Preface

This book is intended as a reference book for advanced graduate students and research engineers in rock mechanics related to civil, mining, hydropower, and traffic engineering, etc. For rock mass during construction, they are often subjected to complicated stress disturbance conditions, such as human-induced and environmental loading acting on rock that is cyclic or fatigue in nature. Typical forms of stress disturbance include excavation unloading, blasting vibration, earthquake, drilling and vehicle loading, etc. Usually, the stress disturbance condition is inferred as a kind of dynamic loading and differs dramatically from those under static loads. Along with the constructions on rock mass, a lot of disasters, e.g., tunnel rockburst, induced seismicity and sand liquefaction, are cyclic and dynamic processes. Nevertheless, insufficient attentions have been paid to the influences of disturbed stress on the long-term stability of rock mass construction so far. The discrepancy between theoretical prediction (by approximating the dynamic problems as static ones) and actual performance of constructed engineering structures is usually tolerated. As a result, investigation of the disturbed stress on rock is always vital to the rational design and the long-term stability prediction of rock constructions.

The book is focusing on the effect of complicated stress disturbance conditions for deeply buried rock mass. Two kinds of typical disturbed stress paths of unloading and fatigue loading are applied to rock obtained from high geo-stress conditions. The first part, Chapters One, Chapters Two, Chapters Three, concerns the macro-meso failure pattern and energy dissipation charactersitics of rock subjected to alternative fatigue loading and confining pressure unloading conditions. The effects of prior damage, disturbed stress amplitude and disturbed frequency on fracture and energy evolution during rock unloading were detailly investigated. The second part, Chapters Four, concerns the mechanical behaviors of hollow hole contained rock exposed to varied frequency-amplitude loads. The influence of hole orientation on the deformation, lifetime, energy evolution and macro-meso failure morphology are deeply investigated. The third part, Chapter Five, concerns the influence of rock bridge length on fracture evolution characteristics of cavity-fissure contained rock. A new damage variable is defined using AE accumulative energy and an inverted “S” shaped damage evolution model was proposed to describe rock damage propagation in the entire process. The fourth part of the book, Chapter Six, concerns

the fracture evolution and instability warning prediction for the fissure-contained hollow-cylinder granite exposed to multi-stage cyclic loads. New insights into the fracture evolution and instability warning prediction for fissure-contained hollow-cylinder granite with different hole diameter under multi-stage cyclic loads were found. Effort has been made to include a list of comprehensive literature citations in each chapter. However, it is impractical to list all available literature. I apologize sincerely for any omissions.

I am fortunate for having the opportunity to work with a group of excellent scholars, Prof. C. H. Li, T. Sun, D. Y. Long, Z. H. Cao, Y. Y. Hu. In fact, most of the materials presented in this book are collections from my published papers. I wish to acknowledge J. Q. Han from the Institute of Acoustics, Chinese Academy of Sciences to help me perform some of the fatigue mechanical tests. I wish to acknowledge the support and guidance of my friends, Drs. It was Prof. X. Li who introduced me to the rock mechanics study when I was a doctoral student when I was in Institute of Geology and Geophysics, Chinese Academy of Sciences.

As mentioned at the beginning, the book is intended as a reference book and not as a text. Thus, the description of phenomena and derivation of equations may not be in depth or in detail as the reader may wish. However, if the reader obtains a clear picture and understanding of the structural-dependent fatigue deterioration of rock mass, I would consider the book a success. It is my sincere hope that this book may inspire further research and development into this fascinating subject.

Yu Wang
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