The VoI for the Lezíria Bridge

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BRISA Group

Lezíria Bridge

The SHM system

The structure – main bridge

Assessment of the structural performance

Current steps towards efficient asset management

Application of the integrated VoI analysis flow chart

BRISA – The group

One of the largest tolled motorway operators in the world

Concessions in the US of America

Operations in the Netherlands and India

The largest transport infrastructure group in Portugal

Management of transport infrastructures (roads and railways)

Investments in SHM

Sorraia Bridge (A13)

Lezíria Bridge (A10)

Escritórios Brisa

Projectos em operação

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Lezíria Bridge – SHM system

Permanent monitoring system
(construction + operational life)

Monitoring project
(as part of the bridge project)

$\cong$ 400 sensors,
(10 different type of sensors)

3 different acquisition systems
(static, dynamic, optic)

> 10km cable length

sampling-rate up to 100 Hz

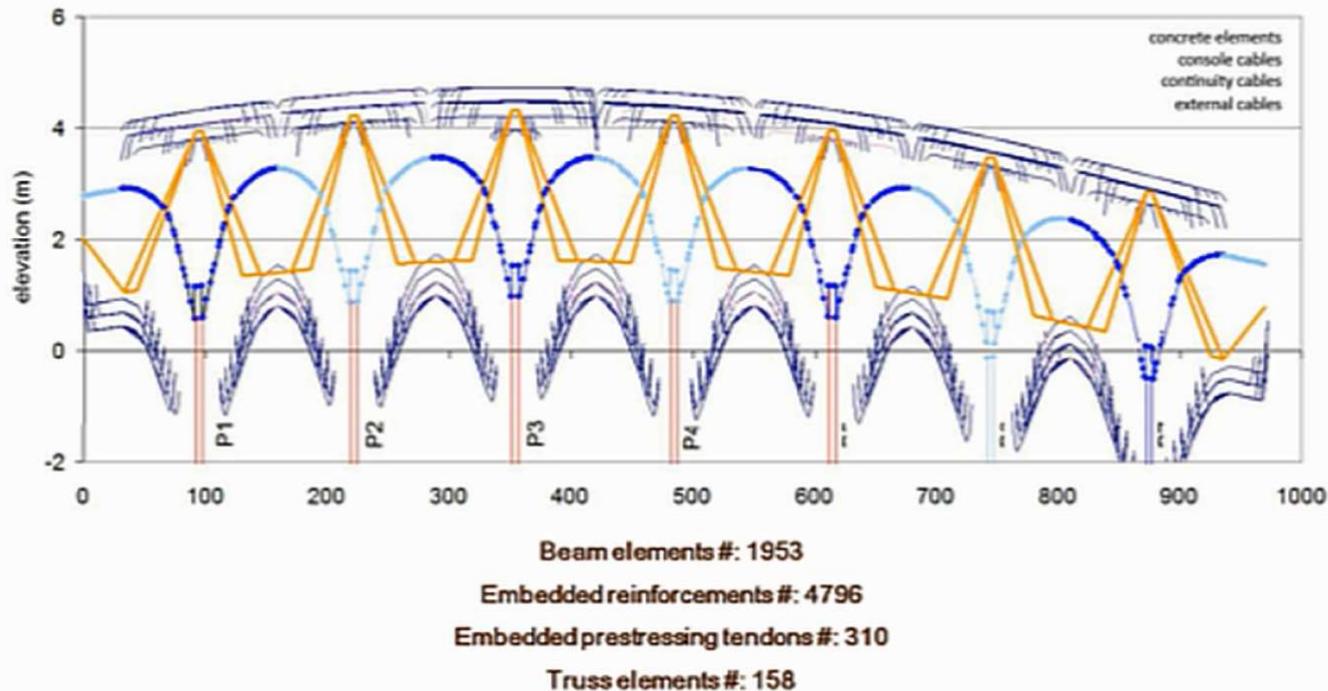$\cong$ 1 000 000 records / year

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Official TU1402 Presentation edited by H. Sousa and L. Santos

Lezíria Bridge - FE modelling approach

- Complexity of the geometry, materials and time-history

- Numerical simulation throughout the bridge lifetime (construction phase + operational life)

- Time-dependent effects (shrinkage & creep and thermal effects)
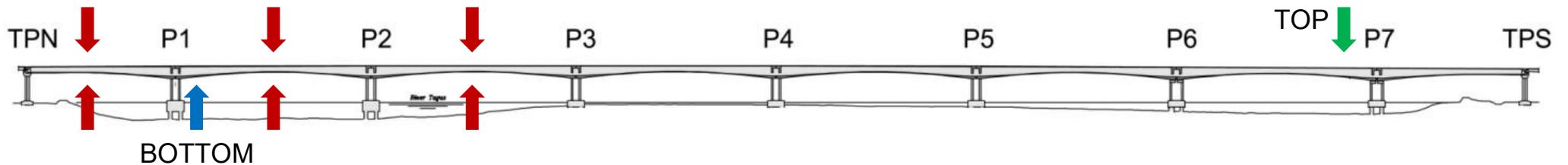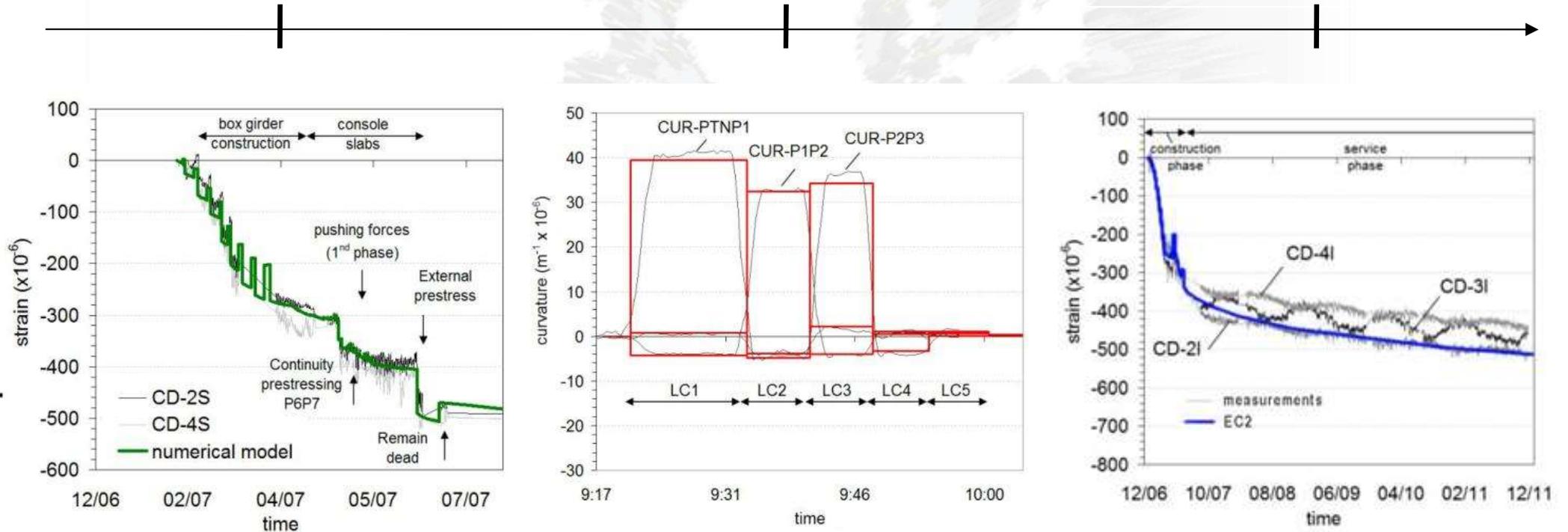
Lezíria Bridge - Long term performance
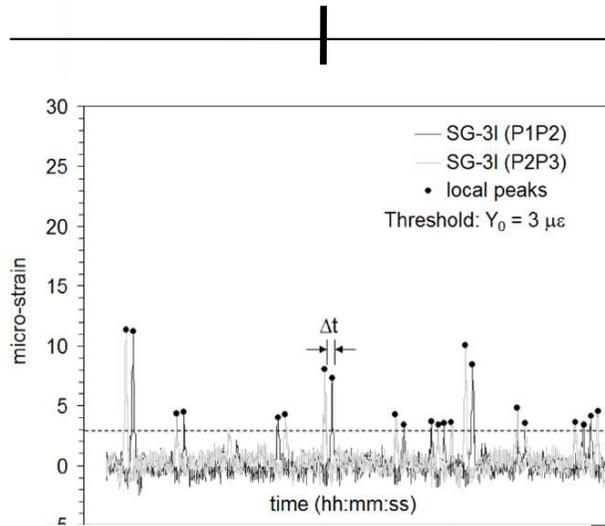
CONSTRUCTION PHASE   LOAD TEST   LONG-TERM

Lezíria Bridge - Short-term performance

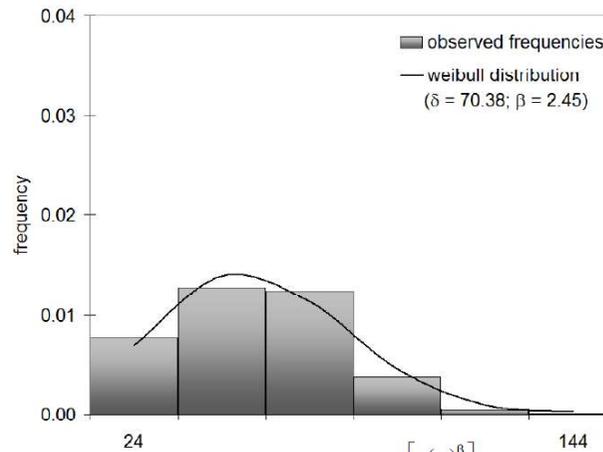OBSERVATIONS LOAD HISTOGRAM EXTREME LOADS

$$P_i(t) = k_2(t) \cdot k_0 \cdot \varepsilon_{i,peak}(t) \qquad (1)$$

$$\begin{cases} k_0 = P_{ref}/\varepsilon_{ref} & (2) \\ k_1 = \varepsilon/\varepsilon_{ref} & (3) \\ k_2(t) = E_{c,ref}/E_c(t) & (4) \end{cases}$$
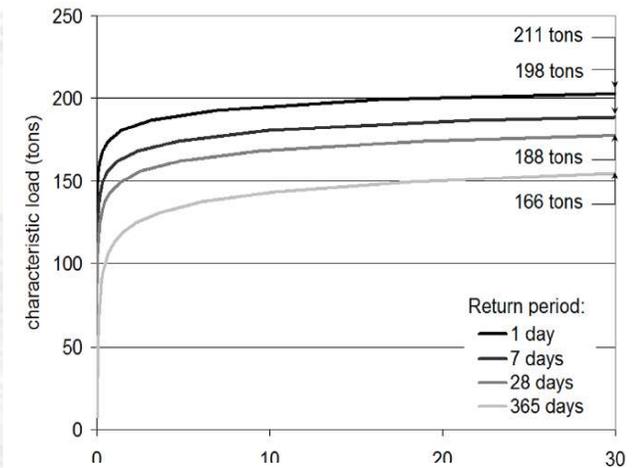
$$f(x) = \frac{\beta}{\delta} \cdot \left(\frac{x}{\delta}\right)^{\beta-1} \cdot e^{\left[-\left(\frac{x}{\delta}\right)^{\beta}\right]}$$

$$x > 0; \delta > 0; \beta > 0$$

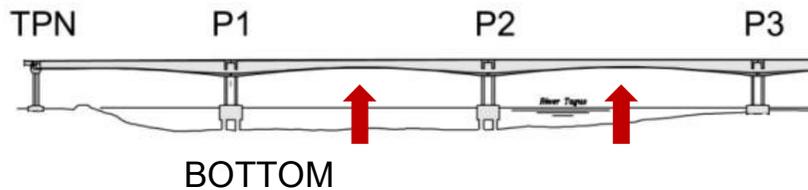$$\overline{f}(x) = \begin{cases} 0 & x \le x_0 \\ \dfrac{f(x)}{\int_{x0}^{+\infty} f(x)dx} & x > x_0 \end{cases}$$

$$R_p(x) = \frac{\tau}{\alpha}, \begin{cases} \tau - \text{observation period} \\ \alpha = 1 - F(x) \end{cases}$$

$$R_p = -\frac{T_{lifetime}}{\ln(1-\alpha)}, \quad \alpha = 0.05$$

Return period	Characteristic load (tons)	Vertical displacement (mm)		Safety level
		Project	Predicted	
1 day	211		44.8	1.23
7 days	198	55*	43.9	1.25
28 days	188		43.1	1.27
365 days	166		41.7	1.32

* Value determined for the characteristic combination of actions, with a lower limit of L/1200.

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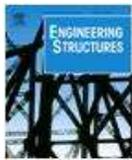
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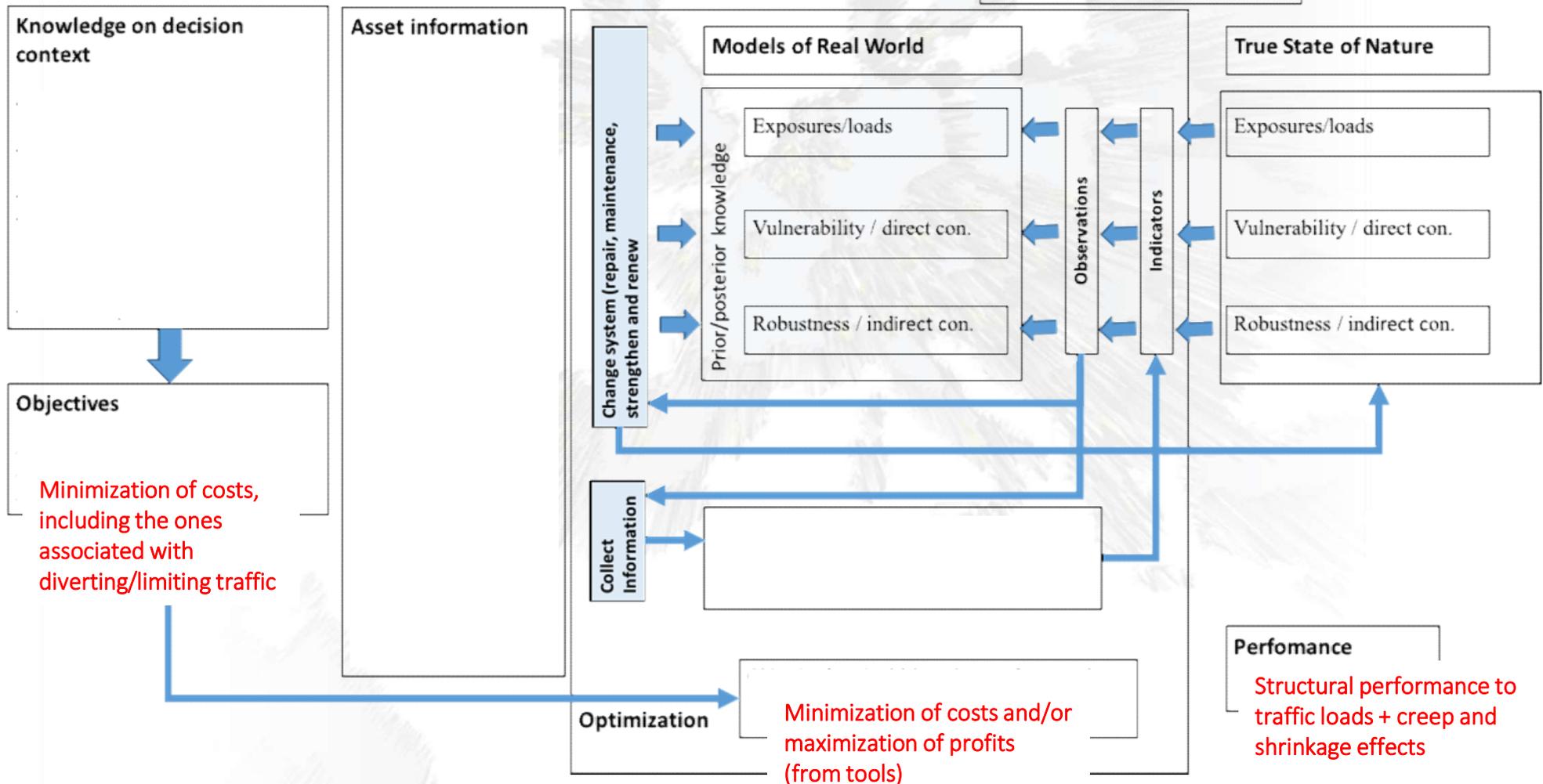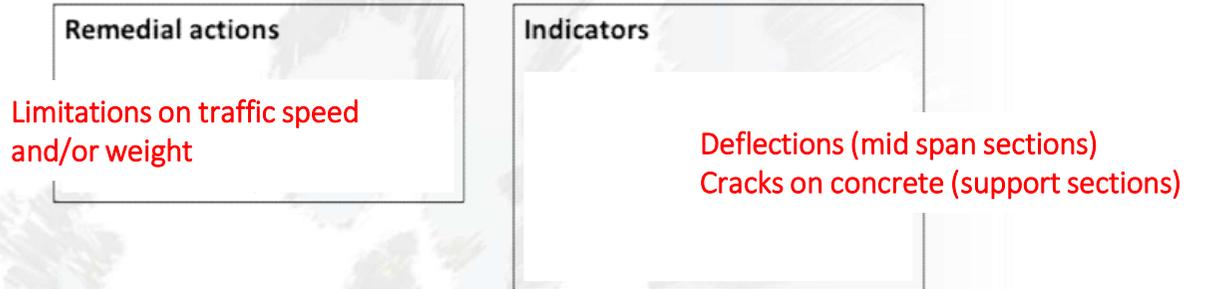http://ascelibrary.org/doi/abs/10.1061/(ASCE)BE.1943-5592.0000604

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Likelihood functions:
- Creep and shrinkage deformations
- Traffic loads on the bridge

Limitations on traffic speed and/or weight

Deflections (mid span sections)
Cracks on concrete (support sections)

Minimization of costs, including the ones associated with diverting/limiting traffic

Minimization of costs and/or maximization of profits (from tools)

Structural performance to traffic loads + creep and shrinkage effects

Thank you for your attention

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