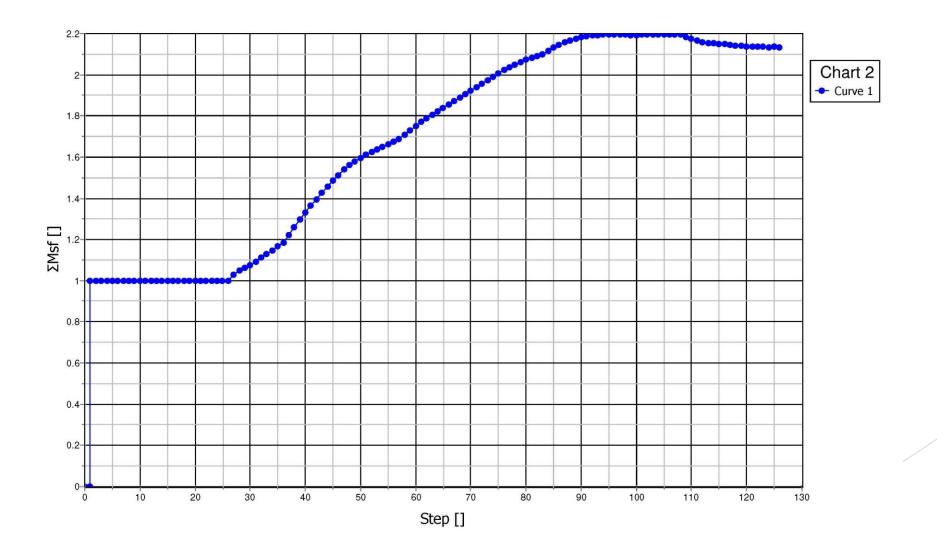








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Review result

- Design was satisfactory, meeting requirements of AS 5100
- Performance was predicted to be satisfactory
- Design and review were further reviewed by in house engineer
- Construction satisfactorily completed in late 2018



Thank you

