Earth Reinforcement Practice, Ochiai, Hayashi & Otani (eds) © 1993 Balkema, Rotterdam, ISBN 90 5410 093 1

Chairman's report: Testing and materials

E.Gartung
LGA, Nürnberg, Germany

All applications of the reinforced earth construction method are dealing with two types of materials; the soil that has to be strengthened and the reinforcing members. For the rational design of reinforced earth structures, the governing material properties of these two components have to be known quantitatively for meaningful performance predictions and for stability assessments. So the topics of testing and materials are fundamentals of the earth reinforcement technique, and accordingly they are given considerable attention in research and in practice. Among the contributions to the International Symposium Kyushu '92 36 papers are focussing on testing and materials.

Whereas the material properties of soils are determined by well established methods of conventional soil mechanics, the properties of reinforcing materials are an important issue of research directed towards the earth reinforcement practice.

The design engineer must rely on the tensile strength of the reinforcing elements. That means, he has to know the stress-strain behaviour of the reinforcing material, the failure mode and the ultimate load that the reinforcing elements can sustain. All of these properties may be time dependent, and they can be altered due to environmental influences. It is there for necessary to study the durability of the reinforcing products and to determine whether they exhibit relevant creep or stress relaxation at levels of stress or strain to be anticipated under operating conditions.

The durability issue has been approached by a number of excellent papers which examine the corrosion resistance of galvanized steel, the hydrolysis of unprotected polyesters in highly alkaline environments and of high density polyethylene under elevated temperatures and in states of uniaxial and biaxial tensile stresses. These studies indicate that there are certain limitations to the application of metallic- and synthetic polymer reinforcement materials. However, even though more research seems to be needed for a deeper understanding of all durability aspects, the results presented so far, also give confidence that the practice of earth reinforcement presently exercised in most countries leads to safe structures. Good understanding of the important material properties and environmental conditions, adequate safety margins against failure, and effective quality assurance programmes in manufacturing and in construction are key issues for safe reinforced earth structures.

Whereas the development of industrial products for soil reinforcement has strongly been influenced by modern material sciences, the application of natural products is linked to a centuries old tradition of craftsmanship and to the art of earth construction. By systematical determination of the properties of natural materials with high tensile strength through adequate testing, modern design procedures can also be applied to reinforced earth structures with jute, bamboo or other natural fibrous materials. This initiative is of great economic importance for those countries which have abundant natural resources of fibrous materials and climatic conditions in favour of their durability when installed in earth structures.

In the earth reinforcement practice, essentually composite structures are built. To fully understand their performance, it is not sufficient to know the properties of the soil and of the reinforcing members individually, but it is of greatest interest to study the interaction of both components. A number of papers presented in session 1 and in the poster session of IS Kyushu '92 are reporting very interesting results of theoretical and experimental studies on the soil-inclusion interaction under operational conditions and at limit states. Regarding the great variability of soil types and different reinforcing materials, the number of parametres influencing the soil-inclusion interaction seems to be very large. So it is not surprising, that no unique answer is found for the description of the soil-inclusion interaction mechanism.

There are some excellent derivations of the distribution of pull-out forces along geogrids under well defined soil conditions. These studies are valuable contributions to the fundamental aspects of the problem. On the other hand, some practical recommendations are given to either use a specified type of pull-out or shear tests to determine the required design parameters on a more empirical basis.

The papers contain a lot of information on testing experiences, advice for the instrumentation of laboratory or field tests and for monitoring of full scale structures. Many details have to be considered in the process of deriving fundamental material properties from measurements through instrumentation, data acquisition, processing and interpretation.

It is also of fundamental importance to do the right test with well defined boundary conditions. In this regard, the development of new testing equipment is interesting, special attention has to be payed to the Automated Plane Strain Reinforcement cell. This device facilitates the transmission of loads to the reinforcing element directly from the surrounding soil which is submitted to a controlled deviatoric state of stress. It is expected, that further research with the APSR-cell will yield interesting results on the topic of interaction between soil geogrids and geomembranes or other geosynthetics.

In the session on testing and materials of IS Kyushu '92 a wide scope of problems has been discussed from fundamental research into the material properties of reinforcing elements, through soil-inclusion interaction, testing and measuring equipment and -techniques to the questions of international standardization of testing- and design methods. The contributions have documented the advances in reinforced earth practice and the great motivation of engineers worldwide to pursue their studies and participate actively in the development of the earth reinforcement practice.