Effective Engineering &

Developing A Sustainable, Low Volume Road Technology

Samuel G. Bonasso, P.E.

131st CCAO/CEAO Annual Winter Conference

Dec. 12, 2011

MECHANICAL CONCRETE®

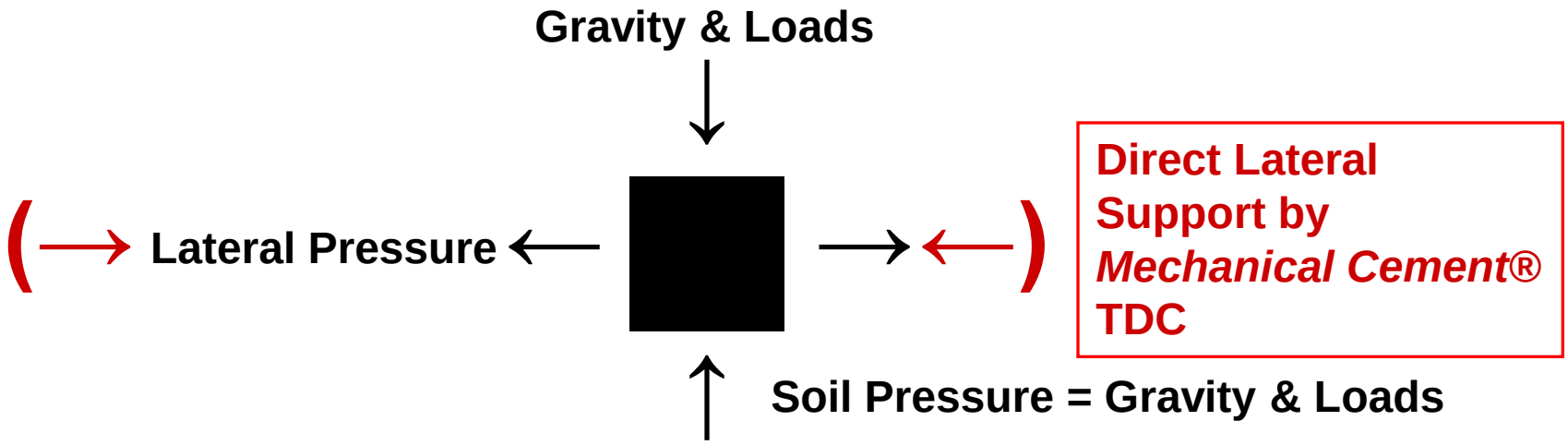
MECHANICAL CONCRETE®

Tire-Derived-Cylinder (TDC)-Mechanical Cement®

+

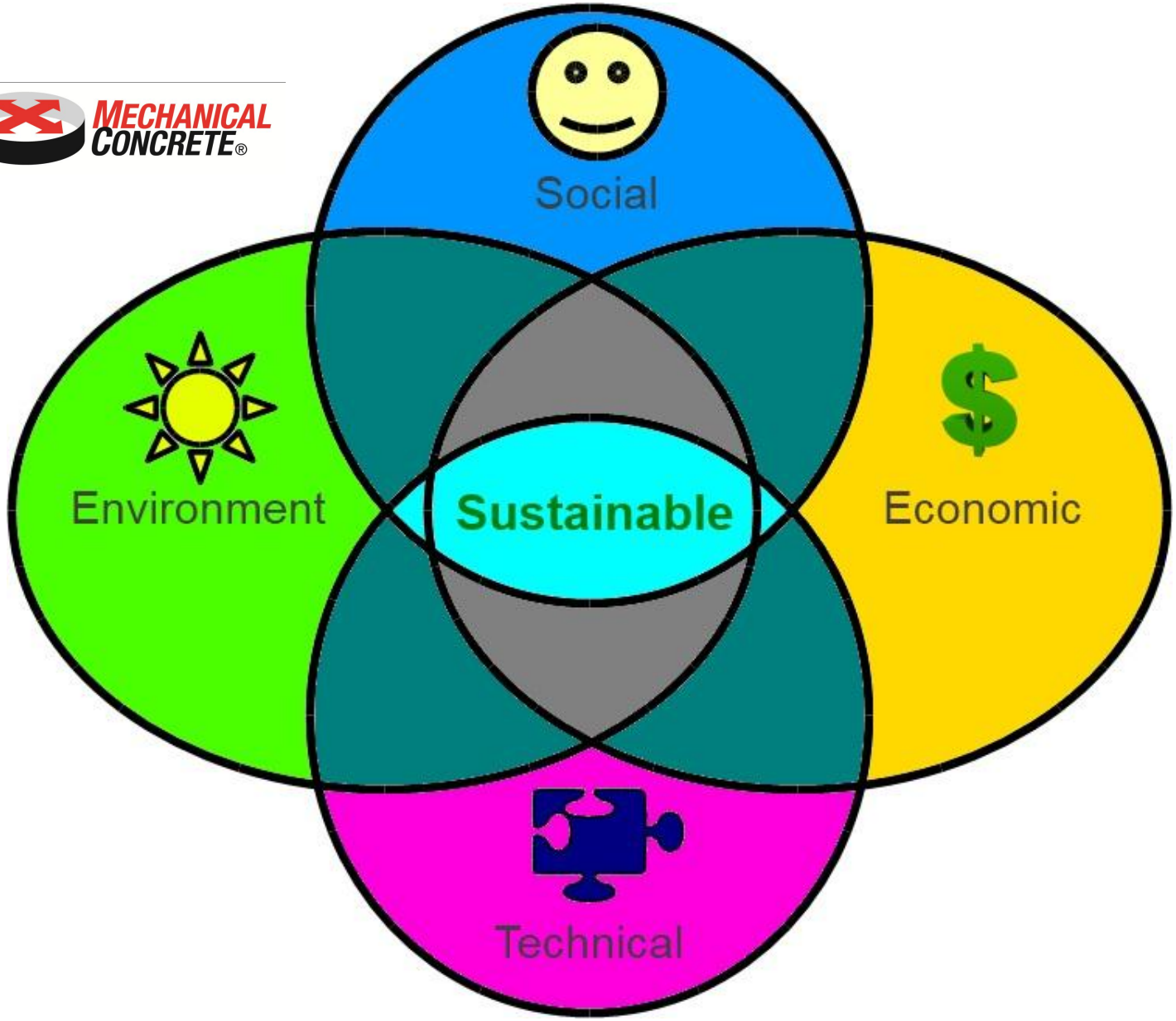
Stone Aggregate Material

How **Mechanical Concrete®** works



- Gravity & Loads on Particles ↓ create
- Soil Pressure Reaction ↑ also
- Creates & Transmits Lateral Pressure →
- **(TDC)** ***Mechanical Cement®*** Cylinder Direct Lateral Support for particles (→ ←)

MECHANICAL CONCRETE®



Four Way Sustainability Criteria

- **Economically Viable—Reduces initial costs, maintenance, & extends useful life**
- **Technically Feasible—Effective, Simple, & Fast with better outcomes**
- **Environmentally Friendly—Reuses & Uses Less: Material, Energy & Labor**
- **Socially Supportive—Preserves scarce resources & improves productivity**

First Wall Section

Basic Load Research Information

- HS 25 Truck Road Tire Pressures ≤ 100psi
- Contact area: 20,000 lb. wheel load ≥ 200 in^2
- Allowable bearing pressure sand 8000-4000 psf ≤ 42psi—21psi

- By what factor will confinement increase this bearing capacity?

R & D

WVU CE Laboratory Tests

TDC 50K Column Strength

Stone Aggregate Behavior

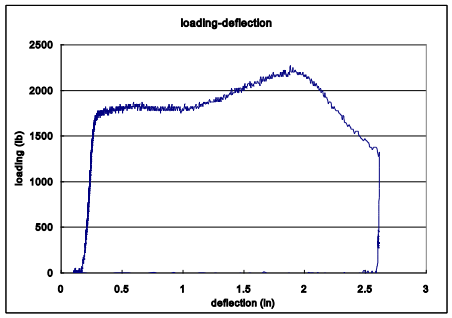
Aggregate Materials Tested

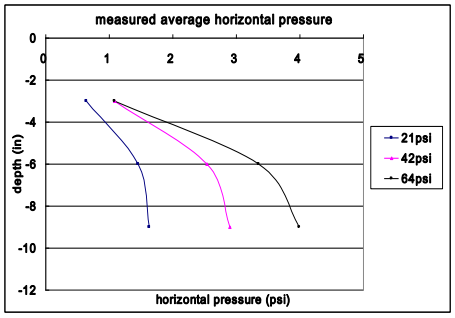
- Compacted Course Sand
- Compacted Crusher Run Limestone
- Compacted AASHTO #8 Limestone
- AASHTO #57 Limestone

Test Results 12” Long 20”φ Tube

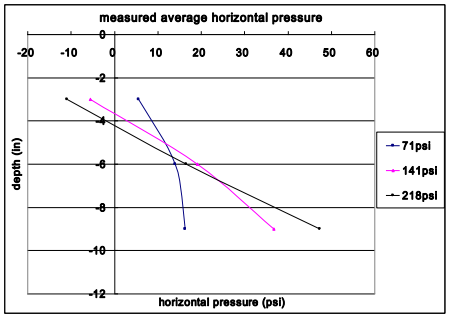
SAND AGGREGATE

12” tube w/ 6” ϕ loading plate (28 in^2) (6000lb max @ 200psi) Bearing Failure at 1800 lb. approx. 63psi

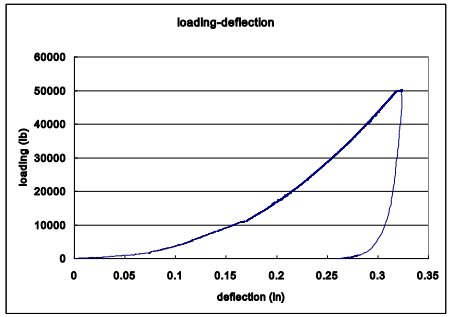


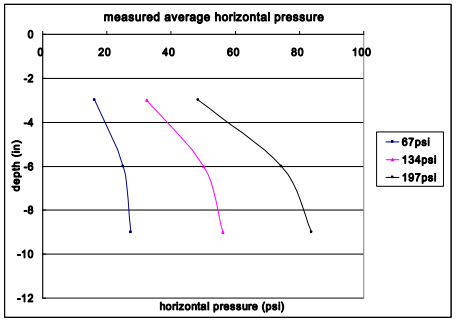


12”tube w/ 12”ϕ plate (113 in^2)sand (200psi)(23,000lb max) (HS 25 Wheel 20,000lbs at 100psi)



12” tube / 18” ϕ plate (255 in^2) sand (200psi) (50,000lb max) (HS 25 Wheel 20,000lbs / 100psi)





More R & D Was Needed

- How would it work in the field?
- Speed of Construction?
- Effect of tire sizes?
- Worker Learning Curve?
- Quality Tolerances?
- Applications?
- Weather and Climate?
- Behavior During Construction & Use?
- Economics?
- ???

Standard Aggregates

Uncompacted

- AASHTO #57 Crushed Stone**
- Any Relatively Uniform Size, #3, #1 Structural Aggregate Material

Compacted

- Sands & Graded Aggregates
- Indigenous materials
- Existing roadway base materials
- All Recycled aggregate materials

Wall Construction Field Trials Laurel Aggregates Quarry in PA

Wall Tests

First Demonstration Projects

West Virginia
Division of Highways

Demo Project Doddridge County

Morgan Run Road Base

350 ***Mechanical Cement®***

Tire-Derived-Cylinders (TDC)

September, 2006


WVDOH EXPERIMENTAL
ROADWAY
MECHANICALLY STABILIZED BASE
MECHANICAL CONCRETE

Test Road filled TDC

Test Road Surfaced

September 27, 2006

First Israel Run Flood April 1, 2007

Israel Run, June 2008
Flooding Damage
2 Feet of Water

Israel Run April, 2009

Israel Run March, 2010

Bowie, Inc.
Clarksburg, WV

January 2007 Demo Project

Sorbello Gas Well

20’ x 40’ Service Pad

200 ***Mechanical Cement®*** TDC

TDC Layout

Dozer

MECHANICAL CONCRETE®

Bowie/Sorbello
Gas Well Service Pad—2 Hours

TRIAD MSE Wall
Demo Project June, 2006

- Larger Structure Demonstration
- 650 ***Mechanical Cement®***

  Steel Belt Truck TDC
- Mechanically Stabilized Earth, MSE
- Use of Medium Truck Tires
- Impacts of Tire Size Variations
- Interconnections between cylinders

Retaining Wall Construction

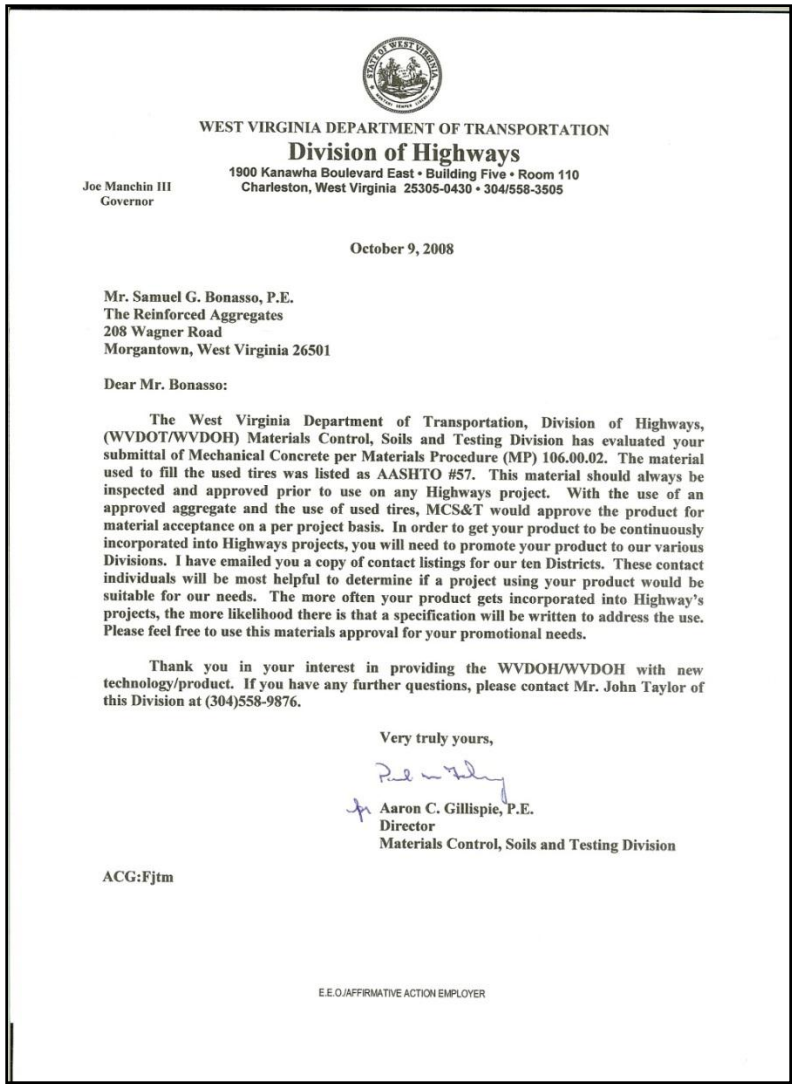
TRIAD MSE Retaining Wall

650 TDC Medium Truck Tires Total Length 190’x15’ Max. Height

First Demo & R/D Outcomes

- Fast, Strong & Economical
- May be surfaced with any material
- Erosion Resistant
- Climate and Weather Resistant (5+yrs.)
- Engineered Product
- Interfaces well with traditional means and methods
- MECHANICAL CONCRETE® worked as predicted(+)!

WV DOH Approval October 9, 2008



WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
Division of Highways
1900 Kanawha Boulevard East • Building Five • Room 110
Charleston, West Virginia 25305-0430 • 304/558-3505

Joe Manchin III
Governor

October 9, 2008

Mr. Samuel G. Bonasso, P.E.
The Reinforced Aggregates
208 Wagner Road
Morgantown, West Virginia 26501

Dear Mr. Bonasso:

The West Virginia Department of Transportation, Division of Highways, (WVDOT/WVDOH) Materials Control, Soils and Testing Division has evaluated your submittal of Mechanical Concrete per Materials Procedure (MP) 106.00.02. The material used to fill the used tires was listed as AASHTO #57. This material should always be inspected and approved prior to use on any Highways project. With the use of an approved aggregate and the use of used tires, MCS&T would approve the product for material acceptance on a per project basis. In order to get your product to be continuously incorporated into Highways projects, you will need to promote your product to our various Divisions. I have emailed you a copy of contact listings for our ten Districts. These contact individuals will be most helpful to determine if a project using your product would be suitable for our needs. The more often your product gets incorporated into Highway's projects, the more likelihood there is that a specification will be written to address the use. Please feel free to use this materials approval for your promotional needs.

Thank you in your interest in providing the WVDOH/WVDOH with new technology/product. If you have any further questions, please contact Mr. John Taylor of this Division at (304)558-9876.

Very truly yours,

Aaron C. Gillispie, P.E.
Director
Materials Control, Soils and Testing Division

ACG:Fjtm

E.E.O./AFFIRMATIVE ACTION EMPLOYER

Reinforced Aggregates Company

- Patent and Trademark Licensor
  - U.S. Patent 7,470,092 B2 (12/2008)
    - Contractor, Manufacturer, Project, Agency, Et. Al. Licenses
  - **Mechanical Concrete® & *Mechanical Cement®***
- Construction Technology R & D
  - Basic Designs, Details, Specs & Standards
- Construction Market Developer

www.mechanicalconcrete.com

Sundt Construction
Tempe, AZ

2009 USDHS-CBP Productivity Assessment

Gibbons Ranch Road, Douglas, AZ

1400 feet unpaved, one lane

3000 *Mechanical Cement*®

Tire-Derived-Cylinders

TDC In Place

Filling TDC with Stone

Filled TDC

Stone Surface

Site / Roadway Construction Productivity Rates

- Auto Tire Derived Cylinder (TDC) Placement
  - 1 Labor Hour = 150-AutoTDC 27”ϕ x 8”
  - 800 ± sf Placed and Attached
  - 80 Labor Hours per 12’ Lane Mile
  - 55 Labor Hours per Acre
- Stone Spreading w/ 3 cy Wheel Loader
  - ± 2400sf / 88 tons per hour
  - 27 Machine Hours per 12’ lane mile
  - 18 Machine Hours per acre
- Roadway / Site Coverage
  - 12,000 - 27” ϕ ATD Cylinders per 12’ lane mile
  - 8100 27” ϕ ATD Cylinders Per Acre

How it supports loads

Sundt Construction
Tempe, AZ

2010 USDHS-CBP Border Roads Project

2miles— 20’ roadway in 4 sections

Mechanical Concrete® 8” Base

Soil-Tac Resin Wearing Surface (6”ABC)

40,000 Tire-Derived Cylinders

USDHS CBP
Imperial Dunes, CA Section 1 mile

USDHS CBP
Imperial Dunes, CA Section

USCHS CBP
O'Neal Valley, CA Section +/- O.5Mile

USDHS CBP
O Neal Valley, CA Section

Dana Prime #1 Mine
Coal Haul Road

Laurita, Inc.

Morgantown, WV

REAGCO N. WV Licensee

Project Features

- 10 inch Reinforced Concrete Surface
- 8 inch **Mechanical Concrete®** Base
- 2 inch AASHTO #57 Cover
- 1450 ***Mechanical Cement®*** Cylinders
- 300 40Ton Coal Trucks per Day

TDC Placement

TDC Filling w/ ASHTO # 57

Concrete Slab Placement

Finished Coal Haul Road

Laurita, Inc.
CORESCO Mon River
Barge Loading Facility
Morgantown, WV

Project Features

- 10” Reinforced Concrete Scale Approaches
- 8” Compacted Limestone Road Surface
- 9” Mechanical Concrete® Base
- 300 Coal Trucks Per Day

CORESCO Tire-Derived-Cylinder Placing

CORESCO TDC Placing and Filling

CORESCO Scale Approach

CORESCO Finished Stone Surface

Longview Power Plant Haul Road—Crafts Run Road

N. WV/SW PA Licensee
Laurita, Inc. ARTBA Member
July, August 2011Morgantown, WV

- 10 inch **Mechanical Concrete®** Base w/ 6” topping
- 10 inch Reinforced Concrete Surface 500feet
- 6 inch Asphalt Wearing Surface 400 feet
- 600 Coal and Refuse Trucks Per Day

Laying the base

Base w/ Geo-Grid Mesh

w/Reinforced Concrete surface

Base Course

Base Course

First Ohio Mechanical Concrete® Project

Liberty Tire Recycling

Monofill Industrial Roadway

Minerva, OH

November, 2011

Liberty Tire Road Under Construction

Liberty Road Completed In Use

Mechanical Concrete®

- **Economically and Sustainably offers an increase in aggregate load carrying capacity of ≥ 3x and**
- **Significantly reduces potential failures**
  - Pothole, Ruts, & Aggregate Friction Loss failures
  - Road intersections, Interfaces and Boundaries
  - Soft subgrade destabilization
  - Ditch line & Shoulder Drainage Erosion & collapse
- UTUBE Videos Available under “mechanical concrete”

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