

HOMEWORK TSR CERTIFICATION

1. What should be the finished height of the TSR puck?
2. What should be the finished air void content of the TSR puck?
Non-SMA: _____

SMA: _____
3. What should be the finished % saturation of the TSR puck?

What should you do if it is low on saturation?

What should you do if it is high on saturation?

4. For Superpave, if the TSR (during production) is 73, what is the pay adjustment factor?
5. Under what conditions is TSR required for BP and BB mixes?
6. What is the minimum acceptable level of TSR for:
 - a) Superpave mix design approval _____
 - b) BB and BP mix design approval _____
7. Where can TSR loose mix samples be obtained?
8. Where should QA obtain their loose mix sample?
9. What is the minimum sampling frequency for QC?
10. What is the minimum sampling frequency for QA?

11. List the TSR sample size reduction procedure.

12. What should the QA inspector do with the loose sample?

13. Why do we need a G_{mm} (Rice specific gravity) value?

14. Calculate the mass (weight) required to achieve 7.0% air voids in a 9.5 cm tall 15.0 cm diameter TSR puck. The following is some information about 3 pucks and a Rice specific gravity that were sampled and tested in the vicinity of the TSR sampling spot.

$G_{mm} = 2.493$

$\pi = 3.14159$

Specimen	1	2	3	
M _{meas} (g)	4951.0	4941.0	4945.0	
G _{mb, meas}	2.375	2.364	2.371	
h @N _{des} (cm)	12.01	12.06	12.04	

For full credit, show all work:

- 1.) Write equation
- 2.) Substitute values into the equation
- 3.) Compute answer

$G_{mb, est}$

1.)

2.)

3.) _____

C factor:

1.)

2.)

3.) _____

Mass of TSR puck:

1.)

2.)

3.) _____g

15. Complete the attached spreadsheet. **Show all work below: 1) write equations, 2) substitute values into equations, 3) compute answers**

Volume of puck:

1)

2)

3) _____ cm³

G_{mb}:-----

1)

2)

3) _____

%Air Voids:-----

1)

2)

3) _____%

Dry volume of air:-----

1)

2)

3) _____ cm³

Average % air voids for the wet set:-----

1)

2)

3) _____%

Volume of absorbed water:-----

1)

2)

3) _____cm³

70% saturated target weight:-----

1)

2)

3) _____g

80% saturated target weight:-----

1)

2)

3) _____g

% Saturation:-----

1)

2)

3) _____%

Indirect Tensile Strength (ITS) of the puck:-----

1)

2)

3) _____psi

Average wet ITS (3 pucks):-----

1)

2)

3) _____psi

Average dry ITS (3 pucks):-----

1)

2)

3) _____psi

TSR: -----

1)

2)

3) _____%



Mix Number	Homework						Gmm =	2.476
							D=	15.0 cm
Gmb Worksheet	Dry Subset			Wet Subset				
Specimen #	1	2	3	4	5	6		
Weight in air (g) [A]	3725.8	3749.7	3755.1	3822.4	3759.7	3692.3	A	
SSD Weight (g) [B]	3735.6	3761.0	3765.0	3833.5	3770.7	3707.9	B	
Weight in water (g) [C]	2114.3	2135.9	2140.2	2180.0	2144.3	2094.9	C	
Height (0.1 cm) [t]	9.5	9.5	9.5	9.7	9.5	9.5	t	
Volume (cm ³) [B - C]	1621	1625	1625	1654		1613	[B-C]	
Gmb [A / (B - C)]	2.298	2.307	2.311	2.312		2.289	A / [B-C]	
% Air Voids [Pa]	7.2	6.8	6.7	6.6		7.5	Pa=100[Gmm-Gmb] / Gmm	
Dry volume of air (cm ³) [Va]	117	111	108	110		122	Va=Pa[B-C] / 100	
Average % Air Voids	Dry=	6.9		Wet=				
Overall								

Rectangular Snip

TSR Worksheet	Dry Subset			Wet Subset			
Specimen #	1	2	3	4	5	6	
Height (0.1 cm) [t]	9.5	9.5	9.5	9.7	9.5	9.5	t
Max. Load (lbs) [P]	3852	3601	3761	1564	1517	1197	P
Ind. Tens. Str.:ITS (psi)*	111	104	108	44		35	ITS=6.4516*2P / 3.1415 t D
* For 15.0 cm diameter specimen[D]	Vacuum SSD Wt. (g)[B']			3902.9	3846.0	3787.3	B'
Avg. Wet ITS (psi)[Swet]		Weight in air (g)[A]		3822.4		3692.3	A
Avg. Dry ITS (psi)[Sdry]	108	Vol. Absorb H ₂ O (cm ³)[J]		81		95	B'-A
TSR (%) [100Swet/Sdry]		Dry volume of air (cm ³)[Va]		110		122	Va
		70% Sat. (Target VSSD)		3899		3778	70% Sat=A+ 0.7Va
	AVG	80% Sat. (Target VSSD)		3910		3790	80% Sat=A+ 0.8Va
Air Voids (%)		% Saturation		73		78	% Sat=100 J' / Va
Dry Subset %Air	6.9		in. Hg	22	23	23	
Wet Subset %Air			Time (min)	8	8	8	
Saturation (%)			in. Hg	25	26	24	
			Time (min)	1	1	1	
		Dry Subset					
Time in 25 C waterbath (2 hrs ± 10 min)	1h 50m	1h 55m	2h				
				Wet Subset			
NOTE: Shaded cells indicate cells needing input values		Time in Freezer (Minimum 16 hrs)		19h 44m	19h 16m	18h 54m	
		Time in 60 C waterbath (24 ± 1 hrs)		23h 30m	23h 30m	23h 30m	
Test Time	12/22/2003 5:25 PM	12/22/2003 5:30 PM	12/22/2003 5:35 PM	12/22/2003 4:20 PM	12/22/2003 4:25 PM	12/22/2003 4:30 PM	