



June 18, 2003

Mr. Craig Williams  
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Subject: Report of Load Tests  
American Step Pulling Irons  
MACTEC project 501 50-2-0240

Dear Mr. Williams:

As you authorized MACTEC Engineering and Consulting of Georgia, Inc (**MACTEC**) performed load tests on Pulling Irons supplied by American Step Company, Inc (American Step). This report describes the tested items and presents the testing procedures and the results.

#### **DEVICE**

The Pulling Iron is a preformed length of 1/2 inches diameter, 270 ksi, 7 wire prestressing strand, which is to be used to lift steel reinforced, precast concrete members. The portion of the Pulling Iron, prebent to an acute angle which protrudes from the concrete and forms a loop, is encased in a thin wall galvanized metal tube. The Pulling Iron is to be placed and tied under the reinforcing steel (rebar) prior to casting of the member. A mill certificate from the manufacturer of the cable is attached.

#### **TEST SPECIMENS**

As instructed by American Step, each of the Pulling Irons was encased in cast in place concrete rectangular prisms (test blocks), which were constructed at our Atlanta, GA laboratory. Wooden forms were made, a 24" long, #4 rebar was tied into the bends at the base of each Pulling Iron, the Pulling Iron and rebars were secured 1" above the floor of the form in order to prevent displacement during concrete placement and concrete was placed into the forms. The test blocks were unreinforced except for the 2, 24" long, #4 rebars. The bottom of the sleeve in the acute

angle of the Pulling Iron was approximately 31/2" to 41/2" from the top of the concrete. Test specimen fabrication was performed by American Step and witnessed and documented by MACTEC. This process is shown in the attached photos.  
from the top of the concrete.

When the concrete was placed, 6"X12" cylinders were molded from the plastic concrete so that the compressive strength of the concrete could be determined. The cylinders were cured beside the test blocks until approximately 1 hour before the cylinders were tested.

### **TEST CONDITIONS**

Six configurations or models of the Pulling Irons were tested. Each is listed below and depicted on the attached drawings supplied by American Step. The size of the concrete test block in which the pulling irons were embedded is listed beside each model.

- 10 1/2 inch 54" X 54" X 6" thick
- 12 inch 54" X 54" X 8" thick
- 15 inch 54" X 54" X 10" thick
- 18 inch 54" X 54" X 13" thick
- 44 inch single 60" X 60" X 40" thick\*
- 44 inch double 60" X 60" X 40" thick
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\* Note: This model was also tested for application in the septic tank industry. The pulling iron was embedded without the 24" long, #4 rebars in a 3" thick wall of concrete that was 40" deep and 60" long. This specimen is shown in Photo 3.

### **TEST PROCEDURES**

The pull out capacity was determined by engaging the loop formed by the acute angle in the Pulling Iron and imposing a load perpendicular to the surface of the concrete from which the device protruded. This loading direction was chosen because it was thought to be more severe than loads that are imposed away from the concrete surface at other angles. The load was imposed with a calibrated 30 ton jack (except for the 44 inch double strand which used a 60 ton jack) supported by a 4 legged frame, which reacted against the surface of the concrete. As the load was applied, the surface of the concrete was observed for evidence of distress. The ultimate pull out capacity was recorded. In each case the failure was abrupt. The load test procedure is shown on an attached photograph.

The strength of the concrete at the time of pull out testing was determined by performing compressive strength tests on 6" diameter by 12" long cylinders, which had been molded when the test blocks were cast. The cylinders were wrapped in plastic and stored outside beside the test blocks. When the cylinders reached the desired strength levels, the pull out tests were begun on the Pulling Irons. Due to equipment problems the 44" double pulling iron was tested approximately one month later than the last concrete was tested. We do not have a record of the concrete strength at the time the test was conducted.

## RESULTS

The test results are summarized in the following table. The failure modes are shown in the attached photographs.

Pulling Iron Identification	Concrete Cylinder Compressive Strength, psi	Ultimate Tensile Load, pounds	Failure Mode
10 1/2"	1590	14,100	Concrete split vertically over legs of pulling iron
10 1/2"	2580	15,670	Same
10 1/2"	4460	17,090	Same
12"	1590	19,200	Same
12"	2490	25,500	Same
12"	4460	30,770	Same
15"	4460	39,460	Same
18"	4460	55,700	Same
44" Septic Tank	3000	57,840	Pulling Iron Strand failed
44"	4010	56,840	Pulling Iron Strand failed
44" Double	Greater than 4460	117,610	Pulling Iron Strand failed

MACTEC appreciates the opportunity to perform this service for American Step. If there are questions concerning this report, please contact the undersigned.

Sincerely,  
MACTEC ENGINEERING AND CONSULTING OF GEORGIA, INC.



John Love, PE  
Principal Engineer



JAC  
WITH PERMISSION



Kevin McCray  
Project Coordinator



Photo 1. Forms before concrete placement

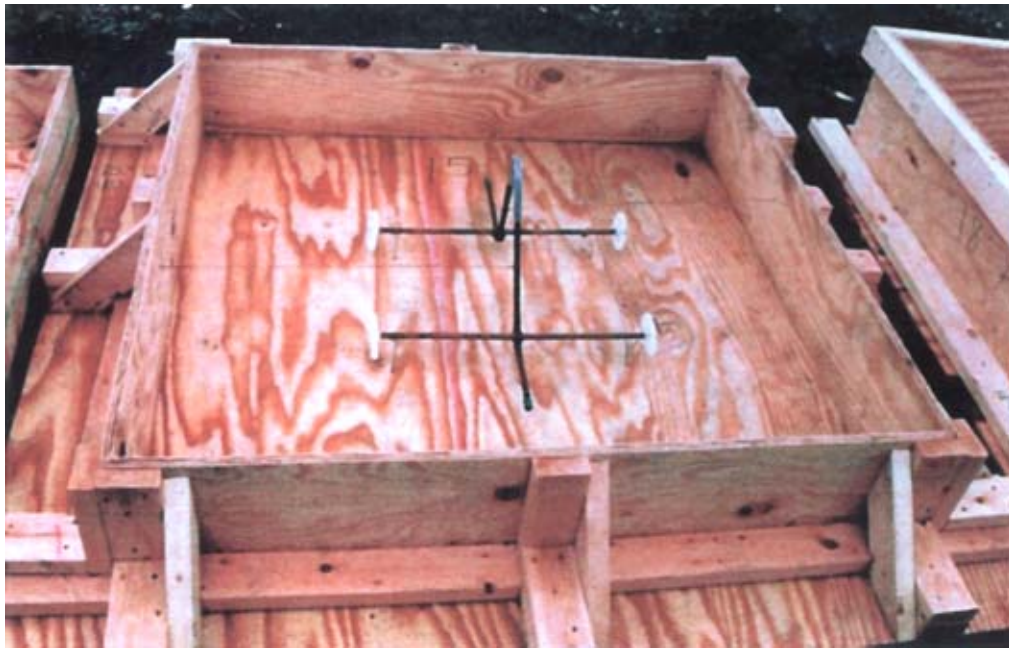


Photo 2. Close up of pulling iron and form

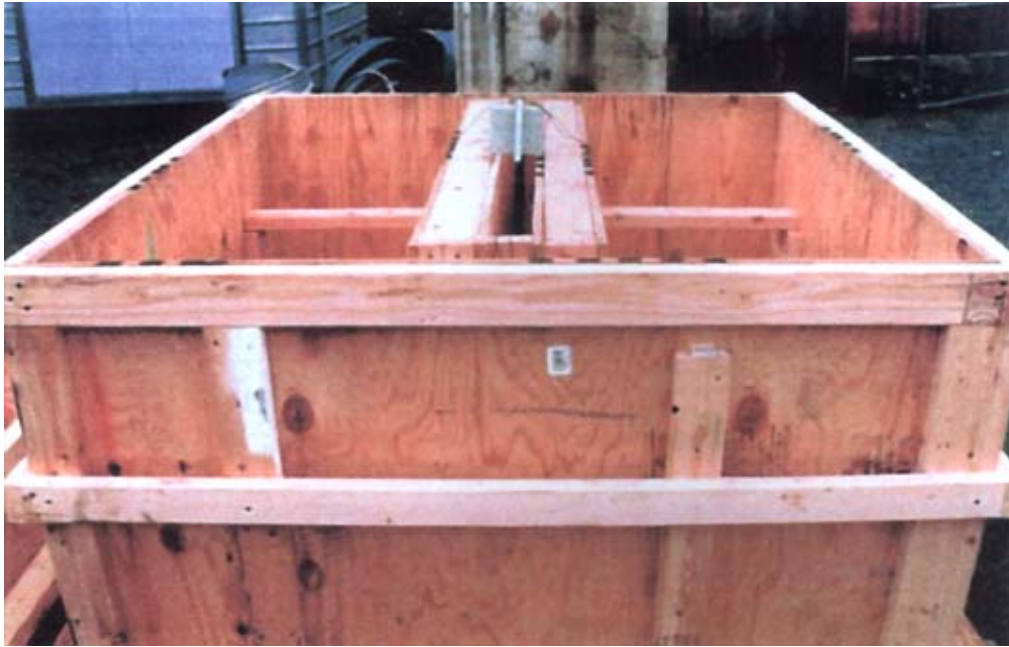


Photo 1. The 44" pulling iron for septic tank. Note block out in form that caused the pulling iron to be embedded in 3" thick wall of concrete.



Photo 4. Load frame, ram, and jack



Photo 5. Typical tensile failure in concrete which caused a vertical crack



Photo 6. Pulling iron strand failure