

much more, including the subjects of choice of different building materials, fire prevention, fire escapes, lift enclosures, reinforced concrete columns, eccentric loadings on columns, and the like, has been ignored altogether.

It is hoped, however, that enough has been said to produce an interesting discussion. Mr. Minister Griffith has, within the last month, informed a deputation from professional institutes and commercial bodies, that he believes the revised Sydney Building Act will be passed before Christmas next, and the author trusts that this paper will show some of the benefits which the community may expect to reap in building practice from that long-promised legislation.

#### Discussion.

THE PRESIDENT: Gentlemen, before the paper Mr. Hart has just read is discussed, I will, if you will allow me, read a note received from Mr. Ross in this connection, which is in the following terms:—

Sydney, 6th July, 1915.

“The Secretary,

“Engineering Association of N.S.W.,  
Royal Society’s Chambers, Sydney.

“Dear Sir,—I have to thank the Council for their kind invitation to be present at a reading of Mr. Arthur Hart’s paper on ‘Building Construction under Modern Acts,’ but I regret that I cannot attend.

“I have read, however, a draft of the paper, and while the subject matter is one which has always been before us, it is a strong commentary on existing conditions. Particularly important is a clause referring to the more general use of rivets instead of bolts. The existing custom in Sydney to use bolts liberally where rivets should be used should be terminated as soon as possible in the interests of durability and strength.

“Also I would refer for a moment to the question of wind pressure, especially as one well known building, not far from the City boundary, was constructed some years ago apparently without any bracing whatever to take charge of wind pressure. Of course, such buildings get protection from their surroundings, but the liability to a local whirlwind which takes little account of surrounding structures has always to be faced. However, the question of lateral wind pressure on structures is a very doubtful one, indeed in the case of some large cylindrical structures, such as gas-holders, the old idea of wind pressure has now been entirely modified, being far less than would be expected from small experiments.

“The author of this paper covers quite a large range, and obviously is only able to touch lightly upon many interesting subjects which would open a large field of discussion, and I think he is to be congratulated upon a very clear summary of an existing constructional system. Yours faithfully,

(Sgd.) HERBERT E. ROSS.”

(The following discussion then took place on Mr. Hart's paper).

MR. WILLIAM POOLE said: Mr. President, and gentlemen,—It gives me great pleasure to move a vote of thanks to Mr. Hart for his very interesting paper, but I regret the paper was not in our hands soon enough to thoroughly digest it. It is a very interesting subject, more especially when we consider how hopelessly out of date are the provisions of the City of Sydney Improvement Act, usually known as the “Building Act,” now operating in Sydney.

No doubt it is very desirable to revise the main body of the Act, but I think the greatest defect of the Act is that the schedules now governing structures are embodied as portions of the Act, instead of being regulations under

the Act, which may from time to time be revised and brought up-to-date in order to cover any new methods of construction which may be introduced. It is not a novel way of drawing up Acts, because I think almost all the Mining Acts of the various States of Australia have provision by which the various Departments of Mines draw up regulations, and alter, delete, or add to the same, as occasion requires, which regulations (after they are approved by the Executive Council of the various States and gazetted), have the force of law, and these are from time to time revised. As far as Queensland is concerned (where I have resided for a number of years), the regulations have been revised, I think, at least three times. If that provision had been made in the City of Sydney Improvement Act, no doubt many things of which architects and engineers now complain would have long since been remedied. With regard to the City of Sydney Improvement Act, one of the chief defects is the poor classification of buildings—any building that is not a dwelling house, or public building such as a church or hall, is classed as a “warehouse.” We have fine tall buildings, such as now exist in Sydney, which may be built exceedingly strong, and others (such as warehouses for hardware), may be very much below the strength required in regard to floor weights.

The local conditions at the time the old Act was introduced had been stereotyped, and no doubt the Act—it is called the “City of Sydney Improvement Act”—worked very great improvements over the conditions that had been in existence before it. Thus it practically did away with wooden structures as far as the City itself was concerned, but the Act goes on the assumption (as Mr. Hart has already pointed out), that all walls may be indifferently built of poor bricks and weak lime mortar; very elaborate rules, and precise directions—especially

for walls—were drawn up on this assumption, and there is no precise mention made of any other material, except in one place where the use of freestone is inferred rather than stated. At the same time, there is an interesting clause in the Act which relates to the relative thicknesses of walls built of materials other than such bricks as aforesaid, which allows the City of Sydney Improvement Board to approve of thicknesses less than what would suit for bricks. The point that naturally occurs to one's mind is, why it has never been made use of. One would think the Civic authorities, like the Government, were interested in the running of brickworks.

Again, no provision is made for properly designing foundation piers, columns, or high chimneys. In the City of Sydney, and round about, there are quite a number of high chimneys which, no doubt, are designed on a practice that has been in vogue elsewhere; and in Sydney itself there is no provision to enforce stability in a structure such as a large chimney stack. In chemical works, where extra height is essential, if a stack of that kind were to fall, the effect in the neighborhood would be very disastrous. Within the City boundary itself, structures have been erected on grounds of somewhat divers kinds. We have sound sand-stone; subsoil and surface soil derived from sandstone; hard shales; clays derived from shales; deep masses of raw sand; peat bog; foreshore silt, and made ground of quite a variety of types. So that in the City itself we have a very large scope of materials, all of which have a very wide difference in their capacity for resisting subsidence.

As has already been pointed out by Mr. Hart (and also in the letter from Mr. Ross), it is very necessary to take into consideration wind pressure on the exposed portions of high buildings, especially tall chimney stacks, and regulations for the same should be embodied in all building Acts.

Provision should be made for the economical use of high-class building materials, such as steel, reinforced concrete, ordinary concrete, brick in cement, and high-class building stones, and safe limiting pressures should be defined to prevent misuse through greed or ignorance. These are conditions which are usually inserted in most modern building regulations.

The introduction of reinforced concrete and steel framing has revolutionised building construction where regulations admit of their full application. These materials have a high unit cost, therefore they must be used economically in order to compete with lower class and lower-priced materials.

To use them economically, and at the same time safely, requires careful design, which cannot be obtained by the more or less ignorant use of "rule-of-thumb" rules—e.g., the safe carrying capacity of rolled steel suitable for simple girders or columns may be obtained in hand-books issued by various steel companies. Special training and knowledge is, however, required when it is necessary to use reinforced, or built up, girders and columns; to design joints so that the loads on one member may be properly transferred to other members; to consider the effect of eccentric loading on columns, and the determination of a sufficient, but not wasteful, excess of steel rods and their proper location in reinforced concrete.

It is also necessary in the interests of good economical work that the quality of rolled steel members and rods, also the cement, etc., should be closely inspected and tested; that the rivetting and joints of steel work be inspected during manufacture, and the erection of both framed and steel-work and reinforced concrete should be carefully supervised during erection. As has been incidentally pointed out, this is, almost essentially, engineering work.

Defectively made joints in steel work, and careless placing of bars in reinforced concrete, may seriously injure a structure that has been carefully designed.

Very few architects have the necessary training and knowledge to enable them to properly design and supervise such work. Structural engineers are therefore being increasingly associated with the architects in the design and erection of such work in large buildings, and in this way safeguarding the interests of owners. The preparation of proper designs is, I think, essential to this work, which I think everybody will agree is special work, and is usually outside the work of most architects. I know that in Sydney we have some architects who have, I think, been trained as engineers first, and architects second; but in most cases gentlemen who have been merely trained as architects are not usually qualified to thoroughly supervise that work. I think, in regard to electrical work, that expert knowledge is needed in most cases in order to draw up specifications, and see that the work is properly carried out.

I might also state that I think it is highly desirable—I do not know exactly what has been done in drawing up regulations under the new Act—that structural engineers should be associated on the committee in drawing up the various regulations, more especially those relating to the use of rolled steel and reinforced concrete.

Mr. Hart made reference, in his remarks, to the failure of the Quebec bridge. That was the subject matter of an investigation which followed, and some engineers who examined the particular member that failed came to the conclusion that the design of the member that failed was according to the accepted rules in the old country, Europe, and also America, and further came to the conclusion that the particular member that caused the trouble was defective. Later on, Mr. Hart referred to the

three R.S.J.'s of the column footing (Fig. 3), and said it would be assumed that the three steel girders would each take a third of the weight. I cannot agree with him in that respect. My opinion is that the centre one would take about half. If the area were divided up into two, the central R.S.J. would take half the pressure of the right-hand side, and therefore the centre one would carry twice as much as either of the other ones. In a building, if the footing of a stanchion is weak, the strain on central parts will be increased. As far as the design of the interior portion of the building is concerned, I know of a case in Sydney where the inside of a large building in quite recent times collapsed, causing a lot of damage.

THE PRESIDENT: We have the pleasure of the presence of one or two visitors from the Institute of Architects; I am sure we shall be very glad to hear them if they will address us.

MR. ANDERSON (President of the Institute of Architects), said: Mr. President and Gentlemen,—I desire, first of all, to thank the association for inviting us to be present this evening.

The question of the Building Act is one which, of course, affects architects particularly. For the past nine years we have been endeavoring to get a Building Act. We prepared a Draft Building Act nine years ago, which was a very extensive measure, and submitted it to the City Council. It duly reached a pigeon-hole, and there, I believe, it has reposed undisturbed ever since. I am rather sorry that Mr. Hart is such an iconoclast that he has little feeling for ancient things—I am quite sure that the antiquated Building Act of the City of Sydney deserves more considerate and respectful treatment than to be compared with a code which was in existence 2250 years B.C.

The points brought forward by Mr. Hart we thoroughly endorse—in fact, every one was mentioned by myself a little time ago in an article in the “Sun” on the Building Act question. Many that were proposed by me have been adopted already by Mr. Griffith. We have got thus far with the proposed new Building Act, that it is to be incorporated in the Greater Sydney Act, and become part of that. The Minister absolutely refused to separate it from the Greater Sydney Act at all, and so we shall have the pleasure of having an Act for the City of Sydney tied up in another Act, which is bound to produce a great deal of opposition, which a Building Act would not at all meet with.

I was very interested in the diagrams which Mr. Hart has reproduced in his paper, and drawn on the black-board, showing the varying thickness of walls required. That is, no doubt, one of the worst blemishes that the City of Sydney Building Act has. From a commercial point of view, taking a recent purchase of property in George Street, City, the necessary thickness of walls—after allowing ample thickness in other constructions—meant that one-seventh of that valuable site had to go in solid brick walls for erecting a building ten storeys high, which is a common occurrence to-day in Sydney.

Referring to the new Act as drafted, I do not know whether members of the association have seen the draft, it provides, as the last speaker (Mr. Poole), has suggested, for regulations which can be modified from time to time as necessity arises. The big defect in the City of Sydney Building Act, as has been already mentioned, is the fact that the schedules of the Act are part of the Act itself, and cannot be altered. The clause to which the last speaker referred, regarding the City of Sydney Improvement Board having power to vary the thickness of walls under certain conditions, has become obsolete long



ago, owing to the simple fact that there is no such board in existence as the City of Sydney Improvement Board. It died—I do not know whether by the natural death of the members that composed that board—about fifteen years ago, and has never been revived since. On that point, one of the present difficulties under the present Act is that there is no power to revive that board at all, consequently we have no Court of Appeal—we have no one to whom we can go. When our plans are submitted to the Town Hall authorities, and they refuse permission to erect a building according to our plans, we have nobody to whom we can appeal. That places a very great difficulty, in many instances, on our shoulders.

With regard to the interior construction of buildings, as Mr. Hart has pointed out, there is not the slightest guide, law, or rule, in the matter whatever—you can do what you like provided you make your walls certain thicknesses. There is a clause which specifies the thickness for internal walls, but I think that clause is very frequently more honored in the breach than in the observance thereof.

Mr. Hart's paper is full of items of interest, and as modern construction is coming more and more in vogue in spite of our Act, the position has simply reached this stage—that some day or another we shall go on and build and defy the Sydney authorities, and see what the effect will be. I do not know, quite, how far their powers extend, or what they can do if a modern up-to-date building was built. I do not know whether they have power to even take it down, or order the owner to pull it down. The only way in which I think they could penalise the owner is by saying that he has put up a building which is not in accordance with the Act, and the Act provides for penalties which would be cumulative. How that would stand I do not know.

However, it is no fault of the architects—I want to make that quite clear—that the Sydney Building Act has not been revised, and that we have not had a new one.

I quite endorse the remarks made by Mr. Hart that the regulations under the Act want to be placed on an absolutely scientific basis. The idea that you must build the walls one-seventh of the thickness of the building (as in the instance just mentioned) in a certain manner, or of certain constituents—brickwork in cement mortar, or brickwork in lime mortar—in which there is a great variation of strength, is absurd and needs correction.

I am very glad to be able to support the vote of thanks to Mr. Hart. I should like to say that, so long as I have known that gentleman, he has endeavored, as far as within him lay, to improve the conditions of the building of Sydney.

MR. WELLS: Mr. President and gentlemen,—Mr. Anderson has placed many matters before you that I had thought of, and which, in his absence, I should have been able to say something about, such as the new Building Act—the necessity for it, and the action which has been taken to get it.

With regard to the thickness of walls given in the author's diagrams, it is not quite clear to me whether they relate to the thickness of the piers, or those parts of the walls in between the piers. For instance, under the Melbourne Building Act, the thickness of the walls is given as 6 inches from top to bottom of any high building. It does not appear to me that a thickness of 6 inches would be sufficient without piers.

MR. A. J. HART: That is the walls between the piers.

MR. WELLS: Is there nothing in the Act with regard to the piers?

MR. A. J. HART: They vary.

MR. WELLS: That is the most important part of the structure. I think, in that respect, if piers are not governed by regulations, the Act has a decided weakness. With regard to the diagram showing the San Francisco and London sections of walls, they do not appear to me to be scientifically determined—I would not like to say absolutely they are not—but they do not appear to be scientific, if the sections of the walls, as given in the diagrams relate to the pier-construction portions of the building.

MR. A. J. HART: No.

MR. WELLS: The London Act also appears to me to be defective in the most essential part if piers are not so regulated, because we look to the piers for stability of the structure. With regard to the New York diagram, which begins with a 20in. wall up to a height of 15 feet, then a 16in. wall up to a height of 60 feet, and a 12in. wall up to a height of 75 feet, it appeared to me that that might be taken for the piers, judging by the section given. I would like to know definitely whether that section relates to the thickness of the piers, or to the filling in between? These different sections seem to me to show that they have been looked at from different points of view altogether by the gentlemen who have framed the by-laws. Perhaps the author will be good enough to enlighten us a little more on that subject.

The next part of Mr. Hart's paper that I made a note about, was with reference to foundations. There is an illustration of special foundations in a paper which I have read, written by an English engineer, who went to America to get experience in steel-masted structures, like the new Commonwealth Bank. I recollect particularly noting that portion of the paper relating to the foundations of the stanchions. There was an extensive base of concrete with steel joists embedded on which

was placed the base of the stanchion itself. The concrete foundation spread about 12 or 14 feet square. The buildings he referred to were erected at San Francisco in soft soil, a somewhat firmer soil called "hard pan," being several feet below the surface. The settlement was very unequal—it was unequal even where the loads were the same. No doubt the variation in the loads would account for most of the differences in the settlement that took place. Special provision had to be made to overcome this difficulty. The buildings were erected so that the ground floors would be approximately 18 inches above the ground to allow for subsidences of anything from 6 to 15 inches. The provisions made were rather ingenious. Under the base of each of the piers was placed a very strong screw-jack, which was regulated to allow for the unequal subsidence that took place and so keep the building, as it should be, in equilibrium. When the final settlement had taken place in 18 months or two years, the screw-jacks were concreted in and left there for good. Similar provisions were made for party walls, and in the case of these walls provision was sometimes made for the foundations of both buildings at the same time, by an agreement entered into between the adjoining owners. That mutual arrangement struck me as being a very excellent one. We do not often meet with problems of this kind in Sydney, but still there are places where we may meet with them if we go in for these very tall buildings.

The reference by the author to the designs for beams in connection with reinforced concrete and steel framings struck me as being rather remarkable. Mr. Hart remarks that it can be said generally that a depth of beam of about 1-12th to 1-15th the span is economical. I was not quite sure whether it meant that 1-12th the depth of the beam was intended for steel joists, and 1-15th for reinforced concrete, or was it intended to show that both