

УДК 528.24

## VERTICAL MOVEMENTS MEASUREMENTS OF EDUCATIONAL CENTRE BUILDING OF WROCLAW UNIVERSITY OF ENVIRONMENTAL AND LIFE SCIENCES

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**Keywords:** precise leveling, vertical displacement measurements of buildings, preparing security solutions to avoid a possible crash of the object.

Measurements, which aim is to provide reliable data of geometric features of constructions, are performed in general since a recorded visible signs of external evidences about the possibility of threats a constancy of buildings. The beginning of the measurements in some cases it is too late. Measurements of subsidence Educational Centre Building at the University of Environmental and Life Sciences in Wrocław, started in October 2006, when cracks of the object walls were found. The building was completed in May 2006, and the measurements were carrying out almost from the beginning of the building operation. (Małowski K., Kuchmister J., 2007, Małowski K., J. Kuchmister, 2008).

A lot of factors may be a reason of buildings stability lack. Before start a operation of building they are: adverse geological and hydrogeological conditions, latent defects and defects of materials, construction and assembling. During the operation: heavy traffic, leading construction works in the neighborhood building, combined with deep excavation and unpredictable ecological disasters.

However, it is impossible to determine a specific impact of most of these factors. Not often it is possible to say whether it actually occurred wrongful act of any factor. Measurements on tested object are performed to determine the causes of scratching walls of the facility, and will help in determining the risk status of the building (Bryś H., S. Przewłocki, 1998).

### Characteristic of research object

Educational Centre Building was built in a flooding area of the Oder river, which riverbed is a few hundred meters from the buildings of the University.

During construction of the building, it turned out, that the soil in place designed for the object is very little concentrated. Despite vibroflotation, or mechanical compaction of soil, after construction, the object began to crack in connecting with an older building, built a few decades earlier. Geotechnical studies have shown, that the carrier material under a part of the building of Environmental Engineering, has been concentrated by works associated with soil tamping on a construction site of Educational Centre Building. It resulted in reducing its volume and consequently collapsing a part of the older building.



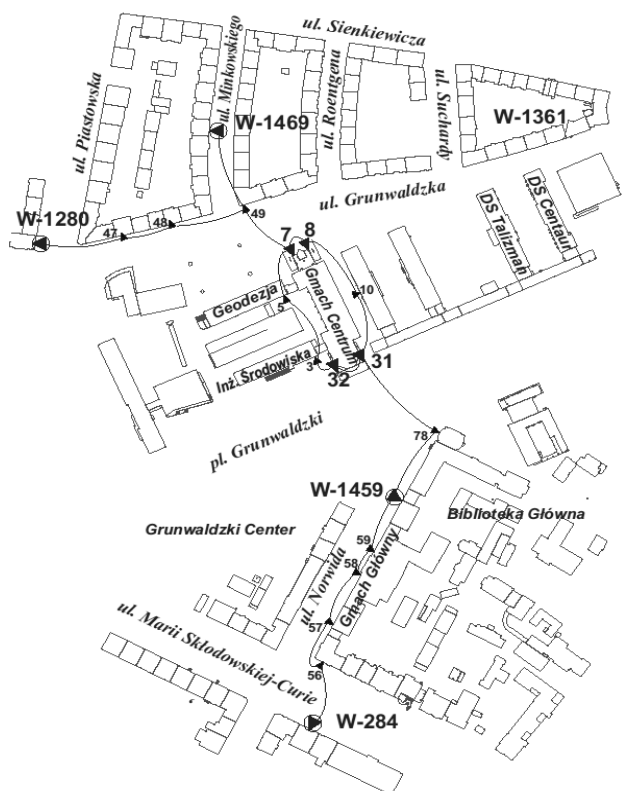


Fig. 1. Network sketch

**Stages of measurements**

The measurements started in July 2006, and further control measurements of the following dates:

- October 2006 – after register crack on the 4th and 5th floor of the building,
- March 2007 – before excavations works on the Grunwaldzki Center facility,
- April 2007 – during excavation works,
- June 2007 – after trench completion,
- April 2008 – after main construction works completion in Grunwaldzki Center,
- August 2008,
- April 2009,
- November 2009
- April 2010,
- June 2010, during a high water level in nearby river ,
- October 2010.

Measurements were carried out by groups of students, members of the Students’ Scientific Circle of Surveyors, using precise leveler Leica DNA03. (Mąkowski K., Kuchmister J., Oblicki R., Karczewaki B., 2008).

The three most recent measurements, which were subjected to a thorough analysis, are the subject of the article.

**Controlled bench marks analysis**

The obtained values of a height difference of controlled bench marks, in full cycle of 12 periodical measurements, are shown in Figures 2, 3, 4 and 5. Bench mark No. 32 was observed only for measurements till September 2008, because it has been destroyed during renovation works of the facade of Educational Centre Building. Analysing the vertical changes of bench marks

shown in Figures 2-5, it is noticeable that after the first phase, in which there is subsidence, due to dewatering ground under facility Grunwaldzki Center, following the phase of lifting, probably resulting of lifting of the ground, through mass loss from the excavation conducted under the above-mentioned object.

The phenomenon is more noticeable for bench marks No. 31 and 32 located closer to build object. In a period after June 2007, after completion of major construction works on the Grunwaldzki Center site, there is a stabilization of the controlled bench marks. A further periodical changes may arise with cyclic annual changes in water level.

Bench marks subsidence determined from the cycle from June to October 2010, possibly due to changes in water level, associated with the flood waters of the Oder river, which took place in summer 2010.

**Conclusions**

Vertical displacements of bench marks located on the Educational Centre Building provides valuable information about vertical changes which take place on the object.

1. The resulting changes in the vertical location of the object, should not constitute a threat to its construction.
2. The results may explain a formation of the cracks in the façade, and structural walls of the building.
3. Changes of water level, caused by excavation works under Grunwaldzki Center site, and the ones resulting of cyclical lifting of water in the Oder riverbed, moved in permanent changes in the ground structure (Wolski, 2001).

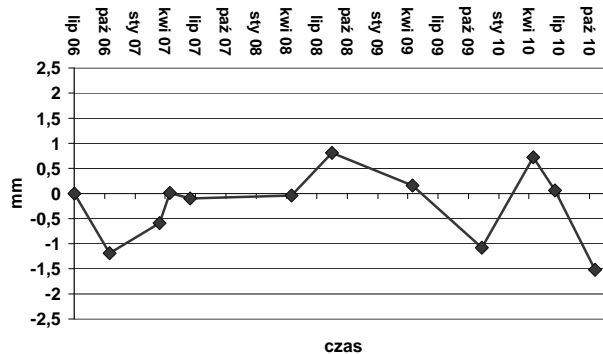


Fig. 2. Graph shows vertical changes of controlled bench mark No. 7

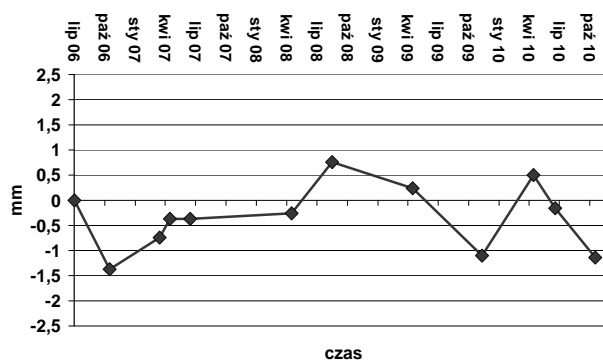


Fig. 3. Graph shows vertical changes of controlled bench mark No. 8

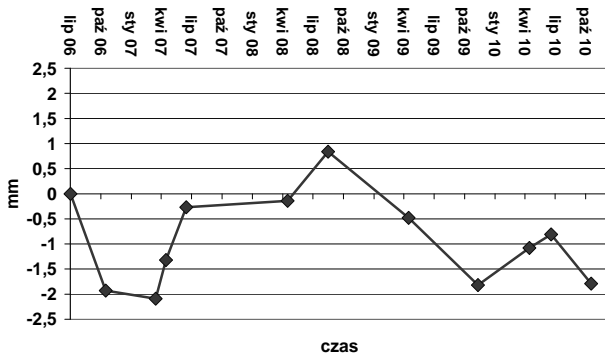


Fig. 4. Graph shows vertical changes of controlled benchmark No. 31

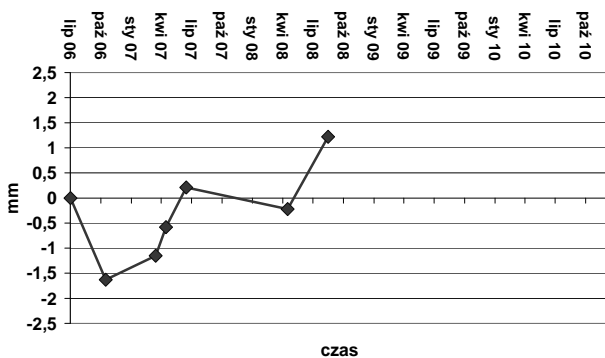


Fig 5. Graph shows vertical changes of controlled benchmark No. 32

### Оцінювання геометричного стану конструкції будинку центрального навчального корпусу Природничого університету в м. Вроцлаві

К. Монкольські, П. Голдин, Я. Казак

Подано результати спостережень за будівлею центрального навчального корпусу Природничого університету в м. Вроцлаві та інтерпретацію змін положення контрольних реперів.

### Оценка геометрического состояния конструкции здания центрального учебного корпуса Естественноисторического университета в г. Вроцлаве

К. Монкольски, П. Голдын, Я. Казак

Представлены результаты наблюдений за зданием центрального учебного корпуса Естественноисторического университета в г. Вроцлаве и интерпретация изменений положения контрольных реперов.

### Vertical movements measurements of educational centre building of Wrocław University of Environmental and Life Sciences

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The article shows results of measurements on Educational Building of Wrocław University of Environmental and Life Sciences, interpretations of controlled benchmark behavior and graphs of their changes.

## Видавництво Львівської політехніки пропонує



За заг. ред. проф. Т. Г. Шевченко  
**ГЕОДЕЗИЧНІ ПРИЛАДИ**

Підручник / Друге видання, перероблене та доповнене / Львів: Видавництво Львівської політехніки, 2009. 484 с.  
Формат 145 x 215 мм. Тверда оправа.  
ISBN 978-966-553-761-8

Затвердило Міністерство освіти і науки України

Викладено основи геодезичного приладознавства, розглянуто теорію, будову, а також способи перевірок та дослідження сучасних геодезичних приладів. Подано відомості з геометричної оптики та оптичних систем, які необхідні для вивчення сучасних геодезичних приладів. Розглянуто теорію та будову основних вузлів геодезичних приладів, а також способи їхнього дослідження. Описано сучасні оптичні та електронні геодезичні прилади, їхню конструкцію, будову, подано принципи функціональні та оптичні схеми приладів. Розглянуто перевірки і дослідження приладів, зокрема й електронних. Сформульовано основні напрями сучасного геодезичного приладобудування.

Для студентів геодезичних спеціальностей вищих навчальних закладів.

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