Tack Coat Best Practices

FHWA Cooperative Agreement Subtask

Tack? Who needs Tack?

Or Rollers?

OK – here's a little tack for you!

OK, OK, we'll use the distributor

OK, OK, we'll use the spray bar

You want tack – we'll give you tack

asphalt institute

Tack Coat Best Practices Outline

- **Terminology**
- **Purpose of Tack Coats**
- **Consequences of Poor Bond**
- **Relative Cost for Tack Coat**
- Tack Coat Difficulties
  - Contractor
  - Agency
- Materials
  - Traditional
  - New Materials
  - Selection

Tack Coat Best Practices Outline

- **Handling and Storage of Tack**
- **Tack Coat Field Operations**
  - **Manuals of Practice**
  - **Research / Bond Strength Testing**
  - **Best Practices**
    - **Surface Preparation**
    - **Truck Setup**
- Tack Coat Application Calculations
- Spray Pavers
- Review and Summary
  - Common Tack Coat Questions
  - Areas of Known Agreement

Consequences of Poor Bond

- Layer independence
  - Reduced fatigue life
  - Increased rutting
  - Slippage
  - Shoving
- Compaction difficulty
- Typically limited to local areas of high stress
  - Braking areas
  - Curves

Days later!

Courtesy of Road Science

Purpose of Tack Coats

- **To promote the bond between old and new pavement layers.**
  - To prevent slippage between pavement layers.
  - Vital for structural performance of the pavement.
  - All layers working together.
  - To be applied along all transverse and longitudinal vertical surfaces.

Bonded Demonstration

- Mini Michael Jackson- ~60 lbs
- 11 sheets of plywood:

  48” x 8” x 11/32” each
- Measure deflection over 36” span
- Compare effect of full-slip versus fully bonded plywood sheets

Courtesy of Wayne Felix

Bonded Demonstration

21 Fold Difference

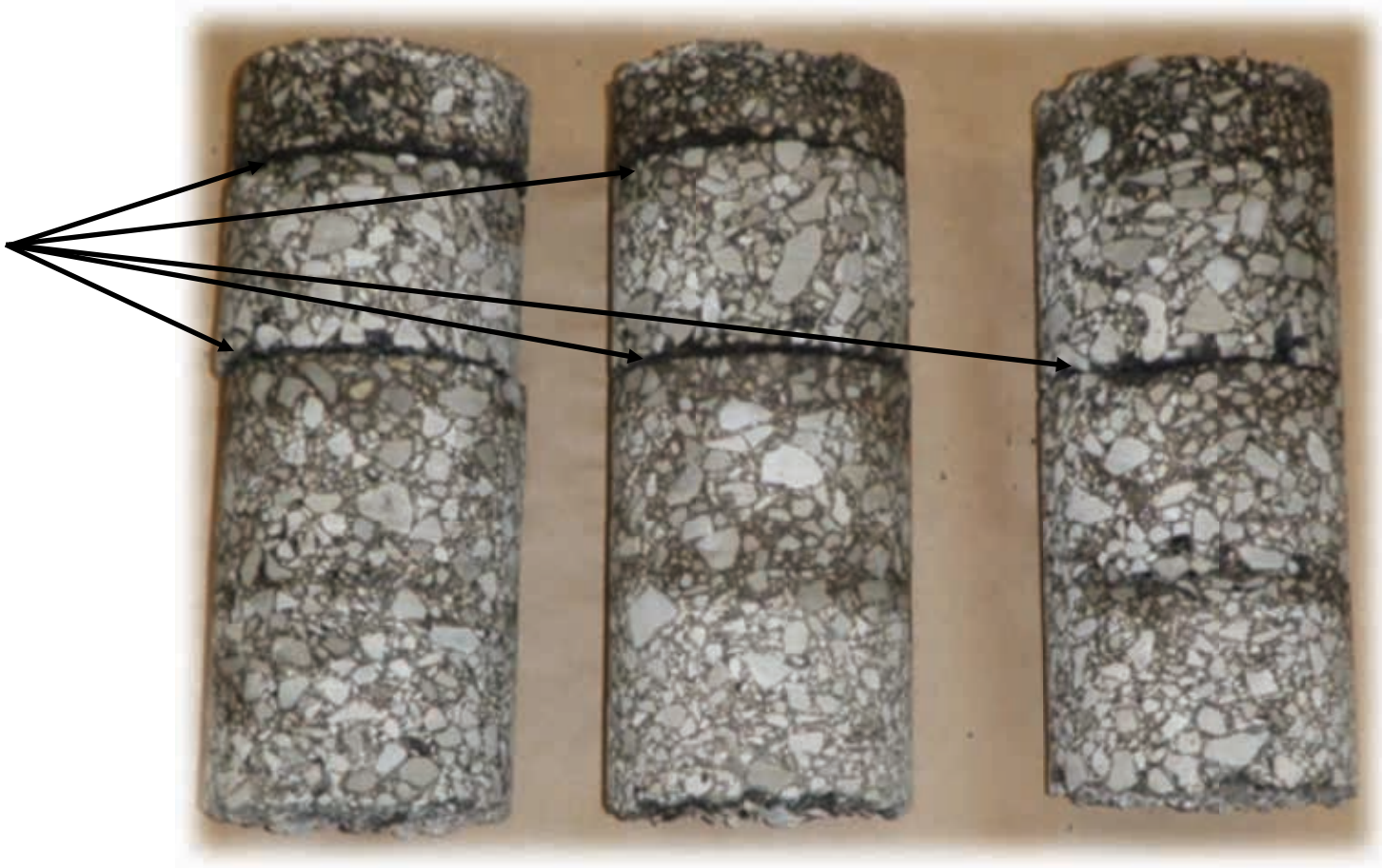
Loss of Fatigue Life Examples

- May and King:
  - 10% bond loss = 50% less fatigue life
- Roffe and Chaignon
  - No bond = 60% loss of life
- Brown and Brunton
  - No Bond = 75% loss of life
  - 30% bond loss = 70% loss of life

8 – 10 years (est.) Interstate Pavement

Cores Showing Debonding

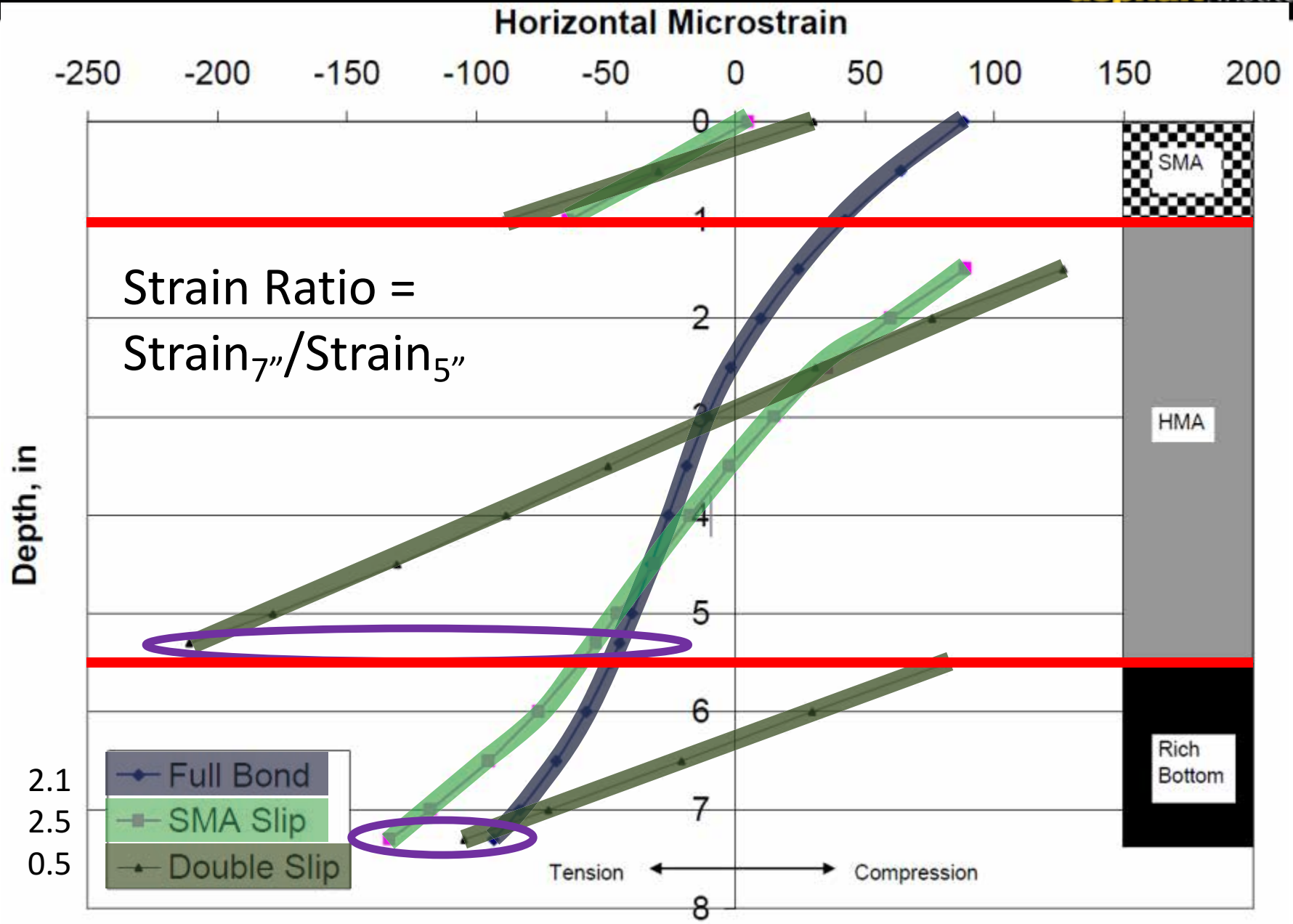
Bonding Failures



Debonding at the NCAT Test Track

National Center for Asphalt Technology
NCAT
at Auburn University

Strain Investigation



Common Tack Coat Materials

- Emulsified Asphalt
  - Most common option
    - SS-1, SS-1H
    - CSS-1, CSS-1H
    - RS-1, RS-1H, RS-2
    - CRS-1, CRS-2
    - PMAE
- PG Graded Binders
  - Neat Binders
    - PG 58-28
    - PG 64-22
    - PG 67-22
  - Polymer Modified
- Non-tracking Emulsions

Standard Emulsion Specifications

- Anionic Emulsion Specifications
  - AASHTO M 140-8
  - ASTM D 977-05

Pen Values 100–200 +				Pen Values 40 – 90	
RS–1	RS–2	HFRS–2		MS–2h	HFMS–2h
MS–1	MS–2	HFMS–1		SS–1h	QS–1h
HFMS–1	HFMS–2	HFMS–2S			
SS–1					

17 States Known to Allow Reduced Tracking Tack Materials

- Alabama
- Florida
- Georgia
- Illinois
- Louisiana
- Maryland
- Mississippi
- Pennsylvania
- New York
- North Carolina
- Ohio
- Oklahoma
- South Carolina
- Tennessee
- Virginia
- West Virginia
- Texas

Material Selection

- State approved products lists
  - Online at most DOT websites
  - Asphalt Institute State Emulsion Data Base
    - http://www.asphaltinstitute.org/public/engineering/state_binder_specs/emulsion-spec-database.dot
- Material availability
- Local experience
- Dynamic area

Tack Coat
Field Operations

Tack Coat Challenges

- Contractor
  - Application Rate
  - Consistency of Application
  - Tack Coat Pickup or Tracking By Vehicles
  - Traction for Construction Equipment
  - Breaking/Setting Time
- Agency
  - Acceptance
  - Dilution?
  - Application Measurement
  - Bond Quality
  - Tort Claims
  - Pulling Up of Pavement

Manuals of Practice

- Asphalt Institute
  - MS-4 *The Asphalt Manual, 7th Edition* (2007)
  - MS-16 *Asphalt Pavement Preservation and Maintenance, 4th Edition* (2009)
  - MS-19 *Basic Asphalt Emulsion Manual, 4th Edition* (2008)
  - MS-22 *Construction of Hot Mix Asphalt Pavements, 2nd Edition*
- Comments
  - AI has a long history of promoting the proper use of tack coats.

Manuals of Practice

- QIP-128,*Tack Coat Best Practices*, NAPA (2013)
- *Hot-Mix Asphalt Paving*, US Army Corp of Engineers (2000)
- *Airfield Asphalt Pavement Construction Best Practice Manual*, NCAT (2008)
- *Tack Coat Guidelines,* Caltrans (2009)
- *Tack Coats: How and what to apply!* Colorado Asphalt Pavement Association (CAPA) (2011)
- *Guide for Using Prime and Tack Coats, C*FLHD (2005)
- *Best Practices for Applying Undiluted Emulsified Asphalt Tack Coats,* CAPA (2013)

Current Research

- SHRP II
- Colorado
- Illinois
- Louisiana
- NCAT
- Texas
- Wisconsin
- International

NCHRP Report 712

- Looked at numerous test methods (shear, tension, torsion)
- Many tack materials
- Four application rates (gsy residual)
  - 0.00
  - 0.031
  - 0.062
  - 0.155
- International survey
- Variety of surfaces both AC and PCC
  - New
  - Old
  - Milled
  - Unmilled
  - Dry
  - Wet
  - Clean
  - Dirty
- Eight test temps.
  - -10—60°C

NCHRP Report 712 Conclusions

- Recommends Shear Testing
- Stiffer based asphalts performed better
- 0.155 gal/yd^2 (residual) best results for all materials
- Current common rates may be too light
- Milled surfaces performed better
- Very good training appendix
- Application rate recommendations for different surfaces

712 Recommended Application Rates

Surface Type	Residual Application Rate (gsy)
New Asphalt	0.035
Existing Asphalt	0.055
Milled Asphalt	0.055
Portland Cement Concrete	0.045

Testing Methods

- Materials
  - Emulsion
  - Paving grade asphalt
- Field/Laboratory Bond Testing
  - Shear Testing
  - Torsion Testing
  - Pull-Off Testing (tension)
  - Cyclic

Best Practices for getting the material on the road!

Best Practices

- Match application to conditions.
  - Materials
  - Residual rate
- Verify application rate.
- Resist tacking too far ahead of paver.

Distributor Truck Setup

Distributor Truck Setup

- Liquid temperature
  - Monitor and Match to material
- Calibrate distributor truck
  - Spray bar height
  - Spray bar pressure
  - Nozzle angle
  - Nozzle selection
  - Thermometers
  - Volumeter

Tack Coat Application

Application Calculations

Student Exercises

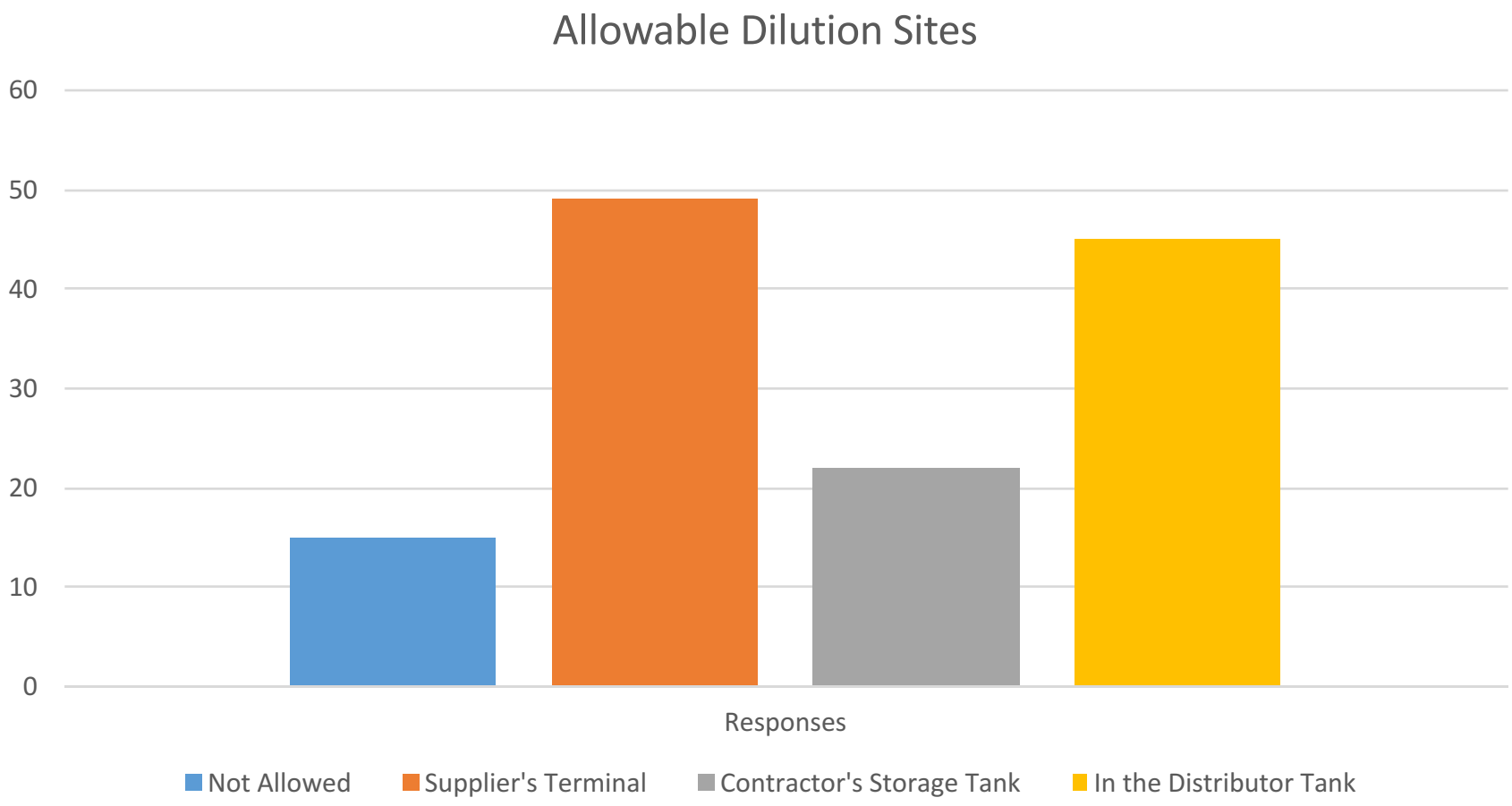
Application of Diluted Emulsion

Specified Residual Rate (qsy)	(57% residual emulsion) Application Rate (gsy)	Rate of Dilution with Water		
		1:1*	1:2*	1:3*
		Appl. Rate	Appl. Rate	Appl. Rate
0.014	0.025	0.50	0.075	0.10
0.029	0.05	0.10	0.15	0.20
0.043	0.075	0.15	0.225	0.30

* Dilution Ratios = parts of emulsion **:** parts of water

- The above stated rates are all at 60°F gallons per sq. yd.
- Application temperatures must be determined and accounted for in order to obtain the exact rate of application

Dilution Allowance Information (NCHRP Report 712)



Calculating field application rates

- There are three primary methods of determining field application rates.
  - Determination by volume.
  - Determination by weight or mass.
  - Determination by direct measurement, ASTM D2995

- We will first look at determination by volume.

Direct Measurement using ASTM D2995

Standard Practice for
Estimating Application Rate of Bituminous Distributors

Direct Measurement using ASTM D2995

- Field Measurement of Application Rate
  - Longitudinally
  - Transversely
  - Units of Gallons/Yard^2 (Liters/Meter^2)

Photos courtesy of
Dr. Louay Mohamad

Critical elements in determining application rates

- Dilution rates are critical in determining final application rates.
- Temperature is important in determining accurate volumetric calculated rates.
  - Higher than 60°F, need to spray more emulsion.
  - Lower than 60°F, need to spray less emulsion.
- Uniform application spreads in distributing tack on the surface of the road.
- Samples of emulsion from the spray bar are only good for estimating dilution rates and residual binder properties.

Spray Paver Benefits

- No tracking of the tack
- Better bonding of overlays
  - Increased Overlay life
  - Reduce Rutting
  - Reduce Cracking
- Improved joint compaction
- Easier compaction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Questions?