JCP VS. CRCP - AGGREGATES WITH HIGH COTE CAN BE USED SUCCESSFULLY IN JCP

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Coefficient of Thermal Expansion Testing

**CoTE by Aggregate Classification**

- **Siliceous Gravel**
- **Siliceous & Limestone Gravel**
- **Limestone**
- **Dolomite**
- **Limestone & Siliceous Gravel**
- **Sandstone**
- **Rhyolite**
- **Granite**

**CoTE Values**

- 3.0
- 3.5
- 4.0
- 4.5
- 5.0
- 5.5
- 6.0
- 6.5

Chart showing the coefficient of thermal expansion (CoTE) values for different aggregate classifications.
High CoTE Aggregates
CoTE Related Distresses in CRCP

- Shallow Surface Spalling at Transverse Cracks
- Mid-Slab Cracking/Delamination
Shallow Spalling at Transverse Cracks

- TxDOT has been investigating this type of distress since 1980.
- TxDOT has spent $1.6 million to fund research to determine how to address these distress.
Shallow Spalling at Transverse Cracks

- Spalling is a result of using coarse aggregates with high CoTE values.

- Valuable technical gains, but no solution that would allow the use of high CoTE aggregate in CRCP.
Horizontal Cracking at Mid-Depth (Early Age)
Horizontal Cracking at Mid-Depth (Later Age)
Horizontal Cracking at Mid-Depth

CTE = $4 \times 10^{-6}/{°F}$; Ec = 4 mil

Principal stress = 681.7 psi

CTE = $6 \times 10^{-6}/{°F}$; Ec = 6 mil

Principal stress = 1093.6 psi
CPCD (JCP) Performance
CPCD Performance

- CPCD – Excellent Performance with few Exceptions
  - No faulting when dowels in joints
    - Dowels required since 1944
    - Faulting only when dowels not used
  - Joint spacing of 15-ft - in general, cracking not a problem
  - Skewed joints – Problems?
  - Performance killer - Poor Base Support
  - Joint distresses
CPCD (JCP) and High CoTE Aggregates
None of the distresses previously mentioned are associated with using high CoTE Aggregates.

15’ joint spacings account for the contraction and expansion due to environmental loading.

Any coarse aggregate may be used in joint concrete pavements regardless of its CoTE value.
Joint Distress due to Saw Cut Timing

- Early entry saw cutting resulted in micro cracking and later spalling.
- This is associated with using hard siliceous river gravel – Not necessarily a CoTE issue, but high CoTE aggregates tend to be harder.
  - Depth of saw cut (T/3),
  - Wears saw blades and equipment
Summary

- CoTE requirements are only intended for CRCP.
- Surface Spalling and Mid-depth Horizontal Cracking in CRCP are associated with use of high CoTE concrete.
- History of excellent performance of CPCD (JCP) with few exceptions that deviated from typical requirements.
- No distress issues directly related to use of high CoTE concrete in CPCD.
  - Any coarse aggregate can be used in CPCD regardless of CoTE value.
  - Saw cut timing is crucial - Too early or Too late can both cause issues.
Questions?