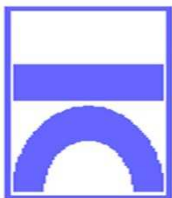


Load test results Internet data base – a new tool in bridge assessment

Piotr Olaszek



Road and Bridge Research Institute
Warsaw, Poland

Internet database of load test results and analytical calculations

- 1. Introduction**
- 2. Internet Software Application**
- 3. The Data Base Analysis**
- 4. Conclusions**

Introduction

- **Many European countries perform load tests on new and rehabilitated bridges.**
- **The information about load test results could be used to optimize assessment of existing bridges.**
- **The database will allow the end users, to judge quickly the behavior of the structure under the loading and suggest the structural assessment method to be used – computation analysis or load testing.**

Application - The data format

The data are organized with the use of sheets

The data set (one record of the database) contains of 4 parts:

- **Bridge description**
 - Bridge description sheet
 - Bridge schemes & photos sheet
- **Analytical model description**
 - Analytical model description sheet
- **Load testing description**
 - Load testing description sheet
 - Static Loading-Results sheet
 - Dynamic Loading-Results sheet
- **Comparison of the load test results and analytical calculations**
 - Static Loading-Comparison sheet
 - Dynamic Loading-Comparison sheet

Application - Review the data Data - Bridge description sheet

<< < > >> User: IBDIM Search

Bridge code: 6 Bridge symbol: IKEAw

Bridge Scheme Model Test Static result Static compare Dynamic result Dynamic compare Guide

BRIDGE DESCRIPTION

Help

Years of the bridge built 2006

Years of the bridge load testing 2006

Bridge Design

- Multi-beam or grider
- Tee beam
- Box beam or grides - Multiple

Bridge Material

- Steel
- Prestressed concrete / Post-tensioned concrete
- Wood or timber

Service on Bridge

General information about the bridge – bridge design & material

Application - Review the data Data - Bridge description sheet

<< < > >> User: IBDIM Search

Bridge code: 6 Bridge symbol: IKEAw

Bridge Scheme Model Test Static result Static compare Dynamic result Dynamic compare Guide

Structure Length [m]
Length of the of roadway which is supported on the independent static scheme bridge structure

Number and Length of Spans
Number of spans in the independent static scheme bridge structure: one span or continuous spans

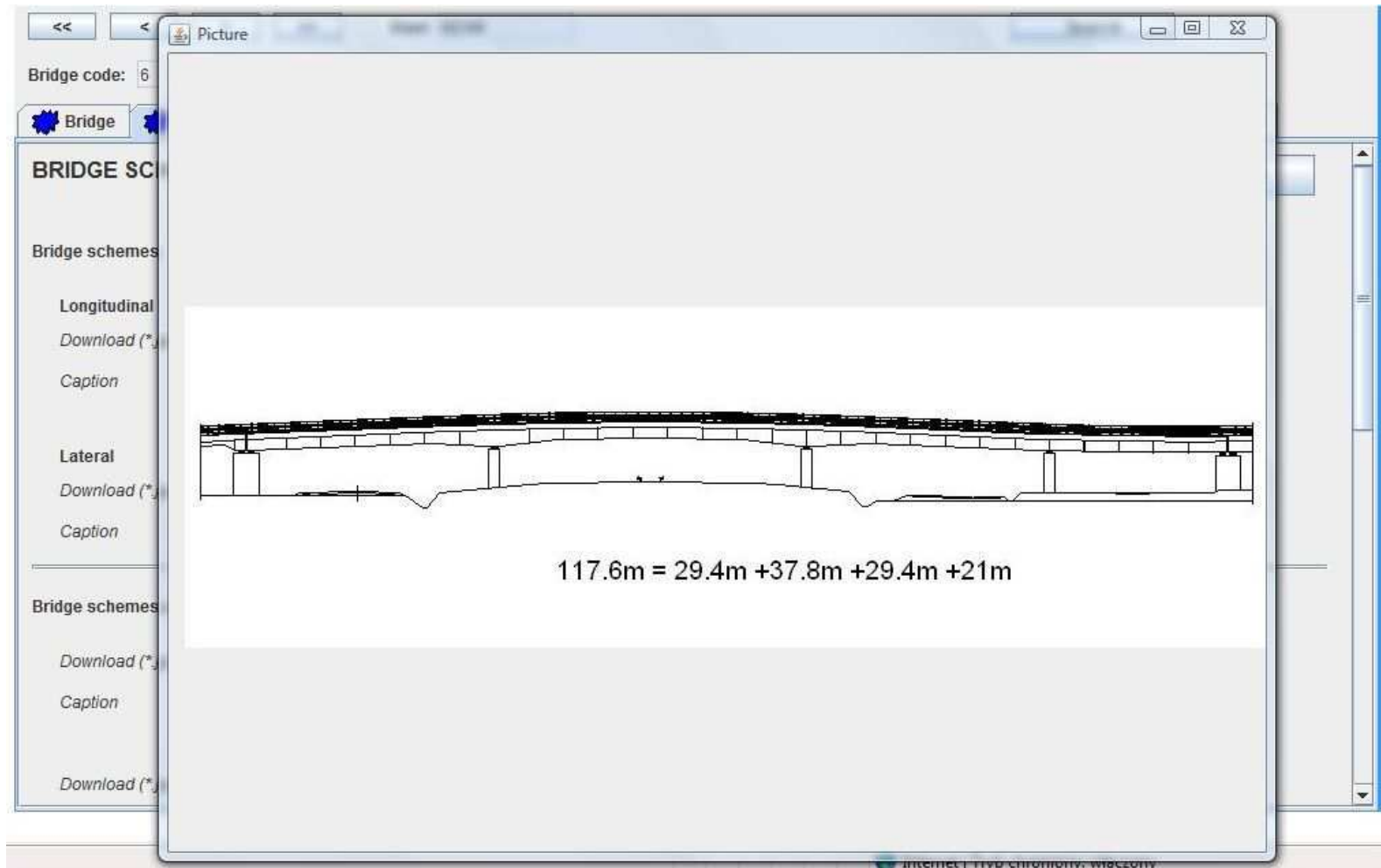
Length of spans

Deck width [m] **Check sum of the width**
The out-to-out width; in the case of the variable width input mean value **The difference**

Number of separate roadways

General information about the bridge – bridge dimensions

Application - Review the data Data - The bridge schemes & photos sheet



The longitudinal scheme of the bridge

Application - Review the data Data - The bridge schemes & photos sheet



The photo of the bridge

Application - Review the data Data - Analytical model description sheet

The screenshot shows a software interface for 'ANALYTICAL MODEL DESCRIPTION'. At the top, there are navigation buttons (left arrow, right arrow, double left arrow, double right arrow) and a 'User: IBDIM' field. Below that, 'Bridge code: 10' and 'Bridge symbol: ERzym' are displayed. A menu bar contains icons and labels for 'Bridge', 'Scheme', 'Model' (selected), 'Test', 'Static result', 'Static compare', 'Dynamic result', 'Dynamic compare', and 'Guide'. A 'Search' button is on the right. The main area is titled 'ANALYTICAL MODEL DESCRIPTION' and includes a 'Help' button. It is divided into three sections: 'Type of the analytical model' with checkboxes for 'Flat' (checked), 'Three-Dimensional', and 'Other'; 'Degree of analytical model detail' with checkboxes for 'Rod' (checked), 'Slab', and 'Girder'; and 'Additional information' with a text area containing 'Analytical model: grid shape.' and a note 'The short non-obligatory additional information'.

The general information about the analytical calculations method

Application - Review the data Data - Load testing description sheet

<< < > >> User: IBDIM Search

Bridge code: 6 Bridge symbol: IKEAw

Bridge Scheme Model Test Static result Static compare Dynamic result Dynamic compare Guide

LOAD TESTING DESCRIPTION

Help

Type of load testing

- Testing bridge before put into service
- Research testing
- Assessment of load carrying capacity

Static loading

Method of loading

Loaded heavy goods vehicles

Maximal number of the vehicles (during all loading variants) 6

The average weight of the single vehicle [kg] 26443.0

Other - text input possible

The general information about the static and dynamic method of loading

Application - Review the data Data - Load testing description sheet

The screenshot shows a software application window with the following elements:

- Navigation buttons: <<, <, >, >>
- User: IBDIM
- Search button
- Bridge code: 6
- Bridge symbol: IKEAw
- Tabbed interface with icons and labels: Bridge, Scheme, Model, Test (selected), Static result, Static compare, Dynamic result, Dynamic compare, Guide
- Main panel title: Investigation range and Measurement methods
- Static section:
 - Deflections
 - Strains
 - Support displacements
 - Other
 - Other
 - Other
 - Other
 - Other
- Dynamic section:
 - Deflections
 - Accelerations
 - Strains
 - Other
 - Other
 - Other

The general information about investigation range

Application - Review the data Data - Static Loading-Results sheet

Navigation: << < > >> User: IBDIM Search

Bridge code: 6 Bridge symbol: IKEAw

Bridge Scheme Model Test **Static result** Static compare Dynamic result Dynamic compare Guide

STATIC-LOADING RESULTS

Range of measured quantities for Bridge Members (BM) Help

Quantity	Ratio R	Range of ratio R		Range of elastic quantities				Range of permanent quantities		Description of loaded BM
				BM loaded directly		BM loaded indirectly		BM loaded directly		
Deflections	Rd	0.92	1.00	-19.26	-20.86			-0.57	-0.74	[mm] deflection distribution at t
Deflections	Rd	0.93	1.00	-13.85	-14.92			-0.84	-0.98	[mm] deflection distribution at t
Deflections	Rd	0.89	1.00	-11.08	-12.42			-0.03	-0.38	[mm] deflection distribution at t
Deflections	Rd	0.00	-0.01	0.05	0.09			-0.08	-0.14	[mm] deflection distribution at t
Deflections	Rd	-0.25	-0.37			6.31	7.75			[mm] deflection distribution at t
Deflections	Rd	-0.41	-0.47			6.14	7.08			[mm] deflection distribution at t
Support displacements	-			-0.65	-0.63					[mm] range of support displac
Support displacements	-			-1.00	-1.38			0.46	0.71	[mm] range of support displac

The ranges of measured quantities for different bridge members

Application - Review the data Data - Static Loading-Comparison sheet

<< < > >> User: IBDIM Search
 Bridge code: 6 Bridge symbol: IKEAw

Bridge Scheme Model Test Static result Static compare Dynamic result Dynamic compare Guide

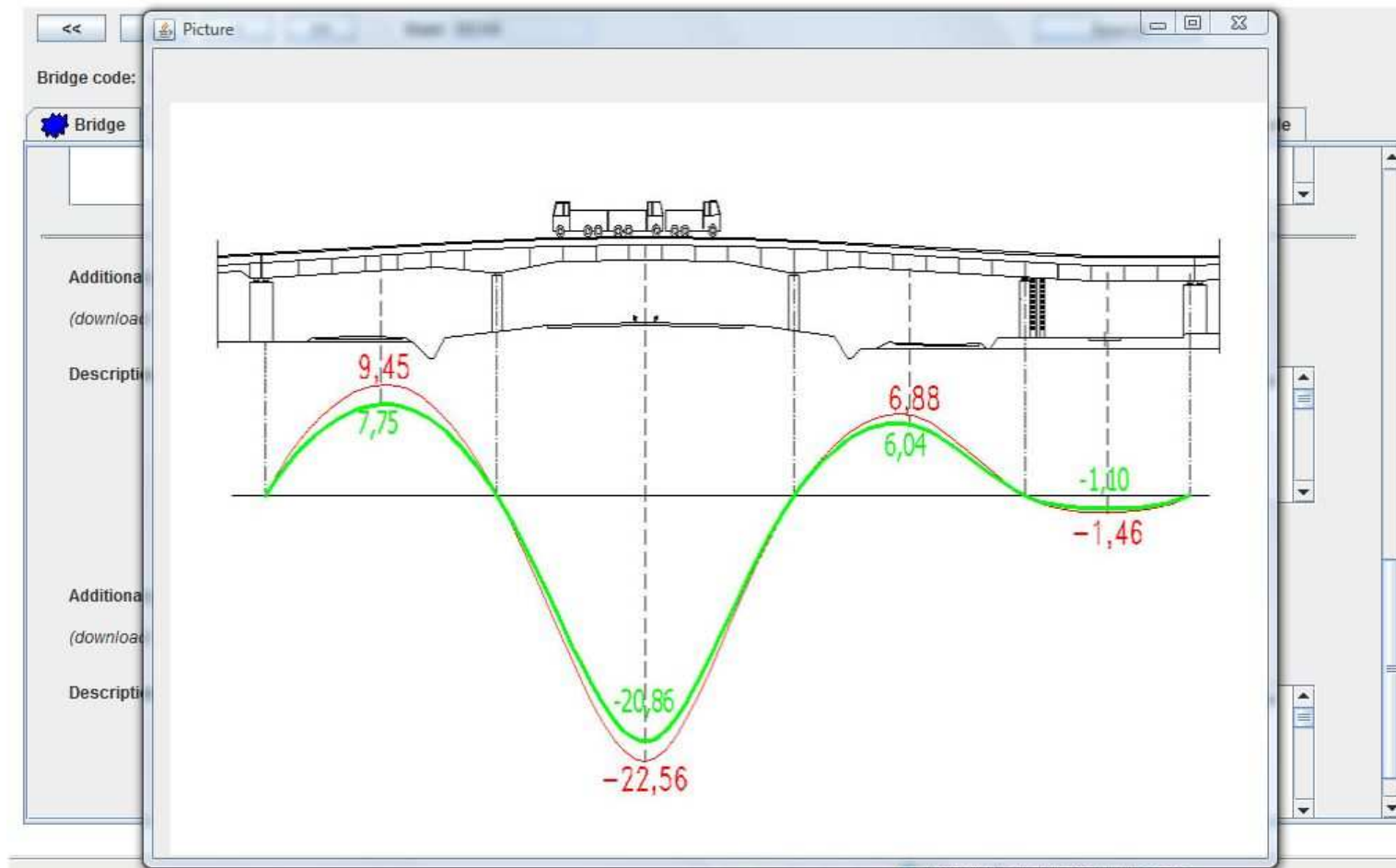
STATIC-LOADING COMPARISON

Comparison factors of the measured and calculated quantities

Quantity	Ratio R	Range of ratio R		Range of comparison factors of measured, elastic quantities [%]				Description of loaded BM
				BM loaded directly		BM loaded indirectly		
Deflections	Rd	0,92	1,00	89	92			deflection distribution at m
Deflections	Rd	0,93	1,00	91	95			deflection distribution at t
Deflections	Rd	0,89	1,00	93	100			deflection distribution at r
Deflections	Rd	0,00	-0,01	9	15			deflection distribution at (
Deflections	Rd	-0,25	-0,37			80	88	deflection distribution at t
Deflections	Rd	-0,41	-0,47			75	84	deflection distribution at t
Support displacements	-							range of support displac
-	-							
-	-							
-	-							
-	-							
-	-							

The table with static loading comparison factors

Application - Review the data Data - Static Loading-Comparison sheet



The additional graphic data: the example distribution diagrams of the measured and calculated deflection in longitudinal bridge section

Application - Review the data Data - Dynamic Loading-Comparison sheet

<< < > >> User: CRBL Search

Bridge code: 50 Bridge symbol: II-11_47+770

Bridge Scheme Model Test Static result Static compare Dynamic result Dynamic compare Guide

DYNAMIC LOADING - COMPARISON

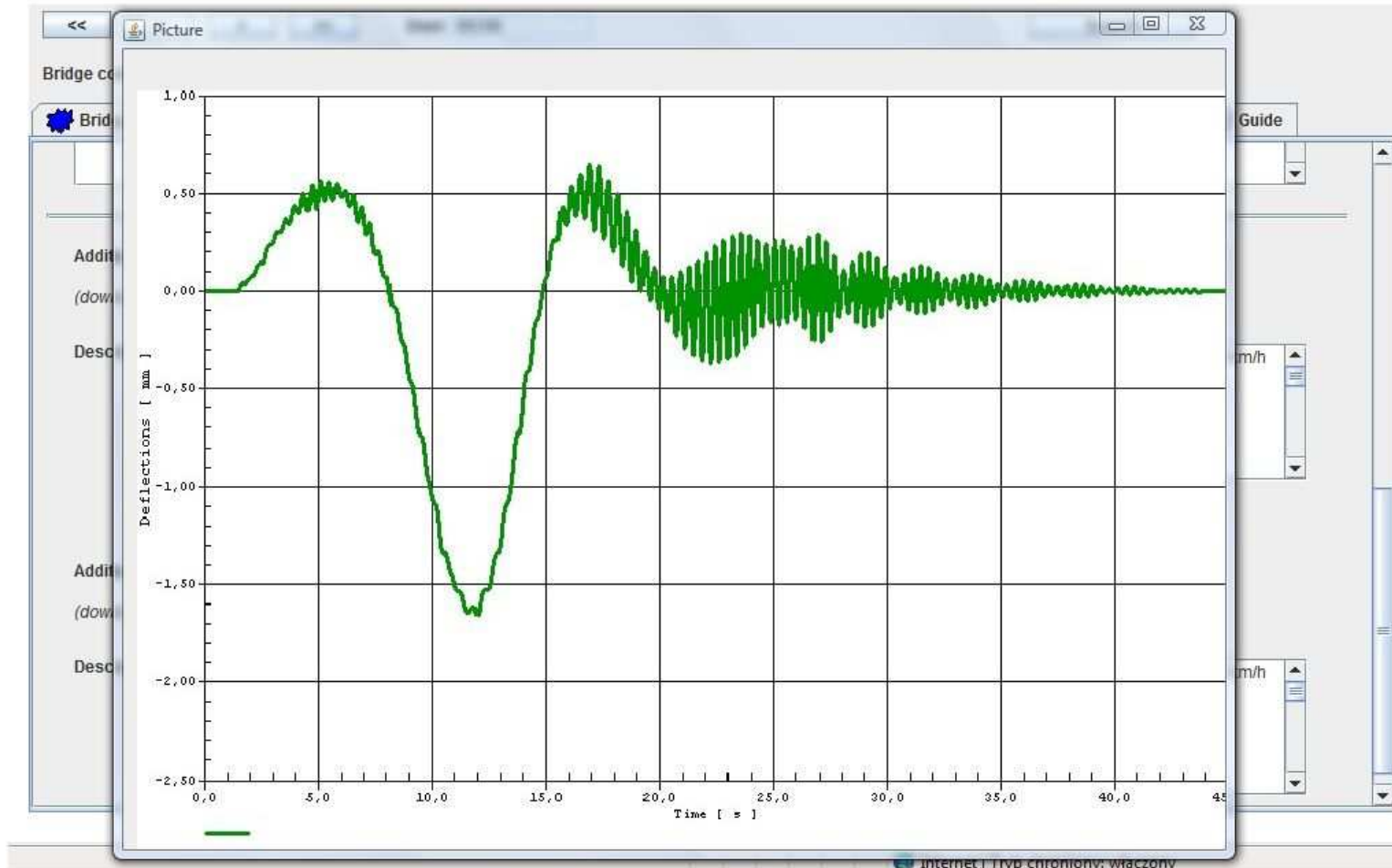
Comparison factors of the measured and calculated quantities (free vibration frequency)

Range of comparison factors [%]		Description
112.5	125	in vertical direction
214.2	214.2	in longitudinal direction
93.5	93.5	in lateral direction

Additional information
The short non-obligatory additional information

The table with comparison factors of the measured and calculated free vibration frequency

Application - Review the data Data - Dynamic Loading-Comparison sheet



The additional graphic data: The example deflection-time diagram of the measured forced and free vibrations during truck passage with the 50 km/h speed

Application - Analysis of the data

The screenshot shows a software interface with a 'Data search' window. The main window has a user field 'User: IBDIM' and a 'Search' button. Below it, 'Bridge code: 1' and 'Bridge symbol: piotrM1' are displayed. The 'Data search' window is titled 'BRIDGE DATA SEARCH' and contains several sections:

- Years of the bridge built:** Two input fields with values '2000' and '2008'.
- Years of the bridge load testing:** Two input fields with values '2000' and '2008'.
- Bridge Design:** A list of checkboxes: 'Slab' (unchecked), 'Multi-beam or girder' (checked), and 'Tee beam' (unchecked).
- Bridge Material:** A list of checkboxes: 'Concrete' (checked), 'Steel' (checked), and 'Prestressed concrete / Post-tensioned concrete' (unchecked).
- Service on Bridge:** A list of checkboxes: 'Motor road' (checked), 'Pedestrian' (unchecked), and 'Bicycle' (unchecked).
- Structure Length:** Input fields for '20' and '100' with a unit label '[m]'.
- Number of Spans:** Input fields for '1' and '5'.
- Length of Spans:** Input fields for '20' and '25' with a unit label '[m]'.
- Deck width:** Input fields for '5' and '20' with a unit label '[m]'.

A 'Find records' button is located to the right of the search criteria. The background window has a 'Help' button and a 'nic compare' button.

The window of the selecting criteria to find records

Application - Analysis of the data

<< < > >> User: IBDIM Search Results
 Bridge code: 102 Bridge symbol: Zaluski Return

Bridge Scheme Model Test Static result Static compare Dynamic result Dynamic compare Guide

BRIDGE DESCRIPTION Help

Years of the bridge built 2007

Calculation results

COMPARISON FACTORS OF MEASURED AND CALCULATED QUANTITIES

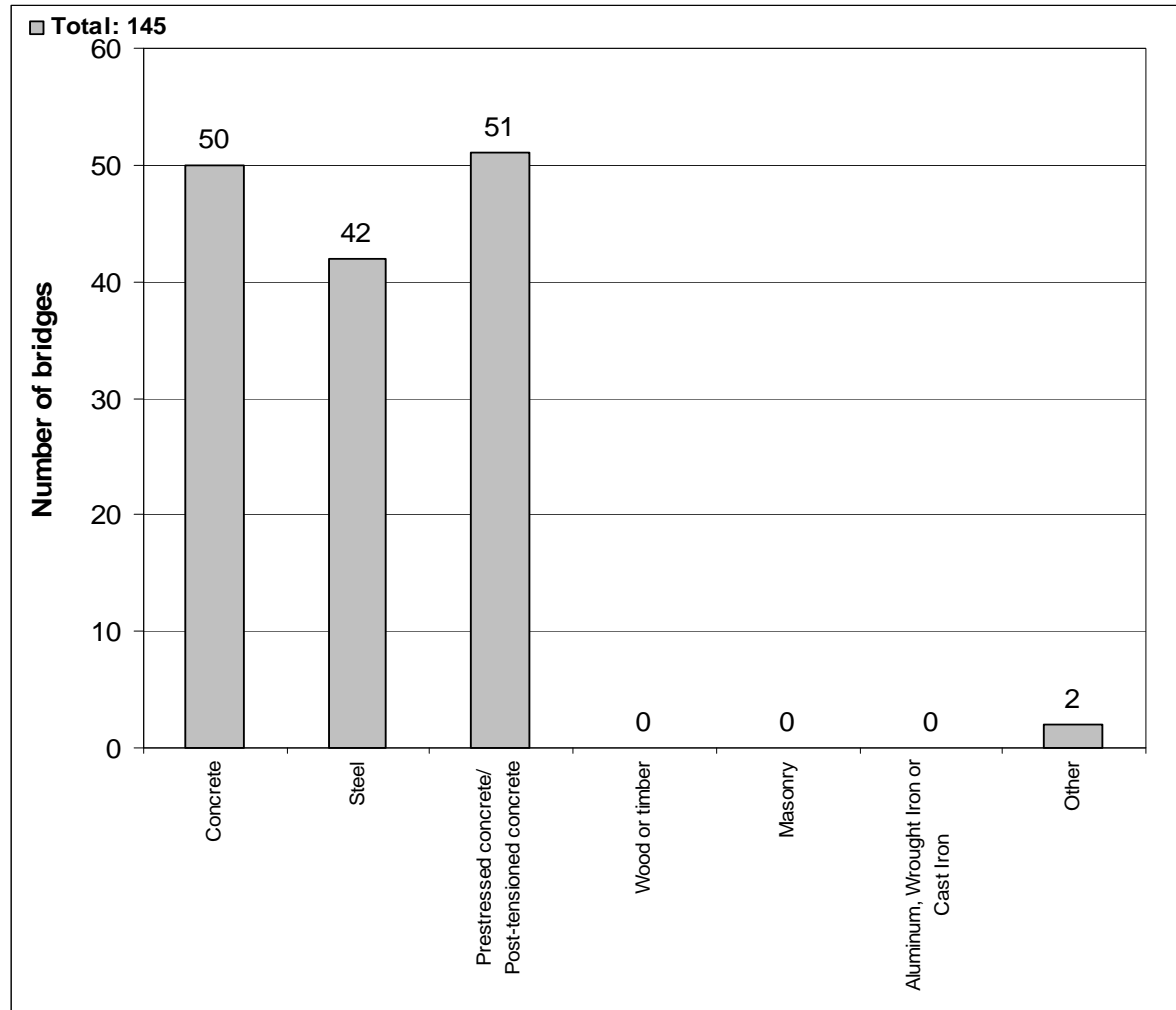
quantity	ratio R	Bridge members loaded directly						Bridge members loaded nderictly					
		Range of ratio R			Range of comparison factors			Range of ratio R			Range of comparison factors		
Deflection	Rd	1.0	+	0.74	88	+	68	-0.35	+	-0.27	75	+	60
	Rf		+			+			+			+	
	Rd & Rf	----				+		----				+	
Strains	Rd	1.0	+	0.74	92	+	74		+			+	
	Rf		+			+			+			+	
	Rd & Rf	----				+		----				+	

The table with analyse of the comparison factors distribution

The data base analysis – bridge review

110 records

Czech Republic
Croatia
Bulgaria
France
Poland
Spain
Slovenia



The bridge material distribution

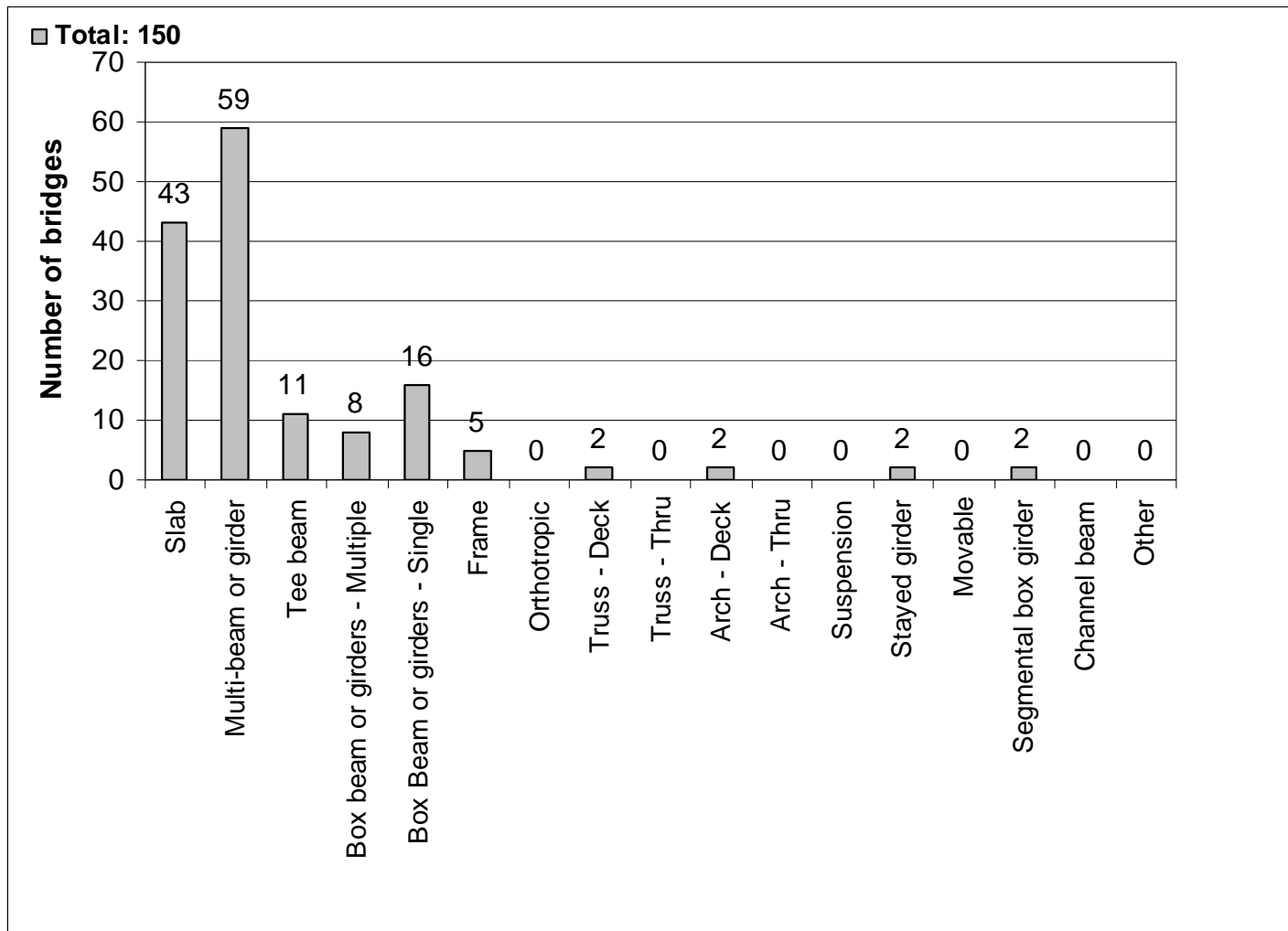
27-28 August 2009
LJUBLJANA



SPENS & ARCHES
FINAL SEMINAR

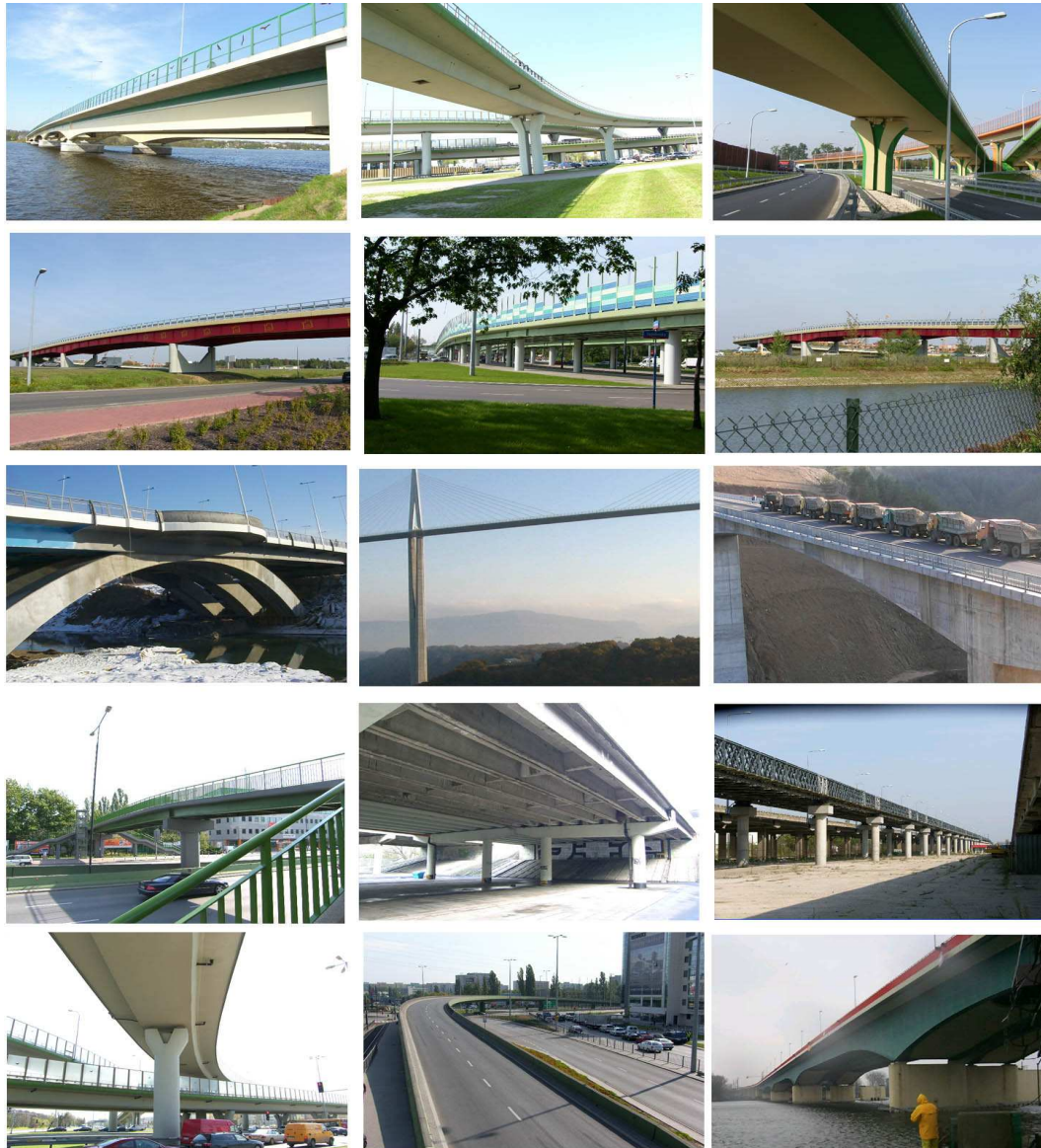


The data base analysis – bridge review



The bridge design distribution

The data base analysis – bridge review



The example
bridge photos

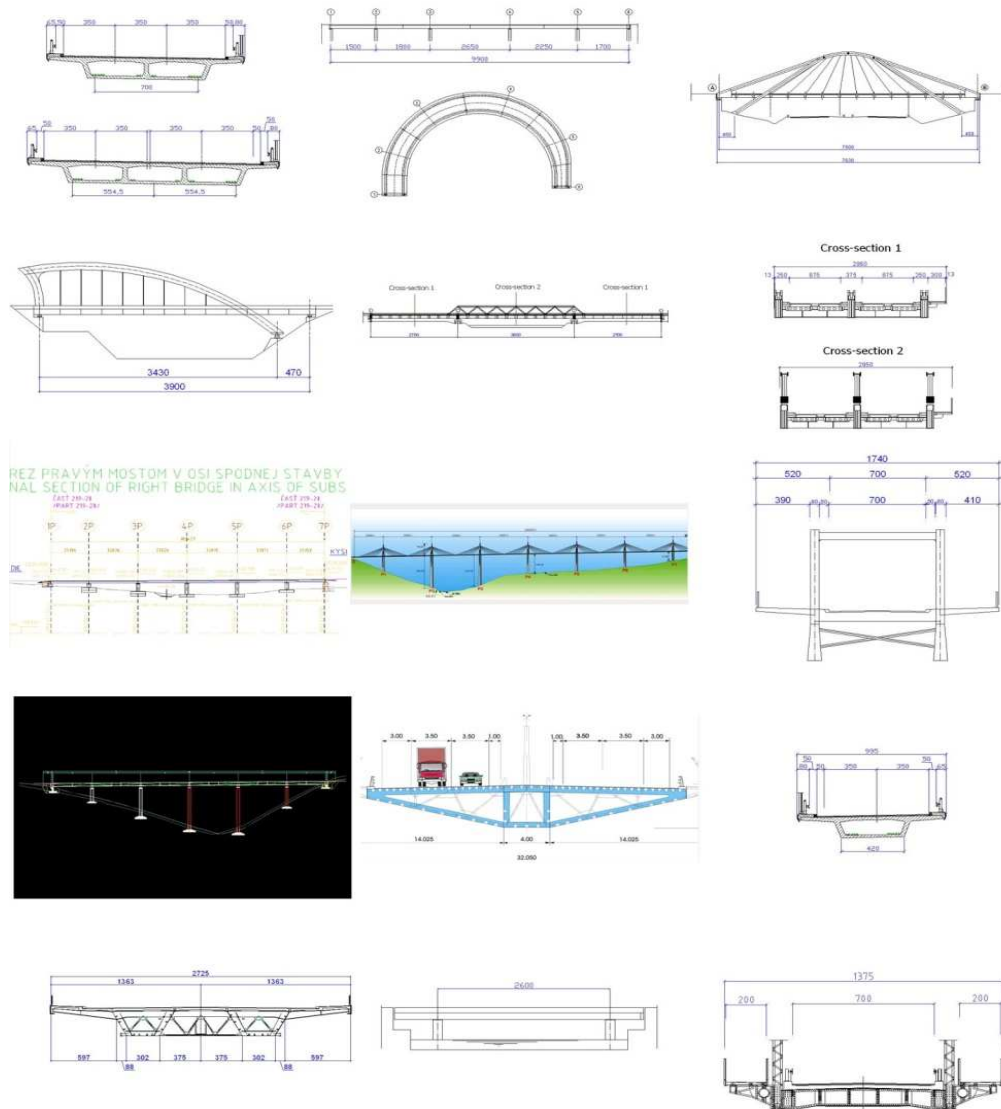
27-28 August 2009
LJUBLJANA



SPENS & ARCHES
FINAL SEMINAR



The data base analysis – bridge review



The example bridge schemes

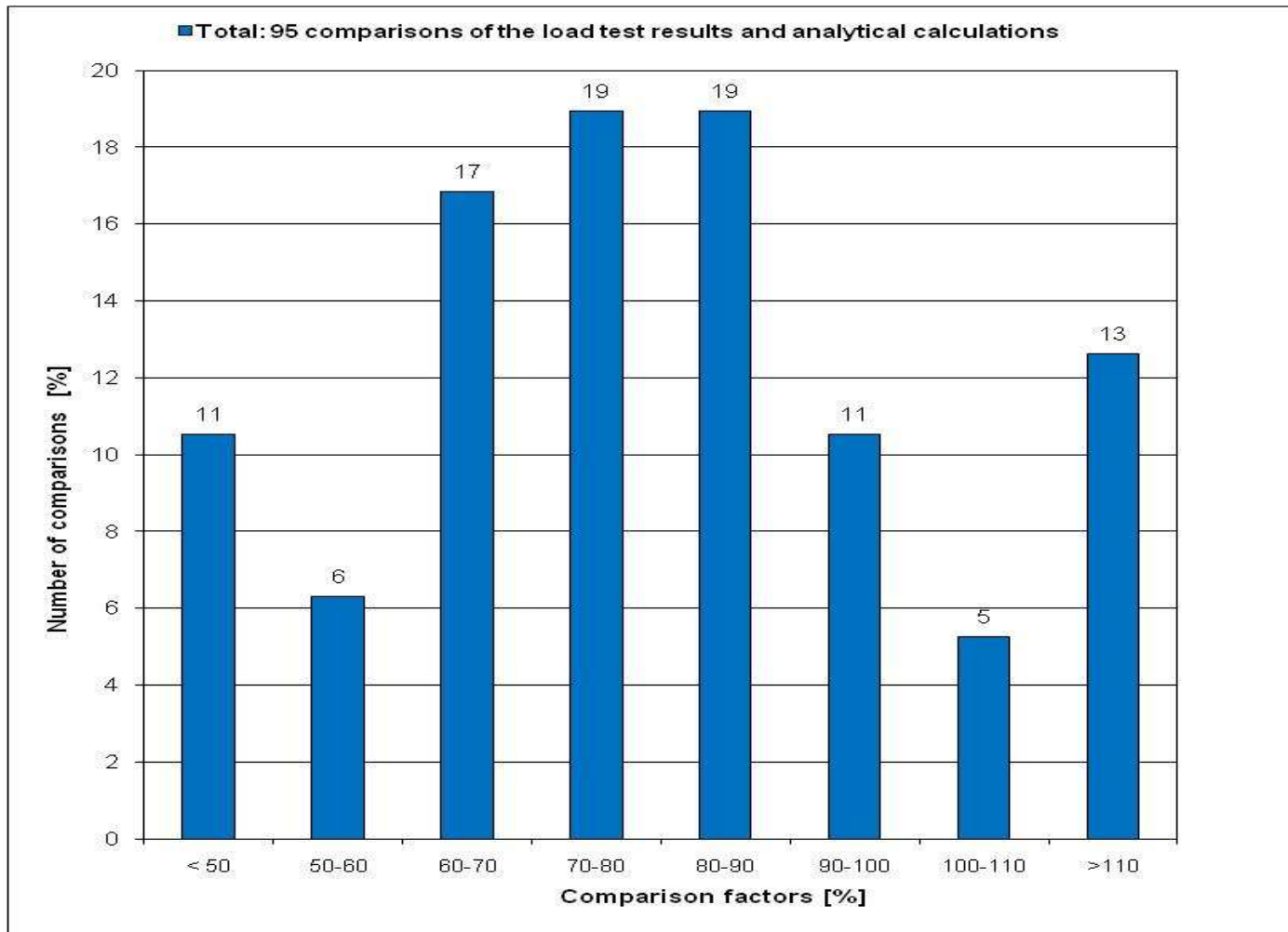
27-28 August 2009
LJUBLJANA



SPENS & ARCHES
FINAL SEMINAR

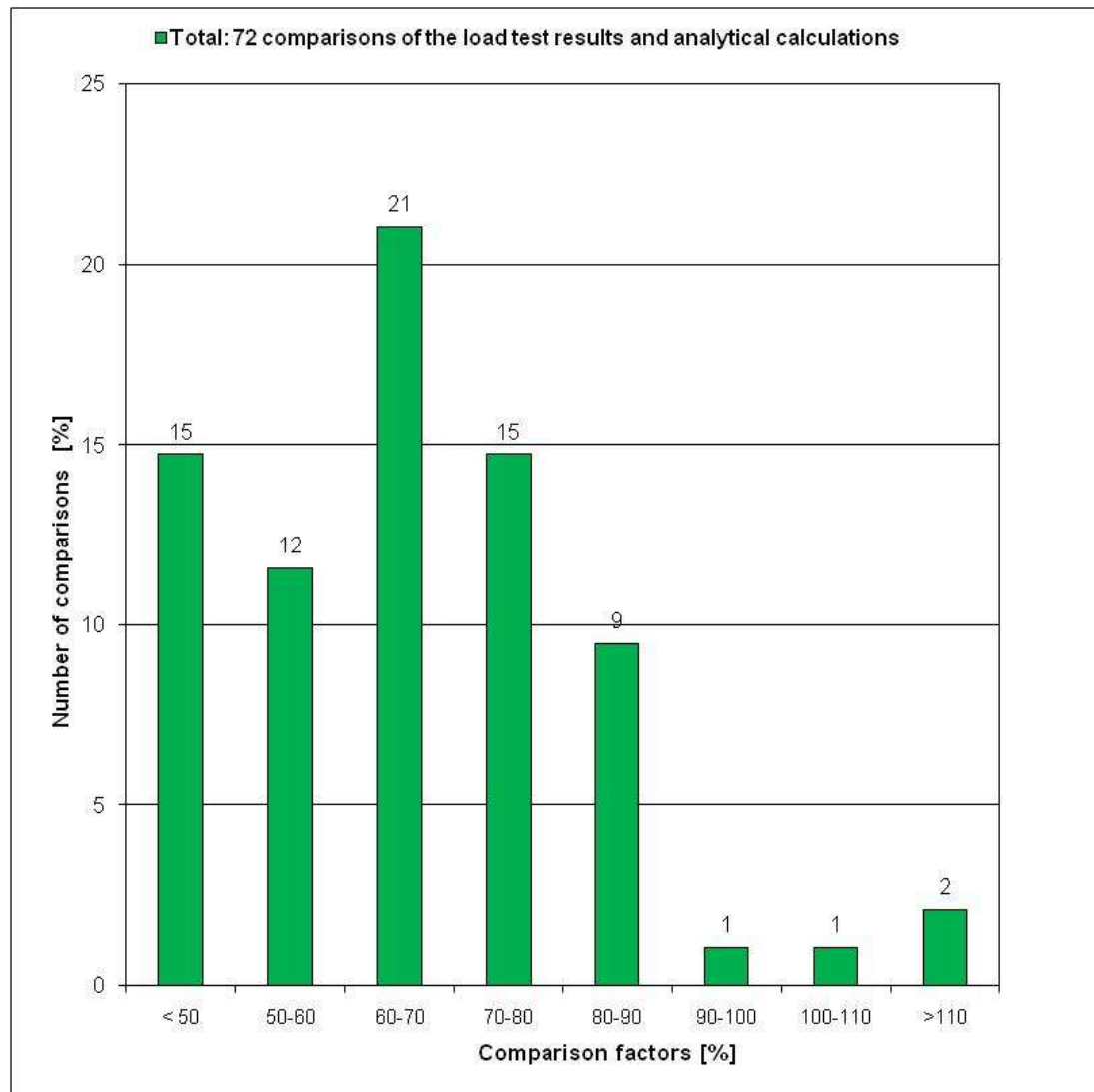


The data base analysis - The comparison factor reviews – static loading



The distributions of average comparison factors for bridge elements loaded directly

The database analysis - The comparison factor reviews – static loading



The distributions of average comparison factors for bridge elements loaded indirectly

The database analysis - The comparison factor reviews – static loading

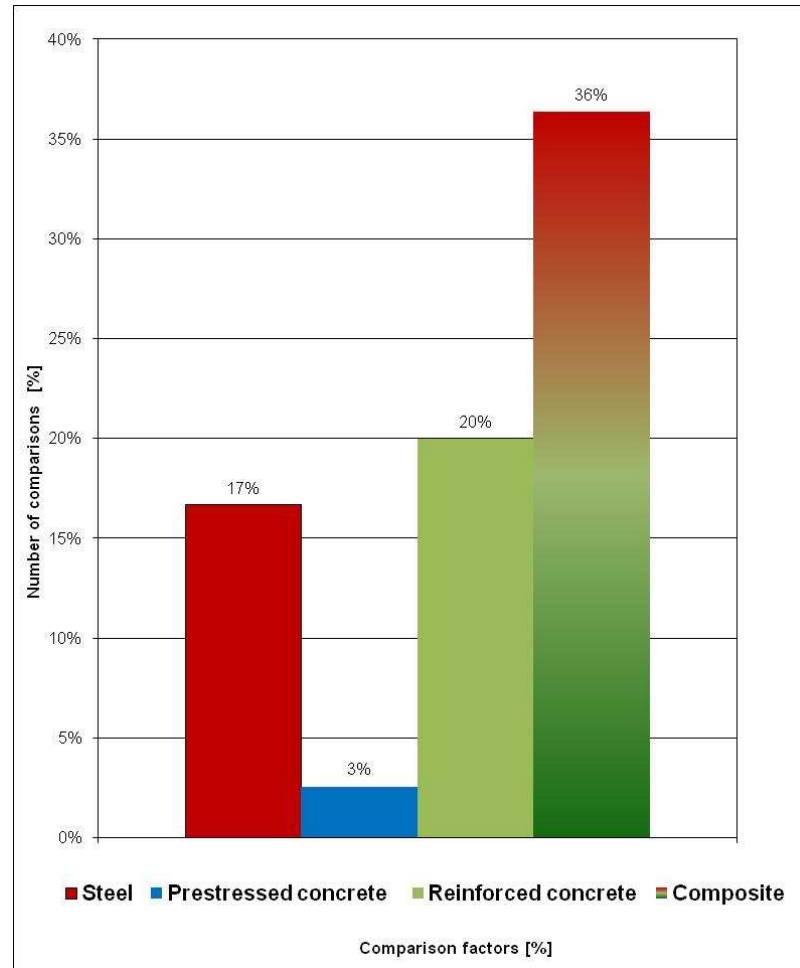
The compatibility of test results and analytical calculation

The assessment process of load carrying capacity based on diagnostic load testing results

An acceptable match is considered to have been reached, when the differences between the site-measured maximum deflections and the analytical values are within the following limits:

- +/- 10% for prestressed concrete and metallic bridges
- +/- 15 % for reinforced concrete and composite bridges.

The database analysis - The comparison factor reviews – static loading



The distribution of comparisons factor with the acceptable match in the function of bridge material

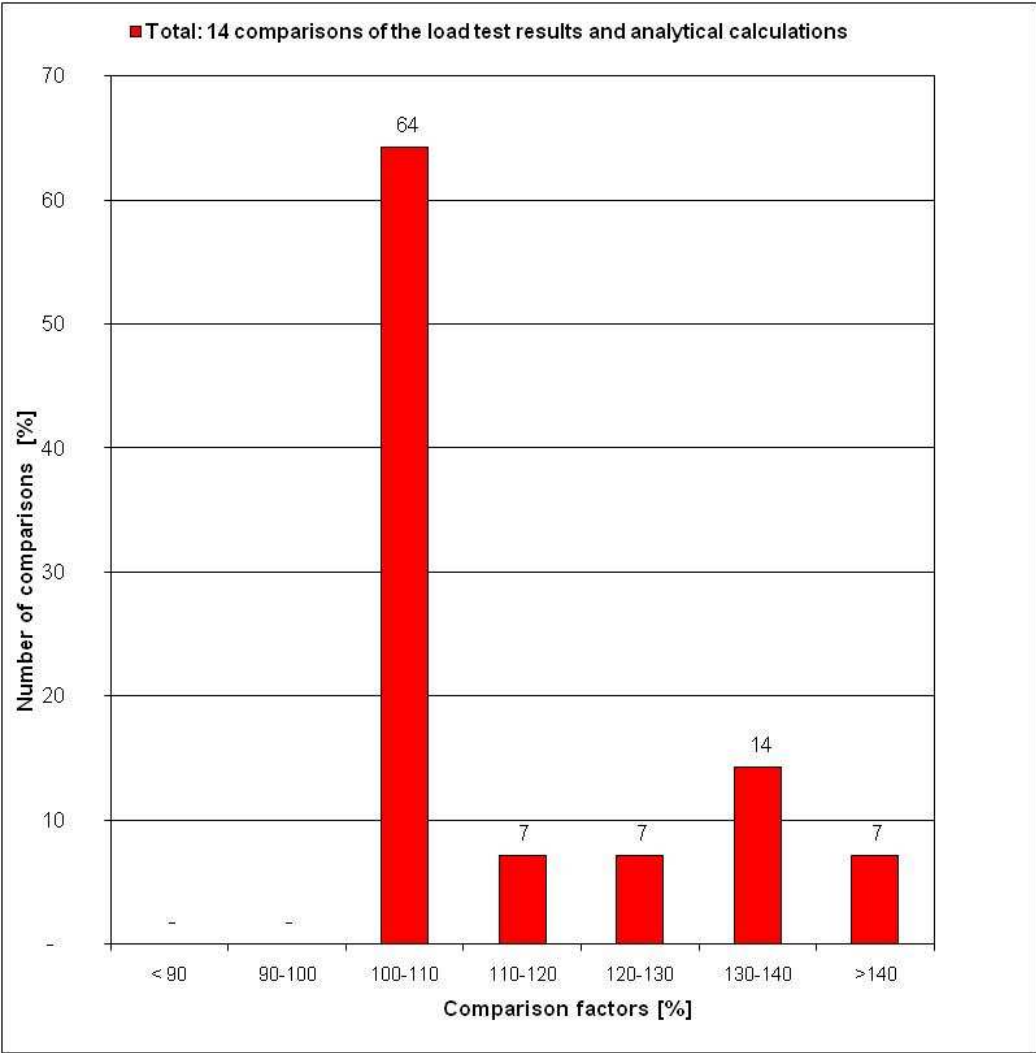
27-28 August 2009
LJUBLJANA



SPENS & ARCHES
FINAL SEMINAR



The database analysis - The comparison factor reviews – dynamic loading



The distribution of comparisons factor of calculate and measured free vibration frequency

27-28 August 2009
LJUBLJANA



SPENS & ARCHES
FINAL SEMINAR



Conclusions - The database analysis - The comparison factor reviews

- Only 3%-36% (depends on the bridge structural material) of presented in the database comparisons contain loaded bridge member with the acceptable match.
- The majority of analytical models presented in the database requires calibration.
- The hypothetical assessment of bridge load capacity with the use of those models without calibration would have unacceptable error.

Conclusions - Internet data base

- The Internet database of load test results and analytical calculations seems to be useful for the end users, to present quickly the behavior of the structure under the loading and suggest the compatibility range between real bridge behavior and results of the analytical calculations.
- The database, to be more useful should contain more information. The additional information about analytical model (the scheme of bridge analytical model, number of the elements and nodes) seems to be very interesting.
- The suitable for the user would be a full database filling.
- The changes require the database developing and inputting the data into the database directly after the load testing execution.

Thank You for Attention

Piotr Olaszek

E- mail: polaszek@ibdim.edu.pl

The application is available at the Internet address:

<http://ambergate.ibdim.edu.pl/arches>

User: wp222

Password: base

The system requirements:

- Windows XP, VISTA,
- Minimum display resolution: 1024 x 768,
- Microsoft Internet Explorer ver. min 6.0,
- Sun Java system min. v. 1.6 installed & allowed in Internet Explorer Settings.

Next login

User: load

Password: testing

27-28 August 2009
LJUBLJANA



SPENS & ARCHES
FINAL SEMINAR



27-28 August 2009
LJUBLJANA



SPENS & ARCHES
FINAL SEMINAR

