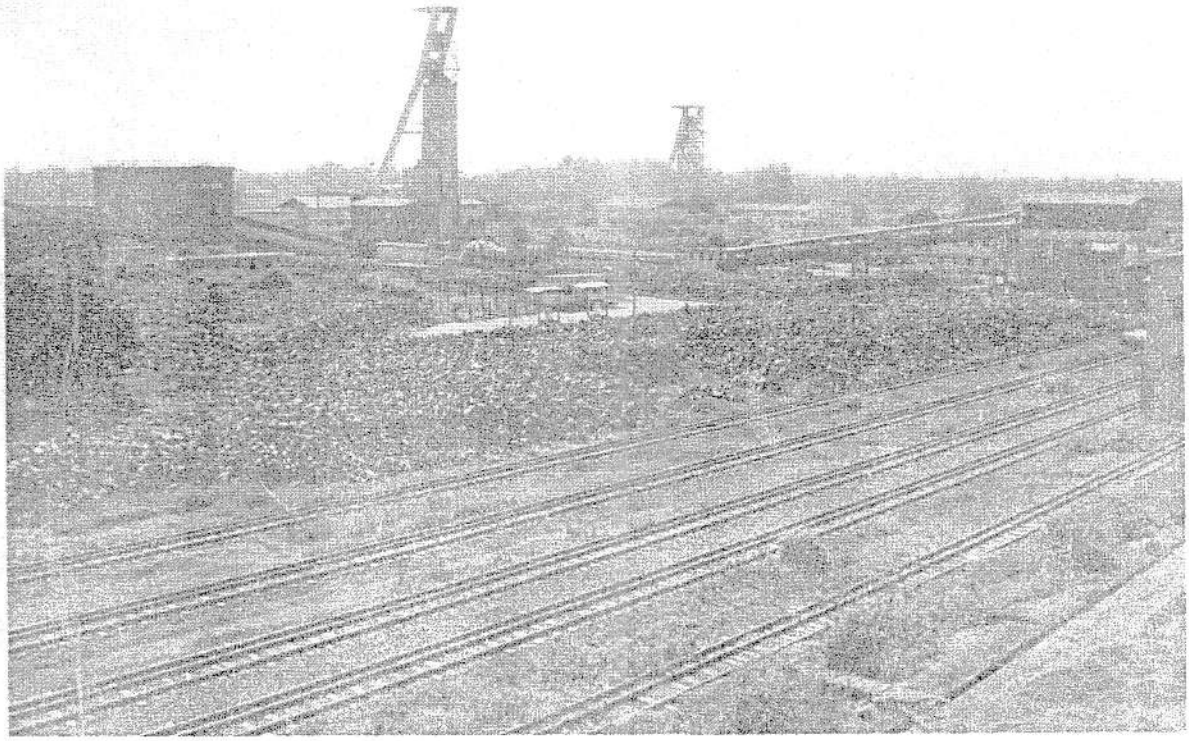
Maddhapara Granite Mining Company Limited (MGMCL)
(A Company of Petrobangla)
Ministry of Power, Energy and Mineral Resources
Government of the People's Republic of Bangladesh

Report
on
Suitability of the Maddhapara Hard Rock for use in Construction Works



Bureau of Research Testing & Consultation
Department of Civil Engineering
Bangladesh University of Engineering & Technology (BUET)
Dhaka-1000

February 2013

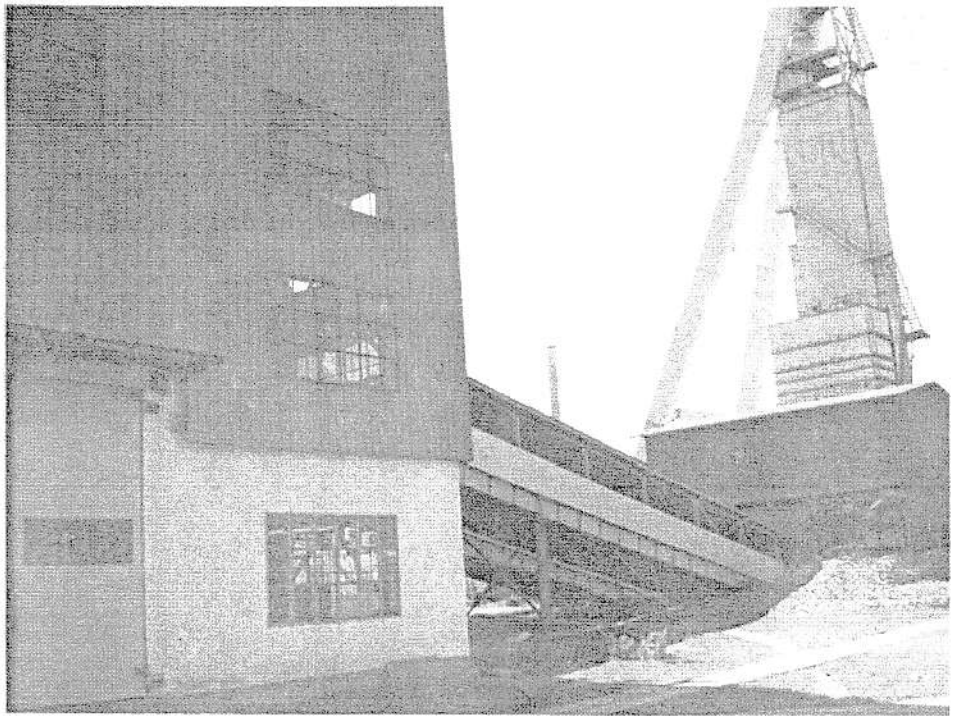
1. INTRODUCTION

In recent time, considerable amount of construction activities are taking place in Bangladesh. Aggregates are the major construction materials of these construction projects. In the forthcoming years the demand of stone aggregate is expected to increase significantly both in public and private sectors. In addition to the hectic construction of residential and office building in the country, quite a few major construction projects (especially, bridge, barrage, runways and highways) are already in the pipeline or in the planning process. During the construction of the Bangabandhu bridge the shortage of suitable aggregate supply was a major concern to the authorities. Ultimately, the bulk portion of aggregates used in the river training work of Jamuna bridge was imported from Bhutan and Indonesia at the expense of hard earned foreign currencies; while the aggregates required for the main bridge construction was furnished from the local source of Sylhet and Panchagarh.

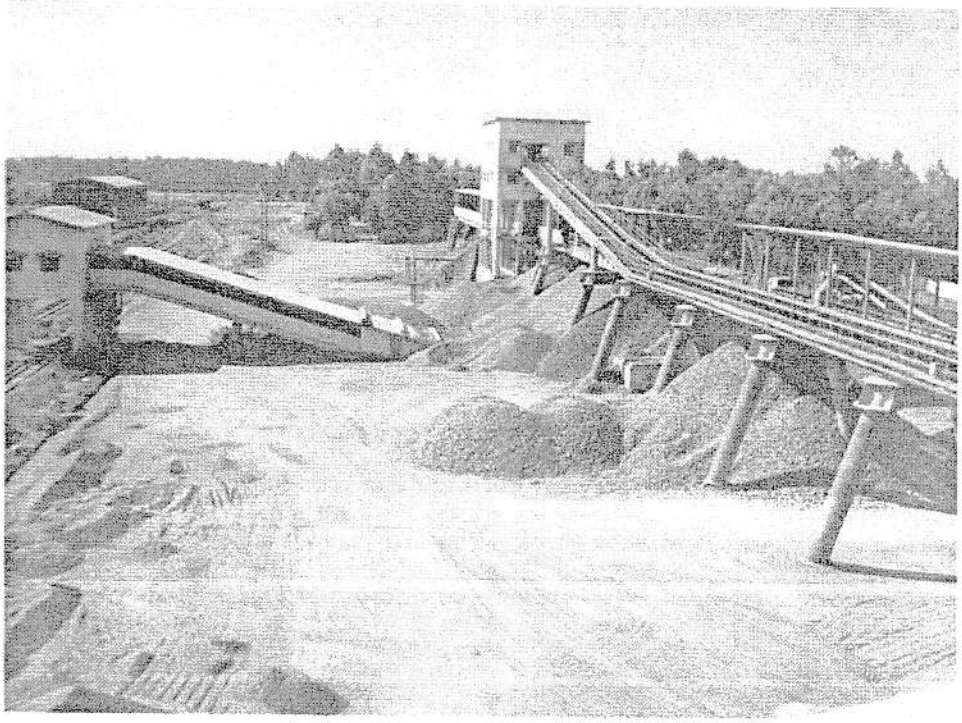
Fortunately, Bangladesh has an underground hard rock deposit of considerable size in Maddhapara, located in the northwestern part of Bangladseh under Dinajpur district. The mine is operated by Maddhapara Granite Mining Company Limited (MGMCL), a company of Petrobangla under the Ministry of Power, Energy & Mineral Resources, Government of the People's Republic of Bangladesh. The company was incorporated on August 04, 1998 with a paid up Capital of Taka 350 Crore under Company Act. of 1994. The mine is designed to produce 1.65 million M. tons of hardrock per annum (daily production capacity of 5,500 M. tons) to meet the requirement of flood control, construction of coastal and town protection embankment, construction and maintenance of bridges, roads & highways, embankment, river training, railway ballast, high rise buildings decorated tiles and other heavy construction works undertaken by different Government entities e.g. Bangladesh Bridge Authority, Public Works Department, Roads & Highways Department, Water Development Board, Bangladesh Railways etc.

The hardrock from the underground mine is transported through two vertical shafts. Rocks are then screened, crushed, washed and sorted for marketing. These are prepared in different categories such as, Boulder (250 mm & above), Crushed Stone (05-20 mm, 20-40 mm, 40-60 mm, 60-80 mm) and Stone Dust (00-05 mm).

MGMCL has formally requested the Department of Civil Engineering, Bangladesh University of Engineering and Technology (BUET) to prepare a report in the suitability of the Maddhapara hard rock as an ample source of coarse aggregate for local constructions. MGMCL further requested BUET to investigate the potential of using their Stone Dust in cement and bituminous concrete. This report thus investigated the physical and engineering properties of Crushed Stone (article-2) and then use of Stone Dust in cement concrete (article-3) and bituminous concrete (article-4).



Rocks are Transported for Crushing



Crushed Stone Sorting Yard

2. PHYSICAL AND ENGINEERING PROPERTIES OF CRUSHED STONE

The physical and engineering properties of Crushed Stone aggregate required for various construction works are investigated. The physical properties investigated are grain size analysis, bulk specific gravity, unit weight, water absorption, flakiness index, elongation index, percent clay lump & friable particles, percent materials finer than sieve # 200. The engineering properties of the aggregates investigated are Los Angeles abrasion value, aggregate impact value, aggregate crashing value, 10% fines value and percent loss in sodium sulphate soundness test. Test results are included in Appendix-A.

The standards related to the aggregate characteristics set by Roads & Highways Department, Bangladesh Railway and some internationally reputed institutions such as, American Standards for Testing Materials (ASTM), American Concrete Institute (ACI), American Association of State Highway and Transportation Officials

(AASHTO), Transportation Research Laboratory (TRL) UK, etc. are presented in the Table 1 and Table 2 along with the corresponding test results for the Maddhapara Crushed Stone. From the table, it is observed that for all the available standards, Maddhapara Crushed Stone meet the required specification for use in railway tracks, highway pavements and cement concrete works.

3. CEMENT CONCRETE MIX DESIGN

The Stone Dust was then mixed with Crushed Stone to produce 32 MPa and 38 MPa cement concrete mix. The mix design reports are included in Appendix-B.

4. BITUMINOUS CONCRETE MIX DESIGN (MARSHALL METHOD)

The Stone Dust was then also mixed with Crushed Stone to produce bituminous concrete for use in medium traffic areas. The mix design report is included in Appendix-C. Sample-1 was prepared mixing 65% of course aggregate, 30% of fine aggregate and 5% of mineral filler. Sample-2 was prepared mixing 70% of course aggregate, 25% of fine aggregate and 5% of mineral filler. In both the cases 80-100 penetration grade bitumen was used.

5. CONCLUDING REMARK

The Crushed Stone from the Maddhapara hard rock meets the standards set by various agencies for different construction purposes. Therefore, its use in both private and public sector construction projects can be recommended. In this context, it can mention here that the Bangladesh Railway has already started to use Maddhapara hard rock as stone ballast. Further, the Civil Aviation Authority of Bangladesh (CAAB) has approved Maddhapara hard rock mine as source of course aggregate for bituminous overlay construction at Hazrat Shahjalal International Airport (HSIA), Dhaka. The Stone Dust can also be used in both cement and bituminous concrete. But mix design should be performed to assess it's appropriate proportion to get desired results.

Table 1: SPECIFICATIONS FOR PHYSICAL AND ENGINEERING PROPERTIES (Road & Rail)

Sl. No.	Name of Test	ASTM D-693 standard for crushed aggregate of macadam pavement (ASTM 1992)	ASTM D-1139 standard for aggregate for bituminous surface treatments (ASTM 1992)	Road note 31 standard for aggregate for asphalt concrete (TRL)	Road Materials Materials and standards study Bangladesh (Roads and Highways 1994)	Crushed Stone Ballast for Bangladesh Railway	Maddhapara crushed stone
1	Los Angeles Abrasion (LAA) ASTM C535	<50 (B.C) <40 (S.C)	<40	<40 (W.C) <50 (others)	30-35(W.C)	<35	28
2	Aggregate Impact Value (AIV) BS812			<25			25
3	Aggregate Crushing Value (ACV) BS812			<25	25-30		23
4	10% Fines Value (TFV) BS812				>125		140
5	Flakiness Index (FI) BS812			<45	20-25		22 (small size) 44 (large size)
6	Elongation Index (EI) BS812						41 (small size) 7 (large size)
7	Coating & Stripping Test						Above 95%
8	% loss in Sodium Sulphate Soundness Test ASTMC88	<20	<12	<12		<8	0.34
9	Bulk Specific Gravity BS812					>2.60	2.755
10	% Water Absorption BS812			<2		<1.5	0.12
11	Unit Weight, Kg/m³ (Loose & Compacted)		>1120				1360 (loose) 1500 (compacted)
12	% Clay Lump & Friable Particles					<2	0.04
13	% Materials finer than #200 sieve					<1	0.16

* Note: WC means wearing course, S.C. means surface course and B.C. means base course.
** According to a report prepared by Samwhan corporation for Jamuna bridge project approach road, total acid soluble sulphates in aggregate should not more than 2.5% and total acide soluble chloride should be within the range of (0.1% - 0.3%) depending on the ingredients of the cement used.

Table 2: SPECIFICATIONS FOR PHYSICAL AND ENGINEERING PROPERTIES (Cement Concrete)

Sl. No.	Name of Test	ASTM C33 stanadard for concrete aggregates (ASTM 1988)	ACI suggested typical range of concrete aggregate properties (ACI 221R-2-1994)	AASHTO M-80 standard for cement concrete aggregate (AASHTO 1993)	Maddhapara crushed stone
1	Los Angeles Abrasion (LAA) ASTM C535	50	15-50	<50	28
2	Aggregate Impact Value (AIV) BS812				25
3	Aggregate Crushing Value (ACV) BS812				23
4	10% Fines Value (TFV) BS812				140
5	Flakiness Index (FI) BS812				22 (small size) 44 (large size)
6	Elongation Index (EI) BS812				41 (small size) 7 (large size)
7	Coating & Stripping Test				Above 95%
8	% loss in Sodium Sulphate Soundness Test ASTMC88	<12	1-12	<12	0.34
9	Bulk Specific Gravity BS812		1.6-3.2		2.755
10	% Water Absorption BS812		0.2-4.0		0.12
11	Unit Weight, Kg/m^3 (Loose & Compacted)	>1120			1360 (loose) 1500 (compacted)
12	% Clay Lump & Friable Particles				0.04
13	% Materials finer than #200 sieve				0.16

Appendix-A

Test Result for Physical and Engineering Properties of Crushed Stone

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

DEPARTMENT OF CIVIL ENGINEERING
Mobile: 01819 557964; PABX: 966 5650-80 Ext. 7226

TRANSPORTATION ENGINEERING LABORATORY

BRTC Bureau of Research, Testing & Consultation

Sieve Analysis and Grain Size Distribution of Aggregate

BRTC No: **110026261/11-12/CE** Date: **01.04.2012**

Reference: **Shila-100.124.18/2894(Ka)MEPC/DPHE/2010/500(03)** Date: **18.04.2012**

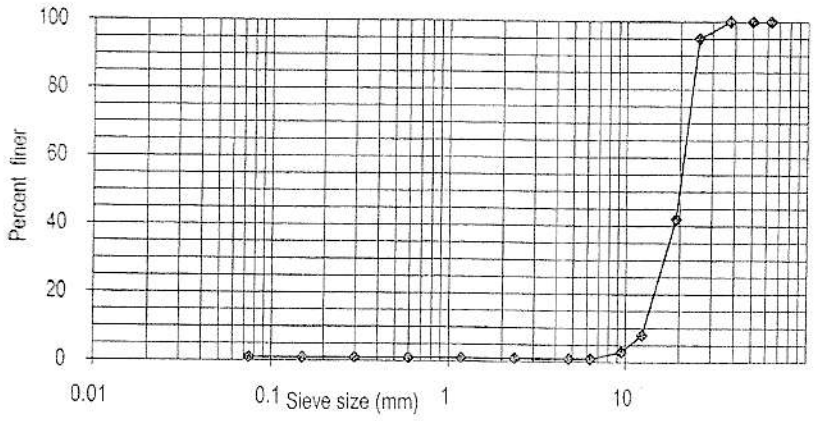
Sample sent by: Engr. Md. Monjurul Hoque, General Manager (Marketing)
Maddhapara Granite Mining Company Limited, Maddhapara, Parbatipur, Dinajpur.

Sample Type: **Crushed Stone**

Date of Test: 01.04.2012 - 15.10.2012

Sieve Size	Material Retained	Percent of Material Retained	Cumulative % Retained	Percent Finer	FM
mm	gm	%	%	%	
63	0.0	0	0	100	
50	0.0	0	0	100	
37.5	0.0	0	0	100	
25.4	261.0	5	5	95	7.49
19.05	2654.0	53	58	42	(seven point four nine)
12.5	1682.0	34	92	8	
9.5	243.0	5	97	3	
6.3	94.0	2	99	1	
4.75	13.0	0	99	1	
2.36	0.0	0	99	1	
1.18	0.0	0	99	1	
0.6	0.0	0	99	1	
0.3	0.0	0	99	1	
0.15	0.0	0	99	1	
0.075	0.0	0	99	1	
Pan	53.0	1	100	0	
Total	5000.0	100.0			

Gradation Chart



Countersigned by

Test performed by

17.10.2012

Dr. Hasib Mohammed Ahsan
Professor, Dept. of Civil Engg.
BUET, Dhaka-1000.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

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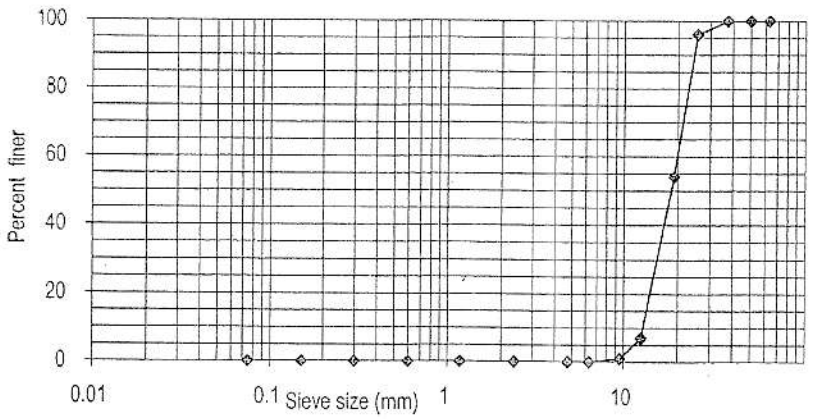
Sample sent by: Engr. Md. Monjurul Hoque, General Manager (Marketing)
Maddhapara Granite Mining Company Limited, Maddhapara, Parbatipur, Dinajpur.

Sample Type: **Crushed Stone**

Date of Test: 01.04.2012 - 15.10.2012

Sieve Size	Material Retained	Percent of Material Retained	Cumulative % Retained	Percent Finer	FM
(mm)	gm	%	%	%	
63	0.0	0	0	100	
50	0.0	0	0	100	
37.5	0.0	0	0	100	
25.4	379.0	4	4	96	**7.45**
19.05	4159.0	42	46	54	(seven point four five)
12.5	4737.0	47	93	7	
9.5	607.0	6	99	1	
6.3	100.0	1	100	0	
4.75	0.0	0	100	0	
2.36	0.0	0	100	0	
1.18	0.0	0	100	0	
0.6	0.0	0	100	0	
0.3	0.0	0	100	0	
0.15	0.0	0	100	0	
0.075	0.0	0	100	0	
Pan	18.0	0	100	0	
Total	10000.0	100.0			

Gradation Chart



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Test performed by

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BUET, Dhaka-1000.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

DEPARTMENT OF CIVIL ENGINEERING
Mobile: 01819 557964; PABX: 966 5650-80 Ext. 7226

TRANSPORTATION ENGINEERING LABORATORY

BRTC Bureau of Research, Testing & Consultation

Sieve Analysis and Grain Size Distribution of Aggregate

BRTC No: **110026261/11-12/CE** Date: **01.04.2012**

Reference: **Shila-100.124.18/2894(Ka)MEPC/DPHE/2010/500(03)** Date: **18.04.2012**

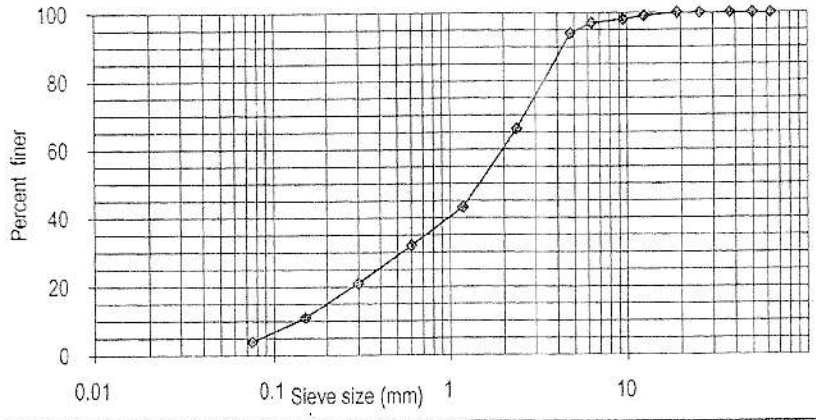
Sample sent by: Engr. Md. Monjurul Hoque, General Manager (Marketing)
Maddhapara Granite Mining Company Limited, Maddhapara, Parbatipur, Dinajpur.

Sample Type: **Crushed Stone Screening**

Date of Test: 01.04.2012 - 15.10.2012

Sieve Size	Material Retained	Percent of Material Retained	Cumulative % Retained	Percent Finer	FM
mm	gm	%	%	%	
63	0.00	0	0	100	
50	0.00	0	0	100	
37.5	0.00	0	0	100	
25.4	0.00	0	0	100	3.35
19.05	0.00	0	0	100	(three point three five)
12.5	6.26	1	1	99	
9.5	2.95	1	2	98	
6.3	4.78	1	3	97	
4.75	14.11	3	6	94	
2.36	139.92	28	34	66	
1.18	114.69	23	57	43	
0.6	56.02	11	68	32	
0.3	54.56	11	79	21	
0.15	48.31	10	89	11	
0.075	32.80	7	96	4	
Pan	25.60	5	100	0	
Total	500.00	101.0			

Gradation Chart



Countersigned by

Test performed by

17.10.2012

Dr. Hasib Mohammed Ahsan
Professor, Dept. of Civil Engg.
BUET, Dhaka-1000.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA
BUREAU OF RESEARCH, TESTING AND CONSULTATION
DEPARTMENT OF CIVIL ENGINEERING

BRTC No: **110026261/11-12/CE** Date: **01.04.2012**
Reference: **Shila-100.124.18/2894(Ka)MEPC/DPHE/2010** Date: **18.04.2012**
Sample sent by: Engr. Md. Monjurul Hoque, General Manager (Marketing)
Maddhapara Granite Mining Company Limited, Maddhapara, Parbatipur, Dinajpur.
Sample Type: **Crushed Stone**
Date of Test: 01.04.2012 - 15.10.2012

TEST RESULTS

(i) Aggregate Impact Value	(per cent)	25 (Twenty Five)
(ii) Aggregate Crushing Value	(per cent)	23 (Twenty Three)
(iii) Ten Percent Fines Value	(kN)	140 (One Hundred Forty)
(iv) Flakiness Index (Small size aggregate for RCC)	(per cent)	22 (Twenty Two)
(v) Elongation Index (Small size aggregate for RCC)	(per cent)	41 (Forty One)
(vi) Flakiness Index (Large size aggregate for Railways)	(per cent)	44 (Forty Four)
(vii) Elongation Index (Large size aggregate for Railways)	(per cent)	7 (Seven)
(viii) Bulk Specific Gravity		2.755 (Two Point Seven Five Five)
(ix) Water Absorption	(per cent)	0.12 (Zero Point One Two)
(x) Los Angles Abrasion value, Grade A	(per cent)	28 (Twenty Eight)
(xi) Los Angles Abrasion value, Grade 1	(per cent)	22 (Twenty Two)
(xii) Percent finer than sieve No. 200 by washing	(per cent)	0.16% (Zero Point One Six)
(xiii) Loose Unit Weight	(kg/m^3)	1360 (OneThousandThreeHundredSixty)
(xiv) Compact Unit Weight by Rodding	(kg/m^3)	1500 (One Thousand Five Hundred)
(xv) Clay Lump and Friable Particles	(per cent)	0.04 (Zero Point Zero Four)
(xvi) Estimated Coated Area for Coating and Stripping Test		Above 95%

Countersigned by :

Dr. Md. Abdur Rouf
Professor
Department of Civil Engineering
BUET, Dhaka-1000, Bangladesh

Test Performed by:

17.10.2012

Dr. Hasib Mohammed Ahsan
Professor
Department of Civil Engineering
BUET, Dhaka-1000, Bangladesh

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DEPARTMENT OF CIVIL ENGINEERING
Mobile: 01819 557964; PABX: 966 5650-80 Ext. 7226

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BRTC Bureau of Research, Testing & Consultation

SOUNDNESS OF AGGREGATE BY USE OF SODIUM SULPHATE (ASTM C 88-90 / AASHTO T104-92)

BRTC No: 110026261/11-12/CE Date: 01.04.2012

Reference: Shila-100.124.18/2894(Ka)MEPC/DPHE/2(Date: 18.04.2012

Sample sent by: Engr. Md. Monjurul Hoque, General Manager (Marketing)
Maddhapara Granite Mining Company Limited, Maddhapara, Parbatipur, Dinajpur.

Sample Type: Crushed Stone

Date of Test: 01.04.2012 - 15.10.2012

A. Quantitative Examination No. of Cycles: 5

Sieve sizes Passing - Retained	Grading of original sample (gm)	(%)	Weight of fraction before test (gm)	Weight of fraction after sieving (gm)	% passing designated sieve after test (% loss)	Weighted percentage loss (%)
Plus 63.0 mm (larger than 2.5")	0.0	0	0.0	0.0	0.0	0.00
63.0 mm - 50.0 mm (2.5" - 2.0")	0.0	0	0.0			
50.0 mm - 37.5 mm (2.0" - 1.5")	0.0	0	0.0	0.0	0.0	0.00
37.5 mm - 25.0 mm (1.5" - 1.0")	379.0	4	0.0			
25.0 mm - 19.0 mm (1.0" - 3/4")	4159.0	42	504.0	502.0	0.4	0.18
19.0 mm - 12.5 mm (3/4" - 1/2")	4737.0	47	671.0			
12.5 mm - 9.51 mm (1/2" - 3/8")	607.0	6	331.0	999.0	0.3	0.16
9.51 mm - 4.75 mm (3/8" - No.4)	118.0	1	0.0	0.0	0.0	0.00
Minus 4.75 mm (Passing No.4) (include if <10%)	0.0	0	0.0	0.0	0.0	0.00
Totals	10000.0	100	------	-------	-------	0.34

Weighted Percentage Loss in Sodium Sulphate = 0.34

Note: Freshly prepared solution was used.

B. Qualitative Examination

Sieve sizes Passing - Retained	Particles exhibiting distress: Flaking No. (%)	Splitting No. (%)	Crumbling No. (%)	Cracking No. (%)	Disintegration No. (%)	Total no. of particles before test
63.0 mm - 37.5 mm (2.5" - 1.5")	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (100)
37.5 mm - 19.5 mm (1.5" - 3/4")	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	27 (100)

Countersigned by :

Dr. Md. Abdur Rouf
Professor
Department of Civil Engineering, BUET.

Test performed by :

17.10.2012

Dr. Hasib Mohammed Ahsan
Professor
Department of Civil Engineering, BUET.

Appendix-B

Test Result for Cement Concrete Mix Design

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557 964; PABX: 966 5650-80 Ext. 7226; www.buet.ac.bd/ce/

BRTC Bureau of Research, Testing & Consultation

CONCRETE LABORATORY

MIX DESIGN OF CONCRETE (ACI 211.4R-93)

BRTC No: **1100-26261/CE/11-12** Date: 01.04.12
Reference: Shila 100.124.18/2898 (Kha) Date: 18.04.12
Sent by: Md. Samsul Mostafa, Deputy Manager (Marketing), Moddhapara Granite Mining Company Limited

Project: Testing of Moddhapara Hard Rock Sample

Contractor: -

Date of Casting: **25-Jun-12**
Trial Mix No.: **M-Para -1**
w/c: **0.50**

Target Mean Stength: **32.0** MPa (Class 24)
Brand Name of Cement: **Holcim (OPC)**
Name of Admixture: -
Coarse Aggregate: **Madha-Para Rock Crushed Stone**

COMPRESSIVE STRENGTH OF TRIAL MIX CONCRETE CYLINDERS

	3-days strength			7-days strength			28-days strength		
	Crushing strength (psi)	Crushing strength (MPa)	Type of Failure	Crushing strength (psi)	Crushing strength (MPa)	Type of Failure	Crushing strength (psi)	Crushing strength (MPa)	Type of Failure
1	----	----	---	3230	22.3	Combined	4550	31.3	Combined
2	----	----	---	3100	21.4	Combined	4680	32.2	Combined
3	----	----	---	3280	22.6	Combined	4830	33.3	Combined
Mean	----	----	-	**3200**	**22.0**	-	**4690**	**32.3**	-

28-Jun-12 [redacted] 2-Jul-12 69% 23-Jul-12 101%

Materials requirement for 1 m^3 of fresh concrete:

Water:	185	kg
Cement:	370	kg
Stone Dust (SSD):	756	kg
Coarse Aggregate (SSD):	1134	kg
Admixture*:	0.00	lt/100kg

Mix proportion (Volume Basis)
C:SD:CA = 1: 2.48 : 3.50

Slump:	15	mm

Countersigned by :

Dr. Md. Abdur Rouf
Professor
Department of Civil Engineering
BUET. Dhaka-1000

Test Performed by :

19.10.12

Dr. Md. Mizanur Rahman
Professor
Department of Civil Engineering
BUET. Dhaka-1000

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557 964; PABX: 966 5650-80 Ext. 7226; www.buet.ac.bd/ce/

BRTC Bureau of Research, Testing & Consultation

CONCRETE LABORATORY

MIX DESIGN OF CONCRETE (ACI 211.4R-93)

BRTC No: **1100-26261/CE/11-12** Date: 01.04.12
Reference: Shila 100.124.18/2898 (Kha) Date: 18.04.12
Sent by: Md. Samsul Mostafa, Deputy Manager (Marketing), Moddhapara Granite Mining Company Limited

Project: Testing of Moddhapara Hard Rock Sample

Contractor: -

Date of Casting: **25-Jun-12**
Trial Mix No.: **M. Para -2**
w/c: **0.46**

Target Mean Stength: **32.0** MPa (Class 24)
Brand Name of Cement: **Holcim (OPC)**
Name of Admixture: Conplast SP 430
Coarse Aggregate: **Madha-Para Rock Crushed Stone**

COMPRESSIVE STRENGTH OF TRIAL MIX CONCRETE CYLINDERS

	3-days strength			7-days strength			28-days strength		
	Crushing strength (psi)	Crushing strength (MPa)	Type of Failure	Crushing strength (psi)	Crushing strength (MPa)	Type of Failure	Crushing strength (psi)	Crushing strength (MPa)	Type of Failure
1	----	----	---	4200	28.9	Combined	5240	36.1	Combined
2	----	----	---	4080	28.1	Combined	5330	36.7	Combined
3	----	----	---	3810	26.2	Combined	5490	37.8	Combined
Mean	----	----	-	**4030**	**27.8**	-	**5350**	**36.9**	-

28-Jun-12 [redacted] 2-Jul-12 87% 23-Jul-12 [redacted] 5%

Materials requirement for 1 m^3 of fresh concrete:

Water:	190	kg
Cement:	413	kg
Stone Dust (SSD):	761	kg
Coarse Aggregate (SSD):	1051	kg
Admixture*:	0.30	lt/100kg

Mix proportion (Volume Basis)
C:SD:CA = 1: 2.24 : 2.91

Slump:	130	mm

Countersigned by :

Dr. Md. Abdur Rouf
Professor
Department of Civil Engineering
BUET. Dhaka-1000

Test Performed by :

14.10.12

Dr. Md. Mizanur Rahman
Professor
Department of Civil Engineering
BUET. Dhaka-1000

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

DEPARTMENT OF CIVIL ENGINEERING

Mobile: 01819 557 964; PABX: 966 5650-80 Ext. 7226; www.buet.ac.bd/ce/

BRTC Bureau of Research, Testing & Consultation

CONCRETE LABORATORY

MIX DESIGN OF CONCRETE (ACI 211.4R-93)

BRTC No: **1100-26261/CE/11-12** Date: 01.04.12
Reference: Shila 100.124.18/2898 (Kha) Date: 18.04.12
Sent by: Md. Samsul Mostafa, Deputy Manager (Marketing), Moddhapara Granite Mining Company Limited

Project: Testing of Moddhapara Hard Rock Sample

Contractor: -

Date of Casting: **25-Jun-12**
Trial Mix No.: **M Para-3**
w/c: **0.46**

Target Mean Stength: **38.0** **MPa** (Class 30)
Brand Name of Cement: **Holcim (OPC)**
Name of Admixture: **Conplast SP430**
Coarse Aggregate: **Madha-Para Rock Crushed Stone**

COMPRESSIVE STRENGTH OF TRIAL MIX CONCRETE CYLINDERS

	3-days strength			7-days strength			28-days strength		
	Crushing strength (psi)	Crushing strength (MPa)	Type of failure	Crushing strength (psi)	Crushing strength (MPa)	Type of failure	Crushing strength (psi)	Crushing strength (MPa)	Type of failure
1	----	----	---	4580	31.6	Combined	5700	39.3	Combined
2	----	----	---	4430	30.5	Combined	5920	40.8	Combined
3	----	----	---	4490	30.9	Combined	6040	41.6	Combined
Mean	----	----	-	**4500**	**31.0**	-	**5900**	**40.6**	-

28-Jun-12 [redacted] 2-Jul-12 82% 23-Jul-12 107%

Materials requirement for 1 m^3 of fresh concrete:

Water:	175	kg
Cement:	380	kg
Fine Aggregate (SSD):	754	kg
Coarse Aggregate (SSD):	1131	kg
Admixture*:	0.80	lt/100kg

Mix proportion (Volume Basis)
C:SD:CA = 1: 2.41 : 3.39

Slump:	150	mm

Countersigned by :

Dr. Md. Abdur Rouf
Professor
Department of Civil Engineering
BUET, Dhaka-1000

Test Performed by :

14.10.12

Dr. Md. Mizanur Rahman
Professor
Department of Civil Engineering
BUET, Dhaka-1000

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BRTC No: **1100-26261/CE/11-12** Date: 01.04.12
Reference: Shila 100.124.18/2898 (Kha) Date: 18.04.12
Sent by: Md. Samsul Mostafa, Deputy Manager (Marketing), Moddhapara Granite Mining Company Limited

Project: Testing of Moddhapara Hard Rock Sample

Contractor: -

Date of Casting: **25-Jun-12**
Trial Mix No.: **M Para - 4**
w/c: **0.42**

Target Mean Stength: **38.0** MPa (Class 30)
Brand Name of Cement: **Holcim (OPC)**
Name of Admixture: **Conplast SP430**
Coarse Aggregate: **Madha-Para Rock Crushed Stone**

COMPRESSIVE STRENGTH OF TRIAL MIX CONCRETE CYLINDERS

	3-days strength			7-days strength			28-days strength		
No.	Crushing strength (psi)	Crushing Strength (MPa)	Type of Failure	Crushing strength (psi)	Crushing strength (MPa)	Type of Failure	Crushing strength (psi)	Crushing strength (MPa)	Type of Failure
1	----	----	---	5340	36.8	Combined	6450	44.4	Combined
2	----	----	---	5140	35.4	Combined	6340	43.7	Combined
3	----	----	---	5680	39.1	Combined	6550	45.1	Combined
Mean	----	----	-	**5400**	**37.2**	-	**6450**	**44.4**	-

28-Jun-12 [redacted] 2-Jul-12 [redacted] 23-Jul-12 [redacted]

Materials requirement for 1 m^3 of fresh concrete:

Water:	170	kg
Cement:	405	kg
Fine Aggregate (SSD):	750	kg
Coarse Aggregate (SSD):	1125	kg
Admixture*:	0.90	lt/100kg

Mix proportion (Volume Basis)
C:SD:CA = 1: 2.25 : 3.17

Slump:	65	mm

Countersigned by :

Dr. Md. Abdur Rouf
Professor
Department of Civil Engineering
BUET, Dhaka-1000

Test Performed by :

14.10.12

Dr. Md. Mizanur Rahman
Professor
Department of Civil Engineering
BUET, Dhaka-1000

Appendix-C

Test Result for Bituminous Concrete Mix Design (Marshall Method)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)

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TRANSPORTATION ENGINEERING LABORATORY

BRTC
Bureau of Research, Testing & Consultation

BRTC No: **110026261/11-12/CE** Date: **01.04.2012**
Reference: **Shila-100.124.18/2894(Ka)MEPC/DPHE/2010/500(03)** Date: **18.04.2012**
Sample sent by: Engr. Md. Monjurul Hoque, General Manager (Marketing)
Maddhapara Granite Mining Company Limited, Maddhapara, Parbatipur, Dinajpur.

BITUMINOUS HOT-MIX DESIGN BY MARSHALL METHOD

Design Requirements:

Dense graded Hot-Mix Asphalt (HMA) wearing course to be used in a medium traffic area. The mixture contains a 25mm nominal maximum particle size aggregate. The adopted gradation for the combined mineral aggregate of crushed stone and crushed stone are attached with this report. A 80-100 penetration grade asphalt was used in the laboratory for design.

Marshall Mix Design Criteria for Medium Traffic (Surface & Base)

Compaction	= 50 blows at each end of specimen
Stability, kg	= 544 minimum
Flow, mm	= 2.03 – 4.06
Percent Air Voids (V)	= 3 – 5
Percent Voids in Mineral Aggregate (VMA)	= 12 minimum for 4% Design Air Voids
Percent Voids Filled With Asphalt (VFA)	= 65 – 78

Design Data and Test Property Curves:

Hot-mix design data by the Marshall method and relevant test property curves are attached with the report. At 4.0 percent air voids, the mixture properties are as following.

Sample-1:

Asphalt Content, %	= 4.8
Stability, kg	= 1450
Flow, mm	= 3.4
VMA, %	= 15
VFA, %	= 74

Sample-2:

Asphalt Content, %	= 4.75
Stability, kg	= 1360
Flow, mm	= 4.4
VMA, %	= 15
VFA, %	= 74

13.01.2013

Comparing these values to the Marshall Design Criteria, it is evident that the mixture for Sample-1 is acceptable for use in medium traffic areas and flow value is slightly higher than the limiting value in Sample-2 due to relatively courser gradation.

Countersigned by:

Dr. Abdur Rouf
Professor
Department of Civil Engineering
BUET.

Test performed by:

13.01.2013

Dr. Hasib Mohammed Ahsan
Professor
Department of Civil Engineering
BUET.

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TRANSPORTATION ENGINEERING LABORATORY

BRTC
Bureau of Research, Testing & Consultation

Sieve Analysis and Grain Size Distribution of Aggregate

BRTC No: 110026261/11-12/CE Date: 01.04.2012

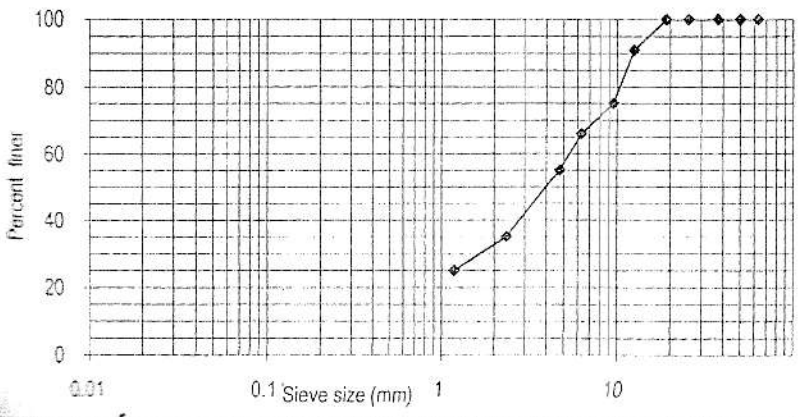
Reference: Shila-100.124.18/2894(Ka)MEPC/DPHE/2010/500(03) Date: 18.04.2012

Sample sent by: Engr. Md. Monjurul Hoque, General Manager (Marketing)
Maddhapara Granite Mining Company Limited, Maddhapara, Parbatipur, Dinajpur.

Sample Type: **Crushed Stone & Crushed Stone Screening (Sample-1)**

Sieve Size	Material Retained	Percent of Material Retained	Cumulative % Retained	Percent Finer	FM
mm	gm	%	%	%	
63	0.00	0	0	100	
50	0.00	0	0	100	
37.5	0.00	0	0	100	
25.4	0.00	0	0	100	**4.65**
19.05	0.00	0	0	100	(four point six five)
12.5	100.00	9	9	91	
9.5	189.00	16	25	75	
6.3	100.00	9	34	66	
4.75	131.00	11	45	55	
2.36	231.00	20	65	35	
1.18	116.00	10	75	25	
0.6	46.00	4	79	21	
0.3	81.00	7	86	14	
0.15	46.00	4	90	10	
0.075	58.00	5	95	5	
Pan	58.00	5	100	0	
Total	1156.00	100.0			

Gradation Chart



Countersigned by

[illegible] Abdur Rouf
Professor, Dept. of Civil Engg.
BUET, Dhaka-1000.

Test performed by

13.01.2013

Dr. Hasib Mohammed Ahsan
Professor, Dept. of Civil Engg.
BUET, Dhaka-1000.

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BRTC No: 110026261/11-12/CE Date: 01.04.2012

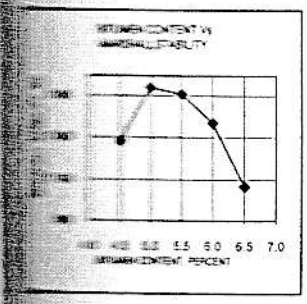
Reference: Shila-100.124.18/2894(Ka)MEPC/DPHE/2010/500(03) Date: 18.04.2012

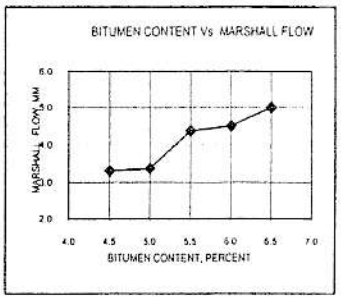
Sample sent by: Engr. Md. Monjurul Hoque, General Manager (Marketing)
Maddhapara Granite Mining Company Limited, Maddhapara, Parbatipur, Dinajpur.

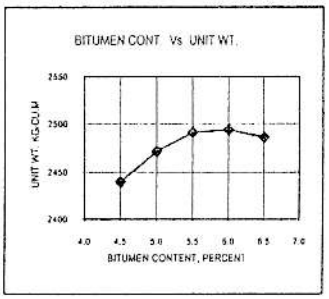
Test Property Curves for Hot-Mix Wearing Course Design Data by Marshall Method

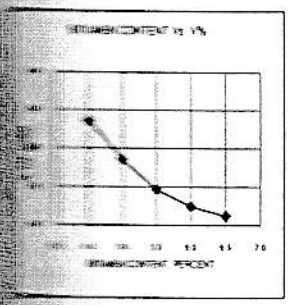
(Sample-1)

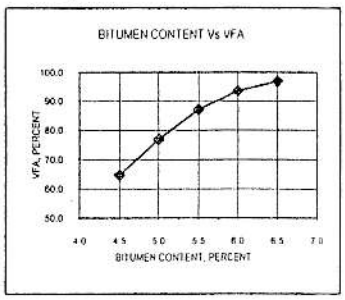
Bitumen Content	Marshall Stability,kg	Marshall Flow,mm	Unit wt. kg/cum	Percent Air Voids	Percent VFA	Percent VMA
4.5	1279	3.3	2440	5.4	64.7	15.4
5.0	1541	3.4	2472	3.4	76.8	14.8
5.5	1508	4.4	2491	1.9	87.2	14.5
6.0	1368	4.5	2494	1.0	93.4	14.9
6.5	1067	5.0	2486	0.5	96.9	15.6

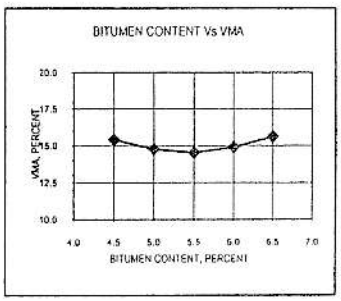












Countersigned By

Dr. Md. Abdur Rouf
Professor
Department of Civil Engineering

Test Performed By

13.01.2013

Dr. Hasib Mohammed Ahsan
Professor
Department of Civil Engineering

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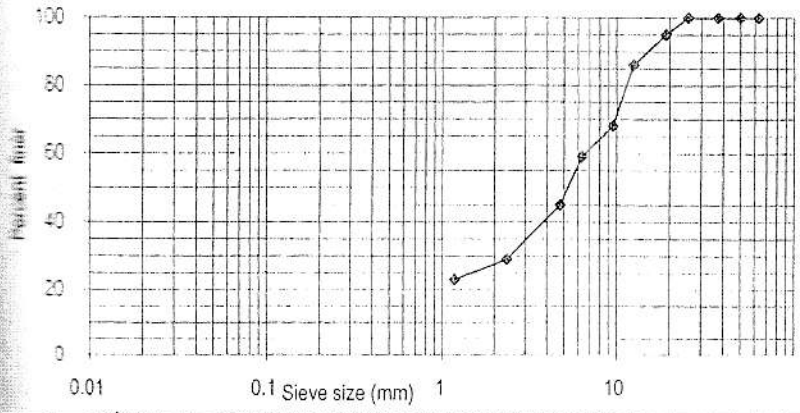
Reference: **Shila-100.124.18/2894(Ka)MEPC/DPHE/2010/500(03)** Date: **18.04.2012**

Sample sent by: Engr. Md. Monjurul Hoque, General Manager (Marketing)
Maddhapara Granite Mining Company Limited, Maddhapara, Parbatipur, Dinajpur.

Sample Type: **Crushed Stone & Crushed Stone Screening (Sample-2)**

Sieve Size	Material % Retained	Percent of Material Retained	Cumulative % Retained	Percent Finer	FM
mm	gm	%	%	%	
63	0.00	0	0	100	
50	0.00	0	0	100	
37.5	0.00	0	0	100	
25.4	0.00	0	0	100	5.03
19.05	58.00	5	5	95	(five point zero three)
12.5	100.00	9	14	86	
9.5	206.00	18	32	68	
6.3	100.00	9	41	59	
4.75	160.00	14	55	45	
2.36	185.00	16	71	29	
1.18	69.00	6	77	23	
0.6	69.00	6	83	17	
0.3	58.00	5	88	12	
0.15	50.00	4	92	8	
0.075	50.00	4	96	4	
Pan	51.00	4	100	0	
Total	1156.00	100.0			

Gradation Chart



Countersigned by

Abdur Rouf
Professor, Dept. of Civil Engg.
BUET, Dhaka-1000.

Test performed by

13.01.2013

Dr. Hasib Mohammed Ahsan
Professor, Dept. of Civil Engg.
BUET, Dhaka-1000.

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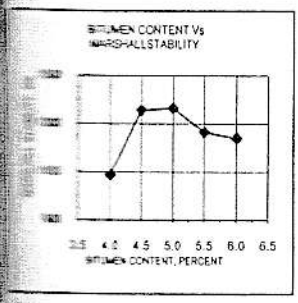
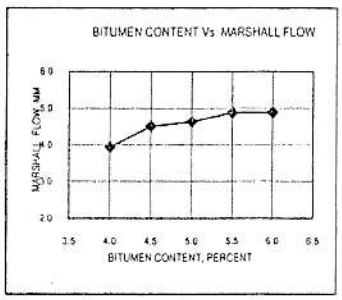
Sample sent by: Engr. Md. Monjurul Hoque, General Manager (Marketing)
Maddhapara Granite Mining Company Limited, Maddhapara, Parbatipur, Dinajpur.

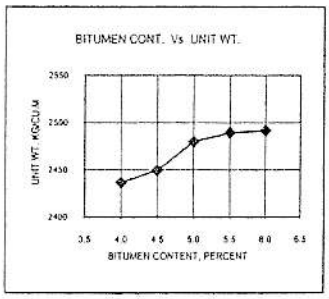
Test Property Curves for Hot-Mix Wearing Course Design Data by Marshall Method

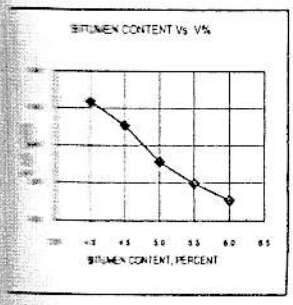
(Sample-2)

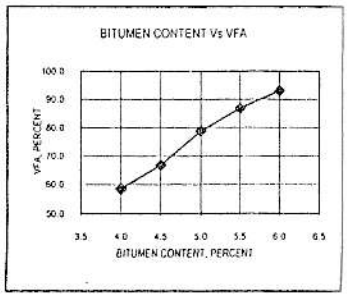
Bitumen Content	Marshall Stability,kg	Marshall Flow,mm	Unit wt. kg/cum	Percent Air Voids	Percent VFA	Percent VMA
4.0	1086	3.9	2436	6.3	58.4	15.2
4.5	1356	4.5	2449	5.1	66.7	15.2
5.0	1365	4.6	2480	3.1	78.8	14.6
5.5	1264	4.9	2489	1.9	86.8	14.8
6.0	1239	4.9	2491	1.1	93.0	15.1

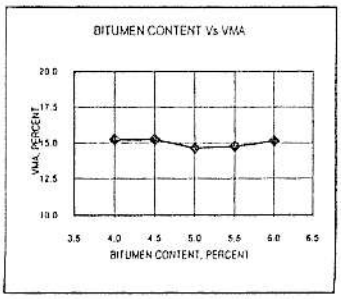












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Department of Civil Engineering

Test Performed By

13.01.2013

Dr. Hasib Mohammed Ahsan
Professor
Department of Civil Engineering