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1914

Institutes of South African Architects and the Chapter of South African Quantity Surveyors

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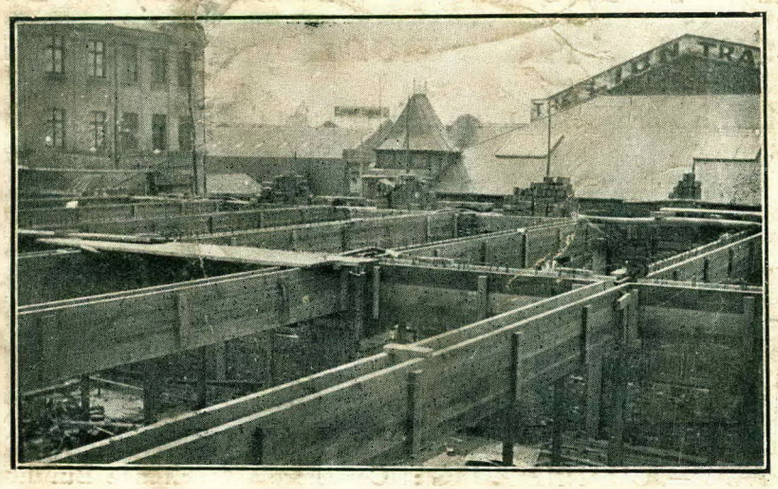

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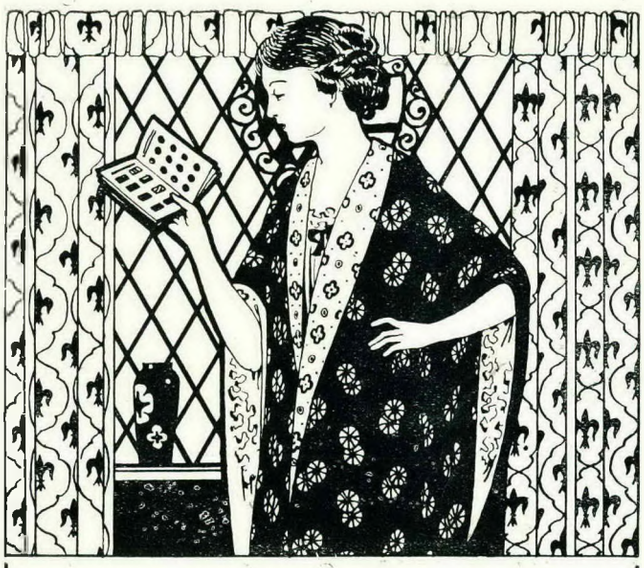

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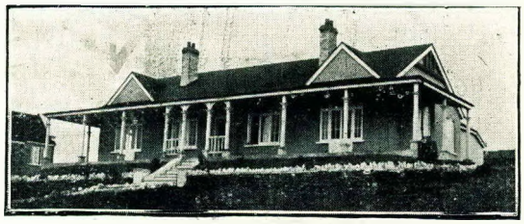

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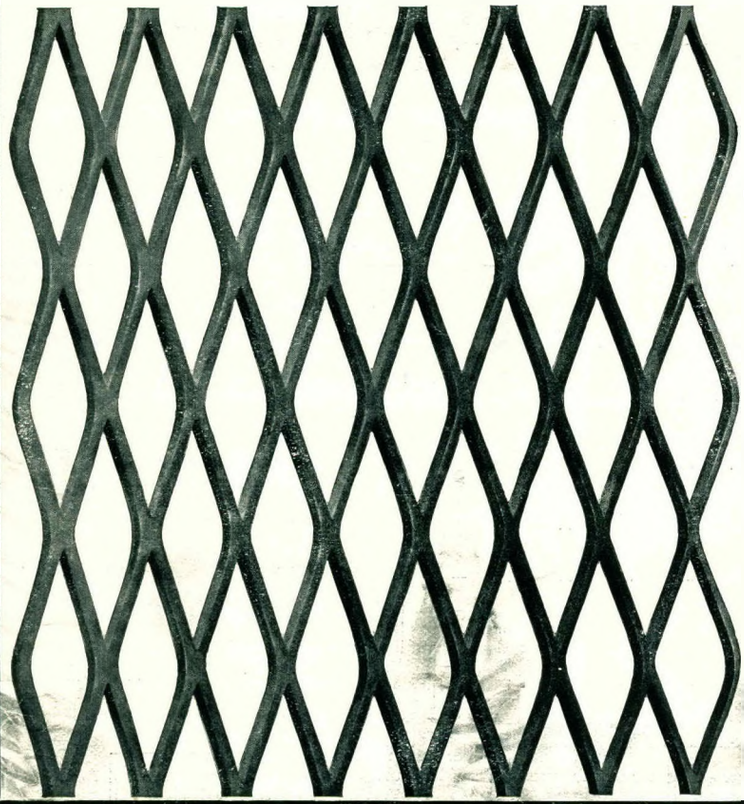

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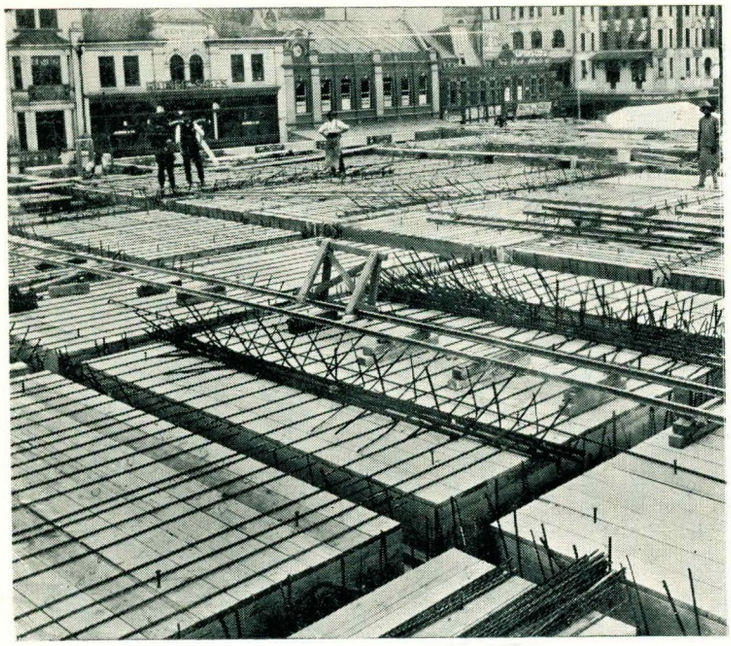

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The
African Architect

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

PROPRIETOR AND RESPONSIBLE EDITOR JAS. T. BROWN

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

ARCHITECTS AND THE WAR.

In another part of this issue we print the outline of a scheme operating in England for the relief of architects whose businesses have been so adversely affected by the European war as to practically deprive them of their incomes. The scheme has been so arranged as to obliterate all suggestion of charity and to provide professional men with work which, though not immediately necessary, could be utilised after the war is terminated Since the rebellion broke out we have had more than one suggestion made to us, though not exactly on all fours with the English idea, very similar in detail. In regard to professional men it is exceedingly difficult to offer financial assistance in time of stress without incurring grave danger of injuring their susceptibilities, and on that account we felt a little trepidation in handling the subject. Now, however, that the scheme we mention has appeared it eases the situation in so far as there is presented with it the preservation of the dignity of labour and the receipt of pecuniary remuneration for services rendered. Undoubtedly the architectural profession is also suffering in South Africa, more, as we have already pointed out, by reason of the rebellion than through the war, for we verily believe that if Beyers and De Wet had not turned traitors of the worst type we should ere now have been enjoying business as usual. With the capture of the latter, which is announced just as we go to press, we are optimistic enough to believe that the rebellion will soon be over, and that those responsible for it will be dealt with firmly and awarded sentences commensurate with their treacherous conduct and the suffering they have caused to the country. Then we may hopefully look for the renewal of trade, and that those works for which plans have been prepared, or are in course of preparation, will be proceeded with. In the meanwhile, however, and until that happy time arrives, we believe we are voicing the opinion of a very large section of the profession, that some con-

sideration should be devoted to a scheme similar to the one inaugurated in England, and we suggest to the various Institutes of Architects throughout South Africa that this be done as soon as possible.

We are given to understand that some hundreds of pounds are at the credit of the Association of Transvaal Architects. Surely some means could be evolved for dealing with such surplus funds to the end suggested by the foregoing.

HERE AND THERE.

The latest issue of the *Journal of the Society of Architects* (London) contains a portrait of Mr. Ivor Lewis and a congratulatory reference to his election as President of the South African Branch of the Society.

The *S.A. Master Builders' Federation Journal* contains the correspondence which passed between the Builders' Federation and the Town Council relating to the erection of the Car Sheds and Converter Station, Germiston, which were carried out departmentally. The Council has agreed to the Federation's offer to defray the expense of employing two qualified Surveyors to measure up the work in order to ascertain the comparative cost of the competitive contract system as against departmental work. The result will be interesting.

Evidently Municipalities are getting more prone to carrying out services departmentally. The latest complaint of the Master Builders comes from Capetown, where public bids were called for a certain Municipal undertaking, and afterwards it was decided to do the work departmentally. The action of Germiston Town Council is a most commendable one and might with example be emulated by other public bodies. The *Builders' Journal*, in an editorial on Germiston's acceptance of the Master Builders' offer, says:—"It is gratifying from several points of view. To begin with, the outcome will, as pointed out in the letter sent from the Federation, afford the surest index of economy in either the departmental or contract systems. Then, again, it will bring clearly home to all parties concerned that the master builders are not afraid to face the issue contained in the arguments they have repeatedly reiterated to those who favour departmental work that this method is costly and uneconomical. Further, and this is what concerns the ratepayers of Germiston, the acceptance of the suggestion of the Federation by the Council distinctly proves that the latter body is made up of sensible business men who grasp the full importance of the result of the enquiry to their constituents. Perhaps the Town Council of Johannesburg will take a leaf from Germiston's book, and likewise accept the offer which was also made to that august body, which up to the moment it has seen fit to ignore. It is never too late to learn, and if the Council of Johannesburg has *nothing to fear* it will be wise in following Germiston's lead. Have we got a business Town Councillor in Johannesburg who will move that such be done?"

A special article in a recent issue of the *Transvaal Leader* reflected rather a gloomy outlook in the building trade, which was scarcely warranted. It arose out of the fact that for the month of October the value of building plans passed by the Municipality of Johannesburg only amounted to some £15,000, as against the average of previous months of from £60,000 to £80,000. Notwithstanding this, here are six jobs in progress and not nearly completed :—

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Normal College	,,	18,000
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Thus, when only a few thousand pounds' value of plans are passed in any one month it can scarcely be accepted as an accurate index of the state of trade, because the following month may compensate for that in which the smaller amount was put through. Again, it does not follow that all the proposed services passed by a Municipal Council will necessarily be proceeded with. Part, or indeed the whole, of the proposed buildings may be held over indefinitely by the owners, and, again, services which were passed as meeting the requirements of the Municipality months ago may be gone on with. In these circumstances, therefore, it is safer to take *twelve months'* building plans as being the surer index of the amount of work carried out over that period, not *any one month as reflecting the state of the trade.*

Undoubtedly the rebellion has much to do with the falling away of business, but once this regrettable blunder is ended one may safely expect a return to normal times. As we pointed out in a former issue, the architectural profession is amongst the greatest sufferers, though a more optimistic note was sounded the other day by architects who informed us that they had received instructions to proceed with several works. We notice that in England a fund has been started to provide work for architects whose means of livelihood are practically stopped on account of the war. The administration of this fund is in the hands of the "Professional Employment Committee," which is occupied, first, in ascertaining those architects in actual need of employment in consequence of the war; secondly, in evolving schemes of a useful nature by which those architects may be temporarily employed; and, third, in appealing for financial support.

PROCEDURE.

1. Architects in actual need of employment in consequence of the war are invited to submit their cases (in writing) to the Hon. Secretary, at 28, Bedford Square, W.C. These cases will be considered by a Sub-Committee in strict confidence.

2. Suggestions are invited for schemes of a useful nature by which architects may be temporarily employed. For instance, small fees might be offered for measured drawings of buildings of architectural or historical interest, or for civic survey work.

   It is thought that the various architectural and other societies throughout the country would be glad to co-operate in giving effect to these proposals.

3. The War Committee have already issued an appeal for funds, and it is hoped that this appeal will meet with a liberal response. The proportion of this fund available for the purpose of providing work can only be regarded as a nucleus, and a generous support should be forthcoming from all who realize that the present opportunity is an exceptional one for undertaking the work proposed. The main object of the Sub-Committee is not to distribute benevolent aid, but to provide architects with temporary work of such a character that at the termination of the war his work would be of a distinct value to the community.

By the way, we hear that Mr. D. M. Sinclair's letter has awakened fresh interest in the subject of the "Standard System of Measurements." In other quarters we learn that it has also caused no little amusement. In any case the letter has done no harm, but, on the other hand, quite a measure of good, if it brings the standard in front of the profession. We are not aware that much has been done in any institute in South Africa to bring about its universal adoption. Possibly, however, the paucity of contracts on account of the rebellion has much to do with this, for we feel sure, whatever the Council of the Association of Transvaal Architects do in the matter, that the Executive Council of the Builders' Federation will not be slow in moving in the proper direction. As the surveyors pointed out to the master builders in a recent interview, it is quite beside the mark that contractors should indulge in a guessing competition on improper quantities while binding down the qualified surveyor to the last letter. Commercially it is unsound. Let us refresh the minds of our readers with an official report furnished by the National Federation of Master Builders. The meeting was held on July 25th, and there were present:—Representing the National Federation: Mr. Jas. Thompson, jun., Vice-President (in the Chair), Mr. Thos. Clark, and Mr. Jas. T. Brown, General Secretary. Representing the S.A. Institute of Quantity Surveyors: Mr. Everard White, President, Mr. F. Hickman, and Mr. J. W. Cowling, Hon. Secretary.

The meeting was held to consider

Unsatisfactory Quantities, which had been discussed at the 10th Annual Congress in Durban, and in response to a letter from the Institute of Surveyors asking for an interview on the subject.

Mr. White said that the support of the Builders' Federation was required to secure the general use of the Standard System of Measurements, and it would immediately assist the Builders' Federation and the Institute of Surveyors if, as

occasion arose, unsatisfactory or ambiguous quantities were reported to this Institute. There was also, Mr. White said, and this was supported by his colleagues, the fact to consider that while the members of their Institute devoted much time and expense in the preparation of quantities, Master Builders sometimes tendered on rough quantities which might be taken for the purpose of a preliminary estimate. It was, as a matter of fact, a commercial proposition, and it was scarcely right to expect that members of their Institute should give this time, which in the preparation of quantities meant money, while the Master Builders were prepared to tender on quantities that took little or no time to get ready, and cost practically nothing. Mr. White, Mr. Hickman and Mr. Cowling argued that these quantities which were considered not to be a fit and proper bill should be immediately referred to their Institute, for, in Mr. Hickman's words, as responsible members of their profession, and allied together in an Institute, they got "shot at while others preparing improper bills got off without any sign of disapproval."

Finally it was agreed that the Federation would circularise its branches to the effect that any instance of unsatisfactory or ambiguous quantities should be immediately referred to the General Secretary, who would in turn pass them on for criticism of the South African Institute of Quantity Surveyors, which would hold a Council meeting immediately, and either *condemn or approve of them.*

It was further agreed that every case should be handled by the headquarters of the Federation, in conjunction with the headquarters of the Institute of Surveyors, and that in each instance the particular Bill of Quantities under review would be considered entirely on its merits.

Anyhow there is no ambiguity in the foregoing report, and doubtless when things get busier we may hear of more than one case of faulty quantities being exposed.

The war is responsible for postponing the issue of the *Architects', Surveyors' and Builders' Annual*, but not for complete abandonment of the idea. This will be, we guarantee, the finest art production that has ever been presented to South African readers. We have had more assistance offered to us than we can accept, and that is saying something. As soon as normal times come round, and we are optimistic enough to believe that that will not be very long, the prospectus will be issued, and the book itself will be on sale within a few weeks later.

Like everyone else the newspapers and other publications have felt the draught of the war pretty badly, and circulation as well as advertisement revenue have suffered equally. In some cases periodicals have ceased publication altogether. We are amongst the more fortunate, which comes of running *standard* publications. So far as circulation goes, as a matter of fact both the *Builders' Journal* and the *African Architect* show an increase this year, which naturally pleases us vastly.

To the Editor,
African Architect,
Johannesburg.

Sir,

I read with interest in your last issue the correspondence relating to the Standard System of Measurements, and, after all is said and done, I do not see much to rouse the "righteous" indignation of our friend Mr. D. M. Sinclair, and certainly nothing, in my opinion, to give reason to introduce the legal element. To be quite plain, I trust that the Builders' Federation will in no case hesitate to promptly communicate to the Council of the Association of Transvaal Architects as well as to the South African Institute of Quantity Surveyors any flagrant violation of proper Bills of Quantities. I quite agree that the Registrar's letter of 7th November is just a little bit ambiguous, and, if I had had anything to do with it, I would have not explained away the request contained in his first letter, but indicated quite plainly to Mr. D. M. Sinclair and "other Architects" that without reference to any section of an Act or Bye-law occasion would be taken to unreservedly expose faulty quantities. At the same time I think it is a pity that we have not got a few more gentlemen of the zeal of Mr. Sinclair, for architectural interest undoubtedly requires a much-needed stimulant. I rejoice, therefore, in a sense, that Mr. Sinclair has wakened things up. Is there any other point, Sir, that you and "other architects" could raise in order to gather in the assistance of your legal adviser, so that fresh life might be infused into other architectural matters.

Yours, etc.,

"ANOTHER ARCHITECT."

REGISTRATION NEWS.

Engineers and Architects.

Prior to the war the N.S.W. Cabinet had under consideration a Bill for the registration of architects and engineers. What fate has befallen it since the outbreak of hostilities is unknown. Probably it has been replaced on the shelf. That is unfortunate, but, of course, there is some palliation for delay in the altered circumstances. Parliament has been dislocated since the change in events, and in all possibility it will be some time ere the legislative machinery is in motion again for the moulding of reforms such as the one indicated.

What can be done, however, is to have the draft measure advanced to a stage ready for presentation to Parliament. As two conferences have been held between the Director-General of Works and representatives of the Engineering Association, the Institute of Local Government Engineers of Australasia, the Electrical Association and The Institute of Architects, that policy will probably be followed.

At time of writing the character of the proposed measure is not publicly known, and those who attended the conference are under their words of honour not to make any public disclosures. We may, however, quote from an article specially contributed to "Building" by Premier Holman some time ago on the question. He said, *inter alia*:

The main difficulty to be overcome is the proper definition of the term "engineer" and the education of the public to a proper appreciation of its true significance; for the present state of the law confers the right to call themselves "engineers" upon persons who possess only the rudiments of a primary education in that profession.

To give effect to the foregoing, an Act of Parliament, which might be styled "The Engineers' and Architects' Registration Act," would be required, and under this Act it would be necessary, in my view, to appoint two boards, one to consider the registration of engineers and the other the registration of architects. The members of the board could be nominated by the Government, by the Senate of the University, and by recognised societies of engineers and architects, respectively. The boards should have the power to register qualified persons of either profession, as the case required, and to cancel such registration for unprofessional conduct; no person, unless registered by the appropriate board, being eligible to call himself either an engineer or an architect. There is little fear that boards so constituted would admit any but the well-educated and thoroughly qualified. They would probably provide for examination for doubtful cases, or perhaps for all, and it could well be left to them to guard the status of the professions.

The proposed measure will in all likelihood be drafted on those lines. The Government, even if it delay the measure through force of circumstances, is worthy of congratulation at this stage for its action in the matter. We trust, when times are more propitious, it will give ready effect to what it has clearly recognised as a duty to the public and a necessity in the efficient development of the State.

Architects.

The draft of a proposed Bill for the registration of architects was read before the meeting of the Royal Victorian Institute of Architects, on August 11th, and unanimously approved. The President (Mr. H. W. Tompkins) remarked that the Bill was entirely in the interests of the public, and that no member present would benefit in any way, because they would have to admit all architects or persons practising architecture at the passing of the Act. He also stated that at the present time there was nothing to prevent anyone from practising as an architect, in many cases at the expense of his client, whereas under the Bill a man would in future have to be duly qualified, thereby raising the status of the profession. The measure provides for a registration board, for examinations to be held, for the appointment of registrar and other officers, and the other requisite machinery. The registration fee is fixed at £3 3s. 0d.

The Bill, it is stated, is identical with one being introduced in the New South Wales Parliament, and probably in Tasmania and South Australia. The Institute has invited the Chamber of Commerce, Chamber of Manufactures, Municipal Association, Property Owners' Association, Health Society, Medical Association, the Master Builders' Association, and other bodies to join in a deputation to the Minister of Public Works, urging the passing of the proposed Bill into law.—*Building, N.S.W.*

The Movement in America.

The Washington Chapter of the American Institute of Architects is making a determined effort to render a real service to the members of the profession in Washington, and, at the same time, to all the people of that City, by urging upon the District Commissioners, the adoption of the Bill prepared by the Washington Chapter, requiring that architects be licensed. It is hoped to secure the approval of the Commissioners to such a Bill, and that it will be so presented in Congress. Under such conditions its chances for enactment would be good.

The Bill is modelled somewhat along the lines of the law now existing in Illinois. It also embodies some of the features of the law of California and several other States.

Through the efforts of the Secretary of the Chapter, Mr. Clarence L. Harding, the Commissioners, on June 9th, gave a hearing to the members of the Washington Chapter, to which the public was admitted. The hearing was attended by about twenty members of the Chapter, many of whom took an active part in the discussion. There were also present the three Commissioners, the Building Inspector, the Municipal Architect, and the Electrical Engineer, all representing the City.

At the request of the Commissioners, Mr. Harding spoke briefly concerning the general purpose of the Bill; Mr. Glenn Brown, President of the Chapter, then presented an able argument in its favour, after which the conference assumed the form of a general discussion, during which some interesting points were brought out.

It was found that, in Washington, a great many men who are not properly qualified are practising architecture. Some of these men are graduates of correspondence schools; some have had a limited experience as draughtsmen; others have had no experience, but feel themselves qualified by inclination to act as architects either for their own buildings or those of others.

It was interesting to note that the Building Inspector, who has large authority in Washington on matters of construction, was heartily in favour of the Bill. He took the position that its enactment would greatly raise the general standard, and would tend to make the new houses of the city more beautiful. He stated, however, that an objection which might be urged to the Bill was that it would raise the total cost of building, so far as those of moderate means were concerned. He further explained that this was, perhaps, a plausible objection without being a real one.

A number of architects then spoke in favour of the Bill.

The hearing adjourned after an interesting statement by Mr. Waddy Wood, of the Chapter, concerning the need for beauty in architecture as well as stability, in which he clearly outlined how this could be accomplished if architects were required to be licensed to practise.

The Commissioners decided to give full consideration to the matter, and render a decision as to the desirability of the proposed Bill.—*Journal of the American Institute of Architects.*

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":—

CONSTRUCTION IN REINFORCED CONCRETE

(Continued from last month.)

PART II.

Columns.

In the design of columns only a certain portion of the area should be considered effective—whatever the type of construction—and the remainder should be allowed for protection from weather and fire. Generally it will be necessary to make an allowance of 1½in. on all sides, more especially if there is any possibility of the structure being subject to fire.

The usual object in column design is to reduce the sectional area as much as possible. In plain columns this can only be done by improving the quality of the concrete. In reinforced columns the load-carrying capacity can be increased by increasing the percentage of reinforcement.

As concrete has a much lower elasticity than steel, it will receive its full working load before the steel is fully loaded, and, in consequence, the load allowed for the steel must be taken at a low value. This is determined by the amount of shortening which the steel has undergone up to the point when the concrete receives its full load.

Since the shortening in the material is proportional to its modulus of elasticity, the working stress which can be allowed in the steel must not be greater than the work stress in the concrete multiplied by the ratio of the moduli of steel and concrete, which is taken as 15.

Plain concrete columns which do not exceed 12 times their diameter (or shortest side) in length may be loaded up to 22½ per cent. of the compressive strength of the concrete at 28 days (450 lbs. per square inch for 2,000 lbs. concrete). If reinforced with bands or hoops of at least 1 per cent. of the volume of the columns enclosed, and spaced at not more than quarter the diameter of the enclosed column, the concrete (in columns not exceeding 18 diameters) may be loaded up to 27 per cent. of the compressive strength at 28 days (540 lbs. per square inch for 2,000 lbs. concrete). The vertical reinforcement may be loaded up to 8,100 lbs. per square inch. Columns reinforced with vertical bars of not less than 1 per cent. nor more than 4 per cent. of the area of the enclosed column and with bands or hoops space not more than quarter the diameter of the column may be loaded when they do not exceed 18 diameters up to 32½ per cent. of the compressive strength of the concrete at 28 days (650 lbs. per square inch for 2,000 lbs. concrete). The vertical reinforcement may be loaded up to 9,750 lbs. per square inch. Columns not exceeding 18 diameters with structural steel units which thoroughly enclose the core may be taken the same as the last case given, but if the unit is in the centre of the column the steel only should be taken into account at the same stress as above. If a greater stress were taken the concrete on the outside of the column would be overstrained and tend to flake off. All the foregoing load values are given for "dead load," so that in cases where live loads have to be provided for they should be given their equivalent "dead load" value.

Systems of Reinforcement.

At the present time there are a large number of firms who specialise in the design of reinforced concrete structures. The majority of these firms have a special system of design. Some firms depend on special formulæ, others on special types of bar, and others on the arrangement or combination of the reinforcing metal. This systematising of reinforced work has probably done more harm in the way of preventing the general use of this material than any other thing connected with it, and the sooner engineers and architects recognise that there is very little difference in cost between most of the systems, provided the work is honestly and correctly designed, the better for all concerned.

The systems may be divided into three classes: (1) Those which use commercial sections of steel; (2) Those which use special sections; (3) those which use netting of one form or another.

The systems which are comprised in the first class are all very much alike, and all have been used in large works. Of those in the second, some are excellent for simple and straightforward work, but they become extravagant when adapted to anything else. Many of this class depend on some form of twisted or indented bar, the object of which is to obtain greater adhesion between the steel and the concrete. These twisted or indented bars may appear to be all right in theory, but, unfortunately, the adhesion of cement to steel is in all probability greater than the internal adhesion of the concrete. The grip between concrete and plain bars, as has been already stated, can safely be taken at 80 lbs. per square inch. If the designer finds that any bar has not sufficient grip on the concrete for its sectional area it is a very simple matter to replace the single bar with two smaller ones, to give the same sectional area, and thus increase the surface.

Of the third class, none are really systems, but most are very good for accomplishing the object for which they were originally intended. They all serve a very useful purpose in conjunction with some other system of reinforcement for floors and walls. It is, however, ridiculous to try to adapt them for use in columns and beams as is sometimes done. The following describes the principal types of reinforcement:—

The Coignet System (Messrs. Coignet, Ltd.).

One of the earliest systems and containing the main principles of reinforcement, it consists of the use of steel rods of ordinary sections embedded in the concrete in the lower portions of beams and floors to take up the tension, with smaller rods in the upper part or compression side. Steel loops or stirrups of small diameter are hooked over the tension and

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compression rods, and are tied to them with annealed wire at frequent intervals. For vertical columns or piles (pure compression members) rods are arranged vertically in the concrete near each face, and tied together with loops or ties to keep the bars in place, and to counteract the bursting tendency of the concrete when under load. These loops are also bound to the rods with wire, as in the beams.

The Henebique System (Mouchel & Co.).

Very similar to the Coignet system, except that generally a portion of the tension bars are bent or cranked near their ends to increase the rigidity of the whole. In this system U-shaped stirrups are used.

The Considere System (Considere Construction Co., Ltd.).

This system differs materially from the two previous ones, where compression stresses are encountered, and steel rod spirals are used to counteract the bursting tendency of the concrete. This method has very great possibilities, one of the most interesting applications of it being in temporary hinges, introduced in arches, to eliminate the initial stresses due to the shrinking of the concrete during setting. The spirals are simple to make. All that is necessary is a drum with a steel centre and wooden covers to give the required diameters. Two men can quite easily work rods up to ⅜in. This method of spirals has also been applied to pier and column founds in place of the gridiron form of found. The



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excavation is left with a cone-shaped hump in the middle on which concrete is placed; the reinforcement is wound round in a spiral, from the base to the apex, and is tied to radial rods at intervals.

The Piketty System (Messrs. Piketty & Co.).

This system is similar to the first two described above, except that rods larger than ½in. have their ends fished or hooked, and those smaller than ½in. are flattened or hooked. This firm has also patented a method of increasing the elastic limit of ordinary mild steel bars by stretching all the reinforcing members used as tension rods or stirrups.

The Paragon System (The British Reinforced Concrete Engineering Co., Ltd.).

The rods are used in the usual way, except that the stirrups are made in the shops, in such a manner that when placed on the rods they grip them tightly. They also make a form of spiral reinforcement for slipping on to the vertical rods of pillars.

The Keedon System (Messrs. Johnston. Clapham & Morris, Ltd.).

This system provides stirrups similar in shape to the Paragon, but differently wound, and they are fixed to the main bars with wedges or keys.

The Leslie System (Messrs. Leslie & Co., Ltd.).

In this system the stirrups are made of ordinary round or flat bars, and are secured to the main rods by means of a metal ring driven over the bent-up ends of stirrup.

The foregoing are the principal systems, none of which require any special forms of bars. The following systems require special forms of bars:—

The Kahn Bar System (Trussed Concrete Steel Co., Ltd.).

This form of reinforcement consists of patented and specially rolled sections of steel bars of various sizes. The diagonal projecting wings or ribs of the bar are machine cut, and are then turned up to form the shear members in place of loose stirrups. Another type of the Kahn bar, called the "Kahn Rib Bar," consists of specially-rolled sections, having transverse ribs at intervals along the whole length of the bar, which obviate the need for hooking and fish-tailing ends and forms a thorough bond with the concrete. This Company also makes Hy-rib sheeting,

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which consists of rolled steel sheets, with perforations; at intervals stiffeners are formed by bending up a portion of the sheet. It is intended for use in the construction of partitions, floors, roofs, culverts, etc.

Indented Bar System (Indented Steel Bar Co., Ltd.).

This Company turns out many types of indented bars, and of these the Columbian bar for floors, etc., is perhaps the best and most commonly used. These bars are used in conjunction with rolled steel joists, to which they are hung with clips, generally spaced about 24in. to 30in. centres.

Perfector Trussed Bar System (Perfector Buildings and Constructions Co., Ltd.).

Consists of a round bar with one rib, which is slotted at intervals for the insertion of stirrups.

Twisted Bar System (Twisted Steel Bar Co., Ltd.).

Twisted square bars to give better bond with the concrete.

Naylor's System (Naylor Bros.).

Main rods latticed with wire.

Finally, the netting or mesh systems are:

Expanded Metal System (The Expanded Metal Co., Ltd.).

This consists of steel sheets, which are cut and expanded by machinery into a diamond or square-shaped mesh; this material is largely used for floors, roofs, walls, etc. The sizes most commonly used are 1½in., 3in. and 6in. mesh. There are several different forms of this expanded metal used for various different purposes.

Clinton System (British Reinforced Concrete Eng. Co., Ltd.).

This is a system supplied by the same firm as the Paragon. It consists of a number of parallel wires, with cross wires at intervals; all the crossings are electrically welded by a special process. It is useful for floors, etc.

Lock-Woven Mesh (Messrs. West & Co.).

Similar to the last described, but in place of welded joints special wire ties are used.

Self-Sentering (The General Fireproofing Co.).

Similar to Hy-rib, only made of expanded metal.

The above described are the principal systems used in Great Britain and Europe.

In America the following systems of reinforcements are used:—

Bona System.

Metal rods of cruciform cross section.

Bertini (Girder Frame).

Horizontal tension members with stirrups shrunk on.

Chaudy & Degon.

Cross rods passed under bearing rods, but looped up beween.

Cottacin.

Round rods interlaced like wire netting.

Cummings.

Bars of different lengths, having their ends bent to an incline and formed into a loop to resist internal stresses.

Cup Bar.

Special rolled section with longitudinal ribs connected at frequent intervals with cross ribs forming cup depressions.

De Man.

Undulated bars.

Diamond Bar.

Bars rolled round with parallel ribs passing along and around the bar, forming diamond-shaped shoulders on surface.

Donath.

Inverted T or I beams connected by horizontal diagonals of light flat metal on edge.

Ferroinclave.

Sheet steel with inversely tapered corrugations to be covered on both sides with concrete.

Gabriel.

Deformed tension members with trussing of hard drawn wire.

Habrich & Dusing.

Flat metal twisted hot.

Herringbone Frame.

Horizontal tension members with special attachment for stirrups.

Holzer.

Metal in form of I beams.

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Hyatt.

Flat bars set on edge and pierced with holes for cross reinforcement.

Johnson.

Corrugated bars.

Lug Bars.

Twisted bars with projecting lugs at intervals on surface.

Melan.

Steel ribs, either I beams of four angles, latticed, embedded in the concrete for arches.

Monier.

Two series of round parallel bars at right angles.

Mushroom.

Flat floor slabs supported by columns with enlarged heads.

Parmley.

Bars with bent ends for the sides of sewers and haunches of arches.

Rabitz.

Various combinations employing galvanised wire.

Ransome.

Square steel rods twisted cold.

Roebling.

Flat steel bars set off edge, clamped to supporting beams and held in alignment by flat bar separators.

Schulter.

Like Monier, only with rods diagonally.

Schofield.

Oval bars with projecting shoulders.

Thracher.

Bulb bars.

Trussit.

Expanded metal or herringbone lath bent to V shape.

Visintini.

Beams of concrete cored out so as to form lattice girders.

Placing in Position.

With regard to the placing of the bars in position in the work, great care should be taken that they are placed accurately, and not displaced during filling or ramming of the concrete. When wood blocks are used to keep the bars in place temporarily they should be made as big as possible, not in small single pieces for each rod. They are then less easy to miss as the work proceeds. It is also advisable to number them and count them at intervals. More than one building has failed in consequence of carelessness in this respect.

The author has seen small concrete blocks specially made for this purpose for use in reinforced concrete floors, and they act very well, because they do not affect the strength of the floor, being below the steel. These concrete blocks are rough on the surface, and are left in the work.

In beam work the top rods are placed roughly in position; the stirrups are then hung on them; the bottom rods are then slipped in. The latter are supported by the stirrups, and thus avoid the necessity for using any blocks in the bottom of the forms. (See Fig. 1.)

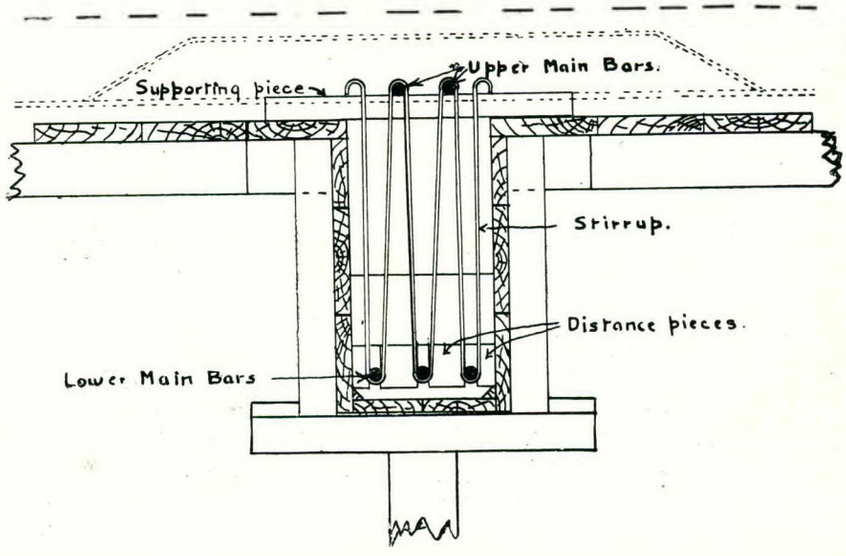

FIG. 1.

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Tying.

The tying of the bars together, where they come in contact, serves principally to keep them in place during construction; it does not have so much effect on the final strength of the structure as is sometimes thought. Particularly is this the case with junctions in continuous tension rods which have to be in more than one piece on account of the limitations of length for convenience of manufacture and handling.

When two bars are tied with wire wrapping they are not easy to pull apart, because the wire adapts itself against the pull by becoming slightly inclined in one direction. (See Figs. 2, 3, 4 and 5.)

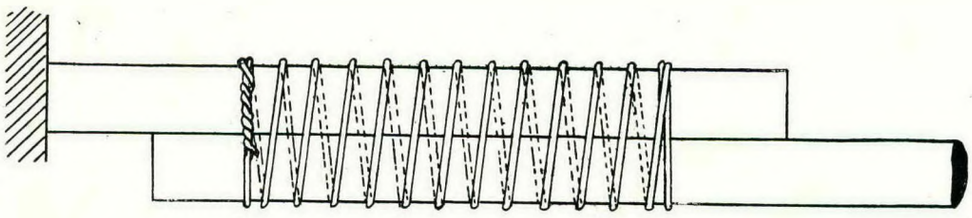


FIG. 2.

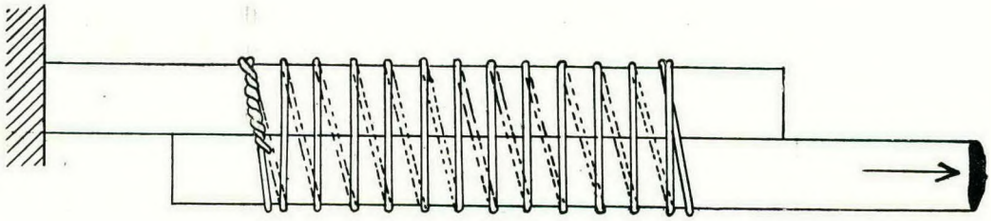


FIG. 3.

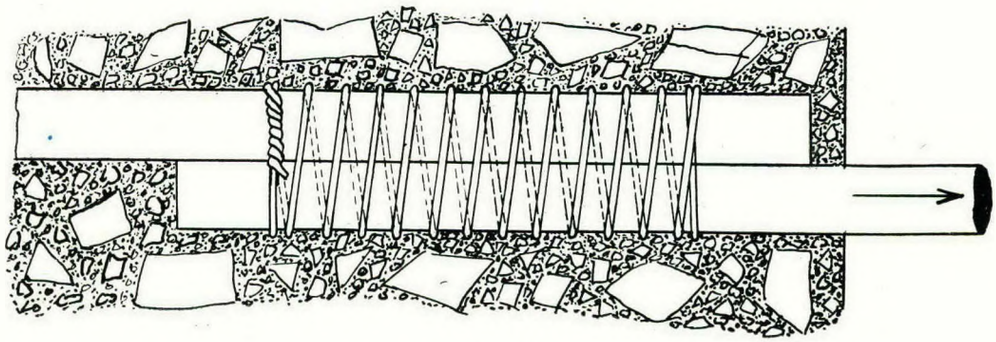


FIG. 4.

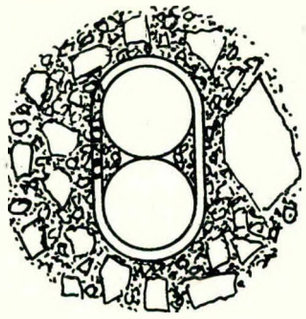


FIG. 5.

Now assume the same thing in the wrapping of rods inside a concrete beam. What will happen? The wire cannot now act as before described because it is impeded by the particles of concrete on either side of it; the concrete cannot come into contact with the bar on account of the wire, nor can it get between the two bars, so there will be a considerable area of metal to metal which cannot exert any very great resistance to slipping.

A better joint is probably obtained by properly overlapping, and bending the rods, and arranging them so as to allow the mortar entirely to envelop them. As a general rule it is best to use small sections, say up to 1½ inches diameter, since these are more easily handled, and bent to the desired shapes.

Bending.

Rods up to 1½ inches diameter can be bent cold by the use of special bending tools, of which there are a few now on the market. There is, however, an excellent opportunity for the display of ingenuity in the design of a really good machine for this purpose. The essentials for such a machine are simplicity and strength. Fig. 6 shows an example of a Kennedy machine which will bend rods from ½ inch to 1½ inches.

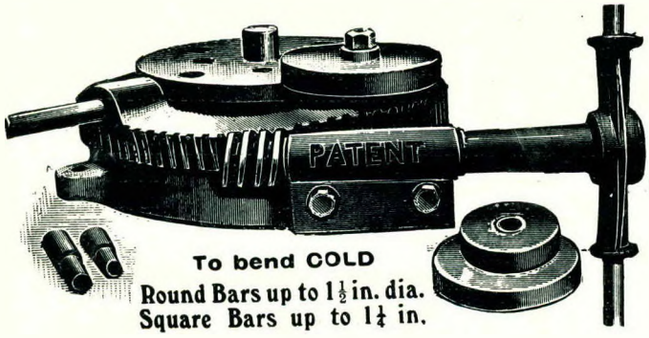


FIG. 6.

Small rods up to ½ inch can be bent with a short claw bar. Three or four steel plugs on a strong wooden table being all that is necessary. The plugs are removable so as to give different templates for the various shapes required. The bending of stirrups is a simple operation, and an unskilled labourer can become quite expert in a very short time. The wire after having been cut to length is simply bent round a series of plugs on a table to the desired shape.

Cleaning Rods.

It is important that the reinforcing rods should be clean and free from scale, slight oxidation, however, does not have much effect on the grip of the concrete. No oil or paint of any sort should be allowed.

Washing the reinforcement with slaked lime, or cement, is sometimes adopted for keeping the bars from rusting until used, it is probable, however, that this does not improve the grip of the concrete unless it is done immediately before use.

Forms.

This is the most important matter which has to be dealt with. The relation between the cost of forms and the total cost of the work may vary from 10 per cent. to 100 per cent. As a general rule, the design of the forms is left to the contractor, with the proviso that he has to submit his scheme to the engineer. The difference in the design of forms is one of the principal causes of the very great discrepancies which are nearly always apparent in estimates and tenders for reinforced concrete work. It has been often contended that this part of the work should be done by the Engineer, and certainly this arrangement would have several advantages. The Architect or Engineer should at least give some indication of the style of forms required by him, so that an uniform basis of tendering can be adopted.

Timber.

The timber for forms should be free from knots, and not overdry, or it will become warped when wet. White pine, yellow pine and spruce are good timber for this purpose. The timber used should be of the following thicknesses:—

For beams, soffits	2″	to 2½″
For beams, sides	1½″	to 2″
For columns	1½″	to 2″
For walls	1½″	

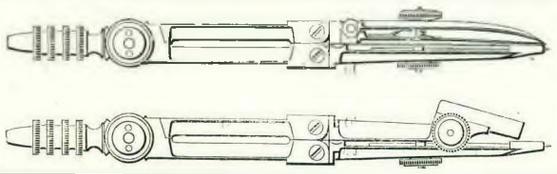
Stout boarding is generally most economical as it can be used many times. For slab panels, 1 inch boarding is frequently used, but 1 inch boards require stays every 2 feet, 1½ inch every 3 feet, and 2 inch every 4 feet to 5 feet.

Design.

In designing centres for beams and floors an allowance for "live construction load" of from 50 to 75 lbs. per square foot should be made, in addition to the actual weight of the structure. It is also necessary to give a camber to beam and floor forms, and this should be about ⅛ inch to 5 feet to allow for the squeezing of the wedges and timber. The forms for beams should be designed so that the sides can be removed before the soffits, in order that the supports may be left in as long as possible. Very few nails should be used in construction of forms, they should not be necessary if the design is good and they spoil the timber for future use. All centres should be wedged or fixed in such a way that they can be eased without jarring the concrete, and removed without difficulty.

Erection.

Form work should be erected with a view to ease and economy of striking. If some time has elapsed between the erection and the start of pouring concrete, the forms should be carefully gone over and aligned,—all cracks in the boards should be made good by filling with plaster of paris or clay. Forms must be cleaned of all sawdust and dirt before pouring. Traps or pockets should be made for this purpose. If



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the forms are not oiled or soaped they must be well wetted before the concrete is placed in order to close the pores.

Striking.

Wall forms may generally be removed in from 24 to 48 hours unless it is intended to fill earth behind the wall at once, in which case they should be well braced and left for at least three or four weeks.

The sides of beam forms may generally be struck in about a week, but the soffits and supports should be left in place for three weeks.

Column forms can be removed in from one to two weeks, but struts should be left to carry a part of the load if the beams above have been erected.

In cold weather the time allowed should be considerably extended, and if there is actual frost the time of its duration should be added to the time allowed for striking.

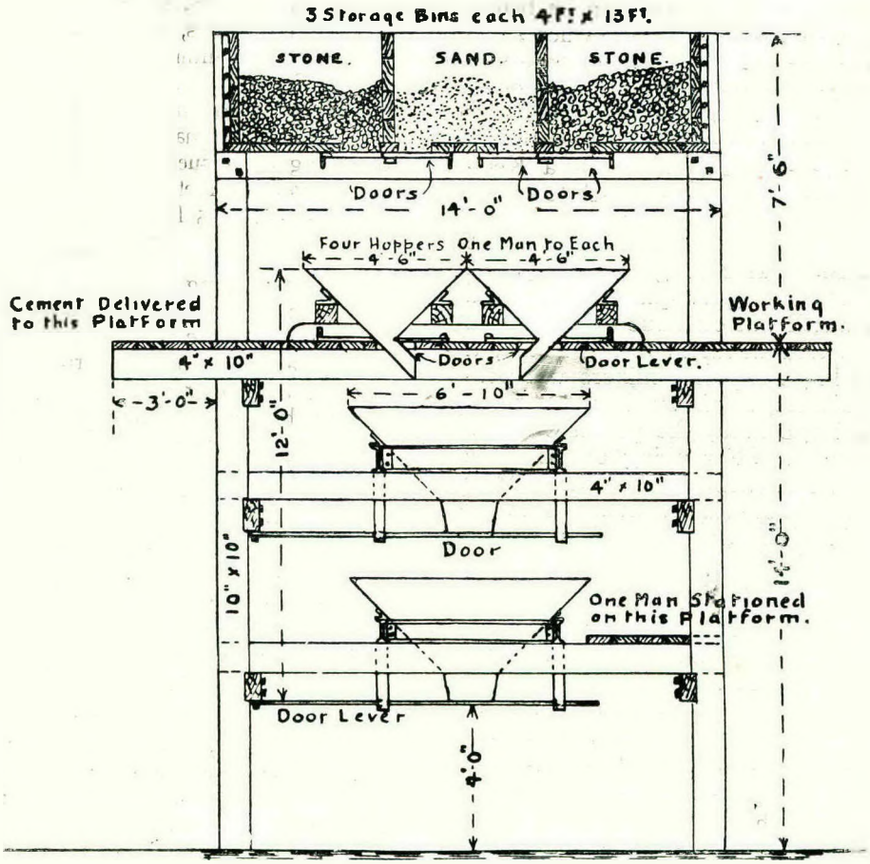
Steel Forms.

There have been many attempts to produce a satisfactory type of steel form, but so far such forms have not been adopted to any extent in Great Britain or Europe. They have, however, been largely used in America, and have given very satisfactory results both as regards the class of work done and economy of construction.

In South Africa, where the cost of timber and skilled labour is exceedingly high, steel forms might be adopted with very great advantage. The use of corrugated sheet steel to support floor slabs is one of the earliest attempts made in this direction, and it is still adopted for floor slabs, where the corrugations in the ceilings are not an objection, as in the case of factories and similar structures.

Plant.

The design and selection of plant for the handling of the materials in reinforced concrete construction depends greatly on local conditions, the size of the work and the speed at which it has to be executed.



Gravity Mixer.

FIG. 7.

The shorter the time allowed for any work the more expensive the general plant becomes.

The first thing to be thought of is the mixing of the concrete, and whether the size of the work warrants the use of a concrete mixing machine. Then, assuming that a mixer has been decided on in preference to hand mixing, there is the type and size of this to be considered. An effective mixer should not only stir the material, in which case it may act more as a separator, it must slice it again and again, so as to produce a homogeneous mass irrespective of the order in which the various ingredients are introduced.

There are two main classes of mixer: (1) Batch Mixers, and (2) Continuous Mixers. The second class should never be used, except in conjunction with an efficient mechanical feed, and even then they will have to be very carefully worked or a uniform quality will not result. Of the first class there are two general types, namely, Rotary and Paddle. The simplest form of rotary mixer is a box in the shape of a hollow cube, having a door with a cover on one of its faces rotating on an axle running through two opposite corners. This form is inexpensive, but not very efficient, and rather slow in working. It has been superseded by the more expensive type of rotating drum fitted inside with the blades of one form or another. Paddle mixers usually consist of a trough or open box, with two or more sets of revolving blades or paddles inside, but this type is not so generally used as the Rotary. There is also another type of mixer which is continuous but may be adapted for batch mixing, this is the gravity mixer, which requires no power to work. It is generally formed of a rectangular tube with fixed blades or obstructions inside, against which the materials strike in their descent. A simple form of this type consists of a series of hoppers, with doors one above the other through which the due proportions of the various materials drop (Fig. 7). Having selected one or other type of mixer the next question to be decided is that of size. This is governed by the size of the work and the largest quantity required per day. For work which will continue over a period of two years or more and which is concentrated, a stationary plant with large capacity mixers will possibly be found most suitable, but in smaller works and works spread over a large area, the portable forms of mixer are more useful. For a big country like South Africa, where works are often separated by long distances and machinery has sometimes to be transported over roads which are not always of the best, the first consideration for contractors' plant is that of weight and portability.

The design of the plant for handling the raw materials and the concrete has often a greater effect on economical production than the type of the mixer used. For the arrangement of this it is impossible to lay down fixed rules, as no two works are ever under exactly the same conditions. The general rule is concentrate. An interesting example of the handling of large quantities of concrete occurs at the Rosyth Naval Base on the Firth of Forth in Scotland, where Mr. Gibb, who is the contractor, has placed all the sheds for cement, bins for sand, crushers, etc., together in a part of the site fenced off from the rest of the work. This position is close up against a cliff, or rather, steep bank, along which a road runs. The crushers are placed on a platform half-way up this bank and immediately against them the bins for broken stone and sand, the cement sheds being as near as convenient. Below the bins are rooms which contain the measuring apparatus and also all cement testing machines and other appliances necessary. Lines of rails run alongside these at a slightly lower level for the contractors' trains. All the materials for concrete are here weighed and measured into lots of about half a cube yard (that is the three materials together) in hoppers which are placed on the trucks and conveyed in trains to the various mixers on the work. These mixers, which are of comparatively small capacity, are placed on platforms running on rails along the top of the various walls, etc., and are each accompanied by a crane. When the train-load of material arrives at the mixer, the crane lifts one hopper at a time and tips the contents into the mixer, which in its turn, after mixing the material, discharges direct into the forms. All this plant is worked electrically from a temporary power station on the site.

Crushed stone can usually be purchased in large towns, but in many places a crusher has to be installed on the site. There are two general types of these, Jaw Crushers and Rotary, the former being more generally used for portable plants. The crusher must be near the mixer, and above it if possible, otherwise a conveyor must be used to lift the broken stone to the required level. In Bridge and Reservoir work, pumping plant must also be taken into consideration, and allowed for in the cost of the concrete.

In building construction the mixing is best done at the ground level, and some form of hoist should be used to convey the concrete to the various floors. Proper planking should be laid for all barrow runs; not only does it make wheeling easier but it prevents the concrete being shaken into its various original constituent parts again, which is rather apt to happen, especially with wet mixtures.

Conclusion.

As reinforced concrete construction involves the use of more than one material in the composition of any member, it is obvious that the main object to be attained is uniformity of quality in each of the constituent parts. Mild steel, one of the principal constituents, is a material which can be purchased in the open market of a very good and uniform quality, and can be easily and accurately tested. It is therefore in the materials of the concrete and in the manufacture of the structure that inequality of strength may occur. The first of the concrete materials, cement, can be obtained of a good and uniform quality in South Africa, and it can be comparatively easily tested. It therefore remains for the contractor and the superintendent of the structure to see that the aggregate is of as good quality as necessary. This can only be done by testing the fine aggregate with the accepted cement, in the form of briquettes as in the cement and sand test, and the coarse aggregate with the two other materials for compression.

It will be generally found that all contractors who are accustomed to reinforced concrete work will carry out tests on these lines for their own satisfaction, but it would still be an advance in this form of construction if the addition of some such wording as the following were made to the present specification for concrete: "Test briquettes composed of three parts of the sand to be used, and one part of the accepted cement, shall have a tensile strength of so much per square inch seven days from gauging, and an increase of so much per cent. at 28 days," or, "shall have a tensile strength of so much per cent. of the strength of briquettes made with standard sand, etc."

For the concrete as a whole, "Cylinders composed of the concrete as used, 8 inches in diameter and 6 inches long shall have a compressive strength of so many pounds per square inch at 28 days from gauging, the Engineer or master of works to have full power to take a portion from any batch of concrete for testing purposes."

Finally, uniformity in quality can only be obtained by constant and efficient supervision during the process of manufacture.

The President said that they had listened to Mr. Forman's paper with the very greatest interest, and he hoped that arising out of it there would be a very useful discussion. There were many members of the Institution who had had a very large experience in almost every form of structure with which the paper deals. The paper brought up to date an account of most of the systems now used for reinforcing concrete, and possibly discussion might decide which, for general purposes, might be the best of the systems.

The author was to be heartily congratulated on the manner in which he had dealt with such a mass of detail. Reinforced concrete was now universally used, and, as experience became more mature, constant changes were being made in the methods of using it.

He had the very greatest pleasure in thanking Mr. Forman for his paper and for the trouble he had taken, not only in getting the whole of the data together, but for making it so interesting by lantern-slide illustrations.

R. C. Warriner (member) seconded the vote of thanks.

E. J. Laschinger (Past President) said that he thought Mr. Forman had given them an excellent paper. He noticed, however, that the author had said practically nothing about reinforced concrete work which had already been carried out, not only in South Africa, but particularly on the Rand, and he thought it would be of the greatest interest if someone would describe and discuss the numerous local examples of reinforced concrete work. A great deal had been done, and more had yet to be done, in South Africa with regard to reinforcing concrete for various structures. In considering the use of reinforced concrete, more especially in ports, harbours, and naval works, as well as the various industries in South Africa, particularly the mining industry, there was a great field for its use.

The local examples of reinforced concrete were somewhat different from what they had seen that evening. Engineers in various capacities must keep their eyes open, make a very complete study of the subject, and undertake experiments if they wished to make structures that would be permanent.

Reinforcing of concrete may be looked upon in two ways. It is possible to have a reinforced structure with a little bit of steel in it, or to take a massive steel structure which is protected by concrete. Between the two arrangements there is a very big difference. To protect steel with concrete is one thing, and to make a concrete structure with steel reinforcement is another.

Between these two extremes we can have great variations as to the relative loads on the concrete or the steel, and in the same structure part of the strength may be due to steel mainly and other parts to concrete mainly. The ingenuity of the designer is exercised in determining the relative proportions of steel and concrete which should be put into the various parts of the structure.

J. A. Vaughan (Past President) said he thought that Mr. Forman's paper was one of the best that had been submitted to the Institution. In the paper, however, which was mainly descriptive, nothing in the way of criticism was entered into. One important point was the permanence of the strength of the steel in reinforced structures. Mr. Laschinger had alluded to two ways of using reinforcement. It might be reinforcement of the steel, or reinforcement of the concrete. Rumours were heard of the failure of steel reinforcements due to galvanic action, and the author had not alluded to this important matter at all. One point he had touched upon was the question of bonding, and mentioned two ways of doing it. In the speaker's knowledge there were one or two instances in which the bonding had been at fault. The matter was one which must be carefully looked into, not only in reinforcement work, but also in ordinary concrete work. He considered that too much attention could not be paid to methods of bonding during construction.

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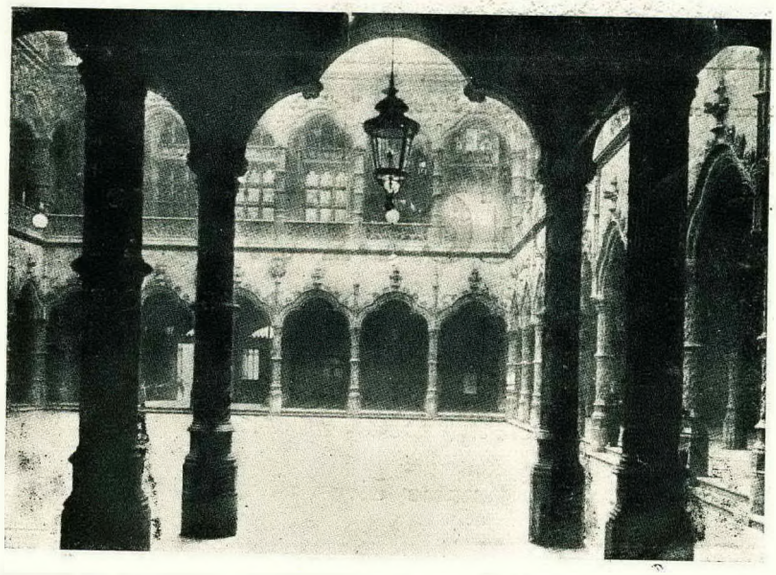

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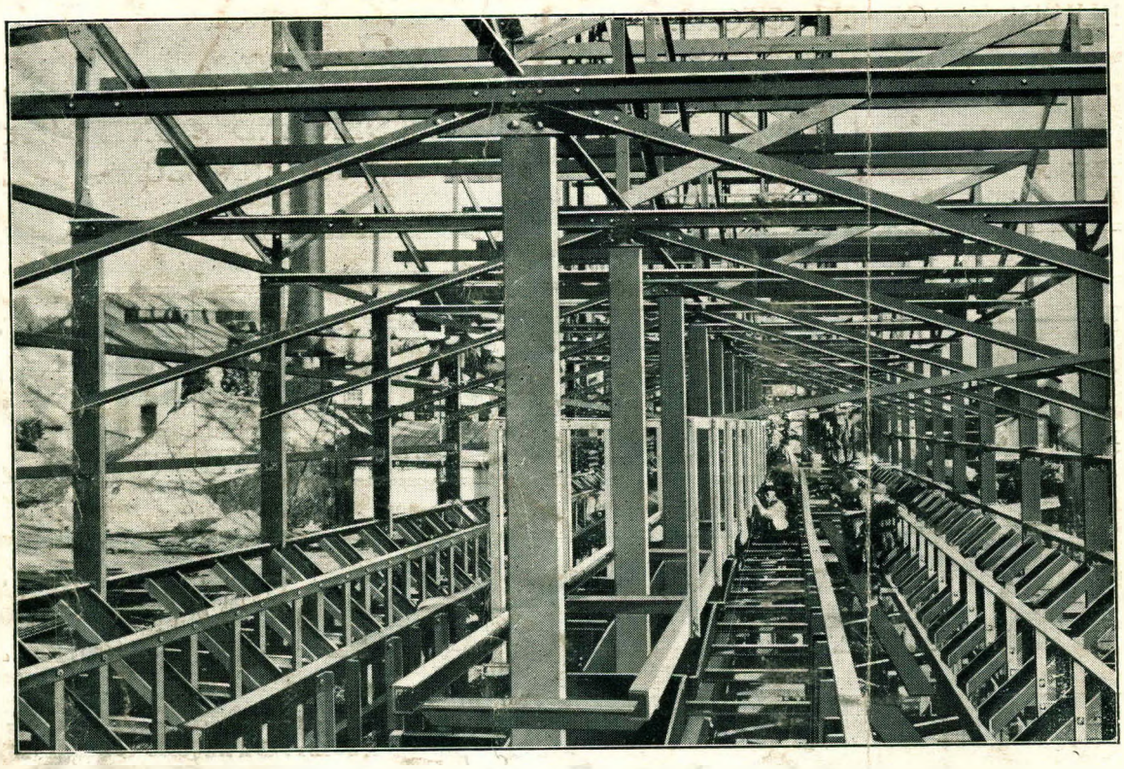

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