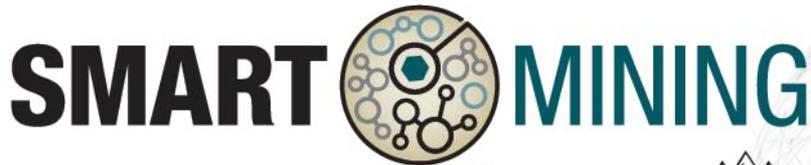


# Constructing Toromocho 5.2Km Conveyor through the Andes Mountains



*Resources for a Connected World*



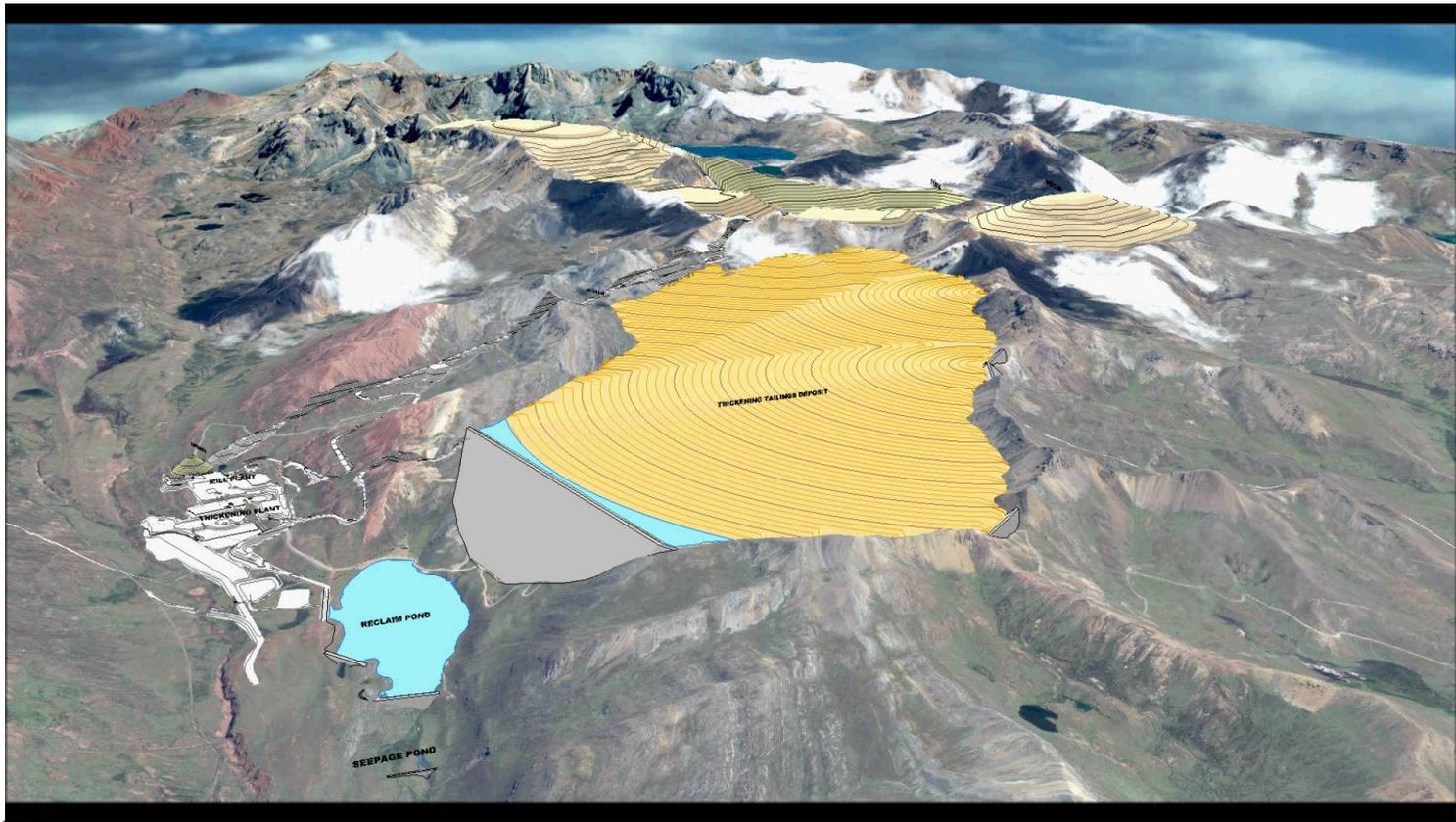
*César Torres – Technical Director Peru*  
*Eric Michiels – Mining Market Manager*

*Maccaferri Mining Solutions*

## Toromocho Project Located

- Toromocho Project is located in:  
Morococha District, Yauli Province  
Junin
- The region has an inclined and rugged topography with elevation between 4500 and 5000 m
- 142 km from Lima land route





## Toromocho Conveyor – Risk of RockFall

- The conveyor passes through three áreas of risk against rockfall
- Identify as:  
Risco Zone, Quarry Zone, Conveyor Zone

RISCO ZONE



QUARRY ZONE



CONVEYOR ZONE



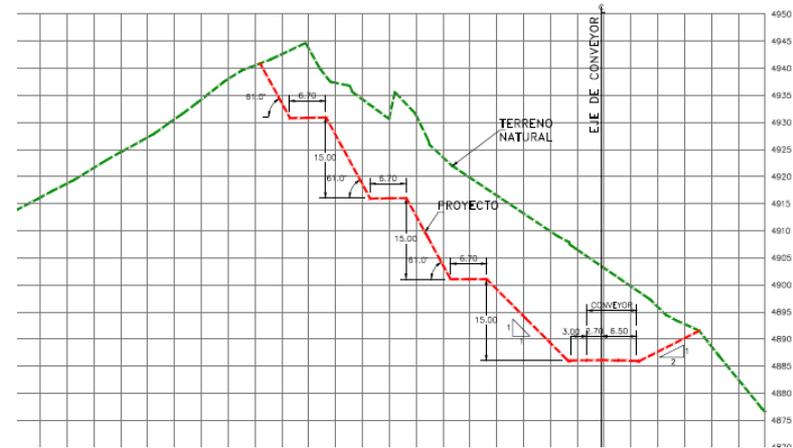
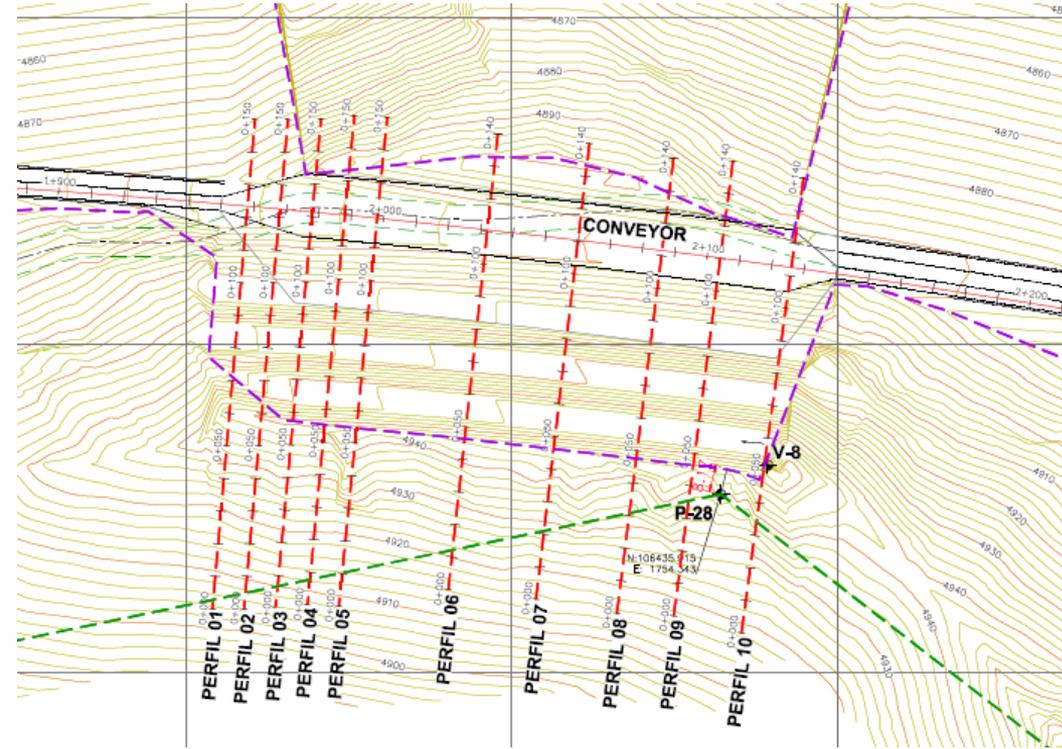
CUTTING WORKS FOR SLOPE



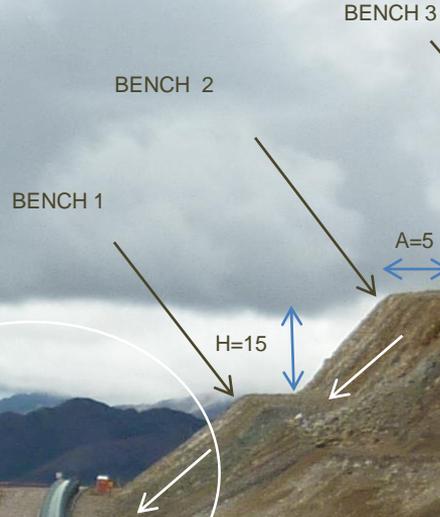
FINAL SLOPE DESIGN



- It was necessary to make topography to the area to obtain the cross sections.
- Rock Slope Stability



RISCO ZONE  
Rocks detachments



- The design of the Risco Zone area was considered three benches
- The design was originally stable, but then they showed problems of rocks fall
- Some rocks came to fall very near the conveyor belt

- Detachment large sized rocks
- 0.50m to 1.50m of diameter
- A solution was needed to ensure the safety of the conveyor belt during operation.
- Geologically the rocks are formed by sandstones and deposits fluvio-glaciers coming from meteorization of the rock.



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**CONVEYOR Km 1+800 - Km 2+300**

**RISCO ZONE**



## CONVEYOR Km 1+800 - Km 2+300

The initial proposal was to stabilize the slope with Steel Grids Mesh and self-drilling bolts.

This solution would help mitigate the problems of falling rocks to the conveyor belt.



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# Conveyor Zone PROG 2+400 - 2+720

ROCKFALL RISK

PASO DE LA FAJA  
TRANSPORTADORA N° 3 ENTRE  
EL CONVEYOR Y EL QUARRY

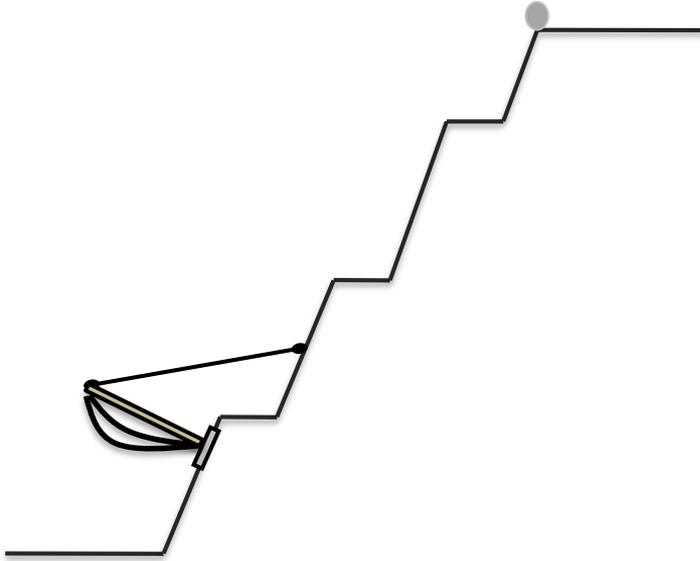
PROG 2+400 - 2+720

REINFORCED SLOPE  
CONVEYOR

CONVEYOR



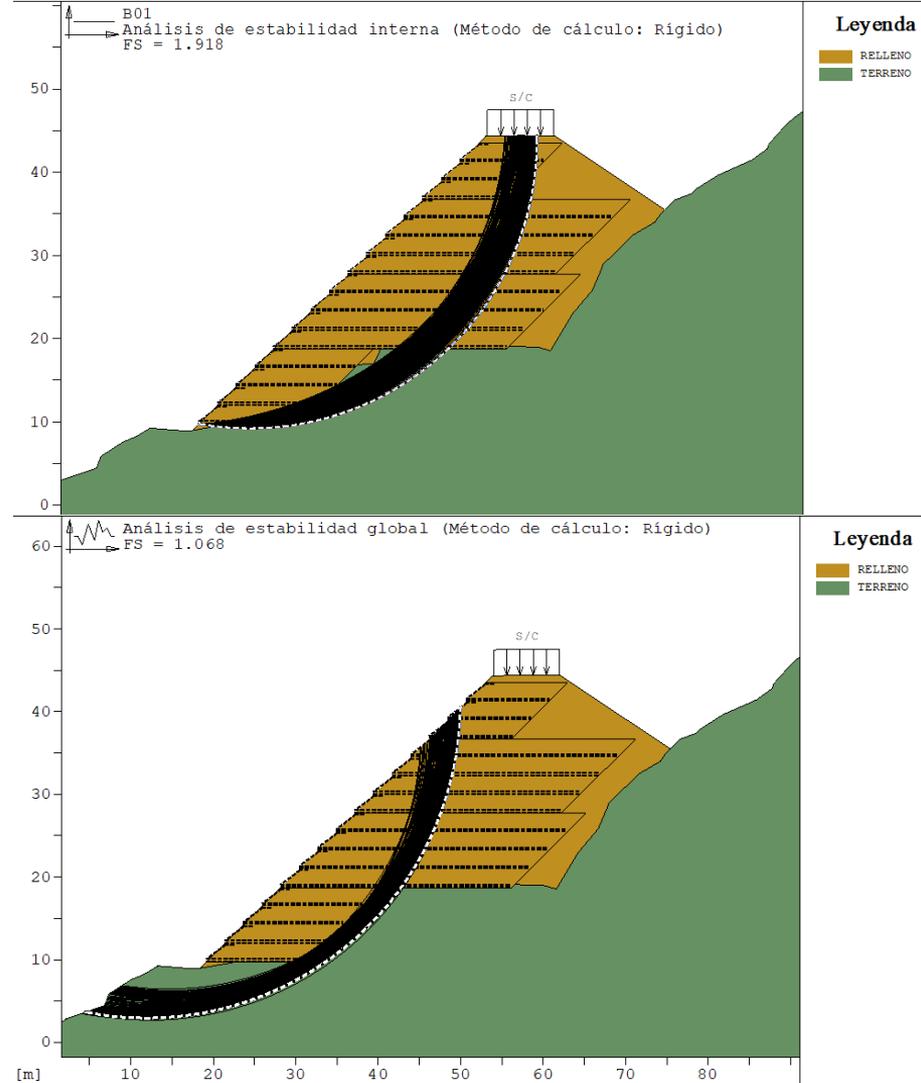
## *Dynamics barriers*



- *Dynamics barriers are often the best solution in cases where it is necessary to intercept the fall of rocks in order to avoid the damage of a near by structure.*
- *Dynamics barriers can be chosen in relation to the level energy of falling rocks(500 a 8500 kJ).*
- *Dynamics barriers have the function of intercepting large-scale rocks blocks (until 6.0 m<sup>3</sup>).*



- The solution in this area was the construction of a reinforced embankment with geogrid of 200-300 KN/m
- Stability analyses were made to the reinforced embankment.





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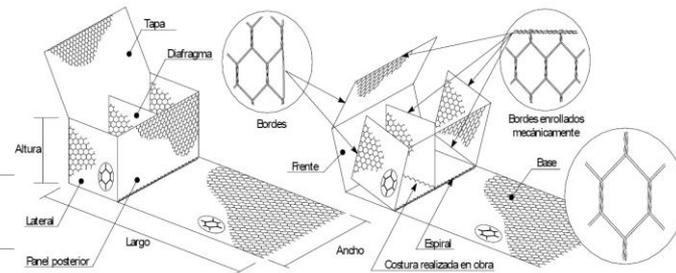
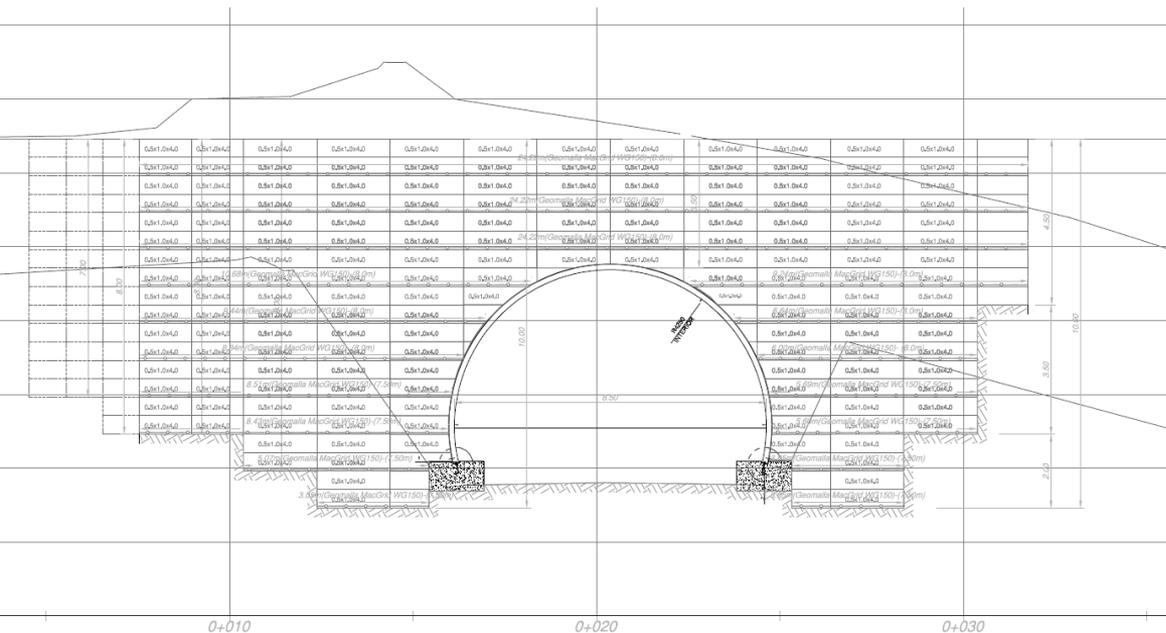
## REINFORCED EMBANKMENT CONVEYOR



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- The last major challenge faced in completing the conveyors was to design a road crossing.
- The safest solution was to route the conveyor under the road.

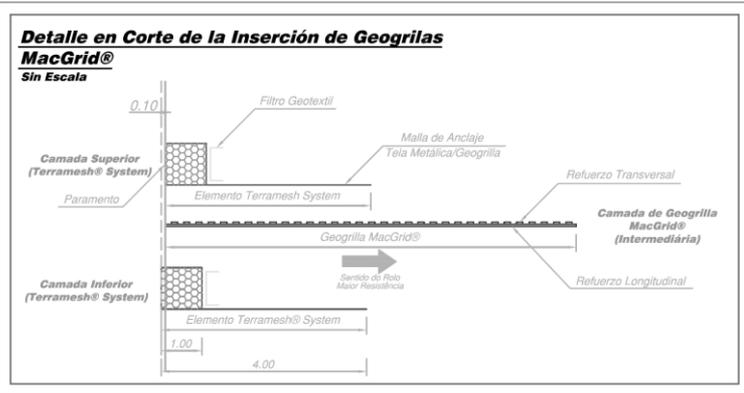




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## Conclusion

Extreme climates and challenging topography can create many risks.

Tailored solutions are the key to a safe and economical design.

Mining *DESTABILIZES* ground conditions, *ENGINEERED SOLUTIONS* stabilize the ground around.