Engineering History and Heritage
Volume 166 Issue EH2
Items of interest from *ICE Proceedings*

Proceedings of the Institution of Civil Engineers
Engineering History and Heritage 166 May 2013 Issue EH2
Pages 119–124 http://dx.doi.org/10.1680/ehah.2013.166.2.119

ice | **proceedings**

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Institution of Civil Engineers
publishing

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History and renovation of existing structures transcend all discipline boundaries and so it is not surprising the many papers of interest to our readers find their way into other specialist titles of the *ICE Proceedings*. We present here the first of what will be an annual review of the papers of historical interest that have been published during the past year in other volumes of the *ICE Proceedings*.

Adamson D and Francis A (2012) Stabilisation of Combe Down stone mines, Somerset, UK. *Proceedings of the Institution of Civil Engineers – Civil Engineering* **165(3)**: 129–137, http://dx.doi.org/10.1680/cien.11.00069

Two centuries of mining Bath limestone in Somerset, UK left a huge underground void just beneath the village of Combe Down. As its thousands of rock pillars degenerated, a growing collapse risk led to one of the country's largest local government civil engineering projects of the past decade. This paper explains how Bath and North East Somerset Council worked closely with the local community to develop a solution which involved carefully pumping over 600 000 m^3 of foamed concrete into the mine with minimal social and environmental impact. The project also set several new good-practice benchmarks for public-sector construction.

Ahmed N and Rafeeqi SFA (2012) Infusing life: restoration of Nadirshaw Edulji Dinshaw city campus in Karachi. *Proceedings of the Institution of Civil Engineers – Municipal Engineering* **165(2)**: 115–119, http://dx.doi.org/10.1680/muen.9.00041

This paper examines the restoration of the city campus of Nadirshaw Edulji Dinshaw (NED) University of Engineering and Technology. It outlines a case for using this example as a framework for similar projects in the city and relevant locations elsewhere. The NED was founded in 1922 as Prince of Wales Engineering College to facilitate the education and training of local engineering graduates and is one of the oldest institutions in the Indo Pak subcontinent. It was built in Karachi city centre but, following a relocation to a new campus, its usage declined. Late in the 1990s, a re-utilisation of the old campus began. A restoration plan was prepared and implemented under the guidance and supervision of architects from the faculty. NED alumni (who have nostalgic association with the campus) showed keen interest in the restoration. Impediments experienced are described, along with the way in which they were overcome.

André J, Beale R and Baptista AM (2012) A survey of failures of bridge falsework systems since 1970. *Proceedings of the Institution of Civil Engineers – Forensic Engineering* **165(4)**: 161–172, http://dx.doi.org/10.1680/feng.12.00012

Bridge falsework systems are frequently used during the construction, rehabilitation and retrofit works of bridge structures. These structures have a significant impact on the cost, construction rate and construction safety of the supported permanent structures. However, the relevant stakeholders often do not consider them to be as important as permanent structures, and in recent years a high number of accidents involving bridge falsework systems have been reported, particularly in the developing world. In order to increase the safety and the efficiency of these systems it is certainly beneficial to learn from past failures. In this paper, a survey of the failures of bridge falsework systems since 1970 is presented. The data will provide useful statistics for risk assessments when considering the potential consequences associated with failures of bridge falsework systems.

Beasley KJ (2012) Building facade failures. *Proceedings of the Institution of Civil Engineers – Forensic Engineering* **165(1)**: 13–19, http://dx.doi.org/10.1680/feng.2012.165.1.13

Building facades serve mainly to protect occupants and contents from the elements. Failure of the building envelope (i.e. walls, roof and windows) to function as intended usually has a significant impact on the serviceability of the building. Roofs and windows periodically fail and are replaced; however, the building facade is expected to endure the forces of nature for the service life of the building. The increasing complexity of modern buildings, combined with decreasing tolerance for undesirable performance of building systems, has resulted in an ever increasing frequency of building facade failures. This paper addresses common serviceability and performance problems associated with various types of building facades. Methods and tools useful for investigation of facade failures are discussed. The paper is not intended to be a comprehensive guide for the forensic investigator, but is offered as an aid to help recognise symptoms and evaluate conditions that underlie common building facade failures. The types of building facades and investigation methods discussed in this paper are primarily based on the author's experience within the USA.

Bennett-Hughes P (2012) Book review: Natural Stone Resources for Historical Monuments: Geological Society Special Publication 333. *Proceedings of the Institution of Civil Engineers – Construction Materials* **165(3)**: 197, http://dx.doi.org/10.1680/coma.11.00038

Blanchard I (2012) The use of natural stone for internal flooring. *Proceedings of the Institution of Civil Engineers – Construction Materials* **165(3)**: 177–187, http://dx.doi.org/10.1680/coma.10.00015

This paper describes the theoretical and technical aspects of using natural stone as a surfacing material for internal flooring, based on relevant recent British and European standard and other literature guidance. The rationale for selecting a specific stone type is discussed, including the appropriateness of some types for specific applications. Additionally, a comparison is given between the geological and commercial definitions of several well-known stone types, which can provide misleading reassurance to end users as to the likely performance of a stone. Various case studies are included based on commercial experience of investigations of floor defects and failures, highlighting diverse issues including movement joint distribution, inappropriate bedding of the stone tiles on mortar dabs, early overloading of installed floors and slip resistance problems relating to surface contamination and to in-service abrasion leading to polishing of the floor. In addition, the resistance to staining and discoloration of floors in service is discussed.

Borthwick AGL (2011) Foreword: Dr Robert Hooke and the origins of engineering science. *Proceedings of the Institution of Civil Engineers – Engineering and Computational Mechanics* **164(4)**: 187, http://dx.doi.org/10.1680/eacm.8.00060F

Callaway P, Gilbert M and Smith CC (2012) Influence of backfill on the capacity of masonry arch bridges. *Proceedings of the Institution of Civil*

Engineers – Bridge Engineering **165(3)**: 147–158, http://dx.doi.org/10.1680/bren.11.00038

The influence of the presence of backfill on the load-carrying capacity of a masonry arch bridge can be considerable. The backfill is responsible for transmitting and distributing live loads from the road or rail surface through to the arch barrel and also for laterally stabilising the arch barrel as it sways under load. However, it can be difficult to separate these two distinct effects, and hence also difficult to ascertain whether existing assessment code recommendations are realistic. To address this, a series of experiments designed to separate these two effects have been performed. A total of 27 small-scale bridge tests were undertaken and the experimentally obtained peak loads then compared with results from limit analysis software of varying complexity. It was confirmed that passive restraint and live load distribution both contribute significantly to bridge-carrying capacity, and that, when failure involves a four-hinge failure mechanism, even comparatively simple limit analysis software can model the various effects remarkably well.

Camposinhos RS (2012) Dimension stone design – partial safety factors: a reliability based approach. *Proceedings of the Institution of Civil Engineers – Construction Materials* **165(3)**: 145–159, http://dx.doi.org/10.1680/coma.10.00018

Today's thin stone veneers must be designed to resist, besides their self-weight, high wind pressures and induced seismic forces. They must accommodate hygrometric differential movement, deflection, vibration and creep, etc. When available, code requirements do not provide an accurate or realistic safety factor for the specific type of anchor and or stone used in a project. Global safety factors that are recommended by stone industry associations are imprecise and used as rules of thumb. Limit state design has replaced the older concept of allowable stress design in most forms of civil engineering. As a result, all modern buildings are designed in accordance with a code which is based on limit state theory for all man-made materials, yet there is an astonishing nonexistence of 'natural stone'. In this paper partial factors of safety are proposed depending on the types and on the coefficients of variation of the distributions of resistances. Their values are determined using structural reliability analysis for the load and resistance factor design format according to Eurocode 1990. Aging and stone resistance decay is outside the scope of the article, yet some guidance is provided on the influence of stone durability on stone cladding performance. An application example is used to illustrate both methods, and conclusions are drawn.

Camposinhos RS and Camposinhos RPA (2012) Dimension stone design – kerf anchorage in limestone and marble. *Proceedings of the Institution of Civil Engineers – Construction Materials* **165(3)**: 161–175, http://dx.doi.org/10.1680/coma.11.00061

This paper describes a study on kerf anchorage behaviour in three types of stones. Two limestone and various marble specimens were submitted to a series of tests – namely standard absorption, bulk specific gravity and flexural strength tests – to determine their physical and mechanical properties. The paper focuses on the results of tests carried out according to the ASTM *Standard Test Method for Strength of Individual Stone Anchorages in Dimension Stone*. These tests were performed on a stiff rail continuous anchorage system on both the front and rear kerf legs. Stress analysis and finite element method calculations were the basis for the proposed semi-empirical formula to estimate this anchorage system's breaking load under the above-mentioned conditions. Through a general but practical example, it is shown that a design focused on the bending strength of stone panels, to the detriment of the kerf anchorage, is an unsafe and yet common practice. The paper emphasises that designing stone cladding systems with continuous kerf must take into account different effects in order to evaluate the effective stress in the critical region of the kerf geometry. Separate stress concentration factors are proposed to account for the kerf geometry and the specimens' specific properties.

Chapman A (2011) Dr Robert Hooke and the origins of engineering science. *Proceedings of the Institution of Civil Engineers – Engineering and Computational Mechanics* **164(4)**: 189–205, http://dx.doi.org/10.1680/eacm.8.00060

When John Aubrey described Hooke as the 'Greatest Mechanick this day in the World', he acknowledged Hooke's genius as an experimentalist. To Hooke, the whole of nature was a great machine or engine in motion, the deepest truths of which could be uncovered by means of ingeniously contrived instruments. In the 1650s, the 'ingeniosi' of the future Royal Society were beginning to revolutionise our sense of 'natural knowledge' and coming to envisage ways of applying it to 'the Relief of Man's Estate'. This paper describes Hooke's early life, his development of precision instruments such as the microscope, his *Micrographia* and its influence on engineering, his work on motion and elasticity, and his inventions, including the airpump, wheel barometer, hygrometer, spring watch, and various machine tools.

Cole I and Corrigan P (2011) Predicting the service life of buildings and components. *Proceedings of the Institution of Civil Engineers – Construction Materials* **164(6)**: 305–314, http://dx.doi.org/10.1680/coma.2011.164.6.305

The prediction of the service life of buildings and engineered structures is complex. Such predictions are usually carried out on a component-by-component basis, but must incorporate variations in component design, material type, usage and environment. Extensive databases of life prediction are required to cover the vast number of components/environments/usage combinations that exist in buildings or engineered structures. This study investigated the diverse methods used to model the life of components in structures, including data mining of maintenance and service records, expert opinion surveys (Delphi surveys), multiscale process modelling, and sensing. These methods were analysed in terms of the issues identified above and their applicability to meet the differing uses of life prediction data. Detailed case studies are presented and the strengths and weaknesses of the methods are analysed with respect to the final uses of life prediction.

Cooper NJ (2012) From the archives – the building of the Tyne piers. *Proceedings of the Institution of Civil Engineers – Maritime Engineering* **165(4)**: 157–158, http://dx.doi.org/10.1680/maen.2012.11

This article summarises a paper produced in 1958 by Raymond B. Porter, the then Chairman of the Northern Counties Association of the Institution of Civil Engineers. Porter's paper presented detailed information on the building of the Tyne piers. The relevance of key aspects of his paper to contemporary maritime civil engineers is discussed within this paper.

De Lorenzis L, Dimitri R and Ochsendorf J (2012) Structural study of masonry buttresses: the trapezoidal form. *Proceedings of the Institution of Civil Engineers – Structures and Buildings* **165(9)**: 483–498, http://dx.doi.org/10.1680/stbu.10.00042

Despite its vital importance for the safety of masonry vaulted structures, the stability of buttresses has been the subject of a limited number of investigations. The collapse condition of masonry buttresses subjected to concentrated lateral loads has been analysed by previous researchers for the simple case of a rectangular buttress, and it has been shown that the formation of a crack prior to collapse may strongly influence the overturning resistance. Buttresses of more complex shapes, such as trapezoidal or stepped, are frequently encountered in masonry buildings or retaining walls, and yet a rigorous analysis of their failure conditions has not been developed. In this paper and a companion paper, the collapse analysis

accounting for fracturing prior to overturning, as well as for possible sliding, is extended to trapezoidal and stepped geometries. In particular, this paper is devoted to the analysis of trapezoidal buttresses. Analytical formulations are developed for the determination of the fracture shape and location, and for the computation of the horizontal force at collapse. The analytical solution, obtained treating masonry as a continuum with no tension resistance, is compared with predictions obtained numerically with the discrete-element method. The numerical model considers masonry as an assemblage of rigid blocks with no-tension frictional joints, and is based on time-stepping integration of the equations of motion of the individual blocks. The satisfactory agreement between predictions of the two approaches gives confidence in both sets of results.

De Lorenzis L, Dimitri R and Ochsendorf J (2012) Structural study of masonry buttresses: the stepped form. *Proceedings of the Institution of Civil Engineers – Structures and Buildings* **165(9)**: 499–521, http://dx.doi.org/10.1680/stbu.10.00043

The stability of masonry buttresses under horizontal forces is of paramount importance for the safety of vaulted structures, and yet has been the subject of limited studies. In particular, buttresses of non-rectangular geometries such as trapezoidal and stepped buttresses, which are typical of Gothic architecture, have not been sufficiently investigated. This study follows on from a companion paper devoted to masonry with trapezoidal buttresses. Based on similar modelling approaches and assumptions, the present paper aims to predict the failure of stepped buttresses. The analytical solution, obtained by treating masonry as a continuum with no tension resistance and accounting for the formation of a fracture prior to collapse, is compared with the predictions of the discrete element method. The numerical approach considers masonry as an assemblage of rigid blocks with no-tension frictional joints and is based on time-stepping integration of the equations of motion of the individual blocks. The relative efficiency of different buttress shapes for a given total volume is also compared, and an example buttress is used as a benchmark to demonstrate the practical applicability of the proposed models.

Dobson S (2012) Historic landscape characterisation in the urban domain. *Proceedings of the Institution of Civil Engineers – Urban Design and Planning* **165(1)**: 11–19, http://dx.doi.org/10.1680/udap.2012.165.1.11

Landscape characterisation has emerged as an important means for assessing the context and broader setting for decision-making as it facilitates thinking outside of the site boundary. Within the domain of heritage planning, this is congruent with a new appreciation of the cultural landscape as heritage with the current English Heritage programme of historic landscape characterisation emerging as an important tool to support this approach. Although initially providing a predominantly rural emphasis, historic landscape characterisation surveys now provide comprehensive coverage of many urban areas and so potentially offer the urban planner and designer with a key source of map data outlining current urban character and its readable historic time-depth. The summarised findings result from participatory action with Sheffield City Council in exploring potential urban applications of historic landscape characterisation. The emerging themes were drawn from numerous practice scenarios and aim to outline opportunities for incorporating historic landscape characterisation in urban decision-making and design.

Donovan J (2012) Designing to heal; reconstructing communities after disasters. *Proceedings of the Institution of Civil Engineers – Urban Design and Planning* **165(2)**: 69–77, http://dx.doi.org/10.1680/udap.10.00009

Disasters, whether caused by nature or human nature are a major and growing issue. This paper explores the human and physical costs of disasters and suggests how planners and urban designers can help create the optimal conditions for people to put their lives back together and access, as far as possible, the opportunities they need to thrive and fulfil their potential. The paper draws on the author's observations from Kosovo, Sri Lanka and Northern Ireland. It concludes that whilst there is a rich vein of initiatives that directly or indirectly assist in the healing and rebuilding process they are unlikely to succeed without wider social, economic measures and political initiatives.

Dounias GT, Anastasopoulos K and Kountouris A (2012) Long-term behaviour of embankment dams: seven Greek dams. *Proceedings of the Institution of Civil Engineers – Geotechnical Engineering* **165(3)**: 157–177, http://dx.doi.org/10.1680/geng.11.00052

The long-term deformation of embankment dams is one of the key safety issues. Mechanisms affecting the post-construction deformation of embankment dams are briefly described. The long-term deformation of seven large Greek dams is presented by examining the crest deformations. The older dams have attained a nearly constant rate of deformation that is very small. More than 100 years are required in order for the crest settlements to reach the design camber, and in some cases many hundreds of years. The crest deformations differ for each dam, but some patterns are identified for similar dams. Factors that influence the deformations include the materials of construction, the core location, the valley geometry and the reservoir fluctuations. Of particular interest are the horizontal crest deflections for dams with central cores, where movements towards upstream are occasionally observed.

Ellis B and Ellis BJJ (2012) New concrete arch bridge at Victoria Avenue, Lincoln, Canada. *Proceedings of the Institution of Civil Engineers – Bridge Engineering* **165(3)**: 195–197, http://dx.doi.org/10.1680/bren.11.00048

The replacement of the Victoria Avenue Bridge in the town of Lincoln, Ontario, Canada was a unique civil engineering project. The cast-in-place construction design was a more costly, but more appropriate and efficient method of replacement for this structure. The alternative pre-cast box units would mar the historical and aesthetic significance of the location in scenic Vineland, Ontario. The design combined elements of new technology while retaining some physical elements of the old bridge. Glass fibre reinforced polymer reinforcing bars and a concrete form liner were used to compliment the reinstated parapet wall features. This project is relevant to civil engineering practice as an example of successfully melding old and new in bridge design. These contrasting characteristics have been blended well with the use of concrete colourisation and finishing techniques. The visual appeal and character created with the reinstated balustrades and end posts have added beauty to a structure engineered for a long lifespan using new reinforcing techniques.

Fenna A (2012) Briefing: Impacts of Victorian engineering on a modern flood risk study. *Proceedings of the Institution of Civil Engineers – Engineering and Computational Mechanics* **165(2)**: 83–87, http://dx.doi.org/10.1680/eacm.10.00035

A strategic flood risk management (SFRM) study was undertaken for the heavily urbanised reaches of the River Medlock through Manchester, UK. Many of the buildings and structures on this reach date back to the Victorian era and the industrial revolution, when rapid growth of cities often focused on areas around sources of water for industrial and transportation needs. Key structures on the modelled reach include the Medlock Cloughs, a group of structures designed by Victorian engineers to actively manage water levels in the Bridgewater Canal and the Medlock. Further downstream at Potato Wharf, Giants Basin allows overflow from the canal to spill back into the river. A one-dimensional hydrodynamic model to represent the study reaches was built. Hydraulic modelling of the Medlock Cloughs and Giants Basin proved challenging for several reasons. It was not possible to verify existing survey data or to obtain new survey data because of health and safety issues. The study team was also unable to establish maintenance

procedures on the structures or determine whether they now operate as intended by the Victorian engineers who built them. These obstacles were overcome by using old survey drawings, historic data and photographs in modelling the structure. The Medlock Cloughs component of the model proved crucial to obtaining accurate level and flow results for the modelled reaches, as the split in flows between the canal and river controlled the water levels upstream. The lessons learnt from this study may have application in assessing flood risk in other similar situations, and included the requirement for credible, accurate data for structures, and the importance of accurately representing, in a computational model, old structures that are no longer operating as intended.

Foglar M and Kristek V (2012) Centre-line optimisation of buried arch bridges. *Proceedings of the Institution of Civil Engineers – Bridge Engineering* **165(3)**: 159–168, http://dx.doi.org/10.1680/bren.11.00030

The arch is the oldest structural shape that mankind has invented. The Romans constructed a large number of stone arch bridges on roads or water supply routes (aqueducts), many of which have survived to the present day. Arch bridges were constructed throughout medieval times; some of them represent masterpieces of the world's cultural heritage. Buried concrete arch bridges are built with spans from 2 m up to 40 m on roads and railways, both as underbridges or overbridges, and as pre-cast and cast-in-place structures. Owing to low construction costs, great durability and endurance, they are favoured by contractors and owners. This paper focuses on the structure–soil interaction of buried arch bridges both in operation and under construction. Based on analytical derivation, a method of centre-line optimisation of cast-in-place buried concrete arch bridges is proposed and applied on an existing structure. The method leads to reduction of bending moments and deflections, thus making the structural system more effective. The impact of the construction phases on the distribution of internal forces is studied. Based on the acquired knowledge, modifications of the construction process are proposed and evaluated.

Gibbons N and Fanning PJ (2012) Rationalising assessment approaches for masonry arch bridges. *Proceedings of the Institution of Civil Engineers – Bridge Engineering* **165(3)**: 169–184, http://dx.doi.org/10.1680/bren.11.00023

Masonry arch bridges, most of which have far exceeded modern design lives, have demonstrated themselves to be sustainable structures with low life-cycle costs. However, increased traffic loading and material deterioration over time necessitate periodic reassessment of these structures. There are numerous different analytical methods available for the assessment of masonry arch bridges. The expectation is that for increasing levels of assessment complexity an increase in load capacity converging on the ultimate capacity would be achieved. In this paper it is demonstrated that this is not always the case. This has cost implications for both the bridge assessment itself and for costs associated with load restrictions and strengthening measures. Five different assessment methods were selected to assess a set of 11 single-span bridges, ranging in span from 2·4 m to 15·2 m, with the objective of reviewing and rationalising current assessment guidelines for masonry arch bridges. The bridges chosen are a representative sample of the stone arch bridges on the Irish National Roads network. It was found that there is a significant variation in assessed capacity depending on the assessment method used. Limit state analysis methods were found to generally result in higher ratings for segmental bridges while elastic methods resulted in higher ratings for three-centred or semi-circular bridges. Assessment ratings found using the Military Engineering Experimental Establishment (MEXE) method were difficult to rationalise across the bridge set considered in this study. Following a review of the origins of the MEXE method and its current form as set out in the assessment guidance, it is recommended that its use as the predominant tool in a simplified assessment procedure is not appropriate and that a more rational approach is required for a more realistic and reliable calculation of bridge capacity. The development of an improved assessment methodology is being considered as part of the current study.

Hieatt M, Shah SRA, Khan RA *et al.* (2012) Some geotechnical aspects of raising the Mangla dam, Pakistan. *Proceedings of the Institution of Civil Engineers – Geotechnical Engineering* **165(3)**: 127–141, http://dx.doi.org/10.1680/geng.11.00041

The Mangla dam project in Pakistan was the largest embankment dam project in the world when it was completed in 1967. The 260 km^2 reservoir is formed by four major dams, each with a different cross-section, and each a significant structure. The original designs included provision for raising the dams by up to 12 m to offset the effects of future sedimentation. In 2000, capacity lost due to sedimentation became a significant issue. The government of Pakistan decided to exploit the raising provisions of the original design, and store flood water that was routinely being released. Following studies to confirm the most economic extent of raising, the original designs were reviewed and modified. Since the 1960s there have been advances in geotechnical and seismic engineering, changes in design parameters and information from 40 years' performance of the dams, all of which had to be taken into account in revisiting the designs for the raising. As a result, the dam cross-sections for the raised embankments have been adjusted using updated parameters, and the opportunity has been taken to address some areas of seepage that have been under observation since the original construction. Construction for a 9 m raise began in 2004 and was completed in December 2009. The total length of dam embankment after raising is 14 km, with a maximum height of 148 m. The work required 31 million m^3 of fill materials, and is one of the largest dam-raising projects ever undertaken.

Hunt DVL, Lombardi DR, Jefferson I, Rogers CDF *et al.* (2012) Appraising infrastructure for new towns in Ireland. *Proceedings of the Institution of Civil Engineers – Urban Design and Planning* **165(2)**: 103–121, http://dx.doi.org/10.1680/udap.9.00019

Over a 20 year period 1996–2016, a new 223 ha town is being developed 10 miles west of Dublin's city centre on the south side of Lucan, County Dublin, in the Republic of Ireland (ROI). This €4 billion 'Adamstown' development is the first of four planning schemes in ROI to be approved as a strategic development zone – an integrated planning framework deemed suitable for creating sustainable neighbourhoods in sites of strategic economic or social importance to the state. The creation of sustainable neighbourhoods in ROI is facilitated through the implementation of a checklist of 60 indicators. This paper critically examines the attempts being made to consider sustainability within the development's overall infrastructure plan, specifically: transport, energy and water services, information technology and waste. Inadequacies in the existing development are linked to shortfalls in the sustainability checklist, by way of a comparison of infrastructure-related indicators from the ROI checklist with those derived for the UK and exemplar European projects (i.e. Bedzed, UK and Freiberg, Germany). The subsequent legacy for future residents of Adamstown is then considered in the context of 'what if' scenarios.

Karaca Z and Onargan T (2012) A new approach to stone deformation: stone deformability index. *Proceedings of the Institution of Civil Engineers – Construction Materials* **165(3)**: 189–195, http://dx.doi.org/10.1680/coma.9.00031

In the present study the deformation behaviour of marbles (Nacre, Yatağan White, Milas White) and limestones (Bursa Beige, Burdur Beige, Orient Pink) over short time periods was investigated under two loads, 19 MPa and 75% uniaxial compressive strength (σ_{UCS}) for 7 h. During the 19 MPa tests, all specimens demonstrated a regularly non-linear elasticity in secondary stage but this regularly non-linear elasticity was not observed during the 75% σ_{UCS} tests. The non-linear elasticity decreased as a function of time and ultimately ended. In the secondary stage, the ratio of the lowest strain value,

ε_i, to final strain value, ε_f, was defined as the stone deformability index (SD_i). Building stone type and strain value were observed to be two important factors in SD_i, which was found to be lower for the limestones than the marbles. The SD_i decreased with increasing stone strength. The crystalline size was also observed to be an important factor in the SD_i of marbles.

Lee WF (2012) Briefing: Bridges at risk from multi-hazards. *Proceedings of the Institution of Civil Engineers – Forensic Engineering* **165(4)**: 157–159, http://dx.doi.org/10.1680/feng.12.00002

Multi-hazards caused by heavy rainfall such as landslides, debris flows and floods have become major threats to infrastructures like highway bridges. This paper summarises failure types and genetic causes of highway bridge damage during typhoon Morakot which invaded Taiwan in 2009. Most bridges suffered the combined effects of at least two kinds of hazards: bridges located in the upstream area were mostly destroyed by debris and landslides; those located in the downstream areas were damaged by outsize floods and scours. Endorsements on improving design and risk analysis of highway bridges are proposed in an effort to provide engineers with fundamental approaches when facing challenges of extreme climate.

Li P, Fairfield C and Fordyce D (2012) Design advice for rigid highway pavements constructed in natural stone. *Proceedings of the Institution of Civil Engineers – Construction Materials* **165(3)**: 135–144, http://dx.doi.org/10.1680/coma.11.00061

Guidance for the design of natural stone setts and slabs as rigid pavement solutions in an urban environment is becoming increasingly important as engineers seek sustainable and aesthetic solutions in conservation areas, for public/municipal projects, and indeed for general environmental enhancement. Due to the demands placed on urban roads (from private cars through to buses and commercial delivery vehicles) the stresses applied to road pavements are constantly increasing especially if traffic volumes continue to rise and vehicle axle limits increase. This paper provides guidance on general fitness for purpose issues and provides a framework for design and installation of rigid pavements constructed with natural stone sett and slab surfaces. Typical stone pavement design examples are provided. Details yielded by the method include: bond adhesive strength, material requirements, overall pavement thickness and individual stone element dimensions.

Macabuag J, Guragain R and Bhattacharya S (2012) Seismic retrofitting of non-engineered masonry in rural Nepal. *Proceedings of the Institution of Civil Engineers – Structures and Buildings* **165(6)**: 273–286, http://dx.doi.org/10.1680/stbu.10.00015

One of the greatest causes of casualties in major earthquakes around the world is the collapse of non-engineered masonry buildings (those built without engineering input). Yet by definition non-engineered structures remain largely outside of the scope of modern engineering research, meaning that the majority of those at risk often remain so. A further barrier to realising research in this field is the significant social and economic challenge of implementation in low-income communities, where non-engineered housing is prevalent. This paper introduces a retrofitting technique aimed at preventing or prolonging the collapse of adobe (mud brick) houses under strong earthquakes. This technique uses common polypropylene packaging straps to form a mesh, which is then used to encase structural walls. The aim of this paper is to give an overview of the retrofitting technique's development and implementation. The key development stages of static, dynamic and numerical testing are presented, showing that the proposed technique effectively prevents brittle masonry collapse and the loss of debris. An implementation project is then discussed, involving a training programme for rural masons in Nepal, a public shake-table demonstration and the retrofit of a real house. The implementation project proved effective at reaching rural communities but highlighted that government subsidies are required to incentivise the safeguarding of homes among low-income communities.

Maddison B (2012) Scour failure of bridges. *Proceedings of the Institution of Civil Engineers – Forensic Engineering* **165(1)**: 39–52, http://dx.doi.org/10.1680/feng.2012.165.1.39

In recent years there have been several bridge collapses in the United Kingdom and Republic of Ireland that have been caused by scour. Towns in the north west of England have been cut off and loss of life occurred. Major railway lines have been closed for extended periods. Although scour is basically the removal of bed material due to flowing water, it has a number of different causes and takes different forms. The paper describes the different forms of scour and looks at a number of case studies to illustrate the different ways in which scour has caused structures to collapse or require protection. The case studies are of railway bridges and are drawn from official investigation reports and underwater examinations carried out by the author. The paper concludes by illustrating ways in which failures due to scour could be avoided by the employment of good bridge management systems.

McGregor T (2012) A Falkland Island roof failure. *Proceedings of the Institution of Civil Engineers – Forensic Engineering* **165(2)**: 77–83, http://dx.doi.org/10.1680/feng.11.00024

This paper presents the results of an investigation into the failure of an accommodation block roof at the Mount Pleasant base on the Falkland Islands in October 2010. The author analyses the likely wind forces acting at the time of the failure and demonstrates how the failure of a simple rubber washer was the likely cause of the failure. The relevance of this incident to similar roof constructions in other parts of the world where prevailing wind speeds are lower is discussed, as is the effect of ageing on the building components. The author argues that although the wind speeds recorded in the Falklands are significantly higher than those shown in the current UK code, the UK figures have recently been revised and this process will, he argues, need to continue as the effects of climate change become apparent.

Parker J, Sharratt M and Richmond J (2012) The Shard, London, UK: response of arches to ground movements. *Proceedings of the Institution of Civil Engineers – Bridge Engineering* **165(3)**: 185–194, http://dx.doi.org/10.1680/bren.11.00017

The Shard is a 310 m high mixed-use tower, built next to the masonry arches that support London Bridge railway station in central London. Ground movements have occurred because of the demolition of the 26-storey tower that previously occupied the site, the excavation of a three storey basement, and the construction of the new building. These ground movements have led to axial and rotational strains in the masonry arches. Enabling works for the Shard in the vicinity have also caused arch movements. Initial assessments of the effects of movement on the arches, including the likelihood of cracking, were carried out using charts published by Boscardin and Cording. However the arches at London Bridge consistently performed better than predicted. This paper presents the results from the Shard project, and discusses possible reasons for the difference from Boscardin and Cording's findings.

Sutherland J (2012) Error analysis of Ordnance Survey map tidelines, UK. *Proceedings of the Institution of Civil Engineers – Maritime Engineering* **165(4)**: 189–197, http://dx.doi.org/10.1680/maen.2011.10

Historical trend analysis is often used at the coastline to provide rates of coastal erosion or accretion as part of shoreline or beach management studies. The long-term data for historical trend analysis at UK sites often come from tidelines (representing high or low water) from Ordnance Survey (or older) maps. Recent Ordnance Survey (OS) digital maps no longer retain the date of survey, which is needed for historical trend analysis. An

alternative is to use datum-based tidelines from survey data, although these are different from the proxy-based tidelines on OS maps. The plotting of tidelines on OS maps is reviewed and the errors involved in establishing the positions of tidelines are divided into source uncertainty, interpretation uncertainty and natural shoreline variability. Methods of calculating these errors are presented and examples provided. The methods for including uncertainties in historical trend analysis are introduced. Adoption of these methods would allow the significance of changes in tidelines to be assessed, which will assist coastal management.

Walshaw A (2012) Briefing: Understanding housing modernisation from the bottom up. *Proceedings of the Institution of Civil Engineers – Urban Design and Planning* **165(1)**: 7–10, http://dx.doi.org/10.1680/udap.2012.165.1.7

Despite a 40 year history of housing modernisation in England and the unrivalled scale of the recent Decent Homes programme, we know little about the experiences of residents as the immediate beneficiaries. This paper helps to address this absent perspective by drawing on data generated through qualitative research in a West Yorkshire city where innovative research methods were employed to reveal rare insights into the residents' experience of housing modernisation. In doing so, the importance of understanding the impact of built environment interventions, especially those associated with a space as personal as the home, from the perspective of their users is underlined.

Wilmers W (2012) Restoration of masonry arch bridges. *Proceedings of the Institution of Civil Engineers – Bridge Engineering* **165(3)**: 135–146, http://dx.doi.org/10.1680/bren.11.00011

Experience with the study of more than 30 masonry arch bridges and their repair is presented. The oldest of these bridges date back to the thirteenth century, while the most recent were constructed in the 1930s; they form an important part of the cultural and historical fabric of the region. Many of these bridges required restoration to make them fit for current and future traffic, using methods, modern materials and techniques that are compatible with stone masonry. This paper describes the procedures for inspecting and assessing arch bridges including foundations, stone and mortar, pavements and waterway hydraulics. Means of repairing masonry, such as the use of specialised mortar and impregnating masonry with stabilising chemicals, are discussed. The strengthening of stone arch bridges by adding internal arches of lightweight concrete is described. Methods of reconstructing roadway pavements and sealing the entire bridge against excessive moisture intrusion are also covered. Examples are given of recently completed projects intended to extend the service life of masonry arch bridges by many decades.

Wynne B (2012) Liverpool's appetite for change. *Proceedings of the Institution of Civil Engineers – Urban Design and Planning* **165(3)**: 147–155, http://dx.doi.org/10.1680/udap.11.00022

The city of Liverpool has a fine legacy of nineteenth century and early twentieth century townscape. Its remarkable history as an international seaport and its impressive historic and cultural heritage have resulted in much of the city centre being designated a World Heritage Site by Unesco. Over the past decade, the city has developed a confident understanding of placemaking and has rejuvenated much of its tired and shabby public realm. The city now boasts an enviable network of streets and open spaces on a par with many of its European counterparts. This paper traces the unfolding of Liverpool's fortunes and identifies the components that have helped the city regain its new-found confidence. Embedded within its story are many practical lessons for the quality of urban life and sustainable development in the twenty-first century.

Yates T, Richardson D and Miglio B (2012) Changes in engineering properties of natural stone. *Proceedings of the Institution of Civil Engineers – Construction Materials* **165(3)**: 127–133, http://dx.doi.org/10.1680/coma.9.00023

It has long been known that some stone types show significant loss in strength, both in compression and bending during the service life of a building. These differences can include changes as a result of long-term changes in physical structure, for example as a result of thermal and moisture cycles, but there can also be shorter term changes between the wet and dry states. The European Standards that are now in place in the UK and the rest of the CEN countries require stones to be tested under ambient conditions and, if required to declare these values as part of the CE marking process. This has led to some concerns that the data available for structural calculations may not reflect the actual performance during use, and as the demands for more slender stone units increase so the margins for error become smaller. The present paper begins by examining a number of reported examples of changes in properties with time as a result of changes in structure in some marbles as well as changes in appearance and strength in limestone and sandstone as a result of salt damage and freeze–thaw action.