Meeting at the Belgrave Square headquarters of the Society of Chemical Industry, the Institute of Concrete Technology held its summer seminar on 27 June, with the support of SCI and the Building Limes Forum. Its title was Natural Cements for Repair and Renovation of Heritage Structures, and it attracted a diverse range of 39 participants, from Austria, Germany, Ireland, the Netherlands, Poland, Switzerland and the USA, as well as Great Britain.

Nineteenth Century and so was both varied and widely applied. He described their common properties and identified applications in masonry mortars, mouldings, rendering and repairs. Cities with a conspicuous legacy of Roman cement buildings include Lviv, Prague, Budapest and Krakov. Perhaps 90% of pre 1920 buildings are rendered, and 25% of these currently need repair. Far from being esoteric, the RoCARE project addressed a pressing need.

Next Christophe Gosselin of Geotest SA, Switzerland, turned to the subject of ‘Composition and Hydration of some Roman (natural) Cements’. Dr Gosselin drew attention to the high clay contents of the marlstones used in Roman cement production, and the presence of variable raw materials such as calcite, quartz, iron sulphate. He also noted that the material was dependant on calcination conditions and that there was no standard of production, but also, that the early age hydration of Roman cements is a very rapid reaction leading to the formation of different hydration products. His paper compared the composition and hydration of different modern Roman cements available on the market and developed within the RoCem and RoCARE Projects.

The day’s programme allowed plenty of time for discussion and the Chairman took questions for both the opening speakers at this stage, before breaking for coffee in the exhibition area.
After the break **Dave Hughes**, formerly Professor of Construction Materials at Bradford, but now enjoying the rewards of recent retirement, addressed the topic, ‘Formulating mortars for use in restoration practice’. He referred principally to a research project that compared the performance of Roman and Portland cement mortars, and those based on limes, particularly in so far as they were used for renders and cast elements. Tested in detail were CEM 1, NHL 5 and three Roman cements (the latter from Gartenau, Wietersdorfer and Vicat.) Prompted by the small size of the squares of repair mortar used at Durham cathedral – necessary as a consequence of the very rapid setting of Roman cements from Whitby – Dave’s project was led to the search for a means of slowing the reaction time. Various forms of retarder were tried, to no avail, so Dave turned to the development of a deactivation process, now known by the acronym ‘DARC’. DARC required the addition of water to the sand, and storage for a preparatory period. This affects the timing of the hydration process and leads to a notable increase in workable life, related to the quantity of water used and the time stored. Yet the early hydration has little adverse effect on the properties of the hardened mortar. The commercial exploitation of this finding is now being undertaken in Germany for the silo mortar market. The addition of quicklime was also explored. The results of testing their respective properties places Roman cement between CEM 1 and NHL5. He concluded that lime does not retard Roman cement, though you might get a substandard product; 50% addition is manageable, but it does reduce strength.

Turning from the laboratory to ‘Practical aspects of restoring with mortars based on Roman Cements’ **Jacek Olesiak** of Remmers Polska rehearsed his experience in the historic city of Krakow, where Roman cement was widely used between 1870 and 1914. From private houses to palaces, schools to banks, many buildings were rendered in this naturally ochre material and left unpainted, embellished by ornaments cast in Roman cement. However, in the years since they have often been badly repaired and inappropriately painted; Jacek pointed out some examples of unwarranted decay. Conversely, the Trade Academy of 1904-06 was restored in 2005-07 as the first full restoration to use one of the newly developed RoCem materials. He described the project. Super-heated water was used to remove paint, and sandblasting to treat surfaces. Some cracks and stains were exposed, but most of the structure was adequate. A broken cornice was repaired, using materials mixed on site and though Portland cement was used to repair the ground floor, as originally constructed, Roman cement was applied to the first and upper floors. Ready-mixed dry mortars were used in some instances, wetted during the first two weeks. Where iron beams had corroded and destroyed the Roman cement-based cover, replacements were epoxy-coated. When the work was completed some lime bloom occurred, but was accepted by the client as a temporary phenomenon.

Jacek’s presentation was highly visual and prompted considerable debate on the advisability of painting and sealing against moisture ingress, whereas questions for Dave Hughes included the reasons for using citric acid as a retarder. (Answer: although old-fashioned, it is cheap and recommended by Vicat.) Animated discussion continued into the adjoining Garden Room where there was an admirable lunch and time to visit the accompanying exhibition.

Exhibitors included Cornish Lime, Fugro Aperio, Lafarge Tarmac and the ICT itself.
After lunch, in a presentation entitled ‘Salt resistant mortars’, Dr Barbara Lubelli addressed the issue of the compatibility of original and repair materials. She identified salt crystallization damage as one of the most common causes of decay for bedding, pointing and rendering mortar but observed that the phenomenon had not been adequately explained. Previous practice in resolving the problem had been directed to increasing the strength of the mortar, the replacement of lime with Portland cement, or reducing the moisture transport capacity by the addition of silicone-based water repellents. These solutions have often displayed limited resistance to salt decay and a low compatibility with historical buildings. Barbara’s research has started to explore new possibilities for improving the durability of mortars to salt damage; these include engineering of the pore size, replacing of silicones with natural organic water-repellent substances (such as linseed oil) and mixing-in of inhibitors able to reduce the harmfulness of salt crystallization (though this can create efflorescence). Preliminary studies indicate that these new directions show promise in obtaining more durable mortars that are compatible with historical buildings.

Paul Livesey confessed that, as a Portland cement man, he had ‘seen the light’ some year ago in Sunderland and persuaded Castle Cement to introduced a wider range of lime-based products. (The scene of his conversion – the Stadium of Light!) He described a spectrum of binders, from agricultural lime to hydraulic lime, natural cements to Portland, and gave a chronological account of their development towards modern materials. He focused on the pioneering period from Smeaton (who tested 300 varieties of limestone in his search for a hydraulic cement) through to the perfection of the Portland cement production process and introduction of the rotary kiln. Speaking authoritatively and elegantly, he indicated the contributions of Semple and Higgins in eighteenth century Britain, and Loriot and Perronnet in France, before James Parker patented Roman cement in the 1790s. The combination of clay and limestone was researched extensively by Vicat, while commercial production of natural and artificial cements grow apace in Britain. Interestingly Paul showed an historical photograph of the Roman cement works at Whitby – the very same location that had been illustrated earlier with a modern picture by Dave Hughes. The account came to a natural climax with Joseph Aspdin’s 1824 patent for Portland cement and his son’s discovery of the importance of clinkering in the 1840s.

Describing Scotland as geographically diverse, with varied building styles in consequence, John Hughes introduced Aberdeen as a city of granite – a low porosity, high strength and durable material. Locally, it seems, there have been problems with dampness in nineteenth century buildings. Drainage failures are a cause of water ingress, but in 30-40% of cases dampness appears to be down to use of the wrong pointing materials. To test this assumption, and investigate what would make an appropriate re-pointing and repair material, the University of the West of Scotland won a couple of research projects that John duly described. Work in 2008 looked at calcium-loading in mortars, and found Portland cement to be present in every mortar. The team looked at hot mixes, including lump quicklime, and various others including Portland cement mixes. They tested for capillary arch and moisture absorption, but lime works differently from Portland cement, and laboratory testing has its limits. It is more difficult to sample traditional mortars in situ.
Although most of the traditional quarries in Aberdeen are no longer operating, Sclatti Quarry contains a Council-owned store of stone from demolition projects, to offset the shortfall of repair material. From this source John and his team took 22 samples of historic mortar – bedding (yellowish, crumbly) and pointing (harder, greyish) – and subjected them to testing. By 2011 the team had moved to developing specifications, and were examining Strength, Moisture and Bond – the most important factor. There are still unresolved questions and Portland cement is not consistent with Scottish conservation practice, so Aberdeen Council is now looking at natural hydrated lime. May be, John wondered, Roman cement could be the answer?

Standing in for the scheduled speaker at very short notice, event sponsor Phil Brown of Cornish Lime described the application of Roman cement in practice, drawing on the prime example of Hadlow Tower, a grand folly that was rendered originally with mortar based on Roman cement from Sheppey. The restoration project got under way in 2009, using Vicat materials, pigmented with stone dust as required. Concentrating on the practical, Phil said that Roman cement feels quite different on the trowel – you have to use it to know – and that it is applied in three coats: ‘fresh on fresh’. Reciting the craftsman’s plaintive cri de coeur: “There’s never time to do it right; but there is to do it twice”, Phil was delighted to claim that the men at Hadlow had got it right first time.

Then, leading into the open discussion session, there was an impromptu addition to the programme. One of the participants, Michael O’Reilly, was one such craftsman and had come armed with a set of photographs of his highly skilled work on recent projects. A five-minute slide show followed, with pictures of renovation work in Buckinghamshire and at Slapton church in Cambridgeshire. Michael shared with the audience his personal and very positive views on the use of Roman cement for restoration.

Winding up the debate, Professor Hewlett summarised the day’s proceedings, commenting on themes such as the pros and cons of sealing Roman cement render, and noting the material’s variability, and expressing a pleasant surprise in the degree of interest and expertise this niche sector had generated in recent years.

Echoing these sentiments, the feedback from speakers and audience alike has been generous:

“Congratulations on organising such a brilliant conference last week. Excellent speakers and everything ran to time, which makes a pleasant change. It was the best conference I have been to for a long time.” [Alison Henry, English Heritage]

“A truly interesting and well organised meeting!” [Prof Johannes Weber, Vienna]; and “… a perfect conference” [Jacek Olesiak, Remmers Polska]

“It was an interesting mix of papers. Whilst sad not to see Gerard there the substitute paper from Vicat was inspirational.” [Prof Dave Hughes, Bradford University]

“I would just like to say a big thank you for organising yesterday’s conference as I thoroughly enjoyed and found it most informing. I think these topical one day events where chemistry meets research, and also site application, are fantastic.” [Ed Hiam, Lime Green]

The full papers will be published in the 2013/14 edition of the Institute’s Yearbook.

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Institute of Concrete Technology