

Laser Scanning Technology: an Assessment of Concrete Deterioration

An Overview Presented by
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Dissertation Title

A Preliminary Investigation Into The Application
of Remote High Definition Surveying (HDS)
Laser Scanning in Assessing Concrete Structures
That Have Been Exposed To Elevated
Temperatures

About Me

- ✍ Callum MacInnes;
- ✍ Graduated from Glasgow Caledonian University in 2008;
- ✍ BSc(Hons) Fire Risk Engineering;
- ✍ Currently working for WSP Fire Engineering Consultants.

Overview

- ✍ Choosing the dissertation subject;
- ✍ The scope and purpose of the research;
- ✍ Laser scanning technology; the progress;
- ✍ The process of the research;
- ✍ Results and findings;
- ✍ The future of the technology.

Choosing the dissertation topic

- ✍ One of the most important stages;
- ✍ The chance to be involved in laser scanning research grabbed my attention;
- ✍ This is an important point;
- ✍ Choose a subject area of interest;
- ✍ It will benefit your experience and outcome.

Scope and Purpose

- ✍ To establish the **effectiveness** of the application of HDS Laser Scanning;
- ✍ Concrete (post fire) for damage/ deterioration;
- ✍ Could **definitive** differences be established?;
- ✍ Previous research using the technology had difficulties;
- ✍ Nottingham University had the facilities, expertise and equipment to facilitate testing.

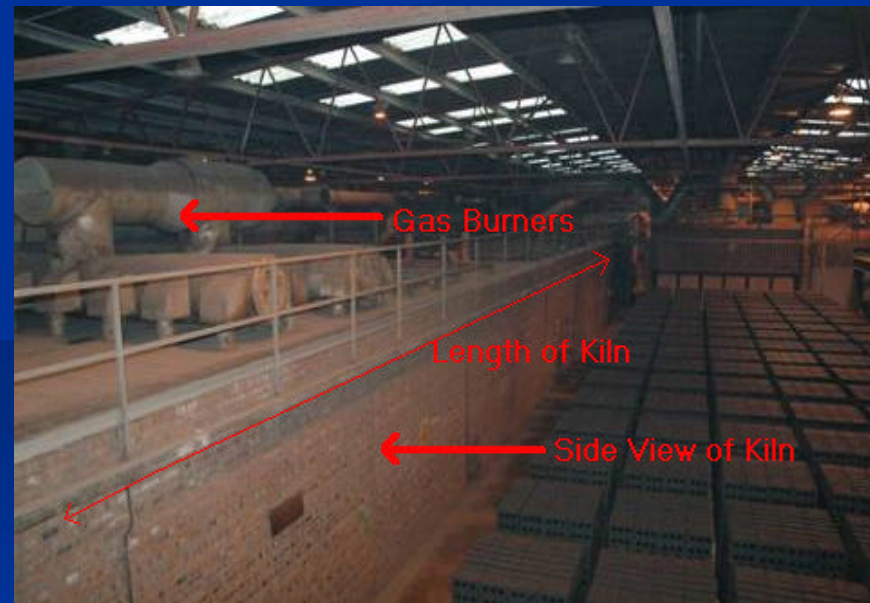
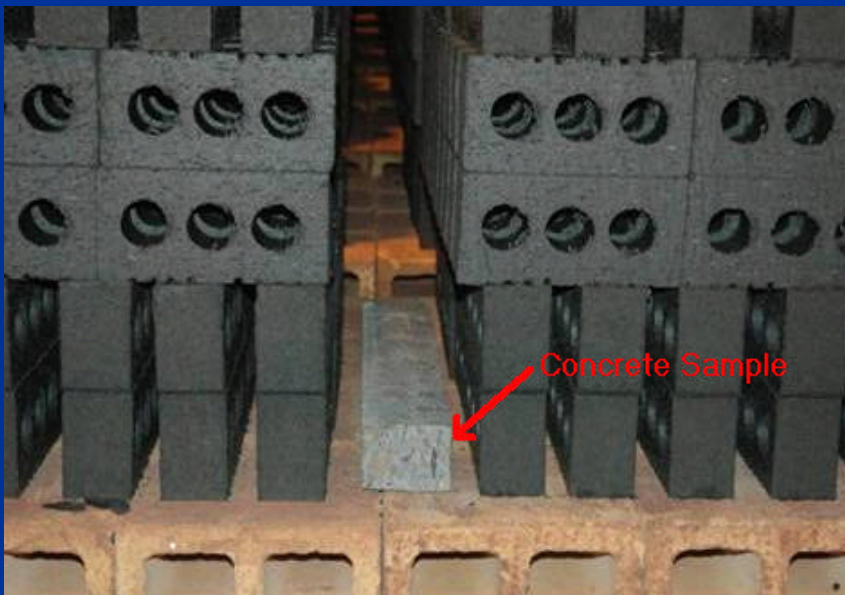
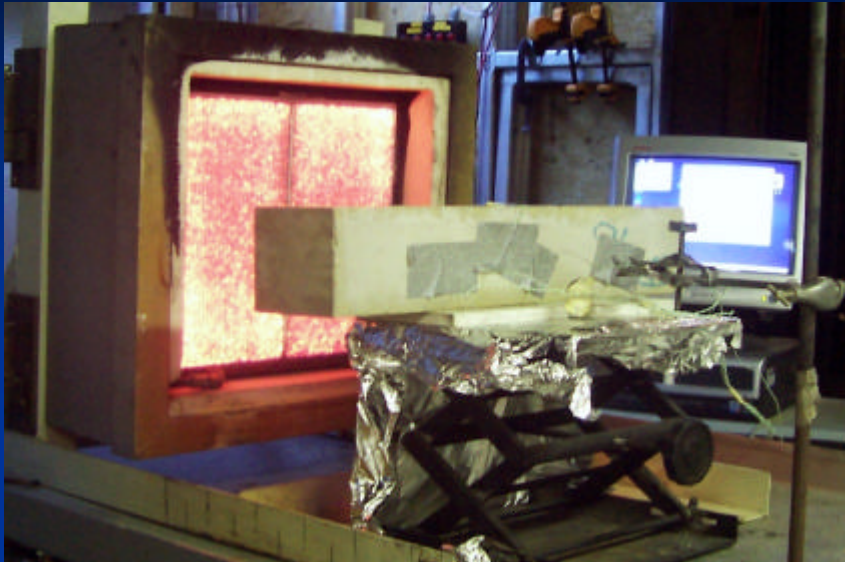
Research Process

- ✍ Reinforced concrete columns were made
 - ✍ 2 columns were cut into 3 sections each
 - ✍ 8mm reinforcement steel bar
 - ✍ Ordinary Portland Cement (OPC)
 - ✍ Dry stored for 1 month



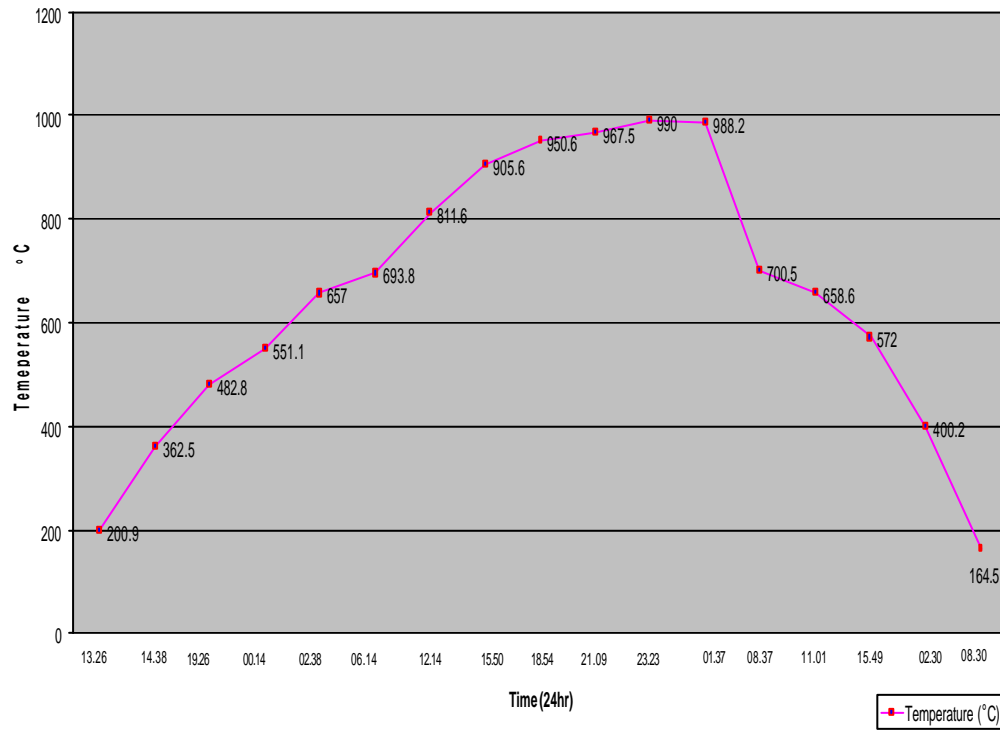
- ✍ Use of industrial Kiln to gain realistic simulation of fire temperatures;

Research Process



Research Process

Time/Temperature Heating Curve



Temperature (°C)	
Inlet temperature →	200.90
	362.50
	482.80
	551.10
	657.00
	693.80
	811.60
	905.60
	950.60
	967.50
Maximum temperature →	990.00
	988.20
	700.50
	658.60
	572.00
	400.20
Exit temperature →	164.50

Laser Scanning

- ✍ Laser scanning has went through impressive advances;
- ✍ Been available for a number of years;
- ✍ Only in recent years have their potential benefits for fire research been realised;
- ✍ Two main base technologies:
 - ✍ “Time of Flight”
 - ✍ “Phase Based”
- ✍ Breakthroughs in handling, managing and visualisation of information (Cloud of Points).

The Scanning Equipment

✎ Leica HDS 3000

- ✎ 500,000 points per second
- ✎ 360 degrees horizontal scanning analysis of the surrounding space and up to a 270 degrees vertical scan.
- ✎ Used for Lincoln Cathedral



Leica HDS 3000

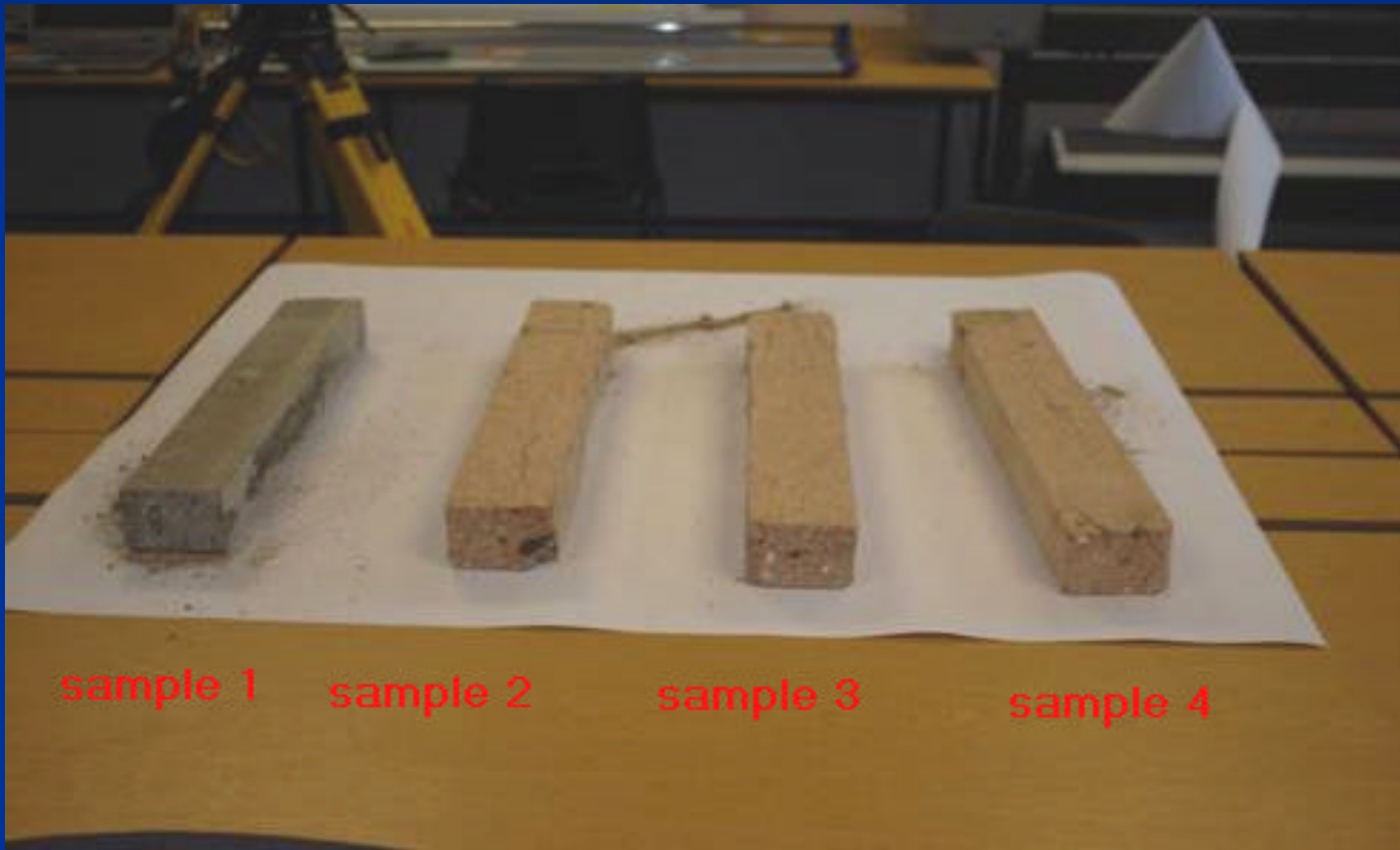
✎ Leica HDS 6000

- ✎ 508,000 points per second;
- ✎ Advance in processing technology;
- ✎ 360 degrees horizontal with 310 degrees vertical scan capabilities.



Leica HDS 6000

Concrete Specimens



sample 1

sample 2

sample 3

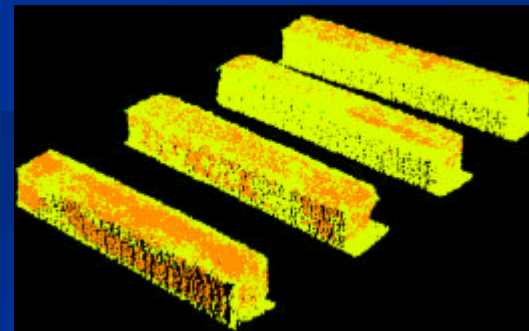
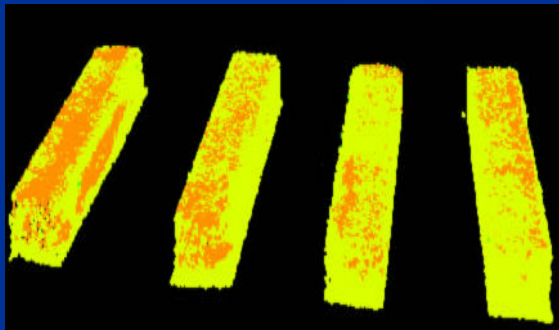
sample 4

The Results

- ✍ Initial visual inspection of change in colouration;

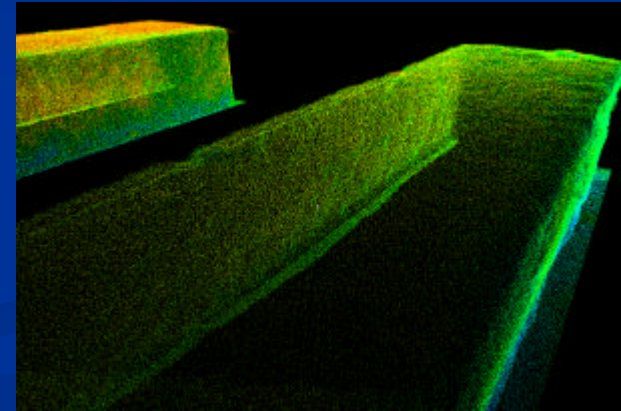
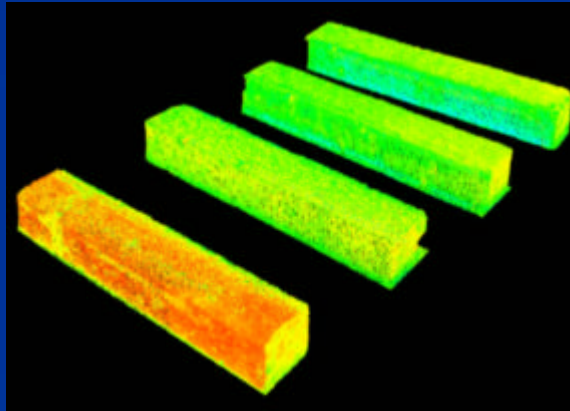
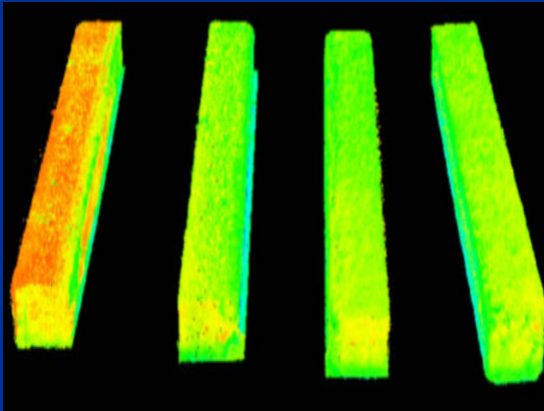


- ✍ HDS 3000 showed limited identifiable differences



The Results

- ✍ HDS 6000 returned more detailed imaging feedback;



- ✍ Clear differences in colouration;
- ✍ The difference in imaging shows the advance in technology;
- ✍ But what does this mean?

The Future

- ✍ The research was not definitive, however;
- ✍ Indication of potential identification of damage;
- ✍ Research is key to establish the limitations;
- ✍ Further research is being looked into by:
 - ✍ Glasgow Caledonian University
 - ✍ Nottingham University
 - ✍ Edinburgh University

Questions?

