SHRP2 SOLUTIONS
STRATEGIC HIGHWAY RESEARCH PROGRAM

Increasing In-Place Densities to Improve the Performance of Asphalt Pavements

SHRP2 Performance Specifications for Rapid Renewal (R07)

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U.S. Department of Transportation
Federal Highway Administration

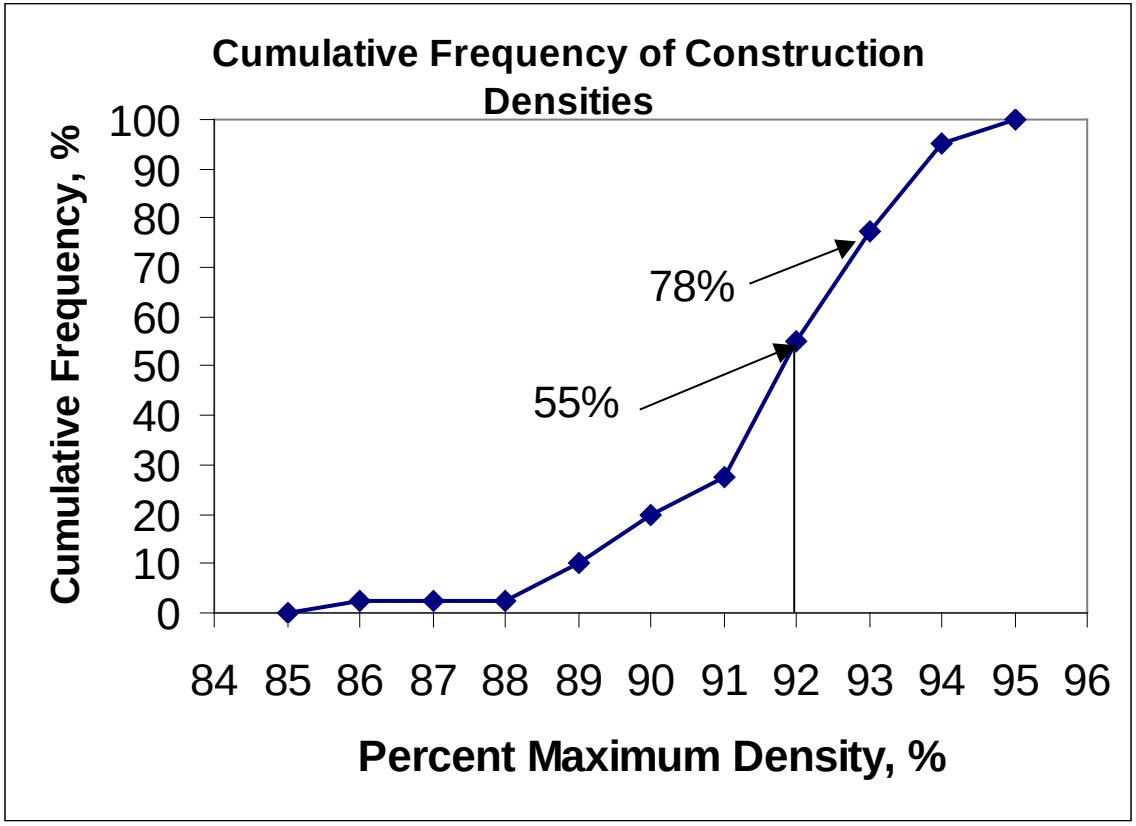
American Association of State Highway and Transportation Officials
AASHTO

Density essential for good performance

- Some say that density is the most important factor that affects performance

- Density may not be the most important factor but it is clearly an important factor

National density variability



Low density causes unacceptable permeability

FHWA funded project to improve density

- NCAT prepared report on expected savings due to increased density
- Ten states funded to investigate improved density
- For each state:
  - Best practices presentation by Asphalt Institute
  - Preconstruction meeting to discuss plans
  - Construction of control section and test section(s) documented by NCAT

NCAT study funded by FHWA

NCAT report showed that 1% increase in density conservatively resulted in at least 10% increase in life

NCAT Report 16-02 (can be downloaded from ncat.us)

ENHANCED COMPACTION TO IMPROVE DURABILITY AND EXTEND PAVEMENT SERVICE LIFE: A LITERATURE REVIEW

By Nam Tran, Pamela Turner, and James Shambley

FHWA funded project to improve density

- Ten states funded to evaluate methods for improving density
- NCAT selected to monitor these projects
- Construction of projects were to be completed in 2016
- Seven of these projects have been completed
- Each project had to have a control section and at least one test section
- For control section the contractor followed his normal compaction procedures
- For test section, contractor looked for ways to improve compaction without changing mix or without adding additional rollers
- Some states elected to construct 2 test sections

Some items being used to improve density

- Increase number of passes
- Apply more passes with vibrator on
- Reduce speed of rollers
- Some states elected to construct a second test section where additional an additional roller was used

Target density

- Percent of Laboratory
  - Not used much today
  - In-place density compared to laboratory density
- Percent of TMD---Generally preferred method
  - Most common method used today
  - In-place density compared to theoretical maximum density
- Percent of Control Strip
  - Still used by some today but must use caution
  - In-place density compared to density obtained in control strip

What density level do we need

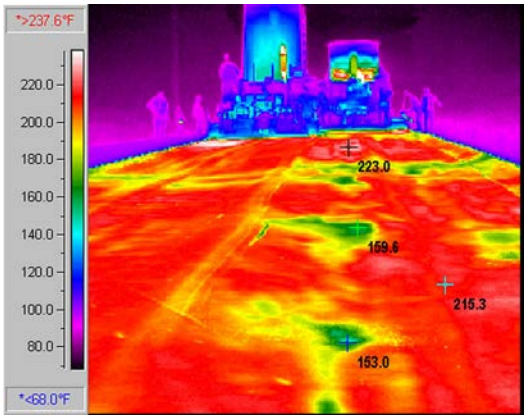
- How about 92% of TMD?
- How about 94% of TMD?
- How about 96% of TMD?

Type of mix

- Fine-graded mixes tend to be less permeable for equal density than coarse-graded mixes

Mix consistency

- Mix variability results in increased variability in density
- Use of material transfer vehicle will help to reduce variability
- Use of infrared camera and IR bar will help to ensure reduced temperature variability



Sampling for QC testing

- Good procedures should be used for sampling whether samples taken from truck or behind paver or from some other location.

Material transfer vehicle

- Some devices remix asphalt and these are preferred
- Even if they don’t remix they do keep paver and trucks separated resulting in smoother pavement

Mix temperature

- As mix cools it generally becomes more difficult to compact
- Some have used WMA as a compaction aid
- Infrared gun measures the surface temp but not internal temp
- Thin layers cool quicker so must be rolled quicker especially in cool weather---this may mean more rollers

Keep rollers close up to paver

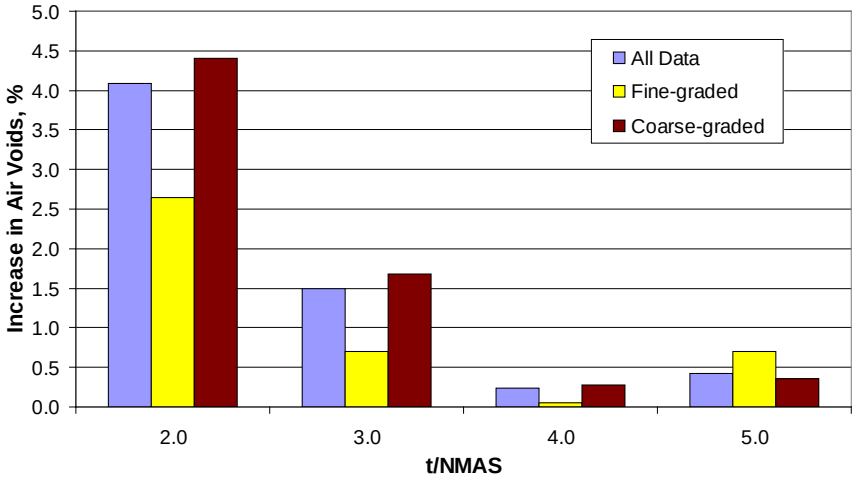
- Typically good to keep rollers close behind paver

Laboratory air voids

- Some have reduced laboratory air voids to help ensure specs are met for density
- Must be careful when adding asphalt cement to lower air voids since this may result in rutting
- This resulted in major rutting prior to Superpave
- Superpave placed emphasis on controlling volumetrics during construction and reduced the amount of projects adding additional asphalt to reduce in-place air voids

Layer thickness and NMAS

- The thickness to NMAS should be at least 3 for fine-graded mixtures and at least 4 for coarse-graded mixtures.



Roller weight and type of roller

- Typically 10-12 ton vibratory rollers used. Weight and tire pressure important for rubber tire rollers.

Oscillating roller

- Oscillating roller has shown some promise to obtain good density but more research needed.

Quality of bond between layers

- Clean underlying surface
- Consistent application of tack coat should be applied
- Too much tack sometimes a problem
- Allow to cure before placing asphalt mixture

Ensuring satisfactory bond

- Bond test has been developed but not implemented by many
- Bond test would be helpful

Roller pattern

- What pattern works on one project may not work on the next project
- Use density gauge to help set rolling pattern

- Watch out for tender zone

Testing location is important

- Some areas receive more compaction than other areas
- Density tests should be at random locations

Summary

- Increased effort to obtain density can result in at least 1 to 2 percent higher density
- 1 to 2% higher density will provide a significant increase in pavement life, generally believed to be 10-20%