

## Towards the second generation of Eurocode 7

Dr Andrew Bond, Geocentrix Ltd, UK, Chairman of TC250/SC7, chairman@eurocode7.com

### ABSTRACT

Work on the second generation of Eurocodes got underway in October 2015, with the planned delivery date for new versions of ENs 1990 to 1999 in 2020 or shortly afterwards. This paper summarizes the work that is now being done to create an improved version of Eurocode 7 that will be fit for the 21<sup>st</sup> century.

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### 1. EUROPEAN COMMISSION MANDATE M/515

In December 2012, the European Commission issued a Mandate (M/515) for “amending existing Eurocodes and extending the scope of Structural Eurocodes”, which would involve:

- development of new standards or new parts of existing standards;
- incorporation of new performance requirements and design methods;
- introduction of a more user-friendly approach in several existing standards; and
- a technical report on how to adapt the ... Eurocodes ... to take into account the relevant impacts of future climate change.

Under this Mandate, EN 1997 (Eurocode 7 – *Geotechnical design*) was classified as a ‘framework/assessment’ Eurocode and placed in Work Package I, alongside ENs 1990 (The Eurocode – *Basis of structural design*), 1991 (Eurocode 1 – *Actions on structures*), and 1998 (Eurocode 8 – *Design of structures for earthquake resistance*).

The outcomes that the Commission would like to see from this work package are:

- a) Significant reduction in the number of Nationally Determined Parameters (NDPs).
- b) Refinement to improve the ‘ease of use’ of Eurocodes by practical users.
- c) Incorporation of recent results of international studies and practical experience from scientific and technical associations and results from research programmes relevant to innovation (including the performance based and sustainability concepts in design and construction).
- d) Incorporation of recent results ... relevant to contribution of structural design to sustainability.
- e) Adoption of ISO standards to supplement the Eurocodes family.
- f) Developing auxiliary guidance documents to facilitate feedback from stakeholders and the practical local implementation wherever necessary.
- g) Developing information on the determination of material and resistance factors, serviceability for buildings and bridges; fatigue verification; improving the fire safety engineering approach (EN 1990).
- h) Incorporating new developments in the field of traffic loads and climatic actions; atmospheric icing; waves and currents (EN 1991).
- i) Providing a clear and complete list of background documents used during the standardisation process.
- j) Developing a technical report analysing and providing guidance for ... relevant impacts of future climate change (general and material specific)

CEN, the European Standards Organization, submitted a technical and financial proposal to undertake this work and, in December 2014, the European Commission confirmed funding of €4.5M to enable Phase 1 of the project to get underway in January 2015. The National Standards Body for the Netherlands (NEN) won the contract to manage the project on behalf of CEN.

A further two Phases of work are anticipated in response to Mandate M/515, which will – subject to approval by and funding from the European Commission – bring the total cost of satisfying Mandate M/515 to over €10M by the end of 2019. This figure does not include the value of all the time volunteered by members of technical committees, working groups, and task groups that have been formed to oversee and review the contracted work.

Figure 1 shows the timeline for development of the second generation of Eurocodes over the period 2010 to 2020.

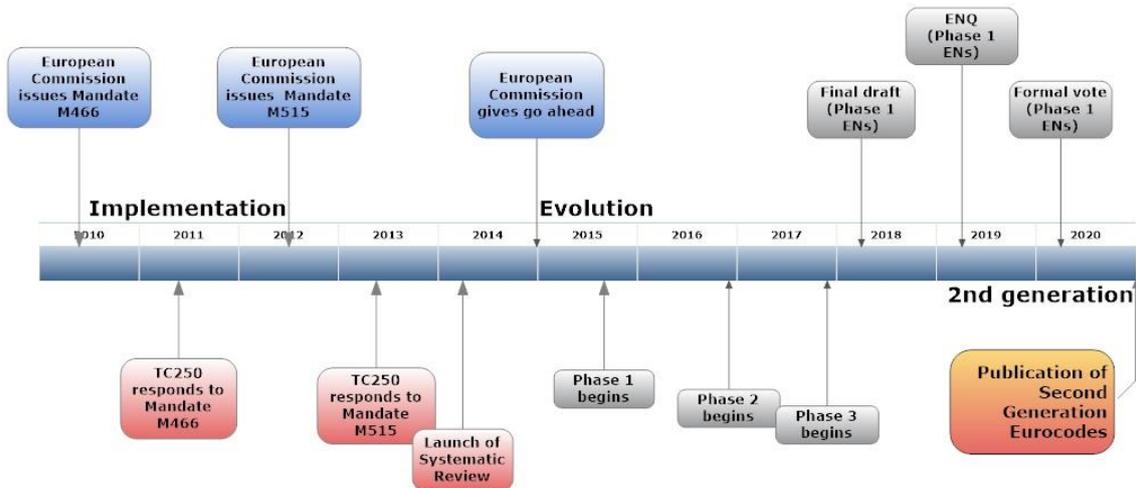


Figure 1. Timeline for development of the second generation of Eurocodes

## 2. INITIAL PREPARATION FOR THE NEXT VERSION OF EN 1997

Planning for the next version of Eurocode 7 began in 2011, when TC250/SC7 – the sub-committee that is responsible for maintenance and development of Eurocode 7 – decided to setup a total of fourteen ‘Evolution Groups’. These groups were asked to undertake ‘blue-sky thinking’ with regards to the changes that could be made to improve the practice of geotechnical design according to Eurocode 7. Figure 2 shows the titles of the fourteen Evolution Groups (EG12 *Tunnelling* was planned but never brought into existence).

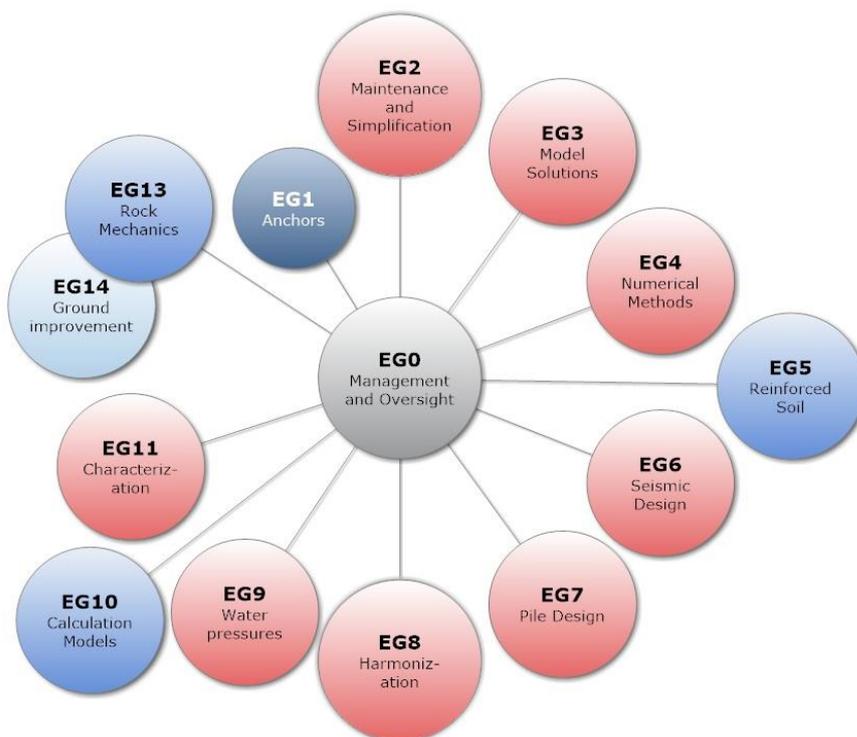


Figure 2. SC7's Evolution Groups, 2011-15

The Evolutions Groups submitted their final reports in December 2015 and these documents have formed the starting point for the development work that has since got underway, as explained next.

### **3. CURRENT PLANS FOR DEVELOPING EN 1997**

#### **3.1. SC7's six Tasks**

As part of CEN's response to Mandate M/515, in 2014, SC7 proposed undertaking six tasks in order to achieve the desired outcomes from Work Package I:

1. Harmonization and ease-of-use of Eurocode 7
2. Improvements to Eurocode 7 Part 1 – General rules
3. Improvements to Eurocode 7 Part 2 – Ground investigation
4. Creation of Eurocode 7 Part 3 – Geotechnical constructions (slopes and foundations)
5. Creation of Eurocode 7 Part 3 – Geotechnical constructions (retaining structures)
6. Improved treatment of rock mechanics and dynamic design

Tasks 1 and 2 are included in Phase 1 of the overall programme of work; Tasks 3-5 in Phase 2; and Task 6 in Phase 3.

Two Project Teams (PTs) were appointed in August 2015 to deliver the outcomes from Tasks 1 and 2. The members of the Project Teams were selected following an open tendering process organized by NEN and overseen by TC250 and the European Commission. SC7 appointed a 'Pre-Selection' Panel – comprising Roger Frank (FRA), Giuseppe Scarpelli (ITA), Jorgen Steinfeldt (DNK), Ivan Vanicek (CZE), Norbert Vogt (DEU), and myself (GBR, SC7 Chairman, ex-officio) – to choose the best candidates to serve as members of the Project Teams.

#### **3.2. Task 1: Harmonization and ease-of-use of Eurocode 7**

The Project Team for Task 1 (PT1) comprises Sébastien Burlon (Team Leader, FRA), Loretta Batali (ROM), Bernd Schuppener (DEU), Brian Simpson (GBR), Carsten Steen Sørensen (DNK), Vincenzo Pane (ITA), Mark Lurvink (SC7 Secretary, ex-officio), and myself (SC7 Chairman, ex-officio).

The major part of Task 1 is to propose a new structure for EN 1997 – one that is easier to navigate; is more consistent externally with the other (structural) Eurocodes and internally between its own Parts; and provides more space for detailed design rules covering a wider range of topics.

The most visible element of this Task is the division of Eurocode 7 into three Parts:

1. EN 1997-1 Eurocode 7 – Geotechnical design: Part 1 – General rules
2. EN 1997-2 Eurocode 7 – Geotechnical design: Part 2 – Ground investigation\*
3. EN 1997-3 Eurocode 7 – Geotechnical design: Part 3 – Geotechnical constructions

\*Note the title will be shortened from *Ground investigation and testing*.

One proposal for the new structure of Part 1 is shown (in part) in Figure 3.

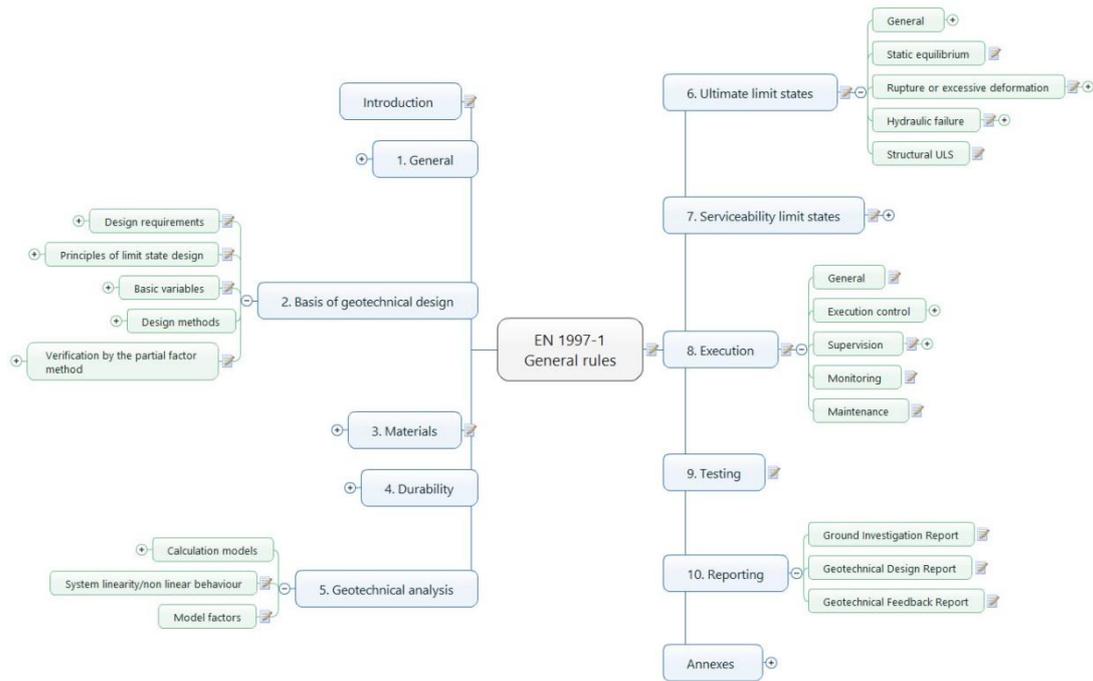


Figure 3. One proposal for the new structure of Eurocode 7: Part 1 – General rules

The current proposal for the structure of the new Part 3 is shown (again, in part) in Figure 4.

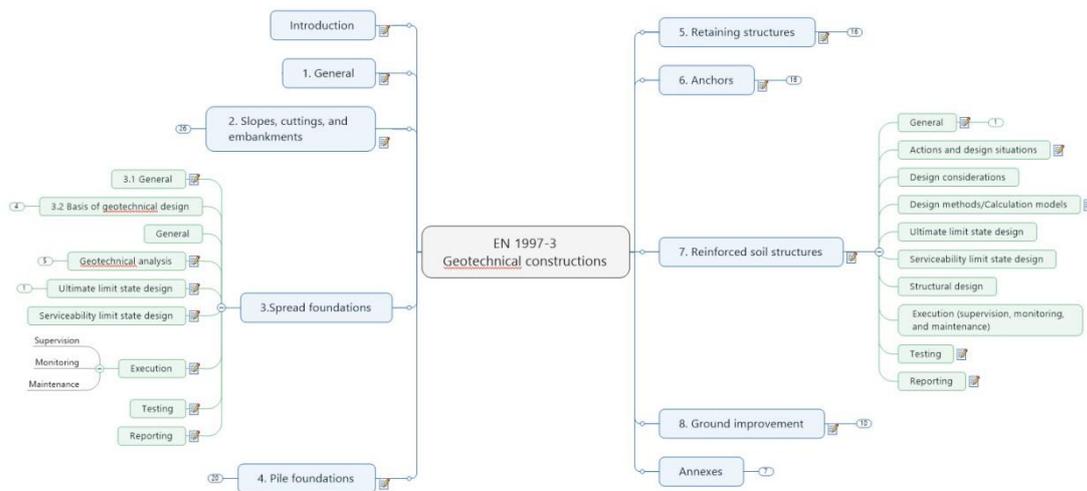


Figure 4. Proposed structure of new Eurocode 7: Part 3 - Geotechnical constructions

A second major element of Task 1 is to dispense with the infamous Design Approaches from EN 1997-1:2004 and to propose an alternative method of selecting partial factors for design that is clearer for practising engineers to use. The current proposal (based on the work of Evolution Group 8) is to introduce different ‘Design Combinations’ that depend on the geotechnical construction being designed.

### 3.3. Task 2: Eurocode 7 – Part 1: General rules

The Project Team for Task 2 (PT2) comprises Gunilla Franzén (Team Leader, SWE), Marcos Arroyo (ESP), Michael Kavvadas (GRC), Andrew Lees (CYP), Adriaan van Seters (NDL), Herbert Walter (AUT), Mark Lurvink (SC7 Secretary, ex-officio), and myself (SC7 Chairman, ex-officio).

The major elements of Task 2 are to propose a method that will allow for reliability discrimination, depending on the consequences of failure in a particular design situation (persistent, transient, etc.); to

provide a better definition of the characteristic value of a geotechnical parameter, taking into account the amount of data available and the size of the foundation; to identify the best methods of establishing design water pressures, whether through the application of partial factors, the introduction of safety margins, or by some other means; and to provide clear rules for using advanced numerical models in day-to-day geotechnical practice.

### 3.4. Task 3: Eurocode 7 – Part 2: Ground investigation

The Project Team for Task 3 (PT3) will be appointed before the end of 2016.

One early decision that PT3 will need to make is how to re-structure Part 2, if at all. SC7's Evolution Group 2 has proposed a radical slimming down of the contents of Part 2, without altering its existing structure.

An alternative proposal that is currently under consideration by SC7 is to completely re-organize the contents of Part 2 in terms of the parameters that a ground investigation can provide to the designer. The initial idea for this proposal came from the Nordic Mirror Group to SC7 and has been developed further by a small group within SC7. The possible new structure is shown in Figure 5.

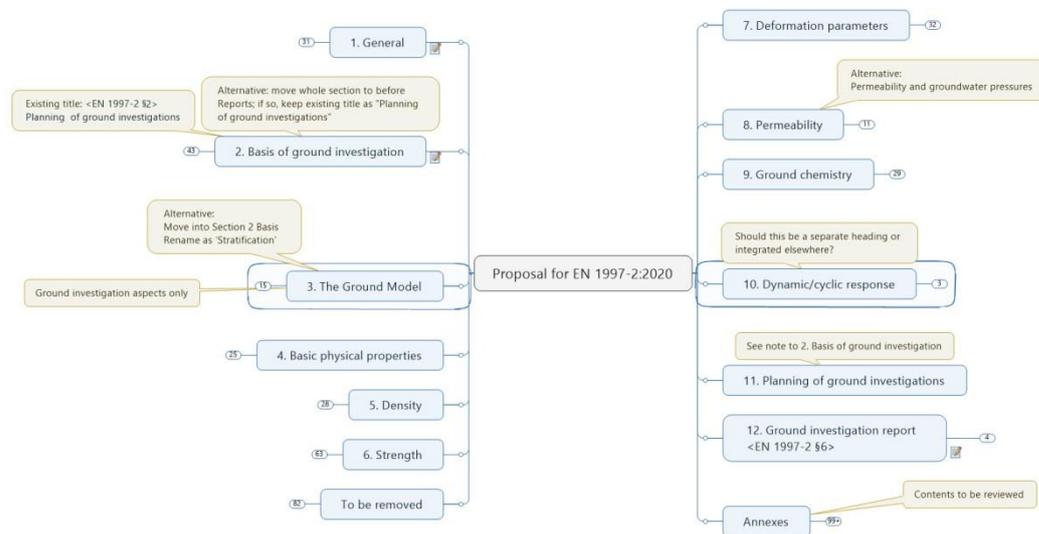


Figure 5. Possible new structure of Eurocode 7: Part 2 – Ground investigation

### 3.5. Tasks 4 and 5: Eurocode 7 – Part 3: Geotechnical constructions

The Project Teams for Tasks 4 and 5 (PTs 4 and 5) will be appointed before the end of 2016.

These two Tasks together are intended to create a new European standard entitled Eurocode 7: Geotechnical design – Part 3: Geotechnical constructions. The current proposal for the structure of the new Part 3 is shown in Figure 4. A key aim of this work will be to ensure consistency between the various sub-sections of the standard, by adopting a common sub-structure, currently expected to be similar to that shown in Figure 6.

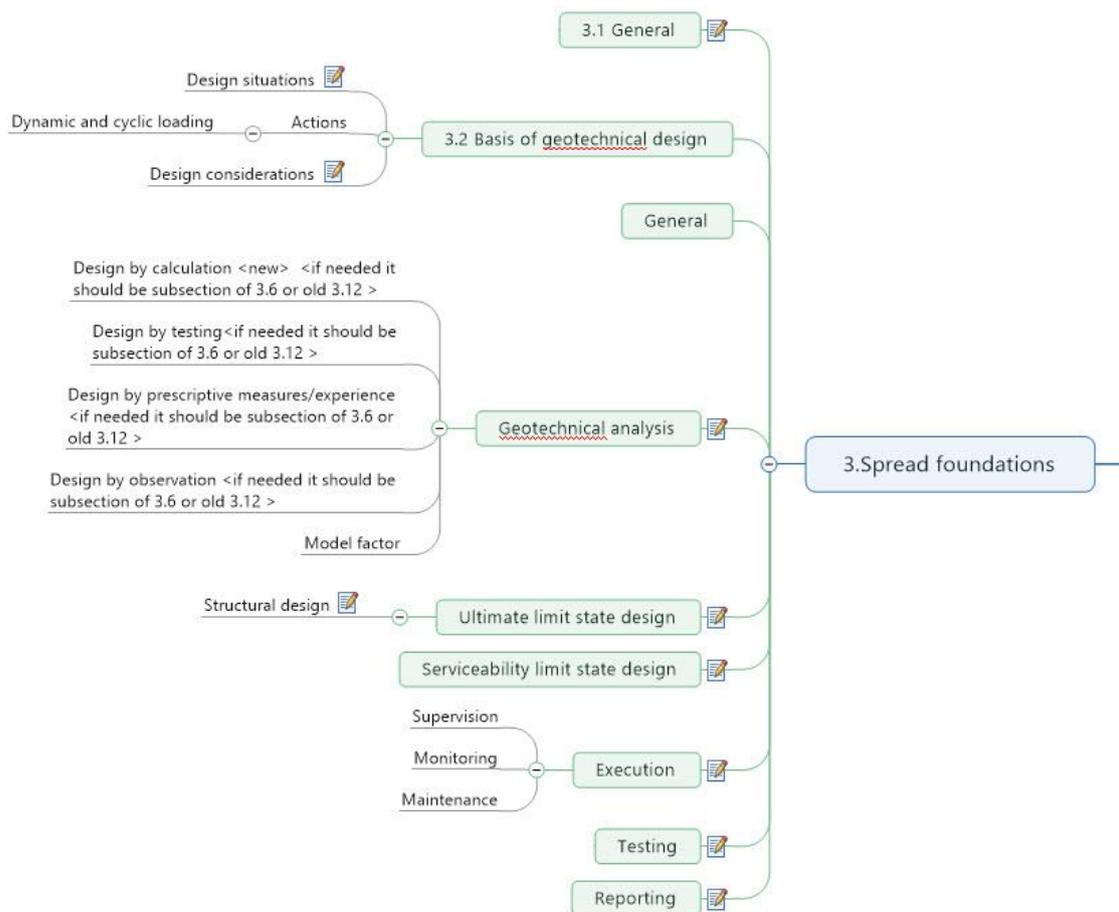


Figure 6. Proposed structure of each section within EN 1997-3

### 3.6. Task 6: Rock mechanics and dynamic design

The Project Team for Task 6 (PT6) is expected to be appointed sometime during 2017.

This Task was established to ensure that the treatment of rock mechanics and dynamic design in Eurocode 7 is greatly improved – to such an extent that rock mechanics is seen as an equal bedfellow to soil mechanics in the new code and the interface between Eurocode 8 (seismic design) and Eurocode 7 is seamless.

## 4. REVIEWING/APPROVING THE WORK OF THE PROJECT TEAMS

The previous section of this paper outlines the very ambitious plans that SC7 has made for the next generation of Eurocode 7. To ensure that the Project Teams deliver what is wanted, arrangements have been made to provide technical support to the PTs as and when they need it. In addition, since SC7 retains overall responsibility for the contents of EN 1997, it is important that it reviews the work of the PTs on a regular basis and approves the final outcomes.

To this end, SC7 has now created three Working Groups to look after the separate Parts of the new Eurocode. Task Groups have been created within those Working Groups, to help focus attention on specific technical topics. The new organizational structure of SC7 is shown in Figure 7 and discussed below.

Individual Task Groups have been established to align with the specific Tasks given in CEN’s response to Mandate M/515. The Task Groups therefore ‘shadow’ the Project Teams that are contracted to do the work. So, for example, Working Group 1’s Task Group 1 (WG/TG1) is responsible for supporting PT1 and reviewing its work on behalf of SC7.

Each country within CEN has been asked to appoint delegates to serve on SC7's Task Groups, on a voluntary basis. As of the time of writing, over 200 geotechnical engineers have put their names forward to help SC7 deliver on its promise of a better Eurocode 7, fit for the 21st Century.

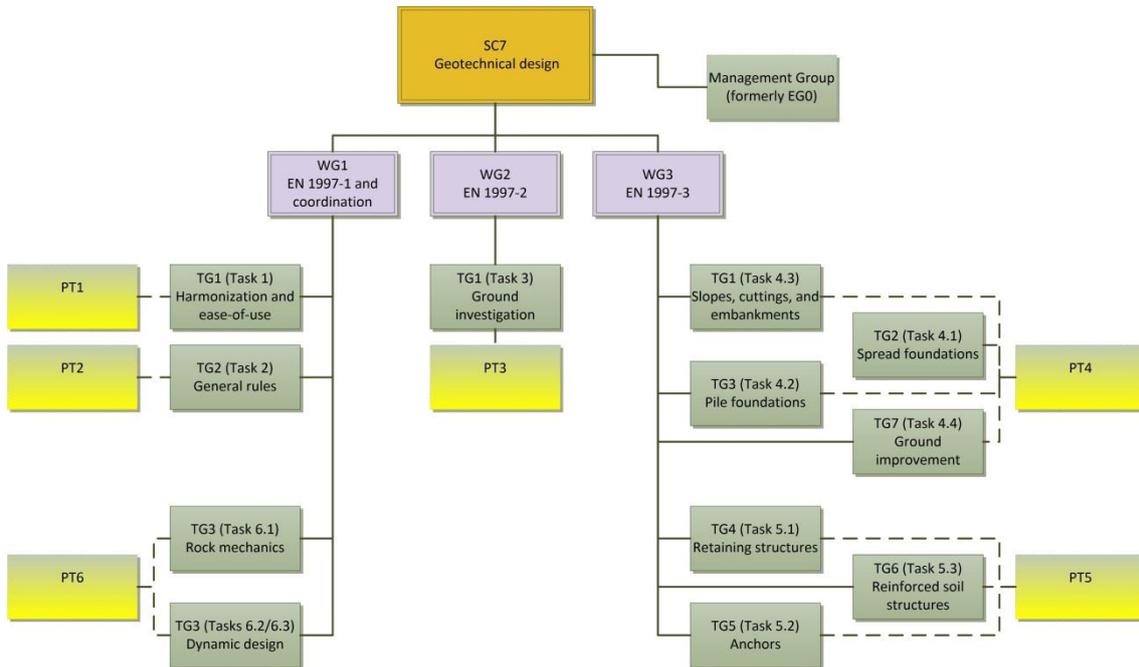


Figure 7. Organizational structure of SC7 from 2016 onwards

## 5. CONCLUSION

A very ambitious programme of work is now underway that aims to deliver a vastly improved European standard for geotechnical design. Major changes to the structure and content of EN 1997 are envisaged that should lead to improved ease-of-use, greater consistency, and better harmonization between the geotechnical practice in different European countries. A large body of experts have volunteered to assist in this work, which will ensure a wide range of opinions will be heard on how to proceed.

My hope is that the second generation of Eurocode 7 will be a worthy successor to the original EN 1997, which itself was a major achievement. As Isaac Newton said in 1676:

*“If [we] have seen further, it is by standing on the shoulders of giants.”*

## REFERENCES

European Commission Enterprise and Industry Directorate-General, Brussels, 12 December 2012, M/515 EN Mandate for amending existing Eurocodes and extending the scope of Structural Eurocodes.

CEN/TC 250, May 2013, Response to Mandate M/515, ‘Towards a second generation of EN Eurocodes’, CEN/TC250, document N993