

Intratech Engineering Laboratories Ltd.

1080 Tapscott Road, Unit 31
Scarborough, Ontario
M1X 1E7

Telephone: (416) 754-2077

Facsimile: (416) 754-1167

**MTO MI-120 PULL-OUT TESTING
OF EPOXY-COATED DOWELS BONDED IN CONCRETE WITH
HILTI HIT- RE 500 INJECTION ADHESIVE
FROM HILTI CANADA LIMITED**

Prepared for:

HILTI CANADA LIMITED
6790 Century Avenue, Suite 300
Mississauga, Ontario
L5N 2V8

Report: 83HL01-02

Date: June 12, 2001



Professional Engineers
Ontario

Inspection • Testing • Research

Intratech Engineering Laboratories Ltd.

1080 Tapscott Road, Unit 31
Scarborough, Ontario
M1X 1E7

Telephone: (416) 754-2077

Facsimile: (416) 754-1167

Hilti Canada Limited
6790 Century Avenue
Suite 300
Mississauga, Ontario
L5N 2V8

Date: June 12, 2001
Report 83HL01-02

Attention: Mr. Vern Lowe, P. Eng.

Dear Sir,

Re: **MTO MI-120 PULL-OUT TESTING
OF EPOXY-COATED DOWELS BONDED IN CONCRETE WITH
HILTI HIT- RE 500 INJECTION ADHESIVE
FROM HILTI CANADA LIMITED**

1. INTRODUCTION:

Intratech Engineering Laboratories Ltd. was commissioned by Hilti Canada Limited to perform pull-out tests on epoxy-coated dowels which were anchored in concrete test blocks using a two component chemical resin identified as Hilti HIT – RE 500 Injection Adhesive. The product was packaged in a 470 g / 330 ml, dual cartridge, mix in nozzle, twin tube system.

The tests were performed in accordance with the Ontario Ministry of Transportation Report MI-120 "Evaluation Of Pull-Out Testing Of Epoxy Coated Dowels In Concrete Using Grouts And Epoxies" (April 1988).

2. TEST PROCEDURE:

The anchor adhesive was tested for pull-out strength in concrete test blocks at dowel embedment depths of 125 mm and 250 mm. Two tests were performed for each embedment depth.

All test blocks were of unreinforced concrete. The test blocks for the 250 mm dowel embedment depths were 300 mm x 300 mm x 300 mm in size. The test blocks for the 125 mm dowel embedment depths were 300 mm x 300 mm x 150 mm in size.

The test blocks were cast using a standard Ministry of Transportation 30 MPa concrete mix with a 70 - 90 mm slump, a 5 - 7 % air content and a Type 10 only cement content of 355 kg/m³. The concrete was supplied by Dufferin - Custom Concrete from their McCowan Road plant.

cont'd.....



Professional Engineers
Ontario

2. TEST PROCEDURE:, Cont'd

The blocks were moist-cured for 14 days and then air-dried for a minimum of 14 days. The concrete strength was 44.0 MPa at 28 days and 47.9 MPa on the day of actual pull tests. (See enclosed cylinder test report, lab No. 470).

In the center of the top face of each concrete test block, a 19mm diameter hole was drilled vertically using the 19mm (3/4") bit supplied by Hilti. For the 125 mm dowel embedment tests, the holes were drilled in the 300 mm x 300 mm x 150 mm test blocks to a depth of 125 mm. For the 250 mm dowel embedment tests, the holes were drilled in the 300 mm x 300 mm x 300 mm test blocks to a depth of 250 mm.

The holes were mechanically cleaned using wire brush and hand-operated blow-out device included in the Hilti installation kit which was provided by the client.

An epoxy-coated rebar of 15 mm diameter, grade 400, was anchored into each test block using the supplied Hilti MD2000 manual dispensing gun. The resin and dowels were installed as per the Hilti Technical Guide 4.2.5.4. (Copy enclosed). The Hilti cartridge was labeled Hilti HIT 8493, RE - 500, 0-95089. The plastic bag packaging containing the twin tube cartridge and mixing nozzle had a bar code identification label *003402252* 470 g /330 ml, 16,6 oz. / 11,1 fl.oz..

The pull-out tests were performed after allowing 24 hours for the resin to cure at 22 degrees Celsius and 50 - 55 % R.H.

The pull-out tests were performed using a steel plate/bridge to distribute the reaction loads to perimeter of the block, and a calibrated hydraulic jack and gauge set-up.

The tensile loads were applied to each steel dowel, in turn, until a failure occurred.

Representatives of the Ontario Ministry of Transportation observed both the installation and testing portion of this work.

3. TEST RESULTS:

The results and observations are presented in accompanying Table, and discussed below:

250mm Embedment Depth

For both tests with dowel at 250mm embedment depths, we considered the adhesive system to have failed when dowel pull-out movement was observed.

Tensile loads of 60 kN and 80 kN respectively were applied and held for 1 minute. There was no movement observed.

Initial movement of the dowel began during load application between 80 kN and 100 kN for both test blocks.

Continued load application resulted in slow extraction of the bar from the test block. Whenever the load application was put on hold, the dowel would stop moving and resist the load already applied.

cont'd.....



3. TEST RESULTS:, Cont'd

250mm Embedment Depth, Cont'd

While movement was taking place, a maximum load of 100.0 kN was achieved for each test block, at which time the test was discontinued. At the conclusion, the bar in block 2A had pulled out 6 mm and the dowel in block 2B had pulled out 5mm.

Some hairline cracks were observed in the side of block 2A after disassembly of the test equipment.

125mm Embedment Depth

A tensile load of 60 kN was applied and held for 1 minute. There was no movement observed.

For both tests we considered the adhesive system to have failed when the concrete blocks split. The failure load was 80.0 kN for both test blocks. There was no indicated movement of the dowel up to the stage when the concrete test block split.

After completion of the tests we observed the following:

- Each of the test blocks 2C and 2D had split into three pieces The concrete showed good aggregate distribution and 100% aggregate shear.
- The dowels did not show any sign that they had pulled out of the concrete blocks when the blocks split
- The dowels had been fully encapsulated in adhesive.
- The resin was well bonded to the epoxy dowel coating.
- The concrete had been well bonded to the adhesive.

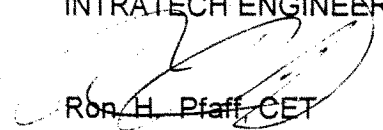
4. CONCLUSIONS:


Based on the results of these tests, the resin adhesive satisfies the minimum 60 kN pull-out strength requirement of the Ontario Ministry of Transportation.

The reported tests were performed under laboratory conditions. In actual field installation, factors such as temperature, condition of the hole, strength of the concrete, and shelf life of the material may have an effect on the in-situ strength.

Intratech Engineering Laboratories Ltd. assumes no responsibility for the use or performance of the tested material.

Respectfully submitted,
INTRATECH ENGINEERING LABORATORIES LTD.


Ron H. Pfaff, CET
Vice President
cc: Client - V. Lowe


Surendra D. Dattani, P. Eng.
President

encl: Photographs
Concrete Cylinder Test Report 470
Technical Data as Supplied by Hilti



**TABLE OF PULL-OUT TEST RESULTS
FOR HILTI HIT - RE 500**

TEST: 300x300x300mm TEST BLOCK WITH 250mm DOWEL EMBEDMENT

Test Mark	Failure Load,	Observations
1A	Between	For both tests with dowel at 250mm embedment depth, we considered the adhesive system to have failed when dowel pull-out movement was observed.
1B	80 to 100 kN for both blocks	

Tensile loads of 60 kN and 80 kN respectfully were applied and held for 1 a 1 minute duration. There was no movement observed.

Initial movement of the dowel began with a load application between 80 to 100 kN for both test blocks. Continued load application resulted in slow extraction of the bar from the test blocks. Whenever the load application was put on hold, the dowel would stop moving and resist the load already applied. While movement was taking place, a maximum load of 100 kN was achieved, at which time the test was discontinued. At the conclusion, the bar in block 2A had pulled out 6 mm and the dowel in block 2B had pulled out 5 mm.

After completion of the tests we observed the following:
- Some hairline cracks were observed in the side of block 2A after disassembly of the test equipment.

TEST: 300x300x150mm TEST BLOCK WITH 125mm DOWEL EMBEDMENT

Test Mark	Failure Load, kN	Observations
2C	80.0	A tensile load of 60 kN was applied and held for one minute. There was no movement observed
2D	80.0	

For both tests we considered the adhesive system to have failed when the concrete test blocks split. The failure load was 80.0 kN for both test blocks.

After completion of the tests we observed the following:
- The dowels did not show sign that they had pulled out of the concrete blocks when the blocks split.
- The dowels had been fully encapsulated in resin.
- The resin had been well bonded to the concrete.
- The resin was well bonded to the epoxy dowel coating.

cont'd.....

