**TC250/SC7/EG14 : Ground Improvement**

**Progress Report No 3 for the period January** **- September 2013**

# Agreed Scope of work

# **To review existing ground improvement techniques and their design in order to find common principles and rules features for inclusion on Eurocode 7.**

# Key issues under discussion

The main issues under discussion may be listed as follows:

* What do we mean by Ground Improvement ? (i.e. find a proper definition of G.I.)
* What is the current practice of Ground Improvement in European countries?
* How could we correlate G.I. design with G.I. techniques ?
* Can we use conventional geotechnical models and procedures or should we consider special approaches for G.I. design ?

# Decisions/outcomes

* It is proposed to restrict the term “Ground Improvement” to those techniques used to cement or densify the ground, with or without addition of artificial material. Therefore, the techniques aiming to reinforce the soil by the inclusion of artificial structural elements, such as reinforced earth or rigid inclusions, will fall in the field of “Ground Reinforcement” (to be dealt with by EG5).
* It was also recognized that EG14 should somehow consider rock improvement methods (not just soil) and, for this purpose, we shall keep in touch with EG13.
* It was further pointed out that tunnels, dams and reservoirs will not be treated by EC7 in the near future. Therefore, EG14 will consider only G.I. applications for Foundations, Retaining Structures and Embankments.
* With specific regard to design, it is proposed to consider two possible design approaches as follows.
* First Design Approach: “Diffused Ground Improvement”. This first approach could be used when the mechanical behaviour of the improved ground can be conveniently modelled by conventional soil (or rock) models (e.g. Mohr-Coulomb failure criterion). In order to follow such approach, the designer should evaluate the change of ground properties (i.e. cohesion, friction angle, etc.) and should consequently define some “Improved Characteristic Values” for the material properties. In principle, once this task is accomplished, conventional calculation methods could then be used for any kind of problem (foundations, retaining structures, embankments) without special requirements. However, the evaluation of such “improved characteristic values” may not be an easy task. With such regard, a close connection with EG 11 (Characterization) should be pursued.
* Second Design Approach: “Structural Element”. This second approach could be implemented for those techniques which are able to create an element of very stiff material provided with (sufficiently) Well Defined Geometry and Mechanical Properties. The latter can usually be defined by uniaxial strength and elastic modulus. Typical techniques falling in this second approach would be Jet Grouting and Deep Mixing. However such design approach may need specific design rules, for the most frequent applications (i.e. Foundations and Retaining Structures). For this purpose, it is important to keep in touch with EG7 (Pile Design).

With specific regard to the clauses in the current EN 1997, the clauses of interest for EG14 are listed in section 5.5: “GROUND IMPROVEMENT AND REINFORCEMENT”. It is a very short section and it was thus copied and pasted in the following page.

A starting change suggested by EG14 is to provide two separate sections: one for “*ground improvement*” and the other for “*ground reinforcement*”.

Therefore, the first clause to be added in the section on “*ground improvement*” is the definition of this term. A tentative definition, to be further discussed in the Vienna meeting, could the following: “*a change of the ground properties by means of well established techniques* *used to cement or densify the ground, with or without addition of artificial material”.*

Present clause 1: “*Geotechnical Investigation etc.”*. This clause is rather obvious in its present form and should be either eliminated or specified.

Present clause 2: “*Factors to be accounted for etc.”*. It is a rather generic clause but it could be maintained with minor changes.

Present clause 3: *Effectiveness of Ground Improvement etc.*. This is not, strictly speaking, a design rule. In its present form it seems to address construction control. This clause should be either removed or clarified.

New clauses to be added. Several clauses need to be introduced, after future extensive discussion. These new clauses should clarify the possible design approaches for ground improvement. At present, the alternative approaches provisionally named “*Diffused Ground Improvement*” and “*Structural Element*” are proposed as previously explained.



# Meetings held/planned

|  |  |  |
| --- | --- | --- |
| Meeting no. | Date held/scheduled | Available from webpage? |
| 1 | Oct. 16th 2012: Face to Face - Brussels |  |
| 2 | February 28th 2013: Tele-meeting |  |
| 3 | May 15th 2013: Tele-meeting |  |
| 4 | June 24th 2013: Tele-meeting |  |
| 5 | October 7th 2013: Tele-meeting |  |
| 6 | October 17th 2013: Face to Face - Vienna |  |

# Active membership

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| --- | --- | --- | --- |
| Name | Position\* | Country | Listed on webpage? |
| Cyril Plomteux | Member | France | ? |
| Norbert Vogt | Member | Germany | Yes |
| Karsten Beckhaus | Member | Germany | Yes |
| Paolo Croce | Convenor | Italy | Yes |
| Alessandro Flora | Secretary | Italy | Yes |
| Beata Gajewska | Member | Poland | ? |
| Jakub Saloni | Member | Poland | Yes |
| Colin Serridge | Member | UK | ? |

# Report prepared by:

**Paolo Croce**

**September 28th 2013**