THE SHALLOW AND DEEP FOUNDATIONS FOR DESULPHURIZATION FLUE GASES PLANTS AT THE THERMAL POWER PLANT UGLJEVIK 1, ACCORDING TO CODE OF PRACTICE AND EUROCODE 7

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Abstract: *The construction of plants for desulphurization fluegases at The Thermal power plant Ugljevik 1, is planned within modernizations The Thermal power plant in according with enviromental rules. The plant is constructed of more objects, which will be founded directly with existin object of The Powerhouse. The complexity of geological terrain construction and the selectio of optimal parameters for objects foundation.*
The conducted researchs are in according with The Eurocod 7 rules, but the budget have been differently carried, for shallow and deep foundations. The shallow foundations is in according with The Code of practice technical norms for building construction foundations, but the deep foundations are in according with The Eurocod 7. There is a common choice of parameters for the separated geotechnical enviroments and their setting in appropriate models. The obtained values are the base for the development geotechnical projects for the foundation of plant facilities.

Ključne riječi: *geological environment, objects, shallow and deep foundations*

1. INTRODUCTION

Within the framework of achieving ecological standards in earlier constructed energetic objects, it is anticipated the plants construction for desulphurization fluegases on The Ugljeviks 1 Thermal power plant. The Plant includes a large number of objects, which will be shallow and deep foundated, right next to the existing object. The geological and geotechnical characteristics are in the 70. years of XX century researched within The construction of The Ugljeviks 1 Thermal power plant, but the results of their resurch are not available. That is why it was necessary to make the new resurch in two phases

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and to give the geotechnical calculation in accordance with The valid Code of practice and Eurocode 7.
The research for the phase of The Conceptual solution, showed that it was the field of very complex geological construction, which is nedeed detailed study, in deppendence of the foundation way, given in The Main project. The moving location plant, in relation to research for the phase of The Conceptual solution, it were required a large number of research works to the depth of the impact of the building on the soil and rocks. The research has been carried in accordance with The Eurocode 7, and calculations for shallow and deep foundations are in accordance with The valid Code of practice and Eurocode 7.

2. GEOLOGICAL TERRAIN CHARACTERISTICS

The field investigation were conducting using exploration drills from 8,0 to 25,o m, in depending on the type of object and the foundation depth. The exploration drills are in full coreed, the Core was photographed, and engineering geological recorded, with taken samples for laboratory tests and again photographed, for documentation materials. In the poor and untied sediments, it were carried experiments of the penetration test, SPT. The samples of the soil and rocks were processed in appropriate laboratory in according with valid Standards for The accredited laboratories. [1].
Parallel to exploration drilling, the field mapping was done on the wider location, to create a complete picture of the field (terrain) construction. It were evidented all spawns on the terrain surface and in the logs, after that performed separation of solid rocky and semi-rocky rock masses of weak and unbounded deluvial, eluvial and alluvial sediments [1,2,3,4,5].
The natural morphology of explored location is as well as its nearly enviromental changed, with the extensive construction activities, for the needs of the construction of The Thermal power plant Ugljevik 1 and unfinished TPP Ugljevik 2, and the surface of the site is covered with technical material.
The natural streams, where the most important river Janja is displaced and regulated in the trough.
The wider terrain area was built by sedimentary tertiary ages, so form subtrat terrain. It is represented by the alteration of black and dark-gray marls, clays and sandstones.
It has rhythmitc character of the cluttering with numerous internal textures, with gradation layer and lamination. According to the author s oppinion, that can be treated as a flees. The rocks of the base mountain are covered with quaternary sediments, which are deposited by Janja river as alluvial sediments. They are represented with tipically development of river deposits, where the bottom deposits are gravel and sand, but the upper part is fine-grained deposits [1,7]. The depth of river sediments is variability in the range from 1,0 to 4,0 m.
The technogenic materials that built the surface part of the location are made clay-sandy-gravel materials with different participation of these individual fractions. The embankment is very often built from gravel and crushed aggregates.
The explored location is characteristic with the presence of faulse, which are registered during the exploratory drilling. There are isolated 4 faults, which make up the network of faults in the wider area. These examples showes us an earlier presence of intense

tectonics, which was particularly manifested in Ugljevik s basin. During the long time, the tectonic activities are muted and there are no elements of modern activity. [8,9,10]
The seismicity of the terrain is at the V and VI levels of MSK-64 for return period of 100 years, but for return period of 200 and 500 years, this is the VII level area of MSK-64. The importanse of objects which belongs to I category, requires detailed seismics research of microlocation objects.
Hydrogeological terrain characteristics are conditioned with heterogeneous lithological components and complex tectonic frame. Depending on lithological composition, porosity type there can be separated rocks based on watertightness level. At the localty of Thermal power plants there are waterproof sediments of intermediate porosity, which are made of alluvial sediments with mostly gravel and sand. With depth to terrain substrate waterproof is lowering, but complex of marls rocks which are made of marl conglomerate and marls sand land is water impermeable [1,7,11] .
Engineeringgeological characteristics of investigated location from surface to depth are usualy made of technogenic parts-embankment, ubound and bound rocks and also bounded halfrocks to mostly halfrocks, Figure 1.

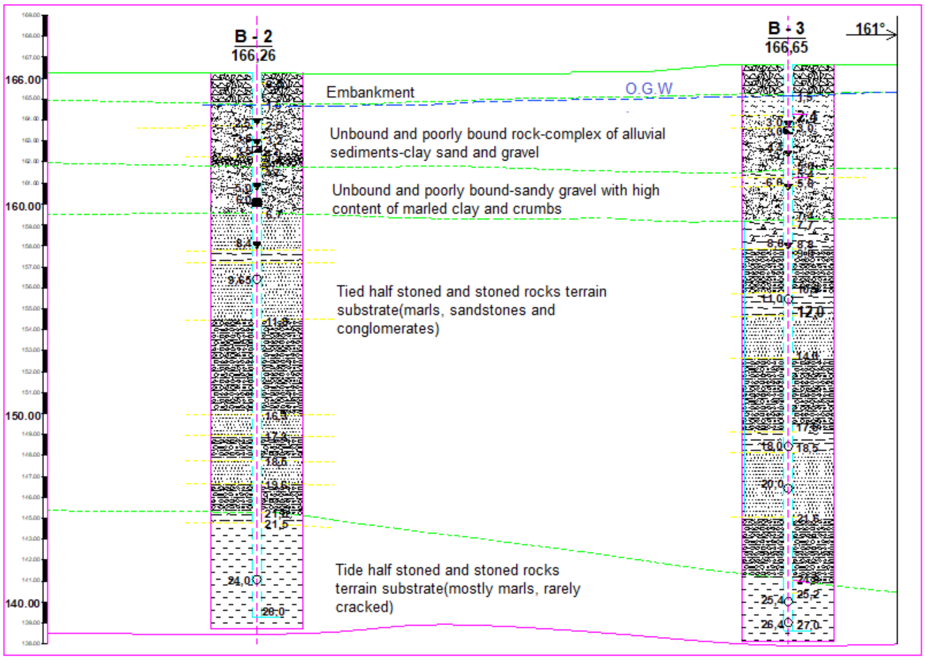

Figure1. Engineering geological type of terrain

Embankment is placed on all terrain profile on investigated location. Thickness is mostly 1.0 meters max to 2.3 meters with heterogenic composition. It is made of clayed gravel and sand in which embankment is placed on entire area of investigated location. His thickness is mostly around 1.0 m max to 2.3 m heterogeneous uneven composition. It is made of clayed gravel and sand with compacted crumbs and breakstone.

Unbounded and poorly bounded rocks, by genetic affiliation, are complex of alluvial sediments, their thickness is from 1.0 to max.5.8 m. The most represented, with depth and horizontal spreading, are clayed sand and gravel. Boundary between sand and gravel is not made clearly and there are variety of sandy gravel and gravely sand. There is not a lot of clayed sediments which do not have spreading continuity, but they appeared as thick lens near the surface. Unbounded and poorly bounded rocks are also in the upper parts of terrain substrate. They are heterogenous wasted and completely degraded terrain substrate rocks, known as cortex of outlay rocks of basic mountains. Their thickness are from 1.5m to max 6.0m, roughly 3.5m. Material composition is made of sandy-gravely fractions with high part of marl clay and crumbs.
Bounded half stoned and stoned rocks are terrain substrate. They are represented with marls, sandstones and congolmerates, which are mostly degraded and crashed, and cracks are changed and rough, mostly field with clayed-sandy material. In deeper parts of terrain there are mostly compacted marl, rarely cracked with subvertical cracks[1,11, 12,13].
Physically mechanical properties of mapped geologically engineered parts which are determined with terrain investigation on the drill holle core and laboratory investigation on the represented samples of individual lithological ground and rock types. Results of terrain identification and clasification with results from laboratory tests made eparration of geological environment in the investigated terrain construction [1,5,11].

3. ANALYSE OF GEOTECHNICAL CONDITIONS OF DESIGN AND CONSTRUCTION OF OBJECTS

Geotechnical characteristic determined from aspect of terrain feature which is working environment for foundation of construction objects. Analyze of results from research and examination is made relative to lithoofacial composition of ground and rocks, their condition, genetic affiliation and physically-mechanical composition.
Unbounded, poorly bounded and bouneded rocks from which is terrain made according to genetic affiliation, are two different complexes of ground and rocks. That is complex of alluvial sediments and complex of terrain substrate rocks or basic mountains. It has been established that within complex of terrain substrate rocks there are differents concernings composition and state of some lithological types, then concerning their spatial placement and mutual relation in terrain construction. That caused their difference concerning physically-mechanical properties, discontinuity, hidrogeological function and... That differences were base for separating three geotechnical environment which are different between each other and they will behave differently with load and unload.
Terrain construction of investigated location are made of four geotechnical location, which are engaged for object construction. Geotechnical environments as the working environments are defined based on physically-mechanical parametres, relevant for geostatic calculations [5,13,14,15,16]:

- results of laboratory samples of ground and solid rocks, taking care of degree of representativity and examination conditions,
- data about real conditions of marl complex and sandstone(lithological rocks of marl complex and sandstone complex((lithological heterogeneity, structured-

textured components, degree of cracks and cracks characteristics, degree of surface degradation)

- existing ones empirical correlation links between physically-mechanical properties, structural properties and level of rock mass (Analysis of Rock/Soil Strength using RocLab)

Geotechnical environment 1 is characteristic of sandy-gravel, alluvial clayed sediments with the thickness from 1.0 m to max 5.8m, roughly 2m. Geotechnical model of first environment is shown in Table 1:

Table 1. Geotechnical model of first environment

Profile sign	Lithological type	Geom. sign	Physically-mechanical parametres	Adopted physically-mechanical parametres
$\mathbf{C^S}$	Sandy clay	CL	γ = 19 kN/m³ c = 18 kPa φ = 12° Mv = 4 000 kPa	γ = 19,0 kN/m³ φ = 20° c = 10 kPa Mv = 8 000 kPa
$\mathbf{S^C}$	Sand, Clayed Pulverulent	SC-SF	γ = 19 kN/m³ c = 13 kPa φ = 18° Mv = 8 000 kPa	
$\mathbf{S^{C,G}}$	Sand, Clayed Gravelly	SC	γ = 18 kN/m³ c = 10 kPa φ = 25° Mv = 10 000 kPa	
$\mathbf{G^C}$	Gravel Sandy Clayed	GC	γ = 18 kN/m³ c = 5 kPa φ = 30° Mv >30 000 kPa	

The most spreading with depth and horizontal spreading have clayed sand and gravel. They are placed on entire location with different thickness from 1.0-4.0 m. In surface level – upper middle part, they are rarely clays with limited spreading-in sight lens. In some areas clay is very slimy, very compressible.

Geotechnical environment 1, is suitable for shallow foundation of objects, thinking of waterground which is located at average depth of 2.0m. If shallow foundation is relyed on slimy sediments, change of material in foundation underground.

Geotechnical environment 2, has products of rocks composition on background – sandstone, conglomerates and marls. They are represented with mostly clayed sand in which are placed unbreakable rocks remains. Locally in surface part of environment, marled clay can be found with clayed gravel and crumbs. On Figure 2 middle is assigned with 2, and geotechnical model is shown in Table 2.

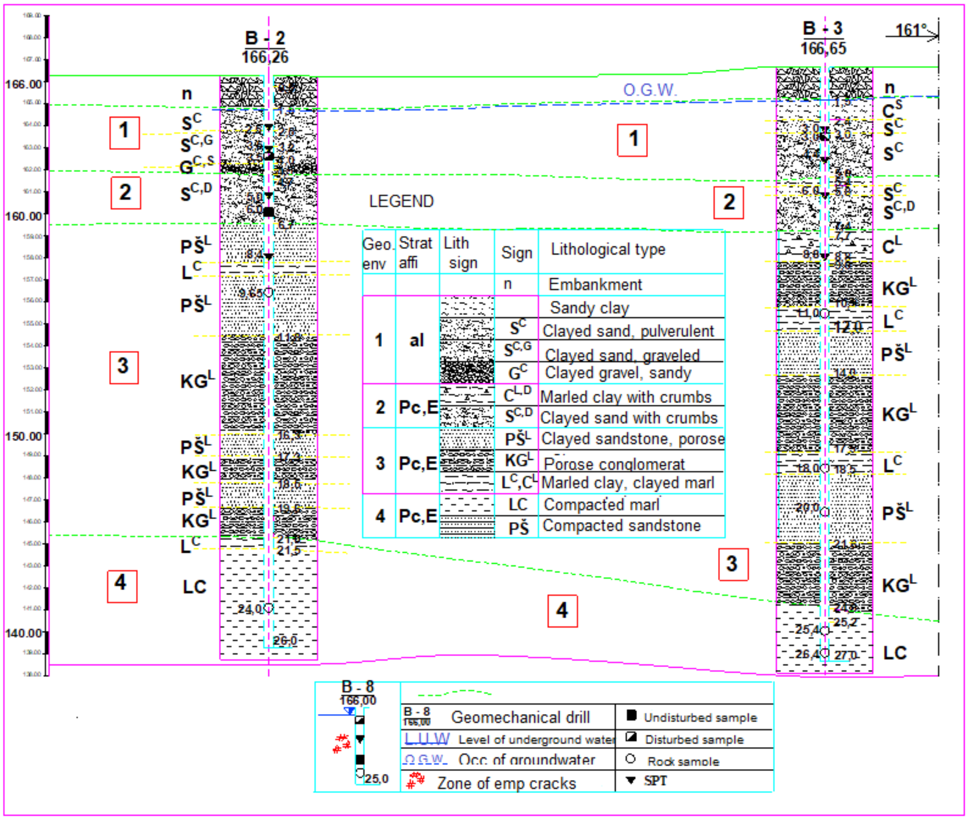

Figure 2. Geotechnical terrain profile with separated geotechnical environments from 1 to 4

Table 2. Geotechnical model of 2nd environment

Profile sign	Lithological type	Geom. sign	Physically-mechanical parametres	Adopted physically-mechanical parametres
$C^{L,D}$	Marly clay with crumbs	CL	γ = 19 kN/m³ c = 20 kPa φ = 17° Mv = 5 000 kPa	γ = 19 kN/m³ φ = 22° c = 10 kPa Mv = 10 000 kPa
$S^{C,D}$	Clayed sand with crumbas	SC-SF	γ = 19 kN/m³ c = 10 kPa φ = 26° Mv >25 000 kPa	

Clayed sand with crumbs and extracts of rocks has the most part in environmental material. In his base are placed sandstones and conglomerates which give sandy-crumbs material with decomposition. Marled clay with rock parts appear in lens shape thickness to 2.0m. Whole thickness of geotechnical environment 2 is very various, maximum to 6.7m, roughly 3.0 m.

Environment is portative, good for foundation, both shallow and deep foundation. There is no water but when they are strong rains there is smaller water quantity timly bounded on rain period. In wide excavation, deeper than 2.0m, besides good physically-mechanical characteristics, there is need to calculate slope stability.

Geotechnical environment 3,is characterized with components and composition substrate terrain rocks. That are sandstones, conglomerates, marls and marled clay.Rock complex terrain substrate is not heterogeneus only by lithological composition than the rocks with different grades of crkacks and degrading. There are separated lower and higher horizonts of substrate terrain rocks, Figure 2.

This environment is represented with rock of higher horizon terrain substrate. In lithological way, they are sandstones, conglomerates in less norm, marls nad marly clay. Sandstones and conglomerates are bigger rocks, with marly binders, so friable, cracked and divided in smal blocks within the cracks. Cracks are filled with marl clay. In vertical section they are conglomerates changes and sandtones in horizontal spreading, with usually exclusion. Geotechnical terrain model, in boundaries of geotechnical 3 is shown in table 3:

Table 3. Geotechnical model of 3rd environment

Profile sign	Lithological type	Geom. sign	Physically-mechanical parametres	Adopted physically-mechanical parametres
PŠ^L	Sandstone, clayly, friable	rock	γ = 22 kN/m³ φ = 25° σ = 4 MPa c = 30 kPa ν = 0,35	γ = 22 kN/m³ φ = 28° c = 30 kPa σ = 3 MPa ν = 0,35
KG^L	Friable conglomerat	rock	γ = 22 kN/m³ φ = 30° σ = 3 MPa c = 30 kPa ν = 0,30	
L^C,C^L	Clayed marl and clay	rock CL-SC	γ = 19 kN/m³ φ = 18^0 σ = 1,5 MPa c = 25 kPa ν = 0,30	

Total thickness of geotechnical environment is roughly 14m, but it goes in depth to 20.0m. Environment is good for support, stable, adequate for deep foundation.Because of very often changes of lithologicall members and their condition thinking of cracks, it is necessary during the drilling for deep foundation, drilled material continuosly mapp and follow with laboratory experiment.

Geotechnical environment 4 is characterized with rocks from lower horizon of terrain substrate. That are marls and sandstones. Marls are more represented relative to sandstones, so it can be said that whole environment is made with marls with stripe sandstones. Thicker layer is presented on latest depths of reserach, from 18 to 23.0m. Geotechnical model of this environment is shown in Table 4:

Table 4. Geotechnical model of 4th environment

Profile sign	Lithological type	Geom. sign	Physically-mechanical parametres	Adopted physically-mechanical parametres
LC	Compacted marls	rock	γ = 22 kN/m³ φ = 28° σ = 8 MPa c = 40 kPa ν = 0,28	γ = 23 kN/m³ φ = 30° c = 40 kPa σ = 8 MPa ν = 0,28
PŠ	Compacted sandstones	rock	γ = 24 kN/m³ φ = 40° σ = 15 MPa c = 70 kPa ν = 0,25	

Rocks cracking is emphasized in this environment. Cracks prevail within interlaced levels. Cracks are compressed or filled with marls clay. In upper level, closer to main congomerates and sandstones, cracks are filled with sand. They are placed on 45° angle to subvertical.
Marls are firmed, and divided with cracks in bigger blocks so RQD values are in range from 60 to 80, rarely < 50. Sandstones are fine, with carbonated and silicated binder, firmed. Till research thickness they do not have continueted spreading, averige thickness is 2.5m.
Foundation environment is good, stable and good for foundation. Foundation will be done with piles, whereby for objects with greater load, allowed capacity is achieving with diameter and length of pile.

4. GEOSTATIC CALCULATIONS FOR OBJECTS FOUNDATION

Obbjects of plant for desulphurization of flue gas are different with civil engineering characteristics and way of foundation. Smaller objects are defined for shallow, and bigger are defined for deep foundation which is shown on Figure 3.
Geostatic calculatons for shallow foundation of objects are made with Code of practice SFRJ (1990) [17], which is valid in state where is object making, but deep foundation is made with Eurocod 7 (EN 1997-1) [5].

Shallow foundation

Objects for shallow foundation are dispersed in plant system, so ther is done geotechnical model for every object accordingly to lithological types [1,13,14,15]. General model which is represented in this work involved all lithological ground levels, while some of them are not identifed on object location, Table 5. In Literature [1] all objects are analyzed separtly. On terrain parts where are slimy layers 2 and 3, it is foreseen material change, and for calculation are used parametres of level 2a.

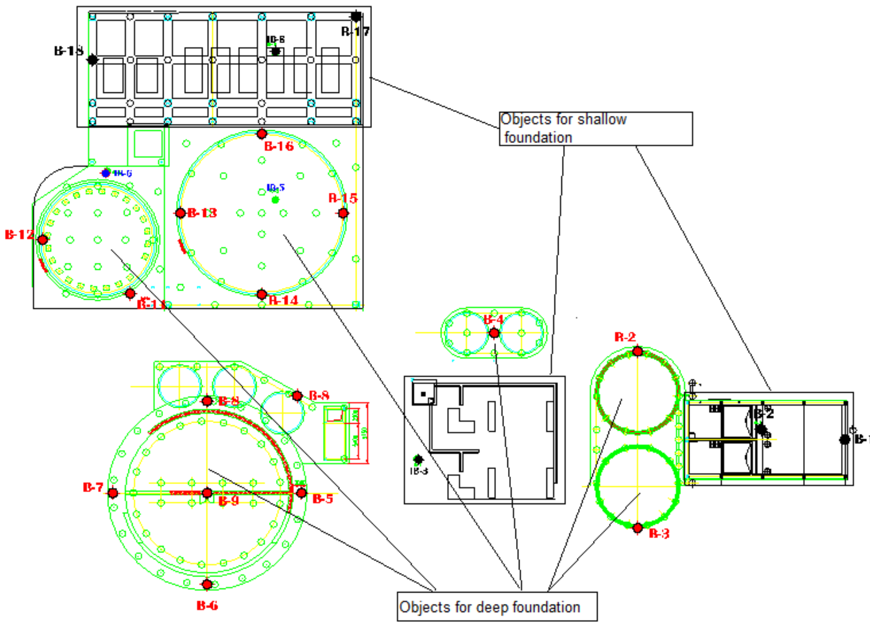

Figure 3. Schedule of objects for shallow and deep foundation

Load bearing capacity and slipping the ground for geotechnical model in Table 5, is shown in Table 6. In estimation are given allowed values for load bearing capacity and slipping ground, allowed load for maximum subsidence from 2.5cm and 1.0cm.

Table 5. Calculating model of geomechanical terrain profile

Sign of work	Sign of layer	Thickness layer from-to	Kind of layer	Model of clutter	Volume weight	Effective cohesion	Eff angle of smoother resist
	-	(m)	-	(kN/m^2)	(kN/m^3)	(kN/m^2)	(^{o})
B – XX	**1**	0.0 - 1.0	Embankment-gravel, sand, clay	-	-	-	-
	2	*1.0 - 2.1*	*Clayed and slimy sand*	*3 800*	*19*	*18*	*13*
	2a		*Clayed and pulverulent sand*	*8000*	*19*	*13*	*18*
	3	2.1 -3.0	Slime and sandy dust	2 000	19	10	18
	4	3.0 - 3.6	Pulverulent sand	8 000	19	13	18
	5	3.6 - 4.2	Gravel clayed and sandy	30 000	18	5	30
	6	4.2 - 4.6	Sandy and pulverulant clay	4 000	19	18	12
	7	4.6 - 8.0	Clayed sand with crumbs	10 000	19	10	26

Table 6. Calculation of load bearing capacity and slipping the ground

Foundation depth, *layer 2 (sand, clay, pulverulent)* Fundamental panel: D = 1,1 m; D_p = 0,5 m					
Foundation	Dimension(m)	Soil characteristics		Characteristics of the object	
		Allowed bearing load q_a (kN/m^2)	Subsidence s (cm)	Allowed load q (kN/m^2)	Subsidence s (cm)
Plate	11,90 x 13,40	117,98	2,683	111	2.5
				57	1,0
	13,00 x 40,00	122,37	2,807	111	2.5
				57	1,0

The deep foundation

The deep foundation is analysed through the calculation of load capacity and settlement for drill rig, the length of L = 25,0 m and radius = 0,60 m. At the time of analysis of load capacity and settlement, the unit load data for individual objects were not available, so that the account is executed without added constant – occasional load [16,18,19,20,21,22]. At this stage of development of the documents, no detailed calculation of the object load is required, these will be defined at the stage of the development of geotechnical projects.
The soil load calculations were analyzed in the zones of all drill rigs, which were selected according to the certain terrain profiles. In this paper are presented the input data of the drill rig, the calculation of the terrain model and the results of the calculation for the general terrain profile, The Chart 7. The input data are related to geotechnical environments, where the parameter values are addopted, and the depths are changed form one to other drill rig.
The results of calculating the rock limit load for some characteristic profiles and drill rigs (wells), for deep foundation, where is the drill rig length L = 25,0 and radius = 0,6 m, are shown at the Table 8.
The settlement drill rig analyze is made using the Rendolph method, for only one. The calculation was made based on the average module along the shell Es = 10 MPa and the module Eb = 30 MPa, for the geotechnic enviroments 3 and 4. The settlement calculation was made for the Force in drill rig of 1 MPa, where the settlement result is s = 39,23 mm.

5. CONCLUSION

The plant for desulphurization of flue gas is very complex project with a lot of support falilities, which will be differently founded (based). The conducted research on the terrain and laboratory tests, enabled the analysis of a larger number of data, based on which 4 geotechnical environments are separated. These environments in dippending of foundation way, will be engaged for construction. Each environment is defined lithology

of soil and rock, and their physical – mechanical properties. For every environment are adopted the calculation parameters, too.
The shallow foundation is made by a local applicable Rules, and the Eurocode 7, for deep foundation. The range of exploring works are succesfull, so that they can set up certain sections of terrain, and every drill rig on a given profile defined the load capacity with 4 project approach.

Table 7. The calculations of the load drill rig capacity, with the input data for the model.

Drill hole zone B - XX

Data about pile geometry			Correlation coefficient	Underground water depth
Pile length	Shell diametar	Diametar of pile base		
L (m)	D (m)	D_b (m)	= q_{cal} / q_k	Dw (m)
25.00	0.60	0.60	1.08	0.70

Podaci o debljini i parametrima geotehničke sredine					
Geot. environment sign	Subsoil environment	Volume weight	Cohesion	Angle of smoother resistance	Degree of over-cons.
	z (m)	(kN/m^3)	c_k (kPa)	k (step)	OCR
1	2.40	19.50	10.00	20.00	1.0
2	3.40	20.00	15.00	22.00	1.0
3	9.40	22.00	30.00	28.00	1.0
4	26.00	22.00	40.00	26.00	2.0

Results of limit load of pile according to EC7

Project approach	Proj. valu of pile resistance	Pile type		
		Refute pile	Drilled pile	CFA pile
PP1/K1	$R_{c,d}$ (MN)=	-	4.85	-
PP1/K2	$R_{c,d}$ (MN)=	-	3.72	-
PP2	$R_{c,d}$ (MN)=	-	5.07	-
PP3	$R_{c,d}$ (MN)=	-	3.17	-

Table 8. The calculations results of drill rig load capacity using Eurocode 7.

	Profile 2 – 2			Profile 3 – 3							Profile 4 – 4	
	B-12	B-13	IB-5	B-7	B-9	IB-3	B-19	B-2	IB-2	B-1	B-2	B-3
PP1/K1	4.85	4.75	4.86	4.58	4.63	5.03	4.61	4.49	4.42	4.78	4.50	4.33
PP1/K2	3.72	3.64	3.73	3.51	3.55	3.85	3.53	3.44	3.39	3.67	3.45	3.34
PP2	5.07	4.97	5.08	4.79	4.84	5.26	4.82	4.69	4.62	5.00	4.71	4.55
PP3	3.17	3.06	3.15	2.94	2.98	3.32	2.93	2.83	2.78	3.10	2.84	2.71

REFERENCES

[1] Study of geomechanical terrain research for the needs of the design and construction of flue gas desulphurization plants of TE Ugljevik, **2016.**

[2] Đurić, N. *Hydrogeology and engineering-geological research,* Subotica Bijeljina, The Faculty of Civil engineering, Technical Institute**, 2011.**

[3] Najdanović, N. i Obradović, R. *Mechanics of soil in engineering practice*. Beograd: Mining Institute, **1981.**

[4] Maksimović, M. M. Mechanic of soil, the second edition. Beograd: Čigoja print, **2000.**

[5] Eurocode 7. Desing assisted by fieldtesting. European Commitete for standarization. Brussels. **1997.**

[6] Čičić S., Mojičević M., Jovanović Č., Tokić S., Dimitrov P. *OGK SFRJ 1:100000, list Tuzla, Beograd, Federal Geological Survey*, **1980.**

[7] Đurić N. The significance of geotechnical research for the installation of flue gas desulphuriration plants TE Ugljevik. XVI Congress of Geologists of Serbia with international participation. *Donji Milanovac, Srbija*, str. 619-623, **2014.**

[8] Nedeljković S., Đurić N., Popović M. Some aspects of the seismic risk of the building site of TE Ugljevik- 3. The collection of papers Archive for technical sciences, num 7, Technical Institute *Bijeljina*, **2012.**

[9] Đurić N., Nedeljković S. Defining the earthquake hazard and project parameters of seumicity at the site TE Ugljevik 3. The fourth scientific expert international consulting: „The earthquake engineering and engineering seismology. *Borsko Jezero, Srbija*, str.107-114, **2014.**

[10] Idriss I. M., Boulanger R. W. Semi-Empirical Procedures For Evaluating Liquefaction Potential During Earthquakes. P*roceedings of the 11th ICSDEE & 3rd ICEGE, Berkeley, California, USA,* pp 32 – 56, **2004.**

[11] Đurić N. Main characteristic of the terrain on the installation site for flue gas desulphurisation of Ugljevik 1, Thermal Power plant. *4. symposium Macedonian association for geotechnics MAG. Struga*. pp. 177-184, **2012.**

[12] Đurić N., Đuran P. Determination of pressing of soft rock at the location of flue gas desulphurisation plant of TE Ugljevik 1. Society for Geotechnics BiH, Proceedings of Works, *"Geoexpo 2014". Mostar. Proceedings of Works* pp. 67-75, **2014.**

[13] Lokin P. *Parameters and classifications of cracked rock masses, Faculty of Mining Geology, Seminar Methodology of rock crash investigation in geotechnics*, Beograd, **1990.**

[14] Mitrović P. Terrain as a working environment for construction – Institute for Roads of Serbia, *Beograd,* **1997.**

[15] Yu H. S. A unified state parameter model for clay and sand, Int. J. Numer. *Anal.Methods Geomechanichs 22(8), pp.621-653,* **1998.**

[16] Ćorić S. Geostatic calculations, Mining- Geological Faculty, Beograd, **2008.**

[17] Rulebook on technical norms for the foundation of construction objects Official paper Službeni list SFRJ, b. 15/90, **1990.**

[18] Huy N. Q., Van Tol A.F., Hölsdher P. *Interpretation of rapid pile load tests in sand ragard to the rate effect and excess of pore pressure*. U Stress Wave, (J.A. Santos, ur.), The 8th International Conference of Stress Wave Theory to Piles; Science, Technology and Practis, Lisabon, **2008.**

[19] Reese C. L, Isenhower W. M., Wang S.T. *Analysis and Design of Shallow and Deep Foundations*. Wiley, **2006.**

[20] Serrano A., Olalla C. *Shaft resistance of a pile embedded in rock*. International Journal of Rock Mechanics and Mining Sciences, Volume 41, Issue 1, pp. 21-35, **2004.**

[21] Serrano A., Olalla C. *Shaft resistance of a pile embedded in rock: Comparison between in situ test dana and theory using the Hoek and Brown failure criterion*. International Journal of Rock Mechanics and Mining Sciences, Volume 43, pp. 826-830, **2006.**

[22] Wyllie, D. C. *Foundations on Rock*, 2th. edition, E&FN Spon, London, **1999.**

PLITKO I DUBOKO TEMELJENJE OBJEKATA POSTROJENJA ODSUMPORAVANJA DIMNIH GASOVA U TERMOELEKTRANI UGLJEVIK 1, PREMA PRAVILNIKU I EUROCODU 7

Resime: *Izgradnja Postrojenja za odsumporavanje dimnih gasova na Termoelektrani Ugljevik 1 planirana je u sklopu osavremenjavanje Thermal power plants u skladu sa ekološkim propisima. Postrojenje se sastoji od više objekata koji će se temeljiti neposredno uz postojeći objekat Thermal power plants. Složenost geološke građe terena i značaj objekata zahtijevali su detaljno proučavanje karakteristika terena i izbor optimalnih parametara za temeljenje objekata.*
Provedena istraživanja su u skladu sa normama Eurocoda 7, a proračuni su različito provedeni za plitko i duboko temeljenje. Plitko temeljenje je u skladu sa Pravilnikom o tehničkim normativima za temljenje građevinskih objekata, a duboko temeljenje prema Eurocodu 7. Zajedničko je izbor parametara za izdvojene geotehničke sredine i njighovo postavljanje u odgovarajuće modele. Dobivene vrijednosti su osnova za izradu geotehničkog projekta temeljenja objekata postrojenja.

Ključne riječi: *geološka sredina, objekti, plitko i duboko temeljenje*