Issued by

The British Stone Federation

141 Streatham High Road, London SW16

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Architectural Engineering Monumental

STONE

information on current stone practice. No. 24: April, 1964

Prefabrication and natural stone

A new technique of bonding thin stone slabs on to concrete has created a new range of building components

PREFABRICATION of components is now accepted as a regular method of building and there can be no doubt that in future years they will be employed even more extensively. Foreseeing this trend, one of the leading member firms of the British Stone Federation embarked some years ago on a programme of research and development of applications of this new method of building to natural stone.

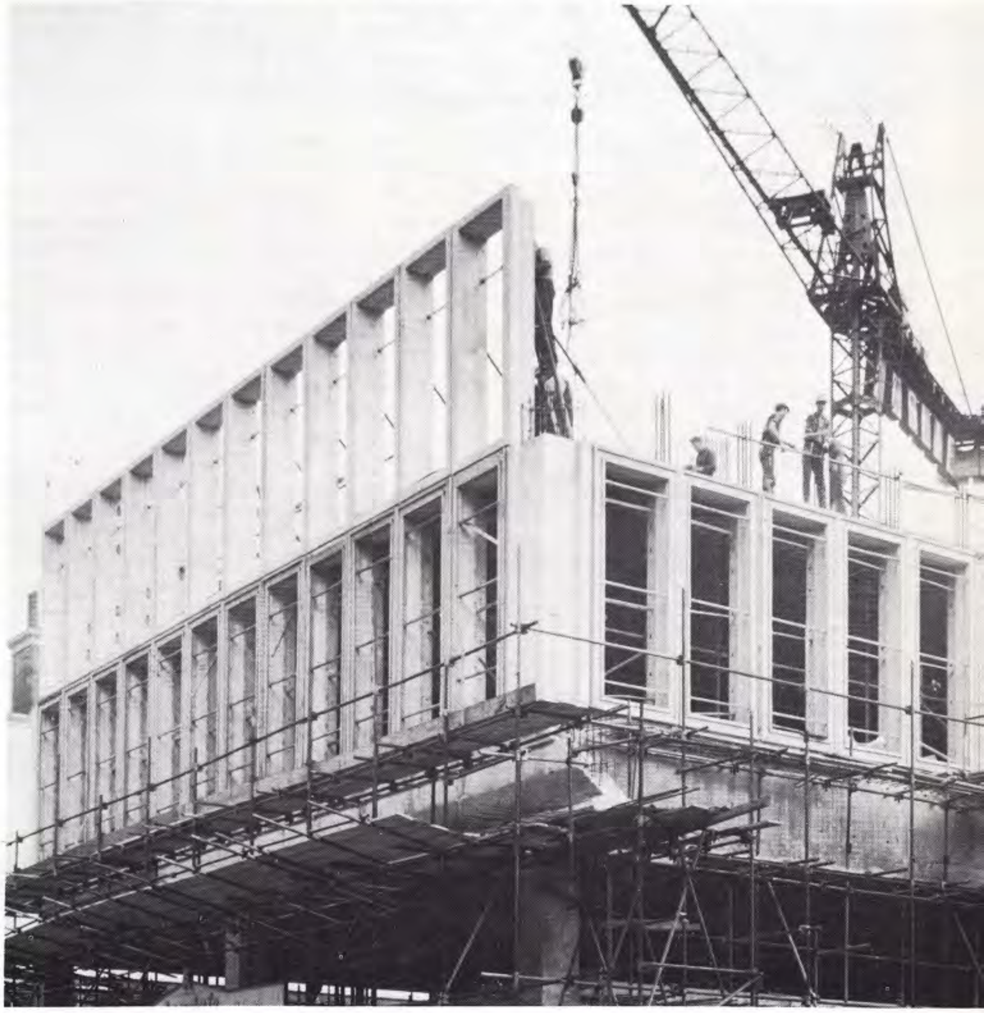
Initially, three sets of questions had to be considered: first, which particular technique of prefabrication would be most suitable? The qualities demanded were that when the units were incorporated in the building it should be economically competitive with conventional methods of building with stone; that its speed of erection should be competitive with other forms of prefabrication; that it should be shown to be constructionally and aesthetically acceptable to all parties concerned; and that it should provide profitable work for the masonry yard.

Secondly, how large was the potential market? For instance, what proportion of prefabricated buildings were in the price range envisaged, and were these buildings of the type to contain stone, e.g. commercial buildings? Would the introduction of stone in this form open up new markets?

Thirdly, what effect would prefabrication have on conventional masonry? It had to be firmly established that the swing to this form of masonry would not be so violent as to undermine the industry's capital investment in machinery designed to produce conventional masonry.

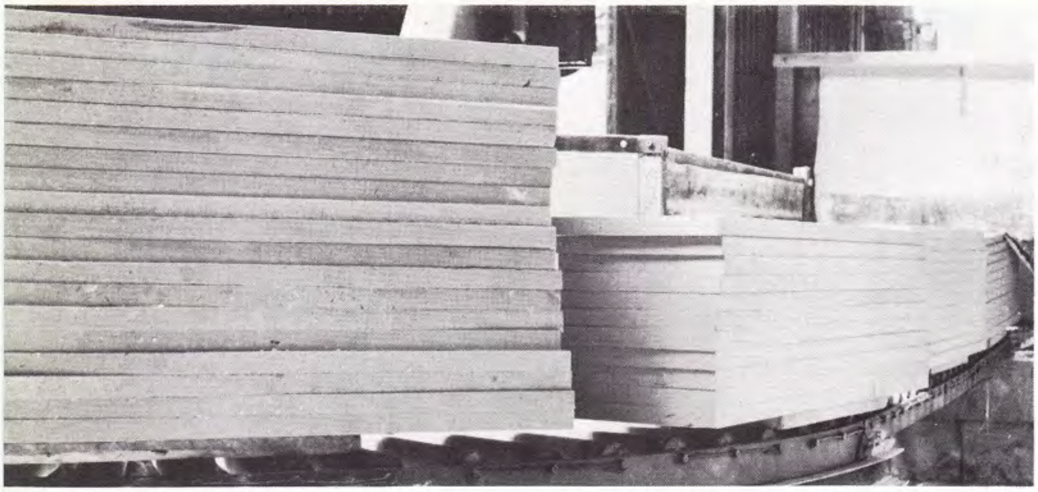
To answer the first set of questions: after experimenting with several different techniques such as the employment of resin adhesives, lightweight metal frame panels, and pre-stressing, it was decided that the most satisfactory method was to back thin slabs of stone with concrete. The latter was already an accepted form of prefabrication and, because of this, the doubts over whether it would be competitive in speed of erection and constructionally acceptable were already answered. A cost analysis proved also that, cost for cost, precast components would be economically competitive with 3 in. ashlar; furthermore, they could be erected far more speedily, but only where the building was designed to have repetitive elements. The fact that large numbers of identical stones would be used meant that their manufacture would be essentially a machine process which, it was calculated, would be equally as profitable per foot super as any form of ashlar. The question of aesthetic acceptability would have to wait until prototypes had been produced, but it soon became apparent that for every architect who considered this kind of veneer treatment to be aesthetically dishonest and unacceptable at least one other architect thought it to be the most exciting thing since concrete itself.

How to assess the potential market presented a very much more difficult problem. It was comparatively easy to calculate the potential proportion of prefabrication in the light of current opinion but allowance had to be made for future increases in demand. There was indeed evidence that a number of architects, not previously disposed to use stone because of its conservative image, now saw the material in a different light. Despite the uncertainty it was decided, without going into lengthy market



PREFABRICATED WINDOW UNITS FACED IN NATURAL STONE ARE SET ON THE FLOOR SLAB AND PROVIDE PERMANENT FORMWORK TO THE IN-SITU COLUMNS AND EDGE BEAMS. AFTER THE FLOOR SLAB IS CAST, THE STRUCTURE IS RIGID AND WORK CAN BE STARTED ON THE NEXT FLOOR. NOTE THAT IN THIS BUILDING NO EXTERNAL SCAFFOLDING IS NEEDED TO ERECT THE PREFABRICATED UNITS. THE BUILDING SHOWN IS ARNDALE HOUSE, BRADFORD

Client: Arndale Property Trust Ltd
Architect: J G L Poulson
in conjunction with G M Baxter
Staff Architect, Arndale Property Trust Ltd
Quantity Surveyor: R G McCaffray
Consulting Engineer: W V Zinn & Associates
Main contractors: Leslie & Co Ltd



surveys, that the market was potentially good enough to proceed with the project.

Finally, what effect would prefabrication of stone components have on conventional masonry? The hesitancy to be expected in the employment of most new methods and the long period necessary — compared at any rate with America — for new ideas to permeate through the building industry suggested that one could be reasonably sure that there would be no rush for the new components. Prefabricated facings manufactured from other materials, often at a higher cost than was possible in the case of stone, were already well established, and therefore to obtain even a part of this market would be an advantage.

Having reached some conclusions about the technique to be used, the size of the potential market, and the long-term effects, the next step was to put theories into practice. Understandably, before anyone was prepared to consider using this type of construction, there had to be proof of its durability. Bonding was achieved through the natural adhesion between cement and limestone, involving both the interstitial penetration of the cement into the stone and the crystalline growth between the two materials. This method had been observed and reported on by a Russian Professor Boudnikov in 1959 and J. Farran of France in 1956. As well as these laboratory observations, practical tests had been carried out in 1946 and the Americans were already marketing a marble-faced panel constructed on a similar principle for which very convincing test results were available. Very encouraging evidence also came from a series of tests in which 1 in. Portland stone was bonded to concrete. At the same time a great many pitfalls were discovered and, as a safety measure, it was decided to use, as the Americans had, a number of wire cramps to tie the stones back. It was also learned that at 1 in. thickness the optimum size of stone was 5 ft. super and that it was necessary to work to much finer tolerances than the masonry industry had known previously.

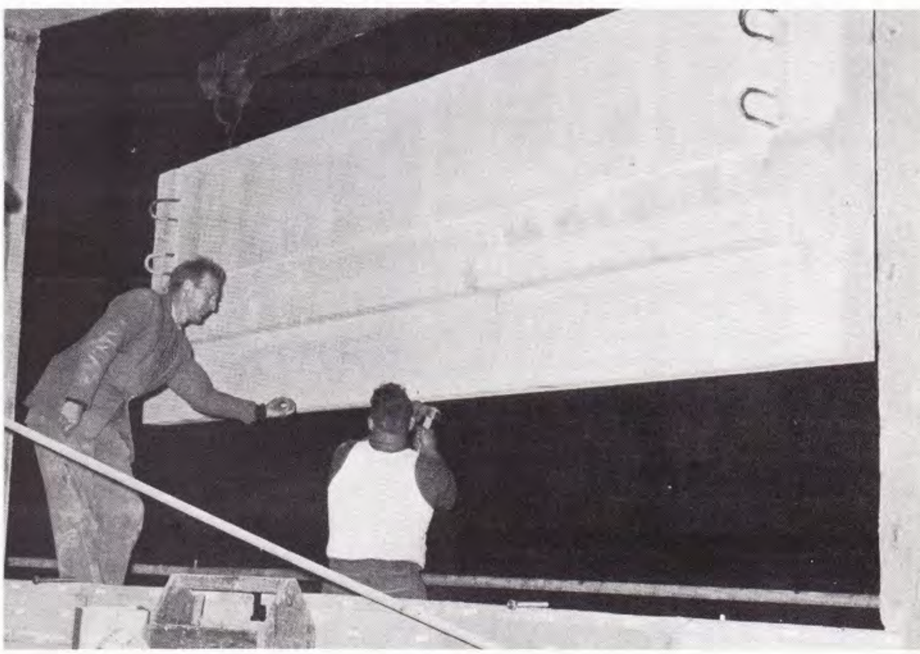
The first supplies of completed precast panels are being fixed by companies that specialize in precast concrete and are experienced in this kind of work. The first contract was begun in the spring of 1963, and since then other contracts have been signed. The stone slabs, pre-drilled to receive cramps, are packed in boxes and carried to the casting works where they are laid into conventional concrete moulds. In some instances a mason is drafted to the concrete company and is responsible for supervising the fitting of the stones. The units are poured in the usual manner and taken from the mould as finished products. At the site they are generally erected straight on to the building from the lorry, though the precise method of fixing the units depends upon the system employed by the concrete manufacturer, and this, of course, can greatly affect the speed of erection. On one particular contract stone-faced panels measuring 12 x 5 ft. could be erected at the rate of one every ten minutes.

Orders for prefabricated stone panels are increasing but, as anticipated, there has been no indication at all that this is causing a reduction in orders for conventional masonry. Many of the inquiries are in respect of hospitals and schools, jobs for which previously stone would not have been considered. There are good reasons for believing that prefabrication will lead to a gratifying increase in the use of natural stone.

Above:
A CONVEYOR SYSTEM MOVES 1 IN. STONE SLABS PRIOR TO DESPATCH TO THE CASTING WORKS

Left:
A PREFABRICATED UNIT IS HOISTED INTO POSITION ON THE BUILDING. NOTE THE COARSE TEXTURE OF THE ROACH STONE

Below:
THIS LARGE PREFABRICATED UNIT WAS FIXED DURING THE NIGHT SO AS TO OBTAIN MAXIMUM USE OF THE CRANE. FOUR 'U' IRONS USED FOR FIXING CAN BE SEEN IN THE BACK OF THE PANEL. THE LONG PRECAST NIB IS CARRIED ON THE FLOOR SLAB



Glossary of stone: Labours and Finishes

THE BRITISH STANDARDS INSTITUTION issues a *Glossary of Terms for Stone Used in Building** It includes the following terms under the heading 'Labours and Finishes', some of which may be unfamiliar to the reader:

Angle droved *(Scotland)* See 'Angle tooled'.
Angle tooled *(Scotland)* Stone dressed so that the tool marks run diagonally across the face.
Axed Having a surface obtained by using an axe, a patent axe or a bush hammer. A surface is said to be 'fine axed' when it has been chopped with fine axe marks. 'Once-axed' is the term used for rough chopping of a surface with an axe.
Batted BROAD TOOLED Having a surface obtained by using a batting tool in parallel strokes each traversing the full depth of the stone face. The strokes may be vertical, when it is often referred to as tooling, or oblique at an angle of 45° to 60°. The result is a regular pattern of fluted cuts in the stone face. The number of strokes per inch may vary from 8 to 10.
Blocking out *(Scotland)* Roughly shaping a slab or stone.
Boasted A stone finished by dressing with a boaster. (Called 'Droved' in Scotland.)
Boasted for carving Reduced by rough dressing, usually with a point tool, to approximately the form required by a sculptor.
Broached *(Scotland)* Worked with a point to show diagonal or horizontal furrows.
Broad tooled See 'Batted'.
Bull faced *(Scotland)* See 'Hammer dressed'.
Carborundum sawn Having a smooth sawn face, as produced by a carborundum saw.
Channelled *(Scotland)* See 'Rusticated'.
Cloured *(Scotland)* Hacked or hammer dressed.
Cloven The surface obtained by splitting or cleaving a rock.
Combed Having all irregularities on the exposed surfaces of soft stones worked off by the use of a drag or a comb. The comb is drawn over the surface of the stone in all directions after it has been roughly reduced to a plane with a saw or chisel, making it approximately smooth.
Dabbed DABBLED *(Scotland)* Fine and close sparrow pecked with a sharp point.
Drafted margin A tooled margin from ¾ in. to 2 in. wide worked on the face of a rough squared stone.
Dragged See 'Combed'.
Dressed 1. Having any kind of worked finish. 2. Of slate, having a bevelled edge as left by a dressing knife or guillotine as opposed to a sawn edge which is not bevelled.
Droved *(Scotland)* See 'Boasted'.
Eggshell Having a dull polish or a matt surface.
Face bedded A stone cut with the laminae running vertically and parallel with the face.
Fluted Having a surface worked into a regular series of concave grooves.
Furrowed Having a surface consisting of small flutings.
Hammer dressed Having a rough face prepared with a hammer. (Called 'Bull faced' in Scotland).
Honed See 'Eggshell'.
Joint bedded A stone cut with the laminae running vertically and parallel with the joints.
Mitring, internal The labour in forming the intersection of two mouldings, splays and the like; the seen faces making an angle less than 180°.
Mitring, external The labour in forming the intersection of two mouldings, splays and the like; the seen faces making an angle greater than 180°.
Moulded Cut to the profile of a moulding.
Nidged Having a fine dressing made with a chisel. Generally applied to kerbs.
Pecked See 'Picked'.
Pencil arrissed PENCIL EDGED Having the arris rounded to a radius of approximately ⅛ in.
Picked A dressing obtained by means of a point tool or a pick.
Pitched A surface produced by a pitching tool to resemble the natural rock face. (See 'Rock faced'.)
Polished Having a high-gloss mirror-like finish.
Polished (slate) This term is synonymous with the term 'rubbed' for stone (q.v.).
Punched A finish obtained by removing the larger irregularities by means of a point tool.
Reeded A surface worked into a regular series of convex ridges.
Reticulated An irregular network of bands worked on a true-faced stone, the sinking between the bands being about ⅜ in. deep, worked true to a gauge and 'picked' with a fine mallet headed point.
Rock faced The natural face of the rock or a dressing resembling it (see also 'Pitched').
Rubbed A finish obtained by rubbing with abrasives to the degree of smoothness required.
Rusticated A stone having a sunk dressed margin. (Called 'Channelled' in Scotland.)
Sanded Finished by rubbing with abrasive.
Scabbled *(Scotland)* Finished by fine angled droving.
Scappled *(Scotland)* Roughly faced with pick or hammer.
Scribbled *(Scotland)* Hammer dressed beds or joints of masonry with marginal chisel drafts.
Shotted The face resulting from grinding with steel shot by means of a heavy steel ring used in a polishing machine.
Snaked See 'Eggshell'.
Sparrow pecked See 'Picked'.
Stugged *(Scotland)* Pecked stone faced with a pick or pointed tool.
Tooled See 'Dressed'.
Vermiculated Having a dressing taking the form of irregularly shaped sinkings resulting in winding, worm-like ridges.

**Obtainable from British Standards Institution, 2 Park Street, W1 (BS 2847:1957, price 7s 6d. net)*

Location of principal quarries throughout the British Isles

Location of principal quarries throughout the British Isles

Tor Down Granite

SOURCE. St. Breward, Bodmin, Cornwall.

GEOLOGY. A true granite, consisting of light-grey translucent quartz, white feldspar (orthoclase), and black mica (biotite) with some white mica (muscovite).

COLOUR. Light grey.

CHARACTERISTICS. Medium grain.

AVAILABILITY. Unlimited.

SIZES. Limited only by the capacity of the lifting gear — which in the quarry is 15 tons — say 200 cu. ft.

FINISH. Rock-faced, fair picked, fine axed, egg-shell, or polished.

CRUSHING STRESS. 1,300 tons/sq. ft.

WHERE USED. T.U.C. Memorial Building, London; Esso House, London; also in numerous engineering works, including almost all the Thames Bridges from Tower Bridge to Kew and the South Bank river wall.

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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 gives architects and others free advice and help on stone matters. Inquiries should be addressed to the Secretary.

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