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OBRAZOVANJE I PROFESIONALNE KVALIFIKACIJE U EVROKODU 7: 202X

Milorad Jovanovski*, Jovan Br. Papić**, Igor Peševski***

* *Univerzitet "Sv. Kiril i Metodij", Građevinski fakultet, bul. Partizanski odredi br. 24, 1000 Skopje, MKD, email: jovanovski@gf.ukim.edu.mk*
** *Isto, email: papic@gf.ukim.edu.mk*
*** *Isto, email: pesevski@gf.ukim.edu.mk*

REZIME
U radu su obrađeni aspekti stepena obrazovanja inženjerskih kadrova koji profesionalno rade u geotehnici, prikazujući trendove u svetlu razvoja nove generacije Evrokoda 7. Prikazani su rezultati Komisije koja duže vremena priprema informativni Aneks, a čiji je cilj lakše priznavanje licenci za rad u različitim zemljama EU. Prikazana su i makedonska iskustva oko profesionalne registracije kvalifikovanih inženjera za geotehnku u Komori ovlašćenih arhitekata i ovlašćenih inženjera Makedonije, kao i neka uputstva za sticanje naziva EUR-ING. Cilj je da se razmene iskustva sa inženjerskim komorama u regionu i razgledaju mogućnosti koordinirane saradnje na nivou evropskog inženjerskog tržišta.

KLJUČNE REČI: EC 7, stepen obrazovanja, Aneks, kvalifikovani inženjer za geotehniku

EDUCATIONAL LEVEL AND QUALIFICATION REQUIREMENTS IN EUROCODE 7:202X

ABSTRACT
The paper presents aspects related to educational level of engineers working in geotechnics. It shows the trends in the new generation of Eurocode 7. Results of Commission which works on Informative Annex are presented: primary goal is enabling easier recognition of licences for work in different EU countries. Macedonian practice regarding professional registration of qualified geotechnical engineers in the Chamber of Certified Architects and Certified Engineers, as well as some guidelines to obtain the title EUR-ING, are presented, with a goal of exchanging experiences with regional engineering chambers and overview possibilities of coordinated cooperation at the European engineering market level.

KEY WORDS: EC 7, education level, Annex, qualified geotechnical engineer

INTRODUCTION

Eurocode 7 (EN 1997, EC 7), beside other important aspects, introduces the necessity of qualified and experienced personnel needed for adequate design and safe construction of geotechnical structures. This aspect is addressed in EN 1997-1 (2004), in several parts from paragraph 1.3 as follows:

- data required for design are collected, recorded and interpreted by appropriately qualified personnel;
- structures are designed by appropriately qualified and experienced personnel;
- execution is carried out according to the relevant standards and specifications by personnel having the appropriate skill and experience;

Fact is that in Europe and worldwide, the study programs at higher level of education differ among countries, and the variation in national registration systems for engineers are significant. The question is how to insure “common platform” for necessary requirements and qualifications for engineers, and to find a legal definition consistent with the European Directive 2005/36/EC on Recognition of Professional Qualifications in engineering disciplines. This question is maybe most complex for professionals involved in ground engineering, because geotechnics deals with variety of problems, covered by engineering geology, soil mechanics, rock mechanics, foundation engineering, risks, environment etc.

In 2015, during the European Conference for Soil Mechanics and Geotechnical Engineering held in Edinburgh, the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) formed a Working Group (WG) which intensively works on the problem of qualification requirements in EC7. Moreover, it held three workshops: in Leuven (2016), Oslo (2017) and Reykjavik (2019).

Previous attempts were made by Joint European Working Group (JEWG) commissioned by three international professional bodies: International Association for Engineering Geology and Environment (IAEG), International Society for Rock Mechanics (ISRM) and ISSMGE. Other authors or national bodies also work on these topics, and they are noted in article prepared by Fintan Buggy from Geotechnical Society of Ireland, chairman of ISSMGE WG (Buggy et al., 2019). Previous paper by Bock et al. (2014) also gives an interesting perspective on the problem of qualification requirements for ground engineering. The JEWG Report (2008) presents an idea for professional competencies of all three primary disciplines (soil and rock mechanics and engineering geology) in terms of key and general competences, as well as specialized fields for work in ground engineering.

Efforts by the European Federation of National Engineering Associations (FEANI) to prepare a guide for establishing a system to support the idea for open engineering market are also important: these are presented in Guide to the FEANI Register EUR INGs approved by the General Assembly on 4 October 2013 (see references).

It is good to mention that the European Technical Committee CEN/TC 341 on "Geotechnical investigation and testing" and the International Technical Committee ISO/TC 182 "Geotechnics" prepare standards on ground investigation according the so-called Vienna Agreement (Eitner and Stölben, 2021)

Related with all these aspects, personal author's experiences from active participation in ISSMGE Commission, Chamber of Certified Architects and Certified Engineers of Macedonia (CCACEM), Engineering Institution of Macedonia (EIM) and in FEANI are presented. Main goal is to exchange experiences with regional engineering chambers and overview possibilities of coordinated cooperation at the European engineering market level.

ELEMENTS OF "COMMON PLATFORM" FOR QUALIFICATION REQUIREMENTS OF GROUND ENGINEER

Following the concept of open market in EU Directive 2005/36/EC, ISSMGE WG tries to reach a common basis for minimum professional competence within ground engineering. Despite the many problems, more than 13 EU countries gave an input to prepare a draft of document that will lead to preparation of Informative Annex in the revised EC 7. In order to present the differences between countries, some data about educational level and minimum requirements are presented in Table 1 (Buggy et al., 2019).

Table 1 is only a part of large one prepared by WG, and here it is presented only to see the main differences between different "schools". Original table is consisted from data for eight countries (Austria, Belgium, Germany, Ireland, Macedonia, Sweden, Norway and UK). From this situation, Commission suggests the draft version of Informative Annex as a part of New EC7 version, presented in Figure 1.1 and Figure 1.2

Tabela 1. Minimalni zahtevi u pojedinim državama za stručni kadar odgovoran za izradu izveštaja iz geotehničkog istraživanja i projektovanja (tabela delimično izmenjena prema Buggy i sar., 2019)
Table 1. Minimum requirements at some countries for persons responsible for Ground Investigation and Geotechnical Design Reports (table partially modified according to Buggy et al., 2019)

Country	Professional Designation	(1) Educational qualification (ECTS credit points)	(2) Professional experience	(3) Continuous Professional Development CPD	Remarks Registration (p) = under private law (P) = under Public Law
Austria	Registered Engineer (geoengi-neering at large)	Master in Civil or Mining Engineering or Natural Sciences	3 years	3-week course & examination on law, standards and management	(P) mandatory: - registration with Chamber of Engineers - liability insurance
Mace-donia	Geotechnical Expert (to comply with EN 1997 and requirements in Mining)	Beng. (Civil or Mining)/BSc. (180-240) Meng. (Civil or Mining)/MSc. (300) Meng./MSc. (300)	Level B: GC 1-2: 2 years Level A: GC 1-3: 5 years	not defined required, but hours not defined	(P) Macedonian Chamber of Certified Architects and Certified Engineers
U.K.	Geotechnical - Professional - Specialist - Adviser (ground engineering at large)	B Sc / B Eng M Eng / M Sc *plus:* Chartered title C Eng or C Geol (Membership with GSL or ICE or IoM³)	Variable number of years of working experience in the field, depending on the area of competence	40 – 60 hrs / year (mandatory)	RoGEP (Registration of Ground Eng.Professionals) in GSL – Geological Society of London, ICE – Institution of Civil Engineers, IoM³ – Institute of Materials, Minerals & Mining

<Drafting note: This Annex was originally prepared by a group within ISSMGE, chaired by F. Buggy. A draft version was discussed at the Oslo meeting. It was decided that a revised version should be included in the October draft of EN 1997-1. Based on comments from SC7 WG1/TG2, SC7 WG1/TG3 and the ISSMGE group this annex has been revised by SC7.PT2.

In addition to this Annex G, it has been proposed that the material that has been prepared by the ISSMGE group, that is not included in the Annex G, should be published as a Joint Research Paper. Referred to as JRP X in the draft.

The ISSMGE group have assist PT2 to prepare this final draft of this Annex. To ensure a broad acceptance of this informative annex, there will be further discussion during phase 4. >

<Drafting note: This annex is informative. The REQ/REC in the Annex are optional, there is no need to comply with these requirements to claim compliance with the Code. The REQ/REC will only be endorsed if the National Body decide so. Based on IR3 >

D.1 Use of this Informative Annex

(1) This Informative Annex provides additional guidance to that given in 1.2 Assumptions.

(2) This Informative Annex establishes one possible way for verifying the assumption that the design and collection of information is performed by competent persons.

National choice on the application of this Informative Annex is given in the National Annex. If the National Annex contains no information on the application of this informative annex, it can be used Scope and field of application

(1) This Informative Annex provides guidelines on requirements for competence of persons responsible for either geotechnical design or ground investigation process.

(2) This Informative Annex is intended to be used in conjunction with other national legislation that gives complementary requirements on competence.

D.2 Guideline

(1) <RCM> The persons responsible for Ground Investigation and Geotechnical Design should have appropriate qualifications and experience within their respective field that includes:

- A diploma demonstrating successful completion of tertiary studies in a relevant field;
- Professional experience in ground engineering;
- Continuous Professional Development (CPD) in ground engineering;
- Membership of a relevant Professional Register, if available or required in individual countries.

The recommended minimum requirements for qualifications and experience are given in Table D-1 (NDP) unless the National Annex gives different requirements. Examples of current and proposed requirements for countries can be found in JRP X[1]

Slika 1.1 Radna verzija Informativnog Aneksa za kvalifikacije i profesionalno iskustvo za realizaciju geotehničkih istraživanja i geotehničkog projektovanja (materijali sa sastanaka radne grupe)
Figure 1.1. Draft version of Informative Annex for qualifications and professional experience for Ground Investigation and Geotechnical Design Reports (material from WG Meetings)

European Commission Directive 2005/36/EC on mutual recognition of professional qualifications acknowledges that engineers are organised differently in various EU member states.

The minimum requirements in Table D-1 are applicable for geotechnical structures that fall within Geotechnical Category 2.

The National Annex can stipulate which professional titles or levels of registration meet the minimum requirements in Table D-1.

Table D.1. (NDP) Minimum requirements for qualifications and professional experience to fulfil the assumptions of clause 1.3 for Geotechnical Category 2 structures [a]

(1)	(2)	(3)	(4)	(5)
Educational qualification (ECTS credit points)	**Professional experience**	**Continuous Professional Development (CPD)**	**Professional Competence**	**Remarks Registration Professional qualifications and application**
NOTE 1	**NOTE 2**	**NOTE 3**	**NOTE 4 and 5**	
B Sc / B Eng (180 – 240) Dipl. Ing. / M Sc / M Eng (300)	B Sc / B Eng 5 years – GC 2 Dipl. Ing. / M Sc / M Eng 3 years – GC 2 and demonstrated appropriate competence	≥ 20 hours /year	General requirements are defined in Note 5.	National requirements for registration may be enforced by private or public law. Applications for professional registration should be documented, subject to independent assessment and include a statement of professional competency and curriculum vitae.

[a] This table is an NDP and the NSB can clarify the following for its application.
- Additional requirements for Geotechnical Category 3 structures
- Additional acceptable academic qualification and associated professional experience
- Specification of criteria for CPD
- Additional general requirements on professional competence
- Specific requirements on professional competence for different technical areas

Core subjects such as soil / rock mechanics, foundation engineering and engineering geology are required as part of university studies.

The professional experience is measured in number of years demonstrating appropriate competence in the application of the relevant clauses of EN 1997.

The criteria for valid CPD hours varies nationally. Learned Societies can give input to the specification.

The required professional competence, including level of competence, depends on which clauses of EN 1997 a person will apply. Specific requirements for different technical areas can vary. Examples of relevant technical areas include planning of field and laboratory investigation, evaluation of ground investigation results, pile design, ground reinforcement, numerical methods. The professional competence also includes general professional competence related to documentation, project management, risk management, and communication.

Slika 1.2 Produžetak radne verzije Informativnog Aneksa za kvalifikacije i profesionalno iskustvo za za geotehnička istraživanja i geotehničko projektovanje (materijali sa sastanaka radne grupe)
Figure 1.2. Continuation of draft version of Informative Annex for qualifications and professional experience for Ground Investigation and Geotechnical Design Reports (material from WG Meetings)

The General requirements in the table are related with competences to solve problems in structures from Geotechnical Category 2 in EC7. They are combination of formal and informal learning, and training and experience (CPD). There are five generic areas of competence and commitment for all ground engineering professionals: A) Knowledge and understanding; B) Design and development of ground engineering processes, systems, services and products; C) Responsibility, management or leadership; D) Communication and inter-personal skills; E) Professional commitment. The necessity of registration of professionals involved in ground engineering including the disciplines of soil mechanics, rock mechanics, geoenvironmental science and engineering geology is strongly underlined by the WG. Commission's opinion is that the concept may not be ideal, but it gives flexible platform for each country, so it is preferred by countries with existing registers. Expectations are that the main concept will be accepted in the final version of the second generation of EC7.

SOME NOTES FOR FEANI EUR ING REGISTER

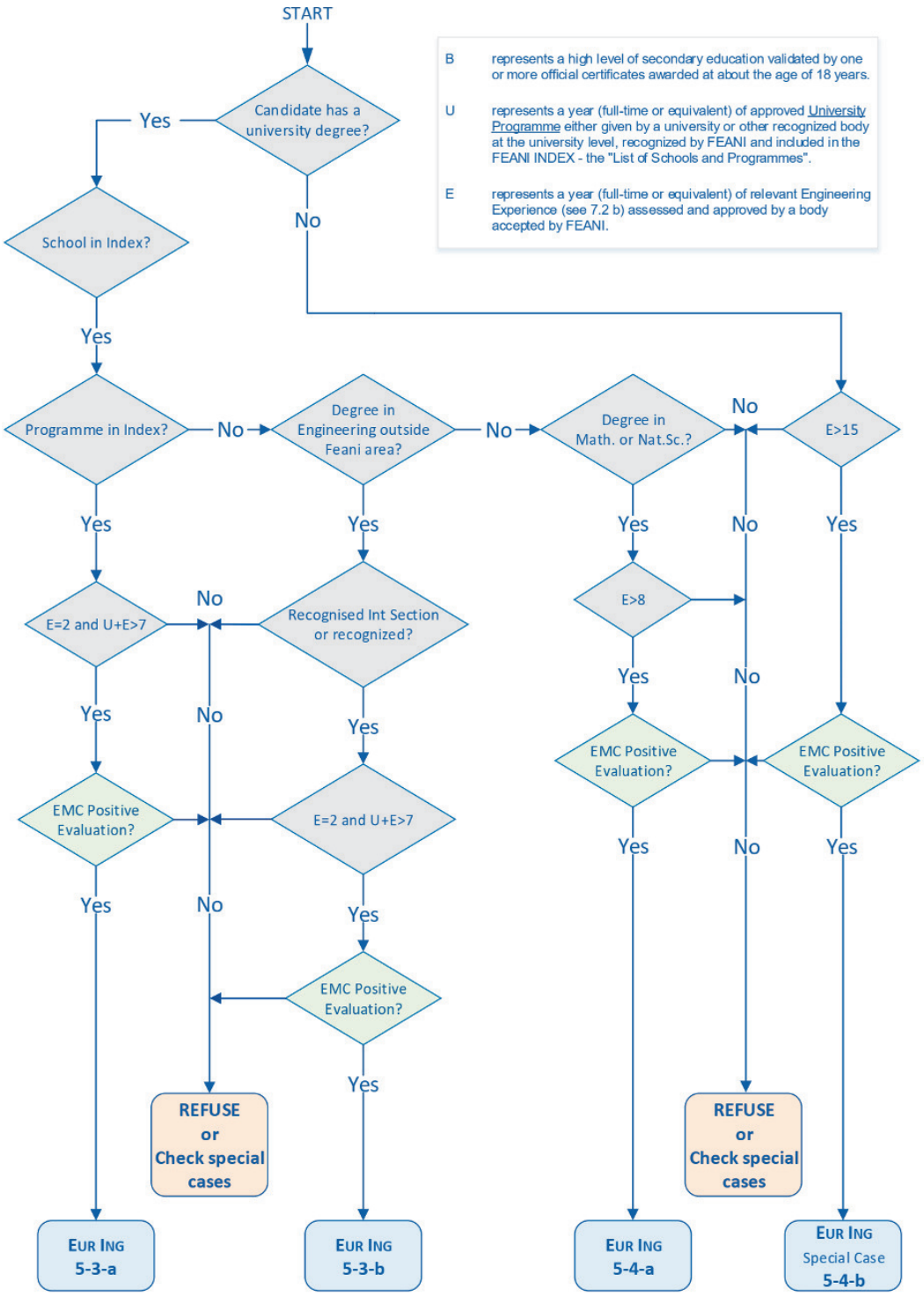
Beside diversity of educational programs, it is important to underline that FEANI set up a List of Schools and Programs in the FEANI INDEX which meet the FEANI education standard and are accredited or officially recognized at national level. They must have curricula making it possible for candidates to develop towards professional competence. The FEANI INDEX has a list of countries inside and outside the FEANI area. There are some standards with minimum requirements for admission to the EUR ING Register and represent stages towards the professional competence. Registration as "European Engineer" gives the right to use the professional title EUR ING (invariable in all member countries) with the national title. The Guide explains the elements of engineering education with the elements B, and U and Professional Engineering Experience E (see Figure 2). The FEANI system offers open market for all engineers, and it can be in correlation with EC7 needs for qualifications of ground engineers. It is good to note that, sometimes, EUR ING card not always correlates with National Certifications and Licenses for engineering works.

The FEANI concept has some similar elements presented in works prepared by ISO/TC 82/WG 4 (Eitner and Stölben , 2021). These deal with qualification criteria for persons and companies that perform sampling, testing, measuring, monitoring and installation of equipment. In the article, terms as "qualified technician", "responsible experts" and "qualified enterprise" are used, with an idea to explain the duties and responsibilities in ground engineering.

All these aspects can be an area for further improvements.

MACEDONIAN EXPERIENCES

The Macedonian system for registration of ground engineers is very flexible and somehow incorporates main findings from all previous documents. The procedures for registration of engineers in Macedonia is defined initially in the version of Law for Construction dating from 2008.

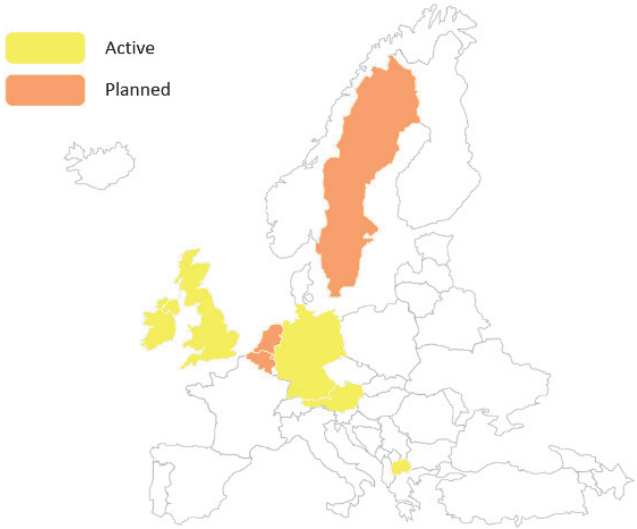


Slika 2. Različiti pravci za priznavanje studijskih programa potrebnih za sticanje titute EUR ING
Figure 2. Different routes for recognition of studies programs necessary to obtain the title EUR ING

It was very positive that the Law, from its beginning, gives authority to the CCACEM to deal with certifications. In the Law, beside other engineering disciplines that deal with different aspects in construction, a separate division for engineering geologist (later engineering geologists and geotechnics) is introduced. At the moment, CCACEM gives Certifications for following engineering disciplines:

• Architecture;
• Civil engineering;
• Electrotechnical engineering;
• Mechanical engineering;
• Urban planning;
• Geodesy;
• **GEOTECHNICS;**
• Safety and fire resistance;
• Environmental engineering;
• Energy efficiency;
• Technology and metallurgy;
• Traffic engineering.

In the Geotechnical division, several engineering disciplines can apply for Certification, such as: graduated geotechnical, civil, geological and mining engineers, with diplomas from 180 to 300 ECTS (see table 1). In fact, CCACEM is one of the rare National bodies that do special registration of ground engineers (Figure 3).



Slika 3. Karta evropskih država sa aktivnim ili planiranim nacionalnim registracionim sistemima za inženjere (Buggy i Franzen., 2019)
Figure 3. Map of European States with Existing and Draft / Proposed Registration Systems (Buggy and Franzen, 2019)

Law on Construction in Macedonia recognizes two levels of Certifications, A and B level, and that Certificates can be issued for Revision, Design, Supervising and Construction (see Table 1 and Figure 4).

Slika 4. Neki tipovi ovlašćenja za geotehniku koje izdaje Komora ovlašćenih inženjera Makedonije
Figure 4. Examples of some certifications for geotechnics issued by CCACEM

If we analyze the suggestions in the Draft Informative Annex for EC7, it can be underlined that CCACEM has already established a system for Continual Professional Development and recognition of foreign engineers in Macedonian market (Figure 5).

Slika 5. Potvrda za posećenu obuku i dobijanje 3 CPD poena (levo); Primer potvrde za priznavanje stranih ovlašćenja (desno)
Figure 5. Certificate for attended training and achieving 3 CPD points (left); Example of recognition of Certifications for foreign engineers (right)

For all types of activities in continual education of engineers, some CPD points are given. For engineers from abroad with some level of Certification approved by their national body, formal documents are prepared by CCACEM. It is obvious that the request from Informative Annex can be adopted in Macedonia relatively easy. The system can be incorporated in European wide agreement, based on a set of fundamental registration requirements and goals. National flexibility should be enabled in order to set rules best suited to local / national practice.

This can be an idea to open wider discussion with neighboring geotechnical societies and chambers in order to try to timely accommodate the region for the wider EU market and needs.

CONCLUSIONS

The problem of qualifications and educational level of engineers whose professional occupation is geotechnics has a high priority level in the light of development of the new generation of Eurocode 7. Here, registration of ground engineering professionals on national and international basis is important. The adoption of an Informative Annex to the revised EN1997 shall be fully compliant with EU Directive 2005/36/EC. All experiences that can lead to successful solution are needed and welcomed.

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