

**Report to the 25th General Assembly
FIG Congress in Washington, 19-26 April 2002**

**FIG COMMISSION 6
ENGINEERING SURVEYS
REPORT ON ACTIVITIES 1998 – 2002**

1. INTRODUCTION

This mandate has been taken over in replacement of Steve de Loach (USA), who could not unfortunately assume the function for unexpected personal reasons. Activities have been driven by the guidelines of the work plan, and by a simple oral incentive: at least one, possibly two professional events organised by each Working Group during the mandate – in addition to their expected contributions at Working Weeks and at the Congress.

Despite a few problems (of which some personal worries), I can frankly consider that this commission have been very active and that most of the objectives have been reached. The response on the Commission 6 working groups for Congresses has always been at the expected level. Participation to Working Weeks has been affected by the choice of themes and by the interest of local organisers with respect to Engineering Surveys – which is closely linked to the technological level of engineering works and of industrial activity in the country, and often dealt with by companies and national bodies which are not closely linked to the “chartered surveyors” bodies which are usually the member-associations of FIG.

2. MAIN FEATURES OF THE WORK PLAN AND STRUCTURE OF THE COMMISSION

2.1 Terms of Reference

- Acquisition, processing and management of topometric data and of all related information throughout the life cycle of a project;
- Development and implementation of adequate survey methods in engineering projects;
- Metrology, quality control and validation for civil construction and manufacturing of large objects;
- Deformation monitoring, analysis and interpretation;
- Prediction of deformation and movements in engineering projects, mines and areas of geological hazard;

2.2 Mission Statement

- Promote the knowledge, skills and abilities of the surveyors in many civil and industrial works, within the various professional fields of engineering;
- Support all development and multidisciplinary expertise leading to integrated survey methods, using various instruments and sensors and combining geometry with all other data relevant to each engineering problem;

- Provide a forum for the development and exchange of knowledge on the engineering analysis of survey data for the study of structures;
- In addition to the links with related Working Groups of IAG and ISPRS, look for possible connections within organisations of civil, structural and mechanical engineers and within those dealing with metrology and quality control – at national and international level;

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2.4 Working Group 6.1

Title

Deformation Measurement and Analysis

Policy Issues

Automation of Monitoring Surveys

Enhancement of Geometrical Modelling of Deformations from integrated deformation surveys

Physical Interpretation of Deformations including Numerical Modelling and Prediction of deformations and Back Analysis

Chair

Adam Chrzanowski (Canada)

Beneficiaries

Geodetic engineers dealing with comparative measurement of deforming or unstable objects, geologists, geophysicists, civil engineers and structural engineers concerned in this matter.

2.5 Working Group 6.2

Title

Special Equipment for Industrial & Engineering Applications

Policy issues

Promoting the use of adapted survey techniques in industry & engineering.
Contributing to the development of special instruments and methods.

Chair

Heribert Kahmen (Austria).

Beneficiaries

Surveyors wanting to acquire more expertise in these special applications, designers and manufacturers in various industrial or engineering activities, engineers dealing with quality control of large objects or structures, manufacturers and users of survey instruments.

2.6 Working Group 6.3

Title

High Precision Metrology for Large Scientific Equipment

Policy issues

Accurate measurement of large equipment or structures in R&D sectors (mainly for particle accelerators and their detectors) and development of adequate special techniques;
Integration of various survey & alignment sensors and actuators for on-line monitoring and control of a given process (dynamic positioning systems);
Multidisciplinary collaboration between survey engineers and R&D scientists on special measuring tools and techniques ;.

Chair

Michel Mayoud (France).

Beneficiaries

Physics laboratories dealing with particle accelerators and detectors, fusion rings, gravitational antennas, power lasers, etc.; All scientists and engineers dealing with large scale metrology and accurate positioning in R&D sectors or in Industry (in connection with WG 6.2); Universities and manufacturers involved in the development of special instruments.

2.7 Working Group 6.4

Title

Transportation and utility lines

Policy Issues

Developing standards and methods for reliable data acquisition techniques, and techniques for data update which cope with the interdisciplinary characteristics of such tasks.

Co-ordinating these activities with both the network providers and research institutes, and establishing connections to the GIS-industry and to the international head organisations.

Chair

Théophile Engel (Switzerland).

Beneficiaries

Engineering surveyors; National and international railway associations; National and international road associations; Universities and manufacturers involved in the development of specific domains of transportation and utility lines.

2.8 Working Group 6.5

Title

Facility Management Systems

Policy issues

The role of the surveying engineer as the responsible manager of spatially referenced information

Support for the co-ordination of the activities of other disciplines

Chair

Lothar Gruendig (Germany).

Beneficiaries

Surveying engineers wanting to access to a new area of application; All engineers and managers involved in Facility Management tasks, like building administration or facility lines.

3. OTHER INVOLVEMENT: LIAISON WITH ISM AND ICSU

Regarding ISM (International Institution of Mining Surveyors), in addition to various general aspects of surveying at surface and underground levels, there are undoubtedly specific techniques where ISM has developed special competence and experience in this particular field - which are interesting for other applications in engineering surveys and from which FIG has certainly to take benefit.

Conversely, in addition to the existing links and contributions (for instance via Prof. Adam Chrzanowski, member of ISM Presidium), special surveying and monitoring techniques used in other engineering problems (including industrial and scientific applications) meet some concerns of ISM.

The following themes of mutual interest have been pointed out:

- General surveying aspects at surface or underground levels: GIS, GPS, Horizontal and Vertical control networks, vertical transfers, traversing, gyro measurements, refraction index assessment in non-standard conditions, cross-section profiling;
- Environmental impacts, site restoration;

- Facility Management Systems, Topological and Graphical data for Exploitation & Maintenance Databases;
- Ground motion, stability control, deformation measurement and analysis, integrated multi-sensor surveys;
- Monitoring, automatic follow-up of works (guiding of boring/grinding machines included);
- Reliability of survey-related data versus specific safety aspects, QAP, norms.

Regarding ICSU (International Committee of Scientific Unions), the role is presently limited to information (on request). As a matter of fact, FIG has no technical means of its own for contributing to joint scientific activities with national and/or international bodies involved in co-operation programs – but visibility has to be maintained there, for other possible kinds of contribution.

4. ACTIVITIES OF THE MANDATE (OUT OF FIG CONGRESSES AND WORKING WEEKS)

- A general symposium on Engineering Surveys **INGEO'98** was held in Bratislava in October 1998.
- A dedicated session of WG6.5 (Facility Management Systems) was included in the **Turkish-German Joint Geodetic Days**, held in Istanbul on June 1-4.
- The **9th International Symposium on Deformation Measurements** was organised by WG6.1 (Deformation Measurement and Analysis) and hosted by the Institute of Geodesy of the University of Warmia and Masuria in Olsztyn, Poland, on 25-28 September.
- **The 6th International Workshop on Accelerator Alignment (IWAA)** was hosted and organised by the European Synchrotron Radiation Facility (ESRF), Grenoble (France), on 18–22 October, with the joint support of FIG WG6.3 and IAG Special Commission 4.
- The international symposium "**Modern Information and GPS Technology - Aspects and Implications of Their Application**" was held in Sofia on 11 and 12 November 1999, co-sponsored by FIG commissions 6 & 5, the International Society for Photogrammetry and Remote Sensing (ISPRS), the International Cartographic Association (ICA), the Union of Surveyors and Land Managers in Bulgaria (USLMB) and the Geodetic Institute of the University of Hannover (GIUH).
- Regarding **railway construction and maintenance**, a **user/producer interaction meeting** took place in the Symposium organised in Beijing, 15-18 December 1999, by the China Ministry of Railways and the International Union of Railways (UIC) – including contributions of WG 6.4 about the use of co-ordinates for track construction.
- Further to the session held in 1998 at the Congress, another "**open railway session**" has been moved for practical reason and will finally take place within the IAG-FIG Berlin symposium "Geodesy for Geotechnical and Structural Engineering" on May 21-24 2002 (see announcements).
- Several contributions were made at the **XIII International Course on Engineering Surveying**, Munich, 13–17 March 2000, co-sponsored by FIG Commissions 5 and 6, as

well as at the **Joint Seminar of FIG Commissions 2, 4, 5, 6 and 7**, held in Malta on 8–21 September 2000;

- The **Hydrostatic Levelling Systems seminar**, CERN, Geneva, 9-11 October 2000 has been postponed for sudden unavailability of the premises and then re-connected to the next IWAA;
- The **10th International Symposium on Deformation Measurements**, sponsored by FIG Commission 6 (WG 6.1), was held in Anaheim (California), 19-22 March 2001;
- The **5th conference on Optical 3-D measurement techniques**, co-sponsored by FIG Commission 6 (WG 6.2), IAG Special Commission 4 and ISPRS, was held Vienna on 1-3 October 2001 under the auspices of the Technical University of Vienna (Prof. Kahmen).
- The workshop on **Facility management systems, transportation and utility lines**, sponsored by FIG Commission 6 (WG 6.4 & 6.5) and planned for being held in Berlin on 11-13 October 2001 has been postponed to a not yet determined date.
- **The 7th International Workshop on Accelerator Alignment** planned for November 2001 in JASRI Laboratory (Japan) has been postponed for practical reasons to 18-21 November 2002, same place.

5. CONCLUSIONS AND PROSPECTS

The question of local participation to commission meetings remains an issue, and it must be clearly announced at each Working Week that such meetings are opened to everybody. Nevertheless, even with a limited number of participants, the discussion in these open forums has always been the most interesting. Recurrent questions and some major points were clearly pointed out and summarised in Seoul, and they are worth to be reported again as significant subjects and prospects for the next mandate:

1. **A fact is that the “art of measuring” is no longer an “art.** If this simplicity calls for less knowledge, it seems that it also generates less and less cares – at a critical point. Beside a possible educational problem, this has to be counterbalanced by strict specifications – hence an increased need for norms, standards, calibrations, field (routine) checks and procedures. It is then wise to make such constraints being legal or simply contractual, in order to guarantee the Quality of the works – and this is indeed a general trend and practice in engineering surveys.
2. **Most of engineering problems call for integrated solutions.** For Civil engineering, construction or structural engineering, as well as for large scale metrology, many measurement and monitoring problems are solved by multi-sensors solutions, in a multidisciplinary approach, where surveying techniques are mixed with others. To better respond to that, surveyors have to know more and more in various related disciplines and technologies, like geophysics, geomechanics, optronics, etc. Conversely, a good teaching of surveying in such other disciplines is also a factor of better complementarity. In all cases, inter-professional meetings would favour a better inter-professional practice.
3. **There has been fast significant changes in large scale metrology.** Beside motorised total stations with automatic target recognition and pointing, laser trackers (now equipped with a very accurate absolute distancemeter) are quickly taking a major part in industry. Optical

(laser) scanners are also more and more an efficient solution for “as built” survey of complicated pieces and structures. Digital photogrammetry with high-density CCD cameras proves to be a reliable solution for bigger and bigger objects. Inserted sensors based on new technologies (like interferometric extensometers on plastic strips) are competing with classical surveying measurements. Monitoring with Hydrostatic Levelling Systems (HLS) and Wire Position Sensors (WPS) can be good at micrometer level, and such sensors are implemented in the survey and monitoring of various industrial and scientific equipment.

The community of surveyors dealing with engineering surveys has to adapt to such trends and changes, and it remains essential that FIG keep at an appropriate technological level in these advanced fields of application.

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