NORDIC COOPERATION GIVES RESULTS

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KEYWORDS

Eurocode 7, NMGEC7, National Annex

ABSTRACT

The Nordic Mirror Group on Eurocode 7 was established in the year 2014, to influence the development of the second generation of Eurocode 7 on the European level and facilitate implementation within the Nordic countries. Our two-day meetings twice a year have been a well-attended forum for sharing national praxis and experience, creative discussions, finding the common base, and identifying the main items to influence. The goal has been to make sure that the second generation of Eurocode 7 is developed with consideration of Nordic geology, climate, and praxis.

The result? Ten years later, there is a long list of items that the Nordic team as a coordinated group has influenced, by assisting each other with arguments and input, for example, the content of FprEN 1997-2 Ground properties, the inclusion of a chapter on rock bolts and another chapter on groundwater control and an annexe on buckling of piles. The paper will give details on these items and others. In addition, the paper will give a first outline of the next challenge that the Nordic team has taken on – a common Nordic national annex for Eurocode 7.

1. EUROCODE 7 – A COMMON EUROPEAN TOOL FOR DESIGN

As geotechnical engineers, we are influenced by a broad spectrum of standards. However, the Eurocodes have a unique position with its mandate to serve as a reference design code, implying that all member states must accept the design according to EN Eurocode and withdraw any conflicting national standards. The Member States of the EU and EFTA have decided that these technical rules (Eurocodes) should serve as reference documents; 1) to prove

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compliance with the fundamental requirements (serviceability, safety, fire, robustness), 2) for contract specification, and 3) as a framework for creating harmonised technical specifications for building products.

2nd Generation of Eurocode

The first generation of Eurocode was published between 2002 and 2007, after a long process of developing the initial draft, pre-standards, and finally compiling the first generation. As a reference design code, Eurocode was expected to facilitate trade and provide a more consistent level of safety within the union.

Eurocode influences over 500 000 engineers' work and a large amount of civil engineering and building projects throughout Europe. It is a tool that needs to be up to date with the technical development (new technology and materials), and adapt to the fact that the demands from society have shifted over the years from the focus on safety to giving a larger consideration to adaptation to climate change and sustainability. In 2015, the first projects team within CEN TC 250 were established with the objective of 1) improving ease-of-use, 2) increasing harmonization, 3) covering aspects of the assessment, re-use, and retrofitting of existing structures, and 4) strengthening the requirements for robustness. For Eurocode 7, the scope of the standard was extended to include the application of rock. In addition, new aspects and geotechnical structures, such as ground improvement, soil nails and dynamic action were added to the scope.

2. NORDIC MIRROR GROUP ON EUROCODE 7

Is geotechnical design without borders possible? The Nordic countries are individually small countries with regards to inhabitants (4 per cent of Europe's population); however, together, our countries cover more than 30 per cent of the surface area of Europe. A surface area with specific geotechnical and climate conditions that the common European reference design code should account for. The question raised in the year 2013 was if we in the five Nordic countries had enough commonalities in our geotechnical design to work as a team on a European level. The aim was to recognize our differences and similarities, working to assist each other with arguments to ensure that the 2nd generation of Eurocode will be feasible to implement for use in Nordic climate and geotechnical conditions.

The first meeting was in August 2013 in Oslo, and since then, the team has met biannually, rotating the location between Norway, Sweden, Denmark, Finland, and occasionally Iceland. No meeting is alike. However, each meeting includes learning from each other's experiences, arguing for our views, laughing, better understanding our differences, and assisting each other to cover all the questions that the 2nd generation of Eurocode raises.

Geotechnical design in the Nordic countries—is it without borders? No, we still have our differences in geotechnical praxis and will always have. But the borders are easier to cross since we now at least understand each other's views.

Figure 1 Part of the NMGEC7-team in 2016 and 2024

3. NMGEC7 ACHIEVEMENT

The aim was to ensure that the 2nd generation of Eurocode would be feasible to implement and use in Nordic climate and geotechnical conditions. To accomplish this the team divided the work between them and ensured that as long as one from the team was present at the numerous meetings developing the Eurocode 7, the views that NMGEC7 had agreed on were expressed. During the work, we also developed a common support for each other in the debate, probably because all our discussions gave us a better understanding of each other's issues.

It is not possible to give a complete list of the items where our common work influenced the final draft, but let's look at some examples.

EN 1997-2 Ground properties

One of the first items recognized in NMGEC7 discussions was that if EN 1997-2 should be useful as a standard, it needed reorganization and updated content. A proposal was prepared to make EN 1997-2 a standard to be used by the designer to determine ground properties, in contrast to the 1st generation, which had more similarities with a guideline for performing ground investigation. A positive response was received at the European level, and the final

version now has a table of contents that focuses on the major groups of ground properties that are needed for design (strength, deformation, state, dynamic, thermal, and groundwater).

Ground investigation

From a Nordic point of view, extensive and high-quality ground investigation is necessary to design a complex geotechnical structure. However, for all projects, the engineer needs to have the flexibility to use engineering judgment to select the most appropriate type and amount of investigation. This was not in line with praxis in other parts of Europe, which asked for requirements on the number of required field and laboratory tests. Endless discussions resulted in that there is a national possibility to add the requirements, and the tables with values were transferred to an informative annexe.

Pile design

The pile design clause has had much debate since the praxis throughout Europe has significant differences. The Nordic tradition of pile testing is not obvious to the rest of Europe; however, in the end, the clause includes three different approaches and, in addition, one combination of two approaches, see Figure 2. The dynamic testing of piles is recognized as an alternative to static pile load tests, and the interpretation of test results corresponds with the current Nordic approach.

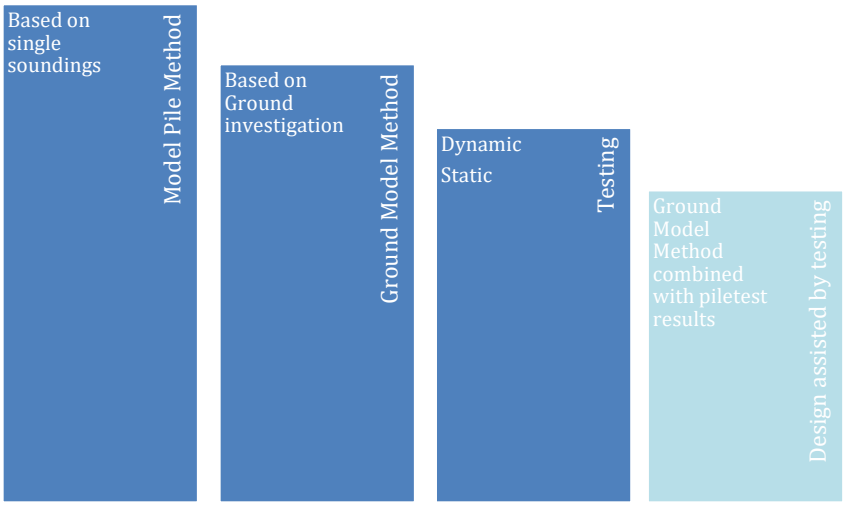

Figure 2 Pile design approaches according to FprEN 1997-3:2024

The structural design of piles requires that we consider the second-order theory determining the buckling of the pile. In EN 1997-3, a separate annex has been included with recommendations on how to treat this phenomenon. This

mostly has been developed by a group with members from the Nordic countries and Germany.

Rock engineering, including rock bolts and rock surface support

The mandate for developing EN 1997 stated that the standard should be equally applicable for rock and soil, and therefore the main word used in the standard is ground. 1st generation mainly considers soil; hence, it was a challenge to rewrite the code to make it generally applicable to rock with a specific focus on foundations on rock and rock slopes. The design of underground openings is still an item that will be developed in the coming years. The Nordic team contributed both to the general inclusion and the specific items, such as the inclusion of rock bolts and rock surface support.

Ground Model and Observational Method

Other items where the Nordic Team has made a substantial contribution are the development of the new sub-clause on the Ground Model (EN 1997-2) and the updated wording on the Observational Method (EN 1997-1).

4. CONTINUATION

The formal vote draft of EN 1997-1, EN 1997-2, and EN 1997-3 have been submitted, and NMGEC7 has contributed to the process. The next step is to implement the design code in our Nordic countries, and for that, we decided to continue our cooperation. We aim to share our views, analysis, and examples in an attempt to facilitate not only the implementation of Eurocode but also our cooperation on a day-to-day basis in civil engineering and building projects throughout the Nordic countries. From the work with NMGEC7, we learned that it is beneficial to work together, even though each country, in the end, needs to prepare its regulations and guidelines themselves, mistakes are avoided, and knowledge and new perspectives are added through the cooperation. At the latest NMGEC7 meeting in May 2024, it was concluded that the Nordic countries would have similar choices for the majority of the NDPs in the national annexe to EN 1997-1. That is a huge step forward to a geotechnical design without borders in the Nordic countries.

ACKNOWLEDGEMENT

The authors would like to thank their colleagues in NMGEC7 for their willingness to share and contribute to the common objectives. The discussion

with an open mind and initially different views are the key to our successful work!

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