Talk on High Accuracy Displacement Transducer for Tunnel Deformation Measurement

by Dr Rini Asnida Abdullah

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The talk on High Accuracy Displacement Transducer for Tunnel Deformation Measurement, was held on 12th September 2017 at Wisma IEM. The speaker was Mr Sendo Hiroshi, President of Sendo Mechanism Design who is also a machine design engineer. The talk was attended by 11 participants.

Mr Sendo began his talk stressing on the importance of achieving high precision in underground monitoring where it should meet the requirement of satisfying targeted accuracy measurement, long-term monitoring possibility, and most importantly it would not be affected by temperature changes as well as it could withstand both water and earth pressures. After which, he introduced an innovation in the displacement transducer which is resistance to both heat and water pressures. In fact, it has been tested to work fine even at both freezing and boiling temperatures.

The instrumentation also made use of ‘cutting edge technology’ materials, i.e. Glass Fiber Reinforced Polymer (GFRP) and Carbon Fiber Reinforced Polymer (CFRP) instead of the normal steel wire for measuring rod, where this could eliminate large linear expansion inherent in steel wire. Both the GFRP and CFRP also could be used for permanent instrumentation, as they are not subject to rusting. The linear expansion has been further reduced by introducing the rotary type transducer, which has less influence in linear expansion than straight type. This is due to it having minimum influence in shape deformation peculiar to circle, as shown in Figure 1. The arrangement of rotary type transducer as shown in Figure 2, also enables 3D movement measurement in one hole. This method eliminates deviation in the measuring position. Besides, the cost also could be reduced since only one borehole is required.

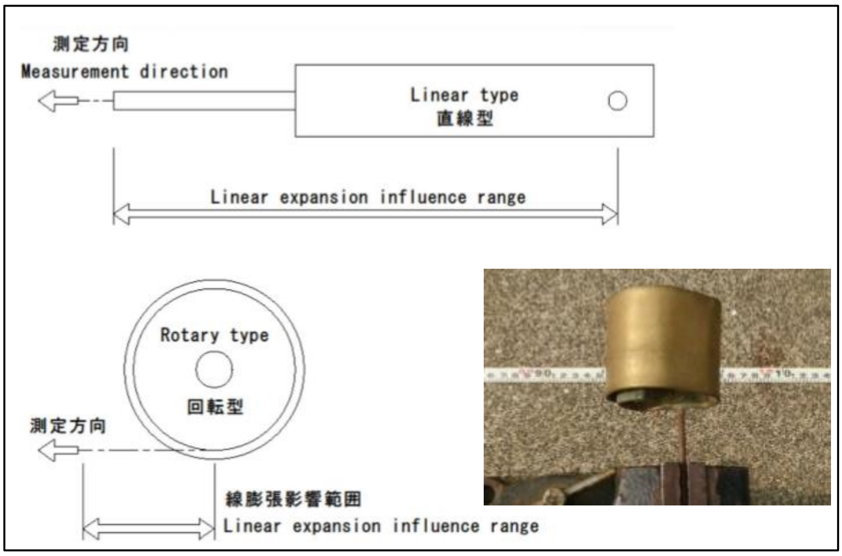


Figure 1: Rotary type transducer reduces linear expansion.

Figure 2: Arrangement of rotary type transducer.

In addition, the instrumentation also could be installed to monitor the tunnel before the excavation start. The procedures are as stated in Figure 3 below.

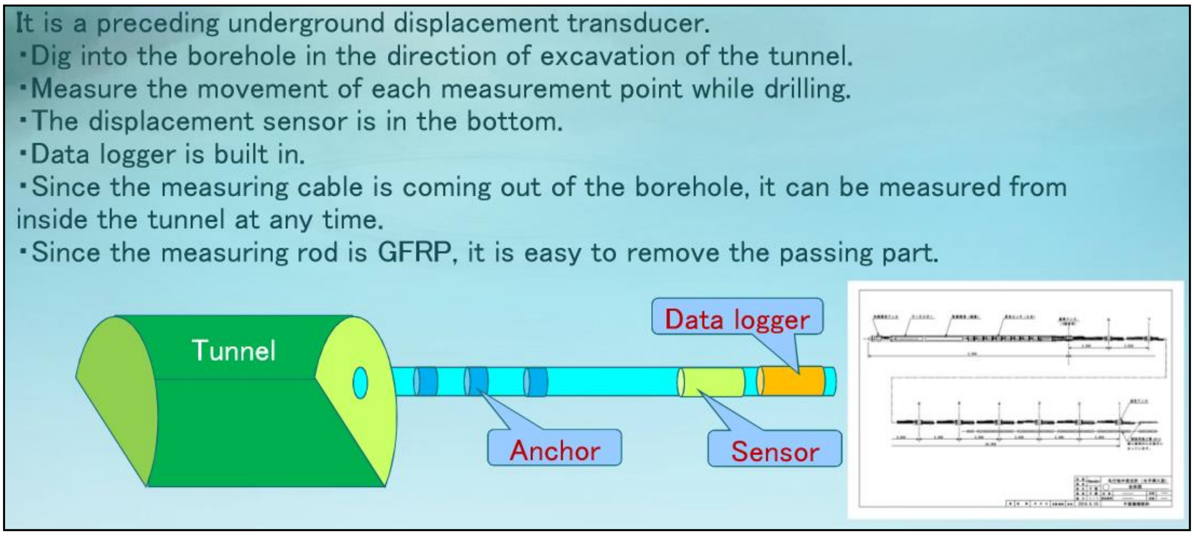
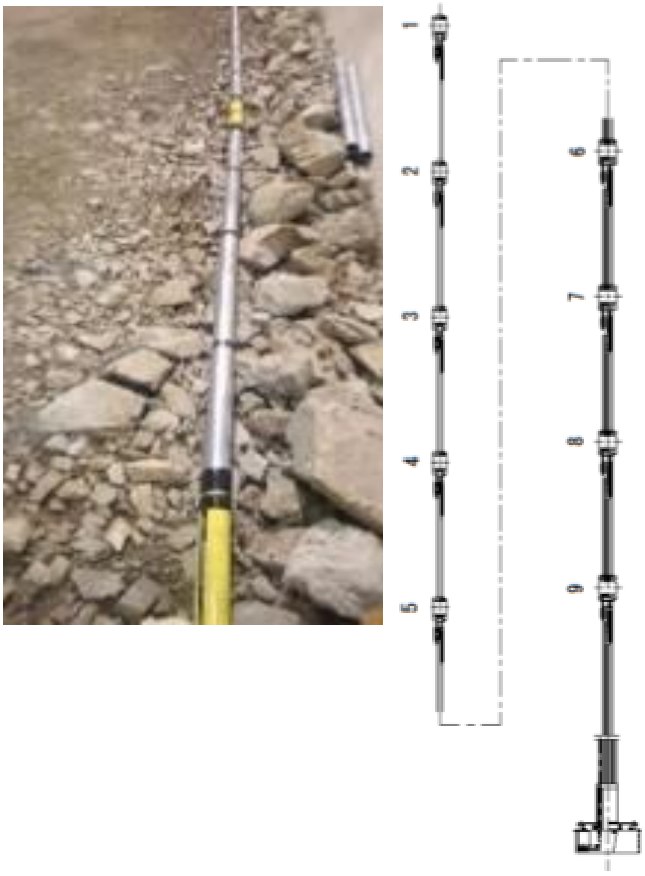


Figure 3: Installation and monitoring of displacement transducer ahead of underground excavation.

Mr Sendo explained the superiority of this transducer based on a few case studies of dam tunnel projects as well as (experimental monitoring data obtained from) the Honorobe Underground Research Laboratory (HURL). Figure 4(a) shows the plant of underground displacement transducer in a borehole, which later, was protected with reinforced concrete as shown in Figure 4(b). In this case, the anchor acted as a 'fixed point' from the inflated metal balloon and provides a good buffer to the surrounding area of the transducer.

(a)



(b)

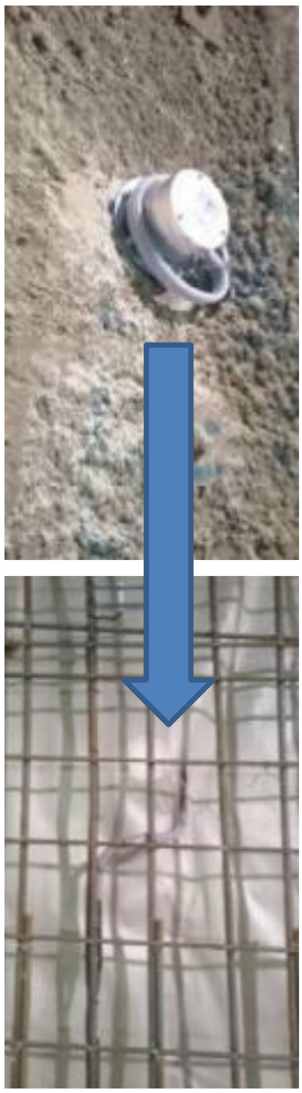
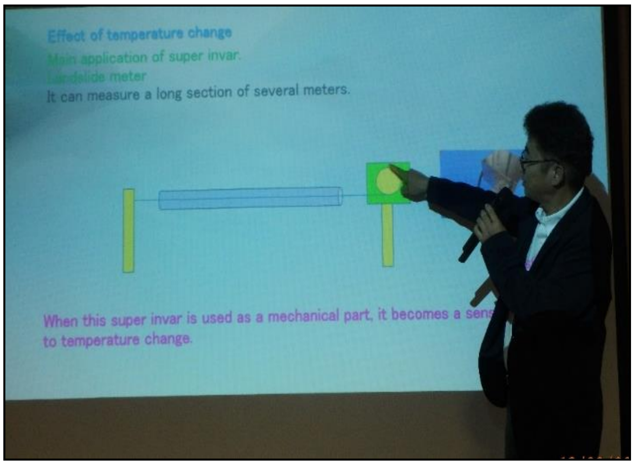


Figure 4: On site installation (a) displacement transducer plant and (b) installation of transducer and protected with the reinforced concrete

Meanwhile, at the HURL, the monitoring motion of rock was reflected to depth of 350 m. The innovation in the displacement transducer had successfully overcome difficulties in measurement due to both high water and earth pressures as well as due to salt water environment. Also, the rust-proof materials used in the transducer fulfil the needs for long-term measurement.

The talk lasted for about an hour and ended with the presentation of a momento of appreciation by the TUSTD chairman, Ir. Syed Rajah Hussain Shaib.



Mr Sendo delivering his talk.

Presentation of a momento to Mr Sendo.