



Intelligent Road Asset Management Platform

# Enhanced modular solutions for pre-manufactured bridges

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**OLD ROADS,  
NEW TECHNOLOGIES**  
safe and intelligent road asset management

## Initial Objectives

- Design a modular and hybrid solution for bridges.
- Optimization of the assets and methods used in bridge construction by increased industrialization level and optimized processes in the bridge components production pipeline.
- Reduce human exposure to dangerous zones during construction.
- Reduce traffic disturbance by faster construction and limited interference with the main highway.
- Contribute to circular economy by using more recycled materials.
- Demonstrate the feasibility of the proposed enhanced hybrid bridge solution and illustrate its advantages from a technical, safety and construction-wise standpoint, by using BIM technologies for the virtual demonstrator.

## Technical Results: Load Test of an Existing Overpass

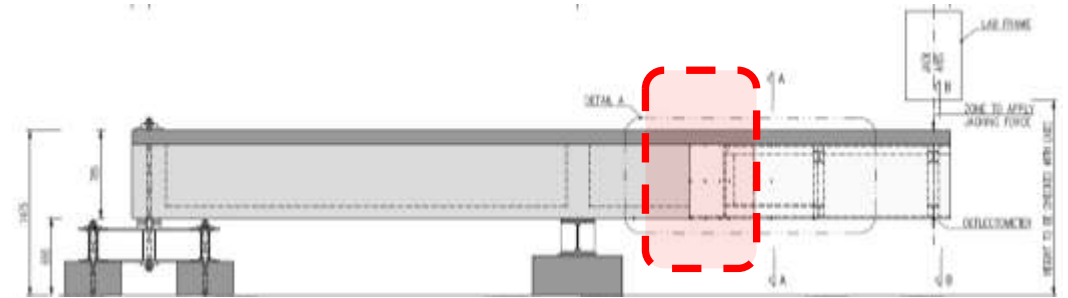
A monitoring campaign was performed in a real hybrid bridge in Portugal to characterise the real mechanical behaviour of the bridge after its construction (2012). The monitoring campaign comprised:

- 1) **Static load testing** – deformations and continuity evaluation of the connection between concrete and steel beams
- 2) **Dynamic load testing** – vibration frequencies, the mode shapes and the damping ratios



## Technical Results: Lab Testing of Prototype

Lab tests provided experimental data to support the analysis and enhancement of critical aspects of the design of the **steel-concrete connection piece** that were adopted on the optimized solution for the construction of hybrid bridge structures over highways.



## Technical Results: BIM-GIS Modelling

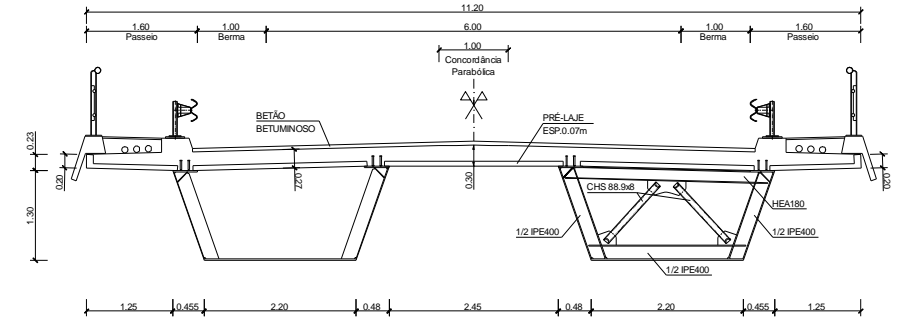
Following the final Design Methodology by Armando Rito:

a. **Alignment** on the scope of BIM modelling.

Foundations, piles and abutments modelled as shapes.

b. **Focus on main area of analysis:** Connections & prestressing.

c. **General quality checks** executed.



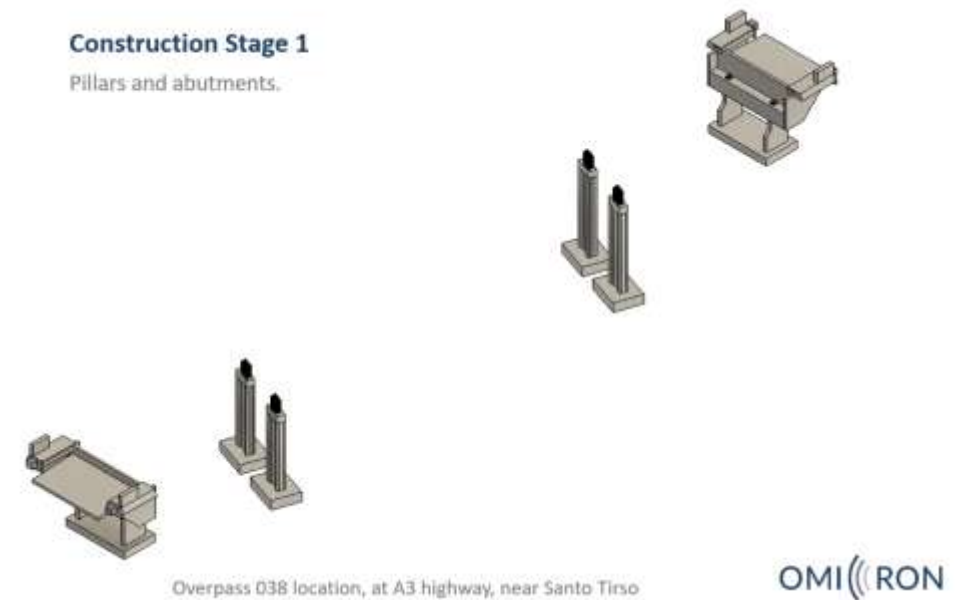
Overpass 038 location, at A3 highway, near Santo Tirso

### Technical Results: BIM-GIS Modelling

Thereby, towards TD1:

- ✓ Digital Model created for Overpass 038 at A3.
- ✓ Construction stages simulated and operated in BIM model.
- ✓ BIM-GIS environment created:

Functional version provided with limitations due to open topography used in the project.



## Demo Results

- The enhanced design of the connection elements in hybrid steel-concrete bridges developed performed as expected allowing to ensure their robustness performance-wise and safety-wise. The design developed provides a methodology to minimize the adjustments required and to make a more general use of this solution, for instance, in scenarios with different span arrangements.
- The virtual demonstrator of the solution exemplified and proved the feasibility and advantages of the enhanced solution for this type of modular and pre-manufactured bridges.



## Evaluation & KPIs

### KPI 10 - Increase in circularity

- OM\_Proposal: -30%.
- OM\_Result: -31%.
- OM\_Difference: +1%.

For the calculation of the KPIs, several EPDs of concrete and steel used in Portugal were analysed, allowing to obtain the following average values:

- ✓ % of recycled material in the production of cement: 22%
- ✓ % of cement on concrete: 10%
- ✓ % of recycled material on the production of concrete: 5%
- ✓ % of recycled material on the production of steel: 80%

	Traditional solution	Omicron solution
Total concrete used (m3)	840,52	698,70
Total concrete used (t)	2 058,43	1 711,11
Recycled material on concrete (t)	148,21	123,20
Total steel used (t)	64,73	130,30
Recycled material on steel (t)	51,78	104,24
Total input materials used (t)	2 123,15	1 841,41
Total recycled input materials used (t)	199,99	227,44
% recycled input materials used	9,42	12,35
% of increase		31,13%





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# Thank you

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