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MERCURY RT
REAL TIME TRACKING SYSTEM

Application report

Fracture detection on the standard cylinder

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Set-up and experimental procedure

This project was about recording the fracture behaviour of standard concrete cylinders as they are used for strength testing. Cylinders with a diameter of 150mm and a height of 300mm in different strength classes (30N/mm² to 150N/mm²) were tested. From normal concrete to UHPC (ultra high performance concrete).
According to the standard test, these cylinders are used to determine the modulus of elasticity. For this purpose, strain sensors are attached which record the compression. A hysteresis is run through three times in which the load levels of 10% to 40% of the expected breaking load are run through. Both the stress and the compression of the test specimen are recorded. Afterwards, the sensors are dismantled and the specimen is driven to break. Thus, from the load level of 40%, there is no information about the specimen compression.
With Mercury, the compression values of the tests could be recorded until the specimen broke. In addition, the area of failure of the specimen could be localised via an area evaluation. According to theory, the fracture of the specimen should always occur in the middle area, since the initiation areas are blocked by the friction on the plates and therefore no expansion in the transverse direction can occur. These tests have proven that fractures can indeed occur in the introduction area. In many cases, the reason for this is the pre-treatment of the specimen introduction surfaces.
By slightly changing the loading scheme, it was possible to establish the post-fracture behaviour and thus a working line of each sample.
All tests and analyses were carried out in cooperation with the Institute for Concrete Construction, Graz University of Technology. A total of 42 tests were carried out.

Configuration and settings

Two Mercury systems in stereo were used to record the strains over most of the sample circumference.

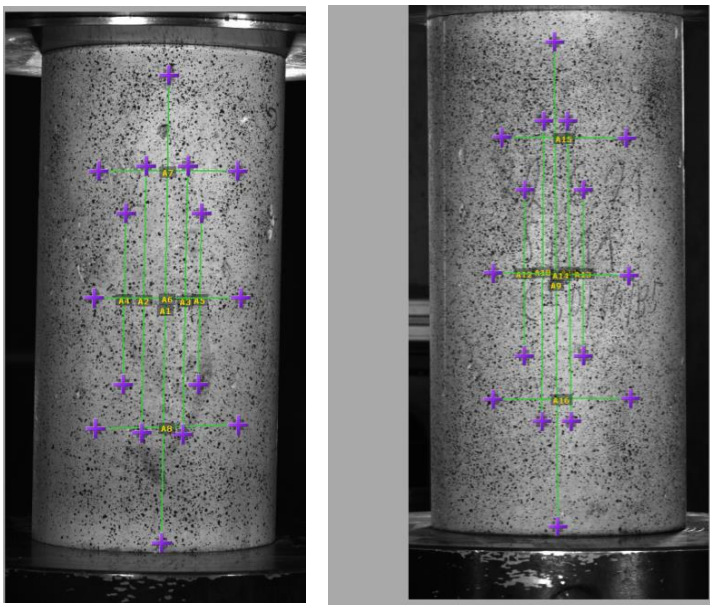
Mercury Measurements on both sides

Especially during the tests with UHPC, the cameras were placed further away for safety reasons, as there was heavy spalling when they failed. In addition, the lenses were fitted with protective glass. The greater distance resulted in a slight loss of quality due to the smaller image section.

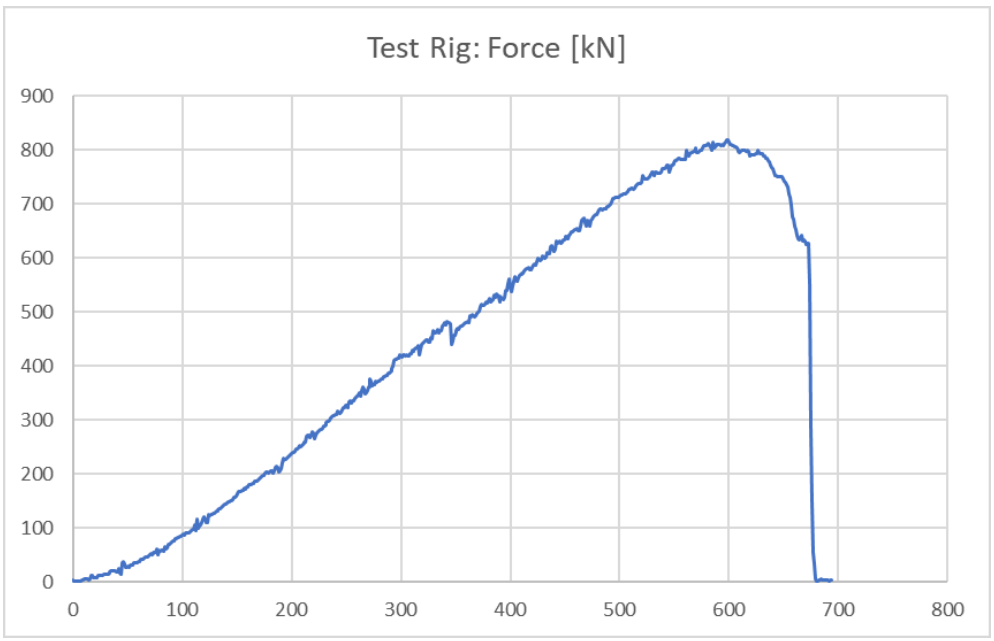
Measuring field size: approx. 300mm x 150mm
Camera resolution: 4864x3232px, resp. 5472x3084px
Focal length: 50mm, resp. 28mm
Aperture: f/11
Distance of the cameras to the object to be measured: 1000mm

Analyses

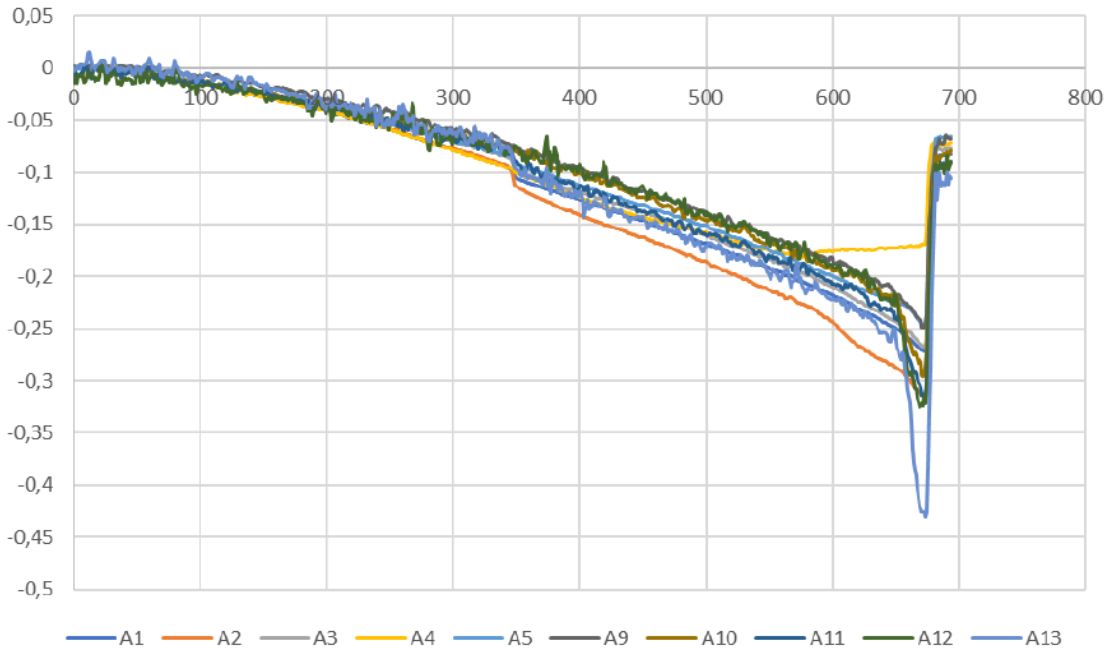
In order to know the fracture compression during the test, a live measurement with line probes was used.



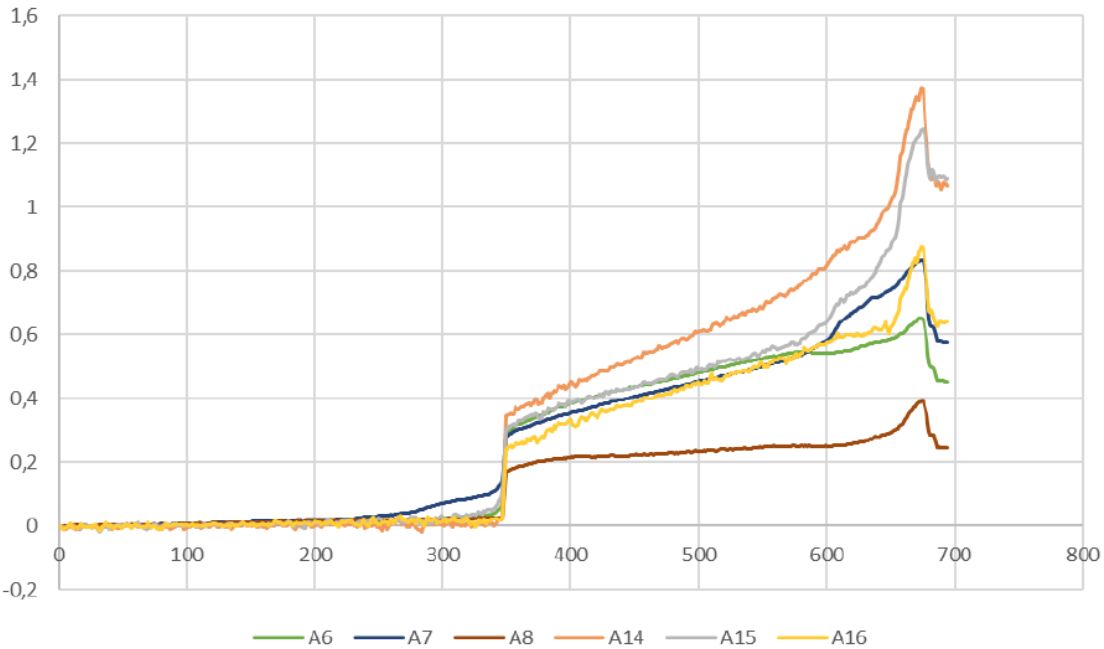
Mercury Line Probes Livemeasurement



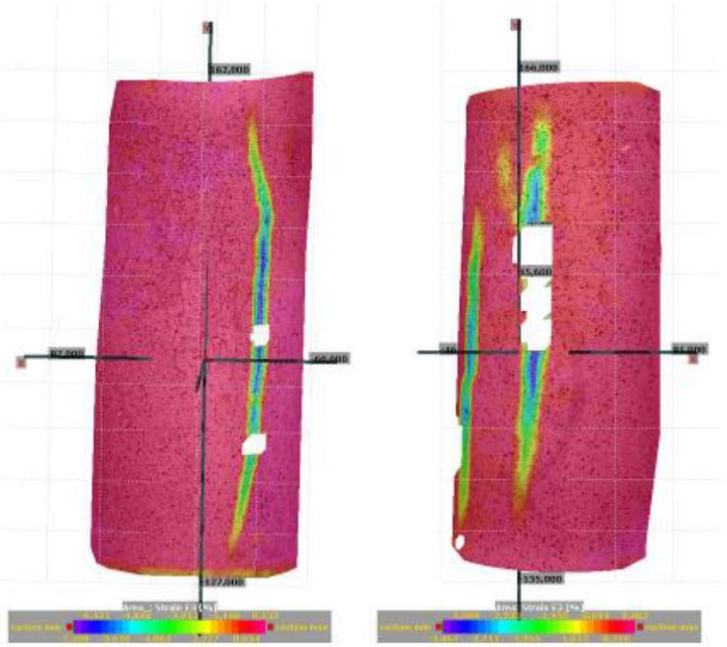
While the specimen load was changed to displacement control, the load drop could also be recorded. In a force-controlled standard test, the specimen would break when the maximum load was reached.



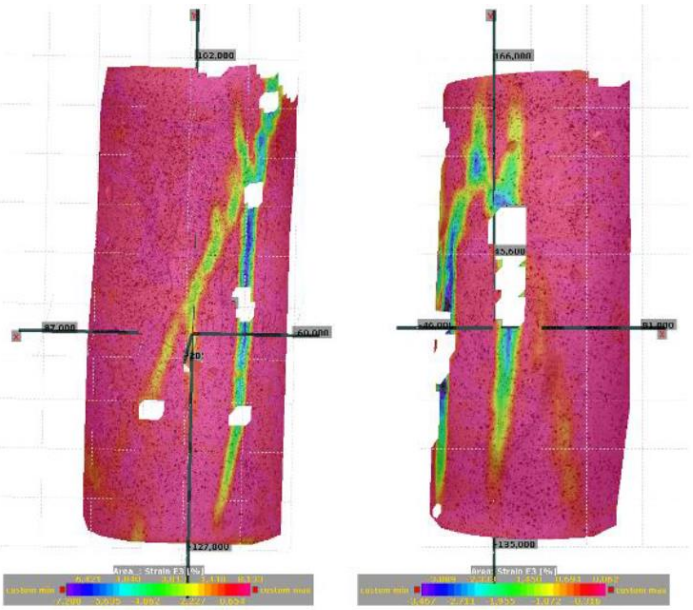
Compressions Longitudinal [%]



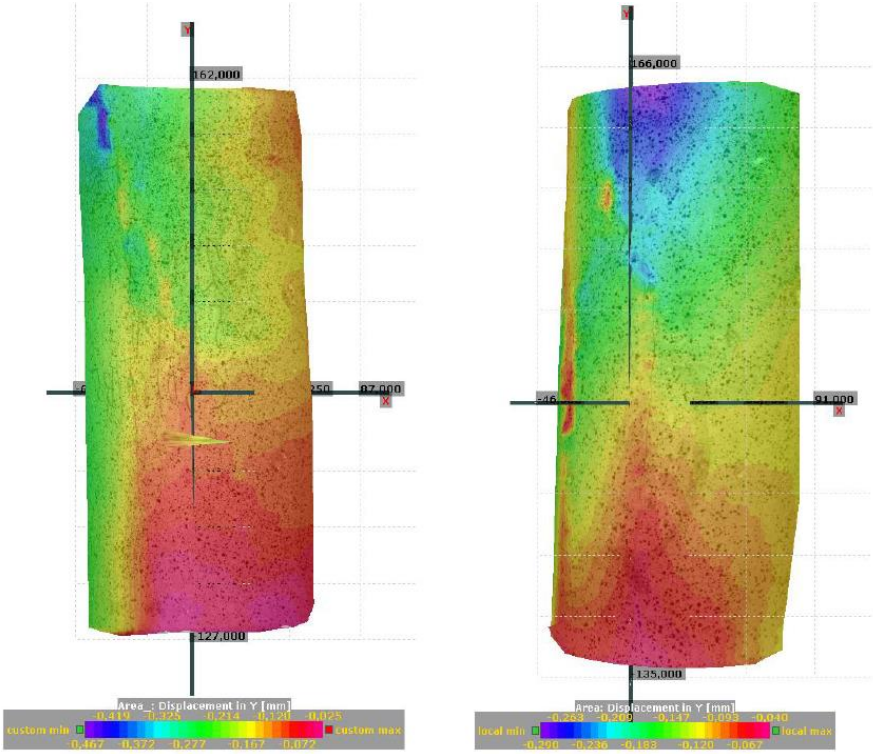
Cross Strains [%]



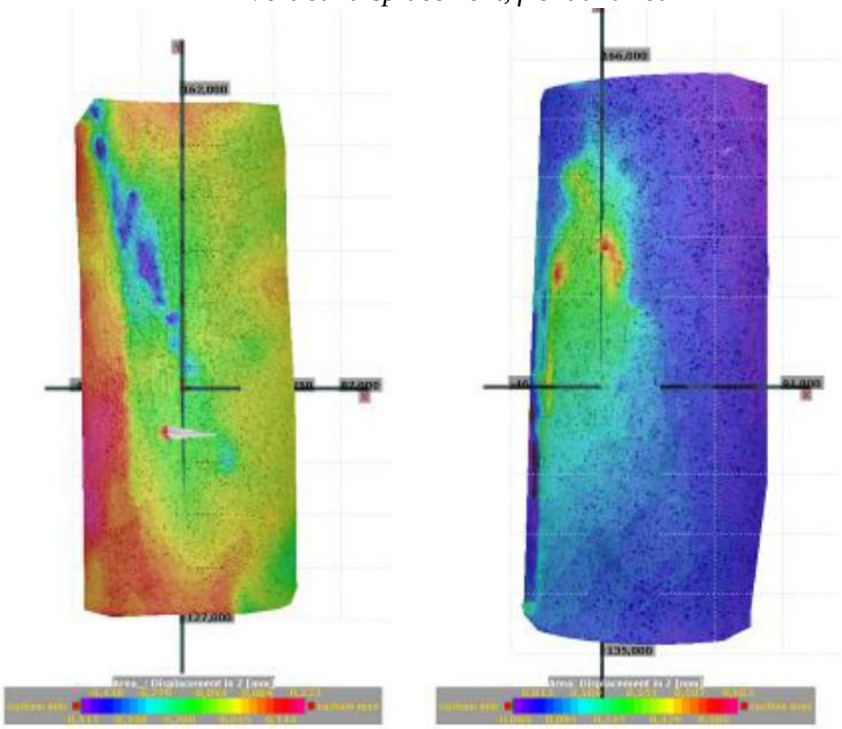
Front and rear compression at Fmax



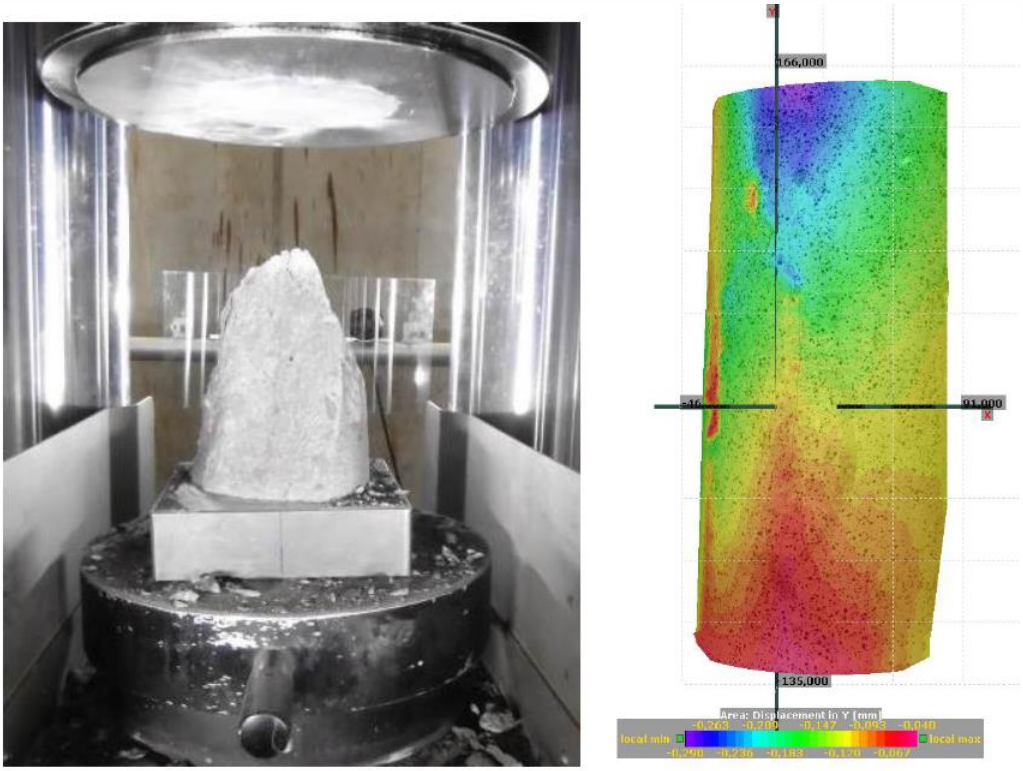
Front and rear compression after load drop



Vertical displacement, front and rear



Out-of-plane displacement, front and back



Sample after the break

Images combined

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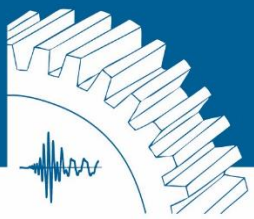

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