

Four/Six Laning of Gandhidham (Kandla)-Mundra Port Section of NH-08A(Extn)  
(Approximate Length of 71.400km) In the State of Gujarat under NHDP Phase - III  
through PPP on Design, Built, Finance Operate and Transfer (DBFOT) Basis

Client : National Highways Authority of India  
Concessionaire : KM Toll Road Pvt. Ltd.  
Independent Engineer : DC DCI Joint Venture (Dorsch Gruppe)  
EPC Contractor : Reliance Infrastructure Limited  
Contractor : Larsen & Toubro Limited - ECC Division

**MIX DESIGN OF BITUMINOUS CONCRETE (BC-1)**

Source of Aggregate : Vidi Quarry, L&T Crusher  
Source of Bitumen : Kotak Petrochem- CRMB60

Proportion of Aggregate

26 to 18 mm	24%	25 0 to 5 mm	45%
18 mm to 12 mm	9%	18 Recycle filler	2%
12 mm to 5 mm	20%	16	

Bitumen 5.0 % By weight of Mix (Optimum Binder Content)

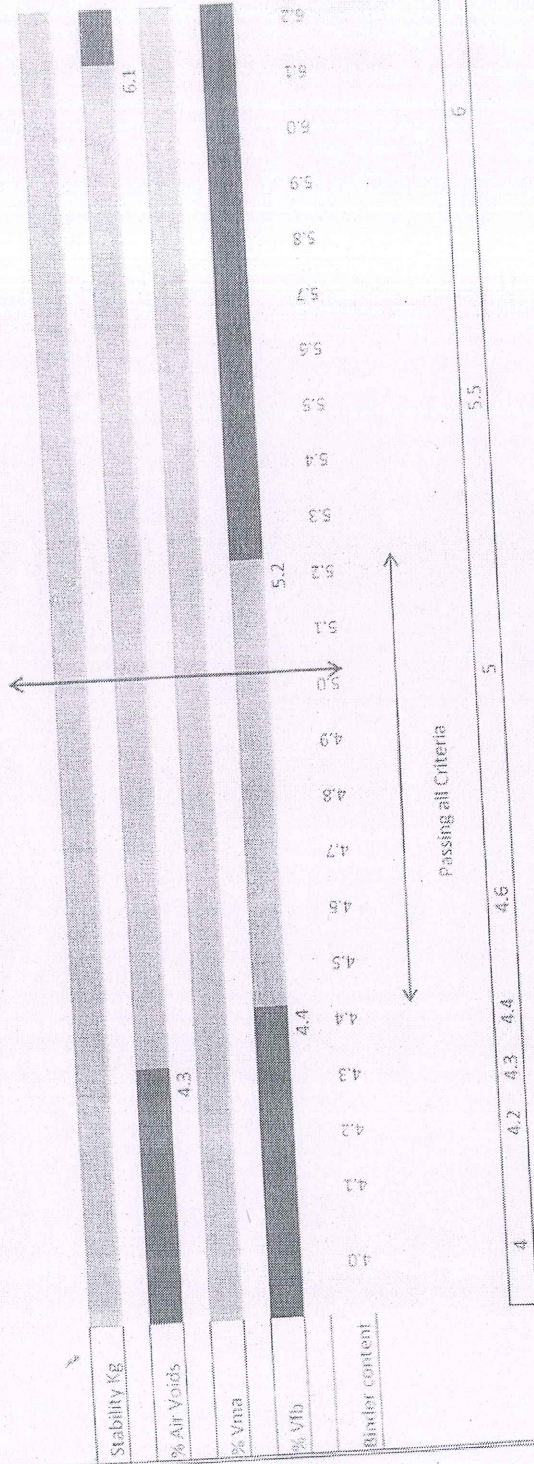
Sr No.	Description	Result	Specification
Matshall parameters at Optimum Binder content 5.0 % from Graph			
1	Stability at OBC	12.9	Min 9.0 KN
2	Bulk Density at OBC	2.532	
3	Air Voids at OBC	4.8	3 to 6
4	VFB %	72.6	65 to 75
5	Flow Value	2.9	2 to 4
6	VMA %	16.5	Min 12.5
Matshall parameters at Optimum Binder content 5.0 % from Confirmatory Trials			
1	Stability at OBC	12.7	Min 9.0 KN
2	Bulk Density at OBC	2.529	
3	Air Voids at OBC	4.51	3 to 6
4	VFB %	72.87	65 to 75
5	Flow Value	3.13	2 to 4
6	VMA %	16.68	Min 12.5

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**DETERMINATION OF OPTIMUM BINDER CONTENT**



(As per MORTH Min. 5% by weight of mix)

% OBC 5.0% By weight of mix

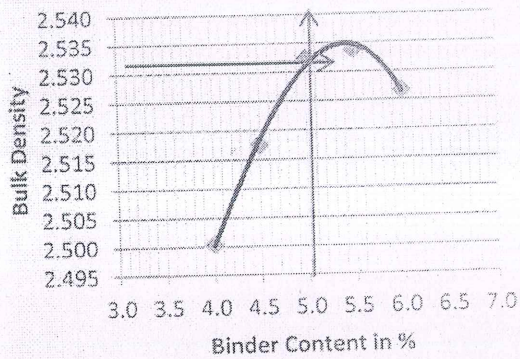
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 For EPC Contractor  
 For L&T/ECCD

For Concessionaire / IE

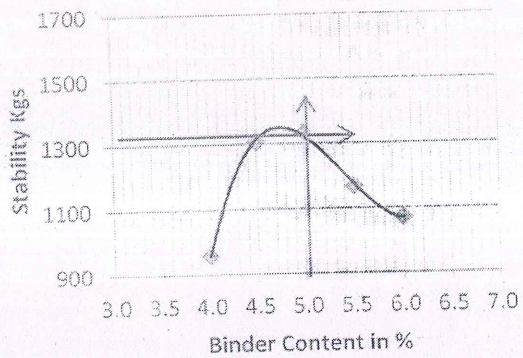
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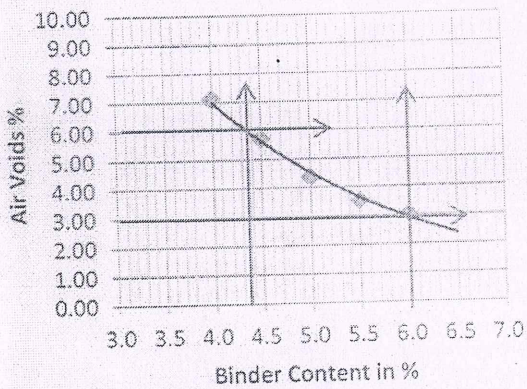
Binder Content V/s Bulk Density



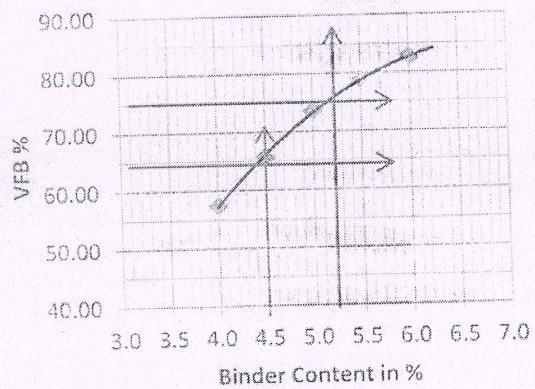
Binder Content V/s Stability



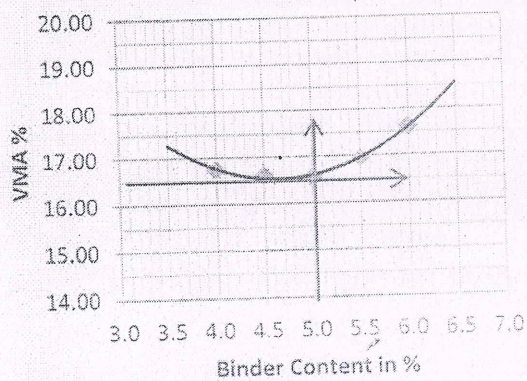
Binder Content V/s Air Voids



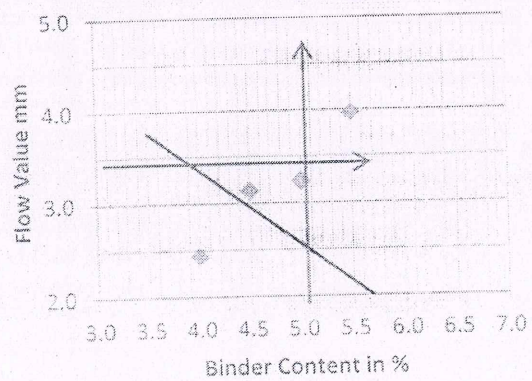
Binder Content V/s VFB



Binder Content V/s VMA



Binder Content V/s Flow Value



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 For L&T/ECCD

For EPC Contractor

For Concessionaire / IE

**Four/Six Lining of Gandhidham (Kandla)-Mundra Port Section of NH-08A(ExIn) (Approximate Length of 71.400km) In the State of Gujarat under NHDP Phase - III through PPP on Design, Built, Finance Operate and Transfer (DBFOT) Basis**

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 EPC Contractor : Reliance Infrastructure Limited  
 Contractor : Larsen & Toubro Limited - ECC Division

**DETERMINATION OF MARSHALL PARAMETERS**

Proving Ring Capacity : 30 Kn  
 Proving Ring No. : 591  
 Proving Ring Factor : 3.27

Gsb : 2.88  
 Gse : 2.88  
 Gb : 1.04

Binder Content	Gum	Weight of Specimen (gm)		Volume	Bulk Density	% Air Voids	% Va	% Vb	% Vma	% Vfb	Dial Gauge Reading	Stability Kg	Correction Factor	Corrected Stability (K)	Flow Value (mm)	
		In Air	In Water													
5	2.648	1244.00	754.00	491.00	2.53	4.4	83.4	12.2	16.6	73	340	1112	1.09	1212	3.2	
		1247.00	755.00	493.00	2.53						310	1014	1.09	1105	3.2	
		1267.00	768.00	501.00	2.53						370	3210	1.04	1258	3.0	
5	2.648	1240.00	751.00	491.00	2.53	4.7	83.2	12.1	16.8	72	400	1308	1.09	1426	3.6	
		1234.00	747.00	488.00	2.53						410	1341	1.09	1461	4.0	
		1245.00	752.00	494.00	2.52						370	1210	1.09	1319	2.8	
5	2.648	1240.00	750.00	491.00	2.53	4.5	83.4	12.2	16.6	73	380	1243	1.09	1354	3.1	
		1242.00	753.00	490.00	2.53						370	1210	1.09	1319	2.9	
		1255.00	760.00	496.00	2.53						350	1145	1.04	1190	2.4	
Avg.															1294	3.13

*[Signature]*  
 For EPC Contractor

For Concessionaire / IE

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**DETERMINATION OF MARSHALL PARAMETERS**

30 KN Proving Ring Capacity  
 591 Proving Ring No.  
 3.27 Proving Ring Factor

Gsb 2.88  
 Gse 2.88  
 Gb 1.04

Binder Content	Gmm	Weight of Specimen (gm)		Volume	Bulk Density	% Air Voids	% Va	% Vb	% Vma	% Vfb	Dial Gauge Reading	Stability Kg	Correction Factor	Corrected Stability kg
		In Air	In Water											
4	2.692	1231.00	745.00	490.00	2.512	7.11	83.26	9.62	16.74	57.45	260	850	1.09	927
		1235.00	740.00	498.00	2.480						290	948	1.04	986
		1232.00	744.00	491.00	2.509						270	883	1.09	962
4.5	2.670	1238.00	746.00	494.00	2.505	5.70	83.39	10.89	16.61	65.60	340	1112	1.09	1212
		1238.00	747.00	493.00	2.511						360	1177	1.09	1283
		1250.00	760.00	493.00	2.535						400	1308	1.09	1416
5	2.648	1250.00	758.00	494.00	2.530	4.36	83.45	12.18	16.55	73.55	370	1210	1.09	1319
		1244.00	756.00	490.00	2.539						370	1210	1.09	1319
		1254.00	759.00	496.00	2.528						400	1308	1.04	1360
5.5	2.627	1268.00	772.00	498.00	2.546	3.53	83.05	13.40	16.95	79.07	330	1079	1.04	1122
		1251.00	757.00	496.00	2.522						330	1079	1.04	1122
		1264.00	767.00	499.00	2.533						370	1210	1.04	1258
6	2.606	1232.00	745.00	488.00	2.525	3.03	82.38	14.58	17.62	82.71	310	1014	1.09	1105
		1265.00	768.00	499.00	2.535						290	948	1.04	986
		1255.00	758.00	498.00	2.520						330	1079	1.04	1122
					2.527									1071

For EPC Contractor

For Concessionaire / IE

For I&T/ESCC

Four/Six Laning of Gandhidham (Kandla)-Mundra Port Section of NH-08A(Extn)  
(Approximate Length of 71.400km) In the State of Gujarat under NHDP Phase - III

Client : National Highways Authority of India  
 Concessionaire : KM Toll Road Pvt. Ltd.  
 Independent Engineer : DC DCI Joint Venture (Dorsch Gruppe)  
 EPC Contractor : Reliance Infrastructure Limited  
 Contractor : Larsen & Toubro Limited - ECC Division

Material	Sp. Gr	%	Gsb	A. Sp. Gr	%	Gsa
26-18	2.902	24%	0.696	2.939	24.00%	0.705
18-12	2.895	9%	0.261	2.930	9.00%	0.264
12-05	2.889	20%	0.578	3.018	20.00%	0.604
5-0	2.869	45%	1.291	3.112	45.00%	1.400
RF	2.859	2%	0.057	3.032	2.00%	0.061

2.883

3.034

Gse

2.958

Sp.Gr. Bit

1.04

$Gse = \frac{Pmm - Pb}{\left[ \frac{Pmm}{Gmm} - \frac{Pb}{Gb} \right]}$	Bitumen	5	
	Aggregate	95	
		37.76	4.81
	Gse	2.883	
$Gmm = \frac{Pmm}{\left[ \frac{Pmm}{Gse} + \frac{Pb}{Gb} \right]}$		5	
		100	
		34.69	4.81
	Gmm	2.532	
Aggregate	Bitumen	Gmm Act.	
96.00	4.00	2.692	
95.50	4.50	2.670	
95.00	5.00	2.648	
94.50	5.50	2.627	
94.00	6.00	2.606	
95.00	5.00	2.648	
94.75	5.25	2.637	
94.50	5.50	2.627	

GMM at 5.0% for calculation

Weight of Sample		2776	2790
Weight of Empty Flask	A	1418	1418
Flask + Mix	B	4194	4208
Flask + Mix+ water	C	7767	7771
Flask + water	D	6037	6037

Gmm

$(B-A)/(B-A)-(C-D)$

2.654

2.642

Gmm

2.648

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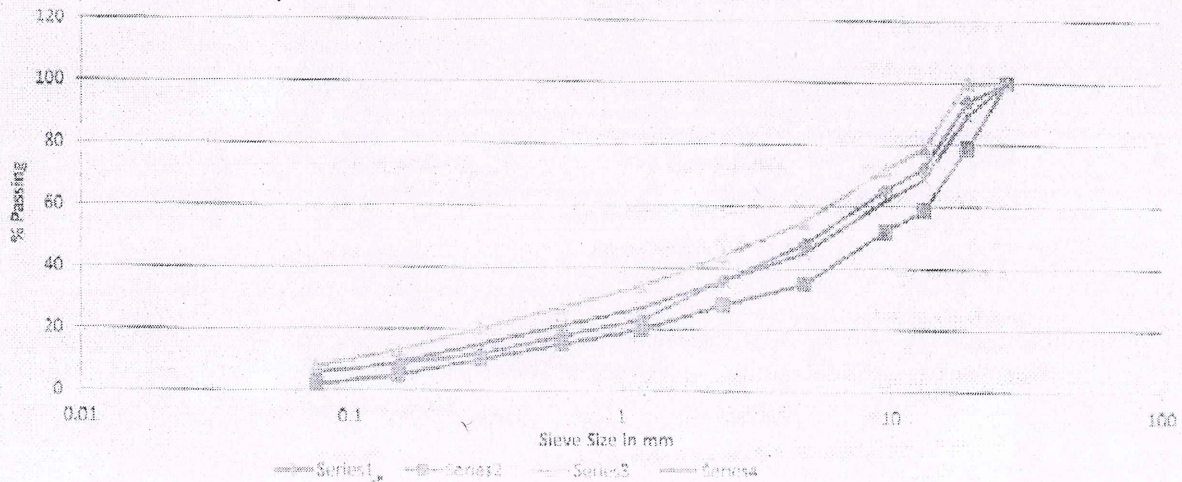
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**BLENDING OF AGGREGATE FOR BITUMINOUS CONCRETE (BC)**

Source: L&T crusher, Vidi

Proportion	1)	26 mm to 18 mm	24%
	2)	18 mm to 12 mm	9%
	3)	12 mm to 5 mm	20%
	4)	5 mm to 0	45%
	5)	Recycle Filler	2%

IS Sieve Size	Percentage passing					Percentage passing					Com. Gradation of Agg.	Gradation Limits (as per MORT&H table: 500-10)		
	26 to 18 mm	18 to 12 mm	12 to 5 mm	5 to 0 mm	Recycle Filler	26 to 18 mm	18 to 12 mm	12 to 5 mm	5 to 0 mm	Recycle Filler		Lower	Upper	MID
mm	100%	100%	100%	100%	100%	24%	9%	20%	45%	2%	100%			
26.5	100.00	100.00	100.00	100.00	100.00	24.0	9.0	20.0	45.0	2.0	100	100	100	100
19	74.51	100.00	100.00	100.00	100.00	17.9	9.0	20.0	45.0	2.0	94	79	100	89.5
13.2	3.77	52.08	100.00	100.00	100.00	0.9	4.7	20.0	45.0	2.0	73	59	79	69
9.5	1.05	6.07	88.21	100.00	100.00	0.3	0.5	17.6	45.0	2.0	65	52	72	62
4.75	0.68	2.16	14.57	94.43	100.00	0.2	0.2	2.9	42.5	2.0	48	35	55	45
2.36	0.61	1.77	6.83	72.00	100.00	0.1	0.2	1.4	32.4	2.0	36	28	44	38
1.18	0.58	1.38	6.15	43.45	100.00	0.1	0.1	1.2	19.6	2.0	23	20	34	27
0.600	0.16	1.23	5.93	31.96	100.00	0.0	0.1	1.2	14.4	2.0	18	15	27	21
0.300	0.16	0.90	5.71	19.04	95.90	0.0	0.1	1.1	8.6	1.9	12	10	20	15
0.150	0.16	0.83	5.48	12.83	88.40	0.0	0.1	1.1	5.8	1.8	9	5	13	9
0.075	0.16	0.67	5.32	6.28	85.58	0.0	0.1	1.1	2.8	1.7	5.7	2	8	5



For L&T EPC

For EPC Contractor

For Concessionaire / IE