Recycled Tires as Lightweight Fill

Geotechnical Engineer,
Jacques Whitford Stantec Limited

RRFB Nova Scotia
Knowledge Session
February 20, 2009
Halifax, NS
Presentation Outline

Part 1: Embankment Failure and Repair Options

Part 2: TDA – Tire Derived Aggregate

Part 3: St. Stephen Rte 1 Reconstruction Design

Part 4: Lessons Learned and Conclusions
EMBANKMENT FAILURE CONDITION
Re-Construction Options

2 Fundamental Strategies were considered:

1. Stabilize or improve the **Foundation Soil** and build embankment using original soil, or

2. Use **Lightweight Fill** and leave the foundation soil in place.
Design Options

Foundation Improvement:

• Removal and Replacement
• Stone Columns

Lightweight Fill:

• Geofoam
• Tire Derived Aggregate (TDA)
Why did NBDOT select TDA?

- Lightweight
- Proven Track Record in the Civil Engineering Community in the USA (ASTM Standard Exists)
- Locally Available (TRACC Facility in Minto, NB)
- Economically Viable
- Sustainability Benefits (1.4 M Tires to Good Use) (Energy Savings Compared to other recycling options)
Tire Derived Aggregate (TDA)

TDA from shredding scrap tires into 50 to 300 mm sizes.
TDA Properties and Applications

• Lightweight (1/3 Weight of Soil) – Embankments
• Free Draining – Landfills, Septic Leach Fields
• Low Earth Pressures – Retaining Wall Backfill
• Good Thermal Resistivity - Insulation below roadways
• Compressible – Induced Trench Applications
• Absorbs Vibrations – Rail Industry
Design Considerations – TDA as Lightweight Fill

- ASTM D6270-98 (Reapproved 2004) “Use of Scrap Tires in Civil Engineering Applications”
- Class II Shreds
- Final In-Place Unit Weight
- Overbuild
- Guidelines to Limit Internal Heating Reaction
Guidelines to Limit Heating Reaction

• Maximum 3 m thick
• TDA Gradation
• Metal Fragments
• Minimize Infiltration of Air and Water
• Separated with a geotextile from surrounding soil
• No hydrocarbon contamination, fire or fire remnants, or organic matter
St. Stephen Embankment Reconstruction Project

Construction Sequence:

- Excavate failed mass down to original grade
- Install Pre-fabricated Vertical Drains through clay (Time Factor)
- Use TDA to lighten the embankment load
- Use a Staged Construction Approach to maintain stability
- Monitor progress using geotechnical instrumentation
Vertical Drains
St. Stephen Embankment Reconstruction Project

- **TDA Supply:**
  - TRACC, Minto, NB – 160 kms from job site
  - TDA quality specifications were developed using ASTM and Maine DOT Specifications - Inspection

- **TDA Transportation:**
  - Floating Floor Trailers were used
TDA Stockpile at TRACC
Loading TDA at TRACC
TDA Delivery to Job Site (35 m³ per load)
1st Layer of TDA
TDA Compaction
Soil Capping Layer
(>30 % Fines)
2\textsuperscript{nd} Layer of TDA
Completed Embankment – December 5, 2008
Completed Embankment – December 5, 2008
Lessons Learned

• Supplying 14,000 tonnes of TDA (1.4 Million Tires) was a huge challenge for the supplier. Construction schedules should allow for and accommodate delays in the delivery of TDA, especially for facilities undertaking TDA production for the first time.

• Steel tracked equipment was preferred for construction over TDA. The contractor experienced numerous flat tires initially when travelling over TDA using rubber tired equipment.

• Floating floor trailers was the preferred method of transporting TDA from the recycling facility to the project site.

• Due to the lightweight nature of TDA, the contractor was able to transport TDA during spring weight restrictions.
Conclusions:

- NBDOT successfully used 1.4 million scrap tires to reconstruct the failed embankment. This quantity of tire is equivalent to approximately 2 years of scrap tires generated in NB.

- The low unit weight, proven track record in the USA, and the local availability resulted in the TDA option being selected.

- The TDA option has resulted in a net savings to NBDOT as compared to the next feasible repair option.

- This project (using TDA in a lightweight fill application) is the first in Atlantic Canada, and the second largest project in North America in terms of TDA volume.
Conclusions (Continued):

• In general, construction using TDA went according to plan. The TDA was relatively easy to load, transport, place, and compact using traditional earthmoving equipment. The use of trailers equipped with “floating” floors was very advantageous.

• Results of the geotechnical instrumentation has shown that the in-place TDA is lightweight with internal temperatures within acceptable and predicted limits.

• The Hwy was opened to the general public in early December 2008. The performance of the embankment is meeting the designer’s expectations.
Contact Information

Jacques Whitford Stantec Limited
711 Woodstock Road,
Fredericton, NB E3B 5N8
Phone (506) 457-9654
Cell (506)461-6906
bernie.mills@jacqueswhitford.com
QUESTIONS ?