

TUNNELLING ASIA '97

SELECT PAPERS

Editors

C.V.J. Varma

A.R.G. Rao



Central Board of Irrigation and Power
New Delhi



**Adhering Committee of International
Tunnelling Association (India)**
New Delhi



A.A. BALKEMA/ROTTERDAM

1997



CONTENTS

ENGINEERING CLASSIFICATION AND CHARACTERIZATION OF ROCK MASS FOR TUNNELLING

THE ENGINEERING CLASSIFICATION OF WEATHERED ROCK MASS <i>Anand S. Gupta and K. Seshagiri Rao</i>	3
---	---

ELECTRICAL RESISTIVITY TECHNIQUE FOR ROCK CHARACTERIZATION <i>C.S. Gokhale and J.M. Kate</i>	11
---	----

PLANNING, INVESTIGATION AND ANALYSIS OF TUNNELS

ROCK BEHAVIOR OF LARGE UNDERGROUND CAVERN DURING EXCAVATION <i>Shigeki Nambu and Keigo Kudo</i>	25
--	----

A MORE REALISTIC DEFORMATION RESPONSE OF ROCK MASS AROUND CIRCULAR OPENING <i>T. Ramamurthy and N.K. Anand</i>	35
---	----

TUNNELLING, STABILIZATION AND SUPPORT SYSTEM

THE EFFECTIVE METHODS OF STABILISATION AND CONSOLIDATION OF ROCK MASS <i>Richard Snuparek</i>	53
--	----

PRE-INJECTION IN HARD ROCK TUNNELLING <i>K.F. Garshol</i>	63
--	----

LONG ROUNDS IN TUNNEL BLASTING <i>Jan Norén</i>	73
--	----

HVALFJORDUR SUB-SEA TUNNEL PROJECT, ICELAND <i>Colin G. Rawlings and Milan Simic</i>	83
---	----

SAFE AND EFFICIENT METHOD OF BLASTING FOR EXCAVATION OF A CROSS DRIFT AND WIDENING OF UNDERGROUND MACHINE HALL TO ITS FULL WIDTH — A CASE STUDY <i>R.B. Singh, M.M. Singh, P.K. Singh and B.B. Dhar</i>	93
--	----

GEOTECHNICAL EXPERIENCES OF MAKING THE RANGANADI HEAD RACE TUNNEL <i>R.K. Mahajan and V.V. Badareenarayana</i>	103
---	-----

GROUTING TECHNIQUES FOR GROUND IMPROVEMENT IN TUNNELLING <i>Colin Rawlings, Emma Hellawell and Mike Kilkenny</i>	117
---	-----

LINING FOR TUNNELS

OPTIMIZATION OF LININGS IN ROAD TUNNELS <i>Arne Grønhaug</i>	137
---	-----

DESIGN OF CONCRETE LININGS OF PRESSURE TUNNELS AND SHAFTS FOR EXTERNAL WATER PRESSURE <i>Anton J. Schleiss</i>	147
---	-----

SPECIFYING STEEL FIBER REINFORCED SHOTCRETE <i>Marc Vandewalle</i>	157
PERFORMANCE OF DRY-MIX STEEL FIBRE REINFORCED SHOTCRETE — A CASE HISTORY <i>Manoj Verman, J.L. Jethwa and S.N. Huddar</i>	163

MONITORING, BACK ANALYSIS

THE PERFORMANCE OF BRACED EXCAVATIONS AND TUNNELS IN ALLUVIUM AND SOFT ROCK FOR THE LOS ANGELES METRO <i>T.P. Smirnoff, K.N. Murthy and A.F. Stirbys</i>	175
AN EXAMPLE OF BACK ANALYSIS OF THE GEOMECHANICAL PROPERTIES OF A ROCK MASS IN "FLYSH" CONCERNED WITH AN HIGHWAY TUNNEL DRIVING <i>G. Sappa and M. Mancina</i>	185

INDUCTION OF MODERN TECHNOLOGY FOR CONSTRUCTION OF TUNNELS AND SHAFTS

UNDERGROUND CONSTRUCTION INNOVATIONS AT THE NEW CLEUSON-DIXENCE HYDRO-ELECTRIC PROJECT <i>Richard R. Robbins</i>	197
CONSIDERATION ON PROGRESS OF "TREVI" FOREPILING METHOD FOR TUNNELING IN JAPAN <i>Iwao Nakahara</i>	209

TUNNELLING IN URBAN AREAS FOR METRO RAILWAY, RAILWAY AND ROAD, WATER SUPPLY AND SEWER LINES

INNER CITY SOFT GROUND EPB-TUNNELLING MRT C201A AND CP264, TAIPEI, TAIWAN <i>Klaus Rieker</i>	223
PERFORMANCE OF COMPENSATION AND CHEMICALLY GROUTED GROUND DURING TUNNELLING FOR THE LOS ANGELES METRO <i>Timothy P. Smirnoff, K.N. Murthy and Anthony F. Stirbys</i>	233
PRESENT SITUATION FOR CONSTRUCTING SUBWAY AND TECHNOLOGY TO ENABLE THE WORKS <i>Masaaki Miura and Shinichi Konda</i>	243
HEATHROW EXPRESS TUNNELS <i>A.P. Deane</i>	257
THE NEW ST. CLAIR RIVER TUNNEL <i>A.P. Finch</i>	267

SUPPORTING SYSTEMS FOR TUNNELLING

HOW TO ACHIEVE MAXIMUM BENEFITS FROM MODERN SHOTCRETE TECHNOLOGY <i>K.F. Garshol</i>	279
NEW DEVELOPMENTS IN TUNNEL SUPPORTS IN THE FIELD OF SPRAYED CONCRETE AND THE PRODUCTION OF TUNNEL LINING ELEMENTS <i>Gustav Bracher and Ernesto Schümperli</i>	289

SHAFTS AND INCLINED TUNNELS

1500MW NATHPA JHAKRI HYDROELECTRIC PROJECT — STRESS RELIEVING ASPECTS IN THE PRESSURE SHAFTS STEEL LINER <i>Vipin Arora, Vatsal Chopra and Arun Goyal</i>	303
SHAFTS AND INCLINED TUNNELS <i>R.D. Varangaonkar</i>	313
DESIGN OF PRESSURE SHAFTS IN RECOGNITION OF ROCK STRUCTURE AND STRESS <i>R. Olsson, U. Lindblom and R. Glamheden</i>	321

TUNNELLING EQUIPMENT

A LINEAR FIRE DETECTION SYSTEM FOR TUNNELS <i>Peter Schenkenhofer</i>	333
TECHNIQUES OF EXCAVATION AND NEW EQUIPMENT FOR TUNNELLING <i>D.G. Kadkade</i>	347
NEW DIMENSIONS IN TUNNEL BORING MACHINES (TBM's) <i>Jagman Singh</i>	357
MAXIMISED PRODUCTIVITY FROM MECHANISED TUNNELLING THROUGH A USER/SUPPLIER PARTNERSHIP IN EQUIPMENT SERVICE — "SOFT SERVICES IN HARD ROCK" <i>Dan Allen</i>	373

COSTING AND CONTRACT MANAGEMENT

CONTRACT MANAGEMENT FOR ACCELERATED COMPLETION OF UNDERGROUND WORKS IN HYDRO-ELECTRIC PROJECTS — CONTRACTORS PERSPECTIVES <i>S.K. Desai and T.S.M. Kurup</i>	383
TUNNELLING CONTRACTS WITH CONTROVERSIAL AND ONE-SIDED CONDITIONS <i>R.D. Varangaonkar and V.M. Dharap</i>	391
<i>Index of Contributors</i>	399