PAV Pan Warping

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Presented at the Asphalt Binder ETG
Fall River, Massachusetts
September 12-13, 2016

Introduction

- Reports of warped PAV pans have surfaced once again
  - ✓ Long-standing issue
    - One of reasons steel pans were specified (SHRP)
    - Issue is recognized in ASTM but ASHTO quiet on this issue
  - ✓ Pan dimensions are a left-over from TFO method
- Conclusion
  - ✓ Means for specifying and measuring allowable warping in PAV pans is needed
  - ✓ Pan dimensions need to be revisited
  - ✓ Levelness of PAV rack may also warrant attention

Why do the pans warp?

- Residual stresses created during manufacture
  - ✓ Two processes – spinning and pressing
  - ✓ In past was traced to manufacturer/process
- Expansion created during filling
  - ✓ Caused by expansion of pan bottom as it is heated during filling
  - ✓ Should be removed when pan comes to uniform temperature at room temperature or in PAV
    - Need to verify

Pan warpage during filling

- Video

Why is levelness important?

- The effect of PAV conditioning depends upon the thickness of the binder film
  - ✓ "Aging" is diffusion controlled thus a non-linear function of thickness
    - "Aging" varies with the thickness squared
  - ✓ Limited amount of published data available on effect of film thickness
    - Available data sufficient to set tentative tolerances for thickness and levelness
    - Total effect is sum of pan warping and PAV rack levelness
- Need is a method for establishing warping and levelness in PAV rack

Existing methods for measuring pan warpage

- Spinning method
  - ✓ Place pan on flat surface and manually spin pan
  - ✓ If pan spins it is not level
  - ✓ Qualitative therefore not definitive and hard to enforce
- Method recommended in Asphalt Institute MS-25
  - ✓ Simple and non-qualitative
  - ✓ No limits given
  - ✓ Good starting point for development
  - ✓ Refine measurement technique and provide limits
    - Use existing data to establish limits

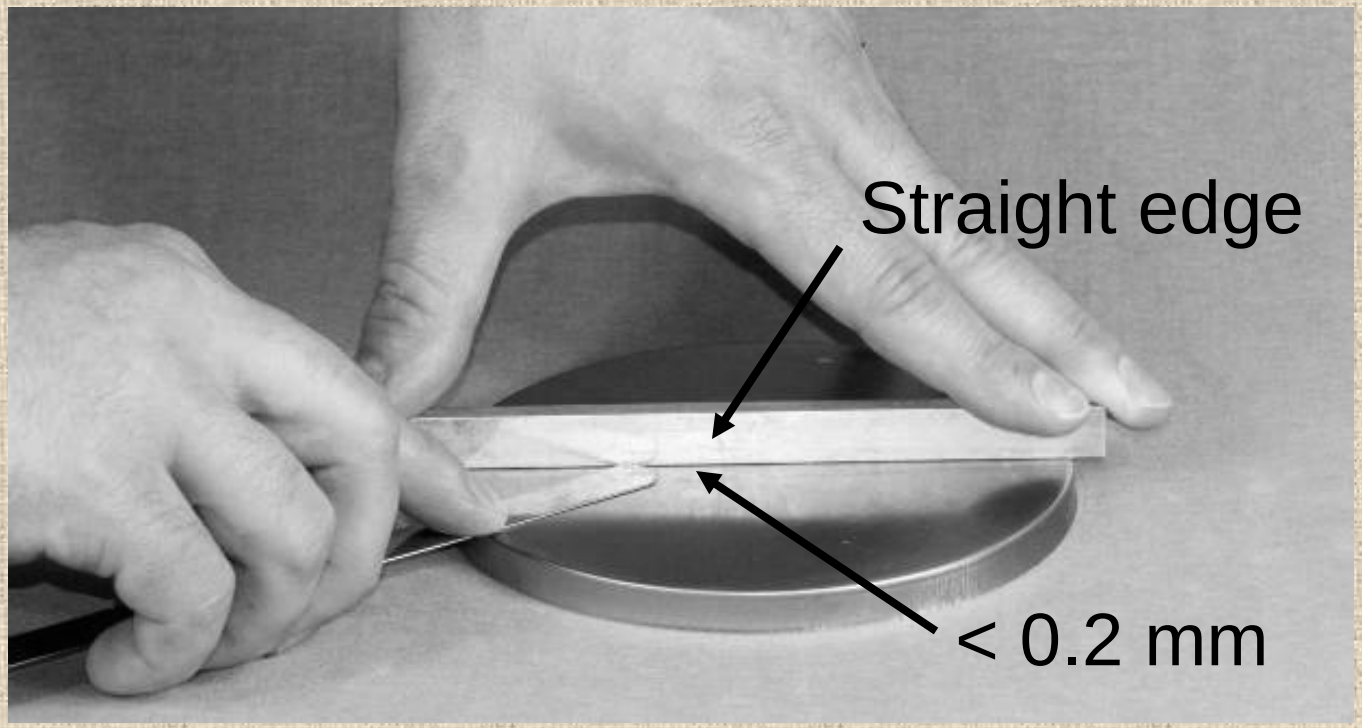
Flatness - Check for Downward Bow

- Press on one side of the pan
  - ✓ Opposite side should not raise by more than 0.2 mm
  - ✓ Rotate pan 90° and repeat

Note: Dimensions given will ensure film uniformity as required by test method. The test method does not require this procedure and its tolerances.

Flatness - Check for Upward Bow

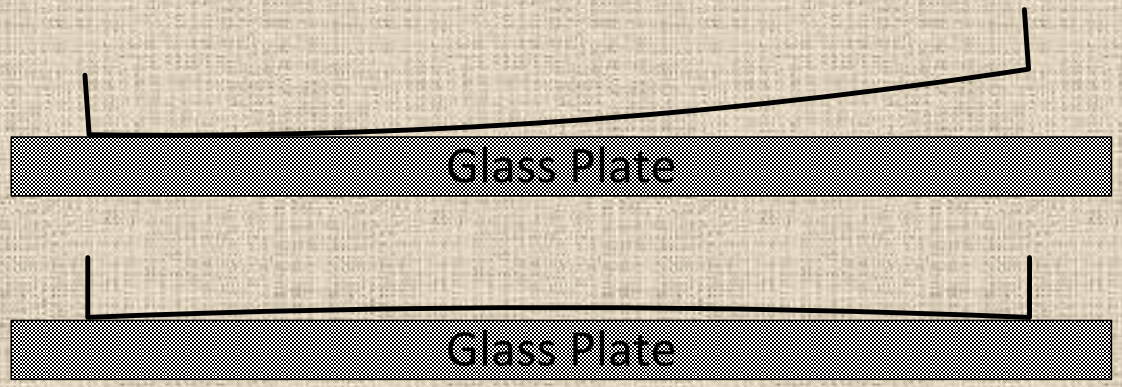
- Invert and check for gap at center of pan



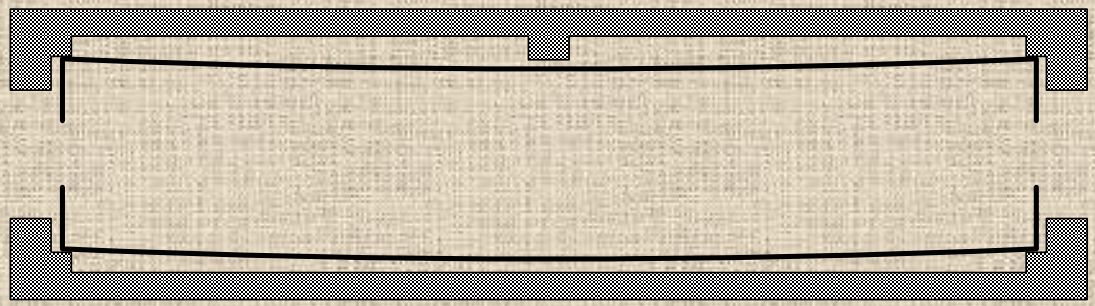
Not in test method: See note on previous slide

TAI vs. suggested go-no go gage

1. Recommended in TAI MS-25



2. Suggested go-no go gage



What about PAV rack levelness?

- Obscure requirements given in initial version of test method
  - ✓ Measured dimensions of rack
  - ✓ Unrealistic and never enforced – since
- AASHTO and ASTM quiet on this issue
- Issue has been discussed periodically
  - ✓ Currently under review by ASTM task force
  - ✓ Varying rack design complicates measurement
  - ✓ Levelness of oven not reliable
    - Warping of vessel can affect rack levelness
  - ✓ Probably less critical than pan levelness

Where do we go from here?

- Update pan dimensions
- Establish tolerances based on data of aged property vs thickness
  - ✓ Additional data and existing data
- Manufacture prototype gages
  - ✓ Collect assortment of warped pans
  - ✓ Evaluate effectiveness of gage design
    - Apply to collected pans
- Continue to develop method for PAV
  - ✓ How critical is it?
  - ✓ Evaluate effect of vessel warpage as reported by some