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BUILDING CONSTRUCTION UNDER MODERN ACTS.

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In presenting this short paper to the Engineering Association, the author has endeavoured to touch upon some of the more interesting points in building construction design which are regulated by modern building Acts, more with the object of promoting interesting discussion of some of the points referred to than with the idea of giving a formal description or exhaustive examination of the regulations enforced by different authorities in various countries.

It has been suggested to the author that the most ancient known Building Act is that now in force in the City of Sydney. This would-be humorous assertion is usually produced in one form or another every time a speech is made at any meeting in Sydney where building matters are under discussion. The author finds, however, from a paper recently read before the Concrete Institute in London, that we have records of Acts that are even more antique. Particulars are given in that paper of the earliest known code, which was compiled in Babylonia 2250 B.C., in which provision is made for due compensation to be paid by the architect to the owner in the event of any disaster happening to the building during or after construction. So much for the architect. If the builder transgressed the building code he was to be publicly whipped until "his body be bloody."

"By inference we see that the erection of a building has been considered at all times as an occupation of im-

portance which should only be trusted to certain individuals." It will be interesting for us to compare the manner in which different individuals and bodies have discharged this trust.

Thickness of Walls.

Of all the galling clauses in obsolete Building Acts which are still in force, there is no doubt that the one clause above all others that calls forth the most bitter denunciation is that specifying the thickness of the exterior walls of a building.

Under modern steel frame or reinforced concrete frame construction, the floor loads are transmitted to the foundations by means of a series of columns, and the floor loads are not carried by the walls. The walls then become screens, keeping out the wind and weather, and lend no assistance to the support of the building. Building regulations still in force, but moulded before this style of construction was introduced, provide walls of sufficient thickness to support the floors, and sufficient to ensure the stability of the building through their own dead weight. As a consequence, in districts where building is governed by regulations which have become obsolete, we see very incongruous mixtures of methods of building carried out, as a result of the manner in which the builder is hampered in his desire to erect a modern building. For instance we may see a steel frame building erected to any height, with all its floors completed at the different levels where they are required, before any walls are built at all. The building, as it then exists, is completely self-supporting, and walls are not needed to complete the stability of the structure. Yet, under ordinary Building Acts, walls must be added to that structure which are of the same thickness as would be required if the building were dependent upon the walls for its support.

The useless expenditure of material, money and space which this means, may be estimated when one knows that under the London Amended Building Acts 1909, any brick external wall in a steel frame building may be any thickness not less than 8½ inches for the top twenty feet of its height, and not less than 14 inches for the remainder of its height below the topmost twenty feet.

Under the New York Building Code, walls of brick built in between iron or steel columns, and supported wholly or in part on iron or steel girders, are required

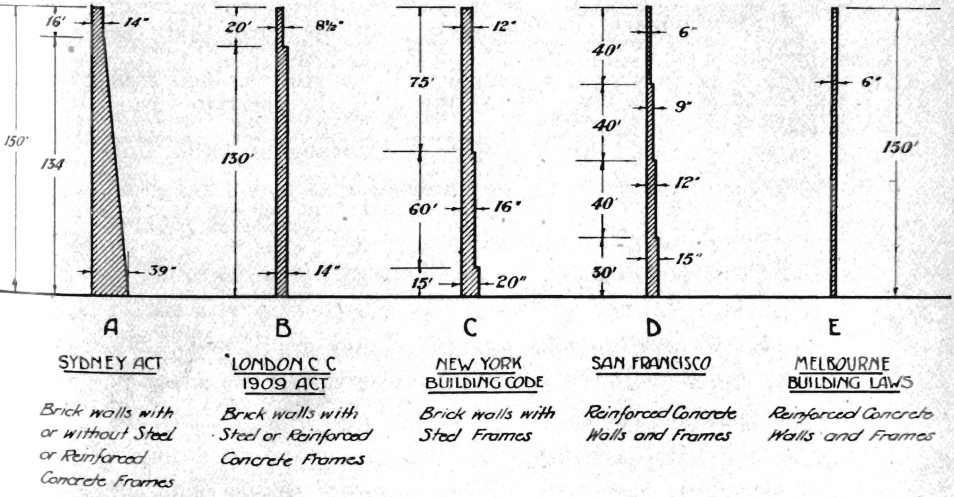

FIGURE 1

to be not less than 12in. thick for 75 feet of their uppermost height, and every lower section of 60 feet or part thereof shall have a thickness of four inches more than is required for the section next above it.

Under the San Francisco 1910 Building Laws, regulating construction of walls in reinforced concrete buildings, it is enacted that the thickness of external walls shall be 6 inches in the upper 40 feet of height of the building, followed by an increase of 3 inches in thick-

ness for every additional 40 feet height. The Melbourne 1913 Building Regulations require a thickness of from 6 to 8 inches in similar structures.

The constrast with these different building laws effect is shown in Figure 1, which illustrates the thicknesses of walls demanded under the Sydney Building Act, which is typical of many others, and the walls demanded under the abovementioned authorities for a building of the warehouse class, 150 feet high.

Foundations.

Under modern building acts it is specified that the pressures per square foot on various soils shall not exceed certain values. The values given by the San Francisco Laws (1910) are typical of most others, and are as follows:

Soft Clay	1	ton	per	sq.	ft.
Sand and Clay mixed	2	„	„	„	„
Firm Dry Clay	3	„	„	„	„
Hard Clay	4	„	„	„	„
Loam or Fine Dry Sand	3	„	„	„	„
Compact Sand	4	„	„	„	„
Coarse Gravel	6	„	„	„	„
Shale Rock	10	„	„	„	„
Hard Rock	20	„	„	„	„

It must, however, he recognised that no hard and fast regulation can be made to cover so variable a thing as the safe bearing resistance of any particular piece of ground, and tables such as the above must be taken by the engineer or architect responsible for the erection of a structure, rather as a guide than as fixed and definite values.

In designing foundations and piers it is enacted under the same code that the following loads on various structural materials shall not be exceeded:

Brickwork in lime mortar ..	7	tons	per	sq.	ft.
Brickwork cement and lime mortar	10	„	„	„	„
Brickwork cement mortar..	15	„	„	„	„
Concrete	20	„	„	„	„
Granite	28	„	„	„	„

These values are more liberal than are those allowed under the present London Act, which is, however, about to be revised.

Under the present Sydney Act, and all other old acts, the thicknesses of brickwork in foundation piers, and other work, required under the regulations were, in the first instance, arranged to allow of construction in lime mortar. The crushing stress exerted upon brickwork and stone, in accordance with old regulations is, therefore, far below their safe values for work constructed in cement mortar.

These old acts further make no stipulation with regard to the size of foundations other than that they shall be "sufficient." In buildings of height not exceeding two or three stories, it is easy to obtain footings which comply with this stipulation, but in higher buildings constructed on ground capable of bearing not more than 2 tons per square foot, the width of the foundations under the walls should often be very much greater than the dimensions they are constructed to.

Whilst speaking of foundations, it is interesting to consider foundations to party walls which have to be constructed without encroaching upon adjoining property. Such footings, even for continuous wall foundations, are not altogether satisfactory, as they are unsymmetrical, and more or less out of balance, but such foundations are even more difficult to treat when they are intended to serve as bases to columns constructed near to the

party wall. The most satisfactory treatment of such cases seems to lie in the construction of a system of foundation beams.

Steel Framing.

It would be an easy matter to write enough under the heading of steel framing to comprise a separate complete paper, but it is more difficult to eliminate all but the most interesting points.

The improvements in the practice of steel construction used during the past ten years, have been very great, and the construction used even that small number of years ago in London was incredibly inferior to that which is customary to-day. The author quotes from a paper read before the Concrete Institute in London in 1913, by the engineer for one of the largest of London designing and contracting steelwork firms. Ten years ago, when fire resisting buildings were required, the floors were usually constructed with solid unreinforced concrete, carried on steel beams 2 in. or 3 in. centres, but very little precaution was taken for stability or protection against fire for the individual member. The pillars were generally made in one storey lengths, with caps and bases. The base of the pillar above was set on the top of the pillar below, and connected with a few bolts, and the girders and beams were supported on the projecting part of cap and base plates. The differences in the level of bottom flanges of beams were made up with fillers, separate brackets were as a rule not used, and rigid connections were usually not provided. In many cases the pillar above was set on the top of the beams resting on the pillar below, and thus the load from the pillar above had to be transmitted by the web of the beams to the pillar below.

To-day, in erecting a building of this class, the floors would be constructed of reinforced concrete, carried on steel beams at about 12 feet centres, and every precau-

tion would be taken to safeguard every individual member of the building against fire, by casing with concrete or terra cotta. The pillars would be made in two storey lengths, with fish plates instead of caps and bases,

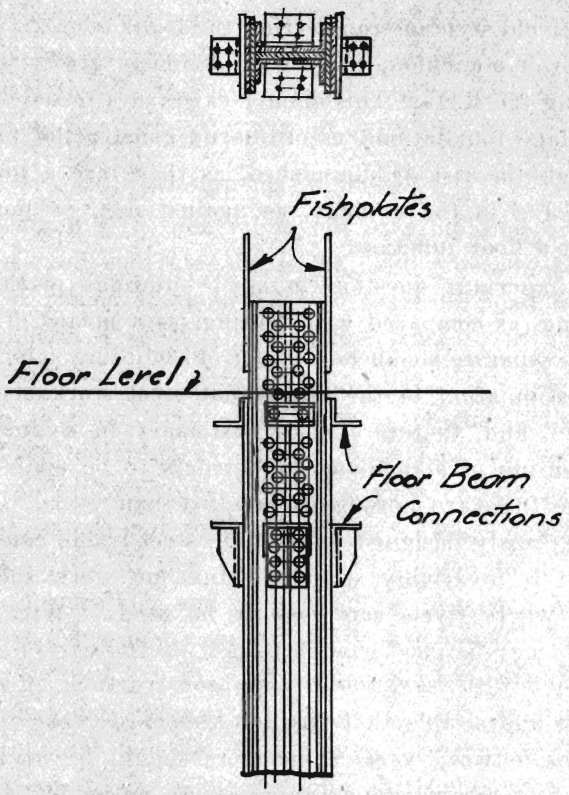

FIGURE 2

brackets would be rivetted to the stanchions to support the R.S.J.'s, and all connections between R.S.J.'s and stanchions made as rigid as possible. The upper stanchions would also be machined to a square bearing, to transfer their load directly through a spreading plate