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Julian Fadda



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# Ad-hoc fire test on a pilot-scale concrete floor slab incorporating cast-in PVC conduits, spanning a fire separating wall

## Test Report

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**Report number:** FSP 2036  
**Date:** 19 August 2019

**Client:** NOS Automation Solutions Pty Ltd

Commercial-in-confidence

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# Ad-hoc fire test on a pilot-scale concrete floor slab incorporating cast-in PVC conduits, spanning a fire separating wall

## Sponsored Investigation No. FSP 2036

### 1 Introduction

#### 1.1 Identification of specimen

The sponsor identified the specimen as various sized PVC conduits carrying various types of cables, cast into a 200-mm thick concrete floor slab.

#### 1.2 Purpose of the test

The purpose of the test is to determine the fire performance of a concrete floor slab incorporating cast-in PVC conduits spanning a fire separating wall. Each conduit was filled with various cables terminated at block-outs located on each side of the fire separating wall.

#### 1.3 Sponsor

NOS Automation Solutions Pty Ltd  
11/22 Northumberland Road  
Caringbah NSW

#### 1.4 Manufacturers

NOS Automation Solutions Pty Ltd  
Hilti Australia

#### 1.5 Test standard

Heating conditions specified in the following test standard:

Australian Standard 1530, Methods for fire tests on building materials, components and structures, Part 4 2014, Fire-resistance tests of elements of construction.

Instrumentation in accordance with:

Section 10: Service penetrations and control joints.



## 1.6 Test number

CSIRO Reference test number: FS 4907/4385

## 1.7 Test date

The ad-hoc fire test was conducted on 12 August 2019.

# 2 Description of specimen

## 2.1 General

The specimen comprised a 2000-mm long x 1200-mm wide x 200-mm thick concrete floor slab incorporating cast-in PVC conduits terminated at block-outs located 1300-mm apart. Each conduit housed various types of cables that protruded at least 500-mm past each end of the conduit block-outs.

The floor slab was placed on top of a single brick perimeter brick wall, with the conduit block-outs located on each side of the fire separating wall.

### Concrete floor slab

The concrete floor slab measured 2000-mm long x 1200-mm wide and was 200-mm thick. Five PVC conduits were cast into the slab, with a nominal concrete cover of 50-mm from the soffit of the slab. The conduits were 1300-mm long and were spaced at approximately 180-mm centres. Each conduit carried various types of cables and terminated at block-outs measuring 150-mm long x 100-mm wide x 75-mm deep.



### Fire separating wall

The fire separating wall comprised a single leaf solid dry pressed brick perimeter wall built on top of the specimen containing frame, with an established fire resistance level of-/240/90, as specified in Clause 6.5 of AS 3700.

The concrete slab was placed directly on top of the fire separating perimeter wall in such a way that the fire exposed block-outs were located 900-mm from the wall and the unexposed block-outs were 300-mm from the face of wall. The fire exposed block-outs were located approximately 100-mm from the back of the furnace chamber.



### Conduit specimens

For the purpose of the test, the PVC conduits were referenced as Specimens 1 to 5.

SPECIMEN 1		
32-mm OD PVC conduit carrying a single electrical cable sealed on the unexposed end		
CAST-IN SERVICE		
Description	Size and location within the concrete floor	End conditions
32-mm PVC conduit	1300-mm long x 32-mm OD PVC conduit located within the concrete floor with 50-mm concrete cover	Conduit sealed on the unexposed block-out end only using Hilti CP606 Firestop Acrylic Sealant to a depth of 20-mm and finished with a 20-mm fillet
Electrical cable	Single 15-mm diameter 16-mm <sup>2</sup> 2 core plus Earth copper/XLPE/PVC electrical cable	Protruded at least 500-mm from each block out end
Photographs	Fire exposed block out end	Unexposed block out end
		
Drawings	Drawings numbered 0-1, Sheets 1 and 2, dated 18 August 2019, by Hilti Australia.	





SPECIMEN 3		
25-mm OD PVC conduit carrying various data and communication cables sealed on the unexposed end		
CAST-IN SERVICE		
Description	Size and location within the concrete floor	End conditions
25-mm PVC Conduit	1300-mm long x 25-mm OD PVC conduit located within the concrete floor with 50-mm concrete cover	Conduit sealed on the unexposed block-out end only using Hilti CP606 Firestop Acrylic Sealant to a depth of 20-mm and finished with a 20-mm fillet
Data and communication cables	<p>One (1) off 7-mm dia. Electra cables Coaxial cable RG6Q (blue)</p> <p>One (1) off 5-mm dia. Clipsal C-Bus Category 5 5005C305BST (pink) data cable</p> <p>One (1) off 5-mm dia. EAS 7206 - 6 core data cable (grey)</p> <p>Two (2) off 5-mm dia. Electra cables CAT6 (blue) data cable</p>	Protruded at least 500-mm from each block-out end
Photographs	Fire exposed block-out end	Unexposed block-out end
		
Drawings	Drawings numbered 0-1, Sheets 1 and 2, dated 18 August 2019, by Hilti Australia	



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## 2.2 Dimensions

The overall dimensions of the concrete floor slab measured 2000-mm long x 1200-mm wide x 200-mm thick, placed on top of a 1200-mm x 1200-mm 110-mm thick single brick perimeter wall constructed within the opening in the specimen containing frame.

## 2.3 Orientation

The concrete floor slab was placed on top of the single brick perimeter wall built within a specimen containing frame. The specimen containing frame and the concrete slab was placed on top of the furnace chamber and exposed to fire from the underside.

## 2.4 Conditioning

The conduit specimens were cast into the concrete floor slab on 18 January 2019 and the services were installed on 24 July 2019.

# 3 Documentation

The following documents were supplied or referenced by the sponsor as a complete description of the specimen and should be read in conjunction with this report:

Drawings numbered 0-1, Sheets 1 and 2, dated 18 August 2019, by Hilti Australia.

# 4 Equipment

## 4.1 Furnace

The furnace had a nominal opening of 1000-mm x 1000-mm for attachment of vertical or horizontal specimens.

The furnace was lined with refractory bricks and materials with the thermal properties as specified in AS 1530.4-2014 and was heated by combustion of a mixture of natural gas and air.

## 4.2 Temperature

The temperature in the furnace chamber was measured by four type K, 3-mm diameter, and 310 stainless steel Mineral Insulated Metal Sheathed (MIMS) thermocouples. Each thermocouple was housed in high-nickel steel tubes opened at the exposed end.

The temperatures of the specimen were measured by glass-fibre insulated and sheathed K-type thermocouples with a wire diameter of 0.5-mm.

Location of the thermocouples on the unexposed face of the specimens are described in Appendix A.

### 4.3 Measurement system

The primary measurement system comprised a multiple-channel data logger, scanning at one minute intervals during the test.

## 5 Ambient temperature

The temperature of the test area was 12°C at the commencement of the test.

## 6 Departure from standard

Ad-hoc fire test with a site specific specimen set up following the heating regime specified in AS1530.4-2014, with instrumentation guided by Section 10 of the standard.

## 7 Termination of test

The test was terminated at 121 minutes by the agreement with the sponsor.

## 8 Test results

### 8.1 Critical observations

The following observations were made during the fire-resistance test:

- 1 minute - Smoke is being emitted from the block-outs of Specimens 2, 4 and 5.
- 3 minutes - The amount of smoke being emitted from the block-outs of Specimens 2, 4 and 5 is increasing.
- 15 minutes - A single spalling sound has been emitted from inside the furnace.
- 20 minutes - Condensation is dripping from inside the block-outs of Specimens 2 and 5.
- 45 minutes - The amount of smoke emitted from the block-out of Specimen 5 has decreased.
- 60 minutes - Smoke is no longer being emitted from any of the specimens.
- 80 minutes - Light smoke and moisture is being emitted from the block-outs of Specimens 2 and 5.
- 120 minutes - Condensation continues to drip from the block-outs of Specimens 2 and 5. Light smoke is emitted from the block-out of Specimen 5.
- 121 minutes - Test terminated.

## 8.2 Furnace temperature

Figure 1 shows the standard curves of temperature versus time for heating the furnace chamber and the actual curves of average and maximum temperature versus time recorded during the heating period.

## 8.3 Furnace severity

Figure 2 shows the curve of furnace severity versus time during the heating period.

## 8.4 Specimen temperature

Figures 3 to 7 show curves of temperature versus time recorded on the unexposed face of specimens 1 to 5.

Figure 8 shows curves of temperature versus time recorded on the unexposed face of the fire separating wall.

## 8.5 Performance

Performance observed in respect of the following AS 1530.4-2014 criteria:

SPECIMEN 1		
Structural adequacy	-	not applicable
Integrity	-	no failure at 121 minutes
Insulation	-	no failure at 121 minutes
SPECIMEN 2		
Structural adequacy	-	not applicable
Integrity	-	no failure at 121 minutes
Insulation	-	no failure at 121 minutes
SPECIMEN 3		
Structural adequacy	-	not applicable
Integrity	-	no failure at 121 minutes
Insulation	-	no failure at 121 minutes

<b>SPECIMEN 4</b>		
Structural adequacy		not applicable
Integrity		no failure at 121 minutes
Insulation		no failure at 121 minutes

<b>SPECIMEN 5</b>		
Structural adequacy		not applicable
Integrity		no failure at 121 minutes
Insulation		no failure at 121 minutes

This report details methods of construction, the test conditions and the results obtained when specific element of construction described herein was tested following the procedure outlined in this standard. Any significant variation with respect to size, constructional details, loads, stresses, edge or end conditions, other than those allowed under the field of direct application in the relevant test method, is not covered by this report.

Because of the nature of fire resistance testing and the consequent difficulty in quantifying the uncertainty of measurement of fire resistance, it is not possible to provide a stated degree of accuracy of the result.

## 9 Tested by



Chris Wojcik  
Testing Officer

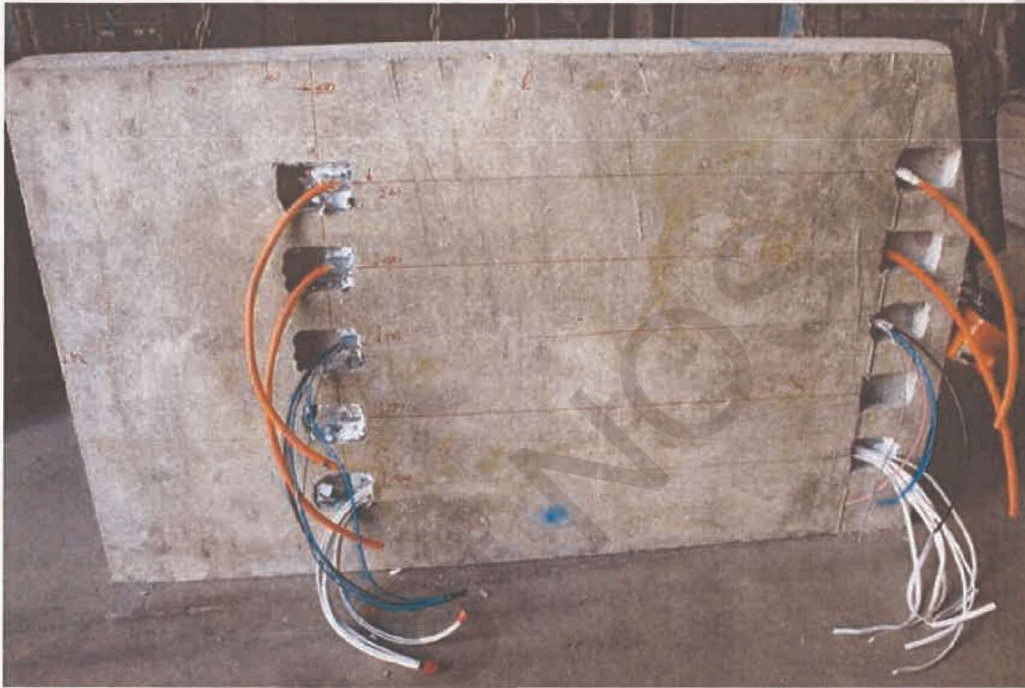


## Appendices

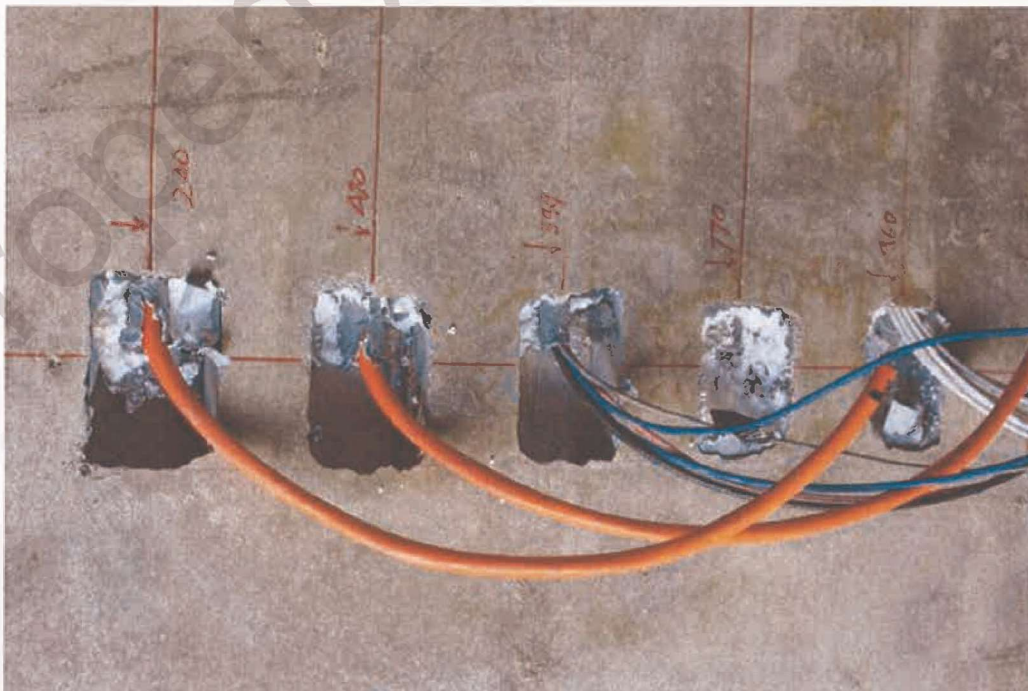
### Appendix A – Measurement location

Specimen	T/C Position	T/C designation
SPECIMEN 1	Cable – 25-mm from conduit	S1
	Underside of the concrete slab – 25-mm from separating wall	S2
	Top of the concrete slab – above the blackout	S3
SPECIMEN 2	Cable – 25-mm from conduit	S4
	Underside of the concrete slab – 25-mm from separating wall	S5
	Top of the concrete slab – above the blackout	S6
SPECIMEN 3	Cable – 25-mm from conduit	S7
	Underside of the concrete slab – 25-mm from separating wall	S8
	Top of the concrete slab – above the blackout	S9
SPECIMEN 4	Cable – 25-mm from conduit	S10
	Underside of the concrete slab – 25-mm from separating wall	S11
	Top of the concrete slab – above the blackout	S12
SPECIMEN 5	Cable – 25-mm from conduit	S13
	Underside of the concrete slab – 25-mm from separating wall	S14
	Top of the concrete slab – above the blackout	S15
Separating wall	25-mm from the top – left side	S16
	25-mm from the top – right side	S17
Rover		S18
Ambient		S19

## Appendix B – Test photographs

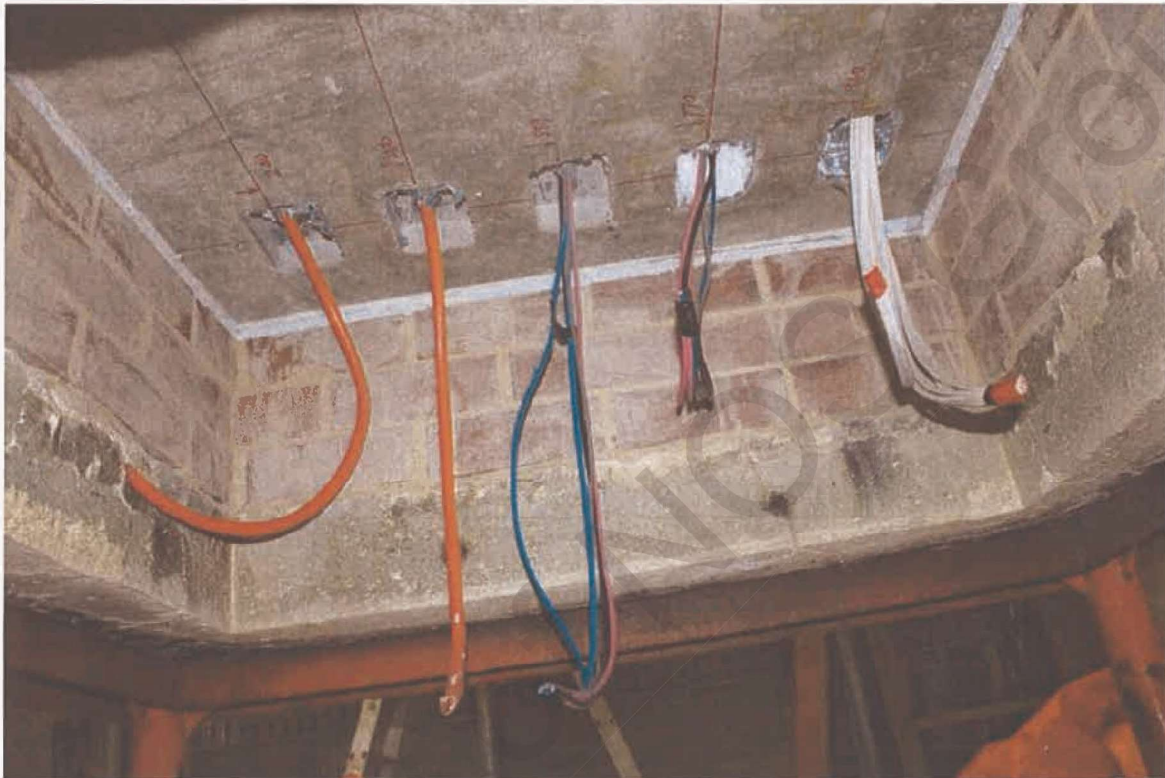


PHOTOGRAPH 1 – UNDERSIDE OF THE CONCRETE FLOOR SLAB PRIOR TO TESTING

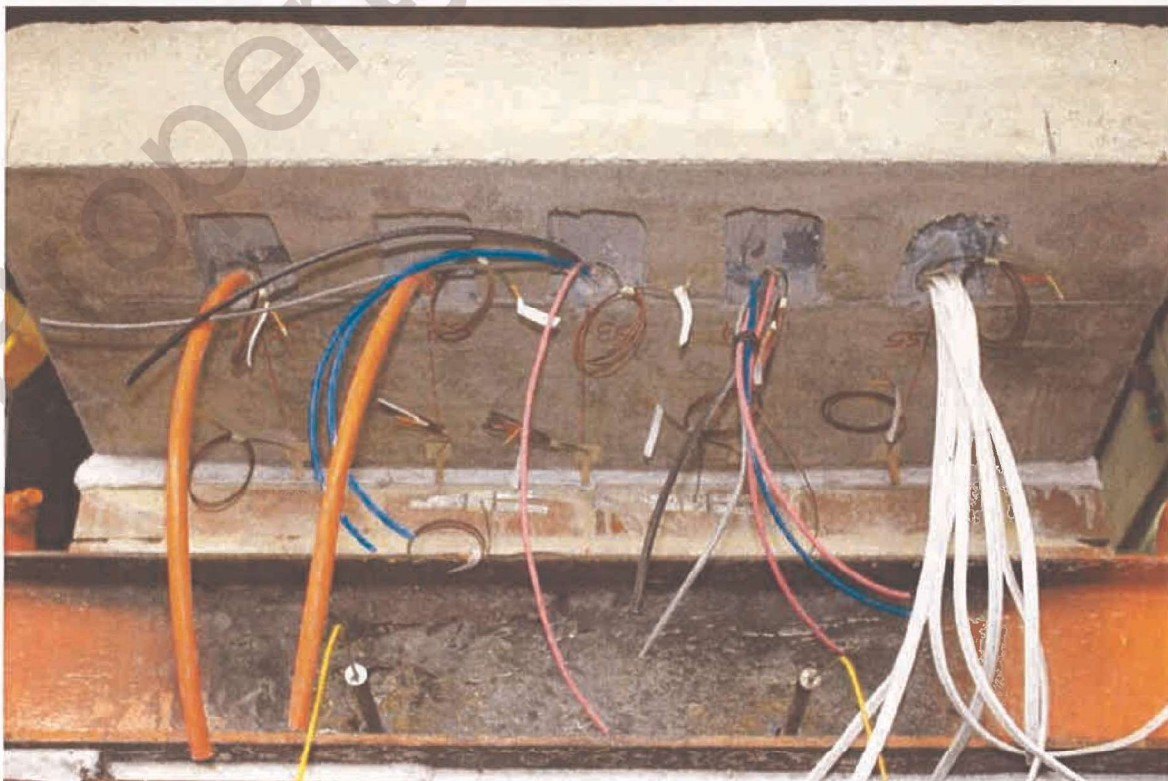


PHOTOGRAPH 2 – CONDUIT BLOCK-OUTS ON FIRE EXPOSED SIDE PRIOR TO TESTING



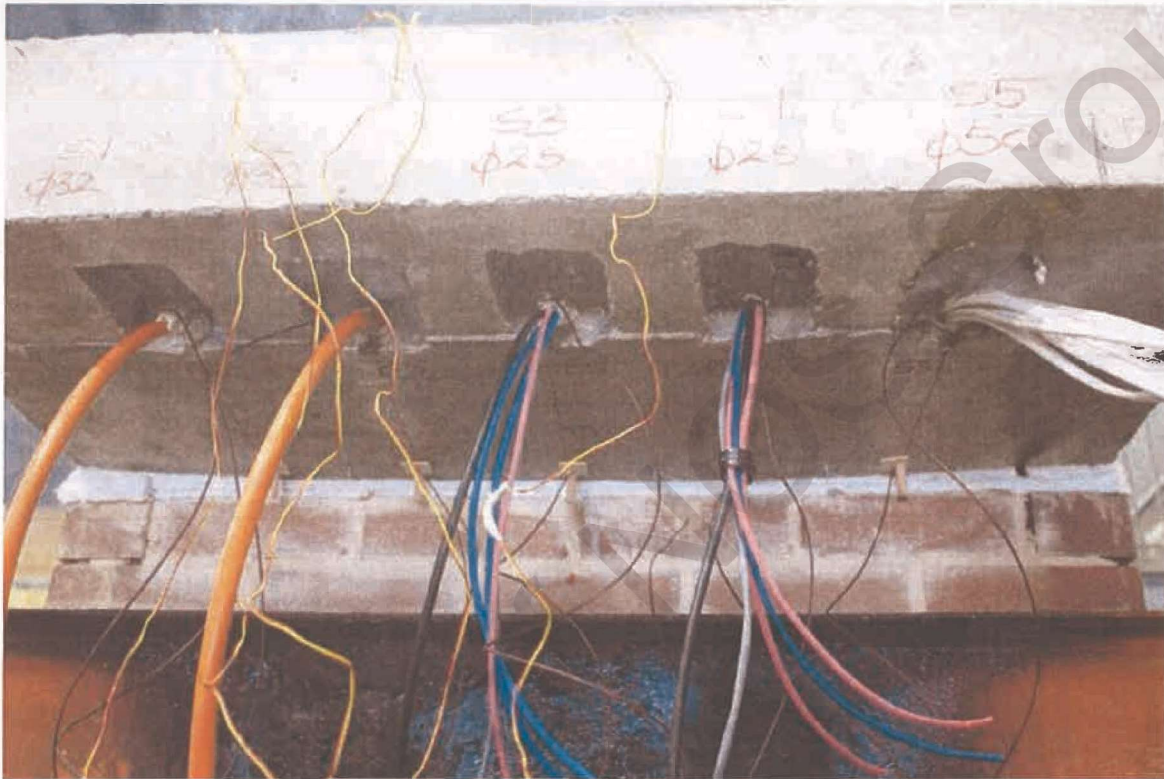


PHOTOGRAPH 3 – EXPOSED SIDE OF SPECIMENS PRIOR TO TESTING



PHOTOGRAPH 4 – UNEXPOSED FACE OF SPECIMENS PRIOR TO TESTING



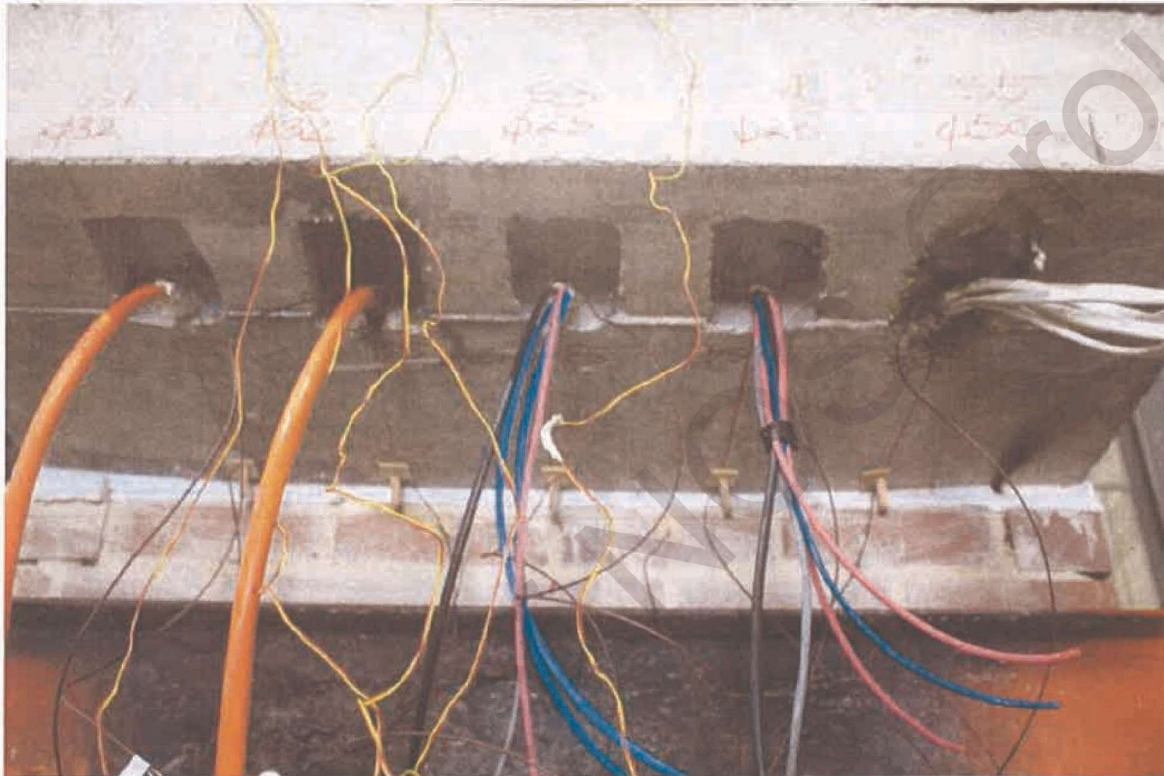


PHOTOGRAPH 5 – SPECIMENS AT 30 MINUTES INTO THE TEST

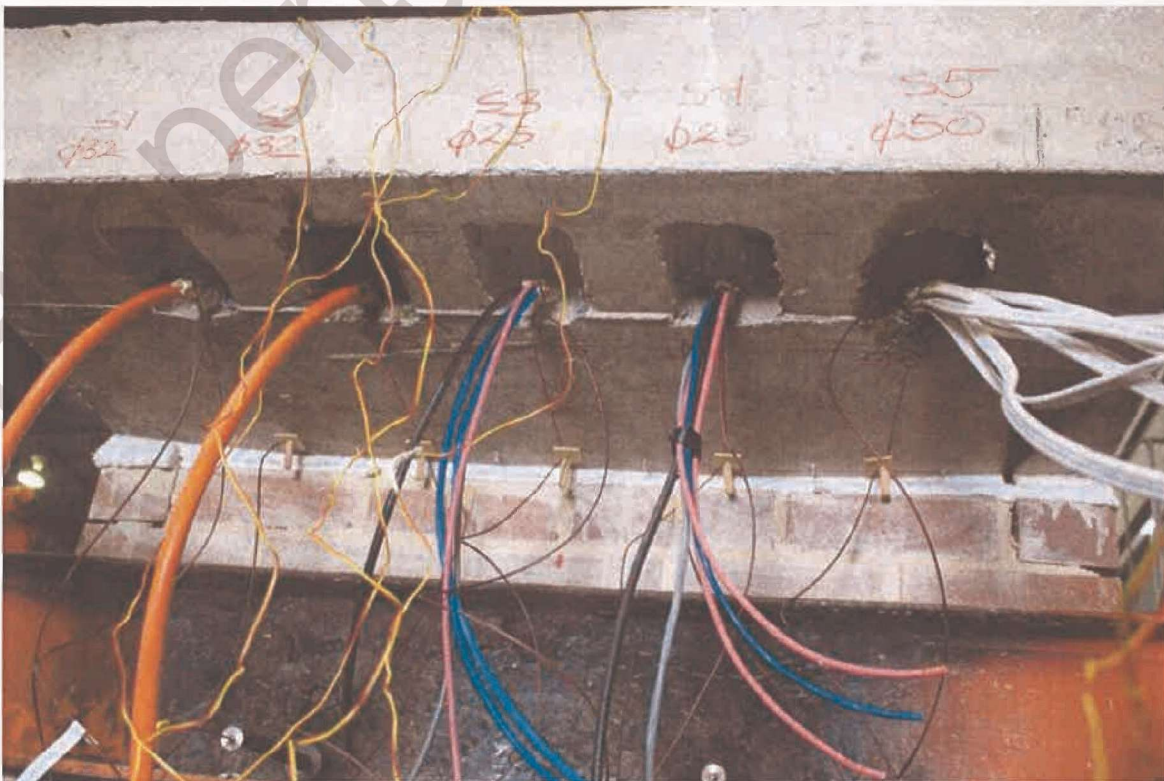


PHOTOGRAPH 6 – SPECIMENS AT 60 MINUTES INTO THE TEST





PHOTOGRAPH 7 – SPECIMENS AT 90 MINUTES INTO THE TEST



PHOTOGRAPH 8 – SPECIMEN AT THE CONCLUSION OF TESTING





PHOTOGRAPH 9—SPECIMEN SET-UP AT THE CONCLUSION OF TESTING



PHOTOGRAPH 10 – EXPOSED FACE OF THE CONCRETE FLOOR AFTER THE CONCLUSION OF TESTING

Appendix C – Test data charts

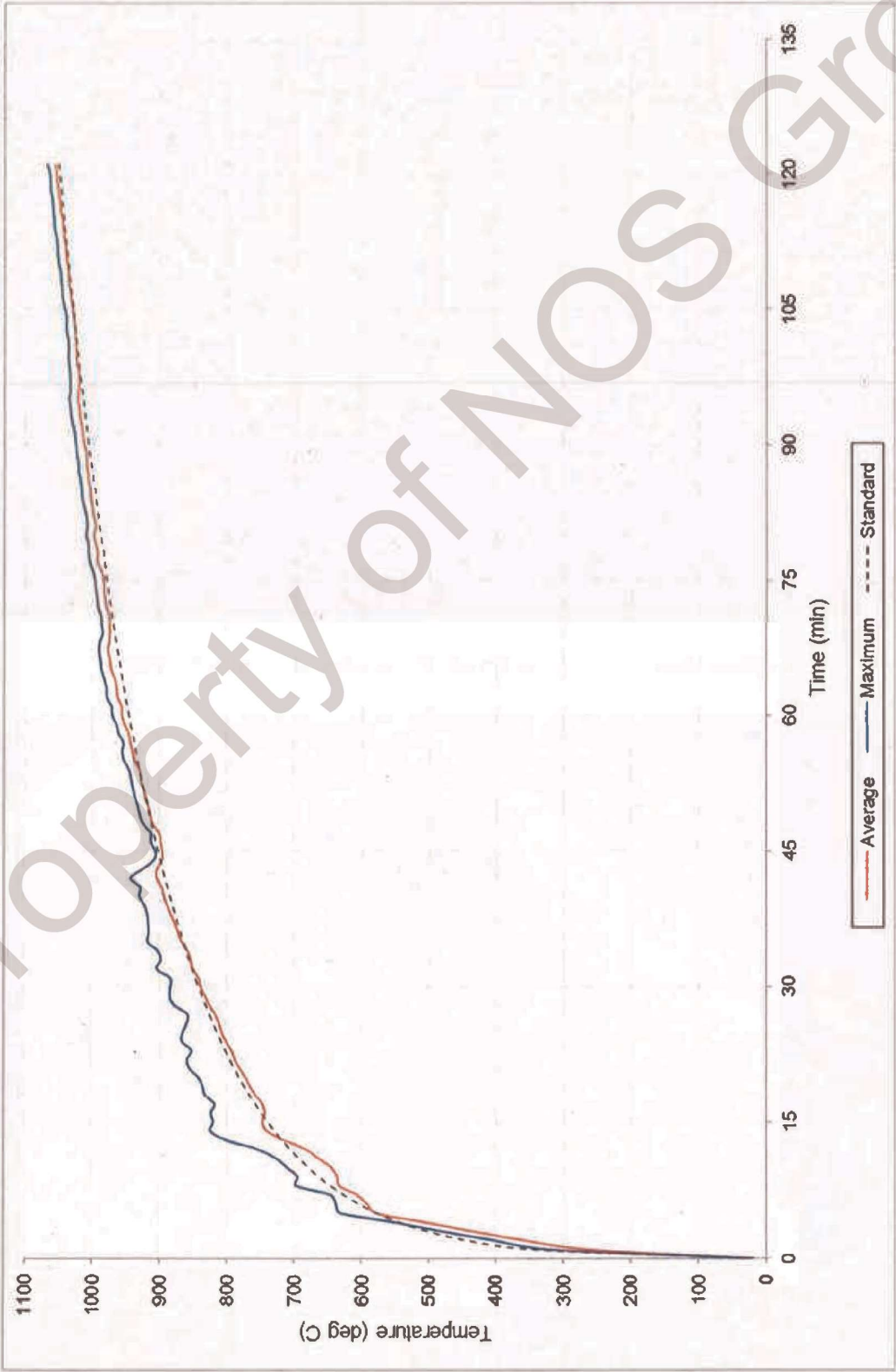


FIGURE 1 – FURNACE TEMPERATURE

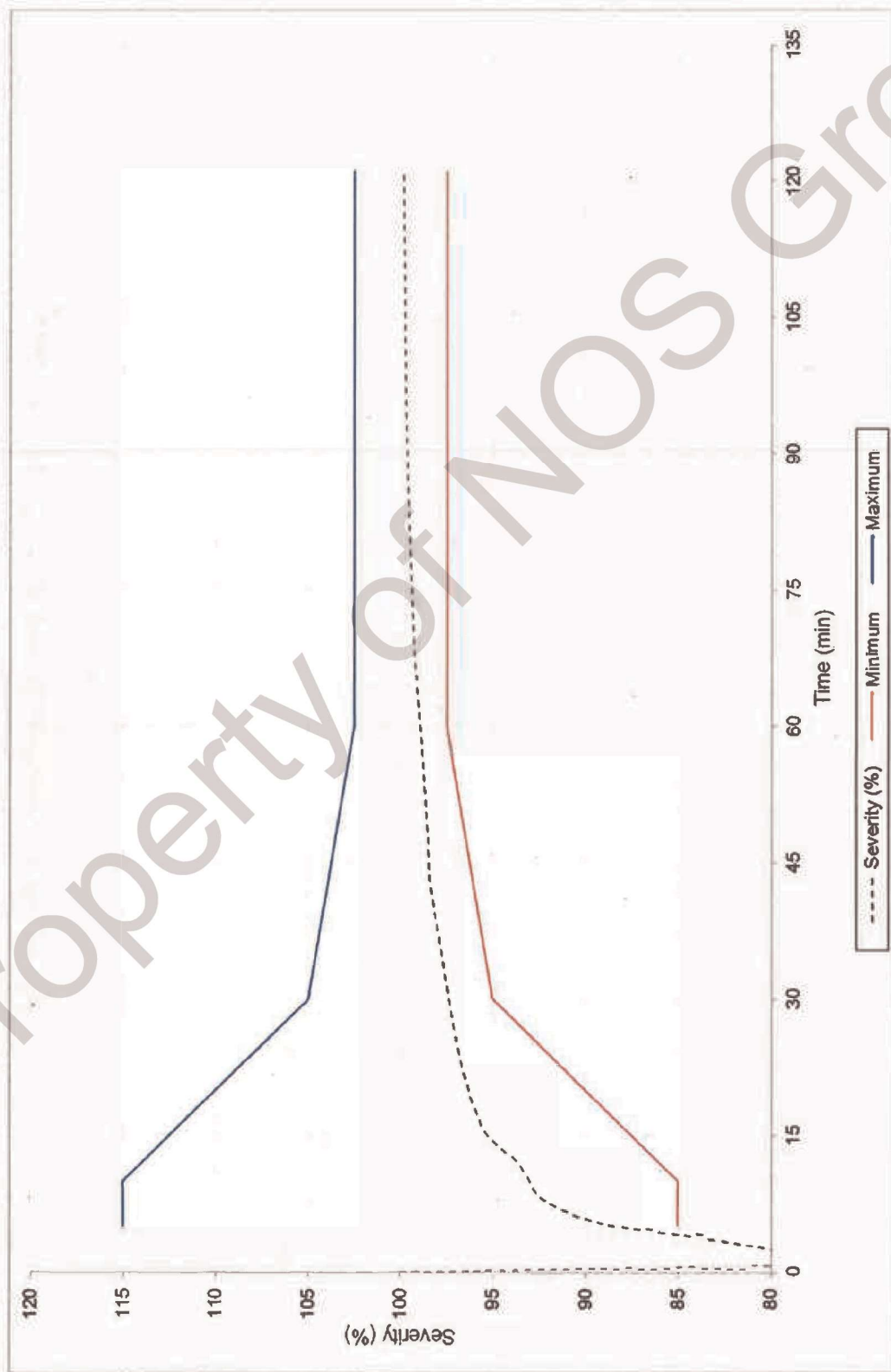


FIGURE 2 – FURNACE SEVERITY



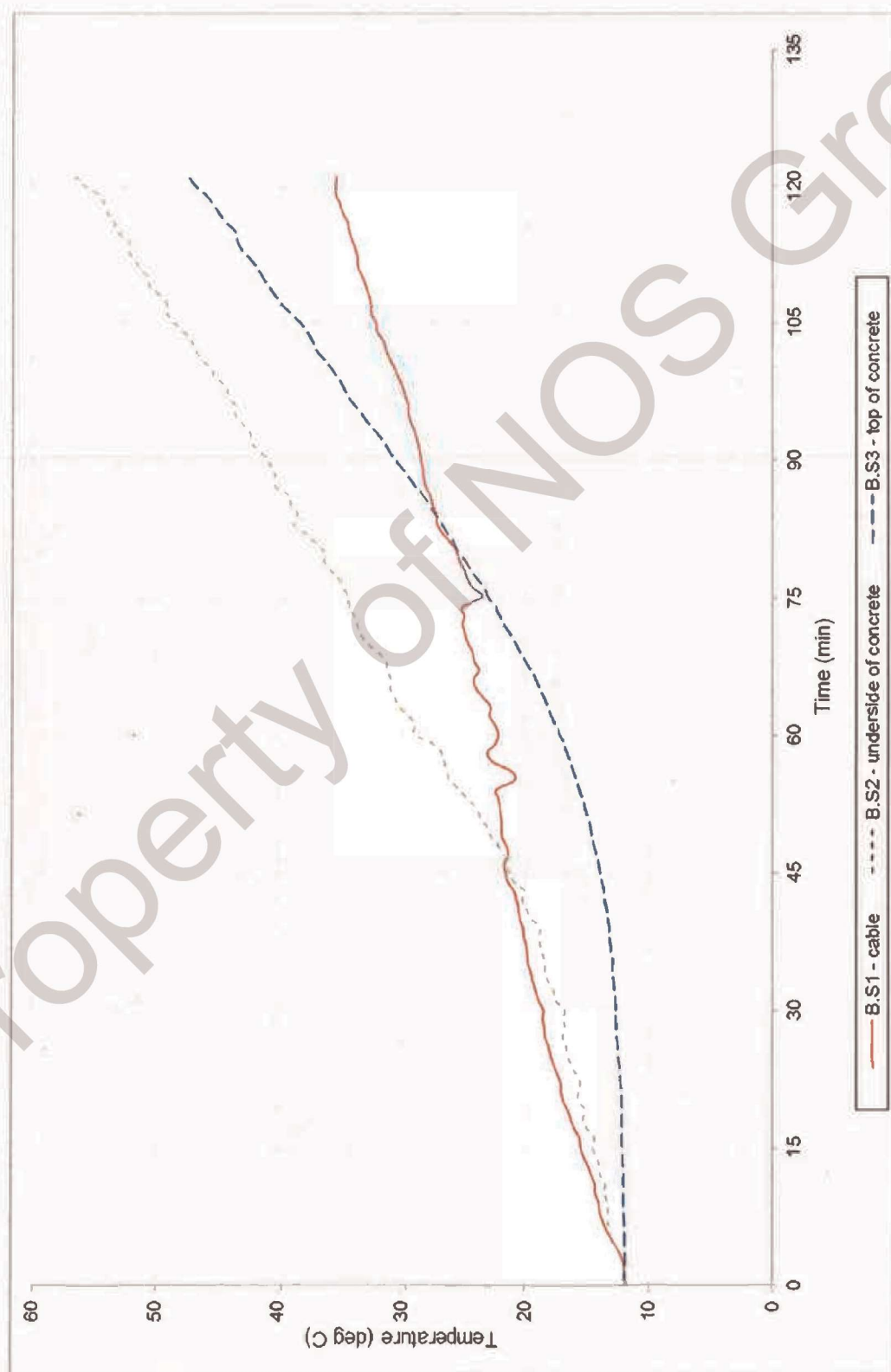


FIGURE 3 – SPECIMEN TEMPERATURE – UNEXPOSED FACE OF SPECIMEN 1



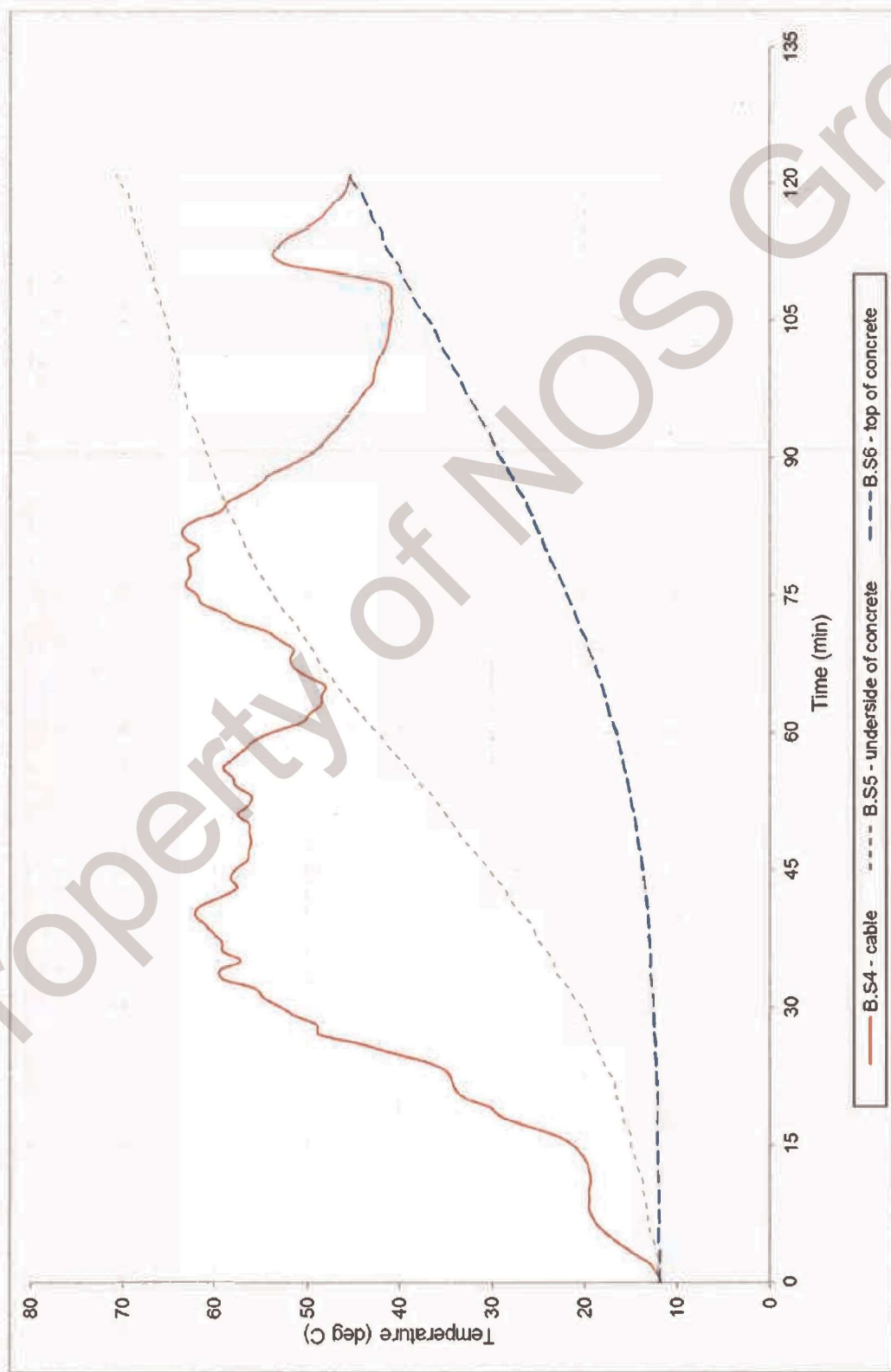


FIGURE 4 – SPECIMEN TEMPERATURE – UNEXPOSED FACE OF SPECIMEN 2

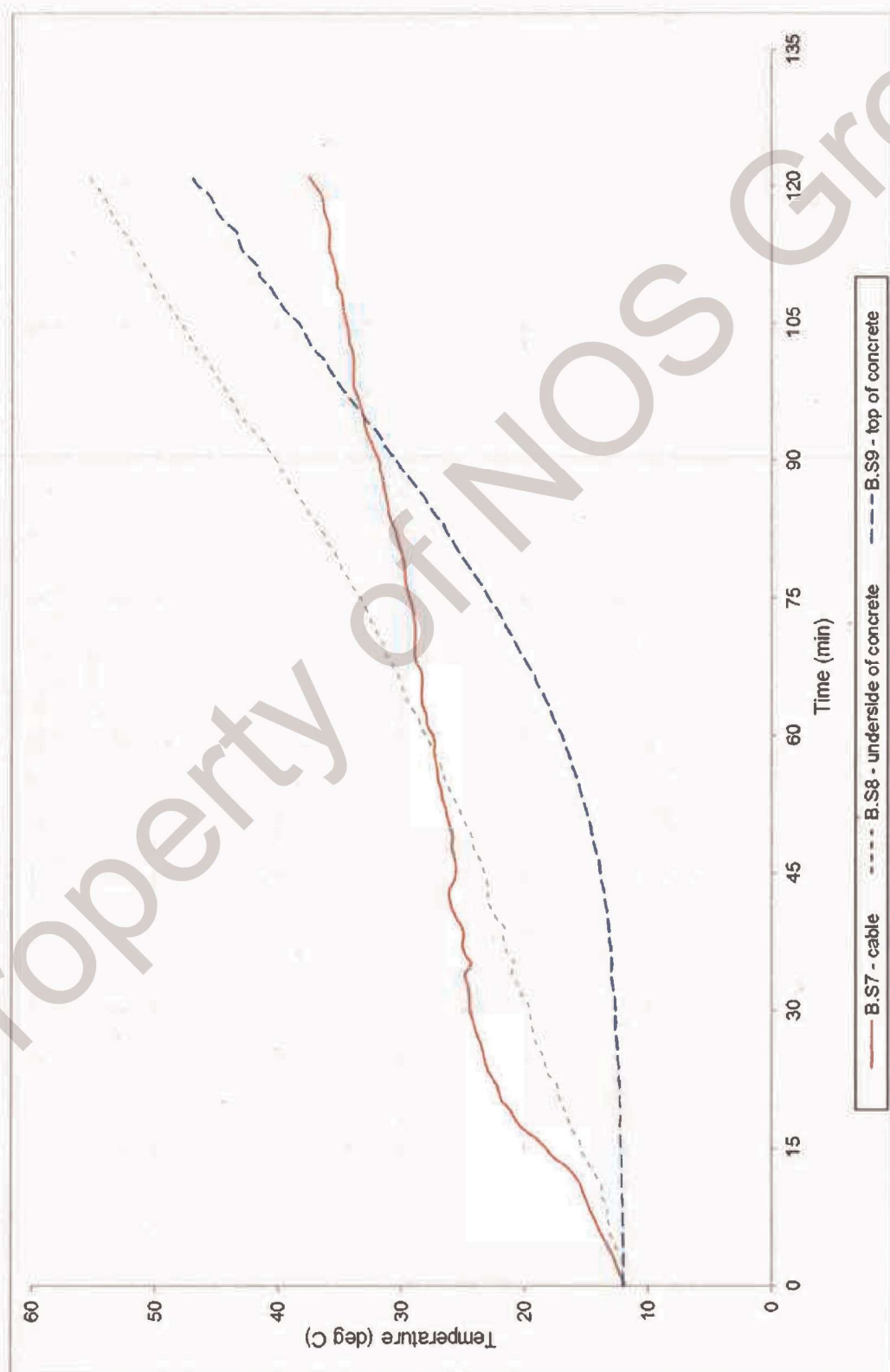


FIGURE 5 – SPECIMEN TEMPERATURE – UNEXPOSED FACE OF SPECIMEN 3

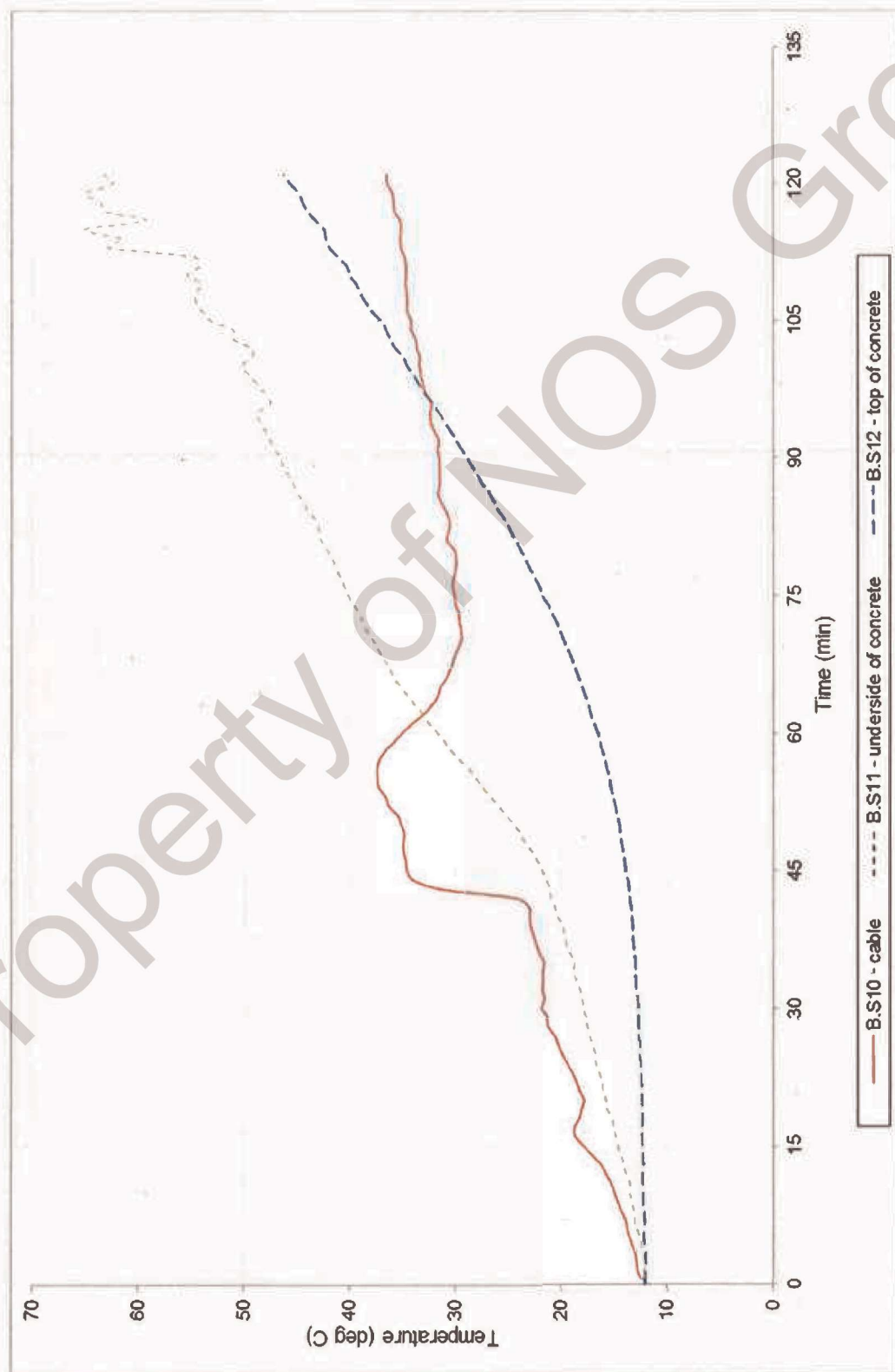


FIGURE 6 – SPECIMEN TEMPERATURE – UNEXPOSED FACE OF SPECIMEN 4

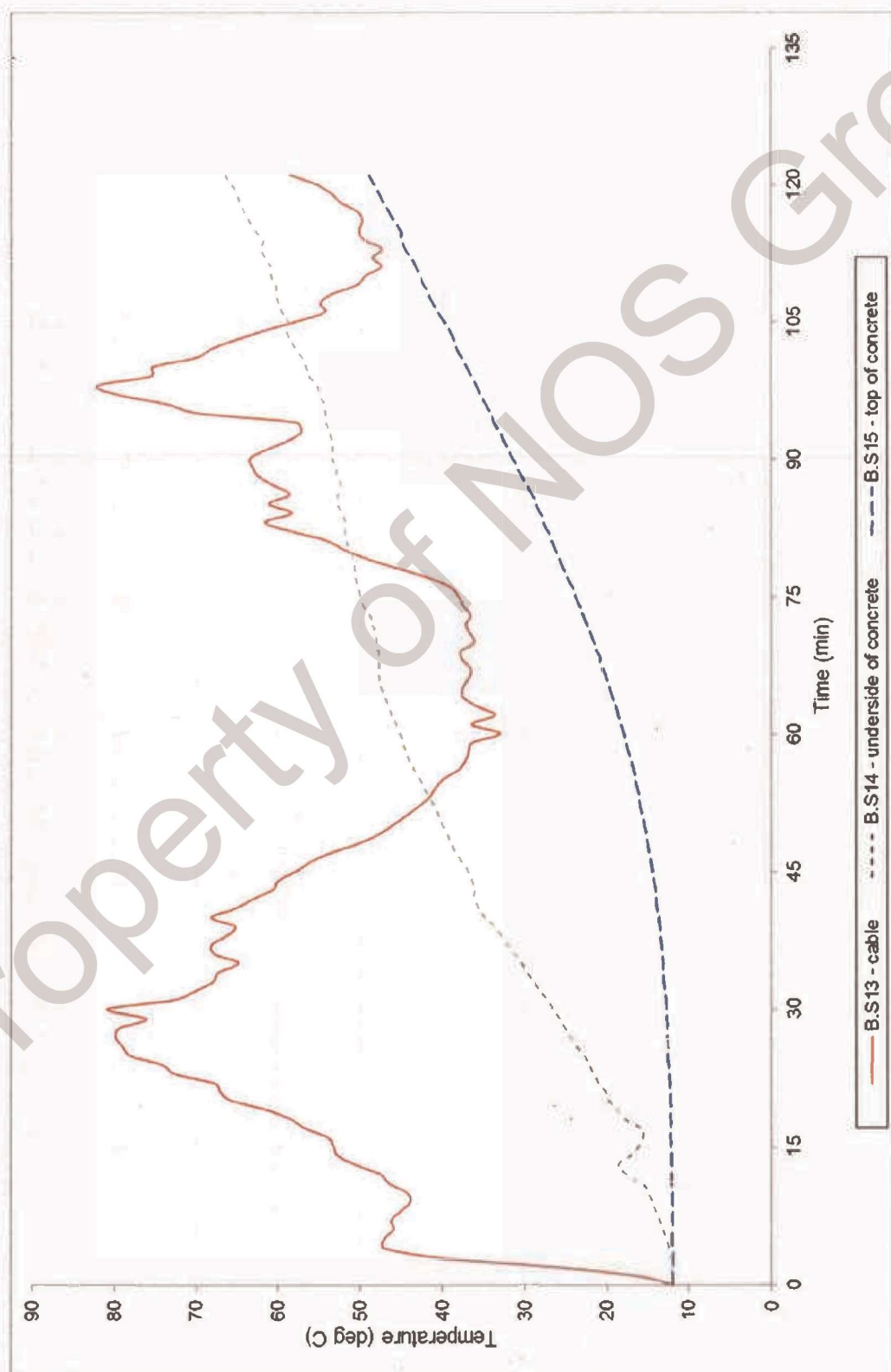


FIGURE 7 – SPECIMEN TEMPERATURE – UNEXPOSED FACE OF SPECIMEN 5



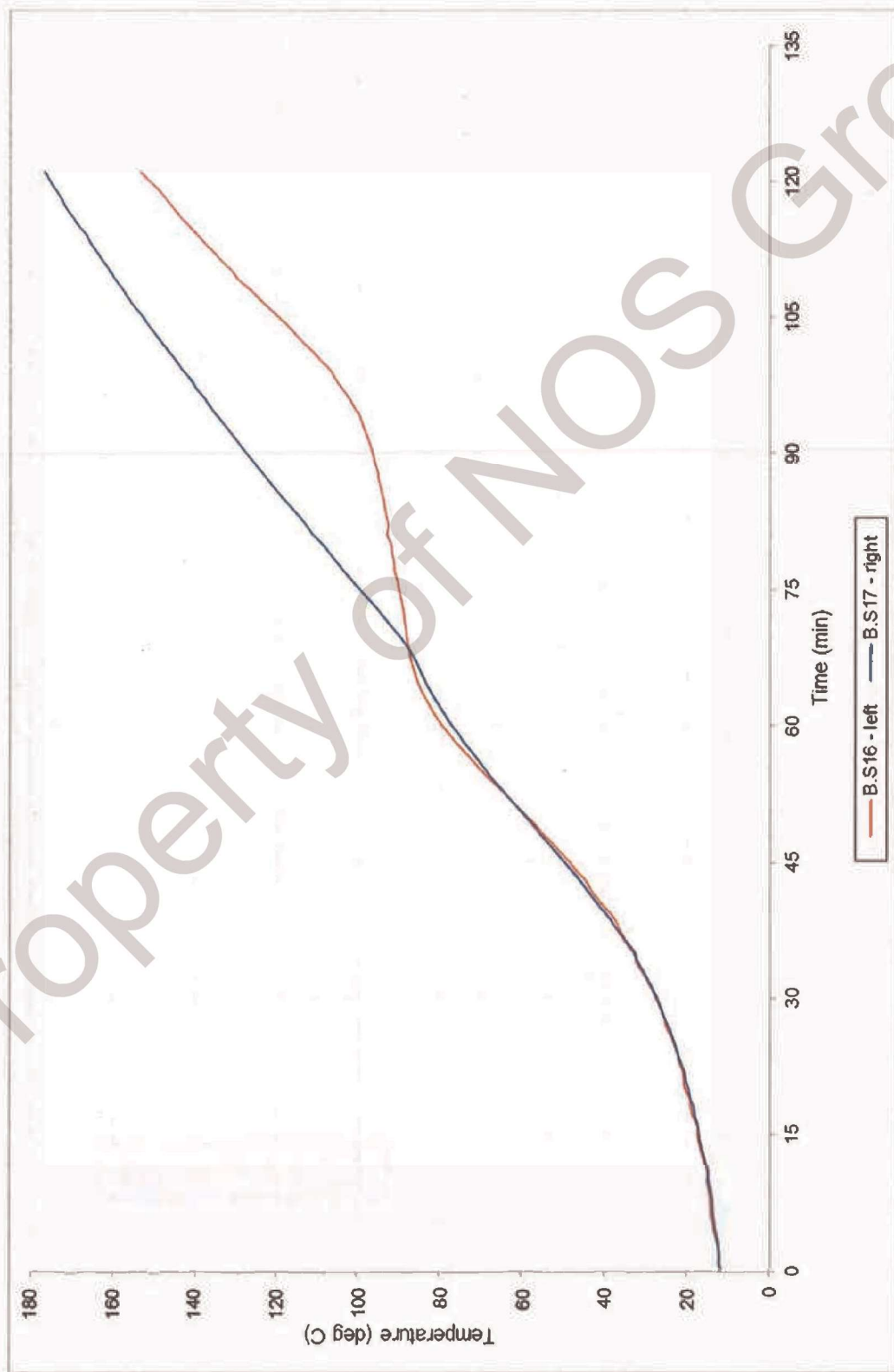
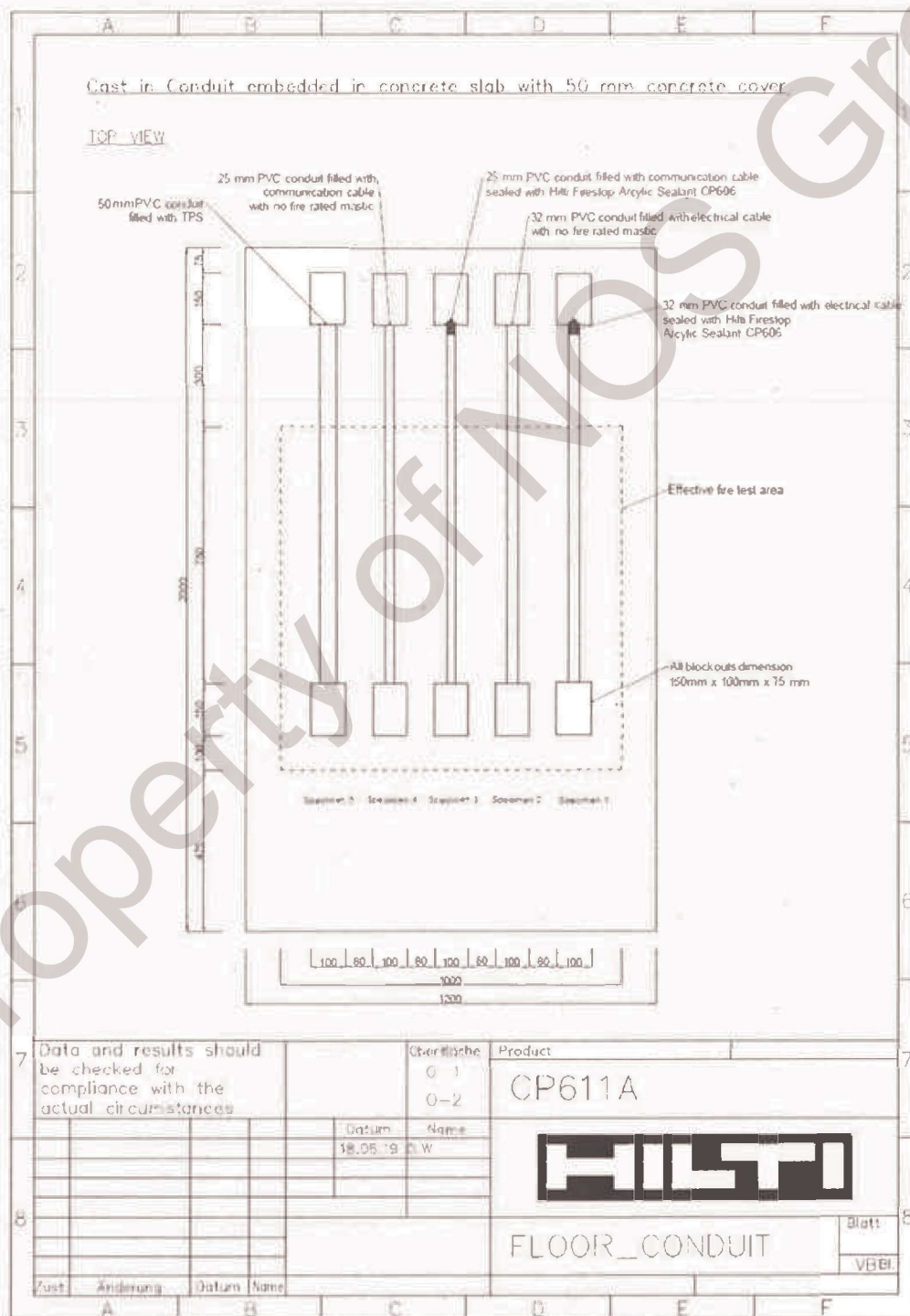
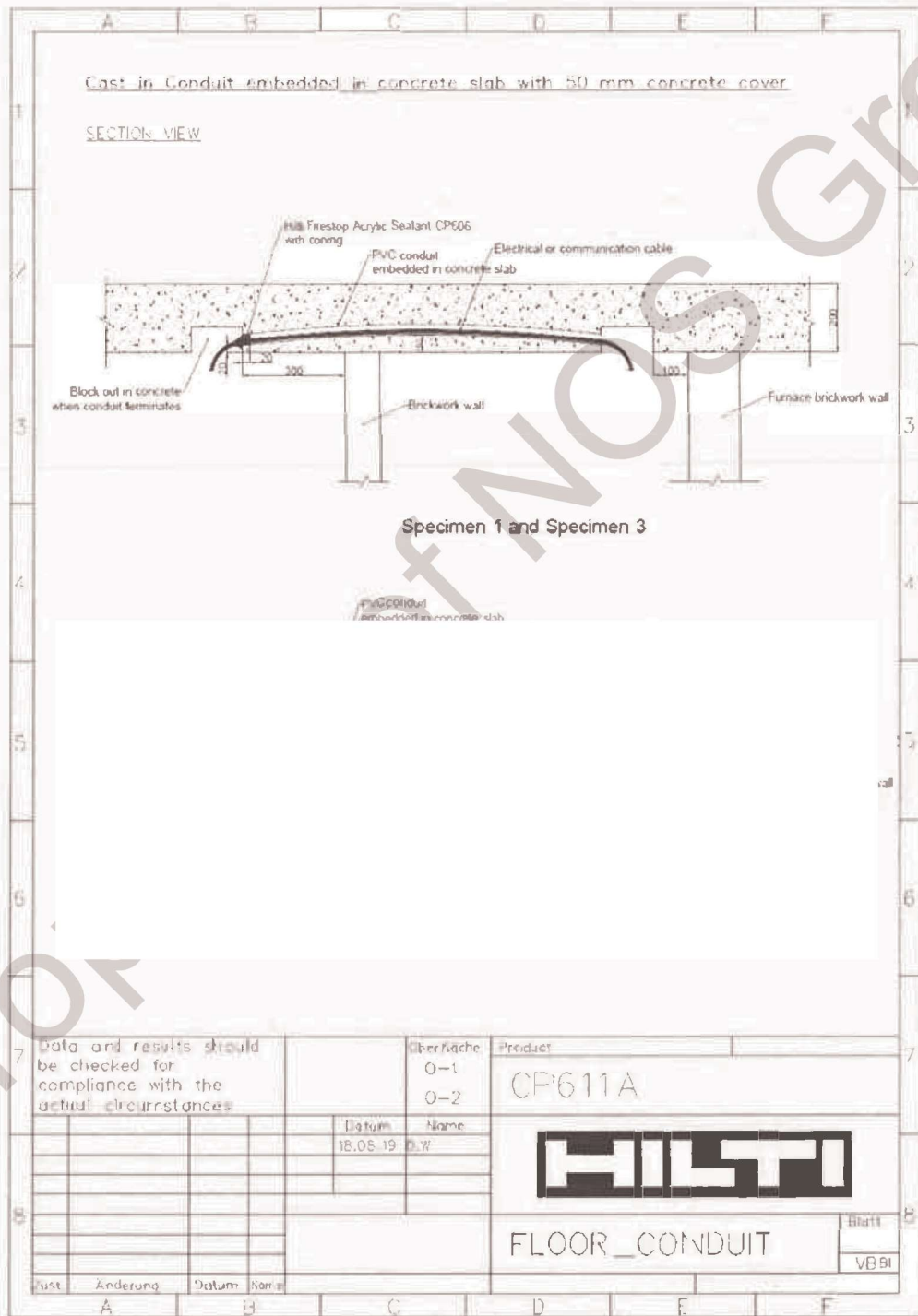


FIGURE 8 – SPECIMEN TEMPERATURE – UNEXPOSED FACE OF FIRE SEPARATING WALL

## Appendix D – Specimen drawings



DRAWING NUMBERED 0-1, SHEET 1, DATED 18 AUGUST 2019, BY HILTI AUSTRALIA



DRAWING NUMBERED 0-1, SHEET 2, DATED 18 AUGUST 2019, BY HILTI AUSTRALIA

## References

The following informative documents are referred to in this Report:

AS 1530.4-2014      Methods for fire tests on building materials, components and structures Part 4:  
Fire-resistance tests of elements of building construction.



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