# *Implementation of HPC*

## *State DOT and Industry Perspective*

***National Concrete Consortium***

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# *Overall HPC Mixture Enhancements - Materials*

- *Total cementitious content reduction*
- *SCM*
  - *State of affairs – what are we getting these days*
  - *Year-round usage*
- *Aggregates*
  - *Quality*
  - *Proportions*
  - *Moisture control*
- *ASR testing*
  - *Test methods – aggregate qualification vs. mitigation*
  - *Mixture approval*

# *Overall HPC Mixture Enhancements - Methods*

- *Improved durability-based test methods*
  - *Current demonstration initiatives*
    - *Air quality – before and after pump/paver*
    - *SAM*
    - *Resistivity*
- *Internal curing – future initiative*
- *Others*

# *Today's Focus: Aggregate Acceptance for HPC*

- *Aggregate gradation can influence other HPC properties*
- *How do we administer the quality oversight for optimized aggregates?*
- *Measure*
  - *Percent retained…8-18 ?*
  - *Shilstone…CF vs WF ?*
  - *"Tarantula" curve ?*
- *Control*
  - *Contractor process control*
  - *A to Z*
- *Accept*
  - *Agency acceptance*
    - *Level of compliance*
    - *Price adjustment*
    - *Audit proof*

# *What is Considered the "Aggregate Source"?*

- *Processing facility*
  - *Pit*
  - *Quarry*
- *Boat dock*
- *Concrete batching facility*
  - *Commercial ready mix plant*
  - *Portable on-site batch plant*
- *Source is where the "program level" QC and QA sampling will be administered*

# *Current MDOT Aggregate Acceptance - Program Level*

- *Two Levels of Aggregate Acceptance*
  - *Prequalified Aggregate Sources*
    - *Sufficient producer/source quality program*
    - *Sufficient process/quality control*
    - *Therefore, reduced acceptance is justified*
  - *Non-Prequalified Aggregate Sources*
    - *Minimal (if any) producer/supplier quality program*
    - *Minimal process/quality control*
    - *Normal acceptance sampling frequency*
    - *Basically…don't ship until it is tested*

# *Aggregate Acceptance*
# *Program Level vs. Project Level*

- *"Program" Level*
  - *Focuses on standard aggregates for normal "vanilla" concreting applications*
  - *Acceptance sampling frequency based on volume produced and shipped statewide*
  - *Region test reports feed statewide program level database*

- *"Project" Level*
  - *Aggregate testing for normal "vanilla" concrete aggregates is administered at the program level*
  - *Basically, "vanilla" gradations are not verified after they leave the source*
  - *But, aggregate gradation "optimization" is **"project-specific"***

# *Project Level Site Conditions: Trunkline Paving*

- *Dedicated concrete batch plant*
- *Non-standard gradations – sometimes customized for optimization*
- *Dedicated aggregate stockpiles*
- *Project specific materials quality control – high volume usage*
- *Daily QC sampling and testing*
- *Control charts*
- *One-stop shopping for acceptance testing*
  - *Good communication*
    - *Agency - materials lab to project staff*
    - *Agency to contractor*
    - *Agency to contractor's QC staff*
- *Cost effective*
- *Seamless accountability to the project*

# *Project Level Site Conditions: Non-Trunkline Paving*

- *Commercial ready mix concrete facilities*
- *Limited real estate – materials handling and storage*
- *Just in time delivery*
- *Limited usage of customized gradations*
- *Daily QC sampling and testing challenges…how to administer*
  - *QC for intermittent placements*
  - *Timely sampling*
- *Costly*
- *Logistics challenges relative to multiple plants/projects*
- *Possible communication breakdown*
  - *Agency to contractor*
  - *Agency – materials lab to project staff*
  - *Contractor to concrete batch plant QC staff*
  - *Agency to concrete batch plant QC staff*

# *Moving from "Program" Level to "Project" Level Aggregate Quality Control and Acceptance for HPC Application*

# *This is what we are working on…*

- *Trunkline Paving – dedicated on-site concrete batch plant*
  - *Contractor Quality Control*
    - *Quality control plan*
    - *Develop mix and optimized gradation proportions in lab – pre-production*
    - *Verify optimized gradation*
      - *Prior to startup*
      - *Randomly during each day of production*
      - *Moving average using control charts*
  - *Agency Acceptance*
    - *Sampling and testing frequency based on volume – 1 test per 5,000 tons of coarse aggregate*
    - *Acceptability based on comparison between agency and contractor test results*
    - *Must plot within CF vs WF “operating zone”*

# *This is what we are working on…*

- *Concrete Production - commercial batch plant*
  - *Contractor Quality Control*
    - *Quality control plan*
    - *Develop mix and optimized gradation proportions in lab – pre-production*
    - *Utilize aggregate producer's weekly gradation reports*
    - *Verify aggregate producer's weekly gradation report results at batch plant*
    - *Monitor optimized gradation*
      - *Prior to startup*
      - *Weekly during concrete production, thereafter*
      - *Frequency may be reduced if history of consistency*
      - *Moving average using control charts*
  - *Agency Acceptance*
    - *Sampling and testing frequency, one sample per…*
      - *5,000 tons of coarse aggregate, or*
      - *2,000 cyds of concrete produced*
    - *Acceptability based on comparison between **agency** and **contractor** test results*
    - *Must plot within CF vs WF "operating zone"*

*Does more testing imply a better quality end product?*

*Does less imply a lesser quality end product?*

*Where is the "sweet spot?"*

*Communication is the key !!*

*Questions*
*and*
*Discussion*