



## Bridge Bearings with Load Measuring Capability



Railway Bridge Zalalövö-Bajánsenye/Hungary (1999 – 2000), 82 pot bearings, vertical load up to 12,000 kN

Very often there is a need to determine the actual vertical load onto a bearing, for example to figure out changes or deviations in the distribution of loads. To serve this purpose, MAURER developed special load measuring bearings. Without inhibiting the functionality of a bearing, such special bearings allow the determination of actual vertical loads acting upon a bearing. Thus, changing of forces and load distributions can be immediately noticed, and their impact onto structural members can be determined. It is therefore not required to measure deflections or strains of the structure and indirectly arrive at the same results, which are the vertical loads at each support.

### Functionality of Load Measuring Bearings

MAURER Load Measuring Bearings are available as

- Pot Bearings
- Spherical Bearings
- Elastomeric Bearings

Independent on their specific design type, they function to the same physical principle: solid mechanical elements

transfer the vertical load onto an elastomeric body and create in that body an internal pressure that is a function of the vertical load. This pressure can be considered to be hydrostatic, i.e. like a fluid that is under pressure, this pressure is constant everywhere.

By means of suitable measuring devices, this pressure can be determined. To achieve this, one of the surfaces that limit the elastomeric compound is being flush mounted a sensor. This sensor consists of a membrane of stainless steel, that will be arched by the acting pressure. Now, strain gauges that are placed on the back side of this membrane will be elastically stretched, hereby changing their electric resistance. Consequently, the electric potential will be changed, providing a precise signal that is in proportion to the hydrostatic pressure in the elastomeric compound.

In applying highly exact strain gauges of reputed suppliers, that employ superior service life and with sensors that are covered by stainless steel, MAURER guarantees decades of exact measuring capacity and functional safety - just what the customer is used already when applying MAURER bearings.

**Bridge Bearings with Load Measuring Capability****Transfer of measured values and their output**

The transmitters that are applied in MAURER load measuring bearings (to be long term reliable and temperature compensated strain gauge sensors) perform independently of the type of the signal processing to come, and always in the same way. However, data transfer and data output can be adopted to the local conditions:

- **Option 1: data query at the bearing**

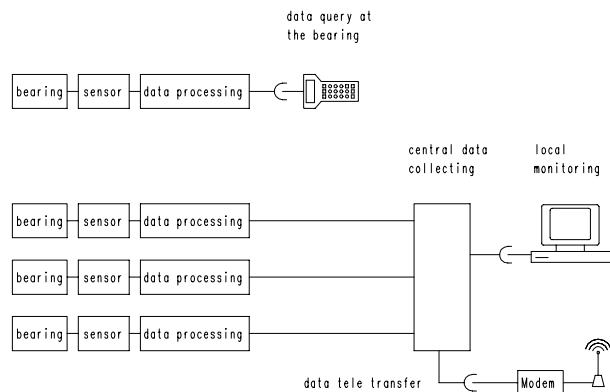
In case that regular inspections are being carried out at the bridge structure, and the measurement of rapid changes of the vertical load (like wind loads and vertical loads) is not required, the vertical load data can very simply and cost efficiently be determined by means of an especially developed hand held device. This hand held device is being connected to the interface that itself is connected to the bearing and that stores all relevant data. The desired value can then be easily retrieved. In addition, the retrieved data can be stored in the hand held device, for subsequent transmission to a PC. The electricity that is required for data retrieval is being supplied by the hand held device, and therefore a separate electric supply is not required.



- **Option 2: central data storage and data output at the bridge structure**

The signals are being transmitted to a centrally located data storage and data output device, whereby the requested data are being queried continuously, in a predetermined frequency. Depending on the preselected frequency, rapid changes in the vertical loads can be acquired.

Electricity can be provided either in AC mode or DC mode.



- **Option 3: data output and data processing independently from the bridge structure by means of telemetry**

The centrally stored data according to option 2 can alternatively be transmitted by telephone line or by a GSM modem to any location. The measured values can at all times and without delay be queried, wherever desired. Also, in this mode the default values at the load measuring location can be modified, like for example increasing the frequency of the data query at times of strong winds.

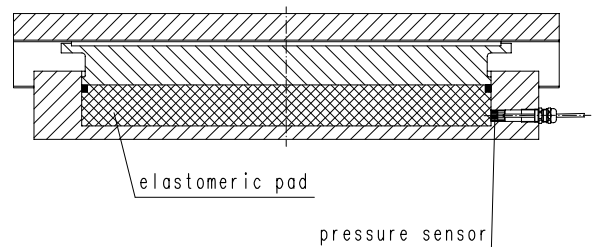


## Bridge Bearings with Load Measuring Capability

### VERTICAL LOAD MEASURING WITH POT BEARINGS AND ELASTOMERIC BEARINGS

#### Pot Bearings

Due to their functional principle, pot bearings provide ideal conditions for the use of the load measuring device. The lid of the pot already acts upon the elastomeric compound, creating a quasi hydrostatic pressure, which is being determined - via a membrane - by a compression sensor that is located in the ring wall of the bearing. The signal is then being modified into an electric signal. With the help of this signal and the area of the elastomeric compound, the vertical load can be determined. The sensor is easily replaceable, because being screwed into the ring wall. Control measurements of the University and MPA Karlsruhe proved a high consistency between the measured values and their theoretical values: at a median (theoretical) pressure of  $45 \text{ N/mm}^2$  the deviation measured was a maximum of  $1 \text{ N/mm}^2$  (equivalent to less than 2.5%).

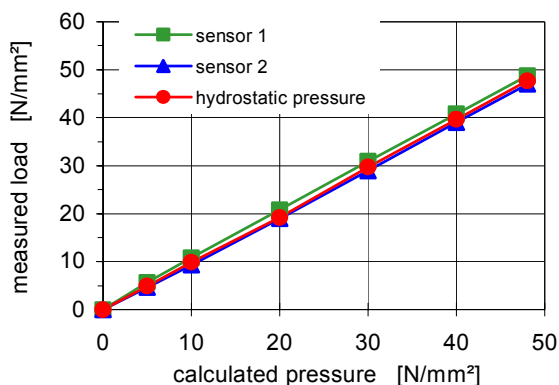


Pot bearing with compression sensor

#### Elastomeric Bearings

Due to the fact that elastomeric bearings are not laterally chambered, load measuring devices can only be placed at the upper or lower cover plate. This however does not inhibit their suitability for vertical load measurement of this bearing type.

University Karlsruhe / MPA



Les Viaducs sur le Rhône, France  
T.G.V. Méditerranée - Lot 2H, 1997 – 1998  
26 pot bearings, vertical loads up to 43,000kN

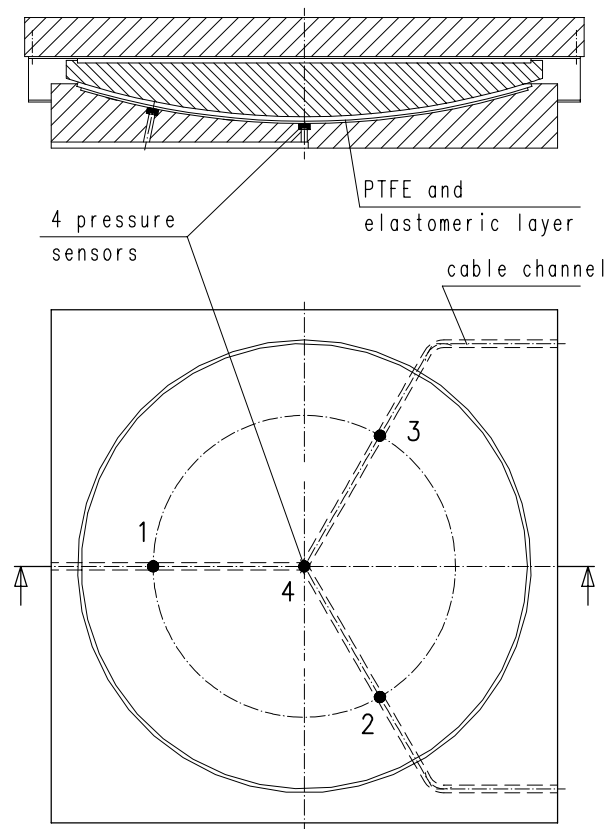
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**VERTICAL LOAD MEASURING WITH SPHERICAL BEARINGS**

Contrary to pot bearings, conventional spherical bearings do not employ the hydrostatically active elastomeric compound that is required for exact measurements. Thus, spherical bearings that are to be provided with a vertical load measuring capacity will be additionally equipped with a load transferring and tilt-rigid elastomeric compound that is located underneath the PTFE sliding area. Comprehensive experiments that were carried out at the Karlsruhe University have shown that such an arrangement allows even measurements at the spherically curved sliding area, with simultaneous input of signals at different locations. The deviation of the theoretical median value is so little that „the selected measuring method is well suited for the measurement of pressure in bearings“ (Test Report # 99 28 34 1035, Institute for Concrete Design).



Canal Bridge Magdeburg, Trough Bridge over the river Elbe, 2000 – 2001  
4 spherical bearings for vertical loads up to 131,000 kN (with spherical- $\varnothing$  2,200mm)  
4 spherical bearings for vertical loads up to 18,000 kN



Spherical bearing with 4 sensors