

Technical Committee No. 14
Elastic Analysis and Design

State of Art Report No. 4

OPTIMIZATION OF STEEL BUILDING COMPONENTS

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1. GENERAL CHARACTERISTICS OF OPTIMIZED STRUCTURAL ELEMENTS

1.1 GENERAL

Optimization of structural elements is understood to be an economy problem to be solved in the best possible way by technical means. Structural engineers have always been interested in structure optimization, but until recently their interest seems to have focused more on obtaining best solutions for components and for some portions of a structural system. Recent progress in electronic computer methods makes it possible to use refined techniques, thus improving and synthesizing the various aspects of design.

Optimum design of a structure where maximum economy is considered presents a very complex problem because of the many correlating factors governing this requirement. The theory and methods of optimization which are being developed in many countries are, at present, usually confined to certain special examples of structural components and are inadequate for general application (1, 2, 3, 4).

1.2 PROBLEMS OF OPTIMIZATION

There are three groups of optimum-design problems:

- a. optimization of components,
- b. optimization of structures of an assumed type and configuration,
- c. optimization of the structure as a whole.

It should be stated that, in principle, obtaining a best result is not possible if only a portion of the structure is considered. However, present-day knowledge does not allow more than a start from simple components from which one proceeds to complex systems. Although optimization is mainly related to elastic and plastic strength, factors associated with utilization of a structure, such as deflection, vibration, fire-safety, etc., which may seriously affect the form of a structure, must be considered. Furthermore, optimization of components or of a structural system cannot be attained without paying attention to foundations, mechanical and electrical systems, and to nonstructural elements such as cladding, partitions, etc.

The first group of optimization problems deals with components, such as floors, beams, columns, curtain walls, partitions, stairs, elevator banks, etc. In designing these elements it is possible to isolate the most important questions, and to define those factors which derive from interaction of these elements, or which are influenced by the whole construction, as limiting conditions which are assumed in advance and have to be satisfied by an optimum design. It was possible to solve many problems belonging to this group satisfactorily even when optimization was not known as a theorem. Using such existing satisfactory solutions makes it easier to obtain an optimum solution, but the result must be recognized as a relative best under existing technological conditions and at the present level of knowledge.

TC 14 ELASTIC ANALYSIS

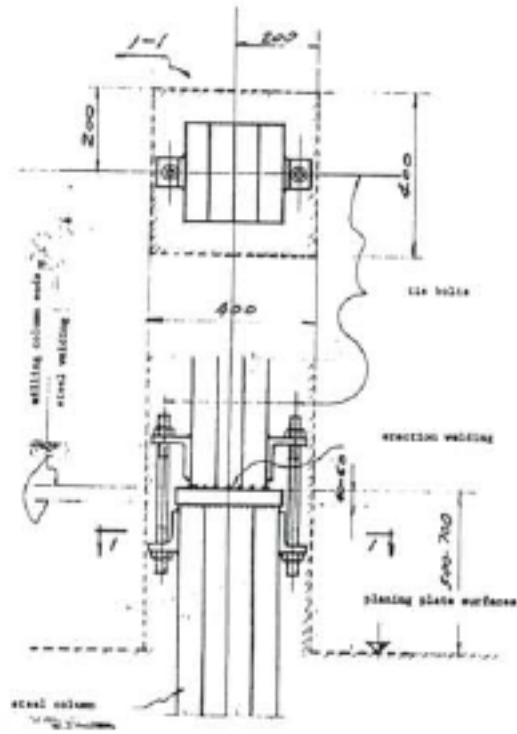


Fig. 14

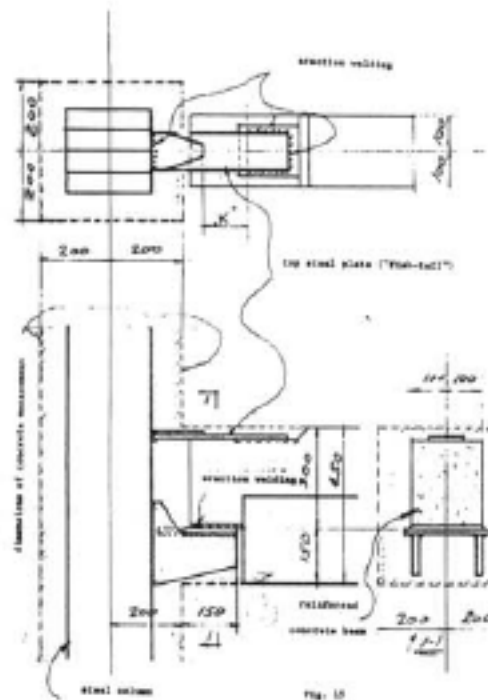


Fig. 15