

# CASE STUDY - RIDDERHAVEN, NETHERLANDS

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## PROJECT SUMMARY

As part of Ridderhavens construction, a material known as OIP (Blast Furnace Slag) was used as a base material under the building and roads. OIP is known to absorb moisture and expand which caused significant cracking of floor slabs and roads. The supporting columns within the structure were also showing signs of severe displacement, raising concerns of potential structural failure. Remedial works have been undertaken to alleviate the OIP expansion pressure on the columns by means of trench excavations. A near real-time monitoring system was installed to provide ongoing displacement analysis and alarming during the remedial works programme to warn construction crews of any significant displacements.

## RESOURCES



### SENSORS

Geosense WI-SOS 480 wireless bi-axial tilt meters with internal thermometers.



### REAL-TIME MONITORING

Geosense WI-SOS 480 central gateway interfaced with Trimble 4D Control.



## PROJECT PHASES

- 1 **BASELINE**  
2 Weeks.
- 2 **REMEDIAL WORKS**  
4 Months.
- 3 **OBSERVATION PHASE**  
1 Year.

## THE DETAIL

Twenty-four tilt meters were installed on a total of eighteen columns. Eight critical boundary columns had both a high and low-level tilt meter installed on the same face, allowing for IPI chain analysis to be performed.

Daily sensor analysis and alarming reports were automatically distributed via email to all stakeholders directly from Trimble 4D. Interpretation of the data indicated that the columns were displacing due to temperature variations within the structure, allowing the OIP to expand and fill any cavities. The resultant effective on the columns showed a net growth displacement in an easterly direction of the structure.

Utilisation of the Geosense wireless tilt meters, and effective campaign design by the LandScope monitoring team, resulted in the realisation of significant time savings and personnel safety during sensor installation.

Conditions														
Wedge	Design	Column	Date Type	Sensor	Level	Micro	Evaluation	Condition Type	Reference Date	if Alert	Attention Threshold	Warning Threshold	Alarm Threshold	No Data Threshold
S	Where	Tilt	Spec	Al	Sens	Micro	Relative Measurement (2)	Direction	22/06/2018 14:30:00	Discrete	±0.78 Al ± 0.001°	±0.78 Al ± 0.001°	±0.78 Al ± 0.001°	Disabled
							0.388°	0.430°	02/06/2018 14:30:00		±0.841 ± 0.002	±0.841 ± 0.002	±0.841 ± 0.002	-
							0.762°	0.714°	02/06/2018 14:30:00		±0.806 ± 0.002	±0.806 ± 0.002	±0.806 ± 0.002	-
							0.722°	0.723°	02/06/2018 14:30:00		±0.811 ± 0.002	±0.811 ± 0.002	±0.811 ± 0.002	-
							-0.111°	-0.141°	02/06/2018 14:30:00		±0.015 ± 0.002	±0.015 ± 0.002	±0.015 ± 0.002	-
							0.028°	0.087°	02/06/2018 14:30:00		±0.008 ± 0.002	±0.008 ± 0.002	±0.008 ± 0.002	-
							0.221°	0.203°	02/06/2018 14:30:00		±0.071 ± 0.002	±0.071 ± 0.002	±0.071 ± 0.002	-
							0.264°	0.168°	02/06/2018 14:30:00		±0.071 ± 0.002	±0.071 ± 0.002	±0.071 ± 0.002	-
							-0.214°	-0.220°	02/06/2018 14:30:00		±0.001 ± 0.002	±0.001 ± 0.002	±0.001 ± 0.002	-