# Report of Commission 6 Working Group 6.1 on Deformation Measurements

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## ABSTRACT

Working Group 6.1 on Deformation Measurements plays an important role in providing a forum for the exchange of information on the new developments in deformation surveys by organizing technical sessions during the FIG Congresses and by organizing specialized international symposia. The first international symposium on deformation surveys was held in Krakow, Poland, in 1975, followed by symposia in 1978 in Bonn, Germany; in 1982 in Budapest, Hungary; in 1985 in Katowice, Poland; in 1988 in Fredericton, Canada; in 1992 in Hanover, Germany; in 1993 in Banff, Canada; in 1996 in Hong Kong; in 1999 in Olsztyn, Poland; and the 10th symposium in Orange, California, in 2001. The published proceedings of those symposia provide an enormous wealth of information on the development of new techniques and new methods in monitoring and analysis of deformations. The Working Group has always been one of the most vital groups of FIG Commission 6 and one of the most active international groups dealing with the problems of monitoring and analysis of deformations in engineering and geoscience projects. Besides organizing the international symposia, WG6.1 calls on *ad hoc* committees to solve special problems of the deformable world through international cooperation between various research centres.

In the beginning, the WG 6.1 concentrated their efforts on the development of new monitoring techniques and on geometrical analysis of geodetic deformation surveys. At the time of the first two symposia, the main problem of the deformation analysis was the identification of unstable reference points in geodetic monitoring networks. Several approaches were proposed by different authors at the 2nd symposium in Bonn in 1978. As a result, an *ad hoc* Committee on Deformation Analysis was established with a task of comparing the different approaches and to develop a unified (generalized) theory for the geometrical analysis of deformation surveys. Several research centres from central Europe and one from Canada (University of New Brunswick) participated in the work of the ad hoc committee. The final report of the committee was presented at the 13-th International Congress of FIG in Toronto in 1986. The committee solved the problem of the identification of unstable reference points in monitoring networks and introduced a classification of deformation analysis into geometrical (determination of the change of shape and dimensions of deformable bodies) and physical (modelling of the load-deformation relationship) using either deterministic or statistical (empirical) methods. The most important outcome was the development of a *generalized method of geometrical deformation analysis* that allows for

using any type of deformation measurements (geodetic techniques and geotechnical/structural instrumentation), even if scattered in space and time, in a simultaneous geometrical analysis of deformation measurements and modelling of displacement and strain fields. The latter is performed by a statistically best fitting of a selected displacement function (deformation model) into the observation data.

During the 5th symposium held in Canada in 1988, the *ad hoc* Committee on Deformation Analysis concluded that all basic problems of the geometrical analysis had been solved and no further international activity in that area was needed. At the same time, the committee suggested that WG6.1 should become more active in an interdisciplinary approach to the physical interpretation of deformation measurements, particularly in the aspects of an optimal combination of the geometrical analysis with deterministic modelling of the load-deformation relationship for the purpose of a better understanding of the mechanism of deformations and better design of the monitoring surveys**.**

In 1992**,** at the 6th symposium in Hanover, the interdisciplinary approach to physical interpretation and modeling of deformation brought some confusion within the geodetic and surveying communities concerning the terminology to be used in deformation modelling and interpretation. Some authors mixed up the use of the terms such as dynamic or kinematic models of deformation, deterministic vs. statistical, or parametric vs. non-parametric modeling, etc. As a result, a new *ad hoc* committee was established to clarify the terminology and classification of deformation modeling. The committee, after 8 years of work and several progress reports, presented their final report at the 10th symposium in California. The report, under the tiltle of "Models and Terminology for the Analysis of Geodetic Monitoring Observations" was published by FIG as a publication No.25 in May 2001.

The current activity of WG6.1, concentrates on the automation of deformation surveys, use of Synthetic Aperture Radar (SAR) in interferometric determination of displacements, and in monitoring and analysis of structural vibrations and cyclic deformations. Through the interdisciplinary approach to deformation studies, the FIG Working Group 6.1 links surveying and geodetic specialists with specialists in structural, mining, geomechanical, and geophysical disciplines. The next symposium on deformation measurements will be held in Greece in May, 2003 (contact: Dr. Stathis Stiros at < stiros@upatras.gr >).

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