CIVIL ENGINEERING APPLICATIONS OF TIRE DERIVED AGGREGATE

Dana N. Humphrey, Ph.D., P.E.
Dean of Engineering
University of Maine

Presented to:
2012 Industrial Materials Conference
November 28, 2012

Outline

Why use TDA?

- Example projects
  - Boundary Road Project
  - Lightweight fill over reinforced concrete culvert
- Design parameters for TDA as retaining wall backfill

Why use TDA?

- TDA has properties that civil engineers need
- Lightweight (1/3 soil)
- Low earth pressure (1/2 soil)
- Good thermal insulation (8 times better)
- Good drainage (10 time better)
- Compressible
- Vibration damping

Why use TDA?

- Can use lots of tires!!!
  - 75 tires per yd^3 of TDA fill
  - 1.2 million tires for highway embankment, Portland, Maine
  - 75,000 for vibration damping layer in San Jose, CA
  - 390,000 tires for highway embankment in Cornwall, Ontario

Boundary Road Project

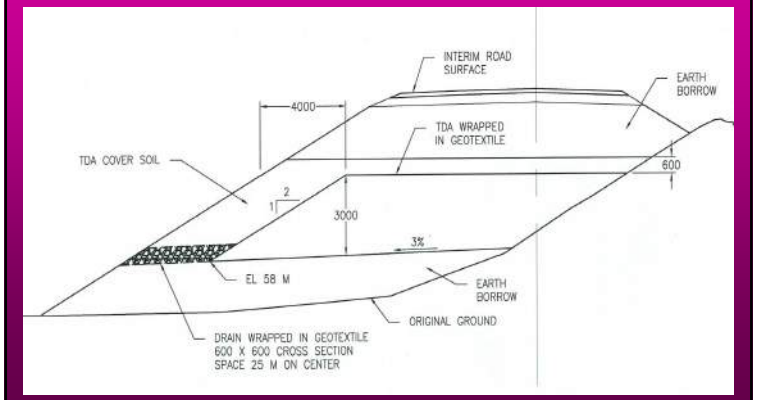
- Cornwall, Ontario
- Reconstructed highway overpass
- Owner: Ontario Ministry of Transportation
- TDA
  - 5000 cubic yards
  - 3400 tons
  - Supplier: Liberty Tire, Brantford, Ontario

TDA Production

TDA Loading

Type B TDA

Typical Cross Section



Site Ready for TDA

Unrolling Geotextile

Unloading TDA

Spreading TDA

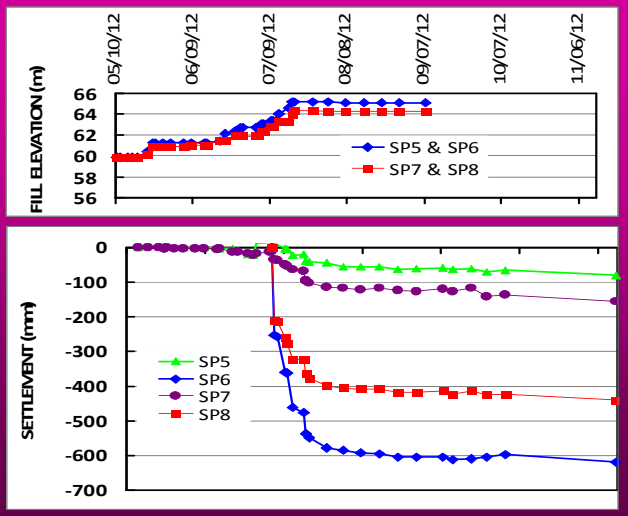
Advancing Lift of TDA

Compacting with Roller

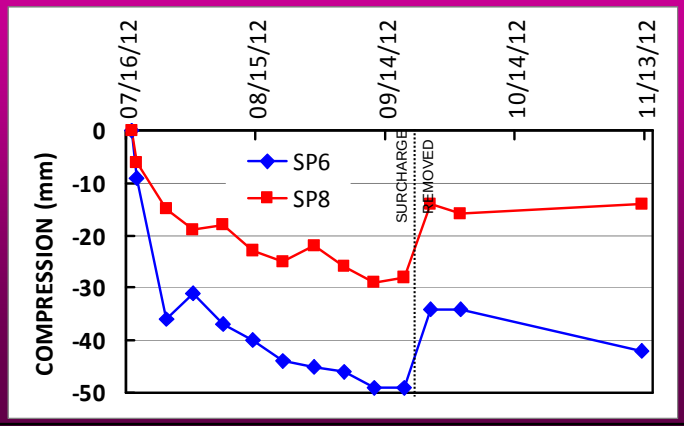
Construction Partners

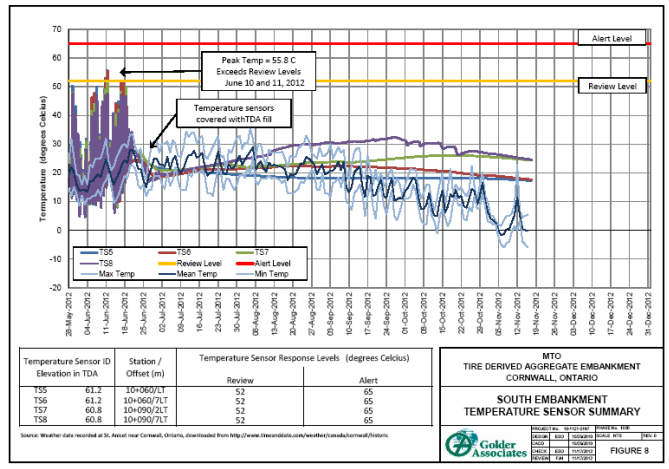
Monitoring Program

- Settlement
- Temperature
- Water Quality



Post Placement Compression of TDA layer – South Embankment





TDA as Lightweight Fill Over Concrete Box Culvert

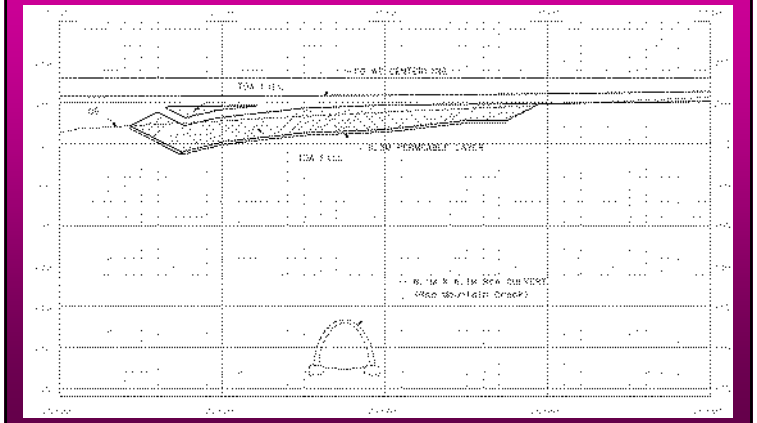
- U.S. 101 – Piercy, California (Confusion Hill) – 200 miles north of San Francisco
- New highway alignment to avoid landslide area
- Existing 6.1 m x 6.1 m reinforced concrete culvert covered by 25 m of fill
- Must add 2 m of fill for road realignment
- Problem: No load can be added to culvert
- Solution: Use TDA as lightweight fill

CalRecycle KENNEC, INC

Confusion Hill Project

Photo: Courtesy of Kennec, Inc.

Longitudinal Cross Section



Confusion Hill – Initial Conditions

Photo: Courtesy of Kennec, Inc.

Confusion Hill – TDA Delivery

Photo: Courtesy of Kennec, Inc.

Confusion Hill – During Construction

Photo: Courtesy of Kennec, Inc.

Confusion Hill – Completed Project

Design Parameters for TDA as Retaining Wall Backfill

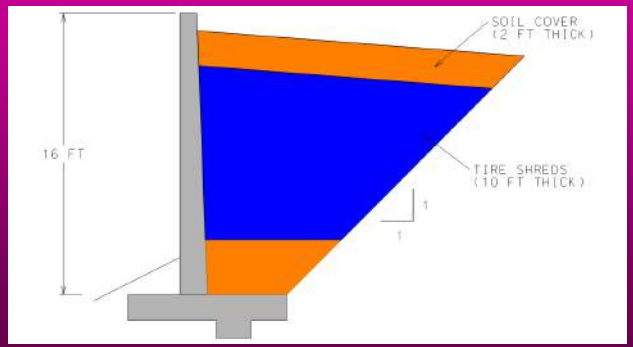
- Earth pressure coefficient
  $K = \sigma_h/\sigma_v$

Instrumented Walls

- At-Rest Conditions
  - UMaine Test Wall
  - North Abutment Merrymeeting Bridge
  - Limestone Run Bridge, Tarrtown, PA
- Active Conditions
  - UMaine Test Wall
  - Wall 119 Riverside, CA
  - Wall 207 Riverside, CA

Pressure cells

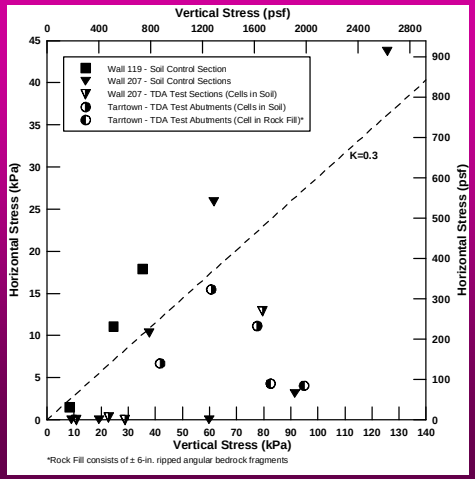
Wall 119 in Riverside, CA



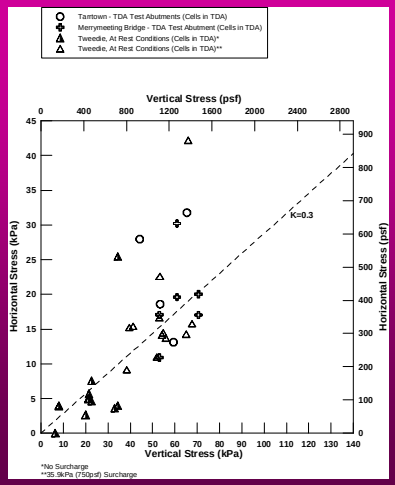
Compacting TDA

Placing soil cover

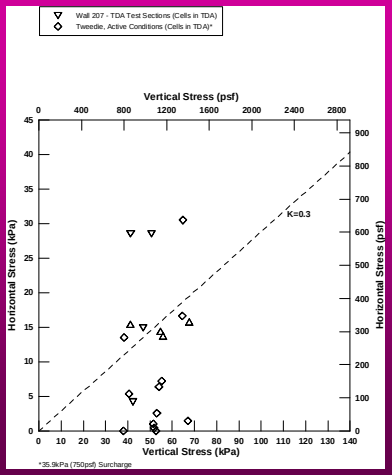
Horizontal vs. Vertical Stress (Cells in Soil)



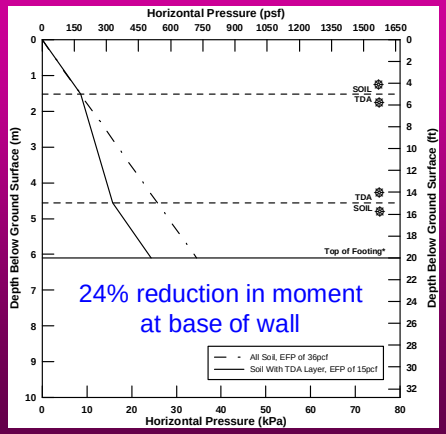
Horizontal vs. Vertical Stress (Cells in TDA, At Rest Sections)



Horizontal vs. Vertical Stress (Cells in TDA, Active Sections)



Example of Potential Benefits



Conclusions

- TDA has properties that engineers need
- Civil engineering applications are critical to managing scrap tires
- Highway applications
  - Lightweight embankment fill
  - Lightweight fill over culverts
  - Retaining wall backfill
- Specifications and guidelines available
- Negligible environmental effects