



PRZEDSIĘBIORSTWO PRODUKCYJNO - HANDLOWO - USŁUGOWE

“GEOBUD” Spółka z o.o.

40-282 Katowice, ul. Sikorskiego 34
phone: 32 256 31 64, phone/fax 32 255 14 82

[e-mail: geobud@geobud.com.pl](mailto:geobud@geobud.com.pl)

www.geobud.com.pl

**GEOLOGY
GEOTECHNICS
DRILLING**

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**PKG CERTIFICATE
NO. 0010**

**EXAMINATION OF THE GROUND TO DETERMINE
THE GEOTECHNICAL CONDITIONS FOR NEW CIVIL
STRUCTURES' FOUNDATIONS**

**DESIGN
AND DOCUMENTATION**

- Geological work designs
- Traffic plans
- Geological documents
- Documents, expert opinions and geotechnical opinions
- Geological and mining expert opinions
- Geophysical opinions

**SUBJECT: RUDA ŚLĄSKA ul. Niedurnego –
— Vicinity of the Blast Furnace of Pokój Steelworks**

FIELD WORKS

- Examination drilling
- Probing and “in situ” tests, e.g.: CPTU, CPT, SPT, WST, FVT, SLVT, DPL, DPM, DPH, DPSH
- Sampling: NNS (non-disturbed structure), NU (natural grain), NW (natural humidity)
- Specialist test in boreholes

LABORATORY

- Examination of physical properties of soil
- Examination of mechanical properties of soil
- Chemical examination of water and soil

**GEOTECHNICAL PROJECT
SERVICES**

- Examination of ground quality and load-bearing capacity
- Geotechnical assessments and acceptance
- Geotechnical consultations

ENVIRONMENT PROTECTION

Study authors:

mgr Adam KOPAŃSKI
geological licence no.: 070536

mgr Bartłomiej KOPAŃSKI
geological licence no.: XI-0068, XII-0061

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1. Introduction

This study is aimed at obtaining preliminary information on the type and condition of subsoil, including the hydrological conditions in the light of the possibility to erect new civil structures.

To carry out preliminary examination of the subsurface and hydrological conditions, 4 geotechnical boreholes 10.0 m deep were made. Loosened samples of soil were examined macroscopically in situ to determine the origin, lithology and condition of the ground. Some of them were collected into tight bags to carry out further examination in the laboratory. After the drilling was completed, the boreholes were filled with dredged material (including compaction), retaining the sequence of the layers drilled through.

As the land user indicated the course of the below-grade infrastructure in the locations of the planned boreholes and we verified it with a below-grade utilities' detector Radiodetection C.A.T.+ (BS EN ISO 9001), no test excavations were required.

This study is based on the following data:

- information provided by the Orderer,
- site inspection of the land,
- above-mentioned field examination,
- examination in the soil mechanics laboratory,
- archived materials, standards, reference works:
 - a. Geotechnical documentation for the land plot no. 3061/2852 at Niedurnego Street in Ruda Śląska, made in 2008 by PPHU „GEOBUD” Sp. z o.o. Katowice.
 - b. A detailed Geological Map of Poland (covered), drawn to scale 1:50,000, sheet Zabrze, including explanations,
 - c. Geological Map of Poland (map with no Quaternary formations), drawn to scale 1:50,000, sheet Zabrze,
 - d. Materials from the document archive of P.P.H.U. „GEOBUD” Sp. z o.o.
 - e. PN-EN-1997-1:2008 Eurocode 7. “Geotechnical Design. Part 1: General rules”

- f. PN-EN-1997-2:2007 Eurocode 7. “Geotechnical Design. Part 2: Ground investigation and testing”
- g. PN-81-B-0320. Building Land. Spread foundations. Static calculations and design.
- h. PN-55-B-04482. Building Land. Examination of physical properties. Macroscopic examination.
- i. PN-74-B-04452. Building Land. Field investigations.
- j. PN-88-B-04481. Building Land. Soil sample examination.
- k. PN-B-02481. Geotechnics. Basic terminology, letter symbols and units of measure.
- l. PN-86-B02480. Building Land. Terms, symbols, classification and description of soil.
- m. PN-B-06050:1999. Geotechnics. Earthworks, general requirements.
- n. Wiłun Z.: Zarys geotechniki, Wydawnictwa Komunikacji i Łączności, Warsaw, 1976, 2007
- o. Myślińska E.: Laboratoryjne badania gruntów, Wydawnictwo Naukowe PWN, Warsaw, 1992
- p. Kostrzewski W.: Mechanika gruntów. Parametry geotechniczne gruntów budowlanych oraz metody ich wyznaczania, Państwowe Wydawnictwo Naukowe, Warsaw, 1980
- q. Pazdro Z.: Hydrogeologia ogólna, Wydawnictwa Geologiczne, Warsaw, 1977

2. Location

In administrative terms, the land being the subject of this opinion is situated in Ruda Śląska.

It belongs to the “Pokój” Steelworks, situated at Niedurnego Street.

3. Geological structure

The geological structure of the described land, investigated down to 10.0 m, includes Quaternary and Carboniferous formations.

Quaternary — is represented by the deposits of the fluvial and fluvioglacial accumulation, taking the form of silts and clays, with layers of medium-grain sands. The entire land is covered with a layer of contemporary man-made fills.

Carboniferous — is represented by sandstone and mudstone with hard coal of the deposits of Ruda.

4. Hydrological conditions

The basic groundwater level is connected with the medium-grain sand deposit. The water infiltrating it is characterised by free water table which was drilled through at 7.5 m below ground in the course of works (September 2017). Moreover, the free table water was drilled through in the fill layer at 3.2 m below ground and in the sandy interclay laminas at 2.7 m below ground. Also local water oozing was recorded at 0.8 and 6.6 m below ground.

The groundwater levels are characterised as unstable, dependent on the season and precipitation.

5. Geotechnical conditions

The investigated ground contains both man-made fills and native soils of a different age, lithology and condition, which is why they are presented as the following geotechnical layers:

Layer Ia	made from non-building fills, composed primarily of the sandy and stone fraction, containing slag, rubble, sand and loamy sand. Locally, a fill composed of the silt and loamy fraction mixed with rubble was drilled through. The thickness of fills in the boreholes made is versatile, ranging 1.1–4.4 m. Given the nature of the investigated land, it is necessary to provide for locally greater fill thickness and smaller or larger parts of underground concrete pieces left by the demolished or rebuilt industrial structures in the preceding decades.
Layer IIa	made from native cohesive, non-consolidated soil, marked “C” according to the standard. Those are loamy sands and silty loams and compact silty loams with stiff structure, with average liquidity index $I_L = 0.10$.
Layer IIb	is also composed of non-consolidated silty soil, but firm, with the average liquidity index $I_L = 0.35$.
Layer III	is made from non-cohesive soil in the form of medium-grain sands, sometimes with loamy sand layers. Those soils are described as medium-compacted, with the average compaction level of $I_D = 0.50$.
Layer IV	is made from proglacial clays and weathering clays, characterised mostly by semi-compact or compact texture with the liquidity index of $I_L = 0.00$.

The geotechnical layer description is complemented by the soil profiles attached (enclosure no. 3.1–3.4) and borehole logs (enclosure no. 7.1–7.4).

Geotechnical parameters of native soils were determined using “B” method, with the assumed major property being liquidity index for cohesive soils and compaction index for non-cohesive soils.

6. Conclusions and recommendations

- a) The native soil deposited in the examined land is layered. Those are load-bearing medium-grain sands of low compressibility (layer III), load-bearing clays of medium compressibility, stiff loamy sands (layer IIa) and silts (layer IV), and less load-bearing firm clays of higher compressibility (layer IIb). The entire land is covered with non-building fill of variable thickness (layer I).
- b) During field works (September 2017), the basic groundwater level with free table was drilled through in the sand layer at 7.5 m below ground. What is more, free table water was drilled through in the fill layer at 3.2 m below ground and in the sandy interclay laminas at 2.7 m below ground. In two boreholes, water oozing was found at 0.8 m and 6.6 m below ground. The measured groundwater depths are characterised as unstable, dependent on the season and precipitation.
- c) The investigation carried out enabled to determine the subsurface and hydrological conditions of the land in a preliminary fashion. According to them, the deposited native soil provides favourable substrate (simple subsurface conditions) for new civil structures. However, the unfavourable component is the relatively thick layer of non-building man-made fills and possible deposits of remnants of civil structures, left from non-existent industrial structures which, depending on the nature of the designed structures, may qualify the subsurface conditions as complex.
- d) The table (enclosure no. 5) stipulates the geotechnical parameters of the native soils constituting individual geotechnical layers of the ground.
- e) During future design works, it is necessary to investigate and consider the local mining and geological situation which will be decisive for the complexity of the subsurface conditions.
- f) Further, detailed geotechnical investigations will be required for the newly-designed civil structures in specific locations.