Performance of High-strength Geogrid in Reinforced Soil Slope at the Yeager Airport

Geosyntec consultants · CR**O**SS USA · G-I

TenCate GEOSYNTHETICS

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IFAI Geosynthetics Conference

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During Construction and Final Slope

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EMAS

https://blogs.agu.org/landslideblog/2015/03/13/yeager-airport-1/

https://www.researchgate.net/figure/Yeager-airport-runway-extensions-Tencate-2014_fig1_283939464

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Constructed Runway Extension
Engineering Materials Arresting System (EMAS)

https://blogs.agu.org/landslideblog/2015/03/13/yeager-airport-1/

Good news… the EMAS worked!

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Slope Failure: Distant View

https://www.wvpublic.org/post/photos-latest-yeager-airport-landslide#stream/0
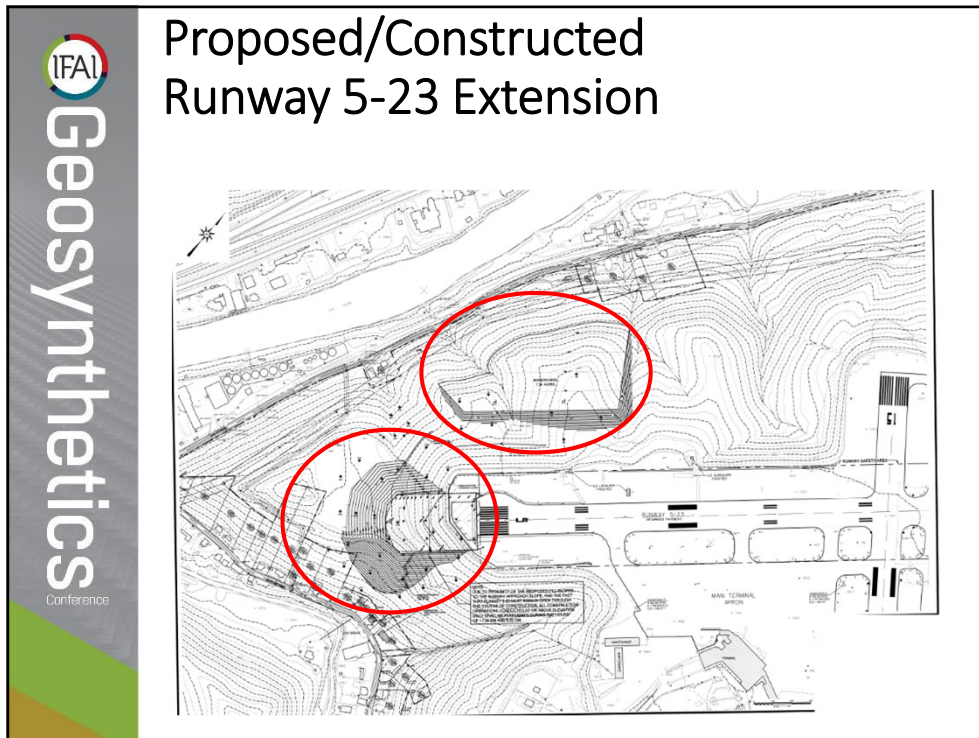

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Slope Failure: Closeup

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Original Runway 5-23

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Proposed/Constructed Runway 5-23 Extension

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Steepest Slope in Section View Original Design

Primary reinforcement was high-strength coated polyester geogrid

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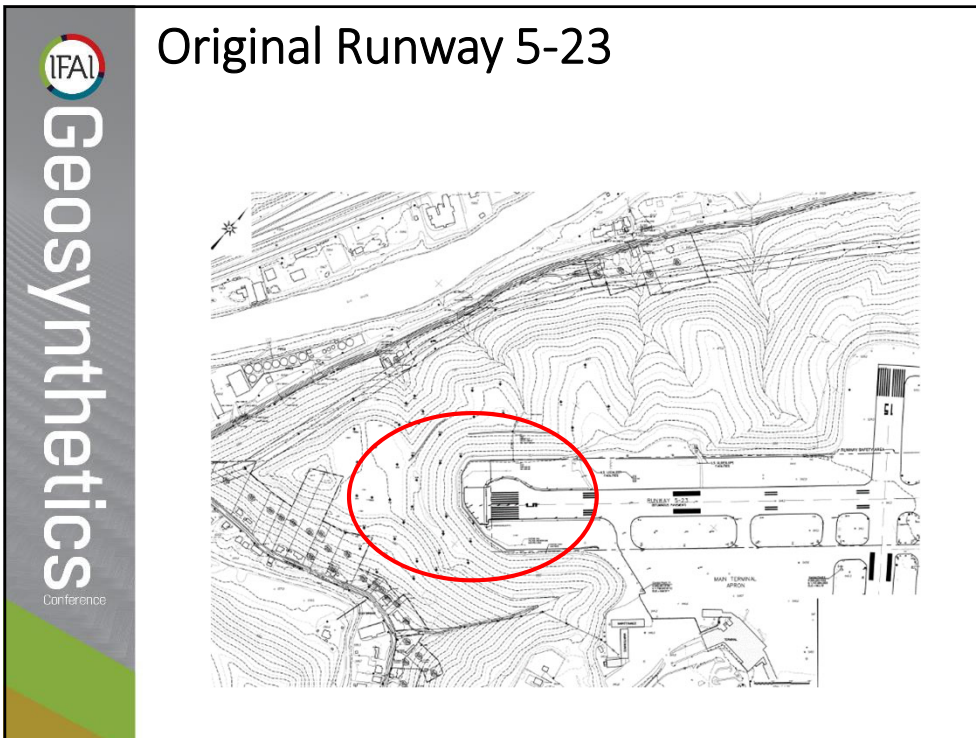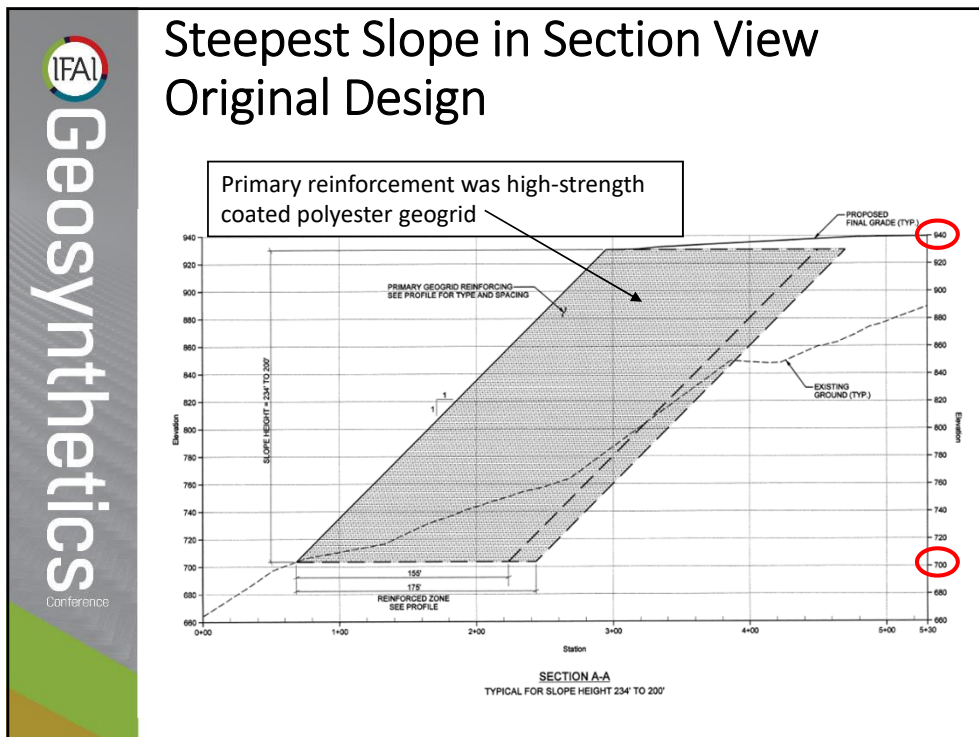
Photo Dated 28 September 2005

First day of geogrid installation

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15 March 2015 Failure

https://wchsnetwork.com/emas-blocks-being-delivered-to-yeager-airport-for-hillside-repair/
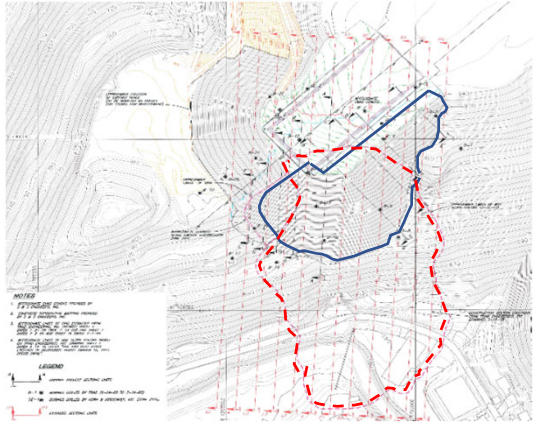
Failure Involved almost all of the RSS

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Phase I - Field Forensic Investigation Health and Safety (H&S) Concerns

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Geogrid Placement Cross-section

Processed Rock Backfill	
Sieve Size	Percent Passing
6 inch	100
No. 4	30 to 100
No. 20	0 to 60
No. 200	0 to 50

Shot Rock Backfill

Rock fragments
Placed in layers <2-ft thick
Maximum Particle Size = 24 in.

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Forensic Analysis Of Geogrid

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Forensic Analysis Of Geogrid

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Forensic Analysis Of Geogrid

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Forensic Analysis Of Geogrid

Atypical Damage

Typical Damage (2-3 per 120 sf sample)

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Geogrid Properties for Design

Geogrid	Ultimate Tensile Strength, T_{ult} kN/m (lb/ft)	Creep Reduction Factor	Installation Damage Reduction Factor	Durability Reduction Factor	Allowable Tensile Strength, T_{all} kN/m (lb/ft)
10XT	145.2 (9,950)	1.90	1.34	1.15	49.59(3,398)
20XT	187.9 (12,870)	1.90	1.30	1.15	66.11 (4,530)

The Long Term Design Strength (LTDS) or Allowable Tensile Strength (T_{all}) is determined as follows:

$$T_{all} = LTDS = T_{ULT} \div (RF_{ID} \times RF_{CR} \times RF_{D}) \text{ Where:}$$

T_{ULT} is the minimum average roll value (MARV) wide width Ultimate Tensile Strength determined by ASTM D6637;

RF_{ID} is the Reduction Factor for Installation Damage;

RF_{CR} is the Reduction Factor for Material Creep;

RF_{D} is the Reduction Factor for Durability; which combines both the chemical and biological degradation reduction factors of the GRI-GT7 method
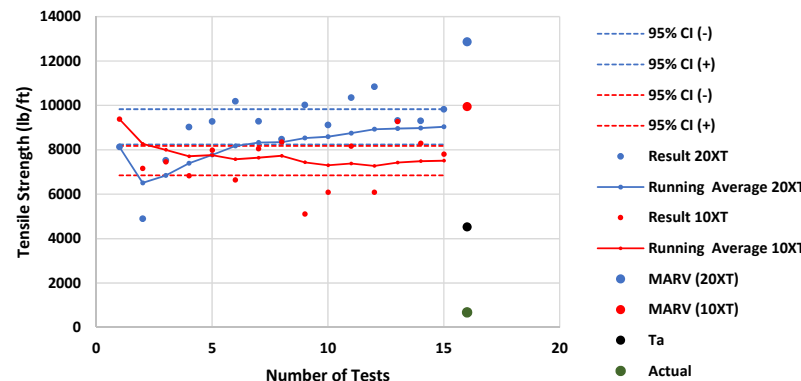
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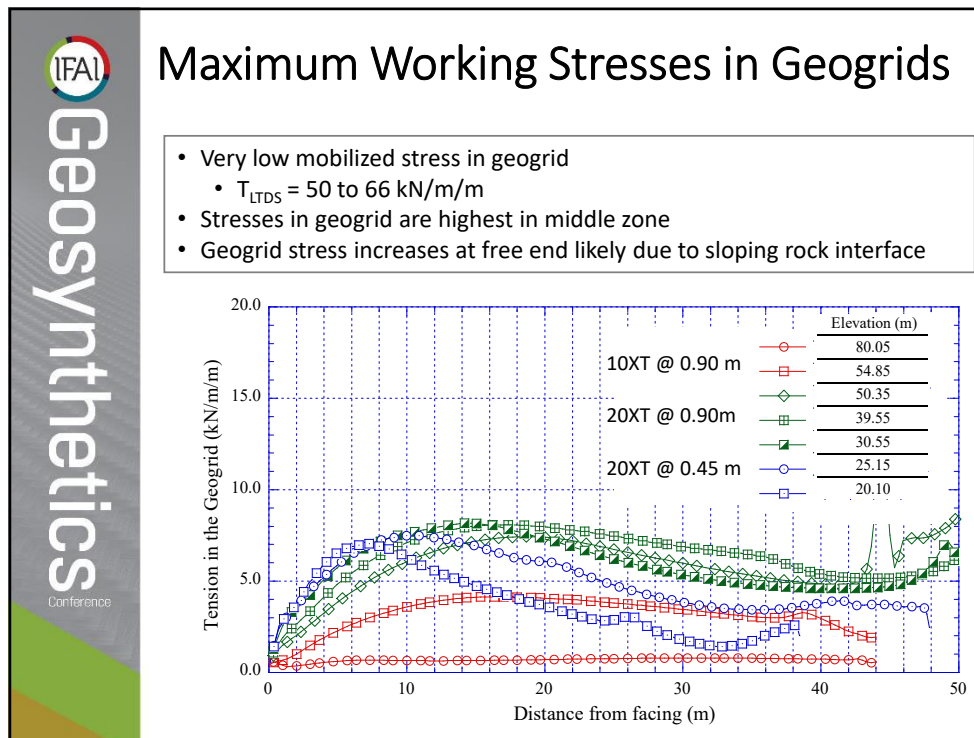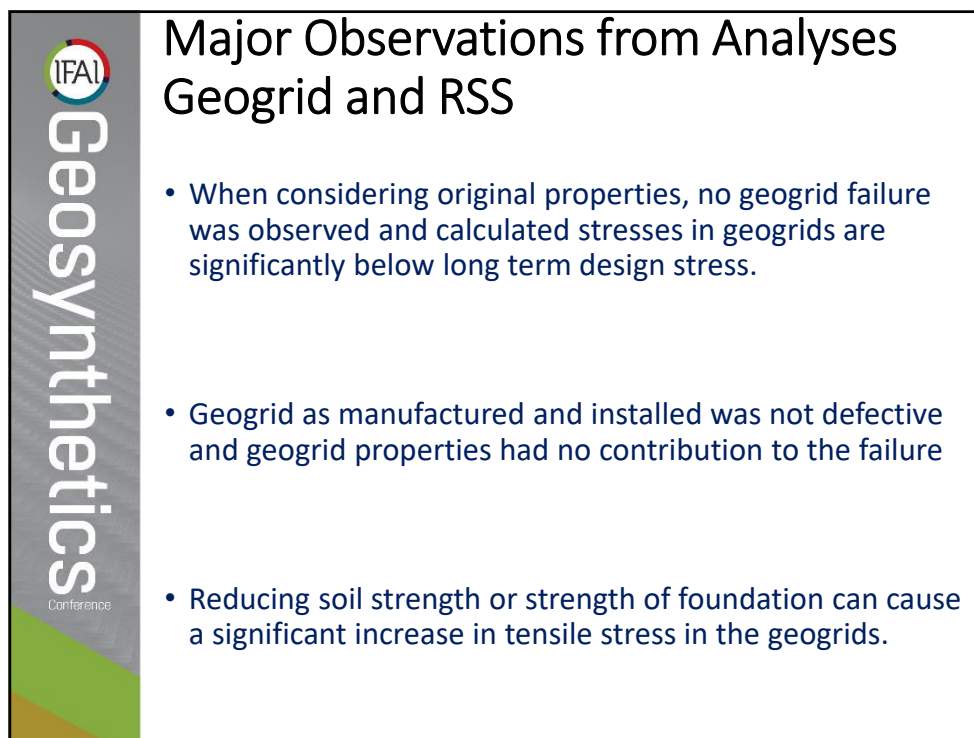# Summary of Geogrid Testing Results from TRI

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Maximum Working Stresses in Geogrids

- Very low mobilized stress in geogrid
  - T_{LTDS} = 50 to 66 kN/m/m
- Stresses in geogrid are highest in middle zone
- Geogrid stress increases at free end likely due to sloping rock interface

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Major Observations from Analyses Geogrid and RSS

- When considering original properties, no geogrid failure was observed and calculated stresses in geogrids are significantly below long term design stress.

- Geogrid as manufactured and installed was not defective and geogrid properties had no contribution to the failure

- Reducing soil strength or strength of foundation can cause a significant increase in tensile stress in the geogrids.

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Performance of High-strength Geogrid in Reinforced Soil Slope at the Yeager Airport

- High-strength coated polyester geogrid reinforcement performed better than anticipated considering potential installation damage

- After 10 years of service, exhumed samples of the geogrid suffered only minor damage, despite use of an aggressive backfill

Thank You for Your Participation Today

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