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Deep impact: why post-tsunami wells need a measured approach

L. Lytton

Proceedings of the Institution of Civil Engineers, Civil Engineering, **161**, No. 1, February, 42–48, doi: 10.1680/cien.2008.161.1.42

Following the Asian tsunami of 26 December 2004, the vital domestic fresh-water wells in the coastal zone were either scoured out of the ground entirely or filled with salt water, mud, debris and bodies. Emergency teams naturally exerted huge efforts in trying to restore intact wells, first clearing and then pumping them out. However, it soon became apparent little could be done to rehabilitate the wells in the short term due to the massive intrusion of saline groundwater as well as the fundamentally unsatisfactory nature of local water supply and drainage arrangements. Based on a study carried out on 64 wells in the Ampara district a month after the event, this paper identifies the long-standing issues that need to be solved before a reliable water supply can be established in the coastal zone.

Tsunami wave loading on coastal houses: a model approach

N. I. Thusyanthan and S. P. Gopal

Proceedings of the Institution of Civil Engineers, Civil Engineering, **161**, No. 2, May, 77–86, doi: 10.1680/cien.2008.161.2.77

The Asian tsunami of 26 December 2004 killed over 220 000 people and devastated coastal structures, including many thousands of traditional brick-built homes. This paper presents the results of model tests that compare the impact of a tsunami wave on a typical coastal house with that on a new 'tsunami resistant' design developed in the USA and now built in Sri Lanka. Digital images recorded during the test reveal how the tsunami wave passed through the new house design without damaging it, but severely damaged the typical coastal house. Pressure sensor results also provided further insight into tsunami wave loading, indicating that the established Japanese method significantly underestimates maximum impact load.

Reconnaissance of levee failures after hurricane Katrina

P. Nicholson and F. Silva-Tulla

Proceedings of the Institution of Civil Engineers, Civil Engineering, **161**, No. 3, August, 124–131, doi: 10.1680/cien.2008.161.3.124

A volunteer team of engineers from the American Society of Civil Engineers visited New Orleans shortly after the catastrophic flooding caused by hurricane Katrina on 29 August 2005. Their mission was to make an independent initial assessment of the failed, US Army-engineered levees and floodwalls, as well as to collect perishable data to help provide answers to one of the worst civil engineering disasters in history. This paper reports on their observations and shows that they compared favourably with the findings of later in-depth investigations, to which the team also contributed valuable forensic data. It highlights the vital role engineering institutions can play in helping both the profession and society understand and learn from disasters.

Wendover arm canal – an early hydraulic use of asphalt

T. Peters and S. Brown

Proceedings of the Institution of Civil Engineers, Civil Engineering, **161**, No. 4, November, 184–191, doi: 10.1680/cien.2008.161.4.184

Recent restoration of the 1797 Wendover arm of the Grand Union Canal in England has revealed one of the earliest uses of asphalt as a waterproofing liner. Following excessive leakage, a length of 4.4 km of the arm was lined in 1857 with coal tar asphalt as an economic alternative to repuddling with clay. However, within 13 years the canal was leaking as before and eventually closed in 1904. As this paper reports, the failure appears to have resulted from use of an excessively rich lining mixture and poor construction practice plus damage from boats, ice breaking and earth movements. It was nevertheless a novel, if ultimately unsuccessful, approach to repairing a seriously leaking canal economically and constituted a significant step in the use of asphalt for hydraulic engineering.

Offshore wind energy—a challenge for UK civil engineering

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Proceedings of the Institution of Civil Engineers, Energy, **161**, No. 1, February, 3–6, doi: 10.1680/ener.2008.161.1.3

This article aims to provide a brief review of the current position

of UK offshore wind energy development, particularly for those who are interested, but not deeply immersed, in the current scene. It is written from the perspective of a civil and structural engineer who has been engaged for some years in the development of a new approach to offshore foundation construction and is concerned that there should be a more visible involvement of the profession in the future development of large-scale offshore and marine renewable energy systems.

The known unknowns of hydraulic engineering

H. Chanson

Proceedings of the Institution of Civil Engineers, Engineering and Computational Mechanics, **161**, No. 2, March, 17–25, doi: 10.1680/eacm.2008.161.1.17

Hydraulic engineers and researchers deal with the scientific challenges presented by turbulent flow and its interactions with the surroundings. Turbulent flows are characterised by unpredictable behaviour, and, as yet, little systematic research has been conducted in natural systems. This paper discusses the implications of recent developments in affordable instrumentation, which was previously characterised by intrinsic weaknesses that adversely affected the quality of the signal outputs. A challenging application is the unsteady turbulence field in tidal bores. The interactions between open channel flows and movable boundaries and the atmosphere illustrate another aspect of our limited knowledge. Rapid siltation of reservoirs and air entrainment in turbulent free-surface flows are discussed. In both applications, hydraulic engineers require some broad-based expertise. In turn, the education of future hydraulic engineers is of vital importance.

Modelling enteric bacteria level in coastal and estuarine waters

L. Yang, B. Lin and R. A. Falconer

Proceedings of the Institution of Civil Engineers, Engineering and Computational Mechanics, **161**, No. 4, December, 179–186, doi: 10.1680/eacm.2008.161.4.179

Details are given in this paper of the development of a numerical model for describing the bacterial transport processes in estuarine and coastal waters. The transport of enteric bacteria is influenced by many physical, chemical and biological factors, including both the suspended and bed sediments. In recent years, an increasing number of studies have shown that generally the sediments contain much higher bacterial population levels than previously assumed. The aim of this study has been to develop a numerical modelling tool for predicting the sediment-linked bacterial concentration levels in coastal and estuarine waters. This paper outlines the theoretical background of an enteric bacterial water quality numerical model. A conceptual model has been established for representing the transport of bacteria due to sediment movement, including deposition and suspension. Details are given of the solute and mass transport equations used to simulate the flow and transport of suspended sediments and enteric bacterial indicators. The enteric bacteria transport equation includes enhanced source and sink terms to represent bacterial kinetic transformation and disappearance or reappearance due to sediment deposition or

resuspension. The model has been applied to the turbid water environment in the Bristol Channel and Severn estuary, UK, with initial results from the modelling study being presented.

Electrochemical stabilisation for offshore model caissons

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Proceedings of the Institution of Civil Engineers, Ground Improvement, **161**, No. 3, August, 131–141, doi: 10.1680/grim.2008.161.2.131

A laboratory-floor experimental study was conducted on the electrochemical treatment of calcareous sand for offshore foundations. A steel tube of diameter 200 mm and length 400 mm was used as a model caisson. Calcareous sand and seawater from the coastline of Western Australia were used in the study. Twelve electrodes made of perforated steel pipes, diameter 14 mm, length 450 mm and filled with soluble CaCl_2 granules as a cementing agent, were installed around the caisson. The electrochemical treatment tests were carried out with two electrode layout configurations in parallel with a control test. The electric power was applied via pairs of the steel pipe electrodes in the first configuration whereas the caisson served as one electrode in the second configuration. The applied direct current (d.c.) voltage was 8 V for the first configuration and 6 V for the second. The pullout resistance of the caisson after the treatment was increased by 140% to reach a value of 304%, in comparison with the control. The cementation generated by the treatment was demonstrated by the formation of a soil plug inside the caisson, soil cemented to the surface of the electrodes and caisson, and the significant increases in pullout resistances. The cementation effects were confirmed by electron microscopy images, X-ray fluorescence analyses and X-ray diffraction analyses.

Legislative frameworks for port concessions in Greece

P. Patsiadas and D. C. Angelides

Proceedings of the Institution of Civil Engineers, Management, Procurement and Law, **161**, No. 4, November, 157–162, doi: 10.1680/mpal.2008.161.4.157

In Greece the legislative framework for concession contracts is mainly governed by recently enacted Law 3389/2005 related to public-private partnerships (PPPs). This paper first sets out the key provisions of the new law, which is basically divided into three main sections: (a) terms, field of application and central support mechanism; (b) award process; (c) contractual framework, financing and tax details. The paper then considers the particular situation of concession contracts involving Greek authorities. Recently, the Greek state started the simultaneous transformation of the twelve main port authorities from public to private entities (*sociétés anonymes*). Two of these entities (Piraeus and Thessaloniki) signed concession contracts with the state, according to which the usage and exploitation of existing and future infrastructure is accorded – in return for a fee – to the port authorities. Finally, other structures of financial cooperation in the port sector are also proposed, such as the creation of joint-venture partnerships.

Determining water surface elevation in tidal rivers by ANN

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Proceedings of the Institution of Civil Engineers, Water Management, **161**, No. 2, April, 83–88, doi: 10.1680/wama.2008.161.2.83

Fluvial flows and tidal flows are governing on tidal rivers while fluvial flows are governing on non-tidal rivers alone. In addition to analytical and numerical models, stochastic methods must be considered to determine water surface elevation at the tidal limit of tidal rivers because hydraulic routing of this reach is very complex. In the present research, the neural network method was considered for determination of water surface elevation at the tidal limit of tidal rivers. The artificial neural network (ANN) method was trained using results from a suitable numerical model. The results of the ANN method were compared with results for the governing regression relation for water surface elevation at the tidal limit of tidal rivers. The ANN method was applied to the Karun river in Iran and the River Severn in the UK. The ANN method was found to produce water surface elevations for different combined return periods in the Karun river and the River Severn.

Critical flow over spillway profiles

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Proceedings of the Institution of Civil Engineers, Water Management, **161**, No. 2, April, 89–95, doi: 10.1680/wama.2008.161.2.89

One of the oldest problems of critical flow in open-channel hydraulics is rise in the channel bottom, which causes a critical flow at the weir crest. Although the classic hydraulic theory for parallel flow shows the usefulness of critical flow leading to unique head–discharge relations over the weir, in practice the parallel flow condition is unreal; theoretical analysis of round-crested weirs is thus restricted to teaching purposes or is used as a rough indication of flow characteristics before using more complete methods. The spillway problem has been treated previously with more laborious methods, either using two-dimensional (2D) hydrodynamic flow nets or accurate physical model experiments. A new extended Bernoulli energy equation, which is valid for moderately curved channel flows, is presented. From this equation, a higher-order critical flow condition suitable for a curved streamline flow has been developed. As a practical application, the flow over spillway profiles used in dam engineering has been studied. The proposed new critical flow theory makes it possible to simulate flow features with a reasonable agreement up to design conditions of the spillway, thus obtaining accurate results in situations in which the velocity is non-uniform, the pressure is non-hydrostatic and conventional critical flow theory is not valid.

Effect of the Froude number on assessment of the bridge afflux

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Proceedings of the Institution of Civil Engineers, Water Management, **161**, No. 2, April, 97–104, doi: 10.1680/wama.2008.161.2.97

This paper presents the findings of laboratory model testing of arch and straight-deck bridge constrictions, in a symmetrical compound channel flume having different roughness conditions. Four different types of bridge models, namely a single-opening, semicircular arch bridge, a multiple-opening, semicircular arch bridge, a single opening, elliptic arch bridge, and a straight-deck bridge with and without piers, were used in the testing programme. The validity of the Biery and Delleur method developed for the single cross-sectional-shaped arch bridge constrictions was examined for a compound channel case. The effect of different definitions of the Froude number on the application of the Biery and Delleur method was also investigated. The results showed that the Biery and Delleur method agreed reasonably well with the University of Birmingham data presented in the current study, provided that the Froude number was defined in the same way as originally envisaged. Significant errors may result, however, from using this method with definitions of the Froude number that are more appropriate to compound channels.

Cardiff Bay barrage: management of groundwater issues

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Proceedings of the Institution of Civil Engineers, Water Management, **161**, No. 6, December, 313–321, doi: 10.1680/wama.2008.161.6.313

The Cardiff Bay barrage, a 1·1 km long structure across the mouth of Cardiff Bay impounding a 200 ha freshwater lake, was central to the UK government's urban development programme to regenerate the docklands area of Cardiff. The Cardiff Bay Barrage Act 1993 included a groundwater protection scheme for buildings, providing owner/occupiers with recourse to remedial works or compensation should circumstances prove that construction of the barrage caused or probably caused groundwater damage. To allow a comparison of pre- and post-impoundment groundwater levels underlying south Cardiff, a groundwater monitoring system comprising 236 automated data loggers covering an urban area of 15km² was established between 1995 and 1999. To mitigate the possibility of a rise in groundwater levels in certain identified areas, various types of groundwater control systems were installed prior to impoundment in November 1999. Management (including collection and interpretation of data) and maintenance of such an extensive system have required great effort, resourcefulness and logistics. This paper presents a brief history of the scheme and an overview of the management of such a diverse and challenging groundwater project.