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www.brimos.com

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research bridges railways tunnelling monitoring technology management international

BRIMOS® References

Cable Assesement

Stay Cable Bridges

Suspension Bridges

External Tendons

Towers & Masts

ISO 9001 certified

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A-1140 Vienna, Hadikgasse 60
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Assessment of Cables with BRIMOS®-selected Reference Projects

Stay Cable Bridges:

- Audenasa Navarra Ebro Bridge (Spain)
- Bad Münster (Germany)
- Berliner Bridge (Germany)
- Binzhou River Highway Bridge (China)
- Donaubrücke Tulln West (Austria)
- Donaukanalbrücke (Austria)
- Donaustadt Bridge (Austria)
- Elorn Bridge (France)
- Hainburg Bridge (Austria)
- Jedlersee (Austria)
- Kao Ping Hsi (Taiwan)
- Lanaye Bridge (Belgium)
- Ljublianica Bridge (Slovenia)
- Pylonbrücke Ludwigshafen (Germany)
- Luling Stay Cable Bridge (USA)
- Normandie Bridge (France)
- Olympic Grand Bridge (Korea)
- River Suir Stay Cable Bridge (Ireland)
- Shin Dong Bridge (Taiwan)
- Siekierkowski Bridge (Poland)
- Songhua River Highway Bridge (China)
- Ständenhof (Germany)
- Steyregg (Austria)
- Swietokrzyski Bridge (Poland)
- Tai Chi (Taiwan)
- Villingen (Germany)
- Lechbrücke Vils (Austria)
- Voestbrücke Linz (Austria)
- Praha Vršovice (Czech Republic)
- Ziegelgrabenbrücke (Germany)

Suspension Bridges:

- Brooklyn Bridge (USA)
- Tete Bridge (Mozambique)

Towers & Masts:

- Schöckl (Austria)
- Wachberg (Austria)

External Tendons:

- Berbke (Germany)
- Donnergraben (Austria)
- Gersbachtal (Germany)
- Grossheim (Germany)
- Hapalova (Czech)
- Murbrücke St. Michael (Austria)
- Rümmcke (Germany)
- Unstrutttal (Germany)
- Weidatal (Germany)

Others:

- Chodov (Czech)
- Seidewitztalbrücke (Germany)
- Svinesund (Sweden/Norway)
- Taichung Bridge (Taiwan)

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Audenasa Navarra Ebro Bridge

Description

The cable-stayed Audenasa Navarra Ebro bridge is part of the Spanish motorway between Madrid and Pamplona. The main span amounts to 146.3m and is supported by 70 cables passed on two levels. The cables offset at the pylon head are re-anchored in two deadmen. Consequently the structure is supported by a total of 140 cables.

All cables were measured by means of the BRIMOS® method and evaluated according to several parameters. In this process a diminished load capacity could be identified not only for the already obviously damaged cables but all in all eight cables had to be classified as at least worthy of being observed. In order to be able to observe the condition change of the cables and to acquire further knowledge on the structure and the behaviour of the cables a close cooperation between the client and VCE is aimed at in future.

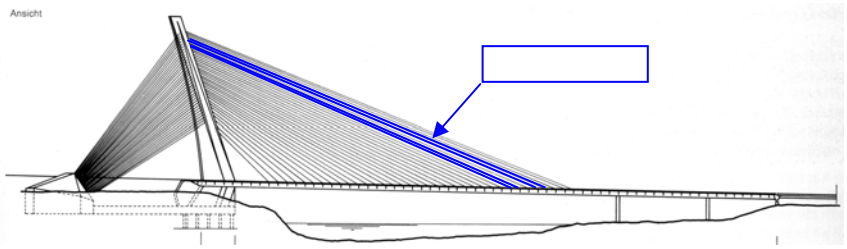
- Client: AUDENASA - Autopistas de Navarra, S.A.
- Location: Pamplona, Spain
- Checking Period: 2002

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☒ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

ISO Certificate 9001

Problematic cables WEST:



Deviations between measured and calculated cable forces:

Cable	Difference	Cable	Difference
BCW-5	+17%	BCE-1	-10%
BCW-15	+11%	BCE-5	+17%
BCW-31	-14%	BCE-19	+17%
BCW-32	-14%	BCE-30	-11%
BCW-34	-22%	BCE-31	-11%
BCW-35	-26%	BCE-32	-14%
		BCE-34	-18%
		BCE-35	-25%

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Pedestrian Bridge Bad Münster

Description

At the pedestrian bridge ("Pouilly Brücke") across the river Nahe in Bad Münster the forces of all cables had to be surveyed through vibration measurements by means of BRIMOS®.

Simultaneously the vibration characteristic and its evaluation should serve to investigate the static condition of the cables on free vibration length and to assess these considering possible defects.

The BRIMOS Technology, used by VCE, offers following advantages:

- Automatically offset adjustment and FFT (Fast-Fourier-Transformation) for the determination of frequency spectra.
- Automatically Peak-Picking for the determination of the first 10 eigenfrequencies from the frequency spectrum; by that the human error is minimized and the evaluation precision is improved.
- Determination of f1 and the related cable stiffness ξ from the first 10 eigenfrequencies by means of a Gauß-Newton algorithm. Due to the consideration of the cable stiffness during the evaluation process the cable forces can be determined exactly.

- Client: Consulting Engineers Verheven
- Location: Bad Münster, Germanny
- Checking Period: 2004

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Berlin Bridge in Halle

Description

Because of the bad condition of maintenance of the old frame bridge in Halle /Germany crossing the station site the building of a new replacing bridge became necessary. This cable stayed bridge with composite slab-and-beam girder and A-pylon made of steel was advertised as competition winning project. The cantilever method of construction with continuously laging mounting of the stay cables was used in constructing the slab-and-beam girder. The cables are fully locked coil ropes with a maximum length of 96 m.

Services: supervision of stay-cable works, Determination of the cable forces with BRIMOS®

- Client: City of Halle
- Location: Halle (Saale), Germany
- Checking Period: 2004 - 2005

BRIMOS® Services conducted:

Lifecycle Management:	☐ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☒ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Binzhou Yellow River Highway Bridge

Description

The bridge with spans of 84+300+300+84 meters is located near Binzhou in Shandong province. The stay cables are equipped with different types of passive and semi-active MR vibration dampers, developed by HIT.

The highly sophisticated monitoring system of the bridge includes 138 optical fibre strains and temperature sensors, 2 anemometers, 38 accelerometers and 4 GPS sensors, which are distributed on the main pylon, the deck and the stay cables. Data transmission is managed by a wireless communication system and data analysis happens in real time.

All the data and evaluation results are stored in a SQL server 2000 database with a visitor permitted website, which is operating in real-time.

In June 2006 the deck and the stay cables of the main pylon were measured with BRIMOS® Recorders.

- Client: Harbin Institute of Technology (HIT)
- Location: Binzhou, China
- Checking Period: 2006

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Tulln West Bridge

Description

The imposing cable-stayed bridge spans the Danube in Tulln. The maximum span is 177 m and the bridge consists of a 70 m high A-shaped pylon. Tests have been performed already during construction and after completion of the bridge.

The system made it possible to keep track of all the changes induced by the construction stages and to show the redistribution of loads in the cables due to creep and shrinkage effects in the concrete bridge. The determination of the actual cable forces (steel) via frequency measurement is a well established method, which provides reliable results. A minor difficulty is the correct interpretation of the effect of the grouting.

- Client: Government of Lower Austria
- Location: Tulln, Lower Austria, Austria
- Checking Period: since 1998 every year

BRIMOS® Service conducted:

Lifecycle Management:	☒ Condition Assessment	☒ Condition Monitoring	☐ Rehabilitation Planning	☒ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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A4 Donaukanalbrücke

Description

During a regular check damages were detected at the cables of the Stay Cable Bridge over the Danube Channel, highway A4. A detailed investigation of the cables, including a measurement campaign shows resonance effects between bridge deck and cables. The heavy truck traffic induces permanent cable vibration which leads to fatigue damage. During rehabilitation special Centralizer/Damper elements were developed and installed to reduce the vibration intensity and the deflection of the cables.

Services:

Cable Measurements, Technical Consulting, Design of the Centralizer/ Damper

- Client: Porr; VT
- Location: Austria
- Checking Period: 2008-2009

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☒ Rehabilitation Planning	☒ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☒ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Donaustadtbrücke

Description

The "Donaustadt" bridge is 340 meters long with a main span length of 186 m. It was designed as a cable-stayed bridge with one 75-meter-high A-shaped pylon made of steel and with steel girders. The 370-meter-long structures over the Danube Island and the New Danube are made of prestressed concrete.

Measurements of the dynamic behaviour were carried out on at the deck and the stay cables in order to determine the actual load-bearing behaviour of the bridge during the construction phases and in its final state. The dynamic characteristics of the bridge deck are identified by means of several ambient vibration measurements.

The cable forces were checked by means of a BRIMOS® measurement.

- Client: Municipal authorities Vienna
- Location: Vienna, Austria
- Checking Period: 1998, 2001, 2003, 2004, 2008, 2009

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☒ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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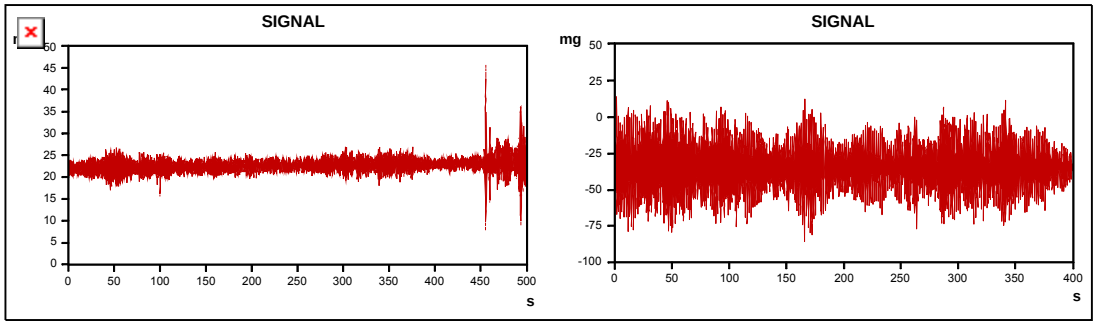
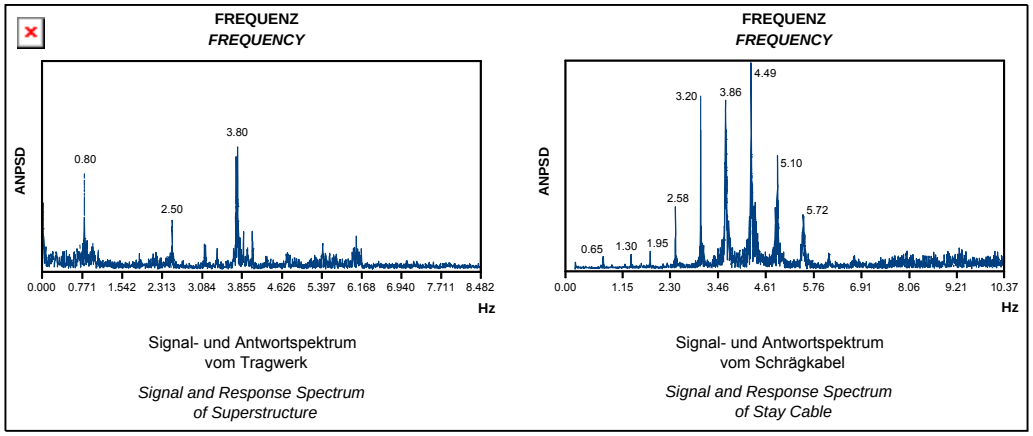
Measurements of Natural Frequencies under Regular Traffic:





Signal- und Antwortspektrum vom Tragwerk

Signal and Response Spectrum of Superstructure

Signal- und Antwortspektrum vom Schrägkabel

Signal and Response Spectrum of Stay Cable

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Le Pont sur l'Elorn

Description

The dynamic assessment of Pont sur l'Elorn carried out by VCE in 2003 was a demonstration measurement for introduction of our ambient vibration testing system BRIMOS®. In addition to this global investigation of the whole structure – except the two pylons – we got dynamic data of all stay cables for determination of the cable forces by means of our mobile data acquisition system BRIMOS®-Recorder.

In general a dynamic assessment of the vibration behaviour serves for the determination of the load-bearing safety and capacity of a structure. In order to achieve an overall picture on the load-bearing behaviour an initial measurement of the whole box girder was carried out. The investigations basically referred to all stay cables as well as the interaction between cable and box girder.

The dynamic characteristic of a structure is a function of the modal parameters eigenfrequencies, mode shapes and damping values as well as vibration intensities which can be determined by BRIMOS®.

- Client: Republic of France
- Location: Brest, Bretagne, France
- Checking Period: 2003

BRIMOS® Services carried out:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Danube Bridge Hainburg

Description

The Danube bridge Hainburg is a two-lane road bridge over the Danube. On both sides there are pavements made of ready-mixed concrete planks. The total width of the structure is 13.40 m.

The river pier, the southern land pier and the separation piers are founded on bored piles (diameter 90 cm) via pile foundation grille plates. All piers are faced with granite stones. The fixed bearing of the bridge and the flexible support of the A-pylon are situated on the river pier. The load-bearing system is a cable-stayed bridge, continuous over three spans and with a box girder, which is exclusively manufactured of steel and reaches a height of 3.50 m. The asymmetrical, lateral, fan-like guys at four positions run over an A-formed steel pylon in inclined levels.

The measurement system BRIMOS® developed by VCE was used. In the course of the measurements the dynamic characteristic of the deck and of all cables was determined.

- Location: Hainburg an der Donau, Austria
- Checking Period: 1997

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Cabel stayed bridge Jedlersee

Description

The cable-stayed bridge Jedlersee is a pedestrian and cycle bridge in steel construction. Each of the four pylons made of reinforced concrete carries four stay cables. The stay cables are aerial ropes with inhibit wires equipped with a special paint against corrosion. The phenomenon of wake-instability could be proved particularly clearly for this bridge. Measurements during heavy, quite horizontal storm events clearly showed that the cable begins to oscillate considerably more at the side sheltered from the wind by its neighbouring cable.

- Client: Municipal authorities Vienna
- Location: Vienna, Austria
- Checking Period: 2001

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Kao Ping Hsi

Description

The Kao Ping Hsi Bridge in Taiwan is a cable-stayed bridge with a record-breaking cantilever of 330 m. The cross-section in the main span is a closed steel box girder and was designed to be able to resist extreme dynamic loads.

The BRIMOS® technology was used for the monitoring of changing conditions due to different design sections. In particular cable-stayed bridges, built in the free cantilever method, require continuous monitoring of the redistribution of the cable forces due to the changing loading condition.

The determination of the forces by means of lift-off tests is considerably time-consuming. In view of the design, mass and bending stiffness of the cables, the cable force can be determined with an accuracy of 1 % by means of BRIMOS®.

- Client: TANEEB
- Location: Taiwan R.O.C.
- Checking Period: 2000,2003

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☒ Condition Monitoring	☐ Rehabilitation Planning	☒ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☒ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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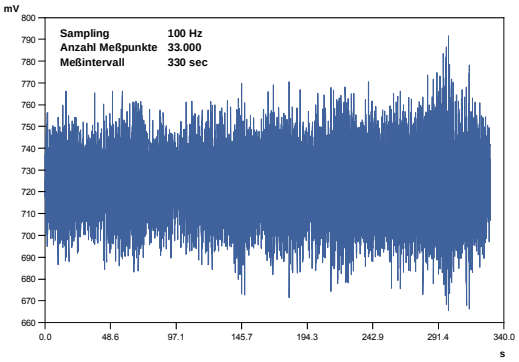
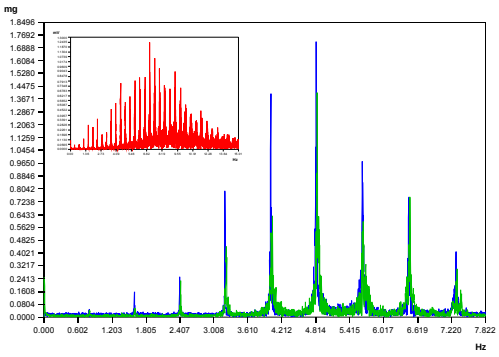
BRIMOS® measuring facility in operation:

Vertical measuring signal (330 sec.):



Vertical frequency spectrum 0 – 8 Hz:



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Lanaye Bridge

Description

The assessment of the vibration behaviour serves for the determination of the load-bearing safety and capacity of a structure. In particular the tension bars of a cable-stayed bridge have great importance for the maintenance. As obvious cable force losses occurred in one of the longest cables of the Lanaye Bridge (clear increase of the cable sag), it had to be clarified by an investigation to what extent possible causes and damage mechanisms contributed to the change. In order to achieve an overall picture on the load-bearing behaviour and the condition of the stay cables all stay cables were investigated and an initial measurement of the stiffening girder was carried out. The investigations basically referred to all stay cables as well as the interaction between cable and stiffening girder. The dynamic characteristic of a structure is a function of the modal parameters eigenfrequencies, mode shapes and damping values as well as vibration intensities which can be unequivocally determined by BRIMOS®.

- Client: Ministere wallon de l´ equipment et des transports, Belgium
- Location: Belgium
- Checking Period: 2002, 2003

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☒ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☒ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Ljublianica Bridge

Description

During the 13th SAMCO Workshop dedicated to the newly associated states (NAS) of the European Union in Ljubljana/Slovenia the Ljubljanica Bridge has been selected as an ideal object for practical demonstration of our bridge monitoring system.

The bridge lovely called 'Harfa' is a cable stayed bridge with three pylons carrying two decks. Parts of one deck have been investigated with BRIMOS® to show the high potential of current practice monitoring system.

Furthermore, one of the longest stay cables has been measured dynamically with the BRIMOS-Recorder® to demonstrate its easy handling and the fast determination of the cable force on site.

- Client: ZAG Ljubljana
- Location: Ljubljana, Slovenia
- Checking Period: 2005

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Pylon Bridge Ludwigshafen

Description

The pylon bridge Ludwigshafen is a steel structure crossing the main railway station of the town of Ludwigshafen. The bridge is part of a higher-ranking road network. The measurements for the identification of the dynamic characteristic were carried out of the bridge deck, the pylon (system behaviour) as well as of the 38 cables. During the measurements a marked vibration characteristic could be determined, especially remarkable were the vibrations in longitudinal direction. The measurements of the stay cables served as supporting measure for the planning of a rehabilitation concept in which the cable forces as well as the cable condition were analysed.

- Client: Municipal authorities Ludwigshafen
- Location: Ludwigshafen, Germany
- Checking Period: 2001

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☒ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Luling Stay Cable Bridge (Hale Boggs Memorial Bridge, New-Orleans, USA)

The 25-year-old Hale Boggs Memorial Bridge, a landmark crossing carries Interstate 310 across the Mississippi River between Luling and Destrehan, La.

The stay cables of the bridge are arranged in groups of two or four, with a total of 24 groups or 72 individual cables. The stays' protective 1/4-in.- to 1-in.- thick, high-density polyethylene sheathing has deteriorated and there is also rust and water leakage in anchorages. The stays will be replaced.

Before replacement VCE performed cable measurements of all 72 stays. The results are the actual cable forces. A second measurement campaign will be performed after installation of the new stays.

- Client: VSL
- Location: Luling, New Orleans USA
- Checking Period: 2009
- Services: Check of cable forces with BRIMOS®

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Normandie Bridge

Description

Completed in 1995, the Le Pont de Normandie is a cable-stayed bridge that connects Honfleur and Le Havre, France. The main span is 2800 feet long and raises 165 feet above the water level. The cable forces were measured using the BRIMOS®-Recorder.

- Location: Honfleur-Le Havre, France
- Checking Period: 2003

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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OGBRIMOS (Olympic Grand Bridge)

Description

OGBRIMOS is a tailor made software for the monitoring of the Olympic Grand Bridge in Seoul, Korea. It provides the surface for the automatic monitoring system of the bridge. Its operation is intended to be fully automatic without the user's interference.

The program is composed of the following components:

- The software package FAMOS by IMC, which provides the mathematical background and principal solutions for the program
- The program package FRAME by IMC, which provides the surface layout and display.
- The software package BRIMOS by VCE, which provides the methodology for the monitoring of bridges.

- Client: YOUONE
- Location: Seoul, Korea
- Checking Period: 2000

BRIMOS® Services conducted:

Lifecycle Management:	☐ Condition Assessment	☒ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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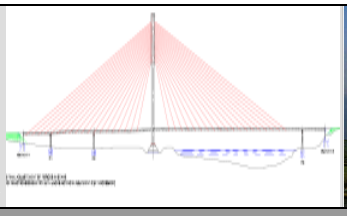

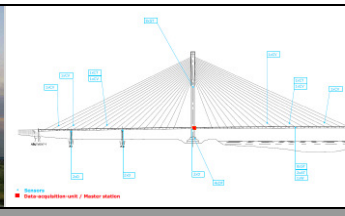

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River Suir Stay Cable Bridge (Waterford – Ireland)

The Waterford Stay Cable Bridge (River Suir Bridge) is part of the Waterford Bypass N25. The cable stayed bridge has a span configuration 40, 70, 90, (230), 35m= 475 m and a deck with of 30.60 meter. The concrete pylon has a height of 95.6 meter above deck. The bridge was completed in September 2009.

Before traffic opening VCE performed cable measurements of all 76 stays. The results are the actual cable forces and the cable damping.

On the bridge a permanent monitoring system was installed by VCE. The system includes 62 measurement channels. The data is automatically analysed on site and presented via internet by the BRIMOS® Web-Interface.

- Client: Mekano4
- Location: Waterford, Ireland
- Checking Period: starting 2009
- Services: Cable measurements
  Permanent monitoring system

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☒ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☒ Lifetime Assessment	☐ Traffic Analysis	☒ Environmental Influences	☐ Risk Assessment
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Shin Dong Bridge

Description

Bridges have to be inspected constantly in order to fulfill their function in road and railway traffic. For this purpose VCE has developed a Bridge Monitoring System (BRIMOS®) which is based on the analysis of the dynamic characteristic of the structure. This system provides additional information for the bridge operator to carry out an accurate assessment of the condition and the remaining lifetime of the bridge.

VCE also developed BRIMOS® applications for the calculation of cable forces of cable stayed bridges, damping values of the cables and related critical wind speed ranges. BRIMOS® presents a multitude of assessment tools for monitoring of bridges which are not offered by the common visual way of inspection.

The involvement of VCE in construction design of a big number of bridges in Taiwan offered the opportunity to carry out dynamic measurements on four cable stayed bridges. Furthermore the stay cables have been measured dynamically with the BRIMOS-Recorder® and an external sensor that allows the fast determination of the cable force directly on site.

- Client: VCT
- Location: Miaoli, Taiwan
- Checking Period: 1999

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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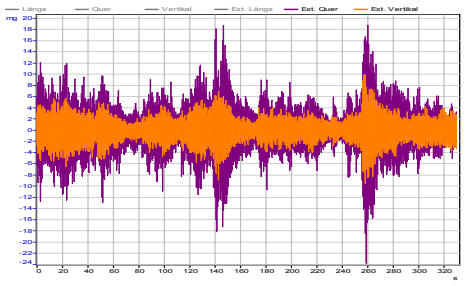
Siekierkowski Bridge

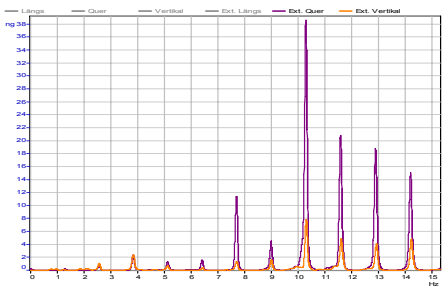
Description

Siekierkowski Bridge in Warsaw is a stay cable bridge with a total length of 500 m and a main span of 250 m. All cable forces had to be checked by means of the BRIMOS® method.

- Client: City of Warsaw
- Location: Warsaw, Poland
- Checking Period: 2004



Picture 3: Signal of Acceleration



Picture 4: A typical spectrum of a cable

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Songhua River Highway Bridge

Description

This cable stayed bridge with a main span of 336 meters was completed in 2004. The bridge is located near Harbin in Heilongjiang province. It is equipped with a permanent monitoring system for some of the stay cables.

Within a monitoring campaign of 3 days all 208 stay cables and the bridge deck were measured with two BRIMOS® Recorders in May 2006.

- Client: Harbin Institute of Technology (HIT)
- Location: Harbin, China
- Checking Period: 2006

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Pedestrian Bridge – Am Ständenhof

Description

At the pedestrian bridge at Ständenhof crossing the B10 at Pirmasens – Hinterweidenthal the forces of the tension bars had to be determined by means of ambient vibration measurements by means of BRIMOS®.

The evaluation of the measurement data was done by VCE considering the specifications made available by the client, such as the weight of the tension bars per length unit and free vibration length.

On the occasion the BRIMOS® Technology, developed by VCE, was used.

- Client: LSV Kaiserslautern / Dahn
- Location: Pirmasens, Germany
- Checking Period: 2004

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☒ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Danube Bridge – Steyregg

Description

In the course of the investigations at the Danube Bridge near Steyregg the global condition of maintenance should be analysed besides the survey of the dynamic characteristic of the load-bearing structure. Further the stay cables were subjected to a investigation.

The current load-bearing behaviour (= system identification) established by interpretation of the measurements and the comparison with computer simulations enabled conclusions on the current condition of the structure.

- Client: Authorities of the Upper Austrian Regional Government
- Location: Austria
- Checking Period: 2001

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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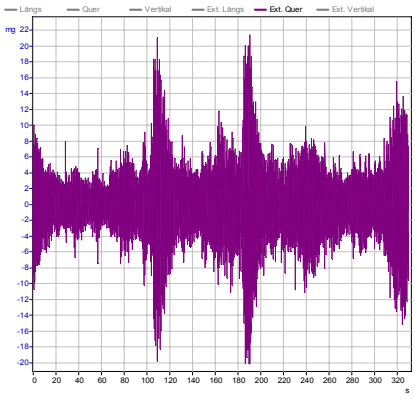
Swietokrzyski-Bridge

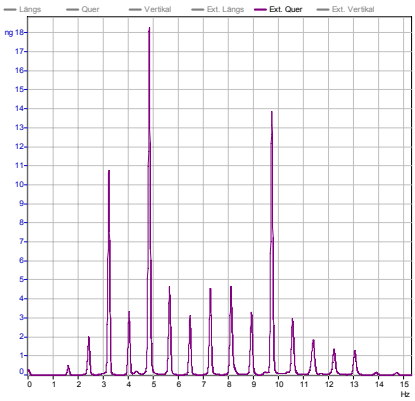
Description

The structure consists of 5 spans, the longest span is 180 m. The main span was constructed in incremental launching. The bridge deck was designed for two traffic lanes in each direction and two bike lanes and comfortable walkways. All cable forces had to be checked by means of the BRIMOS® method.

- Client: Trasa Swietokrzyska S.A.
- Location: Warsaw, Poland
- Checking Period: 2004



Picture 1: Signal of Acceleration



Picture 2: A typical spectrum of a cable

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Ta Chi Bridge

Description

Bridges have to be inspected constantly in order to fulfill their function in road and railway traffic. For this purpose VCE has developed a Bridge Monitoring System (BRIMOS®) which is based on the analysis of the dynamic characteristic of the structure. This system provides additional information for the bridge operator to carry out an accurate assessment of the condition and the remaining lifetime of the bridge.

VCE also developed BRIMOS® applications for the calculation of cable forces of cable stayed bridges, damping values of the cables and related critical wind speed ranges. BRIMOS® presents a multitude of assessment tools for monitoring of bridges which are not offered by the common visual way of inspection.

The involvement of VCE in construction design of a big number of bridges in Taiwan offered the opportunity to carry out dynamic measurements on four cable stayed bridges. Furthermore the stay cables have been measured dynamically with the BRIMOS-Recorder® and an external sensor that allows the fast determination of the cable force directly on site.

- Location: Taipeh, Taiwan
- Checking Period: 2003

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Pedestrian Bridge Villingen

Description

At the pedestrian bridge across the railway site in Villingen-Schwenningen the forces of all cables had to be determined by vibration measurements by means of BRIMOS®.

The condition of the cables on free length and in the anchorage points (pavement expansion joint, pylon head) was checked and assessed for possible damages.

The vibration measurements at the stay cables of the pedestrian bridge were carried out by BBV with the help of the BRIMOS®-Recorder model 800 on November 4th 2004. The external 3D accelerometer of the recorder was fixed on the stay cables in an approximate height of 2 m above the carriageway. The measurements were taken separately, cable after cable.

- Client: City of Villingen – municipal building authority of Schwenningen
- Location: Germany
- Checking Period: 2004

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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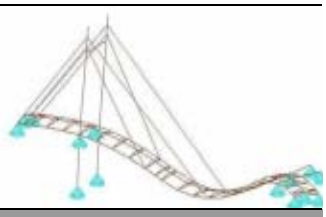

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Lech Bridge Vils

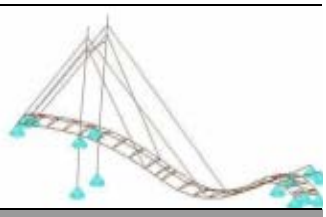
Description

The Lech bridge Vils is a cable-stayed bridge with a total length of 95 metres. The deck consists of a reinforced concrete composite structure. In the course of the examinations at the Lech bridge Vils the global, current condition was analysed. Furthermore the stay cables were separately checked. This check is to serve as supporting measure for the maintenance of the structure in the future. The assessment of the vibration behaviour of the stay cables serves as additional measure for the determination of the load-bearing safety and capacity of the cable-stayed bridge. The tests to be carried out concerned the two main girders, the stay cables as well as the bearing of the total system on piers, pylons and abutments.

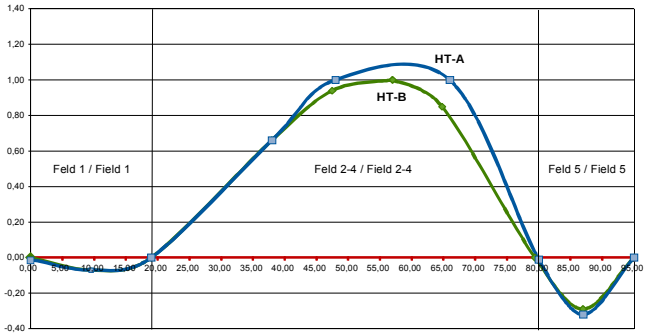
- Client: Government of Tyrol
- Location: Innsbruck, Tyrol, Austria
- Checking Period: 1999

BRIMOS® Services conducted:

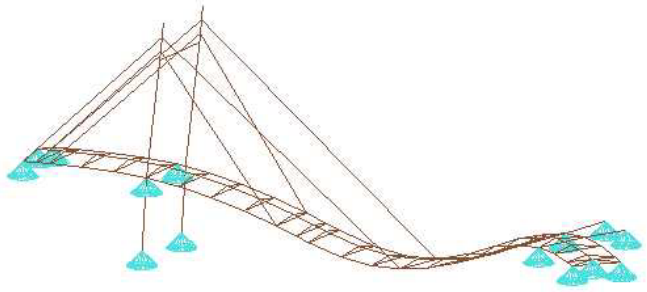
Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics



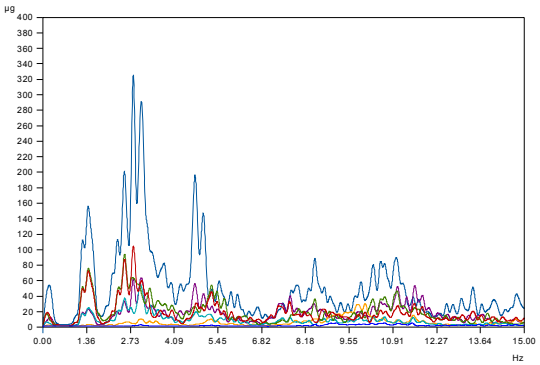
Natural Frequency f = 1.44 Hz - First vertical mode shape, calculated out of measured data:



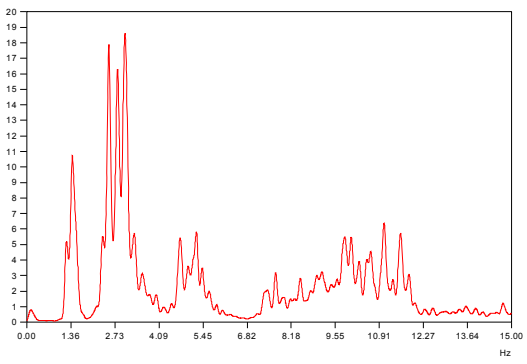
First vertical mode shape from RSTAB calculation (Isomeric):



Vertical, smoothed raw spectrum of all sensors:



Averaged frequency spectrum vertical (ANPSD):



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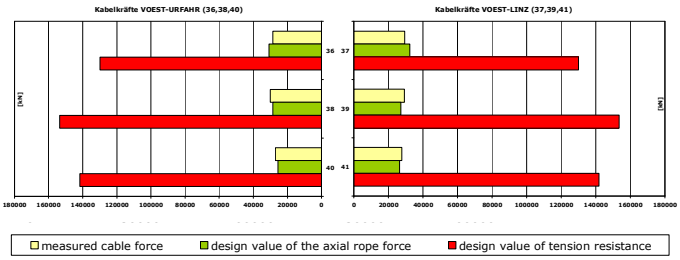
Voest bridge Linz

The Voest bridge Linz across the Danube is part of the motorway A7 and was built between 1969 and 1972. The cable-stayed steel bridge consists of four spans and has a total length of 407 m. While the three shorter spans are 60 and 72 m long, the main span has a length of 215 m. The width of the bridge deck is 34.86 m and its overall height is approximately 4 m. The cross-section consists of four main steel girders and an orthotropic deck plate.

In the course of the prevailing investigation a dynamic monitoring campaign was undertaken in order to determine the vibration behaviour of the cables as well as the global condition of maintenance of the bridge deck (the structure's integrity) by means of BRIMOS®. Along with the conventional bridge assessment this investigation supports the determination and localization of potential problem zones based on the measured structure's vibration behaviour.

The investigation in 1999 is to be understood as an initial measurement, the follow-up measurement was performed in 2008.

- Client: ASFINAG Autobahn Service GmbH Nord
- Location: Linz, Austria
- Checking Period: 1999 – 2008



Comparison of the measured cable force, the design value of the axial rope force and the design value of tension resistance

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☒ Condition Monitoring	☒ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Praha Vršovice

Description

The cable stayed bridge Praha Vršovice is an important part of the city highway system of Prague and has a total length of 400,4 meters.

The superior goal of the prevailing monitoring campaign was an analysis of the vibration behaviour of all 56 cables in order to determine the effective cable forces. The obtained values were compared to the expected, theoretical values based on permanent loading and live loading. Additionally the load bearing capacity of the cables as well as their bending stiffness were determined.

These investigations strongly support the decision process of bridge owners in the course of cost planning for maintenance and possible rehabilitation measures.

- Client: TSK Praha
- Location: Prague, Czech Republic
- Checking Period: 2005

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Strelasund Crossing – Ziegelgraben Bridge

Description

VCE was commissioned with a check of the cables by measurements after the final adjustment of the forces. The measurements were carried out by a measuring team with BRIMOS®-recorders. In the scope of the BRIMOS® method the cable forces are determined from the measured dynamic characteristic taking into consideration the rigidity of the cables.

The available results serve the checking of the cable forces before an opening to traffic and as a reference for the planned follow-up examinations, especially for those before the expiration of the warranty period.

The measurement was carried out with the BRIMOS®-recorder 800 developed by VCE. The external three-dimensional acceleration sensor of the recorder was fixed at the cables a height of approx. 1.5 m over the carriageway. The measurements were carried out separately, cable by cable.

Two measurement files per cable with 330 seconds each and a scanning rate of 5 milliseconds (corresponding to 200 Hz) were recorded. The measurement data were analyzed on the site and checked for plausibility.

- Client: DEGES - Deutsche Einheit Fernstraßenplanungs- und -bau GmbH
- Location: Austria
- Checking Period: 2007

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☒ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Brooklyn Bridge

Description

The behaviour of the Brooklyn Bridge under a severe earthquake shall be assessed. In order to allow proper system identification an ambient vibration monitoring campaign has been performed by Drexel University. In the light of the importance of the structure and the nature of the procedure a 2nd opinion has been asked for by Prof. Aktan of Drexel University. There is a standing collaboration between the European thematic network SAMCO, which is coordinated by VCE, and a number of American institutions. This elaboration is carried out within this collaboration framework.

Historic structures such as the Brooklyn Bridge, comprise a major challenge for the assessing engineer. There is only limited information on material properties and condition. Due to the size and complexity of the system non destructing test methodologies are difficult and expensive to apply. The most economic way to achieve a reasonable result is the application of ambient vibration methodologies. The procedure starts with experiments at the structure, that allow to identify the basic eigenfrequencies of the system. With this information a finite element model is calibrated. This provides the closest fit to reality. The seismic qualification calculation is then carried out with the calibrated model.

Considering the uncertainties of the earthquake input an appropriate level of experiment has to be chosen. The procedure performed in this experiment comprises the best practice for such an important structure.

- Client: Drexel University
- Location: New York, USA
- Checking Period: 2005

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☒ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☒ Seismics

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Tete Suspension Bridge

Description

PONTE DE TETE located in Tete Mocambique was built as a road bridge over the Zambezi River in the sixties of the last century. It is a five span suspension bridge with a total length of 720 meters. The span lengths are 70-180-180-180-70 meters. The flexible bridge deck is supported by 284 hangers and 4 steel struts.

Due to the age of the bridge, the heavy traffic and the partly very bad condition of the bridge rehabilitation measures are necessary. The rehabilitation scheme is designed by GRID, a Portuguese consultant company.

VCE's task was to assess the condition of all 284 hangers and to measure the hanger forces due to self weight with BRIMOS®. The measurements were carried out by a VCE engineer in the period from September 29th to October 9th 2006 using the BRIMOS-Recorder®.

- Client: GRID/ANE
- Location: Tete, Mozambique
- Checking Period: 2006

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☒ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☒ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Berbke Viaduct

Description

The Berbke viaduct is prestressed in longitudinal direction by means of external tendons of the type “BBRV-SUSPA, tendon type SUSPA VI”. The tendons are run directly without any deflection.

BRIMOS measurements were carried out at the external tendons in order to check the tension forces.

- Client: BBV
- Location: Germany
- Checking Period: 2007

BRIMOS® Services conducted :

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☒ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Donnergraben

Description

The "Donnergraben" bridge of the "Tauern" motorway A10 is executed for each lane as a seven-span prestressed concrete structure with a total length of 425.15 m. The width of one system is 14.5 m with a constant box girder height of 4.60 m and was completed in 1979.

Measurements of the dynamic behaviour of the two structural systems as well as an analysis of the actual general condition of the bridge were carried out to set up a basis for investment and maintenance. The remarkable loading impacts, as well as the current bridge condition itself, lead to rehabilitation via external prestressing in 2004. The progression of cable forces during the various construction phases and in the final state was monitored by BRIMOS®. Additionally the degradation of tendon forces after their fixture in the anchorage and due to their geometrical progression within the deviation saddles was quantified.

- Client: Government of Salzburg
- Location: Salzburg, Austria
- Checking Period: 1999; 2002

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☒ Rehabilitation Planning	☒ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Gersbachtalbrücke

Description

The Gersbach bridge is a road bridge over the road L600 (feeder road Pirmasens to the A8/A62 motorways) with a bearing distance of 400m over 8 spans. The load bearing structure is constructed as a box girder made of reinforced concrete and externally prestressed. The bearing distances amount to 38.20, 2x52.6, 55, 3x52.6 and 41.80 m. The total width is 11,30 m at the top edge of the load bearing structure.

In the course of the dynamic tests at the valley bridge Gersbach by means of BRIMOS® the global condition of maintenance of the load-bearing structure was analysed. Along with the conventional bridge assessment this investigation shall serve to call on results calculated from the vibration behaviour of the structure to determine and locate potential problem zones.

Furthermore the condition and the span forces of the external tendons were determined by separate measurements using BRIMOS®.

- Client: LSV Rheinland-Pfalz
- Location: Pirmasens, Germany
- Checking Period: 2003

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☒ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Valley Bridge Großheimer

Description

The valley bridge Großheim crossing the country road L600 (feeder road Pirmasens to the motorways A8 / A62) is a 350 m long bridge of prestressed concrete with 8 zones. The load bearing structure is constructed as a box girder made of reinforced concrete and externally prestressed. The bearing distances amount to 38.00, 5 x 47.00 and 30.00 m; the total width is 11,30 m at the top edge of the load bearing structure.

In the course of the dynamic tests at the valley bridge Großheim by means of BRIMOS® the global condition of maintenance of the load-bearing structure was analysed. Along with the conventional bridge assessment this investigation serves to call on results calculated from the vibration behaviour of the structure to determine and locate potential problem zones.

Furthermore the condition and the span forces of the external tendons were determined by separate measurements using BRIMOS®.

- Client: LSV Rheinland-Pfalz
- Location: Pirmasens, Germany
- Checking Period: 2003

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☒ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Express Highway Bridge I/43 Hapalova

Description

The express highway bridge is formed by two 8-span structures. The cross section is composed of two independent box girders which are connected by a joint deck. The bridge was built of prestressed concrete in 1980 and generally rehabilitated in 2003/2004. In the scope of the rehabilitation each of the four box girders was reinforced by 4 external tendons of the type PROJSTAR each (Monostrand - 12 strands running in a HDPE pipe with a diameter of 110 mm) in longitudinal direction with the external prestressing continuously distributed over all 8 spans.

In the scope of the research project INNO FORCE JHP and VCE were invited to carry out demonstration measurements at the external tendons of the express highway bridge over the Hapalova road by the Czech Motorway and Expressway Authority and the Road Authority Brno.

Subject of the tests was the determination of the effective cable forces of the external prestressing with BRIMOS®. The latter were both compared to the recorded tension forces and with the maximum allowable cable force (maximum permissible tensile force).

- Client: Motorway and Expressway Authority of the Czech Republic, Road Authority Brno
- Location: Brno, Czech Republic
- Checking Period: 08/2007

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☒ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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St. Michael Bridge

Description

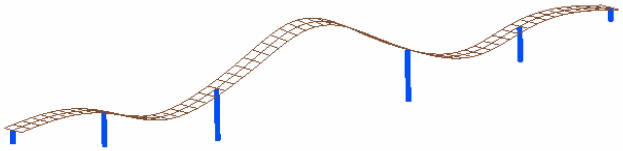
The system consists of two prestressed concrete boxes with an overall length of every 329 m. The maximum length amounts to 105 m, the construction width is about 17.3 m. The measurements were carried out to check the existing structural safety / load bearing capacity whereby the external tendon elements were submitted to a detailed analysis.

- Client: Austrian Motorway & Thruway Corporation
- Location: Styria, Austria
- Checking Period: 1998

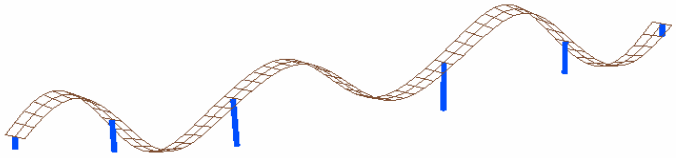
BRIMOS® Services conducted:

Lifecycle Management:	☐ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

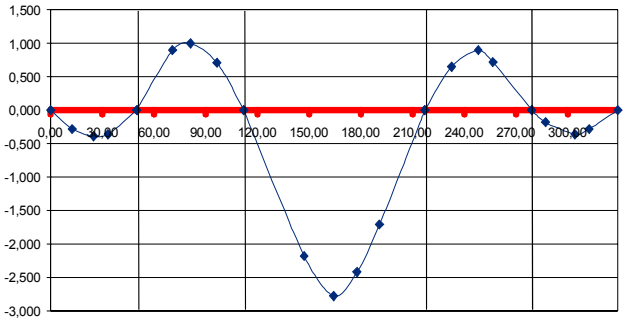
1. First vertical mode shape of the structure (calculation):



2. Second vertical mode shape of the structure (calculation):



Vertical eigen form of the structure (measurement):



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Rümmecke Viaduct

Description

The eastern superstructure of the Rümmecke viaduct is prestressed in longitudinal direction by means of external tendons of the type “VBF-CMM D”.

BRIMOS measurements were carried out at the external tendons in order to check the tension forces. The tendons were fastened by timber wedges in the deviation saddle in order to be able to clearly determine the free vibration length. The latter was measured by laser distometer.

- Client: BBV
- Location: Germany
- Checking Period: 2007

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☒ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Unstrutt Viaduct

Description

The Unstrutt Viaduct was constructed as reinforced concrete box girder with internal and external prestressing (tendon type SUSPA Draht-EX 54) in 2000 – 2001.

The cable force had to be checked with the BRIMOS® measuring system before the expiration of the warranty period of the external tendons.

In September 2008 54 measurements were carried out at 18 tendons in order to determine the tension force. All measuring points were fixed in cooperation with the client.

- Client: Landesbetrieb Bau Sachsen-Anhalt
- Location: Unstrutt, Germany
- Checking Period: 2008

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☒ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Weida Viaduct

Description

The Weida viaduct was constructed in form of two parallel reinforced concrete box girders with internal and external prestressing (tendon type SUSPA Draht-EX 66) in 2008.

Before clearance for traffic the force in the external tendons had to be checked with the BRIMOS® measuring system.

In December 2008 240 measurements were carried out at 120 measuring points in order to check the tension force. All measuring points were fixed in cooperation with the client.

- Client: EHS
- Location: Germany
- Checking Period: 2008

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☒ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Transmitter Mast Schöckl

Description

VCE was commissioned to carry out various measurements and analyses of the dynamic system characteristics based on the latter for the investigation of the vibration problems of the transmitter mast “Schöckl“, in particular of the guy cables. The main objective was the improvement of the vibration behaviour of the total system. On arrangement with the client first the prestress forces in the guy cables were identified by means of a basic measurement and adapted to the dynamic characteristic of the transmitter mast by means of numeric simulations. On the basis of the results improvement measures were proposed.

- Client: ORS GmbH & Co KG
- Location: Styria, Austria
- Checking Period: 2005

BRIMOS® Services conducted:

Lifecycle Management:	☐ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☒ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☒ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Transmitter Mast Wachberg

Description

The transmitter mast Wachberg is the second tallest of the Austrian Broadcast Company. The mast is held in its position by 6 guy cables, which are prone to dangerous cable vibrations. VCE installed a permanent monitoring system including video surveillance to acquire more information on the vibration behaviour.

- Client: ORS GmbH & Co KG
- Location: Austria
- Checking Period: 2008-2009

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☒ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☒ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Footbridge Praha Chodov

The footbridge Praha Chodov is situated in the south-east of Prague and leads across the motorway D1 from Brno to Prague. The bridge - built in 1994 - acts as a symbolic entrance into the capital city of the Czech Republic. In 1995 the footbridge Praha Chodov was assigned as „bridge construction of the year". The structure consists of a steel box-girder with an orthotropic deck and a bottom plate and is supported on a steel arch over a distance of 49.50 m. Additionally the deck is hinged into the arch with two assemblies of 6 thin-walled and prestressed steel hangers.

In the course of the prevailing investigation a dynamic monitoring campaign was undertaken in order to determine the vibration behaviour of the steel hangers and the global condition of maintenance of the bridge deck (the structure's integrity) by means of BRIMOS®.

The superior goal of the prevailing monitoring campaign was the determination of the effective prestressing forces in each of the 12 hangers – based on dynamic measurements. The obtained values were compared to the expected, theoretical values based on permanent loading and live loading. Additionally the utilisation ratio with regard to the load bearing capacity of the hangers was determined. Along with the conventional bridge inspection the assessment of the bridge based on the measured dynamic behaviour of the steel hangers and the bridge deck supports the determination and localization of the structure's weak points or areas.

- Client: AGIP s.r.o.
- Location: Prague, Czech Republic
- Checking Period: 2006

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☐ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Seidewitztal-Bridge

Description

The construction of the new Seidewitztal-Bridge near Dresden is carried out by temporary use of accessory pylons growing along with the construction.

- Client: BBV Vorspanntechnik GmbH
- Location: Dresden, Germany
- Checking Period: 2005

BRIMOS® Services conducted:

Lifecycle Management:	☐ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☒ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Arch Bridge Svinesund

Description

The construction of the new Svinesund Bridge (arched bridge with 250 m main span) between Norway and Sweden is carried out by means of temporary guying of auxiliary pylons, which grow according to the construction progress. The latter are anchored with prestressing cables whose forces were regularly checked by measurements with the BRIMOS-Recorder® with external sensor during the construction phase. The measurements were carried out by the construction company.

The same method for the determination of the cable forces was also brought in constructing the Seidewitztal-Bridge near Dresden.

- Client: BBV Vorspanntechnik GmbH
- Location: Svinesund, Norway / Sweden
- Checking Period: 2003

BRIMOS® Services conducted:

Lifecycle Management:	☒ Condition Assessment	☐ Condition Monitoring	☐ Rehabilitation Planning	☒ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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Taichung Bridge

Description

The Taichung Bridge, opened in 2003, is a Cable stayed bridge for urban traffic located in Taichung in the middle of Taiwan. Due to the requirement to assess the cable forces, the global state of the structure and the dynamic behavior of the pylon base a Permanent Monitoring System has been installed in 2003.

The Taichung Bridge is a Cable stayed bridge with 44 cables and a total length of 189 m which comprises four lanes and two small lanes for pedestrians and bicycles. The superstructure is represented by steel girders and an orthotropic deck.

The Permanent Monitoring System gives an overview about the global behavior of the bridge structure and supplies the actual cable forces. The system consists of following parts, which are monitored:

- Dynamic determination of the cable forces of 8 selected cables
- Measuring of temperature, wind speed and wind direction
- Dynamic measurement of the main girders and the pylon
- 3-dimensional measurement of the pylon base

- Client: BPI Taiwan
- Location: Taichung, Taiwan
- Checking Period: 2003

BRIMOS® Service conducted:

Lifecycle Management:	☒ Condition Assessment	☒ Condition Monitoring	☐ Rehabilitation Planning	☒ Quality Control
	☐ Lifetime Assessment	☐ Traffic Analysis	☐ Environmental Influences	☐ Risk Assessment
Special Measurements:	☐ Attendant Monitoring	☐ Noise and Vibrancy	☐ Deflection Measurements	☐ Seismics

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