Emergency Response to Rockfall on Tennessee's Interstate 75

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I-75 MP 142.5 prior to February 26, 2016

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Failure onto I-75

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Geology

- Coal Bearing Region
  - Hance Formation
  - Interbedded shale, sandstone, siltstone, underclay, coal
  - Strong Units
    - Sandstones
    - Limestones
  - Weak Units
    - Shale, underclay

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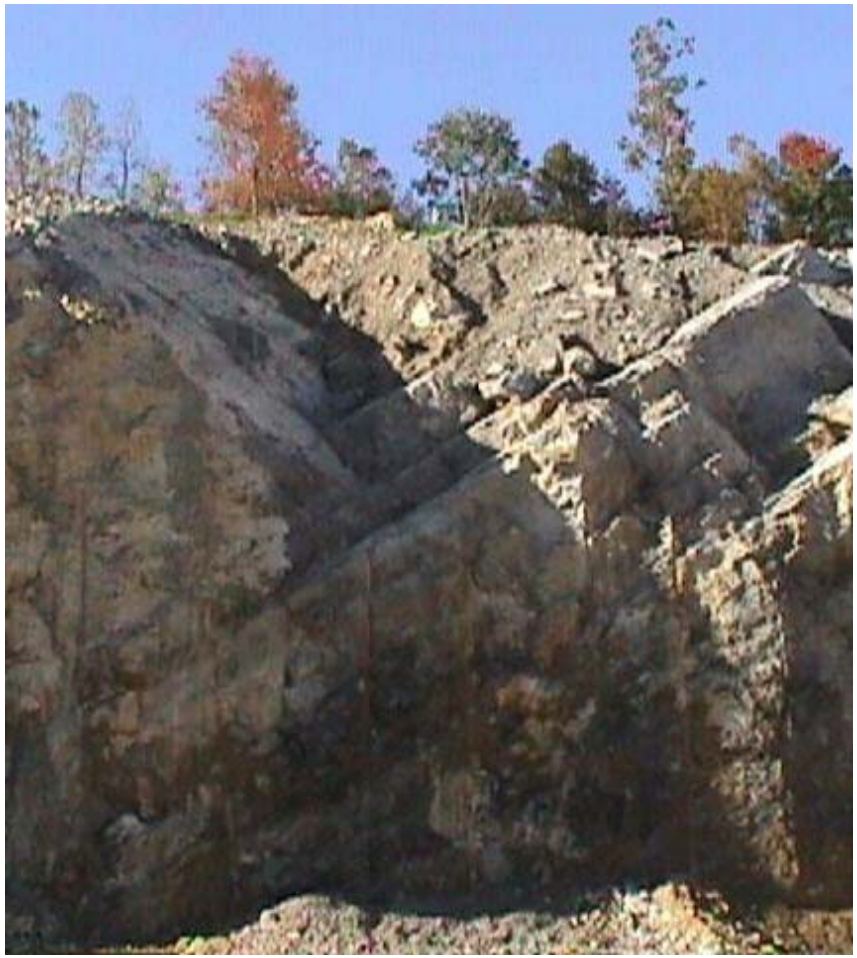
Geologic Structure Control vs. Differential Weathering Control



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Geologic Structure in Appalachian Coal Region

- Discontinuities
  - Geologic Breaks in the rock
- Bedding Plane (generally horizontal)
- Tectonic Joints
- Valley Stress Relief Joint

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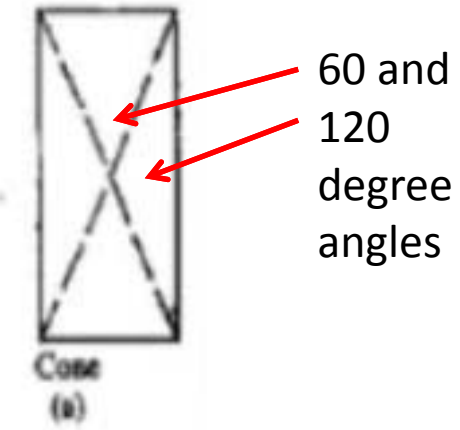
Tectonic Joints



Tectonic Joints are compressional joints; just like a compression test in concrete.

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Tectonic Joints in Coal Region

Compression caused by plates colliding, compression lateral

Creates “Saw-tooth” appearance

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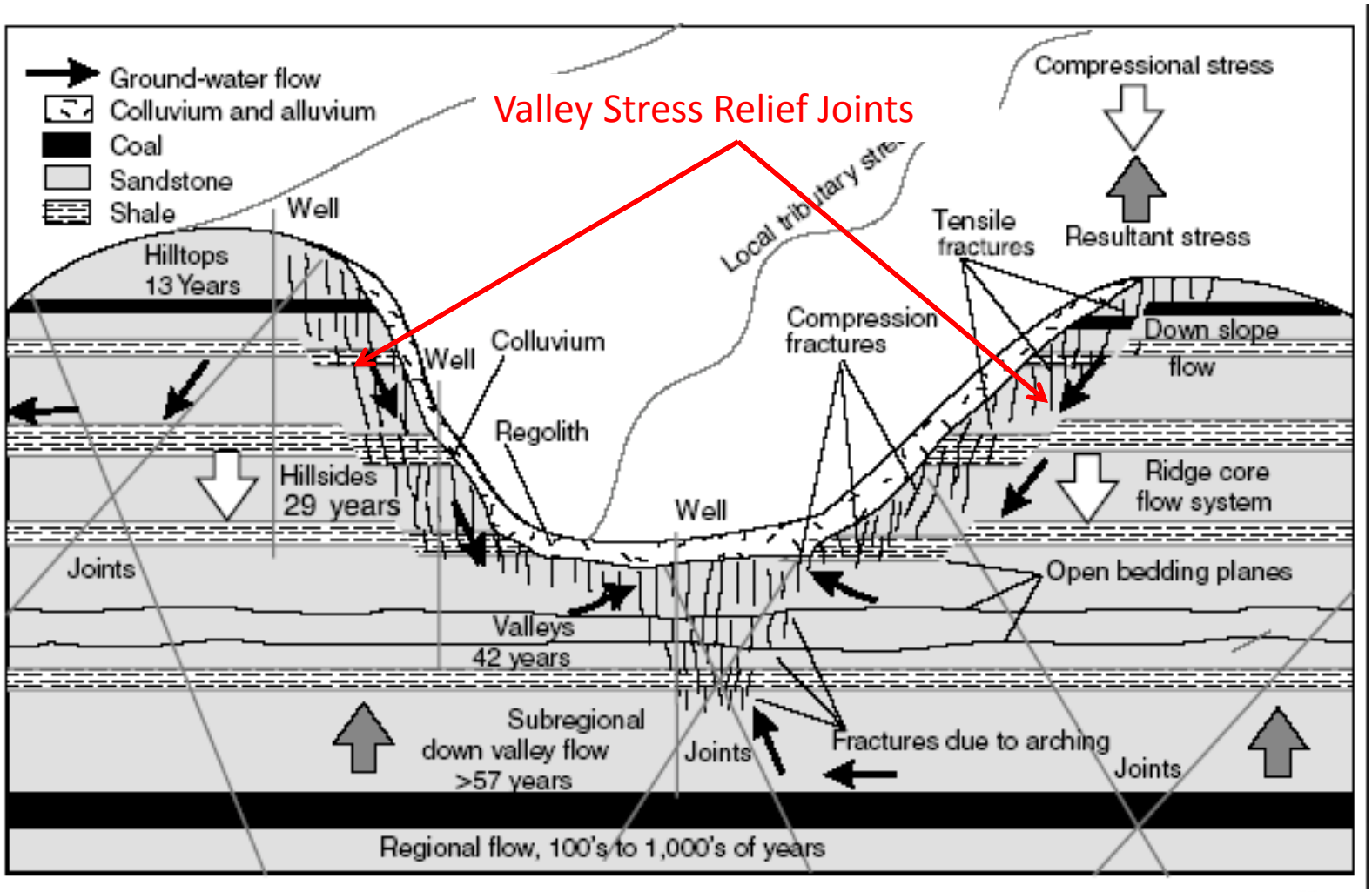
Valley Stress Relief Joint



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Valley Stress Relief Joints

- Overburden Rock is removed
- Stress is Relieved
- Relaxation of the the rock mass causes joints
- Characterized as
  - Nearly vertical
  - Continuous throughout slope
  - Parallel to valley (commonly rivers)

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Local Failures with Valley Stress Relief Joints

Less durable units can erode quicker than more durable units creating overhangs. As erosion continues towards the VSRJ rockfalls can occur

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Large Failures Caused By Valley Stress Relief Joints (VSRJ)

Some slopes can fail along the VSRJ if undercutting or pressures are high enough

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I-75 Failure

Vertical Fractures
(Related to Valley Stress Relief Joints)

Seep Zones

Weak Zones such as a claystone or underclay

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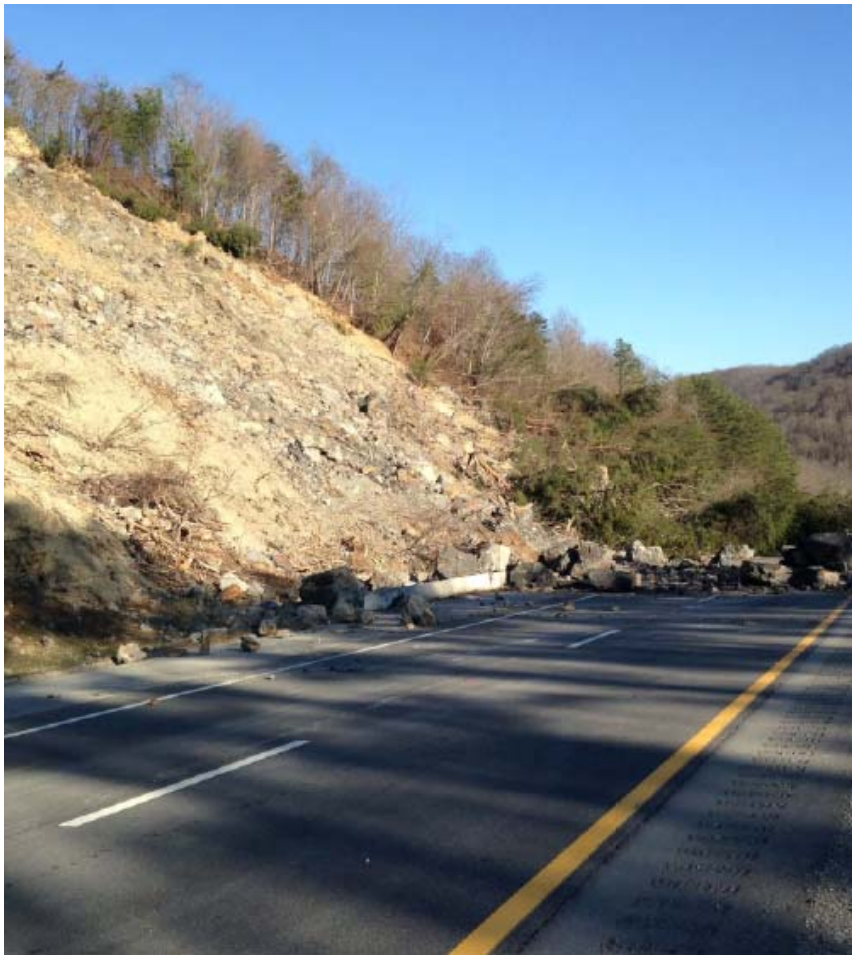
Emergency Response Requirements

- Repair the slope working in conjunction with TDOT and Blalock
- Open Southbound lanes to traffic within 7 days
- Open Northbound lanes to traffic within 21 days



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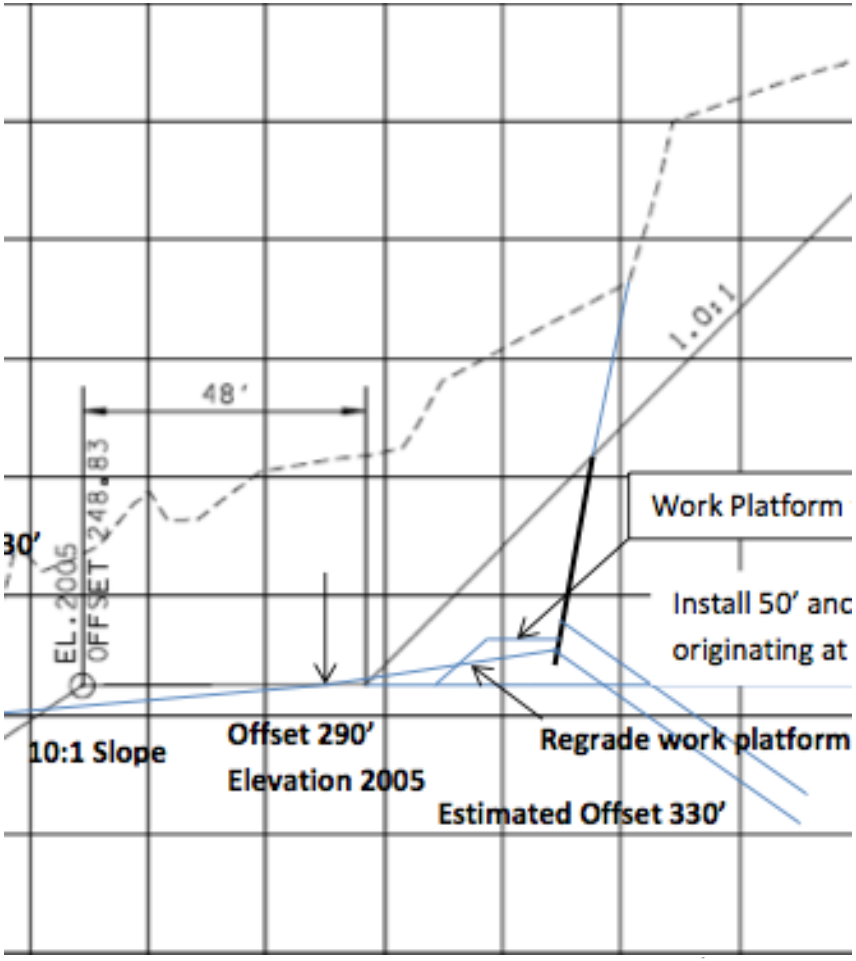
Construction Plan

- Above Failure
  - Lay back to a 1H: 1V
  - Pinned Mesh System
- Near Failure Plane
  - Develop a mid-slope Bench
- Below failure plane
  - Approximate 3H: 1V
  - Need to move fast with road opening requirements



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Blasting

(attempt to make things faster)

- Have to blast upper section to 1H: 1V Slope
- Remove high hazard to southbound lanes to open up lanes
- Remove failed material to prepare to stabilize
- Attempt to do all in ONE step

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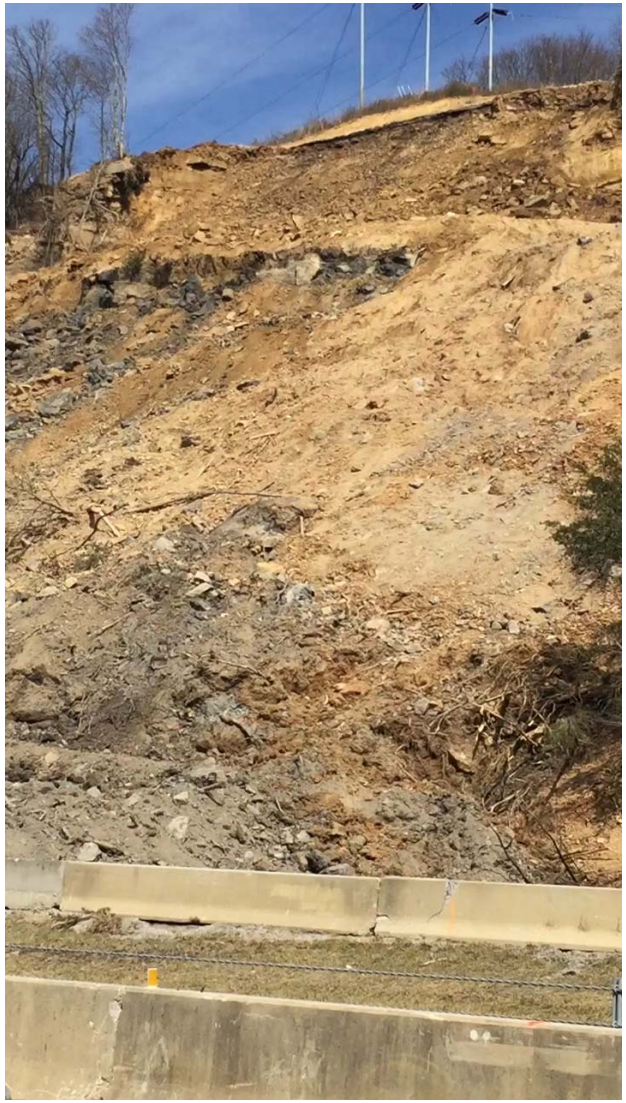

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Results of Blasting

- Top section 1H: 1V slope developed
- Rocks falling only onto Northbound Lanes
- Safe to open Southbound lanes to traffic in less than 1 week

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Excavation Coordination with Blalock Construction

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Excavation of Failed material after blasting

- During excavation vertical structure noticed in middle of slope
- All failed material in front
- Can’t continue 1H: 1V slope
- Valley Stress Relief Joint

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Excavation and Preparation of Vertical Feature

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Slope Protection

- Left with a vertical feature with a 1H:1V Slope above
- GeoBrugg Tecco G65 3mm - Pinned Mesh on 1H:1V Slope above
- Vertical Cut - Shotcrete Surface Protection – VSRJ Area

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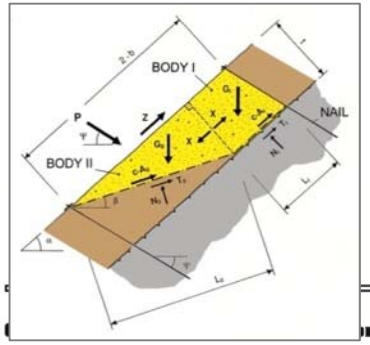
The TECCO® System

1. High-tensile steel wire TECCO® meshes

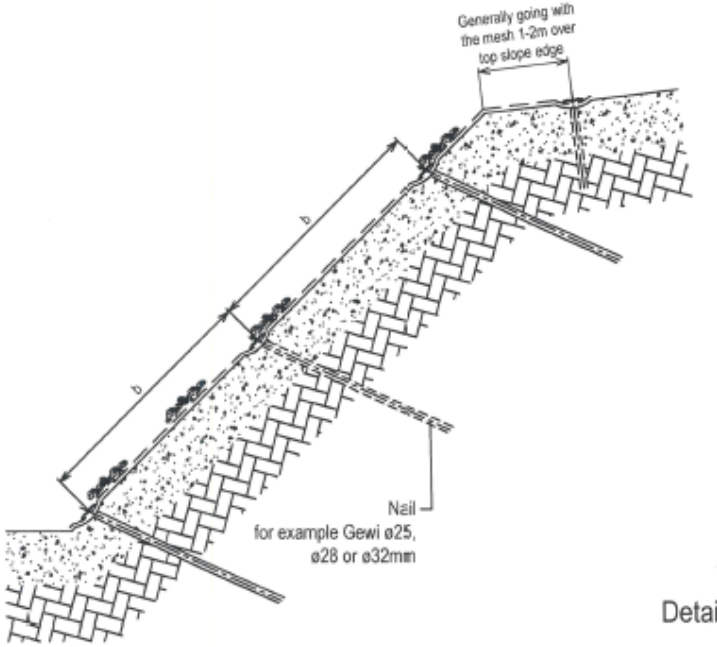
2. TECCO® system spike plates

3. Anchors

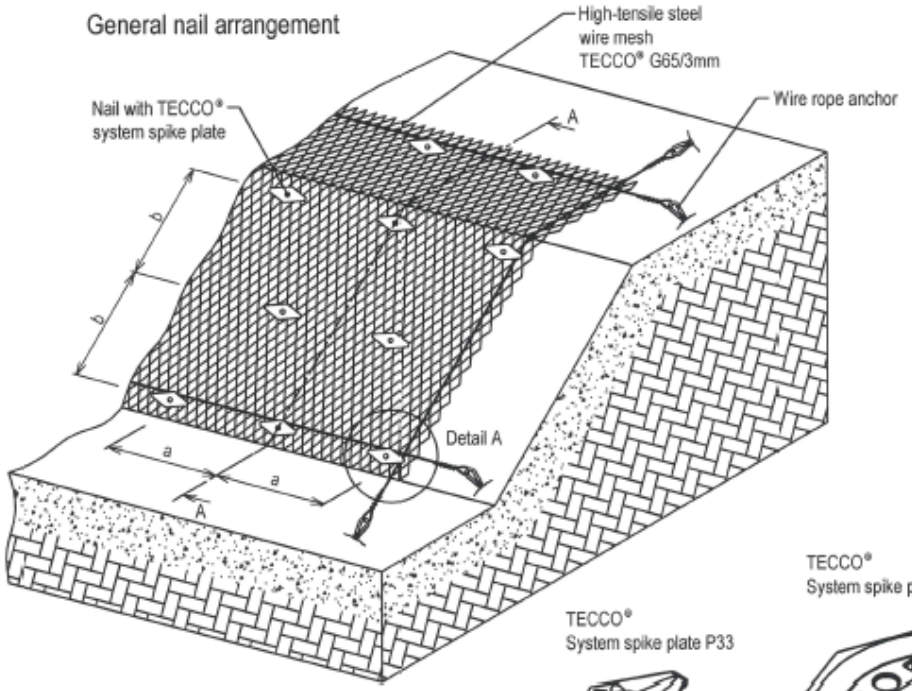
4. RUVOLUM Dimensioning Concept



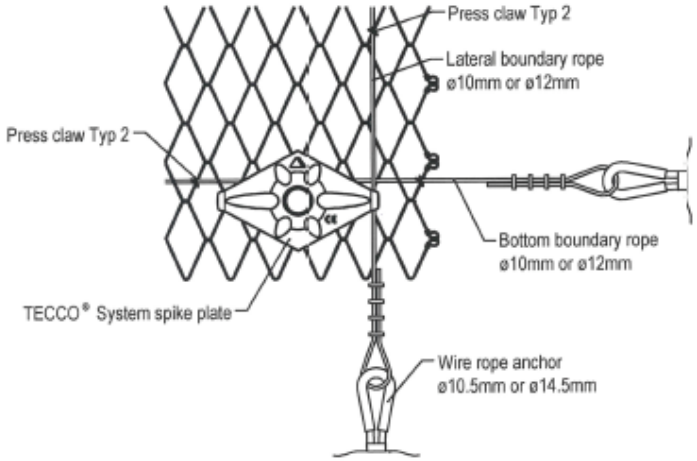
Cross section A-A



General nail arrangement



Detail A



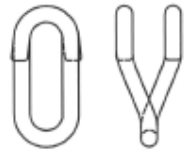
TECCO® mesh connection vertical normally without overlap

TECCO® System spike plate P33

TECCO® System spike plate P66

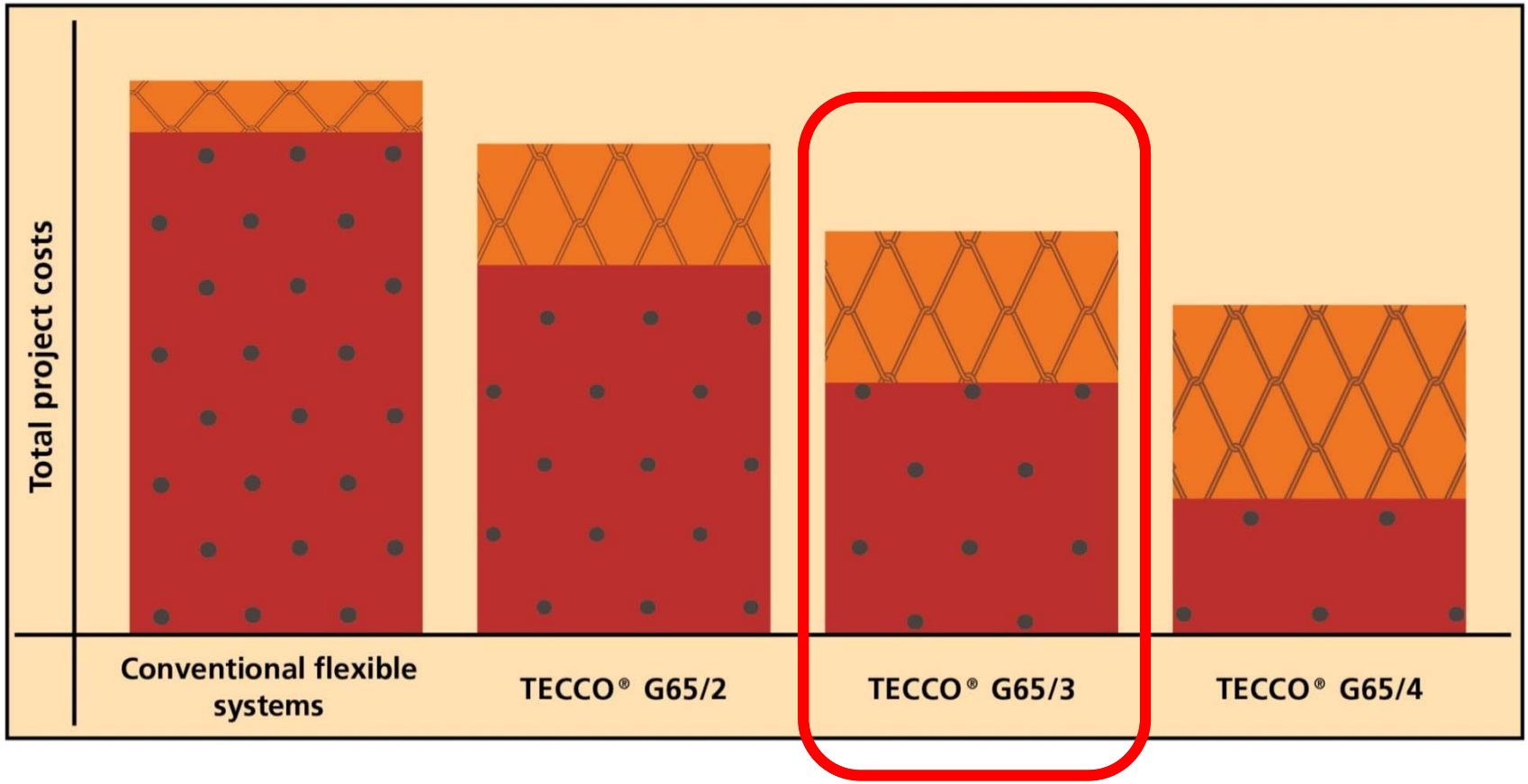
Connection clip T3

Press claw Typ 2



modification: -	M:%	substitute for: GE-1003e ed. 18.04.12 replaced by:		
TECCO® G65/3 **System drawing**		drawn	06.01.14	hb
		checked	06.01.14	hb
		approved	06.01.14	RC
GEOBRUGG AG		**GE-1003e**		

Cost Optimization



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Staging Work

- Working on Upper pinned mesh slope area
- Working on VSRJ area
- Required to stage work so one worker isn't working directly below another worker

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Staging Work

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Working in Stages

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Night Work

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Pinned Mesh Area (top of slope)

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Pinned Mesh/Shotcrete Area

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