**FHWA Density Demo – STH 21**

* QC data gives most complete coverage of the mat
* In hindsight, we should have taken cores rather than gauge readings throughout the entire project (not common practice in WI)
* Since we did not, we must make use of the gauge readings
* When taking cores, QV gauge was used to take nuke readings at core locations prior to extracting cores
* QV because Dept can direct their gauge/technician to perform the additional work, plus QC was occupied monitoring paving ahead
* Again, in hindsight, would have been better to perform this “gauge-to-core” correlation with the QC gauge
* Using QC gauge for correlation would have ensured proper offset for that specific gauge
* Footprint testing showed QC & QV gauges we rereading similarly….
* Therefore, not unreasonable to use QV gauge offset from cores to adjust or “correct” the QC gauge readings
* This is what is presented in this second plot as “corrected QC nukes”
* Cores are displayed simply for a visual…
* Recall, cores were taken from an “isolated” 10-12 foot section down the middle of the driving lane, selected as “representative”
* Cores do not provide nearly the same coverage or representation as the QC gauge readings,
* Which is why the cores were used to determine the offset which was then applied to the QC gauge for most coverage and greatest representation of each section’s average density

**THE PRELIMINARY CONCLUSIONS THAT ARE OBSERVED FROM THE “CORRECTED QC NUKES” ARE AS FOLLOWS:**

* Additional roller shows minimal increase over control
  + Should be noted that compaction effort was minimally increased
* Regressed 3% showed minimal increase over control
  + No real AC added 🡪 running near control mix (AC & 4% Va)
* 3% + Add’l roller shows increase in density
  + Increased compaction effort was apparent & slight increase in AC
  + Cannot attribute increase to one or the other
    - due to lack of data/cooperation on other sections
* WMA shows decreased densities in “adjusted gauge” data
  + Was comparable to control in “uncorrected data,” but
  + Using non-correlated gauges to control operations = bad idea
* HMA w/ Additive = no appreciable increase
  + Does this mean using the additive/compaction aid in HMA is a waste of money??
  + Slight increase in density (according to gauge) is countered by the increase in gauge offset for this mix over control
* Additional additive in WMA to achieve 3% = showed slight increase over WMA
  + Still below control
  + May warrant increasing dosages in cold weather or applications that require WMA??
    - Still lower density than HMA w/ additive, so it is hard to justify reducing temp & increasing dosage, unless the situation forces reduces temps in which case the increased dosage may help account for that
* 9.5mm achieve similar increase to Add’l roller or 3% Va (minimal increase over control)

**Assuming cores are representative (though isolated to small area), data suggests:**

* An additional roller on conventional mix increases the density over 0.5%
* Air Void Regression of the mix (via added AC) resulted in negligible change in density, however
* An additional roller on a regressed mix appears to have taken full advantage of the additional asphalt for lubrication and increased the average core density by nearly 2.4%
* Using WMA resulted in approximately 1.0% higher density than the HMA under similar compaction effort
* Using the warm mix additive as compaction aid (WMA mix run at HMA temps) resulted in roughly 0.7% increase in density, in other words, approximately 70% of the increase found when using WMA
* When increasing the additive dosage rate to yield 3% air voids in the lab, a slight decrease (~0.2%) in density was observed
* Using a finer/smaller NMAS (9.5mm in this case) resulted in 1.7% increase in density over the control mix, in other words, over 70% of the increase seen when using an additional roller as well as increased asphalt content from air void regression of mix
  + For this reason, one may want to compare the %AC in the 9.5mm mix with the increased AC of the regressed mix to see how similar they may be
    - Perhaps part of the increase in density can be attributed to the %AC, however, then both the 3% Regression and the 3% plus additional roller should have %AC verified because the 3% with standard compaction effort resulted in negligible change in density (perhaps no significant increase in %AC?)