DESIGN GUIDELINES FOR THE DYNAMIC BEHAVIOUR OF GROUND SUPPORT TENDONS
Phase I: Technical Information Data Sheets[1]

by

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ABSTRACT

OBJECTIVES. The objectives of the first phase of the project were: (1) to produce technical information data sheets for each support element, which will be used as guidelines and data input for design; and (2) to identify the gaps in the existing knowledge to orientate the future research and testing. The ultimate objective of the project is to produce documented standards and functional support assemblies (and systems) for the reinforcement of rock mass excavations under dynamic loading, and methods to estimate their strength and predict their behaviour.

METHOD. A general review of literature and technical data released on the subject over the last two decades was carried out, along with a gap analysis.

RESULTS. Technical information data sheets were prepared for most ground support elements used in Ontario mines. However, only ground support elements specifically designed for use in dynamic conditions have been tested until now to determine their behaviour under such conditions. Gaps and future research directions were identified.

CONCLUSION. The compilation and analysis of the available data were used to define a road map for the next phases of the project. Most of the gaps identified should be addressed within a second phase of the project.

SUMMARY

Most underground excavations require ground support to maintain stability and ensure the safety of personnel and equipment. Appropriate ground support design matches support characteristics with the anticipated rock mass behaviour. Both static (e.g. supporting the weight of the surrounding rock) and dynamic or large deformation conditions (e.g. surviving additional forces, which may be imposed suddenly and without warning) must be considered. Static characteristics of ground support elements are well-known and widely available, dynamic ones are less. Lately, new support elements have also come out on the market, and some testing has also been carried out to determine their strength and other characteristics in relation with their performance. However, this information is not currently available in a simple, concise, easily-accessible format, nor have gaps and needs for further testing been identified.

As the majority of Ontario mines use ground support to ensure the safety of their operations, and many mines must design for dynamic and large deformation conditions, tendon support design for these conditions was identified by the MASHA Ground Control Committee as a key research priority. A research project was launched in February 2007 to investigate the subject. The objectives of the project were: (1) to produce data sheets for each support element to be used as technical guidelines for design; and (2) to identify the gaps in the existing knowledge to orientate the future research and testing. The project is expected to further enhance the development of new concepts and the quality of ground support installed in Ontario mines.

The activities carried out, observations gathered and results obtained during the first phase of the project are detailed in the present report:

1. The background and objectives of the project are introduced in the first section of the report. Terms and definitions are specified, testing methods are reviewed, tests programs carried out over the last three decades are listed, and results are summarized. The existing information was analyzed and a road map (gap analysis) is proposed for the future phases of the project. The list of quoted references comprise 97 entries;
2. All Technical Information Data Sheets (18) produced over the course of the project are shown in Section II of the report;
3. World-class facilities designed to carry out static and dynamic ground support testing on a current basis are presented in Section III of the report. These facilities are shared between four countries: Australia, Canada, South Africa and Sweden; and
4. A comprehensive, critical review of reference books and international seminar proceedings released on the subject over the last three decades was carried out. Lecture notes of relevant papers were compiled. These are presented in Section IV of the report.

The actual report and data sheets should be considered as a work in progress. The report and data sheets will be updated regularly as new information and technical data become available.

The report and all *Technical Information Data Sheets* are posted on both CANMET-MMSL and MASHA websites – see addresses given below[2] –.

[2] Website addresses are:
- For CANMET-MMSL website: http://www.nrcan.gc.ca/mms/canmet-mtb/mmsl-lmsm/mines/mines-e.htm; and
- For MASHA website: http://www.masha.on.ca/ground_support_tendons.aspx.

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