



*SEVENTEENTH
INTERNATIONAL
CONGRESS
ON LARGE DAMS*

*DIX-SEPTIÈME
CONGRÈS
INTERNATIONAL
DES GRANDS BARRAGES*

*17-21 JUNE 1991
VIENNA - AUSTRIA*

XXVTH INTERNATIONAL
CONGRESS
ON LARGE DAMS

DIX-SEPTIEME
CONGRES
INTERNATIONAL
DES GRANDS BARRAGES

17 JUIN 1974
VIENNA - AUSTRIA

VOLUME

3

QUESTION 66

TRANSACTIONS

COMPTES RENDUS

*Published by the
International Commission
on Large Dams*

*Publiés par
la Commission Internationale
des Grands Barrages*

151, bd Haussmann, 75008 Paris, France
Tél. : 40 42 68 24 - 40 42 67 33 - 40 42 54 38
Télex : 641320 F - Fax : 40 42 60 71

NOTE

Units of Measurement

As for previous Congresses and though some authors do not fully agree, we attempt to follow the recommendations of the International System of Units (SI).

For example, hm^3 and km^3 were preferred to 10^6 and 10^9 m^3 , or million and billion cu.m. See Bulletin 34 "ICOLD Guide for the International System of Units (SI)", page 13.

The decimal sign may be the full stop (Anglo-Saxon usage) or the comma (European usage); but as a safeguard against confusion, full stop (period) and comma are used as decimal sign only.

Where the number of digits before or after the decimal sign exceeds three, the digit should be divided into groups of three by half space.

We meet not enough co-operation from some authors writing in English who go on keeping the comma to separate the groups of three digits instead of using half space. It was not possible to make the appropriate corrections in all the tables provided by the authors and even in the text. Sorry for the inconvenience.

AVERTISSEMENT

Unités de Mesure

Comme pour les Congrès précédents et bien que certains auteurs manifestent des réticences à ce sujet, on s'est efforcé de suivre les recommandations du Système International d'Unités (SI).

Par exemple, on a utilisé plus volontiers hm^3 et km^3 au lieu de 10^6 m^3 et 10^9 m^3 ou million et milliard de mètres cubes. Voir Bulletin 34 « Guide CIGB du Système International d'Unités (SI) », page 13.

De même, on a retenu le point (usage anglo-saxon) et la virgule (usage européen) comme signe décimal, mais pour éviter toute confusion, la virgule et le point ne sont utilisés que comme signe decimal.

Aussi, quand le nombre de chiffres avant ou après la virgule est supérieur à 3, les chiffres sont groupés par 3, chaque groupe étant séparé par un court espace.

A ce sujet nous rencontrons encore des difficultés de la part de quelques auteurs de langue anglaise qui continuent à utiliser la virgule au lieu d'un court espace pour séparer les groupes de trois chiffres. Nous n'avons pas pu apporter les corrections nécessaires dans tous les tableaux fournis par les auteurs et même dans le texte. On voudra bien nous en excuser.

VOLUME III**TABLE OF CONTENTS**

	PAGE
Wording of Question 66	VIII
Table of Contents of Papers on Question 66	IX
Papers on Question 66	1
General Report Question 66	1829

TABLE DES MATIÈRES

	PAGE
Libellé de la Question 66	VIII
Table des Matières des Rapports sur la Question 66	IX
Rapports sur la Question 66	1
Rapport Général Question 66	1829



PAPERS ON Q 66

RAPPORTS SUR LA Q 66

QUESTION

66

Dams on difficult foundations

Subject

- a) Effect of difficult foundations on dam design and construction (watertightness, stability, liquefaction, etc.).*
- b) Unusual treatment of foundations.*
- c) Foundation behaviour on first filling and during operation.*
- d) Unsatisfactory behaviour of foundations : remedial measures and results.*

Barrages sur fondations difficiles

Objet

- a) Effets des fondations difficiles sur la conception et la construction des barrages (étanchement, stabilité, liquéfaction, etc.).*
- b) Traitement spécial des fondations.*
- c) Comportement de la fondation au cours du premier remplissage et pendant l'exploitation.*
- d) Comportement non satisfaisant des fondations : traitements curatifs et résultats.*

TABLE OF CONTENTS
OF PAPERSTABLE DES MATIÈRES
DES RAPPORTS

	Page
R. 1. C. B. ABADJIEV, G. S. MOULESHKOV, V. I. PHILLIPOV (<i>Bulgaria</i>) Stability of a dyke on a low permeable stratum underlaid by a highly permeable layer with direct contact to a high-water river	1
R. 2. P. VANEL, J. MOREY (<i>France</i>) Realisation de coupures par parois moulées en conditions très difficiles : barrages de New Waddel (États-Unis) et de Pehuenche (Chili)	11
R. 3. A. M. SHALABY (<i>Egypt</i>) Foundation soil consolidation for High Aswan dam	31
R. 4. A. SAHUQUILLO, E. CIFRES, J. GARCIA DE LA TORRE (<i>Spain</i>) Hydrogeological and geotechnical problems posed by the highly transmissive and low pervious rocks in the Contreras reservoir, Spain	45
R. 5. A. FOYO MARCOS, C. TOMILLO, J. CERDA RAMOS (<i>Spain</i>) The low pressure test. Determination of permeability and groutability of slate rocks in large dams foundation	61
R. 6. P. COCHET, E. FROSSARD, A. YZIQUEL, P. LONDE (<i>France</i>) Barrage-voûte de Turkwel au Kenya - Conception et réalisation des appuis, des voiles d'injection et de drainage en site rocheux très raide	77
R. 7. W. DOBOSZ, K. FIEDLER (<i>Poland</i>) Advantages from a contour map of foundation displacements of a gravity dam	99
R. 8. J.-L. RIZZOLI, D. LE MOULLEC, B. REVERCHON, F. ISAMBERT, J.-M. DUPAS (<i>France</i>) Observations du comportement de fondations compressibles et projet sur fondations très compressibles : barrages des retenues Seine, Aube et Marne, digue de Lazer/Observations on compressible foundation behavior and very compressible foundation design : dams of Seine, Aube and Marne reservoirs, Lazer dam	105
R. 9. J. TELLERIA, G. GOMEZ-LAA (<i>Spain</i>) Arbon dam - A didactic experience about problems of a dam built on a deformable foundation	135
R. 10. J. W. HATTON, P. F. FOSTER, R. THOMSON (<i>New Zealand</i>) The influence of foundation conditions on the design of Clyde dam	157
R. 11. M. R. ASKARI (<i>Iran</i>) Construction of Sarcheshmeh saddle dam on crushed and altered foundation	179

	Page
R. 12. N. TARKESHDOOZ, M. SHIRVIYEH A., Y. RASTEGARI, M. S. KARBASI, K. JAFARI, R. P. BRENNER (<i>Iran</i>) Embankment dam founded on river alluvium with erratic density conditions	199
R. 13. A. RAMON GUINEA, E. QUILES APARISI, M. FERNANDEZ-BOLLO (<i>Espagne</i>) Traitement de la fondation du barrage José Toran	215
R. 14. J. M. A. SANTA CLARA (<i>Zimbabwe</i>) The complex geology of Kariba's right bank	229
R. 15. N. NAVALON, J. M. GAZTAÑAGA, J. M. LOPEZ MARINAS (<i>Spain</i>) Corrections to the foundation permeability of Cortes dam (Valencia, Spain) during first filling	247
R. 16. K. H. HEITFELD, L. KRAPP (<i>Germany</i>) Problems associated with sulphate karst - Flood control reservoir Salzderhelden, Germany	261
R. 17. J. GIESECKE, M. ROMMEL, R. SOYEAX (<i>Germany</i>) Seepage flow under dams with jointed rock foundation - Parametrical studies of simulated 2-dimensional joint patterns	281
R. 18. C. KUTZNER (<i>Germany</i>) New criteria for rock grouting in dam engineering	307
R. 19. A. CARRÈRE, J. DUSSART, C. LEFÈVRE (<i>France</i>) Fondations rocheuses de barrages en béton : exemples de traitement systématique d'amélioration des propriétés mécaniques naturelles à Gomal-Zam (Pakistan), Takamaka (Ile de la Réunion), Pont de Veyrières (France)	319
R. 20. N. NAVALON, J. M. GAZTANAGA, J. M. LOPEZ MARINAS, N. ALONSO (<i>Spain</i>) Methodology used by Hidroeléctrica Española for the investigation, planning, treatment and control of dam foundation	339
R. 21. A. MARCELLO, G. EUSEPI, S. OLIVERO, R. DI BACCO (<i>Italy</i>) Ravasanella dam on difficult foundation	363
R. 22. K. TAKAHI, E. KIMOTO, S. KANWO (<i>Japan</i>) Design and construction of an earthfill dam on sandy foundation	381
R. 23. K. TAKEMURA, T. NIREI, I. SHIBATA (<i>Japan</i>) Foundation treatments and behavior during impounding at Okuno dam	401
R. 24. T. NISHIGORI, J. TAKIMOTO (<i>Japan</i>) Foundation treatment for alluvial deposits at Tadami dam	417
R. 25. I. SHIBATA, M. IGAWA, Y. MIZUKI (<i>Japan</i>) Impermeable barrier in quaternary welded tuff	437
R. 26. K. TAKEMURA, M. SHIMOMURA, N. MATSUMOTO, Y. YAMAGUCHI (<i>Japan</i>) Behaviors of foundations for fill dams during construction and first filling of reservoirs in Japan	455

	Page
R. 27. T. HASEGAWA, A. MURAKAMI, H. SUZUKI (<i>Japan</i>) Treatment of foundation with base rock containing a horizontal weak layer in moderately high concrete gravity dam	477
R. 28. A. E. SARDINHA, P. C. FERNANDES CORREIA, S. CORRÊA PIMENTA, C. CASARIN (<i>Brazil</i>) Behavior of a sapolite earthfill dam foundation. Salto Santiago hydroelectric power plant	499
R. 29. C. E. SCHNEEBERGER, Y. PIGEON, J. LEVAY, B. BONCOM- PAIN (<i>Canada</i>) The use of slurry wall and jet grouting techniques to repair existing cofferdams at LG-1	511
R. 30. W. D. LIAM FINN, R. H. LEDBETTER, R. L. FLEMING Jr., A. E. TEMPLETON, T. W. FORREST, S. T. STACY (<i>Canada</i>) Dam on liquefiable foundation : safety assessment and remediation	531
R. 31. L. J. CORNISH, C. W. HOLDER (<i>Canada</i>) Seven Mile dam performance during reservoir raising	555
R. 32. T. J. PATAKY, J. K. LOU (<i>Canada</i>) Upgrading the safety of concrete intakes on permeable foundation	581
R. 33. M. BZIOUI, A. F. CHRAIBI (<i>Maroc</i>) Barrage d'Ait Youb. Adaptation du projet aux conditions géologi- ques réelles de la fondation	601
R. 34. M. ZIANI, A. RAHOUTI (<i>Maroc</i>) Barrage de garde sur l'Oued Sebou. Risque de liquéfaction de la fondation et rabattement de la nappe pendant les travaux	615
R. 35. M. MEKBOUL, M. AKHRIF, H. MERGAOUI (<i>Maroc</i>) Fondation du barrage en BCR d'Aoulouz (Maroc). Une dolomie précambrienne intensément fracturée et irrégulièrement altérée	631
R. 36. J. E. SMITH, G. P. BIRCH (<i>Great Britain</i>) Balanga dam and its mudstone foundations	657
R. 37. S. HONG, J. SOHN, G. BAE, K. NA (<i>Rep. of Korea</i>) A case study on differential settlement of rockfill dam	673
R. 38. P. PETER, M. CARAS (<i>Czechoslovakia</i>) Long-term settlement and seepages of the Ružiná dam	689
R. 39. E. LUCA, M.-F. VASILIU, S. TRANDAFIR, D. PASCU, C. PO- PESCU, I. TECUCI, I. POPESCU, A. POPOVICI (<i>Romania</i>) Earth dams on liquefiable or peat-coal and clay-silt soils	699
R. 40. V. TORNER, S. NOVOSAD (<i>Czechoslovakia</i>) The effects of difficult foundation conditions on the conceptual solution and construction of the Slezská Harta dam	719
R. 41. H. FLÖGL, H. STÄUBLE (<i>Austria</i>) Experience with the supplementary installation of an elastic dia- phragm in the rock of Schlegeis arch dam	731
R. 42. G. OBERTI (<i>Italy</i>) The interconnection between concrete dam and foundations	743
R. 43. F. CAIROLI, S. COLONNA, A. ERKASAR (<i>Italy</i>) The complex grout curtain for Gezende dam in Turkey	769

	Page
R. 44. V. CASADEI, A. GALLICO, P. P. MARINI, F. PICCINELLI (<i>Italie</i>) Barrage de Ridracoli - Travaux confortatifs avec retenue pleine ..	785
R. 45. C. LOTTI (<i>Italy</i>) The long-term behaviour of dams built under difficult foundation conditions	801
R. 46. W. K. SHENOUDA (<i>Egypt</i>) Comparison between observed and calculated settlement of High Aswan dam	819
R. 47. A. YAMAZUMI, N. HARA, K. HARITA (<i>Japan</i>) Foundation treatment for Agigawa rockfill dam constructed on fissured rock	831
R. 48. P. BONALDI, G. RUGGERI, G. VALLINO, G. FORZANO, B. D'ANCONA (<i>Italy</i>) Examination of the behaviour of the Corbara dam and its founda- tion during the normal operation period following the improve- ment of the concrete buttresses	853
R. 49. K. GRAYBILL, J. LEVALLOIS (<i>France</i>) Construction d'un écran étanche à l'hydrofraise à travers le noyau du barrage de Mud Mountain/Construction of a cut off wall with the hydrofraise through the core of Mud Mountain dam	879
R. 50. M. D. GILLON, C. J. NEWTON (<i>New Zealand</i>) Abutment repairs at the Matahina dam	909
R. 51. A. BELMAHJOUR, J. SALVADOR FERNANDES, J. M. SOUSA CRUZ, A. QUINTELA (<i>Marc</i>) Traitement de la fondation du barrage de Mechraa El Hajar par des colonnes ballastées	933
R. 52. A. R. DODDIHAL, D. N. KULKARNI, V. C. SHAHANE (<i>India</i>) Effect of difficult foundations on dam design and construction. Dudhganga dam, a case study	951
R. 53. O. DASCAL, M. SMITH, J. MANIEZ (<i>Canada</i>) Manicouagan 3 foundation cut off : fifteen years of operation	961
R. 54. J. GRUMICH (<i>Canada</i>) Développement de nouveaux appareils pour réaliser les essais d'eau et mesurer les sous-pressions dans les fondations des barrages	993
R. 55. M. TURFAN, A. TATLIDIL (<i>Turkey</i>) Low strength concrete (LSC) curtain. Application at Tahtali dam ..	1017
R. 56. V. BILGI, M. ORHON (<i>Turkey</i>) Remedial measures after consecutive tunnel collapses of Koçköprü dam	1035
R. 57. E. BASMACI (<i>Turkey</i>) Foundation behaviour of Atatürk dam on first filling	1051
R. 58. R. B. CATANACH, R. B. HALL, R. L. JAMES, A. L. O'NEILL, J. L. VON THUN (<i>USA</i>) Quail creek dike failure, failure mechanisms, redesign and construc- tion	1063

	Page
R. 59. R. L. VOLPE, C. S. AHLGREN, R. E. GOODMAN (<i>USA</i>) Selection of engineering properties for geologically variable foundations	1087
R. 60. D. E. KLEINER (<i>USA</i>) Evaluation, treatment and performance of difficult sandstone foundations	1103
R. 61. J. J. GILMORE, N. R. TILFORD, R. AKARUN (<i>USA</i>) Keban dam in Turkey - A large dam on karst	1125
R. 62. T. A. LUEBKE, J. McCLAIN, J. A. FARRAR (<i>USA</i>) Application of SMW method to Jackson Lake dam modifications	1159
R. 63. J. E. CAVALLIN (<i>USA</i>) Terminal dam, design and construction of an earthfill dam on a soft foundation	1179
R. 64. W. H. ROTH, G. BUREAU, G. BRODT (<i>USA</i>) Pleasant Valley dam : an approach to quantifying the effect of foundation liquefaction	1199
R. 65. G. C. ANTONOPOULOS, C. KONSTANTELLOS, V. J. ZIPPARRO (<i>USA</i>) Concrete cut off walls and grouting galleries - Design considerations	1225
R. 66. A. VEIGA PINTO, A. QUINTELA, A. SILVA GOMES, A. M. COELHO (<i>Portugal</i>) Beliche dam. Study of a foundation leakage	1241
R. 67. M. HADDAOUI, L. BENABBOU (<i>Maroc</i>) Travaux de confortement du barrage Nakhla	1259
R. 68. A. HAMOUL (<i>Algérie</i>) Travaux d'étanchéité du barrage de Hammam Grouz	1281
R. 69. P. H. PERAZZO, T. I. CHOUDRY (<i>Venezuela</i>) Evaluation of soil liquefaction potential at Caruachi dam	1297
R. 70. A. AJABI, K. AMRANE, M. EZZITOUNI (<i>Algérie</i>) Cheufas II : construction d'un barrage-poids en béton conventionnel sur fondations médiocres	1313
R. 71. A. BOUTAGHOU (<i>Algérie</i>) Cas de la fondation du barrage de Tichi-Haf	1341
R. 72. IZHAR-UL-HAQ (<i>Pakistan</i>) Foundation problems of Tarbela dam project	1353
R. 73. J.-F. TOURNERY, R. MONNET, G. CASTANIER, G. PERARDEL, M. GANDAIS, A. JENSEN, B. COUTURIER, G. MARIOTTI (<i>France</i>) Cas complexes d'étanchement de fondations hétérogènes	1371
R. 74. Th. STROBL (<i>Germany</i>) Rock sealing under dams by means of a hydro mill	1401
R. 75. N. TARKESHDOOZ, F. NAFISSIAZAR, Y. RASTEGARI (<i>Iran</i>) Effects of foundation conditions on the design of Taleghan embankment dam	1415

	Page
R. 76. A. F. SILVEIRA, C. A. B. PINA, C. A. P. COSTA, F. TEIXEIRA DIREITO (<i>Portugal</i>) Influence of foundation heterogeneity on safety of arch dams	1429
R. 77. D. ZOGOVIĆ (<i>Yugoslavia</i>) Hydrogeological conditions of a dam project	1447
R. 78. B. J. GUZINA, M. SARIĆ, N. PETROVIĆ (<i>Yugoslavia</i>) Seepage and dissolution at foundations of a dam during the first impounding of the reservoir	1459
R. 79. A. PUJOL, J. BUSTINZA, E. BECHIS (<i>Argentina</i>) Design changes in Piedra del Aguila dam due to the actual founda- tion conditions	1477
R. 80. W. R. LARSEN, N. R. HOPTON, F. R. RAMIREZ, O. VARDE (<i>Argentina</i>) Yacyreta cement-bentonite slurry cut off	1491
R. 81. V. RADUKIC, M. KRSTAJIC (<i>Yugoslavia</i>) Fly ash tailings dam founded on stiff fissured clay	1519
R. 82. P. R. VAUGHAN, T. A. JOHNSTON, R. W. CHALMERS (<i>Great Britain</i>) Foundation conditions at the reconstructed Carsington dam	1539
R. 83. J. C. BOSLER, C. GRATWICK, N. BEATTIE, S. MASO (<i>Australia</i>) Earthfill dam on a foundation of fissured clay containing an old slide surface	1555
R. 84. R. L. ROGERS, K. G. PEARCE (<i>Australia</i>) Effect of the foundations on design, construction and filling of Split-Yard Creek dam	1577
R. 85. S. Y. LI, S. J. PATERSON, F. L. KINSTLER (<i>Australia</i>) A concrete faced rockfill dam constructed on a deeply weathered foundation	1601
R. 86. P. ANAGNOSTI, N. N. ADAMO (<i>Yugoslavia</i>) Unusual foundation conditions at Badush dam site	1613
R. 87. R. J. WARK, C. E. BRADBURY, M. J. SOMERFORD (<i>Australia</i>) Geotechnical aspects of the foundations for the Harris dam	1623
R. 88. E. SNELL, K. KNIGHT (<i>South Africa</i>) Susceptibility of dams to failure by sliding on sub-foundation strata that dip upstream	1643
R. 89. Z. WENHUA (<i>China</i>) Treatment of fracture zone in Gezhouba project	1667
R. 90. SHI RUIFANG, CHEN FEI, DING GUOQIANG, ZHENG JIANBO (<i>China</i>) Foundation treatment of Longyangxia arch gravity dam on the Yellow river	1681
R. 91. K.-H. CHANG (<i>Korea</i>) Foundation design with slurry diaphragm wall method for Nam- gang project	1697

	Page
R. 92. R. J. TERMAAT (<i>Netherlands</i>) Dams on soft soils : lessons from the Dutch Delta Projects	1709
R. 93. L. FURSTENBURG, J. P. HURAUT, K. R. K. BLAKE, J. A. ZWAMBORN (<i>South Africa</i>) The influence of foundation conditions on spillway and plunge pool design at Katse dam	1727
R. 94. L. P. MIKHAILOV, I. A. PARABUCHEV, D. A. RAGOZIN (<i>USSR</i>) Particular features of design development for large dams to be built on complicated foundations	1745
R. 95. L. HERNANI DE CARVALHO (<i>Brazil</i>) Jaburu dam - Foundation improvement	1755
R. 96. N. W. A. BROUG (<i>Netherlands</i>) Geotechnical design and construction aspects of the Feni River closure dam (Bangladesh)	1765
R. 97. N. R. MORGENSTERN, D. S. MATHESON, J. G. MACPHERSON (<i>Canada</i>) Influence of foundation conditions on design and construction of the Nipawin hydroelectric project	1775
R. 98. H. O. BAYAT (<i>Iran</i>) Stepped spillway feasibility investigation	1803
R. 99. G. NOGUERA, W. GOMEZ (<i>Chile</i>) Diaphragm cut off walls in Chile	1819
General Report/ <i>Rapport Général</i> Q. 66	1829