
Preface

One of the main areas of interest for civil, mining and geological engineers is “rock engineering”. After the establishment of the International Society for Rock Mechanics (ISRM) in 1962, led by Prof. Leopold Müller from Salzburg (Austria), important contributions to rock mechanics and rock engineering have been provided by worldwide efforts over the last 52 years. The main products of ISRM’s work have been generated by its internal Commissions as appointed by the ISRM President and the Commission Presidents. These Commissions are designed to develop practical solutions, methods and data for the wide spectrum of rock engineering problems. Starting with the need to develop a common terminology for the properties of rock material and rock masses and the tests by which they are measured, a Commission on Standardisation of Laboratory and Field Tests (now the ISRM Commission on Testing Methods) was established at the time of the first ISRM Congress, held in Lisbon in 1966.

The tests are published as “Suggested Methods” (SMs)—a term which has been carefully chosen: these are not standards *per se*; they are explanations of recommended procedures to follow in the various areas of rock characterisation, testing and monitoring. If practitioners and researchers have not been involved with a particular subject before and it is described in an ISRM SM, they will find the guidance to be most helpful. The SMs can be used as standards on a particular project if required, but they are intended more as guidance. The methods provide a definitive procedure for the identification, measurement and evaluation of one or more qualities, characteristics or properties of rocks or rock masses and they produce test results.

The ISRM SMs, thus produced by the ISRM Commission on Testing Methods, are developed and established within the consensus principles of the ISRM and approved according to a strict set of ISRM procedures and regulations. When a proposal for a method is accepted by the Commission, a draft document is written by a Working Group (WG) and sent to at least three experts for review. Following revision and further comments by the Commission members, the final document is approved by the ISRM Board as an ISRM SM and submitted to a journal for publication without further review. Since 1974, the ISRM Commission on Testing Methods has generated a succession of SMs covering a wide range of subjects. One SM was published in “Rock Mechanics” (at present “Rock Mechanics and Rock Engineering—RMRE”) of Springer Verlag in 1977, while the remaining ones were published in the “International Journal of Rock Mechanics and Mining Sciences—IJRMMS” of Pergamon Press (an imprint of Elsevier) until 2012. In 2012, RMRE started to publish the ISRM SMs.

The first collection of the ISRM SMs was organised by Profs. Richard Bieniawski and John Franklin and issued in 1981 as the ISRM “Yellow Book” which was edited by Prof. Ted Brown and published by Pergamon Press. Professor John A. Hudson was the President of the ISRM Commission on Testing Methods between 1987 and 2006 until he was elected as the ISRM President for the period 2007–2011. During his Commission Presidential tenure, he continued with the production of the SMs and their publication in the IJRMMS, and initiated a system where the documents were produced more in the form of papers—so that the authors

would receive full citation recognition of their efforts. This development was most successful and the number of new ISRM SMs has steadily increased after 1981.

After his election to the Presidency of the ISRM for the period 2007–2011, Prof. Hudson asked Prof. Ulusay if he would take over the Testing Methods Commission, which he did in 2006. With the 1981 Yellow Book becoming out of print, a new collection containing the complete set of ISRM SMs, from 1974 to 2007, became necessary. In 2007, a book, called the ISRM “Blue Book”, which includes the complete set of 40 SMs generated between 1974 and 2006, was edited by Profs. Resat Ulusay and John A. Hudson and published by the ISRM Turkish National Group. This book was well received and many copies have been distributed worldwide.

However, since 2006, and under the overall leadership of Prof. Ulusay, the ISRM Commission on Testing Methods has established 21 new Working Groups (WGs) for developing new and revised/upgraded ISRM SMs. Between 2006 and 2014, 16 WGs have produced a total of 21 new or upgraded ISRM SMs, which have been approved by the ISRM Board as ISRM SMs. It is also possible for new SMs to be developed through cooperation of two ISRM Commissions. An example of this is the new SMs entitled “SMs for Determining the Dynamic Strength Parameters and Mode-I Fracture Toughness of Rock Materials”—which is a product of the ISRM Commission on Rock Dynamics and the ISRM Commission on Testing Methods.

The current book, called the ISRM “Orange Book”, now contains a total of 21 separate new and upgraded ISRM SMs that have been generated between 2009 and 2014, and is being published as a supplementary volume to the 2007 “Blue Book”. The SMs are collated here in four parts, namely: “Laboratory Testing”, “Field Testing”, “Monitoring” and “Failure Criteria”. Tests and measurements carried out in the laboratory and field have been categorised into two separate sub-divisions. Although some index tests, such as the “Schmidt Hammer Test” and “Needle Penetration Test”, can be performed either in the laboratory or in the field using portable laboratory equipment, they are considered in Part I (Laboratory Testing). It should be noted that the 1975 version of the “SM for Laboratory Determination of the Shear Strength of Rock Joints”, and 1978 versions of the SMs concerning “Schmidt Hammer Test” and “Sound Velocity by Ultrasonic Pulse Transmission Technique” were revised in 2009 and 2013, respectively, so only the updated versions of these SMs have been included in this compilation. In Part II (Field Testing), the tests concerning rock mass displacements, observations on rock fractures and *in situ* properties of rock masses, and establishing a model for the *in situ* stress at a given site (the latter being a supplementary SM for the series of *in situ* stress measurement techniques published in the Blue Book) are included. Part III (Monitoring) includes only a new method for monitoring rock displacements using the Global Positioning System (GPS).

In the application of rock mechanics to rock engineering design, one of the most important issues is the failure of rock: while the failure of rocks is highly desirable during the excavation process, it should of course be avoided or at least controlled in structural rock mechanics applications. For this reason, the failure of rock has been one of the most important research subjects since the formation of the ISRM. However, over the years, it has become difficult to decide which failure criterion can/should be used in specific situations. The ISRM Commission on Testing Methods set out to prepare SMs for Failure Criteria to provide guidance on the nature and characteristics of six existing failure criteria and to suggest circumstances when they could be employed. It is not appropriate for the ISRM to dictate which criteria should be used because rock engineering circumstances can vary: rather, the intention of these SMs is to inform readers about the background, formulation, related experimental data, advantages and limitations, plus recommendations concerning the six criteria. These SMs, which are included in Part IV (Failure Criteria), will assist readers in understanding the nature of each of the failure criteria and hence enable them to make more informed and hence appropriate choices concerning which criterion to utilise in any given circumstance.

The Orange Book also includes two supplementary, but non-SM, documents. One of them is entitled “3D Laser Scanning Techniques for Application to Rock Mechanics and Rock Engineering” by Quanhong Feng and Kennert Röshoff. The 3-D laser techniques have been used in many engineering fields over the last 20 years and show great promise for characterising rock surfaces. The original development of the document commenced in 2007 and was conducted during the 2007–2011 ISRM Presidential period of Prof. Hudson through the Swedish National Group of ISRM. The motivation for the work was to produce a comprehensive report explaining the techniques and advantages of laser scanning for rock mechanics/rock engineering use. Thus, the ISRM Commission on Testing Methods considered that a report concentrating on the description of the laser scanning capabilities, plus the actual and potential rock mechanics applications, would be of great benefit to the ISRM members and the rock engineering community at large and so it is included in the Orange Book as a supplementary document.

The other supplementary document is titled “The Present and Future of Rock Testing: Highlighting the ISRM Suggested Methods”. This document was presented by the Editor of this book at the 7th Asian Rock Mechanics Symposium (ARMS7) in 2012 in Seoul, Korea, as a Keynote Lecture. Following the permission given by the ARMS7 Organising Committee, the tables in the paper are updated to reflect the latest situation of the ISRM Suggested Methods and the slightly revised version of the paper is included in this book. The members of the ISRM Commission on Testing Methods enthusiastically supported the suggestion from one of its members that the Editor’s Keynote paper on the Commission’s work should be included as the first item in the Orange Book in order to provide the historical and current contexts for the production of the Suggested Methods.

New and revised ISRM SMs will continue to be published individually in the journal RMRE as they become available. I believe that feedback and contributions from users are essential for the development of new SMs and updating of the current SMs. Those who can suggest improvements to the published SMs or wish to recommend new techniques or instruments for publication in an SM form are urged to send full details of their proposals to Prof. R. Ulusay, President of the ISRM Commission on Testing Methods, at “resat@hacettepe.edu.tr”.

The publication of this Orange Book could not have been possible without the kind help, efforts, contributions and cooperation of several colleagues. I should like to kindly acknowledge the generous efforts and contributions of all those who have participated and assisted (Chairmen and Members of the Working Groups) in the preparation of the SMs from 2007 to 2014, which numbers many tens of experts. The names of the contributors to each published SM are listed on the title page in each case. Many thanks go to all the contributing experts for their kind reviews and constructive suggestions for the improvement of the SMs before their approval.

I give heartfelt thanks to: the Commission members; Profs. John A. Hudson and Xia-Ting Feng (not only as the Commission members, but also as the past (2007–2011) and present (2011–2015) ISRM Presidents, respectively), Prof. Sergio Fontoura, Dr. Eda de Quadros, Prof. Hasan Gerccek, Prof. Ove Stephansson, Prof. Yuzo Obara, Dr. Robert J. Fowell, Dr. Nuno Grossman, Dr. Don Banks (passed away in 2013), Prof. Frederic Pellet, Dr. Chulwhan Park and Dr. Jose Muralha for their enthusiasm, support and kind contributions since 2006. Dr. Luis Lamas (ISRM Secretariat) and all ISRM Board members (2007–2011, 2011–2015) are also kindly acknowledged for their sincere support and constructive comments on the SMs during the approval stages.

In addition, I greatly appreciate Dr. Nick Barton’s kindness for permission to use his original figure on the cover page of the book and his brief explanation of the figure and for his colleague Ricardo Abrahao from Brazil for his fine drawing of the figure. I am also extremely grateful to Prof. Giovanni Barla, the Editor of RMRE journal, for his enthusiasm, kind cooperation and efforts to ensure rapid publication of the ISRM SMs in the journal since 2012, together with his help in the publication of this Orange Book through Springer Verlag.

Drs. Quanhong Feng and Kennert Röshoff are acknowledged for their kind preparation of their detailed report on laser scanning which is included in the book.

Elsevier is kindly acknowledged for allowing the ISRM to reproduce the two SMs in this printed form and I am sure that its generosity will be appreciated not only by the ISRM members but also by the whole rock mechanics and rock engineering community at large.

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