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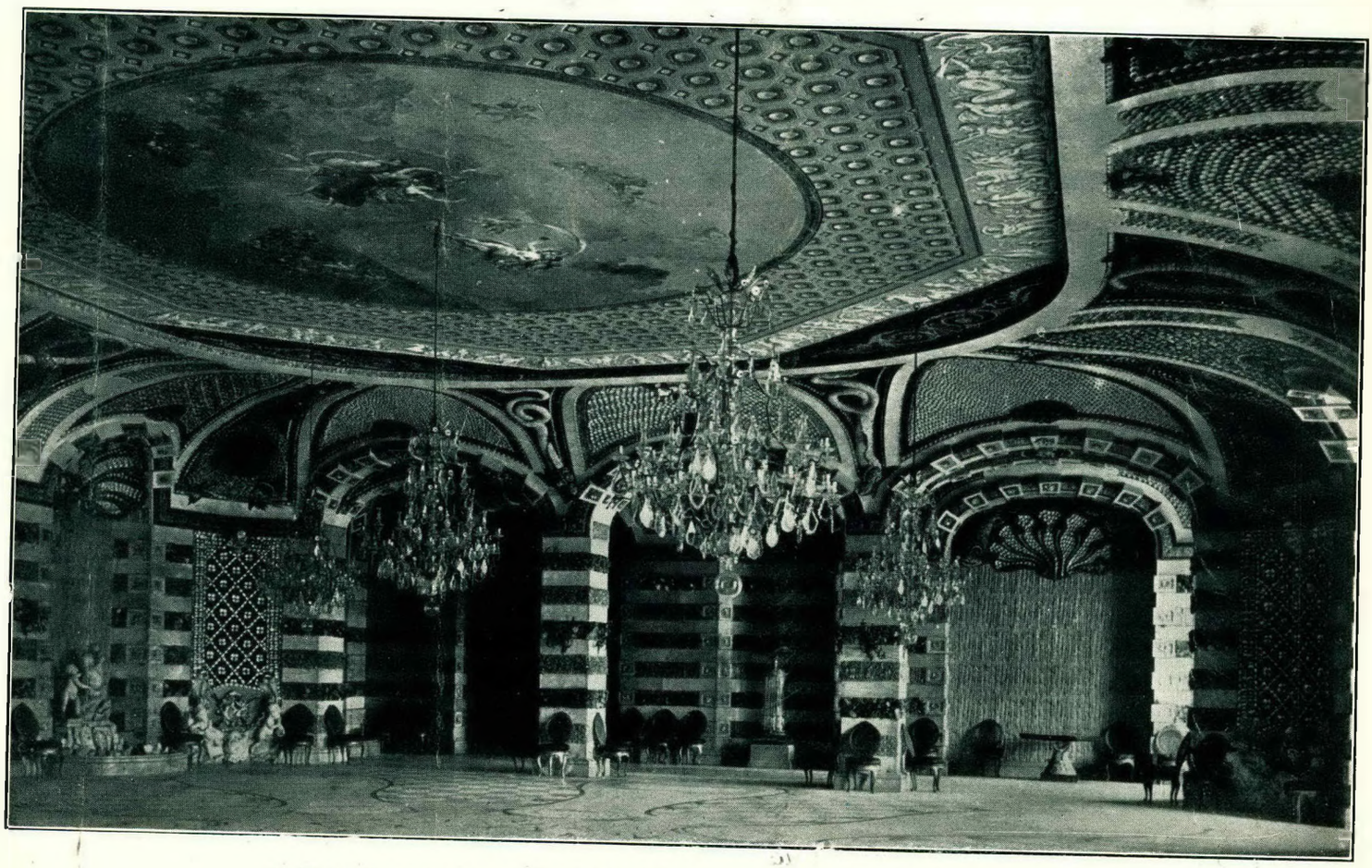


THE MUSIC HALL IN THE NEW PALACE OF THE KAISER AT POTSDAM

We wonder if the Allied Armies will be more generous to Germany in the preservation of its art treasures than its blood-thirsty and fiendish soldiers have been to noble little Belgium

The
African Architect

A JOURNAL DEVOTED TO THE INTERESTS
OF THE ARCHITECTURAL PROFESSION
IN SOUTH AFRICA

PROPRIETOR AND RESPONSIBLE EDITOR JAS. T. BROWN

VOL. 4. No. 5. OCTOBER 1914. 10/6 PER ANNUM, POST FREE

DEPARTMENTAL UNDERTAKINGS.

In these days of universal war it must be admitted that no great interest is exhibited outside of the fighting that is taking place in Europe and, here in South Africa, with the unfortunate rebellion. In matters of architectural interest this also applies, but a "passing show" was given to the Town Council Elections in Johannesburg in view of the fact that three well-known Architects, namely, Mr. Waterson, Mr. J. A. Moffat and Mr. Ivor Lewis, had offered themselves as candidates.

A joint meeting of Architects and Builders was held prior to the date of the election, and at that meeting a sub-committee, consisting of Mr. Veale and Mr. Walter Reid, representing the Architects, and Mr. Thompson, Mr. Douglas and Mr. Brown, representing the Builders, was appointed to go into the matter as to how best to further the candidature of the three architectural candidates before mentioned, as well as to that of Mr. Thos. Clark, Mr. E. O. Leake and Mr. D. Anderson, all prominent Master Builders, who likewise were willing to serve the town. The following two questions were addressed to each of these candidates :—

1. "Are you in favour of abolishing the Town Department for the designing of public buildings, and placing same for competition amongst Architects for large works, also distributing smaller works equally amongst practitioners?"

2. "Are you in favour of all Municipal Services in the nature of building work being put up to public tender and, with the exception of maintenance, abolish Departmental work?"

Mr. Moffat answered in the affirmative to both questions.

Mr. Ivor Lewis said in regard to the latter:—"I am in favour of all Municipal building work being put up to public tender. Maintenance work in connection with buildings I consider should be carried out Departmentally."

Mr. Ivor Lewis, in reply to No. 2, stated that he was in favour of all public buildings being put out to competition amongst Architects. With further reference to the question, he says:—"I do not know how it is proposed to allocate the small works equally amongst practising Architects. I see some difficulty in connection with this, but if a workable scheme was laid before me I would give the matter consideration. From my past experience of Municipal work I find that there is a large amount of miscellaneous work which can be economically supervised by the Town Engineer's Department. This work comprises maintenance of buildings and other works of a similar nature which fall within the province of the Architectural branch of the Town Engineer's Department. This class of work should, in my opinion, be supervised by the Town Engineer's Department."

Mr. E. O. Leake states he would generally support the abolition suggested, believing that the Council of Johannesburg has been going too far in Departmental work of late years.

Mr. Thos. Clark said:—With reference to the questions submitted in your favour of to-day, as you are aware I am entirely opposed to the Departmental system of carrying out contracts in every shape and form, and if returned to the Council I will make it one of my first duties to endeavour to obtain its entire abolition.

With regard to No. 2, I am of the opinion that it would be better and more economical for the city of Johannesburg to do away with an expensive architectural branch, and distribute the work amongst private practitioners. I am also quite in favour of competition amongst architects for the larger of our public buildings.

Yours faithfully,

(Signed) THOS. CLARK.

Mr. Anderson's reply was as follows :—

With reference to the question submitted to me by a Joint Committee representing the Architects and Master Builders' Associations as to whether, *i.e.*, "I am in favour of all Municipal services in the nature of building work being put up to public tender, and, with the exception of maintenance, abolish all Departmental work."

To the first portion of this question my reply is in the affirmative, but to the latter portion of the question I would give no definite reply until such time as I had made a thorough investigation of the conditions prevailing, when, if I found these conditions likely to act against economy, I would certainly oppose them, in the event of my being returned.

We are glad to give publicity to the views of these candidates, and believe this will be of benefit to the profession in casting their votes at the election when it comes off, which on account of the war has been indefinitely postponed by the Administrator. Probably also the publication of the views of the candidates will stimulate fresh interest amongst Architects and Builders generally.

THE STANDARD SYSTEM OF MEASUREMENT.

In the August issue of this journal there was printed the following letter addressed to the General Secretary of the National Federation of Building Trade Employers in South Africa, by the Registrar of the Association of Transvaal Architects :—

Jas. T. Brown, Esq.,
General Secretary,
National Federation of Building
Trade Employers, S.A.

Dear Sir,

Your letters dated 7th, 8th, and 9th July came duly to hand, and were laid before the Council of my Association at their monthly meeting on the 12th ult.

I have been instructed to reply as follows :—

P.C. Sums and Builders' Discounts.

Whilst agreeing in principle that P.C. amounts on provisional allowances made in contracts should not be excessive, it is deemed inadvisable to limit such to any fixed proportions of the contract amount, seeing that circumstances could easily arise whereby such a limitation would hamper the architect and be undesirable in the public interests.

Unsatisfactory Quantities.

The Council having given its assent to the principle of measuring as laid down in the "Standard System of Measuring" will request its members to comply with same.

Should flagrant violations of that principle come to the knowledge of your Federation details of such should be communicated to the Council of this Association to be dealt with by it as it should deem advisable.

Opening of Tenders.

My Council holds, with you, that priced schedules should be treated as confidential, and it has no reason to believe that any member of the profession would regard them in any other light. Accepting this as an axiom, my Council can find no reason why the schedule upon which a contract has been based should not be retained by the architect and filed along with the other contract documents.

Yours faithfully,

CECIL ALDER,
Registrar.

It would seem that umbrage has been taken by Mr. D. M. Sinclair and other architects to the paragraph relating to the Council's action regarding the adoption of "The Standard System of Measurements." Consequently legal advice has been brought into the subject. We have been handed the correspondence for publication, and pass no comment meanwhile, as we understand further action is being taken by Mr. Sinclair and the other architects concerned.

16th September, 1914.

The Registrar,
Association of Transvaal Architects,
P.O. Box 2266.
Johannesburg.

Dear Sir,

We have been instructed by Mr. D. M. Sinclair and other Architects, who are members of your Association, to write to you with reference to the portion of your letter to the Secretary, National Federation of Building Trade Employers, S.A., appearing in the August issue of *The African Architect*.

Our clients instruct us to ask you under which section of the Act or By-law the Council acted in giving assent to the principle of measuring set forth in such letter and in stating that it would request its members to comply with the same. Further, why a general meeting was not called by the Council to consider such an important and serious principle.

We are further instructed to ask why the members of the Association have not been notified as is implied in the letter, more especially in view of the wording of the second paragraph of the letter in question dealing with quantities.

We shall be obliged if you will communicate your reply to us at your earliest opportunity.

Yours faithfully,
(Signed) HENRY LINDSAY,
Solicitor.

ASSOCIATION OF TRANSVAAL ARCHITECTS.

P.O Box 2266,
Johannesburg.
7th November, 1914.

Henry Lindsay, Esq.,
Solicitor,
P.O. Box 1612,
Johannesburg.

Dear Sir,

Quantities.

I have the honour to inform you that your letter in regard to the above matter was placed before my Council at its last meeting.

The Council has given its assent to the Standard System of Measuring and requests its members to do the same The Council did not in the notice require "its members to comply with this request."

The Council does not think it was necessary to call a meeting to affirm the desirability of the adoption of their expression of opinion as its action does not imply any compulsion on any members.

The Council have not notified the members individually as they considered that the notification in the *African Architect* was sufficient publication to persons interested, a custom universal in Architectural bodies in giving notices of a general character.

Yours faithfully,
(Signed) CECIL ALDER,
Registrar.

[Copy.]

The Value of Examinations.

We recommend the budding architect to study "an architect's letter to a student," in the *Builder*, of August 28th. The writer of it, who apparently entered the Institute by the back door, gives the usual excuses for failing to submit himself to the test which he now recommends others to undergo. He admits that success in examinations does not necessarily make an architect, bring him a client,

give him a better standing in the public eye, or secure him the monopoly of a good reputation and practice. The latter may equally be attained by the unexamined.

He appeals to the sporting instinct of the student (so lacking in himself), to take the fence instead of looking for the gate, but the arguments he uses in this direction appear to us to be singularly lacking in conviction.

The advantage of an examination conducted on proper lines is that it forces the student to educate himself gradually for his profession, and does not necessitate cramming merely with a view of passing the test, in other words, it is a means and not an end.

An examination is not necessarily a test of qualification. There are people who while they could not successfully tackle a given problem under pressure and within a stated time, could solve it without much difficulty if it occurred in the course of their practice. Again, an architect of mature years can point to his work as a standing proof of his qualifications in a way which is practically impossible to do in any other profession.

Architectural examinations at present are chiefly a means of entering the body which holds them. They are not essential, however desirable, as a means of entering the profession. The writer of the article referred to gives the chief reason for the falling off of candidates for the final of the R.I.B.A., and the shirking of other architectural examinations, when he admits that as soon as he got his first small commission and became busy, he considered himself too important to bother about examinations. Why? Because he knew that at that time he could enter the Institute without them, and that in any case he could practice without that qualification.

So long as these examinations are voluntary and restricted in their scope, so long will they be evaded; but make them essential to the practice of architecture and give them statutory value, and it will not be necessary to appeal to the sporting instinct of architectural students in order to get them to fulfil what will then be an obligation, if they wish seriously to pursue their profession.

How to Attract an Audience.

Referring to this subject in a leading article, the *Architects' and Builders' Journal* says, there was once a familiar heading in the newspapers "How to Brighten Cricket": that, presumably, being a matter of very great import. We now notice an architectural application of it. The Society of Architects, in the September issue of its *Journal*, seeks to discover some means whereby sessional meetings may be made more attractive, and asks for some practical suggestions to this end. Apparently the cue has been given by a New South Wales journal, which deplores the meagre attendance of members at the annual meetings of the N.S.W. Institute of Architects. One of the absentees was button-holed on the

subject, and his answer was, " What is there in any of the meetings, annual or otherwise, to attract large attendances ? " It may be argued that architects should attend the meetings of their societies as a matter of duty, but the fact is that they do not, and, that being so, says The Society of Architects' *Journal*, they should be attracted by " the discussion of bright subjects of architectural moment; by short papers giving scope for debate on questions exercising the minds of the Executive." The absentee had added : " Let the Council give us something to come along for, something lively, and on new lines. Let us talk about things that will help us in our profession, and the Institute as a body." We have doubts about a policy of discussing " bright subjects of architectural moment " this has rather the smack of social endeavour or popular pleading; but we feel a great deal of sympathy with that absentee. Speaking from our own experience, we must say that the meagre attendance which characterises the meetings of most architectural societies in this country is due entirely to the dull subjects which are discussed and the general dull manner in which papers are delivered. We have always contended that far too many papers of an archæological character are included in the syllabuses. This means traversing the same familiar ground in the familiar way. More than once we have taken up this matter in connection with presidential addresses. What we want is individual expressions of opinion, forceful comment, good delivery, and as high a level of literary attainment as possible. If we recall, for instance, a paper like Mr. Billerey's on " Modern French Architecture," or Professor Lethaby's " Some Things to be Done," and compare these with the stock kind of paper which seems to be expected as the proper thing, it will be recognised how much justice there is in the absentee's comment. Our advice to all the societies is to pay special attention to topics of architectural moment, and particularly to those of practical worth. When a paper like " The Planning of Modern Hospitals " is read at the Institute, the meeting is crowded, but when the topic is "Colour in Architecture" or "Some Fragments of Scandinavian Buildings" it is not surprising that the members prefer to keep away, rather than be hopelessly bored for a couple of hours.

From correspondence we have received, and letters on the subject published by our contemporary, it would seem that in the opinion of those who have so far expressed their views, the remedy lies in making the meetings less formal and holding them either in the afternoon or earlier in the evening than is usually the case so as to permit of the members getting home at a reasonable hour.

Undoubtedly one deterrent is the fact that the paper to be read usually appears immediately afterwards in the columns of the professional journals, and subsequently in the transactions of the Society concerned, so that unless a member is keenly interested in the subject he usually contents himself with reading the paper at his leisure. This is a privilege which is more especially intended for the convenience of country members, who have fewer opportunities than others of attending the meetings.

Town Planning.

Procedure of Local Authorities.

The Garden Cities and Town Planning Association, of 3, Grays Inn Place, W.C., have issued in pamphlet form at the price of one penny, a most useful pamphlet, by Mr. Edmund R. Abbott, Clerk of the Urban District Council of Ruislip-Northwood, setting out in a small compass the procedure to be followed by local authorities in promoting town planning schemes.

It is found that in some cases officials do not read the whole of the Act or the Regulations, but when they get the points summarised there is some inducement for them to go further into the matter.

Some of the chief points to be observed may be roughly epitomized as follows :

The first step is to determine the area of the proposed scheme, and having given the necessary notices to other authorities and owners of land within the area, to apply to the Local Government Board for permission to prepare a scheme.

Various maps have then to be prepared and deposited, and an opportunity for a conference of landowners given.

A further map must then be prepared as evidence of *bona fides* on the part of the Local Authority, to be followed by the most important step of the passing of a resolution applying to the Local Government Board for permission to prepare a scheme. This practically gives the Local Authority control of the development of the area.

Then follows the Local Government Board enquiry, which if granted, necessitates the preparation of a draft scheme and a further map showing the proposals in detail. The co-operation of landowners at this stage is essential, as it is they who develop the land and not the Local Authority.

When the draft scheme is settled by the Local Authority for submission to the Local Government Board, it must be sealed as must also the map, and no further alterations can be made to it by the Local Authority.

The scheme is then considered by the local Government Board, and after possibly a further local inquiry and the making of any required modifications, a draft order of approval is issued and placed on deposit. Interested parties may within one month raise objections to the Board's proposed modifications, and when these have been settled, and the scheme finally approved by the Board, owners have a further opportunity of objecting within twenty-one days.

If any such objections are made, the Order of approval must be laid upon the Table of both Houses of Parliament for thirty days, while they are in Session, or for forty-five days if the scheme suspends any Public Act of Parliament.

CONSTRUCTION IN REINFORCED CONCRETE.

The following interesting article was recently read to the South African Institution of Engineers by Mr. J. H. Forman (member), of the Clyde Construction Company, Ltd., Johannesburg. We reproduce the article and illustrations by permission of "The Journal of the South African Institution of Engineers":—

General.

Concrete is a manufactured conglomerate, composed of pieces of hard material, held together by some form of adhesive, the former being generally termed the aggregate and the latter the matrix. The use of concrete for constructional purposes is very ancient, certainly the Romans knew of it, and in the middle ages it was quite commonly adopted for the construction of fortifications. Up to the end of last century it was very extensively used to replace brick and stone in such heavy structures as foundations, retaining walls, culverts, dock walls, breakwaters, floors on the ground level, and even for small arched bridges. A great advance has been made in the use of this material, because it has been found possible to combine it with metal, to great advantage. When used in this way it is known as Reinforced Concrete, Ferro-Concrete, Steel Concrete, Armoured Concrete, Béton Armé and other similar names. In its modern form it is so adaptable that probably it would be easier to mention the forms of structure which it does not suit. A few of its more common uses are walls of all kinds, columns, piles, beams, floors, roofs, arches, tanks, dams, roads, bridges, posts, sleepers, pipes, sea works, and even boats. One of the earliest examples of the application of reinforced concrete is a boat, built of concrete and iron by Monsieur Lambot in France and exhibited at the Paris International Exhibition of 1855. About 1861 M. Coignet commenced his investigations and in 1866 M. Monier, to whom the credit is often given for the invention of reinforced concrete, applied the use of concrete and iron to various structures.

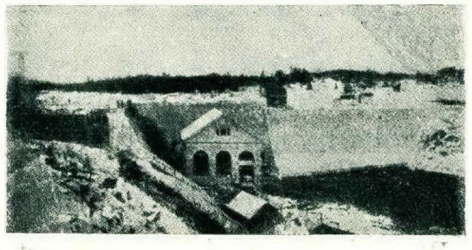
Advantages of Reinforced Concrete.

Concrete has several advantages over other constructional materials, one of the principal being that it can be moulded easily into any desired form. In most parts of the world the materials necessary for its manufacture are obtainable. It has also this advantage over steelwork in bridges, that being manufactured on the site there is much less cost in transport.

Then again, the cost of concrete structures as compared with any others is low. Concrete requires no maintenance, nor do concrete structures require to be insured against fire, and the fire risk on stock contained in them is very much reduced.

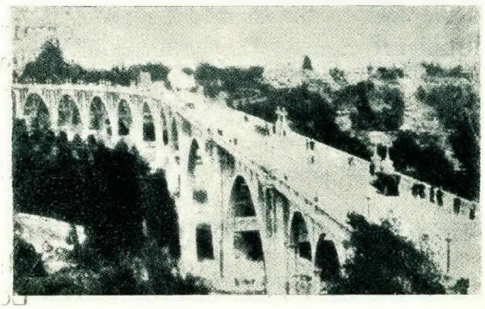
Even with the price of cement, as it is at present, concrete costs less than brickwork, and there is little doubt that within a short time cement will be manufactured in this country to a much greater extent and sold at a more moderate rate than at present.

Speed of construction is another grat advantage in favour of this material, and many instances of quick work can be quoted: The Elsworth Dam on the

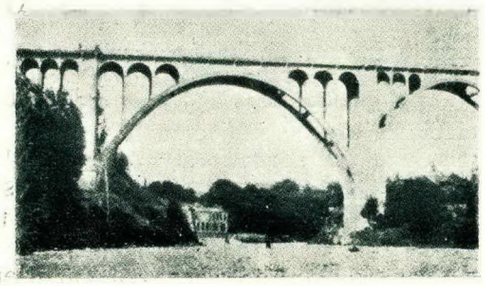


The Elsworth Dam, Maine, U.S.A.

Union River at Elsworth, Maine, U.S.A., which is 500 feet long and 65 feet high, with a power-house and other works included in the contract, was completed in under six months by the Ambrusen Hydraulic Construction Company: the whole work was carried out in reinforced concrete. The viaduct at the City of Pasadena, California, is another example. This



Reinforced Concrete Bridge in California. View taken from west end of Bridge, looking towards Pasadena.



View showing Main Span.

viaduct is 1,467.5 feet long, 50 feet wide, with a roadway of 38 feet, longest span 223 feet, greatest height 150 feet, total cost (including all extras and engineering fees) approximately £40,400. It was designed by Messrs. Waddell and Harington, of Kansas City, Missouri, and the contractors were the Mercereau Bridge and Construction Company of Los Angeles, California. The work was started in June, 1912, and the bridge was accepted and dedicated in December, 1913.

The absence of vibration in concrete structures is another point in favour of this material. Such structures are also less liable to collapse when subjected to earth tremors than steel frame structures;

this is probably due to their monolithic nature. In the San Francisco earthquake this point was given practical demonstration, as few, if any, of the concrete structures collapsed.

Protection from Weather and Fire.

Concrete is one of the few materials which, if well made, requires no maintenance. It has been proved by experiment that when steel is coated with neat cement it can be subjected to the most severe conditions, and will show no sign of rust. It would therefore seem probable that mushy concrete, that is, concrete overwetted, would be best for the protection of steel from weather.

Numerous experimental tests have been made showing the value of concrete as a fire resisting material. The best proof, however, lies in the fact that concrete structures have actually withstood very severe fires better than Terracotta and other so-called fireproof materials.

The reports of Capt. John S. Sewell to the Chief of Engineers, U.S.A., and of Prof. Norton to the Insurance Engineering Experiment Station, on the great Baltimore fire of 1901, give conclusive proof of the value of concrete as a fire resistant. Parts of these reports are worth quoting. Capt. Sewell, in referring to the fire in one of the buildings constructed of reinforced concrete columns, beams, and arches, says:—

> "It was surrounded by non-fireproof buildings, and was subjected to an extremely severe test, probably involving as high temperature as any that existed anywhere. The concrete was made with broken granite as an aggregate. The arches of the roof and the ceiling of the upper storey were cracked along the crown, but in my judgment very slight repairs would have restored any strength lost here."—"The exposed corners of columns and girders were cracked and spalled, showing a tendency to round off to a curve of about three inches radius. In the upper storeys, where the heat was intense, the concrete was calcined to a depth of from quarter to three-quarters inch, but it showed no tendency to spall except at exposed corners. On wide, flat surfaces the calcined material was not more than quarter-inch thick, and showed no disposition to come off. In the lower storeys the concrete was absolutely unimpaired, though the contents of the building were all burned out. In my judgment the entire concrete structure could have been repaired for not over 20 per cent. to 25 per cent. of its original cost."

He then proceeds to describe the testing of certain of the floors and beams, which were found to be capable of carrying their designed total working load of 150 lbs. per square foot; one bay on the second floor being even loaded to 300 lbs. per square foot "without a sign of distress, and with a deflection not exceeding one-eighth inch." Capt. Sewell concludes as a result of his examination of this and other buildings:—

> "As the material is calcined and damaged to some extent by heat, enough surplus material should be provided to permit of a loss of, say, three-quarter inch all over exposed surfaces, if the structure is to be exposed to fire; moreover, all exposed corners should be rounded to a radius of about three inches. This latter precaution would add much to the resistance of all materials used in masonry—whether bricks, stone, concrete or terra-cotta—if they are to be exposed to fire."

Professor Norton's conclusions regarding the action of stone and cinder concrete may also be quoted:—

> "Little difference in the action of the fire on stone and cinder concrete could be noted, and, as I have earlier pointed out, the burning of bits of coal in poor cinder concrete is often balanced by the splitting of the stones in stone concrete. I have never been able to see that in the long run either stood fire better or worse than the other. However, owing to its density, the stone concrete takes longer to heat through."

The conclusion arrived at by Prof. Norton was that two inches of concrete was sufficient to protect a beam, while one-and-a-half inches was sufficient for rods. This may be reduced to three-quarter inch for floor slabs and secondary members.

Impermeability.

As concrete is often employed in reservoirs, dams, and such works, it is very necessary that it

should be possible to render it impermeable. There are several ways in which this can be done:—

1. By accurately grading and proportioning the aggregates and the cement.
2. By special treatment of the surface of the concrete.
3. By the introduction of foreign ingredients into the mixture.
4. By the application of layers of waterproof materials, such as asphalt and felt.

It is often advisable to combine two or more of these methods.

Aesthetic Quantities.

One of the principal objections to concrete face work has been the difficulty of obtaining a large surface of even colour, and without flaws. Roughing the surface by one or other of the methods mentioned later might be a means of overcoming this difficulty. Certainly it has been proved that imitation of stone does not suit this material.

Inception of Concrete Work.

Regarding the different methods of procedure which architects and engineers may adopt for the inception of work in reinforced concrete, nearly all have their advantages and disadvantages. The most commonly adopted, until recently, was that of getting designs and estimates from specialist firms, each design being on a different method. The quantities prepared from these designs were then used in calling for tenders from selected contractors, generally nominated by the specialist firms. The result was that the tenders to be considered were not all on the same basis, and there was great difficulty in deciding which was the best in all respects.

The second method is for the architect or engineer to prepare a general design for the whole work, and then obtain tenders from contracting firms who specialise in reinforced work, but to this there is the same objection as in the former case.

Both these methods are fairly simple in operation, as they relieve the architect or engineer of practically the whole responsibility, but they have the common objecion that in order to cheapen the work, and thus secure the contract, a sufficient margin of safety may not be allowed. Also the preparation of designs in reinforced concrete is an expensive undertaking, and the cost of this work has to be added by the successful firm not only for the job in question, but also for those competitions in which they have been unsuccessful.

The third, and perhaps the most satisfactory, method, is to employ a competent designer to prepare the necessary detail drawings, preferably one or other of the specialist firms. Detailed quantities may then be prepared by a quantity surveyor, and issued to a number of selected contractors for reinforced work. By this means each contractor will submit a tender on the same uniform basis, and the client will obtain all the advantages of competition under normal conditions.

In connection with the choice of contractors, it must be remembered that reinforced concrete work is more dependent on the personal element than any other form of construction. Not only must the best material and workmanship be available, but uniformity, which is essential in work of this class, must be obtained. This is only possible by constant and efficient supervision. Care should therefore be taken that only experienced and reliable contractors be allowed to submit tenders

The fourth method, which is sometimes adopted by corporations or companies when large undertakings are concerned, is that of departmental administration. This is undoubtedly the most costly method, but it has the advantage that the very best materials and workmanship can be provided, and a high standard of construction should result.

The fifth method is to employ a contractor on a prime cost basis with a percentage allowance for establishment charges and profit. This method usually ensures sound material and workmanship, but is generally rather expensive, owing to the fact that the conractor has not the same incentive to prevent waste of time and materials. Probably the third method of competitive tenders from selected contractors gives the best results, both as regards quality of work and reasonable ultimate cost.

It is intended to limit the scope of this paper to construction, and only to treat of design in general terms, in order to give some idea of the methods employed in the consideration of this very important part of reinforced concrete work.

Cement.

The first essential in concrete is good quality cement. The cement for reinforced concrete work should be slow-setting cement, which will comply with

the British Standard Specification for Portland Cement. All cement should be thoroughly tested before use for

(1) Fineness;
(2) Specific gravity;
(3) Chemical composition;
(4) Tensile strength (neat cement);
(5) Tensile strength (cement and sand);
(6) Setting time;
(7) Soundness.

A simple form of the last test, which is useful as a general test, is as follows:—Pats of neat cement are made with about 20 per cent. by weight of water, and pressed on to pieces of window glass. They should be about three inches diameter, half-an-inch thick at the centre, and tapering to a thin edge. These pats should be kept damp for the first 24 hours to prevent the surface drying too quickly, and afterwards placed one in air and another in water. The observation of the pats should extend over 28 days, and at the end of this time they should be sound and free from cracks. Certain small cracks may appear, and do not necessarily indicate poor cement, but if there are any radial cracks extending from the outer edge the cement is unsound, and should be rejected. For all works of importance cement should be stored on the site in sheds large enough to hold an ample supply for two weeks' work. These sheds should have wooden floors with a clear space underneath for ventilation.

Aggregate.

It is quite as important in this class of work that the aggregate should be tested thoroughly as well as the cement. All aggregate under a quarter-inch should be kept separate and treated as fine aggregate, the coarse material being screened to this size.

Fine Aggregate.

Fine aggregate should consist of sand, crushed stone, or gravel screenings, to pass, when dry, through quarter-inch mesh. It should be clean, coarse, and free from vegetable matter or other deleterious material. A graduated size of grain is essential. Washing of sand should be avoided if possible, as a large percentage of the smaller grains is carried away along with the rejected material.

When comparing two or more classes of sand the one giving the smallest volume of plastic mortar, when mixed with cement in the required proportion, will make the strongest and least permeable concrete. The best concrete is probably obtained by using gritty sand and sandstone shivers, mixed in equal parts or in proportions to be decided by experiment, and according to the nature of the fine aggregates available. Although "clean sand" is always specified for concrete, it is nevertheless a fact that dirty sand may give a stronger and less permeable mortar. Clay is sometimes added to the sand to render the concrete more watertight. Whatever may be used as the fine aggregate it is essential that it shall not contain any vegetable matter. Even a very small percentage will render the sand unfit for use. Tests show that 0.5 per cent. is sufficient to reduce the strength of the concrete 60 per cent.; therefore tests are absolutely necessary where the sand contains any suspicion of organic matter.

Coarse Aggregate.

Coarse aggregate is composed of granite, stone, gravel, brick or burnt ballast. Granite forms the strongest concrete, but it is generally expensive. This aggregate should be clean and cube-like. Flaky stones should be avoided as much as possible. The size should vary like the fine aggregate between the maximum and the minimum. The maximum for reinforced work is generally specified to pass one-inch or three-quarter-inch ring; and is, of course, limited by the spacing of the bars between which it should be able to pass easily. The minimum size should correspond with the maximum for fine aggregate.

Water.

The water for concrete should be clean, and in sea works fresh water should be used in preference to salt. The quantity of water to be used varies with the nature of the aggregate. Generally about 30 gallons per cube yard will be found a good basis to start from. The correct consistency of concrete is more a matter of experience than one of fixed rules; but it is better to be a little too wet than too dry, especially for reinforced work. Care, however, should be taken when using a wet mixture that the forms are tight, otherwise the mortar will run off, leaving unsightly and sometimes dangerous pockets in the work.

Proportions.

The proportioning of the concrete is also an important matter, and should always be found in the first instance by measuring the voids in the aggregate. The cement should then be made at least 10 per cent. in excess of the voids in the fine aggregate, and the mortar from these two at least 10 per cent. in excess of the voids in the coarse. For reinforced work a basis of 1, 2, 4 will be found to be about right, and the cement should never be in less proportion than this. For tanks and similar work the proportion of cement should be increased by at least 18 per cent. The following tables give a method of ascertaining the percentage of voids in various aggregates. Table IV. shows the quantities of the various materials required for one cube yard of finished concrete of

different qualities, assuming the voids to be about 45 per cent., which may be taken as an average value. This table is important for estimating purposes, as it will be seen that it takes from 38 to 39 cube feet of material to make a cube yard of finished concrete.

Method of Determining Voids in Various Aggregates.

Use an exact measure, say ½ cube foot. Weigh the measure.

Fill the measure with the material in the state in which the percentage of voids is required (i.e., loose, shaken or packed).

Weigh and deduct the weight of the measure, calling the net weight of a cubic foot of the material, "S."

If the material consists of, or contains sand or fine stone, correct for moisture by taking an exact weight, say 10 lbs., dry it at a temperature of at least 212° Farh. until there is no further loss in weight, calculate the percentage in moisture in terms of the original weight and express this percentage as a decimal "p."

Select from Table I. the weight of an absolutely solid cube and call it "R."

Then:—

P = percentage of absolute voids =

$$\left(1 - \frac{S - Sp}{R}\right) 100.$$

The air voids can be determined if desired by deducting the volume of moisture.

That is:—

$$P_a = \text{percentage of air voids} = P - \frac{Sp}{62{\cdot}3}\,100.$$

TABLE I.

AVERAGE SPECIFIC GRAVITY OF VARIOUS AGGREGATES FOR ABSOLUTELY SOLID VOLUME OF MATERIAL.

Material.	Specific Gravity.	Weight of Solid Cubic Foot. Lbs.	Authority.
Sand	2·65	165	Allen Hazen.
Gravel	2·66	166	A. E. Schutte.
Conglomerate ...	2·60	162	R. Spurr Weston.
Granite	2·70	168	Edwin C. Eckel.
Limestone	2·60	162	do.
Trap	2·90	180	do.
Sandstone	2·40	150	do.
Slate	2·70	168	Tod's Tables (*Encyl. Brit.*)

TABLE II.

Percentage of voids for different weights per cubic foot of SAND or GRAVEL, assuming the specific gravity to be about 2·65.

Weight of 1 cubic foot.	Percentage of Absolute Voids in Materials containing Moistures by Weights.					Moisture by vol. corresponding to 1% by weight
	0%	2%	4%	6%	8%	
	%	%	%	%	%	%
70	57·6	58·4	59·3	60·1	61·0	1·1
75	54·5	55·4	56·4	57·3	58·2	1·2
80	51·5	52·5	53·4	54·4	55·4	1·3
81	50·9	51·9	52·9	53·9	54·8	1·3
82	50·3	51·3	52·3	53·3	54·3	1·3
83	49·7	50·7	51·7	52·7	53·7	1·3
84	49·1	50·1	51·1	52·2	53·2	1·4
85	48·5	49·5	50·6	51·6	52·6	1·4
86	47·9	48·9	50·0	51·0	52·0	1·4
87	47·3	48·3	49·4	50·4	51·5	1·4
88	46·7	47·7	48·8	49·9	50·9	1·4
89	46·1	47·1	48·2	49·3	50·4	1·4
90	45·5	46·5	47·6	48·7	49·8	1·4
91	44·8	45·9	47·0	48·2	49·2	1·5
92	44·2	45·4	46·5	47·6	48·7	1·5
93	43·6	44·8	45·9	47·0	48·1	1·5
94	43·0	44·2	45·3	46·5	47·6	1·5
95	42·4	43·6	44·7	45·9	47·0	1·5
96	41·8	43·0	44·1	45·3	46·4	1·5
97	41·2	42·4	43·6	44·7	45·9	1·6
98	40·6	41·8	43·0	44·2	45·3	1·6
99	40·0	41·2	42·4	43·6	44·8	1·6
100	39·4	40·6	41·8	43·0	44·2	1·6
101	38·8	40·0	41·2	42·5	43·7	1·6
102	38·2	39·4	40·7	41·9	43·1	1·6
103	37·6	38·8	40·1	41·3	42·5	1·6
104	37·0	38·2	39·5	40·8	42·0	1·7
105	36·4	37·6	38·9	40·2	41·4	1·7
106	35·8	37·0	38·3	39·6	40·9	1·7
107	35·2	36·4	37·7	39·0	40·3	1·7
108	34·6	35·9	37·2	38·5	39·7	1·7
109	33·9	35·3	36·6	37·9	39·2	1·7
110	33·3	34·7	36·0	37·3	38·7	1·8
115	30·3	31·7	33·1	34·5	35·9	1·8
120	27·3	28·7	30·2	31·6	33·1	1·9
125	24·2	25·8	27·3	28·8	30·3	2·0
130	21·2	22·8	24·4	25·9	27·5	2·1
135	18·2	19·8	21·4	23·1	24·7	2·2
140	15·2	16·8	18·5	20·2	21·9	2·2

NOTE.—The percentage of absolute voids given in the columns includes the space occupied by both the air and the moisture. To determine the percentage of air space, multiply the figure in the last column by the percentage of moisture by weight, and deduct result from the percentage already found.

TABLE III.

Percentage of Voids for Different Weights per Cubic Foot of Dry BROKEN STONE of Various Specific Gravities.

Weight of 1 Cu. Ft.	Percentage of Absolute Voids Corresponding to Specific Gravities of Stone of					
	(*a*) 2·4	2·5	(*b*) 2·6	(*c*) 2·7	2·8	(*d*) 2·9
	%	%	%	%	%	%
70	53·2	55·0	56·8	58·4	59·9	61·3
75	49·8	51·8	53·7	55·4	57·0	58·5
80	46·5	48·6	50·6	52·4	54·1	55·7
85	43·2	45·4	47·5	49·5	51·3	53·0
90	39·8	42·2	44·5	46·5	48·4	50·2
95	36·5	39·0	41·4	43·5	45·5	47·4
100	33·1	35·8	38·3	40·6	42·7	44·7
105	29·8	32·6	35·2	37·6	39·8	41·9
110	26·4	29·4	32·1	34·6	36·9	39·1
115	23·1	26·2	29·0	31·6	34·1	36·4
120	19·8	23·0	25·9	28·7	31·2	33·6
125	16·4	19·8	22·8	25·7	28·3	30·8
130	13·1	16·6	19·8	22·7	25·5	28·1
135	9·7	13·3	16·7	19·7	22·6	25·3
140	6·4	10·1	13·6	16·8	19·7	22·5

(*a*) Sandstone.
(*b*) Limestone and Conglomerate.
(*c*) Granite and Slate.
(*d*) Trap.

TABLE IV.

Quantities of Material required for One Cubic Yard of Finished Concrete.

Material.	Proportions of Concrete.				
	3, 1½, 1.	4, 2, 1.	5, 2½, 1.	6, 3, 1.	8, 4, 1.
	Cu. Yds.	Cu. Yds.	Cu. Yds.	Cu. Yds.	Cu. Yds.
Stone	·88	·92	·96	·96	96
Sand	·44	·46	·48	·48	·48
Cement	·30 or 728 lbs.	·23 or 560 lbs.	·19 or 462 lbs.	·16 or 388 lbs.	·12 or 292 lbs.

Mixing.

Machine-mixing is preferable to hand. In hand-mixing, which will be found economical when the total quantity of concrete does not exceed 500 cube yards, the batches should be small, so that any preliminary setting of the concrete before use may be avoided. On no account should any concrete which has begun to set be used. Experiments show that concrete which has been mixed two hours before being used loses one-fifth of its normal strength.

The most convenient method of measuring is to base the batch on the capacity of a bag or barrel of cement; boxes should be made to hold the requisite quantities of fine and coarse aggregate—for example, in 1, 2, 4 concrete, taking one bag of cement as weighing 180 lbs., the weight of Pretoria cement (the average weight of cement being about 90 lbs. per cube foot), this gives two cube feet per bag. Therefore the box for fine aggregate should be about 3ft. 6in. by 2ft. 3½in. by 6in. high inside dimensions, and a second frame can be made double the height for the coarse aggregate. These boxes, which have neither top nor bottom, are placed on the mixing platform and filled level with the top; they are then removed, and the fine aggregate is shovelled on to the top of the coarse aggregate in as even a layer as possible. A bag of cement is then spread evenly over the top of this heap, which is then ready for mixing. Two men with shovels then proceed to turn this heap over, starting at one end. Care should be taken that they turn the shovel properly over. A second and third pair of men repeat this operation. After this, water may be added while the fourth pair of men are turning; it should be added through a rose, and not dumped on in bucketfuls. A fifth pair of men again turn over the mass, and it is finally turned into the barrows or buckets, or, if close enough to the work, direct into the forms.

The mixing board should be well laid and water-tight, with a board run round the edge if the platform is small. Some engineers prefer different methods of mixing from the one described, often with sound reason.

One such method is to mix the cement and fine aggregate, first making a paste with water, and then adding it to the coarse aggregate, which has been previously damped.

There are one or two warnings to remember in connection with mixing:

(1) Have a good reliable foreman to superintend the mixing.

(2) Never allow the men to fill a box except on the board, not on the top of another heap or box.

(3) Have a specified number of buckets or cans of water filled for each batch; the right number should be known after the first two batches have been mixed.

Placing in Position and Punning.

The concrete being ready for use, the "placing" in position and "punning" should be commenced with as little delay as possible. In "placing" care must be taken that the reinforcement is not moved in any way; it is advisable to have one or more men for this work alone.

The men carrying the buckets or wheeling the concrete should not be allowed to "place" the concrete excepting under immediate supervision of one of these men, and then only in mass work.

The concrete should be laid in layers of from 6in. to 10in. for dry on medium consistencies, and 12in. to 15in. for wet or mushy, and then punned.

The punning, which is done for the purpose of forcing out the air bubbles in the concrete, should be done with small rammers. For "dry" concrete a rammer with 7in. square face may be used, and one with 2in. square face and 6in. deep is used for work between the bars and forms. For mushy concrete a rammer with a face 5in. x 1¾in. x 7in. deep, and tapered to 1¾in. square where the handle fits in, may be used, but care should be taken not to over-pun, as the large stones are apt to be forced together to the bottom of the mould.

Opinions as to the best form of punner vary considerably; such extreme types as the "sword" or "lath" are used, and they are undoubtedly most useful for face work.

Bonding.

In bonding new work with old, say, on starting the day's work, care must be taken to clean the old concrete thoroughly. Some engineers coat the old work with a strong mortar, say, of 1-2, while the others spread dry cement on the wetter surface of the old work. Some such additional strength is needed where tensile stresses may be encountered, as in the joints in long walls. In tanks or other works, where impermeability is essential, it is best to build continuously, if at all feasible, but if not V joints or some other suitable shape of joint should be made in the finished work before stopping for the night.

Acid is sometimes used for cleaning and roughening the surface of old work, but the use of this involves very great care in washing the work thoroughly before concreting is again proceeded with.

In all reinforced work the joints should be made so as to affect the strength of the structure in the smallest degree.

In columns the joint is best placed immediately under the beam, or, if there is a haunch, some engineers allow the joint at the bottom of this. In floors, or reinforced walls which have to resist pressure, it is best to make the joints perpendicular to the surface at or near the centre of the span.

Joints.

In certain structures, such as long walls, contraction joints are necessary in order that the cracks, which are inevitable, may occur on definite lines.

Concrete while hardening always contracts to a certain extent, and this contraction must be allowed for in walls or floors over 50 feet long. It has been ascertained, though not very definitely, that the contraction due to setting is from ·03 per cent. to ·05 per cent. at the end of twelve weeks; this amounts to about ½in. in 100ft. It is generally accepted that the expansion due to change in temperature is about ·0000055 per degree Fah. for 1·2·4 concrete. This is about ⅛in. per 100ft. for a change of 50° Fah. As a rule, only contraction joints need be provided, since any expansion compresses the concrete. A simple method of forming these joints is to build the work in sections of about 30ft. with vertical ends. Before proceeding with the next section two or three sheets of roofing paper are placed between the old and the new work. The reinforcing rods may be continuous between one section and another.

Expansion joints (which may be necessary as in the case of thick walls with recesses or floors with channels) can best be formed by leaving openings on slits in the work about ½in. wide, and afterwards filling them with a plastic material such as pure asphalt of medium hardness, with which some limedust may be mixed. Perhaps this might be a good method of dealing with some of the Johannesburg pavements near the centre of the town.

Facing.

There are several methods of obtaining a good finish to concrete, the greatest difficulty being to obtain uniformity of colour. One good method is to pick the surface after the forms are removed with a stone-facing pick or a pneumatic tool adapted for facing purposes. A good finish is also obtained by washing the concrete while it is still "green" with a scrubbing brush and plenty of water. A similar finish may be obtained after the concrete has set by rubbing it down with a block of carborundum. Grouting with 1-2 grout, applied with a whitewash brush, also gives a fair finish. It is better not to plaster concrete. Plastering is an unworkmanlike method of finishing concrete, and a needless expense. Cement mortar is not easily applied uniformly to the face of hardened concrete, and it is liable to crack off and become discoloured. Mortar for patching irregularities and pockets, which may sometimes occur in the best work, must have the same proportions of cement and sand as the concrete, or the colour will be different when setting has taken place.

Keeping Damp.

After the concrete has been laid it must be kept damp for at least a week; this is particularly important in a climate such as that of South Africa. It is best done by covering the concrete with empty cement bags, which must be sprayed with a hose three times a day, or oftener if necessary, to keep them thoroughly damp.

Reinforcement.

For strengthening concrete mild steel is the material generally used at the present time. For reinforced work the yield point of mild steel should be taken at 30,000 lbs. per square inch, even though tests of the steel used may give a somewhat higher result. The yield point of the reinforcement must be taken as the point of failure of the structure, because, when the former is reached, the structure will sag or deflect to such an extent (owing to stretch in the material or to slipping due to reduced cross section) that the concrete will be over-stressed in compression and will crush.

High-grade steel—that is, steel with a large percentage of carbon—has a much higher yield point—about 50,000 lbs. per square inch—and therefore if it can be safely used in reinforced concrete work, a smaller percentage would be required for the same stresses. Many engineers, however, do not approve of its use in reinforced work, because it is prohibited in ordinary structural steelwork on account of its brittleness when of poor quality, and the consequent danger of sudden failure. Certainly, if used, it must undergo very thorough tests beforehand. The ideal material for use with concrete should have not only a high yield point, but a proportionately high modulus of elasticity, in order to reduce the stretch under a given load to a minimum. Concrete being a brittle material and steel comparatively ductile, the stretching of the steel under load causes the concrete to crack; but, while this reduces the strength of the structure, the cracks are evenly distributed over the surface, and are so small that the steel is always protected from corrosion up to the elastic limit. In designing structures of concrete and mild steel it is necessary to take this cracking into account, and to provide sufficient steel to take all the tension, since the concrete cannot be depended on to take any part of it. The tensile resistance of the concrete will have some effect on the deflection of the structure at small loads, but once the full load has been applied, it will no longer do so.

Beams.

In beam design the depth of the beam should be taken as the depth from the compression surface to the centre of the steel reinforcement in tension, because the part below this only acts as cover for the steel. This depth should not be less than one-twenty-fourth of the effective span.

The simplest hypothesis to assume for beam design is the "Straight Line Theory"—that is, (1) that a plane section before bending remains plane after bending; (2) that tension is borne entirely by the steel; (3) that initial stresses are absent in the steel; (4) that adhesion between concrete and steel is perfect; (5) that the modulus of elasticity of concrete is a constant, within the usual working limits.

It is safe to assume that the foregoing are essentially correct, for, if anything, they err on the safe

side. Beams designed on this theory and properly built are undoubtedly safe.

The ratio of the moduli of elasticity of steel and concrete is a most important factor in the design of reinforced concrete. For practical purposes this ratio is best taken as 15, corresponding to moduli of 30,000,000 and 2,000,000 respectively. This ratio has been adopted as the standard in the British, American, German and Austrian rules. The French rule allows a range of from 8 to 15 according to conditions. The working stress for steel is generally taken at about 16,000 lbs. per square inch; concrete, 1-2-4 mixture (with a compressive strength of 2,000 lbs. per square inch at 28 days), at 650 lbs. per square inch.

In slab design a 12in. width of slab is treated as a simple beam. Beams are often designed to support concrete slabs, and are then generally treated as T beams. The width of the slab, to be taken as part of the beam, can in no case be greater than the width between the beams, and it is generally fixed arbitrarily, not exceeding quarter the span length of the supporting beam, nor greater, on either side of the web, than four times the thickness of the slab.

The above limits are probably on the safe side, and a somewhat greater ratio of width to thickness may safely be taken. The width of the web is governed by the lay-out of the tension rods and by the shear stresses.

The total vertical unit shear in a beam effectively reinforced with bent bars, or stirrups, or both, is limited to 120 lbs. per square inch for "2,000 lbs. concrete." In calculations for shear the area of the web to be considered, is from the centre of the flange to the centre of the bottom reinforcements. The minimum depth of beam is that at which concrete and steel are stressed simultaneously to their working limits.

The compression in the top of the flange must not exceed the working compressive of the concrete. As a rule, a greater depth than the minimum is used for economy, because deepening the beam reduces the area of steel proportionately. The following formula is suggested by Professors Turneaure and Maurer in "Principles of Reinforced Construction" for the depth for maximum economy:—

Using the notation:

d = Depth of beam from surface of slab to centre of steel.
t = Thickness of slab in inches.
b' = Breadth of web in inches.
r = Ratio of unit cost of steel in place to unit cost of concrete in place (using the same units for both).
fs = Allowable unit stress in steel.
M = Bending moment in inch pounds.

Then:

$$d - \frac{t}{2} = \sqrt{\frac{rM}{f_s b'}}$$

From this formula the most suitable depth can be selected after a few trials. Sometimes the depth is fixed at an arbitrary ratio with the width, of between 2 to 1 and, for very large and deep beams, 4 to 1. The depth of beam may be fixed by questions of headroom, in which case the width must be determined by the area required for shear and the ratio of depth to breadth may then be even less than 2 to 1.

For the section area of steel in a T beam the formula

$$A_s = \frac{M}{f_s\left(d - \frac{t}{2}\right)}$$

may be used with very close results. This formula assumes the centre of compression to be at the centre of the slab, and gives slightly high results for a T beam with very thin flange in proportion to the dimensions of the web and *vice versa*, and should not be used if "d" is less than "3t." The design of a T beam must also be studied for bond of steel to concrete, which can be taken at about 80 lbs. per square inch of surface (drawn wire, 40 lbs. per square inch), and for the design at the supports, which must be adapted to resist the negative bending moment.

(To be continued.)

10th November, 1914.
Johannesburg.

To the Editor,
"The African Architect."

Which Do They Really Mean?

Sir,—The Council of the Association of Transvaal Architects has at various times distinguished itself in its administration of professional matters. I send you herewith the latest instance. For the benefit of your readers I shall be obliged if you will give the following two paragraphs in parallel columns.

1. Extract from letter by the Council published on page 23 of the "African Architect," August, 1914:—

"The Council having given its assent to the principle of measuring as laid down in the 'Standard System of Measuring,' *will request its members to comply with same.*

"Should flagrant *violations of that principle* come to the knowledge of your Federation details of such should be communicated to the Council of this Association *to be dealt with* by it as it should deem advisable."

2. Letter by the Council to Henry Lindsay, Esq., solicitor, dated 7th November, 1914:—

"I have the honour to inform you that your letter (dated 16th September, 1914) in regard to the above matter was placed before my Council at its last meeting.

"The Council has given its assent to the Standard System of Measuring, and requests its members to do the same. *The Council did not in the notice require 'its members to comply with this request.'*

"The Council does not think it was necessary to call a meeting to affirm the desirability of the adoption of their expression of opinion, as *its action does not imply any compulsion on any member.*

"The Council have not notified the members individually, as they considered that the notification in 'The African Architect' was sufficient publication to persons interested, a custom universal in architectural bodies in giving notices of a general character."

The Italics in the quoted paragraphs are mine.

I have only to add, in explanation, that Mr. Lindsay is acting on instructions given by myself and other members of the Association. Further explanation will be impossible, and your readers must be left to puzzle out what the Council really means. You pay your money and you take your choice!

Yours faithfully,
D. M. SINCLAIR.

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