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Chemical And Mechanical Evaluation Of C&D Waste As An Alternative Aggregate For Road Embankments

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2011 TRB Waste Management & Resource Efficiency Workshop
"Sustainability and Liability in Transportation"

July 25th - 27th, 2011 in Portland, Oregon

Outline

- **Introduction**
- **Aim**
- **Experimental Tests**
 - Laboratory : chemical & mechanical
 - In Situ
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Introduction

- ❑ **Find non-conventional aggregates to:**
 - reduce the use of non-renewable sources
 - reduce waste materials and extension of landfills.
- ❑ **Suitable alternative aggregates for road construction:**
 - Environmental safe
 - Mechanically reliable
- ❑ **Support the re-use of local available materials**

Aim

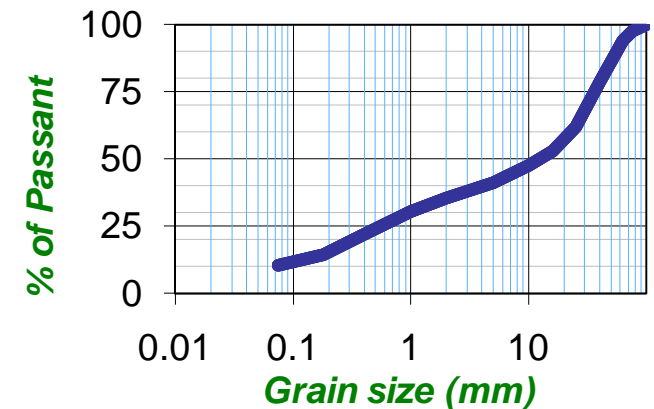
- ❑ **Evaluate the suitability of C&DW produced in Sardinia**
- ❑ **Determine chemical composition & mechanical behaviour**
- ❑ **Compare mechanical behaviour with natural aggregates**
- ❑ **Overcome the distrust for the use of C&D materials**

Experimental tests

- **Laboratory tests in accordance with EN 13242:2002+A1 on two different stockpiles of local C&D**
 - Chemical composition
 - Physical proprieties & Mechanical behaviour
- **Full scale mechanical tests on experimental embankments using C&D from one stockpile**
 - LFWD
 - Plate tests
 - Embedded Instruments

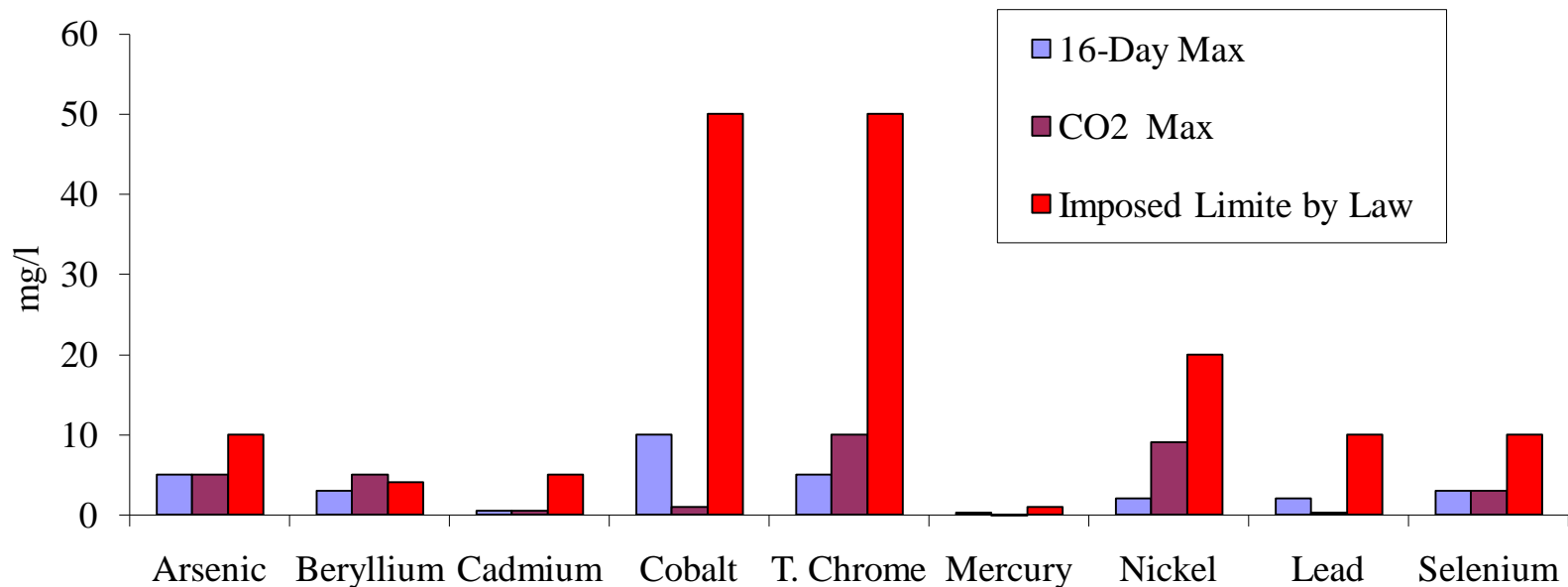
C&D material

- **C&D for laboratory tests from stockpile 1 & 2**
 - Composition: concrete, bricks, ceramic, and light residual materials
 - Reconstructed curve: 0/100 mm
- **C&D for experimental embankment stockpile 1**
 - Size: 0-100 mm



Chemical composition

- Leaching tests on 5 samples from two stockpiles :
 - 16-Day
 - Carbon dioxide saturated water (6h)



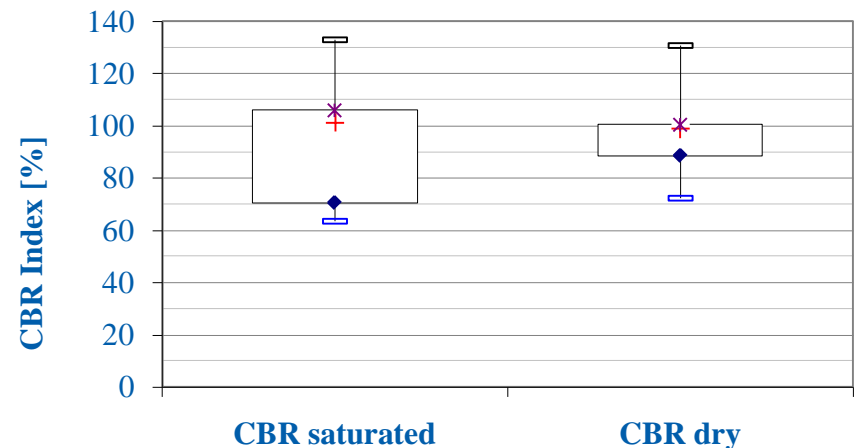
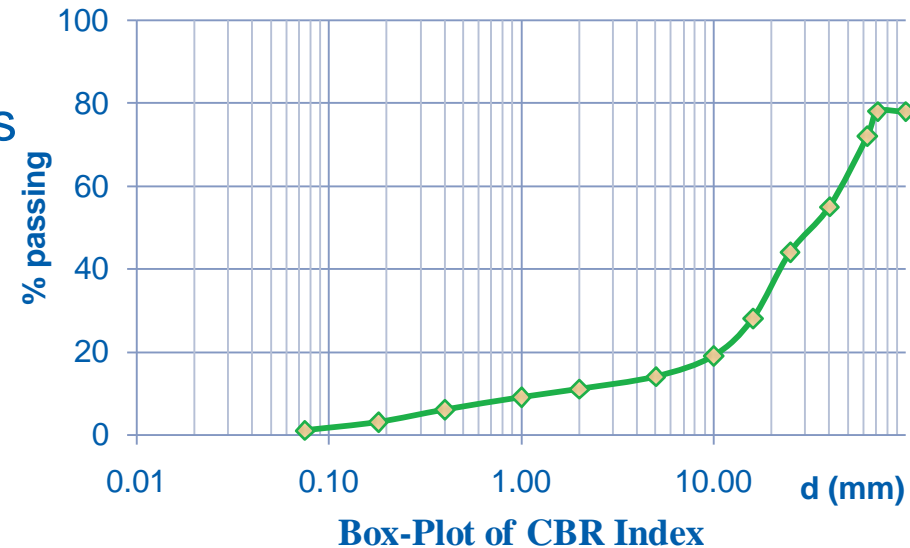
Physical & Mechanical Lab Tests

Physical

- 20 Sieve analysis: heterogeneous
- 4 Plasticity Index: NP
- Maximum density: $\sim 19,58 \text{ kN/m}^3$
- Optimum water content: $\sim 9\%$

Mechanical

- 20 CBR tests: $60 \div 130\%$
- 20 L.A. tests: $36 \div 46\%$



In Situ Tests

□ Embankments with C&D and Quarry Aggregates to compare:

- In situ density
- Bearing capacity
 - Plate test
 - LFWD



□ Instrumented embankment to measure material response under real load:

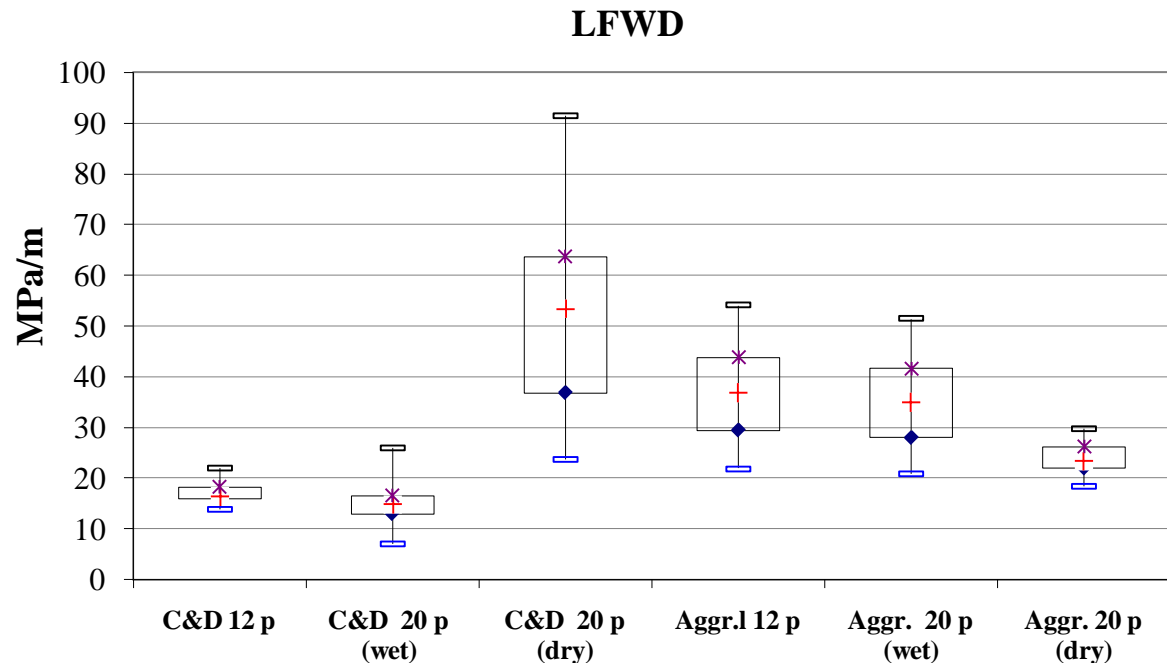
- Instruments: Pressure cells and LVDTs
- Applied Load: Moving truck with 4-axle
 - Full and Empty @4 speeds
 - LFWD, Plate test & Density



Results

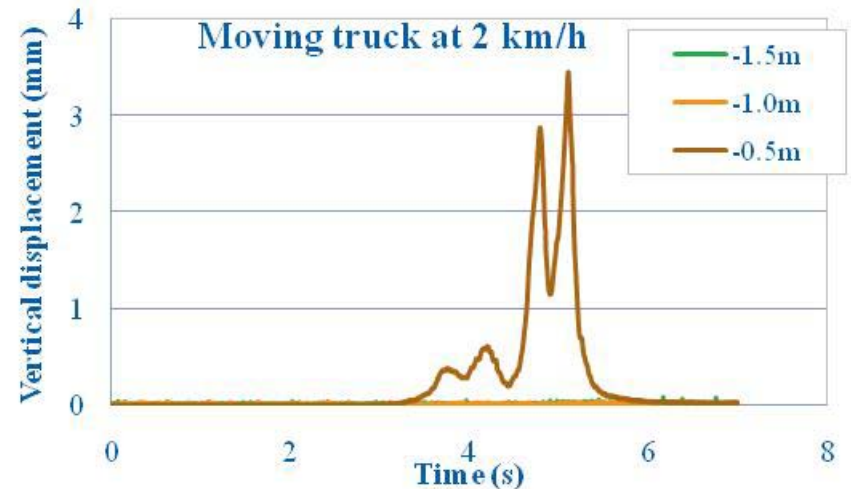
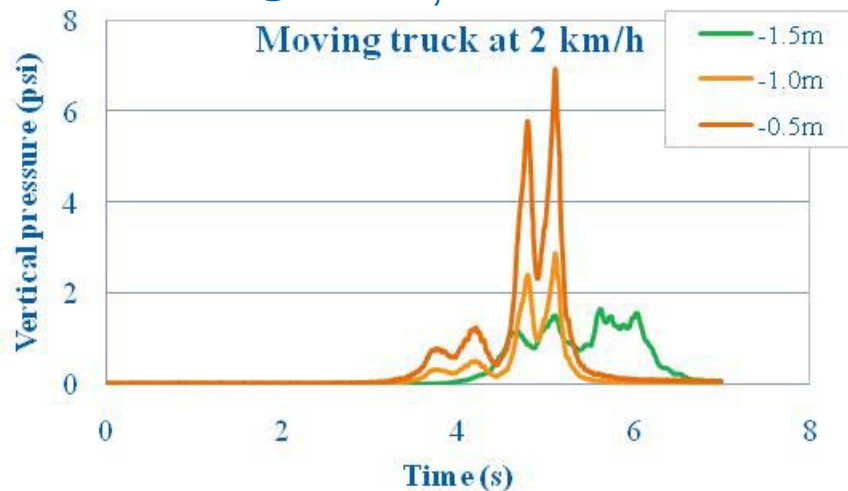
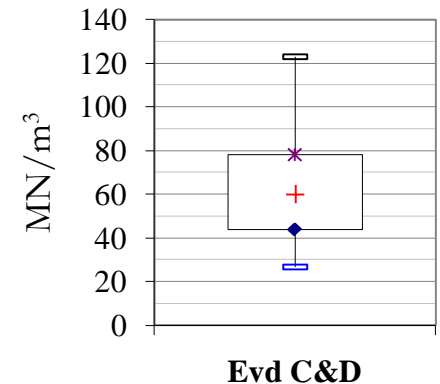
LFWD on C&D and Natural Aggregates:

- 12 passes @75% max density
- 20 passes @94% max density



Results

- ❑ Plate Load Tests: $83 \pm 169 \text{ N/mm}^2$
- ❑ LFWD
- ❑ Stress & strain distribution through 1.5m under moving load
 - Vertical pressure @ -1.5m, -1m & -0.5m
 - Vertical, Longitudinal and Transversal displacement @ -1.5m, -1m & -0.5m



Conclusion & Further Studies

- ❑ **Need to find alternative aggregates**
- ❑ **C&D are environmentally safe**
- ❑ **Good CBR Index**
- ❑ **In situ behavior, evaluated with Plate test & LFWD**
- ❑ **Instrumented embankment**