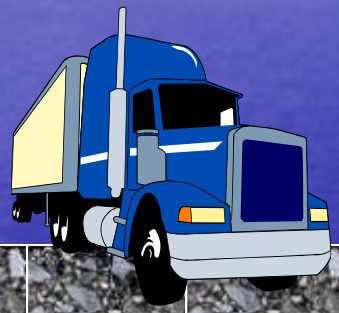
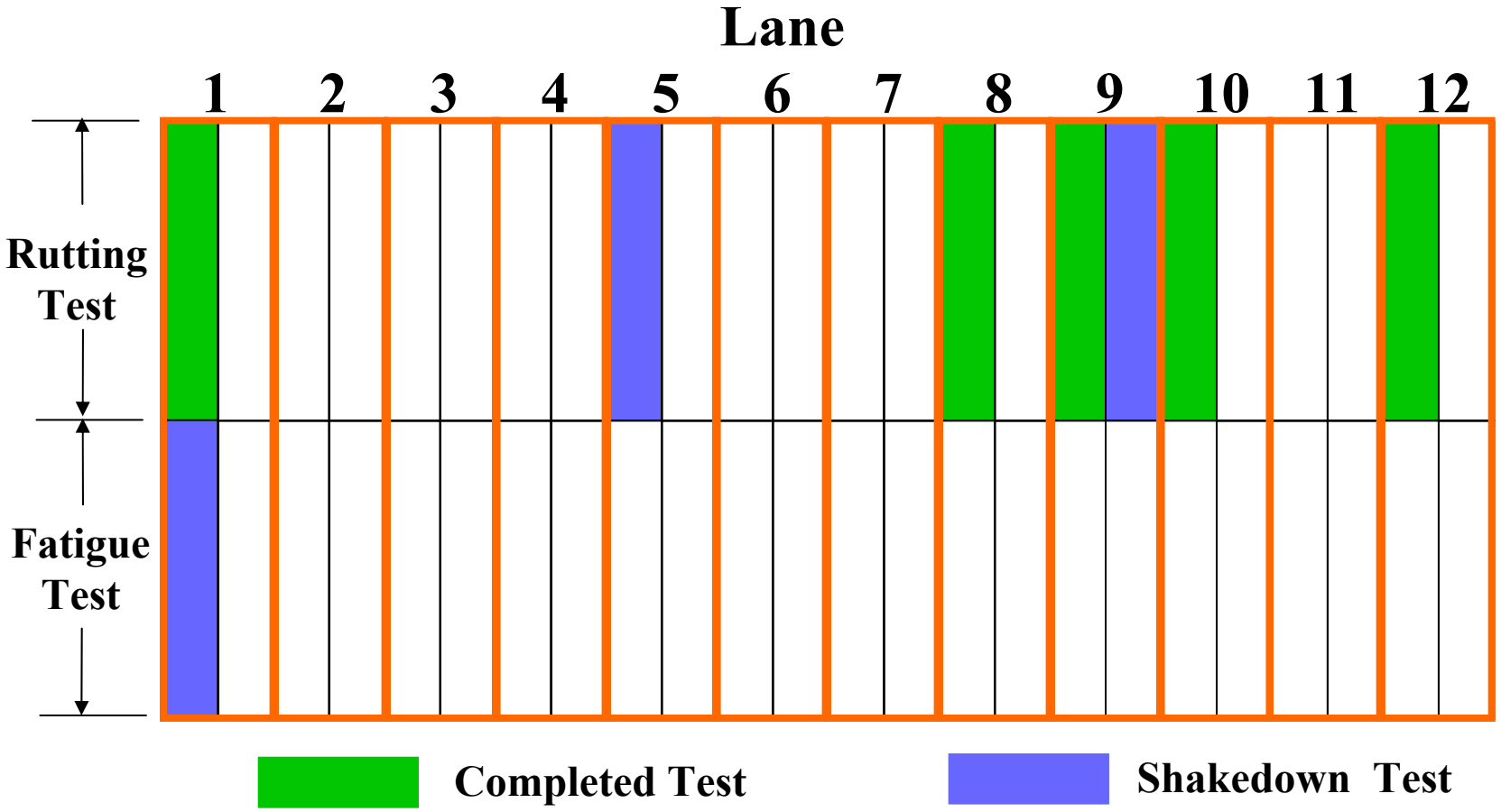
FHWA Research and Equipment Update

ALF Test Site
Final Test Matrix

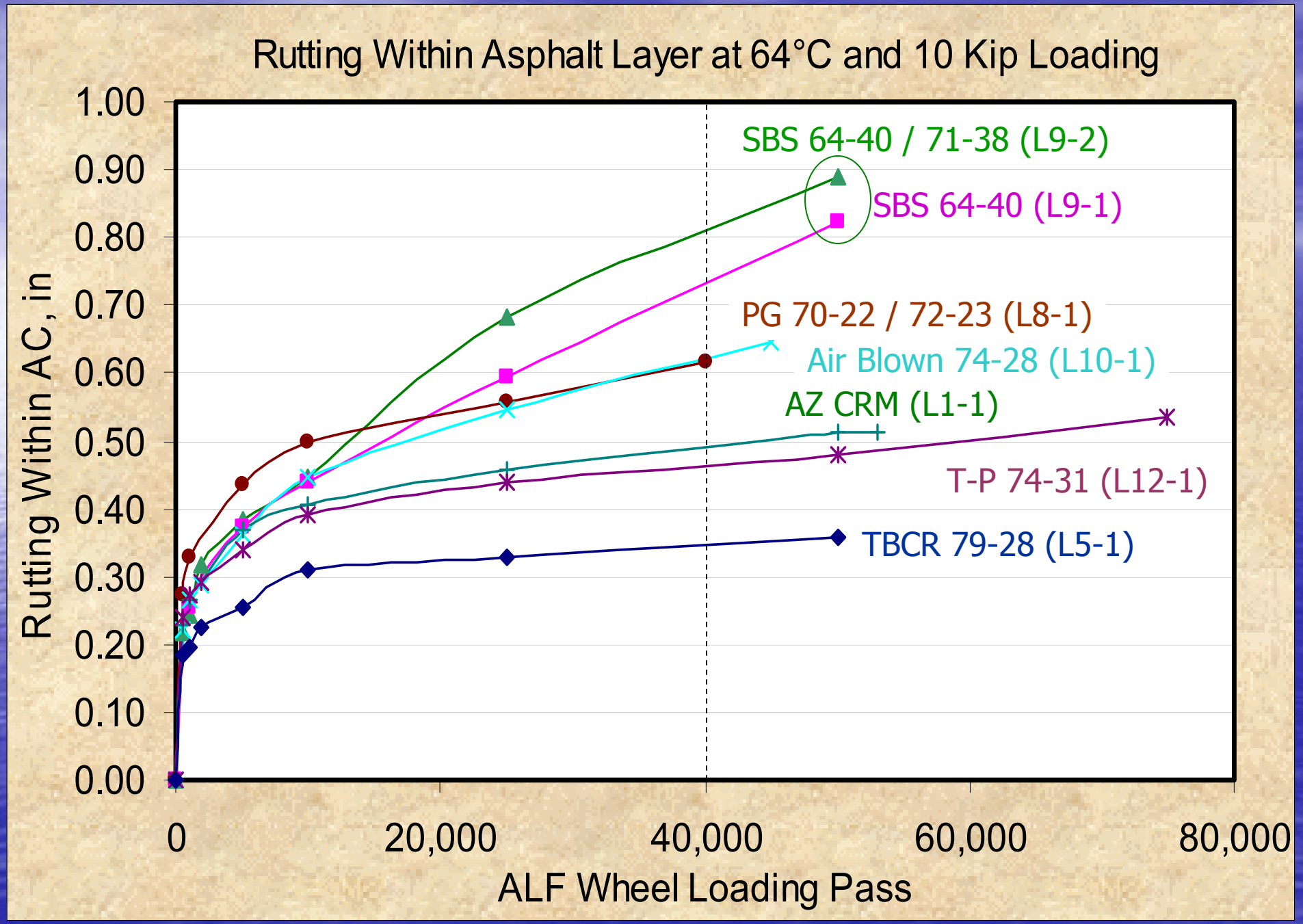


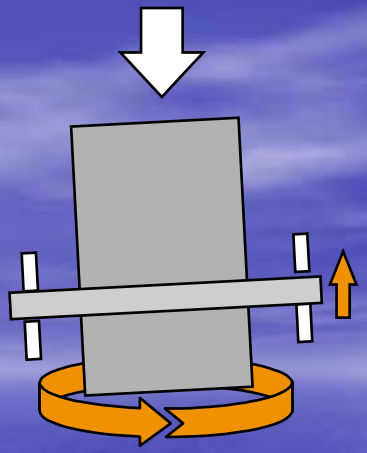
AZ CRM ---- 70-22	PG 70-22 Control	Air Blown	SBS	TX TBCR	T-P	PG 70-22 + Fibers	PG 70-22	SBS 64-40	Air Blown	SBS	T-P
1	2	3	4	5	6	7	8	9	10	11	12

ALF Testing Status



*Initial Strain Measurements: 100% Complete
*Rutting Tests: Shakedown Tests Complete (5, 9)
*Rutting Tests: 5 of 12 Lanes Complete
*Fatigue Tests: Shakedown Test Complete (1)


Rutting Within Asphalt Layer at 64°C and 10 Kip Loading
Rutting Within AC, in
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0
20,000
40,000
60,000
80,000
ALF Wheel Loading Pass
SBS 64-40 / 71-38 (L9-2)
SBS 64-40 (L9-1)
PG 70-22 / 72-23 (L8-1)
Air Blown 74-28 (L10-1)
AZ CRM (L1-1)
T-P 74-31 (L12-1)
TBCR 79-28 (L5-1)



Superpave Gyratory Compactor Calibration

The Angle Evolution

Standard Method of Test for

Preparing and Determining the Density of Hot-Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor

AASHTO Designation: T 312-**03**

REFERENCED DOCUMENTS

- TP, Evaluation of the Superpave Gyratory Compactor (SCG) Internal Angle of Gyration

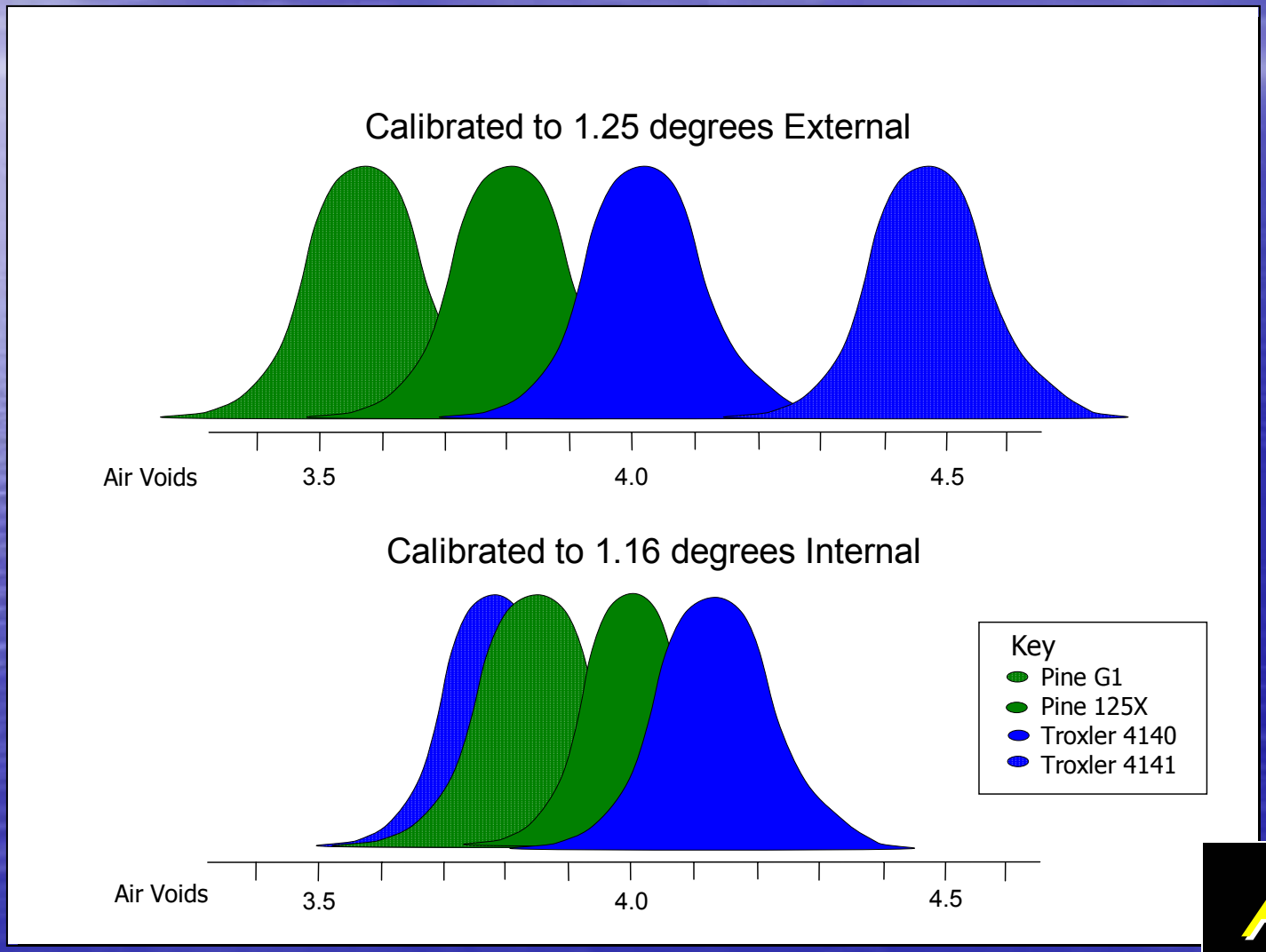
Separate standard for DAV operations

Average Dynamic Internal Angle (DIA)

DAV on Top
to measure α_T

DAV on Bottom
to measure α_B

Studies indicate internal angle 1.16°±0.02° reduces data bias among compactors



APAP

Issue

- DIA is a function of mix stiffness
  - We need a standard mix
- DAV is time consuming
  - Up to 8 hours for SGC calibration

Evolution

- Pine RAM
  (Rapid Angle Measurement)

- Brovold HMS
  (Hot Mix Simulator)
  For use with the DAV

Evaluating the Evolution

- FHWA Study
  - Asphalt Institute
  - University of Arkansas

- "Evaluation of the Effectiveness of Mechanical Mixture Simulation Devices for Determination and Calibration of the Dynamic Internal Angle of Gyration"

Study Objectives
6 Month Project

- Determine the relationship between mix stiffness and eccentricity.
- Establish and average mix eccentricity – "Standard Mix Stiffness" for calibration
- Compare the RAM and the HMS
- Evaluate Mix-less procedures to DAV

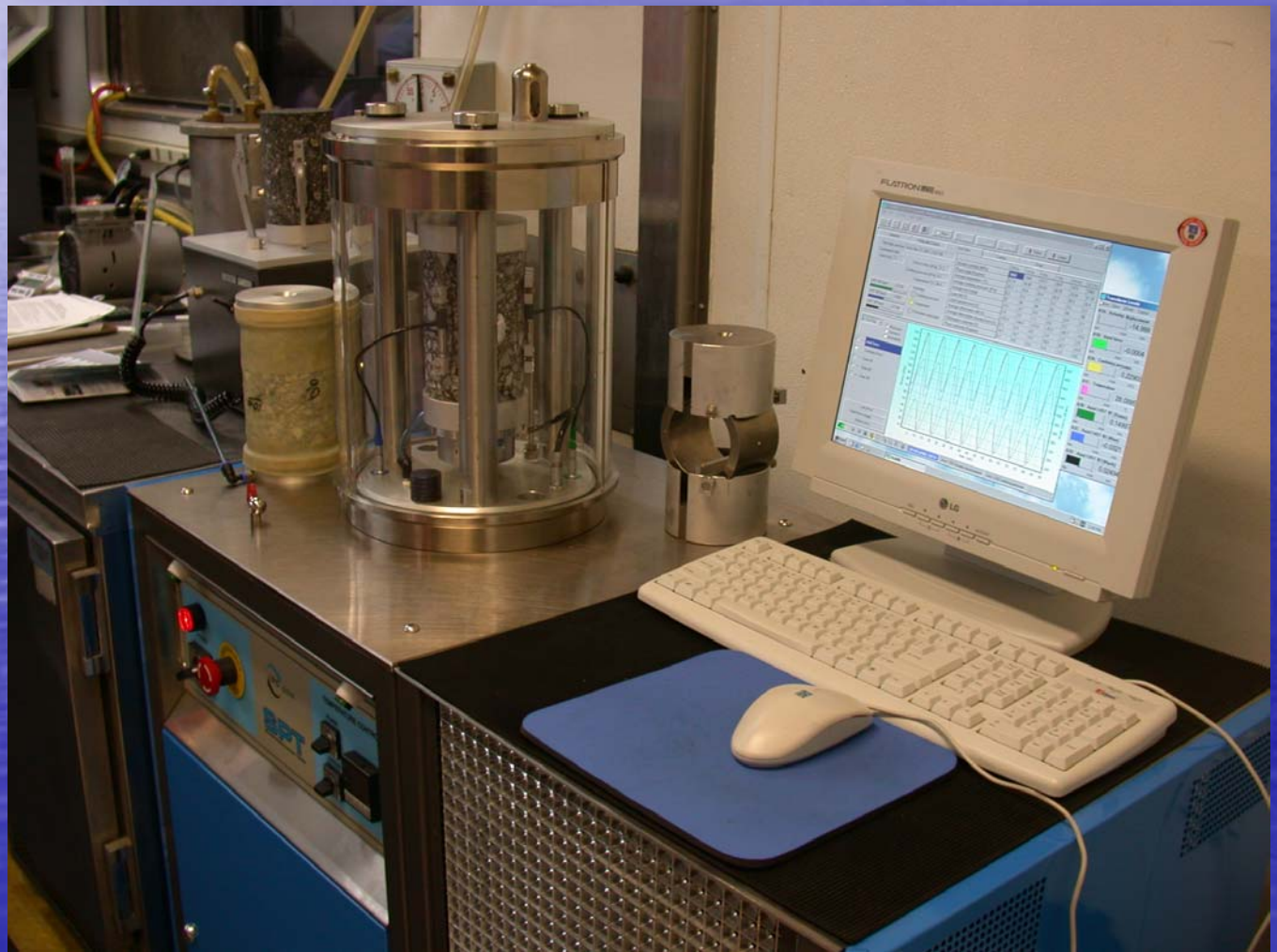
New Equipment Evaluation

Compactor Comparison

Servopac

Brovold

Superpave Performance Tester



Performance Sample Preparation

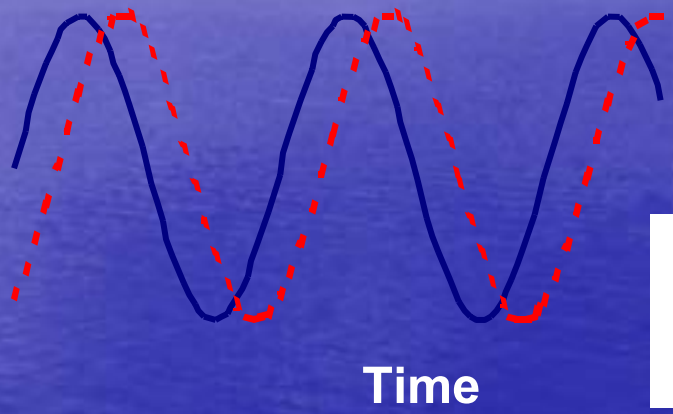
Specimen Preparation

- Specimen fixed in place
- Sawing & coring took approximately 10 minutes

Specimen Tolerances

Parameter	Recommended Specification
Diameter (mm)	100 to 104
Height (mm)	147.5 to 152.5
Diameter Std Deviation	SD < 1
End Parallelism (deg)	± 1° 1.3 mm
End Flatness (mm)	± 0.3

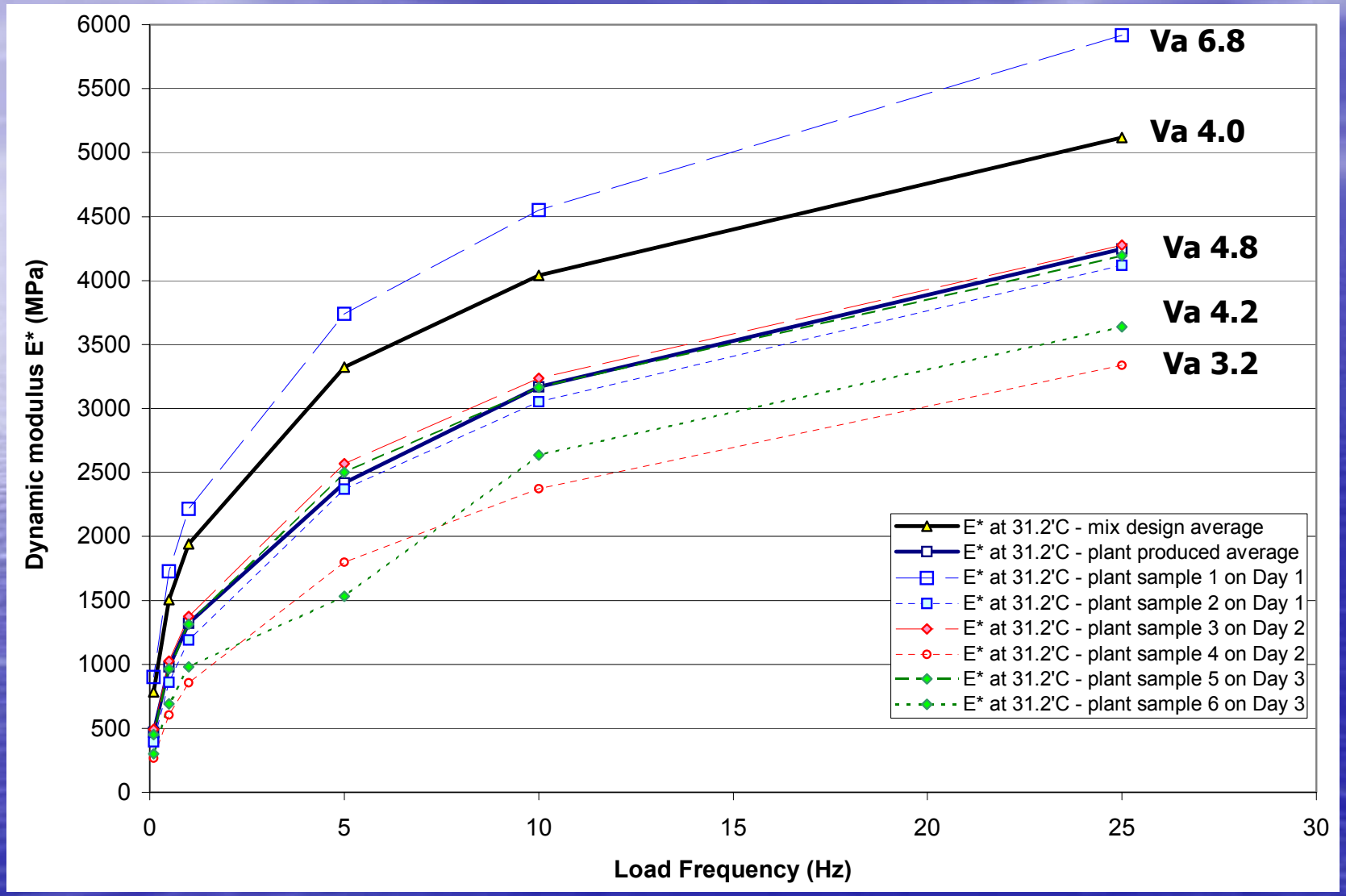
Dynamic Modulus Test



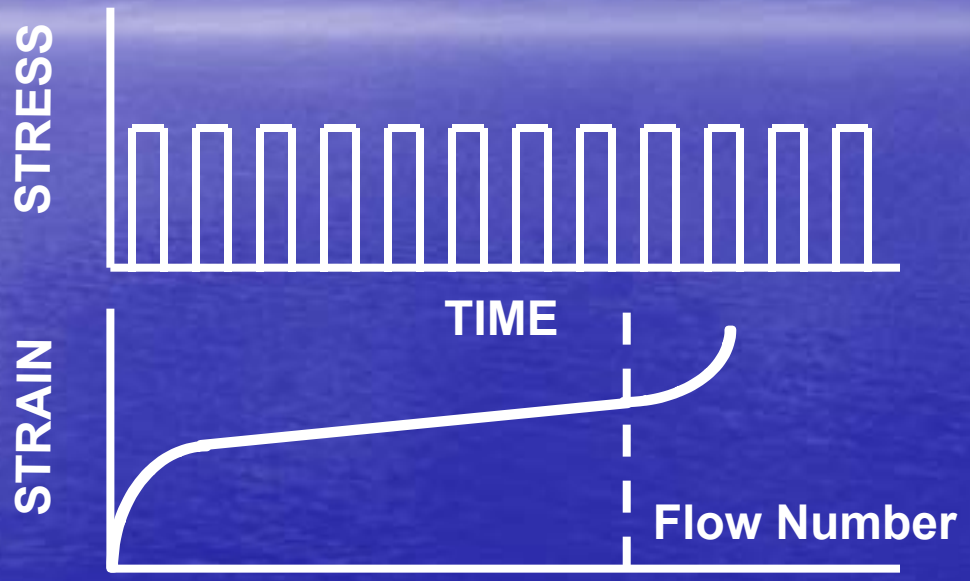
$$|E^*| = \frac{\sigma_0}{\varepsilon_0}$$

- Rutting
  - Min |E*| at High Temp
- Fatigue Cracking
  - Max |E*| at Intermediate Temp

Mix Performance at T_{eff} for Rutting

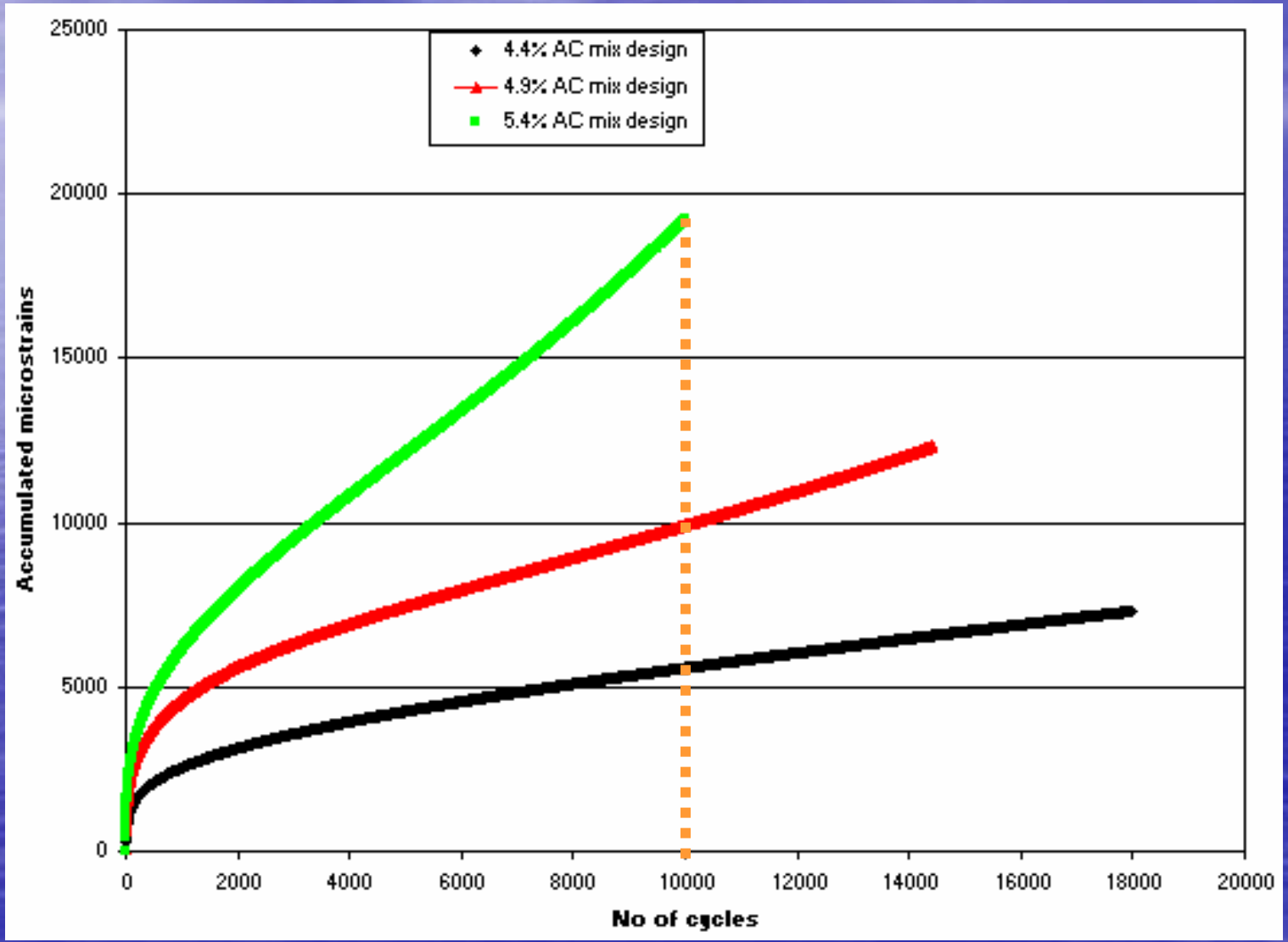


Repeated Load Permanent Deformation Test

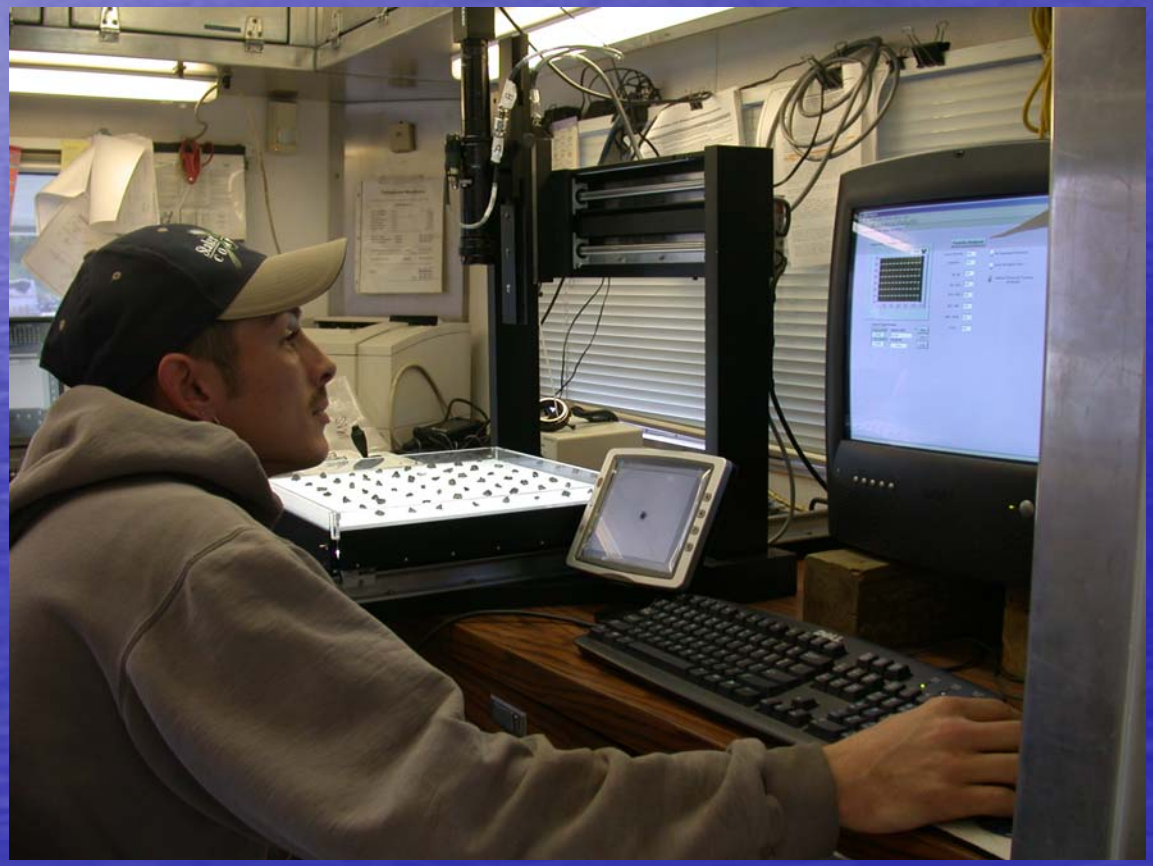


- Rutting
  - Min FN at High Temp

Flow Number


4.4% AC mix design
4.9% AC mix design
5.4% AC mix design
Accumulated microstrains
25000
20000
15000
10000
5000
0
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
No of cycles

Aggregate Imaging



Aggregate Imaging

- **Coarse aggregates**

Stockpiles

#1 Stone

1/2” chip

3/8” chip

Source

WLS west quarry

- **Fine aggregates**

Types

Natural Sand

Manufactured Sand

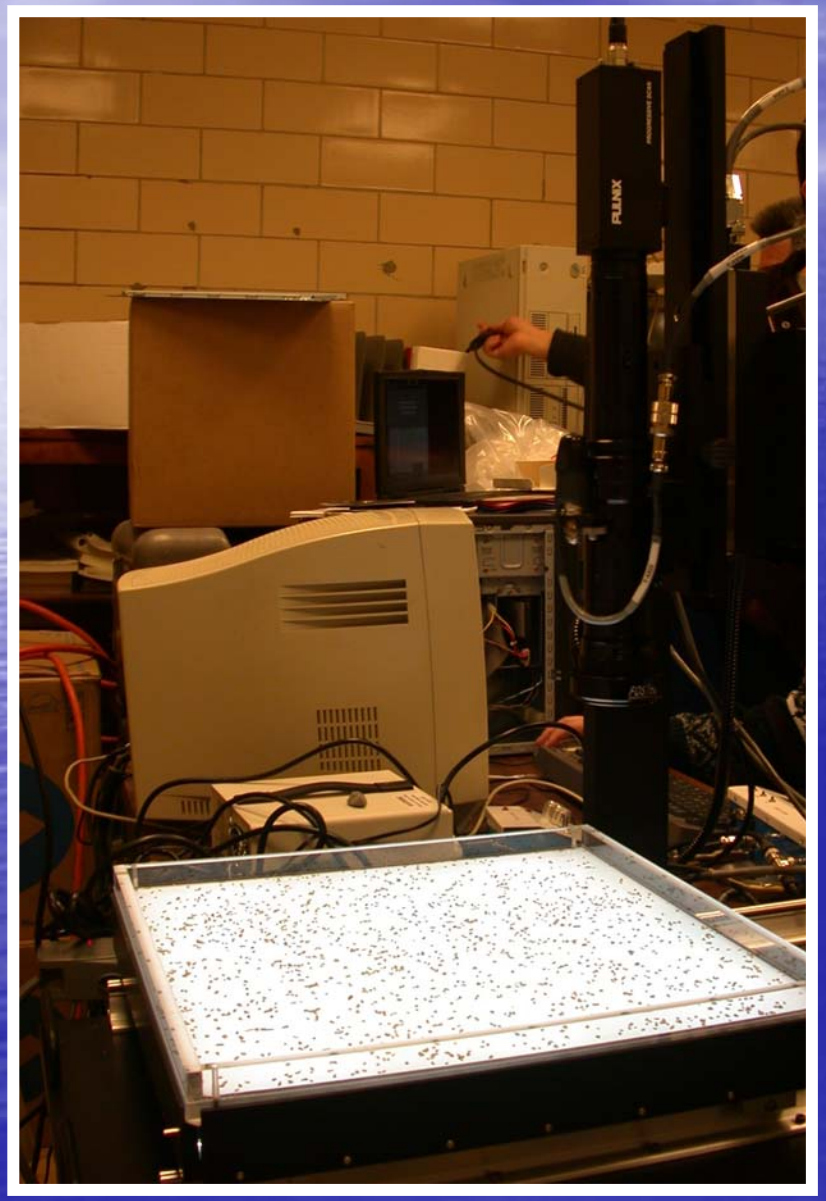
JMF Blend

Sources

WLS west quarry

Honey Creek pit

AIMS Image Device capture Fine Agg



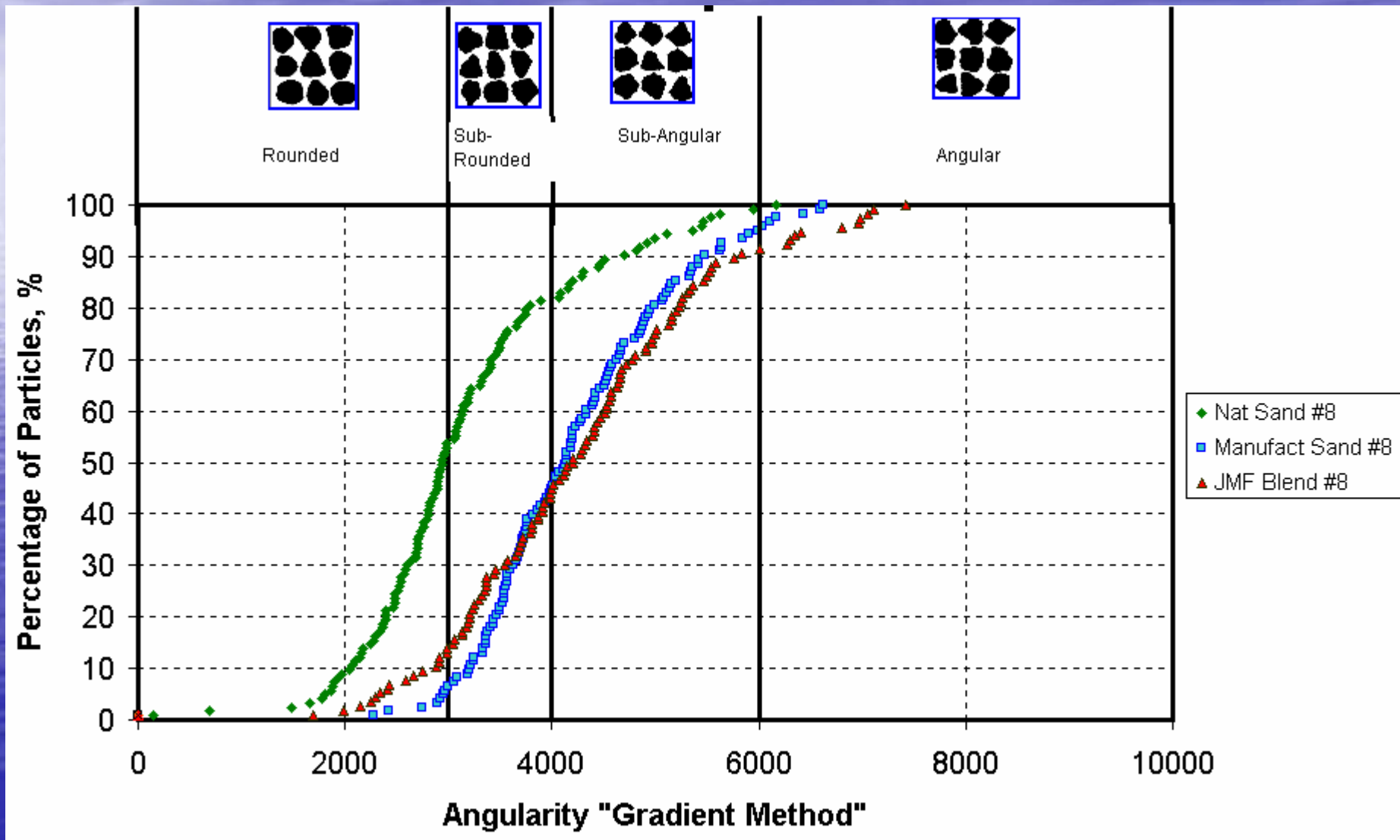
Fine aggregate

No. 8 aggregates

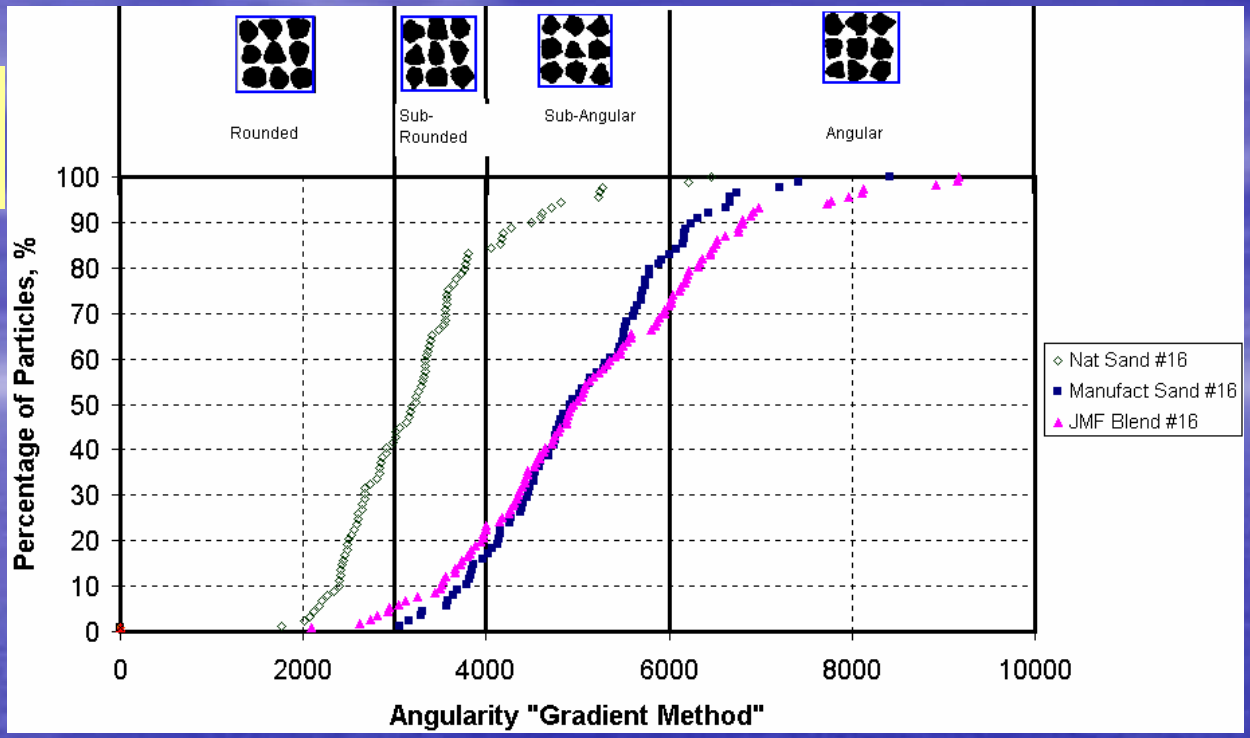
FAA N Sand =39.8

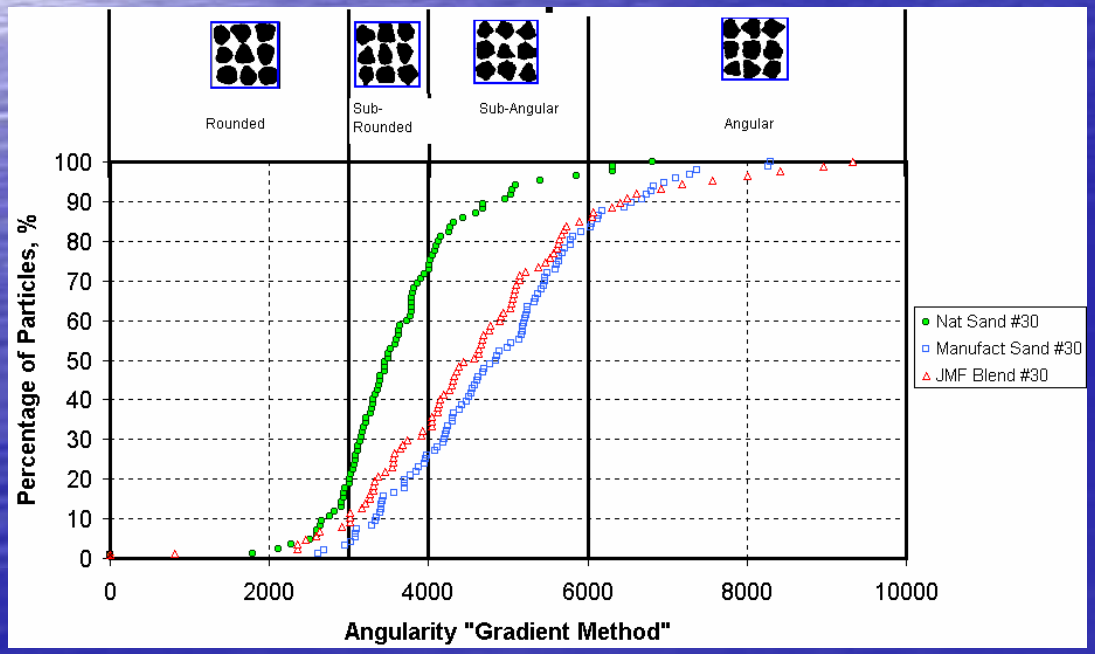
FAA M Sand =48

FAA blend =45.6



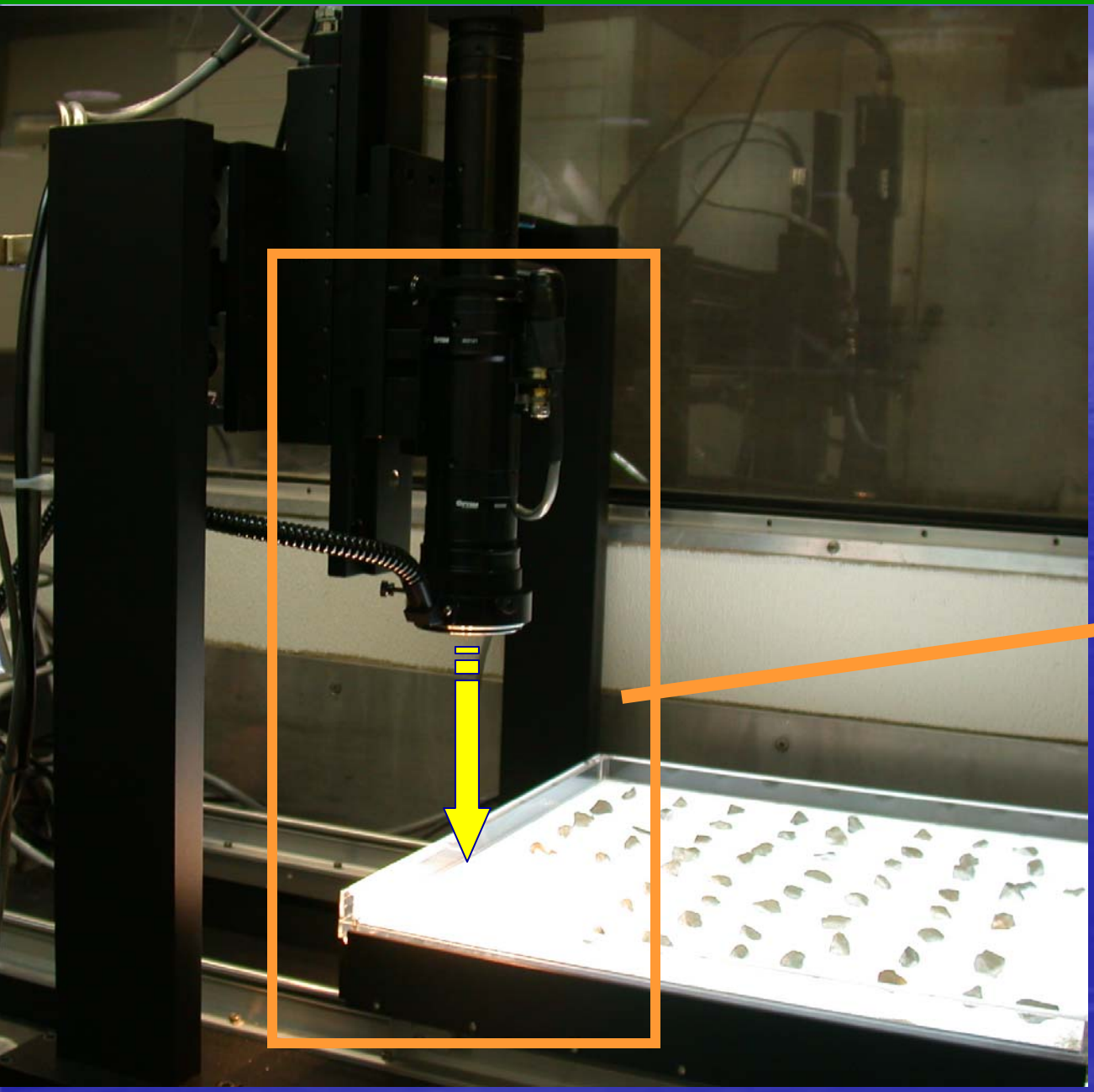
No. 16 aggregs



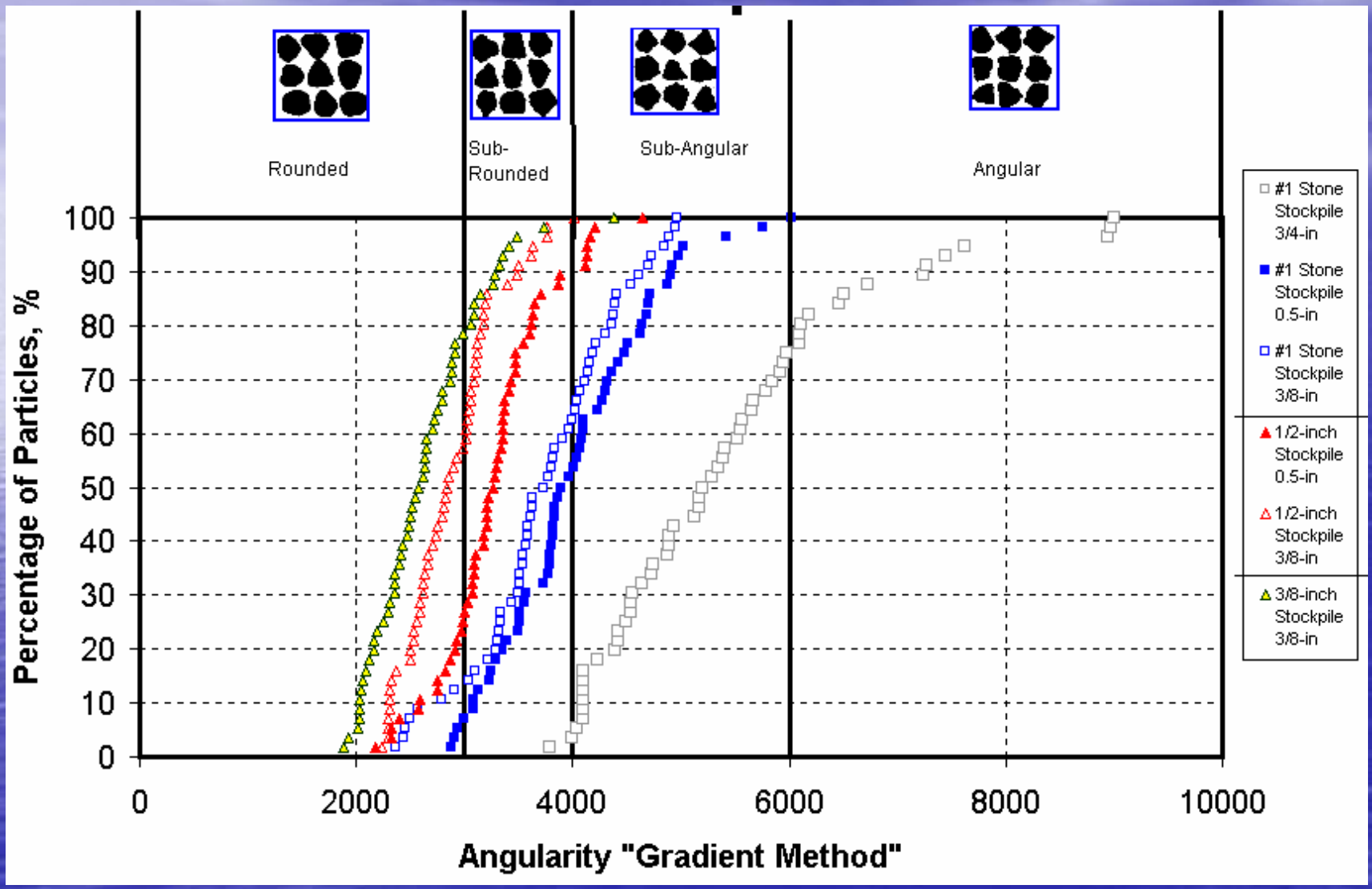


No. 30 aggregs

Coarse Aggregate Analysis



Coarse Aggregate



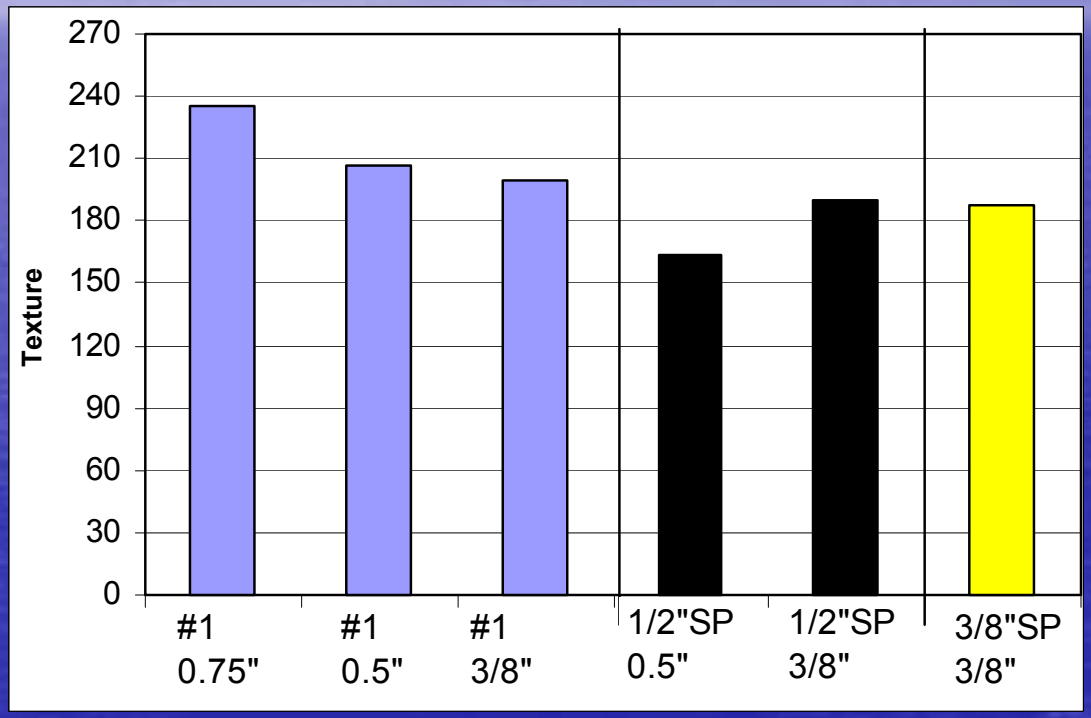
#1 Stone exhibits highest angularity Small agg mostly sub-rounded

Coarse Aggregate

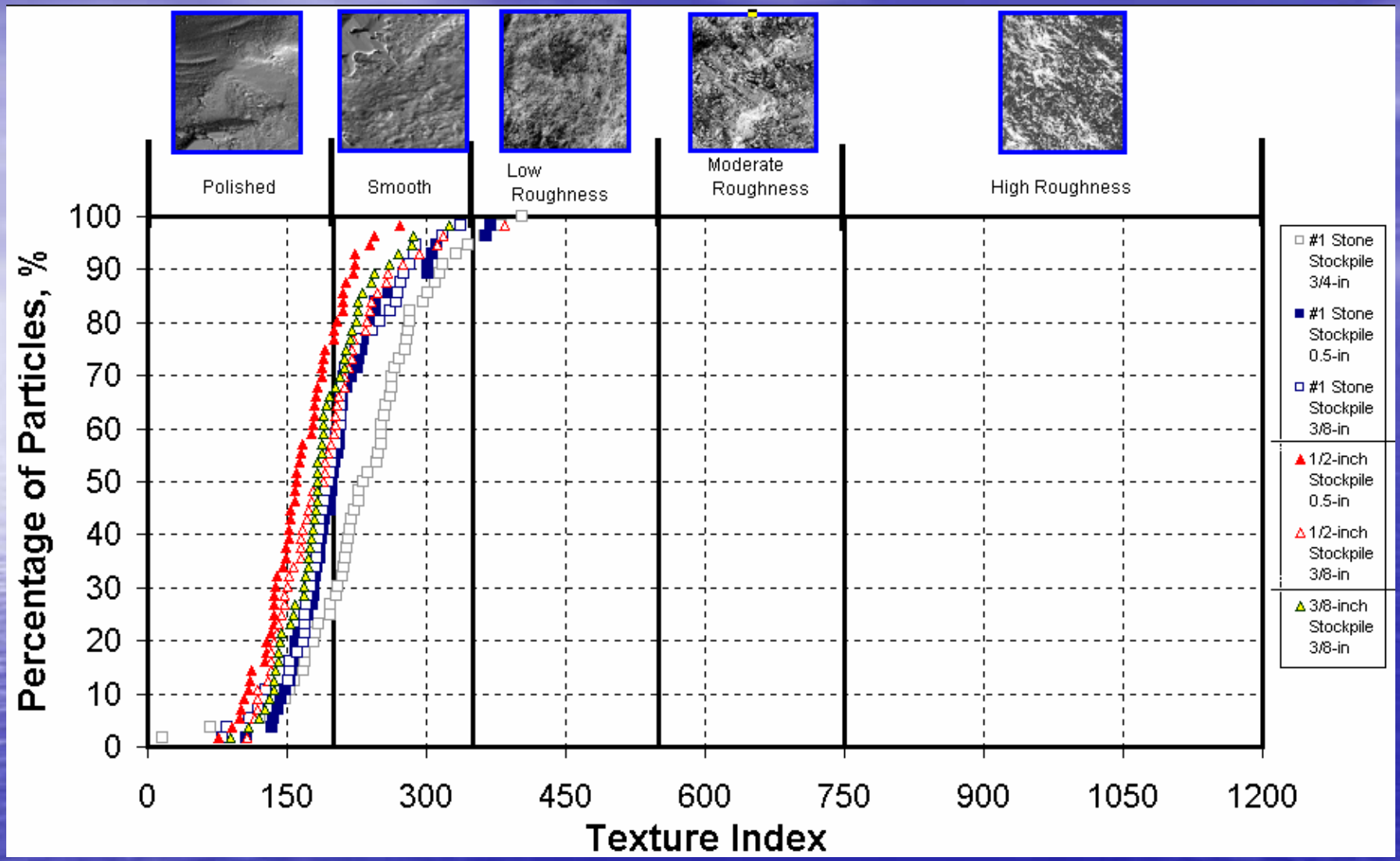
Texture

Compare 3 aggregate sizes:

- 3/4-inch
- 1/2-inch
- 3/8-inch



#1 Stone stockpile has highest texture,
but no real difference among aggreg stockpiles



#1 Stone exhibits higher texture, but all aggs rated as Smooth in video analysis

Coarse Aggregate

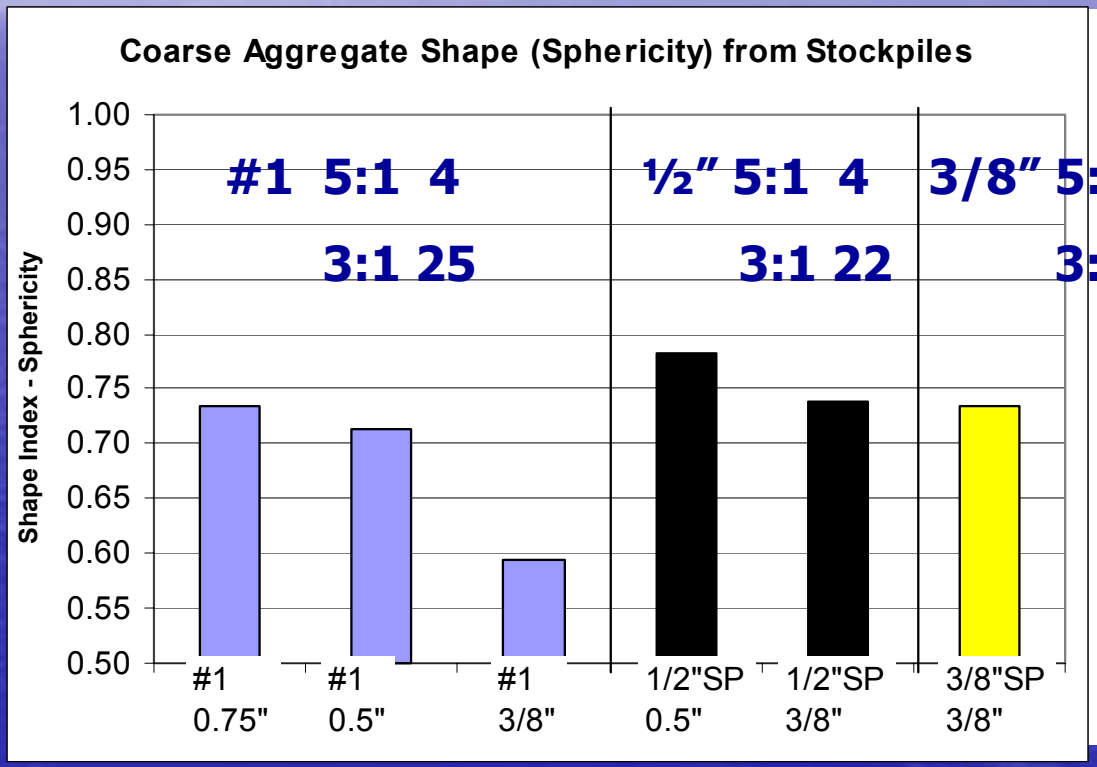
Shape Index - Sphericity

Shape Index = 1
- Aggregate is perfect sphere

Superpave F:E

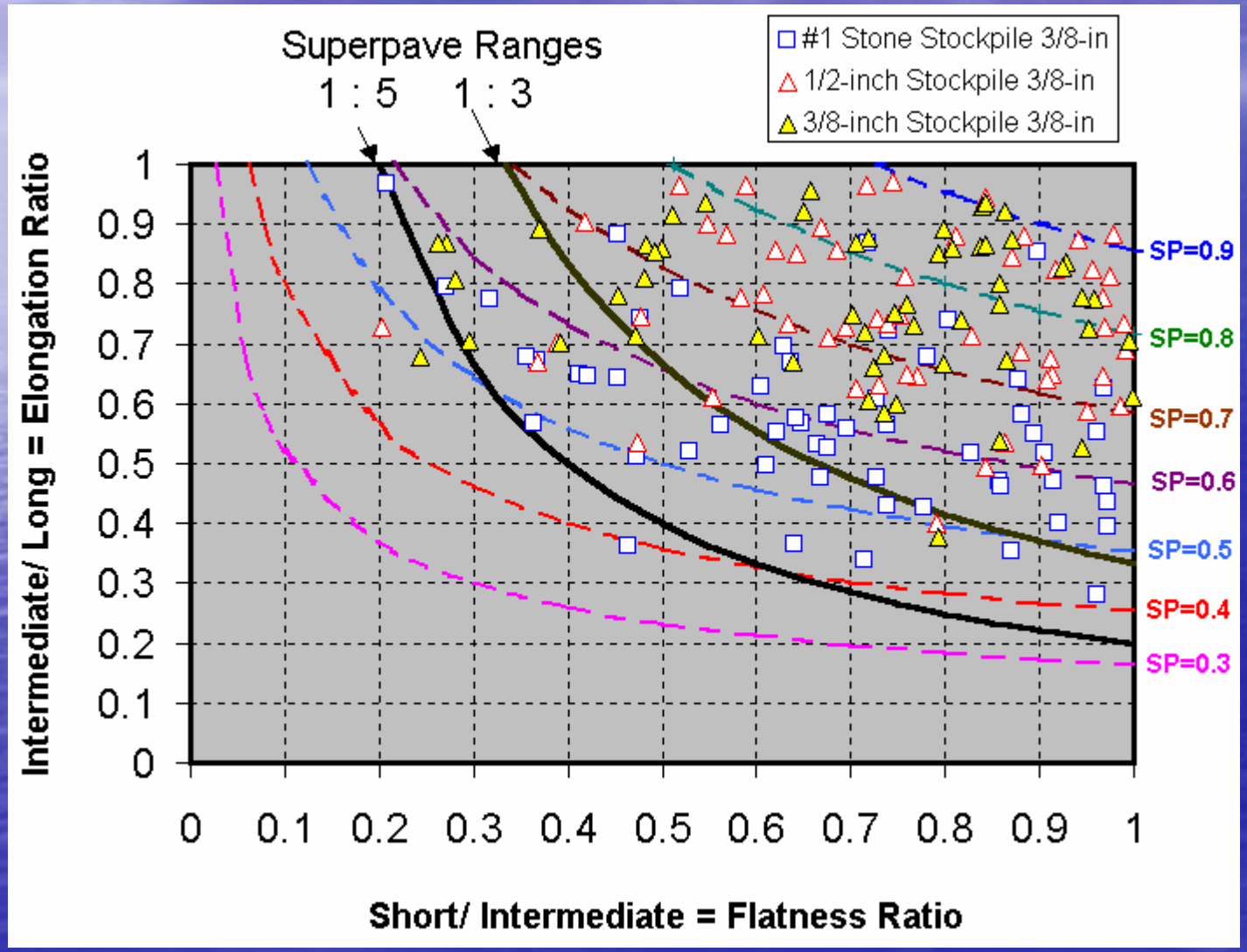
1:5 Ratio 6%

1:3 Ratio 22%

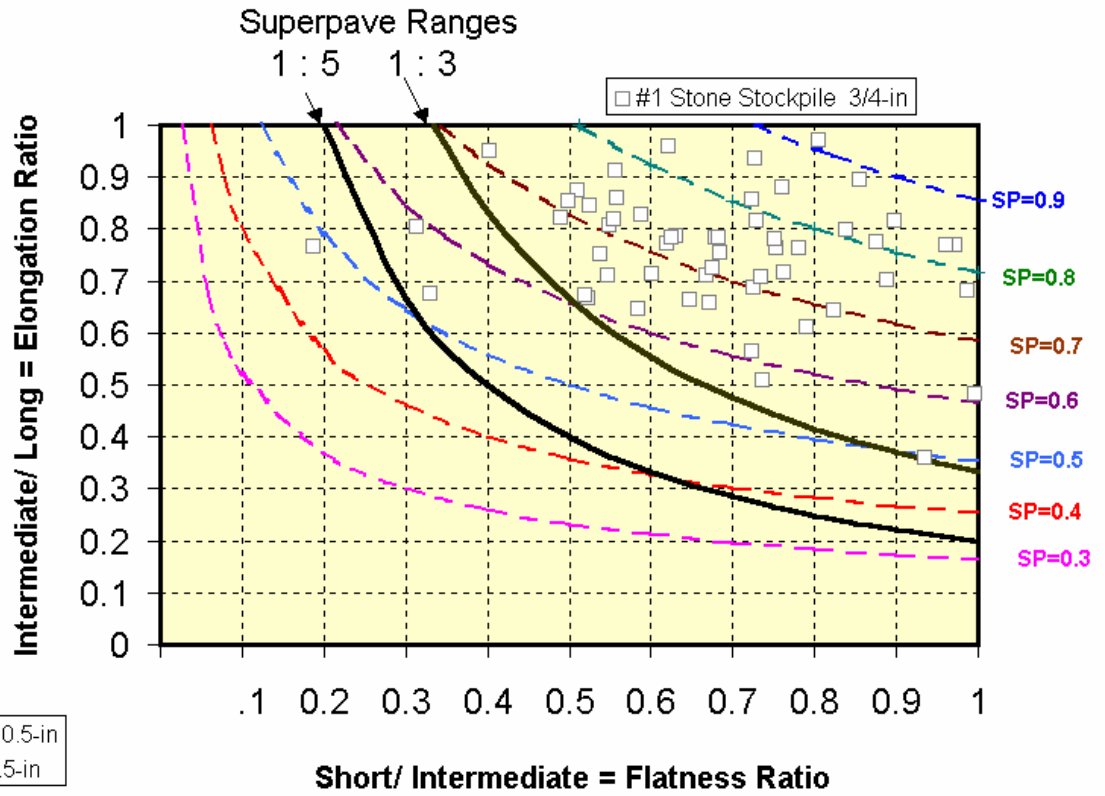


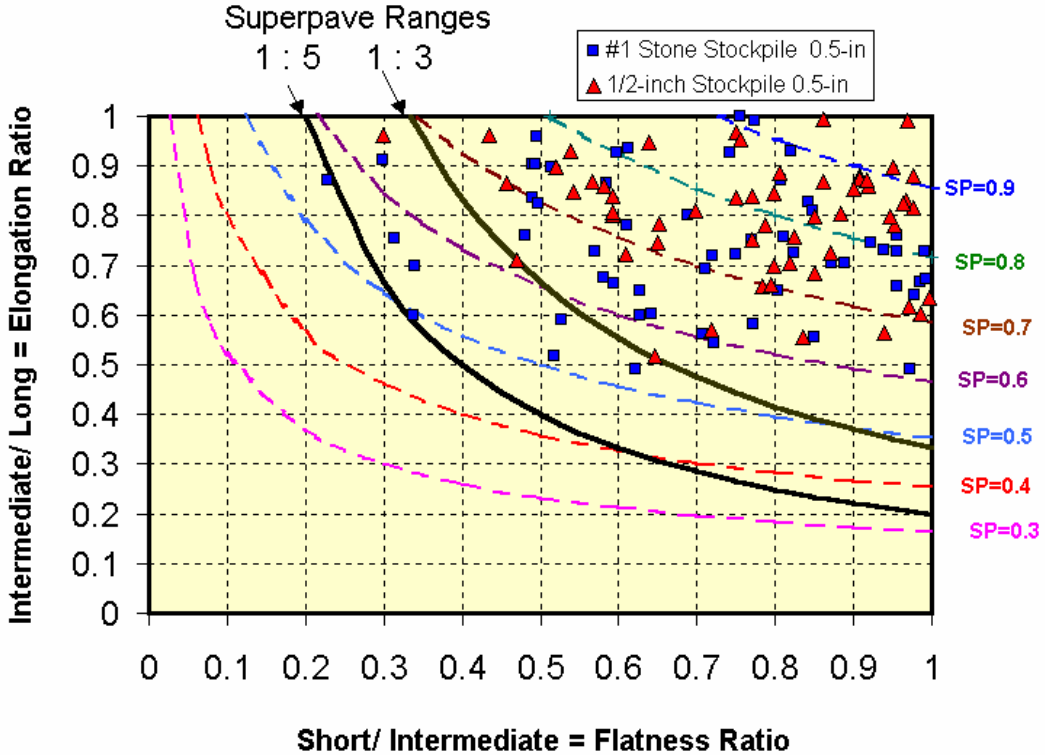
Aggregate from #1 Stone appears more flat & elongated

3/8-inch (9.5mm) aggregates



3/4-inch (19.5mm) aggregates





1/2-inch (12.5mm) aggregates

Aggregate Imaging

So what?

- Time savings – rapid return on test results
- Comparable with Superpave F:E test results
- Potential ties to performance test data
- Production monitoring of aggregates

Summary

How can data from SPT be used?

Pavement distress predictions in AASHTO design software are based on actual measured asphalt mix properties

Mechanistic-Empirical !!!

Other testing

Questions