Today access to healthcare for the whole population has become a universal right. But in the world of structures preventive care is granted to only a privileged few, either because they are prestigious or because they are already in critical condition.

Imagine a detector, practically invisible, placed on each bridge and recording its health status continuously: overall stability of the structure, stresses during service, seasonal behavior, and so on. This attentive onboard sentry will detect any anomaly well before a serious problem occurs, allowing timely corrective action.

While this might sound like science fiction, in fact many structures around the world are already being monitored using the OSMOS system, which is not only simple to install but extremely precise.

The system is so good that it won the coveted FROST & SULLIVAN award for Structural Health Monitoring, in 2004. This issue of OSMOS NEWS, entirely focused on bridges and our leadership in this field, is intended to illustrate the benefits of OSMOS monitoring.

OSMOS’s challenge in the years to come is to ensure that its advanced technology becomes a reality for all bridges and road networks, and proclaim equal opportunity for all!

As part of this audacious and innovative approach, I am pleased to welcome two new OSMOS affiliates TEKNIKA HBA in Canada and OFI, in Austria. We all wish them much success!

Bernard Hodac, Chairman and CEO of the OSMOS Group

To replace this swing bridge over the Harlem River in New York, a 91-meter span steel bridge has recently been installed after a sea voyage of more than 2,000 km from its fabrication site in Alabama.

Our partner Urbitran was contracted by the New York City Department of Transportation to monitor the bridge during the various phases: transportation, various construction activities and installation. Once the OSMOS system had measured the initial static parameters of the bridge, each phase could be monitored objectively comparing actual values with the acceptable limits. The optical strands installed during construction made a key contribution to the quality assurance of the finished bridge, by ensuring its well being during travel, construction activities and final lifting to its service position.
Special issue: Bridges

The masonry arches of the Leominster road bridge in Massachusetts are showing signs of severe cracking. In order not to interrupt the traffic, the operator decided to keep the bridge open but with safety monitoring.

SubTerra’s competitive bid proposing the OSMOS system was selected. After a complete monitoring cycle, a repair specification and operating recommendations will be submitted to the client.

At the start of the monitoring phase, several loading tests using heavy vehicles (> 40 tons) were performed to measure the bridge’s behavior under severe stress. Although the first results confirm its expected behavior, these measurements are just a starting point that will be enriched over time. Knowing the manner in which the structure reacts, it will be valuable in planning the repairs and adapting them to the specific requirement of this bridge. On this project continuous monitoring plays its role to the fullest: ensure safe operation of the bridge, define appropriate repairs, assess the effectiveness of repairs and finally confirm the structural integrity of the bridge in the future.

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Paerdegat Basin Bridge, New York

Intensive monitoring of a patient in danger

The Paerdegat Basin Bridge spans New York’s Belt Parkway over the Paerdegat Basin, an area of salt marshes in Brooklyn. Although the structure is planned for reconstructions in the near future, it has recently been placed under close structural monitoring.

The bridge has been permanently damaged by a barge, resulting in restrictions on the weight of vehicles traveling on the bridge. In order to avoid traffic interruption before its complete reconstruction, the New York City Department of Transportation (NYCDOT) asked URBITRAN, an OSMOS affiliate, to place the bridge under continuous monitoring. It is essential to detect any degradation, no matter how small, to ensure timely intervention if any signs of failure should appear.
Reuss Bridge, Switzerland

Heavyweights... come and be weighed!

The Switzerland-Austria freeway bridge crossing the Reuss River is subject to particularly intense heavy freight traffic. For this reason BASLER & HOFMANN, an OSMOS affiliate in Switzerland, is monitoring this structure continuously.

A number of monitoring criteria were selected and covered by suitable OSMOS instruments: stability of the pre-tensioning (optical strand), behavior of expansion joints (EX-Large) and classified counting/weighing of vehicles by OSMOS-WIMS.

Konrad Adenauer Bridge, Mülheim, Germany

Identifying causes from effects

In addition to its 40,000 vehicles per day, the Konrad Adenauer Bridge in Mülheim is regularly crossed by exceptionally heavy vehicles, generally at night and at low speed.

These ultra-heavy loads must follow a well-defined path to avoid transversal deformation of the deck. TÜV-OSMOS monitors the bridge using a combination of optical strands and WIMS sensors. In this manner, the causes and effects are recorded in parallel. For example, an increase in traffic correlating with a irreversible deformation of the structure will enable an initial conclusion to be drawn.
What does modern man and our road traffic have in common? Both are rather overweight!

For bridges at least, the OSMOS system enables the risks to be controlled by simultaneous installation of:
• automatic weighing/counting (WIMS sensor),
• monitoring of flexure in the bridge beam mid-spans,
• monitoring of shear forces.

This is the global solution chosen by the Belgian Roads Department for three of its bridges: Heusden, Vlassenbroek and Stasegem. The required equipment was ordered from STAMOTEC, an OSMOS affiliate in Belgium.

For the operator, LIN, this project provides a valuable baseline, constantly being enriched, and is of interest to bridge owners all of whom are interested in monitoring their structures. These three installations demonstrate perfectly the technical maturity and cost-effectiveness of OSMOS systems for preventive monitoring of all the bridges managed by the same operator.

Heusden Bridge

Example of a WIMS sensor on Heusden Bridge.

OSMOS-WIMS (Weight in Motion System) maximizes the utilization of each bridge by providing an estimate of the degree of wear of the road network of which it is a part. One to three WIMS sensors installed in less than a day can cover 80% of existing configurations at a very modest cost.

Vlassenbroek Bridge

Example of an optical strand for monitoring mid-beam flexure at the Vlassenbroek Bridge.

Installation of the optical strand on the underside of deck enables permanent confirmation of the absence of irreversible deformations and the stability of the pre-tensioning.
Example of shear stress measurements on Stasegem Bridge

It is known that the deformation amplitudes associated with shearing forces applied to a structure are much smaller than those caused by mid-beam flexure forces. Conventional short-base instruments are unable to reliably and plausibly anticipate these orders of magnitude.

An optical strand placed along the entire length of the dimensioning part (see photo) delivers a specific and highly meaningful signal that can be utilized directly.

Schindgraben Bridge, Germany

Regular heartbeat despite explosions close by

This new structure on the A71 German freeway is being monitored in view of its close proximity to a quarry where explosions are frequent.

TÜV-OSMOS has fitted the structure with accelerometers, optical feelers on the bridge bearings and optical strands to evaluate the dynamic effect of shock waves caused by the explosions. The initial results are reassuring: the alarm threshold values have never been exceeded. In fact, the explosions cause deformations much smaller than those due to road traffic.
**Schiffmühle Bridge, Germany**

**Useful life extended**

This 30-meter reinforced concrete bridge over the Oder river has revealed some particularly troubling symptoms with concrete spalling in many places and some exposed reinforcing bars in an advanced state of corrosion.

The Brandenburg Land in charge of the bridge decided to place it under safety monitoring in the hope of prolonging its useful life if possible by several years until a budget for its reconstruction can be allocated.

The OSMOS monitoring, started in 1999, has perfectly fulfilled its role to the complete satisfaction of the customer (see customer testimonials on page 12).

**Megurogawa railway bridge, Japan**

**Adjacent work under close surveillance**

A bridge at Megurogawa rail station on the Tokyo express network is at risk due to its location close to a building site.

JGC is monitoring the structure and its surroundings using a combination of carefully targeted optical extensometers and optical strands.

The very severe monitoring parameters confirm the perfect stability of the structure, which means the work on the adjacent site can proceed without risk.
Honmoku interchange, Japan
Status survey before enlargement of the bridge

This freeway interchange in the Yokohama metropolitan area is to be enlarged as part of a general traffic optimization program.

JGC is monitoring various critical points of the structure using crossed optical extensometers.

The longitudinal and transversal deformations of each point are obtained with absolute synchronization, making the structure reveal all its secrets to provide a complete and detailed picture prior to construction.

Saint-Gervais Bridge, France
A wooden structure on the road network

This 32-meter span bridge can be considered to be the first wooden bridge used on the French road network. Since 1996, OSMOS has been monitoring it continuously to assess the behavior of the structure over time and the long-term rheology of the wood.

The first measuring period involved two complete annual cycles, but in view of the increasingly heavy-vehicle traffic using the bridge, OSMOS pursued the continuous monitoring without losing the original “zero point”.

Thanks to OSMOS, the bridge remains operational and under control, which is reassuring for the operator and a valuable source of data for the designers of this prototype structure.
Five overpasses on the A4 Highway, France
Equal opportunity for all bridges - even in sleeping mode!

Every bridge should have the right to an onboard quality monitoring system instead of being judged only on the basis of its appearance.

And useful does not necessarily mean costly! As confirmed by the sleeping-mode monitoring developed by OSMOS.

Five structures crossing the A4 Paris-Metz Highway have been equipped with this effective system, with one or more optical strands fitted to each bridge.

After installation, a reference value is recorded then the monitoring station is disconnected, leaving only the optical strand and its connector on the structure. The monitoring station can be reconnected later to provide further static and dynamic measurements by each optical strand, enabling comparisons between long cycles and between the responses of the structure to traffic loads.

Only OSMOS offers such a simple onboard measuring system. Indeed, it is so simple and inexpensive to operate that it can be generalized to all the structures operated by the client.

Oberhausen Bridge, Germany
Resting comfortably on its two beam spans

The client's need: the bridge known as “West-Ost-Rampe” in Oberhausen is a new construction composed of two longitudinal steel beam spans and prefabricated sections for the deck.

Since it is a new type of bridge the Authorities wanted to know more, right from the start of service, about the long-term behavior of these steel beams under maximum stress conditions, and the shear stresses in the area of the bridge bearings and in the bearings themselves. TÜV-OSMOS installed the monitoring system and will be observing the structure over a long period.
**Bridge in Hokkaido, Japan**

OSMOS eligible for preventive maintenance of large structures

An independent civil engineering research and administrative center, the Hokkaido Institute and Hazama Corporation have carried out a joint operational and maintenance study of bridges. As a case study, they chose the bridge on Route 275.

This structure was studied to define the relationship between the degree of deterioration of the concrete and the dynamic performance of the structure. Hazama, an OSMOS affiliate in Japan, has employed the OSMOS system to measure deformations of the superstructure (beam, deck, etc.) and characteristic vibrations of the bridge caused by the dynamic load of moving vehicles.

This study confirms that the OSMOS system is perfectly suitable for deformation measurements on long structures.

**Structure number 8 at Orly Airport, France**

Under OSMOS monitoring right from birth

This structure of pre-stressed concrete cast in place is located right next to the underground car-park of Orly South Airport.

Six 2-meter steel-sheathed optical strands were embedded during concrete placement. Integrated in the bridge structure before pre-tensioning and removal of formwork, the optical strands will be used to monitor both the tensioning operations and the first three years of service in order to detect any later changes.
### Onboard Monitoring:

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an idea that gains ground
Eighteen months after its commissioning, an OSMOS system providing “permanent inspection” of the Köhlbrand Bridge has proven its worth in the eyes of the authorities and will provide a guarantee of safe operation of the structure for many years.

Hermann Jonetzki, Hamburg Port Authority

The Schiffmühle Bridge on the National 158 road crossing the Oder was equipped with OSMOS optical strands in the summer of 1999 as part of a preventive monitoring program intended to prolong the useful life of the structure.

Since 1999, static and dynamic effects have been recorded continuously. OSMOS supplies us with a quarterly summary of results and preliminary diagnostic assessments. This approach combining conventional classic methods (routine inspections and calculations) and continuous optical strand monitoring has enabled the Schiffmühle Bridge owner to keep the bridge safely in service for an additional 6 years.

Wolfgang Macheleidt, Brandenburg Land, Germany

For 5 years OSMOS has been providing safety monitoring of the state of the crushed limestone storage dome, an old and degraded structure.

This provides permanent information on the evolution of the degradation and is a much-appreciated aid when making decisions to repair or renovate the structure.

Jacques Moret, Director of Fours à Chaux de Sorcy

The OSMOS system was installed on a workshop traveling crane in a factory at Villefranche-sur-Saône. The goal was to perform a critical assessment of the OSMOS system and try to quantify its industrial potential for overhead cranes.

The installation, carried out very quickly and without difficulty, confirms the particularly original design of the system and its excellent overall performance.

Gérard Piron, Technical Manager, REEL

Teknika HBA Inc. is a Quebec-based company that has built a solid reputation in engineering since 1928, is proud to have signed a partnership agreement with the OSMOS Group.

Today Teknika HBA employs 625 people in 19 business centers around the world. Drawing on its broad success and fine reputation in engineering since 1928, is proud to have signed a partnership agreement with the OSMOS Group.

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The Austrian Research Institute (OFI) is a certified parapublic organization whose core skills lie in building and public works, environment and life sciences, and polymers. OFI services range from quality control to material characterization to certification and expertise in pathologies.

As Austria’s leading technical inspection entity, the OFI is also a founder member of Austrian Cooperative Research. Dr. Michael Balak, Dr. Günther Rosbacher and Dr. Günther Fleischer will manage the OSMOS department within OFI.

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