Journal of Young Scientist, Volume III, 2015
ISSN 2344 - 1283; ISSN CD-ROM 2344 - 1291; ISSN Online 2344 - 1305; ISSN-L 2344 – 1283

STUDIES REGARDING THE DETERMINATION OF GEOMETRIC DIMENSIONS AND GEOMETRICAL DEVIATIONS COMPARING WITH THE PROJECTED ONES FOR FUEL TANKS

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Abstract

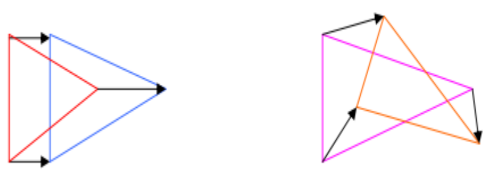
The study was realised having purpose to make the topographical measurements in view of determining the geometrical dimensions and the geometrical deviations of the tank for rating his technical condition. First of all we made the recognition of the placing area of the tank subjected to determinations and in the same time the visual inspection was made and were determined a number of 16 stationary points . For the field work were used full stations and GNSS receptors. The geometrical dimensions and the geometrical deviations of the bottom of the thank were determined by inside measurements from one stationary point . The measurements processing was made with specialized programs from my own equipment. The results of the measurements regarding the geometrical dimensions and the shape deviations of the tank have been submitted in specialised statements provided by the beneficiary.

Key words*: fuel tank, geometrical dimensions, deviations, deformations, measurements.*

INTRODUCTION

The measuring of deformations means all measurements realised to establish a permanent or elastic deformation of objects, under the influence of internal and external forces. Such deformations, and the need to referr them, appear in various fields. Using the topo-geodetic measurement methods has particular importance (Coşarcă, 2011).

The displacement means changing the position of a point of the construction submitted to solicitations and deformation means changing the relative distance between the points of that construction (Ortelecan and Pop, 2005).



a) Defomation b) Displacement

Figure 1. Defomation and displacement

The movements may be linear (in the case of translational movement) or square (in the case of rotary movements) (Palamariu and Popa, 2009). In the category of linear movements and deformations are: - settlements, or downward vertical movement of construction foundations due to deformation of the foundation soil; - Bulging or lifting up which is the vertical movement of building foundations; - Arrows of some construction elements (beams, columns, slabs) subjected to vertical or horizontal loads causing bending thereof; - Biases due to uneven settlements without interference of geometrical constructions and their component elements, that can be expressed by linear or angular value; - Cracks and fissures, which are breaks in the plane or in separate parts of the structure, due to uneven subsidence and the occurrence of additional stresses; - Horizontal displacements, of some elements of the building or the construction as a whole, due mostly to horizontal forces (pushing the earth, pushing water, etc.), or change in the balance of the soil foundation construction (Pop and Ortelecan, 2005).

MATERIALS AND METHODS

Body of property that has the tank R4 (Figure 2) subject to topographic measurements in order to determine the geometric dimensions and geometrical deviations is owned by Rompetrol Warehouse Craiova , Dolj County.

Figure 2 Fuel tank R4

During field reconnaissance it was identified the site of the 3150 m3 R4 tank and station points were set so that they can perform in all necessary measurements to determine the geometric dimensions and geometrical deviations requested. For the measurements were determined following points:

– starting point and traverse closure, denoted by RPT2;

– point of orientation for the traverse, denoted by RPT1;

– traverse points, marked from R41 to R49 and R410 to R416.

The point RPT2 was established in the tank R4 and RPT1 point was established in the tank R1, both near the wall of the containment tank. R41-R49 and R410-R416 points were established in the 16 rays from the manhole shaft clockwise.

To realise the traverse measurements and sideshot for external details, it was used a total station Leica TCR 1205 (Figure 3), for sideshots representing details inside the tank, it was used a total station Leica TC 410 C, and for determining the coordinates of starting, closing and guidance of the traverse used ProMark2 Ashtech GNSS receivers type. Given the location of the tank R4, i.e. a retention tank with high walls allowing visibility only inside it was established as a method for determining the coordinates of the station points, closed traverse on the starting point.

Figure 3. Total station Leica TCR 1205

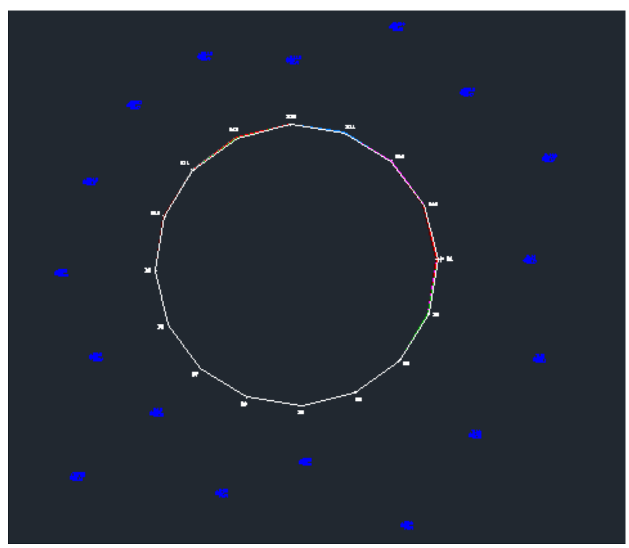


Figure 4 Related to the fuel stations

Outline of measuring the R4 tank - For realizing the measurements with sufficient accuracy , there were used topographic measuring instruments (level and theodolite). The circumference of the reservoir was divided into 16 arcs of a circle (Figure 3), resulting in eight diameters. There were measured :

• The bottom of the tank for each of the 8 diameters ;

• Shell height and verticality deviation measured between core and mantle -cap combination for each of the 16 points on the circumference ;

• The diameter of each sleeve tank for the 8 diameters thereof;

• Local defects of the shell for the entire outer surface thereof .

RESULTS AND DISCUSSIONS

Checking the bottom of the tank geometry R4 - According to Norm C 220 , for tanks made by rolling , local deformations of the bottom of the tanks must fall within ± 30 mm length of 3.00 m . As shown in the bottom profiles (Figure 5), based on made measurements, the measured deviations are above this level. Generally the bottom of the tank has a sinusoidal profile with a minimum in the center and maximum in the area near the mantle.

Compared to the virtual center line of the bottom there were measured large deviations in the following areas:

• Positive deviations between the D1 point and the center tank 40 mm and 43 mm positive deviations between the center of the tank and the 43mm D9 point;

• Negative deviations in the D2 point near the sheath (35 mm) and positive deviations in the opposite diametral area D10 (45 mm);

• Positive deviations in the D3 point near the sheath (49 mm) and in the opposite diametral area D11 (35 mm);

• Positive deviations in the point D4, near the mantle (69 mm);

• Positive deviations in the D5 point near mantle (60 mm);

• Positive deviation in the D6 point near the sheath (61 mm);

• Positive deviation in the point D7 near the mantle (44 mm) and in the opposite diametral area, from the point D15 and the reservoir mantle (57 mm);

• Negative deviation in the D8 point near the sheath (28 mm) and positive drift in the opposite diametral area, from the point D16 and the reservoir mantle (75 mm).

The measurements confirm the results of visual inspection. Also, the measurements yielded relatively high rate differences between diametrically opposed points detailed in Table 1.

Verification of the geometry of the tank shell R4 - According to the Standards R4 tank C220 offset from verticality and the height difference between the top and bottom (Figure 6) must be less than ± 60 mm (tanks manufactured by rolling with a volume of 2000 ... 5000 m^3) .

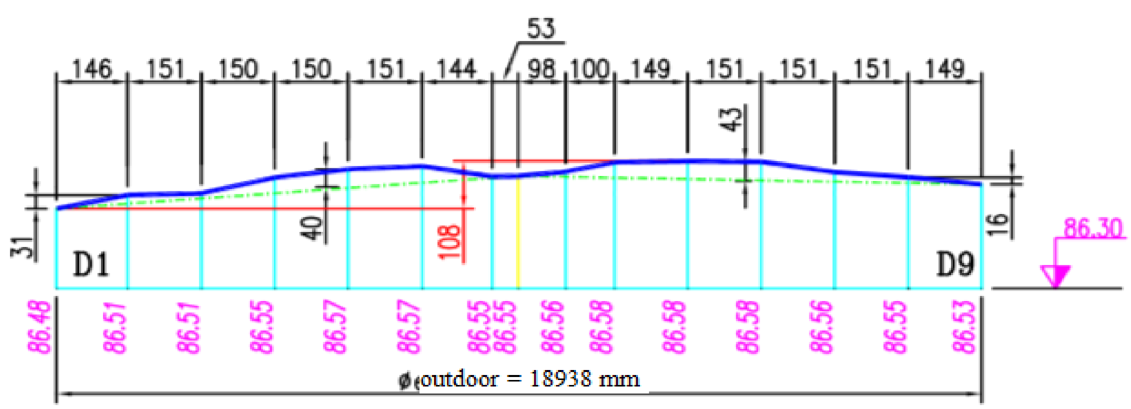


Figure 5. Example of Section of the Bottom (D1-D9 diameter)

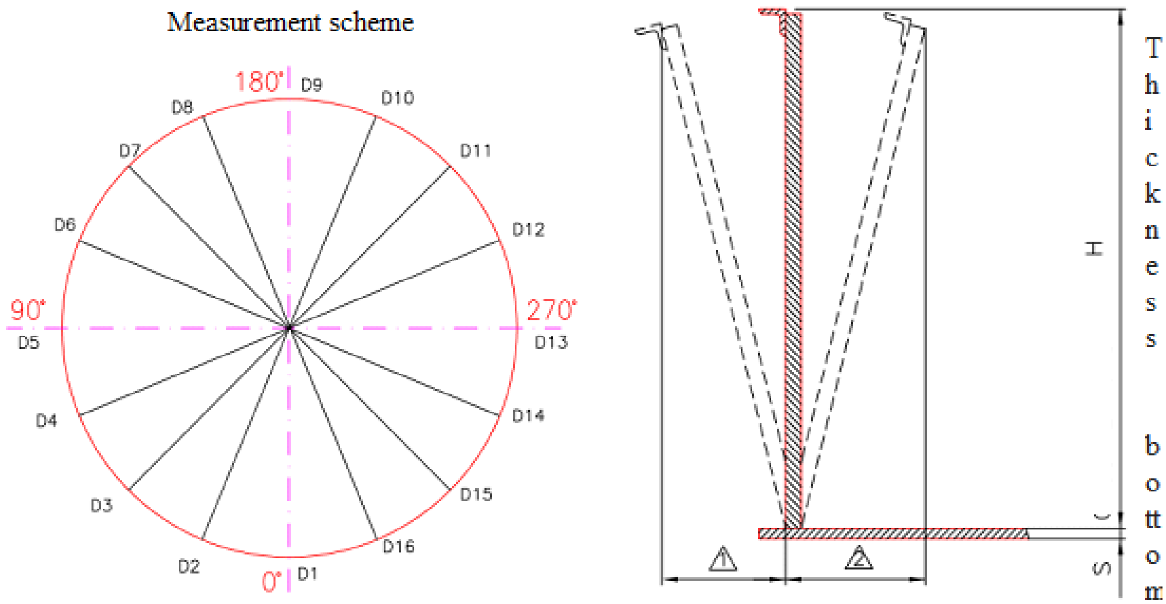


Figure 6. Offset from verticality and the height difference between the top and bottom

From the measurements sheet it is found that the deviation from verticality is in some measure points above the permissible limits according to Table 2.

Deviation from the shell height falls within acceptable limits. The deviation of the diameter of the cover , according to Norm C 220 must be within ± 60 mm . To determine the relative deviation was considered average diameter (arithmetic mean of the diameters measured for each sleeve (Figure 7).

Table 1 - Diameters

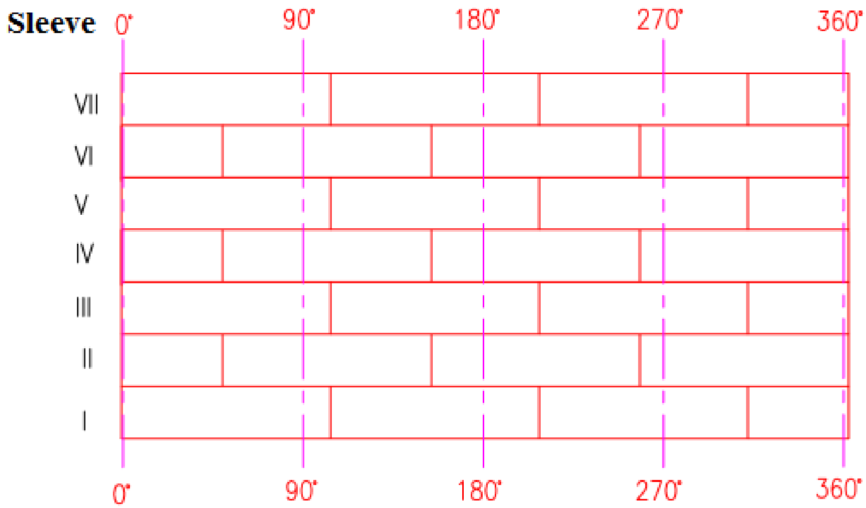
Nr. crt.	Diameter	Share	Difference (mm)
1.	D1 – D9	D1: 86.48; D9: 86.53	50
2.	D2 – D10	D2: 86.45; D10: 86.55	**100**
3.	D3 – D11	D3: 86.45; D11: 86.55	**100**
4.	D4 – D12	D4: 86.46; D12: 86.55	**90**
5.	D5 – D13	D5: 86.46; D13: 86.45	**70**
6.	D6 – D14	D6: 86.48; D14: 86.54	60
7.	D7 – D15	D7: 86.50; D15: 86.51	10
8.	D8 – D16	D8: 86.52; D16: 86.50	20

Table 2. Deviations

Nr. crt.	Measuring point	Deviation (mm)
1.	D1	-94
2.	D2	-72
3.	D10	+69
4.	D11	+97
5.	D12	+86
6.	D16	-62

Sheet measurements shows that the diameter D8 - D16 of the sleeve V relative deviation exceeds allowable deviation . In addition, V2 ... V7 shells absolute deviation , calculated as the difference between the maximum diameter and the minimum diameter of the shell thereof, is greater than the permissible deviation. The largest absolute deviation is recorded for Virola V and lowest for Virola I. Based on data sheet thicknesses tank geometry, resulting average diameter of each sleeve jacket, in Table 3.

Analyzing the data in the table above, it appears that the maximum difference between the inner diameters is 18974-18952 = 22 mm. Concerning the local deformations (concavity, convexity), Norm C 220 requires it to be within the range ± 12 mm on length of 1.00 m. Sheet measurements shows that the tank has 17 local deformation zones (Figure 8) exceeding the allowable deviation. Most of them are in the area between the axes of 90° and 180°, on the entire height of the tank, which is the welding of the mounting on site, of the shell.



Measurement scheme

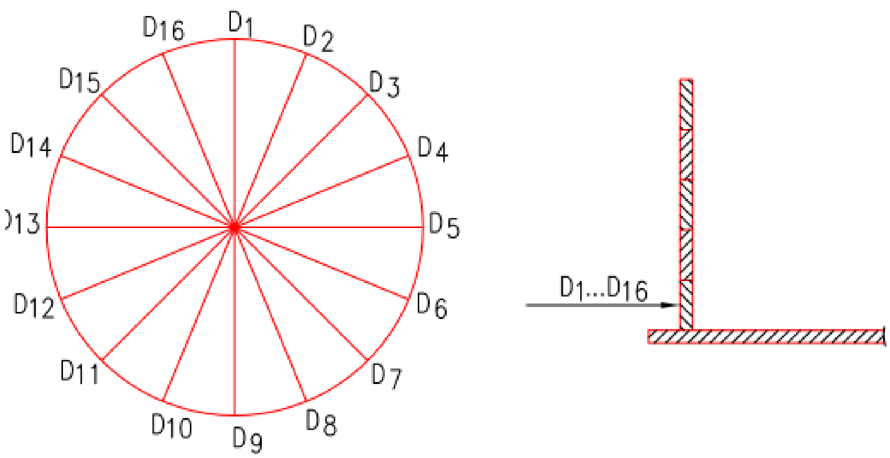


Figure 7. Diameter of the cover

1. A negative deviation: the distance between the perpendicular lower point of welding of the sheath to the cap and the horizontal plane of the container is in its interior. Positive deviation: the distance between the perpendicular lower point of welding of the shell with the cover of the container and the horizontal plane is situated outside it.
Verification of R4 tank compaction - No measurements were performed to establish the foundation subsidence but measurements analysis revealed a mean difference of level between the top and bottom of the tank and the foundation ring of about 6 cm. This value can be regarded as settling tank on the elastic bed of the foundation...Sheet measurements shows that the bottom subsidence occurred in the points D1 ... D5 and between axes 0 and 90 of the tank. On the other hand, an attempt to seal the space between the shell and the foundation ring with asphalt mortar does not lead to the prevention of water infiltration below the bottom of the tank.
Moreover, this measure could exacerbate corrosion of the weld bottom corner and outer sheath because the water does not evaporate from the area after the cessation of the rain. During winter, the frozen water in the area of contact between asphalt mortar and combination bottom-shell also hastens corrosion.

Nr. crt.	Number sleeve	Average diameter outdoor (mm)	Average thickness of the sheet (mm)	Average diameter interior (mm)
1.	V1	18972,5	8,65	18955
2.	V2	18982	7,74	18966
3.	V3	18987	6,72	**18974**
4.	V4	18966	6,65	18953
5.	V5	18972	6,70	18959
6.	V6	18965	6,71	**18952**
7.	V7	18972	6,63	18959

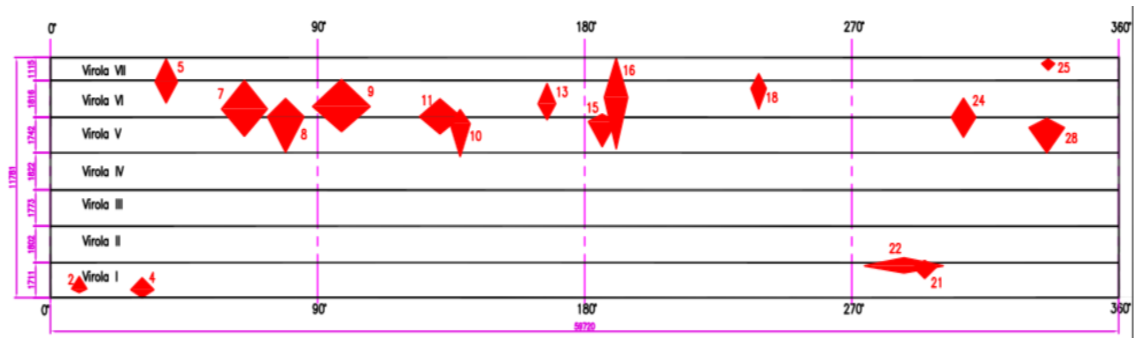


Figure 8 Local deformation zones

CONCLUSIONS

The causes of deformations can be summarized into two groups: a) deformations that may occur due to the action of permanent or temporary factors: nature of the terrain, the static structure of the building, normal wear or responding to changing meteorological factors; b) deformations that may occur also because of mistakes in execution, the use of improper materials or due to external influences such as earthquakes, vibration, flooding or underground works.

Particular importance of displacements measurements is given to the fact that it can achieve both geometrical sizes actual control (displacements, size, flatness, roughness) and the fact that a number of other physical quantities can be determined by measuring the effect produced by this materialized effect by the movement of a point (pressure, force, level, temperature, etc.) which are usually characterized by small movements (linear and angular).

Following studies on reservoir R4 on determining the geometric dimensions and geometrical deviations is found that the largest deformations are between axes 0 and 90 of the tank. Measurement, processing, calculation and representation settlements, horizontal displacements or inclinations of higher buildings can be done today with Topo-geodesic modern technologies, automated, which associated with the correct application of specific methods, gives the guarantee of a fair highlights of instability phenomena of the buildings.

Thus, based on studies and concrete results in various stages of research, we found that choosing the correct methods and appropriate technology, is sure a correct interpretation of the measured values and further processed on the basis of calculation algorithms based on the concepts of processing the observations of the theory of measurement errors.

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