# SENSING SYSTEMS PREP for HAMPDEN BRIDGE MONITORING

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## INTRODUCTION

Distributed sensors for bridge monitoring provide a better understanding on structural performance and deterioration. A new composite bridge (Hampden, ME) has been selected for the application of recently-developed sensing textiles in this joint effort by UML, Saint-Gobain, UMaine, AIT Bridges, and MaineDOT. This poster describes our preparation for the sensor instrumentation on three composite bridge girders.

## INSTALLATION APPARATUS

### 1. Installation procedure

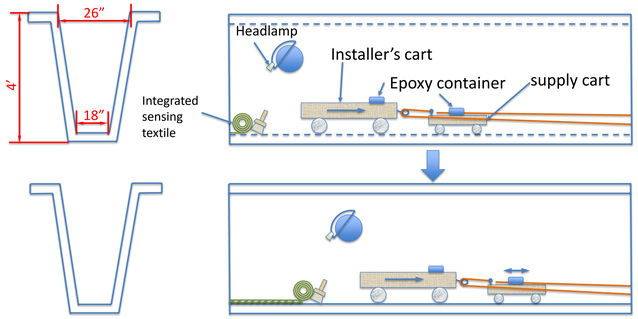



**Figure 1.** Installation schematic

Sensing textiles comprised of optical fibers, strain gauges, and fabrics are first rolled up into a spool configuration. Figure 1 shows how a sensing textile is installed onto a composite gride girder with one person sitting on an installer's cart.

### 2. Sensor integration

A strain gauge system and an optical fiber system using BOTDA are used in sensing textiles. First, optical fibers are sewed onto a fabric substrate by Saint-Gobain with their patented technique. Strain gauges are then integrated to form a sensing textile. Figures 2~5 illustrate one integrated sensing textile as an example.

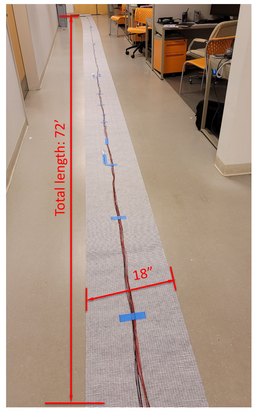



**Figure 2**. Unfold integrated sensors

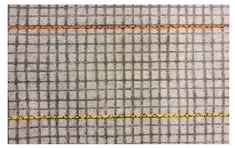


**Figure 3**. Sensing textile

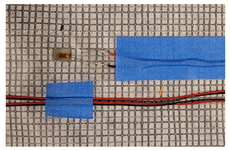


**Figure 4**. Strain gauge on sensing textile

**Figure 5.** Rolled up integrated sensors

### 3. Installation carts

Two carts were designed and manufactured; installer's cart and supply cart. Surface dimensions of the installer's cart are 15"x 3'. A mat composed of 4 layers of different thicknesses of sponges is made to make the cart more comfortable to be sat on. The size of the supply cart in Fig. 7 is 15"x 15".

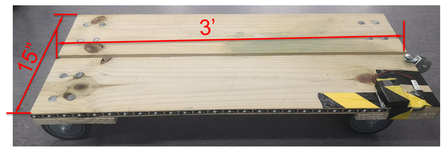



**Figure 6**. Installer's cart

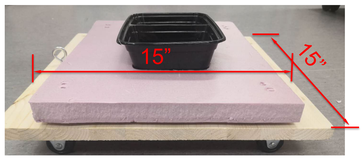



**Figure 7.** Supply cart for epoxy supply

**Figure 8**. Mat on installer's cart

### 4. Bridge girder model

An 8-ft long 1:1 scale mock-up bridge girder model was made with foam boards for the preparation of sensor installation. It was used to practice installing sensing textiles and the design of installation carts.

**Figure 9**. Composite bridge girder at AIT Bridges

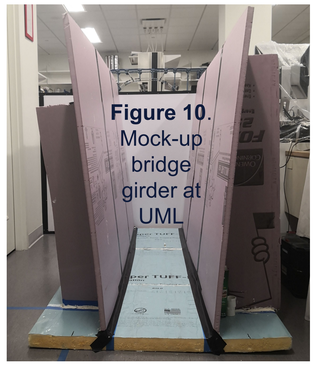


**Figure 10**. Mock-up bridge girder at UML

### 5. Epoxy curing effect

Two strain gauges were used to study the effect of epoxy curing. One strain gauge was applied with epoxy on one side, and the other was applied with epoxy on two sides. In Fig. 11, it shows that two-sided epoxy deployment causes less strain change than one-sided epoxy deployment.

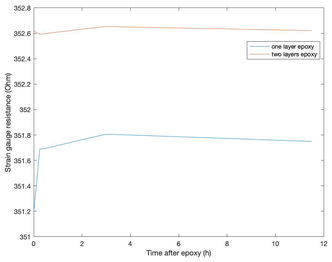
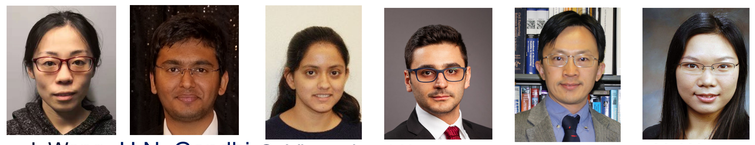



**Figure 11**. Strain change due to epoxy curing

## CONCLUSION

We designed, manufactured, and tested three integrated sensing textiles for the new Hampden Bridge. We also developed an installation apparatus and a procedure, as well as practicing sensor installation on campus.



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