

methods of construction meant 1-12th or 1-15th? If it does, it strikes me as remarkable that, with reinforced concrete we should have a beam made just as strong as a steel joist with the same depth.

With regard to floor loads, I have not the slightest doubt that all regulations relating to the weights to be carried by floors of various buildings, and the many other details that are required in connection with building structures, will be provided for in the by-laws under the new Building Act that is promised us.

I know that Mr. Hart is very keen on reinforced concrete. I have had the pleasure lately of looking over Wirth's Hippodrome, Sydney, which is the finest example of reinforced concrete work we have, I believe, in Australia. There we see, in the interior of the building, galleries and nearly all the different structural features that we meet with in building, including stanchions, beams, arches, cantilevers, and a framed truss over the 50ft. proscenium opening. I must say that the visit I paid to the building was most edifying; and, if I may say so, I think Mr. Hart should be good enough to extend the invitation to others who are interested in reinforced concrete work. It showed me, practically, what can be, and is being done in this direction. Hitherto, as far as my personal experience is concerned, I have never got beyond floors, fire-proof staircases, and walls of two-storeyed buildings in the use of reinforced concrete, but no doubt architects in the near future must be prepared to design in the latest method of building construction.

There is another point to be thought of besides construction, viz., the public taste. Great buildings faced with concrete are not particularly pleasing in appearance. Structures of that kind are, no doubt, useful, but they do not lend themselves very well to artistic finish or aesthetic design. I am not going to say it is impossible

to make an artistic looking building of reinforced concrete, because I have seen plenty of examples with arches, mouldings, cornices, and columns—practically all the ornaments that we have been designing in brick and stone; but there is the all-pervading dullness of colour which rather palls on one. I should be very sorry to see examples carried out to any great extent round about Sydney in our finest specimens of architecture. There are things which can be done to improve the appearance of these buildings, one I consider as worthy of mention being to improve the finished color. I have seen remarkably fine specimens of cement finish where sand of a bright yellow colour had been used. I do not know where the sand was found, but it was somewhere near Sydney. The finished color was a bright buff, very like our best sandstone. Such a finish would certainly go a long way towards making reinforced concrete with cement more acceptable to the aesthetic ideas of the people and architects of Sydney. I thank Mr. Hart for his interesting paper.

MR. TOURNAY-HINDE said: I think everybody is agreed that the subject that Mr. Hart has placed before us this evening is a very important one, and any reference to the antiquity or uselessness of the City of Sydney Building Act, on my part, would be unnecessary. I am glad to hear that the new Act, if it does go through, will contain provisions sufficiently elastic to meet emergencies, because very often one is brought up against conditions which require certain modifications to permit of the construction of an economical building.

(With reference to the thickness of walls, I was, not so very long ago, up against having to erect a building of three storeys high, length about 50 or 60 feet, and width about 35 feet. It was impossible to get sufficient bricks to construct the walls the usual thickness, and the building

had to be completed within a certain time. When, however, I looked into the question of how many bricks would really be necessary to construct the building, very much to my surprise I found that rather less than one-third would be sufficient for the loads the floors were designed to carry. The second floor had to carry centrifugal machinery, or hydro-extractors, which, at times, when slightly out of balance, would set up a fair amount of vibration. After a lot of consideration and careful calculation, we decided to build the walls, which were 40 feet high, 11 inches thick, and without piers. The walls were cavity, with the usual galvanised iron ties. The floors were carried on steel beams that crossed from wall to wall, and these provided for the necessary stiffness to the walls. Where the beams landed on the walls, they rested on cast iron plates placed so as to distribute the load from the steel beams to the walls, and the brickwork for about five courses below was built in cement. The walls generally were built in lime mortar and clinker ground together, to which was added about 12 per cent. of cement. The building was erected to time, the machinery put in, and was started in operation almost as soon as the walls were completed. We had no trouble whatever, and the building has been in existence now some three years, with the same operations continually going on. I merely mention this to show that there appears to be no necessity to build walls of the great thickness that are suggested by text-books, and other authorities.

Also, in regard to the riveting of steel structures, one is sometimes up against trouble with boiler-makers. I remember one occasion particularly where, in order to avoid a difficulty with boiler-makers, in a structure that had been designed for rivets, we bored the holes large enough and drove black bolts in, otherwise we could not have had the structure up in time. I do not commend

that as a thing that ought to be done, but as long as there is sufficient latitude in the working of the Act to permit of modifications of a similar kind, it may possibly enable one to avoid troubles or strikes due to the action of trades unions, which otherwise you might be unable to get around.

With regard to the rivets in the gusset-plates in the steel columns mentioned by the author, I am rather inclined, on general principles, to agree with the London regulations, for the reason that unless you can make dead sure that the bottom of the joist transmits its proportion of weight as well as the gusset-plates—that is to say, everything at the column end is a dead true surface—there is no guarantee that a column does transmit any of the weight direct to the ground; it may all go through the gusset plates, and the rivets, therefore, may carry the whole load.

I have appreciated listening to Mr. Hart's paper this evening, and have very much pleasure in supporting the vote of thanks moved by Mr. Poole.

THE PRESIDENT: Gentlemen, you have heard the motion. Being neither engaged in architectural nor structural engineering, I have nothing to add to the matter. Technically, I am rather disappointed, because I have not yet discovered what I had hoped to discover, namely, the real reason why the Building Act does not get altered. To the outsider it is a profound problem, a puzzle, a conundrum. Everybody has agreed that it ought to be done. It is an easy thing to talk about, but it is, to the ordinary person, an absolutely incomprehensible problem. There may be some deep reason why it has not been seen fit to alter it. I always feel profound admiration for the skill of architects in the work in which they are engaged—they have often to work under conditions involving a mass of brickwork instead of the space that is wanted to work in.

A remark was made, I think, by Mr. Wells, with which he will perhaps allow me to disagree with him, on the question of the appearance of concrete. I have never yet been able to regard the right way to treat concrete to attempt to put it on the outside of mortar, nor by the addition of color or other stuff to make it look anything but concrete. I should hesitate to put forward that opinion as an architectural opinion generally, if it were not for the fact that I have the strongest support in one of the greatest authorities in a text-book forming part of a series of volumes known as the "Home Universal Library," the second chapter of which I would commend to the architects, on the question of the treatment of concrete in buildings. I do not think that the author of that book would have any sympathy for the proposals to make concrete look anything but concrete; and he urges that the time has come when the construction of buildings in concrete has to be undertaken in the way in which we erect buildings of any other substance, namely, to make use of the characteristics of the material itself, and not attempt to make it appear anything it is not, and he looks forward to the time when public buildings which are to be monuments of artistic capacity for centuries to come will be built of concrete as concrete buildings. I think the case he makes out for concrete is quite incontrovertible. However, my opinion may be worth nothing, but I venture to put forward that book as being worthy of the notice of anyone interested in the use of concrete.

There is one other to which I should like to call attention, and that is the change of opinion that has come about in the last four or five years with regard to what constitutes a "high" building. Even five years ago, as to any building like Culwulla Chambers, or the "Daily Telegraph" building, or any other building regarded by us as "high," all sorts of efforts were made by the City Coun-

eil to prevent it being built. What the public now come to regard as ordinary-sized buildings will possibly in the next few years be regarded as insufficient, and no doubt we shall have buildings of very much greater height. No one can study the locality of any building, in regard to the value of the ground area without realising that buildings must move upwards, as they cannot spread laterally.

I was in New York about a year and a half ago, and one could not help being struck with the beauty that the effect of the lamps give; and the buildings, which were very tall ones, seemed to fit into the architectural picture in a most admirable fashion, and buildings of ten, fifteen, and twenty storeys high seem to be something that we have to look forward to in Sydney in the near future. I hope that when the Building Act is brought in, and the regulations considered, there will not be any notion that we are going to stick to the buildings that we now have to stop at. I shall never forget the effect, when we left New York, of the City lit up entirely with the glare and glow of the lamps. The whole city always had an air of illumination about it, and the effect of the wonderful sky-line of New York was something to be remembered, particularly as some of the buildings were 750 feet high. Some of the buildings from 400 to 600 feet high were lost in the mist, but the tops of the tall buildings showing against the sky-line looked like the top of a mountain coming out of the mist—the effect was magnificent. Comparing buildings there with buildings as we erect them here, I hope no support will be given by the professional side of the architectural calling, or our engineers, to what, in my opinion, is the quite hopeless position of keeping buildings down to what used to be regarded as normal size.

I am afraid my remarks have not added much to the discussion to-night, but I have very much pleasure in of-

fering Mr. Hart a most cordial vote of thanks for his very interesting and stimulating paper.

MR. A. J. HART, in reply, said: Mr. President and gentlemen,—I am much obliged to you for the kind way in which you have received my paper, and for the vote of thanks.

Mr. Poole, in discussing the paper, referred to the fact that the present City of Sydney Improvement Act is inelastic—that no provisions are made for the revision of clauses from time to time as building practices become revised and improved, and he pointed out that that is a very great defect.

I have here the draft regulations to be made under the provisions of section 23 of the London County Council General Powers Act, 1909. These are revisions of the original Act, and they are the sort of thing which Mr. Poole says we should have, and no doubt we should have.

Mr. Poole also touched on the subject of chimney stacks, and argued that they should also be constructed under special regulation, and pointed out that there were none such in Sydney. Chimney stacks have been known to be condemned by various City authorities, where stacks have been erected which did not comply with the regulations in force in the district where they were built. I know one place where an engineer designed a chimney stack and upheld his design, although the municipal engineer said it was not in accordance with the Act. When the municipal engineer went into the figures, he was very much astonished to find that not only was the chimney unstable, as the first engineer had designed it, but the chimney was also unstable when designed in accordance with the regulations of the principal Act in regard to the wind pressure which the Act required that the chimney should resist.

The question of wind pressure was also touched upon by Mr. M. E. Ross, in the letter which the President read from him, in which he said that small experiments cannot afford a guide, as the pressure of the wind (resistance to which has to be provided for) was less, in some instances, than would be expected from small experiments. I might mention that I recently read that the London authorities were about to make rules or stipulations for providing for a wind pressure of 20lb. to the square foot, which is a considerable reduction on their present requirements. There is no doubt that opinion as to the intensity of wind pressure is in a very unsettled state as yet.

Mr. Poole also touched on the necessity for careful design of all joints in structures. No doubt the design of all joints is a very important thing, and receives less attention than it deserves.

A few days ago I was looking at some silos which had been recently constructed of brick, strengthened with flat iron ties, about 3in. x $\frac{1}{2}$ in., strapped round the outside of the silo walls and bolted together at the corners in such a way that if any pressure came upon the ties they would bulge and curve and allow the brickwork to crack in all directions. It will be very interesting to watch and see how much, and when, the silo actually does crack. I think the design of joints calls for a good deal more attention than the matter usually gets.

Mr. Poole also touched on the question of designing stanchion bases with three rolled steel joints on the top of the grillage, as in Fig. 3, in the paper, and said that, in his opinion, it was more likely that the centre one of these joists got about half the total load of the stanchion. It is quite possible that it does, but I do not think we know it for certain—it is a thing which can be argued about a good deal.

Mr. Anderson (in reply, I think, to our President, who wants to know why the Building Act does not get altered), gave us two reasons. The real reason seems to be one of politics. The Building Act is not a political measure—there are no votes attaching to it, and with party politics it seems that these things always militate against the introduction of the new Bill. As Mr. Anderson has said, the new Sydney Building Act is to be incorporated with the Greater Sydney Act, which is liable to come in for a great deal of discussion, so I fear we may be still as far off as ever from getting what is requisite. Mr. Anderson suggested that one means of testing the City Council's powers under the present Act would be for someone to put up a building and defy the City architects to pull it down again. I wish someone would do it—it would be very interesting to see what the City authorities could do. Mr. Anderson was good enough to say he thought that I had done something to improve the building around Sydney. I do not know that I have a great deal of influence in that direction, but I would be very glad if I could do anything which would put an end to the existing state of affairs where so many things seem to be done in a haphazard fashion.

Mr. Wells remarked about the thickness of the walls as drawn in Fig. 1, the dimensions given therein are all intended to be the thickness between the piers. I thought it was clearly stated, but it evidently was not. The Sydney Act calls for walls of the thickness shown in the figure. I know, however, that the City authorities will allow walls to be built which are only this thickness for the width of the piers, which piers have to total one-fourth of the total length of the building, the panels between the piers being built in 14in. work. I do not know that that arrangement is exactly in accordance with the Act—it is a sort of concession. All other walls shown in

Fig. 1 are for the thicknesses between the steel stanchions and R.S.J.'s, or reinforced concrete columns and beams. The design of the piers themselves in all the cases given, except Sydney is governed by separate distinct regulations. Mr. Wells took up, I think, this position—that the San Francisco and London sections of walls was not scientific if the diagram referred to the thicknesses of piers, but I have explained that they do not. The construction of piers, except in Sydney, is regulated under different clauses of the Building Acts, which determine their design absolutely, that they shall stand a certain number of pounds pressure per square foot, and comply with certain other conditions.

Mr. Wells also gave some very interesting accounts in connection with screw-jack foundations. I have never seen the sort of thing he spoke of, but I know that in a town in a country which is subject to earthquakes—Messina, in Italy—buildings were built of strongly reinforced concrete which had jacks placed under the four corners, so that in the event of a disturbance of the buildings they would be brought back to horizontal lines.

There is no trouble, in ordinary cases, of making reinforced concrete beams the same strength as steel beams of the same depth, although when one comes to big loads it is more or less awkward sometimes.

With regard to the new Hippodrome, now being erected for Wirth Brothers, by the City Council, I shall be very pleased to show any members over the building who care to come along. The building contains many constructional features of interest, including a big tank where we shall have elephants and rhinoceroses disporting themselves. The building is the most up-to-date of its kind in Australia, and has the largest stage in the Continent.

With regard to color of concrete, Mr. Wells does not like the appearance of the grey color of concrete, and has drawn attention to different methods of coloring concrete. Buff, and other colors, can be easily obtained by colored renderings, but there are various ways in which tints can be varied by the mixing of sand and cement. I have seen colored sand very successfully used in Melbourne. Of course this rather touches on the President's remarks with regard to the color of concrete. In massive work the grey of concrete is a very fine color and cannot be improved on. An example that occurs to me is the Roman Catholic Cathedral at Westminster, London. The interior is of lofty domed construction, and it is a quite plain mass of concrete. Of course, the building is more or less dimly lit, and there is always a certain amount of incense floating about it, and the all-dull grey has a really impressive and splendid effect.

Mr. Tournay-Hinde made some very interesting remarks about the quantity of brick actually required to erect a building strong enough to carry a quantity of machinery, and how constructional difficulties were overcome. It is always very interesting to hear remarks of that nature. It shows how lightly buildings can be constructed with full strength to meet all requirements, and what a tremendous waste of strength, and waste of money, there must be where ordinary obsolete Building Acts are complied with. Mr. Tournay-Hinde also recommended that we should frame a clause in the new Building Act to allow for bolt-work, and so on, so as to meet difficulties with Trades laws to suit the Trades Unions on technical points of this kind.