

STRAIN MEASUREMENTS AT HIGH TEMPERATURES IN A CONCRETE STRUCTURE REPRESENTING A CYLINDRICAL SECTION OF A PCRV WITH HOT LINER

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SUMMARY

In an experimental ring, representing a 1 m high section of the Austrian PCRV-Model with hot liner, different types of strain gauges were installed in the insulating concrete and the prestressed concrete. As in the PCRV-Model the thermal conditions in the ring were such, that at a liner temperature of 300°C in the insulating concrete experienced temperatures from 300°C to 120°C, the prestressed concrete from 120°C to 100°C.

The different strain gauges were:

- Resistance strain gauges;
- Vibrating wire strain gauges;
- Fluidic strain gauges;
- Mechanical gauge systems.

In addition, temperature measurements and measurements of the moisture in the concrete were made.

Samples of the gauges had been subjected to long-term laboratory tests at 300°C resp. 120°C beforehand, and had withstood without damage.

Nonetheless in the test facility the resistance strain gauges and the wire strain gauges failed at temperatures above 80°C due to penetration of moisture into the gauges. Only the resistance strain gauges were brought back to use by installation of a vacuum system while the damage done to the wire strain gauges turned out to be irreparable in situ. This failure led to extensive amendments in the design of the resistance and wire strain gauges used in the PCRV-Model.

This paper deals with the results of the measurements made during several temperature cycles with temperatures up to 300°C at the hot liner.

Measurements of gauges reading vs. temperature were taken over a time of more than two years. In order to interpret these values in terms of actual strains in the concrete, the gauges characteristics as well as the material data of the concrete must be known in great detail. Longtime-performance of the gauges, possible effects of drift, creep and hysteresis at different temperatures and different ages of the concrete ring were investigated. From the concrete material data the thermal expansion coefficient as a function of temperature and time, creep, shrinkage and moisture content and for the later calculation of stresses the modulus of elasticity are especially necessary to be known exactly.

Results of the measurements, corrected with concrete material data and corrected for gauge behaviour are presented and discussed for the different gauges and a tentative comparison with static calculations is attempted.

An estimate of the errors due to the uncertainties in the concrete material data and the characteristics of the gauges was made.

