Appendix to item 13

FIG Commission 6 – Engineering Surveys

Work Plan 2015–2018

1. Title

Engineering Surveys

2. Terms of Reference

- Acquisition, processing and management of topometric data and all related information throughout the life cycle of a project (at construction site).
- Quality control and validation for civil engineering constructions and manufacturing of large objects (method statements).
- Deformation monitoring, analysis and interpretation, measurement of dynamic loaded structures (general).
- Prediction of deformation and movements in engineering projects, mines and areas of geological hazard such as landslides, subsidence etc.
- Automatic measuring systems, construction and industry and multi-sensor measuring systems.
- Real-time deformation monitoring, analysis and interpretation, measurement of time series, measuring and analyzing the load caused the stress and strain response of the engineering structures.
- Data acquisition, pre- and post-processing. Optimization and control of the data management during the life cycle of a project, final data integration, and its accuracy reliability for wide range processes of the structural engineering.

3. Mission statement

- Implementation of innovative technologies and modernization of the engineering surveys processes of data acquisition, processing, interpretation and quality control but also the epoch by epoch data management and analysis of the engineering object condition changes as important part of the maintenance and emergency situation alert.
- Developing and implementation of calculation algorithms for optimization of the surveying data pre-and post-processing.
- Further development of the process of design, construction and exploitation of engineering objects.
- Support all development and multidisciplinary expertise leading to integrated survey methods, using various instruments (geodetic, geotechnic, fast motion) and sensors and combining geometry with all other data relevant to each engineering problem (as example BIMS.
- Engagement in the West and Central Asia region and acquisition of interest for joining the FIG.

- Cooperation with the ISM (International Society for Mine Surveying).
- Organize regional FIG events, and participates on events organized by sister organizations.

4. General

This working plan covers the implementation, integration and data fusion of the results from the new measurement technologies with the traditional survey methods in order to reach higher reliability and quality of the final results, to ensure safety operation.
Commission 6 will consist of 4 Working Groups.
Commission 6 is divided into working groups profiled in specific areas of the engineering survey, data acquisition and analysis. Their work can be used for the FIG contribution to respond to the structural monitoring, predicting of deformations of natural and artificial structures and to prevent building collapses and disasters.

5. Working Groups

Working Group 6.1 – Deformation Monitoring and Analysis

Policy Issues
Deformation studies in Engineering Surveying are based on a broad knowledge of suitable sensors and their potential, modern data storage and communication solutions and advanced processing and analysis methods. Additionally a thorough understanding of the behavior of monitoring objects (large scale structure or landslide effected area), is essential to set-up and operate an optimum monitoring system. Nowadays deformation tasks are more and more oriented towards real-time systems, which require automation of data capture and new concepts in data processing, analysis and interpretation.
WG6.1's main goals will be to support specialists in deformation studies with state-of-the art solutions and provide latest developments and future oriented concepts:

- Support studies on the potential of existing and new sensors to determine geometric deformation quantities from surveying and adjacent fields (such as geotechnics).
- Support the development of concepts for automated data storage, data transfer and data pre-processing.
- Support the adaptation of numerical algorithms to derive relevant deformation quantities in real-time, including concepts from time series analysis.
- Support a multidisciplinary collaboration between surveying, structural and geotechnical engineers to understand the behavior of structures and geotechnical objects.
- Study of most modern concepts for data analysis (e.g. artificial neural networks, fuzzy logics and generic algorithms).
- Initiate investigations to extend the range of deformation studies to higher frequencies, specifically in Structural Health Monitoring (study of oscillations and vibrations and their effects on critical structures).

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Specific projects

- Prepare reports on State-of-the-Art for typical deformation tasks (e.g. dams, bridges, high buildings, landslides, rock-fall, etc).

- Comparison of data acquired with different modern automated deformation measurement systems.
- Optimization and modernization of calculation algorithms and processes.
- Comparison of concepts from artificial intelligence for deformation analysis.
- Case studies: e.g. application analysis concepts and tools for definition of typical data set of continuous observation.

Workshops/Symposia
Every 2nd year
"Joint International Symposium on Deformation Measurements" in cooperation with IAG, commission 4 "Applications"
JISDM will take place in Vienna from March 30 till April 1, 2016; the responsible person at TU Vienna is Prof. - Dr. Hans Neuner

Publications
- Proceedings of the symposia, the high-level papers as an special printed book

Beneficiaries
- Surveying professionals dealing with all aspects of deformation studies.
- Surveyors interested in high-level automated instrumentation.
- Geologists, structural, geotechnical and mining engineers concerned with deformation tasks.

Outcome of the work
Support to the specialists in deformation studies and providing information on state-of-the-art solutions and future oriented concepts.

Working Group 6.2 – Engineering surveys for design, constructive works and exploitation of buildings and transportation infrastructure

Policy Issues
- Initiate a multidisciplinary collaboration between survey engineers, civil engineers, structural and mechanical engineers.
- Creating an awareness of surveyors through a task force "Geotechnical sensors" as the trend today is going for an integration of those sensors in the geodetic deformation analysis and vice versa.
- Support the design and usage of real-time deformation monitoring solutions and their systems for awareness during the constructive and exploitation period of an infrastructure object.
- Support the integration of adapted techniques and methods for the targets of the engineering surveying. Combination of the 'Smart technology solutions' with the objectives of the engineering surveying for optimization the processes of train and automobile control system, and traffic management.
- Interaction with the requirements of the common used CAD systems and final product delivery forms.

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Specific projects

- Precise methods and equipment for staking out during construction and structural works.
- QC and documentation for 'as-built' compared to 'as-designed'.
- Precise methods and equipment for engineering surveys for visualization and photo match.
- Precise methods and equipment for remote surveys.
- Dynamic Monitoring of Buildings and Structures during and after construction
- Offshore construction surveys.
- Integration of sensors for engineering survey.
- Rail and road tracks construction setting out, final survey and documentation.
- Standardization and reliability of the process for monitoring of railway and land transportation networks.
- Preservation of evidence.

Workshops

- One Workshop

Publications

- Proceedings of the working weeks and regional conferences

Beneficiaries

- Surveying profession becoming involved in this developing technology which will partly replace current network adjustment processes.
- Surveyors wanting to acquire information about geotechnical sensors as used in engineering structures such as dams.
- Engineers who have to decide about the best techniques to monitor civil engineering structures.
- Engineering surveyors and engineers involved in the construction and setting out will benefit, as well as structural engineers, current buildings and future building designs.

Outcome of the work

Surveying profession becoming involved in developing new innovative technologies, which will partly replace current state-of-the –art processes.

Working Group 6.3 – Sensor fusion, data acquisition and processing techniques for moving measuring complexes

Policy Issues

This WG targets are the integration and the combination of signals in a complex sensor network.

- Developing of new processing algorithms, data filtering and optimization of calculation process.
- Understanding the principles and applying the multi-channel systems for areas with no permanent GNSS availability, for surface scanning and investigations.
- Increased understanding of the theory and practice of designed moving measuring complexes for real-time automatic analysis of determined physical features (structure pressure and temperature, settlements and etc.).

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Specific projects
- Data modeling and engineering features extraction.
- Clearance Analysis for the railway and automotive transportation network.
- Limit checks.
- Monitoring of underground natural and artificial engineering structures.

Workshops
- Surrounding modelling and collision prevention for intelligent traffic systems, 2017

Publications
- Proceedings of the meetings

Beneficiaries
- Automotive industry
- Railway industry
- Forest industry
- Precision framing

Outcome of the work
Increased understanding and improved practical application of the theory of sensor fusion, data acquisition and processing techniques for moving measuring complexes.

Working Group 6.4 –Wide Area Engineering Surveys for Monitoring, Features Determination and Environmental Management

Policy Issues
- Support the integration of MLS and Airborne systems (manned or unmanned) for the railway and road sectors for fast and precise surveying, monitoring and inventory documentation.
- Power lines infrastructure inspection and documentation.
- Support the geophysical, hydrographic and engineering surveys and data interpretation for stable wind power offshore facilities planning. This includes the position planning, cable route planning, interaction with the shipping, oil and gas industries, assurance for safety exploitation and protecting of the environmental heritage.
- Oil and gas pipelines, new clear power plants. Integration of fixed and moving sensor systems for continuous real-time monitoring and diagnostics.
- Support the LiDAR systems for the purposes of the waterways management, for surveying and estimating the corridor (natural and artificial one) width for the purposes of the infrastructure and water vehicles and floods damage preventing.
- TerraSarX time series and maps primary used for settlements control.
- UAV, Helicopters and Copters systems as effective and rapid data acquisition tools for the needs of the rail and road industry, for the mining surveying and data management.
- LiDAR systems for monitoring of water reservoirs and mine basins, for creating of bathymetric and topographic models.

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Specific projects
- Optimization and automation of the methods for features extraction.
- 3-D system applications and surveyed data integration in the GIS, in the damage control and early alert systems.
- Landslides control.

Workshops
- Yearly based symposia

Publications
- Proceedings of the meetings

Beneficiaries
- Railway and automotive industry
- Electric-, gas- and oil companies
- Telecommunication companies
- Disaster management

Outcome of the work
Support the integration of MLS and Airborne systems (manned or unmanned) for concerned industry sectors, as well as UAV, Helikopters, Copters systems as effective and rapid data acquisition tools for fast and precise surveying, monitoring.

6. Co-operation with Other Commissions and organizations

- Joint Working Groups with Commission 5 Positioning and Measuremen (Commission in lead is 6) and Commission 10 – Construction Economics and Management (Commission in lead is10)
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7. Co-operation with other partners

- Cooperation with the ISM (International Society For Mine Surveying)

8. Commission Officers

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January 2015