

# SHRP2

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International Symposium on Non-Destructive  
Testing for Design Evaluation and Construction  
Inspection

18 January 2008  
Washington DC USA

# Existing and emerging technologies and techniques

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By

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France**

On behalf of FEHRL ( the Forum of European  
Highways Research Laboratories)

# NDT needs in renewal projects (1)

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We have considered these in terms of:

- § Design
- § Construction activities
- § Performance monitoring

For the following construction components:

- § Pavements – flexible and rigid
- § Bridges
- § Earthworks
- § Tunnels (and other structures?)

# NDT needs in renewal projects (2)

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	Design	Construction	Performance
Pavements			
Bridges			
Earthworks			
Tunnels			

# NDT needs in renewal projects (3)

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We have also tried to keep in mind the overall objective of the SHRP2 Renewal project:

The research objective of SHRP 2 highway renewal is to achieve renewal that is **performed rapidly, causes minimum disruption**, and produces **long-lived** facilities

Whilst considering Tactic 3:

*. Perform Faster Construction Inspection and Monitoring.*

Develop **innovative, high-speed** construction inspection processes that can be used to make sure that the overall quality is obtained **without delaying the project**.

And meeting the objectives of the Research Project R06:

A Plan for Developing **High-Speed**, Non-destructive Testing Procedures for Both Design Evaluation and Construction Inspection

# Status of Technologies and Techniques

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- Production models in routine use
  - Pre-production models
  - Several road prototypes
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- Single road prototype
  - Research version
  - No known current solution

# Status of Technologies and Techniques

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## *Existing and emerging technologies and techniques*

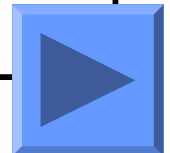
- Production models in routine use
- Pre-production models
- Several road prototypes

## *Unfulfilled needs based on current and emerging technologies and techniques*

- Single road prototype
- Research version
- No known current solution

# Examples of existing technologies

	Design	Construction	Performance
Pavements			
Bridges	/		
Earthworks	/	/	/
Tunnels	/	/	/



# Pavement subgrade support

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## Lightweight FWD

(Rapid but discrete measurement of bearing capacity of granular layers.)



DRI, Denmark TRL, UK

## Portancemètre/dynaplaque

(Continuous measurement of bearing capacity of capping layers at 3.6km/h)



LCPC, FR

These tools have a role both in assessing the design and the construction quality



# Pavement construction thicknesses

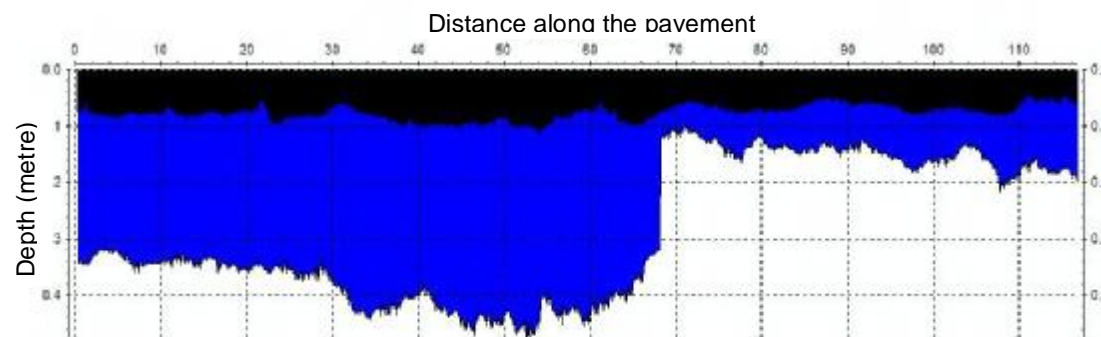
High speed GPR for

- thickness
- construction changes



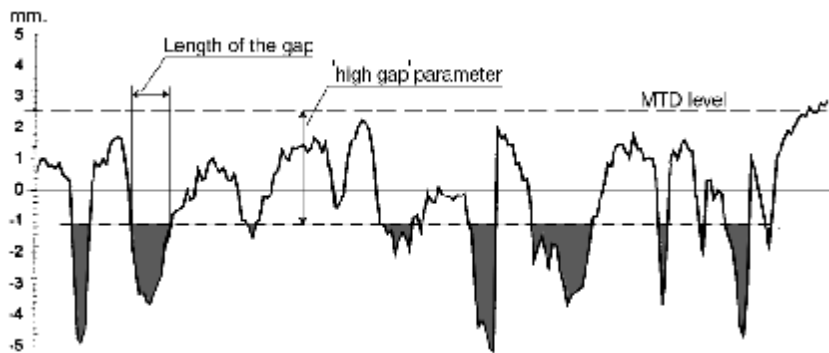
GPR has a role both in assessing construction quality and in performance monitoring, particular as an input to the assessment of structural condition

IBDIM, Poland, LCPC, FR  
TRL, UK



# Surface ravelling

The main purpose of measuring ravelling/fretting is for performance monitoring and assessing maintenance need



DVS, The Netherlands and TRL, UK



# Static and dynamic testing of bridges

Types of load test:

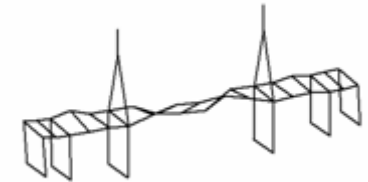
§ proof

§ diagnostic

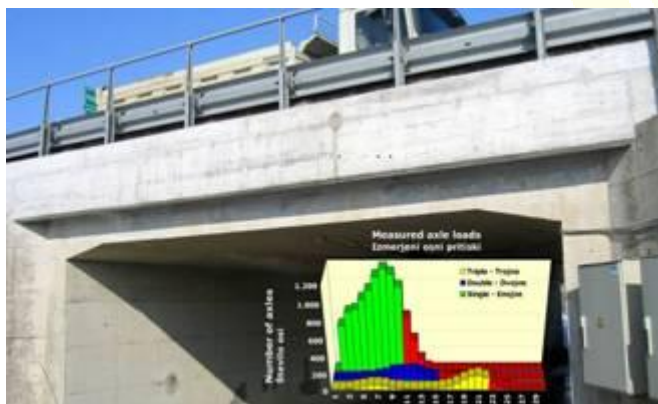
§ soft

§ dynamic

Could be used for assessing construction quality or more usually performance monitoring



— 100,000

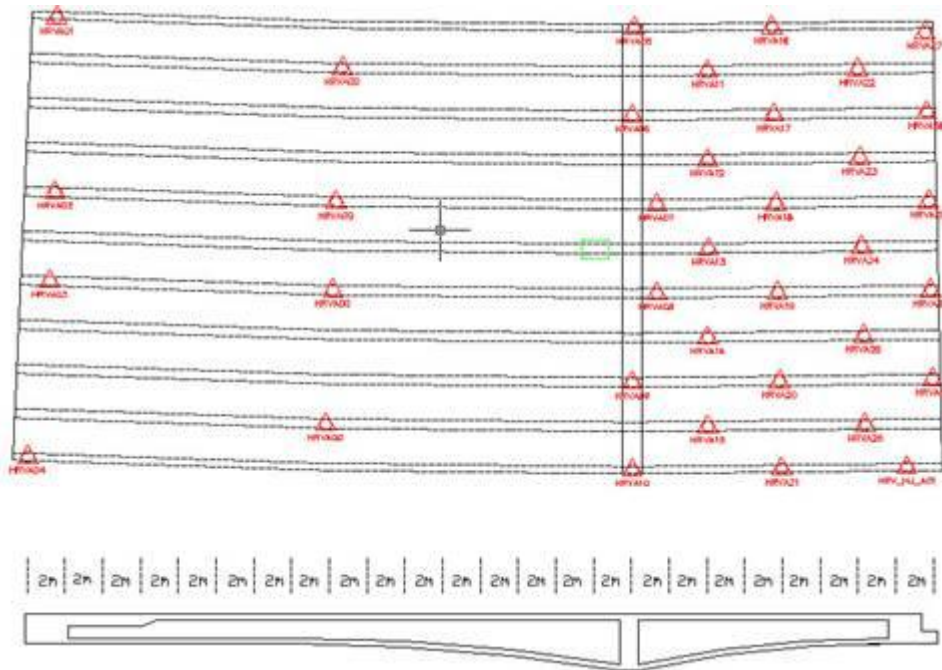


ZAG, Slovenia



# Acoustic emission testing of bridges

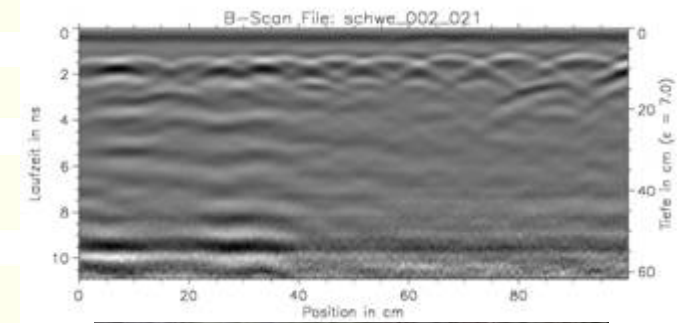
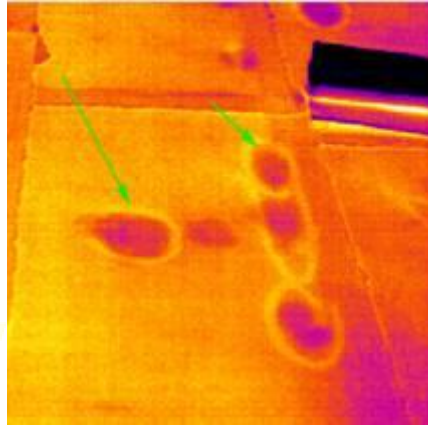
This technique is used for performance monitoring



TRL, UK and LCPC, France

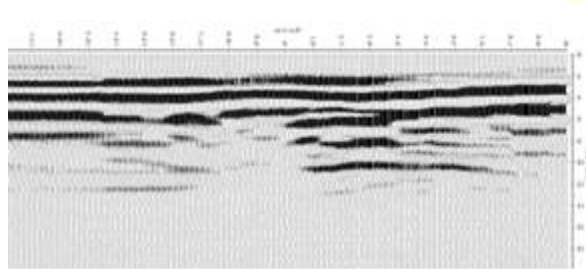


# But also...



# And also.....

## UK GPR tunnel assessment



## 3D laser tunnel scan



## FEHRL Comparisons and UK Accreditation trials



# In summary.....

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Do these examples of existing NDT solutions meet the main criteria of the project? i.e. minimises disruption.

	Design	Construction	Performance
Pavements	Subgrade support	High speed GPR	Surface ravelling
Bridges	/	Dynamic testing under ambient vibration	Acoustic emissions
Earthworks	/	/	/
Tunnels	/	/	/

# In summary.....

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Tunnels	/	/	/

# Some publications.....

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Some examples of recent publications that summarise the latest NDT position in Europe:

1. European Project "FORMAT" including a review of pavement condition monitoring techniques published in 2005
2. A French review of NDT testing of concrete structures in France – 2005
3. The latest UK Government advice on NDT testing of Highway Structures and pavement assessment in their Design Manual for Roads and Bridges - 2006
4. The latest UK Government advice on Pavement Assessment in their Design Manual for Roads and Bridges -2004 and 2008
5. European Project "Sustainable Bridges" including review and development of bridge condition assessment and monitoring published in 2007

# (1) FORMAT Report

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Project funded by the European Community under the 'Competitive and Sustainable Growth' Programme (1998-2002)

## Fully Optimised Road MAintenance (FORMAT)

Work Package 6 : Monitoring

Deliverable Reports

D6 – Optimised pavement condition data collection procedures

**D12 - Assessment of high speed monitoring equipment**

D17 – Application of high-speed equipment in pavement maintenance planning

Issued 2005, 250p in total

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## (2) NDT of concrete structures

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### State of the art (2005, 555p)

- § mechanical waves (ultrasons-transmission mode-, impact écho, acoustic emission, tomography, surface waves)
- § electromagnetic methods (BF, radar, capacité),
- § Infrared thermography
- § electric methods (resistivity, corrosion rate, corrosion potentiel)
- § radiography (gamma, X)
- § optic methods (shearography, holography, fringe projection)



### Method currently applied in France

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## (3) UK Advice on NDT of Highway Structures

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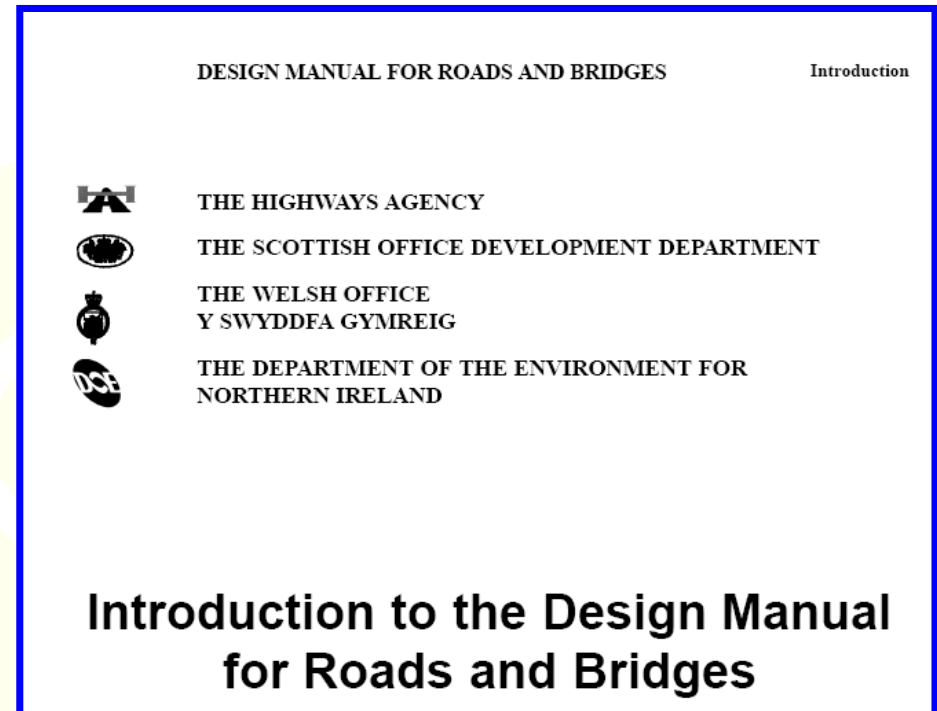
Design and  
Maintenance of Roads  
and Bridges

Volume 3

Highway Structures  
Section 1 Inspection

**Part 7 BA 86/06**

**Advice Notes on the Non-Destructive Testing of Highway Structures**



# (4) UK Advice on Pavement Assessment

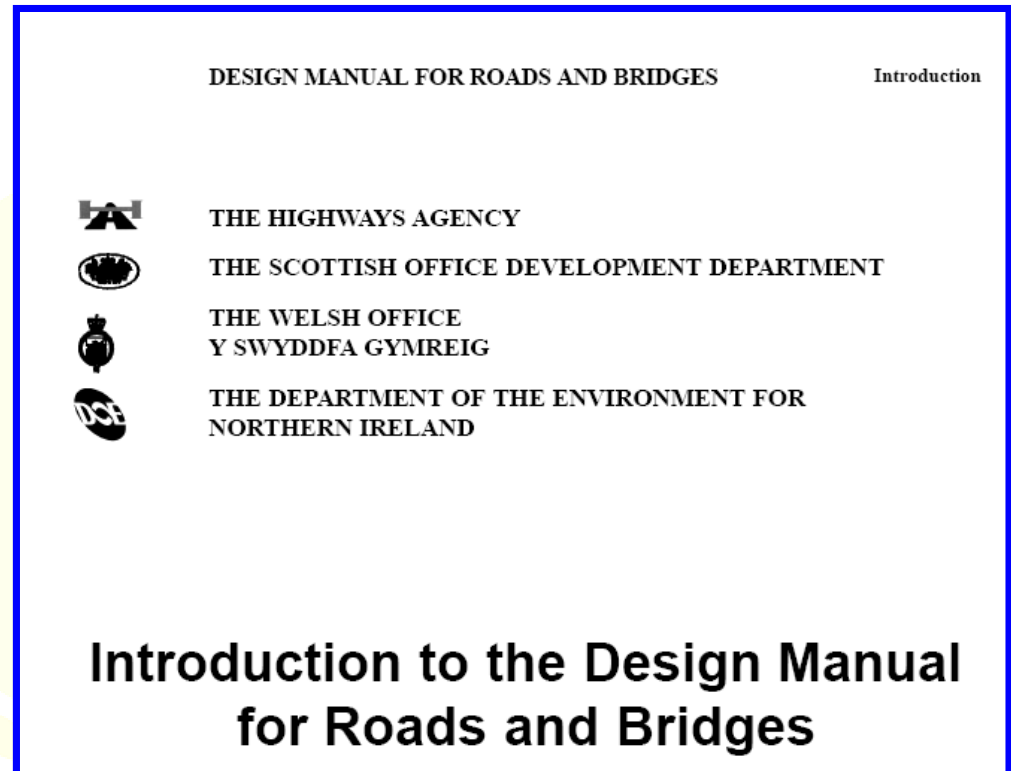
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Design and Maintenance  
of Roads and Bridges

Volume 7

Pavement Design and  
Maintenance

Section 3 Pavement  
Maintenance Assessment



**Part 2 HD28/04 and HD29/08**

**Skidding resistance and Data for Pavement Assessment**

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## (5) Sustainable bridges project

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Sustainable Bridges



Project funded by the European Community under the  
'PRIORITY 6 SUSTAINABLE DEVELOPMENT  
GLOBAL CHANGE & ECOSYSTEMS' Programme (2003-2007)

Dedicated to railway bridges

Work Package 3: Condition Assessment and Inspections

Work Package 6: Monitoring

Deliverable Reports: guidelines

<http://www.sustainablebridges.net>

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**Thank you for  
listening!**

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