TOGGLE SHEAR TESTING

Test Report

Prepared for:	**Prepared by:**
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TEST REPORT

Transverse shear tests with Mateen dowels

Product:	Mateen dowels as 38 mm toggle
Customer:	Pultron Composites Ltd 342 Lytton Rd / PO Box 323 Gisborne 4040 New Zealand
Contractor:	Uniservices Ltd. The University of Auckland Department of Civil and Environmental Engineering Private Bag 92019 Auckland 1142 New Zealand
Operator:	Dr. Steffen Franke Prof. Pierre Quenneville
Pages:	5
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1 Scope

For the product certification of the Mateen dowel, the shear strength has to be determined. The product to be tested is a large rod with a diameter of approximately 37.5 mm. The test has to be performed as a double shear test with an expected maximum load in the range of 400 to 500 kN.

The contract comprises the set up of the testing machine with the test jig and run a sample. The test jig used was manufactured and provided by the customer. After the sample run, at least five samples have to be tested together with photos and the notation of the failure modes. The raw results have to be sent and a test report has to be produced.

2 Test method

The test consisted of a double shear test conducted with a test jig provided by the customer and according to a test method specified by the customer, as shown in Appendix A. This includes:

- Mounting the specimen in the center of the shear test apparatus
- Uniformly applied loading without subjecting the specimen to shock
- Loading rate of 30 to 60 MPa per min shear stress
- Continued loading until specimen fails
- Visual inspection of the failure

3 Test procedure

The test jig and 8 samples were delivered on 19/04/2010 and stored at a dry place and at room temperature until testing. The test jig included 4 tubes of steel. Two of the tubes were always used for the outer ones, whereas the other two tubes were used for the inner one, which was changed between each test. The outer tubes were supported, whereas the inner tube was free in moving vertically, as shown in Figure 1.

Prior to the testing, the samples were numbered and the diameter was measured. The samples were inserted in the provided test jig. No gap was visible between the inner and outer tubes. The load was applied with a flat plate from the top to the inner tube at a nearly constant rate. The load was recorded in a frequency of 2 Hz. All eight tests were carried out in an AVERY 1000 kN tension/compression test machine at 21 °C by Dr. Steffen Franke and Mark Byrami on the 21st and 22nd of April 2010.

It was mentioned before, that the testing machine has to be controlled manually and in this kind of test with a high stiffness and very small deformations, an absolute constant rate and the setup of a specific rate cannot be guaranteed.

After failure, the test jig was removed from the test machine and the samples were taken out of the jig and the steel tubes. The steel tubes were checked for visible damage at the edges of the inner holes and the shear planes. No distinctive damage was observed.

Figure 1: Test setup

4 Test results

The test results are listed in Table 1. All specimens failed in shear as shown in Figure 2. Upon further displacement of the test machine, the specimen failed in a secondary mode of failure as shown in Figure 3.

Table 1: Experimental Results

sample	diameter [mm]	rate of loading [MPa/min]	max load [kN]	max shear strength [MPa]
1	37.62	88.5	442.7	199.1
2	37.65	73.2	437.9	196.7
3	37.60	54.8	456.7	205.7
4	37.60	102.7	425.8	191.7
5	37.62	157.3	442.6	199.1
6	37.65	100.7	427.1	191.8
7	37.58	145.8	433.4	195.4
8	37.60	102.8	430.0	193.6
mean	**37.62**	**103.2**	**437.0**	**196.6**
stdev	0.04	34.23	10.27	4.65
COV	0.1%	33.2%	2.4%	2.4%

Figure 2: Initial Failure after short displacements

Figure 3: Secondary failure after large displacements

Appendix A

Test method and details required for the test report; provided by the customer

TRANSVERSE SHEAR TEST METHOD FOR MATEEN DOWEL (38mm Toggle)

8 *Test method*

8.1—The specimen should be mounted in the center of the shear apparatus, touching the upper loading device. No gap should be visible between the contact surface of the loading device and the test specimen.

8.2—The specified loading rate should be such that the shearing stress increases at a rate of 30 to 60 MPa per min. Load should be applied uniformly without subjecting the specimen to shock.

8.3—Loading should be continued until the specimen fails. The failure load should be recorded with a precision to three significant digits. Loading may decrease temporarily due to the presence of two rupture faces.

9 *Calculations*

9.1—Failure, whether it is due to shear or not, should be determined by visual inspection.

9.2—Shear strength should be calculated according to Eq. (1), with a precision to three significant digits

$$\tau_u = \frac{P_s}{2A} \qquad (1)$$

where
τ_u = shear strength, MPa;
P_s = maximum failure load, N; and
A = cross-sectional area of specimen, mm^2.

10 *Report*

The test report should include the following items:

10.1—The trade name, shape, and date of manufacture, if available, and lot number of product tested.

10.2—Type of fiber and fiber binding material as reported by the manufacturer and fiber volume fraction.

10.3—Numbers or identification marks of test specimens.

10.4—Designation, diameter, and cross-sectional area.

10.5—Conditioning of specimens before testing.

10.6—Date of test, test temperature, and loading rate.

10.7—Maximum failure load for each test specimen, average of maximum failure loads and shear strength.

10.8—Failure mode of each test specimen. Failure modes are generally described as being shear, fiber debonding, or a combination of both. Typical specimens that have failed in the shearing mode are shown in Fig. B.4.4.