GRAPHICAL ANALYSIS OF ROOF TRUSSES; FOR THE USE OF ENGINEERS, ARCHITECTS AND BUILDERS

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649048717

Graphical Analysis of Roof Trusses; For the Use of Engineers, Architects and Builders by Chas. E. Greene

Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

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Trieste

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BY

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ILLUSTRATED BY THREE FOLDING PLATES.

NEW YORK:

JOHN WILEY & SONS,

No. 15 Astor Place.

1883.

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INTRODUCTION.

The use of Graphical Analysis for the solution of problems in construction has become of late years very wide-spread, and recent discoveries in this line have extended its application in many new directions. The representation to the eye, in one diagram, of the forces which exist in the several parts of a frame, possesses many advantages over their determination by calculation. The accuracy of the figure is readily tested by numerous checks. Any designer who fairly tries the method will be pleased with the simplicity and directness of the analysis, even for frames of apparently complex forms. Those persons who prefer arithmetical computation will find a diagram a useful test of the accuracy of their results. Being founded on principles absolutely correct, these diagrams give results depending for their accuracy on the exactness with which the lines have been drawn, and on the scale by which they are to be measured. With ordinary care the different forces may be obtained much more accurately than the several parts of the frame can be proportioned.

It is advisable to draw the figure of the frame to quite a large scale, as all the other lines are drawn parallel to those of the frame. If it is objected by any that a slight deviation from the exact directions will materially change the lengths of some of the lines, and therefore give erroneous results, it may be suggested that just so much change in the form of the frame will produce this change in the forces; one is therefore warned where due allowance for such deformation should be made by the proper distribution of material. The comparison of different types of truss for the same locality can be made with ease, and the changes produced in all of the forces in any frame by a modification of a few of its pieces can be readily shown. By applying each new principle to a new form of truss, quite a variety of patterns have been treated without an undue multiplication of figures.

No instruments but those which are at the hand of every draughtsman are needed to apply this method. No claim is made for originality, unless it be in the arrangement of the subjects and some minor details. The graphical determination of bending moments, etc., is added, to make the analysis of the forces complete, and finally some useful data and formulæ are given.

These pages first appeared as a series of articles in "*Engineering News*," and that fact will account for the arrangement of subjects and method of reference.

CHAPTER I.

GENERAL PRINCIPLES.

It is proposed in this series of articles, to explain and illustrate a method for finding the stresses in all the pieces of a roof or other truss, under the action of a steady load, and to show how the wind or any oblique force alters the amount of the stresses arising from the weight. The diagrams, as here developed, are credited in England to Prof. Clerk-Maxwell, and the method is known by his name. But little previous knowledge of Mechanics will be required of the reader to understand the explanations, and we shall endeavor to make all points clear as we proceed.

Taking it for granted that, if two forces, acting at a common point, are represented by the two adjacent sides of a parallelogram *ca* and *cn*, Fig. 2, their resultant will be equal to the diagonal *cb* of the figure, drawn from the same point, — a force equal to this resultant, and in the opposite direction, will balance the first two forces. Thence, considering one half of the parallellogram, we have the well-known proposition that, if three forces act at a single point and are balanced, and a triangle be drawn with sides parallel to the three forces, these sides will be proportional in length, by a definite scale, to these forces. The forces will also be found to act in order round the triangle. If the magnitude of one force is known, the other two can be thus readily determined.

For example: — Let a known weight be suspended from the points 1 and 2, (Fig. 1,) by the chords 1-3, 3-2, and 3-4. Draw *cb* to a convenient scale, vertically, to represent the weight, by so many pounds to the inch. This line will, of course, be parallel to, and will equal the tension on 3-4. Draw *ca*, parallel to 1-3, and *ba* parallel to 3-2. Then will the triangle *cba* represent the forces