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Heathrow Terminal 5: energy centre

G. Adams

Proceedings of the Institution of Civil Engineers, Civil Engineering, **161**, Special issue – Heathrow Terminal 5, May, 60–64, doi: 10.1680/cien.2008.161.5.60

Heating and cooling the vast new terminal buildings at London Heathrow airport's £4.3 billion Terminal 5 development is undertaken by a dedicated energy centre, which provides continuous supplies of hot and chilled water for heating and air-conditioning respectively. The hot water is provided by a combination of a local combined-heat-and-power source and natural gas boilers, which can also run on fuel oil, and the chillers are powered by high-voltage electricity. This paper describes the design and construction of the highly efficient centre, which also made extensive use of off-site testing and manufacturing.

Thermal cycling of wheat straw ash concrete

N. M. Al-Akhras, K. M. Al-Akhras and M. F. Attom

Proceedings of the Institution of Civil Engineers, Construction Materials, **161**, No. 1, February, 9–15, doi: 10.1680/coma.2008.161.1.9

This study investigated the effect of wheat straw ash (WSA) on the performance of concrete in response to thermal cycling, which was evaluated by measuring the compressive strength and electrical resistivity and by visual inspection of cracks in the concrete specimens. Three levels of WSA replacement – 5, 10 and 15% by weight of sand – were utilised. The other experimental parameters investigated in the study were: aggregate type (volcanic tuff and crushed basalt), water-to-cement ratio (w/c; 0.5 and 0.7) and air entrainment (non-air-entrained and air-entrained). After an initial moist curing period of 90 days, the concrete specimens were subjected to thermal cycling over the range 30–150°C for a period of 24 h using an electric furnace. The results of the study showed that thermal cycling of WSA concrete induced many cracks that were dispersed over the surface of the specimens. The WSA concrete was found to be more resistant to the effects of thermal cycling in comparison with plain concrete and

furthermore, the performance of WSA concrete in response to thermal cycling improved with increasing WSA content. WSA concrete containing tuff aggregate showed more resistance to thermal cycling than that containing basalt aggregate. In response to thermal cycling the WSA concrete at a w/c ratio of 0.5 was observed to show better performance in comparison with WSA concrete at a w/c ratio of 0.7. The air-entrained WSA concrete showed a greater improvement in response to thermal cycling in comparison with non-air-entrained WSA concrete.

IHA sustainability guidelines and assessment protocol

P. Karki

Proceedings of the Institution of Civil Engineers, Engineering Sustainability, **161**, No. 1, March, 3–5, doi: 10.1680/ensu.2008.161.1.3

This article discusses the development of the International Hydropower Association's (IHA) sustainability guidelines and assessment protocol for the hydropower industry as a tool for advancing sustainable hydropower.

A comparative analysis of two building rating systems.

Part 1: Evaluation

R. A. Fenner and T. Ryce

Proceedings of the Institution of Civil Engineers, Engineering Sustainability, **161**, No. 1, March, 55–63, doi: 10.1680/ensu.2008.161.1.55

Buildings are responsible for a significant proportion of world energy usage, raw material consumption, fresh water withdrawals, carbon dioxide (CO₂) emissions and municipal waste production. In recognition of these problems, buildings are increasingly being procured through green design principles, and a number of tools have been developed to evaluate their environmental performance. This paper compares the two most widely adopted schemes – the UK Building Research Establishment Environmental Assessment Method (Breeam) and the international Leadership in Energy and Environmental Design (Leed), as implemented by the Canada Green Building Council. The nature and limitations of these kinds of building rating systems are discussed and their performance is analysed by considering the way credits are allocated, their ability to be customised, the complexity involved in the assessment process and the accessibility of the information they generate. The paper indicates some limitations in current practice. Emerging trends that will shape the development of future building rating systems are discussed.

A comparative analysis of two building rating systems.

Part 2: Case study

R. A. Fenner and T. Ryce

Proceedings of the Institution of Civil Engineers, Engineering Sustainability, **161**, No. 1, March, 65–70, doi: 10.1680/ensu.2008.161.1.65

The results of an assessment of a building incorporating a number of sustainability features using two different building rating systems (the UK Building Research Establishment Environmental Assessment Method (Breeam) and the international Leadership in Energy and Environmental Development (Leed), as developed by the Canada Green Building Council) are described. The building scored well under both systems, although the credits achieved were more equally distributed in the Leed Canada assessment than under Breeam. A number of differences between the schemes are highlighted; the categories achieving the highest percentage credits under both tools were water, energy and occupant health. The paper concludes that, while the two schemes may differ in name, applications style and ranking mechanisms, the tools are more similar than dissimilar and provide broadly comparable assessments.

Sustainable groundwater-source cooling systems

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Proceedings of the Institution of Civil Engineers, Engineering Sustainability, **161**, No. 2, June, 123–133, doi: 10.1680/ensu.2008.161.2.123

Groundwater, abstracted from aquifers beneath buildings, can be used as a heat-rejection medium as part of a building cooling system. Such systems have the potential to reduce carbon emissions and provide cost savings, relative to traditional cooling systems that reject heat to air. Three principal configurations of groundwater-source cooling system are used: open-loop systems where the groundwater is discharged to sewer or surface watercourse; open-loop systems where the water is re-injected back into the aquifer; and standing-column boreholes. To date there have been relatively few large-scale applications of groundwater-source cooling systems in the UK. Clear definitions of sustainability targets for such systems do not exist. The current paper identifies characteristics of sustainable groundwater-source cooling systems. A series of tests to determine whether a groundwater-source cooling system can be considered 'sustainable' are identified.

Erosion of sediments beneath an oscillating cylinder

R. Narayanan and A. Aminzadeh

Proceedings of the Institution of Civil Engineers, Maritime Engineering, **161**, No. 1, March, 33–42, doi: 10.1680/maen.2008.161.1.33

The depth of erosion of cohesionless sediments underneath horizontal circular cylinders that are oscillated periodically in still water was of primary interest in this study. In this investigation anthracite was used for the sediments. First the formation of vortex ripples was studied by oscillating a box containing anthracite on its own in still water without the cylinder. The geometrical characteristics of the ripples obtained compared well with those of other investigations. In the experimental range studied, the low density of sediments had no explicit influence on the features of the vortex ripples. The box filled with anthracite and the cylinder were oscillated together

to perform periodic motion and the depth of erosion beneath the cylinder was measured. For the diameters of cylinder tested, the height of the vortex ripples formed on both sides of the cylinder was comparable with the depth of scour underneath the cylinder. The experimental results are categorised as clear water scour and live bed scour. For both cases, the relative scour depth was weakly dependent on the Shields parameter for Keulegan–Carpenter numbers less than about 30. For Keulegan–Carpenter numbers greater than about 30, it increased with the increasing value of the Shields parameter.

Numerical study of scour around a pipeline bundle

D. Liang and L. Cheng

Proceedings of the Institution of Civil Engineers, Maritime Engineering, **161**, No. 2, June, 89–95, doi: 10.1680/maen.2008.161.2.89

A well-established two-dimensional numerical model was employed to study the scour-hole development around a pipeline bundle, which was composed of a main pipeline and a piggyback pipeline. Both the current and wave flow situations were simulated with parameters chosen to represent prototype pipeline scour in adverse weather conditions. Under the same hydraulic and soil conditions, the scour around the main pipeline alone and around an equivalent pipeline was also simulated, and these served as reference cases for studying the scour around pipeline bundles. The focus of this paper is the equilibrium scour depth and the development rate. It was found that the pipeline bundle produced a deeper scour depth with a larger time-scale in comparison with the scour occurring for the single-pipeline case; thus the equivalent-pipeline representation may lead to an unsafe design. The differences between the pipeline bundle and single pipeline scour were larger under the current alone flow condition than those under the wave condition. These differences in the scour development can be explained by examining the flow fields around the pipeline.

Energy balance framework for appraising road projects

J. B. Odoki and R. Akena

Proceedings of the Institution of Civil Engineers, Transport, **161**, No. 1, March, 23–35, doi: 10.1680/tran.2008.161.1.23

The appraisal of road transport projects is primarily based on the assessment of economic benefits, which are estimated by comparing the total discounted costs calculated for a base case against that for the project case. This is essentially an economic balance analysis. A similar analytical framework is proposed for comparing the total energy used by different modes of road transport for the base case and project case. The proposed energy balance framework has been implemented in the new Highway Development and Management (HDM-4) model. This can be used to calculate total energy consumption at project and network level analyses of road investment policies and strategies, differences in the consumption of renewable and non-renewable fuels by non-motorised and motorised road transport modes, energy use during road-works, and the total national energy consumption in the road sector. This permits comparisons to be made between different modes of road transport and thereby influence policy on long-term investments in the road sector. The application of the energy balance framework is demonstrated using case studies featuring typical examples of road investment schemes.

Novel passive treatment for mine water discharges

S. P. Burke and S. A. Banwart

Proceedings of the Institution of Civil Engineers, Water Management, **161**, No. 6, December, 367–374, doi: 10.1680/wama.2008.161.6.367

This paper describes the research and development of a novel passive treatment system to remove iron and acidity from water discharging from coal mines. The system aims to remove Fe(aq) at the point of discharge, rather than allowing the dissolved iron load to impact the ecology of receiving streams. Field-test

results show that the surface-catalysed oxidation of iron occurs and is best suited to alkaline mine water discharges with the influent pH, alkalinity and the Fe(II)aq concentration having a strong influence on the performance of this technology. The results also demonstrate the suitability of a model developed to assist in understanding the processes that have occurred in the reactor. The data presented show that by using this reactor system, some dissolved iron may also be removed at acidic discharges and demonstrate the importance of the microbially mediated oxidation of Fe(II)aq as expected at low pH.

