Mounting arrangement for a refinery vessel

by Heinz Joas

A refinery vessel, about 25 m (82 ft) high, stands on a concrete tower which is also about 25 m (82 ft) in height and the vessel is bolted to the tower plinth using anchor bolts. Carbon, a residual product from oil refinement, is stored in the vessel. It is emptied every 48 hours and during the emptying process is cooled from 400°C (750°F) with a water spray.

The anchor bolts on the vessel frequently came loose and fractures sometimes occurred. Although a number of constructional modifications were made to the joint between the anchor bolts and the steel reinforcement, including an increase in the bolt diameter, no satisfactory remedy was found. Strain, displacement, acceleration and temperature measurements were taken to examine the conditions. **Figure 1** shows the vessel, the mounting fixtures and the measuring points used.

The forces in the bolts were measured with strain gages and inductive displacement transducers measured both the radial and vertical vessel movements as shown in the illustration of a mounting point in **Fig. 2**. The temperature at the measurement location was about 45°C (113°F). The measuring signals were amplified and continuously recorded. It was found that every 48 hours, in the course of the cooling process, severe loads appeared on the bolts. During a six week measurement period, the measured bolts were on average twice subjected to loads which exceeded the yield point of the bolt material. This effect can be seen in the measurement trace in **Fig. 3**.

The summarized measurement results showed that the vessel was subject to increasing radial and axial movement in the region of the plinth as the direct result of corresponding temperature differences along the

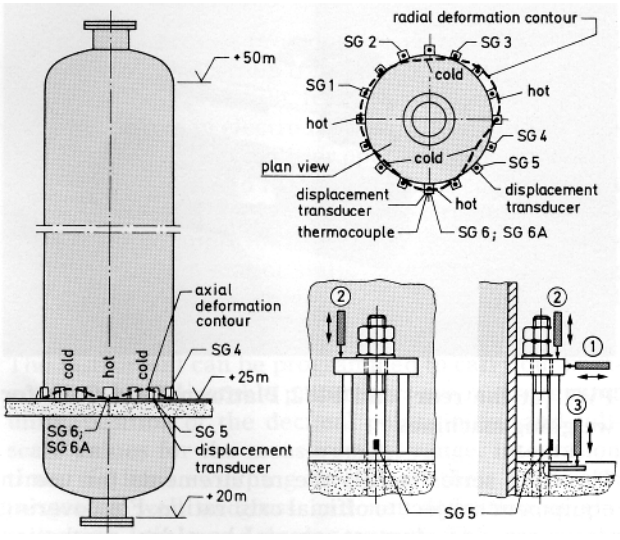

Fig. 1: Vessel mounting showing the arrangement of the measuring points

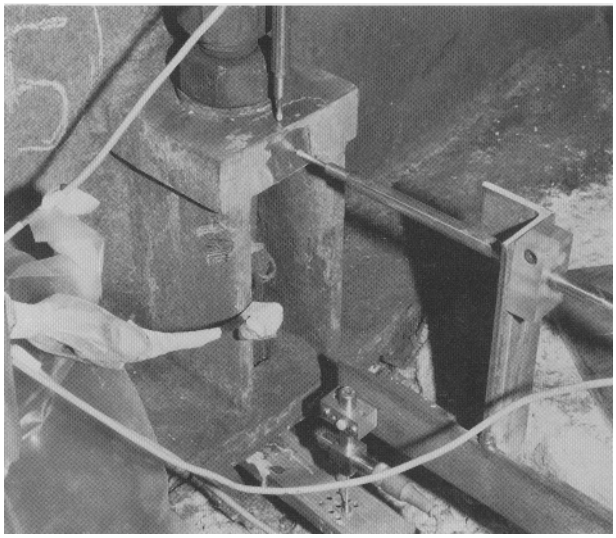

Fig. 2: Inductive displacement transducers on an anchor point

circumference of the vessel. The restriction in the deformation along the vessel's longitudinal axis – at locations on the vessel which are up to 100 K cooler – leads to high loads on the bolts.

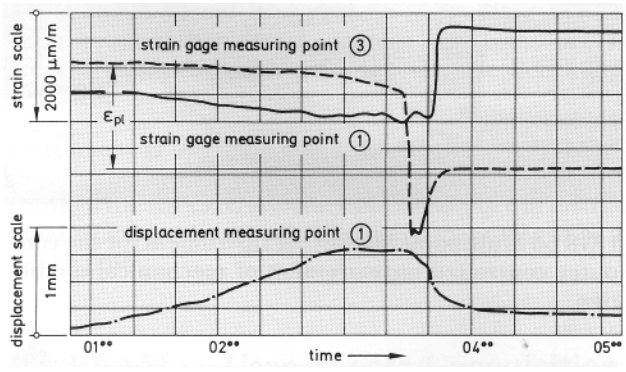

Fig. 3: Trace of on-site measurements

Since the temperature distribution, and hence the deformation of the vessel, caused by the process could not be altered in the short term, a new type of flexible mounting was produced. This has now been working without problem for seven years.

The usefulness of measurement techniques is made apparent with this successful investigation into a long-standing problem. Based on the measurements taken, the technical implementation of the corrective action presented no serious difficulties.

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