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

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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.
Bridge Weigh-in-Motion (B-WIM)

Bridge WIM Concept:

\[ M_{i}^{th} = W_{1} \times I_{1} + W_{2} \times I_{2} + \ldots \]
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
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)

Loops & Pries Sensors Installation Area

Temporary Power Supply through existing underpass to Control Cabinet (Phase 1) (Approx. 36m)

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B-WIM Installation

South

Span 19m

North

Beam No.

6

7

8

9

10

11

AD1

W1

AD5

AD2

W2-5

AD6

NAD

AD3

W6

AD7

AD4

W7

AD8

W8

W9

Axle detecting sensors attached to soffit of bridge slab

Additional axle detecting sensors attached upper side face of Y4 beams

Weighing sensors attached to midspan soffit of beams influenced by traffic in lane one

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B-WIM Calibration

DVA Weigh Station

Bridge Site
B-WIM Accuracy

\[ B(10) \]

GVW

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Successful new method of axle detection

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THANK YOU

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