Emerging Trends in Concrete Construction

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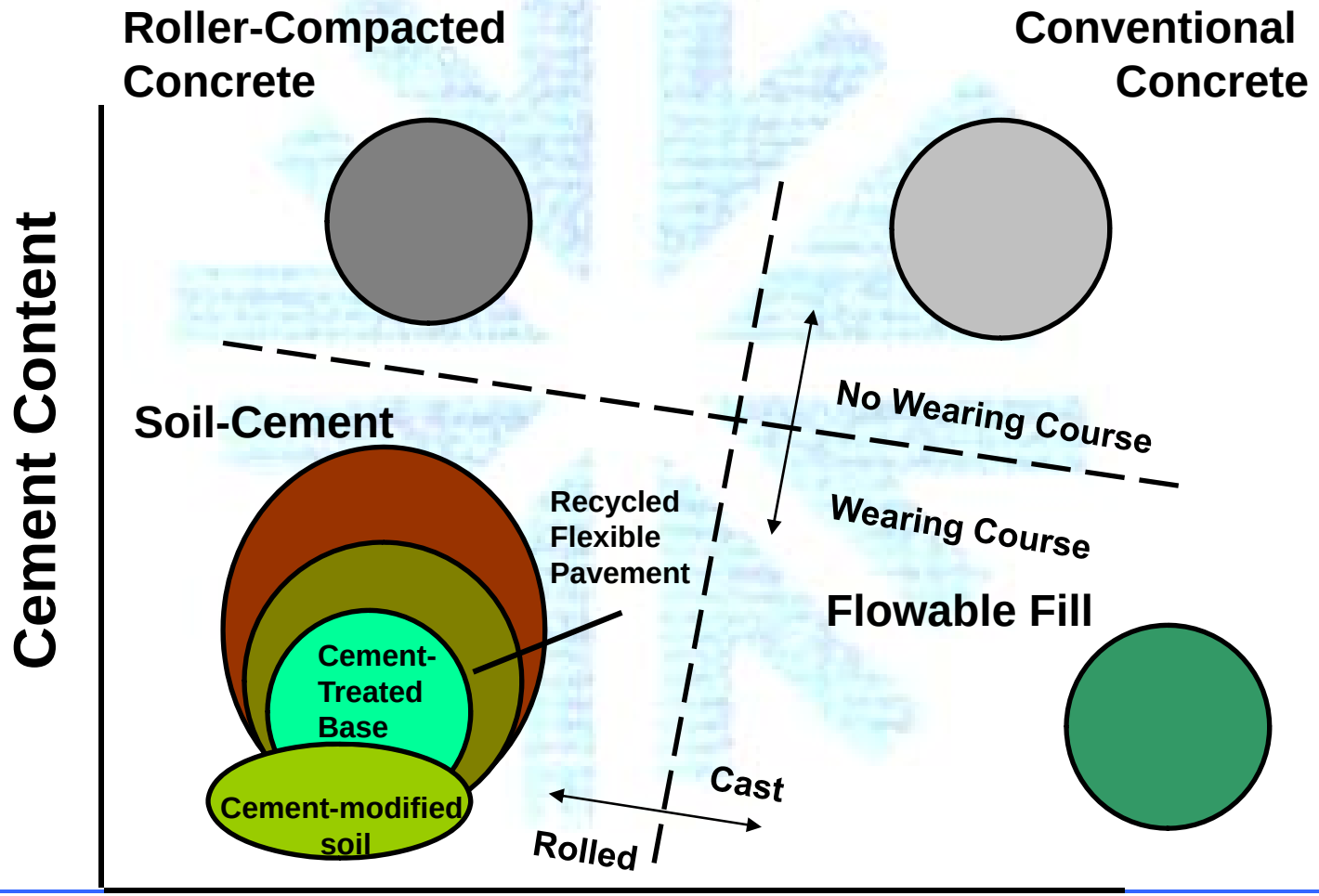
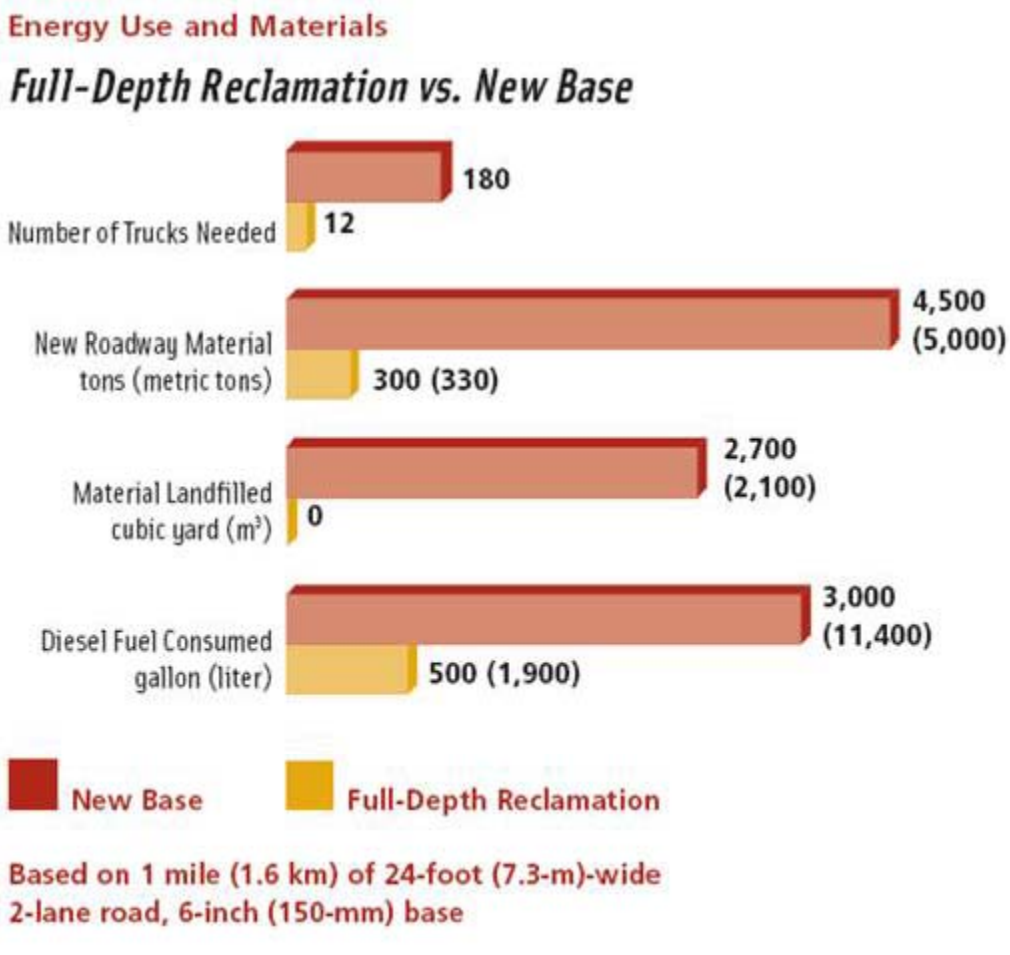
Cement-Based Pavement Materials



Soil Cement/FDR *(Full Depth Reclamation)*

- **Now more economical**
- **Environmentally friendly**
- **Increased use in the Northeast and in New Jersey**



6-Step Process

1. Pulverize the old road or existing subgrade

2. Initial shaping and grading

6-Step Process

3. Spread the cement

4. Mixing water & cement into the aggregate-soil mixture

6-Step Process

5. Compaction

6. Curing – water or asphalt primer

Roller-Compacted Concrete Pavements

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Definition

"Roller-Compacted Concrete (RCC) is a no-slump concrete that is compacted by vibratory rollers."

- Zero slump (consistency of damp gravel)
- No forms
- No reinforcing steel
- No finishing
- Consolidated with vibratory rollers

Concrete pavement placed in a different way!

Why Use RCC?

- Low cost
- Easy preparation
- High-volume production
- Minimal labor
- High strength and durability
- Proven performance

Benefits of RCC

- Economical
- High load carrying ability
- Eliminates rutting and spans weak subgrades
- Excellent freeze-thaw durability
- Simple, fast construction
- No forms or finishing
- Light surface reduces lighting requirements

Off-Highway Applications

- Parking Lots
- Storage/Lay down areas
- Truck terminals and distribution centers
- Haul roads
- Military applications
  - Tank hardstands
  - Maintenance yards
- Intermodal shipping
- Airfield apron areas

Mercedes Benz
Georgia

Honda
Alabama

Streets and Highways

- Industrial access roads
- Residential streets
- Highway inlays
- Fast-track, high-volume intersections
- Shoulders and turn lanes

Industrial Drive

Tennessee DOT

secondary roads

subdivision streets

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Engineering Properties

- Compressive strength
  - 4,000 to 10,000 psi
- Flexure strength
  - 500 to 1,000 psi
  - $f_r = C(f'_c)^{1/2}$
- Modulus of Elasticity
  - 3,000,000 to 5,500,000 psi
  - $E = C_E(f'_c)^{1/2}$

Mixture Design

Conventional concrete mixture procedures are not appropriate!

- Not air-entrained
- Retarders or water reducers can be used to increase working time
- Lower water content
- Lower paste content
- Larger fine aggregate content
- Nominal maximum size aggregate 3/4" or 5/8"

Important!

- Dry enough to support a vibratory roller
- Wet enough to permit adequate distribution of paste

Aggregate Selection

- Highway base course, asphalt, or concrete aggregates can be used.
- 3/4" or 5/8" NMSA
  - For smooth surface, lower segregation
- Higher fine aggregate content than conventional concrete mixes
  - For adequate stability under vibratory roller
- 2% to 8% passing #200 sieve
  - Provides paste to fill voids and maintain tight surface

Basic Construction Sequence

- Produced in a pug mill or central batch plant
- Transported by dump trucks
- Placed with an asphalt paver
- Compacted by vibratory and pneumatic-tired rollers
- Cured with water or curing compound

Continuous Pug Mill

- High-volume applications
- Excellent mixing efficiency for dry materials
- 250 to 500+ tons/hr
- Mobile, erected on site
- Higher mobilization costs

Central Concrete Batch Plant

- Highly accurate proportioning
- Local availability
- Smaller output capacity
- Longer mix times than conventional concrete
- Frequent cleaning
- Dedicated production

Dry Concrete Batch Plant

- Highest local availability
- 2-step process
  - Feed into transit mixers
  - Discharge into dumps
- Very slow production
- Frequent cleaning
- Segregation
- Least desirable method

Transporting

- Rear dump trucks normally used
- Minimize transport time
- Covers required for long hauls, or hot/windy conditions

Preparation for Placement

- Simple preparation: no dowels, reinforcing, or forms
- RCC ideal for wide-open, unimpeded placement runs
- Block off fixtures
- Ensure subbase is smooth and at specified grades
- Set up stringlines
- Moisten subbase prior to RCC placement

Placing

- Layer thickness
  - 4 inches minimum
  - 8 inches maximum
  - 10 inches with some heavy-duty pavers
- Timing sequence
  - Adjacent lanes placed within 60 minutes for "fresh joint"
  - Multiple lifts placed within 60 minutes for proper bonding
- Production should match paver capacity
  - Continuous forward motion for best smoothness

Placing Equipment

- High density ABG pavers
  - Vibrating screed
  - Dual tamping bars
  - High initial density (90% to 95%)
  - Reduces subsequent compaction
  - High-volume placement (1000 - 2000 tons/shift)
  - Designed for harsh mixes
  - Smoothest RCC surface

Placing Equipment

- Conventional Asphalt Pavers
  - Provides some initial density (80%-85%)
  - Relatively smooth surface
  - May require modification
  - Increased cleaning and maintenance

Compaction

- Proper compaction is critical for strength and durability
- Compact to 98% of Modified Proctor
- Vibratory roller
- Non-vibratory steel wheel roller
- Rubber-tire roller

Curing

- Extremely important; ensures surface durability
- Low moisture in RCC
- Three methods:
  - Moist cure
  - Concrete curing compound
  - Asphalt emulsion

Saw-Cut Joints vs. Natural Cracks

- More aesthetically pleasing
- Soff-Cut very effective, shortly following placement
- Need to saw within 12 hours to avoid uncontrolled cracking

- 30 to 80 ft spacing
- Often first cracks appear within 24 hours
- Narrow crack widths
- Seal if > 1/8 inch
- Best load transfer
- Minimal raveling

Surfacing

- Paver-placed RCC needs no surface for durability
- Adequate for low-speed traffic
- High-density ABG pavers can provide smoothness for medium-speed traffic
- Thin asphalt surface (1-1/2 to 3 inches)
  - Improves surface for high-speed traffic
  - Placed immediately or any time thereafter

Surface Smoothness

- Unsurfaced RCC can be built for low to medium speed traffic
- High density paver achieves good ride quality
- Joints/cracks do not affect ride quality appreciably

Questions???

Concrete home survives Hurricane Ike at Gilchrist, Texas

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