Recycled Concrete Aggregate in Unbound Base Construction

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Recycled Concrete Aggregate

- What is RCA and Why Use it?
  - Concrete that is no longer needed
    - Crushed to size
    - Contaminates removed
    - Meets normal aggregate specifications
    - Aggregate properties do not change
      - Good aggregates remain good aggregates
  - Meets Engineering, Economic and Environmental Parameters

What is RCA and Why use it?

- Engineering Perspective
  - Equal or better performance than virgin
  - Angularity and unhydrated cement contribute to strength increase
  - AASHTO Specification Since 2002
    - M 319 – Reclaimed Concrete Aggregate for Unbound Soil-Aggregate Base Course
What is RCA and Why use it?

- Economic Perspective
  - Cost savings possible
    - $2.00 to $4.00 per ton savings reported
    - Contingent upon normal market forces
  - More readily available than virgin in some markets

- Environmental Perspective
  - Reduces waste
    - Landfill
    - Waste pits
    - Bury on site
  - Potential energy savings
  - Reduced transportation costs
    - Can be crushed on site

How is RCA Made

- Concrete obtained from demolition of:
  - Known Sources
    - Structures and pavements “on site”
    - Concrete elements from other projects
  - Unknown Sources
    - Commercial sources – actual origin may not be known

- Stockpiled on site
  - Mobile crusher brought to project
- Central crushing facility
  - Demolition debris carried to central site
- Main difference from virgin aggregate
  - Removal of contaminants
    - Wood & Brick
    - Ferrous materials (reinforcing)
    - Soil
How is RCA Made

- Manual or Mechanical pre-separation
- Primary Screening to remove soil
- Primary Crushing
- Magnetic Separation to remove steel
- Additional Crushing, Screening
- Additional Manual or Mechanical Contaminant Removal
- Washing (if required) and Final Sizing

State Practices

- Survey to State Materials Engineers
  - September 2012
- 39 States and DC Responded
- Simple Survey
  - Do you allow RCA?
  - Limitations?
  - Estimated Tonnage
  - Environmental Issues?
  - Link to Specifications

State Practices

- 33 States Allow RCA as Base
- 7 Do Not Allow
  - Two of those considering allowing
  - One other would allow “if requested”
  - One other allowing on one project

Recycled Concrete Aggregate Base Use

Allows RCA
Does Not Allow
No Response
State Practices

- Considerable Variation across States
  - Same as Virgin Aggregates
  - 50% Blend
  - Known Source Only
  - Not with Fabric Wrapped Subdrains
  - Prequalification Requirements
  - Some Testing Variations

State Practices

- Estimated Tonnage Varied Considerably
  - 1.8 Million Tons in Texas
  - One other in excess of one Million Tons
  - Several states in the 100 to 200 Thousand Tons Range
  - Several States with only Token Tonnage

State Practices

- Most States Had No Environmental Issues

Environmental Issues Listed
  - Leachates
  - Freeze-thaw
  - Corrosion of zinc coated and aluminum pipe (pH)
  - Precipitates
  - Asbestos & lead

Areas of Concern

- Leachates
  - Corrosion of metal pipe & vegetation damage
  - Addressed in AASHTO M 319
    - Not use in low, wet areas
  - Precipitates clogging filter fabrics
    - RMRC developed recommendations to limit and testing protocol
    - One state blends with virgin to address
**Areas of Concern**

- **Hazardous Materials**
  - Asbestos & lead from commercial sources
  - Require Supplier certification
  - State DEPs have range of requirements
    - One legislature exempted RCA from permitting
    - One state developed a compliance agreement for RCA
    - One state exempted from solid waste regulation for on site use

- **Gradation and Allowable Contaminants**
  - Gradation varies by state
  - Most allow 5% brick & 5% asphalt pavement
  - AASHTO M 319 gives Performance Criteria
    - CBR testing
    - Resilient Modulus testing
    - Field validation (test strips) or historical data

**Areas of Concern**

- **ASR**
  - Not an issue

- **Sulfate Attack**
  - Could be an issue with some aggregates
  - Local experience valuable
  - If an issue, test soils and surface water that may contact RCA in place

**Availability and Economics**

- Estimated 140 Million Tons produced annually in USA
- Market forces could increase this amount
- New Aggregate Sources costly and time consuming to open
- Some areas do not have quality virgin aggregates available
Availability and Economics

- Cost savings of $2.00 to $4.00 per ton estimated from several states.
- Savings of up to $6.00 per ton experienced in areas with limited supply of virgin aggregates
  - Most states do not differentiate in bids, so actual cost savings difficult to document

Pathway to Expanding Use of RCA

- Uniform Application of Specifications
  - Varies between states
  - AASHTO M 319 only referenced by one state
- Uniform Environmental Requirements
  - Uniformity would help industry that does business across state lines – and help reduce cost

Pathway to Expanding Use of RCA

- Technology Transfer Between States
  - Significant research completed by states
  - Similar research producing similar results by states increases costs and delays acceptance
- Advance and Improve Existing Specifications
  - Means to address remaining concerns
  - Establish ETG?

Pathway to Expanding Use of RCA

- Identify “Champions” to Communicate Facts about RCA
- Provide Brochure or Fact Sheet for Specifiers
Summary

- Significant Research in last 10 Years
- RCA shown to meet engineering requirements as a base material
- Most states conclude that RCA is an environmentally acceptable choice
- Many states realize economic benefits by using RCA
- National Standard in place since 2002

(Summary from 2004 FHWA State of the Practice National Review)

Challenge

- Review & Support Research
- Communicate!!
  - Understand and Address Barriers
- Build on Existing Experience
- Encourage Use of AASHTO M 319

(Summary from 2004 FHWA State of the Practice National Review)
Resources

• Construction & Demolition Recycling Association
• TRB
• Industrial Resources Council
• FHWA
• Recycled Materials Resource Center
• State DOT Research

Thank You