



Probability Based Maintenance Optimisation of Bridges Located in Marine Environments

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European Union
European Regional Development Fund



Investing in our common future



ATLANTIC AREA
Transnational Programme



Reabilitar 2010
Special Session: DURATI Net 24th June 2010







1. Problem Definition

For a given structure how do we decide upon the optimal maintenance strategy as a function of age, condition, importance, **required remaining life** etc. in a robust/repeatable manner, avoiding generalisation/excessive conservatism such that our maintenance budget is optimised???

e.g. *Victoria Falls 1905,*

Storstroem 1937, 3.2km

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> **Action N° 1**

Establishment of requirements for repair optimization of transport infra-structures

> **Action N° 2**

Main deterministic and probabilistic methodologies to support repair decisions

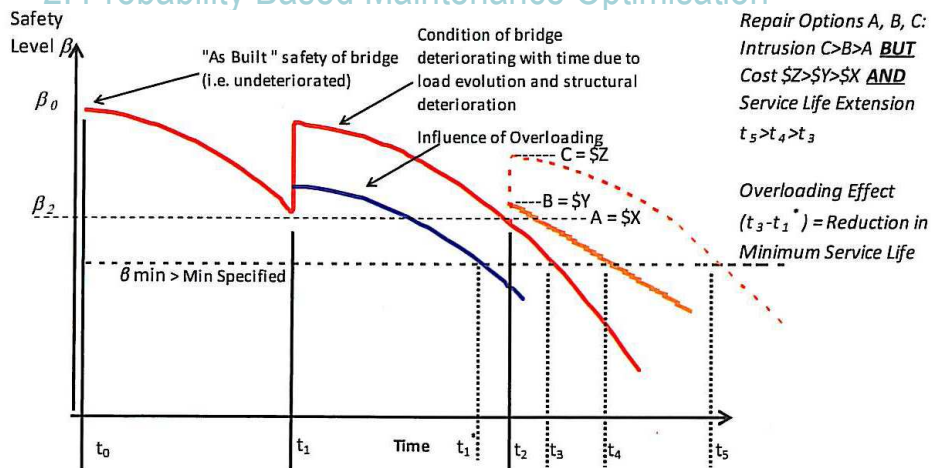
> **Action N° 3**

Example applications

Partners involved: 9 (National Roads Authority (NRA)), 10 (Estradas de Portugal, SA), 11 (REFER, E.P.) and 14 (Conseil General de la Charente-Maritime (CG-17))



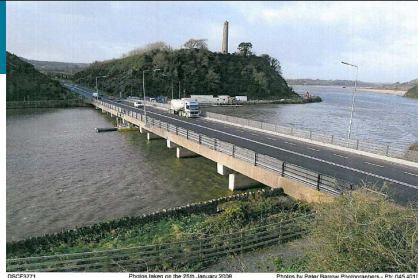
2. Probability Based Maintenance Optimisation



Case Studies

(i) Ferrycarrig Bridge, Ireland

- 126m long, 8 Span
- Opened 1980
- In 2002 extensive cracking of crosshead beams discovered
- The 7 crosshead beams repaired in 2007 using 5 different repair strategies;
 - Ordinary Portland Cement (OPC)
 - OPC with increased cover
 - OPC + Surface Treatment
 - Ground Granulated Blastfurnace Slag (GGBS)
 - OPC + Corrosion Inhibitors
- The crossheads were instrumented with:
 - Chloride-ion penetration depth probes
 - Corrosion potential probes
 - Corrosion rate probes



Lab Testing

- > Due to slow process of chloride ingress it is unlikely meaningful results obtained from the Ferrycarrig Bridge over the life of my PhD
- > To investigate the relative merits of the repair strategies in the short term accelerated chloride ingress testing being carried out at T.C.D.
- > First phase of testing - mix designs identical to Ferrycarrig Bridge repairs, in addition PFA also being investigated
- > Testing carried out in two salt spray chambers in T.C.D. Laboratory; walk in spray chamber & open-lid spray chamber

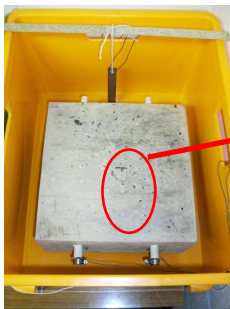




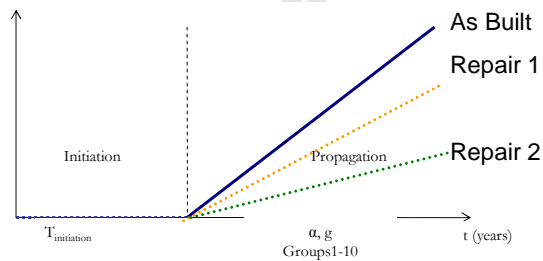
- > Walk in spray chamber: 300mm x 300mm x 120mm samples
- > Open lid spray chamber 100mm cube samples
- > Two wet days per week; samples subjected to 5% NaCl fog for 24 hours
- > First phase of testing completed 2 weeks ago after 8 months of sample exposure in salt spray chambers
- > Analysis of samples has just commenced;
 - Profile grinding of samples at 2mm depth increments
 - Acid soluble potentiometric titration analysis

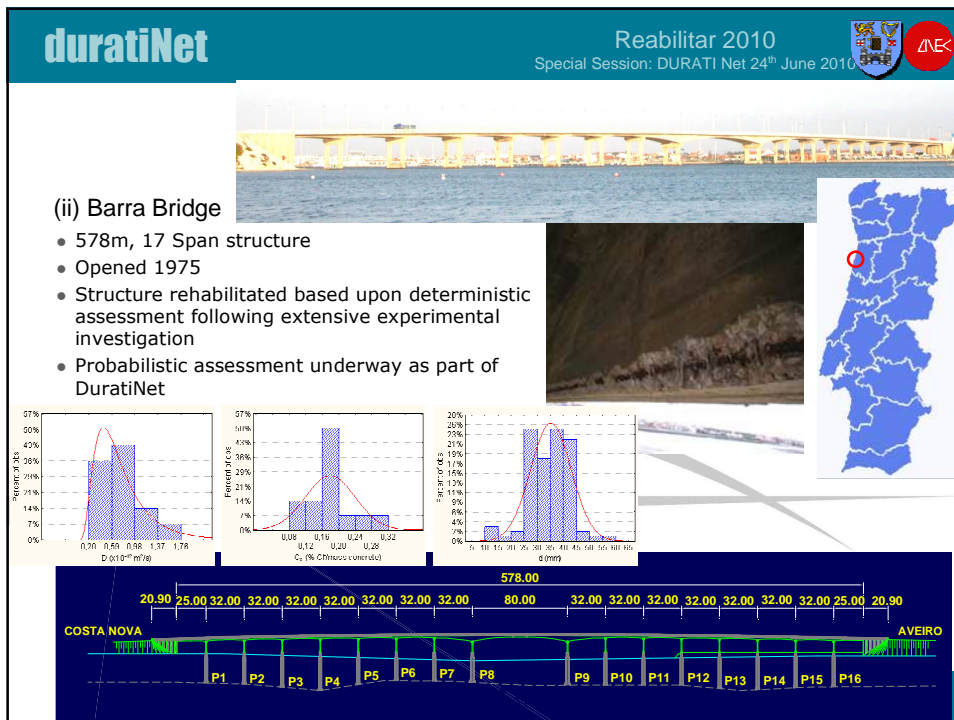
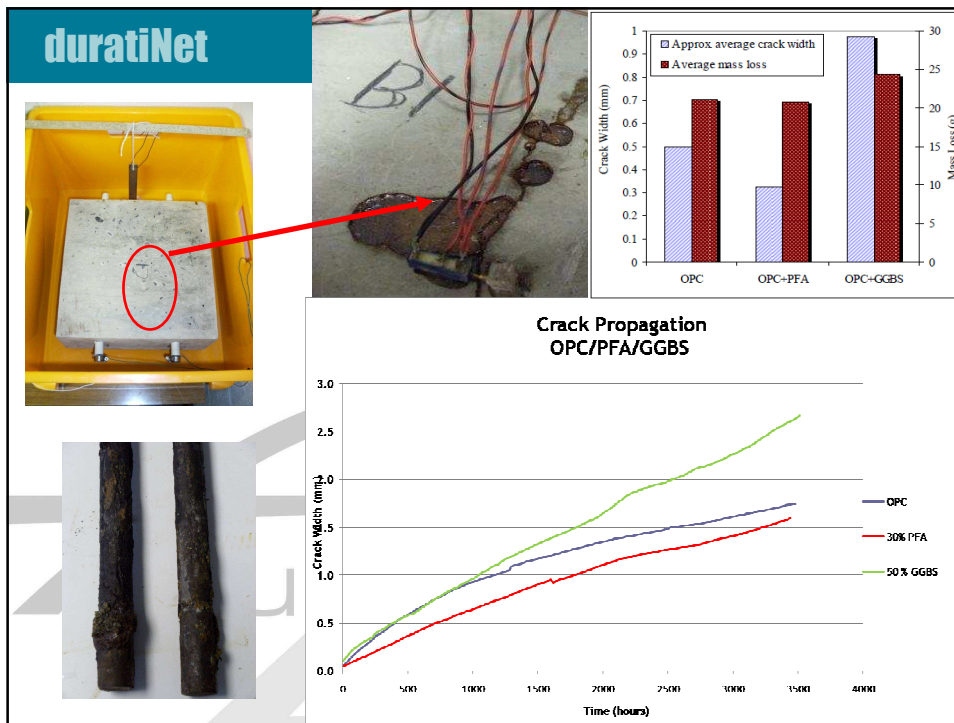


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Crack width





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> **Questionnaire:**





- DURATINET – 2009-2011
 NETwork for DURABLE Transport
 Infrastructure in Atlantic Area

*Questionnaire intended
for infrastructure owners and end-users*



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General planning: Semester 4 etc.

Activity/action		2009				2010				2011			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
2	Maintenance, Decision tools and Requirements for Optimisation of repair												
2.1	Questionnaire (Establishment of requirements for repair optimization of transport infra-structures)			validation	Dissemination								
								Summary and analysis					
2.2	Main deterministic & probabilistic meth. (decisions) Time I Assessment												
	Ageing laws												
	Inspection												
	Repair												
	Optimization												

