

Using digital level Trimble DiNi for building vertical shiftings determination

Alexandra POPA, Assist. lect. PhD. stud. eng., Universitatea “1 Decembrie 1918” Alba Iulia, alexandra.popa@hotmail.com

Adrian DREGHICI, eng. S.C. RealTopo S.R.L. Alba Iulia, adrian_dreghici@hotmail.com

Abstract: For a good functionality of a building, it is necessary to observe the building behavior, using precise surveying methods and instruments. The observations must be made at different measuring époques. After computing the observations, the data can be used in order to predict the trends of building behavior.

In paperwork, as a practical example, there are presented aspects concerning the use of the digital level Trimble DiNi for surveying in order to determine vertical shiftings of the sterile deposit “Stejaris”. The sterile deposit has a big importance in the area, being near the river Mures and populated areas. A bad functioning of the sterile deposit may cause damages and negative effects for the environment.

Keywords: building vertical shiftings, surveying methods and instruments, digital level, sterile deposit

1. Generalities concerning the trends of buildings vertical shiftings behavior

The surveying methods used with the purpose of predicting the trends of building behavior are tightly related to the type of shifting and distortion pursued. So, for buildings vertical shiftings and deformations, it is used the geometrical leveling method, the trig leveling method and the hydrostatical leveling method.

These methods can be used separately or combined, depending on the nature of the parameters highlighted for the observed building.

The geometrical leveling method of high precision is the method that provides the highest precision in measuring the vertical shiftings of the observed buildings. It is used in observing the building behavior that requires a high level of precision (buildings, industrial halls, social-cultural edifices, radio and television towers, nuclear reactors, bridges, viaducts, sluices etc.).

Depending on the type, shape and dimensions of the observed building, the geometrical leveling network is created, including tracing marks (placed on the observed building) and control points (placed outside the influence area of the observed building).

The geodetic observation network used in determination of the vertical shiftings of the buildings is an altimetric one, meaning the position of the points that compose the network is defined by a single coordinate, the altitude. With a less accurate precision it is determined the planimetric position for these points. Inside an altimetric network the points are materialized in contouring marks and hall marks.

Generally, a geodetic altimetric observation network is a superficial one, the observation marks being placed on the observed object, being usually stationable and included in line leveling.

2. The Trimble DiNi Digital Level

The Trimble DiNi Digital Level is a digital height measurement sensor designed for any job site where fast and accurate height determination is required. Use the Trimble DiNi for applications such as precise leveling of flat and sloping surfaces, establishing the vertical component of grade and ground profiles, subsidence monitoring, and establishing the vertical component of control networks.

The Trimble DiNi Digital Level lets you:

- Determine accurate height information 60% faster than with automatic leveling;
- Eliminate errors and reduce rework with digital readings;
- Transfer data to the office easily;
- Measure to a field of just 30 cm.

The easy-to-use and accurate Trimble DiNi offers numerous features to maximize your productivity in the field.



Fig. 1. Trimble DiNi Digital Level

The applications that the digital level can accomplish with the “Survey” menu are:

- Single point measurement – allows measuring a single point;
- Line leveling – it is used in the case of line leveling, that can be afterwards calculated and computed;
- Intermediate Sight – it is used in case of intermediate observation;
- Stake Out – application used for level stake-out.

3. Application – The sterile deposit from Stejaris

The purpose of the sterile deposit “Stejaris”, Ocna Mures, is storing the sterile resulted from the manufacturing the chlorosodium and from the purifying of the residual water on unlimited (or undetermined) period of time.



Fig. 2. The sterile deposit Stejaris

Depositing the sterile in the deposit has to be made only in secured conditions, stability and protection of the environment, keeping in mind the fact that near the deposit are agricultural and populated areas and the Mures river.

The residual water is restored to Mures river, and this requires the quality of the rinsed water (that has to fit in the standards established by the environment laws). It also requires the flow and the level that the Mures river has to reach so that an undangerous dilution proportion can be accomplished, in the favor of the flora, fauna and the users downstream.

Hereby, an observation of the behavior of the sterile deposit, by overlooking the deposit of the sterile operation, the draught and the restoration of the rinsed water in the emissary is imposed.

The goals of observing the sterile deposit behavior are:

- ensures the security and tenacity, by tracking down dangerous phenomena and the areas where they show up;
- observing the evolution of predictable phenomena, with possible adverse effects;
- operative signalization of reaching the warning criteria and the limit values given by the measuring and control equipment;
- verifying the efficiency of all the intervention measures applied;
- verifying the impact the sterile deposit has on the environment.

The topographical measuring supervising considers:

- the position of the subterranean water table level;
- the variation of the flow of water infiltrated from the deposit;

- the interior and exterior subsidence of the deposit embankment;
- the efficiency of the antipollution measures stipulated.

In that direction, in the purpose of observing the behavior of the sterile deposit "Stejaris" an geodetic altimetric observation network was determined, consisted of:

- 11 observation marks placed on the deposits' embankment, 8 of them placed upstream, 3 of them downstream. As long as the deposit exploitation will advance, a number of new observation marks will be determined in areas where vertical shiftings are expected;
- 17 control points, placed around the outline of the deposit, but also in the downstream area. These points allow the later determination of other observation marks.

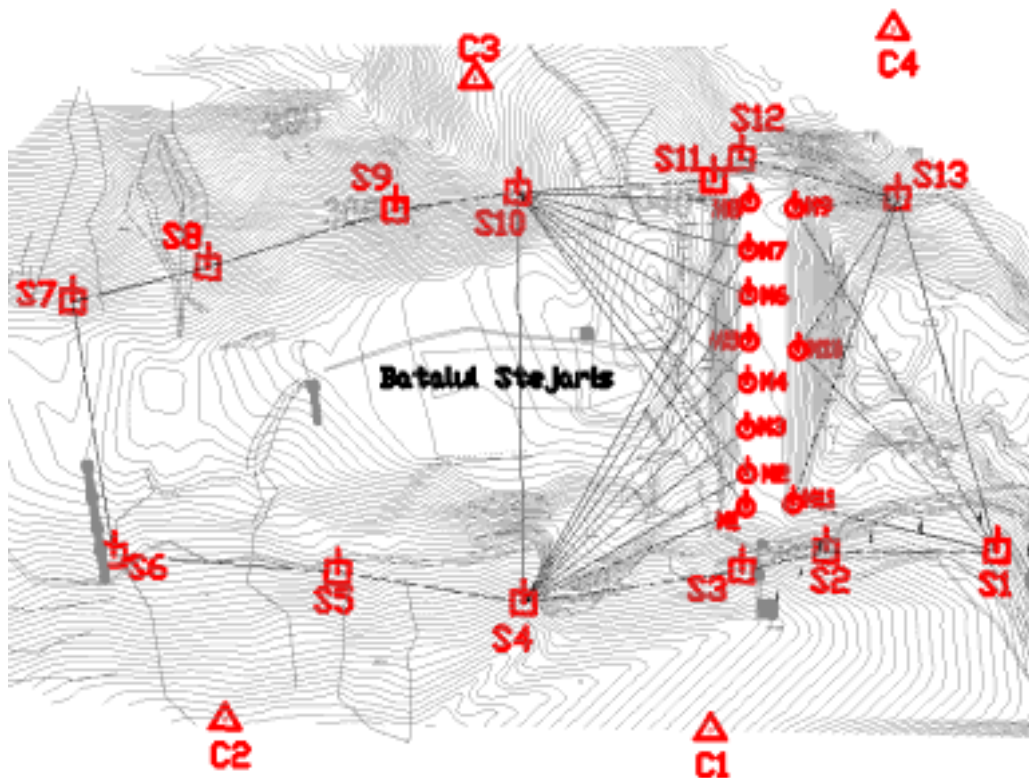


Fig. 3. The geodetic observation network of the sterile deposit Stejaris, Ocna Mures

The observations made within the geodetic observation network for the vertical shiftings determination were made with the digital level Trimble DiNi, and the data processing was made using the soft TerraModel.

```

STATIONINFO 2
  REFSTATION 2      STAFFBACKSIGHT 1.535 STAFFDISTANCE 30.065
  REFSTATION 2      STAFFBACKSIGHT 1.534 STAFFDISTANCE 30.067
  REFSTATION 11     STAFFFORESIGHT 1.929 STAFFDISTANCE 34.769
  REFSTATION 11     STAFFFORESIGHT 1.929 STAFFDISTANCE 34.767
STATIONINFO 11
STATIONINFO 10
  REFSTATION 10     STAFFBACKSIGHT 1.264 STAFFDISTANCE 95.746
  REFSTATION 10     STAFFBACKSIGHT 1.266 STAFFDISTANCE 95.985
  REFSTATION 11     STAFFFORESIGHT 0.147 STAFFDISTANCE 80.080
  REFSTATION 11     STAFFFORESIGHT 0.147 STAFFDISTANCE 80.011
STATIONINFO 11
STATIONINFO 10
  REFSTATION 10     STAFFBACKSIGHT 1.274 STAFFDISTANCE 77.732
  REFSTATION 10     STAFFBACKSIGHT 1.274 STAFFDISTANCE 77.632
  REFSTATION 9      STAFFFORESIGHT 1.434 STAFFDISTANCE 76.037
  REFSTATION 9      STAFFFORESIGHT 1.434 STAFFDISTANCE 76.087
STATIONINFO 9
    
```

Fig. 4. Extract from the observations

Considering the fact that the sterile deposit is still under construction, the measuring époques were set at 3 months range. After finishing the construction of the sterile deposit, the measuring époques will be set at 6 months range in the first 5 years and after that, at 1 year range.

4. Conclusions

After processing the observations made in different measuring époques, different altitudes were obtained for each observation mark.

Marca	Iul 2008	Ian 2009	Dif iul-ian
M2	353,898	353,893	-0,005
M3	353,677	353,657	-0,020
M4	353,261	353,244	-0,017
M5	353,242	353,231	-0,011
M6	353,075	353,062	-0,013
M7	352,707	352,698	-0,009
M8	352,601	352,600	-0,001
M9	352,250	352,247	-0,003
M10	352,420	352,382	-0,038
M11	353,500	353,500	0,000

Tabel 1. Observation mark altitudes at different measuring époques

The differences between the observation mark altitudes show a slowly vertical shifting (sag) of the embankment. Taking in consideration the fact that the deposit is still under construction, these differences have insignificant values and could not have a negative effect on the environment. Though, until the end of the construction period, but also after that, the surveyings are necessary to be done strictly, with high precision instruments – digital levels, like Trimble DiNi – at precise time range or whenever elements that could cause the degradation of the deposit are observed: cracks, level of the water table etc.

References:

1. NEAMȚU, M., ONOSE, D., NEUNER, J., (1988) – *Topographic surveying of building, shifting and distortion, Technical University of Civil Engineering of Bucharest*
2. ORTELECAN, M., POP, N., (2005) – *Topographical methods of observing building and surrounding terrain behavior, AcademicPres Cluj-Napoca*
3. PALAMARIU, M., POPA, A., (2008) – *Observing Terrain and Building Behavior, University „1 Decembrie 1918” Alba Iulia*
4. POPA, A., (2006) – *Geodesical and Topographical Methods Used for observing stability of sterile deposit 5+6 Ocna Mures, Diploma Paperwork*
5. POPA, A., (2007) – *Surveying Methods Used for Vertical Shifting Determination for Sterile Deposits, RevCAD'07, University„1 Decembrie 1918” Alba Iulia*
6. POPA, A., DREGHICI, A., (2008) – *Determination of the geodetic observation network of Sterile Deposit Stejaris, Ocna Mures, RevCAD'08, University „1 Decembrie 1918” Alba Iulia*
7. ***, *Trimble DiNi User Guide*
8. www.trimble.com