

Sensors & Applications  
**Structural Monitoring and  
Building Material Production**



More Precision



Due to increasing requirements, infra-structural buildings are successively subjected to greater stress. This increasingly confronts owners with the task of evaluating their building stock in terms of safety and the residual useful life derived from it. Reliable statements regarding load-bearing safety, serviceability and fatigue safety are therefore necessary for further use. However, current information regarding the structural properties is often insufficient or incomplete. With our sensors, the required information can be obtained accurately and reliably with an easily adaptable, modular measurement concept.



### **inertial**SENSOR

Precise inclination and acceleration sensors

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Highest accuracy and resolution for precise measurements

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Extremely stable measurement signal even with strongly fluctuating temperatures

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High EMC resistance  
(robust aluminum die-cast housing)

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Customer-specific designs

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### **thermo**METER

High performance industry pyrometers for industrial series applications

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Temperature ranges from -50 °C to 1100 °C

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First-class signal stability for highest reliability

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Best temperature stability even with strongly fluctuating ambient temperatures

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Individual sensor configuration via sensorTOOL Software

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### **wire**SENSOR

Robust draw-wire displacement sensors

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Displacement and position measurements with measuring ranges up to 30 m

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Analog and digital outputs

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Flexible measuring wire, ideal for difficult-to-access positions

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Compact design for integration into confined spaces

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### **opto**NCDT ILR

Laser distance sensors for large ranges

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Precise measurement of displacement, distance & position on different surfaces

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Large measuring range for indoor and outdoor use

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High repeatability

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Extremely compact without external controller

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# Structural monitoring



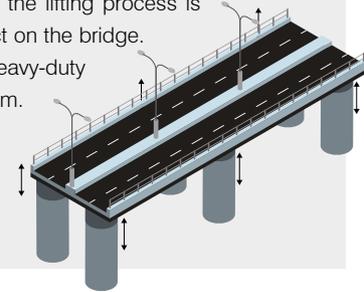
- Ideal for inspection and long-term monitoring
- Robust designs for outdoor use
- Detection in small and large measuring ranges



### Lift height measurement in heavy-duty lifters

The supports on bridges must be renewed from time to time. The supports bear the weight of the bridge superstructure and absorb vibrations and expansions of the bridge. As the properties of the rubber bearings change over time, they must be replaced regularly. For such maintenance work, the bridge piers are lifted by 10 to 15 mm with heavy-duty lifters. After the maintenance work has been completed, the superstructure is lowered onto the new supports. When lifting bridges, it is important that the lifting process is absolutely synchronous so that no torsion forces can act on the bridge. Therefore, a draw-wire sensor is integrated in each heavy-duty lifter, which reports the current stroke to the control system.

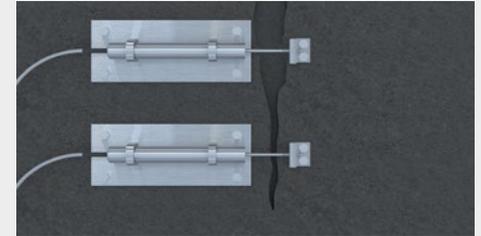
Sensor: *wireSENSOR*



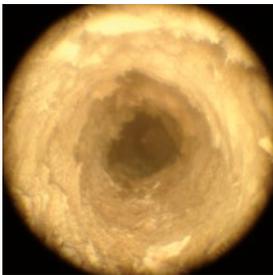
### Monitoring the tidal influence on buildings

Waterproof eddy current displacement sensors are used to monitor the influence of tides on old buildings. The sensors measure onto a metallic measuring object that is attached to the building. The robust sensor design and additional sealing allow even measurements over longer periods in salt water.

Sensor: *eddyNCDT*



Crack monitoring with LVDT displacement sensors. The sensors can also be connected to the MSC multi-channel controllers.



Corroded pipes

### Building inspection using endoscopes

Technical endoscopes from Micro-Epsilon are used wherever preventive or scheduled inspection is required. The endoscopes are suitable for mobile use and are very user-friendly. The XLED PRO DUAL VIEW video endoscope is the preferred tool for inspecting building structures or building materials. This endoscope works with two integrated cameras which can be used with direct (0°) or lateral (90°) viewing direction. These viewing directions can be displayed either individually or in combination on one monitor. There is no need for laborious lens changes, repeated search for the problem area or a second visual inspection. Eltrotec endoscopes provide reliable and fast results, which can be transmitted via WiFi in real time and/or stored on a chip.

Sensor: *Eltrotec video endoscope*

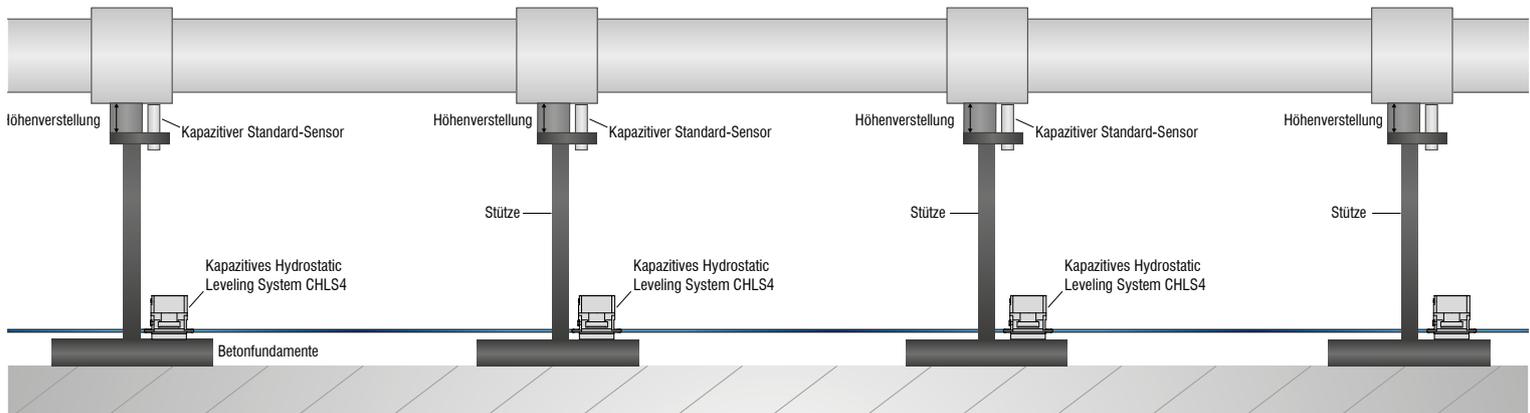
# Structural monitoring



## Capacitive spirit level for high-precision position measurements

The CHLS4 capacitive hydrostatic levelling system from Micro-Epsilon is based on the hose level principle and is used to monitor changes in the height of building parts and pipe systems. The sensor system detects minute changes in height through changes of a correlating water level with sub-micron accuracy. The CHLS4 is used, for example, in particle accelerators. It checks the position of the tubes or the position of the concrete foundations in relation to each other. Since the change in position has to be balanced again, there are actuators attached to the blocks which correct the respective supports by the measured height difference. Those actuators must also be controlled using capacitive sensors.

Sensor: *capaNCDT CHLS4*





### Monitoring the deflection of concrete ceilings

Laser sensors from Micro-Epsilon are used to measure the deflection of concrete slabs during casting. Depending on the accuracy requirements and measuring range, laser triangulation sensors or laser distance sensors are used. These sensors detect and log the deflection with high precision. If the deflection exceeds the defined limit values, additional supports are installed.

*Sensors: optoNCDT / optoNCDT ILR*



### Monitoring the extension of pipelines

Pipelines in power plants are exposed to high pressures and temperatures. These extreme loads cause the pipes to vibrate and result in thermal extensions of up to 1 m at some points. Constant hangers are used to compensate for these thermal displacements. Draw-wire sensors from Micro-Epsilon transmit the movement information reliably and safely to the control center. The optoNCDT ILR3800 laser distance sensors are recommended for monitoring from a long distance.

*Sensor: wireSENSOR / optoNCDT ILR*



### Distance monitoring on bridges and wind turbines

optoNCDT ILR3800 laser distance sensors are used for distance measurements on bridges, buildings and also wind turbines. Their low weight and compact design allow for the sensors to be attached to drones. Aerial measurements not only enable the controlled focus of the cameras but also the referencing of building dimensions.

*Sensor: optoNCDT ILR3800*



### Monitoring the thermal expansion of concrete walls

Electrothermal energy storage systems are filled with volcanic rock, which absorb excess energy in the form of heat and release it back into the power grid when needed. The lava stones are filled into a container made of reinforced concrete. Due to thermal expansion, the reinforced concrete tank must be permanently monitored. For this purpose, optoNCDT ILR3800 laser distance sensors detect the smallest movements of the reinforced concrete walls. The measured values are transmitted to a PLC via the analog interface. If the setpoint is exceeded, the energy supply to the stones is stopped immediately.

*Sensor: optoNCDT ILR3800*

# Structural monitoring



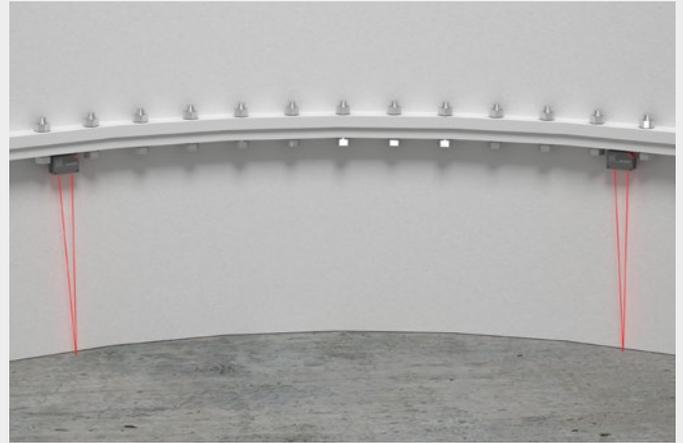
- Compact sensors with large measuring ranges
- Ideal for predictive maintenance
- High accuracy and stability



### **Nacelle movements**

The changes in distance between the nacelle and the ground are used to monitor tower swayings. For this purpose, optoNCDT ILR3800 laser distance sensors are mounted in the nacelle and measure down to the ground. Their high signal stability even on weakly reflecting surfaces ensures reliable measurement results.

*Sensor: optoNCDT ILR3800*



### **Measurements on the foundations of wind turbines**

To detect tower movements of wind turbines, several laser triangulation sensors measure the distance from the base ring to the foundation. Due to the high measuring rate and accuracy, changes are reliably detected. If the permissible limit values are exceeded, the system is shut down to prevent damage. Depending on the number of sensors installed, detailed evaluations about the vibration behavior can be made.

*Sensor: optoNCDT*

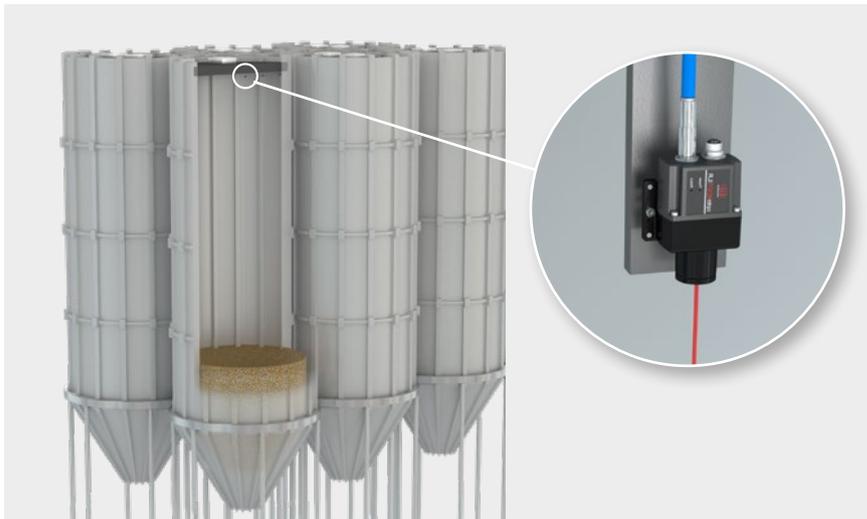


### **Monitoring the tower sway in wind turbines**

Wind turbines are exposed to high stress caused by swaying. In order to avoid damages and downtimes, the tower sway is permanently monitored. Inclination and acceleration sensors from Micro-Epsilon detect tower sway to the highest precision. The sensors provide stable measurement results even with high temperature fluctuations.

*Sensor: inertialSENSOR*

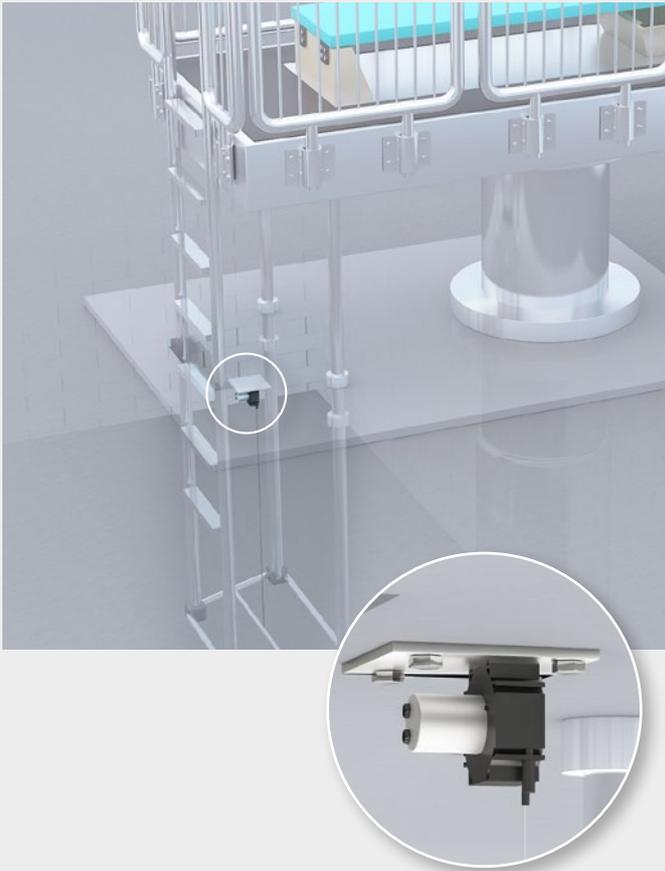
# Structural monitoring



## Filling level measurement in silos

Accurate quantity measurement of bulk material or plastic granulate is a decisive factor for the smooth running of production and logistics processes. In order to avoid production downtimes due to a lack of material, the filling levels in the storage silos are therefore detected automatically. Laser distance sensors from Micro-Epsilon impress here with high measurement accuracy. These laser sensors are mounted on the ceiling of the silo and measure continuously down to the silo bottom. The laser distance sensors precisely measure the distance between the sensor and the bulk material or granulate and transmit the measured height to the control system.

*Sensor: optoNCDT ILR3800*



#### Displacement measurement in hydraulic diving platforms

Height-adjustable diving platforms are used in competitive sports to set individual jump heights or identical heights for synchronized divers. Draw-wire displacement sensors from Micro-Epsilon measure the height of the tower and ensure that the tower is in the exact position. The sensor detects the retraction and extension of the ladder, which is recessed in the floor of the swimming pool hall. If the tower is moved, the ladder and the strut with the measuring wire move in the same way.

Due to their large measuring range, the robust aluminum profile housing and durable design with wear-free encoders, the draw-wire sensors of the wireSENSOR series also provide reliable measurement results.

Sensor: *wireSENSOR*

#### Monitoring the position of the facade during construction

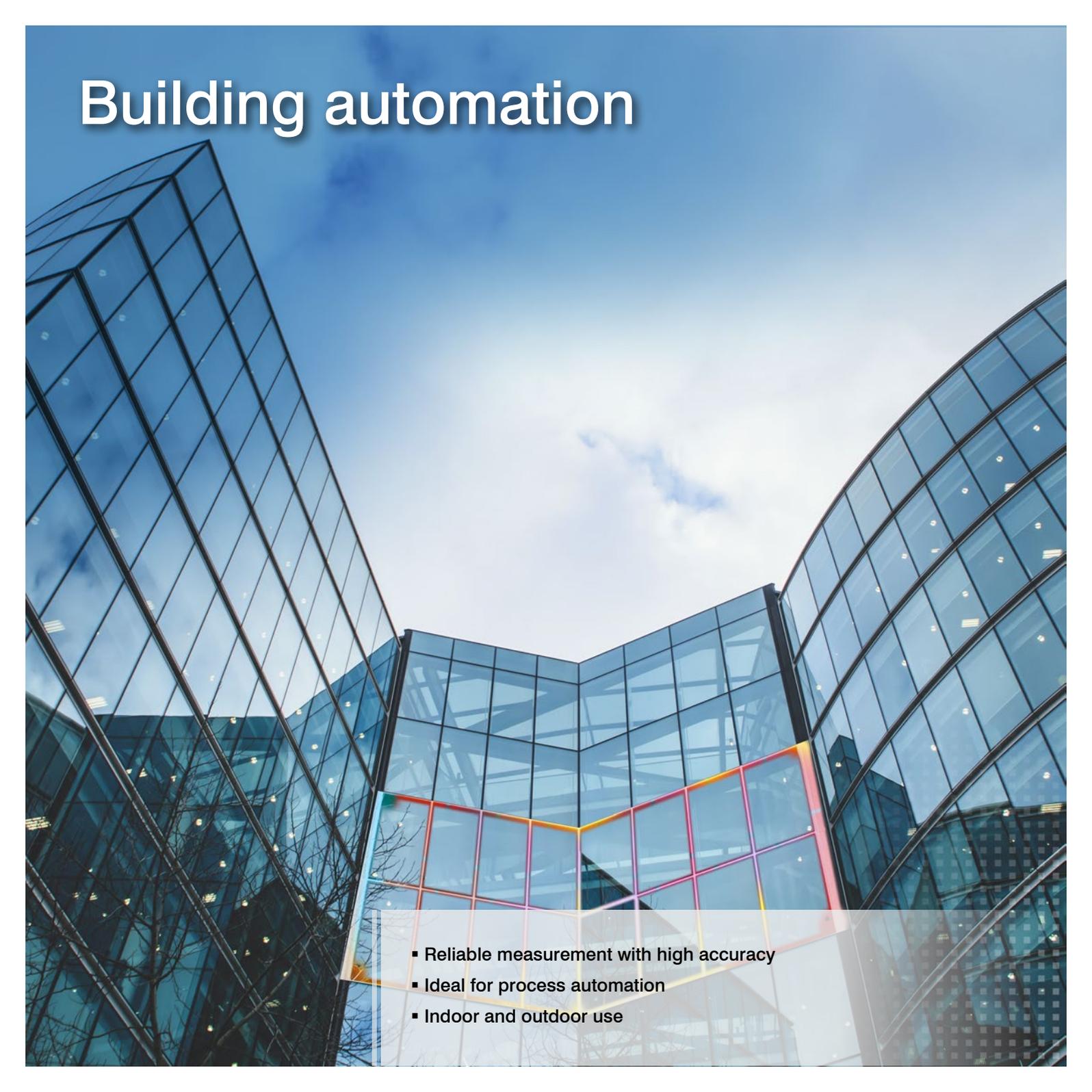
optoNCDT ILR3800 laser sensors are used for distance measurements of listed facades. These sensors provide high measurement accuracy even on weakly reflective surfaces such as masonry. Due to their large measuring range, they measure the distance on selected facade points even from a great distance. This is how masonry movements that occur due to construction machinery or loads can be quickly detected. The distance values are recorded and output as an alarm signal in the event of limit value deviations.

Sensor: *optoNCDT ILR3800*



Laser distance sensors are also used to monitor ancient buildings.

# Building automation



- Reliable measurement with high accuracy
- Ideal for process automation
- Indoor and outdoor use



### **Color inspection of liquids**

colorSENSOR CFO gauges are used for the evaluation of industrial water and other liquids. These measure the color of the liquid from the outside based on the transmitted light principle. Special models also measure from the inside. The sensor's high accuracy enables the reliable detection of even the smallest deviations. Thus turbidity, foreign liquids or the degree of purity of different liquids can be detected.

*Sensor: colorSENSOR CFO*



### **Black ice detection for automatic traffic guidance systems**

In order to increase safety at safety-relevant points, non-contact infrared pyrometers are installed at pedestrian crossings. Thanks to the large measurement distance, the thermoMETER from Micro-Epsilon records the ground temperature from a safe distance and provides high measurement accuracy. When icing starts, the pyrometers send a signal to the traffic control system, which converts it to an ice warning or to speed regulation on traffic signs. In addition to pedestrian crossings, the pyrometers are also used at motorway and highway bridges or road sections where black ice frequently occurs.

*Sensor: thermoMETER FI*

# Production of building & construction materials

A wide-angle photograph of a large industrial factory interior. The scene is dominated by a long, straight yellow metal walkway with railings that recedes into the distance. To the left of the walkway, there are various pieces of industrial machinery, including large pipes and what appears to be a conveyor system. The floor is dark and reflective. The ceiling is high and features a complex network of steel beams and lighting fixtures. The overall atmosphere is industrial and brightly lit.

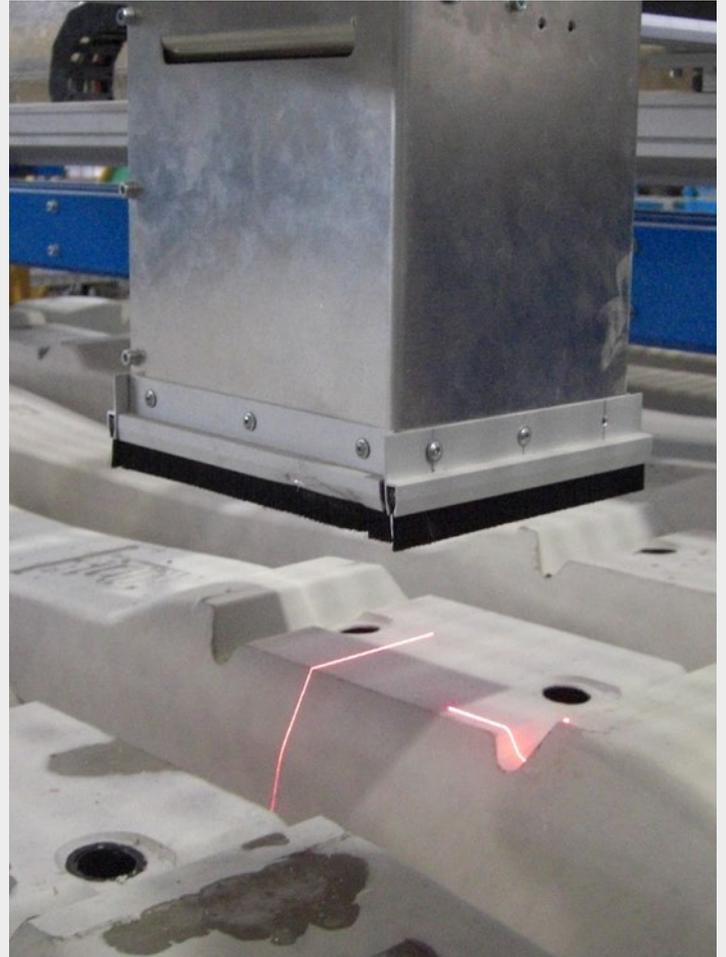
- Smart sensors for quality inspection and process monitoring
- High accuracy and speed
- Ideal for process automation
- Indoor and outdoor use



### Quality assurance in the production of railway sleepers

3D measuring systems are used for the inline quality inspection of railway sleepers. The systems consist of a gantry construction mounted on the forming station above the conveyor system. Two scanCONTROL laser profile sensors travel along the axes of the gantry and scan the sleepers from above. Software is used to compile the data into a 3D image and to determine the specified measured values. The measurement data for the sleepers is assigned to the respective metal mold and stored in the database. In addition, non-contact temperature sensors from Micro-Epsilon monitor the surface temperature of the sleepers throughout the production line.

*Sensors: scanCONTROL / thermoMETER*



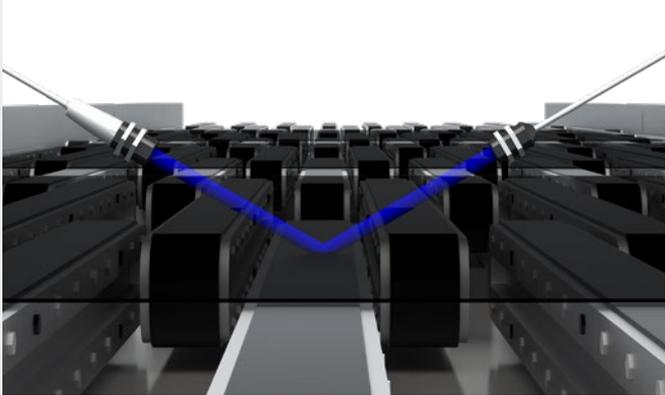
### Web edge control in the production of plasterboards

For the automatic cutting of plasterboards, the correct feeding of the boards is crucial for dimensional accuracy. For the detection of the web edges, optoCONTROL laser micrometers are used, which are mounted at the edges of the transport web. The micrometers continuously measure the web edge and detect skewed incoming sheets, which are then brought into the correct position. Thanks to the large measuring range and the high measuring rate, the laser micrometers can be integrated in a process-safe manner.

*Sensor: optoCONTROL 2520-95*



# Production of building & construction materials



## Inline color testing of facade glass

The color of glass is the crucial and visually distinctive feature of many different glass products. Color sensors from Micro-Epsilon are used in the coating of facade glass to check the color and tint during the production process. For this purpose, colorCONTROL ACS3 sensors are used in an angled arrangement and measure onto the glass panes. Thanks to their high accuracy, the sensors provide information about the degree of tinting. The colorCONTROL ACS systems are designed for inline monitoring and are used directly in the production line.

*Sensor: colorCONTROL ACS*



## Color inspection of strip processes

In strip processes for the production of insulation material and plasterboards, colorSENSOR CFO gauges are used to monitor the color. Thanks to their high accuracy, the sensors detect even slight color deviations. Color inspection is used in various fields and can be used for presence control, foreign object detection and process control.

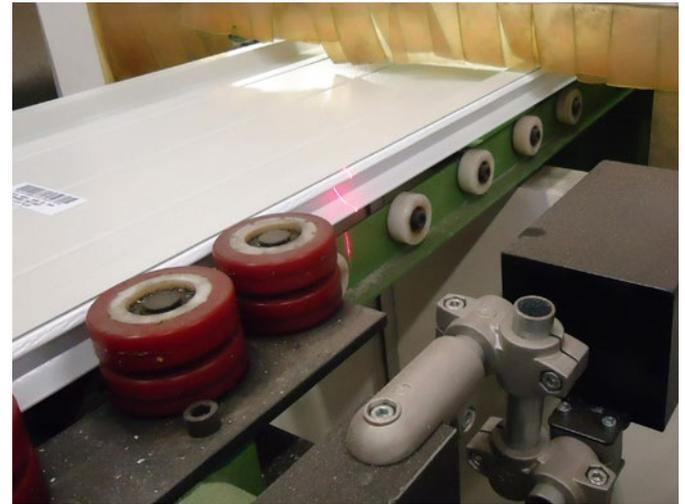
*Sensor: colorSENSOR CFO*



### Thickness measurement of mineral wool

In addition to the homogeneous material structure, thickness is a quality feature for maintaining the insulating properties of mineral wool. At the end of the production line, the webs are trimmed and milled to standard thickness. To optimize the production effort and to reduce waste, the material thickness is measured on two tracks before the milling cutter. This allows the pre-thickness to be optimized without affecting the final result. Two optoNCDT laser sensors are used for thickness measurement. If larger distances have to be maintained for safety reasons, optoNCDT ILR3800 laser distance sensors are used. The thickness is calculated based on the distance from the mineral wool to the sensor and the support. The measured data is then transferred to the control system.

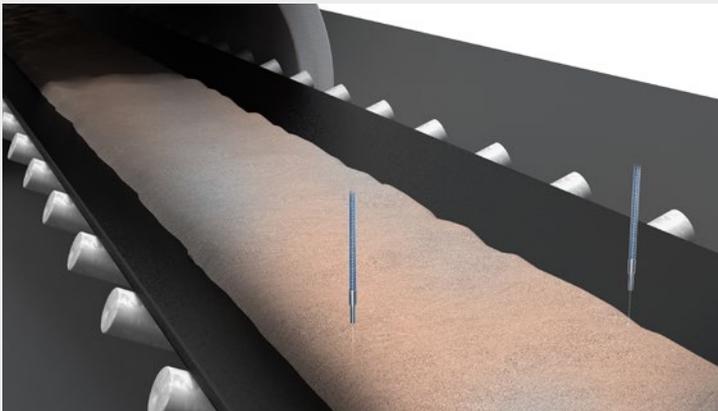
*Sensors: optoNCDT / optoNCDT ILR*



### Dimensional accuracy of sectional doors

The individual sections of sectional doors are connected with a tongue and groove joint. For a tight and permanently flexible connection, compliance with the nominal dimensions is of decisive importance. Strong temperature differences lead to jamming and consequently to a poor fit of the doors if the dimensions are inaccurate. Therefore, precise inspection of the tongue and groove profiles is important for compliance with the manufacturing tolerances. The measurement is performed with scanCONTROL laser profile scanners. An anchor point is defined in the profile, which provides the reference for all calculations. As a result, all fluctuations within the strip process can be compensated for. These results are transmitted to the production line control room.

*Sensor: scanCONTROL*



### Color measurement of cement powder

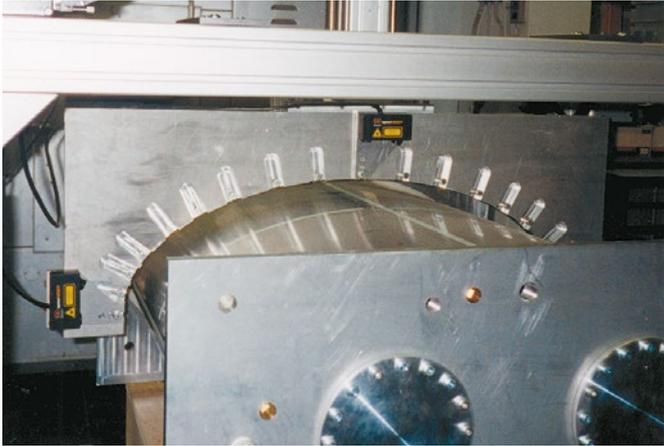
Process-related discoloration can occur during the production of cement powder. The color can change to gray or pink which is an indicator of production quality. The powder is transported on a conveyor belt and can be tested after initial cooling. If the color is within the reference range, further cooling takes place; if the color deviates from the reference value, the powder is discharged from the process.

*Sensor: colorSENSOR CFO100*

# Material analysis & testing



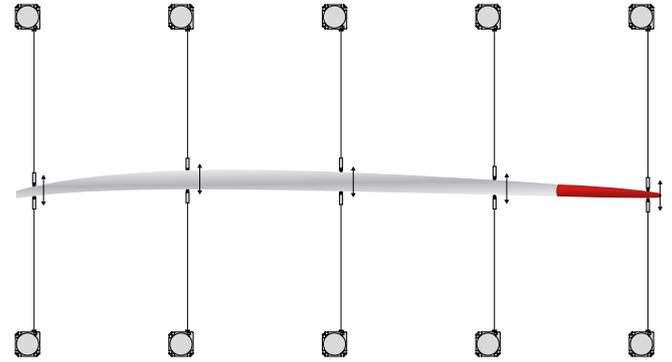
- Inspection and long-term monitoring
- Detection in small and large measuring ranges
- Ideal for multi-channel evaluations



### Deformation measurement of lightweight structures

For the investigation of component deformations under load, specially designed measuring systems are used, which detect the surface contours in a reactionless way. The measuring system consists of a movable half frame on which two laser distance sensors are mounted. They detect the deformation of the components at different load levels. Highly accurate measurement data is recorded with each sensor which produces an overall profile of the deformation.

Sensor: *optoNCDT*



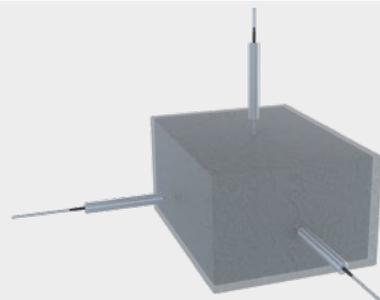
### Stress tests in the rotor test bench

Rotor blades for wind turbines are inspected in test rigs that simulate real loads caused by wind and weather. The tip of the rotor blade can be distorted by up to 10 m due to mechanical loads. Several draw-wire sensors are used on the test rig to monitor the deformation. Two sensors per traction point measure the deflection and torsion of the rotor blade. The draw-wire sensors operate with measuring ranges between 3 m and 10 m. The digital signal provided is used for further simulations.

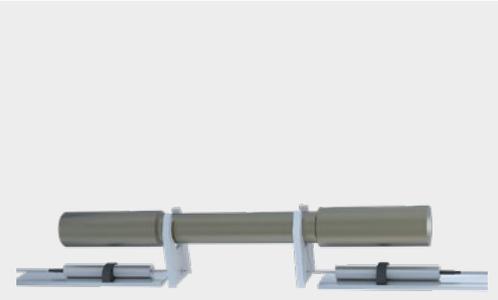
Sensor: *wireSENSOR*



Deformation test under load



Geometry inspection of concrete blocks



Monitoring the axial extension of pipes

### Geometric testing of building materials

Numerous material tests are performed during the development of high-performance building materials. Inductive displacement sensors from Micro-Epsilon are used for geometric testing. These sensors are extremely robust and impress with their high measurement accuracy. The corresponding MSC controller is a multi-channel solution which therefore enables the synchronous recording of several measurement signals.

Sensor: *induSENSOR*

## Sensors and Systems from Micro-Epsilon



Sensors and systems for displacement, distance and position



Sensors and measurement devices for non-contact temperature measurement



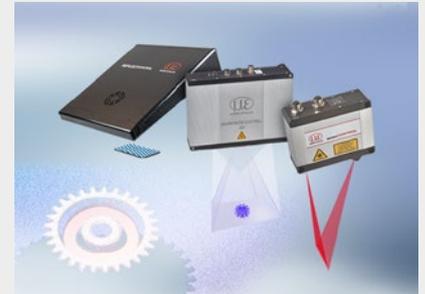
Measuring and inspection systems for metal strips, plastics and rubber



Optical micrometers and fiber optics, measuring and test amplifiers



Color recognition sensors, LED analyzers and inline color spectrometers



3D measurement technology for dimensional testing and surface inspection

## More Precision

Whether it is for quality assurance, predictive maintenance, process and machine monitoring, automation or R&D – sensors from Micro-Epsilon make a vital contribution to the improvement of products and processes. High precision sensors and measuring systems solve measurement tasks in all core industries – from machine building to automated production lines and integrated OEM solutions.



[www.micro-epsilon.com](http://www.micro-epsilon.com)