

## **BUSINESS PLAN**

### **CEN/TC 396**

### **EARTHWORKS**

#### **EXECUTIVE SUMMARY**

Earthworks are a major part of each new contract for the construction of transport infrastructures and represent a major economic activity.

Earthworks are a civil engineering process that includes to extract, load, transport, transform/improve, place, stabilise and compact natural materials (soils, rocks), secondary or recycled materials in order to obtain stable and durable cuttings, embankments or engineered fills. Earthworks require planning, design, construction and maintenance.

Earthworks have also strong links with social and environmental aspects as well as sustainable development:

- Optimise use of non-renewable resources;
- Reduction of the externalisation of stockpiles and borrow-pits;
- Reduction of transports (CO<sub>2</sub>) and of the discomfort of the neighbourhood;
- Landscaping and integration of the project in the site.

The European standardisation of Earthworks includes terminology, principles, rules for defining earthwork processes, tests, classification, quality control and monitoring, construction procedures for standard and special fills, considering the environment. It will be beneficial for individual countries because the existence of a common framework will give access to possibly better practices and because it is the way to find common answers to the new social demand for more sustainable and environment friendly development.

CEN/TC 396 gathering European experts of earthworks will ensure full consistency for earthwork operating process.

Benefits that are expected from the work of CEN/TC 396 are as follows:

- To improve exchanges between European countries in order to enlarge shares of progresses to a best use of no-renewable resources;
- To harmonize national guidelines and recommendations throughout Europe to ensure mutual understanding and cooperation;
- To make easier contracts interpretation for Earthworks contractors and designers who export in Europe or overseas (to get more credibility to European know-how);
- To develop European research in this area which is a large part of the amount of the transport infrastructures, especially to improve and develop criteria of performance-based requirements.

## **1 BUSINESS ENVIRONMENT OF THE CEN/TC**

### **1.1 Description of the Business Environment**

*The following political, economic, technical, regulatory, legal, societal and/or international dynamics describe the business environment of the industry sector, products, materials, disciplines or practices related to the scope of this CEN/TC, and they may significantly influence how the relevant standards development processes are conducted and the content of the resulting standards:*

Earthworks are a civil engineering process aimed at creating earth-structures by changing the geometry of the earth surface for construction or other activities. Application fields of earthworks are associated with:

- transport infrastructures (road and motorways, railways, waterways, airports),
- platforms for industrial, commercial and residential buildings;
- water engineering, flood defence and coastal protection works;
- harbours and airport areas, including the construction of embankments in water,
- river dykes and marine embankments for land reclamation,
- earth and rock fill dams;
- onshore embankments made of hydraulically placed fill;
- landscaping embankments;
- backfilling of open mines,
- tailing dams,
- etc.

They are characterised by the need to use available natural or recycled materials and to handle them in a way appropriate to yield prescribes properties.

#### NOTE 1

Trenches and small earthworks with their specific requirements are not considered in the scope of this TC, but some of the rules developed may be applicable to them.

#### NOTE 2

Capping layers, the upper part of embankment and the embankment are covered by CEN/TC 396. Earthworks are considered to be performed according to the same processes for applications for roads, railways, waterways, etc. Earthworks for special applications with specific demands of bearing capacity and serviceability, such as insulating layers over land fills, may need coordination with the organisation responsible for design.

#### NOTE 3

Dykes and dams include earthworks and may have specific design and construction requirements. Nevertheless offshore and nearshore dykes and dams and fills might be included in the scope of CEN/TC 396 (as special constructions).

#### NOTE 4

There is no conflict between the scope of CEN/TC 396 and the scope of Eurocode 7 (CEN/TC 250). As an example, for projects consisting of cuts, embankments, retaining structures, bridges with their foundations, etc. the scopes of earthworks standards and Eurocode 7 are roughly defined as follows:

- Eurocode 7 = Design: stability and deformations of cuts and embankments + foundation structures + retaining structures + ground improvement or reinforcement

- Earthworks = Transformation of project design into a construction process: Execution of cuts + Execution of embankments + Re-use of materials

#### NOTE 5

Regarding the presence of polluted soils in earthworks (depending on leaching potential) CEN/TC 396 will just say that if pollution is found then the problem has to be solved. A close liaison with CEN/TC 345 is needed.

It is clear that designers need to consider this topic from the beginning of a project to maximise chance of re-use.

It is made clear that:

- earthworks produce earth-structures (embankments, cuts) which have to be designed following the rules of Eurocode 7 (TC250/SC7), with respect to stability and deformations, using design parameters determined following the standards prepared by TC341; if reinforcements or improvement of the ground below the embankment or next to the cut are necessary, they will be designed following Eurocode 7 and executed as specified by existing standards, if available;
- the specifications for the mechanical properties of the upper part of the embankment are related to the structures lying on top of it (pavement, railway, construction,...);
- the construction works and the exploitation of the structures must take account of possible pollutions (covered by specialised TCs: TC 292, TC 308, TC 345, TC 351).

To conclude, the scope of the European standardisation of earthworks (excavations and fills) includes terminology, principles, rules for defining earthwork processes, tests, classification, quality control and monitoring, construction procedures for standard and special fills, considering the environment.

This standardisation is applicable to all types of earth-structures, whatever their intended use is (roads, railways, airfields, waterways, buildings, landfills, tailing dams, etc.), except where listed below:

- some specific types of works such as the execution of trenches and small earthworks may be organized using simplified or specific rules;
- some structures, such as dykes and dams, need earthworks which have specific design and construction requirements: these may extend beyond the rules of this standard.

## **1.2 Quantitative Indicators of the Business Environment**

*The following list of quantitative indicators describes the business environment in order to provide adequate information to support actions of the CEN /TC:*

- Earthworks are an important part in the contract of transport infrastructures and represent a major economic activity:
  - 15 to 20% on average of the “civil engineering works” activity;
  - between 1 and 2 billions cubic meters excavated and to be used each year in Europe;
  - major activity in the field of transport infrastructures;
  - main impact on the project economy of motorways and “High Speed Lines” railways realization.

- Natural, non manufactured materials are often used in earthworks. Then particular consideration has to be given to the geological conditions and uncertainties, and meteorological conditions during construction.
- In earthworks use of secondary or recycled materials is possible or can be made possible, thus helping to preserve other resources. Standardisation may facilitate the use of such materials.
- Despite the existence of efficient national guidelines and recommendations in some countries, the diversity of these rules, which use different words and different thresholds or numerical values, is a major obstacle for mutual understanding and cooperation.
- European countries also have different test methods but in all cases the evaluation of parameters is part of the process of design. Work is needed on standardising ways of interpreting the test results.
- There will be an in depth exchange of knowledge and expertise. Individual countries will certainly find in the sum of European countries practices, some items which are treated more efficiently than in their own guidelines and recommendations, and get direct benefits from the new CEN works. European competitiveness will be enhanced.
- The community of earthworks specialists throughout Europe must be mobilized to undertake the preparation of standards, etc. for earthworks. Reference documents for this field should not be made by experts from other domains and published without due coordination by earthworks specialists and yet become applicable to earthworks.

It thus must be concluded that there are very relevant and important normative needs for this activity, which is presently ruled by national regulations, specifications or standards.

## **2 BENEFITS EXPECTED FROM THE WORK OF THE CEN/TC**

At the present time, the methods in force for executing earth works vary considerably from one country to another, sometimes for objective reasons such as the diversity of the climates (frost, more or less aggressive rainfall, drought...), of the soils or of the stresses to which the construction works are subjected, but often because the practices stem from a long national tradition, the bases of which could be reassessed, for example because they are expensive or environmentally harmful

Nevertheless, CEN standards for earthworks should respect national experience and allow each country to maintain any rule proven to be efficient.

Another effect of the creation of European standards might be the need in some countries to change the way in which prescriptions for earthworks are combined with administrative procedures in national or regional regulations. European standards should be acceptable from the point of view of the national practices and experience of earthworks.

In this context, what could we expect of a European standardization?

- A better use of no-renewable resources by sharing our knowledges and experiences;
- Easier contracts interpretation for Earthworks contractors and designers;

- A base to establish common criteria of performance-based requirements;
- A base to develop European research in this topic.

### 3 PARTICIPATION IN THE CEN/TC

*All the CEN national members are entitled to nominate delegates to CEN Technical Committees and experts to Working Groups, ensuring a balance of all interested parties. Participation as observers of recognized European or international organizations is also possible under certain conditions. To participate in the activities of this CEN/TC, please contact the national standards organization in your country.*

CEN/TC 396 has six working groups:

- WG 1: General matters
- WG 2: Soil and rock classification for earthworks
- WG 3: Construction procedures
- WG 4: Quality control
- WG 5: Hydraulic fill
- WG 6: Hydraulic placement of mineral waste

#### NOTE 6

Some European countries have standards which stem from American methods dating back to the 1950's, with national amendments, which do not appear to take account of the experience gained from the major earthwork projects conducted in Europe in the second half of the 20th century. Other countries have, on the contrary, more or less abandoned these references, capitalising rather their experience acquired over the last decades and currently have at their disposal well-proven methods, which are less conservative, but hard to export because they are based on an essentially national experience and therefore not properly recognised. Thus, a corpus of new European standards specific to earthworks would lend these said methods different weight in order to constitute a credible alternative to less effective national standards, and would constitute an efficient vector for this industrial sector.

### 4 OBJECTIVES OF THE CEN/TC AND STRATEGIES FOR THEIR ACHIEVEMENT

#### 4.1 Defined objectives of the CEN/TC

CEN/TC 396 covers the following subjects which are not taken into account by existing TCs:

- Terminology for earthworks (Terms and definitions).
- Test methods (Characterisation for earthworks of natural soils and rocks in laboratory and in situ – including improved soils treated with binders or lime or other “additives” used in earthworks).
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- Classification systems of soils and rocks suitable for use in embankment construction, possibly leading to a unified classification system or principles/rules for classifying soils and rocks for earthworks purposes.
- Characterisation of extraction ability ("excavatability").
- Design of earthworks.
- Quality control of works and monitoring.

### NOTE 7

For earthworks, "designing" means "defining the process" enabling to transform natural in situ ground (soil or rock) and/or (re-used) secondary or recycled materials into a well compacted and durable embankment with the required properties. This decision process includes the characterisation of natural ground, the choice of suitable equipment and rules to plan extraction, transport, compaction and control of the materials.

The products of this "designing" are for instance risk assessment reports, execution plans, time-tables, work-flow schemes, etc.

Regarding the stability of permanent or temporary excavations and trenches, the rules are defined in Eurocode 7. CEN/TC 396 will not work on this topic. In order to keep a clear boundary between CEN/TC 396 and EC 7 it is suggested that the earthworks standards/reference documents do not include rules related to safety verifications.

Since national experiences of "designing" earthworks include the national classifications of soils and rocks for earthworks, the way to European standards should be based on a common understanding of national practices and on finding out how these practices could be expressed in a common framework. This would result in a series of reference documents (standards, codes of practice, etc.) on material classification for earthworks, excavation, placement and compaction of fill layers, etc., allowing for the preservation of national experience. Test standards could be prepared in parallel.

### NOTE 8

CEN/TC 396 has identified frontiers with existing CEN/TCs, managed by establishing efficient liaisons with them:

- CEN/TC 341 "Geotechnical investigation and testing"
- CEN/TC 288 "Execution of special geotechnical works"
- CEN/TC 227 "Road materials"
- CEN/TC 256 "Railway application"
- CEN/TC 250/SC 7 "Eurocode 7"
- CEN/TC 154 "Aggregates"
- CEN/TC 51 "Cement and building lime"

The set of standards prepared by CEN/TC 396 is divided into several parts, which correspond to different steps of the planning, execution and control of earthworks and have to be considered for executing earthworks:

- Part 1: Principles and design
- Part 2: Classification of materials
- Part 3: Construction procedures
- Part 4: Soil treatment with binders
- Part 5: Quality control
- Part 6: Land reclamation with dredged hydraulic fill
- Part 7: Hydraulic placement of soils and mineral waste

These “Earthworks standards” do not apply to the environmental planning and geotechnical design that determines the required form and properties of the earth-structure that is to be constructed (these aspects are covered in other European standards). They apply to the design of the earthworks materials, execution, monitoring and checking of earthworks construction processes to ensure that the completed earth-structure satisfies the geotechnical design.

#### **4.2 Identified strategies to achieve the CEN/TC.s defined objectives.**

CEN/TC 396 members are convinced that the practices of earthworks design in European countries are similar and are based on the same principles. Besides, the classifications of soils and rocks used in all countries are based on the same tests and the same types of equipment are used for excavation and compaction works. This is certainly related to the fact that procedures and guidelines for earthworks were developed in each country by professionals of this specific field of activity.

#### **4.3 Environmental aspects**

Earthworks have strong link with social and environmental aspects as well as sustainable development (Optimise use of non-renewable resources).

European cooperation is needed to give proper answers to the social demand for more sustainable and environment friendly development. In the field of earthworks, this covers extending the limits of acceptable materials for embankment construction, decreasing the production of CO<sub>2</sub> and other atmospheric dangerous gases, decreasing the consumption of water and fossil energy.

Such cooperation would benefit from the existence of a common description of earthworks practice, which can be provided by European reference documents/standards.

The work of CEN/TC 396 will thus directly (for instance less transport) or indirectly (for instance re-use) contribute to minimizing the environmental “footprint” of earthworks in terms of CO<sub>2</sub> emission, soil or groundwater pollution, use of limited resources and habitat preservation, etc.

### **5 FACTORS AFFECTING COMPLETION AND IMPLEMENTATION OF THE CEN/TC WORK PROGRAMME**

Attention will be paid to the national practices in the CEN member countries. Typical national variations concern the use of some country specific tests, the definitions and limits of the material classes and the specifications for material handling and compaction. They have to be carefully analysed to assess the similarity of the national approaches. It is deemed that they could be treated as national variations of common principles (Activities of CEN/TC 396/WG 1).

Differences between contract laws from one country to the other are an additional source of variations, which shall be accounted for when writing the standards and codes of practice on earthworks.