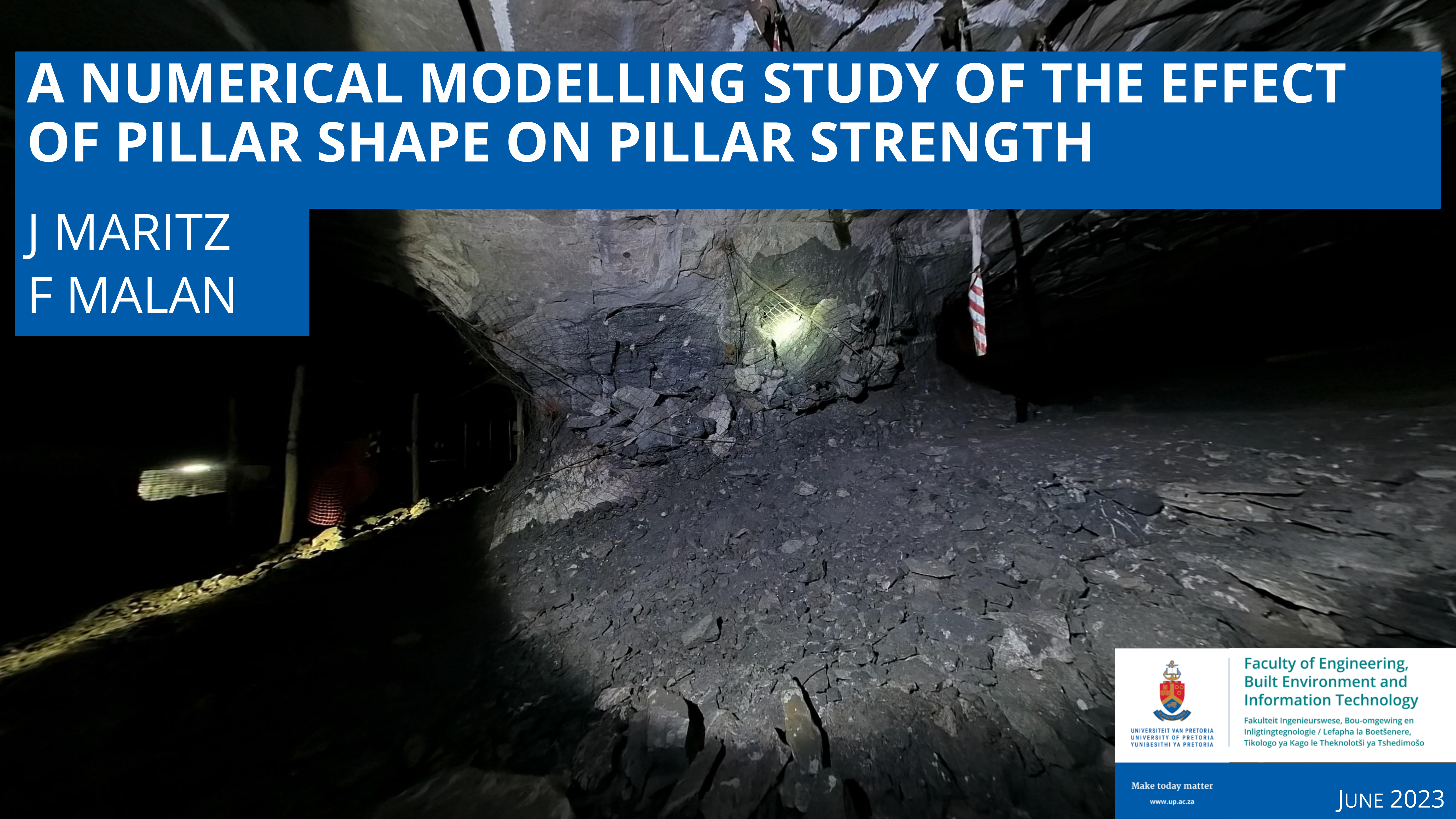

A NUMERICAL MODELLING STUDY OF THE EFFECT OF PILLAR SHAPE ON PILLAR STRENGTH

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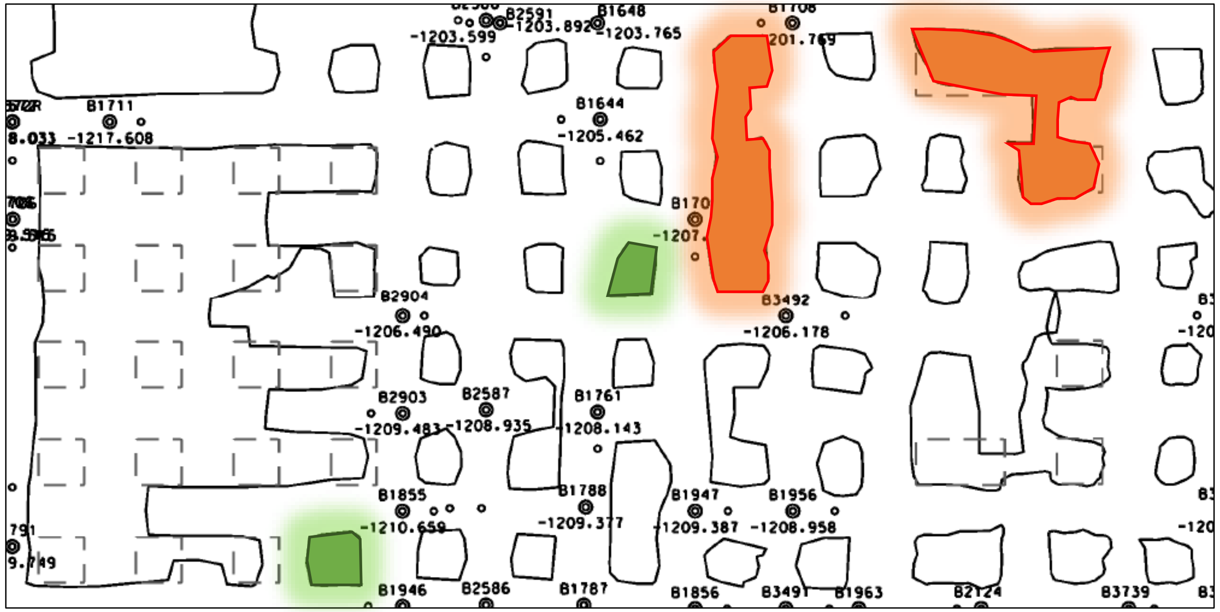
Outline

- Introduction / Background
- Numerical simulation of the effect of pillar shape
- Results
- Conclusion

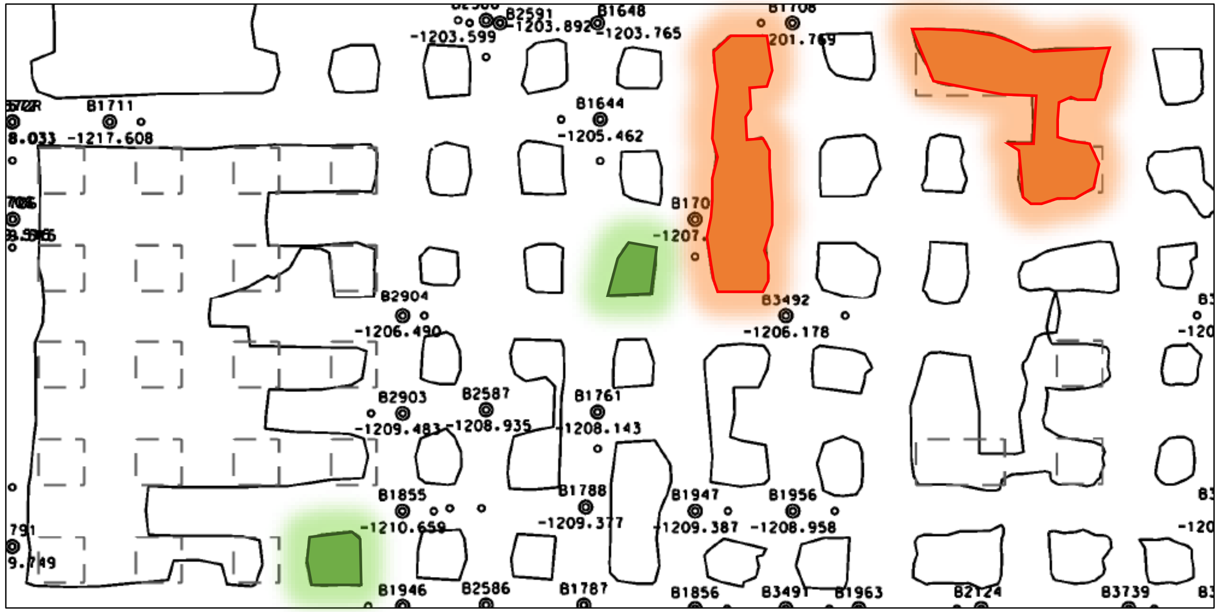
Introduction

- Room-and-pillar layouts
- Plan vs Actual pillars
- Shape influence strength
- No methodology to determine these strengths



Introduction

- Room-and-pillar layouts
- Plan vs Actual pillars
- Shape influence strength
- No methodology to determine these strengths
- $W_{eff} = \frac{4A}{C} = \frac{2wL}{w+L}$
  - f = 1.4 for infinitely long pillar
  - *Wagner (1974), Maritz (2017)*
- Strengthening factor
  - f = 1.0/1.1/1.2/1.3 for w/L = 1/2/4/∞
  - Ryder & Ozbay (1990)

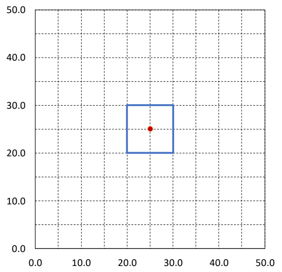


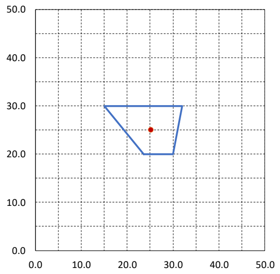
Numerical simulation of the effect of pillar shape

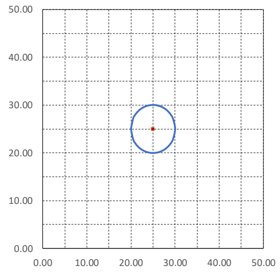
- TEXAN (Malan and Napier, 2007)
  - DD, BE
- DD with Limit Equilibrium (Napier and Malan, 2018 / Couto and Malan 2022)
  - Allows for modelling of pillar failure

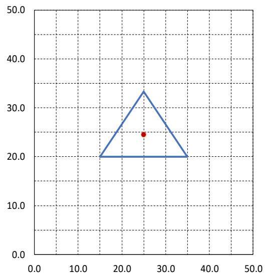
Numerical simulation of the effect of pillar shape - **Geometries**

- Will identical w_{eff} result in similar peak strengths
  - Triangle significantly larger area

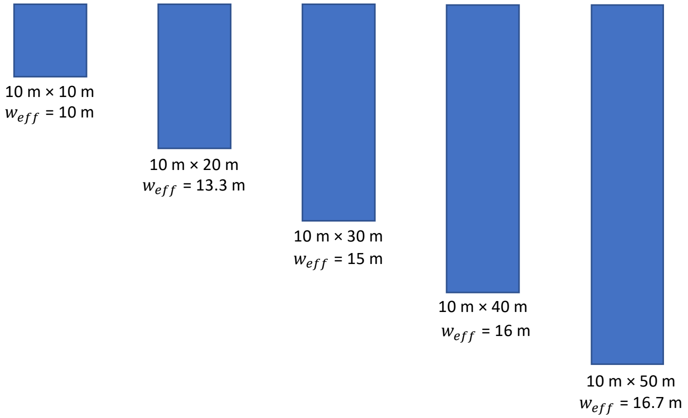






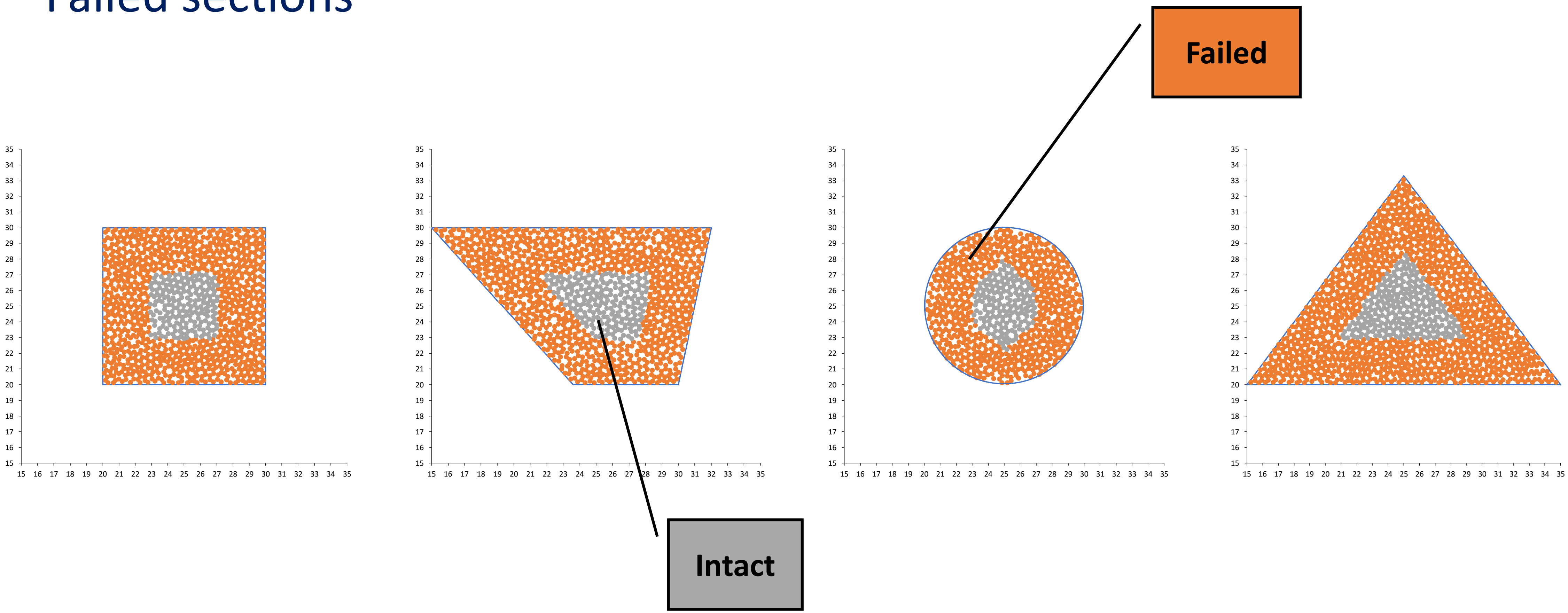


- Effect of elongation
  - 10 x 10 / 20 / 30 / 40 / 50
  - w_{eff} = 10 / 13.3 / 15 / 16 / 16.7



Results – Similar w_{eff}

- Failed sections



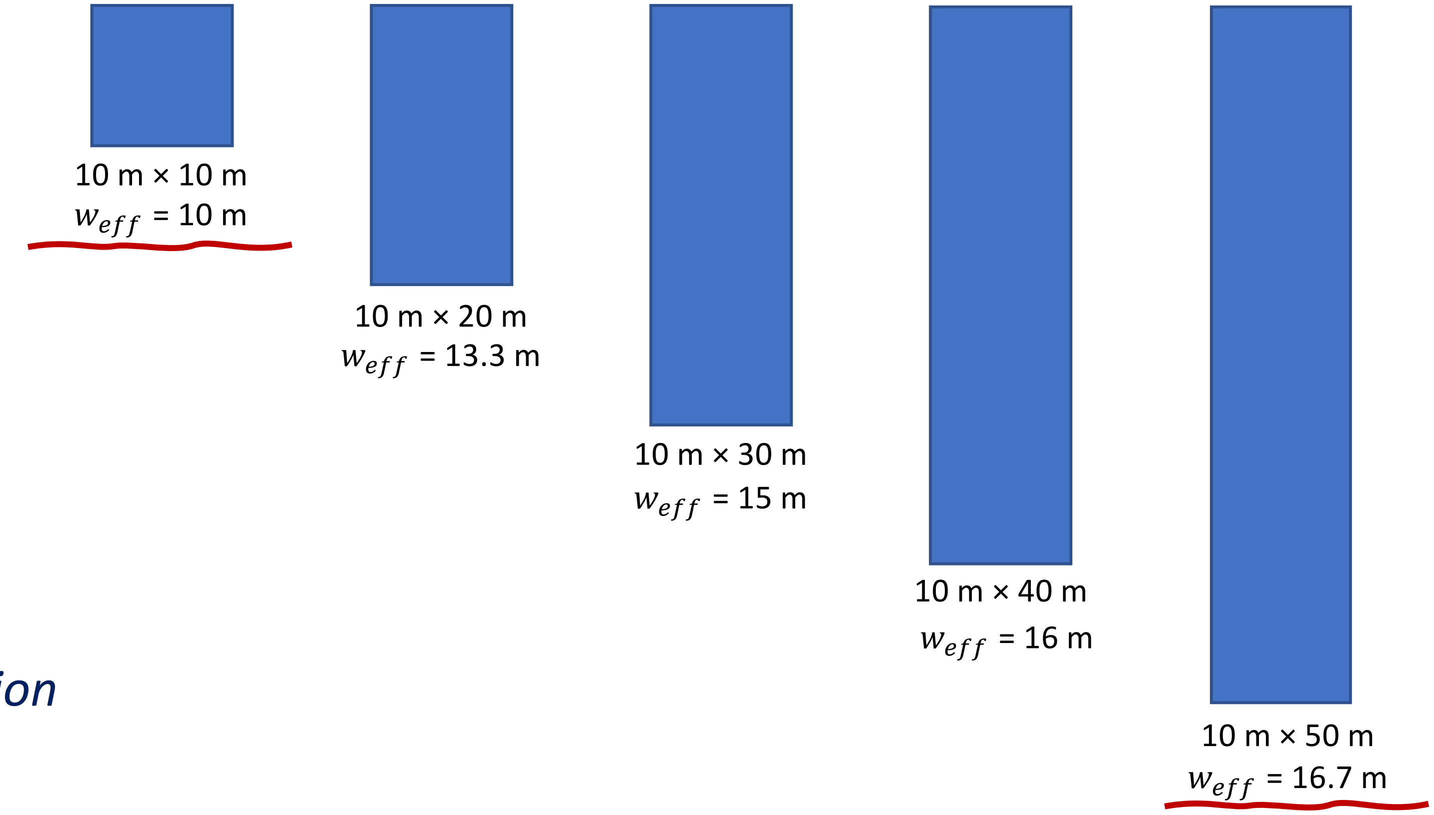
Results – Similar w_{eff}

- Simulated strengths

Results – Elongation

- Increasing w_{eff}

- Area increase ~ 5x
- w_{eff} increase ~ 1.6x



Maximum w_{eff} = 2x shortest dimension

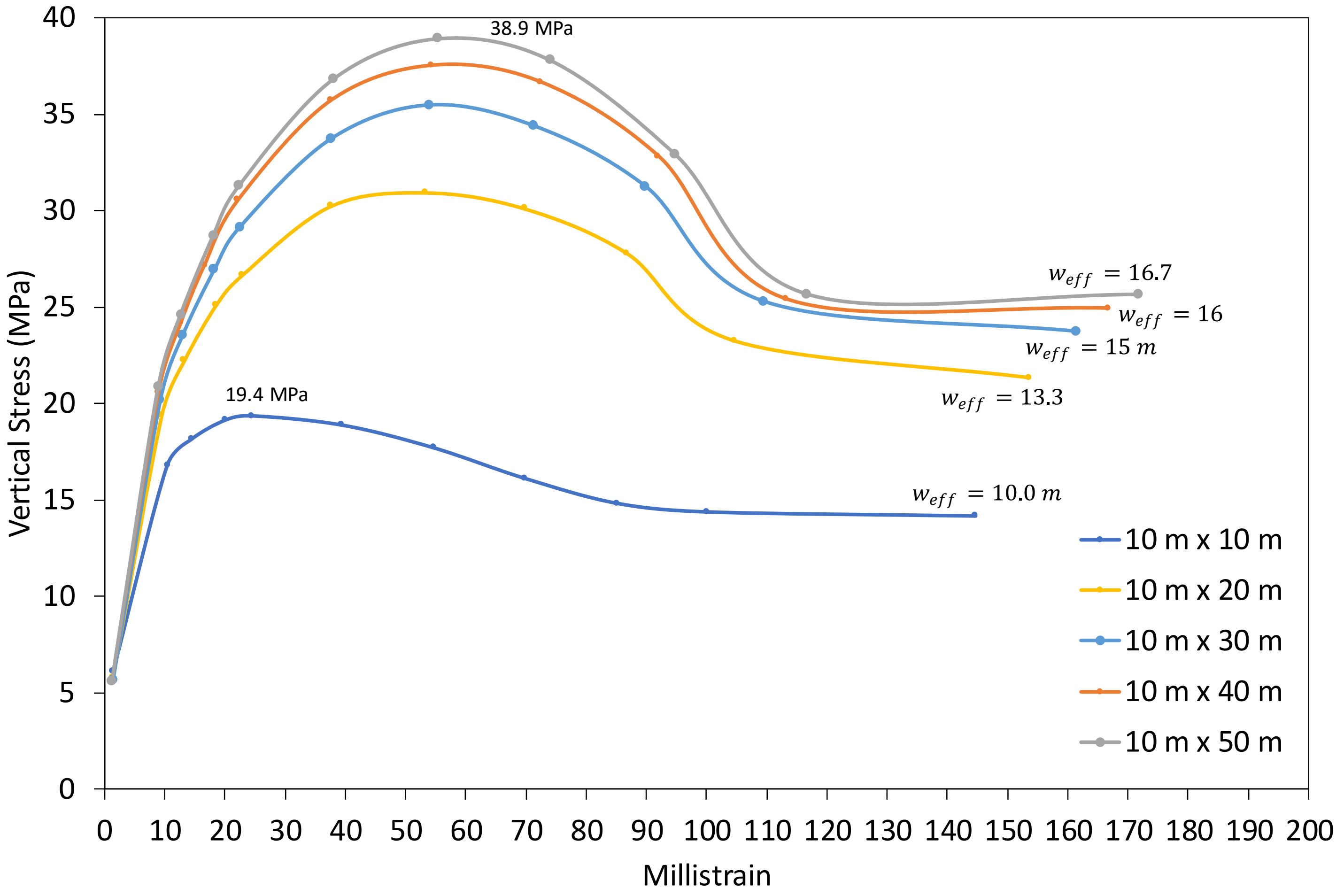
Elongation = ∞

Results – Elongation

- Increasing w_{eff}

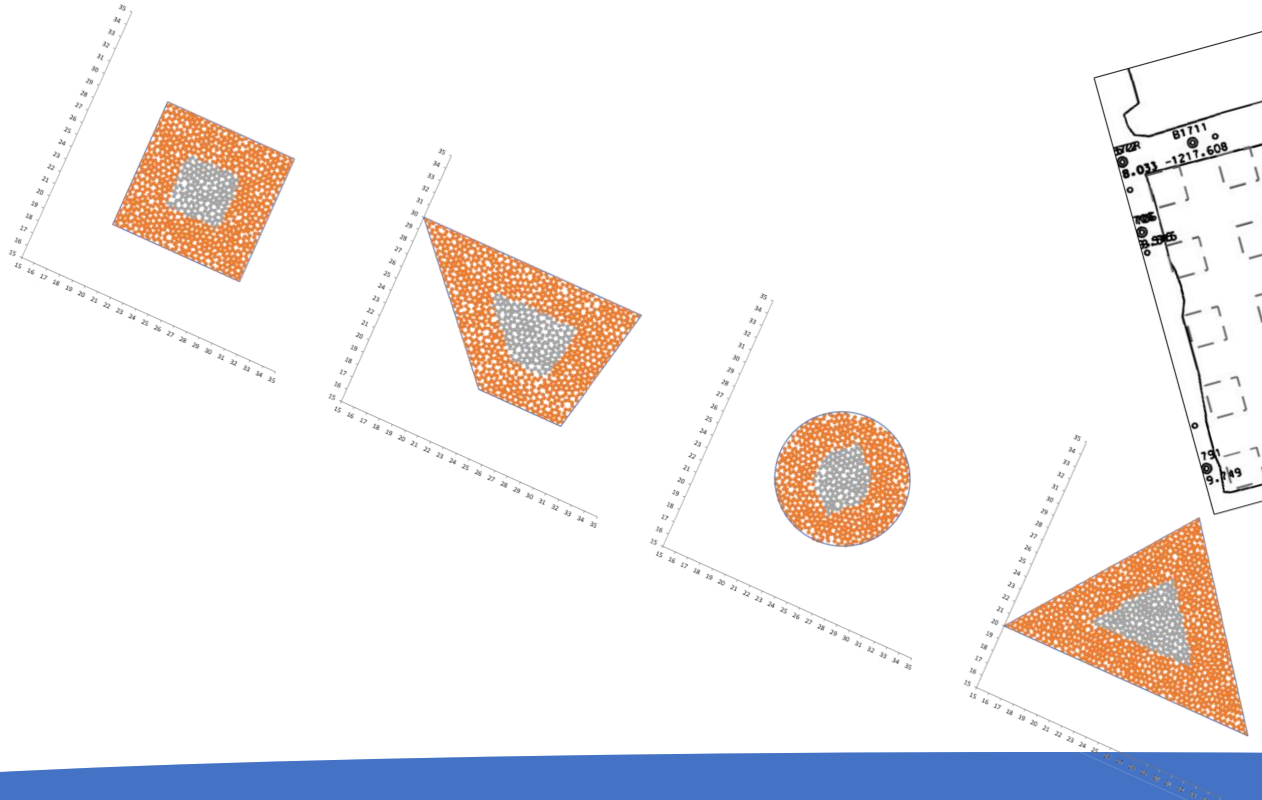
- Area increase ~ 5x
- w_{eff} increase ~ 1.6x

- **Strength increase ~ 2x**
- w_{eff} increase ~ 1.4x



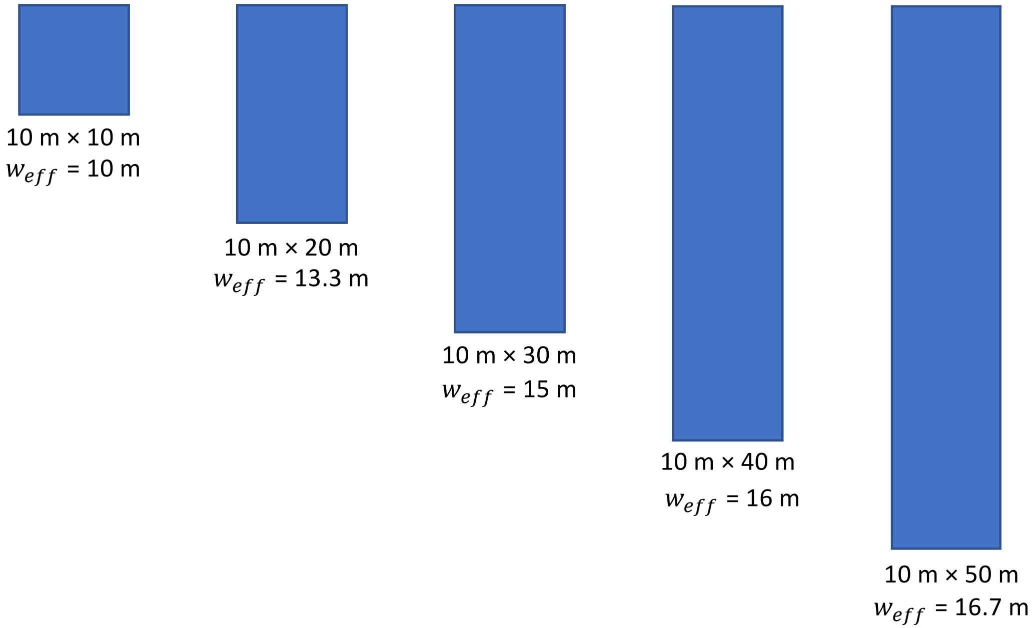
Conclusion

- Caution on Application of w_{eff} to irregular pillars
  - Constant w_{eff} with various shapes similar strength
  - Circular "stronger"



Conclusion

- Strength increase with w_{eff} increase
  - w_{eff} indicate 1.4x increase to strength with infinite long pillar



Conclusion

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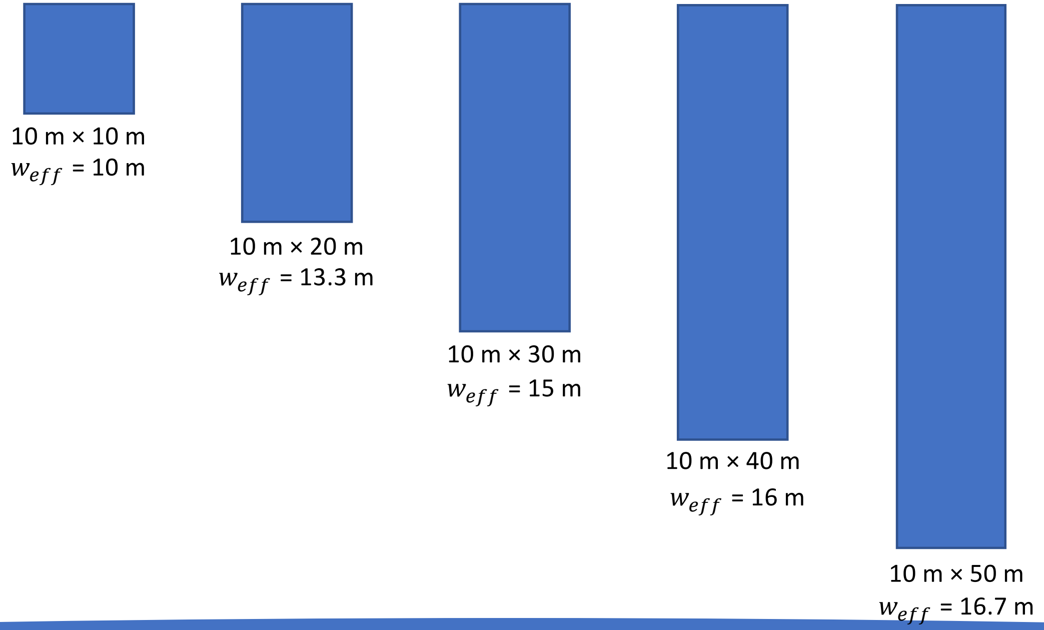
- w_{eff} indicate 1.3x increase to strength vs 2x increase from modelling



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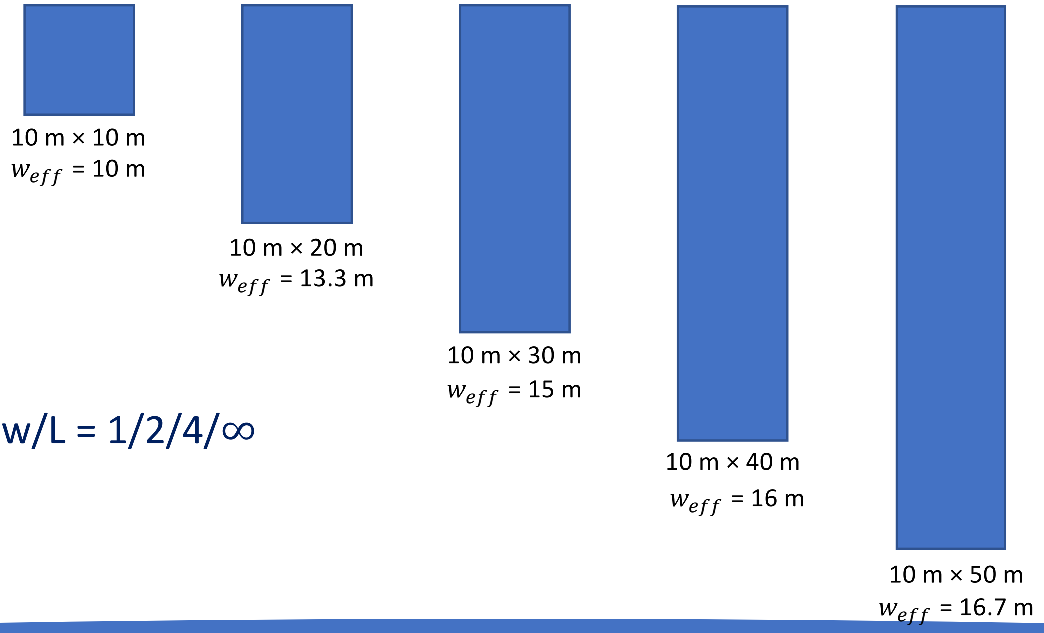

Strengthening factor

f = 1.0/1.1/1.2/1.3 for w/L = 1/2/4/∞

Ryder & Ozbay (1990)

Questions?