Issued by

The British Stone Federation

70 Victoria Street S.W.1

Telephone VICtoria 6018/9

Architectural Engineering Monumental

STONE

information on current stone practice. No.14: May, 1958

Modern stone preservation and restoration—2

This concluding article discusses various methods of repair and renewal

WHATEVER form deterioration in a stone may take, the most frequent, though sometimes indirect, cause is the absorption and retention of water (*see previous article*). Much research and experiment have therefore been undertaken to discover methods to prevent this happening. The simplest and most obvious method of waterproofing is to apply a coating of oil-paint and for certain surfaces this is very efficient, but its use is normally unthinkable as it entirely masks the stone's character. Linseed oil, without a pigment, provides a certain amount of protection, but its effect on the stone's appearance, though less drastic than paint, is also appreciable; its useful life is limited and it collects soot and dirt.

Various processes have been devised for hardening the surface and thus making the stone impervious to moisture or atmospheric pollution. The silico-fluorides are sometimes used for this purpose as they react with the chemical constituents of various stones and create toughening deposits. Though they have little or no effect on appearance, their disadvantage—and indeed of all the methods discussed so far—is that they entail forming a skin with different properties from the stone itself. Even if theoretically the chemicals used possess the same thermal qualities as the stone beneath it, cracks in the skin inevitably appear somewhere and once rainwater has penetrated it is far more likely to be trapped and thus cause flaking and other damage—often far removed from its point of entry.

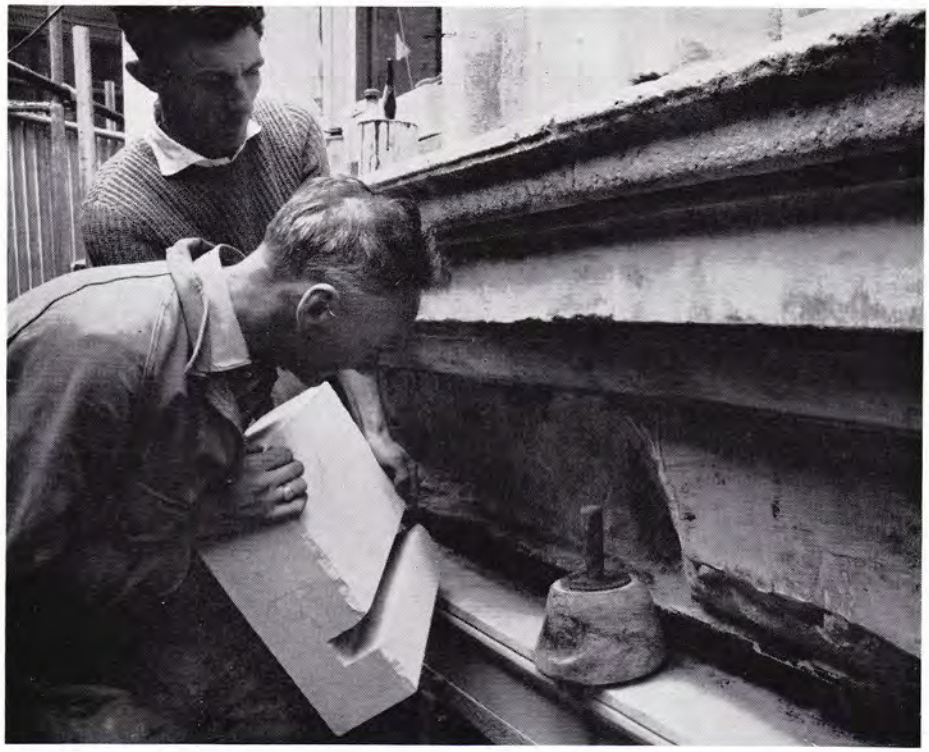
Apart from small areas of stonework which can be treated frequently and kept under close observation, even these invisible types of preservatives cannot therefore be recommended, and until very recently no reliable method of treatment was known—in addition, that is, to regular cleaning with brushes and water as described in the first of these articles. The new method is the application of silicones, either to the surface and/or the built-in surfaces of the stone, and though far too little experience has yet been gained, even of an experimental nature, there are good reasons for believing that they will prove to be very effective.

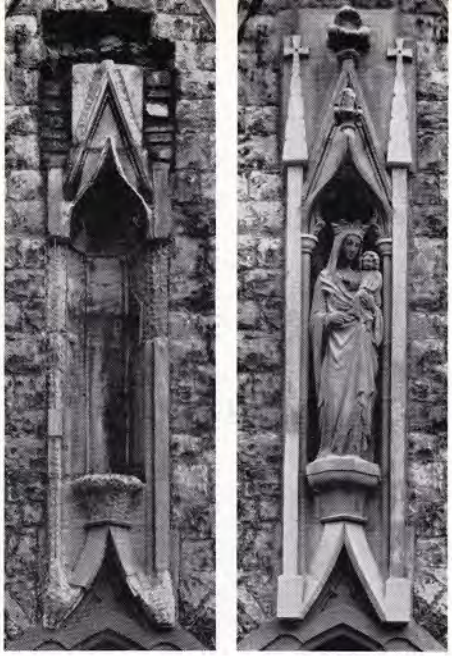
Various compounds of silicon—the silicones and siliconates—have the property of acting as a water-repellant. When applied to a stone's surface, they do not form a skin yet they repel water by changing its facial tensions with the stone's surface. Instead of entering the material, the water forms larger drops and runs off—the effect is similar to water running off a duck's back. It must be remembered though that, as silicones do not seal a stone's interstices, they only protect vertical surfaces.

These new silicone preparations can be sprayed or brushed on. The surface should be

FEW REPAIR OPERATIONS ARE AS EXTENSIVE AS THOSE NOW BEING CARRIED OUT AT THE HOUSES OF PARLIAMENT. THE ORIGINAL STONEWORK CAN BE DISTINGUISHED BY ITS DARKER COLOUR.

THIS NEW STONE FASCIA IS TO REPLACE THE ORIGINAL CRACKED BY RUST EXPANSION ON THE R.S.J. BEHIND





BEFORE AND AFTER.
THE STATUE WAS BADLY STAINED AND PITTED, AND HAD BEEN DECAPITATED.

clean and dry. Depending upon the porosity of the particular stone, a gallon is sufficient to treat 100-200 sq. ft. Commercial production of silicone compounds for stone treatment began some two years ago, and B.S.I. specifications are being prepared.

Silica, the oxide of silicon, also has its uses; it possesses the great asset of being chemically inert—it will not easily combine with other substances. Quartz is a crystalline form of silica which is found to some extent in most rocks and generally speaking strengthens them considerably. To apply it artificially, use is made of a compound of silica with alcohol, known as silicon ester. When this is made to soak into the stone the alcohol gradually evaporates and the silica tends to form connecting bars between the ooliths of limestone or the grains of sandstone, thus fortifying the stone's structure. Silicon ester has no effect on the stone's appearance, forms no impervious surface skin, and can be said to delay further decay.

Where deterioration is excessive there can be no really adequate alternative to replacement by new stone. In certain fairly limited circumstances repair by patching, usually with plastic, is sufficient, but at the outset it must be made clear that 'stone dentistry', as it is sometimes called, is inevitably less durable and that often the cost of new stone in the end proves more economical. In the case of decorative features exposed to severe weathering it may well be cheaper, even on a short term, to replace with new stone than become involved with elaborate filling and patching. Which method is chosen, however, depends on several considerations, including the extent of the damage and the character and aesthetic qualities of the building. When the problem arises with ancient buildings of architectural importance, the wish to keep as much of the original structure as possible is natural. William Morris in a lecture in the 1880's asserted '. . . ancient buildings, being both works of art and monuments of history, must obviously be treated with great care and delicacy; that the imitative art of today is not, and cannot be the same thing as ancient art, and cannot replace it; and that therefore if we superimpose this work on the old, we destroy it both as art and as a record of history!' Morris's strictures on some Victorian restorers were undoubtedly merited and his warning holds equally for the present day, but with imagination and great discrimination replacement of even large areas with new stone can be very satisfactory.

No trouble must be spared in seeking a stone which is exactly similar in type and texture to that used in the sections of the building which have weathered best. Clearly a limestone building should not be renovated by inserting sandstone, or a close-textured stone be placed amid a wall of open-textured material—there are often chemical as well as æsthetic objections to this. If stone from the same beds as those quarried originally is unobtainable, an expert opinion in finding a substitute is always advisable. When replacing stonework it is usually difficult to know where to stop; sometimes it is a case of deciding whether to remove and renew the old stone complete or to cut away the surface of the damaged portions to a depth of about 3 in. and only face up with new pieces.

Where the damage is superficial enough to be patched or filled, the cavities or fissures must be thoroughly cleaned and all rotten material be extracted. Soft, decayed stone must never be covered with repairing material. The mortars employed are usually based on Portland cement, or have a binder such as zinc oxychloride. The aggregate may be sand or crushed natural stone similar to that being repaired. Hand-made roofing tiles, cut to the shape of the cavity, are recommended by some as a basis for the plug. The dangers of patching are similar to those of putting a new piece of cloth into an old coat. When set and hard, the mortar should not only have the same colour and texture as the surrounding stone, but also the same qualities of strength and porosity. There is sometimes a risk that the patch will be too thin; as mortars shrink on drying, they need good support from the surrounding stones into which the edges should be undercut so as to avoid feathering. It may be adequate to prime or grout small cavities, but for those of any size non-corrosive metal dowels will probably be needed.

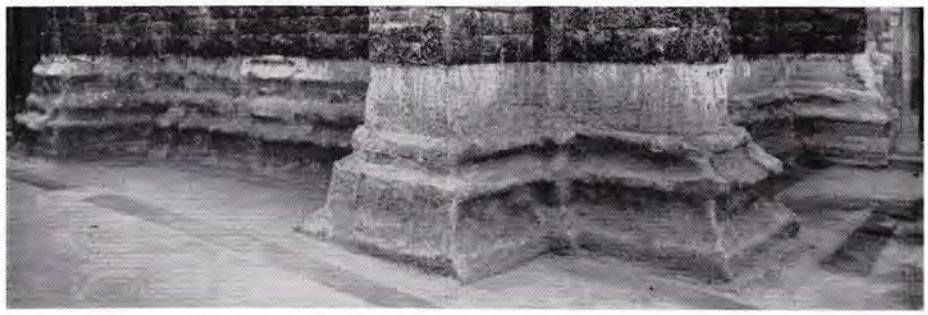
Similar considerations apply to repointing old stonework, an operation which calls for much skill and judgement. The mortar for this should generally be neither stronger nor denser than the stone it binds. It is a fallacy to assume that weakness in the stone can be compensated by increasing the strength of the joints or the pointing. Ideally, the mortar should allow a slight yielding of the masonry joints.

Before specifying any form of restoration work, whether by replacement or plastic patching, it is always advisable to make a careful survey of the entire structure so as to arrive at a correct assessment of the extent of the damage and, equally important, to discover its cause. This must determine the treatment prescribed and may even show up the need for a minor alteration in the building's design. Defects in gutters, rainwater pipes, flashings, or damp-courses may be the culprits, and it is pointless to restore the stonework without attending to these at the same time. It has yet to be proved that there is a more durable and continually pleasing building material than natural stone, but it needs and deserves to be well chosen, to be wisely cut and laid, and cared for reasonably well and with respect.

Photographs by courtesy of the Ministry of Works and Szerelmey Ltd.

The previous issue of STONE *dealt with the chief causes of stone deterioration and the most effective methods of cleaning. Copies of this and of all previous issues (1-13) can be obtained free of charge from the Secretary, The British Stone Federation, 70 Victoria Street, S.W.1. A new 16-page* QUARRY DIRECTORY, *containing details of quarries in the British Isles producing stone, granite, and slate for building is also available on request.*

BEFORE AND AFTER. A DECAYED STONE PLINTH IS RESTORED BY DRESSING IT BACK TO A NEW PROFILE.



Stone preparation

1—Primary sawing

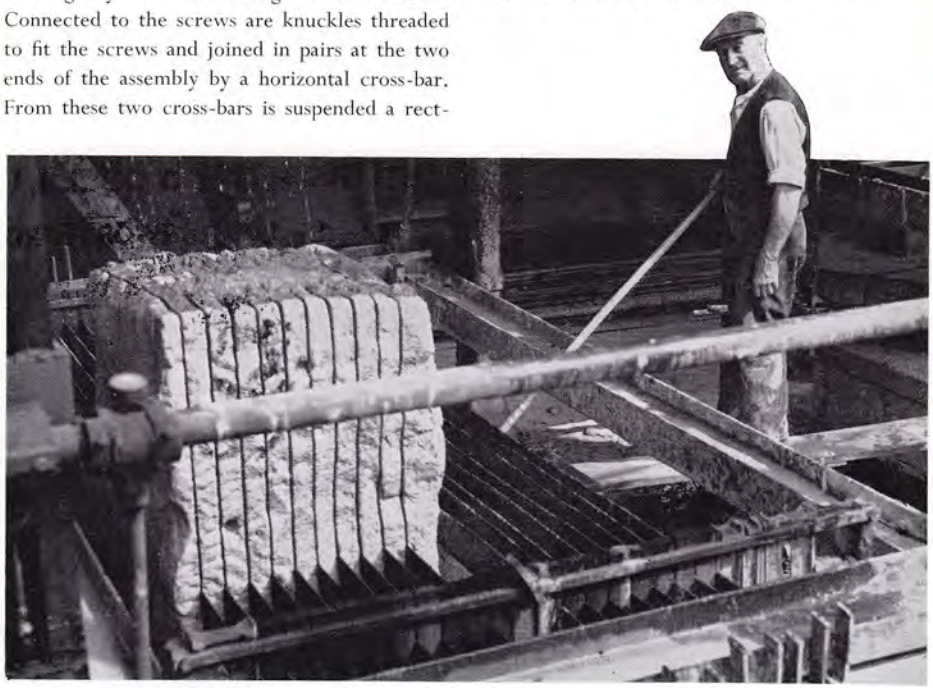
This is the first of a new series of six articles

PRIMARY SAWING is the name given to the first operation in the conversion of block stone into a finished piece of masonry. Apart from the wire saw which has a limited use, the machines used for primary sawing are either of the reciprocating frame or circular blade types.

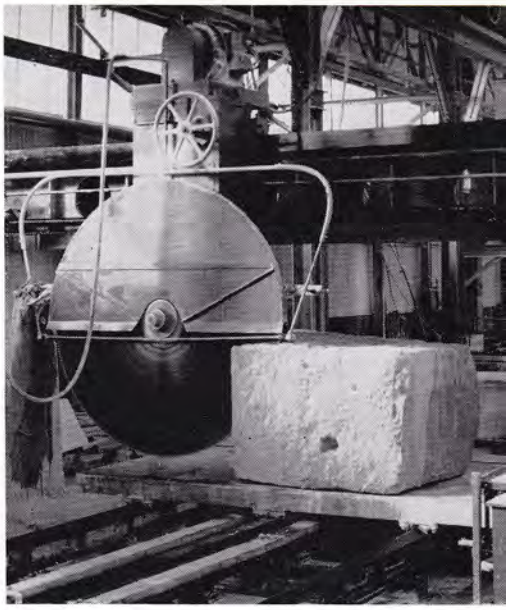
Reciprocating frames, which are the older type of machines but still in wide use, consist of four vertical hollow pillars braced together for rigidity and containing vertical screws. Connected to the screws are knuckles threaded to fit the screws and joined in pairs at the two ends of the assembly by a horizontal cross-bar. From these two cross-bars is suspended a rectangular frame of steel-channel or H-joists and longitudinally on this frame are fitted steel saw-blades on edge. The blades are spaced to suit the cutting required and are held in tension by means of buckles and wedges.

The frame is connected by a long spear rod to a crank-shaft which is driven by electric or other power. The crank-shaft gives a swing of about 12 in. to the action of the suspended frame. The blocks of stone are loaded on a bogey which is run under the frame and the cutting is done by the edges of the steel blades acting on a mixture of sand and/or steel-shot and water which is fed into the cuts. The rate of cutting is controlled by gearing run from counter-shafts and operating on the vertical screws, and this varies from 1 to 6 in. per hour depending on the hardness of the material being cut and the number of blades in the frame. Blocks up to 5 or 6 ft. high can be cut by this means.

A circular saw is used where the blocks of stone are up to 3 ft. high generally. It consists of a circular blade with the perimeter set with sockets containing single diamonds or diamond dust. The blade can be mounted on a spindle running on fixed bearings and the block loaded on a table which moves mechanically under the blade, or it can be mounted on a cross-head on which it travels over the block lying on a fixed table. With the circular blade one cut is made at a time but the operation is very much faster than that of the frame saw.



THE BLADES OF THE FRAME SAW ACT ON A MIXTURE OF SAND AND/OR STEEL-SHOT AND WATER WHICH IS FED INTO THE CUTS.



THE CIRCULAR BLADE IS SET WITH SOCKETS CONTAINING SINGLE DIAMONDS OR DIAMOND DUST.

The block is usually cut in one of two ways. More usually the cuts are made parallel to the stone's bed planes so that these primary cuts form the top and bottom beds of the finished piece of masonry, but the cuts can also be made vertical to the bedding planes so forming the front and back faces of the finished job.

At the Portland Stone Quarries the circular saw has been developed up to nearly 12 ft. diameter, enabling blocks of up to 5 ft. high to be cut by this means and eliminating almost entirely the reciprocating frame saw.

The next article in this series will deal with Secondary Sawing. The preparation of granite will be described in a separate article.

'Stones of Britain'

BY B. C. G. SHORE

Leonard Hill, 66s.

Architects, builders, surveyors, and all connected with the building industry—and also the layman—will find this newly published work on natural stone and its uses of real practical value and interest. The author, who is himself an architect, equals his weighty knowledge of the subject with an admiration—'affectionate passion' would be a truer description—based on long experience. Though some might wish the text's arrangement had been more systematised, it is an essentially personal book; parts indeed are more like a scrapbook or journal of snippets and explanatory captions to photographs, of which there are a large number. Of particular value are the sections on maintenance, 'dendistry' repairs, combating damp, and cleaning. The rich endowment of building stones bestowed by Britain's geological structure is also discussed with plenty of sensible advice. Colonel Shore calls his book a 'pictorial guide to those in charge of valuable buildings'—one might add: and to all those who wish to appreciate them with a richer understanding.

B. S. F. Conference in Weymouth

It has become the custom to hold the British Stone Federation's annual conference at a town near to the President-Elect's place of business. This year's President-Elect is Mr. P. Pakenham of the Bath and Portland Stone Firms Ltd., and so from 9-13 May delegates will assemble at Weymouth's Gloucester Hotel. An extensive visit will be made to the Portland quarries.

Location of principal quarries throughout England, Scotland and Wales.

Guiting Stone

SOURCE Temple Guiting, near Cheltenham, Gloucestershire.

GEOLOGY Cotswold oolitic limestone; Jurassic.

COLOUR Cream and Buff.

CHARACTERISTICS Medium grain with minute shells. Easily worked and suitable for exterior use.

AVAILABILITY Can be supplied on demand. There are ample stocks at the quarry and, owing to extent of deposits, there is a considerable future reserve.

SIZES Average size blocks are up to 35 cu. ft., to comply with normal lifting facilities; but blocks often measure 16 ft. × 3 ft. 9 in. × 3 ft. 9 in. before reduction to customer's requirements.

PHYSICAL PROPERTIES Density: 130 lb. per cu. ft.

WHERE USED Has been used in the North Cotswolds since Norman times, an outstanding example being Stanway House (circa 1630); it can also be seen in innumerable local churches and other public buildings. Among other structures containing it are Balliol College (1911 extension); Royal Oxford Hotel; Eynsham Hall, Oxfordshire; Birmingham Oratory; Lloyds Branch Banks, Coventry; R. C. Church, Cardiff; Warley Church, near Birmingham; Taunton College Chapel; additions to Eton College; Abbey Bridge, Worcester; St. Swithin's Schools, Winchester; Farmers Union Building, Stratford-on-Avon; etc., etc.

ADVISORY SERVICE

The British Stone Federation has made a close study of all the problems relating to the use of stone, and has set up an advisory panel, which is freely at the service of architects and others, to give advice and help on stone matters. Inquiries should be addressed to the Secretary, The British Stone Federation, 70 Victoria Street, S.W.1.

CONSTRUCTIONAL NOTES

Fixing Stone Facings to Reinforced-Concrete

THE ATTACHMENT of stone facings to steel-framed structures does not pose a very difficult constructional problem, but when the facing stones are to be attached to and supported by reinforced-concrete, it becomes more involved. As concrete in its plastic state can be moulded or cast into any desired form by the use of suitably designed moulds, early collaboration between the structural engineer and the masonry contractor is always desirable. Allowance can then be made for anchoring the facings when planning the concrete's detailed design.

The accompanying sketch shows the construction of stonework forming the facings to a building with a reinforced-concrete frame. The fascia stones are supported by a projection formed as part of the lintel of reinforced-concrete which spans the opening between the vertical framing-members and also supports the floor slab. The top surface of the concrete projection is inclined towards the lintel, thus forming a key to the bottom portion of the fascia stones and upon which they are bedded. The top portion of the fascia stones is held in position by metal wall-cramps.

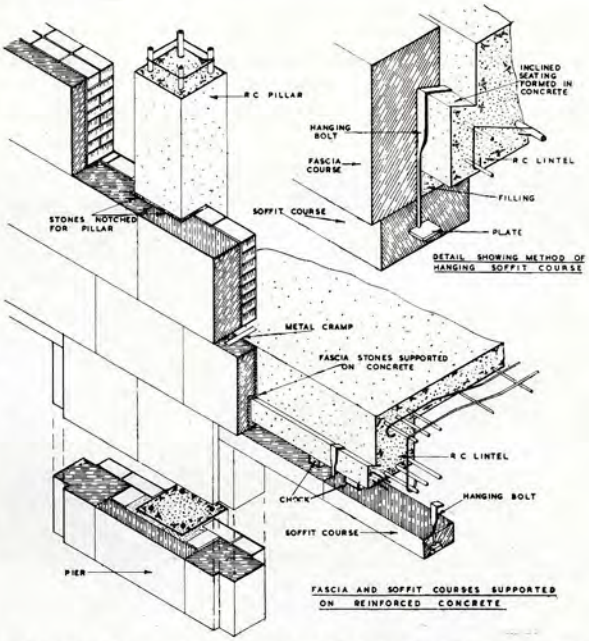
The inclined surface of the concrete projection also forms a seating and anchorage for the metal hanging bolts by which the soffiit stones are suspended. Metal plates are threaded on these bolts and inserted in mortices cut in the joints of the soffit stones. A threaded nut on the underside of the plate is adjusted to fix the plate in the required position before the adjacent stone is added.

When the soffit course is completed and the stones are in position, the joint-spaces between them are pointed and the interstices filled with cement grout. Care must be taken to ensure that the grouting material fills all the spaces between the metal plates and the sides of the mortices, so that after the cement has set hard and the weight of the soffit stones is transferred to the hanging-bolts, the stones will remain rigid and secure in their correct position.

The space between the bottom surface of the structural member and the top surface of the soffiit stones should be filled tight with bricks and cement-mortar, which should be allowed to set before the front fascia stones are placed in position. Failure to observe these essential conditions will cause cracks to form in the face of the stonework.

Any Questions?

Readers are invited to submit questions about methods of erecting stonework. Detailed replies by an expert will be sent, a selection of which will be published in future issues.



ODD CHIPPINGS

'If you build more in stone you will build cheaper in stone. You will also put up buildings that won't have a mere 30 or 40 years of useful life but will last as long as anybody wants to use them. With proper care, you could count the life of a well-built stone house in centuries. . . .

'If you build a house, you should be building something that will last for generations and carry the past into the present and the future. That means that we in Scotland should be building again in stone. We have the stone. Let us have the sense of true economy and of continuity to make use of it'.—*Scottish Daily Mail.*

Some 2,000 tons of Portland stone were used in the facade of Lewis's new store in Bristol; they were divided into close on 40,000 individual blocks.

A 16 mm. sound film entitled *Building in Stone* can now be hired free of charge from the London Association of Master Stonemasons. It runs for 34 minutes and traces stone through all its stages, from the quarry to where it is being fixed in position on the building site. Application should be made to the Secretary, L.A.M.S., 47 Bedford Square, London, W.C.1.

PRINTED BY KENNERLEY PRESS LTD., LONDON, N.1—9658