Tensile creep testing apparatus (for CIPP liners)

Introduction

Creep is the tendency of a solid material to move slowly or deform permanently under the influence of mechanical stresses. It can occur as a result of long-term exposure to high levels of stress that are still below the yield strength of the material. It is expected that CIPP liners are susceptible to creep, and these tests will quantify the impact. Creep testing in CRC-P project will be conducted at Monash University using laboratory manufactured CIPP samples. The creep tests will be run according to the ASTM D2990 (2001) and ISO 899-1 (2017) standard, using AS1145 (2001) for specimen sizes. Numerical modeling will be conducted to obtain realistic stress levels to be applied on the test samples.

Creep testing set-up at Monash University

A creep testing rig was designed and 20 new rigs were manufactured at Monash University. The new rig is capable of applying up to 40 (potentially up to 60) kg of load on the rig frame and 160 kg on the test specimen due to the lever arm. The creep rig has a lever arm of 4:1. The samples will be under water throughout the creep test. The design of the creep rig is shown in Figure 1 and the manufactured rigs are shown in Figures 2 and 3.

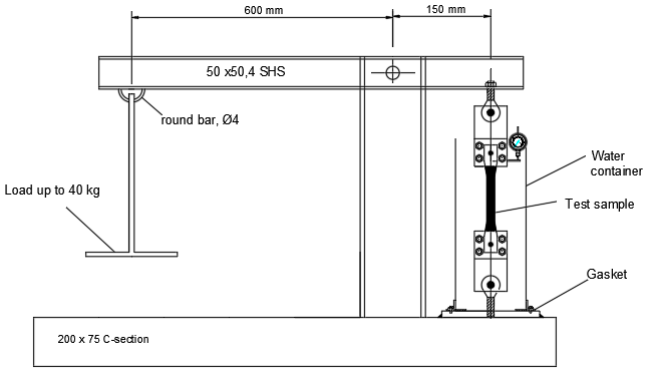

Figure 1. Creep testing rig (design) for CIPP testing at Monash University

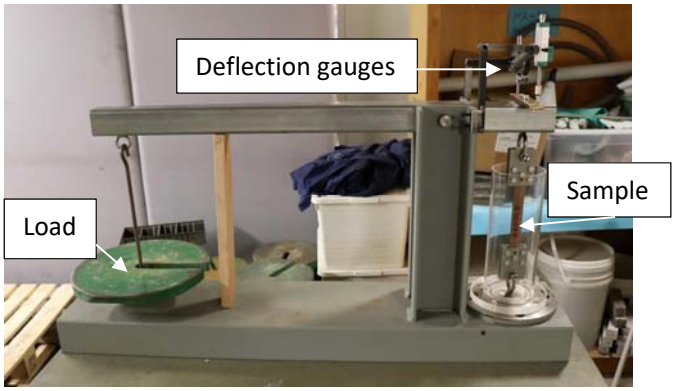

Figure 2. New creep testing set-up (manufactured)

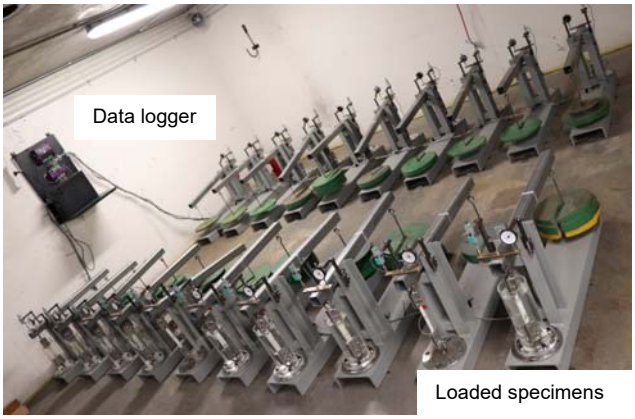

Figure 3. 20 creep rigs shown during creep testing in the basement of Civil Engineering Laboratory

Instrumentation

The displacement of the CIPP samples over time will be measured using one MDP42 electronic displacement sensor (resolution 0.01 mm) (Figure 4a) per sample (total of 20 sensors/samples). All 20 sensors will be connected to DT80 Universal Input Data Logger for logging and storing (Figure 4b). As some of the creep test samples will run for a long duration (potentially up to 2 years during the CRC-P), analogue dial gauge type displacement gauges were also installed in each creep rig as a backup system in event of unplanned power interruption. A universal power supply will ensure that the data logger continues to run under short power interruptions.

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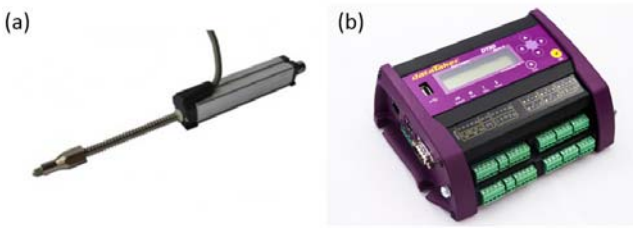

Figure 4. (a) MDP42 displacement sensor, (b) D80 Data logger

References

AS 1145.4 (2001). Determination of tensile properties of plastic materials. Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites. Sydney, Australia, Standards Australia.

ASTM D2990-01, Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics, ASTM International, West Conshohocken, PA, 2001.

ISO 899-1 (2017). Plastic - Determination of creep behavior - Part 1: Tensile creep. Geneva, Switzerland, International Standard Organization: 1–14.