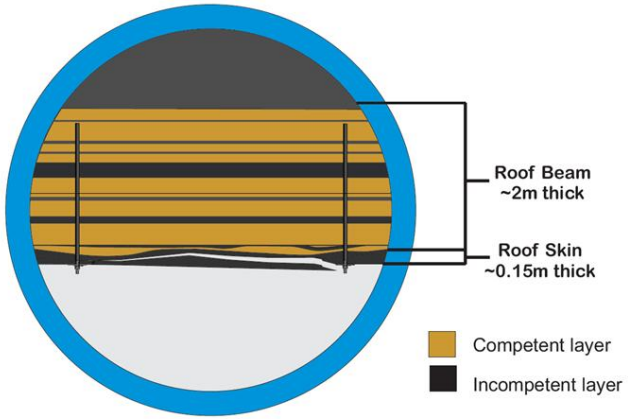
MANAGING LOADED MESH

5 June 2025

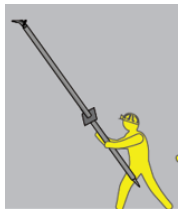
AGENDA

- MANAGING SKIN FAILURES
- INCIDENT SHARE
- STAGES OF MESH LOADING
- ASSESSING THE STAGES OF MESH LOADING
- STRATEGY COMPARISON
- MESH BLEEDING AS A STRATEGY
- STRAPPING AS A STRATEGY
- FUTURE PROJECTS

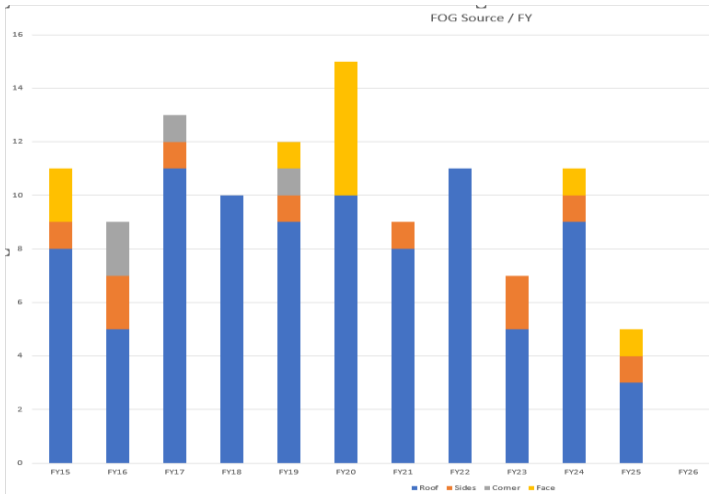
MANAGING SKIN FAILURES



Systematic Approach – Design based control	Risk Based Approach – Human based control
• **HARD BARRIER = EFFECTIVE ONCE IMPLEMENTED** • Area cover – 3.15mm & 4.0mm mesh • Area support – 5.6mm mesh & straps & liners • Increase bolt density – hard roof environment	• **SOFT BARRIER = NEED HUMAN DISCRENTION AND INTERVENTION FOR IT TO BE EFFECTIVE** • Sounding & Barring • Risk area mesh • Spot bolting • Roof horizon control & remove unstable material during cutting.
	



Hard hat rated to provide protection up to 50Joules



Average persons length - 1.65m Size of fall - 0.297m x 0.42m x 0.05m RD 2500 (15.6kg)			Potential Accident Outcome
Seam height (m)	**Free fall distance(m)**	**Kinetic Energy Joules**	
1.8	0.15	23	Slight
2	0.35	54	Minor
2.5	0.85	130	Major
3	1.35	206	
3.5	1.85	283	
4	2.35	360	Fatality
4.5	2.85	436	
5	3.35	512	

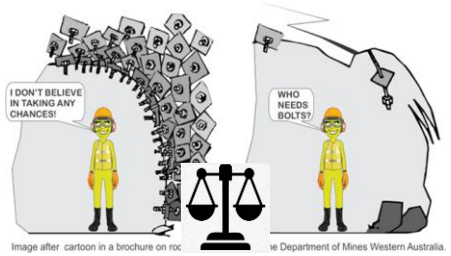
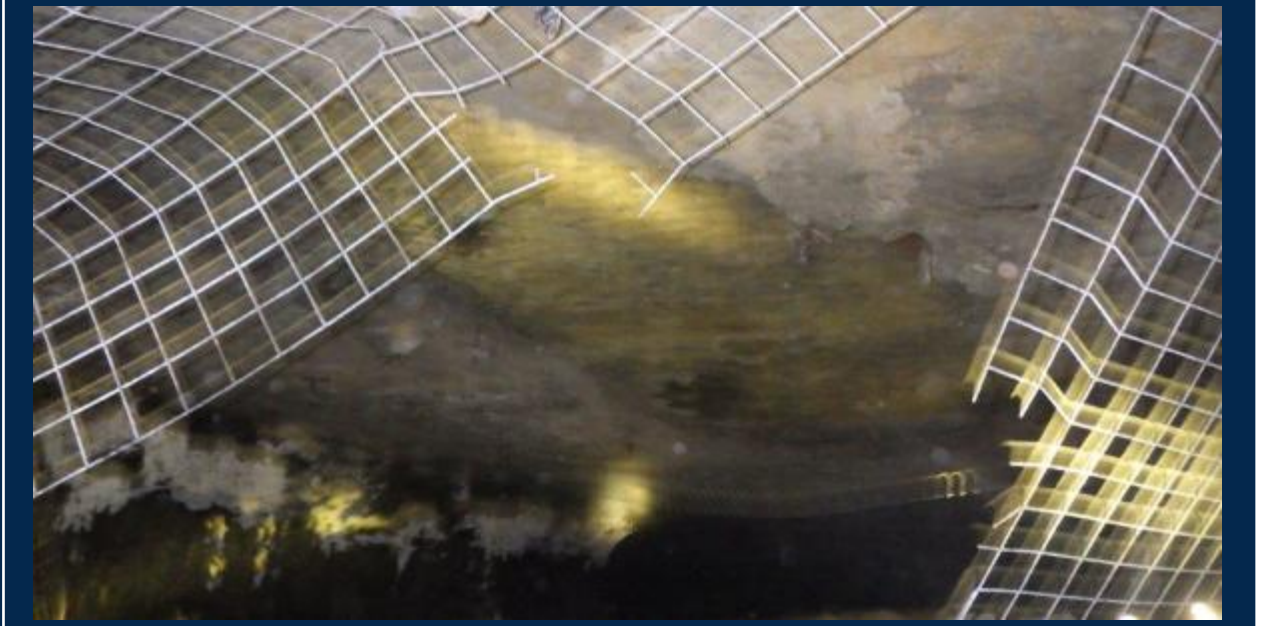


Image after cartoon in a brochure on roc ...e Department of Mines Western Australia.

INCIDENT – TRIGGERED REVIEW ON BLEEDING



- 2 x persons where stationed on belt structure when cutting the mesh. (LWDC) – High severity incident
- Size of loose material on top of mesh underestimated.
- Wrong positioning whilst cutting mesh.
- Cutting tool did not enable cutting from a safe distance / position.

- Yellow stains on roof of fall cavity– oxidation indicates existing delamination with air and water on bedding plane.
- Notice how wires were cut around the bolt plates rather than along the length of the sheet.

STAGES OF MESH LOADING

ASSESSING THE STATE OF MESH LOADING – IDENTIFYING CORRECT STRATEGY THROUGH USE OF THE MESH CONDITION ASSESSMENT SHEET

- **NONE / SLIGHTLY LOADED MESH**
  - Accept residual risk.
  - No immediate action.
  - Monitoring strategy.
- **LOADED MESH**
  - Strap.
  - Double nut new sheet of mesh over existing loaded. sheet.
- **OVERLOADED MESH**
  - Focused bleeding – higher level supervision required.
  - Mechanical remote removal.
  - Strap if localized area with safe access is available.

Document 6: Mesh Condition Assessment Sheet			Date:		Reference Number:	
Mine:		Area / Panel:		Split	From:	to
CRITERIA	LOW		MODERATE (loaded)		HIGH (overloaded)	
Mesh / loading condition (Assessment on the amount of deformation on the sheet)	No deformation as a result of material build-up Bulging as a result of poor installation		Limited bulging Less than 500mm sag from roof elevation		Severe bulging More than 500mm from roof elevation	
	No deformation to aperture around bolt plates		Limited deformation to aperture around bolt plates		Severe deformation to aperture around bolt plates as well as along edges of mesh sheet	
	No welds strained		Welds strained but none failed due to shear		Shear failure on welds especially close to bolt plates	
	All strands intact		Strands failed in tension (< 20%)		Strands failed in tension (>20%)	
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	No corrosion		Limited corrosion		Severe corrosion impacting the integrity of the sheet	
	3 block overlap		2 block overlap		1 block overlap	
Failed Material (Assessment on the size of the material as that can be linked to impact severity should failure occur)	Few small pieces Once-off failure within competent roof area		Accumulation of numerous small pieces Isolated slabs Roof above failed material stable and not resting on the failed material. View of roof not obscured (Roof above failed material still visible for inspection) Time dependant failure and potential further loading in mesh		Excessive small pieces Multiple slabs Large slab No opening / gap between failed material and roof - view of roof above material obscured Extend of failure cannot be verified Possibility of multiple layers resting on mesh which can dislodge when mesh fails Expecting further time dependant failure	
Risk Exposure (Assessment on exposure to risk of sudden mesh failure)	No need for access to the area		Occasional access required		Frequent access required	
	Area can be permanently barricaded		Area can be temporarily barricaded and access managed where and when required		Not possible to manage access through barricading due to permanent access required.	
	Isolated area where risk is present				Excessive or extensive areas	
	Area can be declared safe		Area can only be declared safe if mitigation is implemented. E.g. Monitoring and additional support		Area can only be declared safe once rehabilitation strategy is implemented.	
ASSESSMENT OUTCOME	LOW		MODERATE		HIGH	
STRATEGY	No action required Area can be declared safe		Install DTM Straps as per procedure		Implement bleeding strategy as per procedure or mitigation as recommended through JSA and site specific risk assessment.	

Accept – No action required

Strap & Double nut

Bleed & Mechanical remote removal

STRATEGY COMPARISON

STRAPS	BLEEDING	DOUBLE NUTTING
Advantages: • Support unit. • Build-in Tell Tale – enable safe declaration. • Fast & easy to install especially when extensive areas need urgent attention as soon as possible. • Can be managed cost effective by implementing different patterns. • Can be installed from ground level. • Potential ease for future bleeding – cutting straps only. Disadvantages: • Load not removed but managed with providing additional support & monitoring. • New system that need to prove itself. • Service providers not keen to implement due to loss of income as this system replaces the need for bleeding and re-support work.	Advantages: • Existing support replaced with new support – new cycle of support resistance rendered. • Potential energy from load is removed, risk eliminated once bled. Disadvantages: • Loaded mesh removed under tension. • Safe position during cutting is not clearly defined and need to be determined for each scenario. • Height restriction – safe position & tools • New support to be installed prior declaring area safe. • Difficult and time consuming to bleed and then replace the mesh – shortcuts taken to increase advance & income. • Cost impact to mine – remove and then replace support.	Advantages: • Existing support replaced with new support – new cycle of support resistance rendered. • If proper tools & procedure is available, it can be installed from ground level. • Less costly than bleeding and replacing mesh sheets. Disadvantages: • Load not removed. • Limited additional support rendered – second mesh sheet will also reflect a loaded state and will also fail once the maximum load bearing capacity of the original sheet is breached. • Potential that team will require to work from a step ladder to keep mesh in place prior to securing it with plate.

MESH BLEEDING AS A STRATEGY

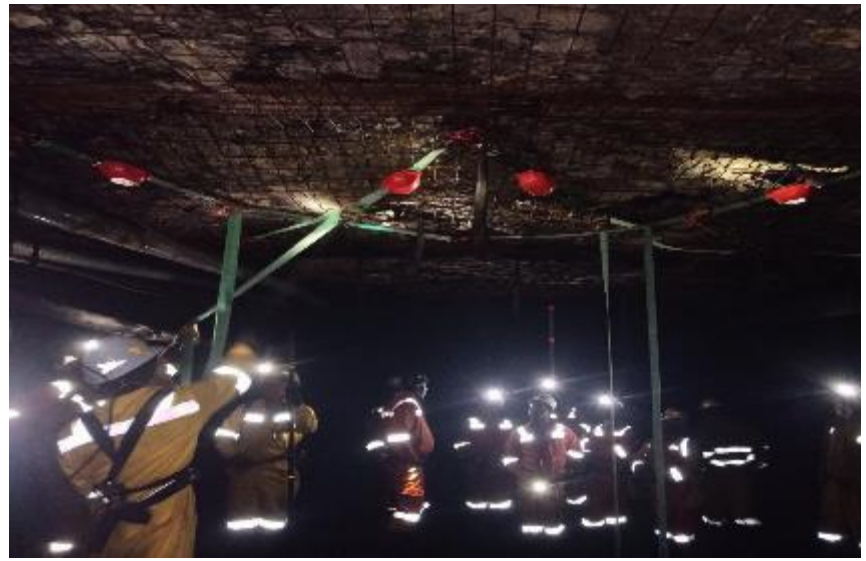
High level enablers

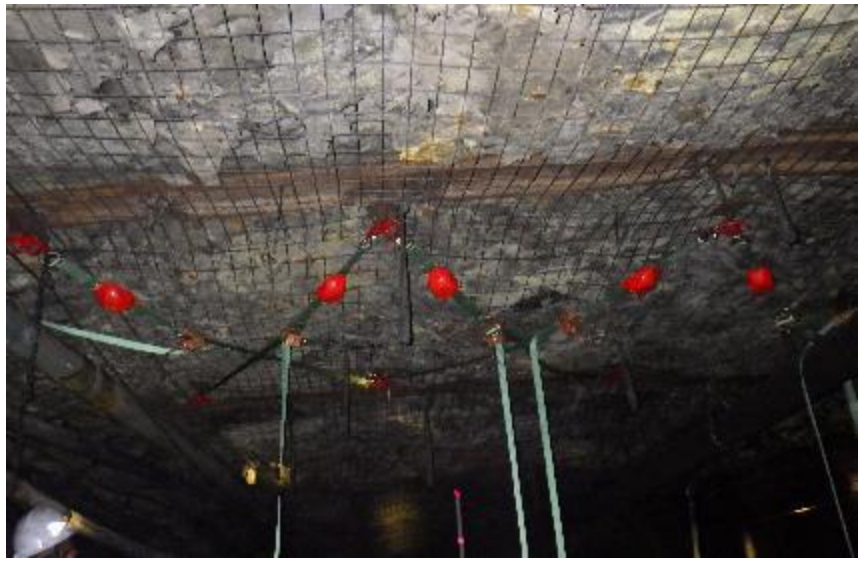
- Need a special cutting tool to allow cutting from a safe distance (2.5m away from fall path)
- Need a proper method statement to guide team on what procedure to follow for different scenarios. – Derived from a risk assessment
- Higher level supervision – to indicate cutting strategy and the safe position when cutting from different position.
- Discipline from team to adhere to the procedure as the procedure will not always be the easiest and fastest way.

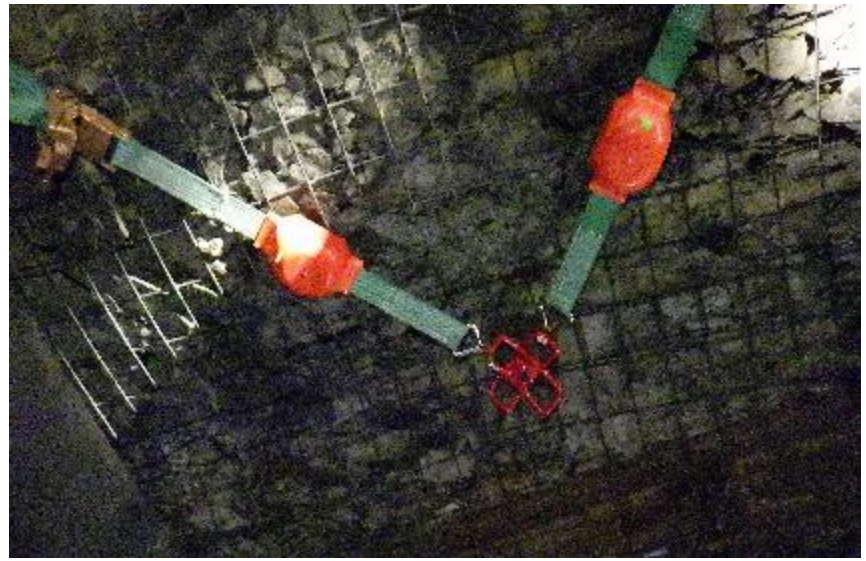
STRAPPING AS A STRATEGY

High level enablers

- Apply on areas pre-assessed for suitability – areas with loaded mesh.
- Need safe access from both sides when overloaded mesh is treated and access from underneath when installing it in extensive areas with loaded mesh.
- SOP to support above process.
- Need a special strap that has a build-in Tell Tale monitoring system.
- Need to have a build-in pretension setting / indicator.
- Need to be easy & quick to install.
- Proper QAQC process to verify compliance to design.
- Design load to be more than that of the original mesh sheet.







TECHNICAL SPECIFICATIONS - STRAPS

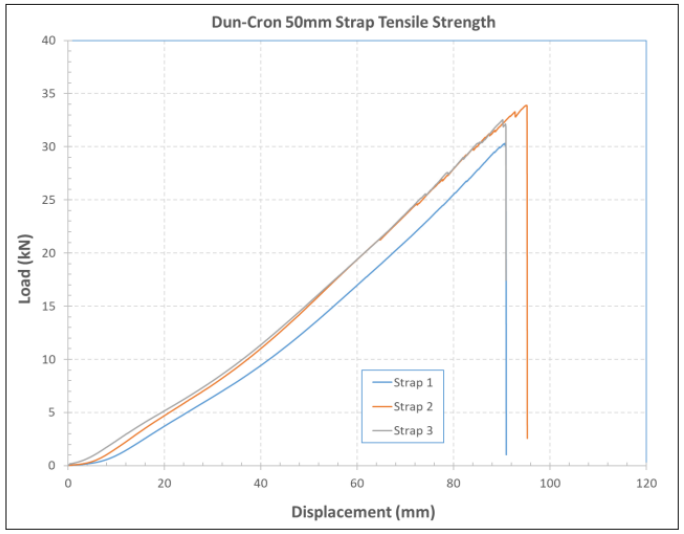
Design specifications on straps:

- Max 2-ton load on system – thus 4 tons when installed in cross bracing pattern.
- Build-in Tell Tale system that triggers at 1.7 tons.
- Ratchet build into strap to allow strap to be tensioned to 70kg – tension indicator on Tell Tale box

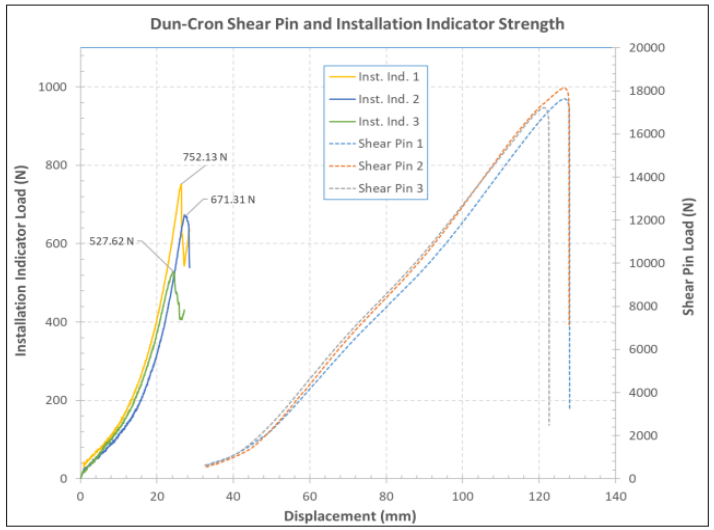
- Above loads verified and certificated by independent testing facility.

- Future tests will be conducted on a regular basis and in house testing will also form part of the supplier QAQC process and will be formulated in the supplier agreement and reflected on the COC accompanying the batches.

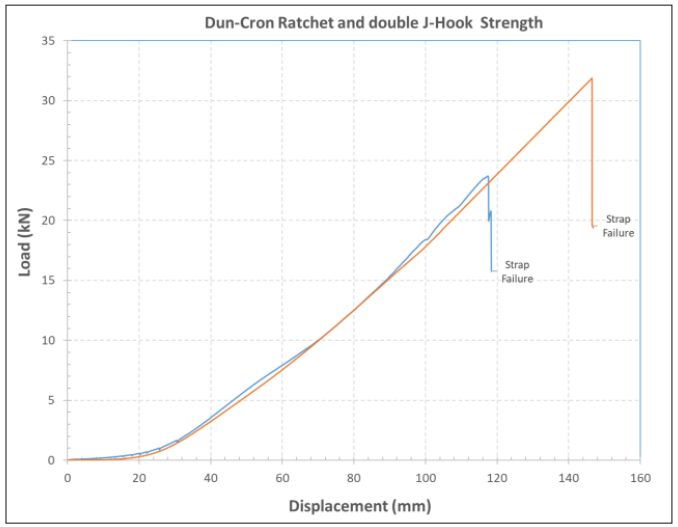
50mm Strap



Shear Pin and Installation Indicator



Ratchet and double J-Hook



Prepared by: Dr. H Yilmaz
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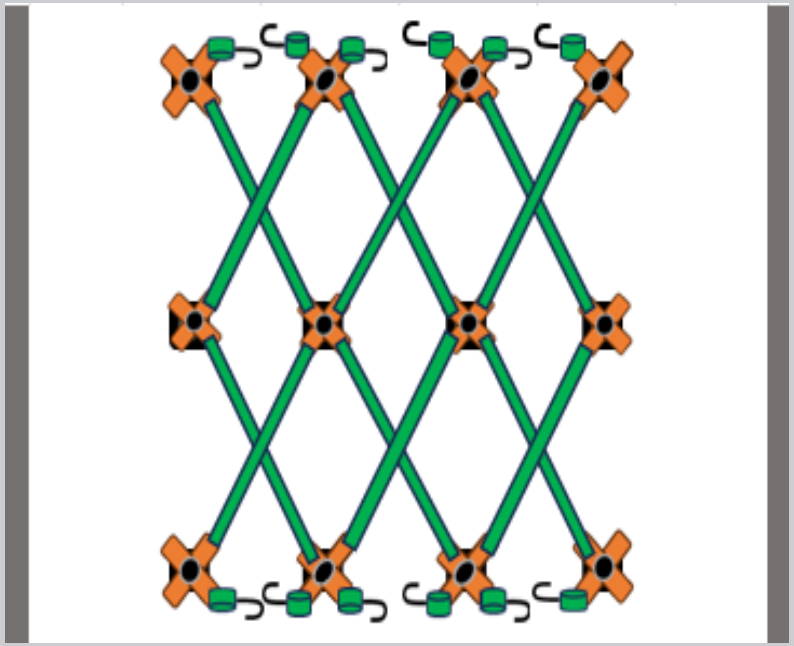
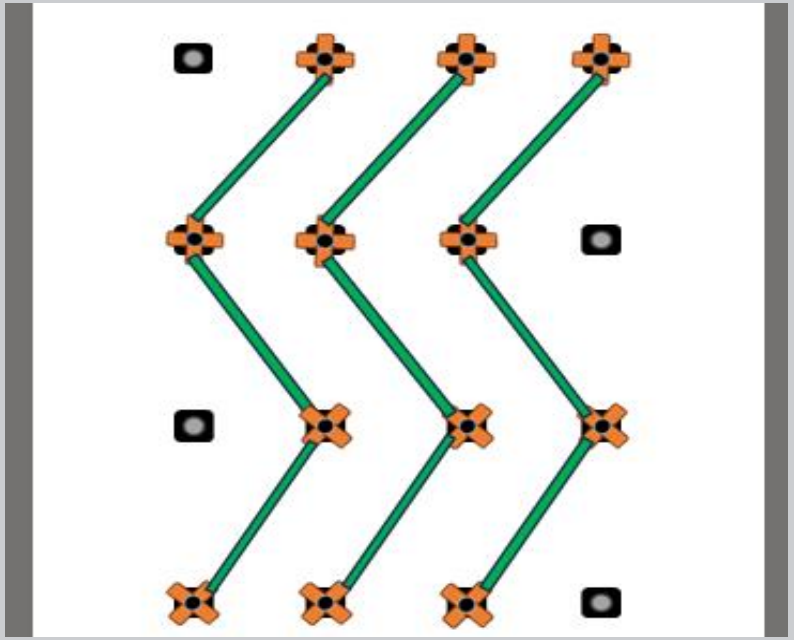
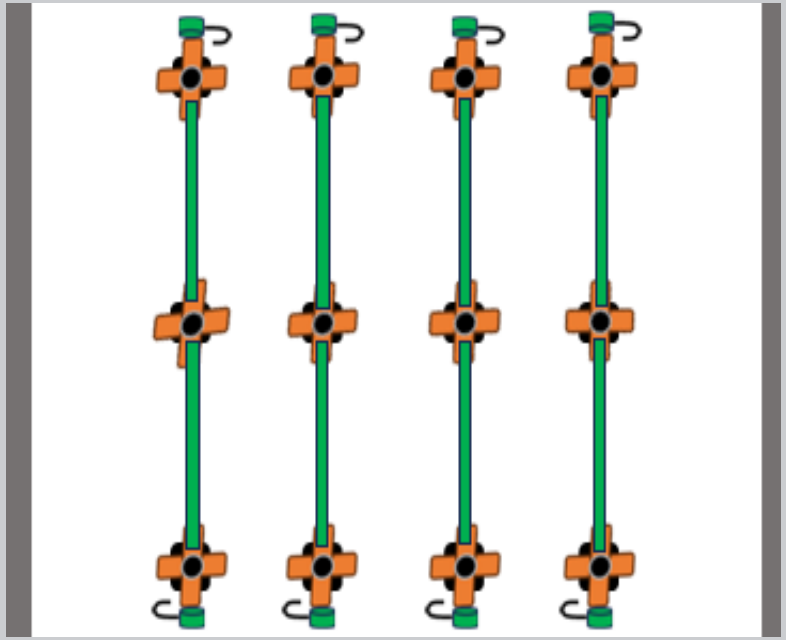
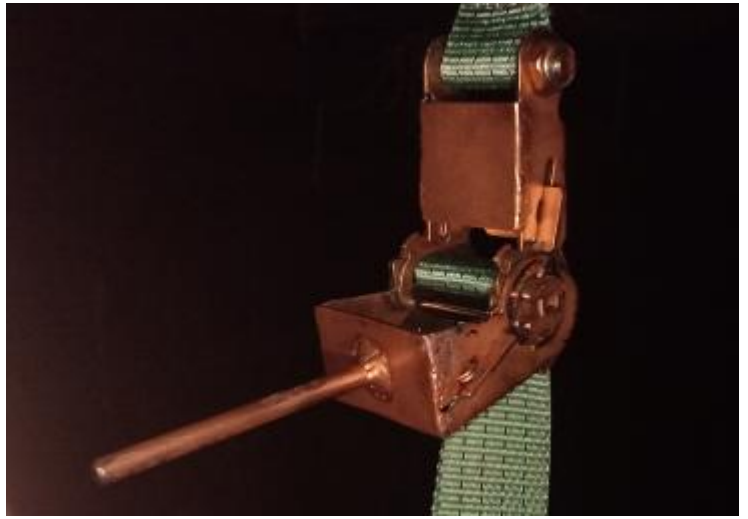
Johannesburg - South Africa

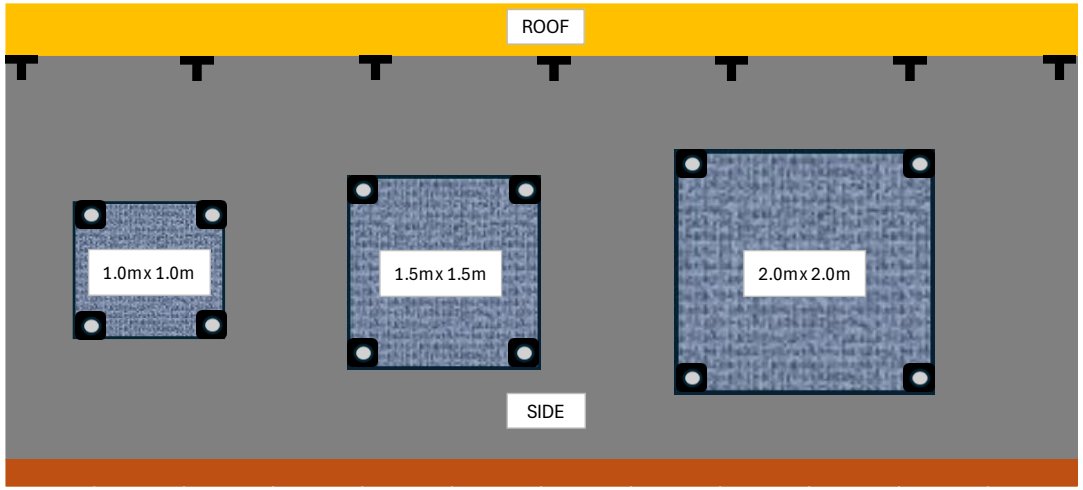
STRAPPING PATTERNS

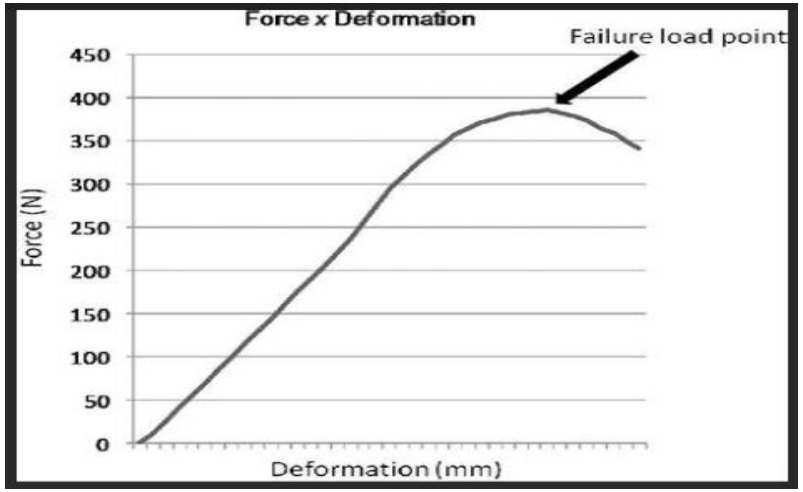
Cross Bracing	Staggered Bracing	Linear Bracing
		

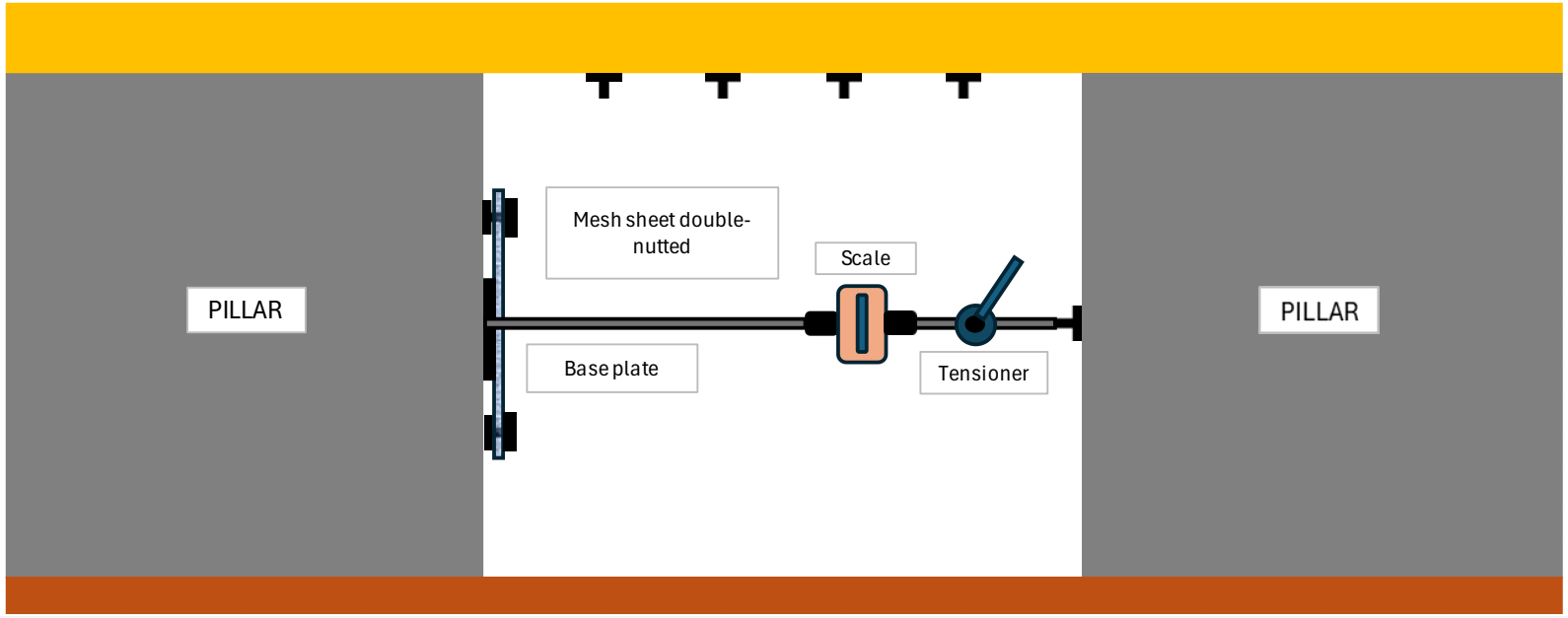
DTM STRAP - GENERAL



FUTURE PROJECTS - UNDERGROUND MESH SHEET LOAD / DEFORMATION TESTING







FUTURE PROJECTS – IMPLEMENTATION & CALIBRATION OF MESH CONDITION ASSESMENT SHEET

- All learnings over time to be build-in into the current assessment sheet to give even better guidance on state of mesh loading as well as the strategies to deal with each scenario.
- The assessment sheet to be integrated into the current Ground Management System.

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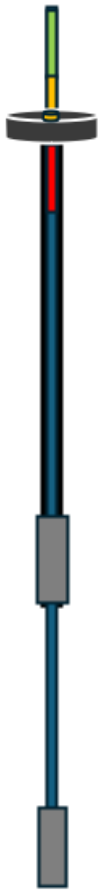
FUTURE PROJECTS - DETERMINING THE STAGES OF MESH LOADING USING A MESH FEELER GUAGE

Displacement Plunger



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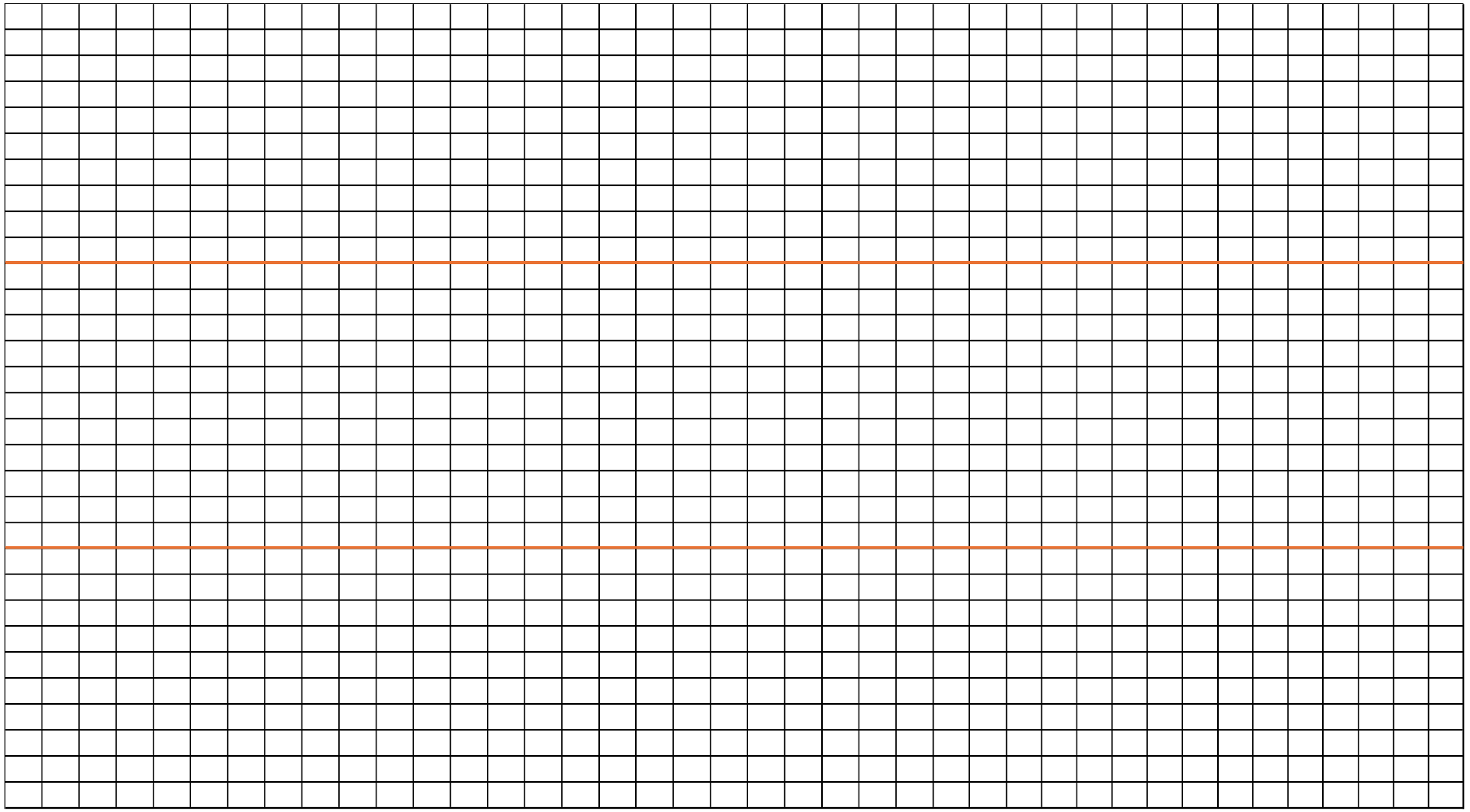
Bolt spacing (m)	Displacement (mm)		
	LOW	MODERATE	HIGH
1	0 - 50	51 - 150	> 150
1.5	0 - 150	151 - 250	> 250
2	0 - 200	201 - 300	> 300

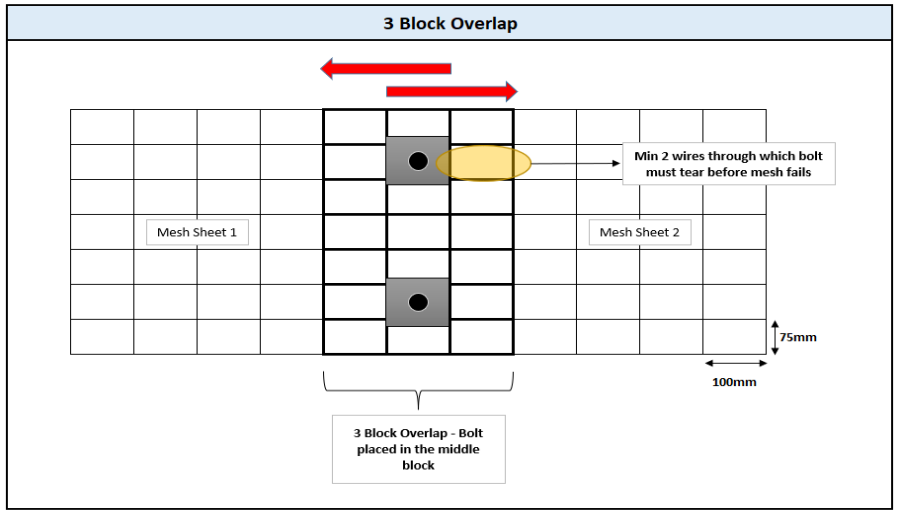
FUTURE PROJECTS - MESH SHEET BUILD-IN LOAD INDICATOR

- On a 4.0mm wire diameter weld mesh sheet insert 3.15mm wire strands on a pre-determined interval.
- Assumption is that the 3.15mm wire strand & weld will fail before the remainder of the strands – thus if the 3.15mm strands are intact then the sheet is deemed loaded and not overloaded.
- Above assumptions to be tested for relevance.



FUTURE PREVENTATIVE CONTROLS - MINIMISE NEED FOR MANAGING LOADED & OVERLOADED MESH

- Reduce the maximum spacing between lines (max 1.5m or even 1.0m) – Long term excavations
- Manage minimum overlap between mesh sheets



- Increase wire diameter to min 4.0mm
- Heavy galvanizing coating – less damage due to corrosion over the long term (corroded mesh sheet need bleeding & replacement)
- Mesh handling & installation review
- Review Skin Assessment sheet

QUESTIONS???