REPORT ON ACTIVITIES OF TC 13
COMPTE RENDU DES ACTIVITES DU COMITE TECHNIQUES -13

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SYNOPSIS: This paper reports the activities of TC13 during the term (1989-1994).

PURPOSE OF TC13

In recent years, the mechanics of granular materials has been developed extensively through theoretical, computational and experimental studies, and it has been found that the mechanics of granular materials is essentially important not only to theoretical researches in soil mechanics but also to practical ones on the geomechanical problems, such as the liquefaction phenomena or the debris flows. Unlike classical continuum theories, theories for granular materials have to take into account the discrete character of materials, and such micromechanical background has been emphasized in the studies of granular materials both in theories and computer simulations.
The Technical Committee on Mechanics of Granular Materials was established in 1985 as the 13th Technical Committee (TC13) of ISSMFE and has continued for the last two terms (1985-1994). The aim of this committee is to promote the above-mentioned studies on the mechanics of granular materials and to publish a state-of-the-art report on the mechanics through the discussions between members of the committee.

ORGANIZATION OF TC13

The present members of TC13 are 22 researchers from 16 countries as shown below.

Chairman:	Prof. M. Satake	Japan
Co-chairman:	Prof. H.B. Poorooshasb	Canada
Secretary:	Prof. Y. Kishino	Japan
	Dr. U.M. Arslan	Germany
	Prof Ch.S. Chang	USA
	Dr. J. Feda	Czech Republic
	Prof. J. Ghaboussi	USA
	Prof. J. De Jaeger	Belgium
	Prof. P. Lade	USA
	Dr. J. Lanier	France
	Prof. H. Matsuoka	Japan
	Prof. F. Molenkamp	Netherlands
	Prof. E. Pasqualini	Italy
	Dr. A.V. Pinto	Portugal
	Prof. C.S. Pinto	Brazil
	Prof. T. Ramamurthy	India
	Prof. L. Rothenburg	Canada
	Dr. P. Scharle	Hungary
	Prof. J.A. Suárez	Argentina
	Dr. C. Thornton	UK
	Prof. I. Vardoulakis	Greece
	Prof. E. Yanagisawa	Japan

It was a great regret that a member Professor Moust Jacobsen, Aaborg University, Denmark, passed away in November 1992.
TC13 is supported by the Japanese Society of Soil Mechanics and Foundation Engineering (JSSMFE), and to assist the activities of TC13, the Japanese Working Committee on Mechanics of Granular Materials (JWC) has been set up in JSSMFE. The members of JWC are listed below:

Chairman:	Prof. M. Satake	Prof. T. Nakai
Secretary:	Prof. Y. Kishino	Dr. K. Nishi
	Prof. N. Abe	Prof. M. Oda
	Prof. K. Hashiguchi	Prof. F. Oka
	Prof. H. Hashimoto	Dr. T. Shiomi
	Dr. K. Iwashita	Prof. T. Tamura
	Prof. R. Kitamura	Prof. Y. Tobita
	Prof. H. Matsuoka	Prof. I. Towhata
	Prof. S. Miura	Prof. E. Yanagisawa
	Prof. N. Moroto	Dr. T. Naruse

PUBLICATION OF TECHNICAL REPORTS

TC13 published a state-of-the-art report entitled "Mechanics of Granular Materials" at the time of XII ICSMFE, Rio de Janeiro, in 1989. The contents of the report is as follows:

1. **Fundamentals of mechanics of granular materials**
   - 1.1 **Fundamental quantities**
   - 1.2 **Significance of anisotropic fabrics**
   - 1.3 **Measurement -application of stereology-**
   - 1.4 **Concept of effective stress**
   - 1.5 **Spatially mobilized plane (SMP) with applications**
   - 1.6 **State quantities**
   - 1.7 **Stochastic processes**

2. Quasi-static behavior of granular materials
   - 2.1 Elastoplastic models
   - 2.2 Elasto-viscoplastic models
   - 2.3 Models for cyclic loading
   - 2.4 Theory of two-phase mixture
   - 2.5 Slip-line analysis
   - 2.6 Simulations of quasi-static behavior

3. Flow behavior of granular materials
   - 3.1 Analysis of granular flows
   - 3.2 Rapid granular flows -kinetic theoretical approach-
   - 3.3 Simulation of rapid granular flows

4. Applications to engineering problems
   - 4.1 Introduction
   - 4.2 Applications to static problems
   - 4.3 Applications to dynamic problems

The contents of this report clearly show the present system of theories in mechanics of granular materials. The seven contributions from members of TC13 which deal with supplementary or peripheral topics are also included in this report. The report has been read by researchers and engineers of very wide scientific fields. However, after the publication of this state-of-the-arts report, the development both in theories and applications in the mechanics of granular materials has been very rapid. Approaches, such as the bifurcation analysis for shear bands, were newly attempted and the techniques of computer simulation made further progress. So the demands for publication of a supplementary volume for the previous report had widely arisen. Thus the publication of the supplementary volume which covers the new fields of the mechanics as well as some other important fields missed in the previous report was intended as the most important work of TC13 in this term..
This Technical Report, the supplementary volume for the previous one, was published and circulated at the XIII ICSMFE, New Delhi, in 1994. The contents of the report are shown as follows:

Discrete-mechanical formulation of granular materials *(M.Satake)*
Inter-particle contact properties and elastic moduli for sand *(C.S. Chang)*
Extension of spatially mobilized plane (SMP) to frictional and cohesive materials *(H.Matsuoka and D.A.Sun)*
Prediction of plane strain responses *(T.Ramamurthy)*
Deformation characteristics of sand during rotation of principal stress axes *(E.Yanagisawa and T.Sugano)*
On the stability of undrained deformation of water-saturated sand *(I. Vardoulakis)*
Instability of viscoplastic constitutive model for clay *(F.Oka)*
CVR and shear band thickness determined from direct shear test *(J.De Jaeger)*
Non-invasive studies of particle aggregation by magnetic resonance imaging *(M.Nakagawa et al)*

Copies of this Technical Report are available from JSSMFE as well as the previous report.

TECHNICAL COMMITTEE MEETINGS

The Meetings of TC13 were held for three times during this term. The fist Meeting was held at Florence (Palazzo dei Congressi), Italy, in May 29th 1991, at the time of X ECSMFE, the second at Birmingham (Aston University), England, in July 11th 1993, at the time of the 2nd International Conference on Micromechanics of Granular Media (Powders & Grains 93) and the third at New Delhi (Ashok Hotel), India, in January 7th 1994. The agenda of the committee meetings include general discussions on the activities of the committee and some presentations on the recent and important topics in the mechanics of granular materials.
The subjects presented at the committee meetings are as follows:

In TC Meeting at Florence;

Contribution of crushing to deformation of granular materials *(T. Dietrich)*
A computer simulated experiment of strain localization in granular assemblies *(Y.Kishino)*

In TC Meeting at Birmingham;

Extension of spatially mobilized plane (SMP) to frictional and cohesive materials *(H.Matsuoka)*
Experimental study of displacement and rotation of grains in a 2D granular media *(J.Lanier)*
Experimental research on arching in granular soils *(E.Pasqualini)*
On the stability of undrained deformation of water saturated sand *(I.Vardoulakis)*
Non-invasive studies of particle aggregation by magnetic resonance imaging *(M.Nakagawa)*

In TC Meeting at New Delhi;

Gradient depend constitutive models *(F.Oka)*
Prediction of plane strain responses *(T.Ramamurthy)*
Discrete-mechanics of granular materials *(M.Satake)*

CONTINUATION OF THE COMMITTEE

According to the law decided at the council meeting in Rio de Janeiro that the same technical committee can not be extended over two terms (eight years), JSSMFE will not continue to support TC13 for the next term.However, regarding the importance of the mechanics of granular materials, which is developing increasingly and has many new research subjects,the most members of TC13 do wish to continue the committee in a possible form. This matter was discussed in the committee meetings at Birmingham and New Delhi, and members from Canada and USA proposed to promote the continuation of the committee to their national societies.