bers. The extra 10 per cent. being in some sense to represent the proportion of shape in contact with the plates. The suggestion that multiple plates, building up webs of channels or similar sections of members, act individually is not sustained by practice, but it is hoped the suggestion may help to correct doubtful designing, considering it will present little or no difficulty and add nothing to cost.

In rolled or built channels or similar forms it is obvious that there should be a relation of "radii"; neutral axis both parallel and perpendicular to web. This proportion in practice is 1 to 5.8 extreme for rolled channels.

An extended review of specifications of American practice in bridge work indicates in the matter of unit stress, conventional relation between tension, shear, bearing and flexure of extreme fibre. The suggestion presented follows such relation. In attempting to express relations for parts forming a compressive member, it is necessary to take unit stresses in consideration, as well as formulæ for compression.

In the various standard specifications we find additions and exceptions in the application of unit stress, to be the rule and not an exception. More than fifty different unit stresses are specified in one standard specification, both confusing and exasperating in attempting to follow, and the cause of many misundertandings and blunders in proportioning parts.

For the purpose of design, dead load only is positive. The load of wind may actually exist, but is entirely an assumption as to the exact amount. The live load is usually the principal one, but is an assumption in so far as occasion for changing unit stress.

It appears to me the maximum-minimum formula, also the quite common one of assuming dead load stress at two and live load stress at one for main members is unfortunate in the fact of not caring for secondary members and details with that certainty of proportion and relation that seem desirable.

It may be doubted if the author of either of the methods suggested above can tell us where "we are at" when reversals of stress as in chords of a drawbridge, with further demand that compression and tensions stress shall be provided for separately and added to arrive at the section of a member. Surely it is unnecessary, both the uncertainty and absurdity as illustrated in this case.

Assume a stress that we are willing to use for dead load and then assume a wind pressure that we would be willing to care for with the same unit stress and wishing a structure proportioned for a live load known as Cooper's E. 50. double live load, that is, assume a Cooper E. 100; with unit stress of 20,000 pounds per square inch (or any other stress desired), we would have developed a balanced structure, undoubtedly the intention of the specifications though not fully specified.

A recent paper before an engineering society shows deficiency of standard specifications in that an increase of live load of only 25 per cent. developed in one member an increase of 166 per cent. in stress in no way provided for and in another member, a reversal of stress, where a reversal was in no way contemplated. It is obvious that the method herein proposed fully cares for all the problems of counters, under increased live load of 100 per cent.

Suggestions herewith presented, attempt to express the proportion and relation of component parts of columns as derived from practice, to the end that the relation and proportion may be used to develop columns of any size with some hope of satisfactory results.

The writer in no way claims originality in the suggestions. The various points considered are well understood by engineers familiar with metal design and have long been a matter of discussion and interchange of thought one with the other. Am inclined to say that engineers have considered the points made here merely fundamental and directed by common sense, at least I know of no written presentation of the proportions. The suggestions may be unnecessary, but surely will do no harm.

The suggestions in no way having to do with quality of material or details of connection, but are intended to fill in where standard specifications seem to be lacking.

Suggestions of Proportions of Parts for Rectangular Wrought Compresisve Members for Framed Structures.

Unit Stress——————————

Compression—Unit Stress, times $\dfrac{1\frac{1}{2}}{1+\dfrac{L^2}{5000\ R^2}}$

$\dfrac{L}{R}$ = "Radii"

Compression, never to exceed ¾ unit stress.

Flexure, extreme fibre = 1½ times the unit stress.

Bearing = 1½ times the unit stress.

Shear = ¾ times the unit stress.

Tension = Unit stress.

The method of applying force shall be such as to distribute over the entire area of the member equally for each unit of the entire section of load. Force applied to the member only through the center of gravity, if necessarily otherwise applied, bending stress shall be duly considered in reducing the value of the material.

Compressive members composed of shapes or combination of shapes and plates, shall preferably have the least possible number of shapes and plates to form said member, and to be as definitely and firmly fixed by riveting together as practicable.

If an enclosed box, four or more plates and shapes, 25 per cent. of the entire area shall be of shapes; if with two or more shapes and two plates then 60 per cent. of the entire area shall be in shapes.

If a trough, one side laced, 33⅓ per cent. of the entire area shall be composed of shapes.

If of two or more built channels or similar forms, two sides laced, 40 per cent. of the entire section of the members shall be of shapes.

If of four shapes and plates, laced on all four sides, 50 per cent. of the entire section to be of shapes.

Rolled or built channels or similar forms shall have a radius of gyration at least 1/5 as great when the neutral axis is parallel to the center line of web, as when the neutral axis is perpendicular to the web.

Pitch or panel of lacing shall be such that the "radii" of a rolled or built channel or similar section with neutral axis parallel with the web never need be less than 25 and never more than the "radii" of the member of which said channel forms a part.

Plates in webs shall preferably be no more than 24 times as wide as thick on members less than 71 "radii." On members 71 "radii" and more in length, "radii" through center of any plate transverse to length of member shall be no greater than "radii" of member. Shapes used with plates to form built channels or similar sections shall have flanges equal to 1/5 the width of said channels or similar member and said shapes shall have thickness of metal equal to "radii" transverse to shape through center of flange of ¼ the "radii" of the member, 71 "radii" and more. On members less than 71 "radii," a projecting flange shall not be less than ⅛ as thick as wide.

If shapes or plates of lesser thickness than preferred thickness are used, then the area shall be reduced to equal Preferred Thickness divided by the square of the Actual Thickness.

Plates grouped together, surfaces in contact and riveted, shall not be assumed to support one another, that is, if each or any of the individual plates are thinner than the preferred relation, as indicated above, then the reduction for thickness shall apply as specified for a thinner plate.

Compressive members, box or with one or more open sides, shall be stayed on all such open sides by lattice and at the ends with batten plates.

Cover plates and lattice shall have the ability to care for ————per cent. of the entire compression, as sheer at each end of member.

Batten plates to be placed as near as practicable to the ends of compressive members with sufficient rivets; moment of inertia of the group of rivets being considered to determine