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Public Works Engineering

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and Chartered Civil Engineer and Surveyor*

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Engineering is a creative activity involving imagination, intuition and deliberate choice

Ove Arup

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Preface

Public Works Engineering embraces the many aspects of civil engineering and associated building work which are of use and benefit to the public and they may be undertaken by public, private or statutory undertakings. In general, civil engineers change the natural environment, preferably in a sympathetic way, for the benefit of humanity, and provide, operate and maintain the infrastructure of structures and services which are so essential to the survival of a modern civilisation. The infrastructure is the fabric of a nation, forms the foundation on which the standard of living is built and serves the essential needs of industry and commerce.

The range of activities is enormous from transportation and highway and traffic engineering through to wastewater engineering, solid waste management and water engineering. Conservation work, the building of new towns, enhancement of the environment and the provision of major recreational facilities all fall within its scope. Flood relief work, coastal and river engineering, harbour regeneration and construction, offshore works and energy generation all form vital areas of public works engineering, and are all explored in such depth as the reasonable size of the book permits. There are many references for readers who wish to pursue particular aspects in greater detail.

Widely dispersed, challenging and informative examples have been selected as case studies to illustrate the problems encountered in many parts of the world and how they have been overcome, preceded by an analysis of the principal design, construction, management and maintenance aspects. These schemes are of great benefit to those who use the facilities or are served by them.

Special emphasis has been placed on the provision of supporting photographs, to give a better

comprehension of the nature and scope of projects and to help bring the text to life, using colour where this will be of particular benefit to the reader. There are also more than 100 diagrams showing details of projects to assist the reader in appreciating and understanding the more important features incorporated in the selected schemes.

The book commences with a study of the organisational, financial, legal, management and marketing aspects of public works engineering, which it was felt would provide a useful backcloth to the subject. This introductory chapter is followed by seven self-contained chapters each encompassing important and far reaching facets of public works engineering.

Many aspects of transportation are considered and compared, including the provision of major highway and motorway projects and bus stations in the UK. Other topical highway aspects examined include the relief of traffic congestion, forecasting traffic flows, park and ride schemes, road pricing and private sector initiatives. A comparison is made of UK, French and Australian railways with their different objectives, followed by an analysis of the civil engineering problems associated with the electrification and modernisation of railway networks. The importance of modern mass/light rail transit systems to help combat severe urban congestion is illustrated by reference to London Docklands Light Railway, Tyne and Wear Metro, Greater Manchester Metrolink, Hong Kong Mass Transit Railway and Singapore Mass Rapid Transit System. The principal civil engineering works associated with the extensive UK canal network are examined together with interesting major projects at Limehouse Tidal Lock, Llangollen Canal, Stanley Ferry Aqueduct and Blisworth and Netherton Tunnels. The design, construction

and possible problems in the operation of the Channel Tunnel are explored. The selection of airport sites and the design and maintenance of airfields are followed by a comparative study of recent airport projects at Heathrow Terminal 4, Gatwick North Terminal, Stansted, Changi (Singapore) and Mount Pleasant (Falklands Islands).

Highway planning, design, construction, management, widening and maintenance are all considered, together with their practical implications and the provision of major road junctions and intersections in the UK, Hong Kong, Oman, Singapore and Australia. Extensive and exciting bridge projects are examined in the UK, Hong Kong, South Korea and Japan. Road safety, lighting and parking also receive attention.

Sewer and manhole design, construction and rehabilitation, together with the provision of long sea outfalls and associated headworks, to reduce pollution of beaches, are examined and described. Major wastewater schemes at Cairo and Shanghai are analysed and compared, and the design and construction of sewage pumping stations are illustrated by reference to projects at Portland, Royal Docks and Ameria (Cairo). The main wastewater treatment processes are investigated and treatment plants in the UK, Middle East and Hong Kong are described and illustrated.

Solid waste management processes, including collection and disposal methods, are analysed together with the nature and purpose of solid waste transfer stations, incineration, waste derived fuel and composting plant, with supporting examples. The Rechem Pontypool hazardous wastes disposal plant and the disposal of radioactive wastes are also examined.

Water supply management processes are becoming increasingly important and these are examined and described with reference to the UK and developing countries. The methods of construction of reservoirs and dams are investigated with illustrated descriptions of the impressive Mudhiq Dam in Saudi Arabia and the vital Queen's Valley Reservoir in Jersey. Boreholes and wells, with their associated pumps, and water supply networks and services, including the London ring main, are suitably detailed. Water treatment processes are analysed and com-

pared and a variety of water treatment plants in the UK, Sicily, Bombay, Iraq and Malaysia examined in some detail. Attention is paid to the important aspects of leakage control and metering, and the provision of service reservoirs, water towers and pumping stations, with detailed case studies of two complex pumping stations in Hong Kong.

A comparative study, with practical examples, is made of housing development and new towns in the UK, Hong Kong and Singapore, and an analysis of modern commercial and industrial developments, including business and science parks. The increasing importance attached to conservation work is recognised and studies embrace the Albert Dock, Liverpool and the current Singaporean policy in a multi-racial country. Urban renewal projects, which are becoming increasingly urgent with such large areas of derelict land in the UK and many other countries, centre around London Docklands, Swansea Maritime Quarter and Darling Harbour in Sydney.

Flood relief schemes include the Thames and Barking Barriers and two projects in Yorkshire, while sea defence and coastal and river management systems are examined and supported by practical examples. Port and harbour construction and regeneration schemes embrace Aberdeen, Felixstowe, Umm al Qaiwan (United Arab Emirates), and the Hebrides and Shetlands. The design and siting factors of container terminals are considered with case studies of Bahrain and Indonesia. Extensive reclamation processes in Singapore and Hong Kong are examined together with their important after-use. The importance of irrigation in dry regions, including the re-use of sewage, is examined supported by relevant examples in the Middle East and Madeira. The main characteristics and hazards of offshore works are investigated and a study made of the Magnus Oilfield and other North Sea projects.

A variety of recreational facilities are considered ranging from water based sports to swimming pools and sports stadia, illustrated by noteworthy examples such as the Holme Pierrepont Water Sports Centre and Toronto's Sky Dome. Other famous recreational structures in-

vestigated include the Sydney Opera House and Sydney Centrepoint Tower. The study of recreational facilities also encompasses national parks and associated recreational features, garden festivals and Sentosa Island, Singapore.

Energy generation involves extensive civil engineering works and particular attention is paid to the design and construction of power stations, with practical examples taken from China and Hong Kong. The importance of hydroelectric schemes is recognised and the study includes major schemes in Malaysia, Java and Kenya. The final chapter concludes with a comparison of the Severn and Mersey Tidal Barrage schemes and the use of wind energy systems.

The book is designed to meet the needs of a wide range of readers in the UK and overseas, ranging from practising civil engineers and civil engineering students, to consultants, contractors and clients. There is much within its pages of

interest to a wider readership including structural engineers, architects, surveyors, builders, planners and environmentalists, and also lay persons who wish to know more about the provision, operation and maintenance of a country's infrastructure.

The preparation of the book has involved the author in extensive research and the text has benefited enormously from the contributions made by the numerous persons and organisations listed in the *Acknowledgements* section of the book and throughout the various chapters. They have all given so freely and so willingly of their time and resources.

Abbreviations are used extensively and they are listed in the Appendix at the end of the book for ease of reference.

IVOR H. SEELEY

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A great debt of gratitude is owed to the many persons and organisations who gave so much assistance in such a willing and helpful way. It is not possible to mention them all personally, but the following are specifically listed as supplying plates and/or diagrams or in giving permission for their reproduction, and these have done much to enhance the quality and usefulness of the book. I have also drawn readily from technical publications listed in the references at the end of each chapter for which my grateful thanks are due to the authors and publishers respectively.

Proceedings of the Institution of Civil Engineers and Thomas Telford Publications: figures 2.5, 2.6, 2.7, 2.10, 2.11, 2.14, 2.15, 2.16, 2.23, 2.31, 3.1, 3.2, 3.3, 3.10, 3.11, 3.12, 3.13, 6.11, 6.12, 6.13, 6.14, 6.15, 6.16, 6.17, 6.18, 6.19, 6.20, 8.9, 8.10, 8.23, 8.37, 8.38 and 8.39.

Municipal Engineer and Thomas Telford Publications: figures 2.2, 2.3, 2.4, 3.9, 4.15, 4.16, 4.17, 4.18, 8.6, 8.13, 8.14, 8.25 and 8.26.

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Rendel Palmer & Tritton, Consulting Engineers: figures 3.14, 3.15, 8.1, 8.2, 8.3, 8.11, 8.15, 8.16, 8.20 and 8.40 and plate 41.

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Shepherd Construction Ltd (copyright): figures 2.12 and 7.12 and plates 23 and 39.

Ministry of Transport: figure 4.1.

Sports Council: figure 8.24.

Greater London Council: figures 5.3, 5.4 and 7.1.

Isle of Wight County Council: figures 5.10, 5.11 and 5.12.

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Hong Kong Territory Development Department: figures 3.7, 7.2, 7.8 and 7.19 and plates 19, 20, 21, 30, 34 and 35.

Singapore Housing and Development Board: figures 7.3, 7.4, 7.5, 7.6, 7.20, 8.17, 8.18 and 8.19 and plates 22 and 31.

Singapore Mass Rapid Transit Corporation: figures 2.17 and 2.18.

Singapore Public Works Department: figures

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The publications of the Institution of Civil Engineers and Thomas Telford Publications Ltd have been invaluable sources of technical data, and I am very much indebted to the authors and publishers respectively. My discussions with civil engineers in widely dispersed locations have proved most enlightening.

As with previous publications, I would like to express my sincere thanks to Malcolm Stewart of Macmillan Education for his continual help and advice and to my wife for her background assistance and understanding.

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