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JOINT EDITORS: PROFESSOR G. E. PEARSE, W. D. HOWIE

CONTENTS FOR SEPTEMBER 1945

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IMPRESSIONS OF ELIZABETHVILLE

By Betty Spence, B.Arch.

From Bulawayo through the Rhodesias and well into the Congo, Africa is covered with flat bush country which is deadly monotonous to the traveller. In this undulating blue-green sea man has carved himself sites for habitation and built small towns upon which the bush presses jealously. Elizabethville, the southernmost Congo town, is like its Rhodesian neighbours, and yet there is a difference compounded of the continental tradition and its tropical affiliations. To me, used to the mad rush of Johannesburg streets and to the impersonality of a big city, there was a delightful intimacy in the town. On a five minutes bicycle ride (the bicycle is a vehicle of transport admirably suited to the town's dimensions) one can visit any friend.

There are always many people in the streets wandering inconsequentially over the roadways and gravel sidewalks. A large number of these are Native women, who accompany their husbands when they come on labour contracts to the town. During the day they are to be seen padding the streets in bare-footed single file, remarkably graceful and erect, balancing bundles on their heads and children slung from their bodies. Often the child is swung from back to front and the mother continues her journey apparently unconcerned while the infant sucks at her exposed breast.

The cotton clothing these women wear is of a standard type, but many coloured. A loose blouse gathered into a low circular neck-band is worn off one shoulder. This is held at the waist by a length of cloth forming the skirt and falling almost to the ankles. Their heads are covered by "doeks" knotted at the back. Many of them are decked with necklets or earrings of metal or beads (5).

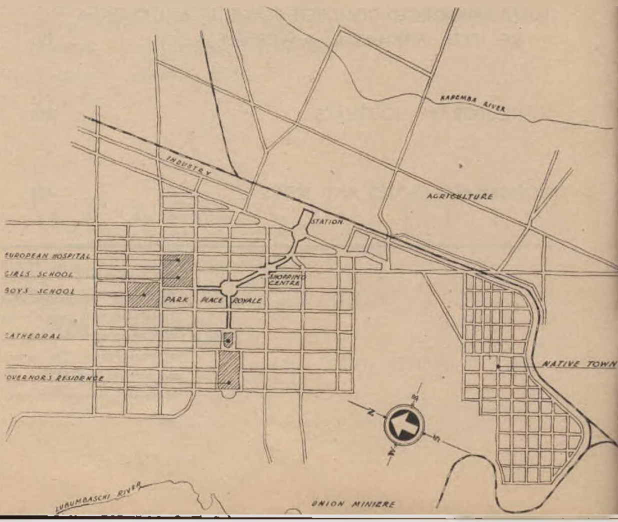
In the architecture there is a casual lightness which is almost Southern European in character. Curved form appears in arches to window heads, in arcades, in iron grilles to openings and in metal brackets. The Roman tile ripples along copings, breaking the severity of a straight parapet. Bright flashes of colour stand out against the cool pastels of plaster walls. Here and there a pavement café emphasises the fact that this is no British heritage.

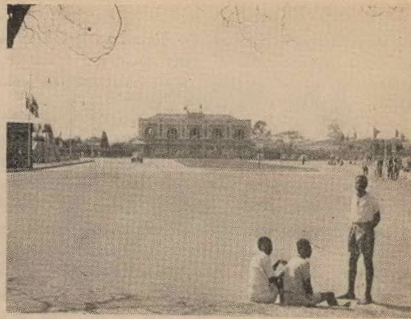
Elizabethville was founded in 1910, when the first Europeans came to the Katanga to open the Star of the Congo Mine. Now it has a population of 5,965 Europeans and 11,634* Natives. It owes its existence to the development by the

*This figure gives the population of the "centre extra-coutoumier" of Elizabethville and does not include the enormous camps where the Union Miniere and other companies house their workers.

BELOW: A typical view of the bush country of the Congo.

RIGHT: Plan of Elizabethville, showing the principal places, the European and Native parts of the town and the relative disposition of industrial and agricultural areas, all of which have room for outward expansion.





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The white buildings reflect the tropical climate. These are: (1) The Palace of Justice. (2) The Station, with the broad place fronting it. (3) The Post Office, and (4) A typical sidewalk cafe reminiscent of Europe. (5) Native women photographed in a street in the town.

5

Union Miniere of mineral deposits in the vicinity, and although it is so small it is none-the-less a very prosperous industrial centre. The Congo, so far as Europeans are concerned, is a rich country, and the population of Elizabethville is almost entirely middle-class.

The climate is tropical, with torrential rains in the hot summer months, and a pleasant coolness in the short winter season. With it go the scourges of white ants and anopheles mosquitoes. In this high altitude the nights are always cool, and the blisteringly hot days followed by sudden chill bring the malarial incidence to one of the highest in the continent.

The town is well zoned in plan and gives the impression of being well controlled in practice. Residential and business areas are grouped together on the west of the railway. Along the line are small factories and workshops, giving way, further east, to farm buildings. Also to the west, but south of the European area and separated by a treed park is the "cite indigene," where most of the Natives employed in the town have their home. West of the town, in the valley of a small river, is the Lubumbaschi smelting plant of the Union Miniere. The site of the town is practically flat, falling gently towards the valley on the west. The last houses on this side have a magnificent view of distant bush country. Here are the "grosses residences" of high government officials, company directors and bank managers.

The town is laid out on the usual gridiron, but one which has been cut across by a superior network linking the important public centres. The cathedral, the schools, the administrative offices, the shopping centre and the station are designed in a direct and simple relationship to one another. The centre of the town is grouped, continental fashion, on three open places. The law courts, municipal offices and social club stand on the circular "Place Royale," richly planted with trees. Here few people come. A diagonal road, but one block long, changes the character from one of peace to populous activity. The commercial centre is on a star-shaped traffic division dominated by the post office (3). The trees have vanished, and in their place are arcaded shops on wide gravelled sidewalks. A road from here leads to a turning circle, beyond which is the station square. At the end of this in minor magnificence the station building holds court (2).

The buildings of the town centre are uniformly low in height. On the ground floor are shops fronted by a covered way; above there is, for the most part, one storey of offices and rooms. As in any modern town, there are a multiplicity of different styles. The Mediterranean character of low parapeted roofs, arcades and wrought iron work is contradicted here and there by steeply pitched roofs with dormer windows. Most of the modern buildings are rather florid, but I found one or two which were sufficiently formal to satisfy my taste.

In the residential district the streets are well shaded by jacarandas and other taller trees. Often the paving under foot is shaped cobbles of local stone. The majority of the houses are of a bungalow type, not unlike those of suburban Johannesburg, though the proportion seems distorted by the high ceilings adopted on account of the heat, and the gable with a wide roof overhang and projecting side pieces has taken the place of the Doric columned porch.

The roofs in the residential area, as in the town, vary from a flat to a steep pitch usually associated with Northern countries. Concrete has not been found to stand up well to the wide range of daily temperature, and most modern houses are roofed with lean-to roofs hidden by parapets (18). The steeply pitched roofs, on the other hand, are popular by virtue of the insulation they provide (15, 16).

Most of the houses are plastered and patterns are formed by decorating rough cast surfaces with bands of smooth work.

A pleasant feature of the domestic work is the fairly general use of colour. Windows, doors and fascia boards are painted in vivid red, marine blue, cobalt or green. Sometimes smooth plaster wall surfaces are also painted in pale pastel shades.

6.7.8






9.10.11

From the dominating feature of the climate, the hot sun of the summer months, the houses are protected by overhanging eaves and canopies sheltering individual windows; unexpected openings above the average window line give ventilation to the roof: rooms are large with high ceilings and concrete floors; and passages are omitted so that the air may circulate freely from one room to another; while all living rooms are on the south away from the hot mid-day sun.

These local requirements present problems to Congo architects with which we, in South Africa, do not have to deal. The most tiresome is the placing of the canopies. These are usually formed of 3 in. reinforced concrete slabs projecting about 1 ft. 6 in., and sometimes trimmed with tiling. Their position over windows fixes them at a point just half-way up the wall. In the average pitched-roof house the projecting eaves and, under them, the canopies tend to form an unhappy duality of projections. The best solution seems to be in the use of a steeply pitched roof (15), which, while allowing the full room height internally, also descends so that the eaves shade the windows. Canopies cause less trouble on houses with parapets, where this duality does not arise.

The vents to the roof have been more successfully resolved into features of architecture. As a rule they are placed in the gable end (15, 19) or, where a parapet is used, echoeing the rhythm of the windows in the upper part of the wall (18). Unlike our ubiquitous air bricks, their presence is never hidden, but rather emphasised, perhaps by an outline of smooth plaster work, perhaps by a wrought iron grill of romantic design.

The interiors can be delightful. The sunlessness, almost cavernous high-ceilinged rooms offer a cool and sombre retreat from the glittering blaze of the sun. The materials used are impervious and smooth. The walls are plastered but without skirting or picture rail, which would encourage white ants. The well-polished granolithic floor, with a few mats, provides an excellent setting for the light upholstered furniture of pale-coloured Congo woods. The rooms appear to be limited only in length and breadth, for the ceiling, 14 feet from the floor, is beyond the natural angle of vision and hidden in gloom above the windows (20).

The external doors and windows are, rather unexpectedly, rebated $2\frac{1}{4}$ in. into the walls. They are placed flush with the internal plaster, and a fillet or architrave covers the joint. For convenience the windows usually open inward and mosquito netting is fixed to the outer surface of the frame. Gutters must also be omitted because of the malarial danger, and instead houses are surrounded by two or three feet of paving.

Although the white ant is fairly efficiently excluded from buildings by concrete floors and the meagre use of wood in construction, a regulation stipulates that in addition all walls must have a concrete layer at ground floor level.

Elizabethville is not on an easy trade route, and it is therefore fortunate that most building materials can be found near

UNIVERSITY OF THE WITWATERSRAND
1945
LIBRARY.

The buildings of the town are uniform mainly as regards their height. On the ground floor are shops fronted by a covered way (6, 8, 9, 10). Above there is, for the most part, one storey of offices and rooms. As in any modern town, there is a multiplicity of styles; the Mediterranean character of low parapeted roofs, arcades and wrought iron work is contradicted here and there by steeply pitched roofs with dormer windows and numerous buildings which show a rather florid interpretation of contemporary influences. The building workers in the Congo are all Natives (12), though the work is usually supervised by one or two European foremen.

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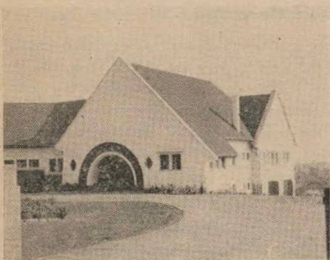

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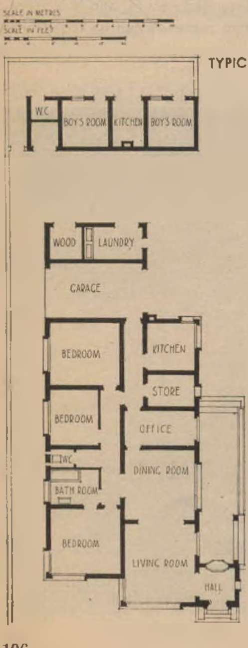

TYPICAL HOUSE PLAN.

From the dominating feature of the climate, the hot summer sun, the houses are protected by overhanging eaves and canopies over individual windows. Unexpected openings above the windows give ventiliation to the roof (14, 15, 18, 19). Rooms are large with high ceilings (20) and concrete floors. As shown on the left, passages are omitted so that air may flow freely, and all living rooms are on the south away from the hot sun. Most of the houses are plastered, and patterns are formed in rought cast and smooth finishes, with colour generally used—reds, blues and greens—on windows and woodwork. The most successful solution to the problem of duality between the eaves and canopy projections seems to be the use of the steep pitch, as in (15), or the parapet concealing the lean-to roof, as (18). This duality is unsatisfactorily evident in (19).

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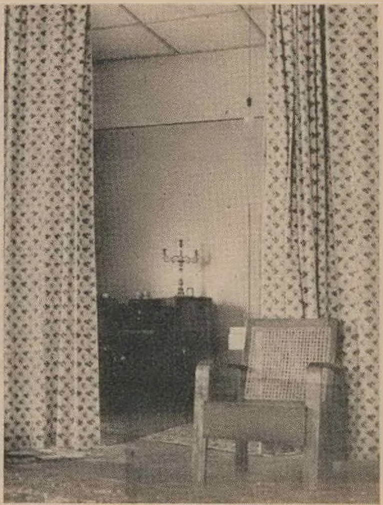

the town or further afield in the Congo. The main structural material is brick, which is made locally. Cement is also made locally, but concrete is not popular, particularly for roofing, as it does not stand up well to the wide temperature range. Roofing is usually of tile or imported corrugated iron. A locally-made cement dyed a rather pale pink is being used extensively. Windows and doors are made of various Congo woods, of which there are sufficient for local supply, but not for export. Floors are of granolithic or terrazzo slabs, but in a few cases imported tiles are used very successfully. Even the material for the decorative wrought iron work is mined by the Union Miniere.

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The profession of architecture is not exactly thriving in the town. Most of the houses are built by contractors on speculation, and only a few of the richer inhabitants live in houses designed by qualified men. In the field of larger buildings, where a proper plan is necessary, the profession has to compete with draughtsmen who have not received a full training. In this light it is not surprising to find that of five or six qualified men not one has found it possible to live on his practice. With the exception of one, who runs a newspaper as well as his practice, they are employed either in one of the large companies or by the Belgian Government. The policy, however, is to develop an independent profession, and to this end architects are encouraged to take private work, and periodically the Government holds a competition for a large building.

Nor is the building trade in a more satisfactory position. The building workers in the Congo are, of course, Natives, though the job is usually supervised by one or two European foremen. For these men the Government secondary schools provide a three-year technical course, which includes carpentry, masonry and metal work. The majority of the building workers have been through one of these schools, though there is no Trade Union to prevent the hiring out of untrained men. Considering the disadvantages under which the Native labours, he has achieved considerable success. Although in the Congo Natives are encouraged to learn technical skills, their general cultural level is little different from that of Natives in the Union. Nor is the training offered by the secondary schools comparable with that of an apprentice in a European country. In spite of this, the construction of the Elizabethville house built for speculation is not much below the standard of its brother in the Union. Where an architect is employed and thorough European supervision is permanently on the job, the work is eminently satisfactory.

Photo: Howard Coster, F.R.S.A.

PROFESSOR SIR PATRICK ABERCROMBIE

By Augustus Muir

Sir Patrick Abercrombie, Britain's greatest expert in town-planning, received his knighthood in the New Year Honours List of 1945. After 20 years' experience of town-planning and "civic design" as a Professor in Liverpool, he was appointed, in 1935, to University College, London. Since the war, he has helped to re-plan blitzed areas in Clydeside, Hull, Plymouth and Bath; and the greatest of the schemes associated with his name, "London of To-morrow" was published not long before the announcement of his richly deserved honour.

The publication of a plan for the London of to-morrow has brought the name of Professor Sir Patrick Abercrombie prominently into the news headlines. This tall, spare, immensely industrious man of sixty-five is the creator and designer of the greatest plan of its kind ever drawn up. It involves more than ten million people and 2,700 square miles : it foreshadows the moving of more than one million people to new homes, and the creation of ten new satellite towns separated from Greater London by a green belt of country-side. The whole conception shows a daring imagination linked with a very practical grasp of reality; and these two qualities Patrick Abercrombie himself posseses in a notable degree.

He has spent his life dreaming of stone and lime, of streets and highways, and of those things that provide the amenities of daily living—from the site of a railway station to the location of a letter-box. In his earliest days, he was eager to be an architect—to plan buildings and streets—and it was but a step further for him to plan cities and whole country-sides.

After leaving school, he entered upon six years of exacting work in architects' offices, where he became intimate with all the multitudinous details of building. His first important post was his appointment to the editorship of a new periodical, "The Town Planning Review," and he wrote a large part of it himself. Already his future career was shaping itself; for it was clear that he was destined to become a planner on the grand scale. At a time of enthusiasm for civic improvement, Dublin invited architects of all nations to submit their plans for the rebuilding of the city. In collaboration with a friend, Abercrombie entered this competition and won it. In the following year he became the Professor of Civic Design in the School of Architecture at Liverpool University.

This was a new subject for university study, and under his hands it grew in importance. He brought to bear upon it an experience that every year became wider. He studied abroad, at Vienna, Paris, Berlin, Brussels. And he did not merely teach his subject to others; he put his expert knowledge to practical use, and produced town-planning schemes for places like Sheffield, Bristol, Doncaster. He collaborated in projects for the development of wide areas of the English countryside. Together with his brother, the late Lascelles Abercrombie, an Oxford University lecturer who earned fame as a poet, he was chosen to draw up a report on the preservation of Stratford-on-Avon—that town of pilgrimage and homage for those who honour the works and the memory of Shakespeare.

The Stratford-on-Avon task was one in which he took a peculier delight because of his interest in the drama. In Liverpool, where his vivacity of mind and discriminating taste gained him many admirers, he was a supporter both of the Repertory Theatre and of the Philharmonic Orchestra. Indeed, he is a devotee of most of the arts, which his visits abroad have enabled him to enjoy with a cosmopolitan appreciation. He became a member of the Royal Fine Art Commission, and helped to found the Council for the Preservation of Rural

England. In 1935 his headquarters were transferred to London, for he was invited by London University to become the Professor of Town Planning at University College. He continued to retain this post and to carry out his academic duties, while at the same time he was active in many directions.

The outbreak of war in 1939, and the subsequent destruction caused in so many British towns by aerial bombardment, has increased the tasks that were piled upon his shoulders. He had previously planned a new centre for the naval port of Plymouth; and after the grave damage it suffered from the Luftwaffe, Abercromie was given the task of providing a new lay-out for the town. He undertook also the re-planning of blitzed areas such as Clydeside, with its ship-building and other industries, and the port of Hull, which for long periods was under constant enemy bombardment. He undertook the restoration of the gracious and dignified eighteenth-century town of Bath, damaged by bombs because of Germany's deliberate attempt to leave a savage mark upon a number of English towns of historical interest and cultural importance. In his work on the re-planning of Bournemouth, Professor Abercrombie was faced with problems of a different kind : for that famous seaside health resort contained many an elegant mansion which cannot be occupied by its former owners in the more austere days ahead. Thus, his creative genius is many-sided, including in its sweep a consideration for the beauties of residential areas, as well as for the functional demands of industrial districts, and the specialised requirements of a naval base.

But wider in extent than any of these was his work upon the London plan, in which he collaborated with the London County Council architect and a staff of experts. This plan envisages dramatic changes, such as the clearing of the ugly river frontage not far from the Houses of Parliament and the creation of a great recreational area with cafés, gardens, youth centres, and theatres. While the finest elements of traditional London are to be preserved, the road and rail transport system is to undergo a revolutionary change. To study this plan is to enter into a new age, with beauty and amenity fused into one ideal.

The true significance of this plan became apparent when Professor Abercrombie published a scheme for the future development of the great area surrounding the present confines of London. The development of London as a single area must cease; satellite towns must begin to grow in selected places, with the fullest transport facilities between them; no longer must factories be situated along the main exits from the metropolis, but must be carefully grouped in relation to the homes of the workers. Abercrombie's vision may take many years to materialise; but nobody can doubt the magnificence of his conception and the severely practical way in which he has worked it out in detail. In recognition of his services, he was created a Knight Bachelor in the New Year Honours of 1945.

He has lived a life busier than most men—the life of an artist with a keenly developed social sense and a burning desire to give his fellow men scope to reach higher levels in the art of living. His work is fundamental; without it, plans for social betterment would lack foundation. To the post-war surge of energy for the rebuilding of Britain, the realistic dreams of Professor Sir Patrick Abercrombie will give wise guidance and provide ideas both solid and enduring.

IMPROVEMENTS IN BRICKS AND MORTAR

By Clyde Ferguson, A.M.Inst.C.E., Structural Engineer (Architectural Department), Transvaal Provincial Administration.

Science has recently provided much new knowledge regarding bricks and their relations with the mortars employed. This new progress calls for revised brick-specifications and new methods of testing bricks and mortars.

It will be some time before the South African Standards Association is able to publish specifications for the building trade, and in the meantime, buildings are being erected with brick masonry so weak that it is only a little better than the old pioneer construction of sun-dried bricks.

This condition can be improved by easy stages, without undue trouble for the building industry.

The dry, absorptive bricks commonly used in South Africa might well be described as "Blotting Paper Bricks." Classification of bricks by their compressive strength will come later, but the urgent task is to obtain an adhesive bond between bricks and mortar. The first step is to use bricks which will not take water from the jointing mortar, either too quickly or in too great a quantity, and then to provide a mortar proportioned and graded for "water retention."

The bricklayer's trouble has been that he has received unsuitable bricks which absorb the water from the mortar, as soon as the mortar-bed is laid. By the time he has placed a brick upon the mortar-bed, the further absorption so stiffens the mortar that the joint cannot be controlled and levelled.

The practical bricklayer tries to find a mortar-mix to suit these impossible conditions, and produces a mortar which is workable but is little better than "dagga."

There can be no strong brick masonry if the mortar does not conform with the following regulation:—

"The volume of aggregate in mortar shall be at least two times but not more than three times the volume of cementitious material."

The production of mortars has now become an exact science, and it will require some years for South Africa to adapt herself to the new methods which call for mechanical tests. It is important to note that in the four classes of mortar, standardized in America, cement is mentioned in them all. Since cement cannot set and harden except in the presence of water, it follows that no cement-mortar should be used with highly absorptive bricks.

First-class cement mortar should be specified for 11-inch cavity walls, for example, so this type of construction is only advisable if bricks of low absorbency are available.

Two simple site tests, which a clerk of works may use for "Rate of Absorption," are as follows:—

(1) The 1-inch Diameter Ring Test.

This test consists in drawing a circle 1 inch in diameter, on the flat of the brick, with a wax pencil. (A coin or circular guide is used.) Twenty drops of water are applied to the surface thus limited, and the time for complete absorption is noted. If this time exceeds $1\frac{1}{2}$ minutes, the bricks need not be wetted, but if less than $1\frac{1}{2}$ minutes wetting is recommended.

The average of several tests on different parts of the brick is in some cases essential.

(2) Quantitative Absorption Test.

A brick laid in any mortar containing cement shall be wetted when laid, unless the gain in weight resulting from partial immersion flatwise in $\frac{1}{8}$ inch of water for one minute is less than one ounce.

In the extremely dry air of South Africa, it is most undesirable to use a highly absorptive brick because, by capillary attraction, it serves as a very efficient apparatus for the transfer of moisture from a mortar joint to the outer air. Wetting bricks is useful in maintaining "workability" of a lime mortar, but its effect is too temporary when considering the curing period during which cement mortars require surface moisture (three to seven days).

Some miscellaneous samples of Pretoria bricks were tested for "quantitative absorption," in $\frac{1}{8}$ inch deep water for one minute, with the following results:—

Sample No.	Type	Water absorbed (ozs.)
1	Pressed	3.63
2	"	3.32
3	Wire-cut	1.2
4	Pressed	0.85
5	"	0.32
6	"	4.97
7	"	0.81
8	"	3.32
9	"	4.85
10	Wire-cut	1.13
11	Pressed	3.92
12	Wire-cut	1.94
13	Pressed	0.71
14	"	1.23
15	"	0.42
16	"	3.52
17	"	5.00
18	"	1.48
19	"	2.94
20	"	2.48

Only 25% of the bricks tested had a satisfactory absorption, i.e., less than one ounce.

After improvement has been made in the type of brick used, it remains to provide some similar improvement in mortars.

It should be possible to introduce the travelling test-van or trailer, which is equipped to carry out the necessary tests on bricks and mortar.

There is the "Water Retention Test," which is a slump test carried out on a mechanical table moving up and down. This test is associated with the "Flow After Suction Test," which requires a vacuum chamber to suck water from the mortar, like an absorbent brick sucks from its mortar bed.

Sand grading, with sieves issued to the Clerk of Works, can be adopted at once, and will give an immediate improvement in mortars.

Sand Grading for Mortar:

Sand for mortar shall be uniformly graded from fine to coarse, within the following limits:—

Passing	No. 8	sieve	100%
"	No. 50	"	15 to 40%
"	No. 100	"	0 to 10%
"	No. 200	"	0 to 5%

Cement mortars should be laid within 20 minutes from the time of adding water to the mix. Cement mortars must not be disturbed after initial set has taken place, i.e., 30 minutes from the time of adding water to the mix.

If interest can be aroused in this subject, which calls for some application of science, one of the major factors which cause buildings to crack may be eliminated.

WARTIME BUILDING

This Supplement is the last of a series published by courtesy of the Building Control Section, with the object of keeping Members informed of the development of constructural methods, new and substitute materials, and tests, which have come about as a result of war conditions.

TIMBER REINFORCED CONCRETE BEAMS

By A. J. Ockleston, B.F., Ph D., A.M.I.Struct.E.

Concrete, though strong in compression, is relatively weak in tension, and reinforcement is required in beams if full advantage is to be taken of the compressive strength of the concrete. Besides increasing the strength very considerably, reinforcement prevents the sudden brittle failure which occurs with plain concrete beams.

For reinforcement steel is almost invariably used, but when it seemed probable that owing to war-time conditions there would be serious shortages in the Union of both steel and timber, an experimental investigation was begun, on behalf of the Investigation Section of Building Control, into the possibility of using timber as reinforcement for concrete members. In the event of serious shortages, this method of construction would have released for other use a considerable amount of the steel normally used in light reinforced members. The timber position would also have been eased. Less timher would be required for reinforcement than for all-timber members; moreover, types and sizes of timber unsuitable for carpentry work could be used for reinforcement. Timber reinforcement may sometimes be used to advantage in normal times, particularly where steel is expensive and difficult to obtain. In Siberia bridge abutments have been built with timber reinforcements, and in the Far East and parts of North Africa a similar method of construction, bamboo-reinforced concrete, has been used.

The shortages of steel and timber in the Union did not become as serious as was at one time expected, and the attention of the Investigation Section of Building Control was largely diverted from timber reinforcement to other, more urgent, problems. The work on timber-reinforced concrete was, however, continued, though slowly; a summary is given here of the results obtained, and recommendations are made for the design of timber-reinforced concrete beams.

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This investigation was carried out by the writer, in the Civil Engineering Laboratories of the University of the Witwatersrand, Johannesburg, with the assistance of Messrs. N. Stutterheim, B.Sc. (Eng.) and J. Shaw, M.Sc. (Eng.).

I STRENGTH AND ELASTIC MODULUS OF TIMBER.

Tests were carried out to determine the strength and elastic modulus for a number of species of timber which were available in fair quantities and might be used as reinforcement. The timber was tested air-dry, and in the form of rough-sawn laths, generally about 1 in. x $\frac{1}{2}$ in. in section. To allow for the weakening effect of crookedness of grain, relatively long specimens were used; these were not specially selected for straightness of grain.

For the various species tested the mean tensile strength, in the direction of the grain, of specimens free from knots, ranged from about 5,000 to 1,500 lb./sq. in. The relative strengths of the different species are indicated by the working stresses given in Section V. The variation in the strength of different pieces of the same species of timber was appreciable, being generally of the order ± 45% of the mean strength.

In tension timber was found to be almost perfectly elastic. No yielding occurred, and the stress-strain relationships remained linear until the beginning of failure. The mean values of the elastic modulus in tension for the different species ranged from about 1.4×10^6 to 3.4×10^6 lb./sq. in. The variation in the value of elastic modulus for different specimens of the same species was generally less than that for tensile strength.

Of the timbers tested, one of the commonest species, Eucalyptus Saligna, was found to have much more variable properties than any of the others. The timber from young trees is white in colour, that from older trees, pink. The pink type is generally heavier, harder and stronger, and has a higher elastic modulus than the white, though the lower limits for the pink type and the upper limits for the white overlap somewhat. Most of the Eucalyptus Saligna commercially available is of the white type, and the working stresses given in Section V are based on the mean values for this type.

Knots and similar defects reduce the strength of timber. It was found, as a result of a number of tests, that the reduction in strength of a piece of timber in tension was approximately proportional to the section area of the knots. For reinforcement two grades of timber were considered: Grade 1, in which the area of knots at any section is less than one-fifth of the section area, and Grade 2, in which the area of knots exceeds one-fifth but is less than one-half of the section area. The strength of Grade 2 timber is about two-thirds that of Grade 1.

II—ADHESION AND BOND STRENGTH.

The chief difficulties to be overcome in the use of timber as reinforcement are those due to the moisture movements of the timber. When cast into concrete timber absorbs moisture from the wet mix and swells; if any appreciable swelling occurs after the concrete has begun to set the concrete surrounding the timber may be cracked. When the member and the reinforcement dry out the timber shrinks, and the adhesion between it and the concrete is reduced.

A similar difficulty occurs when bamboo is used as reinforcement. This has been overcome by other investigators by painting the bamboo with white lead paint to which 10% of varnish has been added. When this investigation was begun, neither white lead nor varnish were available in appreciable quantities. A series of tests, in which Pinus Insignis and white Eucalyptus Saligna were used, was made with the object of finding other types of paint which would be suitable for use with timber reinforcement. The most satisfactory results were given by paints made by thinning red iron oxide paint with mineral turpentine and by fluxing hard bitumen and coke oven and gasworks pitch with suitable solvents. The timber was dipped into the paints and the paint films allowed to dry before the reinforcement was used. Timber so treated gave bond strengths considerably greater than those for untreated timber.

Test beams were made, reinforced with Pinus Insignis and white Eucalyptus Saligna treated with these paints. Where a minimum cover of ½ inch was used some cracking occurred, mainly at the level of the top of the reinforcement, indicating that the treatments did not entirely prevent the swelling of the timber. With ¾ in. minimum cover this cracking was considerably reduced, there being little more than hair cracking. When the beams were tested the cracks appeared to have no adverse effect on the strength. When test beams were made with Eucalyptus Maculata reinforcement the cracking was much more serious and caused premature failure. Similar cracking occurred when paint-treated specimens, of the various species of timber considered, were cast into concrete cubes to form pull-out bond strength specimens. Some of these cracks extended through two inches of concrete.

Further investigation was therefore made into the effect of paints on the absorption and consequent swelling of timber. It was found that although the paints all reduced the rate of absorption none of those used, nor the white lead paint which had been found satisfactory for bamboo reinforcement, prevented absorption. The reduction of the rate of absorption in some cases aggravated the effect, appreciable swelling occurring after the concrete had begun to set; this caused severe cracking.

As paint treatments had proved unsuitable, other means of overcoming the difficulty due to moisture movements of timber were sought. The swelling and shrinkage of timber can be reduced by various methods. A simple and effective method is to soak the timber in a solution of sugar. This treatment could not be used with reinforcement since very small quantities of sugar seriously weaken concrete and may even prevent its setting. Tests were carried out to find some treatment which would reduce the swelling of timber, be simple and cheap enough for the purpose, and have no harmful effects on concrete. Of the many treatments investigated immersion in a 10% solution of aluminium sulphate was the most satisfactory. This treatment did not reduce the absorption, but, by affecting the timber colloids, reduced the consequent swelling of the timbers tested by about half. As the rate of absorption of some of the timbers, particularly the harder gums, was very slow, immersion for ten to fourteen days was found necessary. When aluminium sulphate treated timber was allowed to dry before being used as reinforcement, sufficient swelling occurred to cause cracking of the surrounding concrete. If, however, the timber was cast in within a day of its removal from the solution no such cracking took place.

The bond strength of aluminium sulphate treated timber in concrete was found from both pull-out and beam tests. The variation in the bond strength of individual specimens of the same type was considerable. This was particularly so with the pull-out tests, probably due to the relatively short length of timber embedded. The beam tests gave somewhat less variable results. The mean value for rough-sawn timber of the different species tested ranged from about 50 to 90 lb./sq. in.; the extreme values were 32 and 129 lb./sq. in. The strength of the concrete did not seem to have any appreciable effect on the bond strength. The chief factor affecting bond strength appeared to be the surface roughness; the values given here, and the working stresses in Section V, are for rough-sawn timber having surface serrations about one thirty-second of an inch deep.

III—DURABILITY OF TIMBER REINFORCEMENT.

The durability of timber-reinforced concrete members will depend mainly on that of the timber. For timber the chief destructive agency is decay. This is due to the attack of fungi which require for their existence air, warmth and moisture. The moisture requirements of the fungi causing the decay of timber are somewhat critical. If the moisture content of the timber falls below 20% by weight decay cannot occur, and any decay which may have begun will cease.

It was found that, although shortly after casting into concrete the moisture content of timber reinforcement exceeded the critical value, if the member was exposed to the air and protected from the weather, the moisture content would fall below the critical value in one or two months. If the member was kept in moist surroundings, or exposed to the weather, the moisture content of the reinforcement was likely to remain above the critical value.

To determine whether concrete cover would protect timber, a number of specimens of timber cast into sand-cement mortar were tested by the Transvaal Chamber of Mines Timber Research Laboratory. These specimens were exposed for a year to attack by timber-destroying fungi under conditions most favourable to fungal growth. Timber with a cover of only $\frac{3}{4}$ in. was not attacked, although unprotected timber specimens were badly decayed. Similar results were obtained from other tests in which timber-reinforced members were exposed to very moist conditions, or partially buried in moist earth, for periods of a year or more. These results indicate that, if it is sound, the concrete cover forms an effective protection against fungal attack. It would, however, be advisable not to use timber-reinforced members in moist situations, since cracking or honey-combing of the cover might expose the timber to fungal attack.

Some tests carried out in Russia indicated that there might be some deterioration in the strength of timber reinforcement due to the effects of the lime in the cement and of the fermentation of the plant juices. Any reduction in strength due to these factors would not be progressive and would be relatively small.

IV—TEST BEAMS.

A number of concrete beams with timber reinforcement were made and tested to investigate the behaviour of such members. Concrete of different strengths, and nine different species of timber, in some cases both first and second grades, were used, and the percentages of reinforcement ranged from 0.9% to 16%. In all, seventy-nine beams were made and tested.

The test beams were all 4 ft. long and rectangular in section. The overall dimensions of the sections ranged from about 3 in. x 4 in. to 7 in. x 6 in. The timber reinforcement was in the form of laths, generally rough-sawn, and about 1 in. x $\frac{1}{2}$ in. section. The minimum clear spacing between pieces of reinforcement, and in most cases the minimum cover, were both $\frac{3}{4}$ in. No special end anchorage was provided, the reinforcement extending only about $1\frac{1}{2}$ in. beyond the points of support of the beams. No diagonal tension reinforcement was used.

The beams were tested at ages of from three days to nine months. They were in all cases simply supported on a span of 42 in., and centrally loaded. The cube strength of the concrete, at the time of testing, varied from 2,490 to 7,150 lb./sq. in.

The first observable signs of failure were generally the formation of vertical cracks near the point of maximum bending moment. The average load at which these cracks were first observed was about half the ultimate load. During the early stages of loading the deflections were small, but after cracking had begun the beams became more flexible. The deflections of the beams at the maximum loads were considerable. Of the beams tested three broke suddenly. In all other cases the beams did not collapse until the deflections were much greater than those for the maximum loads.

In the majority of cases failure was due to the timber reinforcement breaking in tension. Bond failures occurred in some beams, particularly those in which timber with a smooth surface was used as reinforcement.

The failing loads were, as a rule, somewhat higher than those calculated, by the method generally used in the design of steel-reinforced concrete beams, from the strength of the concrete and the average properties of the timber used.

V RECOMMENDATIONS FOR DESIGN.

From the information obtained in the investigation described above, the following recommendations for the design of timber-reinforced concrete beams have been drawn up. The working stresses given have been based on a minimum factor of safety of 2.5.

GENERAL :

Timber-reinforced concrete beams should be designed by the straight-line no-tension theory commonly used for the design of steel-reinforced concrete beams.

The design should, unless otherwise recommended, be generally in accordance with the provisions of the Code of Practice for Reinforced Concrete.

Beams should be so proportioned that diagonal tension (shear) reinforcement is not required.

TIMBER :

Timber for reinforcement should be straight-grained, free from decay, and have a moisture content not exceeding 15% by weight. The surface should be rough, and not planed or smoothed in any way.

For Grade 1 timber the area of knots and other defects at any section should not exceed one-fifth of the section area; for Grade 2, the area of knots and defects may exceed one-fifth, but should not exceed one-half of the section area.

Before being used as reinforcement the timber should be immersed for 14 days in a solution containing 1 lb. of aluminium sulphate per gallon.

The timber should be cast into the concrete within 24 hours of its removal from the aluminium sulphate solution.

MODULAR RATIOS AND WORKING STRESSES FOR TIMBER:

The modular ratio for the various species of timber are given in Table I.

The tensile working stresses for timber reinforcement should not exceed the values given in Table I.

The bond stress used in the calculation of anchorage of timber reinforcement should not exceed the value given in Table I.

TABLE I—MODULAR RATIOS AND WORKING STRESSES FOR TIMBER.

TIMBER	Modular Ratio	WORKING STRESSES (lb./sq. in.)		
		Tension (Grade 1)	Tension (Grade 2)	Bond (Anchorage)
Eucalyptus Maculata (Hook)	1.6	3700	2500	12.5
Eucalyptus Diversicolor (F. v. M.)	1.7	3100	2050	"
Eucalyptus Pilularis (Sm.)	1.4	2650	1750	"
Acacia Mollissima (Wild)	1.0	2500	1650	"
Eucalyptus Globulus (Labill.)	1.2	2300	1550	"
Acacia Mollissima (Wild)	.74	1800	1200	"
Pinus Pinaster (Soland.)	1.0	1750	1150	"
Eucalyptus Saligna (Sm.)	.82	1350	900	"
Pinus Insignis (Doug.) syn. Pinus Radiata (D.Don)	.71	1350	900	"

WORKING STRESSES FOR CONCRETE:

The working stresses for concrete in compression due to bending and in diagonal tension (shear) should not exceed the values used for steel-reinforced concrete beams.

ANCHORAGE:

Exclusive of end anchorage tensile reinforcement should extend from any section a distance sufficient to give, by anchorage bond stress, a resistance not less than the tensile force in the reinforcement.

To provide end anchorage the reinforcement should extend an additional distance, sufficient to give, by anchorage bond stress, a resistance not less than 0.3 of the tensile working strength of the reinforcement.

BOND STRESS DUE TO BENDING:

At any section the bond stress due to variation in bending moment given by the expression :

$$\frac{S}{a\ o}$$

where

S = the total shear force at the section,
a = the arm of the resisting moment of the beam,
o = the sum of the perimeters of the tensile reinforcement at the section,

should not exceed twice the anchorage bond stress, i.e., should not exceed 25 lb./sq. in.

MINIMUM COVER AND CLEAR SPACING:

The cover over reinforcement and the clear spacing between pieces of reinforcement should not be less than $\frac{3}{4}$ inch. This value has been found satisfactory for 1 in. x $\frac{1}{2}$ in. reinforcement, and should be increased proportionately for larger sizes.

MINIMUM REINFORCEMENT:

If possible at least two pieces of reinforcement should be used at any section, so placed that knots and defects in one piece do not occur at the same section as those in the other.

If the stronger species of timber are used, timber-reinforced concrete beams can be designed by the method outlined above to have working strengths of up to about three-quarters of those for beams of the same dimensions with a moderate amount of steel reinforcement. With timber the area of reinforcement required will be much greater than with steel.

The safe loads for timber-reinforced beams will be from half to three-quarters those for deal beams of the same overall dimensions.

Owing to the relatively low bond strength of timber in concrete, timber reinforcement will not, as a rule, be suitable for beams subject to large shear forces.

CONTEMPORARY JOURNALS

"THE ARCHITECTURAL REVIEW." *June, 1945.*

This is a number devoted to the "Review's" case for a "Programme for the City of London," and in the words of the editors is "meant as a contribution to visual planning." It will be recalled that some months back the "Review" put forward their provocative argument in favour of the visual approach, the art of being irregular in town planning, and borrowed Sir William Temple's word "Sharawaggi" to define this procedure. This issue carries the theory a stage further, and shows it applied to a definite problem. The theory of the "picturesque" is re-examined and interpreted in terms of the urban English scene in which the changing pattern of many ages and styles is characteristic. Commencing with a pictorial anthology of city life, the number is developed in three parts: the first on principles of planning for England and London, the second on their application to the city, and the third on St. Paul's precinct. Each part is aptly and extensively illustrated, and in the latter the "Review's" plan for the precinct is shown supplemented by a series of 'visuals' brilliantly drawn by Hugh Casson, whose subtle skill and persuasive selection so charmingly captures the spirit of the argument. These aim to show "a planned London that can be developed not mechanically but organically, with all the old spontaneous variety of incident characteristic of the genius of the place." The theory would seem to have justification when seen against the background of the English scene, but those of us unfamiliar with these characteristics find the picturesque approach to town planning not a little difficult to accept.

"THE ARCHITECTURAL RECORD." *June, 1945.*

This issue contains Building Types Study No. 102, prepared in collaboration with "The Nation's Schools," and discusses neighbourhood schools, their characteristics, planning provisions, and relation to the community they serve. The emphasis here is on the completeness of development for public needs, and the seven examples illustrated are of buildings designed for multi-purpose flexibility. Included also in this issue are a number of designs for small houses and the San Antonio Municipal Airport.

"PENCIL POINTS." *June, 1945.*

This issue appears with a variety of interest covering many aspects of planning, and ranging from a minimum house to the city planning study for the San Fernando Valley and Los Angeles. There is also a well-integrated recreational plan for Lake Texoma, the object of which is to bring outdoor recreational facilities to 6,000,000 persons. Another interesting design is that of the Community Building in Zurich, which is designed to serve all the cultural, communal and devotional needs of the community, and in a well-planned economical structure provides for a school, library, club, theatre, banqueting, dancing, religious services and social welfare requirements.

Under the heading "The Performance in the Theatre," the various sequences of operations are examined, and the architectural requirements are derived in each case.

"THE ARCHITECTURAL FORUM." *June, 1945.*

Seven houses and types of school building constitute the bulk of this issue, and in addition re-development studies for a civic centre, a cultural centre and a residential area in Detroit, prepared by private architects, are illustrated. These have been "formed out" by the City Plan Commission, and all constitute study portions of the existing master plan.

Oscar Niemeyer's project for the National Stadium at Rio de Janiero is included. A most complex problem, it is one of the most ambitious athletic arenas yet seen. It was designed in 1942 for a Government sponsored competition which was not concluded, and the fate of the scheme rests in the hands of the Minister of Education and Health, who has done so much to encourage modern architecture in Brazil. Included in this scheme is a stadium to seat 100,000, one for 10,000, and two for 5,000 persons, as well as a complete National School for Physical Culture, a polo field, and parking for 10,000 cars.

PROFESSIONAL NOTES AND NEWS

CHANGE OF ADDRESS.

Messrs. Hanson, Tomkin, Finkelstein, M.M.I.A., A.A.R.I.B.A., have moved their offices to 2nd Floor, 20th Century Building, President Street, Johannesburg. Telephone Number: 22-7992.

NOTICE.

We are pleased to announce that Mr. A. Axelrod has returned from active service and has joined the firm of Ferguson and Stakesby Lewis, Washington House, Commissioner Street, Johannesburg.

We are pleased to announce, too, that Mr. Gordon Summerley has returned from active service and has resumed practice in the firm Nurcombe, Summerley and Lange, Jubilee House, Simmonds Street, Johannesburg.

Accent On Housing !

THE over-riding preoccupation of the architectural and building world will for some time rightly be the provision of housing.

While, however, the national shortage of domestic building receives immediate priority, there are also to be met the huge accumulated demands for commercial and institutional construction, for which plans must be prepared to be put into operation as soon as the limited factors of labour and materials are available.

Here the need will once more be felt for expert design and craftsmanship in the provision of those features for which in the past the House of Sage has set a standard and established a tradition. With resources renewed and experience enhanced by the exceptional services to which it was called during the war years, it is to-day ready to play its expected and important part in the appropriate spheres of the wider field of Post-war Reconstruction.

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