



# SGI TESTING SERVICES

A GEORGIA LIMITED LIABILITY COMPANY

17 November 2016

Amit Agarwal  
CTM Technical Textiles Ltd.  
205, New Cloth Market  
Ahmedabad - 380 002, India

Subject: Laboratory Test Results Transmittal  
Connection Strength Testing  
CTMGGU 40, CTMGGU 60, and CTMGGU 80 Geogrids between  
12 inch Deep Omega Blocks

Dear Mr. Agarwal,

SGI Testing Services, LLC (SGI) is pleased to present the attached test results for the above-mentioned testing program. The note section below addresses sample preparation, sample disposal and a disclosure statement.

SGI appreciates the opportunity to provide laboratory testing services to CTM Technical Textiles Ltd. Should you have any questions regarding the attached document(s), or if you require additional information, please do not hesitate to contact the undersigned.

Sincerely,

Zehong Yuan, Ph.D., P.E.  
Laboratory Manager

## Attachments

### NOTES:

- (1) Unless otherwise noted in the test results the sample(s)/specimen(s) were prepared in accordance with the applicable test standards or generally accepted sampling procedures.
- (2) Contaminated/chemical samples and all related laboratory generated waste (i.e., test liquids, PPE, absorbents, etc.) will be returned to the client or designated representative(s), at the client's cost, within 60 days following the completion of the testing program, unless special arrangements for proper disposal are made with SGI.
- (3) Materials that are not contaminated will be discarded after test specimens and archived specimens are obtained. Archived specimens will be discarded 30 days after the completion of the testing program, unless long-term storage arrangements are specifically made with SGI.
- (4) The reported results apply only to the materials and test conditions used in the laboratory testing program. The results do not necessarily apply to other materials or test conditions. The test results should not be used in engineering analysis unless the test conditions model the anticipated field conditions. The testing was performed in accordance with general engineering testing standards and requirements. The reported results are submitted for the exclusive use of the client to whom they are addressed.

SGI13020.REPORT.2016.02.CTM

**MAIL TO: SGI TESTING SERVICES, LLC**  
P.O. Box 2427  
LILBURN, GA 30048-2427

**FACILITY LOCATION**  
4405 INTERNATIONAL BLVD., SUITE B-117  
NORCROSS, GA 30093

WEB SITE: [WWW.INTERACTIONSPECIALISTS.COM](http://WWW.INTERACTIONSPECIALISTS.COM)

PHONE: 770.931.8222 FAX: 770.931.8240

**ATTACHMENT A**

**PARTICLE SIZE CURVE OF AASHTO #57 STONE  
AND TEST PHOTOS**



# SGI Testing Services, LLC

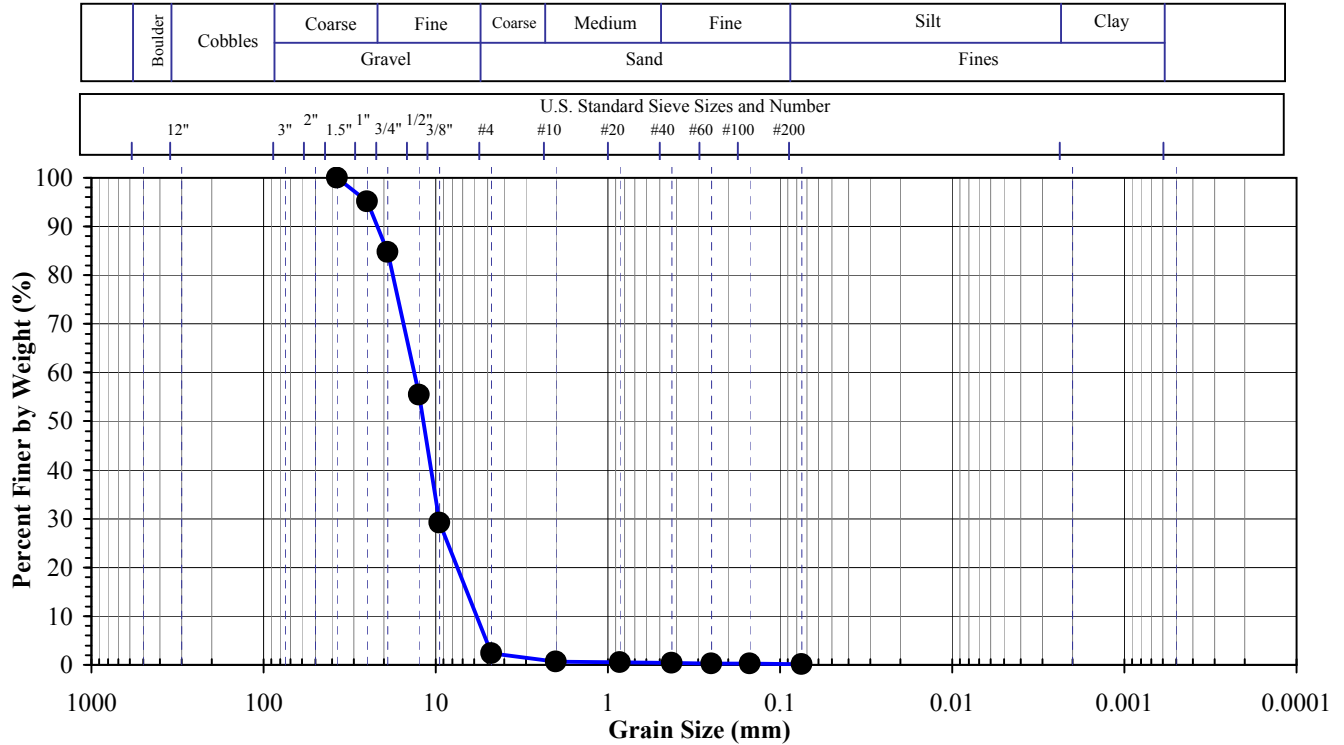
4405 International Blvd., Suite B-117, Norcross, GA 30093  
 Ph: (770) 931 8222 Fax: (770) 931 8240

Project Name: Connection Testing  
 Project No: SGI12036  
 Client Sample ID: AASHTO #57 Stone  
 Lab Sample No: S11651

ASTM D 2216, D 1140, D 422,  
 C 136, D 4318, D 2487

## SOIL INDEX PROPERTIES

Moisture Content, Grain Size, Atterberg  
 Limits, Classification

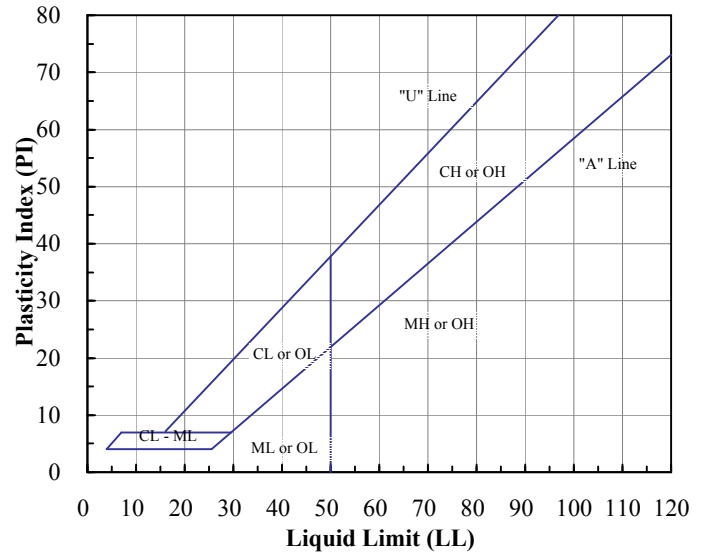


Sieve No.	Size (mm)	% Finer
3"	75	
2"	50	
1.5"	37.5	100.0
1"	25	95.2
3/4"	19	84.8
1/2"	12.5	55.4
3/8"	9.5	29.2
#4	4.75	2.3
#10	2.00	0.7
#20	0.850	0.5
#40	0.425	0.3
#60	0.250	0.3
#100	0.150	0.3
#200	0.075	0.1

Hydrometer Particle Diameter (mm)	% Finer
0.0500	
0.0200	
0.0050	
0.0020	
0.0012	

Gravel (%):	97.7
Sand (%):	2.2
Fines (%):	0.1
Silt (%):	0.1
Clay (%):	

Coeff. Unif. (Cu):	-
Coeff. Curv. (Cc):	-



Client Sample ID.	Lab Sample No.	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits			Engineering Classification
				LL (%)	PL (%)	PI (-)	
AASHTO #57 Stone		-	0.1	NP	NP	NP	GP (Poorly Graded Gravel)

Note(s):



Figure A-2. Connection test setup.



Figure A-3. Typical failure mode: sliding of XD ribs (junction failure), abrasion damage to, and rupture of geogrid ribs.





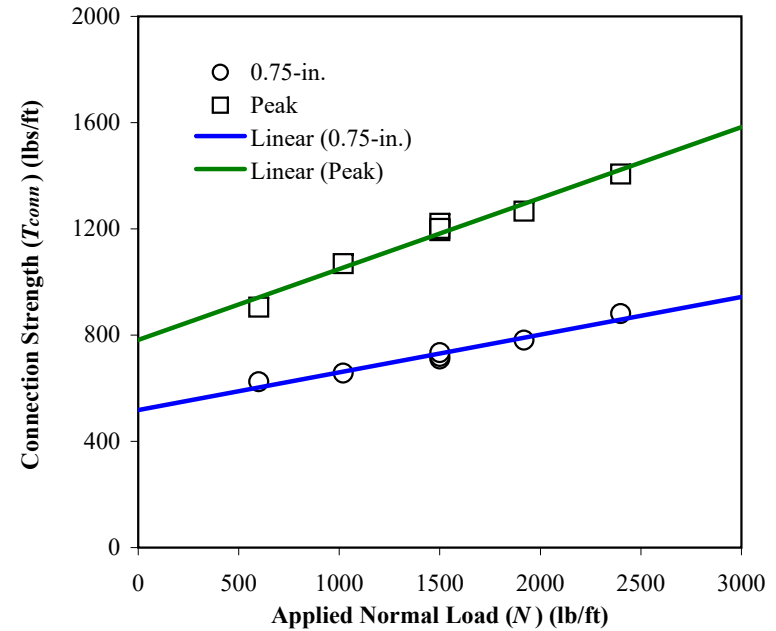
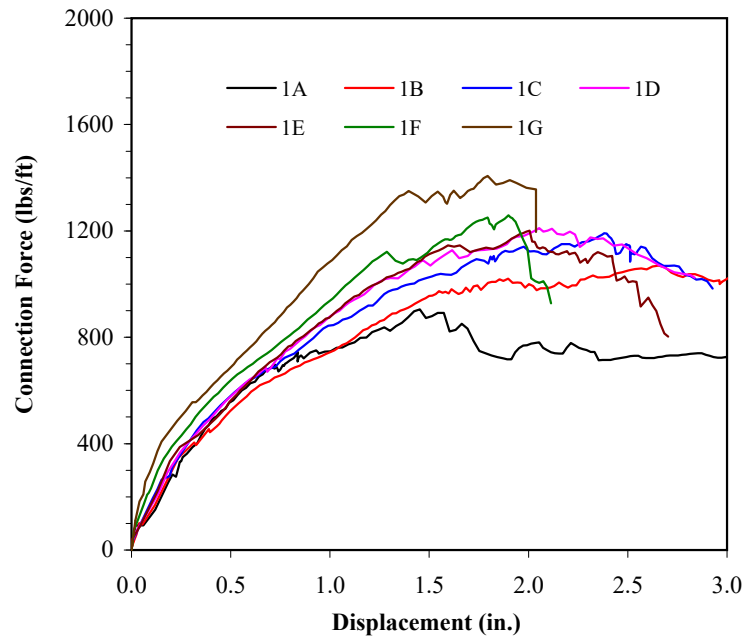
Figure A-4. Junction failure (sliding of a XD rib along MD ribs) and rib rupture of CTMGGU 80 geogrid at the completion of test #3G at 4800 lbs/ft normal load.

**ATTACHMENT B**

**CONNECTION TEST RESULTS**

**CTM TECHNICAL TEXTILES LTD.  
CONNECTION STRENGTH TESTING (ASTM D 6638)**

TEST SERIES NO. 1: CTMGGU 40 geogrid in machine direction between two courses of 12" deep Omega blocks with compacted AASHTO #57 stone in block cores and spaces between blocks



Test No.	Geogrid Specimen Width <i>W</i> (in.)	Test Normal Stress $\sigma_n$ (psi)	Equivalent Normal Load <i>N</i> (lb/ft)	Approximate No. of Blocks <i>n</i>	Approximate Wall Height <i>h</i> (ft)	0.75-in. Strength $T_{0.75-in}$ (lb/ft)	Peak Strength $T_{peak}$ (lb/ft)	Connection Strength Equations (Strength assumed to be linearly related to <i>N</i> )
1A	32.0	4.2	600	8	5.0	624	905	$T_{0.75-in.} = 515 + (N) \tan ( 8^\circ )$ $T_{peak} = 780 + (N) \tan ( 15^\circ )$
1B	32.0	7.1	1020	13	8.5	656	1069	
1C	32.0	10.4	1500	19	12.5	710	1193	
1D	32.0	10.4	1500	19	12.5	720	1221	
1E	32.0	10.4	1500	19	12.5	734	1201	
1F	32.0	13.3	1920	24	16.0	780	1267	
1G	32.0	16.7	2400	30	20.0	881	1406	

**NOTES:**

Nominal Dimensions of Block: 18" wide x 12" deep xx 8" thick  
 Weight of Full-Size Block: . 86 lbs  
 Average Unit Weight of Facing: 120 pcf.  
 Failure Mode: Rupture of MD geogrid ribs against shear keys in each test.

DATE REPORTED: 9/15/2016



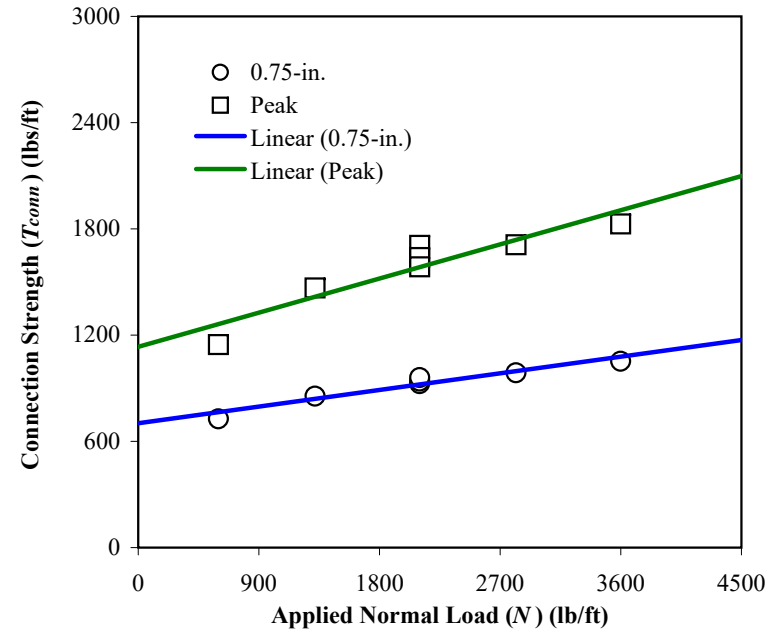
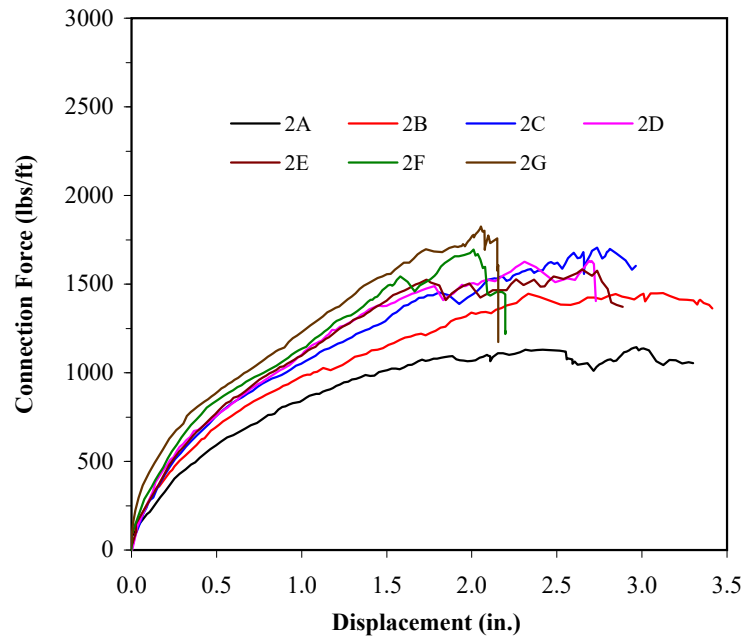
**SGI TESTING SERVICES, LLC**

FIGURE NO. C-1  
 PROJECT NO. SGH13020  
 DOCUMENT NO.  
 FILE NO.



**CTM TECHNICAL TEXTILES LTD.  
CONNECTION STRENGTH TESTING (ASTM D 6638)**

TEST SERIES NO. 2: CTMGGU 60 geogrid in machine direction between two courses of 12" deep Omega blocks with compacted AASHTO #57 stone in block cores and spaces between blocks



Test No.	Geogrid Specimen Width <i>W</i> (in.)	Test Normal Stress $\sigma_n$ (psi)	Equivalent Normal Load <i>N</i> (lb/ft)	Approximate No. of Blocks <i>n</i>	Approximate Wall Height <i>h</i> (ft)	0.75-in. Strength $T_{0.75-in}$ (lb/ft)	Peak Strength $T_{peak}$ (lb/ft)	Connection Strength Equations (Strength assumed to be linearly related to <i>N</i> )
2A	32.0	4.2	600	8	5.0	727	1146	$T_{0.75-in.} = 700 + (N) \tan ( 6^\circ )$ $T_{peak} = 1135 + (N) \tan ( 12^\circ )$
2B	32.0	9.2	1320	17	11.0	855	1465	
2C	32.0	14.6	2100	26	17.5	926	1706	
2D	32.0	14.6	2100	26	17.5	939	1637	
2E	32.0	14.6	2100	26	17.5	959	1584	
2F	32.0	19.6	2820	35	23.5	987	1710	
2G	32.0	25.0	3600	45	30.0	1053	1827	

**NOTES:**

Nominal Dimensions of Block: 18" wide x 12" deep xx 8" thick  
 Weight of Full-Size Block: . 86 lbs  
 Average Unit Weight of Facing: 120 pcf.  
 Failure Mode: Rupture of MD geogrid ribs against shear keys in each test.

DATE REPORTED: 9/15/2016

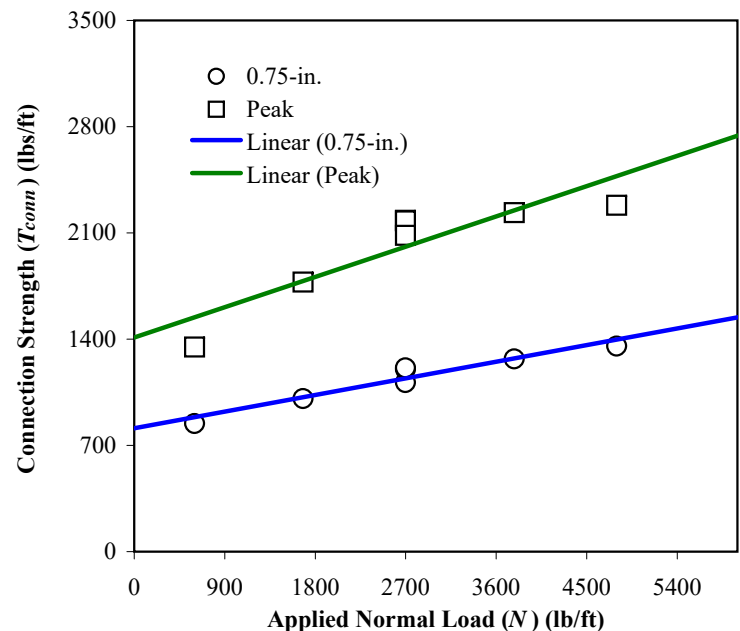
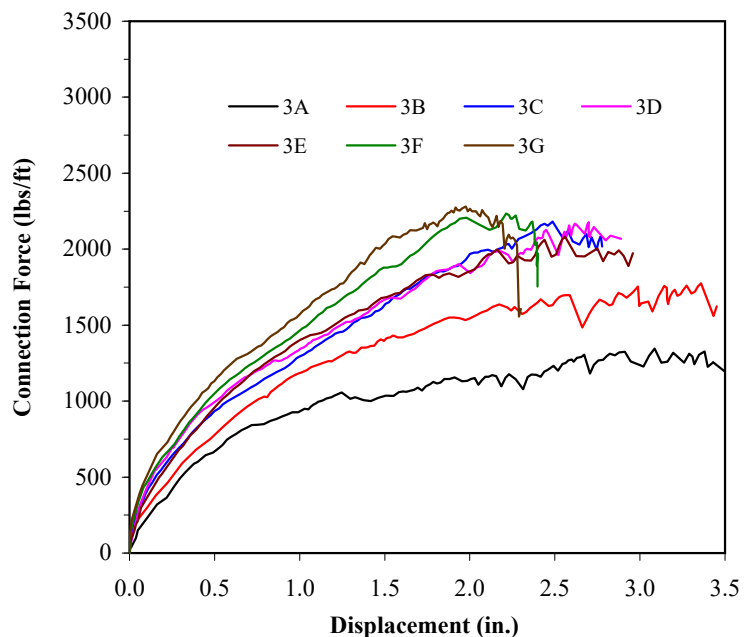


**SGI TESTING SERVICES, LLC**

FIGURE NO. C-2  
 PROJECT NO. SGH13020  
 DOCUMENT NO.  
 FILE NO.

**CTM TECHNICAL TEXTILES LTD.  
CONNECTION STRENGTH TESTING (ASTM D 6638)**

TEST SERIES NO. 3: CTMGGU 80 geogrid in machine direction between two courses of 12" deep Omega blocks with compacted AASHTO #57 stone in block cores and spaces between blocks



Test No.	Geogrid Specimen Width <i>W</i> (in.)	Test Normal Stress $\sigma_n$ (psi)	Equivalent Normal Load <i>N</i> (lb/ft)	Approximate No. of Blocks <i>n</i>	Approximate Wall Height <i>h</i> (ft)	0.75-in. Strength $T_{0.75-in}$ (lb/ft)	Peak Strength $T_{peak}$ (lb/ft)	Connection Strength Equations (Strength assumed to be linearly related to <i>N</i> )
3A	32.0	4.2	600	8	5.0	844	1347	$T_{0.75-in.} = 815 + (N) \tan ( 7^\circ )$ $T_{peak} = 1410 + (N) \tan ( 12^\circ )$
3B	32.0	11.7	1680	21	14.0	1008	1775	
3C	32.0	18.8	2700	34	22.5	1114	2181	
3D	32.0	18.8	2700	34	22.5	1200	2178	
3E	32.0	18.8	2700	34	22.5	1210	2083	
3F	32.0	26.3	3780	47	31.5	1268	2234	
3G	32.0	33.3	4800	60	40.0	1354	2281	

**NOTES:**

Nominal Dimensions of Block: 18" wide x 12" deep xx 8" thick  
 Weight of Full-Size Block: . 86 lbs  
 Average Unit Weight of Facing: 120 pcf.  
 Failure Mode: Rupture of MD geogrid ribs against shear keys in each test.

DATE REPORTED: 9/15/2016



**SGI TESTING SERVICES, LLC**

FIGURE NO. C-3  
 PROJECT NO. SGI13020  
 DOCUMENT NO.  
 FILE NO.