square inch. Inquiry among engineers and a review of practically all the literature on the subject availed me nothing; therefore I made a test on a circular figure of 1-20 size, height and thickness; that is, thickness was 1-80 in., diameter 16 in., height 57 in., and was agreeably surprised to note that the material in this form developed 7,000 pounds per inch ultimate strength. (See Fig. 1.)

These examples are on circular figures where the circular element has to do with the ability of very thin material to resist compression. What of the plate in a rectangular compressive member? Someone has specified that it must be 1-30 as thick as wide. For want of other basis it has generally been accepted. The radius of gyration will modify and hold in check any disposition to use material of undue thickness, but what of thin plates? They are frequently used and surely of some value. Also thin plates in multiple with more or less efficient riveting, however, in no way forming a homogeneous whole.

As to the value of flat plates in compression, one or in multiple and the relation of thickness to width, we have no definite knowledge.

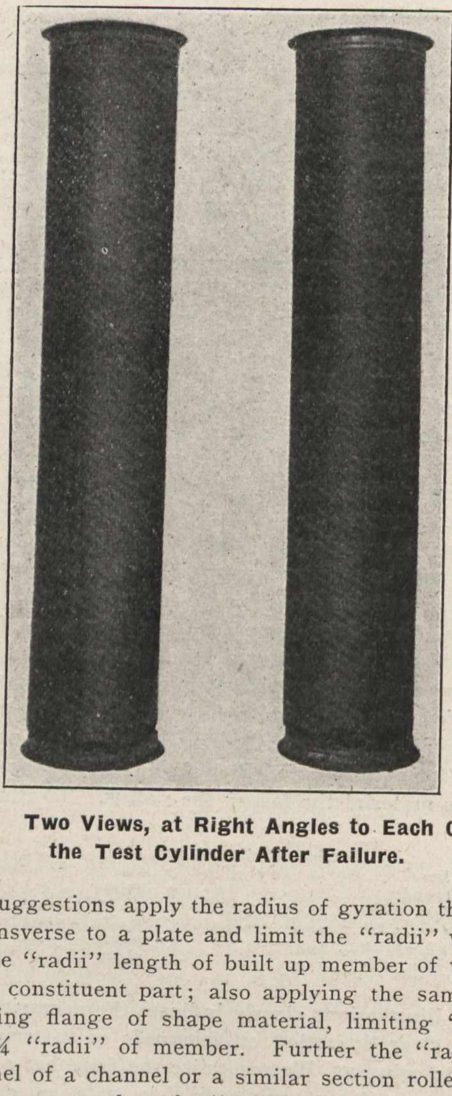

Fig. 1. Two Views, at Right Angles to Each Other, of the Test Cylinder After Failure.

The suggestions apply the radius of gyration through the center transverse to a plate and limit the "radii" width of a plate to the "radii" length of built up member of which the plate is a constituent part; also applying the same method to projecting flange of shape material, limiting "radii" of same to ¼ "radii" of member. Further the "radii" of a lattice panel of a channel or a similar section rolled or built shall be no greater than the "radii" of the entire member.

These applications of the radius of gyration will produce results not materially different from practice in the average and usual member, but will allow thinner material as the "radii" of the member increase. The compressive formula presented in the suggestions, only works a reduction of compressive unit value when over 71 "radii"; hence the application of "radii" as indicating thickness of plate material will only apply as member is 71 or more "radii" in length. In members 71 "radii" and less plates will be 1-24 thickness of width.

Of proportion or percentage of shapes necessary to properly combine with plates, we have only suggestion from practice.

Columns of 100 "radii" will, under compression, yield by bending. The same column under a transverse load will also yield by bending and here we have evidence that compression and transverse load will develop shear, termed eccentricity by many writers, in all cases, however, it will be noticed that the eccentricity is arbitrarily arrived at. Of shear or proportion and relation of shear to compression, acting through the member, specifications are absolutely silent.

Practice shows shear to be well provided for by cover plates, tie plates and lattice as used on typical columns of medium size in box or laced members and does in all cases provide for 5 per cent. at each end of the compressive force acting through the column. This is the basis of analysis of both cover plates, stay plates or lattice as used on rectangular compressive members.

Many specifications in general use, have specified an ability in tie plates at the end of open lattice column to transfer 25 per cent. of the load across the column and is safe practice; this carried into the lattice would seem excessive, but surely somewhere between 5 per cent. and 25 per cent. will give safe results.

The proportions of shapes and plates and thickness, to width of plates and shapes in connection with shear, are vital ones in designing a safe compressive member, and undoubtedly have as much importance as the "radii" in determining the unit value of the material used.

It is hoped that investigation and research may be undertaken on the immediate relation of parts similar to those used in composite rectangular compressive members. We surely can gain knowledge from models at even 1-16 size tested to destruction at comparatively small cost.

To design to the accompanying suggestions, will show us difficulties in making a latticed compressive member of excessive size, both in the size of lattice and the connection of the lattice with the flanges. This leads to the very natural conclusion that when an extraordinary large section is to be built, box members will be used for the same reason that practice has forced the use of plate or box girder under somewhat similar conditions; that is, where considerable shear exists and a very shallow girder is a necessity.

The compression formula presented herewith does not limit the "radii" length a member may be built, but does reduce for increased "radii" very much more rapidly than formulæ as usually written. It also limits maximum compression to ¾ tension. The particular formula was arrived at because it fairly fits, using 20,000 dead load unit stress, and the standard straight line formulæ of the day, in its application to chord members and also for posts with modified unit stress.

Accompanying is an extension of the formula showing the relative position with the straight line formulæ referred to, and Pin Bearing Formula on page 143 of the Carnegie Hand Book for 1903, and the further fact of having knowledge of tests on solid rounds 300 "radii," which also justifies the form of the formula. It is proposed to use this formula in all compressive members, because compressive members in a truss structure are only fixed by other compressive members subject to flexure from the same load.

I have noticed a tendency to use excessive unit stress in compression members of small "radii;" while it is a fact, tests of homogeneous steel in short lengths show an ability to resist compression equal to its ability to resist tension. It must not be overlooked that a compression member, however short, of any form used in construction, is a composite and not homogeneous body. It is entirely impossible to be certain of a reasonable uniform distribution of force over the entire section of a short member. Undoubtedly a member 100 "radii" is as reliable as one 5 with same load, because of want of ability to distribute the load uniformly over the short section and the further fact that a member 5 "radii" long is not likely to present conditions to successfully combine parts approximating a homogeneous member. Standard specifications allow only 6-10 of load on 100 as on 5 "radii" column.

The suggested limitations and relation of parts forming a member, are derived from our experience and practice. In a rolled channel or beam at least 30 per cent. of the section is in the flanges, but 40 per cent. has been suggested as the proper proportion of shapes in built channels or similar mem-