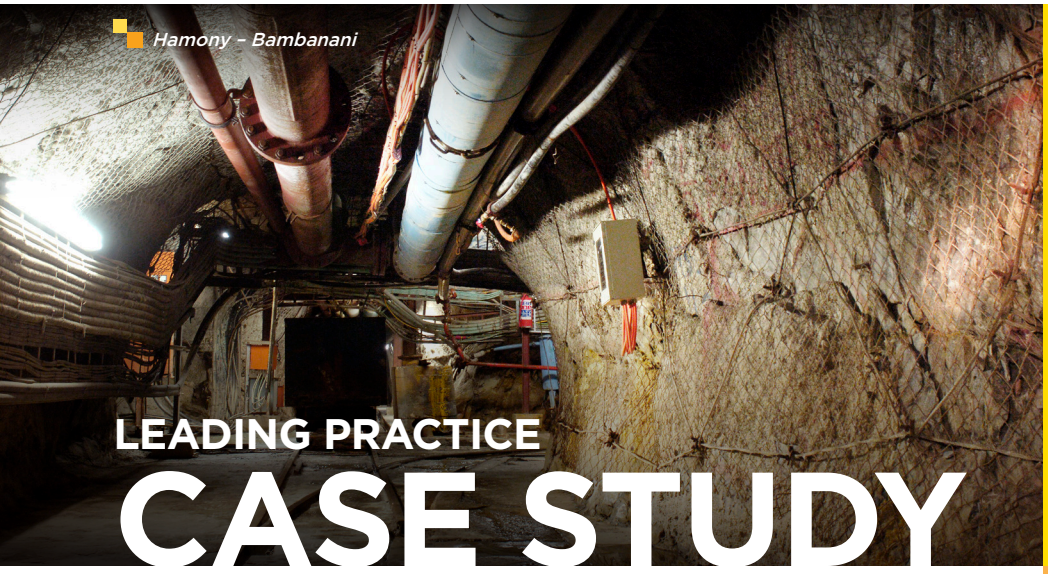
MINING INDUSTRY OCCUPATIONAL SAFETY & HEALTH

MINERALS COUNCIL SOUTH AFRICA

LEADING PRACTICE IN-STOPE PERMANENT MESH SUPPORT CASE STUDY AT BAMBANANI MINE



"Implementation of in-stope netting at Bambanani Mine reduced FOG risk."

FULL DESCRIPTION OF THE RISK ADDRESSED

Stoping operations at Bambanani Mine (Shaft pillar extraction) are conducted in a discontinuous rockmass, where hanging wall stability is complicated by fractured ground and geological complexities. The fall-of-ground (FOG) risk was reduced by the implementation of permanent in-stope netting to cover the complete stope hanging wall. The in-stope netting at the mine was started after the unfortunate loss of life of two of our colleagues on 27 September 2010. In the initial phase, temporary in-stope polypropylene netting was trialed. This was later changed to permanent in-stope netting which was unsuccessful as it was damaged by the blast. In 2012 it was decided to move to permanent in-stope mesh in the form of steel nets and the roll out of the netting started in the same year.

The support system in the face area comprises of hydraulic props and the system has sufficient support resistance to cater for the 95% fall out thickness as determined from the FOG database. Hydraulic props with headboards only cover 8.5% of the hanging wall in the face. Nets are thus not installed to improve the support resistance of the support system but to improve the aerial coverage between support units. The net was extended down on the last line of props installed to cover the panel faces (fastened with slings at the bottom), to assist as a mitigating control during face bursting. The net was also extended down the props in the top abutment to mitigate the risk of rolling rocks from the top abutment. Making use of the Harmony Risk Management Bowtie Model indicated below, it can be seen that in-stope netting falls under Corrective Controls. (Preventative controls have now failed and the rock is falling, the net control incorporated to stop the rock from possibly striking an employee).

The net consists of 5mm galvanised steel cable, with net sizes being 10mx3m and 5mx3m and having a 150mmx150mm aperture. The net is mainly suspended against the hanging wall using rapid yielding hydraulic props.

OVERVIEW

Mining company

Harmony

Commodity

Gold

Operation/Mine

Bambanani Mine

Health and safety case study

Permanent in-stope netting

Number of employees affected by the health and safety case study

±1000 (Personnel working in stopes)

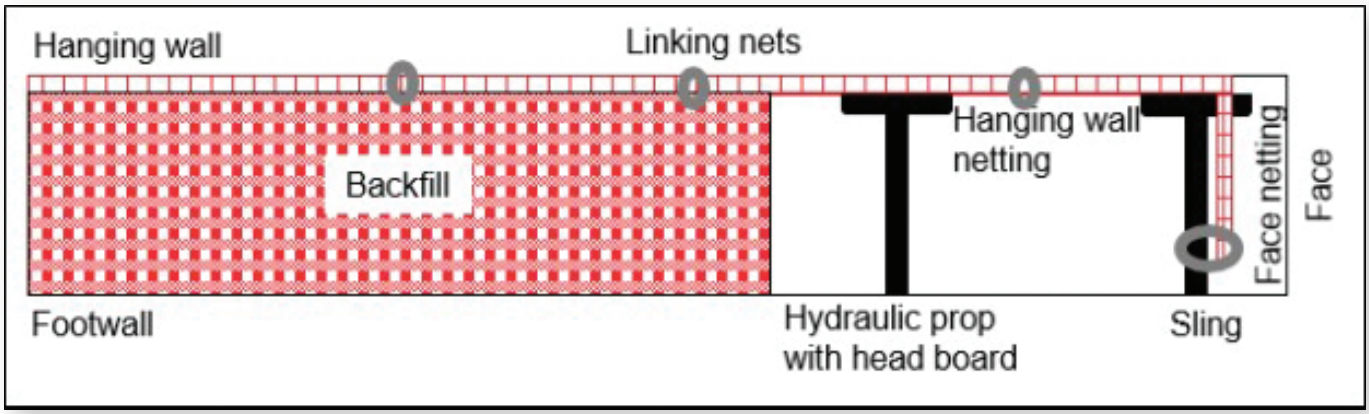
Stakeholders consulted

Unions and health and safety structures

Occupations affected/benefited

Mining stoping section (Rock drill operator, assistant, winch driver, stope team, team leader, miner, shift boss, mine overseer, service departments)

Permanent in-stope net installation
(section view – not to scale):



FINDINGS AND LESSONS LEARNED FROM THE ADOPTION OF THE LEADING PRACTICE OR IMPLEMENTATION OF THE COMPANY BEST PRACTICE

- The design of in-stope netting is important – take cognizance of the net sag, with specific reference to how the inner net is fastened to the outer perimeter of the net as it could result in additional sag when allowed to move.
- Guidance in terms of the installation procedure and standard is common place, but should also include procedures on how to deal with rocks suspended in nets.
- In-stope netting is only as good as the support suspending it to the hanging wall. (The current specified requirement is to suspend a fall of 450kg, steel cable netting can support peak loads in excess of 8 tonnes, far exceeding the required specification because of the seismic risk faced and multiple falls which could be contained in the net).
- In-stope netting (which might be installed sub-standardly, corroded, poorly suspended, not properly linked or overlapped), could create a false sense of security.
- Take cognizance of corrosion on steel netting in the underground environment. Storing of steel netting should be taken into consideration. Steel netting should also be monitored in terms of corrosion and suppliers should have a verification programme in place to confirm mill certification in laboratories.
- After an incident in which an employee freed themself from a trapped position, the supply and use of compact wire cutters which fit into a carry pouch was found to be useful. This also assists with emergency response, having the tools available to free a trapped employee when you have limited time.
- Barring during the daily making safe process can become neglected.

Hamony – Bambanani

BENEFITS AND IMPROVEMENTS REPORTED BY AFFECTED STAKEHOLDERS

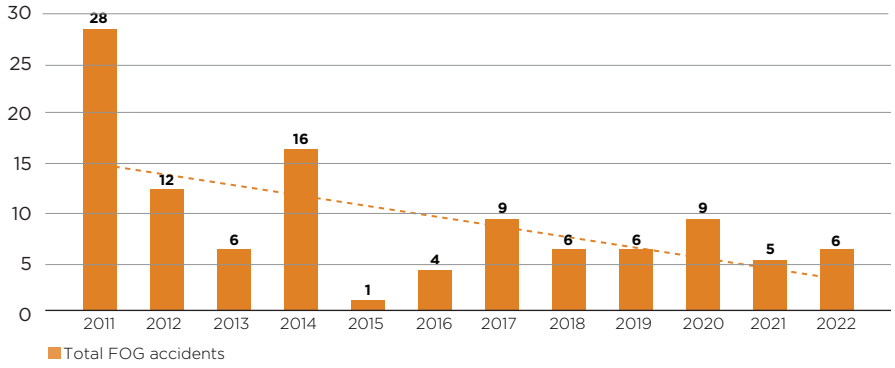
Permanent in-stope netting was a critical contributor to the Bambanani Mine shaft pillar extraction safety record as can be seen listed below:

- The initial sentiment of employees towards the in-stope nets were negative, transporting in and installing the nets was seen as extra work without appreciating the importance. After discussions the crews were compensated for the additional work of installing the nets. The acceptance of the netting only came after the crews started seeing its performance, to the extent that crews were not willing to work in the shaft pillar if they did not have the nets installed.
- Bambanani Mine has received numerus safety awards since 2011 after the implementation of permanent in-stope netting including the "Fall of Ground Safety Award - South African Operations 2014".

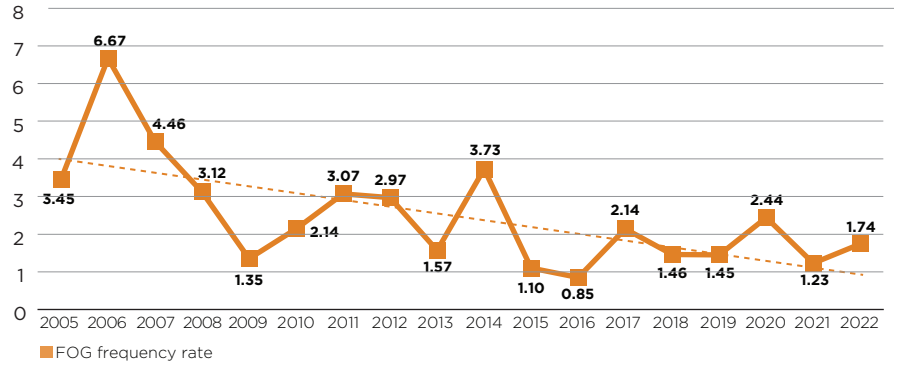
FOG statistics:

Since the implementation of in-stope netting as indicated by the blue line in the graph below, a significant reduction in FOG injuries was recorded.

Bambanani FOG (gravity and seismic) injuries: 2021-2022



Bambanani FOG (gravity and seismic) frequency rate: 2005-2022



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BENEFITS AND IMPROVEMENTS REPORTED BY AFFECTED STAKEHOLDERS CONTINUED

List of known FOG accidents from 2019 to 2022 in which employees were saved from possible serious injury and/or loss of life by the in-stope netting (netting does not always stop the FOG accident, but plays an important role in mitigating the severity):

Date	Working place	People injured	Seismic/gravity
04 Dec 2019	66-86 N3 Gully	Mr Pitso, Mr Lesiba and Mr Shiba	Gravity
19 Mar 2020	69-86 S6 Wide raise face	Mr Pitso, Mr Mohoalali, Mr Motlalane, Mr Gaborone and Mr Siyunguma	Seismic ml1.6
01 Dec 2020	71-86 S7 Face	Mr Mhlaba, Mr Sehlabaka and Mr Mokobane	Seismic ml1.0
11 Aug 2021	66-86 S6 Wide raise face	Mr Thakadu and Mr Matina	Seismic ml1.3
22 Jan 2022	69-80 S4 Reef stripping gully	Mr Nqombolo	Gravity

General conditions when installed underground:

Undercut panels with stoping width 1.8m – RB80 props and steel netting

Open cut panels with stoping width >2.5m – Omni props and steel netting

On 9 June 2021 a ml2.1 seismic event occurred at the 71-80 raise line causing a fall from the hanging wall and face ejection contained in the hanging wall and face netting. The crew was working on the face during the time of the seismic event.

On 13 January 2022 a ml1.7 seismic event occurred at the 71-80 raise line causing a fall from the hanging wall and face ejection contained in the hanging wall and face netting. The crew was working on the face during the time of the seismic event.

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