ANALYSIS OF DISPLACEMENTS FOR FLUE GAS DESULPHURIZATION UNIT OF TERMAL POWER PLANT TURCENI

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***Abstract**: Thermal power plants are part of important buildings B and the law benefits tracking behaviour while the behaviour of building. Upgrading this building through building new gas desulphurisation installations led to the need to extend the existing networks and to build new tracking networks, and integration with old networks. Specifics construction and forces acting on these newly built plants require careful and rigorous tracking of movements that may occur during their operation.*

***Keywords:** thermal power plants, vertical displacements*

1. Introduction

The significant increase in the volume of civil, industrial, socio-cultural and hydro constructions, the increase of communication paths and artworks, the gradual replacement of traditional building procedures and the implementation of new ones, faces specialists with the need for more detailed knowledge on the changes of geometric figures and of the buildings' spatial positions, both during drafting the execution projects, when trying the construction elements and structures, as well as during implementation and operation.

Improved quality construction and optimal solutions in terms of socio-economic are achieved by adding laboratory experimental research to the strength and stability calculation. The laboratory experimental researches are performed on models, with construction measurements and observations in nature and by means of high-tech devices and methods.

2. General data on the studied objective

Tracking the buildings' behaviour through various means has been and will remain a very important activity for their managers. This action leads to data on the construction's condition and on any of its atypical behaviour phenomena. This information enables appropriate and timely decisions before they become dangerous. In addition, both in our country and worldwide, there are legislative provisions requiring directors or their owners to monitor the behaviour of a building throughout its life.

Turceni Thermal Power Plant is the largest thermal power plant in Romania and provides, with an installed capacity of **2,310 MW**, about 10% of the annual electricity consumption of Romania. Together with the other two energy complexes in Oltenia (TPP Rovinari and TPP Craiova), it covers about a third of Romania's electricity production. In the context of Turceni TPP concerns on pollution reduction, in 2013, the installation of flue gas desulphurisation was completed. It consists of the following construction elements: limestone storage building, limestone-crushing building, limestone grinding building, substation

building, absorber drainage tank, oxidation station building, 4 towers for gas pickup, treatment and exhaust, plaster storage building.

Fig. 1 Turceni Thermal Power Plant

Since the constructions that compound this gas desulphurization plant, fall into the B class of importance, they benefit from the special tracking programme, which provides inclusively biannual geodetic measurements in order to determine the vertical displacements occurred during the operation. These settlements are mainly due to the vibrations occurring during the operation. They manifest more in the towers of flue gas takeover, treatment and exhaust, in the limestone crushing and grinding units, as well as under the large charge the structures of the limestone and gypsum storage buildings have to support.

3. Physical manifestation of the levelling network

The special programme for tracking the construction requires determining the vertical displacements of the constructions composing the desulphurization plant. To achieve this project, a lift network was designed consisting of three new fundamental benchmarks, 76 tracking benchmarks fixed in the buildings' concrete foundations and 75 benchmarks set on the metal structures(fig. 2).

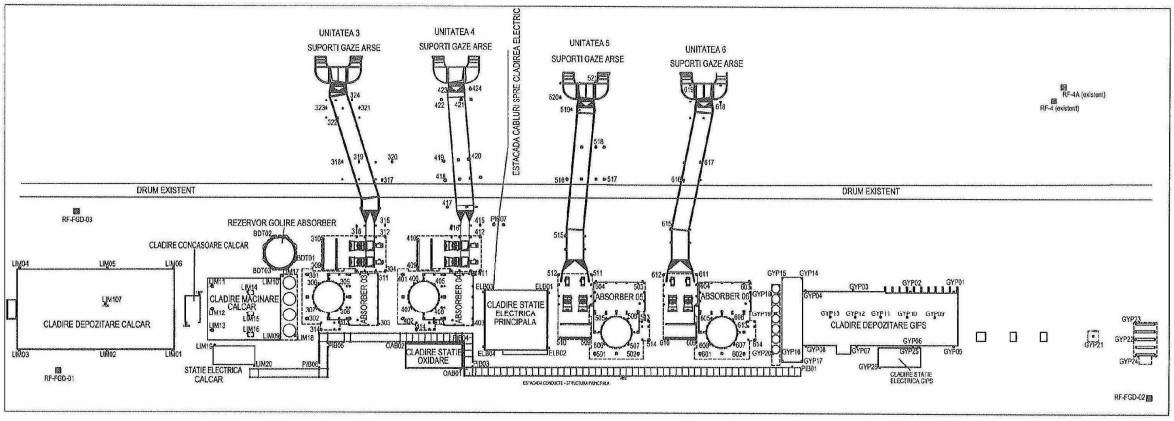

Fig. 2 Placement scheme of benchmark for tracking for vertical movement.

To ensure the stability of the fundamental benchmarks, they were achieved by running a drill to the bedrock where a pipe 219mm wide and 16m long was introduced. The pipe has been previously holed along its entire length. After entering these pipes in the borehole, they were filled with concrete, for it to penetrate through the holes and fix the pipe in the rock. At the end of the pipe, the metal benchmarks were welded.

Because there is intense heavy traffic in the area of heavy trucks carrying limestone for desulphurization, the fundamental benchmarks were protected by building masonry manholes covered with a casting lid and wire netted (fig. 3).

Fig. 3 Fundamental benchmark

The study benchmarks were made of steel and were of two types:

- Benchmarks for tracking the concrete constructions, which were installed by drilling the concrete and their fixing with chemical anchors (Fig. 4)

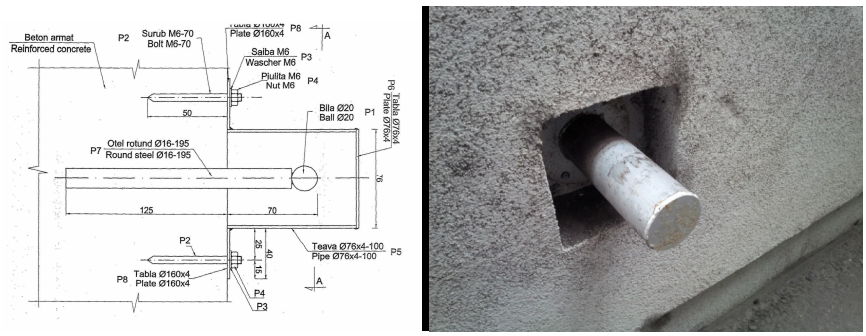

Fig. 4 Benchmark for tracking concrete constructions

- Benchmarks for tracking the metal structures, which were fixed by welding on the steel structure (Fig. 5)

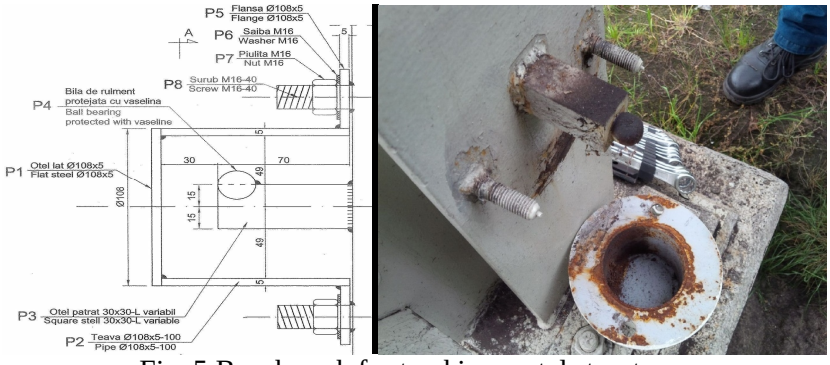

Fig. 5 Benchmark for tracking metal structures

Both benchmark types were protected by fitting painted steel lids and secured with screws.

4. Measurements

The two series of measurements were achieved through the equipment supplied, and according to the specific measurements of deformations applied to this objective, there was used the LEICA DNA 10 kit with 3m invar stages .

The first series of measurements was performed before the plant's commissioning, when 90% of it was built. Approximately two months after the plant's commissioning, the second series of measurements was run.

In order to determine the subsidence of the benchmarks mounted on buildings and installations, the method of preciseness geometric levelling was chosen, at first checking the stability of the fundamental levelling benchmarks consisting of RF4A, RF4, RF-FGD-01, RF-FGD-02, RF-DGF-03 to determine their stability.

RF4A benchmark – a benchmark of the old Turceni Thermal Power Plant network was considered as fixed reference marker in computations and in calculating the main network compensation. The rest of the network benchmarks have settlements due to the fact they haven't completely stabilized remaining as they are relatively newly built.

Based on the benchmarks' level of the fundamental tracking network, topo-geodetic measurements were performed on the levelling benchmarks located on the targets studied.

This was done through levelling traversing performed depending on the location of the fundamental and the levelling benchmarks.

Observations were made through two determinations (turn-return), accepting the 0.05mm carts per level, consistent with the quality required and necessary for such studies.

5. Conclusions

After processing the data collected in the field, the objective's vertical displacements were determined. Of the values obtained, only for a few benchmarks located on major buildings will be presented.

Table 1. Benchmarks levels during the first two series

FUNDAMENTAL TRACKING BENCHMARKS			
BENCHMARK NAME	**LEVEL SERIES 0 - 05.2011**	**LEVEL SERIES 1 - 11.2011**	**LEVEL DIFFERENCE**
	[m]	**[m]**	**[mm]**
RF4A	118.8258	118.8258	0
RF4	119.7045	119.7037	-0.8
RF-FGD-02	117.1884	117.1871	-1.3
RF-FGD-01	117.1206	117.1147	-5.9
RF-FGD-03	118.4185	118.4171	-1.4

LIMESTONE STORAGE BUILDING - EK540073.P.120.2501			
CONCRETE STRUCTURE BENCHMARKS			
BENCHMARK NAME	**LEVEL SERIES 0 - 05.2011**	**LEVEL SERIES 1 - 11.2011**	**LEVEL DIFFERENCE**
	[m]	**[m]**	**[mm]**
R-LIM-b 01	117.7219	117.7211	-0.8
R-LIM-b 02	117.8422	117.8372	-5.0

R-LIM-b 03	117.8034	117.7999	-3.5
R-LIM-b 04	118.8697	118.8676	-2.1
R-LIM-b 05	restored	118.4492	-
R-LIM-b 06	117.8177	117.8166	-1.1
R-LIM-b 07(107)	128.4801	128.4778	-2.3

LIMESTONE CRUSHING BUILDING - EK540073.P.120.2502			
CONCRETE STRUCTURE BENCHMARKS			
BENCHMARK NAME	**LEVEL SERIES 0 - 05.2011**	**LEVEL SERIES 1 - 11.2011**	**LEVEL DIFFERENCE**
	[m]	**[m]**	**[mm]**
R-LIM-b 07	117.7974	117.7930	-4.4
R-LIM-b 08	117.9371	117.9330	-4.1

LIMESTONE GROUNDING BUILDING - EK540073.P.120.2503			
STEEL STRUCTURE BENCHMARKS			
BENCHMARK NAME	**LEVEL SERIES 0 - 05.2011**	**LEVEL SERIES 1 - 11.2011**	**LEVEL DIFFERENCE**
	[m]	**[m]**	**[mm]**
R-LIM-m 09	118.0796	118.0781	-1.5
R-LIM-m 10	118.0489	118.0458	-3.1
R-LIM-m 11	118.3454	118.3405	-4.9
R-LIM-m 12	118.2786	118.2746	-4.0
R-LIM-m 13	118.2809	118.2754	-5.5
CONCRETE STRUCTURE BENCHMARKS			
BENCHMARK NAME	**LEVEL SERIES 0 - 05.2011**	**LEVEL SERIES 1 - 11.2011**	**LEVEL DIFFERENCE**
	[m]	**[m]**	**[mm]**
R-LIM-b 14	118.0107	118.0080	-2.7
R-LIM-b 15	118.0032	118.0007	-2.5
R-LIM-b 16	117.9955	117.9919	-3.6
R-LIM-b 17	restored	117.2085	-
R-LIM-b 18	restored	117.2549	-

LIMESTONE SUBSTATION BUILDING - EK540073.P.120.2504			
CONCRETE STRUCTURE BENCHMARKS			
BENCHMARK NAME	**LEVEL SERIES 0 - 05.2011**	**LEVEL SERIES 1 - 11.2011**	**LEVEL DIFFERENCE**
	[m]	**[m]**	**[mm]**
R-LIM-b 19	restore	117.8160	-
R-LIM-b 20	117.7969	117.7902	-6.7

ABSORBER DRAINAGE TANK - EK540073.P.120.2505			
CONCRETE STRUCTURE BENCHMARKS			
BENCHMARK NAME	**LEVEL SERIES 0 - 05.2011**	**LEVEL SERIES 1 - 11.2011**	**LEVEL DIFFERENCE**

	[m]	[m]	[mm]
R-BDT-b 01	restored	117.2131	-
R-BDT-b 02	restored	117.2115	-
R-BDT-b 03	117.2081	117.2057	-2.4

AIR OXIDATION STATION BUILDING - EK540073.P.120.2506			
CONCRETE STRUCTURE BENCHMARKS			
BENCHMARK NAME	**LEVEL SERIES 0 - 05.2011**	**LEVEL SERIES 1 - 11.2011**	**LEVEL DIFFERENCE**
	[m]	**[m]**	**[mm]**
R-OAB-b 01	117.8347	117.8338	-0.9
R-OAB-b 02	117.8024	117.7994	-3.0

ABSORBER ZONE 03 - EK540073.P.120.2507			
CONCRETE STRUCTURE BENCHMARKS			
BENCHMARK NAME	**LEVEL SERIES 0 - 05.2011**	**LEVEL SERIES 1 - 11.2011**	**LEVEL DIFFERENCE**
	[m]	**[m]**	**[mm]**
R-03-b 03	117.5442	117.5403	-3.9
R-03-b 04	117.5634	117.5600	-3.4
R-03-b 05	117.5166	117.5139	-2.7
R-03-b 06	117.5210	117.5189	-2.1
R-03-b 07	117.5396	117.5316	-8.0
R-03-b 08	117.5145	117.5061	-8.4
R-03-b 09	117.8887	117.8885	-0.2
R-03-b 10	117.9081	117.9069	-1.2

Given the above, the following conclusions arise:

- **RF-FGD-01** fundamental benchmark shows a more pronounced settlement due to its location in the limestone grinding station;
- Subsidence are uniform; there are no cases of uneven (tilt) subsidence;
- It was seen that the largest displacements were recorded at the buildings housing moving machinery (limestone crushing and grinding plant).

6. References:

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