Bridge weigh-in-motion system and Structural Health Monitoring using fiber optic sensors

Queen’s University Belfast
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WHAT?
Structural Health Monitoring (SHM)

SHM is a means to enable a structure to generate and communicate information concerning changes in its structural health condition, potential damage and deterioration.
Structural Health Monitoring (SHM)

Detect
Recognise
Localise
Quantify

Pain
Exam and Diagnosis
Cure

Defect
Inspect
Diagnosis
Repair

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Bridge Weigh-in-Motion (B-WIM)

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Bridge WIM Concept:

\[ M_{th}^{th} = W_1 \times I_1 + W_2 \times I_2 + \ldots \]
WHY?
Increased loading:

- A large amount of the bridges across the world are reaching the end of their design lives
- The intensity and type of loading induced is very different from those anticipated at design stage
- There is a requirement to retain infrastructure for longer and enhance its capacity
Structural Challenges:

- Materials have inbuilt imperfections/flaws
- Degradation and wear from corrosion, fatigue or systemic overloading
Structural Challenges:

- Some older structures were not designed for modern demands
- Changes in the environment impose higher loads such as wind loads
- Extreme events such as impact damage, flooding or vandalism
Our Solution
Bridge site Loughbrickland, Co. Down:
B-WIM System development

- Lab trials and Finite Element modelling carried out to determine critical sensor locations and predict bridge behaviour
B-WIM System development

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B-WIM Installation layout

Proposed Sensors
Location beneath, on Bridge Beams (Phase 2)

Proposed Control
Cabinet & CCTV
Installation (Phase 1)

Temporary Power Supply
through existing underpass
to Control Cabinet (Phase 1)
(Approx. 80m)

Loops & Pilez
Sensors Installation Area

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B-WIM Installation

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B-WIM Calibration

DVA Weigh Station

Bridge Site

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B-WIM Accuracy

B(10) GVW

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Successful new method of axle detection
THANK YOU