Modified Rubblization for Urban Concrete Pavement Rehabilitation in Fort Worth

Presented by:

Marwan Hafez, PhD, PE, PMP

Sr Professional Engineer

Transportation & Public Works Department

City of Fort Worth

26th Annual Public Works Roundup
September 4th, 2025

Agenda

- Background on concrete pavements
- Challenges in urban areas
- Cost comparisons
- Introduction to rubblization
- Fort Worth pilot study
- Regional recommendations

Background – National Context

- 2.8 million miles of U.S. paved roads
- 7% of U.S. paved roads are concrete (~200,000 miles)
- Higher concentration in urban areas and major corridors
- Typically stronger & more durable than asphalt pavement
- Heavy-duty applications: Arterials and Collectors

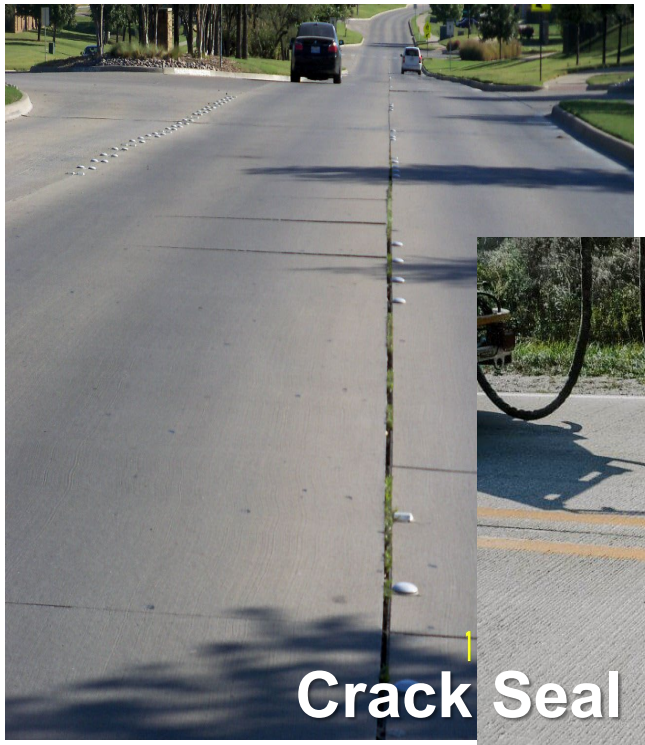
Sources: FHWA & BTS, 2023

Challenges for Urban and Suburban

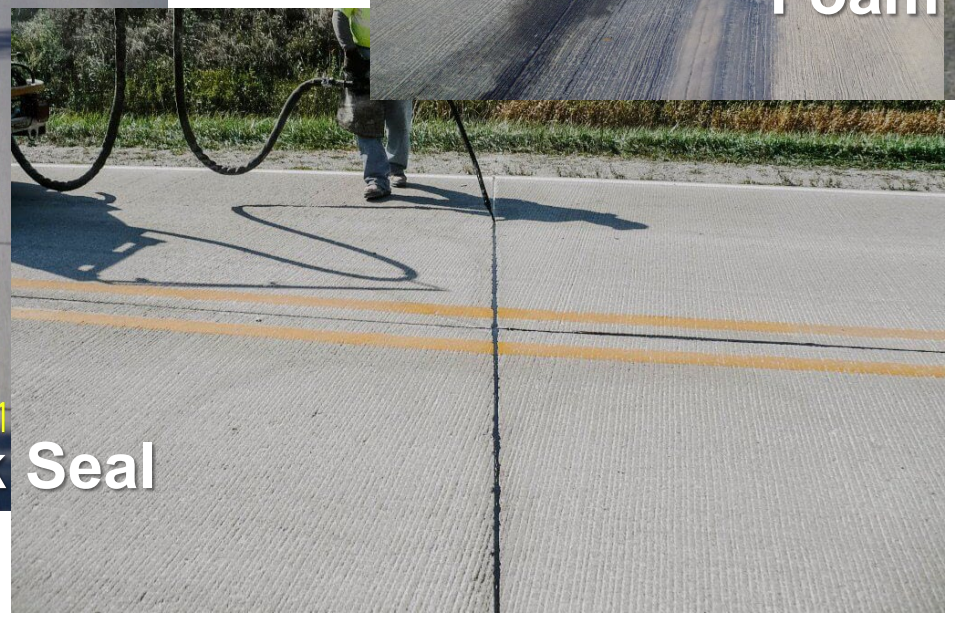
- Many streets were built in the 1950s
- Aging infrastructure
- Budget limitations
- Degradation includes
  - spalling, joint failure, base erosion
- Temporary repair
  - Individual concrete panel replacement
- High cost of full-depth reconstruction (materials, traffic control, time)

Concrete Maintenance

- Preventive



Crack Seal



Foam Injection

Concrete Maintenance

- Corrective

Concrete Restoration
Panel Replacement

Full Reconstruction

Asphalt Overlay Vs. Concrete Recon

Asphalt Overlay

$24 ~ $40/Square Yard

Reconstruction

$240 ~ $312/Square Yard

Asphalt Overlay Reflective Cracking

- Overlaying HMA on jointed PCC often leads to reflective cracking at joints and cracks.
- Reflective cracks reduce overlay life and increase maintenance costs.
- Mitigation methods (interlayers, CAMs) exist but add cost and complexity.

What is Concrete Rubblization?

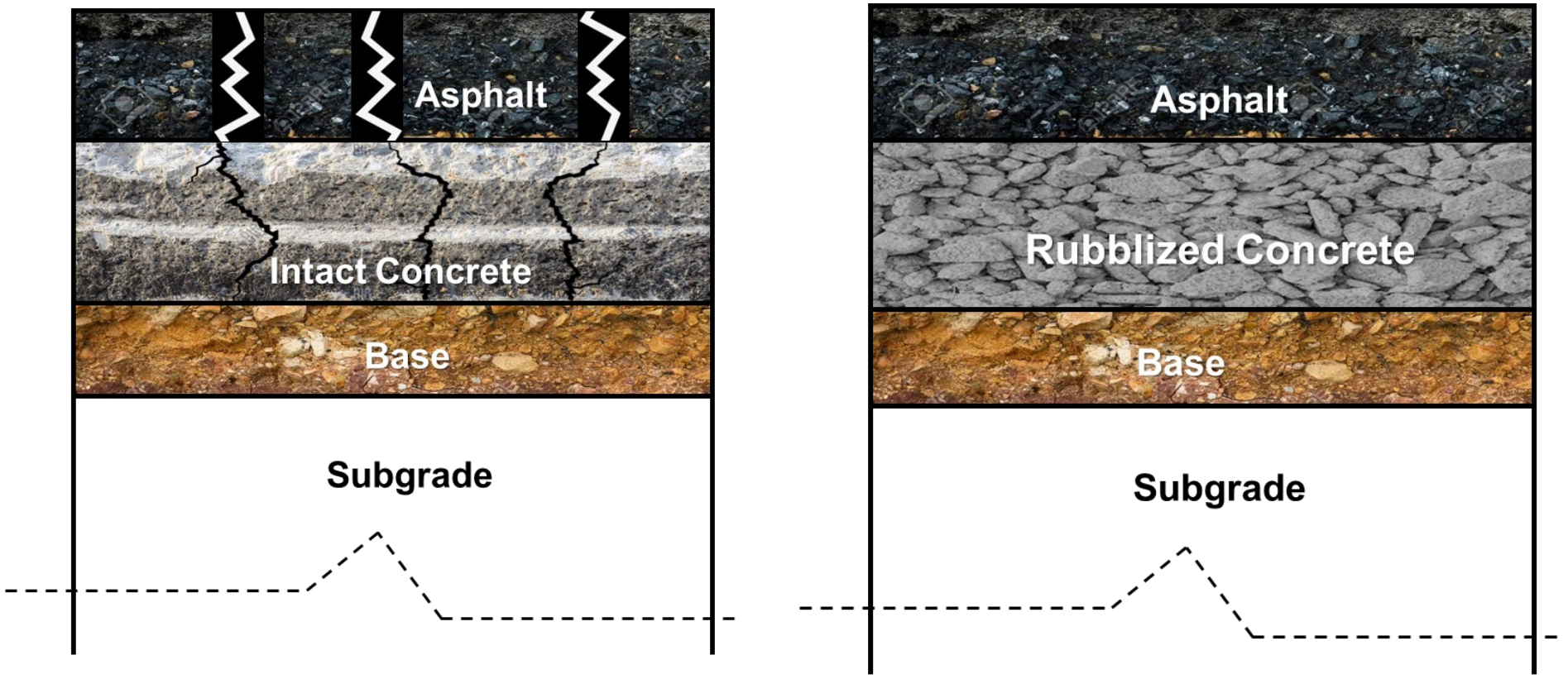
Source: www.antigoconstruction.com

- A rehabilitation alternative for concrete pavement
- In-place recycling: fracturing old PCC into an interlocked base and overlaying with asphalt.
- Controllable slab break, isolates reinforcing steel, and minimizes future reflective cracking.
- Cost-effective, faster, and more sustainable.

Benefits of Rubblization

Eliminates reflective cracking

Traditional vs. Rubblized



Concrete Rubblization Specification

Special Specification 3038
Rubblizing Existing Concrete Pavement

Texas Department of Transportation

1. DESCRIPTION

Rubblize and compact existing concrete pavement.

2. MATERIALS

2.1. **Aggregate.** Furnish aggregate of the type and grade shown on the plans and conforming to the requirements of Item 247, "Flexible Base."

2.2. **Hot-Mix Asphalt.** Furnish dense-graded hot-mix asphalt of the type shown on the plans and conforming to the Item number 340 "Dense-Graded Hot-Mix Asphalt (Method)". (Note: This is patching materials for failed areas, not HMA overlay).

3. EQUIPMENT

Provide either a Type I or Type II rubblizer, unless otherwise shown on the plans, and necessary rollers for compacting the rubblized pavement.

3.1. **Type I Rubblizer.** A self-contained, self-propelled, resonant frequency breaker, capable of producing low-amplitude, 2,000 lb blows, at a rate not less than 44 Hz.

3.2. **Type II Rubblizer.** A self-contained, self-propelled, multiple-head breaker, with each hammer independently adjustable, and capable of rubblizing a width of up to 13 ft. in one pass.

3.3. **Roller-Vibratory.** Drum (Type C), with a static weight ≥ 10 tons, meeting the requirements of Item 210, "Rolling."

3.4. **Roller-Medium Pneumatic.** Conforming to the requirements of Item 210, "Rolling."

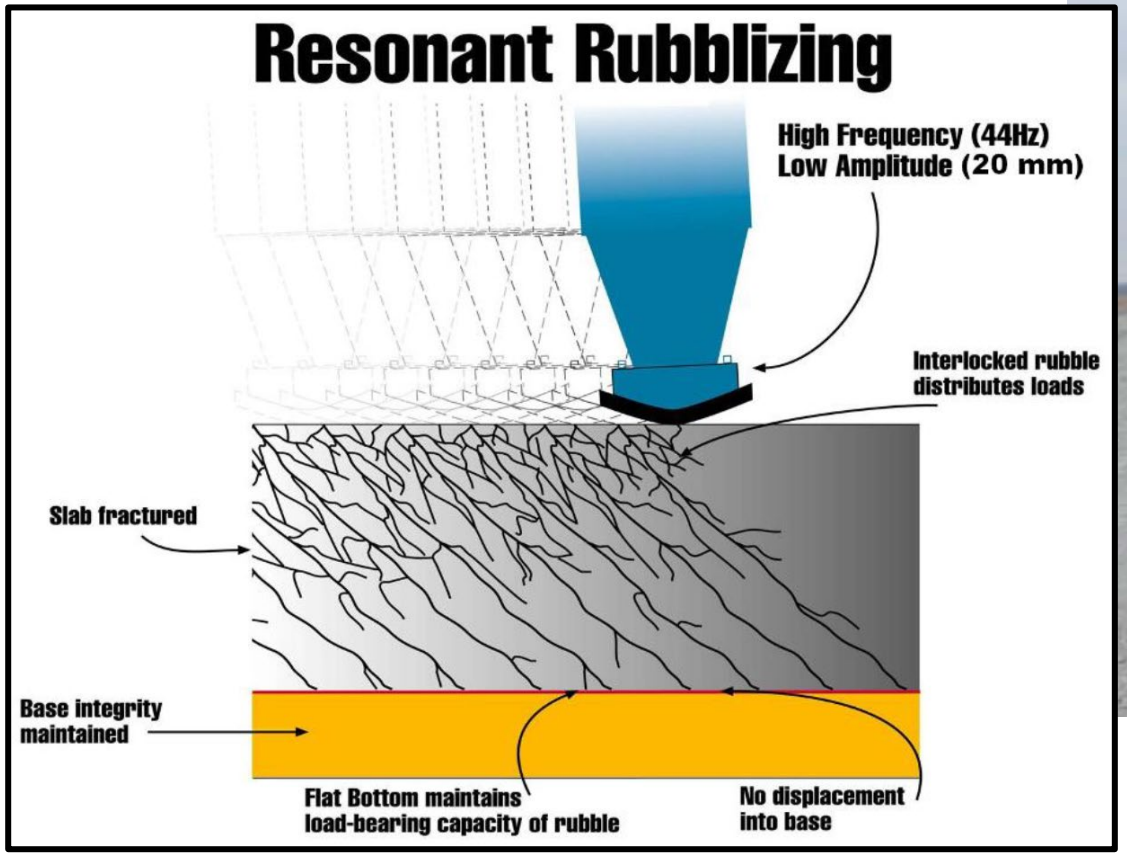
3.5. **Roller-Heavy Pneumatic.** Conforming to the requirements of Item 210, "Rolling."

3.6. **Roller-Z Grid Vibratory.** When rubblizing with Type II equipment, provide a steel wheel, self-propelled vibratory roller, with a minimum weight of 10 tons, and a Z-pattern cladding bolted transversely to the surface of the drum.

3.7. **Concrete Saw.** When rubblization is required adjacent to concrete pavement to be retained, provide a concrete saw capable of sawing a vertical cut full depth through the concrete pavement and reinforcing steel in a single pass.

Concrete Rubblization Techniques

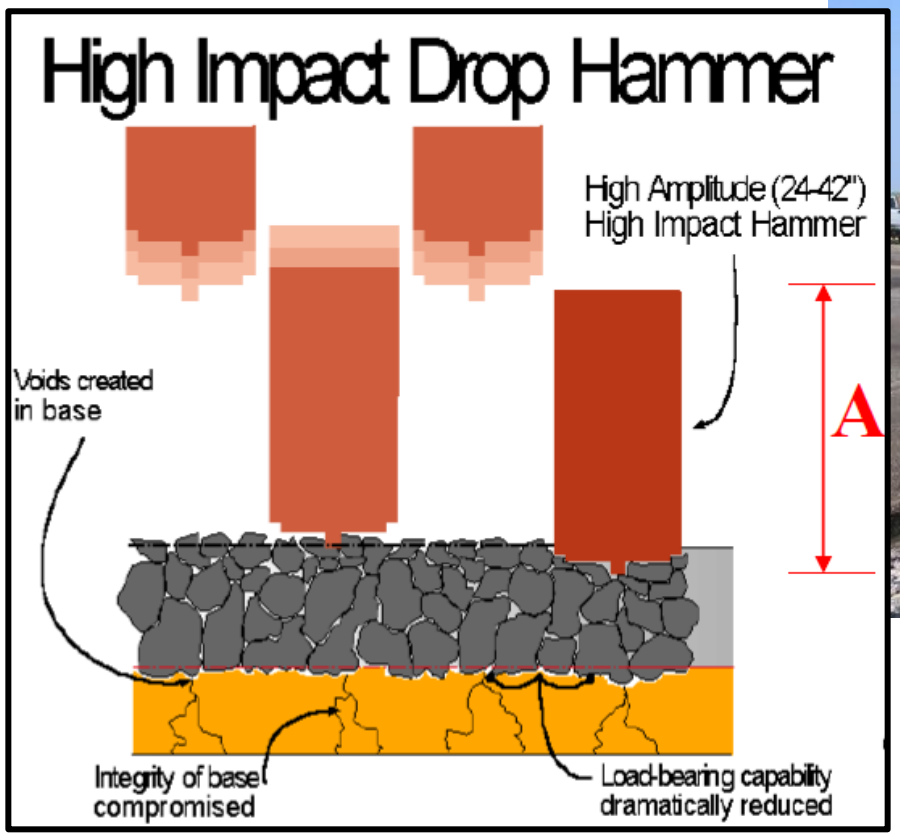
- Type 1 – Resonant Pavement Breaker



Source: Texas A&M Institute

Concrete Rubblization Techniques

- Type 2 – Multiple-Head Breaker



Source: Texas A&M Institute

Full Rubblization

- The concrete pavement is completely broken down into very small, gravel-sized fragments (typically 1–3 inches on top and smaller at the bottom).
- Eliminate slab action entirely so the old concrete behaves like a flexible base layer.
- The existing joints and cracks are fully destroyed, preventing reflective cracking when a new asphalt overlay is placed.

"Full Rubblization "

Modified Rubblization

- The concrete pavement is broken down into larger pieces (often 9–12 inches or so), not fully fractured into small gravel.
- Reduce slab action but still leave somewhat larger interlocked pieces for additional load-carrying capacity.
- Typically used when subgrade is weaker, or where full rubblization may cause too much loss of support.

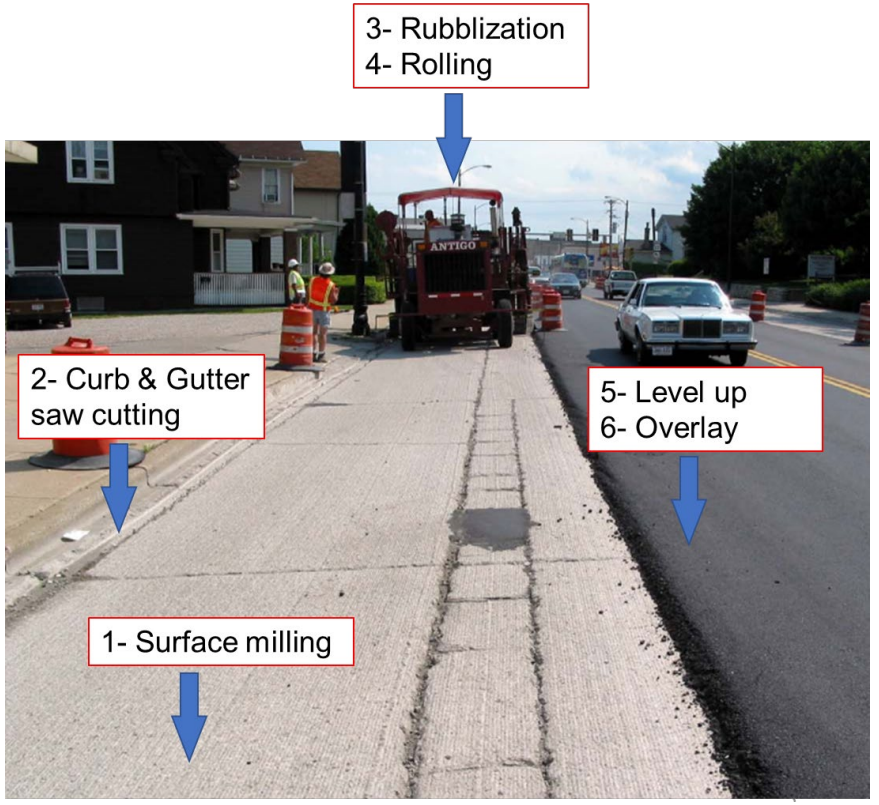
Modified Rubblization Pilot Project in Fort Worth

Why Concrete Rubblization?

- The City has almost **14.2 lane miles** of concrete arterial and collectors in need of Reconstruction
- This is a total cost of almost **$27.6 million**
- With rubblization, this can be done for **$8 million**, saving the City **$20 million** while repairing very important arterials.
- Arterials of concern
  - Trinity Blvd
  - Northern Cross Blvd
  - Tension Dr
  - Hulen Bend Blvd
  - E Long Ave

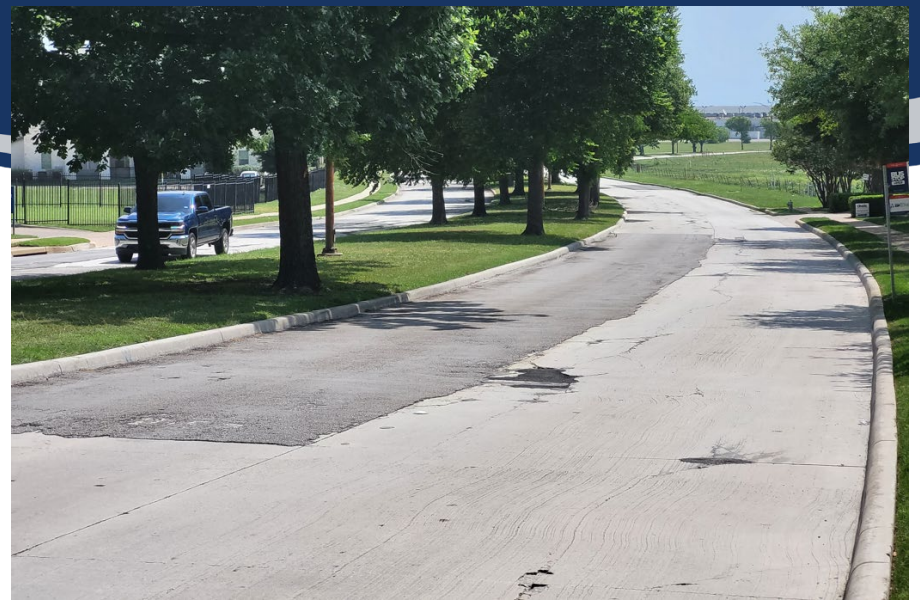
Rubblization in Urban vs. Rural Env.

- Maintaining existing grades of gutter lines
- Protecting curbs and gutter
- Protecting utilities
- Limited leveling/overlay thicknesses
- Drainage control



The Pilot Project

- The City executed a modified rubblization pilot on Northern Cross Blvd (≈1.54 lane miles).
- Objective: test cost savings, constructability, and performance on a city street with mixed traffic.
- Reported benefits: significant cost savings vs full reconstruction, shorter closure time, successful overlay placement.






Pre-Construction Condition

The Process – Northern Cross Blvd

- Remove/mill existing overlay

The Process – Northern Cross Blvd

- Sawcut curbs and gutters
- Sawcut around manhole

The Process – Northern Cross Blvd

- Rubblize concrete pavement

The Process – Northern Cross Blvd

- Roll rubblized concrete

The Process – Northern Cross Blvd

- Remove exposed rebars

The Process – Northern Cross Blvd

- Apply coat
- Place HMA leveling course & overlay

Post-Construction Condition

Achieved Benefits

- Total Cost = $400,000
- Reconstruction Cost Estimate = $2.8 million
- Cost Saving = 85%
- Serviceability restoration time = 3 weeks
- Projected service life = 10-15 years

Takeaway Notes for Rubblization

- ✓ Rubblization is a rehabilitation alternative to restore service life on concrete
- ✓ Rubblization is environmentally friendly, cost-effective, and fast process
- ✓ Ideal candidates: pavements with minimum subgrade issues
- ✓ Rubblization will not eliminate poor subgrade problems
- ✓ Use additional leveling overlay for smoother finish
- ✓ Adjust rubblization size based on subgrade conditions
- ✓ Maintain drainage ability of the fractured surface
- ✓ Sawcut full depth to isolate connecting assets
- ✓ Apply tack coat thoroughly to seal all voids
- ✓ Avoid driving on rubblized surface; exposed rebars may cause tire damage

Questions

Contacts:

Marwan Hafez, PhD, PE, PMP
TPW, City of Fort Worth
817-392-7968
Marwan.Hafez@fortworthtexas.gov