



AMEC Environment & Infrastructure Inc.

www.amec.com

615.333.0630



KODI KLIPTM

Rebar Connection Systems

LABORATORY TESTING REPORT

Tests were performed over a 28 day period to determine if the strength performance of reinforced concrete was impacted by the use of KODI KLIP polycarbonate rebar connectors rather than tie wire.

- Compressive strength on concrete cylinders
- Flexural strength on concrete beams
- Determine area of placement
- Determine absorption percent

The following pages detail test results



December 29, 2014

Mr. Jon Kodi
Kodi Klip Corp.
314 S. Cumberland Street
Lebanon, TN 37087

**Re: Results of Requested Lab Testing
AMEC Project No. 768214037**

Dear Mr. Kodi:

AMEC has completed the laboratory testing which included the testing of concrete with reinforcing ties and Kodi Klips as requested to supply data for comparison purposes. Below is the laboratory testing that we performed and the results of these tests are attached.

- Twenty-eight day compressive strength of three 6" x 12" concrete cylinder with two #3 reinforcing bars placed horizontally at the mid-point of the cylinder and tied together with tie wire;
- Twenty-eight day compressive strength of three 6" x 12" concrete cylinder with two #3 reinforcing bars placed horizontally at the mid-point of the cylinder and connected with Kodi Klips;
- Twenty-eight day flexural strength of three 6" x 6" x 20" concrete beams with three #3 reinforcing bars placed horizontally at the mid-point of the beam (one 18" long and two 4" long, placed at third points of the beam) and tied together with tie wire;
- Twenty-eight day flexural strength of three 6" x 6" x 20" concrete beams with three #3 reinforcing bars placed horizontally at the mid-point of the beam (one 18" long and two 4" long, placed at third points of the beam) and connected with Kodi Klips;
- Determine the area displacement of the number 5 (white) Kodi Klips;
- Determine absorption on the number 5 (white) Kodi Klips;
- Cast two 6"x12" concrete cylinders with 2 #5 rebar and 1 Kodi Klip (after curing, saw through cylinders, rebar and Kodi Klip's to show if any voids are present).

AMEC Environment & Infrastructure, Inc.
3800 Ezell Road, Ste 100
Nashville TN
USA 37211
Tel (615) 333-0630
Fax (615) 781-0655
www.amec.com

After performing the tests stated above the following results were determined:

- 6" x 12" cylinders – The average compressive strength of the concrete cylinders cast with tie wire was 8490 psi and the average compressive strength of the concrete cylinders cast with Kodi Klips was 8360 psi. This was a difference of 130 psi. After testing the cylinders and examining the cylinder, the Kodi Klips were still intact and were not damaged.
- 6"x6"x20" beams – The average strength of the concrete beams cast with tie wire was 1054 psi and the average strength of the concrete beams cast with Kodi Klips was 1024 psi. This was a difference of 30 psi.
- 6"x12" cylinders with #5 rebar and one Kodi Klip – Two concrete cylinders were cast with two pieces of #5 rebar and one Kodi Klip at the center location of the cylinder. After curing for five days the cylinders were sawed through the center of the cylinder, rebar and Kodi Klip. Cylinders were visually examined and there were no visual signs of voids around the kodi Klips or rebar.
- Attached are photos of the two cylinders that were sawed to examine for voids, one cylinder cast with tie wire that was tested for compressive strength, one cylinder cast with Kodi Klips that was tested for compressive strength and one beam that was tested for flexural strength.

While the laboratory testing yielded differences in the ultimate strength between the specimens using conventional tie wires and the Kodi Klips, it is difficult to determine the precise cause for the results. Deviations in results are inherent in all laboratory testing. The deviations in the results of our testing could have resulted from a variety of reasons, such as the concrete mix used, chemical interactions between the Kodi Klip and the cement, and/or from the reduced contact area between the concrete and rebar created by the presence of the Kodi Klips.

We understand that the intent of this testing was to determine whether Kodi Klips impacted the strength performance of reinforced concrete, and if there was an impact, would that impact present a major concern that would preclude their use in construction. Based on the results of our testing, the specimens that were prepared with Kodi Klips yielded somewhat lower strength than those prepared with conventional ties. Without knowing the intent/application/purpose of the reinforced concrete in which the Kodi Klip system is intended for use, we cannot render an opinion as to whether the strength reduction observed in our testing would preclude the use of Kodi Klips in general construction. That determination should be left to the structural engineer in charge of the reinforced concrete design on a case-by-case basis.

To assist structural engineers with that determination and/or to better understand the impact of the Kodi Klip system on reinforced concrete, you may wish to perform additional laboratory testing to increase the number of samples that are tested from which to base a determination such that a statistically significant number of tests/trials are performed. Additional testing could include not only an increase in the number of samples, but also variations in the mix designs (including admixtures), rebar sizes, curing duration (early and late), and specimen size.

Construction Materials Testing Services
Jon Kodi - Reinforcing Klips
AMEC Project No. 768214037
Page 3 of 3



AMEC appreciates this opportunity to be of service to Kodi Klip Corp. Let me know if you have any questions or require additional services.

Yours truly,

AMEC

A handwritten signature in blue ink, appearing to read "Dale Truitt".

Dale Truitt
Senior Project Manager

AMEC Environment & Infrastructure, Inc.
3800 Ezell Road, Ste 100
Nashville TN
USA 37211
Tel (615) 333-0630
Fax (615) 781-0655
www.amec.com

5211 LINBAR DR. SUITE 513
 NASHVILLE, TENNESSEE 37211
 TELEPHONE: 615-831-9202 FAX: 615-831-9516

REPORT OF COMPRESSIVE STRENGTH OF 6" X 12" CYLINDRICAL TEST SPECIMENS

CLIENT: Kodi Kip Corp Lab PROJECT NO. (see strength): 76921400 / 10000
 REPORT NO.: _____
 PLACE DATE: November 12, 2014
 PROJECT: Kodi Kip Corp Lab Testing REPORT DATE: December 17, 2014
 LOCATION: _____ NO. OF CYLINDERS IN THIS SET: 3
 SERVICES: Compressive strength tests on cylindrical concrete specimens DATE REC'D. November 17, 2014 SET NO. 2 of 2

PROJECT DATA

CONTRACTOR: _____ MIX DESIGN NUMBER: _____ H₂O ADDED (gal.): _____
 CONCRETE SUPPLIER: _____ CLASS OF CONCRETE: _____ TIME BATCHED: _____
 PLANT: _____ TIME ARRIVED: _____ TIME SAMPLED: _____
 SPECIFICATION REQUIREMENTS: _____ TIME EMPTY: _____ BY: _____
 SPECIFIED STRENGTH: _____ PSI @ 28-DAYS TEMPERATURE (°F): AIR: _____ CONCRETE: _____
 SPECIFIED SLUMP: _____ IN. TRUCK NO.: _____ TICKET NO.: _____
 SPECIFIED AIR CONTENT: _____ % AGGREGATE CONTENT (%): _____ UNIT WEIGHT (pcf): _____
 METHOD OF TEST: ASTM C31 ASTM C175 PLACEMENT LOCATION: 3 6" x 12" concrete cylinders with 2 #3 rebar
 ASTM C138 ASTM C231 *** and 60 wire
 ASTM C143 ASTM C697 _____
 ASTM C172 ASTM C1064 _____

TEST RESULTS (ASTM C 39)

CONCRETE COMPRESSIVE STRENGTH - 6" X 12" CYLINDERS

CYLINDER MARKED	MEASURED SLUMP (in.)	DATE TESTED	AGE (days)	MAXIMUM LOAD (lbs force)	COMPRESSIVE STRENGTH (psi)	CYLINDER DIAMETER (in.)	BREAK TYPE
9400		12/10/14	28	239450	8500	5.96	1
9401		12/10/14	28	230000	8410	5.97	1
9402		12/10/14	28	237320	8510	5.96	1

** DO NOT ACCENT SPECIFY TO COMPRESSIVE STRENGTH

*** AIR CONTENT DETERMINED PER ASTM C 391 UNLESS OTHERWISE NOTED

COMMENTS: _____

DISTRIBUTION: _____

Debra

 LABORATORY SUPERVISOR



5211 LINBAR DR. SUITE 513
 NASHVILLE, TENNESSEE 37211
 TELEPHONE: 615-831-9202 FAX: 615-831-9518

REPORT OF COMPRESSIVE STRENGTH OF 6" X 12" CYLINDRICAL TEST SPECIMENS

CLIENT: Kodi Klip Corp Lab PROJECT NO (per drawing): 768254037 400001
 REPORT NO.: _____
 PROJECT: Kodi Klip Corp Lab Testing PLACEMENT DATE: November 12, 2014
 LOCATION: _____ REPORT DATE: December 11, 2014
 SERVICES: Compressive strength tests on cylindrical concrete specimens NO. OF CYLINDERS IN THIS SET: 3
 DATE REC'D: November 17, 2014 SET NO. 1 of 2

PROJECT DATA

CONTRACTOR: _____ MIX DESIGN NUMBER: _____ H₂O ADDED (gal.): _____
 TEST SUPPLIER: _____ CLASS OF CONCRETE: _____ TIME BATCHED: _____
 PLANT: _____ TIME ARRIVED: _____ TIME SAMPLED: _____
 SPECIFICATION REQUIREMENTS: TIME EMPTY: _____ BY: _____
 SPECIFIED STRENGTH: _____ PSI @ 28-DAYS TEMPERATURE (° F): _____ AIR: _____ CONCRETE: _____
 SPECIFIED SLUMP: _____ IN. TRUCK NO: _____ TICKET NO: _____
 SPECIFIED A/R CONTENT: _____ % ACTUAL AIR CONTENT (%): _____ UNIT WEIGHT (pcf): _____
 METHOD OF TEST: ASTM C31 ASTM C173 PLACEMENT LOCATION: 6" x 12" concrete cylinders with 2 #3 rebar:
 ASTM C138 ASTM C231 *** and #3 Kodi Klip
 ASTM C143 ASTM C617 _____
 ASTM C172 ASTM C1064 _____

TEST RESULTS (ASTM C 39)

CONCRETE COMPRESSIVE STRENGTH - 6" X 12" CYLINDERS

CYLINDER MARKED	MEASURED SLUMP (in)	DATE TESTED	AGE (days)	MAXIMUM LOAD (lba force)	COMPRESSIVE STRENGTH (psi)	CYLINDRICAL DIAMETER (in)	BREAK TYPE
9397		12/10/14	28	222055	7930	5.97	2
9398		12/10/14	28	245720	8840	5.95	1
9399		12/10/14	28	234490	8300	6.00	1

** DOES NOT MEET SPECIFIED COMPRESSIVE STRENGTH

*** A/R CONTENT DETERMINED PER ASTM C 231 UNLESS OTHERWISE NOTED

COMMENTS: _____

DISTRIBUTION: _____

[Signature]

 LABORATORY SUPERVISOR



AMEC GEOTECHNICAL AND CONSTRUCTION MATERIALS LABORATORY

5211 Linbar Drive, Suite 513, Nashville, Tennessee 37211

Telephone: 615/831-9202 Fax: 615/831-9516

FLEXURAL STRENGTH OF CONCRETE (USING SIMPLE BEAM WITH THIRD POINT LOADING) ASTM C 78 / AASHTO T 97

PROJECT NAME: Kodi Klip Lab Testing **DATE:** 12/10/2014

CLIENT: Kodi Klip Corporation **PROJECT NO.:** 768214037

REMARKS: 6"x6"x18" Concrete Beams with 2 #3 Rebar & Tie Wire

BEAM TYPE: X **CAST-IN-PLACE** **SAWED**

Sample / Test Information

BEAM IDENTIFICATION	1	2	3				
DATE RECEIVED	11/12/2014	11/12/2014	11/12/2014				
DATE TESTED	12/10/2014	12/10/2014	12/10/2014				
AGE OF SPECIMEN	28	28	28				
TOTAL LENGTH OF SPECIMEN (IN.)	20.00	20.00	20.00				
AVERAGE WIDTH (IN.)	6.00	6.00	6.00				
AVERAGE DEPTH (IN.)	6.00	6.00	6.00				
AVERAGE SPAN (IN.)	18.00	18.00	18.00				
SPECIMEN DEFECTS	none	none	none				
CURING HISTORY ¹	X	X	X				
MOISTURE CONDITION @ TESTING ²	X	X	X				
MAXIMUM LOAD (lbs.)	12,585	12,740	12,625				
MODULUS OF RUPTURE (psi)	1049	1062	1052				

Calculate Modulus of Rupture (R) by: $R = PL / bd^2$

where: P = maximum load

L = span length

b = average width

d = average depth

¹ 1 = lime saturated water
2 = none (tested upon receipt)

² 3 = moist at time of testing
4 = as received

REMARKS: _____

NOTE: Test results shown were derived from tests performed in accordance with the applicable test method(s), unless otherwise noted

 Christine Tognoni
 LABORATORY SUPERVISOR



AMEC GEOTECHNICAL AND CONSTRUCTION MATERIALS LABORATORY

5211 Linbar Drive, Suite 513, Nashville, Tennessee 37211
Telephone: 615/831-9202 Fax: 615/831-9516

FLEXURAL STRENGTH OF CONCRETE (USING SIMPLE BEAM WITH THIRD POINT LOADING) ASTM C 78 / AASHTO T 97

PROJECT NAME: Kodi Klip Lab Testing **DATE:** 12/10/2014

CLIENT: Kodi Klip Corporation **PROJECT NO.:** 768214037

REMARKS: 6"x6"x18" Concrete Beams with 2 #3 Rebar & 1 Kodi Klip

BEAM TYPE: X **CAST-IN-PLACE** **SAWED**

Sample / Test Information

BEAM IDENTIFICATION	1	2	3				
DATE RECEIVED	11/12/2014	11/12/2014	11/12/2014				
DATE TESTED	12/10/2014	12/10/2014	12/10/2014				
AGE OF SPECIMEN	28	28	28				
TOTAL LENGTH OF SPECIMEN (IN.)	20.00	20.00	20.00				
AVERAGE WIDTH (IN.)	6.00	6.00	6.00				
AVERAGE DEPTH (IN.)	6.00	6.00	6.00				
AVERAGE SPAN (IN.)	18.00	18.00	18.00				
SPECIMEN DEFECTS	none	none	none				
CURING HISTORY ¹	X	X	X				
MOISTURE CONDITION @ TESTING ²	X	X	X				
MAXIMUM LOAD (lbs.)	12,330	12,230	12,300				
MODULUS OF RUPTURE (psi)	1028	1019	1025				

Calculate Modulus of Rupture (R) by: $R = PL / bd^2$
 where: P = maximum load
 L = span length
 b = average width
 d = average depth

¹ 1 = lime saturated water
 2 = none (tested upon receipt)
² 3 = moist at time of testing
 4 = as received

REMARKS: _____

NOTE: Test results shown were derived from tests performed in accordance with the applicable test method(s), unless otherwise noted

 Christine Tognoni
 LABORATORY SUPERVISOR



AMEC GEOTECHNICAL AND CONSTRUCTION MATERIALS LABORATORY

5211 Linbar Drive, Suite 513, Nashville, Tennessee 37211
Telephone: 615/831-9202 Fax: 615/831-9516

SPECIFIC GRAVITY, ABSORPTION & DISPLACEMENT

SAMPLE NO. _____

CLIENT: Kodi-Klip Corporation PROJECT NO.: 768214037
PROJECT NAME: Kodi-Klip Laboratory Testing DATE: December 2, 2014
DATE RECEIVED: _____

SPECIFIC GRAVITY (Bulk Calculation)

A)	Oven Dried Weight of Sample	<u>37.4</u> (gms)
B)	Weight of Saturated Sample in Water	<u>5.9</u> (gms)
C)	Saturated Surface Dry Weight of Sample	<u>37.5</u> (gms)
$G_s = A / (B - C)$		Specific Gravity = <u>1.18</u>

ABSORPTION (test performed on four (4) #5 (white) Kodi Klips)

Absorption % = $((B - A) / A) \times 100$ Absorption = 0.3%

DISPLACEMENT

Four (4) #5 (white) Kodi Klips had a displacement of 1.831 cubic inches.
(0.458 cubic inch displacement for each #5 (white) Kodi Klip)

NOTE: