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FACULTY OF APPLIED SCIENCES

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CIVIL ENGINEERING
MECHATRONICS

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ПРВА МЕЃУНАРОДНА КОНФЕРЕНЦИЈА НА ПРИМЕНЕТИ НАУКИ

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Tetova, Macedonia

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ОБЕМ НА ИСТРАЖНИ РАБОТИ И НОСИВОСТ НА ПОЧВИТЕ СПОРЕД ЕВРОКОД 7 (ec7)

Aleksandra Angelova[1], m-r ass. Radmila Karanakova Stefanovska[2], Doc. d-r Risto Popovski,

Prof. d-r Zoran Panov

University „Goce Delcev“-Stip, Faculty of natural and technical science, Institute of mining

aleksandra.gf@hotmail.com, radmila.karanakova@ugd.edu.mk, risto.popovski@ugd.edu.mk, zoran.panov@ugd.edu.mk

Апстракт

Во овој труд презентирана е методологија за обемот на истражните геомеханички работи и носивоста на почвите според Еврокод 7. Притоа демонстриран е начинот на дефинирање на геомеханичките истражни работи, како што се: бројот, распоредот и длабочината на истражните работи за различни типови на градежни објекти и прикажан е начинот на пресметување на носивоста на почвите во дренирани и недренирани услови.

Клучни зборови: Геомеханички истражувања, носивост на почвите, градежни објекти, Еврокод 7

researce works and bearing capacity of the soil acording evrocode (EC7)

Abstract

In this paper is presented a methodology for the scope of the geomechanical researches works and bearing capacity of the soil according the Eurocode 7th.

Thereby is demonstrated the manner of defining the geomechanical research works such as: the number, distribution and depth of the researces work for different types of buildings and show how to calculate the bearing capacity of the soil in drained and non-drained conditions..

Key words: geomechanical research, loads of soil, buildings, Eurocode 7

1. INTRODUCTION

The main task of geomechanics as engineering work is to study the interaction of natural geological environment and engineering activities, ie terrain, which is the subject of research to explore to the depths of which are expected to be in the zone of interaction with the object itself.
The zone of interaction means the volume who can feel the effects from the object to ambient.
To resolve the problems that arise within the geomechanics is necessary to apply appropriate methods ie terrain and laboratory studies that collected relevant information relating to the terrain, which is subject to execution of an engineering facility and its wider ambient.
Often the problems are arise when in geotechnical research encountered in ambient with unfavorable geotechnical characteristics, yet the solution of these areas carry complex of engineering interventions and constructive solutions. In the last thirty years in Europe develops unique composition of norms for the design of building structures under a common name Eurocodes. They collected extensive worldwide experience of modern design.
The Eurocode who develops standards for geomechanical design is named Evrokod7 (EC7).
Besides the most norms which elaborates Eurocode 7 is defining expression for calculation of the bearing capacity of the soil.
The purpose of EC7 is that from the existing methods for calculation of loads, such as methods of Hansen, Terzaghi, Prantil etc., to give a single expression that will be used in the practice of the European countries.
This paper is shown and developed this term, and programming methodology of the investigations.

2. SCOPE OF RESERACES WORKS ACORDING EC7

The Eurocode 7 (EC7) is consists from two parts: one part (EN 1997-1: 2004) refers to the general rules to approach geomechanical design and it is covered mostly computational works, while the second part (EN 1997-2: 2004) refers to terrain and laboratory researches works.
According EC7 location and depth, researches works should be selected on the base of preliminary tests, depending on the geological conditions, the dimensions of the building construction and other problems that could arise during the examination.
Basic steps after that we should be adhered are following:

- Correct position of the places which are researching;
- The places which are researching for buildings should be placed at critical points in terms of shape, structure and behavior of the expected schedule of loadings;
- The places which are researching for line structures should be located at a reasonable distance from the center line, depending on the overall width of the structure, such as the base of the dam or cut;
- The places which are researching for the structures on or near the ladder terrain, slopes and excavations should be placed outside of the project area in order to assess the stability of the terrain.
- The places which are researching should be allocated properly for they do not pose a threat to the construction, environmental, or construction;
- Where the situation on the terrain is pretty equal or if the soil has sufficient strength and rigidity, then you can take a greater distance or fewer investigative sites.

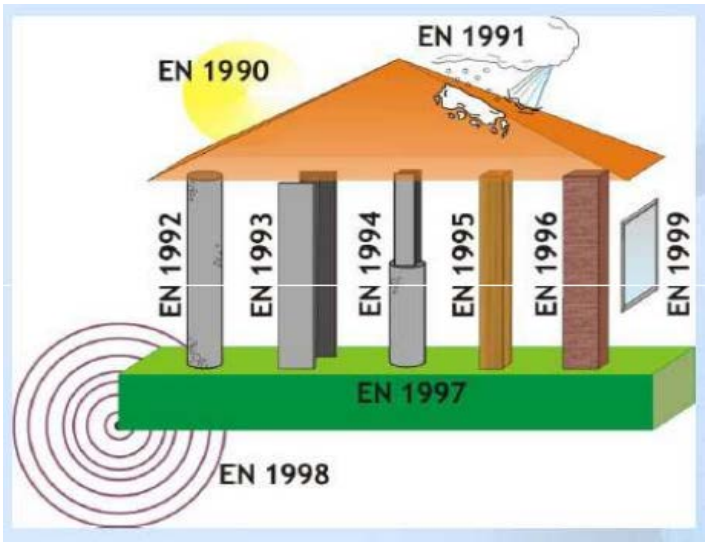

Fig. 1 Development of the Eurocodes by years

The depth of research needs to be a present in all layers that effect on the building project or are affected by the very building.
For those objects that are below the level of research and where drainage is included, the depth of the research should be selected as a function of the hydrogeological conditions
The terrain with slopes should be explored to a depth deeper than any sliding surface.

- Recommended depth for a research are summarized below:
  - Bigger investigation depth should be chosen whenever assume unfavorable geological conditions
  - For a highand linear structures and posts that are built on the appropriate layers, depth of research can be reduced to 2m, and when the geology of the area is uncertain at least one hole is need to put down a minimum of 5m.

3. SOIL LOADS ACORDING EUROCOD 7 (EC7)

The design of the foundation must satisfy two conditions: to be avoided complete destruction of solid fundament with appropriate safety factor and total or relative sinking of the foundation to be in limits which are tolerant for buildings.

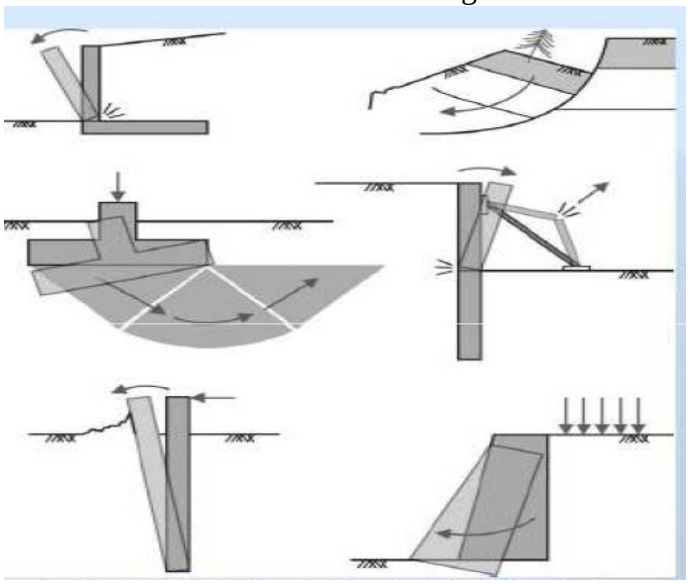
Fig. 2. Deformation of the structure, including the foundation, basement walls, etc.

The main members are contained in the terms of calculation of the bearing capacity of the soil in the Eurocode 7:

$A' = B' \times L'$ – effective area of the foundation, a part from the surface of the foundation base who is loaded centrally

B	width of foundation
B’	effective width of foundation
D	depth of foundation
e	eccentricity of the resultant force, with index B and L
i	factor of slope, with index of cohesion c, load q and bulk weight γ
L	length of foundation
L’	effective length of foundation
m	exponent in the formula for the slope factor i
N	load factors, with index c, q and γ
q	load or load pressure in zone of foundation
q’	effective load in zone of foundation
s	form factors in zone of foundation, with index c, q and γ
V’	vertical load
α	slope of the base
γ ‘	effective bulk soil weight under zone of foundation
θ	attack angle of H.

Approximate calculations for vertical loads, derived from the theory of plasticity and experimental results can be used.

Should be taken following effects:

- The strength of the soil, generally shown by the values for c_u, c’ and φ’ ;
- Eccentricity and load inclination;
- The shape, depth and slope foundation;
- Ground-water pressure and hydraulic gradients;
- Unchanging base, especially layering.

The calculation of the bearing capacity of the soil according Eurocode 7 are different for the drainage and non-drained conditions, and it is characteristic that the depth factor is not mentioned.

Calculation of bearing capacity of the soil in non-drained conditions

For non-drained conditions bearing capacity of the soil can be calculated with the following equation:

$$\sigma_{doz} = \frac{R}{A'} = (\pi+2)\, c_u b_c\, s_c i_c + q$$

where:

$b_c = 1 - \frac{2\alpha}{(\pi+2)}$ - factor of the slope foundation

$s_c = 1 + 0.2(\frac{B'}{L'})$ - the shape factor of the foundation for rectangular shape

s_c = 1,2 – the shape factor of the foundation for square or circular shape

$i_c = \frac{1}{2}\left(1 + \sqrt{1 - \frac{H}{A' C_u}}\right)$ – load slope, caused by the horizontal component H, while $H \leq A' c_u$

In this case it is recommended partial factor of safety for non-drained cohesion Cu, with a value of 1.4.

Calculation of bearing capacity of the soil in drained conditions

For drained conditions bearing capacity of the soil can be calculated with the following equation:

$$\frac{R}{A'} = c'\,N_c b_c s_c i_c + q' N_q b_q s_q i_q + 0.5\,\gamma' B' N_\gamma b_\gamma s_\gamma i_\gamma$$

The factors of the bearing capacity are calculated according:

$N_q = e^{\pi\, tan\varphi'}(45 + \frac{\varphi'}{2})$

$N_c = (N_q - 1)\cot\varphi'$

$N_\gamma = 2(N_q - 1)\tan\varphi'$, каде $\delta \geq \frac{\varphi'}{2}$(rigid foundation)

The factors of the slope fundaments are equal of:

$b_c = b_q - \left(\frac{1-b_q}{N_c}\right) \times tan\varphi$

$b_q = b_\gamma = (1 - \alpha \times tan\varphi')^2$

Факторите на формата на темелот се еднакви на:

$s_q = 1 + (\frac{B'}{L'})sin\varphi'$ for rectangular shape;

$s_q = 1 + sin\varphi'$ for square or circle shape;

$s_\gamma = 1 - 0.3(\frac{B'}{L'})$ for rectangular shape;

$s_\gamma = 0.7$ for square or circle shape;

$s_c = \frac{(s_q N_q - 1)}{(N_q - 1)}$ за правоаголна, квадратна или кружна форма

Slope factors of the load caused by the horizontal component is equivalent to::

$i_c = i_q - \frac{(1-i_q)}{N_c\, tan\varphi'}$;

$i_q = \left[1 - \frac{H}{(V + A' c' \cot\varphi')}\right]^m$;

$i_\gamma = \left[1 - \frac{H}{(V + A' c' \cot\varphi')}\right]^{m+1}$, where:

$m = m_B = \frac{\left[2 + (\frac{B'}{L'})\right]}{\left[1 + (\frac{B'}{L'})\right]}$ where H acts in the direction of B’

$m = m_L = \frac{\left[2 + (\frac{L'}{B'})\right]}{\left[1 + (\frac{L'}{B'})\right]}$ where H acts in the direction L’

In cases where the horizontal component of the load acting in the direction forming an angle θ to the direction L ', m can be calculated by the expression:

$$m = m_\theta = m_L cos^2\theta + m_B sin^2\theta$$

4. CONCLUSION

The purpose of Eurocode 7 is to define a single equation for calculate the bearing capacity of the soil. What is generally new to Western countries in terms of what it offers Eurocode 7, here is just a continuum-continuous extension of previous calculations, because the partial safety factor that introduces Eurocode, exist in the equations of the Rule book, according to which performed our previous calculations related to the bearing capacity of soil.
These partial factors of safety to us and Eastern Europe are introduced according the example of Denmark from 1957, which is why in our country will not call a big change in the way of calculating.
The application of the partial safety factor is justified because we know who and where parameter as entering, and as we increase his or reducing its value.The advantage is that it will involve more parameters, one example being the members of the group q, i.e. Nq, which do not exist in the Rule book, although the equation given in EC7 may need to be shown in the general form proposed by Hansen in 1968., as an expression that covers all possible factors. Sure, justifying why it is not done is to facilitate the procedure for calculating and still retaining some of the factors that have the greatest, and most commonly, impact on bearing capacity.

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