

CIVIL ENGINEERING APPLICATIONS UTILIZING TIRE DERIVED AGGREGATE (TDA)

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CalRecycle's Main Objective is to get TDA Accepted by the Civil Engineering Community

- Educate Local Public Works, CALTRANS, Private Consulting Civil Engineers and State and Local Environmental Agencies on the benefits of TDA
- Research – Develop Sustainable, Environmental Beneficial and Cost Effective Civil Engineering Reuses for Waste Tires
- Coordinate and Assist Waste Tire Processors to assure there is adequate TDA to meet future demand.

Services Available from CalRecycle to Promote TDA

- TDA Technical Expertise –
 - Provide TDA project design Assistance
 - Provide education and training on the technical aspects and benefits of using TDA
- TDA Project Management
 - Provide construction management assistance
 - Provide procurement and staging for TDA projects
 - Provide performance and environmental monitoring for TDA projects

Future TDA Projects in California

- BART and MTA Goldline Extension, Vibration mitigation for over 15,000 Linear feet of track! – San Jose and Azusa –
- Construction of Type 1T(TDA) Retaining Wall Pilot project
- Retaining Wall Seismic Research Caltrans and UCSD
- Septic system leach field research
- TDA in MSE applications – MSTDA – Ortega Ridge
- TDA in LFG Systems

Design guidelines for using TDA

- History of TDA use in United States
 - During the 1990s, research and the use of waste tires in civil engineering applications increased dramatically
 - **1994-1996 Expensive Failures.** At the end of 1995 and beginning of 1996, reports of three projects that experienced catastrophic internal heating reactions caused a halt to other tire projects around the country. Two of these were road projects in Washington and one was a retaining wall project in Colorado.
- Development of guidelines
 - **1997 TDA Design Guidelines Established.** An ad hoc civil engineering committee, a partnership of government and industry, was formed to investigate project failures and establish guidelines to minimize internal heating of tire shred fills. The committee identified the following factors that are thought to create conditions favorable for oxidation of exposed steel and/or rubber:
 - free access to air;
 - free access to water;
 - retention of heat caused by the high insulating value of tire shreds in combination with a large fill thickness;
 - large amounts of exposed steel belts;
 - smaller tire shred sizes and excessive amounts of granulated rubber particles;
 - and the presence of inorganic and organic nutrients that would enhance microbial action

Design guidelines for using TDA

- Design guidelines

- ASTM D6270, Standard Practice for Use of Scrap Tires in Civil Engineering Applications, August 1998, revised and approved in 2008
 - TDA should be covered with a sufficient thickness of soil to limit deflections of overlying pavement caused by traffic loading. Soil cover thicknesses as low as 2.6 feet (0.8 m) may be suitable for roads with light traffic.
 - TDA layer shall not be more than 10 feet thick in a vertical direction
 - Multiple TDA layers shall have a minimum 3 feet thick separation layer of non organic soil
 - TDA layer should be wrapped completely in a layer of nonwoven or woven geotextile to minimize infiltration of soil particles into the voids between the tire shreds.

- Placement guidelines

- Tire shreds shall not contain any contaminants such as oil, grease, gasoline, diesel fuel or other chemical substances, shall not contain fragments of wood, wood chips, or any other fibrous organic matter, and shall not contain loose wire or metal fragments.
- TDA material shall be spread using track-mounted equipment
- TDA lifts shall be compacted using a minimum of six complete coverage passes by a vibratory smooth drum steel roller imposing a minimum static weight of 10 tons.

Design guidelines for using TDA

- Material guidelines
 - ASTM D422, and ASTM D6270
 - No “free” steel
 - Limited amount of “exposed” steel
 - Limited amount of “fines”
- Type A TDA

Sieve Sizes	Percent Passing (by weight)
100 mm (4 inch)	100
75 mm (3 inch)	90-100
4.75 mm (No. 4 Sieve)	0-5

Type B TDA

Sieve Sizes	Percent Passing (by weight)
450 mm (18 inch)	100
300 mm (12 inch)	90-100
37.5 mm (1.5 inch)	0-25
4.75 mm (No. 4 Sieve)	0-1

Environmental Considerations

- Water quality
 - Primary Drinking Water Standards – TDA is OK (Humphrey, Katz, 2002)
 - *Secondary Drinking Water Standards -- Elevated Iron and Manganese significantly reduced with time, soil, and/or dilution.*
 - Below the water table, VOCs negligible and unlikely to pose a quantifiable threat to aquatic species. (Exponent 2003)
- Air quality
 - Testing during placement of material showed non detect of VOCs (CalRecycle, 2005)
- Regional Water Quality Board Waiver, San Francisco Bay Area
 - Extensive aquatic study determined “negligible impacts in applications within the ground water table”
 - RWQB releases waiver for all use 5 feet above water table, requires notification for other applications, even though RWQB recognizes “negligible impacts” in groundwater applications
- California TDA Project Success
 - Following developed TDA guidelines, California implements a long list of successful projects!

Completed California TDA Projects

- 2001 - First TDA Project, Dixon Landing Interchange Project
- 2003-2007 - Hwy 215 and Route 91 Retaining Wall research projects. Joint project with Caltrans
- 2004 - Valley Transit Authority - Vibration Mitigation Project
- 2007 - Marina Dr, Mendocino Co. Landslide Repair
- 2008 - Riverside County Landfill Gas Collection system, Pilot projects
- 2008 - Caltrans Confusion Hill, Lightweight fill Embankment
- 2008 - Sonoma Co. Geysers Rd. Landslide Repair Project
- 2009 - Sonoma Mtn. Road, Landslide Repair Project
- 2009 - Sacramento County Keifer Landfill, Landfill Leachate recirculation project
- 2010 - Santa Barbara County, Palomino Rd Slide Repair

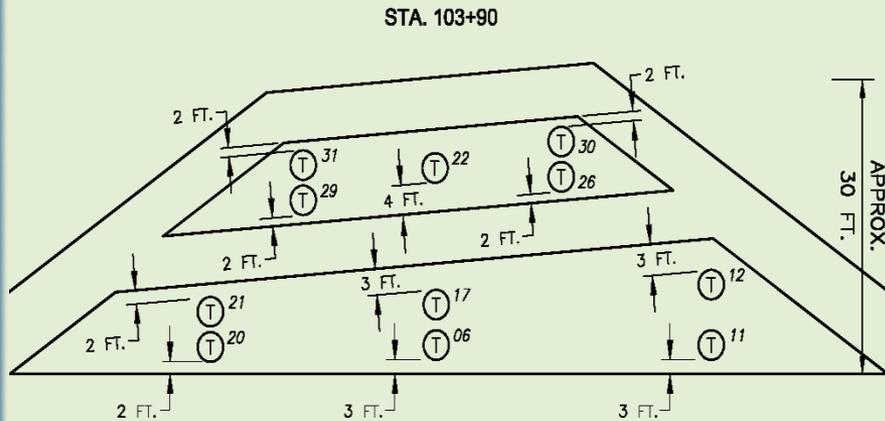
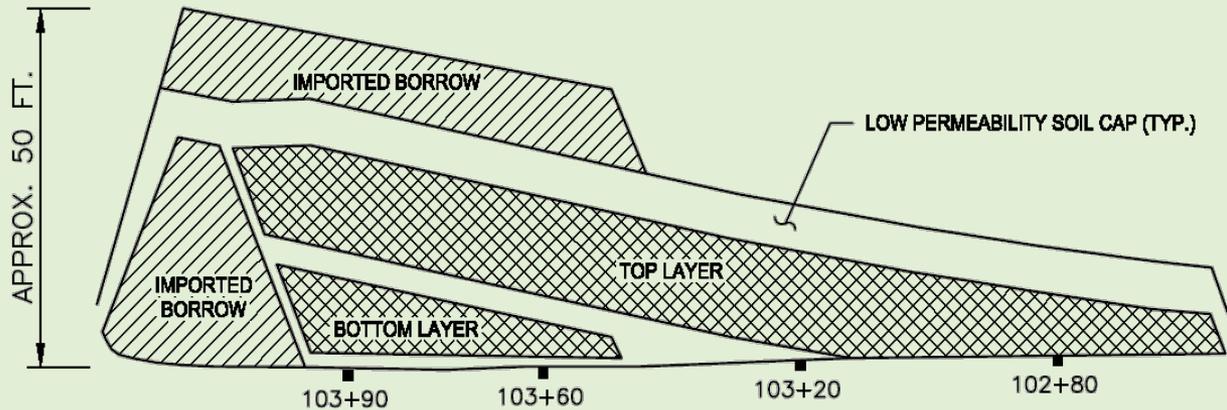
Beneficial Properties of Tire Derived Aggregate (TDA) in Civil Engineering Applications

- Tire Derived Aggregate (TDA) has properties that civil engineers, public works engineers & contractors need
 - Lightweight
 - Free Draining/High Permeability
 - Low earth pressure
 - Good thermal insulation
 - Durable
 - Compressible
 - May be cheapest solution
 - Help solve significant environmental problems
 - Conserve natural aggregate resources

Uses for Tire Derived Aggregate

- Lightweight fill for Embankments
- Lightweight fill for Slide Repair
- Lightweight backfill for Retaining Walls
- TDA used in Vibration Mitigation Applications
- TDA in Landfill Applications

Dixon Landing/HWY 880 Interchange Project



660,000 Tires



Dixon Landing/HWY 880 Interchange Project

Savings to the State \$240,000



Dixon Landing/HWY 880 Interchange Project

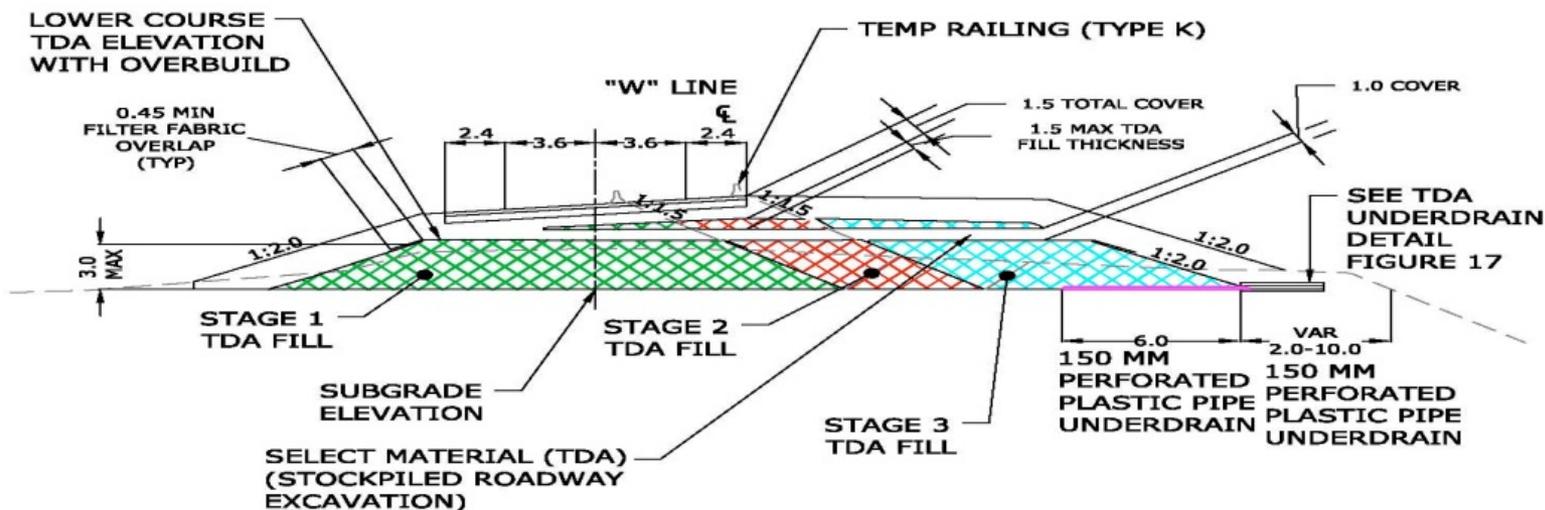
Confusion Hill Embankment Project



Confusion Hill - Lightweight TDA Embankment Project 2008

LEGEND

-  STAGE 1 TDA FILL
-  STAGE 2 TDA FILL
-  STAGE 3 TDA FILL



CONFUSION HILL TDA EMBANKMENT HIGHWAY 101 - TIRE DERIVED AGGREGATE LIGHTWEIGHT FILL

270,000 Tires



Confusion Hill - Lightweight TDA Embankment Project 2008

Saving to State \$320,000



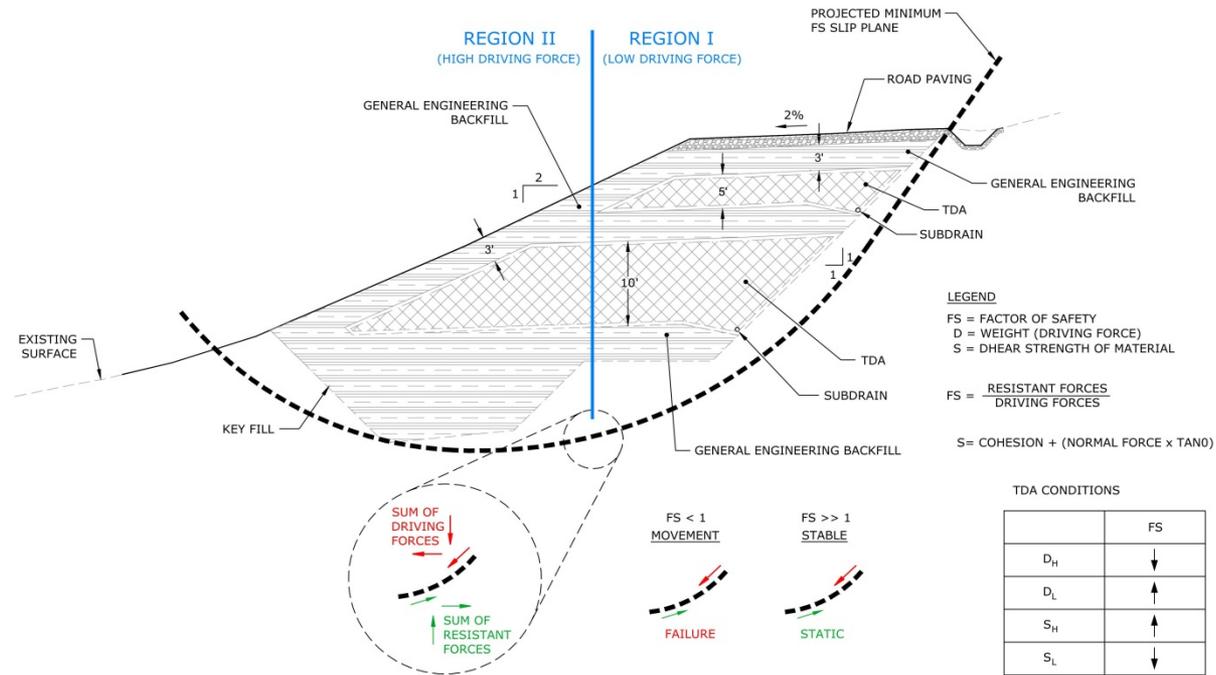
Confusion Hill – Final Project

Lightweight TDA Fill for “Slip Outs”

Lightweight Fill for
“Slip Out”
Road Slide Repair
Mendocino and Sonoma Counties



General View of TDA Slide Repair



GENERAL TDA SLIDE REPAIR SECTION

Marina Drive Slide Repair



133,000 Tires



Mendocino County, Marina Drive

Saving to the County \$90,000



Marina Drive Slide Repair

Geysers Road Slide



150,000 Tires



Geysers Road Slide Repair

Saving to the County \$128,000



Before



Geysers Road Slide Repair

After

Sonoma Mtn. Road, Sonoma County



330,000 Tires



Sonoma Mountain Road

Saving to the County \$590,000



Sonoma Mountain Road

Palomino Road, Santa Barbara County, Slide Repair



Savings to the County \$90,000

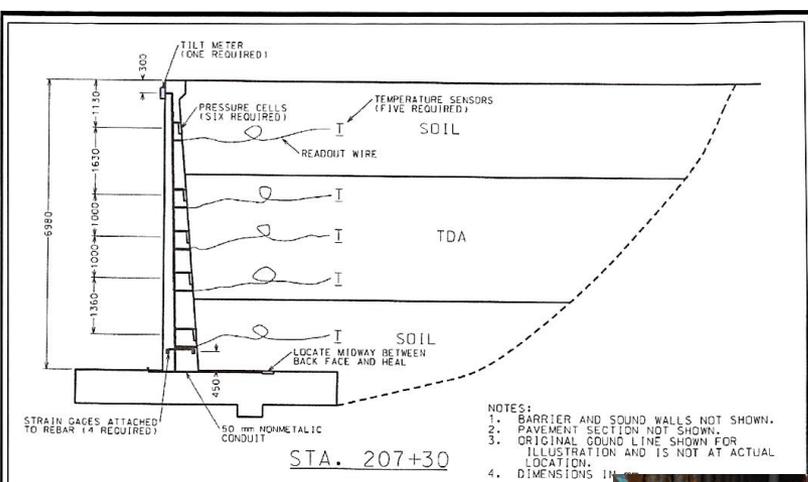


Palomino Road, Slide Repair

Lightweight Backfill behind Retaining Walls



Lightweight Application Wall 119 & 207



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CIWMB
CALTRANS WALL 207
RIVERSIDE, CALIFORNIA

STATION 207+30 SENSORS
TDA BACKFILL SECTION

Lightweight Backfill Behind Retaining Walls Riverside, Ca Wall 119 and 207



Lightweight Application Wall 119 & 207



TDA placement



TDA placed and compacted

Wall 119 Riverside, CA

Final geo-textile wrap



Wall 119 Riverside, CA

cover soil installation, 2 feet



Typical gravel/soil section



Wall 207 Riverside, CA



Type 1 T Retaining Walls



Estimated Savings on Future Walls - \$100/ lineal foot

TDA in Light Rail Vibration Mitigation



Conventional Vibration Mitigation Technology \$800+/ft



TDA Vibration Mitigation \$150/ft



Saving to VTA \$1,000,000

100,000 Tires



VTA Vassona Line Light Rail

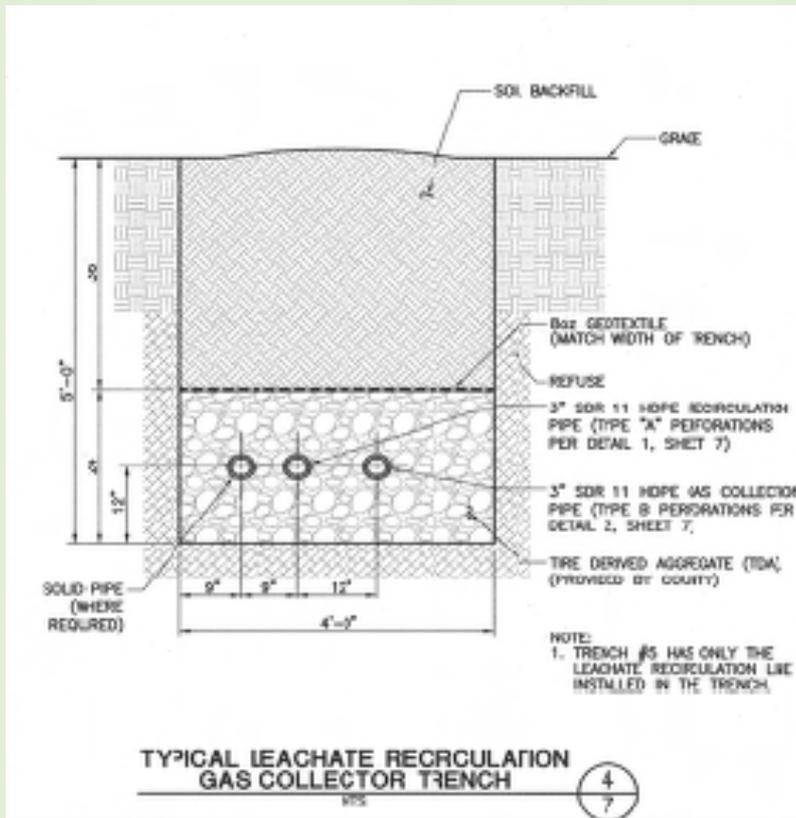
TDA in Landfills Applications

- Leachate Percolation/Injection trench System (Bio-Reactor Design)
- Drainage Layers in Landfill Covers
- Horizontal and Vertical Landfill Gas Extraction Trenches/wells
- Wet Weather Pad

Why use TDA in Landfill systems

- High Permeability/Free Draining
- Compressible
- Lightweight
- Cost savings
- Recycling (100 Tires = 1.5 cy)

LFG TDA Recirculation Trench Construction



Kiefer Landfill, Leachate Recirculation and Gas Extraction trench design for Bioreactor landfill operation

LFG TDA Recirculation Trench Construction



Typical Trench Construction



Welding of leachate injection pipe

LFG TDA Recirculation Trench Construction



Trench extraction and recirculation lines installed



Trench completed and Buried

Landfill Wet Weather Pad Construction using TDA



- TDA Subgrade layer provides drainage

Landfill Wet Weather Pad Construction using TDA



- TDA Subgrade layer provides drainage
- Crushed concrete / Brick Provides bulk driving surface
- Roofing tile pieces on top finish the driving surface

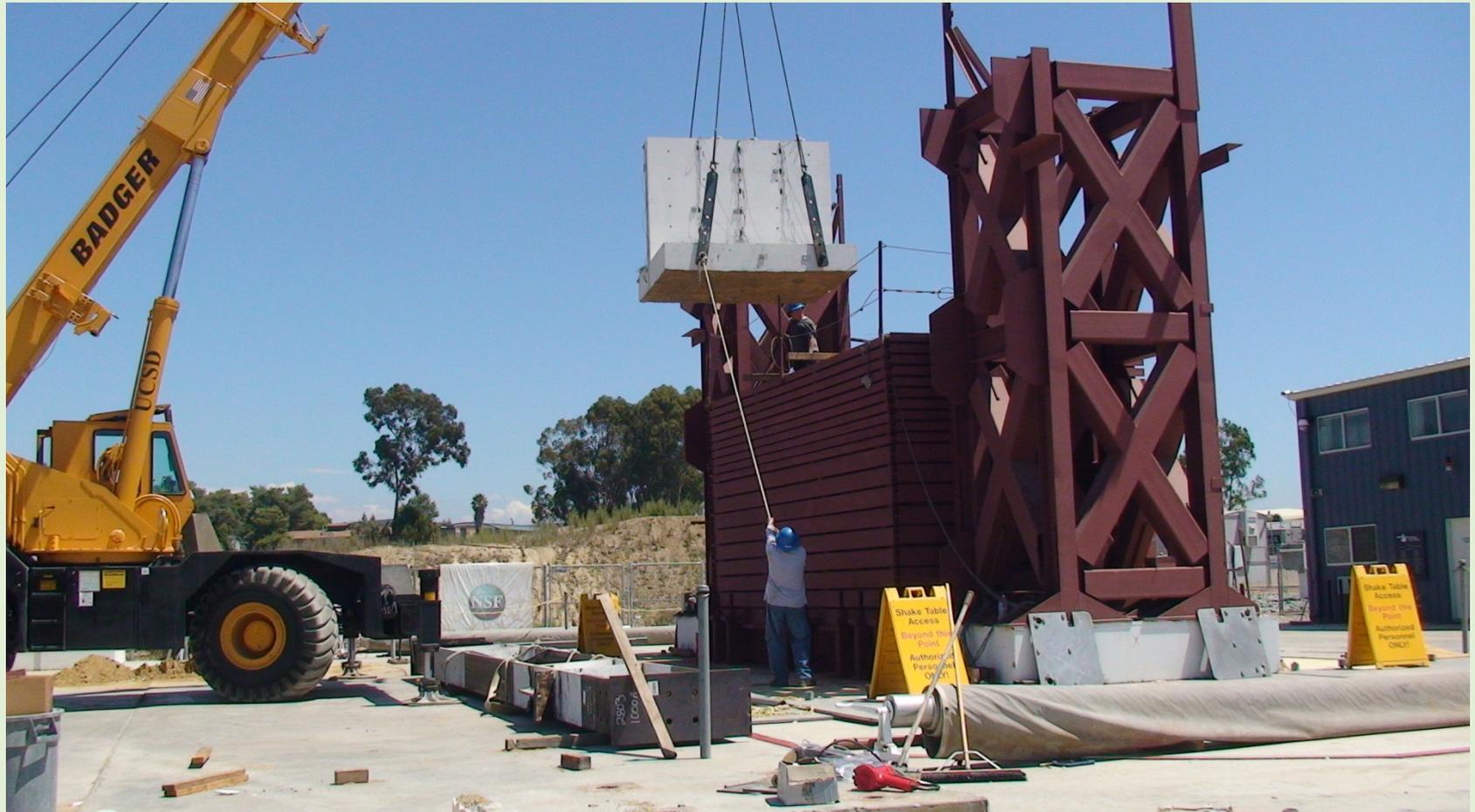
TDA Research Projects

- Retaining wall seismic research, Caltrans and UC Davis
- Mechanically Stabilized Tire Derived Aggregate (TDA), Caltrans and Fresno State University
- Septic leach lines, Humboldt State University
- Material properties, direct shear of type B TDA, UC San Diego

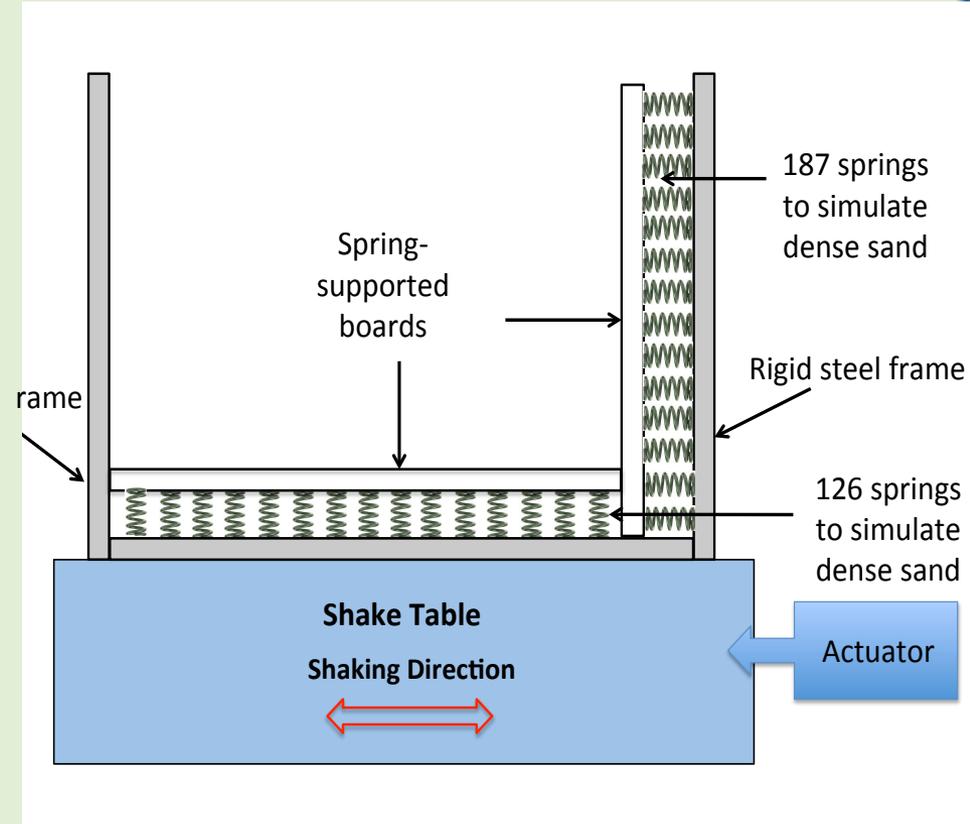
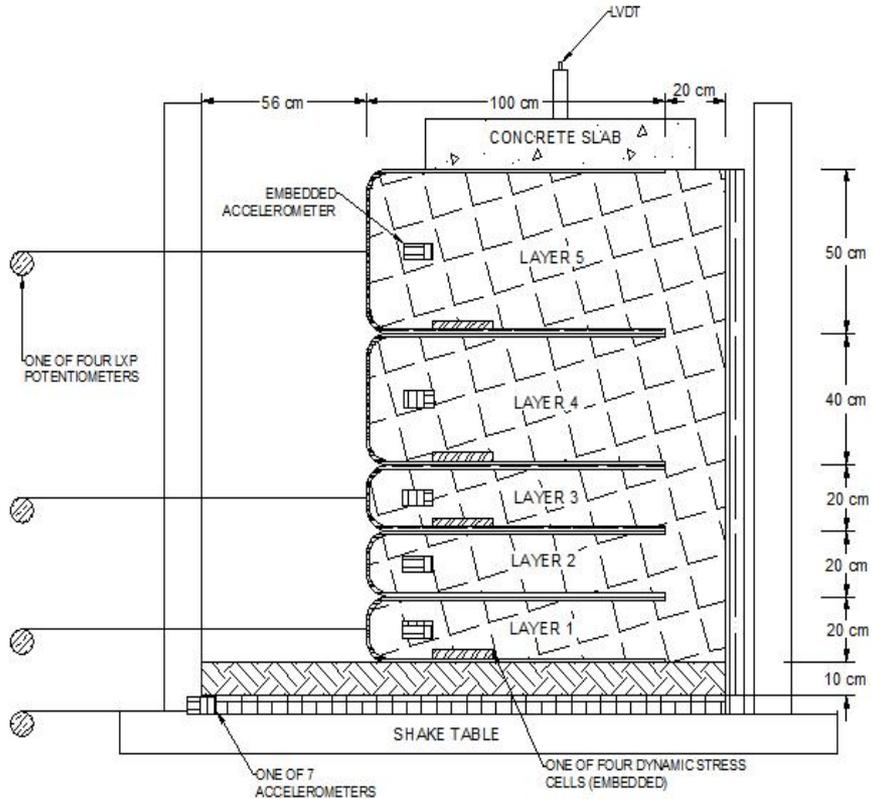
Retaining Wall Seismic Testing



Retaining Wall Being Placed on Shake Table



Mechanically Stabilized TDA Testing



Geo Grid Reinforced TDA Layers

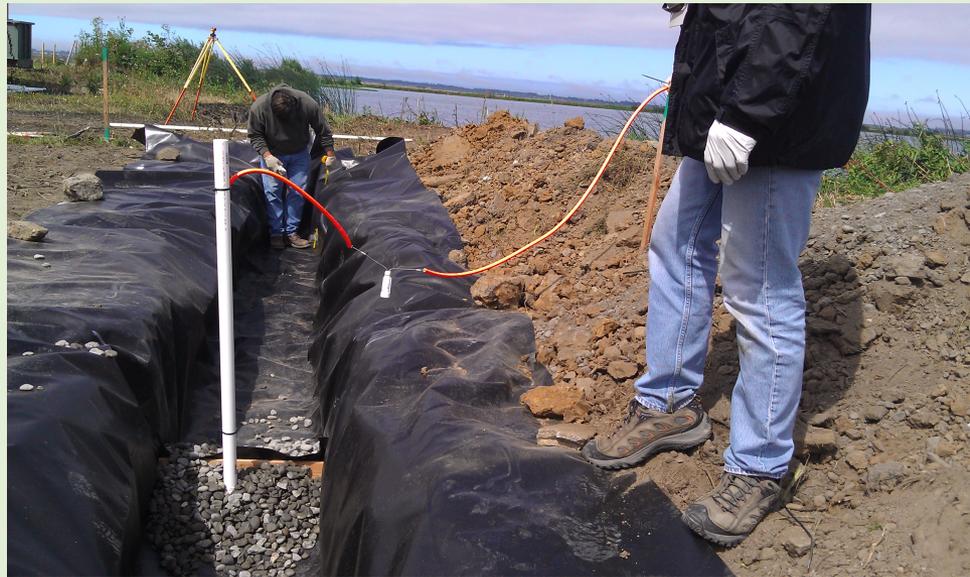


MSTDA Seismic Shake Test Video 8/23/12



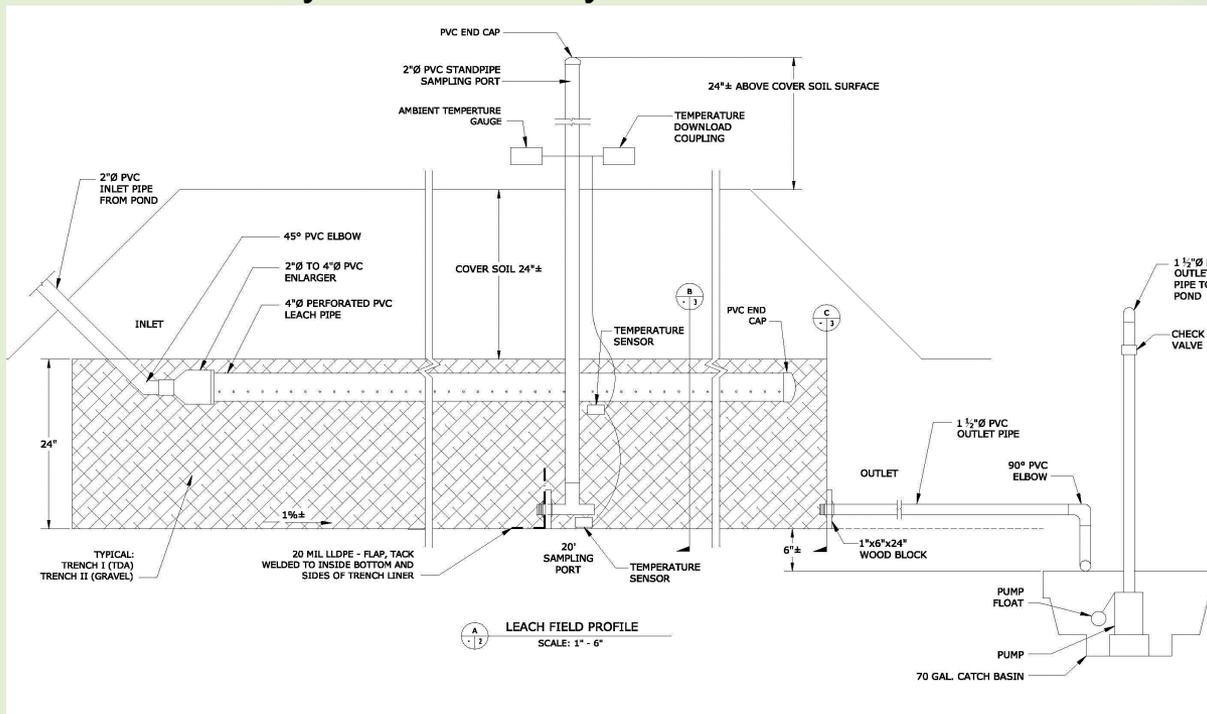
Septic System Trenches Current California Research

- TDA Septic Leach trenches used in 13 states
- Alabama's 2010-11 incentive program highly successful, especially where natural resources are limited
- California question of regulatory jurisdiction, Counties Prevail
- CalRecycle has partnered with Humboldt State University to research and better understand the water quality in a TDA leach system versus traditional gravel



Septic System Trenches Current California Research

- Type A TDA material trench performance compared to gravel
- Typical residential Septic leach trench design
- Void ratio of TDA under loading
- Constituent analysis over one year



Materials research, Direct shear testing, Interface strengths, void space ratio and more..

- TDA shear properties unknown for larger sized material (Type B)
- Oversized shear box designed and constructed for oversized materials
- Void space ratio, water and gas treatment characteristics of TDA
- Define the envelope of usability and material benefits of TDA
- CalRecycle has partnered with UC Davis, UC San Diego, Fresno State University, and Humboldt State University to research the material properties of typical California produced TDA



CM Aspects for TDA Projects

- Pre-Construction
- Construction



Pre- Construction Activities

Design and Overall Project Understanding

- Develop Comprehensive Understanding
 - Communication with team for Design, Construction, and Construction Management
 - Delivery methods and rates
 - Material quality/verification
 - Stockpile location



Regulatory Agency Outreach

- Education and Communication
 - Local Water Board
 - Local Fire Department
 - Interagency Agreements



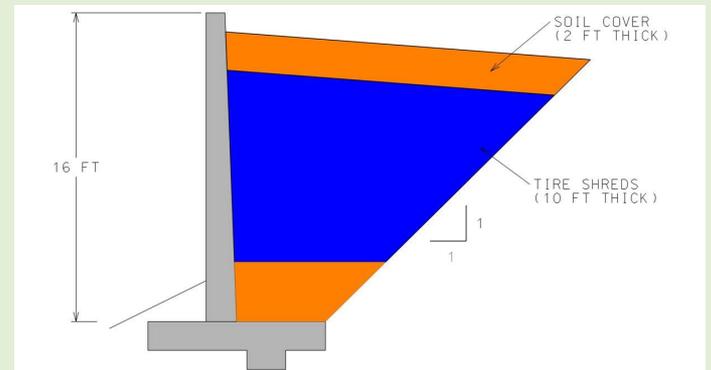
Construction Activities

Construction Understanding

- Communication with team at kick off meeting, TDA Construction, when, where and team expectations.
 - Placement techniques
 - Rates of Delivery, number of suppliers
 - q/a of material
 - Advantageous changes in techniques
 - Documentation of work

As-builts

- Documentation of changes
 - Data retrieval methods and verification
 - Drawings of TDA location, sensors etc.



Grant Program Overview

TDA Grants

Grant Program Overview TDA Grants

- FY12/13 & FY13/14: \$1,500,000 Allocation each
- Grant Amount: \$350,000 Maximum (\$750k for large project)
- Eligible Applicants
 - Local Governments (cities and counties)
 - Special Districts
 - State Agencies
 - Qualifying Indian Tribes
 - Private, for-profit entities

Grant Program Overview TDA Grants

- Eligible Projects/Categories
 - Lightweight fill
 - Landfill applications
 - Retaining wall backfill
 - Vibration mitigation

Grant Program Overview TDA Grants

- Project Requirements
 - 100% CA-generated waste tires
 - Minimum 500 tons of TDA materials
 - Landfill projects must not use more than 0.75 ton of TDA per lineal foot of landfill gas collection or leachate injection system
 - Plans and specifications are subject to review by CalRecycle's engineering staff
 - Technical assistance/training will be provided by CalRecycle contractors and/or staff

Grant Program Overview TDA Grants

- Eligible Cost
 - TDA material
 - Transportation
 - Installation
 - Testing
 - Engineering/Design Work

Grant Program Overview

- How to apply?

Check out the following websites for current information
Green Roads General TDA Information and Outreach
www.calrecycle.ca.gov/Tires/GreenRoads/TDA.htm

Tire-Derived Aggregate Grant Webpage: [http://
www.calrecycle.ca.gov/Tires/Grants/TDA](http://www.calrecycle.ca.gov/Tires/Grants/TDA)

If you have grant questions, contact Loreto Tamondong
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Questions?

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