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CONTENTS FOR MARCH 1954

VOLUME 39

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Cape Town Office: D.F.B. Building, 16, Mill Street. P.O. Box 4562. Phone 3-2682

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INFORMATION SHEET

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Roof Pitch in Relation to Wind Damage

150 Q. Does the pitch of a roof affect its liability to wind damage ?

A. Yes, especially for high speed straight winds, although it must be realized that the twisting wind of a tornado is liable to damage a roof of any pitch. Winds of hurricane force occur from time to time in most parts of South Africa. These are liable to cause a fair amount of damage to roofs made up of wooden trusses and purlins clad with corrugated iron, as did the recent severe gale in the Transvaal. After this storm, it was observed that the majority of roofs damaged were of the fairly flat monopitch type, which indicated that roofs of a flat pitch were more prone to damage than those of a steeper pitch. These observations emphasized that, when all other factors are the same, the pitch of the roof does affect the liability to damage.

Tests on models in wind tunnels have shown that if the inclination of the sloping surfaces of a roof to the horizontal plane is less than 30°, the wind causes an uplift on both the windward and leeward slopes. When the sloping surfaces are at 30° to the horizontal, a negligible force is exerted on the forward slope but on the back slope the uplift is approximately the same as with flatter roofs. When the angle of inclination increases above 30°, the force exerted on the windward slopes becomes a pressure which increases as the slope increases, while the uplift, on the leeward face, alters very little. Allowance for this variation of pressure with inclination to the horizontal of a roof is incorporated in the standard loading regulations of many countries. An example based on the design criteria recommended by the South African Bureau of Standards in Chapter 3 of their model building regulations will illustrate this.

Assume that pitched roofs for two buildings have to be designed for a wind of 75 m.p.h. the height to the ridge being 20 feet. Let one roof have a slope of 10°, to the horizontal, and the other a slope of 35°. For this height and wind velocity, the above regulations specify a basic design wind pressure of 13.9 lbs. per sq. ft. To obtain the positive or negative wind pressures normal to the windward and leeward roof surfaces, this basic design wind pressure must be multiplied by experimentally determined factors, which vary with the slope. For the roof with the 10° slope the factors are —0.66 on the windward half and —0.50 on the leeward half, and for the roof with the 35° slope, +0.08 and +0.50 respectively. Thus, for the roof with a 10° slope the windward portion must be designed for a suction of $13.9 \times 0.66 = 9.18$ lbs. per sq. ft. acting normal to the roof surface and the leeward portion for a suction of $13.9 \times 0.50 = 6.95$ lbs. per sq. ft. For the roof with 35° slopes the windward portion must be designed for a pressure of $13.9 \times 0.08 = 1.11$ lbs. per sq. ft. and the leeward portion for a suction of $13.9 \times 0.50 = 6.95$ lbs. per sq. ft. Therefore, for the flatter roof a suction of 9.18 lbs. per sq. ft. must be used in the design of the anchors whereas for the steep roof only 6.95 lbs. per sq. ft. would be used.

Repairing of Cracks in Buildings

151 Q. What procedure should be followed in repairing cracks in buildings ?

A. Cracks in buildings may be due to many different causes and may range in severity from barely discernible hair cracks to serious cracks which may affect the building structurally.

When the cracking is serious, it is necessary to know the cause, as this determines the appropriate remedial measures. The various causes of such cracking are discussed in Information Sheets DIS 10, 11, 13, 16, 21, 22 and 25.

Crazing, or the appearance of essentially superficial cracks in a plaster, is unimportant structurally and is best repaired by redecoration. However, this may be only a temporary step, as the crazing is likely to reappear in time.

Fine cracking in plaster may be due to slight movements in the underlying masonry and in such cases the crack pattern tends to follow joints. It may be widespread when a large number of small cracks appear, or it may be localized when a limited number of somewhat larger cracks appear. With widespread cracking the best treatment is redecoration but this again is generally only temporarily effective as any repetition of structural movements will cause recurrence. Larger localized cracks can be filled in with a suitable mortar, or, in internal walls, with plaster of Paris. Such rigid materials are, however, not satisfactory where the movements are progressive, and in such cases the crack should be filled in with a mastic material which retains its flexibility. Subsequent movements, particularly if large enough, will cause disfigurement of such mastic fillings, but they generally prove somewhat superior to rigid materials.

A special case of structural cracking which is of considerable importance is that encountered when buildings are erected on heaving

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clay foundations. It is considered that mastic materials, applied, for instance, by means of a pressure gun, represent the most promising treatment for this type of crack.

A further special case is that resulting from the expansion of unsound lime mortars. This type of failure, which is characterised by a crack pattern outling the masonry units and is generally more severe in the upper 10 courses of brickwork, generally becomes progressively more serious with time. Redecoration is only effective in very mild cases and, since even in more severe cases the cracks are not wide enough to fill with mastic, this treatment cannot be effectively applied. The application of a textile scrimming and redecoration or alternatively the application of wallpaper, are probably the best treatments for this defect. but even these will prove inadequate if the cracking is very serious.

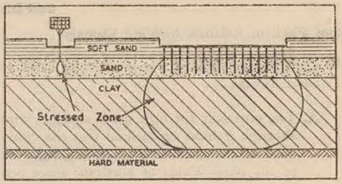
Design for Foundations on Bearing Piles

152 Q. Can load tests on single piles be used as a basis for designing a foundation supported on bearing piles ?

A. When interpreting the results of load tests on single piles, it should be remembered that they provide data which only concern the bearing capacity of single piles. A thorough study of the profile is necessary before conclusions as to the behaviour of a larger group of piles can be made.

During a load test on a single pile only a small volume of soil in the immediate vicinity of the pile is stressed by the applied load. With a structure acting as the applied load on a group of piles, stresses of equal intensity will reach to a much greater depth in the soil, as shown in the diagram. Should it happen that a weaker layer is located at greater depth, as shown in the diagram, only negligible stresses will be induced by a single loaded pile. However, in the case of the structure itself, considerable stresses will be transmitted to the underlying layer with the possibility of overstressing the weaker material and thus causing settlements.

Similar conditions exist with the use of load plates for foundation design. It is therefore obvious that the use of loading tests as a basis for foundation design should be very carefully examined in every case, where it is proposed to use such tests.



Artificial Lighting

153 Q. How can the total running cost of a lighting installation be calculated ?

A. In a lighting installation the lamps are consumable articles and, therefore, the initial as well as the replacement costs of lamps should be treated as running costs. The calculation of the running cost of an installation also depends on other factors, of which the hours of operation and the cost of electricity are the most important.

When comparing the running cost of one installation with another, the calculations are based on a lumen-hour basis. A convenient formula to use is the following :—

$$C = \frac{1000}{F}\left\{\frac{c}{h} + (Cc \times P)\right\}$$

where C = total running cost in pence per million lumen-hours.

c = cost of lamps in pence.

Cc = cost of current in pence per unit.

F = lumen output of lamps.

h = lamp life in thousands of hours.

P = lamp wattage.

When calculating Cc it should, however, be kept in mind that allowance should be made for any kilowatt or maximum demand changes. This must be divided by the estimated annual burning hours.

For the comparison of different fittings, the lamp lumens (F) should be multiplied by the appropriate Coefficient of Utilisation.

MORCO HOUSE, BENONI

GEORGE CANDIOTES, ARCHITECT

Morco House, the new six-storey building in Commissioner Street, now completed, was originally designed to consist of shops with basements and one floor of offices. Much credit is due to the owners, S. F. Morris and Son (Pty.) Ltd., for their enterprising decision to erect an additional four floors of offices, and by thus doing, have displayed their faith in the future commercial prosperity of Boksburg.

In the planning of Morco House, the architect, Mr. George Candiotes, was given the basic requirement that good architecture should go hand in hand with economy in construction. A building designed in the contemporary idiom to fulfil the exacting needs of the professional man and office worker was called for. Facing North, Morco House occupies a very prominent position opposite the Town Hall gardens and no stone has been left unturned in planning and designing a building that will not only be a credit to Boksburg, but, it is hoped, to the profession of architecture in general.

Much time and thought was given to the design and detailing of this building and to the imaginative choice of colours, textures and materials. To avoid heavy maintenance costs, it was felt that the materials chosen, wherever possible, should be permanent and durable, and be aesthetically appealing.

GROUND FLOOR

The show windows to the three shops on the ground floor have been set back some six feet from the building line, thus creating display areas which are uninterrupted by structural columns, and forming a pleasant recess, which by the choice of appealing colours and materials, has been designed to attract the man in the street and potential customer ; this, after all, is the function of good shop design. In order to ensure that merchandise displayed is seen to the best advantage, adequate fluorescent lighting has been planned for the display areas ; the specially designed light fittings form an integral part of the shop front design. The stallrisers to the shop fronts are faced with Chiampo Onyx marble and the floor of the recess is paved with cream coloured cement terrazzo tiles, simply patterned with black and red squares. The five free standing circular columns which form part of the structural system of the building are finished with yellow glass mosaic and the underside of the canopy with rough cast " Tyrolean " plaster.

Each of the shops is conveniently related to its basement and a fourth basement under the main entrance to the building is accessible from the rear yard and has been provided for the use of the building owners.

That portion of a building from which one gains first impressions of the interior, namely the entrance hall, has come in for special attention in its detail, decoration and finish. It will be seen that by the imaginative use of inexpensive materials, unusual and pleasing effects can be achieved.

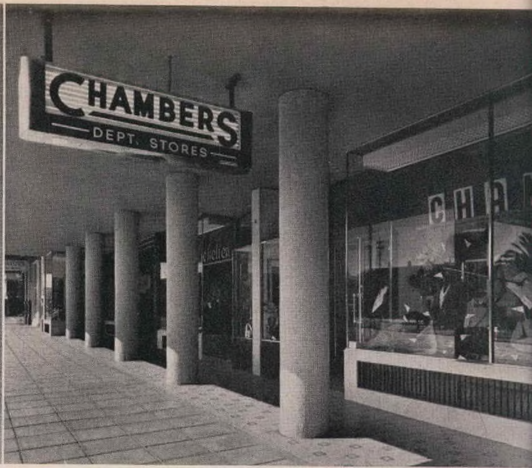
OFFICES

The offices have been designed on the " module system " for maximum flexibility and convenience. Tenants may have offices of 11 feet, 14 feet, 17 feet or any other greater " module " width to suit their needs. This is made possible by the design of the windows which make provision for a wall to be built every few feet, as required. As good lighting is an important factor in office planning, large windows have been provided.

Each office can be fitted with a washbasin at short notice. The necessary plumbing is " built in "—false ceilings over each corridor conceal sundry main water and waste pipes, etc. Provision has also been made in offices for individual electric hot water geysers for the use of dentists, medical practitioners and any other tenants. Wiring and cables for Government telephones and private inter-communication systems are planned and concealed behind hollow skirtings, thus obviating an eyesore that is common in many buildings.

Although not generally appreciated, the correct application of colour to buildings does play an important part in shaping our everyday lives. To use colour requires courage, and failure to understand the fundamental principals of Colour Dynamics often leads to a " play safe " attitude being adopted. This results in creams, browns and such similar non-stimulating colours being used. On the other hand, if colours (other than creams and browns) which are not harmonious are used, then the results will jar and not satisfy.

Having regard to these facts the architect has departed from the conventional attitude and a sincere effort has been made to improve the general environment by introducing carefully selected colours which will not only enhance the surfaces to which they are applied but will create a most satisfying and stimulating sense of well-being.



ABOVE, LEFT THE MAIN ENTRANCE As with other parts of the building, colour and materials are extensively used. The space behind the building line is floored with off-white terrazzo tiles with maroon pattern The steps have grey marble treads and mottled red risers. The wall at right is in "Slasto" with the show window set on a quarry tile podium capped with slate, and the wall flanking the entrance is in off-white terrazzo. The "eggerate" motif is dark grey with white edges, the light ceiling is pale green and the lintel over the door is deep red. RIGHT : THE SHOP WINDOWS. The soffit of the pavement canopy is pale rose "Tyrolean" plaster The columns are finished in yellow glass mosaic, and the stall risers are faced with beige marble with bronze coloured grilles in front of pale grey wall and window surfaces. Mottled red marble flooring marks the shop entrances. The light troughs have a pale primrose base, powder blue box and ivory eggerate. The name sign was not designed by the architect

Six of the nine offices on each floor face north and command extremely attractive views of the Town Hall gardens in the foreground and Boksburg Lake in the distance. It is seldom that an office block can have such a garden setting.

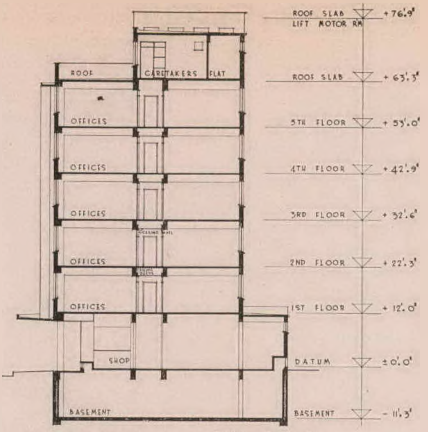
The walls and ceilings of the offices generally are plastered and painted with washable distemper ; the corridor walls are finished with roughcast Tyrolean and the floors generally are patterned with asphalt tiles.

A sense of individuality has been imparted to the corridors on each floor by the choice of distinctive colour arrangements for walls, floors and ceilings.

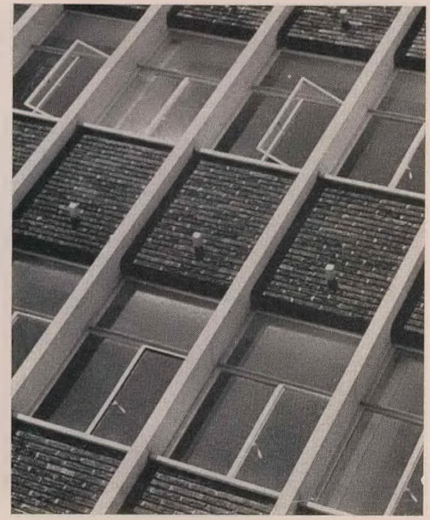
A caretaker's flat of generous proportions consisting of a living room, bedroom, bathroom and kitchen has been provided on the roof. As the roof buildings can be seen from some distance as one approaches the centre of Boksburg, great care was taken to integrate the lift motor room and flat harmoniously with the rest of the building.

Simplicity is the keynote of the main elevation facing Commissioner Street, and the architect's efforts to break away from the usual greys, creams and browns is again strikingly apparent to the onlooker. This elevation is faced generally with multi-colour facebrick panels capped with white terrazzo sills. The vertical white terrazzo fins between windows form the "module" controlling the positions of walls internally. A sense of unity of the whole elevation is achieved by the enclosing sides and top surround which are faced on the leading edge with white terrazzo and on the return with a lemon-coloured rough-cast Tyrolean plaster.

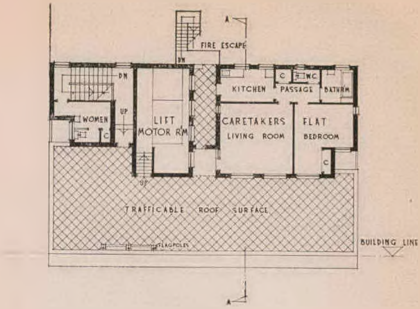
The steel windows are painted an Eau-de-nil green and at the heads of these windows the steel members supporting the rustic facebrick panels are painted an orange-red colour. To add to the interest of the elevation, two inch square white terrazzo blocks projecting $4\frac{1}{2}$in. have been positioned under the windows in each facebrick panel, and also at regular intervals along the multi-rustic parapet wall of the roof. During sunny weather these blocks cast interesting shadows on to the brickwork.



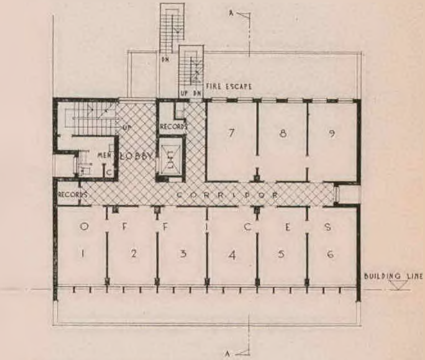
SECTION A-A



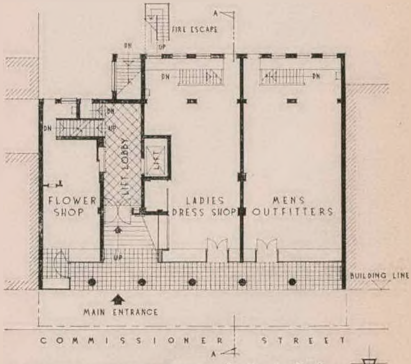
DETAIL OF THE FACADE. The vertical divisions and the main surround are white precast terrazzo, the returns on the latter being lemon yellow "Tyrolean." The spandrils are faced with 2in. rustic face-bricks with white precast terrazzo sills and "accents." Windows are painted pale green.



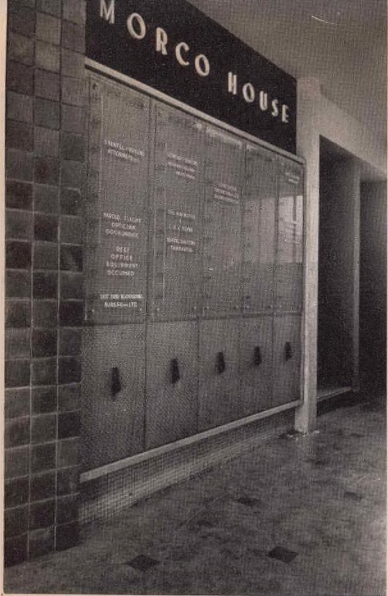
ROOF PLAN



TYPICAL FLOOR PLAN



GROUND FLOOR PLAN



BUILDING CONTRACTORS : Ferrar Bros. (Pty.) Ltd., Boksburg
Electrical Consultant : Ronald A. Nell, Johannesburg
SUB-CONTRACTORS :

Shopfronts and Entrance Hall Fittings	R. R. Hurlin (Pty.) Ltd.
Reinforced Concrete	Concrete Construction Co. (Pty.) Ltd.
Steel Windows and Door Frames ...	Transvaal Metal Industries (Pty.) Ltd
Precast Terrazzo	Premier Concrete Works
Steel Fire Escape	L. & F. Metter (Pty.) Ltd.
Painting and Decorating ...	Leo Whittle (Pty.) Ltd.
Lift Installation	Waygood-Otis (S.A.) Ltd.
Electrical Installation	Morgan & Co. (Pty.) Ltd.
Marble Work	Marble Lime & Associated Industries Ltd.
Precast Cement Terrazzo Tiles	Union Flooring Tiles Factory
Asphalt Tiles and Linoleum ...	North British Rubber Co. (S.A.) Pty. Ltd.
Flush Panel Doors	Veneered Plywoods (S.A.) (Pty.) Ltd.
Fire Fighting Equipment ...	H. Alers Hankey Ltd., and Minimax (S.A.) Ltd.
Ironmongery and Sanitary Fittings	Parker Wood & Co. (Pty.) Ltd.
Facebricks	Primrose Brickworks (1936) Ltd.
Flat Roof Waterproofing	Hunt, Leuchars & Hepburn (Pty.) Ltd., and Mazista Slate Quarries Ltd.
Electric Light Fittings	New Era Fluorescent Lights (Pty.) Ltd.
Mosaic	Central Agencies & Import Co. (Pty.) Ltd.
Plastic Numerals	V. Smith

ABOVE : ENTRANCE HALL NAME BOARD The name boards are set on "basket patterned" plywood doors in an Oak frame over the yellow mosaic skirting and which cover the electrical distribution board. The handles are maroon. The floor is mottled "light rust" with blue inserts in linoleum, and ceiling is pale primrose stippled plaster. The name panel is deep red with pale blue letters, painted white on the faces. BELOW, LEFT : OFFICE CORRIDOR. Floors are patterned in asphalte tiles, walls are "Tyrolean" plaster and the fibre board ceiling conceals a service duct. Distinctive colour arrangements are used on each floor. BELOW, RIGHT : THE MAIN STAIR. Steps are black granolithic, balustrade walling and soffits in salmon pink "Tyrolean," side walls are similarly finished in silver grey and landing walls are pale green. The capping to the balustrade if off-white terrazzo.

MANUFACTURE AND SPECIFICATION OF CONCRETE

By C. P. LANGE, M.I. Sruct. E., A.M. (S.A.), I.C.E., M. (S.A.), Cons. E.

A Paper delivered at the 1953 Summer School of the Institute of South African Architects, in Johannesburg

It was a great pleasure for me—and a great compliment—to be asked to address you today on the subject of the manufacture and specification of concrete, and I should like, if I may, to express to your President and Council my sincere thanks for giving me this opportunity of talking on a subject which has, for many years, been a particular pet of mine. I greatly regret to have to tell you that many of my contractors, though, appear to consider that, far from being an amiable pet of mine, the subject is, in fact, a most abominable obsession.

In its infancy, the manufacture of concrete was a haphazard affair. It consisted of a more or less arbitrary mixing of various proportions of stone, sand and cement, to which the contractor continued to add water until a workability of the mix was arrived at which he personally considered to be the most easily handled and placed. At a later stage, the old well-known 4:2:1, 3:1½:1, and 2:1:1 mixes came into general use, but the actual quantity of added water to be used was still never specified. A good many years ago now, and as the essentials of a good concrete began to be more clearly understood, professional people overseas began to realise how seriously wrong these old mixes, used for so long, could be—how seriously wrong from the points of view of desired strength, durability and permeability, how seriously wrong from the point of view of economy. The enormous importance of such things as the correct aggregate grading, the cement content, water content, water/cement ratio, and the placing and curing of concrete came to be more correctly understood, and gradually much more stringent specifications for the manufacture of concrete were drawn, and their compliance with by the contractors insisted upon. Such specifications are now normal practice overseas, particularly in the United States and on the Continent, and production of good concrete is almost automatic there.

Unfortunately we, in this country, are, so far as the manufacture and specification of concrete is concerned, still living almost entirely in the Dark Ages. Admittedly, the standard of manufacture of concrete has greatly improved in the last 20 years, but we are still specifying a 4:2:1 mix with a ¾" stone, and we still do not specify the actual quantity of water to be used, nor do we specify any grading of the aggregates. As a result, and alas, only too often, we see on a job NOT CONCRETE being PLACED, but a particularly vicious and horrible brand of SOUP being POURED. Then, when the shuttering is removed, we raise Cain with the contractor because his concrete is all honeycombed and disgraceful. Latterly it is becoming frequently more the custom to specify that cube tests shall be made on site—still, mind you, with the same old 4:2:1 concrete mix specification. The cubes are tested at 28 days, and, instead of showing at least 2,500 lb. per square inch, we are horrified to find that they only give 1,500 lb. per square inch—and again we swear at the contractor. But it is too late to do anything by then—the shuttering for the next floor is already in position. The only solution is to go on swearing hopefully—and, of course, praying very hopefully.

All this may sound amusing, but it is, in fact, a very sad state of affairs which we, as professions, should be most thoroughly ashamed of, more particularly so as it is a state of affairs which can so easily be remedied. You take the most meticulous care and trouble to specify exactly and specifically how bricks are to be laid, how joinery is to be made, and how finishes are to be applied—and yet you condemn to a few brief lines your specification for concrete : and, by modern knowledge and standards, your specification is usually entirely wrong. And it is on the concrete that the basic stability of your building depends—surely a matter of far greater import than the correct application of a finish?

Admittedly, it is the contractors who actually make the concrete and, of course, they are more often than not seriously to blame for the very bad concrete so frequently to be met with out here. We must be careful to remember, though, that they, and their fathers and grandfathers, have been brought up for years by us to make bad concrete, and, as I see it, it is our duty to start to teach them as quickly as possible to make, almost automatically, the good concretes which are standard overseas. I know that, if the architects throughout the country can be persuaded to assist in educating such of the many contractors as still need it up to the making of good concrete, a very rapid improvement in the present only too frequently lamentable standards would result.

Having most thoroughly choked my hosts off in a most disgusting fashion, I shall now proceed to try to explain the essentials of a good concrete, and how easy it is, really, to specify a good concrete, and to ensure of its being produced.

Maximum Size of Coarse Aggregate.

A most important mistake which is almost invariably made in specifying a concrete is the use of too small a maximum size of coarse aggregate. (At this stage I should like to explain that aggregate in concrete consists of coarse aggregate, which may be stone, crushed clinker, foamed slag or some other suitable material, and fine aggregate, which may be sand or crushed stone or again some other suitably graded material.) Coarse aggregate is defined as that which is retained on a No. 4 B.S.S. (i.e., 3/16" square mesh), fine aggregate is that which passes a No. 4 sieve. In this lecture I shall generally use the terms coarse and fine aggregate, rather than "stone" and "sand."

Now, you may take it as correct and firmly and definitely established as a hard and fast rule that the larger the maximum size of the coarse aggregate, the lesser are the quantities of fine aggregate, cement and water necessary for a given workability and strength of the concrete. The factors laid down in most standards and codes which determine the size of the maximum size of the coarse aggregate to be used in any portion of a particular structure are that this maximum size should not be larger than 1/5 of the narrowest dimension between the parallel sides of the forms of the members for which the concrete is to be used, and that it should not be larger than ¼" less than the minimum clear lateral distance between the reinforcing bars. (Please note that the dimension of the cover of concrete is not specified —but as I shall point out later, the aggregates must be correctly graded.) If you will give these requirements a little thought, you will realise that in almost every normal case in practice, to specify a ¾" maximum coarse aggregate is wrong. Very seldom should anything less than a maximum coarse aggregate size of 1" be specified, and, as a much more general rule, this maximum size should not be less than 1½". Quite certainly in such portions of a reinforced concrete structure as, for example, normal spot column foundations, or fairly deep mushroom floor slabs, nothing less than at least an 1½" maximum size of coarse aggregate should ever be specified.

The Necessity for Grading Aggregates.

Before I start on this subject, I must make it quite clear that the remarks under this heading apply only to concretes which are to be placed by hand. They do not, of necessity, apply to concretes which are to be vibrated. I shall discuss the question of vibration later in this lecture.

You will all, of course, realise that the denser a concrete is, the stronger that concrete must, of necessity, be, and, of course, the more durable and impermeable it will be. Furthermore, the coarse aggregate—usually stone—is, generally speaking, the strongest and cheapest constituent of the concrete. It follows, therefore, that as much stone, or coarse aggregate, as possible should be used in a given volume of concrete. The voids between the maximum sized particles in the coarse aggregate must, of course, be filled, and it is self-evidently better to fill these voids rather with smaller particles of the coarse aggregate than with fine aggregate and cement. The smaller the aggregate in a given volume, the greater must be the total surface area of all the grains in that aggregate. Therefore, the smaller the aggregate, the greater must be the amount of cement paste required entirely to cover its surface area. It is evident, then, that the less the quantity of fine aggregate in a given volume of concrete (bearing in mind, of course, density and workability), the less will be the quantity of cement and water required for a given strength.

Of course, the most expensive ingredients in a concrete are the cement and the sand. A little consideration along these lines will, I am sure, make it quite clear why it is advisable to use a graded aggregate—and, of course, this applies right through the whole range of coarse and fine aggregates.

For all these reasons, correct grading of the aggregates actually, therefore, reduces the cost of the concrete. Of very great importance, indeed, though, is the fact that correct grading of the aggregates results, in itself, in greater workability of the concrete. This means that, if a correctly graded aggregate is used instead of a single sized, or badly graded aggregate, less water is required per given volume of cement and aggregate for a given workability. In other words, if you correctly specify the grading of the aggregates, you will find that the contractor will quite automatically use less water per yard of concrete to get a workable concrete. You have, of course, specified the ratio of cement to aggregate. Again automatically, therefore, the contractor will give you a higher water/cement ratio, which, of course, means a stronger concrete. At the same time he will automatically give you a concrete with a lower water content per yard of concrete, resulting immediately in less setting-shrinkage and greater durability and permeability—in short, a much better concrete. I shall attempt, at the end of this lecture, to demonstrate these facts to you by actually casting concretes of the various types which I have been discussing.

Crusher-run aggregate

At this stage I must point out the grave dangers of using a "crusher run" aggregate—that is, a run-of-crusher aggregate as it comes, unscreened from the crusher. The use of crusher run aggregate, with its various gradings from coarse to fine, would appear, at first sight, to be the answer to the grading of aggregates which I have been discussing. Unfortunately, however, a crusher run aggregate suffers from a very grave and unsurmountable defect, and that is that it is extremely liable to segregation. It starts to segregate when it is being tipped into the storage bin from the conveyor belt leading from the crushers. It continues to segregate as it is delivered from the storage bin to the delivery truck, and, before the truck has travelled almost any distance at all, segregation is complete with all the fine materials at the bottom of the load and all the coarse materials at the top. You will immediately realise then what happens when the truck-load is tipped on to a heap on the site: the coarse materials at the top of the truck are tipped out first, and finally all the fine materials are tipped out. As a result, as the stone is drawn from the heap, the first batches of stone drawn consist of fine material only and the final batches drawn consist of coarse material only. Now, nothing is more deleterious to the consistency of good concrete than variations in the coarse aggregate grading. This is very fully realised in America where on any job of any importance the use of single sized aggregates are, of course, insisted upon, but it is further insisted upon that even the single sized aggregates be re-screend again to single size on site immediately before delivery to the concrete mixer. Under these circumstances, ladies and gentlemen, I most earnestly beg of you, never, under any circumstances, to permit of the delivery of a crusher run aggregate to any job.

It may appear to you that my advocacy of the use of two or more single size coarse aggregates will tend to increase the cost of concrete. I have specified the use of single sized coarse aggregates on my jobs for many years now and, once the contractors have got used to using them, they have invariably told me that, in fact, their use actually reduces the cost of the concrete. After all, if a normal size mixer is used on the job, then, even if only one size of aggregate were to be used, this would have to be put into the mixer in at least two boxes, because the total weight of coarse aggregate in any one batch would be too heavy for two boys to lift. Naturally, it is no more expensive to lift up two boxes each containing a different sized coarse aggregate than it is to lift two boxes of one sized aggregate. Furthermore, the contractors are finding that there are undoubted savings in the actual placing of the concrete due to the very much greater workability attained by using a graded coarse aggregate.

I should like to point out, at this stage, that though it is advisable to grade both the coarse and the fine aggregates, the effect on the workability of a concrete of a badly graded fine aggregate is not nearly of the same importance as the effect of a badly graded coarse aggregate. Even when a bad sand, therefore, has in practice to be used, a good concrete can still be obtained, provided that the coarse aggregate is efficiently graded. Care, however, must be taken to see, particularly in the case of very fine aggregates, that not more than 8% by weight of the fine aggregate passes a No. 100 B.S.S. sieve.

Under-sanding of Aggregates.

Many experiments all over the world have definitely and finally proved that the old 4:2:1, 3:1½:1, 2:1:1 and similarly proportioned mixes are badly under-sanded, particularly in view of bulking of fine aggregate with moisture content. Very much better concretes for hand placing are obtained when the ratio of fine/coarse aggregate is considerably increased. Thus, for example, in, say a 6/1 mix, so often still specified as 4:2:1, the mix which should in fact be specified is a $3\frac{1}{2}:2\frac{1}{2}:1$ mix.

Water in Aggregates and Bulking of Fine Aggregates and Cement.

As you are aware, both the fine and the coarse aggregates are liable to retain moisture. The amount of moisure retained by the coarse aggregates need not be taken account of except where specially high-strength concretes are required. Very definitely, however, account must be taken of the moisture retained in the fine aggregates. The normal moisture content of a sand as delivered to the site is in the neighbourhood of 5% by weight. With a concrete mix consisting of, say $3\frac{1}{2}$ cu. ft. of graded coarse aggregate to $2\frac{1}{2}$ cu. ft. of sand and 94 lbs. of cement, you will see then that the volume of water retained in the sand amounts to somewhere between one and one-and-a-half gallons. When you have decided on the water/cement ratio to which you wish to work, you will, of course, be able to specify the amount of water which has to be added to the aggregates and cement on the basis of the aggregates being dry. If the sand is moist, as it practically always is, the amount of moisture in the fine aggregate must, of course, be deducted from this added water. When the sand is very dry, less water, of course, has to be deducted, and, when it is very wet, as after a shower of rain, more water has to be deducted.

As you are also, of course, aware, fine aggregates bulk with the addition of water. If we consider a certain quantity of absolutely dry sand to have a volume equal to unity, then this volume increases with the moisture content of the sand up to a maximum when this moisture content amounts to approximately 5% by weight. The increase in volume varies from ten to fifteen per cent. with a coarse sand up to anything between thirty and even fifty per cent. with a very fine sand. Once the moisture content exceeds approximately 5%, the increase in volume decreases again until when the sand is completely inundated with water, the volume again arrives at the figure of unity. You will then realise how essential it is to take into account this bulking of sand when the fine aggregate is measured by volume. For example, in the old-fashioned 4:2:1 mix, if a fine sand is used and no account is taken of the bulking due to moisture content, the actual concrete mix might very easily arrive at the stage of being only $4:1\frac{1}{4}:1$. Even the 4:2:1 mix with a practically dry sand is badly under-sanded. If the sand were wet, the under-sanding would then reach a stage where the concrete would be practically unworkable even with the addition of such large quantities of water that the final strength of the concrete would be probably under 1,000 lb. per square inch at 28 days. This is one of the reasons why this old-fashioned mix specified as 4:2:1 by volume should never, under any circumstances, be used.

I have pointed out that the normal moisture content of a fine aggregate is only in the neighbourhood of 5% by weight. I have also pointed out that the bulking of a fine aggregate with moisture content may be anything up to 50%. If the sand were to be weighed instead of measured by volume, any small variation in weight due to small variations in the moisture content would have an almost negligible effect on the actual quantity of sand used and the effect of bulking would immediately be obviated entirely. It is, therefore, of the utmost importance that we start to specify the measuring of sand by weight instead of by volume just as soon as we possibly can. Stone, or coarse aggregate, can still be measured by volume if it proves easier to do so. Cement, of course, must definitely be measured either by weight, or, alternatively, the mix must be arranged so that a full pocket of cement can be used for each batch. This will mean that a mixer large enough to take one whole pocket of cement at a time must be used. In the case only of small jobs, such as houses, etc., I am prepared to countenance the use of half quantities of aggregates and cement, so that only half a pocket of cement may be used at a time and so that a smaller mixer may be used. In this case, however, I insist that the full pocket of cement be measured by eye into two separate one cubic foot measuring boxes so that the volume of cement in each box appears to be the same. One of each of these boxes is then emptied into the mixer for consecutive batches.

Actual Specifications.

To summarise now, the points which I have been discussing, the following must be carefully remembered :

1.—The quantity of water for each mix must be specified.

2.—The largest possible maximum size of coarse aggregate must be used, bearing in mind the code requirements in this connection which I have explained.

TABLE I.—CONCRETE MIXES FOR SMALL JOBS

CONCRETE CLASS			A	B	C		
Sub. Class	Max. Stone Size	Ingredients	Proportions			Units	Total water per cubic yard of concrete
1	¾"	¾" Stone	2	2¼	3	cu. ft.	37 gallons
		½" Stone	1	1¼	1½	cu. ft.	
		Sand	1¾	2½	3¼	cu. ft.	
		Cement	94	94	94	lbs.	
		Water (approx.)	4½	5	6¾	gallons	
		Cement per cu. yd.	7½	6	4¾	pockets	
2	1"	1" Stone	2	2¼	3	cu. ft.	36 gallons
		½" Stone	1	1¼	1¾	cu. ft.	
		Sand	1¾	2¼	3¼	cu. ft.	
		Cement	94	94	94	lbs.	
		Water (approx.)	4½	5	6¾	gallons	
		Cement per cu. yd.	7¼	6	4½	pockets	
3	1½"	1½" Stone	2	2½	3	cu. ft.	35 gallons
		¾" Stone	1¼	1¼	2	cu. ft.	
		Sand	1⅜	2¼	3¼	cu. ft.	
		Cement	94	94	94	lbs.	
		Water (approx.)	4½	5	7	gallons	
		Cement per cu. yd.	7	6	4½	pockets	

NOTE: This table clearly shows the savings in cement, sand and water with increase with maximum aggregate size. It should also be realised that if the actual size of the stone on a job is smaller than that specified, more sand will have to be added to attain equal workability—and, of course, vice versa.

3.—The aggregates must be graded by the suitable additions of two or more single sized coarse and fine aggregates to the mixer.

4.—The old 4:2:1, etc., mixes are badly undersanded, and should never be specified.

5.—Less fine aggregate, cement and water per yard of concrete is required as the maximum size of coarse aggregate is increased, and this must be taken care of in the specification. On the other hand, leaner mixes require a higher fine/coarse aggregate ratio than richer mixes, and this must also be taken care of.

6.—The bulking of fine aggregates due to moisture content, and the actual moisture contents of the aggregates must be taken account of.

7.—Cement must always be weighed or used in whole pockets.

8.—Too much stress cannot be laid on the necessity for effective curing of concrete and your specifications should be drawn to make it absolutely certain that this curing is ensured. It should be specified distinctly that the top horizontal surfaces of all concrete should be kept continuously moist for not less than ten days, and that vertical surfaces, such as walls and columns, should be thoroughly sprayed with water at least four times a day for at least ten days after concreting. I would even go so far as to advocate the actual measuring in the Bill of Quantities of such curing. I feel that if the contractors were to be paid for carrying out this work they would be very much more likely to do it. The curing of all concretes is essential, but concretes which are to be impermeable, as, for example, water-containing structures, must be cured with even greater care.

9.—You are all aware, of course, that special precautions must be taken when concreting in freezing, or near freezing, weather. No concreting at all should be done on a falling barometer below 40° F. If frost is anticipated shortly after any fresh concrete has been placed, in, for example, a floor slab, I insist on braziers being placed at about fifteen to twenty-foot centres each way on sheets of corrugated iron on the slab, and that these braziers be kept continually fired until such time as the concrete has properly set or until the temperature rises again.

Concrete Mixes.

I have produced a series of concrete mixes which are suitable for various strength requirements and various portions of a structure, for both " small " and " large " jobs.

The mix proportions on Table II are given in weights and are for dry materials. If these weights are converted to dry volumes, you will find that the mix proportions agree almost exactly with those given in the excellent handbook on concrete mixes produced by the South African Concrete Association. The mix proportions on Table I are again in volume so far as the aggregates are concerned and normal bulking of fine aggregate has been taken into account. Also, a slightly greater percentage of cement per yard of concrete has been used than in Table II. If you study Table II you will see that it clearly bears out the various points which I have already made during this lecture. Thus, from the last column in the table, you will see that as the maximum size of coarse aggregate increases, the necessary volume of water decreases. Again, by following the three columns of mix proportions vertically downwards, you will see that with increases in maximum size of coarse aggregate, the proportions of sand and cement both decrease. Also, if you follow the quantities of sand for each sub-class horizontally across the table, you will see that as the mix gets leaner, the proportion of sand increases.

Mix "A" can be used for heavily loaded members which, for any particular reason, require to be particularly small in section. As I pointed out, though, it should not be used if possible.

Mix "B" should be used for all normal reinforced concrete work.

Mix "C" should be used for mass concrete, such as brick wall foundations and so on.

I have drawn up a Memorandum addressed to your Council in which I have embodied these tables of mixes, and also actual suggested specifications in full covering the manufacture of concrete for various classes of work. I do not propose to go into the detail of these suggested specifications now, as I understand that they will be published by your Council at a later date. There are, however, one or two points which I should like to stress now, as they are most important.

1.—The Danger of Too-Rich Concretes.

The richer a concrete mix is, the greater is the resulting setting shrinkage. It should be a rule, therefore, that rich concrete mixes should be avoided wherever possible. In the table of concrete mixes which I have suggested you will see that the richest mix shown is that classed as "A," and that this mix is a nominal $4\frac{1}{2}:1$ mix. I, personally, very seldom use even as rich a mix as this and then only in small section columns or other load-bearing members where it is essential to keep size down to a minimum. With the "B" class of mix shown on my table, a minimum 28-day crushing strength of 3,500 lb. per square inch is very easily obtainable indeed, providing that the coarse aggregates are properly graded and that the water content does not exceed the figures given in the table. It is very seldom necessary in the normal reinforced concrete structure to use a concrete with a greater 28-day crushing strength than this.

2.—Time of Mixing Concrete.

It is absolutely essential that once all the constituent parts of the concrete mix, including the water, have been added to a mixer, then mixing should continue for a period of not less than two minutes. Now, this time is, in fact, quite definitely a long time and, unless some mechanical timing device is provided, you will find that concrete is never mixed for anything like this time. I, personally, have found that the easiest mechanical timing device consists of an old-fashioned hour glass, timed to allow the sand to run from one bulb to the other in two minutes. Such an hour glass can be produced very easily by any chemist at a negligible cost and its working is perfectly easily understood even by a Native.

3.—Amount of Water to be added to Mix.

I have pointed out to you the essentiality of specifying the quantity of water to be added to each batch. You know as well as I do, though, how extremely difficult it is to ensure in practice, particularly on the smaller jobs, that the correct amount of water is added in each case. You may take it that when the concrete is tipped out of the mixer into a barrow, if then the concrete in the barrow heaps slightly and does not run flat immediately, then the quantity of added mixing water may be taken to be about correct. This heaping should not be too pronounced but should be such that when the barrow has been wheeled for some twenty feet, the concrete has settled

TABLE II.—CONCRETE MIXES FOR LARGER JOBS

CONCRETE CLASS			A	B	C	Units	Total water per cubic yard of concrete
Min. 28 day works cube strength			3750	3000	1500		
Sub. Class	Max. Stone Size	Ingredients	Proportions				
1	¾"	¾" Stone	170	190	250	lb.	37 gallons
		½" Stone	80	90	120	lb.	
		Sand	170	230	310	lb.	
		Cement	94	94	94	lb.	
		Water	5.20	6.0	8.20	gallons	
		Cement per cu. yd.	7	6	4½	pockets	
2	1"	1" Stone	180	200	270	lb.	36 gallons
		½" Stone	80	100	130	lb.	
		Sand	170	220	310	lb.	
		Cement	94	94	94	lb.	
		Water	5.20	6.0	8.20	gallons	
		Cement per cu. yd.	7	5¾	4¼	pockets	
3	1½"	1½" Stone	180	210	280	lb.	35 gallons
		¾" Stone	90	100	140	lb.	
		Sand	160	220	310	lb.	
		Cement	94	94	94	lb.	
		Water	5.20	6.0	8.20	gallons	
		Cement per cu. yd.	7	5¾	4¼	pockets	

NOTE: The above aggregate weights are based on a coarse aggregate having a specific gravity of 2.65, and the fine aggregate one of 2.60. When, in practice, the actual specific gravities differ materially from these figures, due allowance must be made.

down to a flat surface in the barrow. I, personally, have found this visual test to be very useful. Even the Natives who usually work the concrete mixers understand it and are prepared to adhere to it.

4.—Danger of Vibration.

I cannot too strongly emphasise how dangerous vibration of concrete can be unless the concrete has been specially designed for vibration and unless there is very adequate supervision. The ordinary concrete specified for hand placing will segregate immediately when vibrated. Furthermore, if the vibrator is an internal one and is permitted to vibrate against the reinforcing steel in, for example, a beam, then immediately a buble of water is formed under the bar. This bubble will increase in size and ultimately the bond between the concrete and the steel may be destroyed altogether. I must impress on you most strongly that vibration should never be specified unless the concrete specification has been drawn up by a consulting engineer and placing of the concrete is supervised by him.

5.—Placing of Concrete.

Concrete should always be placed so as to minimise any possible chance of segregation of the aggregate. When tipping a barrow, the barrow should always be tipped towards the concrete already placed and not away from it. When placing concrete in any vertical member, such as a column or a wall, a tremmie (or vertical shute) with a conical hopper top should always be used. This will prevent the concrete fouling reinforcement on its way down and will also assist in preventing segregation. The bottom of the tremmie should be kept within a few inches of the surface of the concrete placed.

When a shute from a central tower is used, the concrete should never be permitted to discharge straight down the shute and straight out from the bottom of it. A baffle should be arranged at the lower end of the shute in such a manner that the concrete is ultimately delivered vertically.

6.—Lifting Blocks for Reinforcing Steel.

Too often lifting blocks are not employed in beams to maintain the bottom steel the designed distance above the shuttering, and almost invariably no lifting blocks at all are used for bottom steel in slabs or for the top steel in cantilevered slabs. The use of such lifting blocks is essentiol and should be invariably specified. I might mention that I am trying to get a number of firms interested in the manufacture of standard lifting blocks as is done in the United States.

* * * *

I should like to summarise briefly by enumerating the steps which I consider should be taken to attain the ends I have discussed in this lecture.

1.—I would like to suggest that we should begin by teaching our students at university the elements and essentials of the manufacture of good concrete. I should like to go further and suggest very strongly to the architectural faculties that they insist that the students spend say at least their first two long vacations in learning all they can of the actual practice of the building trade. Thus, their first vacation might be spent in some large contractor's workshop studying, and actually carrying out joinery, carpentering and the like. Their second vacation might be spent on some large job actually working with the contractor on the various trades, including the handling and placing of concrete and steel. I feel that such practical experience would be invaluable, and, alter all, the architectural student is compelled to spend his fourth year in an architectural office and I feel that he could then satisfactorily learn the office end of affairs. All engineering students have to do such practical work and I know how invaluable it is to them.

2.—All architects should, as soon as possible, learn and master the simple requirements for the manufacture of good concrete.

3.—Careful specifications should always be written for every job, whether it is small or large, to ensure that the contractor is clearly and exactly told how he is to make and place the various concretes which have been decided upon.

4.—Insist absolutely and definitely that your specification be carried out—throw away any bad concrete that is mixed, and pull down any bad concrete that is placed, and do not, under any circumstances, accept any excuse whatsoever for bad concrete.

At this stage I should like to express my most sincere appreciation of the great help which has been given to me, both in the preparation of the Memorandum which I drew up for the use of your Council, and in the preparation of this lecture by the National Building Research Institute, the Concrete Association of South Africa, and by a number of students of this university.

* * * *

In conclusion I should like to tell you a short and absolutely true story which I think is apposite.

During the 1930's I was responsible for a large amount of work in Lourenco Marques. I found that over 75% of all the buildings down there, including private residences, had flat concrete roofs. In the whole town there was only one roof covered with a waterproofing specification, and this was the only roof which leaked ! I found that in those days in Lourenco Marques, the man ultimately responsible for both the architectural and structural design of the building was the consulting engineer. If an architect were employed at all he was employed by the consulting engineer. I might mention that I, personally, was not impressed with the architecture in Lourenco Marques ! However, I also found that if anything went wrong on any building, if there was a collapse, or even of the roof leaked, the consulting engineer was held solely responsible. He was immediately brought to trial in the Civil Courts and, if the case was proved against him, he was sent summarily to jail without the option of a fine. The concrete in Lourenco Marques was perfect, and the roofs did not leak.

I should like to put it forward as a concrete proposal that this Lourenco Marques law might, with great benefit, be made to operate in the Union, bearing in mind, of course, that the man ultimately responsible for a building here is the architect.

ARCHITECTURAL COMPETITION FOR NON-EUROPEAN HOUSING

In the latter half of 1953 the Institute of South African Architects promoted a competition, open to all registered architects—it was separately open to students—for the design of low-cost houses. The primary object of the competition was to produce a number of selected designs of aesthetic merit, within the limits of a low construction cost potential, that can be developed to a suitable form and made available on a " pro Deo " basis to non-Europeans who desire to build their own houses.

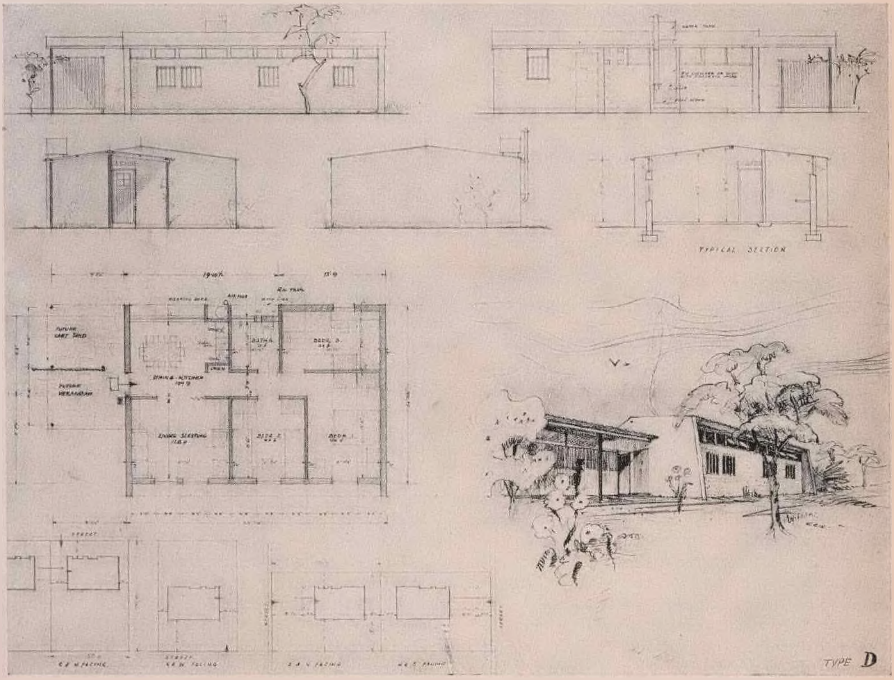
Studies undertaken by the National Building Research Institute (competitors were referred to Bulletin No. 8) had shown that some 40% of South Africa's non-European population could afford to build basic houses within the £250-£400 range, and that of this group one quarter should be able to afford relatively better houses with reduced occupancy, that is, with no sleeping in the living room.

Consequently, while low-cost and economy were fundamental, the houses concerned were distinct from the sub-economic housing schemes being undertaken by various authorities.

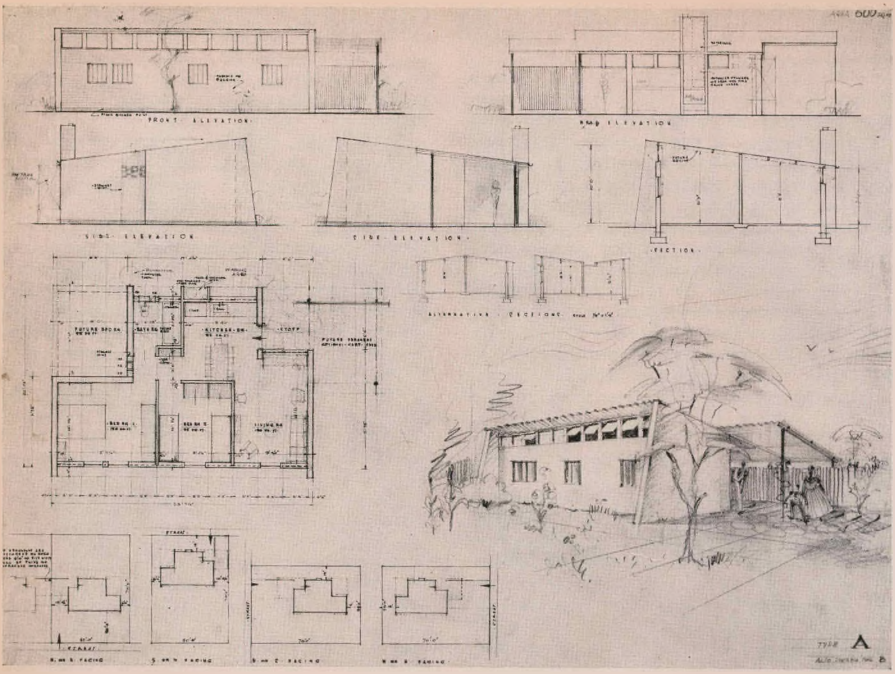
Competitors were required to adhere to Public Health Regulations for Housing, but not necessarily to local authority regulations. Conventional building materials had to be used and the designs, planned as single dwellings, had to comply with the requirements of minimum standards of accommodation as defined in the N.B.R.I. publication.

Designs were required for four classes of houses :

Class A : Two-bedroom house (occupancy 5),



(i) Design Placed First. A Class D house designed by H. W. E. Stauch and Partners.



(ii) Design Placed Second. A Class A house designed by H W. E. Stauch and Partners.

bathroom and w.c., kitchen, living and dining facilities, verandah and terrace, and with provision for a future bedroom.

Class B : Two-bedroom house (occupancy 7), bathroom and w.c., kitchen and dining space, living-sleeping room, verandah or terrace, and provision for a future bedroom.

In both cases the plot size was 50ft. by 70ft., with restrictions on the width and position of the dwelling.

Class C : Three-bedroom house (occupancy 7), bathroom and w.c., kitchen, dining and living facilities, verandah or terrace.

Class D : Three-bedroom house (occupancy 9), bathroom and w.c., kitchen and dining space, living-sleeping room, verandah or terrace.

In the two latter cases competitors were permitted to increase the plot size to 60ft. by 70ft.

The Assessors were Mr. J. E. Jennings, M.Sc., A.M.I.C.E., Director N.B.R.I., Mr. W. Gordon McIntosh, A.R.I.B.A., M.I.A., and Mr. C. Erik Todd, A.R.I.B.A., M.I.A.

Sixteen entries were received, fifteen from members and one student entry. Each competitor submitted one or more entries in the various classes, giving a total of sixty-two designs in all ; seventeen in Class A, thirteen in Class B, sixteen in Class C, and sixteen in Class D.

The Assessors considered that, with the two placed schemes and the six Honourable Mentions, together with a number of others suitably developed there were sufficient for a brochure to be prepared.

First Place, premium sixty guineas, was awarded to a Class D scheme submitted by H. W. E. Stauch and Partners, who were also awarded Second Place, premium thirty guineas, for a Class A scheme. This firm is also to be congratulated in receiving Honourable Mention for a further scheme in each of the Class A and C categories.

Mr. Brian Sandrock received two Honourable Mentions in Class C and one in Class D, and Mr. D. H. Robinson one in Class C. No award was made in the Students' Section

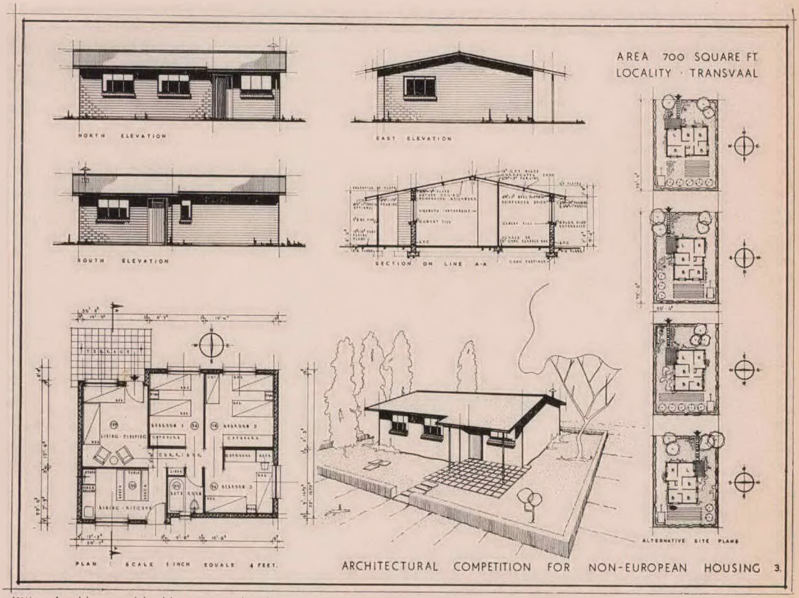
REPORT—H. W. E. STAUCH AND PARTNERS

The design is suitable for conventional construction in bricks, field stone or concrete blocks, which is recommended for individual contracts. By basing the plan on a modular unit, the scheme is suitable for standardisation of the structure or a portion thereof. In any event, it is proposed to standardise the doors, windows and roof structure. Furthermore, the external walls can be prefabricated in unit panels. The module of 3' 3" was chosen because it fits the requirements of domestic planning best.

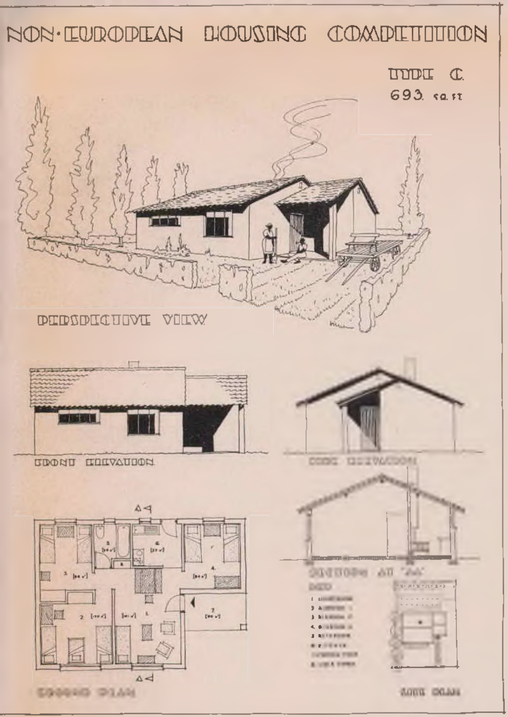
The plan is so dimensioned that it fits on to a standard site in various different ways, as shown on the site plan. The depth has been kept to a minimum, which makes it possible to place the house with the gable end facing the street and yet leaves enough space between the main front and the side boundary opposite it. This means that the main rooms can always face the best way, i.e., North or East. It is thus possible to achieve a great variety in appearance, thereby avoiding the effect of repetition and monotony. Furthermore, due to the windowless gable ends, the type is suitable for semi-detached houses or row houses, which might in some schemes be desirable in order to effect economy of land.

With special regard to evasion of monotony it is proposed that just the basic form of the house remains the same. The additional features such as the screen between the cart shed and verandah, and extension to the gable walls can be done in various materials such as brick, splitpoles, field stone, reeds, etc., thus achieving a variation of appearance. Furthermore, the section itself can be varied as indicated on the plans by using normal pitched butterfly roofs, for both of which the plan is suitable.

The monopitch roof is preferred in Class A and C because of its great economy in this instance where the depth of the house is not excessive, since it provides the greatest height in the most important rooms and lesser height in the secondary rooms



(iii) An Honourable Mention. A Class C house designed by Brian Sandrock.



(iv) An Honourable Mention. A Class C house designed by D. H. Robinson.

Gutters can be fitted very cheaply and rain water can be collected in a tank which can be placed at a convenient position.

The principle of fenestration and ventilation is based on a series of standard louvres or windows at the highest point of the rooms, with additional small " look-out " windows at convenient positions. This arrangement has the advantage that burglar proofing is simplified. It is suggested that standard wooden frames form the base of this feature, and simple wooden flaps or glazed wooden or steel sashes as preferred and found most economical, can be fitted. If not all sections require to be opened, a fixed glass pane can be fitted directly into the frame.

This system would provide excellent cross ventilation and obviate draughts. This ventilation is particularly important before the ceilings have been installed.

For the future ceilings any of the known makes of ceilingboards can be used. A suggestion suitable for individual contracts might be to fit aluminium foil and grass-matting or reeds to the underside of the beams. The foil would give excellent insulation at low cost, and the matting could be cheaply done by the Natives themselves.

Simplicity of outline and section should favour low cost and at ruling rates it should be possible to build the house well within the cost margin.

EXTRACT FROM MR. B. SANDROCK'S REPORT

The use of indiginous Native building methods is precluded by economic and practical necessity, and the competitor feels that it would be unwise to attempt to introduce the Native architectural idiom in terms of European building materials. He considers that it would be advantageous to introduce a link with tribal heritage by sympathetic town-planning and by the encouragement of individual expression in home decoration, but that the assimilation of Bantu culture cannot be carried further.

On the other hand, the non-European cannot afford the synthesis of European building materials to which our sense of appreciation has become attuned and we have, therefore, no established aesthetic precedent in the field of non-European housing.

If past experience is to serve as a guide, the aesthetic solution will be found in a straight-forward and unprejudiced representation of the requirements. To point this solution the designs should fall within the limits of economic possibility, for if this were not the case their aesthetic merit would be irrelevant.

With this idea in mind, and on the assumption that the Minimum Standards are at the same time sufficient, the competitor has attempted to provide a range of solutions that falls within these economic limits. At the one end of the scale they provide a sufficiency of space, light and ventilation, and at the other there is an extravagance that almost approaches the European conception while remaining only just in economic reach.

The accent is on sufficiency because there is a greater need for the more economic solutions.

Each design has been considered with reference to the four basic site orientations, the 20th scale plans showing minor modifications in plan or fenestration that will be required when adapting the design to these alternative sites. The individual site is zoned with a recreation area having shade trees, lawn and garden ; in addition a small yard, vegetable patch and a few fruit trees are provided. Cart storage is shown, but no turning space has been allowed since it is assumed that draft animals will not be brought on the site.

A PRIMARY SCHOOOL TO ACCOMMODATE 320 PUPILS

K. Night, B.sc., (Civil Eng.).
P. Coltman, B. Arch., M.L.A.

A view of the School from the South-East.

BANTU SCHOOL AT KWA-THEMA, SPRINGS

In December, 1952, the Municipality of Springs approached the National Building Research Institute for assistance in planning a primary school—the first—in the new Bantu town of Kwa-Thema.

The Town Plan for Kwa-Thema had been drawn up in the offices of the National Building Research Institute, and the request for a school building arose from the desire to provide the initial basic amenities for the new inhabitants of Kwa-Thema. The sites for these amenities had been allocated in the Town Plan, and it was decided to provide the first school in an area of low-income families, where all the houses had already been occupied.

With the request from the Springs Municipality came a standard school plan issued by the Native Education Department. A study was made of this conventional type layout and various factors which it was felt could be improved upon, were noted.

Generally the points were :

(1) No regard was paid either to aspect or site contours. The " U " shaped plan could be neither correctly orientated nor economically placed on sloping ground.

(2) Toilet facilities were isolated from the main building, making access to cloakrooms in wet or cold weather unnecessarily uncomfortable.

(3) Wash basins were provided in the school itself and these would require a drainage system separate from the cloakrooms.

(4) Structure, particularly in the roof, was uneconomical and could be simplified.

(5) The " U " shape was questioned, regardless of point 1 above, as being conducive to excessive noise when children play in the courtyard, and staff-rooms were arbitrarily placed due to the symmetry of layout.

(6) Aesthetically, the facades could be improved.

With these points in mind the school was redesigned. The size of the classrooms, namely 22ft. 6in. x 25ft., was accepted as adequate, although there is no definite information that this size and shape are ideal for non-European pupils, where teachers have, of necessity, to handle large classes and where furnishing is of the barest kind.

In order to assess whether the improvements envisaged were justifiable and practical, the school design had to be considered from many points of view and the factors influencing the ultimate layout were listed as follows :

1.—Site and contours.
2.—Orientation and natural lighting.
3.—System and simplicity of structure.
4.—Control of children by staff.
5.—Position of cloakrooms.
6.—Possible future extension.
7.—Social and aesthetic considerations.
8.—Cost of the structure.

Each one of these factors would have a bearing on the comfort and reactions of both pupils and staff, the efficiency of the layout, and the status of the school and its function in the area.

Some factors, naturally, had to take preference over others, but despite the simplicity of the ultimate layout, most of the planning requirements have been satisfactorily met.

Site and Contours.

The site was an irregular rectangle covering a little over four acres, and was completely encircled by terraced houses which fronted on to the area.

The average fall over the site for the school was in the region of 1 in 60, with contours running from north to south. It was decided to attempt to build the school along the contours in order to economise as much as possible on foundation walling and filling for floors. The views from the school site were similar in all directions, with the long terraced house units framing the area, so that any special direction in the aspect of the building was unimportant.

Orientation and Natural Lighting.

This factor is of extreme importance, for direct sun-penetration into classrooms can be aggravating and upsetting, while insufficient light may be detrimental to the health of the pupils.

It was decided that south light should form the major part of the daylighting of the classrooms, and this meant that the axis of the school building would be across the contours. Because of this decision it became necessary to ignore the slope of ground, since it was very slight, and expend some additional monies on the extra building-up required.

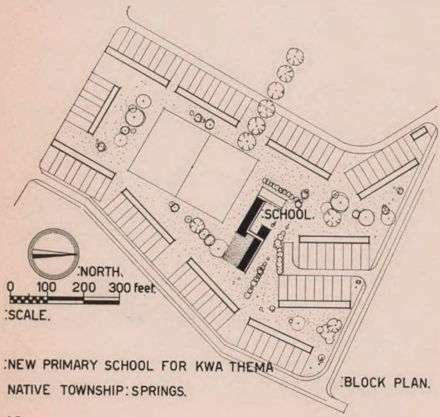
Since it was anticipated that afternoon classes would be held, the north facing windows required protection from direct sunlight. By using the covered access corridor to classrooms as a shield from the sun, any additional expense for sunlight protection was eliminated.

Initially, large window areas were provided for the classrooms with a head height of 8 feet in order to achieve maximum penetration into the room areas, and various combinations of standard window types were investigated to assess economies and suitability.

About this time salvage work was going on in the Payneville location after the advent of a tornado which had destroyed several hundred temporary houses. The windows of these houses were steel-framed, set into pressed steel surrounds, the overall size being 4ft. 3in. by 3ft. 3in., and it was decided by the Springs Town Engineer that these windows should be employed in the building of the school. There were thus the limitations of height and width imposed and it was decided that the windows should be fixed with their heads at the first brick course over 7 feet from the floor, and with horizontal spacing as close as possible. The school was then laid out with 9in. piers between windows, but, bearing in mind the degree of skill of the builders and the load being transmitted from the roof, it was decided that the piers should be larger. The windows were re-spaced and the final dimension fixed at 13½in. between windows.

Meanwhile, calculations were carried out to test the efficiency of the daylighting in the classrooms, and the final daylight factor achieved was 2.9%. This was .9% better than the recommended minimum factor proposed by the Building Research Station in England, and was, therefore, considered to be adequate. The calculation was made for the worst lighting condition in the classroom.

It is interesting to note that the area of glass is 17.5% of the floor area.



NEW PRIMARY SCHOOL FOR KWA THEMA NATIVE TOWNSHIP: SPRINGS.

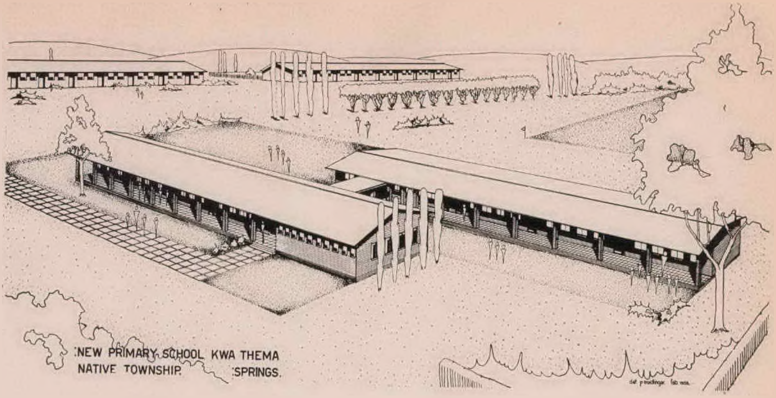
BLOCK PLAN.

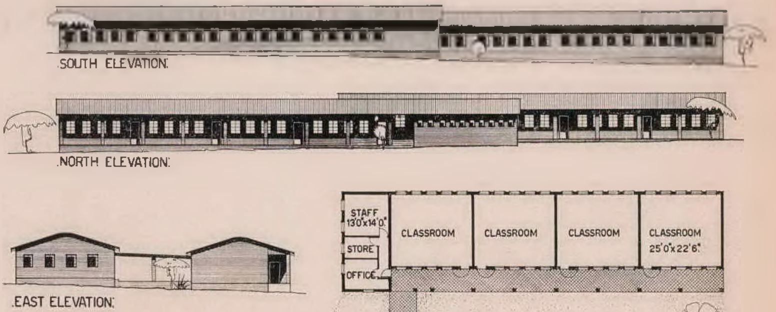
System of Building and Simplicity of Structure.

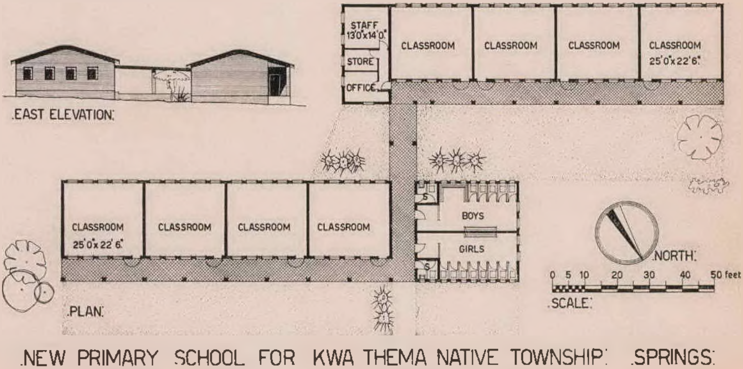
All the building work was carried out by non-European building operatives. The men had been engaged upon house construction in Kwa-Thema for a period of twelve months previous to their transfer to the school. Their training had been such that they were used to working in teams on specialist jobs and they now had to extend their capabilities to something less specific. Unless simplicity of design could be maintained, valuable time would be lost in directing and explaining the new work. The prime object was, therefore, to keep all structural work as nearly as possible the same as that of the housing project on which the men had been engaged. Foundations were 18in. by 9in., 8:4:1 concrete. Walling was 9in. brickwork with some 4½in. internal walls. Doors were framed, ledged and battened. Door frames were pressed steel sections. Lintels were reinforced brick. Roof was corrugated iron on 3in. by 2¼in. purlins with a curved ridge.

Roof trusses were 4½in. by 1½in. timbers with 6in. by 1½in. tie-beams.

Ceilings were corrugated cardboard on 1½in. by 1½in. brandering. Floors were 3in. ashcrete slabs with untinted granolithic topping.







NEW PRIMARY SCHOOL FOR KWA THEMA NATIVE TOWNSHIP. SPRINGS.

Finishes were stockbrick facing externally and along corriders, with oiled brick dados internally up to 5ft. height in classrooms and cloakrooms and limewashed above.

Staff-rooms were plastered and limewashed. Blackboards were black-painted masonite.

The ceiling, though not provided in the housing at Kwa-Thema, was felt to be essential for the comfort of children during both winter and summer and a tough corrugated cardboard was used.

Some shelving was installed in the store, and a cupboard was allowed for in each classroom. Wash basins, water closets, and a urinal were provided in cloakrooms.

By employing the traditional building methods outlined, efficiency of workers was not impeded, and final costs were thereby kept to a minimum.

Control of Children by Staff.

It was decided that " policing " of the school by the headmaster was undesirable. Each class teacher should be able to control his or her own group, and only in extreme cases should the headmaster be concerned in general discipline of the pupils. In this way it would be possible to develop more self-reliance in teachers and more responsibility and respect in pupils. The necessity for complete control of the school from the headmaster's office was considered to be an unimportant planning factor.

Position of Cloakrooms.

In the standard plan employed by the Native Education Department, cloakrooms are sited at a distance from the main building, and are never placed under the same roof. This layout probably arose from the use of pit or pail latrines in older schemes, but where waterborne sewerage is available such a layout is undesirable and unnecessary. In the Kwa-Thema plan the cloakrooms are an integral part of the building and, as such, are never inconvenient to reach in wet or cold weather and all the ablution facilities for staff and pupils are concentrated in one area.

Initially the plan did not include separate cloakrooms for staff. It was intended that staff should be provided with one w.c. lock-up unit in the pupils' cloakrooms, but ultimately, after consultation with teachers, it was thought preferable to provide the accommodation as it is shown on the final plan, with a separate w.c. and wash-hand basin for male and female staff.

A very important consideration in the provision of cloakrooms as part of the school was that the children would be far more inclined to maintain the facilities in an hygienic state where staff control was near-by. Many of the children receive little or no personal hygiene training in their homes, and the school becomes an important educational factor from this point of view.

It is interesting to note that the headmaster has divided his pupils into teams, each team being responsible for the cleanliness of the cloakrooms for a week at a time. This might never have arisen where the lavatories were isolated from the school, there being consequently no immediate necessity for cleanliness.

Possible Future Extension.

The school is not complete as it has been planned ; it is intended that two more large classrooms be added which can be thrown open to form an assembly or meeting space. These rooms, for convenience, will be built on the west side of the school, and tree-planting will help overcome excessive sun-penetration from the west side during the afternoon. East windows will be protected by the covered way.

Social and Aesthetic Considerations.

It was eminently desirable that the school be acceptable and accepted as a part of the life structure of the people it was to serve. In this respect several economic and planning factors had a profound effect. The approach to the problem and its solution were instrumental in integrating the school with its community.

(a) Materials and structure are similar to the surrounding houses, the same type of brick having been used, and the corrugated iron roof is at the same pitch, with a curved ridge. The school is not overpowering in its size.

(b) The plan aids in overcoming excessive discomfort by providing proper lighting conditions, and some measure of protection from excessive heat gains or losses by the installation of a ceiling. It is unfortunate that a warmer type of floor surface could not have been provided.

(c) Self-reliance and cleanliness are engendered in the pupils by removing, to some extent, the constant full-scale control by the headmaster, and the siting of the cloakroom block has brought about some practical hygiene work.

(d) It was felt most strongly that fencing the school would immediately isolate it from the life of the community, and it was advised that no fencing be erected which would serve to create any such barrier. The playground is part of the residents' park space and can be used on all occasions when the children are not in occupation.

Cost.

It was essential that the capital outlay for the school be kept to a minimum. The severely limited funds available had to be carefully and most beneficially allocated.

Various factors influence the costs, among which are the efficiency of the use of space, type of structure, materials and finishes employed, the method of execution, and positioning of areas requiring drainage. These are not the only cost considerations, but they have borne directly on costs in this scheme. The final cost of the school was £5,000, the cost per square foot of building being 13s. 2½d. It must be noted that doors and windows re-used from the temporary housing scheme at Payneville were costed at 75% of their original purchase price. The final cost included the cost of cupboards in each classroom, and fencing to the gardening space.

The foregoing is a description of the influences motivating the design of the first primary school in Kwa-Thema, where the population already numbers some 5,000. Other schools are now urgently required, and it is hoped that the experience gained in the design and erection of the first will set a pattern for those which follow.

It is necessary here to outline some of the criticisms levelled against the school plan since its erection ; most of the points are due to too much stock having been laid on the conventional school plans which have been employed to date. A list of critical notes relating to the standard school plan has already been given in this report, and it appears a compartive analysis will have to be undertaken before any final decision can be reached as to whether the new layout is preferable to the standard plan.

It is important to note that the standard plan is based on the principle of education and supervision only, whereas the new plan attempts to cover the social and physiological aspects of education, with the school forming an integral and permanent part of community life.

Some of the criticisms recorded against the plan are listed below :

1.—The layout does not provide for an assembly quadrangle ;

2.—The principal does not have direct supervision over the whole school ;

3.—The cloakroom blocks should be isolated from the school ;

4.—The lower window panes in classrooms should be transluscent to prevent distraction of pupils ;

5.—The school should be fenced, especially since gardening is a school subject and some protection for plants is necessary.

Points 1 and 2 are satisfied by using the conventional " U "-shaped plan, but in the new plan there is in any case an assembly area north of the eastern wing which is enclosed on two sides, with the future classroom wing forming a third side. A row of trees would create the enclosed space for assembly. Also, the principal has an indirect control from his own office if this is felt necessary. From his window he can see the south windows of one classroom wing, and from his door he can control the entire corridor of the second classroom wing.

Point 3 was considered when planning was undertaken and the integration of w.c. blocks with the school has proved entirely successful. There can be only one reason for isolating the w.c. blocks and that would be where no sewerage service is available.

Point 4 is an exceptionally conservative assumption. One can only say that windows will often be open, and a full view to the outside will be possible in any case. The window sills are of such a height from the floor that when children are seated at desks there is very little likelihood that a full view of outside activities will be obtained.

Point 5 was regarded as a justifiable criticism but it was felt that the open playgrounds should not be enclosed. Instead, the rectangular area bounded by the school walls to the north and west was enclosed and there is no restriction on the use of the playing field when it is not occupied by scholars.

Because of various criticisms, an alternative plan was prepared by the Springs Municipality, but was abandoned when estimates indicated that its cost would probably be double those achieved in the execution of the existing building.

Since the completion of the school it has been continuously occupied by two separate groups of children. The morning school caters for 385 pupils ; this is the recognised Government school. A second school, organised by the Native Advisory Board, takes occupation during the afternoon. This is a " Private " school, where each scholar pays one shilling per term.

There is obviously an urgent need not only for more schools but also for larger schools, so that administrative and staff costs can be ultimately reduced. It is hoped that the new school will soon extend to include the original ten classrooms scheduled, and that funds will be made available to provide additional school buildings more convenient to those areas which are at a distance from the existing school.

NOTES AND NEWS

TRANSVAAL PROVINCIAL INSTITUTE

MEMBERSHIP : Mr. C. J. Grobbelaar and Mr. R. H. Waring (Salisbury) have registered as Practising Members and Mr. J. M. V. Rosekilly as a Salaried Member. It was recently incorrectly announced that Mr. M. D. Silverman was a Salaried Member. Mr. Silverman is practising at 115 Norwich Union Buildings, Johannesburg.

TRANSFERS : Mr. J. Biccard has transferred from salaried to practising, while Miss D. M. B. Hodgson and Mr. A. G. Jesseman has transferred from practising to salaried membership.

Mr. E. Cassarkis has transferred to the C.P.I. and Mr. D. Lyall Watson from the C.P.I.

ELECTION TO FELLOWSHIP, R.I.B.A. : Congratulations to Mr. R. G. Abbot on his direct election to F.R.I.B.A., which on the recommendation of Central Council was unanimously agreed by the Council of the R.I.B.A.

NATAL PROVINCIAL INSTITUTE

Mr. Barry J. Clark has opened an office at 116 S.A. Mutual Building, Gardiner Street, Durban, and would be pleased to receive trade circulars.

ERRATA

Prof. Paul H. Connell was Consulting Architect (not Engineer) to the Windmill Fertilizer Factory (February issue) and the article was written by Engineer W. F. Connell.

PROVINCIAL WORK

LIST OF ACCEPTED TENDERS FOR MAJOR PROVINCIAL SERVICES FOR QUARTER ENDING 31st DECEMBER, 1953

SERVICE	ARCHITECTS	QUANTITY SURVEYORS	CONTRACTORS	AMOUNT
Erection of Main Block at the Southern Suburbs Hospital	Haddon & Allen	Labuschagne, Law, Kennedy & du Toit	Messrs. Petro Construction Ltd.	£404,840 0 0
Erection of Protea Coloured School	Woudstra & de Ridder	Departmental	Messrs. J. W. Louwrens & Co.	£6,616 0 0
Erection of Hostel at the Witbank	Departmental	Departmental	Messrs. Atomic Con- Construction Co. Ltd.	£54,321 0 0
Erection of School and Teachers' High School Quarters at Halmdene	Cooper & Hellmann	Departmental	Messrs. Pax Construction Co. (Pty.) Ltd.	£10,700 0 0
Erection of new Krugersdorp Central School	Departmental	Departmental	Messrs. J. W. Louwrens & Co.	£86,853 0 0
Erection of Primary School at Blyvooruitzicht	Departmental	Departmental	Messrs. Van Heerden & Johnson (Pty.) Ltd.	£16,198 0 0
Erection of Hostel at Potchefstroom Central School	E. Todd & Horrel	Departmental	Messrs. G. Vincent & Co. (Pty.) Ltd.	£48,000 0 0
Alteration and Additions to the Linden High School	Geers, Geers and Partners	R. W. Skudder	Messrs. M. Klawansky & Co.	£42,857 16 8

TRADE NOTES AND NEWS

Bitroid Limited, of 107 Anglovaal House, Fox Street, Johannesburg, have announced the incorporation of their company in the Union, with an authorised capital of £150,000. Their primary object is to manufacture damp-proof coursing and roofing felts, and they aim to produce an article competitive in quality and price with imported material. The factory which is nearing completion in Boksburg is under the control of experienced personnel. It is planned to start with the manufacture of damp-proof coursing, followed soon by a full range of roofing felts and other bituminous products. Bitroid Limited is within the Anglo-Transvaal Industries Group and enjoys the vast benefits which such association offers.

The Trinidad and General Contracting Co. (Pty.) Ltd., announce that their products, which include Trinidad Asphalte Mastics for Roofing, Damp-proof courses and Tanking for trowel and float application, now bear the S.A.B.S. mark.