Journal of Young Scientist, Volume IV, 2016
ISSN 2344 - 1283; ISSN CD-ROM 2344 - 1291; ISSN Online 2344 - 1305; ISSN-L 2344 – 1283

DESIGN OF THE WASTEWATER TREATMENT PLANT BUILDING IN HULUBEȘTI VILLAGE

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Abstract

The article refers to the construction of the wastewater treatment plant building from Hulubești village, located in Dâmbovița county, Romania.
The building will be a new rectangular reinforced concrete semi-buried construction. It was adopted the elastic mat foundation type.
For checking the strength of the structure, it has been treated the loads given by: weight, wind, snow, service loads and seismic action. As a result of stability calculations it could be adopted the best solution regarding the building construction.

Key words*:stability calculations, loads, building, construction.*

INTRODUCTION

Wastewater treatment plant is designed to take waste water from street containers and to change its physio-chemical parameters in order to obtain values permitted by legislation for the evacuation.
Construction of the wastewater treatment plant building does not involve any special requirements in terms of structure. Wastewater treatment plant has both underground and over ground components and it is partially covered with the operational building (S.C. ProMs Concept Group S.R.L., 2012).
The positioning of tanks as well as the aboveground components is given by technological characteristics and conditions of the site.
The wastewater treatment plant building has a rectangular structure in plan and is made of monolith reinforced concrete. The foundation will be of elastic mat.

MATERIALS AND METHODS

The materials used for the construction of the wastewater treatment plant building are the following:

- Autoclaved aerated concrete bricks (B.C.A.),quality class GBN30, GBN20 (SR EN 771-4:2004/A1:2005) 30 cm and 20 cm thickness;
- Concrete for structural strength elements classC25/30 (SR EN 206-1, SR EN 13510, CP012/1-2007);
- Reinforcing bars: longitudinal- steel PC52; transversal- steel OB37.

The following material characteristics are taken into account (Table 1):

Table 1. Materials features

CONCRETE C25/30	Compressive strength of concrete	R_c= 25 N/mm^2
	Compressive strength calculation for persistent design situations	$R_{c.calc}$= 16,667 N/mm^2
	Tensile strength of concrete	R_i= 1,5 N/mm^2
	Tensile strength calculation of concrete for persistent design situations	$R_{i\text{-}calc}$= 1 N/mm^2
B.C.A	Specific weight	Y_c= 6 kN/m^3
STEEL	Feature resistance	R= 360 N/mm^2
	Strength calculation	R= 300 N/mm^2
	Elastic modulus	E= 210000 N/mm^2
	Poisson's ratio	ν = 0,3

I considered in the calculations, the following loads (Table 2):

- Weight;
- Snow (SR EN 1991-1-3:2005/NA:2006 TABLE NA1);
- Wind (SR EN 1991-1-4:2006);
- Seismic action (P100/2006);

Table 2. Loads

	Exterior Masonry	Interior Masonry	Current Floor Plate	Terrase Plate Type
Weight	8,576 kN/m	6,806 kN/m	2,16 kN/m^2	2,385 kN/m^2
Snow	-	-	-	1,6 kN/m^2
Wind	0,803 kN/m^2	-	-	0,803 kN/m^2
Seismicity-behavior factor	2	2	2	2

RESULTS AND DISCUSSIONS

The stability calculations are synthetized in Table 3 and demonstrate that the structure checks all the conditions in this regard.

Table 3. Stability verifications

Test	Equation	Value	Conclusion
The pressure on the sole foundation	$p_c = \frac{G_{str}}{A_{as}}$	140,805 kPa	Verification satisfied
Floatability	$V_{FL} = \frac{G_{str}}{R_{FL}}$	5,632	Verification satisfied

Reinforcement sizing calculations were done using SCIA ENGINEER software for plate type terrace; the bending moment diagrams in the X and Y directions are presented below (Figures 1, 2, 3, 4).

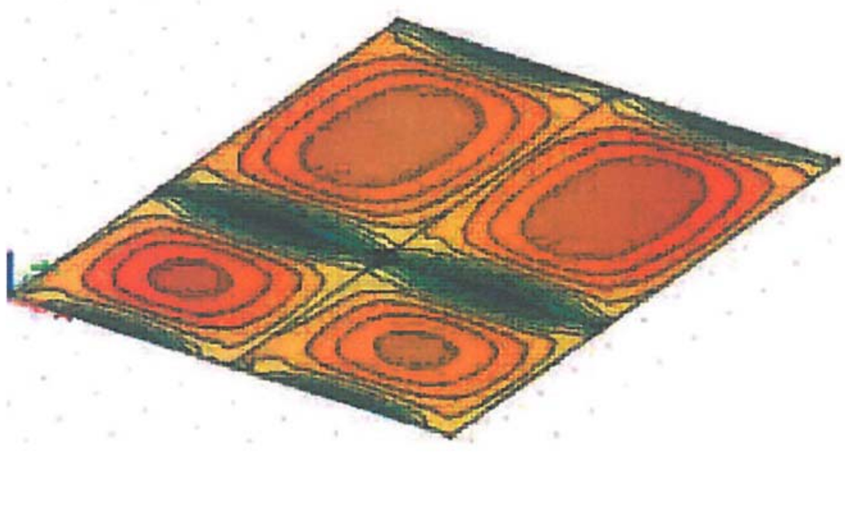

Figure 1. Bending Moment Diagram My- in Plate (Support)

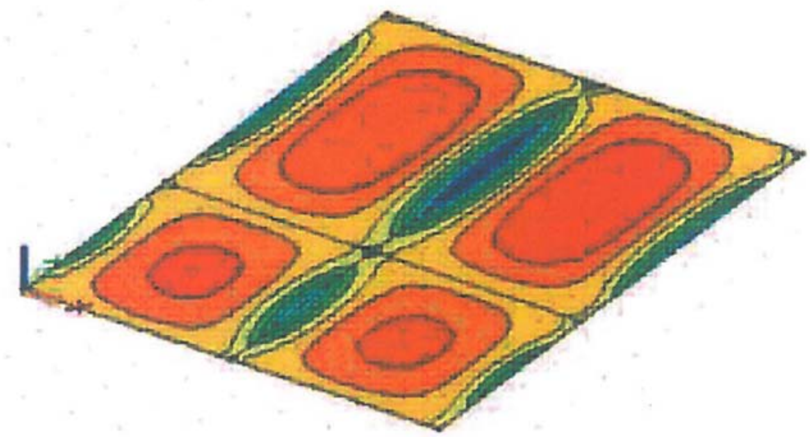

Figure 2. Bending Moment Diagram Mx- in Plate (Support)

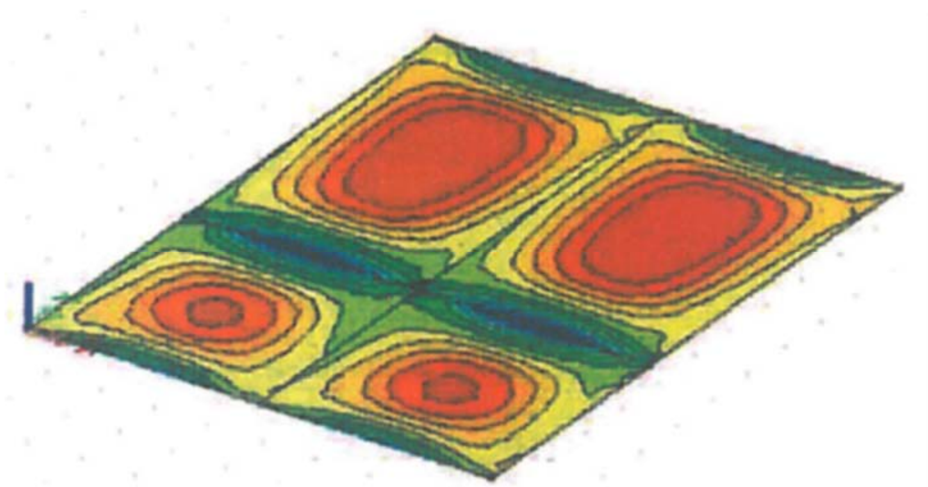

Figure 3. Bending Moment Diagram My+ in Plate (Field)

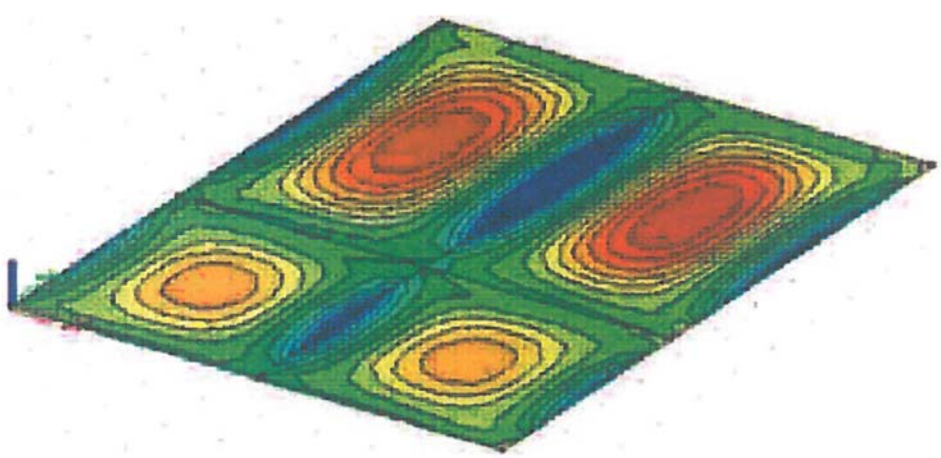

Figure 4. Bending Moment Diagram Mx+ in Plate (Support)

Structural and calculation elements for the analysed structure are presented below (Table 4).

Table 4. Structural and Calculation Elements

Element	Value			
	Field		Support	
	Direction X	Direction Y	Direction X	Direction Y
Plate thickness, t_p(cm)	15			
Maximum moment M_c (kNm)	7,67	9,81	12,25	15,115
The concrete cover plate a(mm)	30			
Effective cross-sectional height h_0(cm)	12			
Bending moment coefficient m_f	0,032	0,041	0,051	0,063
The ratio between the compression area and the effective area ξ	0,032	0,042	0,052	0,065
The minimum calculated reinforcement percentage p_{minc} (%)	0,18	0,232	0,291	0,362
Necessary reinforcement area $A_{a.nec}$(mm^2)	216,573	278,309	349,436	433,987
Reinforcement bars diameter ϕ_b(mm)	8	8	10	10
Bars distance l_b(cm)	15	15	15	15
Effective reinforcement area A_{ef} (mm^2)	335,103	335,103	523,599	523,599

Calculations and diagrams obtained (Table 4, Figures 1, 2, 3, 4) entitles me to propose the following reinforcement:

- For field- direction X and direction Y- bars ϕ 8/15 cm;
- For support- direction X and direction Y- bars ϕ 10/15 cm.

CONCLUSIONS

1. The treatment plant building is indispensable to achieve the goal of wastewater treatment.
2. The shape and size of the building are imposed by technological processes that are required for wastewater treatment.
3. The verification of stability and strength calculations supports the final solutionproposal for the plant building underlying the actual design.

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SR EN 1992-1-1:2004 "Eurocode 2: Design of concrete structures. Part 1-1: General rules and rules for buildings"

SR EN 1991-1-3:2005/NA: 2006 "Eurocode 1 - Actions on structures - Part 1-3: General actions - Snow loads. National Annex",Table NA1

SR EN 1991-1-4:2006 "Eurocode 1: Actions on structures - Part 1-4: General actions - Wind actions"

SECTION 03
DISASTER MANAGEMENT