

Research Unit Mining

Geotechnical Design of Coal Bord and Pillar Panels: Some Complementary Suggestions

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Venue: Sun City, Rustenburg, South Africa
21-23 JULY 2025 – Conference

SANIRE SAIMM 150 AFRIR-CK 2025

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Background to paper

Around 1990, I worked on coal pillar design and pillar extraction at COMRO.

Today, I am rather an outsider.
Although I hesitated to write this article or not, I finally decided to do it.

One of the reasons to do it:

PIONEERING PROGRESS : THE FUTURE OF ROCK ENGINEERING

One aspect is to look back with a critical eye.

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Background to paper

“The goal of this paper is to identify how the future design of coal bord and pillar workings can be improved, starting from the insights gained in the past.”

Although I am critical, I am not criticising the work of the past, or trying to downsize the merits of the past and current work.

The opposite is true.
[progressive insight]

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First thought or concern.

The focus is very much on the pillars.

Reason is logic, as some of the major disasters are due to pillar collapses.

However, we are not building pillars, but excavating rooms.

Even that the bord width in coal mines is mostly assumed to be 6 m, one should start by looking at the **stress redistribution around a room.**

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First thought or concern.

Excavating a room leads to a stress redistribution

Position of stress peak around excavation, based on a simple 2D elastic model.

This information is used for design of roof support.

The zone left of stress peak in the pillar is wider for:
**Higher horizontal stress,
Larger mining heights.**

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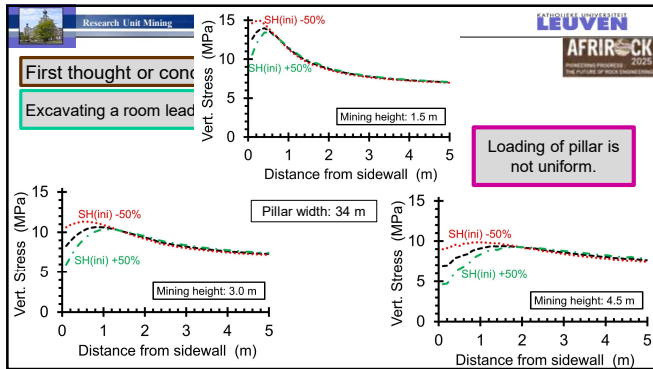
First thought or concern.

Excavating a room leads to a stress redistribution

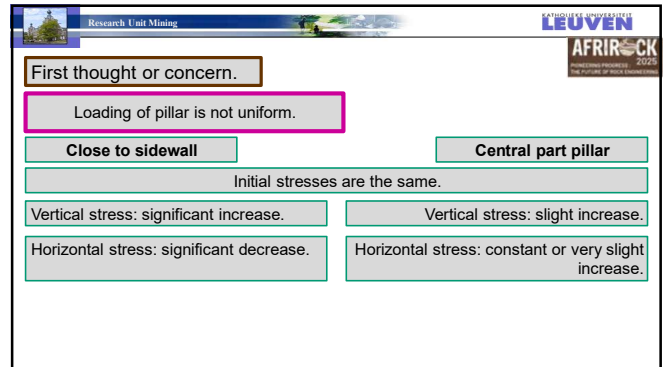
Pillar width: 34 m

Mining height: 3.0 m

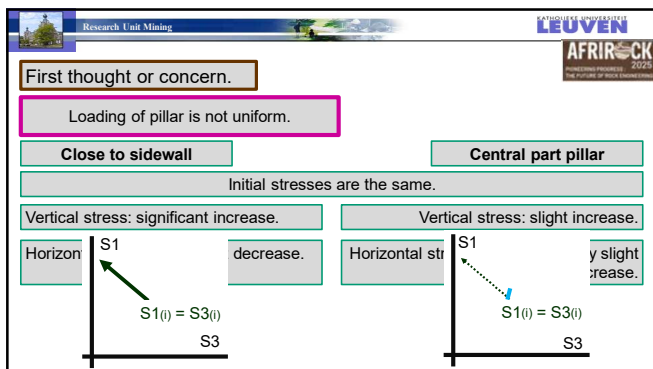
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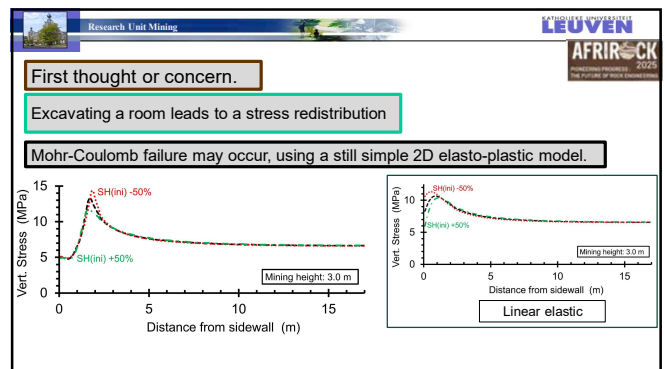
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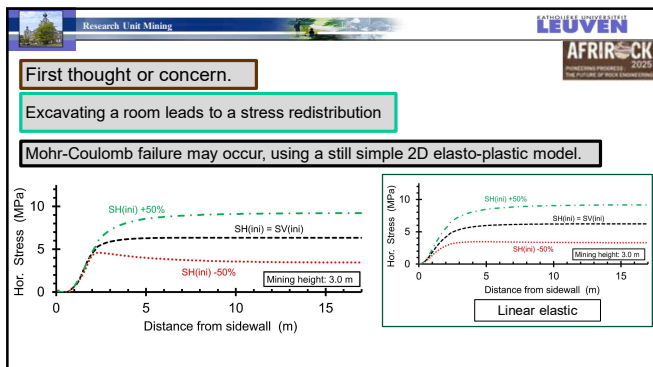
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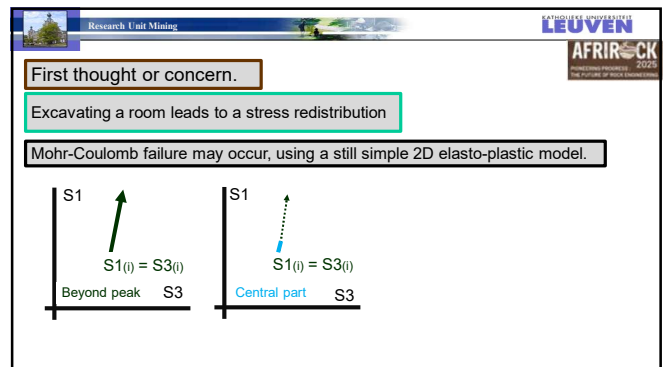
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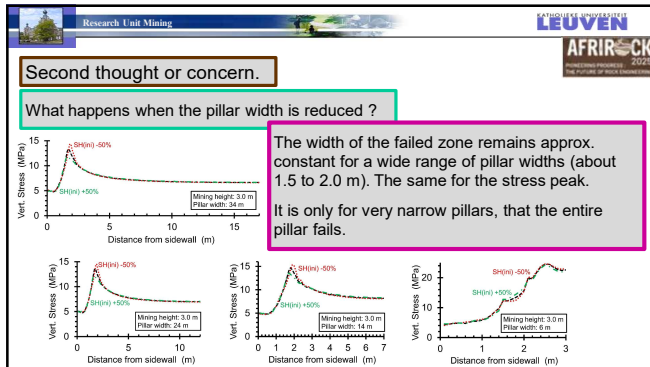
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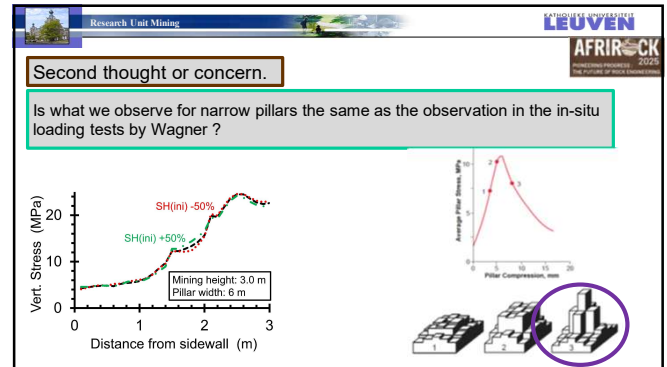
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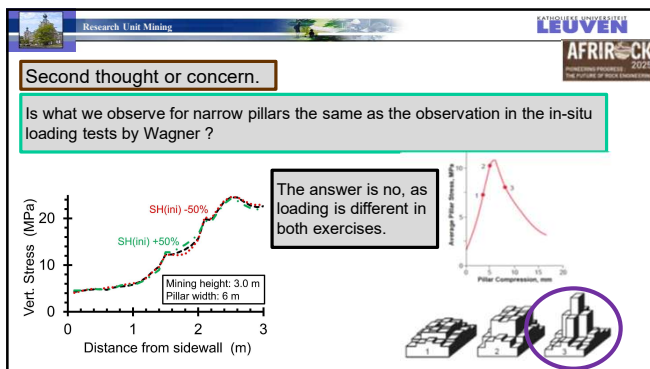
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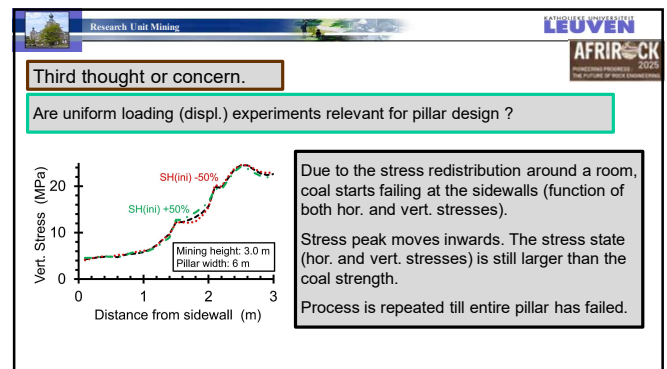
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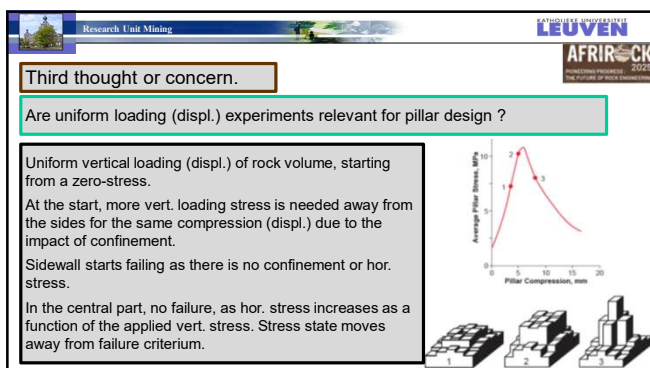
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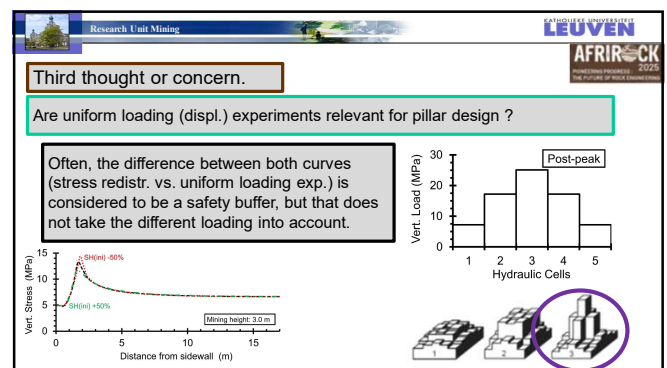
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Third thought or concern.

Are uniform loading (displ.) experiments relevant for pillar design ?

One learned a lot from such experiments (lab and in-situ), about size effect, shape effect, impact of coal-roof contacts, etc.

Is it applicable to pillar design?

I have my doubts.

Reason: Strength, incl. pillar strength, is a **non-intrinsic property**, meaning its value is function of shape, size, etc., but also **function of type of loading**.

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Third thought or concern.

Are uniform loading (displ.) experiments relevant for pillar design ?

experiments (coal-roof co)

I have my doubts.

Reason: Strength, meaning its value is **function of type of loading**

Never cross a river 4-feet deep "on average"

intrinsic property, but also **function**

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Third thought or concern.

Are uniform loading (displ.) experiments relevant for pillar design ?

experiments (coal-roof co)

Coal pillar extraction.

I have my doubts.

Reason: Strength, meaning its value is **function of type of loading**

intrinsic property, but also **function**

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What is the way forward?

In one way, the Salamon & Munro formula should address all concerns raised. One could see it as an "AI-exercise *avant-la-lettre*".

The data for real in-situ behaviour of a large number of bord and pillar panels is used to determine the various coefficients in the strength formula.

One must have a lot of respect for the work done in the sixties, i.e., without any computer power, but now we are sixty years later.

So, is the combination of AI and discrete element modelling the way forward? [model of entire panels?, more parameters, more realistic input-restrictions, etc.]

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What is the way forward?

Crucial questions remain:

How does one define pillar strength ?

How does one define safety factor ?

When one knows that loading of pillar is not uniform.

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What is the way forward?

Good starting point is the approach by Monsalvi et al., 2025.

Mining, Metallurgy & Exploration (2025) 42:501–522
https://doi.org/10.1007/s42461-025-01210-7

A Risk-Based Pillar Design Approach Combining Stochastic Continuous and Discontinuous Modeling in an Underground Stone Mine

Juan J. Monsalvi¹ · Aman Soni¹ · Richard Bishop¹ · Jim Hazzard² · Adrian Rodriguez-Marek³ · Cheng Chen⁴ · Nino Ripepi²

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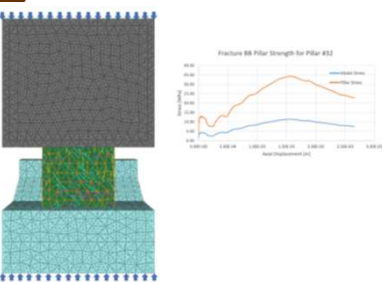
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What is the way forward?

3D
Pillar: discontinuum

First excavation: so, stress redistribution (positive).

Second constant velocity on boundaries (?)



Fracture BB Pillar Strength for Pillar #12

Y-axis: Stress (MPa) from 0.00 to 40.00
X-axis: Time (seconds) from 0.000E+00 to 2.000E+01

Legend: Average Stress (blue line), Fracture Stress (orange line)

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Final slide

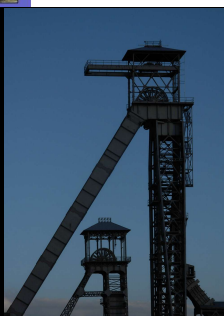
“The goal of this paper is to identify how the future design of coal bord and pillar workings can be improved, starting from the insights gained in the past.”

Rock does not recognise average stresses, but local stresses.

Not building pillars, but excavating rooms.

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THANKS

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