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03.06.04

ZÁVEREČNÁ SPRÁVA

FINAL REPORT

NÁZOV ÚLOHY	:	Kyslíkový aparát č. 9 – príprava územia
TASK NAME	:	ASU 9 – Preparation of the territory
ETAPA PRIESKUMU	:	podrobný inžinierskogeologický prieskum
WORK STAGE	:	detailed ingeneering geological survey
ČÍSLO ÚLOHY	:	2004 05 12 012
DEMAND NO.	:	2004 05 12 012
ZADÁVATEĽ	:	U.S. Steel Košice, s r.o.
CUSTOMER	:	U.S. Steel Košice, s r.o.

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1 GEOLOGICAL TASK AND DATA ON THE AREA
1.1 GOALS OF THE GEOLOGICAL TASK

Geological task title: ASU 9 – Preparation of territory
Cadastre name and identification number: Košice - Šaca township area, 599841
Engineering geological and hydrogeological investigation for the ASU 9 within the US Steel Košice s. r. o. plant area was made according to Contract with U. S. Steel Košice Company. Geological work was carried out in the sense of approved project of geological task.
The aim of geological work was engineering geological exploration of foundation soils in the place of planned construction. The exploration was mainly oriented onto the distinction of single lithological soil types down to 8.0 m depth and their classification in the sense of Slovak State Norms (STN). Further task was the determination of mechanical and physical properties of soils. Laboratory tests, assessment of hydrogeological conditions as well as that of groundwater pollution resulting from anthropogenic activity on construction site result in optimum foundation proposal for single construction objects. The amount of drilling and drill-hole sites within the building site reflects requirements of construction designer. In the frame of exploration, six engineering geological drill holes were deepened into 8.0 m depth each. Drill cores served for semi-disturbed soil sample collection during the drilling aimed at laboratory tests. Setting out from test evaluation and geological profiles, three engineering geological sections have been completed and proposal for construction foundation of single object issued.
Results of completed geological work are summarized in this final report and in appended drawings. For the contractor's archive, one piece of final report is submitted in digital form written in requested formats on CD.

1.2 CHARACTERISTICS OF INVESTIGATED AREA
1.2.1 Characteristics of geological structure

According to the geomorphologic subdivision of Slovakia, the investigated area belongs into the Košice basin region and its sub-unit of Košice lowland. Characteristic feature of area is a flat slowly inclined surface of prolluvial plane, in places completed by slowly dipping valleys and alluvial plains of local streams.
The area is situated in southwestern part of East Slovakian Basin and the geological structure comprises exclusively Cenozoic as well as Quaternary deposits. Cenozoic is built of molasse sediments covered by a Quaternary sheet.

Cenozoic - Sečovce Formation
The formation is generally of freshwater origin composed of clay and claystone alternating with siltstone and with sand, conglomerate, volcanic clastite, carbonaceous clay and lignite seams. Clay and silt beds are generally variegated, grayish yellow, ochre to reddish violet, non-calcareous, composed of illite to montmorillonite and rare kaolinitic layers (or illite-kaolinite mixed clay). Beside variegated colors, claystone to siltstone layers contain variable amounts of psephitic to psammitic admixture. Cenozoic sediments do not outcrop in surroundings because are covered by thick Quaternary prolluvial beds.

Quaternary - Upper and Middle Pleistocene
Quaternary beds occur in wider surroundings as prolluvial sediments.
Prolluvial sediments (Upper Pleistocene) consists of arenaceous to loamy gravel are situated between the US Steel (USS farther) area and Šaca township. The development comprises of fluvial cone of not exceeding 10 m thickness. Gravel is mainly made of crystalline debris.

These are on the surface covered by loamy sediments of variegated thickness.
Prolluvial sediments (Middle Pleistocene) are made of loamy to arenaceous gravel and cover the main part of USS area as well as the area proposed for investigation of environmental conditions. This area is built of pronounced fluvial cone of Ida brook. Gravel is of the same lithological composition as the younger cone superposed onto it.

1.2.2 Hydrogeological conditions of the area

As for hydrogeology, the investigated area belongs to area with proportion of layer type water-bearing beds in Cenozoic as well as Quaternary sediments.
Water bearing beds of Quaternary age are:

- Fluvial plain sediments of Ida brook between Veľká Ida and Nižný Lanec villages (western margin of the area)
- Prolluvial sediments between Šaca and Perín (central part of area).

Fluvial plain sediments of Ida brook attain 3.1 to 7.5 m thickness in the area. A single well may produce somewhere even over 10 l.s-1 yield. Hydraulic parameters of water-bearing layer characterized Jetel (in Kaličiak et al., 1996a) by an average filtration coefficient k = 8.9.10-4 m.s^{-1} reflecting a relatively high, third class permeability.
Prolluvial sediments between Šaca and Perín may be as for hydraulic properties subdivided into two types:

- Middle Pleistocene prolluvial gravel covering the main part of USS area have variable thickness increasing in southerly direction, the average value amounting 2.3 to 14.1 m. Yield of a single well may attain the maximum value of 6.5 l.s-1. Permeability characterized by third class is reflected by average filtration coefficient k = 2.2.10^{-4} m.s^{-1}.
- Lower Pleistocene prolluvial gravel occur southerly from the USS area attaining average thickness of 6 m (maximum 11.5 m) and reflect by permeability 3rd class (relatively strong). A single well obtained here maximum yield of 12.5 l.s-1 (minimum was 1.9 l.s-1).

2 PROCESS OF GEOLOGICAL TASK SOLUTION
2.1 DATA ON WORK REALIZED
2.1.1 Drillings

Drilling consisted of six engineering geological exploration drill-holes to 8.0 m depth. The single drilling sites reflect request of construction designer and are drilled in proposed sites. Mobile drilling rig of UGB 50 M type was used for core drilling without flushing media. The drilling diameter was 171/156 mm lined by technological lining to protect drill-hole collapse. The planned as well as achieved core yield was 100 per cent. The drill core was described by geologist. Drillings after finishing and ground water table measurement were liquidated by filling up using common soil.
Written description of drilling logs is in Appendix No 3 of this final report.
Drill cores of drillings are registered on photographs and taken pictures are in digital form on attached CD.
Sites of drill-holes are in Table No 1:

Table 1

Drilling designation	Final depth (m)	Drilling diameter (mm)	Drilling mouth elevation (m above sea level)	Drilling bottom elevation (m above sea level)

VK-2	8.0	176/156	224.91	216.91
VK-2a	8.0	176/156	225.34	217.34
VK-4	8.0	176/156	225.59	217.59
VK-9	8.0	176/156	224.64	216.64
VK-12	8.0	176/156	225.05	217.05
VK-23	8.0	176/156	224.59	216.59

2.1.2 Sampling and laboratory tests

Drill cores were sampled for semi disturbed soil samples with the aim to test mechanical and physical properties of foundation soils and test their mechanical texture. Altogether seven samples were collected.

The aim of test was to allow soil categorization, to determine their exploitability and to submit data for construction foundation. Tests were made by Ingtest Košice laboratory and results are in Appendix No 4 to this final report. Aggressivity of groundwater onto concrete and steel was tested on a single groundwater sample test made by Sitas Košice laboratory.

To assess rock and groundwater pollution, three soil samples and one groundwater sample were tested for NEL IR. All samples were tested at Ekolab Košice accredited laboratory.

Results of all laboratory tests are in Appendix No 4.

2.1.3 Surveying

Surveying consisted of drilling location and surveying after finishing. Location and surveying was carried out by surveying team of USS Košice.

The following table indicates coordinates of realized drillings and their altitude (Jadran altitude system).

Table 2

Drilling designation	X coordinate	Y coordinate	Z altitude
VK-2	3043.65	11097.40	224.91
VK-2a	3025.10	11097.40	225.34
VK-4	3066.15	11098.55	225.59
VK-9	3055.95	11132.90	224.64
VK-12	3110.35	11125.00	225.05
VK-23	3042.00	11132.90	224.59

2.2 RESULTS OF EXPLORATION WORK REALIZED

2.2.1 Results of exploration work realized

Evaluation of engineering geological as well as Hydrogeological conditions of single construction objects foundation is setting out from the results of realized exploration drilling into 8.0 m depth and from laboratory test result as well.

Anthropogenic made up ground

As anthropogenic made up ground there are distinguished:

- Concrete surface
- Blast furnace slag made up ground

- Loamy- gravel soil made up ground

Concrete surface
Drilling VK-12 (profile 1-1) traversed 0.3 m thick, simple cast concrete without armoring equipment. In 0.8 - 1.1 m depth interval an armored concrete plate was traversed.

Blast furnace slag made up ground
Blast furnace slag was proved by drillings VK-2a into 0.3 m depth from drilling mouth on the outer side of crane track and within the scrap deposit area by drillings VK-2 (0.0 - 1.1 m), VK-9 (0.0 - 0.7 m) and VK-23 (0,0 - 0.8 m). These are incoherent weakly compact seams containing fragments of 10 - 20 cm size.

Loamy - gravel made up ground
Anthropogenic layers of loamy gravel were traversed by drillings outside actual scrap deposit into 0.7 to 2.0 m depth below the surface (VK-2a drilling between 0.3 - 1.5 m, VK-4 between 0.0 - 0.7 m and VK-12 between 0.3 - 2.0 m with an armored concrete layer at 0.8 - 1.1 m).. According to description, these are consistent soils of F2 class with CGY symbol or inconsistent soils of G3 class, symbol G-FY.

Consistent soils of Quaternary age
Consistent soil of Quaternary age creating cover to prolluvial gravel was drilled only at VK-4 drilling between 0.7 - 1.0 m. This is arenaceous to silty arenaceous loam of brown color, of solid consistency with small pebbles admixture of 1 - 2 cm size amounting up to 10 %. Mechanical texture test proved consistent soil of F6 class, symbol CL - clay of low plasticity. From the viewpoint of foundation, the meaning of this layer is negligible.

Inconsistent soils of Quaternary age
Prolluvial gravel of Quaternary age attains greatest thickness in building site. These were found in all drillings. According to core description and laboratory tests, two lithological types of gravelous sediments are discerned depending on the fine-grained constituent content.
Upper part of prolluvial flood layer consists of medium to mostly coarse grained arenaceous, less loamy to arenaceous compact gravel. Average size of sub-oval to sub-angular pebbles is 2-4-6-8 cm; rare pebbles attain 10 - 15 cm size. Gravel has grayish-brown to brown color. Quartz, quartzite, quartzite slate and amphibolite pebbles prevail. According to the constructed engineering geological sections, this compact arenaceous gravel reaches into 4.6 - 7.8 m depth from the surface.
According to mechanical texture gravel are classified into G3 class, symbol G-F compact gravel with fine-grained soil admixture.
This upper layer of compact arenaceous to loamy arenaceous gravel passes into a layer of strongly compact medium to coarse grained loamy gravel of brown to grayish brown color. Pebbles attain 2 - 4 cm average size, maximum up to 8 - 10 cm and their composition is the same as in the previously described layer.
Laboratory test classify this gravel into G4 class, symbol GM - loamy gravel compact as well as into G5 class, symbol CL– clay of low plasticity of solid consistency.
In places, the gravel soil of G3 and G5 class contains incoherent arenaceous clay seams and layers of gray to ochre greenish color of firm consistency. These occur at 4.3 - 4.6 m in drilling VK-2a, at 2.3 - 2.6 m in drilling VK-4 and 7.3 - 7.8 m depth below the surface in drilling VK-23. Laboratory tests proved consistent soil of F4 class, symbol CS - arenaceous clay of hard consistency.

2.2.2 Laboratory test results

Laboratory tests produced basic physical tests of semi disturbed soil samples, short groundwater sample test of aggresivity again concrete and iron construction as well as NEL testing in sampled soils and groundwater.
Semi disturbed soil samples were taken from representative lithological layers discerned in amount of 7 samples. Groundwater aggresivity was tested on a single sample. NEL in IR domain was tested on three soil samples and one groundwater sample. The following tables indicate laboratory test results.

Table 4

Drilling designation	Sample site (depth in m)	Plasticity limit W_P (%)	Liquidity limit W_L (%)	Plasticity number I_P	Natural humidity W_N (%)	Consistency number I_C	Classification sensu STN 731001
VK-2	4.5 - 4.8			9.26			G3, G-F
VK-2a	7.1 - 7.3	16.8	30.36	13.56	15.97	1.06 - stiff	F2, CG
VK-4	2.4 - 2.5	19.66	30,44	10,79	21.94	0.79-firm	F6, CL
VK-4	5.4 - 5.7				8.62		G3, G-F
VK-9	4.2 - 4.4	15.36	22.47	7.11	15.19	1.02 - stiff	G5, GC
VK-12	3.0 - 3.3				6.31		G3, G-F
VK-23	2.7 - 2.9				10.39		G3, G-F

Table 5

Drilling designation	Sampling depth (m)	Sample type	NEL – IR mg/kg	NEL - IR mg/l
VK-2	1.45 - 1.50	Arenaceous gravel	134.00	
VK-9	1.90 - 2.00	Loamy arenaceous gravel	21.00	
VK-23	0.95 - 1.00	Loamy arenaceous gravel	<20.00	
VK-9		Groundwater sample		0.376

3 ASSESSMENT OF ENGINEERING GEOLOGICAL CONDITIONS

3.1 ENGINEERING GEOLOGICAL CONDITIONS OF BUILDING SITE

According to paragraph 20 of STN 73 1001 and based on exploration results, conditions of construction may be assessed in investigated site as simple. Foundation soils in the limits of building site are invariable, single layers display roughly constant thickness and are deposited horizontally. Groundwater table level was found in 3.9 m to 5.4 m depth below the surface and the table is only slightly strained. For areal foundation of construction objects in the layer of bearing compact gravel the groundwater table does not reach the foundation level.

All drillings found anthropogenic deposits below the surface till 0.7 to 2.0 m depth made of concrete (VK-12 between 0.0 - 0.3 m and 0.8 - 1.1 m), blast furnace scarp layer in places with crushed stone aggregate and construction debris as well as loamy gravel soil of G3Y class, symbol G-FY and F2Y class, symbol CGY. These soils are less to medium compact in places even loose.

Consolidated soil of Quaternary age above prolluvial gravel was found only in VK-4 drilling between 0.7 - 1.0 m. The soil represents class F6, symbol CL - clay of low plasticity and solid consistency. From the viewpoint of foundation, this occurrence is negligible.

Consolidated arenaceous to loamy and arenaceous gravel in proluvial cone is bearing, only weakly compressible foundation soil of class G3 to G-F. This occurs 0.8 - 2.6 m deep below the surface. Drillings proved down to 8.0 m depth in lower part of prolluvial gravel a layer of strongly compact gravel with higher content of fine fraction, class G4, GM or G5, GC.

3.2 GEOTECHNICAL PROPERTIES OF FOUNDATION SOILS

Based on results of engineering geological drillings and that of laboratory tests from semi disturbed samples, following tables indicate dimensional standard characteristics of single discerned lithological types of foundation soils.

Anthropogenic made up ground

Gravel soils of arenaceous gravel composition, class G3Y, symbol G-FY - gravel with fine-grained soil admixture medium compact to loose, seldom with concrete fragment and construction debris admixture.

Table 5

Dimensional standard characteristics	class G3Y, symbol G-FY
Volume weight g ($kN.m^{-3}$)	19
Poisson's number n	0.25
Deformation modulus E_{def} (MPa)	50
Effective angle of internal friction j_{ef} (o)	33
Effective coherence c_{ef} (kPa)	0
Tabled foundation bearing value R_{dt} (kPa)	195
Relative compactness I_D	0. 38

Consolidated soil, class F2, and symbol CGY

Table 6

Dimensional standard characteristics	class F2, symbol CGY
Volume weight g ($kN.m^{-3}$)	19,5
Poisson's number n	0,35
Deformation modulus E_{def} (MPa)	10
Effective angle of internal friction j_{ef} (o)	24
Effective coherence c_{ef} (kPa)	12
Tabled foundation bearing value R_{dt} (kPa)	100

Prolluvial sediments of Quaternary age

Cohesive arenaceous loam of F6 class, symbol CL - low plasticity clay, eventually class F6, symbol CI - medium plasticity clay of soft, solid and hard consistency.

Table 7

	firm	stiff
Dimensional standard characteristics	F6, CL	F6, CL

Volume weight g (kN.m^{-3})	21	21
Poisson's number n	0,4	0.4
Deformation modulus E_{def} (MPa)	5	10
Effective angle of internal friction j_{ef} (o)	18	20
Effective coherence c_{ef} (kPa)	14	20
Total angle of internal friction j_u (o)	0	5
Total cohesion c_u (kPa)	50	80
Tabled foundation bearing value R_{dt} (kPa)	100	200

Arenaceous coarse grained gravel, class G3, symbol G-F - gravel with fine-grained soil admixture, medium dense to dense

Table 8

Dimensional standard characteristics	class G3, medium dense	class G3, dense
Volume weight g (kN.m^{-3})	19	19
Poisson's number n	0.25	0.25
Deformation modulus E_{def} (MPa)	50	95
Effective angle of internal friction j_{ef} (o)	33	37
Effective coherence c_{ef} (kPa)	0	0
Tabled foundation bearing value R_{dt} (kPa), foundation width 1 m	290	450
Relative compactness ID	0.38	0.7

Loamy gravel, medium to coarse-grained, strongly cemented, class G5, GC - argillaceous gravel, dense

Table 9

Dimensional standard characteristics	G5, GC dense
Volume weight g (kN.m^{-3})	19.5
Poisson's number n	0.3
Deformation modulus E_{def} (MPa)	50
Effective angle of internal friction j_{ef} (o)	30
Effective coherence c_{ef} (kPa)	5
Tabled foundation bearing value R_{dt} (kPa), foundation width 1 m	150
Relative compactness ID	0.6

3.3 SOIL EXPLOITABILITY

Anthropogenic made up ground of arenaceous gravel composition, class G3Y, that of gravel loam, class F2Y with fragments of construction debris and stone aggregate admixture as well as blast furnace slag are classified according to STN 73 3050 into the 2nd and 3rd class of workability.

Compact soils of F6 class are classified into 2nd class of workability.

Compact gravel soils of the prolluvial cone of G3 class are classified into 3rd and 4th class of workability.

Determination of approximate excavation slopes into 3.0 m depth sets out from the wording of STN 73 3050, paragraph 83. For excavations, it is recommended to modify slopes of temporary slopes of foundation dugouts to 1:1 maintaining conditions of indicated paragraph.

3.4 FOUNDATION CONDITIONS OF BUILDING SITE

Based on results of completed engineering geological exploration it may be concluded that the geological structure of investigated area is generally simple. From the surface down to 0.7 - 1.7 m there is a layer of anthropogenic made up ground. In its underlie, there is a medium dense to dense layer of prolluvial gravel with fine grained soil admixture of G3 class, symbol G-F. In the gravel soil layer, intercalation of stiff soil of F6 class, symbol CL - clay of low plasticity and solid consistency.

Groundwater table was found in all exploration drillings in 3.9 - 5.4 m depths below the surface and groundwater table stabilized roughly 0.1 m above the found level.

Foundation bearing value

Based on exploration results, bearing ground is represented by dense, coarse grained arenaceous to loamy-arenaceous gravel of G3 class, symbol G-F - gravel with fine-grained soil admixture. This gravel occurs below the anthropogenic made up ground or below the layer of cohesive arenaceous loam. It occurs within the construction site in about 1.5 to 2.6 m depth below the surface (according to description of drilling profiles).

Shallow build foundations are recommended for single construction objects as continuous footing or foundation slab.

Under the condition of continuous foundation, for given soil type the following values of tabled foundation bearing values shall be considered:

Foundation width 0.5 m $R_{dt} = 300$ kPa

Foundation width 1.0 m $R_{dt} = 450$ kPa

Foundation width 3.0 m $R_{dt} = 700$ kPa

Foundation width 6.0 m $R_{dt} = 500$ kPa

For foundation of single building objects in depths over 1.0 m below the surface the tabled foundation bearing value may be increased by 2.5 times of effective strength of foundation soil weight between real and assumed foundation slab.

From the viewpoint of compressibility, gravel foundation soil represents very little compressible foundation soil. Load settlement of single building objects will be small and its main part will occur during the construction.

3.5 HYDROGEOLOGICAL CONDITIONS OF BUILDING SITE

Hydrogeological conditions of building site reflect its geological structure, surface morphology and climatic conditions. Groundwater table was found in the layer of arenaceous to loamy arenaceous gravel of prolluvial cone that serve as hydrogeological water bearing level. Based on several hydrogeological investigations in nearer surroundings of building site, the filtration coefficient value of this gravel is about $n.10^{-3}$ to $n.10^{-4}$ $m.s^{-1}$. Such values reflect rock of 3rd class permeability, which is rocks considerably well permeable (Jetel 1989).

During the exploration realized, the found groundwater table level was recorded in drillings and about 4 hours later the stable groundwater depth as well. For the purposed of building design, the following table indicates found and stable groundwater levels.

Table 10

Drilling designation	Drilling mouth altitude (m above sea level)	Found groundwater table altitude (m above sea level)	Stable groundwater table altitude (m above sea level)	Found groundwater table depth (m below surface)	Stable groundwater table depth (m below surface)
VK-2	224.91	220.81	220.91	4.1	4.0
VK-2a	225.34	220.24	220.34	5.1	5.0
VK-4	225.59	220.19	220.29	5.4	5.3
VK-9	224.64	220.54	220.64	4.1	3.9
VK-12	225.05	219.65	219.75	5.4	5.3
VK-23	224.59	220.69	220.,79	3.,9	3,8

The groundwater sample analyzed in the sense of STN EN 206-1 does not contain aggressive constituents affecting concrete.

3.6 ASSESSMENT OF ENVIRONMENTAL POLLUTION

Assessment of rock environmental pollution in aeration zone and that of groundwater pollution are setting out from laboratory tests of three soil samples from single lithological levels down to 2.0 m depth and one groundwater sample. Previous exploration results were considered as well (Ondrejka 2001).

After sensorial assessment of drilling core, three soil samples were collected from drillings within building site, aimed at determination of non-polar extractable matter by IR spectrometry from various depth intervals. Laboratory test confirmed in aeration zone samples no increased oil substance concentration. The highest NEL-IR content in soil sample of VK-2 drilling (1.45 - 1.50 m; 134 $mg.kg^{-1}$) does not exceed B category limit (500 $mg.kg^{-1}$ of dry matter). The found values are rather phon levels reflecting natural concentration or sensitivity limits of analytical determination. NEL-IR concentrations in soil samples and limit concentrations recommended by Instruction of Ministry of Management and Privatization of National Property and Ministry of Environment of the Slovak Republic No 1617/1997 Z. z. dated 15 December 1997 are listed in table 11:

Table 11

Parameter	Limit values accorfing to Instrictuon			VK-2 1.45-1.50 m	VK-9 1.6-2.0 m	VK-23 0.95-1.0 - m
	A	B	C			
NEL-IR ($mg.kg^{-1}$)	50	500	1000	134	21	<20

Assessment of oil matter pollution in groundwater by non-polar extractable matter is setting out from laboratory test of water sample taken at VK-9 drilling. The found NEL-IR concentration value of 0.376 $mg.l^{-1}$ slightly exceeds B category limit according to Instruction, when the origin of pollution shall be explained (table 12).

Table 12

Index	Limit values accorfing to Instruction			VK-9
	A	B	C	
NEL –IR ($mg.l^{-1}$)	0,05	0,20	1,00	0,376

Higher NEL-IR concentration in soils found during previous exploration in the surroundings (Ondrejka 2001) that exceed limit value of B category (drillings V-1, V-2 and V-3) and higher NEL-IR concentrations in groundwater sample exceeding limit value of C category (groundwater in drilling V-4) are not confirmed within building site.

3.7 ASSESSMENT OF SEISMIC HAZARD OF CONSTRUCTION EDIFICE 73 0036

Macro-seismic features of earthquakes are classified by scale of macro-seismic activity. Seismo-tectonic sensible areas are determined according to the scale of macro-seismic activity MSK-64. Based on Macro-seismic map of Slovakia (Appendix A.2) the building site belongs to area with presumed seismicity intensity of 6° grade MSK-64.

According to the subdivision of Slovakia into source areas of seismic hazard (fig. 1 in the cited norm), the building site belongs to area 4 and the seismic hazard is in the entire area constant. The basic seismic acceleration a_r reflects earthquake with the frequency of 450 year occurrence and it is related to building objects with signification coefficient g1 = 1.0 and average life interval of 50 - 100 years. For the area 4 of seismic hazard is the indicated standardized value $a_r = 0.3\ m.s^{-2}$.

The proposed seismic acceleration a_g for building site and free field surface is calculated from basic seismic acceleration a_r for the appropriate category of basement. According to known parameters of geological structure, the building site is after paragraph 4.3.1 classified into B category as layers of medium-compact to compact sand, gravel or medium compact clay in

10.0 m depth. For epicenter area is $a_g = 1.1\ a_r$, i. e. $a_g = 1.1\ .\ 0.3 = 0.33\ m.s^{-2}$.
The value of proposed seismic acceleration $a_g = 0.33\ m.s^{-2}$ is almost similar to the value of $a_g = 0.3\ m.s^{-2}$ (paragraph 4.1.2.6), hence seismic effects onto the building object negligible. It is possible to exclude the hazard of exceeding value of proposed seismic acceleration a_g due to very adverse seismo-tectonic conditions.

4 CONCLUSIONS

The presented final report submits results of engineering geological exploration realized for future construction of oxygen plant No 9 in the Košice U. S. Steel plant. Based on drilling and laboratory tests realized, lithological types of foundation soil are delimited and tested into 8.0 m depth below the surface. Dimensional standard characteristics were determined and the stable groundwater table depth established. Alternative solution of foundation for single building objects is proposed.

Drillings found anthropogenic made up ground in the entire building site down to 0.7 -1.7 m below the surface. Made up ground is made by loose blast furnace slag in the upper levels in places with construction debris and concrete fragment admixture. In part of the building site made up ground of less to medium compacted gravel soil of G3, G-FY class in places with layers of cohesive soil of F2 class, CGY, aggregate stone and construction debris.

Cohesive soils of Quaternary age made of plastic clay class F6, CL of stiff consistency compose only thin layers in gravel soil.

Bearing and less compressible soils of Quaternary age represent compact medium to coarse-grained gravel of G3 class creating bearing basement in the entire building site. According to exploration results, these occur in depth 0.8 - 2.6 m below the surface. Drillings to 8.0 m depth traversed layers of loamier, dense and heavily cemented gravel of G5 class. The found soil of F6 class of stiff consistency compose only isolated layers in compact gravel and owing to the depth of occurrence do not influence total bearing of gravel soil.

Shallow foundation of single building objects is recommended over continuous footing or areal foundation.

For dugouts temporary excavation slopes are recommended to modify with slope 1:1 maintaining conditions of STN 73 3050 paragraph 83.

For foundation trench dugouts of building objects the last layer over the foundation level is recommended to complete by hand. This should prevent disturbance of gravel compactness in their natural state.

However, the definite manner of building object foundation should be proposed by designer and based on static calculations.

The found groundwater table level is in the entire building site 3.9 - 5.4 m below the surface. In respect to found groundwater level, groundwater will not influence foundation for constructions.

Environmental pollution in aeration zone exceeding by insoluble extractable matter content (NEL) limit value of B and C category was not found down to 2.0 m depth from the surface. Slightly higher NEL-IR content in groundwater sample taken from VK-9 drilling indicates possible groundwater pollution in broader surroundings of building site. This may result from old industrial pollution of the environment by metallurgical plant.

PRÍLOHA

K ZÁVEREČNEJ SPRÁVE
APPENDICES TO FINAL REPORT

NÁZOV PRÍLOHY	:	Situácia inžinierskogeologických vrtov
APPENDIX NAME	:	Situation of engineering geological drillings
ČÍSLO PRÍLOHY	:	1
APPENDIX NUMBER	:	1
ČÍSLO ÚLOHY	:	2004 05 12 012
DEMAND NUMBER	:	2004 05 12 012