

Presentation on Design and Construction of Reclaimed Asphalt Pavement –RAP Base Course as per Annexure IX, IRC 37-2012

BY

ANKUR SINGH

DIRECTOR

ANULAB AGRA

PROJECT DETAILS

▶ Zone	Gorakhpur Zone, PWD, Gorakhpur
▶ Circle	Gorakhpur Circle, PWD Gorakhpur
▶ Division	Provisional Division, P.W.D. Gorakhpur
▶ Road	पटनाघाट रिठुआखोर घघसरा अ0जि0मार्ग के चौड़ीकरण एवं सुद्वढ़ीकरण
▶ Contractor	M/s. R.K. Traders, Gorakhpur-273003, U.P.
▶ Length of Project	10.000 Km
▶ Cost of Project	Rs. 18.180 Crore
▶ Existing Width	3.75 m
▶ Thickness of Crust	31.50 Cm
▶ Wearing Course	PC 20 mm (PMGSY Spec.)
▶ Base Course	WBM (PMGSY Spec.)

SCOPE OF WORK

- ▶ Widening of Carriageway Width to 7.00 m
- ▶ Width of Shoulder 1.6 m each side
- ▶ Thickness of GSB in Wideing (115 mm)
- ▶ Thickness of WMM in Wideing (200 mm)
- ▶ Modified WMM with 3.5% Emulsion (RAP 2)
- ▶ Recycling Depth of Existing Surface – 100 mm
- ▶ Addition of 15% Fine Aggregate - Crushed Stone Dust to RAP
- ▶ Addition of 1.0% Cement OPC 43 Grade to RAP
- ▶ Addition of 3.5% Max. Emulsion Grade SS2 to RAP

CHALLENGES

- ▶ Heavy Traffic
- ▶ Limited Right of Way ROW
- ▶ No Previous Experience of Recycling by 4 Wheel Recycler
- ▶ Width of Recycler 2.4 m
- ▶ Existing Pavement Width 3.75 m
- ▶ Absence of Recycling Machinery in Gorakhpur
- ▶ Improper Design Provided by Emulsion Manufactures

PREPARATION OF SITE BEFORE RAP

- ▶ Widening of Road with GSB as sub base 115 mm thick as per Clause 401 MORTH Vth Rev 2013
- ▶ Compacting full width 1.62 m (Both side) with WMM as per Clause 406 MORTH Vth Rev 2013
- ▶ Sampling of RAP for JMF by Writgen 4 wheel Recycler at 500m
- ▶ Selection of Emulsion Brand for Uniformity
- ▶ Verification of JMF Design at PWD Lab
- ▶ Stocking of Additional Aggregate

PHOTOGRAPHS OF RAP SAMPLING

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research@anulab.org 9897077259

PHOTOGRAPHS OF RAP SAMPLING

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PHOTOGRAPHS OF RAP SAMPLING

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SAMPLING VIDEO

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RAP JOB MIX FORMULA SPECIFICATIONS

- ▶ Reference 1: IRC:37-2012 Annexure IX
- ▶ Reference 2: Asphalt Institute MS – 14 Cold Mix Manual
- ▶ Reference 3: ASTM D6931 Test Method for Indirect Tensile Strength
- ▶ Reference 4: ASTM D4123 Resilient Modulus – MR Value Test
- ▶ Reference 5: ASTM D6927 Marshall Stability at 22.2 oC
- ▶ Reference 6: IRC: SP : 100 - 2014

JMF CHECK LIST FOR SITE

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- ▶ Blended RAP Condition (Wet)
- ▶ Additional Water for Optimum Flied Content – OFC
- ▶ Check for clay contamination
- ▶ Insitu Compacted Density at 24 hr & 72 hr.
- ▶ Marshall Test at 22.2oC -96 hr.
- ▶ Loss in Strength after soaking

PHOTOGRAPHS OF JMF

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① As received milled RAP from project site.



② Addition of SS2 emulsion at 3.0, 3.5 & 4.0%.



③ Mixing of RAP + aggregate+cement in pan at 22°C



④ Compaction of ITS & Marshall specimen-36 Nos.

PHOTOGRAPHS OF JMF

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⑨ Marshall test specimen with digital LVDT.



⑩ Automatic ITS testing machine with peak arrest.



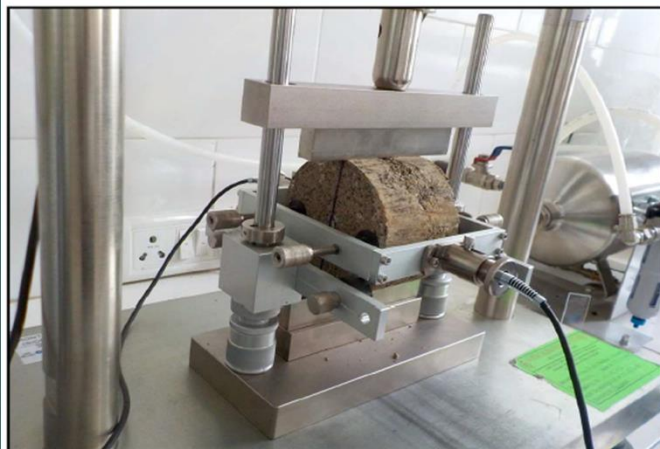
⑪ Closeup view of ITS specimen at 25°C



⑫ Broken test specimen showing crack.

PHOTOGRAPHS OF JMF

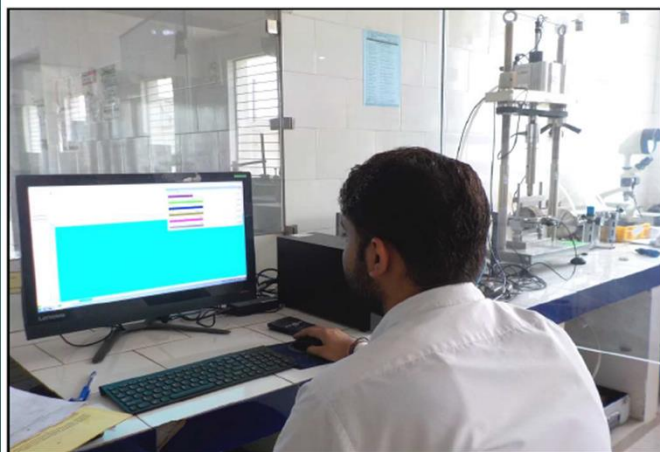
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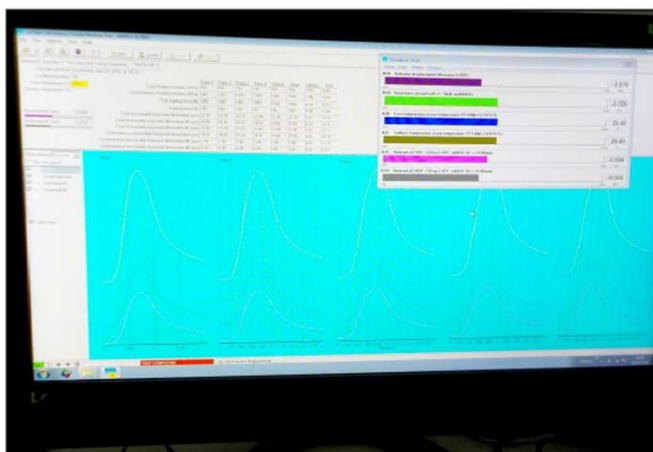
⑮ Conditioning of test specimen at 25°C in chamber.



⑯ Resilient modulus test data being input in software.



⑰ Cyclic loading within 0.1 μ s pulse being applied.



⑱ Graphical representation of data at the end of test.

PROPERTIES OF JMF

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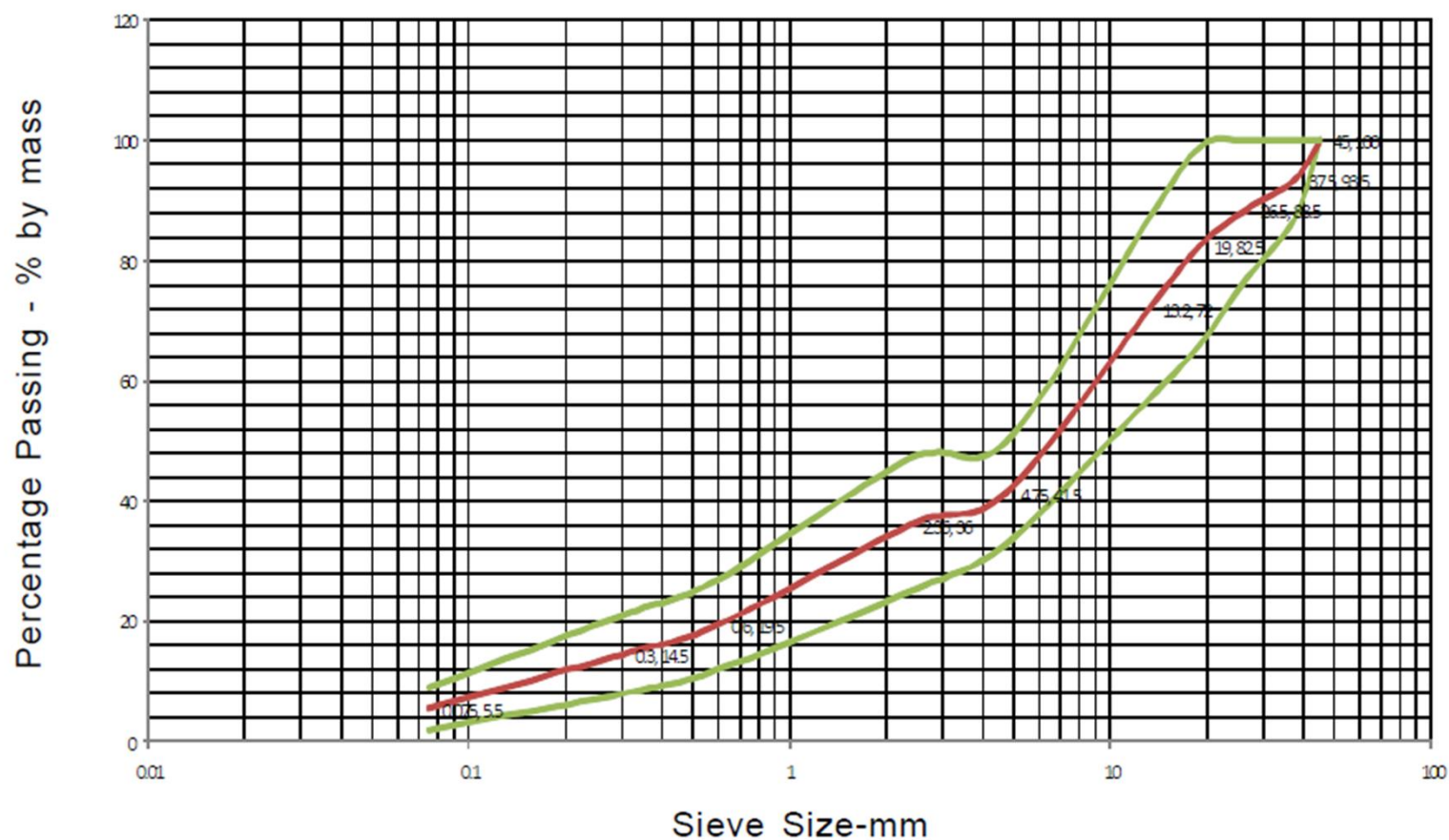
5.1 BLENDED RAP DESIGN BLEND-THEORETICAL (RAP : COARSE AGG. -20MM: CEMENT = 90:09:01)

Sl. No.	IS Sieve -mm	RAP Material	Aggregate -20 mm	Cement OPC-43	Comb. Grading	Mid. Value % Passing	Table IX-1 IRC: 37-2012	Conformnity
1.	45.0	90.00	9.00	1.00	100.00	100.00	100	Yes
2.	37.5	83.79	9.00	1.00	93.79	93.50	87-100	Yes
3.	26.5	71.82	8.87	1.00	81.69	88.50	77-100	Yes
4.	19.0	63.90	6.35	1.00	71.25	82.50	66-99	Yes
5.	13.2	56.07	0.94	1.00	58.01	72.00	57-87	Yes
6.	4.75	32.85	0.04	1.00	33.89	41.50	33-50	Yes
7.	2.36	26.55	0.03	1.00	27.58	36.00	25-47	Yes
8.	0.600	17.55	0.03	1.00	18.58	19.50	12-27	Yes
9.	0.300	14.49	0.03	1.00	15.52	14.50	8-21	Yes
10.	0.075	6.75	0.02	1.00	7.77	5.5	2-9	Yes

PROPERTIES OF JMF

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5.2 GRADATION OF BLEND OF RAP WITH FRESH AGGREGATES & CEMENT.



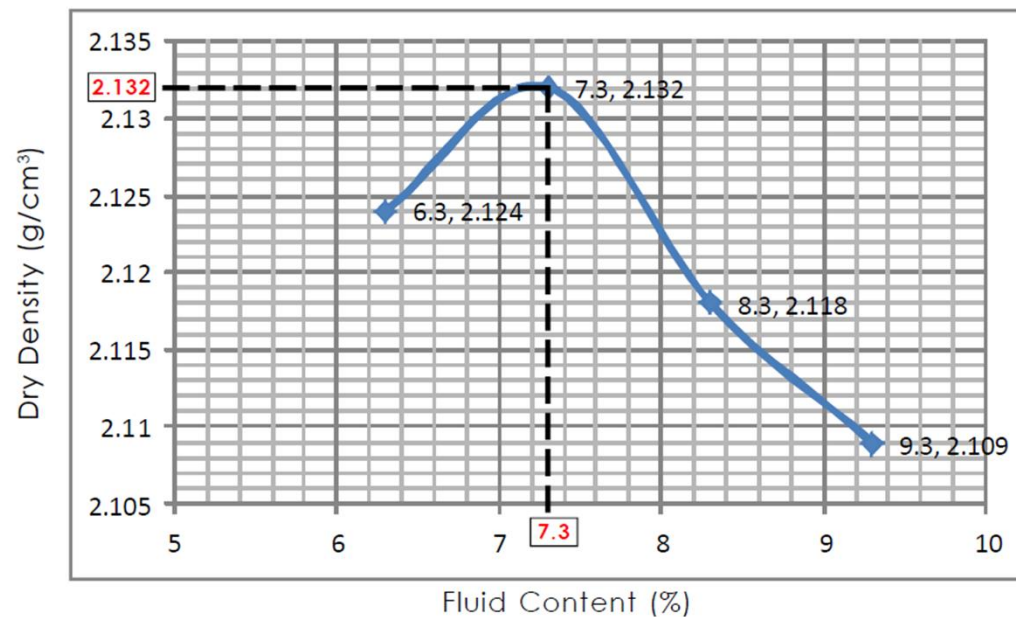
PROPERTIES OF JMF

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9.1 - SUMMARY OF DENSITY TEST FOR OPTIMUM FLUID CONTENT-OFC

1.	Emulsion Content	%	3.0	3.0	3.0	3.0
2.	Moisture Content in Blend	%	0.3	0.3	0.3	0.3
3.	Additional Water Added	%	3.0	4.0	5.0	6.0
4.	Total Fluid Content	%	6.3	7.3	8.3	9.3
5.	Dry Density	g/cm ³	2.124	2.132	2.118	2.109

9.2-GRAPH FOR DRY DENSITY VS FLUID CONTENT



PROPERTIES OF JMF

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REQUIRMENTS FOR THE MIX

Sl.	Characteristic Parameters	Unit	Test Method	IC 37-2012 Ann.IX Limits	Results	Conformity
1.	Depth of RAP Excavation	mm	IRC 37-2012	100 Max	100	Yes
2.	Emulsion Content	%	MS - 14	3.0-40	3.5	Yes
3.	Bulk Density ($G_{mb} \times 0.997$)	g/cm^3	ASTM D2726	To Report	2.278	Yes
4.	Dry Density	g/cm^3	ASTM D2726	To Report	2.142	Yes
5.	Fluid Content	%	ASTM D2216	To Report	7.3	Yes
6.	Dry Stability at 22.2°C	kN	ASTM D6927	2.224 Min.	18.0	Yes
7.	Soaked Stability at 22°C (1 hour)	kN	ASTM D6927	To Report	11.83	Yes
8.	Stability Loss - ITS_{dry} at 25°C	%	ASTM D6927	50 Max.	34.3	Yes
9.	ITS_{Dry} at 25°C	kPa	ASTM D6931	225 Min.	340.0	Yes
10.	ITS_{Wet} at 25°C (24 hours)	kPa	ASTM D6931	100 Min.	268.4	Yes
11.	Resilent Modulus M_R at 25°C	MPa	ASTM D4123	600-1200	764	Yes

PROPERTIES OF JMF

PROJECT: जनपद गोरखपुर में केन्द्रीय मार्ग निधि के अन्तर्गत पटनाघाट रिदुआखोर घघसरा मार्ग (अ.जि.मार्ग) के चौड़ीकरण एवं सुदृढीकरण का कार्य। लम्बाई 10.00 कि०मी०।

MIX PROPORTION AT OFC

Sl.	Characteristic Parameters	Unit	Test Method	Results
1.	RAP Material-Milled	% by mass of Aggregate Mix	IS 2386 P 01 (Wet)	90.0
2.	Coarse Aggregate 20mm			9.0
3.	Cement - OPC 43 Grade			1.0
4.	Emulsion SS2 Grade	% by mass of Total Mix	Annexure IX IRC: 37-2012	3.5
5.	Water (Added to Emulsion)			3.5

CONSTRUCTION FLOW CHART

- ▶ Widening 1.6 m on both sides
- ▶ Verification of WMM Density
- ▶ Recycling of Entire Width in 3 parts
- ▶ 2.4m + 2.4m + 2.4m
- ▶ Grading & Compaction of RAP
- ▶ Passage of Traffic after 24 Hr.
- ▶ Curing of RAP for 72 Hr.

CONSTRUCTION FLOW CHART

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- ▶ Application of Prime Coat VG-10
- ▶ Laying of DBM Grading -2
- ▶ Verification of Density & Thickness
- ▶ Laying of BC Grading – 2
- ▶ Verification of Density & Thickness

COMPACTION OF SUBGRADE FOR GSB²²



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research@anulab.org 9897077259

WMM COMPACTED WITHOUT EMULSION



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research@anulab.org 9897077259

RAP 4 WHEEL RECYCLER

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research@anulab.org 9897077259

CEMENT SPREADER

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INPUT OF JMF VALUES IN RECYCLER

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LAYING OF ADDITIONAL AGGREGATE

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research@anulab.org 9897077259

MIXING OF RAP + AGGREGATE + CEMENT + SS2 + WATER

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GRADING / SPREADING OF RAP

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COMPACTION OF RAP BASE LAYER

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RAP RECYCLING STAGE I COMPLETED

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CORE CUTTING OF RAP

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CRUST THICKNESS OF RAP

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TEST DURING CONSTRUCTION

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- ▶ DENSITY
- ▶ RESIDUAL BINDER CONTENT
- ▶ GRADATION
- ▶ MARSHALL DRY
- ▶ LOSS IN STRENGTH

HOT MIX PLANT

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research@anulab.org 9897077259

HOT MIX PLANT

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GRADATION VERIFICATION

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LAYING OF DBM

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COMPACTION OF DBM

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CORE CUTTING

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research@anulab.org 9897077259

VERIFICATION OF DENSITY (13.05.18)

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research@anulab.org 9897077259