

SMR: Sensor Monitoring of Remote and Underground Northern Structures

Deployment of small modular reactors in remote, northern locations poses challenges with respect to construction and monitoring above those of existing large scale facilities. The challenges extend from the effectiveness and reliability of the sensors at the front end to the security and reliability of the communications with distant control centres.

Permafrost Construction:

Modelling of permafrost heat transfer has been performed and presented at the 2019 CNS annual conference.

"Consideration of Geothermal Aspects for SMR Installation in Northern Permafrost Lands"

Next steps: Perform simulations to test the model and engage with Technical Experts in the field.



Secure Remote Monitoring of Autonomous SMRs:

SMR Control System Architecture requirements have been identified.

System architecture is being finalized. Procurement and construction is underway.

Next steps: Establish cybersecure network between Fredericton and Chalk River and integrate with Concrete Monitoring systems.

Future Work: New initiative to collaborate with Royal Military College to make the RMC Slowpoke-2 reactor a test bed with the aim to provide regulatory guidance of remote monitoring and operational requirements for SMRs.

Concrete Crack Detection:

Paper presented at the 1st international conference on Gen-IV and Small Modular Reactors: *"High-Resolution High-Sensitivity Crack Monitoring in Concrete Structure Using Distributed Fibre Optic Sensors"* and accepted to the ASME Journal of Nuclear Engineering and Radiation Science.

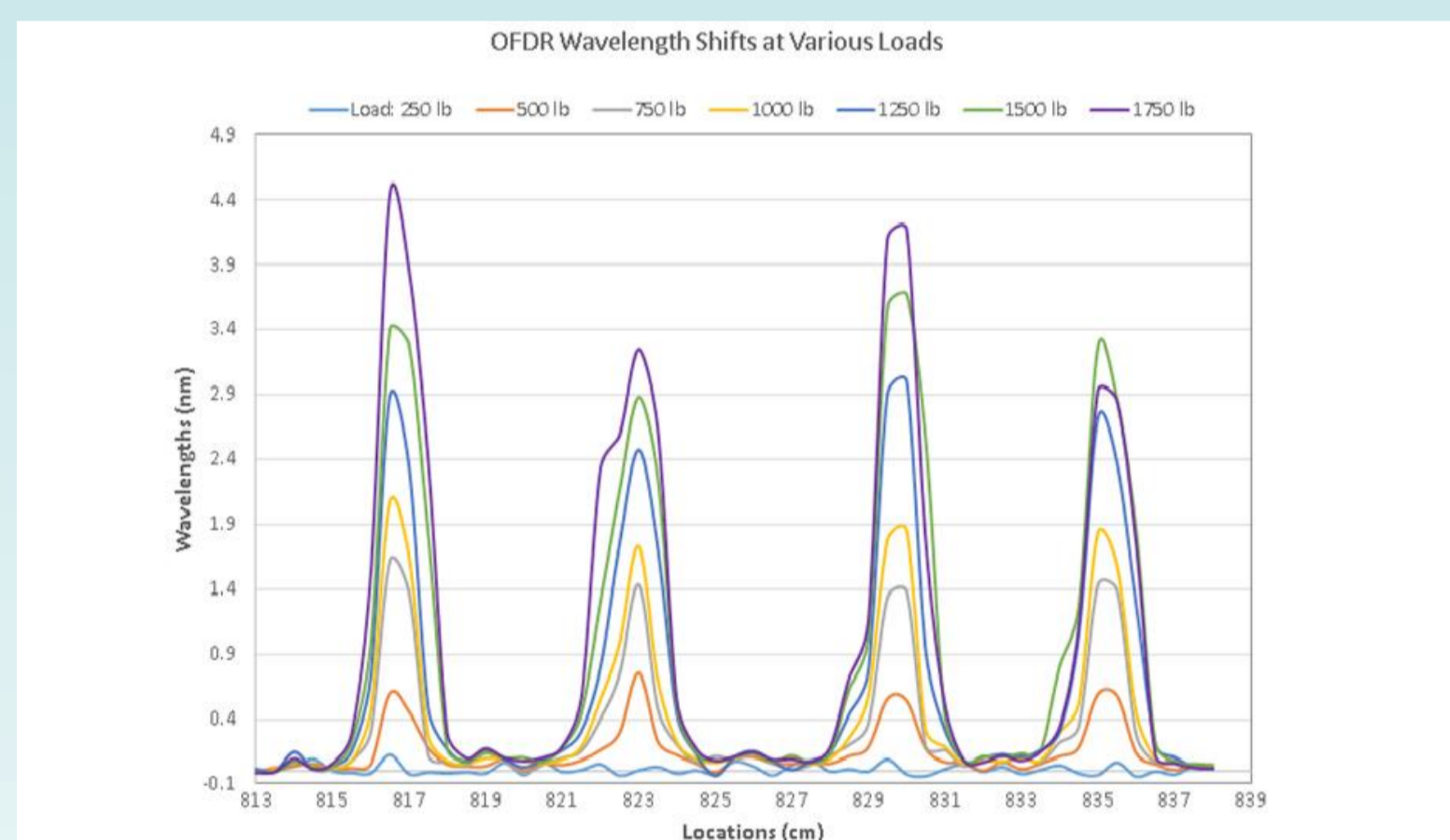
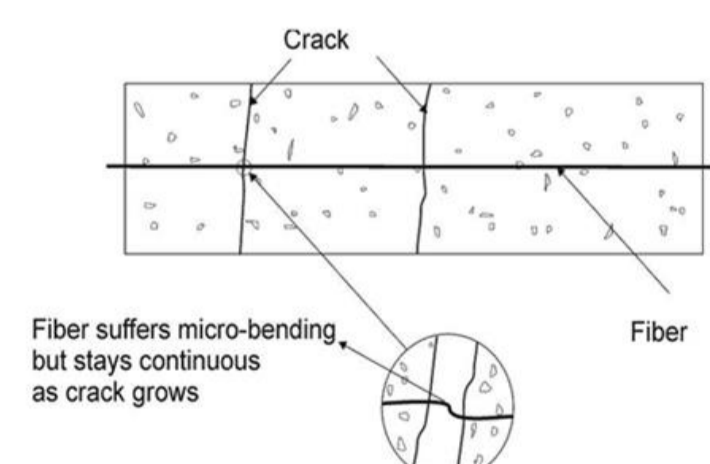


Figure 8 Detected wavelength curves along the sensing fibre. 4 peaks in each curve indicate the cracks' positions, and the wavelengths variations at the vicinities of the cracks.

Fabrication of Embedded Concrete Beams and design of Fibre Optic Sensor Instrumentation are currently underway.



Next steps: Assembly and testing of Fibre Optic Sensor Interrogator, Concrete Beam Load Tests and Quantitative measurement of crack growth using fibre optic sensors.



Concrete

Temperature Cycling:

Requirements for (concrete) embedded-sensor qualification facility have been documented.

Freeze-thaw cycling apparatus, to transfer the concrete 'Big' block in and out of freezing winter temperatures, was developed.

A new industrial freezer is being commissioned to allow for better control of freeze-thaw cycling of the concrete (no longer dependent on weather).

Next step: Temperature cycle testing



Stakeholder: CNSC

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