



## TECHNICAL REPORT

### *European Railway Bridge Demography*

#### *Deliverable D 1.2*

Project acronym:	<b>Sustainable Bridges</b>
Project full title:	<b>Sustainable Bridges – Assessment for Future Traffic Demands and Longer Lives</b>
Contract no.:	<b>TIP3-CT-2003-001653</b>
Doc. nr, revision date, status	<b>WP1-02-T-040531-R-Deliverable D 1.2</b>
Date of original release:	<b>2004-05-31</b>
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**PRIORITY 6**

SUSTAINABLE DEVELOPMENT  
GLOBAL CHANGE & ECOSYSTEMS

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# 1 Introduction

This report comprises deliverable D 1.2 from Work Package 1, defined in the contract documentation as *“a report on the age profile and condition of existing European railway bridges, transition zones and embankments, subdivided by construction material”*.

Although the contract deliverable mentions that bridge condition would be reported, it was thought that seeking such data was likely to inhibit responses from the railways approached, since they may well regard it as sensitive. To ensure the return of as many completed replies as possible this topic was not included in the questionnaire, since it is not relevant to the scientific aims of the Sustainable Bridges project. Existing bridge condition will be more important in gauging uptake of the scientific advances coming out of the project and will probably be a topic in future questionnaires. Nevertheless, some indication of bridge condition across Europe is available in the “maintenance” survey data reported as deliverable D1.3.

The data presented within this report has been collected from the 17 European railway administrations that responded to a questionnaire initially formulated following preliminary discussions within WP 1 and amended at the request of the other WP leaders.

The report discusses the methodology used in obtaining the data, the success in obtaining data from those requested to provide information and the reliability of the data obtained. It then goes on to present the analysed data in outline.

The questionnaire used for this data gathering is reproduced as appendix A1. Detailed spreadsheets, giving the breakdown of the data by railway are given in as appendix A2.

## **2 Survey Methodology**

### **2.1 Initial ideas**

From the very early meetings to prepare the Sustainable Bridges bid, it was realised that the small number of railway owners represented in the consortium would not be able to give a fully representative view of the problems affecting railway bridges across Europe. The bid thus allowed, within the activities of WP1, for a survey of all major European railways.

It was initially uncertainty whether this survey should be based on face-to-face interviews, telephone interviews or the use of a questionnaire. During contract negotiations with the EU the funding available to the project was reduced from the original bid figure and, in order to reserve as much funding as possible for RTD activities, it was decided that face to face interviews would not be feasible.

Hence, either telephone based interviews or the use of a questionnaire were the options taken forward to the kick off meeting.

### **2.2 Preparation of questionnaire**

#### **2.2.1 Barcelona meeting**

At the Barcelona kick off meeting, the railway contractors agreed that the best format for the railway survey would be a questionnaire, distributed electronically to selected railways by nominated "partner" railways within the Sustainable Bridges consortium. The leaders of WPs 3 to 9 were asked to let WP1 have details of the initial information that they would require to enable them to make an early start to their work.

The "railway" contractors agreed to meet in early January 2004 in Frankfurt, under the joint auspices of WP1 and WP2, to finalise the creation of the questionnaire and to choose the railways asked for data. In addition, the "technical" Work Packages (WP3, WP4, WP5 and WP 6) arranged a joint meeting in Paris in late January 2004.

To enable WP1 to make a meaningful presentation to the Paris meeting each railway contractor agreed to provide basic statistical data on bridge type, maintenance problems and a list their current research activities to the WP leader, by the end of December 2003.

#### **2.2.2 Frankfurt meeting**

At the Frankfurt meeting the initial returns from the railway contractors, processed into a Power Point presentation were analysed and discussed, and it was agreed that the leader of WP1 should present these initial findings to the Paris meeting mentioned above. Since two of the WP members were attending the UIC (Union Internationale des Chemins de Fer) Structures Experts' meeting in Paris they agreed to brief that meeting on the aims of the Sustainable Bridges project and to seek the assistance of the UIC Structures Experts in completing the questionnaire.

The following split of responsibilities for data gathering was agreed;

DB	Switzerland and Austria
SNCF	Italy, Belgium, Holland
NR	Spain, Portugal, Republic of Ireland, Northern Ireland
BV	Denmark, Norway
PLK	Czech Republic, Slovakia, Hungary, Croatia, Slovenia
RHK	Latvia, Lithuania

The meeting agreed that following topic areas, incorporating requests received from other WP leaders, that should be included in the questionnaire.

*Statistics of bridge stock:* (number, type, typical span range <10m; 10-40m; >40m, age of superstructure).

*Problem areas:* Can be connected to the structure type - include piers (including columns), substructure, abutment, foundation, bearings. Give some lines to write additional information.

*Current research activities financed from Railway owners:* Give "tick" options to categorise by different areas such as new materials, surface coatings, design, assessment, and lines for other research, split between theoretical and applied.

*Research wish list (5 areas with highest priority).*

*Existing codes and standards for existing railway bridges.*

There was some discussion about enabling of the questionnaire for on line completion. The initial decision was to proceed on that basis but subsequent enquiries into costs showed that it would be uneconomic, since only 24 questionnaires were to be used (six to WP1 members and 18 to other railways).

### **2.2.3 Paris meeting**

Following the Frankfurt meeting outlined above, a first draft of the questionnaire was prepared, and circulated it initially to the WP1 members. After incorporating minor corrections, a modified draft questionnaire was circulated to all the other WP leaders, with a request that they propose further amendments no later than the close of the Paris meeting.

A presentation made to the Paris meeting outlined the initial findings from the partner returns. This suggested that masonry arch bridges have insufficient project effort when compared with other bridge types, whilst the effort in relation to concrete bridges could be over generous.

### 3 Questionnaire circulation and response levels

Following further minor amendments to the questionnaire the final version was placed on the project intranet on 4 February 2004. The six partner railways then approached their 18 nominated contact railways, requesting return of the completed questionnaires by the end of February. Regrettably, there was a quite considerable delay in obtaining completed questionnaires, with seven of the railways originally approached failing to respond by the final cut off date of early May. It is fortunate that all the “non responders” are relatively small railways and their absence should not detract from the conclusions of from the survey.

The completed returns cover a good geographic spread across Europe, spanning from Italy in the South to Finland in the North and from Poland in the East to the Irish Republic in the West, and represent all the major European railways. They also successfully cover several different European climates; hot dry Mediterranean; colder Alpine/Nordic and wet/warm Atlantic seaboard.

An Excel spreadsheet was drawn up to record the data as it was received and three successive versions were placed on the project intranet site between late March and early May 2004. A Power Point presentation was prepared to give the results then available to a meeting of WP6 in Stockholm in March 2004, which was updated for a presentation to WP4 in Copenhagen in April 2004. In addition, at these WP meetings the basic Excel spreadsheet as made available so that the WP leaders could analyse the data in a way more appropriate to their needs, should they so desire.

All the completed questionnaires received have been placed on the project intranet site, so that all partners are able to extract data relevant to their work that is not in an appropriate format on the final spread sheet, which contains information on over 220,000 railway bridges. This final spreadsheet was made available to all partners on the intranet site in May 2004.

## 4 Survey results

A full Excel spread sheet recording the data obtained from the survey, divided between responding railways appears as Appendix A2. Below there is some discussion on the quality of data received and “headline” figures in a number of headings.

### 4.1 Data quality

Before presenting the main highlights, it is probably as well to comment on the quality of the data received. Unfortunately, there is no way of checking the data produced in response to the questionnaire independently but, generally, the data appears to be of high quality.

However, there are question marks around some of the returns; for instance the data suggests that in excess of 1,800 concrete bridges are over 100 years old, nearly 500 masonry arch bridges are less than 20 years old and over 2,000 steel/concrete composite bridges are over 100 years old. These questionable figures represent 4%, 1% and 7% of the respective totals for each type and are not significant in any subsequent analysis of the data.

Information relating to the age of substructures has been more difficult to obtain, with only three returns containing any data in this area. This limited sample suggests that over 60% of substructures are in excess of 100 years old and a further 20% are aged between 50 and 100 years. The WP considers that it is appropriate to regard these values as representative for the purposes of the project. However, they are probably statistically on the low side, since it is normal railway practice to only replace bridge superstructures and the majority of railway routes in Europe are in excess of 100 years old.

### 4.2 Bridge types

Overall, nearly 23% of the bridges surveyed are of concrete construction, 21% are metallic, 41% are arches and 14% have steel/concrete composite or encased beams construction. These figures are broken down in more detail below. From the returns, it was not possible to determine material type for some 2,400 bridges, which is about 1% of the total number of bridges included in the survey. This very low rate of error means that the data presented below can be considered to truly reflect the European railway bridge stock.

#### 4.2.1 Concrete

The survey contains data relating to almost 50,000 concrete bridges. It shows that 78% of concrete bridges are classified as reinforced and 21% are either pre stressed or post tensioned. For a small number of bridges it was not possible to determine from the returns the sub type within the overall concrete category.

#### 4.2.2 Metal

The survey contains data relating to just over 47,000 metallic bridges. It shows that 3% of metallic bridges are cast iron, nearly 25% are wrought iron and almost 53% are steel. For 21% it was not possible to determine from the returns the sub type within

the overall metallic category, but it can be assumed that the split would be similar to the percentages quoted above for each sub type.

### **4.2.3 Arches**

The survey contains data relating to nearly 90,000 arch bridges. It shows that 52% have brick arch barrels and 33% have stone barrels. The remaining 15% either have concrete barrels, or the construction material was not specified by the respondent. It is probably reasonable to assume that concrete barrels will equate to no more than 5% of the total, with the remaining 10% split 52:33 between brick and stone.

### **4.2.4 Steel/concrete and encased beam**

The survey contains data relating to over 30,000 steel/concrete or encased beam bridges. This data has not been split down between these two sub types.

## **4.3 Bridge age profile**

Overall, nearly 11% of the bridges surveyed are less than 20 years old, 22% are between 20 and 50 years old, 31% are between 50 and 100 years old and 35% are over 100 years old. These figures are broken down in more detail below.

### **4.3.1 Concrete bridges**

The survey shows that 25% of concrete bridges are less than 20 years old, 55% are between 20 and 50 years old, 16% are between 50 and 100 years old and 4% are over 100 years old (this is doubtful, please note comment in 4.1 above).

### **4.3.2 Metallic bridges**

The survey shows that 10% of metallic bridges are less than 20 years old, 22% are between 20 and 50 years old, 40% are between 50 and 100 years old and 28% are over 100 years old.

### **4.3.3 Arch bridges**

The survey shows that 1% are less than 20 years old (this is doubtful, please note comment in 4.1 above), 1% are between 20 and 50 years old (this is also doubtful, please note comment in 4.1 above), 34% are between 50 and 100 years old and 64% are over 100 years old.

### **4.3.4 Steel/concrete and encased beam bridges**

The survey shows that 25% are less than 20 years old, 33% are between 20 and 50 years old, 35% are between 50 and 100 years old and 7% are over 100 years old (this is doubtful, please note comment in 4.1 above).

## **4.4 Bridge span profile**

In dealing with spans, the data requested specified the size of individual spans in multi span bridges, rather than the full length of such bridges.

Overall, nearly 62% of the bridges surveyed span less than 10m, 34% span between 10m and 40m and 5% have spans greater than 40m. These figures are broken down in more detail below.

### **4.4.1 Concrete bridges**

The survey shows that 63% of concrete bridges span less than 10m, 33% span between 10m and 40m and 4% have spans greater than 40m.

### **4.4.2 Metallic bridges**

The survey shows that 45% of metallic bridges span less than 10m, 44% span between 10m and 40m and 11% have spans greater than 40m.

### **4.4.3 Arch bridges**

The survey shows that 75% span less than 10m, 24% span between 10m and 40m and 1% have spans greater than 40m.

### **4.4.4 Steel/concrete and encased beam bridges**

The survey shows that 47% span less than 10m, 48% span between 10m and 40m and 5% have spans greater than 40m.

## 5 Conclusions

Seventeen responses have been received to questionnaire requesting statistical data on bridge types, ages and span characteristics that was circulated to twenty-four European railways. The returns that were not received were from smaller railways and the absence of data from those railways will not significantly affect the data analysis and conclusions drawn.

The data received, which geographically covers most of Europe and its major climate zones, shows that the European railway bridge stock is generally quite old and contains a mix of bridge types. The predominant type of bridge is the arch, mostly having brick construction, with lesser, but almost equal, quantities of metallic and concrete bridges. The stock also contains a smaller number of composite bridges. The majority of European railway bridges are small span (below 10m), with spans over 40m only accounting for 5% of the bridges in the survey. Most long span bridges are of metallic construction.

This data has been analysed and preliminary outputs already presented to WP 4 and WP 6 to enable them to check that their proposed work plans remain logical. Other WPs should similarly check their work plans in the light of their data presented here and in the parallel deliverable D1.3, which reports the survey results as they reflect maintenance and renewal activities and priorities and R&D needs for the European railways.

The data gathering would not have been possible without the support of the railway undertakings who are partners in the Sustainable Bridges consortium; Network Rail Infrastructure Ltd (UK), Banverket (Sweden), Deutsche Bahn AG (Germany), RHK (Finland), Société Nationale des Chemins de fer Français (France) and PKP Polskie Linie Kolejowe SA Poland).

## **Appendices**

## **A1**

### **Questionnaire sent to selected railways**



## Questionnaire for European Railways

### Introduction

Sustainable Bridges is an Integrated Project, funded through the EU 6<sup>th</sup> Framework programme, which is attempting to assist the railways in Europe to meet, with minimum disruption, the European Commission's policy of increasing the use of railways for both passenger and freight traffic. The consortium consists of 32 partners, with the following railway administrations being partners in the project; Network Rail Infrastructure Ltd, Banverket, Deutsche Bahn AG, RHK (Finnish Railway Administration), Société Nationale des Chemins de fer Français and PKP Polskie Linie Kolejowe SA. More information can be found on the project web site <http://www.sustainablebridges.net/>.

In order to ensure that the project produces results that will be useful to the majority of European railways it is important that the size, type and condition of existing railway bridges is known, that real maintenance problems are addressed and that existing or on going research is not duplicated.

The consortium would be very grateful if you could take a few minutes to answer the following questions (preferably in English) on behalf of your railway, it should not take more than 15 to 30 minutes of your time. When completed please return the questionnaire to the railway partner who approached you initially, either by fax or by e-mail. If you are filling in the questionnaire by hand please print your answers in capital letters.

Firstly, please indicate below your contact details for the person filling in this questionnaire.

Name of Railway	
Address	
Name of contact person	
Job title of contact person	
e-mail address	
Telephone number	
Fax number	

## PART 1 - BRIDGE STATISTICS

### Superstructure Materials

Please give the total number of bridges owned and maintained by your railway, having a span of more than 2m, divided into the following materials. Please count multi span viaducts as one bridge. For the secondary data, please give this if it is readily available either as a number, or an approximate percentage of the type. The information should be given to the best level of accuracy readily available (the nearest 500 will generally be quite good enough except for the smallest railway administrations).

Bridge type			Number
Arch		Type total	
Brick	No. or %		
Natural stone	No. or %		
Concrete	No. or %		
Other material	No. or %		
Concrete beam		Type total	
Reinforced concrete	No. or %		
Pre-stressed or post tensioned concrete	No. or %		
Steel/concrete composite or embedded girder		Type total	
Metallic beam		Type total	
Steel	No. or %		
Wrought Iron	No. or %		
Cast Iron	No. or %		
Other		Type total	
<b>Grand total</b>			

Please indicate in the space below what “other” materials are included above.

### Age

Please give below the approximate age profile of each category below by percentage.

Category	Approximate age			
	<20 yrs	20-50 yrs	50-100 yrs	>100 yrs
Arch				
Metallic				
Concrete				
Steel/concrete composite				
Sub structure				

**Span length**

Please give below the approximate span (superstructure) profile of each type of bridge by percentage.

<b>Bridge type</b>	<i>Span range</i>		
	<b>&lt;10 m</b>	<b>10-40 m</b>	<b>&gt;40 m</b>
Arch			
Concrete			
Steel/concrete composite			
Metallic			

**Bridge status**

Please indicate the percentage of bridges by the following categories.

<b>Category</b>	<b>% of total</b>
Under the railway	
Over the railway	

<b>Of those over the railway</b>	<b>% of sub total</b>
Carrying public roads	
Carrying footpaths	
Carrying waterways	
Carrying private roads	

**New lines**

Is your railway building any new railway lines?

**Yes/No**

If so, roughly what length is:

Under construction?

Km

Planned?

Km

What is the main bridge type? (For example *post tensioned concrete*; *steel/concrete composite*.)

**Track gauge**

What track gauge(s) exist on your railway? Please indicate the approximate percentage of each gauge if you have more than one.

<b>Track gauge</b>	<b>Percentage</b>

**PART 2 – BRIDGE INSPECTION & MONITORING****INSPECTION**

Please give the normal interval between bridge inspection cycles.

<b>Examination type</b>	<b>Interval (Years or months)</b>
Visual (i.e. <i>without using special access</i> )	
Detailed (i.e. <i>at touching distance</i> )	

Do these intervals vary between different types of bridge? **Yes/No**

If so, please specify by how much and why below;

**b) MONITORING**

Has your railway ever used monitoring/instrumentation to check bridges? **Yes/No**

Does your railway regularly use monitoring/instrumentation to check bridges? **Yes/No**

If you have answered “yes” to either of the above, please specify below the reason(s) for using monitoring.

Please say what information that could be obtained by new or improved monitoring systems would improve or reduce the cost of bridge ownership to your railway.

Please indicate below the types of system that are/have been used for bridge monitoring, their usefulness and the approximate number of times per year that they are/have been used.

Monitoring system	Used		Useful		Level of use (Times/year)
	Yes	No	Yes	No	
Strain gauging					
Deflection monitoring - manual					
Deflection monitoring - lasers					
Vibration monitoring					
Crack monitoring - manual					
Crack monitoring - automatic					
Chloride and/or carbonation					
Half cell potential					
Sonic transmission					
Tomography					
Ground probing radar					
Acoustic emission					
Train/axle weight					
Track unevenness (for bridge dynamics)					
Other (please specify)					

Please say below why the monitoring was or was not useful.

### **Existing bridges**

Are you planning to monitor any existing bridges in the next two years? **Yes/No**

Would you be willing to share monitoring data with the project, or would be prepared to make an existing bridge available to the project for monitoring? **Yes/No**

### **New bridges**

Do you have any new bridges planned or under construction that would benefit from monitoring? **Yes/No**

Would you be willing to make a new bridge available for monitoring under the project, if an appropriate type was identified? **Yes/No**

**PART 3 - MAINTENANCE ISSUES**

Please indicate the major maintenance problems that your railway has with the following types of bridge. If you do not have a particular type of bridge on your railway please enter N/A.

**SUPERSTRUCTURES**

**Pre stressed/post tensioned concrete** (For example *inspection of tendons for corrosion; lack of grouting*)

--

**Reinforced concrete** (For example *corrosion of reinforcement; fatigue*)

--

**Steel/concrete composite of embedded girders** (For example *examination of shear studs*)

--

**Steel** (For example *brittle fracture; fatigue*)

--

**Wrought iron** (For example *rusting/delamination; rivet condition*)

--

**Cast iron** (For example *deterioration of exposed surfaces; sudden failure*)

--

**Brick or stone arches** (For example *cracking; distortion*)

**Concrete or other arches** (For example *water ingress*)

## SUBSTRUCTURES

**Bearings** (For example *lack of movement; difficulty of inspection*)

**Abutments** (For example *differential movement; embankment settlement*)

**Piers/columns** (For example *cracking*)

**Foundations** (For example *settlement; failure of bearing piles*)

**Approach embankments/transition zones/bridge ends** (For example *settlement; deterioration*)

**PART 4 - MAINTENANCE ACTIVITIES**

Please indicate, by the use of approximate percentages, the proportion of your railway's bridge maintenance activity undertaken in the following areas.

In this table:

- "Rehabilitation" means returning the bridge as nearly as possible to its original condition and carrying capacity.
- "Strengthening" means improving the carrying capacity beyond that for which the bridge was originally designed.
- "Replacement" means either the replacement of the superstructure or the total replacement of the bridge, either in its original position or in a new position.

<i>Bridge Type</i>	<i>Maintenance activity</i>		
	<b>Rehabilitation</b>	<b>Strengthening</b>	<b>Replacement</b>
Stone or brick arch			
Other arch types			
Concrete			
Steel/concrete composite			
Metallic			

For rehabilitation activities, please indicate if possible the approximate percentage break down of the activities undertaken (by volume or cost), and also the priority order (most important scored 1) of the various activities to your railway; please add to the list as necessary:

<b>Rehabilitation Activity</b>	<b>%</b>	<i>Priority</i>
Embankment remediation at bridge ends		
Underpinning of foundations		
Pointing of brick or masonry		
Patch repair of damaged brick or masonry		
Stitching of masonry ( <i>Fondedile type</i> )		
Patch repair of corroded metalwork		
Painting of metalwork		
Concrete repairs		
Re-alkalisation or chloride extraction		
Application of cathodic protection		
Reinforcement replacement		
Tendon replacement		
Waterproofing		
Bearing replacement		
Other (please specify)		

For strengthening activities, please indicate if possible the approximate percentage break down of the activities undertaken (by volume or cost), and also the priority order (most important scored 1) of the various activities to your railway; please add to the list as necessary::

<b>Strengthening Activity</b>	<b>%</b>	<b>Ranking</b>
Embankment remediation at bridge ends		
Underpinning of foundations		
Reinforcement of arches (within the ring)		
Concrete saddling of arches		
Steel, concrete or brick underlining of arches		
External pre-stressing – concrete bridges		
External pre-stressing – metallic bridges		
Increasing section – concrete bridges		
FRP strengthening - masonry arches		
FRP strengthening-steel		
FRP strengthening-concrete		
Replacement of metallic structural members		
Additional reinforcement		
Additional metallic structural members		
Soil improvement		
Other (please specify)		

**PART 5 - RESEARCH ACTIVITIES**

Please list briefly below any bridge related research or development funded by your railway that is currently underway. (Do not list any other research that you may know of, since that will be collected separately from Universities and national research bodies.) Please make the description brief (for instance: new materials, bridge assessment) and indicate whether the research is theoretical (T) or applied (A).

Since two work packages are concerned with monitoring bridges (both existing and new), please specifically list any studies ever undertaken into monitoring.

Please give a contact name, phone number and e-mail address for somebody in your railway who can be interviewed in more detail about projects relevant to Sustainable Bridges.

Please list any other considerations that may affect the installation or use of monitoring systems (for instance: *electrical compatibility with signalling, telephone or traction power systems; special training to go on the track*).

Please also give contact name(s), phone number(s) and e-mail address(es) for people in your railway who can be interviewed in more detail about the issues identified above.

**PART 6 - YOUR PRIORITIES FOR THE SUSTAINABLE BRIDGES PROJECT**

In order to enable your railway to meet the stated aim of the EU to see a 30% increase in passenger traffic and a trebling of freight traffic on the railways in Europe, without seriously disrupting the day to day operations of the railway network please list, in priority order, your top research or development areas, preferably no more than 5, that should be addressed by the Sustainable Bridges consortium.

## PART 7 - EXISTING DOCUMENTS

The Sustainable Bridges project wishes to compare current practice amongst the European railways, with a view to identifying best practice. We hope that your railway will be prepared to make available any existing internal codes, standards, handbooks or guidance dealing with existing railway bridges for inspection. At the moment we are not interested in design codes for new bridges.

Please indicate, by ticking the appropriate boxes, whether you have any documents in the following areas and also whether you would be prepared to make copies available to the consortium. Please also show the date of issue. Please do not include UIC, National or CEN standards, as these will be obtained from other sources.

Topic	Have document		Willing to share		Date of issue
	Yes	No	Yes	No	
Examination ( <i>mainly visual</i> )					
Monitoring ( <i>mainly using instrumentation</i> )					
Condition ranking					
Bearing capacity calculation (Assessment)					
Intervention planning					
Maintenance					

**For your bearing capacity code** (if you have one) please complete the following by ticking the appropriate box.

The safety format used in the code is:

Partial safety factors	
Partial factors + load combination factors	
Allowable stresses	
Reliability indices	
Probability of failure	
Other (please specify)	

If the partial factors were calibrated to a target reliability index, or if a reliability index or probability of failure is directly mentioned in the code, please indicate the value of:

Target reliability index	
Target probability of failure	
Corresponding reference period	

## The end - thank you!

*This questionnaire was prepared on behalf of the Sustainable Bridges consortium by the leader of Work Package 1, Brian Bell, Structures Research and Development Engineer, Network Rail, London. If necessary, he may be contacted by phone (+44 20 7557 8355), fax (+44 20 7557 9132) or e-mail (brian.bell@networkrail.co.uk).*

## **A2**

### **Questionnaire returns**

**Sustainable Bridges - Bridge types**

Railway	Concrete			Metal				Arch			Composite or encased	Not Specified	Rly total
	RC	PS/PT	n/k	CI	WI	Steel	n/k	Brick	Stone	n/k-conc			
Aus	3,703	154	0	0	462	1,132	0	231	885	167	64	0	6,797
Bel	1,094	699	0	0	0	564	0	2,100	21	45	683	0	5,206
Cz	1,651	431	0	0	601	1,988	0	417	2,848	867	1,600	0	10,403
Den	1,785	0	0	0	0	0	150	0	0	225	0	0	2,160
Ei	382	101	132	0	6	265	105	40	1,691	5	21	670	3,418
Fin	1,450	159	0	338	0	60	0	0	76	42	122	0	2,247
Fra	7,553	398	0	226	4,594	2,033	678	2,708	14801	542	7,951	0	41,482
Ger	1,200	5,500	0	0	0	0	8,000	0	0	9,100	8,600	0	32,400
Hun	1,306	14	0	0	0	530	0	250	90	158	882	0	3,230
Ita	1,650	550	0	60	0	2,940	0	21,560	0	440	8,800	0	36,000
Pol	5,535	36	0	0	0	3,229	0	1,877	1165	300	0	0	12,142
Por	1,391	0	0	0	0	661	0	1,921	481	0	53	0	4,507
S'kia	0	48	0	0	0	0	498	0	0	0	0	1734	2,280
Spa	1,767	388	0	0	0	1,112	0	566	1,415	1,163	0	0	6,411
Swe	2,670	200	0	0	0	550	0	0	115	35	50	0	3,620
Swi	3,149	842	0	49	327	190	0	0	893	261	1,704	0	7,415
UK	2,929	1,071	0	687	5,635	9,678	0	14,898	5,102	0	0	0	40,000
<b>Sub total</b>	<b>39,214</b>	<b>10,591</b>	<b>132</b>	<b>1,360</b>	<b>11,625</b>	<b>24,932</b>	<b>9,431</b>	<b>46,568</b>	<b>29,582</b>	<b>13,349</b>	<b>30,530</b>	<b>2,404</b>	
<b>Type total</b>	<b>49,937</b>			<b>47,348</b>				<b>89,499</b>			<b>30,530</b>	<b>2,404</b>	
<b>Grand total</b>	<b>219,718</b>												

Type %	78.5	21.2	0.3	2.9	24.6	52.7	19.9	52.0	33.1	14.9	100.0	100.0
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Overall %	22.7			21.5				40.7			13.9	1.1
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## Sustainable Bridges - Bridge age profile (yrs)

Railway	Concrete				Metal				Arch				Steel/conc composite			
	<20	20-50	50-100	>100	<20	20-50	50-100	>100	<20	20-50	50-100	>100	<20	20-50	50-100	>100
Aus	1,388	2,083	347	38	350	462	606	175	13	90	564	615	24	25	15	0
Bel	360	1,253	180	0	56	452	56	0	0	0	2,058	108	105	544	34	0
Cz	446	702	860	73	239	724	866	759	107	85	834	3,105	686	831	83	0
Den	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Ei	450	105	0	0	11	98	248	19	0	0	0	1,734	21	0	0	0
Fin	780	785	86	0	32	159	201	0	1	26	89	2	17	15	100	0
Fra	1,590	5,565	795	0	753	3,012	3,765	0	0	361	2,166	15,342	n/d	n/d	n/d	n/d
Ger	1,099	4,690	871	40	480	1,840	3,600	2,080	27	100	2,184	6,789	516	1,462	5,418	1,204
Hun	436	845	40	0	55	184	239	20	15	134	149	199	9	247	617	9
Ita	440	1,100	660	0	750	750	1,350	150	0	0	20,900	1,100	4,180	4,400	220	0
Pol	115	1,668	1,976	1,685	111	647	1,085	1,386	302	57	305	2,678	38	104	270	347
Por	1,226	149	41	0	56	218	268	119	0	57	229	1,528	53	0	0	0
S'kia	n/d	n/d	n/d	n/d	12	258	173	55	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Spa	216	1,401	539	0	56	0	834	222	0	314	472	2,358	0	0	0	0
Swe	1,100	1,420	340	10	70	100	350	30	2	12	66	70	48	2	0	0
Swi	958	2,434	559	40	73	85	277	130	11	46	311	785	51	68	1,516	68
UK	1,200	2,400	400	0	1,600	1,600	4,800	8,000	0	0	0	20,000	0	0	0	0
<b>TOTAL</b>	<b>11,803</b>	<b>26,600</b>	<b>7,694</b>	<b>1,886</b>	<b>4,704</b>	<b>10,589</b>	<b>18,718</b>	<b>13,145</b>	<b>478</b>	<b>1,283</b>	<b>30,327</b>	<b>56,413</b>	<b>5,748</b>	<b>7,698</b>	<b>8,273</b>	<b>1,628</b>

<b>Type profile</b>	<b>25%</b>	<b>55%</b>	<b>16%</b>	<b>4%</b>	<b>10%</b>	<b>22%</b>	<b>40%</b>	<b>28%</b>	<b>1%</b>	<b>1%</b>	<b>34%</b>	<b>64%</b>	<b>25%</b>	<b>33%</b>	<b>35%</b>	<b>7%</b>
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<b>Overall profile</b>	<b>11%</b>	<b>22%</b>	<b>31%</b>	<b>35%</b>
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## Sustainable Bridges - Span profile

Railway	Concrete			Metal			Arch			Steel/conc composite		
	<10m	10-40 m	>40m	<10m	10-40 m	>40m	<10m	10-40 m	>40m	<10m	10-40 m	>40m
Aus	2,083	1,620	154	574	829	191	1,167	90	25	9	40	15
Bel	450	1,343	0	0	480	84	1,733	433	0	0	683	0
Cz	1,760	302	21	893	1,498	194	3,388	723	4	0	1,205	395
Den	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Ei	400	215	0	263	113	0	1,667	69	0	0	21	0
Fin	1,077	529	3	34	284	80	91	27	0	104	18	0
Fra	4,770	2,385	795	3,012	3,012	506	13,718	3,429	900	795	6,360	795
Ger	3,819	2,546	335	2,320	5,200	480	6,643	2,457	0	6,622	1,849	43
Hun	785	108	2	58	350	88	491	5	1	802	80	1
Ita	440	1,760	0	300	2,400	300	13,200	8,800	0	4,840	3,960	0
Pol	4,680	835	44	1,130	1,808	290	3,171	167	3	190	402	167
Por	363	115	10	315	286	60	975	84	6	19	32	2
S'kia	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
Spa	1,509	625	22	167	656	289	2,767	362	16	0	0	0
Swe	1,950	940	10	190	300	50	130	15	5	0	40	10
Swi	2,235	1,157	599	113	306	147	784	242	127	1,278	358	68
UK	3,200	800	0	11,200	2,400	2,400	16,000	4,000	0	0	0	0
<b>TOTAL</b>	<b>29,521</b>	<b>15,280</b>	<b>1,995</b>	<b>20,569</b>	<b>19,922</b>	<b>5,159</b>	<b>65,925</b>	<b>20,903</b>	<b>1,087</b>	<b>14,659</b>	<b>15,048</b>	<b>1,496</b>

<b>Span profile</b>	<b>63%</b>	<b>33%</b>	<b>4%</b>	<b>45%</b>	<b>44%</b>	<b>11%</b>	<b>75%</b>	<b>24%</b>	<b>1%</b>	<b>47%</b>	<b>48%</b>	<b>5%</b>
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<b>Overall</b>	<b>62%</b>	<b>34%</b>	<b>5%</b>
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