11th. World Congress on Computational Mechanics (WCCM2014)
5th. European Conference on Computational Mechanics (ECCM V)
6th. European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

NEW METHOD OF APPROXIMATE CALCULATIONS OF STATICALLY INDETERMINATE TRUSSES

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Key words: *Static Analysis, Truss Structure, Frame Structure, Static Indeterminate System.*

This study presents basic principles of the two-stage method of calculation of the statically indeterminate trusses, which have been worked out during the initial analyses of the tension-strut trusses, schemes of which are shown in Fig. 1a-d [1],[2]. Inspirations for the development were patterns of such tension-strut systems subjected by forces of values bigger than they are allowed by the conditions of their suitable pre-stressing. In these cases certain tension members, made as members of a large slenderness ratio, do not participate in the process of the force transmission which further implies that the initially statically indeterminate truss becomes a statically determinate truss. The point of this method is to determine two schemes of simple statically determined trusses, which after superposition of their patterns will give in result a pattern of the basic, more complex form of the statically indeterminate truss. Each of the simple trusses can be the calculated by means of Cremona's or Ritter's method, each truss has to be of the same clear span and the load forces of the half values have to be applied to nodes having appropriate positions like in the basic truss, see Fig. 1e-g. A basic conditions of equilibrium [3],[4],[5] to justify the two-stage procedure proposed method are visually shown in Fig.2.

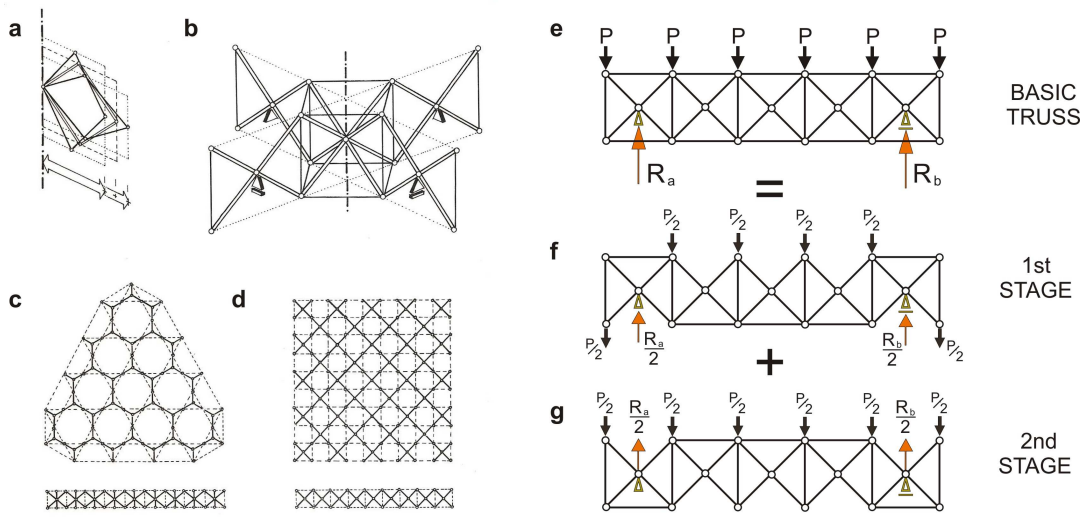

Fig. 1. Schemes of certain group of the tension-strut trusses together with schemes of the two stages of the proposed method of approximate calculation of statically indeterminate trusses.

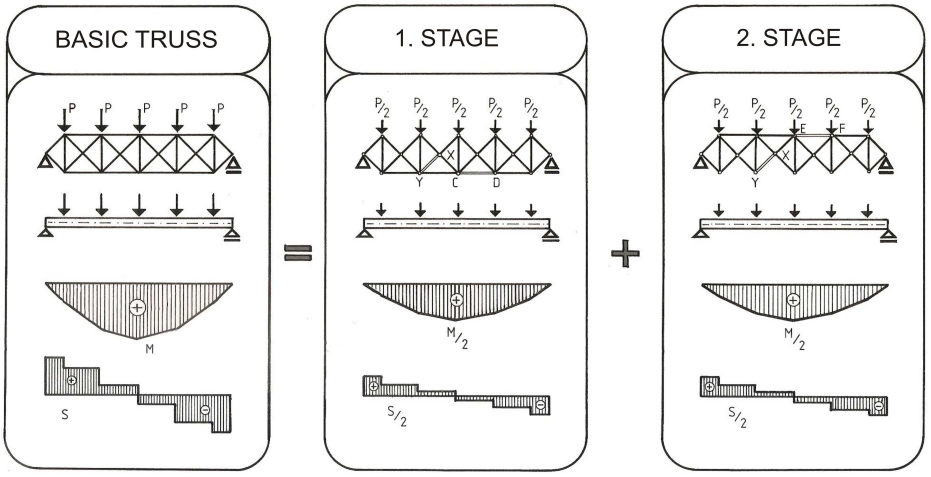

Fig. 2. Statically justification of correctness of the two-stage procedure of the method.

The number of members necessary to be removed from the basic system equals the degree of its inner statically indeterminacy [1],[2]. In the first stage all members of the upper chord, see Fig. 2, have to be removed from the basic truss which makes this truss a statically determinate system, which now has to be loaded by forces of half the value than forces applied to the basic system. In the second stage all the members of the lower chord have to be removed from the basic system and like previously the forces applied to the same nodes are of half the initial values. Each of the two simple trusses has to have the same clear span like the basic system. Values of forces calculated in each stage have to be summed up for each respective member of a truss. The force values acting in the upper chord are calculated in the first stage while values of forces acting in lower chord are calculated in the second stage. Because in each stage of the calculations we do not take into consideration the differences between stiffness of members jointed in the common nodes therefore forces determined in this way are approximate to forces values defined in the exact methods. In spite of these differences one should state that in many cases the approximation is good enough for application of the proposed method for the initial structural design [6]. The simplicity of this method justifies an expectation that the development potential of the two-stage method can be really great.

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