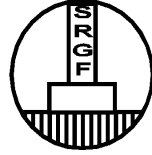




Universitatea Tehnică
de Construcții București



SOCIETATEA ROMANA DE
GEOTEHNICĂ ȘI FUNDAȚII

L'investigation géotechnique en Roumanie – Nouvelle édition de la norme NP 074 – 2022

Geotechnical investigation in Romania – New edition of NP 074 - 2022

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1. INTRODUCTION

Geotechnical investigation is conducted in Romania based on technical norm NP 074

- Recently revised in 2022 and published in February 2023
- Previous editions 2014, 2007
- In fact, NP 074 is about geotechnical documents in general, not only geotechnical investigation
- A Guidance on geotechnical investigation just started
- NP 074 is in good correlation with EN 1997, although there are some national practices included
- NP 074 cites SR EN 1997 – Eurocode 7 and its RO NA

1. INTRODUCTION

Geotechnical investigation is conducted in Romania based on technical norm NP 074

- To be noted that in RO standards are not applied directly, technical norms are mandatory and citing a standard makes it mandatory
- EN 1997-1 is accompanied in RO by NAs and National technical norms on:
 - Shallow foundations NP 112
 - Ground anchors NP 114
 - Geotechnical parameters NP 122 + GP 129 – Technical guidance on geotechnical design
 - Pile foundations NP 123
 - Retaining structures NP 124
 - Collapsible soils NP 125
 - Swelling soils NP 126
 - Dewatering NP 134

2. GEOTECHNICAL A

Geotechnical documents in RO

- Preliminary geotechnical advice
- Geotechnical study
- Geotechnical design report
- Geotechnical monitoring report
- Geotechnical expertise

Zone urban plan (P.U.Z.)
Detailed urban plan (P.U.D.)
Pre-fezability study (S.PF.)
Fezability study (S.F.)
Technical documents for building permit (D.T.A.C.)
Technical project (P.Th.)
Execution details (D.E.)
Execution
Post-execution (existing work)

Geotechnical investigation	Geotechnical design	Geotechnical monitoring	Expertise	
			Geotechnical investigation	Design, execution or post-execution

Preliminary geotechnical advice (AGP)				Geotechnical expertise Authorized expert	Geotechnical expertise Authorized expert
	Geotechnical study (SG) Verification	Detailed geotechnical study (SGD) Verification	Geotechnical design report (PG) Verification		

2. GEOTECHNICAL APPROACH IN ROMANIA

- **Geotechnical category**

1. Soil conditions – **good** / medium / difficult soils

No.	Soil type
1	Boulders, cobbles, gravels, with less than 40 % sand and less than 30 % clay, for a horizontal and uniform lithology (less than 10% inclination)
2	Sandy soils, including silty sands, dense, for a horizontal and uniform lithology
3	Fine soils with $PI < 10\%$: clayey sands, sandy silts, with $e < 0.7$ and $I_c \geq 0.75$, for a horizontal and uniform lithology
4	Fine soils with $10\% < PI < 20\%$: clayey sands, sandy – silty sands, with $e < 1.0$ and $I_c \geq 0.75$, for a horizontal and uniform lithology
5	Fine soils with $PI > 20\%$: sandy clays, silty clays and clays with $e < 1.1$ and $I_c \geq 0.75$, for a horizontal and uniform lithology
6	Rocks for a horizontal and uniform lithology
7	Engineered compacted man-made fills
8	Any combination of 1÷6

NOTE: Are excepted from 4 and 5 collapsible and swelling soils

2. GEOTECHNICAL APPROACH IN ROMANIA

- **Geotechnical category**

1. Soil conditions – good / **medium** / difficult soils

No.	Soil type
1	Sandy soils, including silty sands, medium dense, for a horizontal and uniform lithology (less than 10% inclination)
2	Fine soils with $PI < 10\%$: clayey sands, sandy silts and silts, with $e < 0.7$ and $0.5 < I_c < 0.75$, for a horizontal and uniform lithology
3	Fine soils with $10\% < PI < 20\%$: clayey soils, sandy – clayey silts, with $e < 1.0$ and $0.5 < I_c < 0.75$, for a horizontal and uniform lithology
4	Fine soils with $PI > 20\%$: sandy clays, silty clays and clays, with $e < 1.1$ and $0.5 < I_c < 0.75$, for a horizontal and uniform lithology
5	Clayey soils with reduced – medium activity, per NP 126
6	Engineered man-made fills with known composition, less than 5% organic content or uncompacted fills of more than 10 – 12 years age.

2. GEOTECHNICAL APPROACH IN ROMANIA

- **Geotechnical category**

1. Soil conditions – good / medium / **difficult** soils

No.	Soil type
1	Sandy soils, including silty sands, in loose state
2	Sandy soils, saturated, prone to liquefaction under seismic actions
3	Fine soils with $I_c < 0.5$
4	Colapsible soils as per NP 125
5	Swelling soils, with high and very high activity, as per NP 126
6	Soils with high organic content (more than 5 %)
7	Sloped grounds prone to landslides
8	Uncontrolled man-made fills less than 10 years old
9	Waste fills, regardless the age

2. GEOTECHNICAL APPROACH IN ROMANIA

- **Geotechnical category**

- 2. Groundwater conditions*

- a) No influence on the construction, no dewatering;

- b) Influence on the construction, ordinary dewatering works required, no risk of unfavourable influence on neighbouring structures;

- c) Influence on the construction, special dewatering works required, with risk of unfavourable influence on neighbouring structures (interaction between multiple aquifers, confined aquifers, high draw-down, high flow rates, ..)

MODIFIED

2. GEOTECHNICAL APPROACH IN ROMANIA

- **Geotechnical category**

3. Importance of constructions

a) exceptional

b) special

c) normal,

d) reduced

4. Neighbouring structures

a) No risk;

b) Moderate risk;

c) Major risk.

5. Seismic conditions

2. GEOTECHNICAL APPROACH IN ROMANIA

- Geotechnical category

Factors	Points					
Soil conditions	Good soils	2	Medium soils	3	Difficult soils	6
Groundwater	No dewatering	1	Ordinary dewatering	2	Special dewatering	4
Importance	Reduced	2	Normal	3	Special, exceptional	5
Neighbouring	No risk	1	Moderate risk	3	Major risk	4
Seismic conditions	$a_g < 0,15g$	1	$0.15g \leq a_g < 0.25g$	2	$a_g \geq 0,25g$	3

2. GEOTECHNICAL APPROACH IN ROMANIA

- **Geotechnical category**
 - Depending on GC: Requirements for geotechnical investigation and design (methods, types, quantity etc)

Points	Geotechnical category
6...9	1
10...14	2
15...22	3

2. GEOTECHNICAL APPROACH IN ROMANIA

- **Preliminary geotechnical advice**
 - Including mainly archive data
 - Can also include new investigations, if required

(Basu et al, 2013)

2. GEOTECHNICAL APPROACH IN ROMANIA

- **Geotechnical study**
 - Equivalent with the Ground investigation report in EN 1997-2, although some differences
 - It has to be linked to a certain construction
 - Basis: investigation theme elaborated by the designer / consultant / client
 - ✓ Technical data about the construction
 - ✓ Preliminary estimation of the investigation works
 - ✓ Requirements regarding the data assessment

NEW

2. GEOTECHNICAL APPROACH IN ROMANIA

NEW

- Geotechnical study
 - *Minimum requirements on the geotechnical investigations*
 - Minimum number of drillings

Construction type	Minimum no. Of geotechnical drillings N_{min}	Maximum distance between geotechnical drillings X_{max}
Single family houses less than 200 m ² , maximum 2 stories	1	30 m
Buildings with min 3 stories and industrial buildings	2	15 - 40 m
Constructions on large surfaces, including waste landfills	5	Grid with less than 60 m distance
Linear constructions (roads, railways, dikes, retaining walls)	2	20 - 200 m
Underground networks (canals, pipes)	1	100 m - 500 m
Tunnels	3	50 m - 100 m
Bridges, crossings, viaducts	2	For each abutment / pier one drilling
Tanks	1	Under each tank
Machine's foundations	1	Under each foundation
Dams and spillways	2	10 - 15 m along cross sections
Landslides and sloped grounds (more than 10% inclination)	3	Minimum 1 cross section with minimum 3 drillings
Runways	6	50 - 100 m
High-raised structures (towers, wind turbines, chimneys etc.)	1	Under each single foundation
Silos	1	Under each cell
Photovoltaic parks	3	Grid 60...100 m

2. GEOTECHNICAL APPROACH IN ROMANIA

- Geotechnical study - Minimum depth of drillings

Construction type	Minimum investigation depth Z_a (m)
Buildings and engineering works with shallow foundations	Maximum of: <ul style="list-style-type: none"> • $Z_a \geq 6\text{m}$ • $Z_a \geq 3.0 \times B_f$, where B_f is the small side of the foundation • For rafts and foundations with superposed effects: $Z_a \geq B_b$, where B_b is the small side of the raft
Embankments	<ul style="list-style-type: none"> • $0.8h < Z_a < 1.2h$, where h is the height of the embankment • $Z_a \geq 6\text{m}$
Unsupported cuts	<ul style="list-style-type: none"> • $Z_a \geq 2.0\text{m}$ • $Z_a \geq 0.4h$, where h is the depth of the excavation
Linear structures – roads, railways and runways	<ul style="list-style-type: none"> • Roads and railways: $Z_a \geq 4\text{m}$ below the proposed layer • Runways: $Z_a \geq 6\text{m}$ below the proposed layer • + provisions for embankments and cuts
Linear structures – pipe trenches	<ul style="list-style-type: none"> • $Z_a \geq 2\text{m}$ below excavation bottom • $Z_a \geq 1.5b_{Ah}$ where b_{Ah} is excavation's width
Parking platforms	$Z_a > 2\text{m}$ below the proposed layer Se vor respecta și prevederile de la umpluturi și excavații
Supported cuts	<ul style="list-style-type: none"> • $0.8h < Z_a < 1.2h$, where h is the excavation's depth • $Z_a \geq (t + 2.0)\text{m}$, where t is the embedment length of the retaining structure
Cutoff walls	<ul style="list-style-type: none"> • $Z_a \geq 2.0\text{m}$ below the impervious layer
Piles under predominant axial actions	<ul style="list-style-type: none"> • $Z_a \geq 5\text{m}$ • $Z_a \geq 3B$ where B is the base diameter • $Z_a \geq b_g$, where b_g is the small side of the pile area, at its base
Tunnels and underground works	<ul style="list-style-type: none"> • $b_{Ab} < Z_a < 2b_{Ab}$, where b_{Ab} is the excavation's width
Landslides	<ul style="list-style-type: none"> • Min 5 m below the stable ground or up to a depth at which the landslide is not expected • Drillings for inclinometers shall be extended over a depth more than than the slip depth

NEW

2. GEOTECHNICAL APPROACH IN ROMANIA

- **Geotechnical study**

- *Minimum requirements on the geotechnical investigations*
- Minimum no. of drillings – for GC 1 and 2. For GC3 - + 20 – 50 %
- For GC1 and constructions of reduced importance, max 50% of the drillings can be replaced by other site investigations;
- For GC2, drillings can be supplemented by other site investigations;
- For GC3, drillings have to be supplemented by other site investigations

NEW

2. GEOTECHNICAL APPROACH IN ROMANIA

- **Geotechnical study**
 - National practice based mainly on laboratory tests
 - Geotechnical design based on geotechnical parameters
 - Correlations are required, with variable degree of confidence
 - In situ tests: SPT (mainly granular layers), CPT (much less)

NEW

2. GEOTECHNICAL APPROACH IN ROMANIA

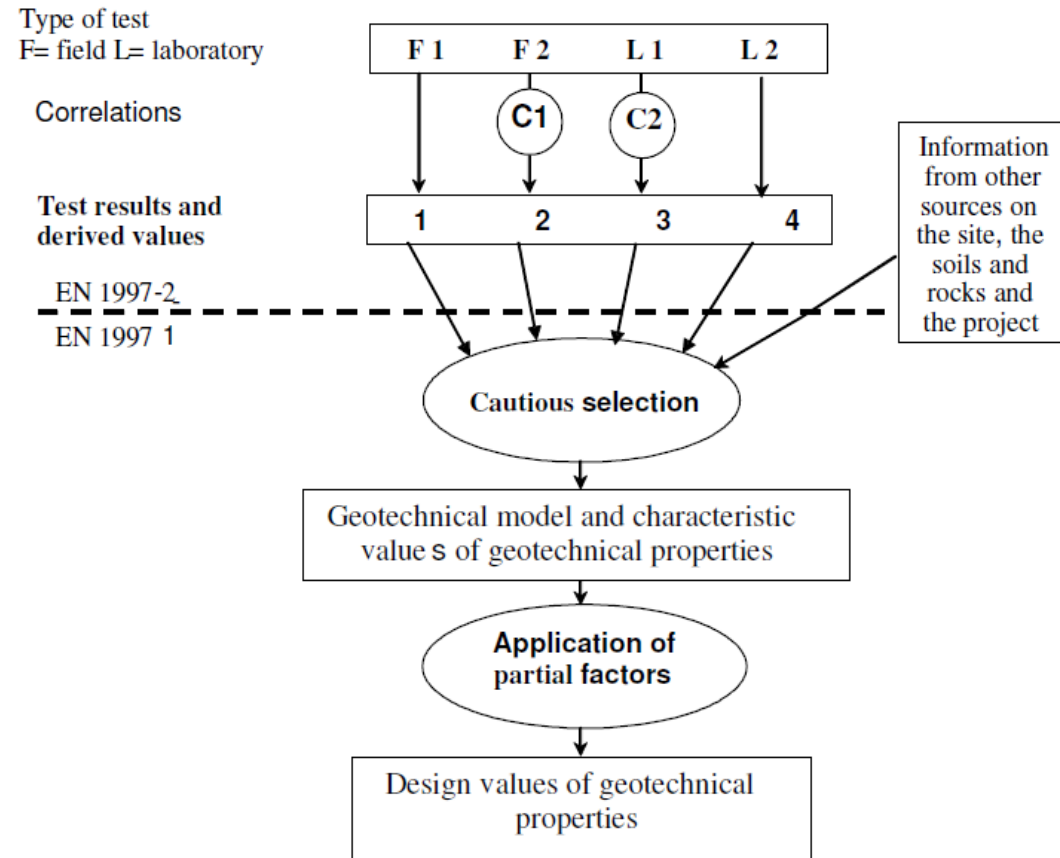
- **Geotechnical study**
 - *Data assessment*
 - NP 074-2014 – characteristic and design values; calculations for bearing capacity and settlement; recommendations for foundations etc.
 - Mix between geotechnical investigation and geotechnical design
 - NP 074 – 2022 – modifications – only derived values, no calculations

NEW

2. GEOTECHNICAL APPROACH IN ROMANIA

- Geotechnical study
- *Data assessment*

EN 1997-2



2. GEOTECHNICAL APPROACH IN ROMANIA

- Geotechnical study
- *Data assessment*

Bond, Harris – Decoding Eurocode 7

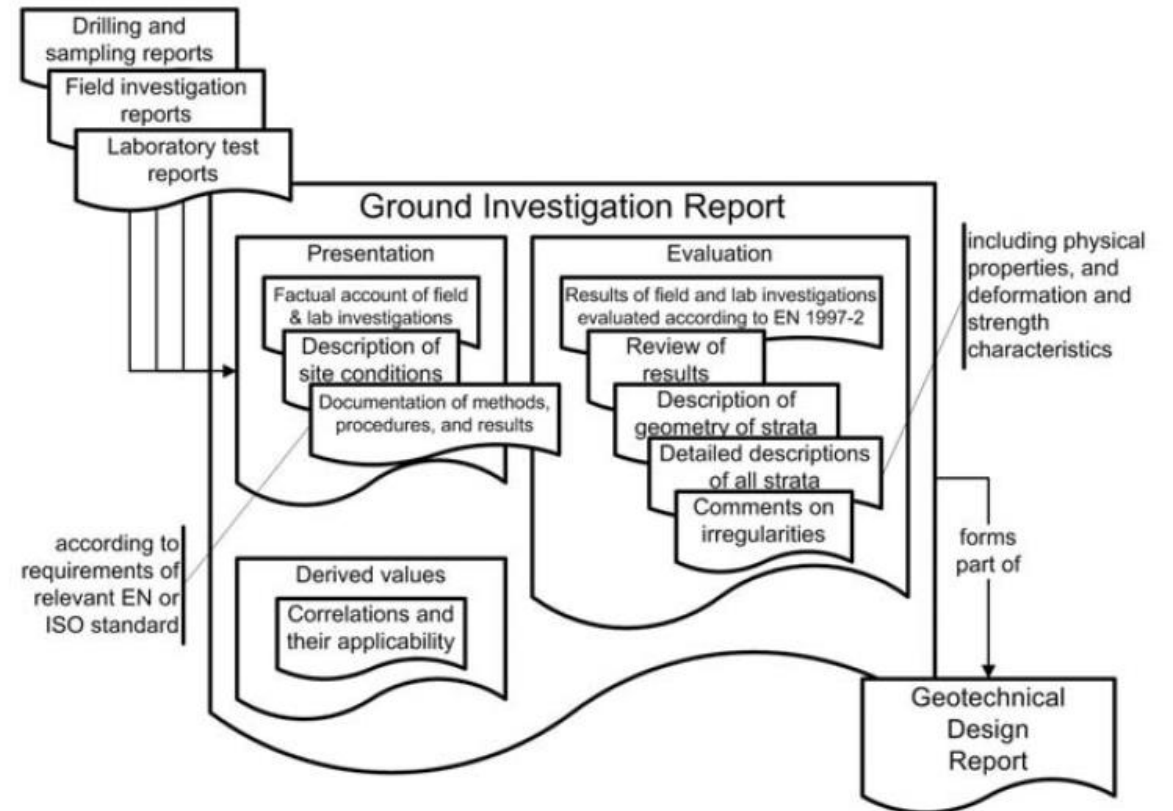


Figure 16.5. Contents of the Ground Investigation Report

2. GEOTECHNICAL APPROACH IN ROMANIA

- **Geotechnical study**
 - *Data assessment*
 - GIR ends up with derived values
 - GDR includes data processing for derived values in relation to analyzed ULS
 - All geotechnical calculations for ULS and SLS are done during the geotechnical design phase
 - GIR has to provide the ground model and derived values of geotechnical parameters for each layer , including local conditions
 - Characteristic values of geotechnical parameters are linked to ULS, therefore belong to geotechnical design

2. GEOTECHNICAL APPROACH IN ROMANIA

- **Geotechnical study**
 - *Ground model*
 - Representation of topographical, geological, tectonic, hydrogeological and geotechnical conditions, which are relevant for the site, based on the results of the geotechnical investigations
 - For the zone of influence
 - Is the main result of the geotechnical investigation
 - Basis for the geotechnical design model

NEW

2. GEOTECHNICAL APPROACH IN ROMANIA

- **Geotechnical study**

- *Ground model*

- GC1: general lithology, including derived or measured values of the geotechnical parameters for each layer, general hydrogeological conditions
- GC2: general and detailed lithology, including local conditions, including derived or measured values of the geotechnical parameters for each layer, general or detailed hydrogeological conditions depending on each case
- GC 3: general and detailed lithology, including local conditions and emphasizing the variability of the ground, including derived or measured values of the geotechnical parameters for each layer, general or detailed hydrogeological conditions depending on each case

NEW

2. GEOTECHNICAL APPROACH IN ROMANIA

NEW

- **Geotechnical design report (project)**
 - Analysis by calculation of the resistance and stability of the ground, establishment of foundation solutions and design of geotechnical structures, including soil – structure interaction.
 - Geotechnical design model
 - For each analyzed design situation, considering the relevant limit states
 - For the whole zone of influence
 - Includes characteristic values of the geotechnical parameters for each layer, suitable for the design situation and limit state that is analyzed
 - For verification by calculation, it includes also the design values of geotechnical parameters corresponding to design approaches

3. CONCLUSIONS

- Romanian practice for geotechnical investigation is/was based on:
 - Mainly drillings and lab tests on soil samples
 - In situ tests mainly for granular soils (SPT) + correlations for deducing the geotechnical parameters
 - Geotechnical study used to give info and recommendations for elements that are under the scope of the geotechnical design
 - Now, the 2 phases are more clearly separated
 - Separation also between the verification exigencies – Ag (only geotechnical investigation) and Af (both geotechnical investigation and design)
 - To be analysed in a couple of years!



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Merci!

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