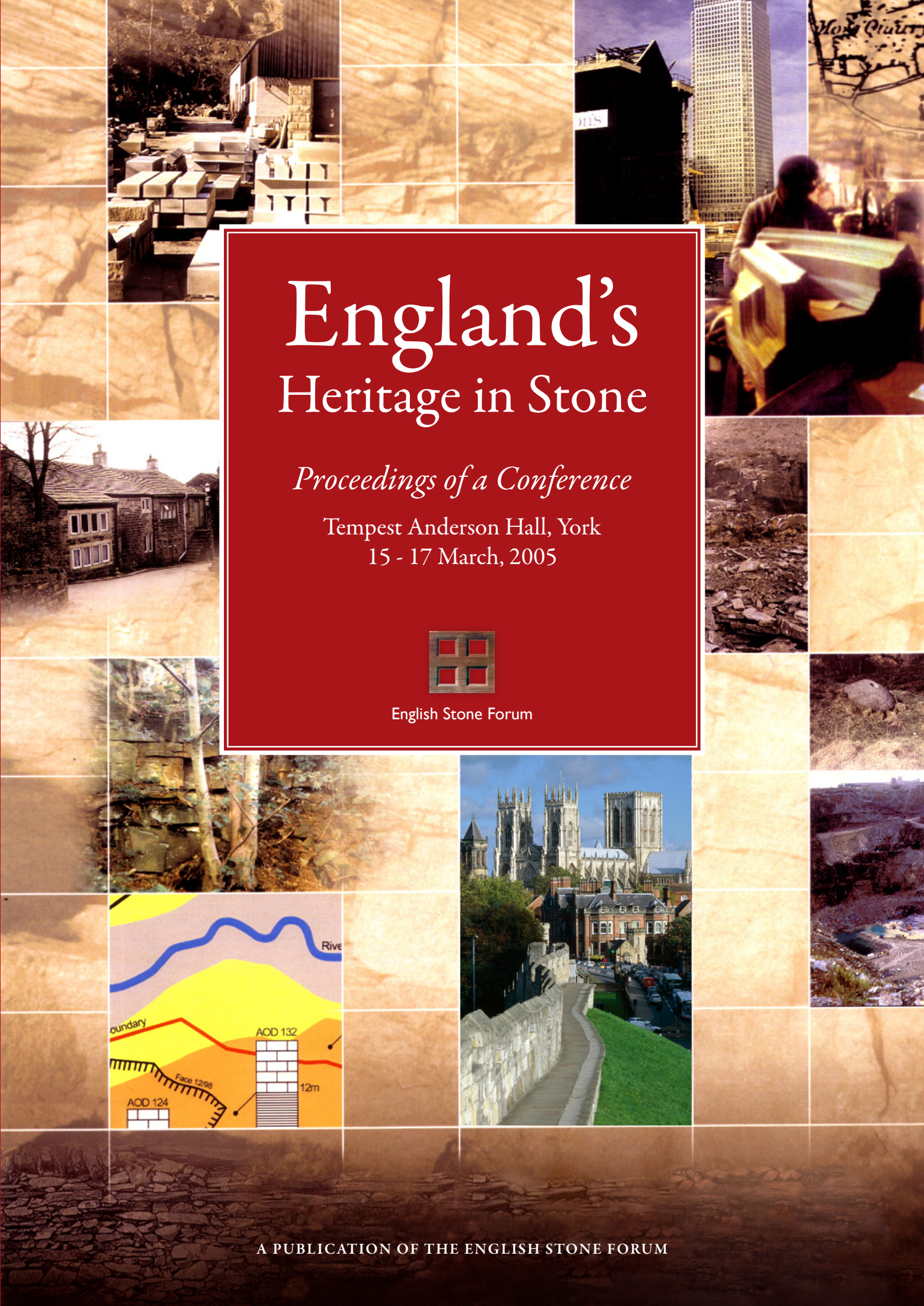

England's Heritage in Stone

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Historical Perspective of Conservation: the importance of stone, today's problems and lessons from the past

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Building conservation as we know it today has only really been practised over the last 150 years or so. As this volume is intended to highlight the importance of stone, I have widened my perspective to look further back than that, before concentrating on today's issues.

Most people know what conservation is. Recent work at York Minister nearby epitomises the sort of issues and conflicts encountered when considering the best way to conserve precious building fabric. Until the 1990s the general practice of the in-house masons was to replace decayed stone rather than repair it. The work to the Great West Door, however, was a very successful blend of the two.

The conservation approach is to try and keep as much original fabric as possible. In 1978 seriously decayed arch stones were treated with Brethane, a specially devised consolidant to slow the natural decay. However, for various reasons this was not entirely successful, and there was continuous loss up to 1997 when its condition was re-evaluated.

The arch voussoirs were replaced by the Cathedral masons with new magnesium limestone to a contemporary design (Fig 1). Lime shelter coats (Fig 2) and mortar repairs were made to the rest of the superstructure to conserve these and blend it with the new work. The completed job and the approach adopted has been favourably received.

Fig. 1. *Until the 1990s the general practice of the York Minster in-house masons was to replace decayed stone rather than repair it. The work to the Great West Door, however, was a very successful blend of the two. Where replacement was essential eg the arch voussoirs, decayed stone was replaced with new magnesium limestone to a contemporary design.*

Fig. 2. *On the superstructure of York Minster's Great West Door, lime shelter coats and mortar repairs were also used to conserve the stone and blend with the new work.*

This article is divided up into four parts. Starting with the origins of the conservation movement it then considers the historical development of stone buildings before describing today's problems and explaining English Heritage's role in addressing these. Issues include: sourcing and selecting new stone, crafts skills and good conservation practice. Hopefully it will also demonstrate why the establishment of the English Stone Forum is welcomed.

CONSERVATION

There have been many definitions of conservation. This one is from the British Standard (1998):

'Action to secure the survival or preservation of buildings, cultural artefacts, natural resources, energy or any other thing of acknowledged value for the future'. Note: When buildings or artefacts are involved, such actions should avoid significant loss of authenticity or essential qualities

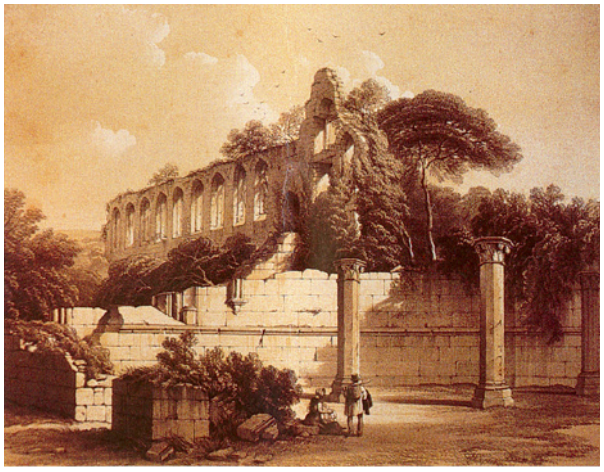

Fig. 3. *During the late eighteenth century Uverdale Price introduced an appreciation of romantic and dignified decay as a visual and spiritual delight. At that time there were a great many important buildings that were severely neglected, particularly churches and great abbeys.*

Emphasis is very much on the word action, as distinct from the rather static notion of preservation. Applied to individual buildings, careful conservation requires a thorough understanding of the significance of a structure and an ability to analyse a problem and determine the extent of remedial action needed. The emphasis is very much on care. Amongst the typical principles associated with conservation today are: conserve as found, minimum intervention, like for like repair, truth to materials, authenticity, reversibility, and recording. So the first question is what were the origins of these concepts?

During the late eighteenth century, romantics wrote about the 'picturesque'. Uverdale Price described 'beautiful buildings with their smooth surfaces and even colouring, decaying gracefully into romantic ruins'. He introduced an appreciation of romantic and dignified decay as a visual and spiritual delight. At that time there were a great many important buildings that were severely neglected, particularly churches and great abbeys (Fig 3).

Selby Abbey, provides a typical example. By the middle of the nineteenth century it was described by the younger Pugin (Bristow 1990): 'the font was disused, transept chapels were full of rubbish, one even being used as a coal hole, and the East windows were disfigured by having two large stove pipes carried through them'. Church naves often housed sheep. The reaction to this atheistic vandalism was a desire to revive ancient dignities of worship, and in 1839 led to the creation of the Cambridge Camden Society. This was to have a devastating effect on ancient structures the length and breadth of the country.

The Society began a massive mission to restore religious buildings. The first and best-known example was the Church of the Holy Sepulchre, in Cambridge. The small eleventh century Romanesque church had an upper storey and windows added in the fifteenth century. Work was needed to stabilise the tower, vaults and wall. The architect, Salvin went much further. He rebuilt the wall and vault and also removed the upper storey of the tower. He also replaced what he called the unsightly Perpendicular windows which disfigured as well as weakened the walls of the circular aisle' with his version of 'original' Norman designs. The significance of Salvin's approach lies in the return to a structurally perfect condition and a restoration to an earlier presumed state. To many the most important aspect of the work was the smoothing and redressing of the remaining ancient stonework, which left the Church bereft of patina and 'scraped' clean. This was a matter reported on by the Society with great enthusiasm. The restoration principle was henceforth advocated throughout the country.

But, there were powerful objectors notably from the acerbic pen of John Ruskin (1849) who described restoration as: a 'lie from beginning to end' and 'the most total destruction a building can suffer'. Another was William Morris founder of the Society for the Protection of Ancient Buildings (SPAB) again railing against restoration to the Annual General Meeting of SPAB in 1879: 'It is never too late to restore a building; nay it can be pulled down and rebuilt at any time'. And in the SPAB Manifesto in 1877:

'the whole surface of the building is necessarily tampered with, so that the appearance of antiquity is taken away from such old parts of the fabric as are left, and there is no lying to rest in the spectator the suspicion of what may have been lost, and in short a feeble and lifeless forgery is the final result of the wasted labour'.

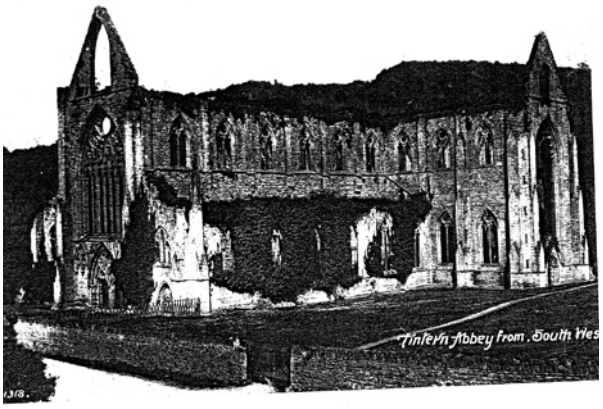

Fig. 4. *Tintern Abbey built by the Cistercians in the thirteenth century became a cause célèbre and is a typical example of the bitter conflicts about how historic buildings should be conserved.*

Morris's Manifesto was a milestone and has dominated thinking about the repair of historic buildings ever since, both here and abroad. He emphasised the need for careful and consistent maintenance by 'daily care' and particularly preserving the patina of age. He did, however, acknowledge the need for the renewal of decayed stone although this should be clearly distinguishable from the old. Tintern Abbey built by the Cistercians in the thirteenth century became a cause célèbre and it is a typical example of the bitter conflicts about how historic buildings should be conserved (Fig 4). In 1900 the ruins came into the guardianship of our predecessor the HM Office of Works' Historic Buildings Branch. Various works of consolidation were undertaken over the next few years, which raised 'considerable anxiety'

for some members of the SPAB Committee.

There was much criticism in the national press in 1922 and this extended to the way that other monuments in state ownership were being looked after. One issue was the presentation of ruins and the extent to which they should be stripped of long-established vegetation. A more specific issue at Tintern concerned the use of ferro-concrete in stabilisation. Trenched ringbeams were built into wall-heads (Fig 5). The use of ironwork was strongly opposed by some

Fig. 5. *Various works of consolidation were undertaken at Tintern which raised 'considerable anxiety' for some members of the SPAB Committee. These included trenched ring-beams built into wall-heads as in this recent example. The use of ironwork was strongly opposed by some SPAB members – predicting the iron would rust and cause huge disruption. Interestingly, discussions with those looking after the monument since the Second World War confirm that there has been no rusting or failure.*

SPAB committee members – predicting the iron would rust and cause huge disruption at the wall-head. Interestingly, discussions with those looking after the monument since the Second World War confirm that there has been no rusting or failure at wall-head. Back in the early part of the century, the alternative to the ferro-concrete would have meant more rebuilding of the structure and new buttressing.

Much pioneering work on monuments was carried out in the early decades of the twentieth century, much of it innovative and done to a very high standard. Now of course we would argue against some of the materials and techniques used, such as excavating and rebuilding of the core of a wall in concrete and the widespread use of cements that today cause us so many problems.

Fig. 6. *There are nearly half-a-million listed buildings in England. A significant proportion of these will be built in stone. Today however, English Heritage's conservation role extends beyond buildings and embraces the whole historic environment.*

After 1945 there was much greater awareness and articulation of conservation and this was manifested in new protective legislation including the listing of buildings, designation of conservation areas, creation of National Parks and other countryside designations. Now there are reckoned to be nearly half-a-million listed buildings in England and nearly 10,000 conservation areas. A significant proportion of these will be built in stone. What this actually means for stone buildings is that if they are within a conservation area or listed, they are most unlikely to be demolished and greater care should be taken over alterations and extensions, which in many cases should mean using new stone to match. National Parks were established to protect areas of open countryside and landscape value, but it is important to emphasise that their appearance today is due to human activities, which include buildings and former quarry workings. Today our interest in conservation within English Heritage is much wider and embraces the whole historic environment (Fig 6).

Now for a very selective look at the way we try and conserve our stone heritage and some of the problems we get involved with – starting with what some would call our most significant cultural site.

HISTORICAL PERSPECTIVE

Our stone legacy spans four millennia and there is no better example than Stonehenge of the wider importance of a site than merely the structure which stands upon it (Fig 7). It is in English Heritage guardianship being both a scheduled ancient monument and world heritage site and has a huge cultural and social significance. But this includes a wide area of surrounding landscape with many more ancient monuments and historic remnants. As a result we are looking at very grandiose plans for its enhancement which include undergrounding roads, and the construction of a new visitor centre well away from the stones.

In terms of the structure and its significance, we know that the stones were imported. The sarsens were brought from the Marlborough Downs and the bluestones from South Wales, which involved a massive human effort. A relatively high level of workmanship is evident from the tooling and the mortice and tenon arrangement for posts and lintels. Although the stones are aligned to the summer solstice and appear to have an astrological significance, we are not certain what its purpose was or how it was used.

The Romans gave us composite construction; two facing walls with a rubble core which was a very resilient form of construction still used in the twentieth century. Again, great skills in workmanship and an understanding of materials is evident. Pevensey Castle (Fig 8), a Saxon

Fig. 7. *Our stone legacy spans four millennia and there is no better example than Stonehenge of the wider importance of a site than merely the structure which stands on it.*

Fig. 8. *The construction of stone buildings needs great skill in workmanship and an understanding of materials. This is evident in Pevensey Castle a Saxon fort dating from 280AD.*

Shore fort dating from around 280 AD has a fallen bastion, the remnants of which are in a remarkably good condition and survive today where they fell in the fifth century (Fig 9). The fort was originally built on the coast but sea levels rose, which undermined the footings. Archaeologists have shown that some of the timber foundations are missing. One suggestion was that as Roman construction gangs were in direct competition with each other and speed determined pay, a rival gang could have sabotaged their work. The other point to emphasise is the quality of Roman mortar, which has survived even though neglected for over 1500 years. Within the original curtain wall it has eroded back to the same line as the soft Greensand stone it surrounds, something that modern cement would not do. Unfortunately, twentieth century wall cappings have been carried out in cements, which have caused considerable difficulties in successfully maintaining these monuments. They invariably crack or worse, cause the surrounding masonry to crack, which lets in water and again is subject to the destructive forces of freezing and thawing.

During Anglo-Saxon and Norman times, transport costs usually far outweighed that of the stone and determined the amount of material used. During the Middle Ages it was still only very wealthy establishments that could afford to build in stone. Salisbury Cathedral was started in 1220 and uniquely was completed without a break being largely finished in 1265. The spire was added by 1310. What also makes Salisbury unique amongst medieval cathedrals, is that the whole of the interior was built to the designs of one man, Nicholas of Ely the master mason. English Heritage is involved with all cathedrals in one-way or another. Our Inspectors often sit on Fabric Advisory Committees but significantly since the 1990s we have dispensed a great deal

Fig. 9. *At Pevensey Castle the remnants of a bastion which fell in the fifth century remains intact today.*

of funding to cathedrals. Some of this was used to research technical problems and here at Salisbury our team was involved in quite intensive monitoring of the condition of the lead roofs, death watch beetle and deteriorating Purbeck limestone shafts, particularly in the Cloisters (Fig 10).

Fig. 10. *Since the 1990s English Heritage has funded research into the technical problems of building stone. At Salisbury Cathedral for example our team was involved in intensive monitoring of the condition of the lead roofs, death watch beetle and deteriorating Purbeck limestone shafts.*

Most of our funding has been for grants for repair works, the most recent being the conservation of statuary on the West Front. This included various methods of low-pressure cleaning and lime mortar repairs (Fig 11).

Some years ago we were asked to carry out a training exercise using lime mortars into very narrow joints. Angle grinders had previously been used to cut out old mortar joints. These can cause a lot of damage, but even though it was carried out carefully, damage to stones was still evident (Fig 12). In the training exercise, hand tools proved to be perfectly effective. It is our view that in many instances re-pointing is not needed, even where the mortar appears to be soft. Some of the Cathedral masons regarded much of the medieval work as being of very poor quality. Hence there had been a lengthy programme of replacement. This is often very controversial. One good thing for us however was that it provided a lot of excellent material to use for training students at our former centre at Fort Brockhurst. Most recently we've also been asked to support an application to extend the Chilmark quarry, which now provides the replacement stone and the applicants' estimate that over 22 per cent of output goes to repairing historic buildings.

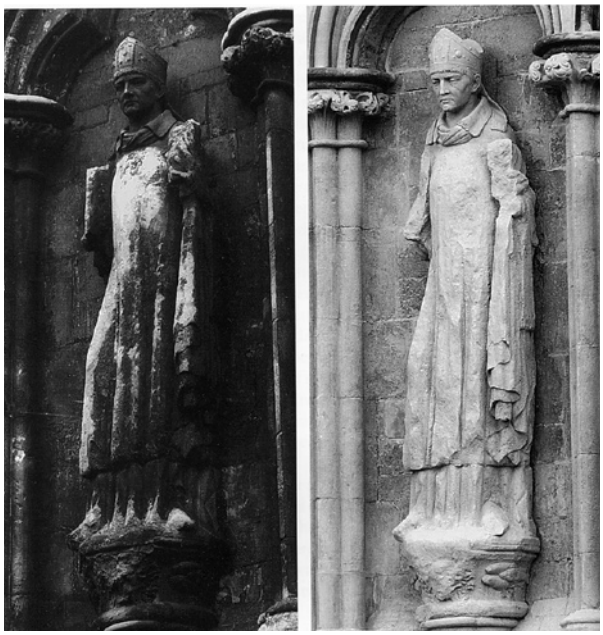

Fig. 11. *Research has been funded into conservation techniques such as low-pressure cleaning and lime mortar repair.*

Fig. 12. *Too often building repair techniques have been damaging in themselves. Cutting out mortar joints with angle grinders will often damage the stone even when carefully executed. English Heritage has developed training programmes to improve skills.*

The quality of medieval masonry is a highly debatable issue. We don't know a lot about the masons, very little having been recorded. They came from a great variety of backgrounds with most learning their craft from working at the quarry and thence onto site at a young age. Tools were relatively simple and it was clear that demands for their services from royalty and the church meant that most were journeymen who travelled extensively for work. There were no formal apprenticeships before the 15th century but a similar system was clearly in place. The Master mason was responsible for design and execution, the skilled journeymen worked at shaping and setting of stones and the lifting, carrying, splitting and scappling was done by the unskilled. Isolated written records give a sketchy idea about medieval construction. No drawings survive (if indeed they ever existed), but some indication is provided by contemporary sketches, and occasionally the odd gem survives. The drawing floor at York Minster shows how the Master mason set out his designs for the building (Fig 13).

During the Gothic period again, transport costs limited the use of stone. Other significant factors affected construction and many were cataclysmic such as civil strife, which often led to masons being press ganged to work on castles, or diseases like the Black Death in the middle of the fourteenth century. All these factors caused sudden dearths in skilled craftsmen – a complaint well recorded in contemporary documents.

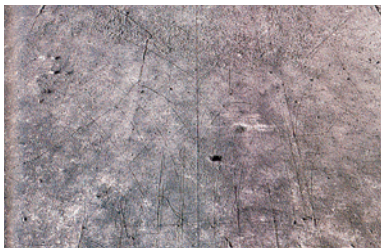

Fig. 13. *There are few written records of medieval masons and their techniques and there are no surviving drawings. The drawing floor at York Minster provides possibly a unique example of how the Master Mason set out his designs for the building.*

Timber framing became popular in the wealthier Tudor period but as stocks of oak ran out there was a renewed interest and fashion for using stone. Many of the dissolved religious houses made good quarries and the Elizabethan era saw a great many houses rebuilt or refaced in stone. Where material could be locally sourced whole towns were built in stone with numerous examples following the limestone belt through the spine of England. The Burfords, Cirencesters and Stamfords are very much the stuff of today's conservation areas but also unusual groups like the field barns and dry stone walls in the Yorkshire Dales National Park are similarly designated (Fig 14). Many of these towns, villages and areas have been subject to townscape grants. Unfortunately very few of the original stones used can be sourced today.

Fig. 14. *The Swaledale dry stone walls and field barns are one example of successful conservation. This was in large part due to the existence of one very small quarry which could supply the original stone for repairs to walls and roofs. Unfortunately in many regions authentic stone is simply not available.*

Fig. 15. *Conservation is seldom straightforward and some building owners seriously neglect their properties. Buxton Crescent had deteriorated to the extent that English Heritage was prepared to compulsorily purchase it.*

The Georgians were very keen on stone. Buxton Crescent is a classical piece of eighteenth century townscape where English Heritage was even prepared to compulsorily purchase the buildings because of extreme neglect (Fig 15).

Fig. 16. *Some structures such as the third Eddystone lighthouse, show the unique quality of stone as the only material that could perform in the most hostile conditions. Two of the reasons for its success were the quality of the Devonian moorstone granite blocks and the well researched mortar using eminently hydraulic lime from Watchet in Somerset with a pozzolana giving a very quick set but accommodating the requisite movement.*

All these examples have shown how important stone is in providing local distinctiveness. There are some structures, which show the unique quality of stone as the only material that could perform in the most hostile conditions. An excellent example is the third Eddystone lighthouse which was built on a reef 14 miles south of Plymouth and which was dismantled and moved to Plymouth Hoe in the 1880s. It is now a Grade I listed building (Fig 16).

The first two lighthouses were destroyed so in the 1757 John Smeaton was commissioned to design a replacement. It was a superb feat of design and engineering being the first wave-washed rock light to successfully develop and prove the principles and strength of interlocking masonry. Each stone was carefully dressed to interlock with its neighbour and these were locked into place with the use of marble joggles (Fig 17). There were three other reasons for the success of the new Eddystone. Firstly, the quality of the Devonian

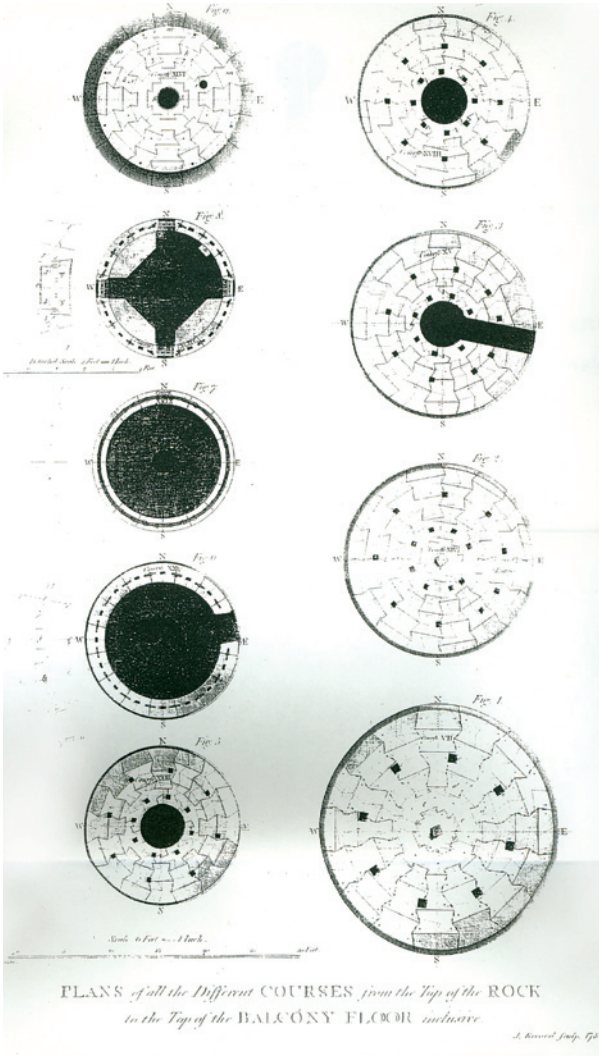

Fig. 17. *The tragedy of Eddystone lighthouse and so many other buildings is that dressed granite, of which we have so much, is no longer available in England. It is now all imported. Neither do we have any hydraulic lime from Somerset. Local objections prevented a former quarry being re-opened, so it now comes from France.*

moorstone granite blocks, some of which weighed over two tonnes. Secondly, the design, which was based on an oak tree with a low centre of gravity to withstand the main force of the waves, and thirdly very well researched mortar using eminently hydraulic lime from Watchet in Somerset with a pozzolana giving a very quick set but accommodating the requisite movement. When measured in 1826 it was only a quarter of an inch out of plumb and throughout its 123 years on the rock, was always reported to be dry on the inside. It was only abandoned because the reef below was becoming severely eroded.

The lighthouse on Plymouth Hoe is now a tourist attraction and we were involved with grant aid and advising on its repair (Fig 18). Ironically the main problem was damp penetration. The Victorians on moving it were not too concerned with replicating details, using a copious amount of cement, ignoring the marble joggles and the chains that held the structure together. As a result there were a number of problems. The tragedy is that dressed granite, of

Fig. 18. *Unfortunately when the Victorians moved the Eddystone lighthouse to Plymouth Hoe they were not too concerned with replicating details, using a copious amount of cement, ignoring the marble joggles and the chains that held the structure together. As a result there were a number of problems including water penetration.*

which potentially we have so much, is no longer available in England. It is now all imported. Neither do we have any hydraulic lime from Somerset. Local objections prevented a former quarry being re-opened, so it now comes from France. Since this talk was given, production has begun in Lincolnshire.

The problems of driving rain on solid masonry walls and the potential solutions are something that we are currently studying. The granite tower of Zennor Church in Cornwall is typical (Fig 19). Again it is built of ashlared granite, but unlike the old Eddystone still suffers from damp. Unlike Smeaton's interlocking stone, this is not cut six sides square, with the result that bed joints touch a few millimetres

Fig. 19. *The problems of driving rain penetrating solid masonry walls and the potential solutions are something that English Heritage are currently studying. The tower of Zennor Church in Cornwall is typical. Built of ashlared granite the bed joints touch a few millimetres in so there is very little mortar to resist water ingress. To overcome this walls were originally either rendered or had lime slurries and limewash regularly applied even though this would obscure the decorative appearance of the ashlar blocks*

in, so there is very little mortar to resist water ingress. Our forefathers knew this and most of these towers, even ashlared ones were either rendered or had lime slurries and limewash regularly applied . So much of this was lost with

Fig. 20. *The scraping clean associated with the nineteenth century restorations removed much of the limewash or render leading to water penetration. Challacombe Church in North Devon was originally rendered but this was stripped in the nineteenth century*

the scraping clean associated with the nineteenth century restorations. Challacombe Church in North Devon was originally rendered but this was stripped in the nineteenth century (Fig 20). Driving rain caused significant penetrating damp with ferns growing on the inside face of the tower. Levels of damp have been monitored for the last few years and the subsequent repairs and rendering have resulted in a dramatic drying of the structure (Fig 21).

One more comment on the romantic ruin. We are currently researching the effects of growing grass on ruined wall tops as an alternative to the use of mortar and stone. Soft capping experiments are being carried out in the laboratory and on a number of sites including Byland Abbey in North Yorkshire, an English Heritage property (Fig 22). The problems with 'traditional' hard caps have been that lime mortars are sometimes not durable enough to resist harsh climates and cements trap moisture and are prone to cracking. The experiments with turfs aim to assess their effectiveness at preventing water ingress and minimising temperature extremes at the wall head. Results so far are looking very promising.

Fig. 21. *Levels of damp in Challacombe tower have been monitored for the last few years and the subsequent repairs and rendering have resulted in a dramatic drying of the structure.*

Fig. 22. *The problems with traditional hard cap wall protection are being researched. Lime mortars are sometimes not durable enough to resist harsh climates and cements trap moisture and are prone to cracking. Grass caps are being tested at a number of sites including Byland abbey.*

Moving on to more recent times, Liverpool Anglican Cathedral is the last great gothic extravaganza, started in 1904 and finished in 1978 built with a brick core and skins of the local Woolton sandstone. Because this building was quite recent we have good records of its construction and detailing. A very high level of masonry skills is evident although the photographic evidence suggests that interest in health and safety issues was negligible (Fig 23).

Many craftsmen spent most of their working lives building the Cathedral. But as in medieval times, work was interrupted by wars, which meant loss of men at both the site and the quarry. Not only were valuable skills lost but it proved difficult to recruit men for such arduous work. Despite the quality of workmanship and design, recent repairs have highlighted a problem with the materials and techniques originally used. A lot of pointing had dropped out and some of the edges of stones were spalling; the reason being that cement mortar had been used over a lime ash core mortar. The cement mortar had cracked and even affected the stone. Our involvement was another training

Fig. 23. *In more recent buildings such as Liverpool's Anglican Cathedral we have good records of its construction and detailing. Despite of a high level of construction and masonry skills, recent repairs have highlighted a problem with the materials and techniques originally used. A lot of pointing had dropped out and some of the edges of stones were spalling because cement mortar had been used over a lime ash core mortar.*

exercise in pointing techniques but also to prove that lime mortars could be made to work in this hostile environment (Fig 24). The training and test panels were carried out on one of the belfries, which faced the Irish Sea, and was some

Fig. 24. *English Heritage's involvement at Liverpool's Anglican Cathedral was training exercise in pointing techniques but also to prove that lime mortars could be made to work in this hostile environment.*

250 feet above ground level.

A number of listed modern (post Second World War) stone built or stone clad buildings, have undergone

Fig. 25. *A number of listed modern stone built or stone clad buildings have undergone extensive works of repair. At Liverpool's Roman Catholic Cathedral the work has concentrated on the Portland stone chapels. In time all these modern buildings will need stone to repair them.*

extensive works of repair. At Liverpool's Roman Catholic Cathedral (Fig 25) work has concentrated on the Portland stone chapels. In time all these buildings will need stone to repair them.

Clearly some aspects of conservation as we know it, were practiced before the middle of the nineteenth century. There were clear indications that buildings were cared for and maintained and authentic materials used for repair. However this was dictated by pragmatism rather than any philosophy. The survival of so many stone buildings, which were frequently neglected or left as shells, is often a testimony to the enduring qualities of the material used and the skills of the masons in design and construction.

TODAY'S PROBLEMS

There are many issues of concern today; the ones concentrated on here are: sourcing supply, public awareness, knowledge, training and the use of correct material. It has to be stressed, that we need new material; not just for repairs, but also extensions, alterations and new buildings. English Heritage and its predecessors have consistently had to find old sources to repair its own monuments. Over the last twenty years our team have commissioned numerous searches to find original sources of stone, but opening old quarries has proved to be very difficult.

Many of the problems were illustrated during our 'Roofs of England' campaign, which set out to rejuvenate stone slating in England. By 1990 only two areas were producing any significant quantities of material. Prior to the start of the twentieth century there were at least 40 major different types of stone slate and many smaller ones. The study was based in the South Pennines, mainly encompassing the Peak District where there had been no supply for many years.

There is little doubt just how important the local stone is to the national park, not just to the individual historic buildings but also to the streetscape and wider landscape (Fig 6). The study also looked at the economics and practicalities of smallscale quarrying. It found that it was not very remunerative and that in order to be viable, production of ancillary products such as paving, kerbing etc may well be essential. The result in the Peak District of having no new supplies is that roofs are cannibalised or in extreme cases

Fig. 26. *Two consequences of a lack of supplies of new stone are that roofs are cannibalised or in extreme cases stolen.*

stolen (Fig 26). The other result is that we see concrete substitutes or more foreign imports whose longevity and performance is unknown and which are likely to weather very differently.

Our view that small scale quarrying is usually not harmful is illustrated by this project in Shropshire. The nave roof of the twelfth century Pitchford Church, near Shrewsbury was covered with the local Harnage stone and needed re-roofing. Harnage stone slates though had not been commercially produced for over100 years and there is nothing similar. Fewer than 25 buildings are believed to be still roofed in Harnage nonetheless many are very important listed buildings such as Pitchford Hall, Langley Chapel and parts of Wenlock Priory (Fig 27).

Fig. 27. *Until 1998 Harnage stone slates had not been commercially produced for over 100 years and there is no other similar stone. Fewer than 25 buildings including Wenlock Priory still have Harnage roofs.*

Fig. 28. *In order to be able re-slate the Harnage roof of Pitchford Church in Shropshire, a number of potential stone slate sources were investigated so asto establish the size of the resource and the suitability of the stone.*

We had to investigate a number of potential sites where good quality fissile stone could be found (Fig 28). This is an essential part of the process and as well as establishing the size of the resource, detailed petrographical assessment was needed to establish the quality of the stone. A bolster and lump hammer is needed on site to establish the fissility of the material and ensure that it can be dressed satisfactorily. Part of the grant for the works included finding a suitable source of new material, and to win enough to cover the whole roof; with any surplus stored for use on other Harnage roofs. Quarrying for stone slates is still essentially a hand operation (Fig 29). The cost of this was included as part of the grant and it was a nerve-racking time, as only so much funding was available and it was vital to make sure that enough good quality material was produced in the time allowed (Fig 30). To make it worse, the quarrying took place on the wettest month Shropshire had experienced since records began in 1841. The contractors completed the trimming and dressing under cover in their own premises

Fig. 29. *Part of the grant for the Pitchford church roofing works included finding a suitable source of new material, and to win enough to cover the whole roof; with any surplus stored for use on other Harnage roofs. Quarrying for stone slates is still essentially a hand operation.*

Fig. 30.

Production at the quarry resulted in these roughly dressed slates prior to sending them away for further dressing. Detailed petrographical assessment was also needed to confirm the quality of the Harnage stone.

Fig. 31. *The trimming and dressing was done under cover. This was more productive as well as more comfortable for the men. Equally importantly, it was a major factor in getting planning permission, because it meant minimum disturbance and traffic at the quarry site.*

(Fig 31). This was obviously more productive as well as more comfortable for the men. Equally importantly, it was a major factor in getting planning permission, because it meant minimal disturbance and traffic at the quarry site.

Fig. 32. *A detailed investigation of the collapsing Pitchford Church roof was carried out to see why it had failed after only 60 years. A one-metre wide trench was excavated from ridge to eaves on both sides.*

A detailed investigation of the roof was carried out to see why it had failed after only 60 years (Fig 32). A one-metre trench was excavated from ridge to eaves on both sides. The problem was that many of the slates were too small probably because they had had to use dressed down slates from the failed roof and had not found an adequate source for the production of new ones. (Contemporary correspondence had indicated that considerable effort had been made to find a new supply in the 1930s.) To compensate for the small sizes and inadequate head and side laps copious amounts of cement mortar had been used to bed the slates.. This of course only encouraged and held further moisture and led to the laths and pegs rotting prematurely. In the end the replacement of the failed roof used mainly new slates (Fig 33).

Fig. 33. *In the end the replacement of the failed Pitchford Church roof used mainly new slates because the existing slates were too small to be reused especially after dressing off softened areas.*

At its height the temporary quarry, which was in a listed historic parkland did produce quite a scar (Fig 34) but this was landscaped within months of the completion of quarrying (Fig 35). The landowners have renewed their planning permission to continue winning new stone should there be new demand for Harnage stone. This is written up in detail in English Heritage Research Transactions Volume 9: Stone Roofing. (English Heritage 2003).

Seventy thousand new stone slates were needed to repair the roofs of Dore Abbey in Herefordshire (Fig 36). There was a great deal of local enthusiasm for sourcing the stone locally because it could provide farmers with an alternative income following the ravages of foot and mouth disease. A very helpful mineral planning authority eased the difficulties of obtaining consents for two small quarries (Fig 37). Old Red Sandstone slates are now available again for repairing these distinctive roofs throughout Herefordshire. The project also ran training sessions in dressing slates for

Fig. 34. *At its height the temporary Pichford quarry, which was in a listed historic parkland, produced quite a scar.*

Fig. 35. *Within three months of starting quarrying at Pitchford the quarry had been landscaped and within a year was virtually undetectable.*

Fig. 36. *At Abbey Dore in Herefordshire 70,000 new stone slates were needed to repair the roofs of Dore Abbey. Although there was no exiting quarry, there was a great deal of local enthusiasm for sourcing the stone locally not least because it could provide farmers with an alternative income following the ravages of foot and mouth disease.*

Fig. 37. *The very helpful Herefordshire mineral planning authority eased the difficulties of obtaining consents for two small quarries. Besides successfully re-roofing Dore Abbey, Old Red Sandstone slates are now available for repairing these distinctive roofs throughout Herefordshire.*

Fig. 38. *The Dore abbey project also ran training sessions in dressing slates for farmers and other interested locals*

farmers and other interested locals (Fig 38).

Linshaws Quarry, near Holmfirth, West Yorkshire is an infamous case which highlights some fairly intractable difficulties. A local resident applied to re-open an old quarry to work the Rough Rock Flags right on the boundary line of the Peak District National Park in West Yorkshire. The site measured one hectare and was covered by a number of important designations, the most significant being a candidate Special Area of Conservation which covered 65,000 ha. No priority species of flora were threatened by the proposal and consultant ecologists concluded that the important heathland species would re-colonise quickly and other areas could be planted by way of compensation. Trial holes, which had been dug some months earlier, recolonised with some of the species within months (Fig 39). Nonetheless the application was eventually rejected.

Regardless of the merits of either set of arguments there is one issue that is virtually impossible to resolve. Objectors to quarries invariably suggest that there must be somewhere else more suitable where the right stone can be quarried. For many years the Peak District National Park has lacked any supply of new material for stone roofs and frequent searches had failed to establish one. As we know, our ancestors knew best where to look. But even though Rough Rock Flags occur in several northern counties, that is no good unless you have suitable fissile material (very rare),

Fig. 39. *Obtaining planning permission for small stone quarries is not always straightforward as at Pitchford and Abbey Dore. At Linshaws on the edge of the Peak District National Park, a very small scale proposal was eventually rejected because it was within a candidate Special Area of Conservation. The proposed quarry would have occupied one hectare in a 65,000 ha SAC and would not have threatened any of the priority species of flora. Indeed the existing flora recovered very quickly after the trial pit was back-filled.*

a willing entrepreneur and land owner plus local support to sustain its production. Those are rare things to find, particularly when the profit margins on this hand-crafted operation are relatively small.

Public opposition can also cause major problems. Another application to re-open an old quarry working on a farm, relatively remote from other buildings, outside the National Park and not in any area of designated land took five years to get consent because of concerted opposition from residents in the wider vicinity. Tackling public perceptions and fears about small scale quarrying is clearly essential if historic buildings are to be properly conserved.

PUBLIC PERCEPTION

Instances where things do work need to be highlighted. Ladycross quarry in Northumberland has produced stone slates since the eighteenth century. The quarry manager also runs it as a nature reserve having recorded 143 species of birds, insects and animals (Fig 40). It plays host to innumerable local school parties and other groups. He enjoys tremendous local support.

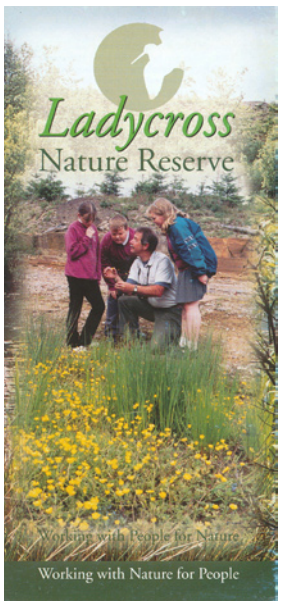

Fig. 40. *Instances where things do work need to be highlighted. Ladycross quarry in Northumberland has produced stone slates since the eighteenth century. The quarry manager also runs it as a nature reserve. 143 species of birds, insects and animals have been recorded within the site.*

English Heritage have

also supported a bid for Heritage Lottery Funding for the Building Stones Awareness Programme submitted by the Geology Trusts representing eight county geological groups in the midlands and the west. The funding would be to research relationship between buildings and geology with the aim of creating trails using examples of significant buildings such as Goodrich and Kenilworth Castles (in English Heritage guardianship) as well as local vernacular buildings.

We need to work with other groups to explain our needs. A common misconception is that quarrying is all about aggregates and the difficulties posed by old mineral permissions. 'Ticking Time bombs', a report by the Council for National Parks and the Friends of Peak District enhanced this impression. Media attention was captured by the title and the widely used quote from the report: 'Quarrying in national parks is like sticking drawing pins in the Mona Lisa'. In fairness the report was very factual and did make mention of the different issues surrounding building stone.

Despite the examples cited, it is not all negative. English Heritage is working with English Nature (now Natural England) on a relevant project mentioned below and we have been having fruitful discussions with CPRE (Campaign to Protect Rural England) and others over their policies for small quarrying for building conservation.

KNOWLEDGE

Improving our knowledge and information was something specifically recommended in the Symonds study (Capita Symonds 2006), which to us is a very important document. Two of its recommendations are particularly relevant. The first being that Mineral Planning Authorities should identify and protect 'heritage quarries' and that a database of information should be built up. For this we will be relying very much on bringing information together and the success of this will rely heavily on the work of local and national geological groups.

Although the idea of producing a national database is a mammoth undertaking, English Heritage has commissioned the Strategic Stone study using geologists from the British Geological Survey (BGS), Building Research Establishment (BRE) and two consultants to carry out a pilot study in Shropshire, Worcestershire and Warwickshire, to see how best to gather the information suggested by Symonds. This study is being financially supported by the Office of the Deputy Prime Minister (now Communities and Local Government) and English Nature (now Natural England). It is evaluating a number of relevant factors including: former quarries and possible new sources, assessing the demand for stone by surveying the buildings and discussing need with specifiers, conservation officers, contractors etc. An even more fundamental objective is to find out just how many buildings were built in particular stones. We even have little idea how many listed buildings are constructed in which stones or indeed where they came from. The aim is to devise a methodology for doing this for vernacular as a well as regionally and nationally important stones. The aim is to have this information available on a Graphical Information System via the web. A national database possibly offers a long-term solution to the problem of sourcing stone for repair, but is unlikely to be a significant help in the short term because of the size of the task and its likely cost.

TRAINING

Establishing an adequately skilled workforce has arguably always been a problem. This was mentioned earlier in regard to medieval times. Nowadays it is blamed on the demise of apprenticeships. But the same moans were heard back in the 1870s and again after the Second World War, when only half the requisite number of masonry apprentices were actually employed. In 2006 the estimated spending on the heritage sector is £3.6bn. We know from our grant aided work and other advisory cases that although we have good experienced conservators and masons, a huge amount of very poor work is being done. And it's not just conservation work that is suffering: new stone and the skills to produce and work it are needed for both repair and new build for walls, roofs, paving, kerbs, etc. English Heritage has been working with the Construction Industry Training Board (now known as ConstructionSkills) to address the skills shortage over the whole sector and has set up and funded the National Heritage Training Group (NHTG).

English Heritage also ran specialist training courses mainly in masonry conservation at Fort Brockhurst in Hampshire and these are now run at West Dean College in West Sussex. This may provide the venue for future NHTG courses designed to 'train the trainers' in this very specialist field.

USING THE CORRECT STONE

Using the correct stone is of paramount importance to us if buildings are to be conserved correctly. This is not just

Fig. 41. *Using the correct stone is of paramount importance if buildings are to be conserved correctly. The combination of Bath stone and granite at Truro Cathedral highlights a typical problem. The impermeability of the granite caused moisture to migrate to the more porous Bath stone resulting in its deterioration. In this case the Box Ground limestone appeared to be inferior. A range of English stones were tested in an environmental chamber at Sheffield Hallam University.*

Fig. 42. *In the Sheffield Hallam environmental chamber accelerated temperature and humidity cycles found at Truro were simulated followed by standard stone durability tests.*

a philosophical issue. It is important for technical and aesthetic reasons.

We have had to source stone for many of our properties and assisted the search for others we have been grant aiding. Truro Cathedral highlights a typical problem. Designed in the nineteenth century by Pearson and built with granite

Fig. 43. *The environmental testing demonstrated that the best performer was another Jurassic limestone, Syreford.*

and Bath stone; an unfortunate combination because the impermeability of the granite caused moisture to migrate to the more porous Bath stone (Fig 41). In this case the Box Ground appeared to be inferior and not what Pearson had specified. Rather than agree to the current Architect's desire to use a French stone to repair, we tested a range of English stones in an environmental chamber at Sheffield Hallam University (Fig 42). This simulated the temperature and humidity ranges found at Truro and an accelerator put them through harsher tests (Fig 43). Standard durability tests were also carried out. The best performer was another Jurassic limestone, Syreford which I believe is being used for the repairs.

English Heritage are shortly going to publish a Technical Advice Note: Selecting and Sourcing Stone for Historic Building Repair (published in March 2006). This recommends that the criteria for selecting replacements should be based on: petrography, chemistry, appearance (when viewed in block form) and that it should be of a similar geological age or from a similar sedimentary environment. Usually this means that replacement would be obtained from the original quarry or at least, one in very close proximity to the original source.

With new build it is not so easy to specify identical stone. There is much more freedom of expression in terms of design, although local authorities are very keen to emphasise local distinctiveness and use of sustainable materials and sources. Some would contend there is nothing more sustainable than producing local material, involving minimum energy input in production and transport, employing local people which reinforces the unique appearance and character of that particular, village, town, or landscape. Our 'Streets for All Campaign' is likely to emphasise this.

CONCLUSION

So where do we go from here? There is a clear need to: bring all supportive interests together, create a champion for indigenous stone, establish a centre for the accumulation and dissemination of knowledge, support efforts at boosting supply, improve support for training and coalesce interest groups in order to ensure that our rich and varied stone heritage is maintained. A united voice is required and that all points to the creation of a body such as an English Stone Forum.

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