FIFTH INTERNATIONAL
ITASCA SYMPOSIUM
ON APPLIED NUMERICAL MODELING IN
GEOMECHANICS—2020

Investigation of the effect of critical parameters affecting caveability using numerical modelling

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F Suorineni
B Hebblewhite
J Oh

OUTLINE

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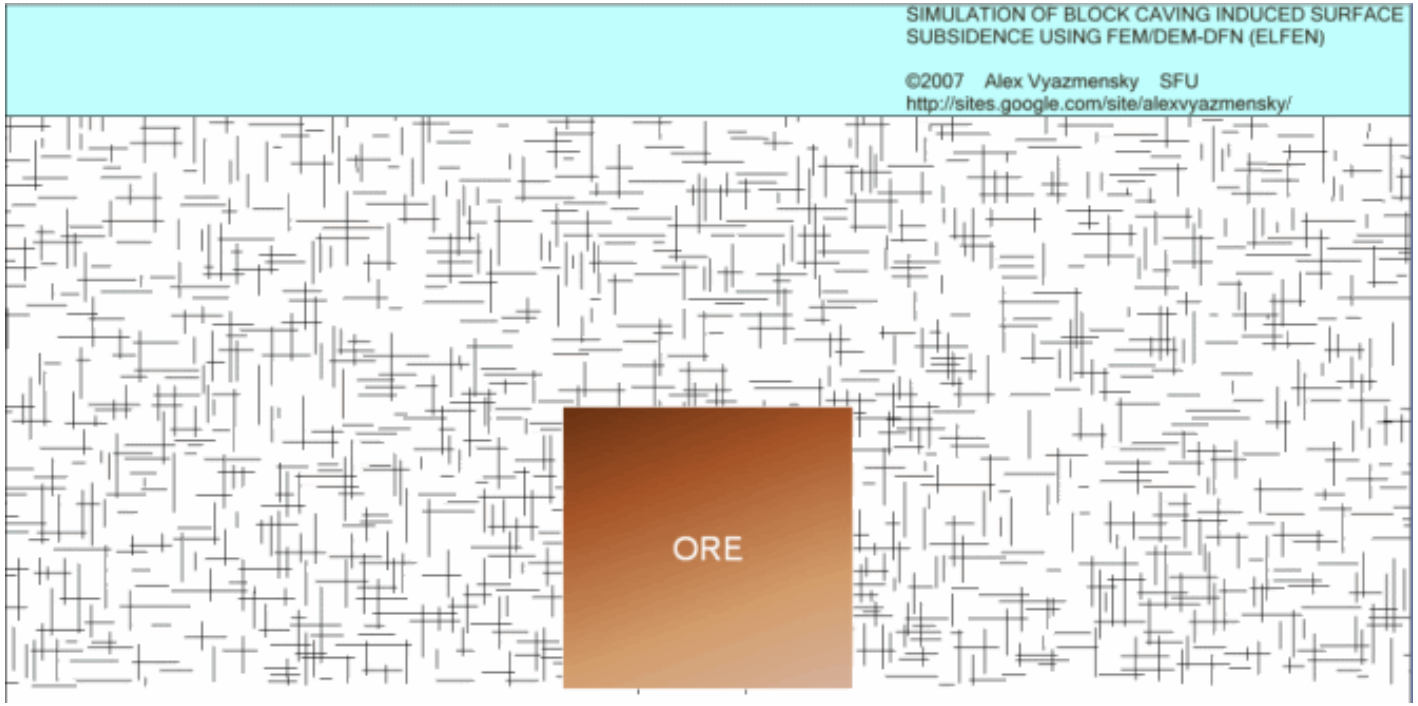
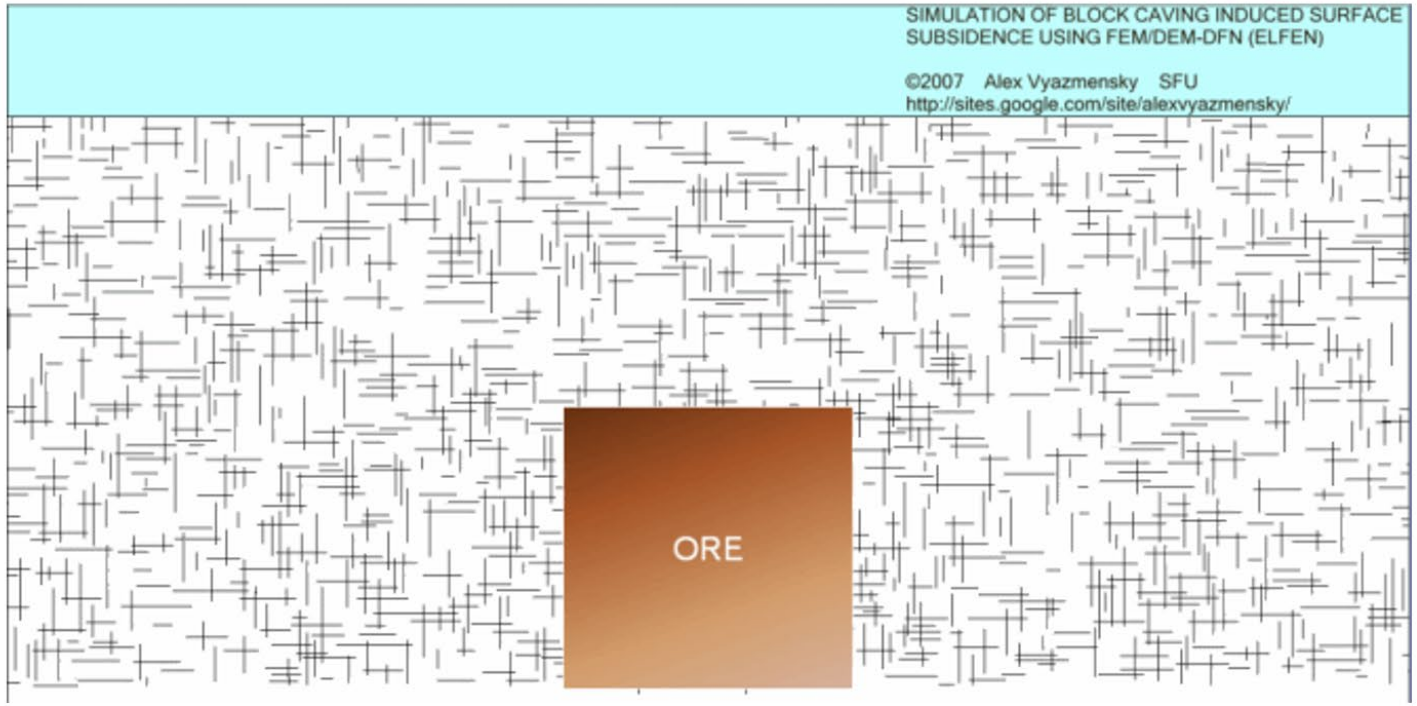
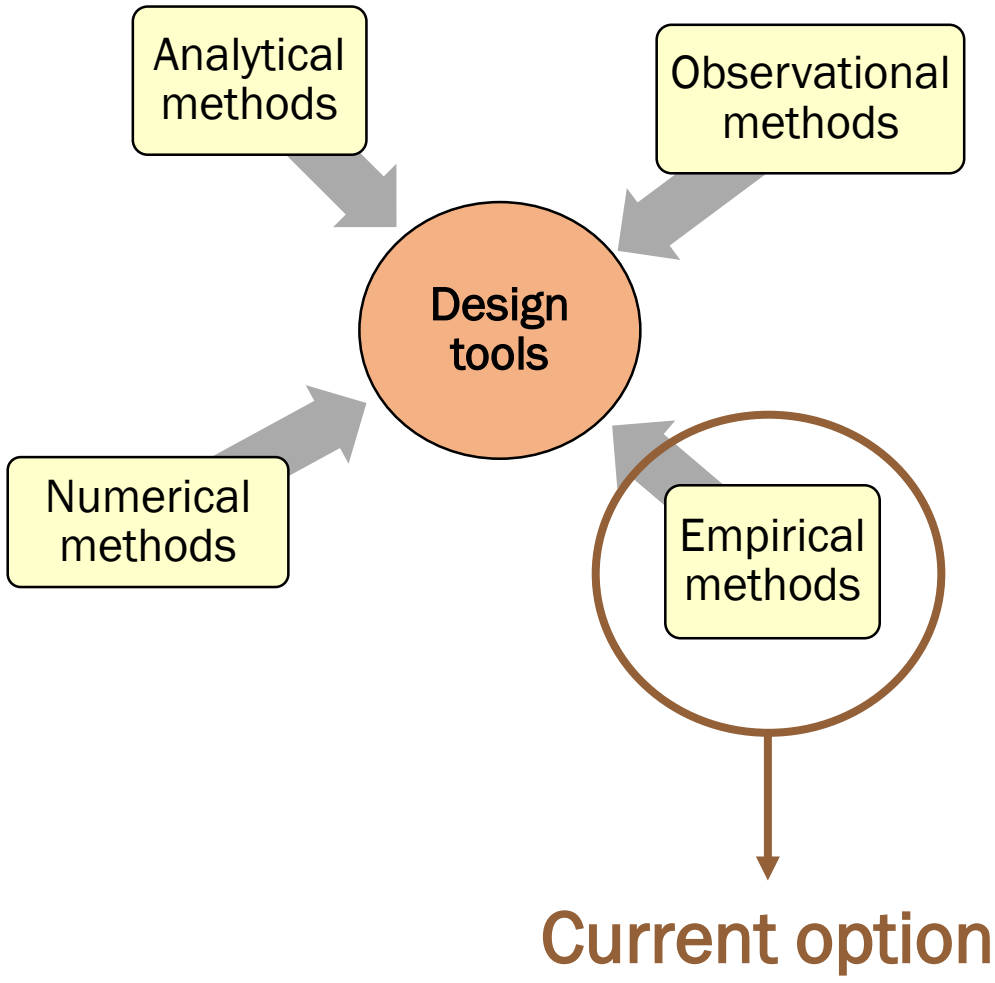
2. Design
3. Results and Discussion
4. Conclusions

INTRODUCTION

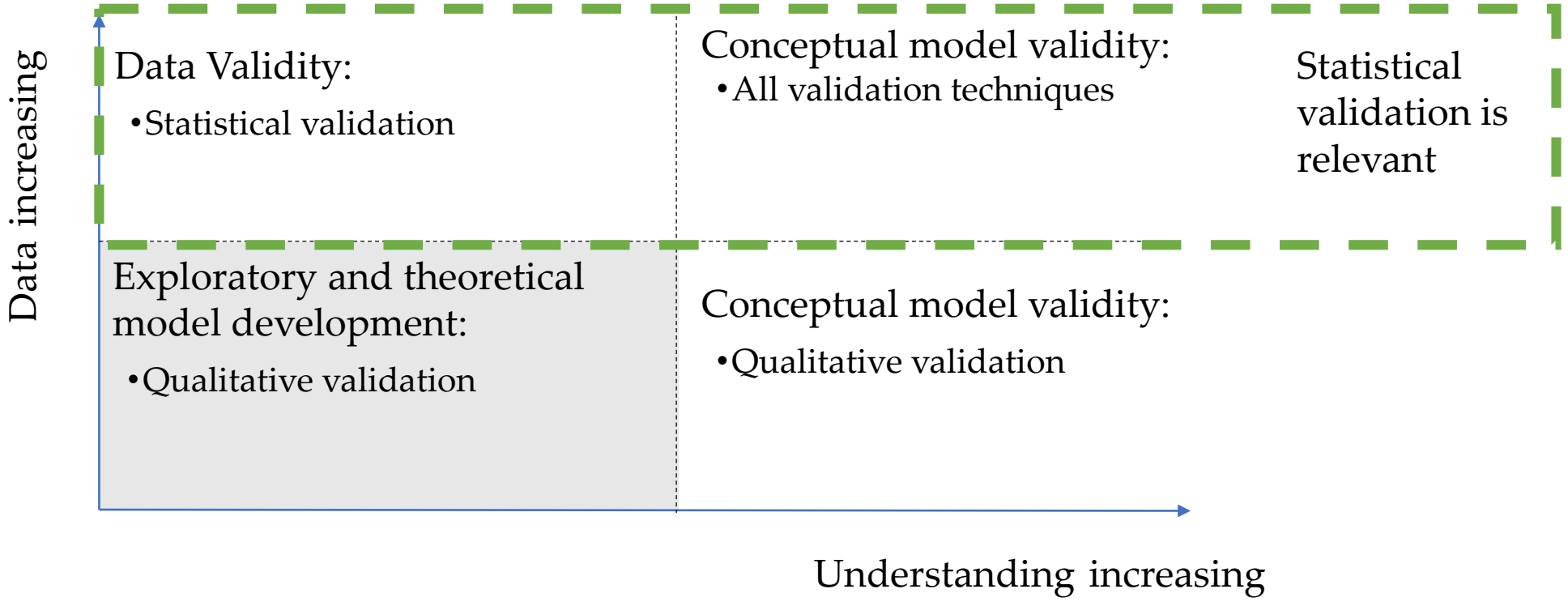


INTRODUCTION

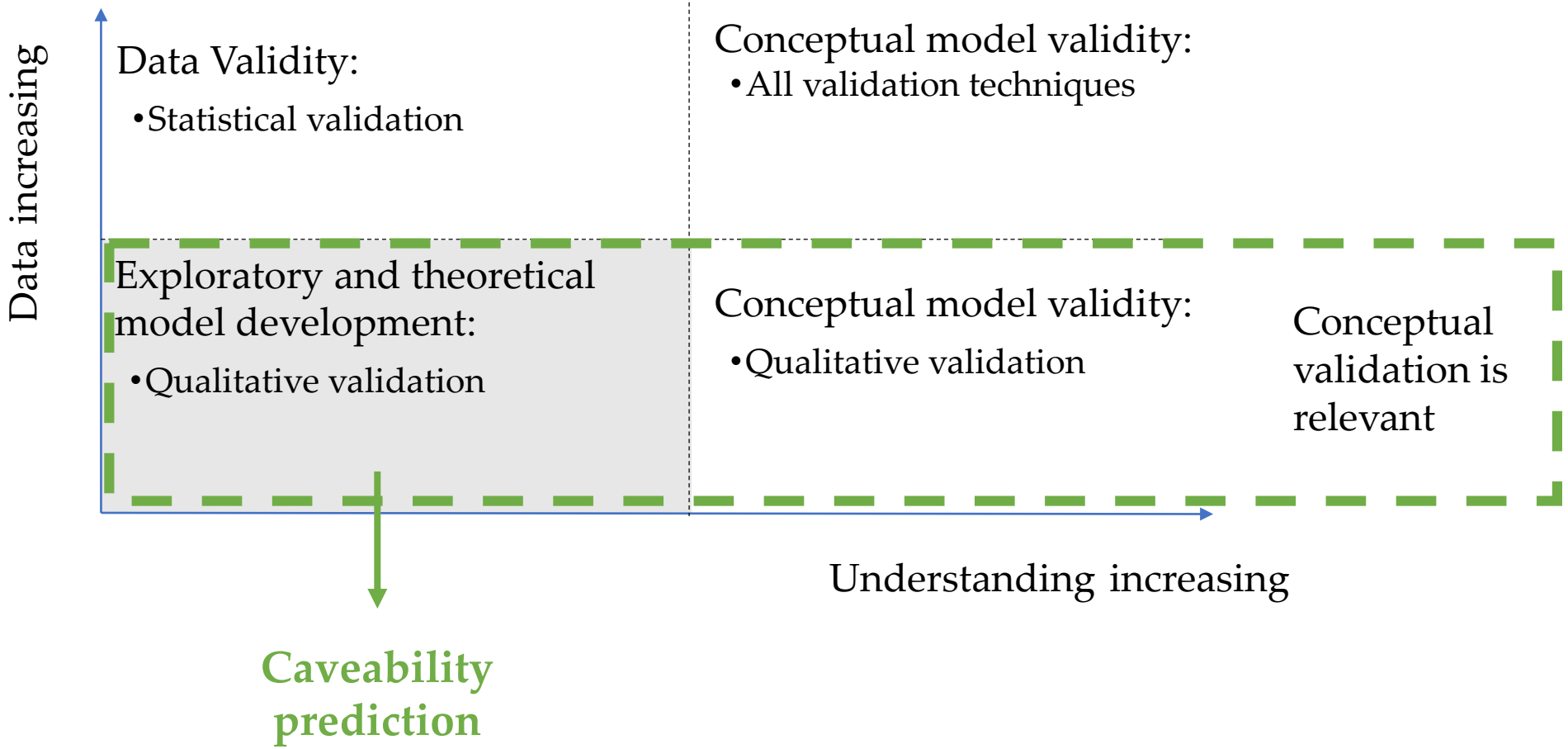




INTRODUCTION



INTRODUCTION



INTRODUCTION

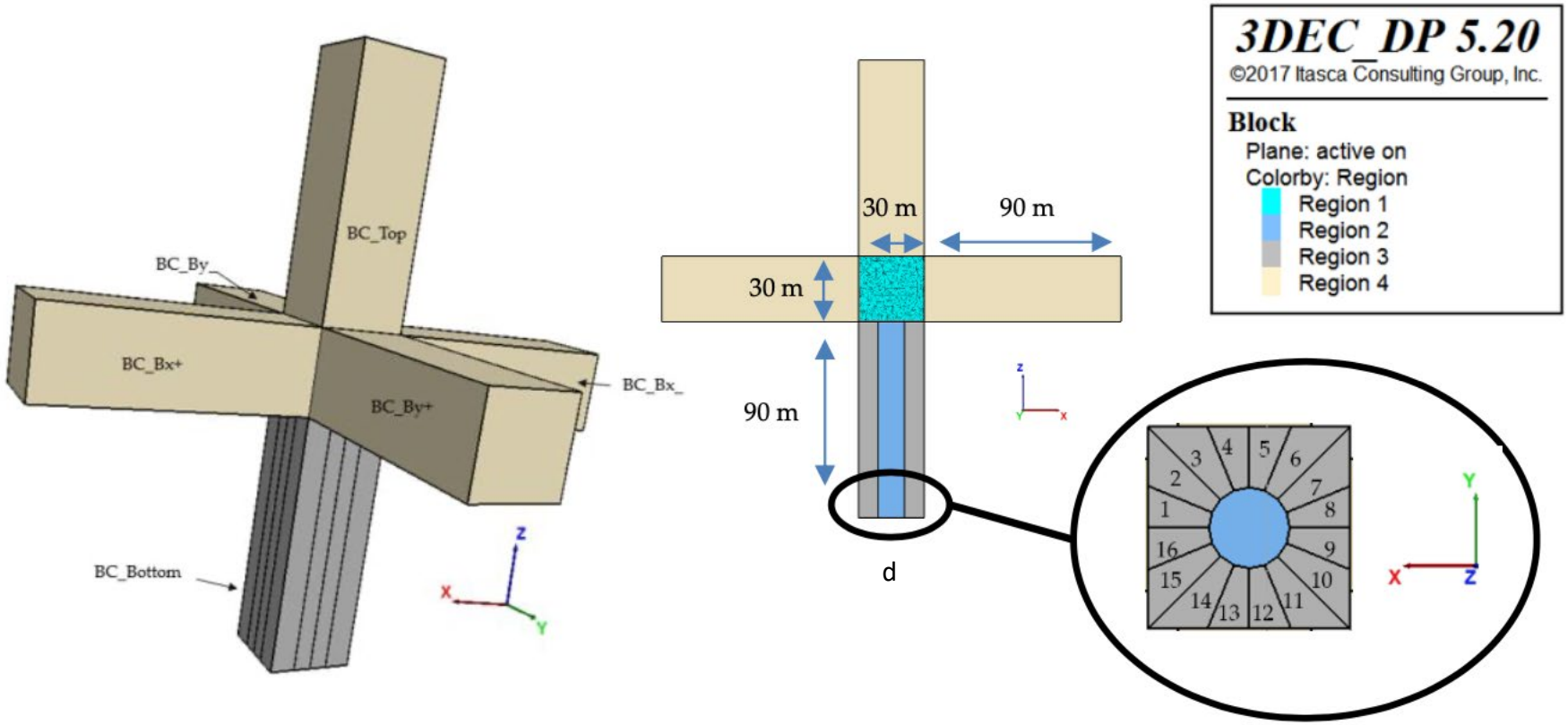
Study Objective

The **objective** of this research is to identify and define the significance of the effect of dominant parameters affecting caveability.

For this purpose, a discontinuum model is used to represent and test the responses of cases described by different combinations of factors.

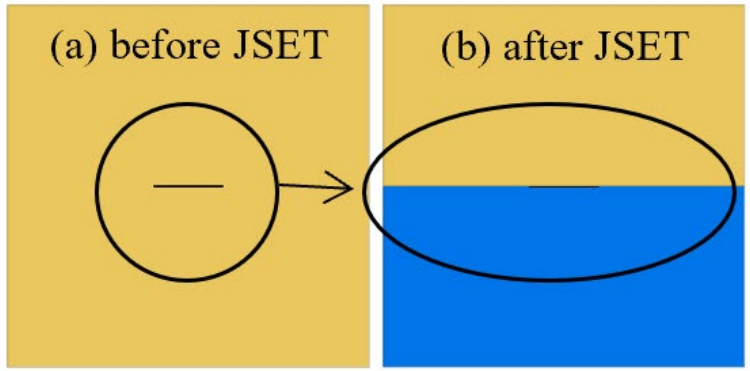
DESIGN AND ANALYSIS

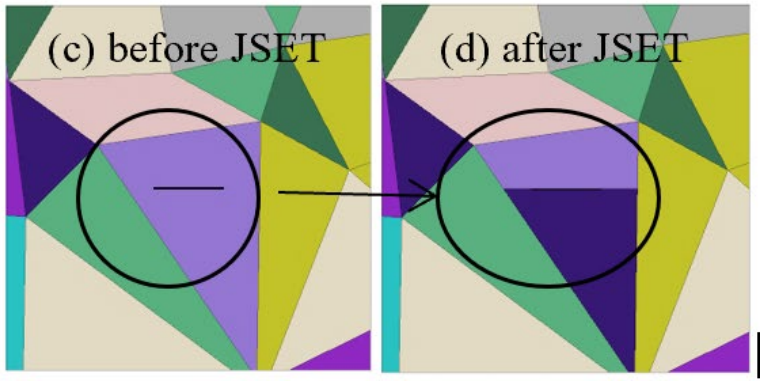
Numerical Modelling Process Design



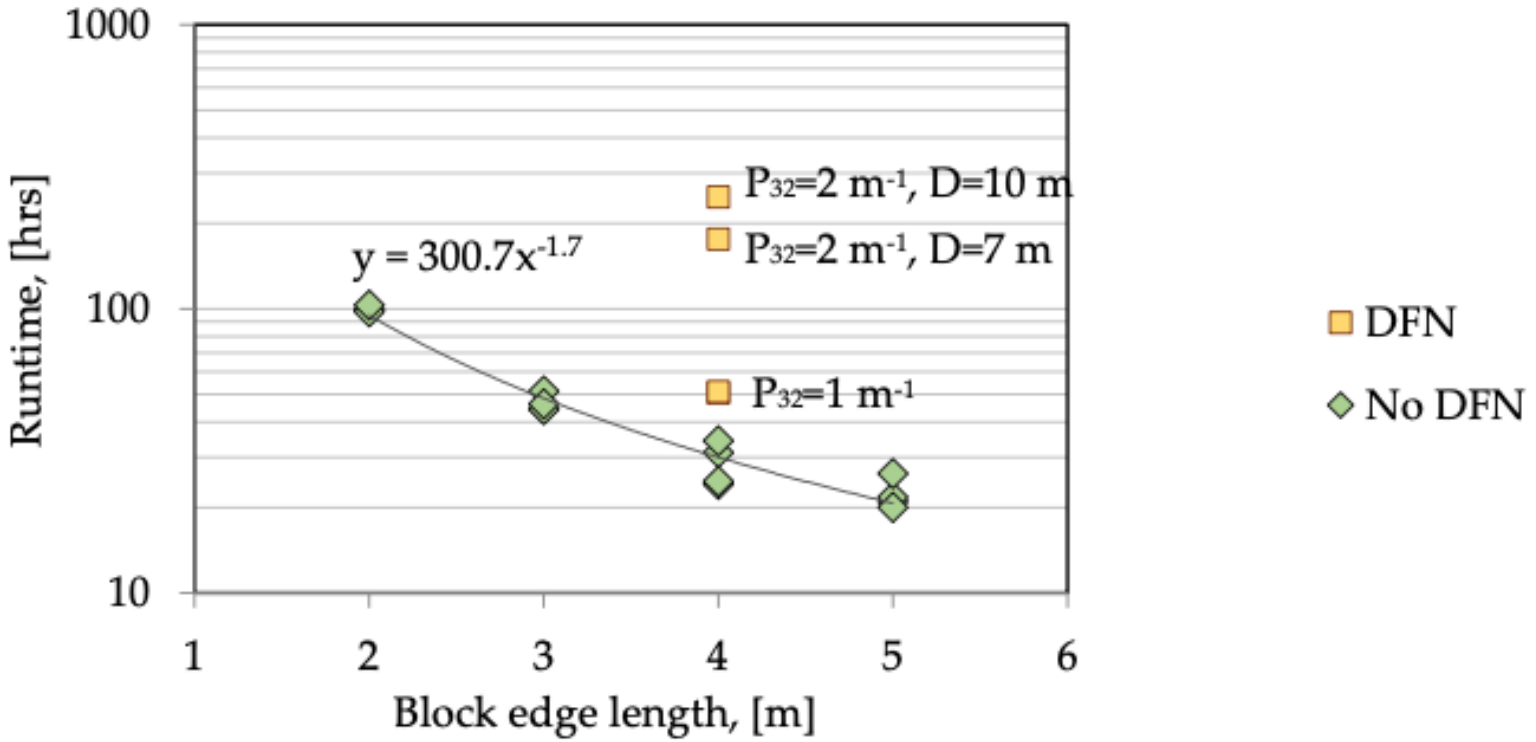
Adapted from Garza-Cruz and Pierce (2014)

DESIGN AND ANALYSIS



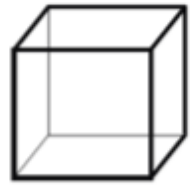


Configuration:
30 m × 30 m × 30 m created in Kubrix



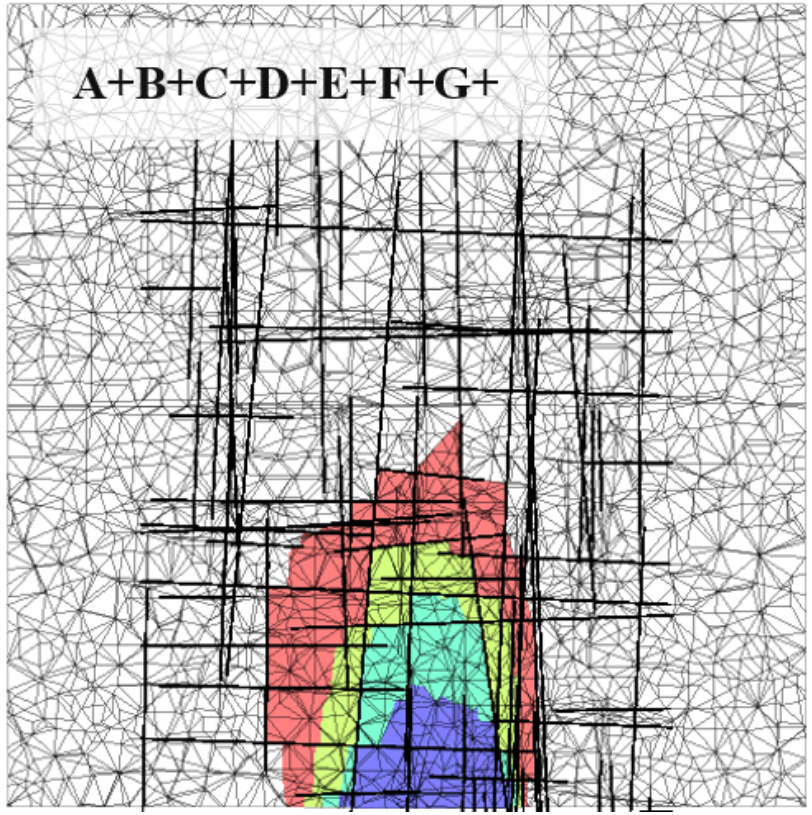
DESIGN AND ANALYSIS

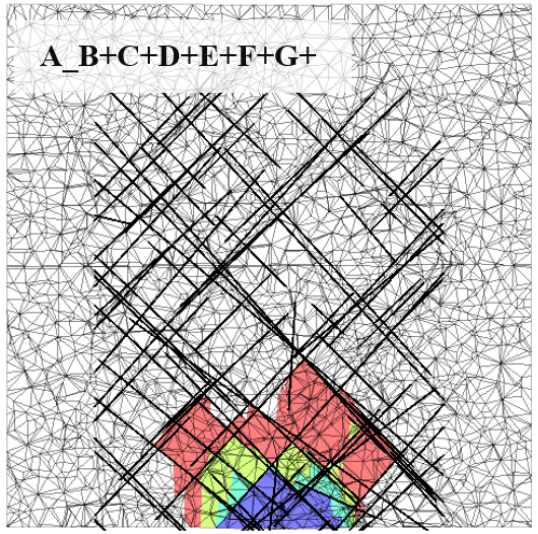
Selection of parameters

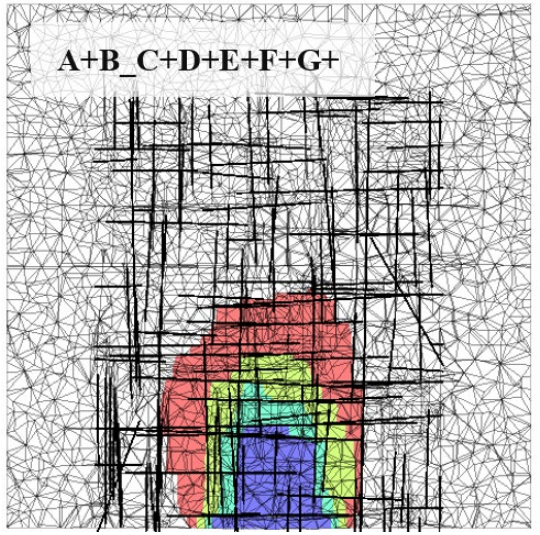
	Parameters	Low level (_)	High level (+)
A	Joint orientation	Configuration J_1 	Configuration J_3 
B	Joint persistence	Low persistence	High persistence
C	Joint intensity	$1\ \mathrm{m}^{-1}$	$2\ \mathrm{m}^{-1}$
D	Intact rock category	very hard	Hard
E	Joints category	no filling	soft filling
F	In-situ stresses magnitude	$\sigma_1 = 30$ MPa	$\sigma_1 = 70$ MPa
G	Hydraulic radius (diameter)	1.75 m (7 m)	2.5 m (10 m)

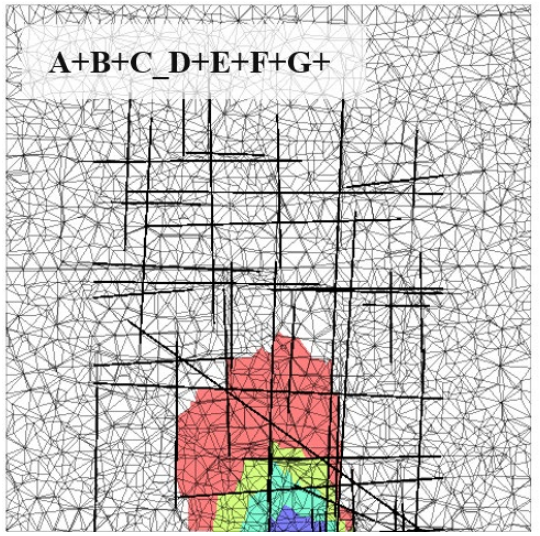
(Suzuki Morales, 2019)

RESULTS AND DISCUSSION









	Parameters
A	Joint orientation
B	Joint persistence
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D	Intact rock category
E	Joints category
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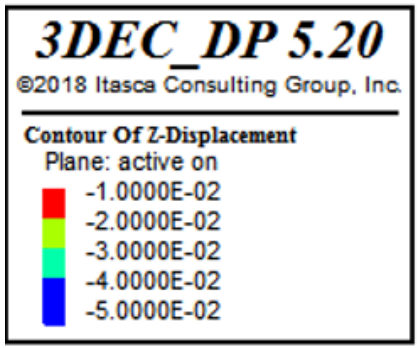
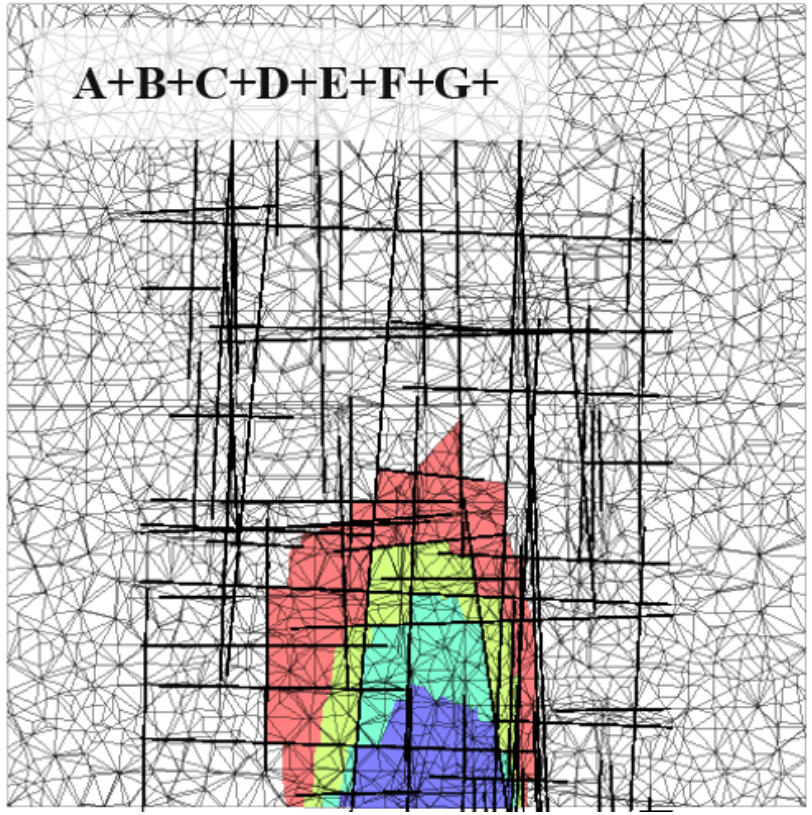
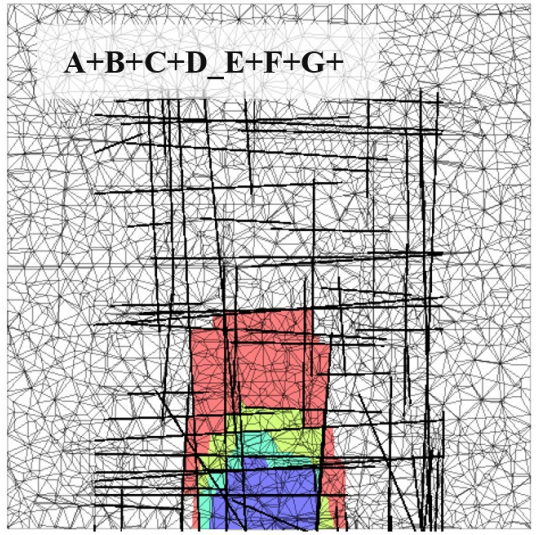
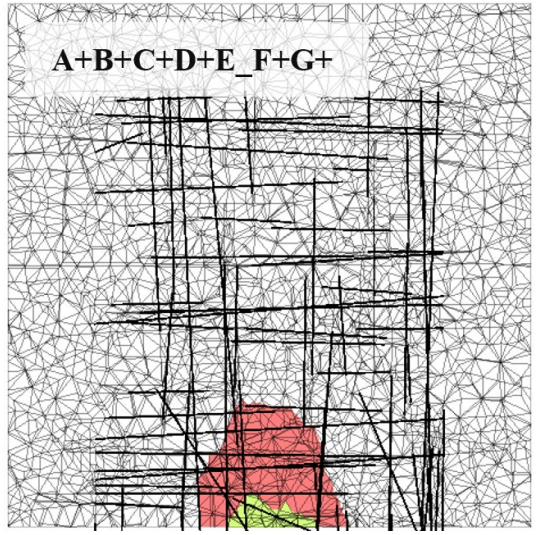


RESULTS AND DISCUSSION







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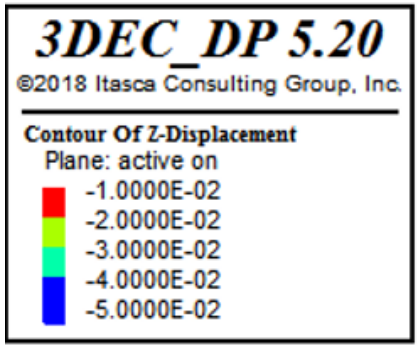
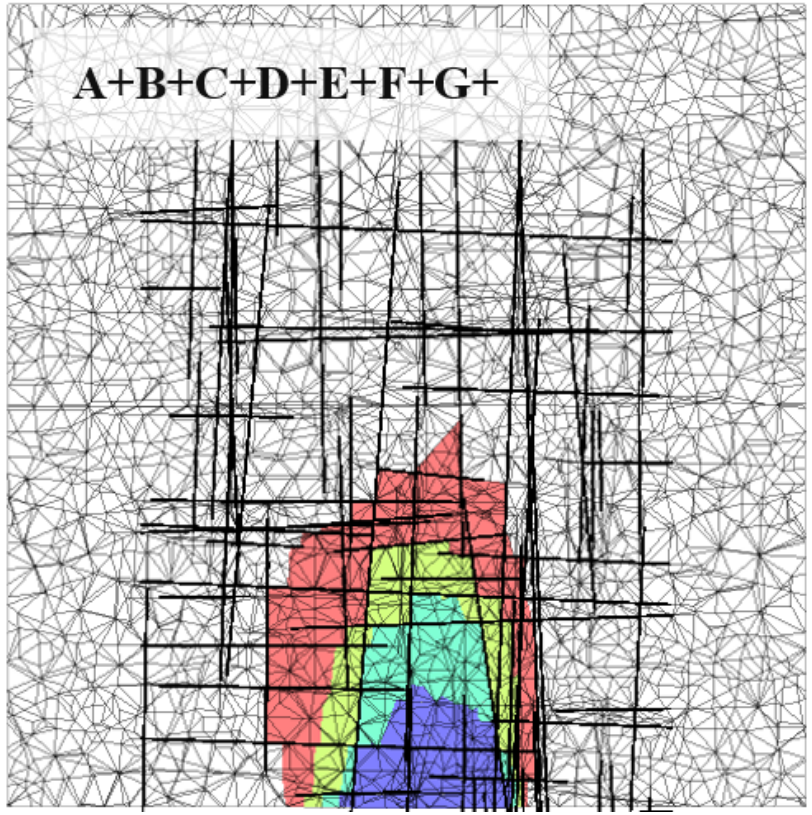
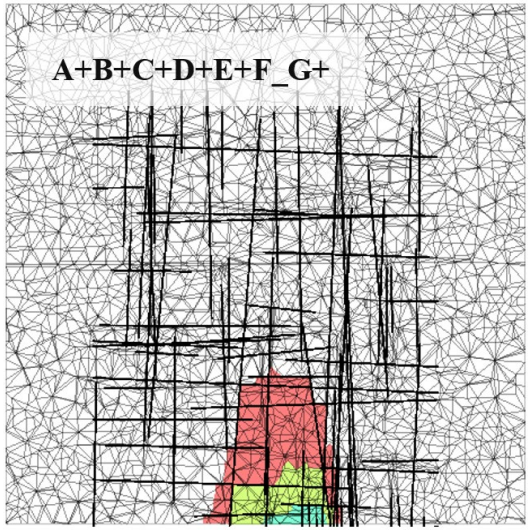
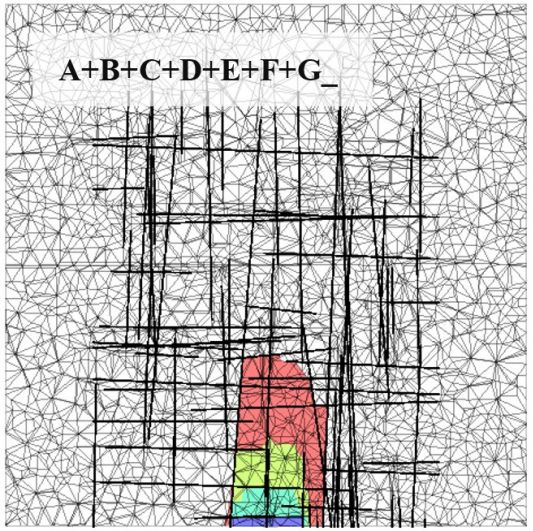


RESULTS AND DISCUSSION







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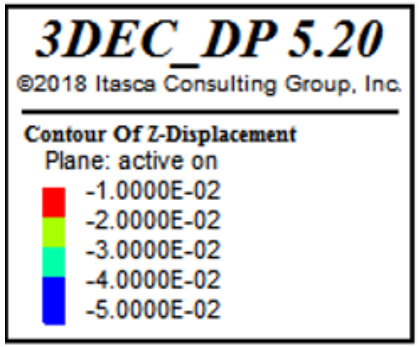
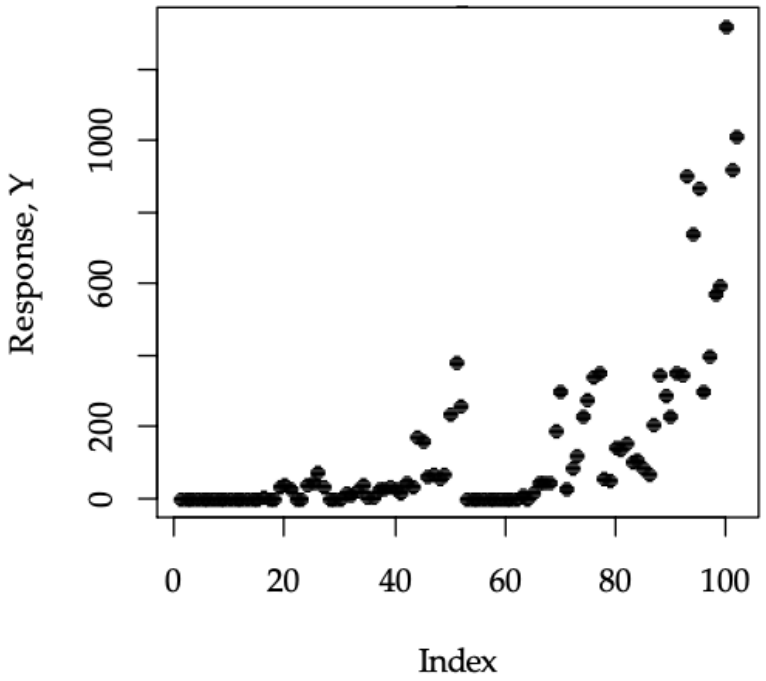


RESULTS AND DISCUSSION

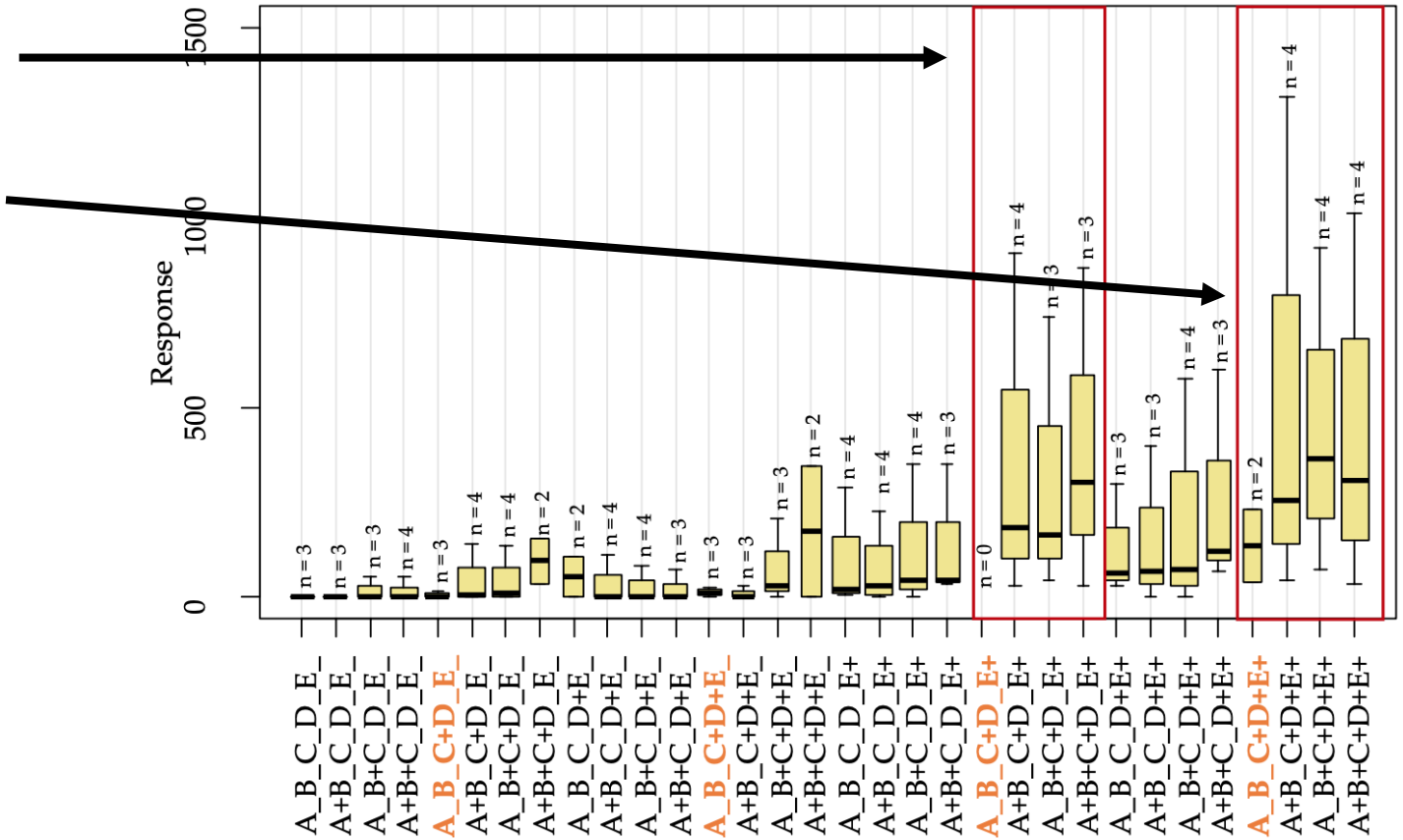
A factorial design for seven factors results in 128 simulations. This work contains 102 simulations (80% of the total).



The responses range from 0 to 1,310, where the unit of measurement represents volume in m^3.

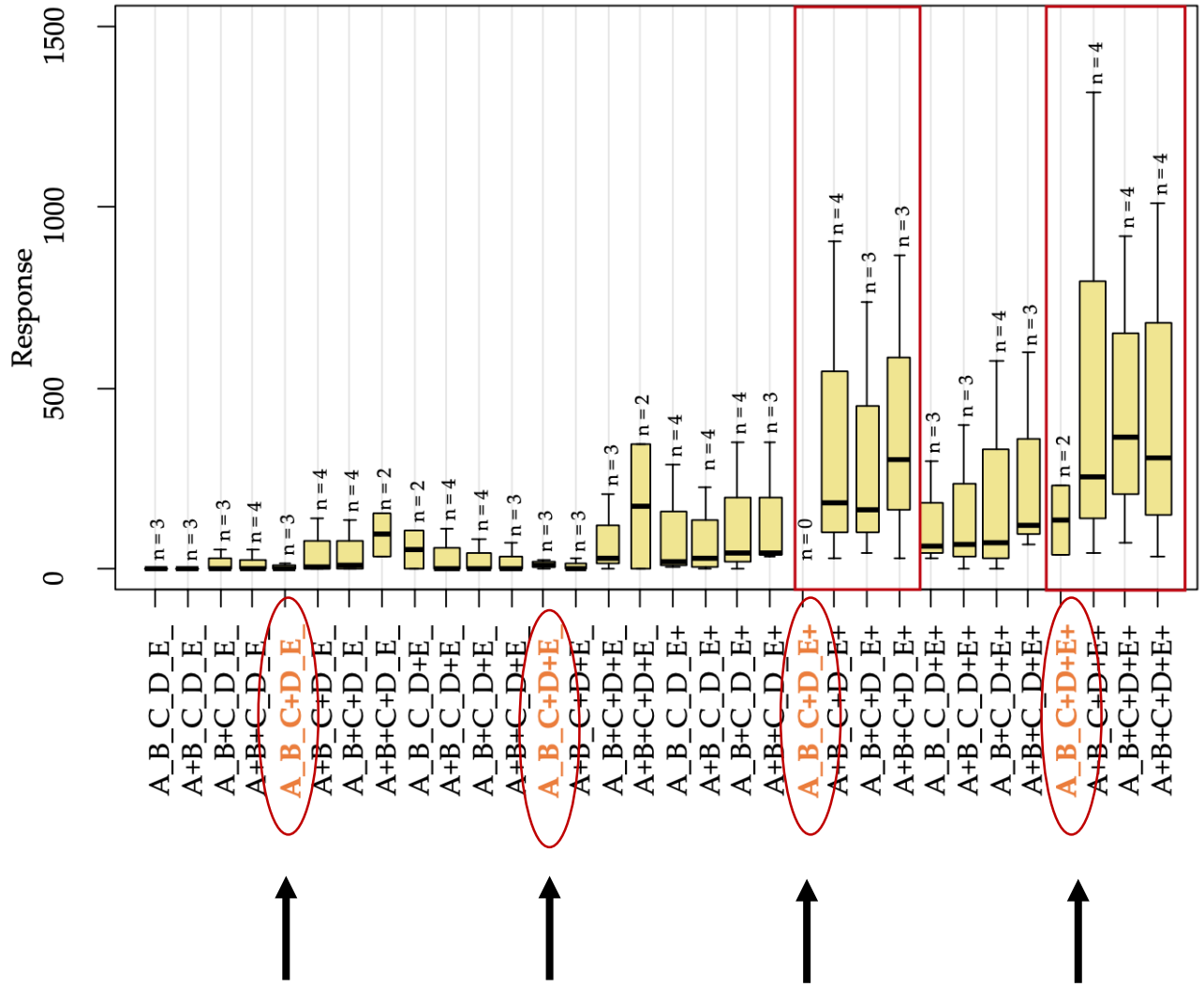
RESULTS AND DISCUSSION

These combinations give higher mean responses compared to other combinations



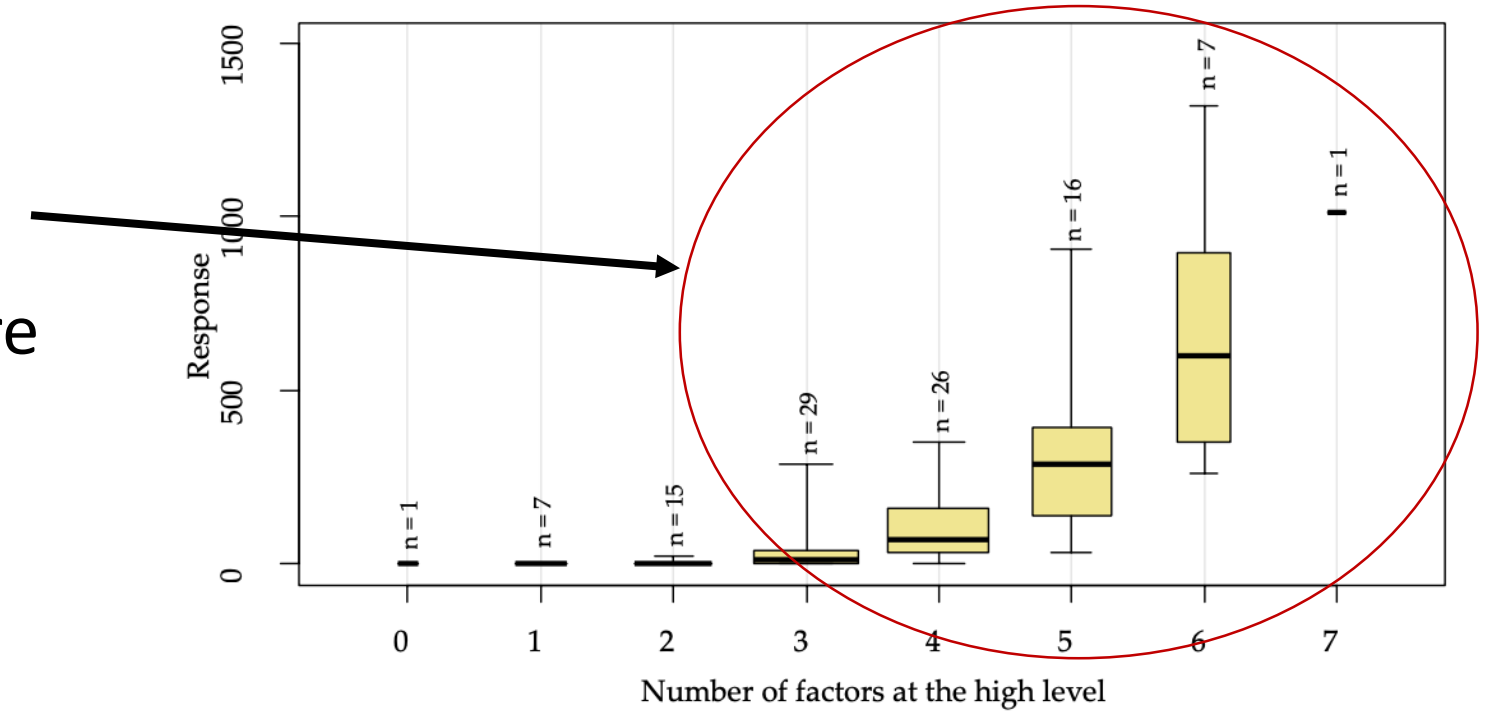
RESULTS AND DISCUSSION

The few simulations that resulted from this combination resulted in low mean responses.



RESULTS AND DISCUSSION

The responses at the combinations containing more than three factors depend on which factors are at the high level.



RESULTS AND DISCUSSION

	Parameters
A	Joint orientation
B	Joint persistence
C	Joint intensity
D	Intact rock category
E	Joints category
F	In-situ stresses magnitude
G	Hydraulic radius

Gamma or Tweedie (ξ = 2) GLM		
	Coefficients	p-value
(Intercept)	3.10	0.00
G	1.22	0.00
C	0.90	0.00
E	1.43	0.00
F	1.33	0.00
D	0.26	0.00
C:G	-0.23	0.00
E:G	-0.21	0.00
E:F	-0.39	0.00
C:F	-0.19	0.00
B	0.12	0.00
F:G	-0.13	0.01
A:G	0.07	0.06
C:D	-0.06	0.07
C:E	-0.08	0.09
A**	0.04	0.28

The model describes factors that predict positive responses

α=0.25

CONCLUSIONS

- Limited data exists and one of the primary issues in block caving practice is the lack of understanding of the caving geomechanics.
- This work conceptualized the caving process and used generic models.
- Modelling the complete caving process remains a challenge due to computer capacity limitations. However, numerical modelling is shown to have the ability to theoretically define the significance of the effect of parameters in the rock mass response to caving if it is assumed that the results from simulations run until a preliminary stage represents the rock mass behavior at initial caving stages.
- The results will be validated in future studies.

ACKNOWLEDGEMENTS

Thank you for your attention