



Application of Structural Fire Design, 29 April 2011,  
Prague, Czech Republic

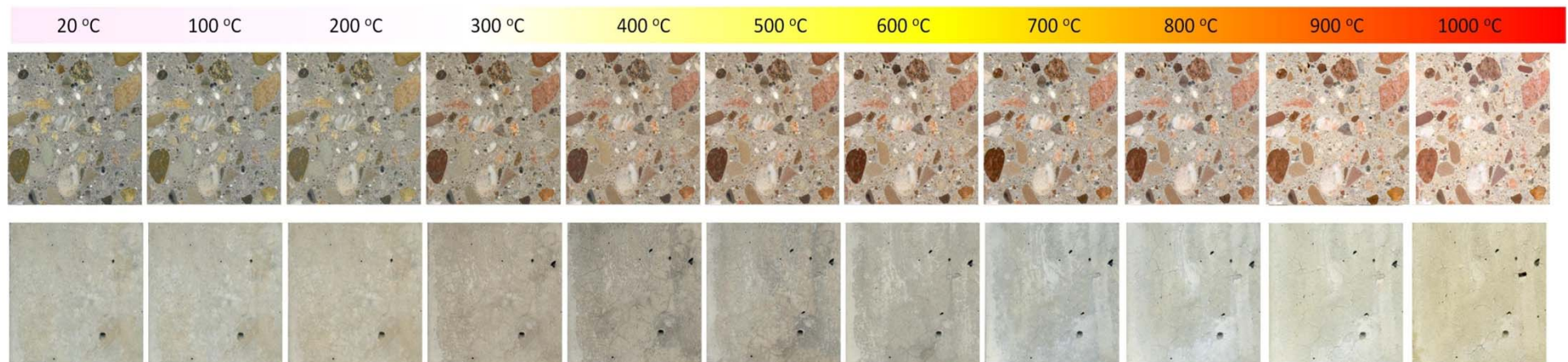


# COLOUR CHANGE OF HEATED CONCRETE

## RGB colour histogram analysis as a method for fire damage assessment of concrete

Izabela Hager

Cracow University of Technology, Cracow, Poland, [ihager@pk.edu.pl](mailto:ihager@pk.edu.pl)



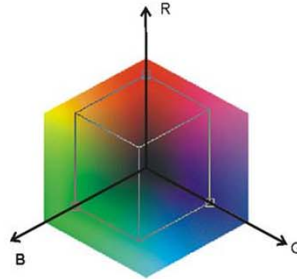
# TESTING PROCEDURE



Concrete samples heating



Flatbed scanner for samples scanning and converting to a digital image



## RGB colour system

Red, Green, Blue  
values from 0 to 255

(R,G,B)

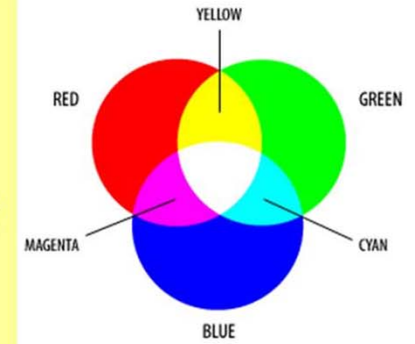
Black (0, 0, 0)

White (255, 255, 255)

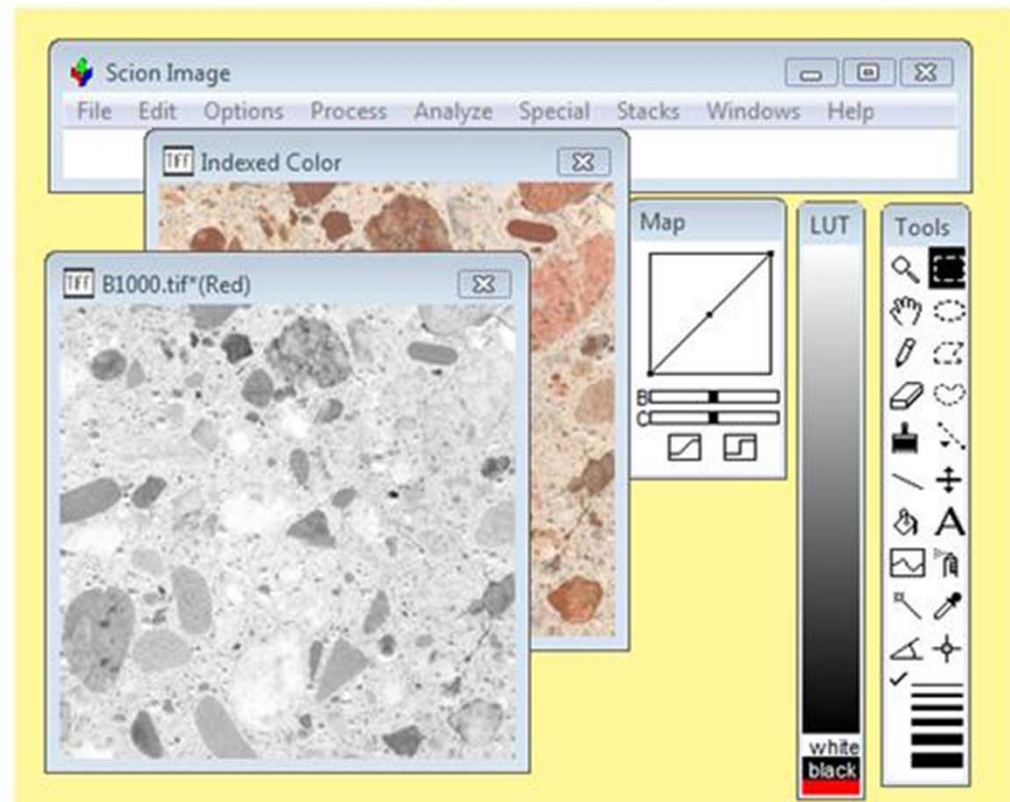
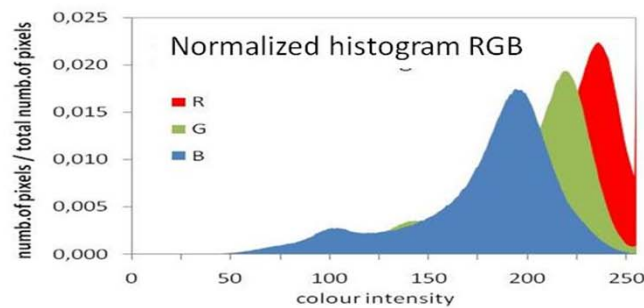
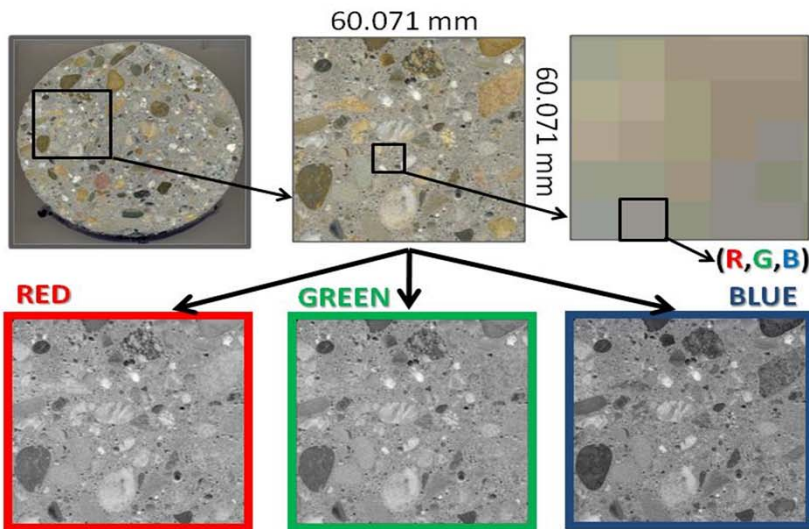
Red (255, 0, 0)

Blue (0, 0, 255)

16 777 216 colours

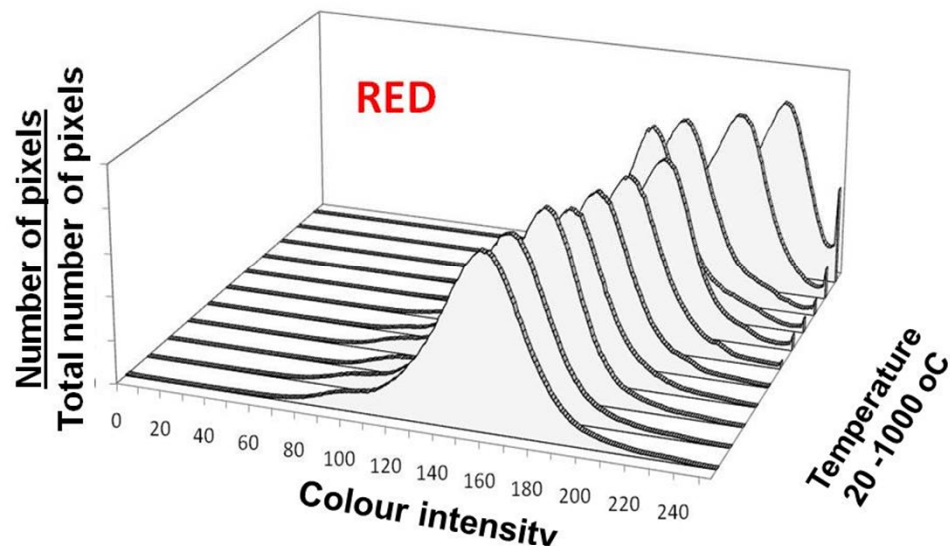


Scion Image v. 4.0.3, (Scion Corporation ©, USA)



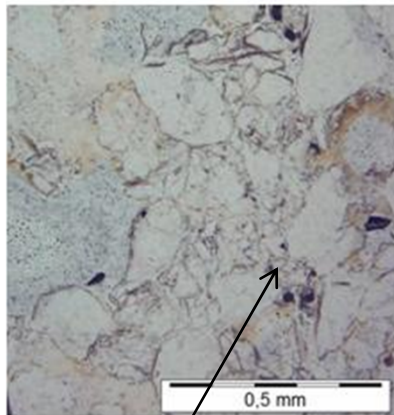
# TESTING PROCEDURE

## Normalized histogram - calibration scale

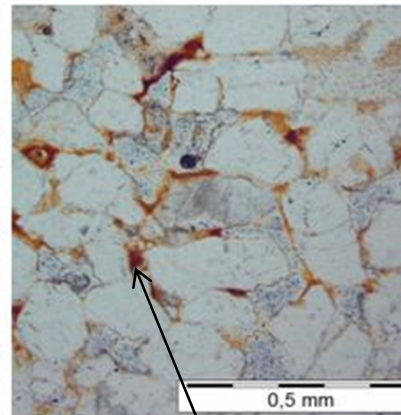


20°C

800°C



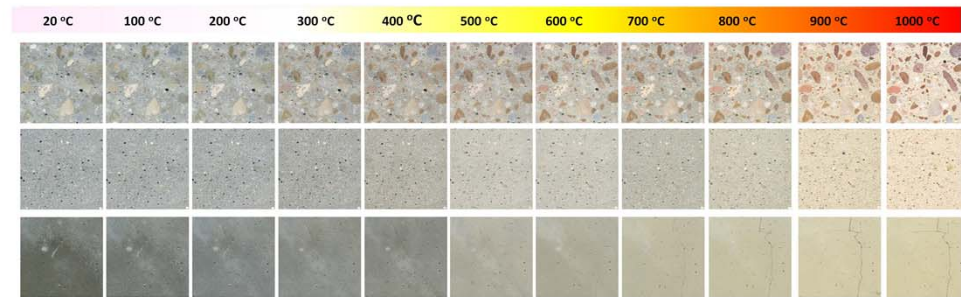
amorphous iron hydroxides



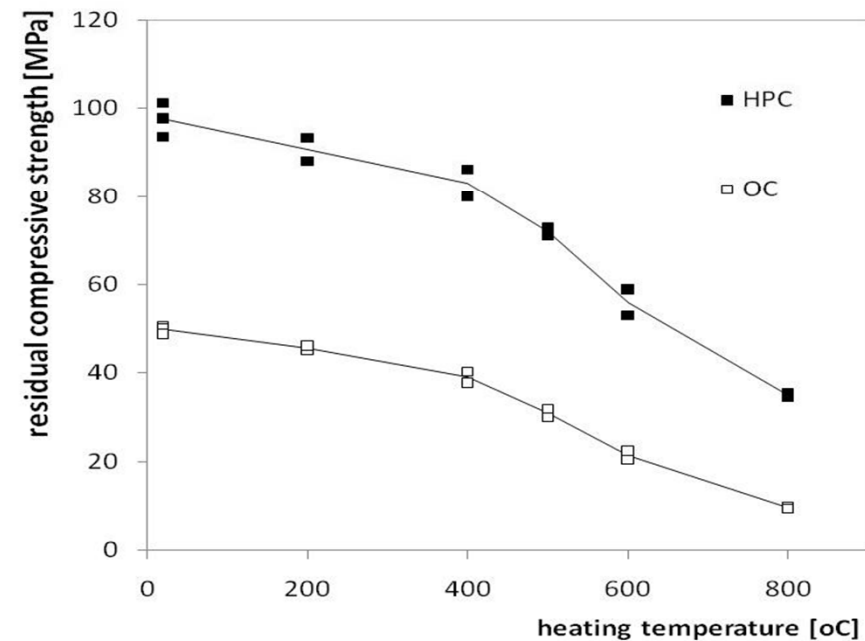
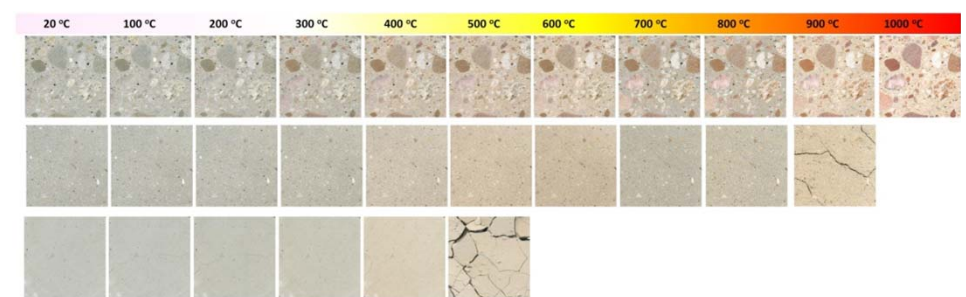
crystalline iron oxides  
Yellow - brown

sandstone, 80x, polarized light microscope

## HP concrete, mortar and cement paste

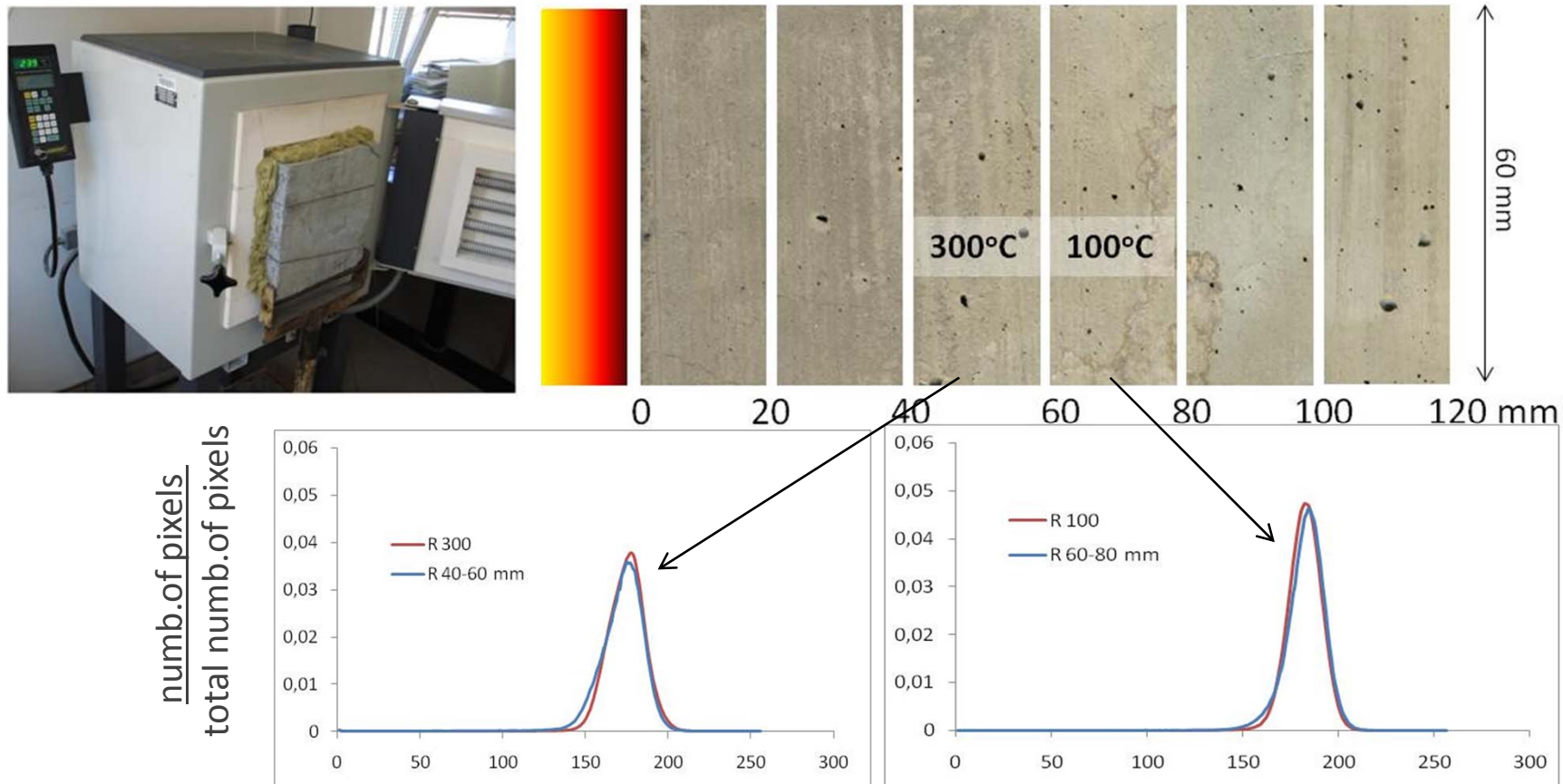


## Ordinary concrete, mortar and cement paste



# APPLICATION

- non - stationary heating;
- external surface of the concrete specimen 0.30 x 0.30 x 0.12 m;
- R histograms of each slice compared with calibration scale.



**calibration scale** – external surface of the sample (cube, a= 0,1 m)



## CONCLUSIONS

- Presented method is an practical technique for estimating the maximal exposition temperature of concrete subjected to fire by using an analysis of the colour image;
- a scanner seems to be a useful and simple tool for making digital images of samples/cores resulting in guaranteed consistent lighting conditions;
- colour analysis was performed using the RGB model and the readily available software package Scion Image;
- a calibration scale was produced by taking images of concrete samples heated to temperatures across the 100 - 1000 °C range. The scale can be used to estimate the exposition temperature of concrete in structures subjected to a real fire;
- In practice, several techniques should be combined in order to obtain a complete and accurate picture of the concrete member damage.