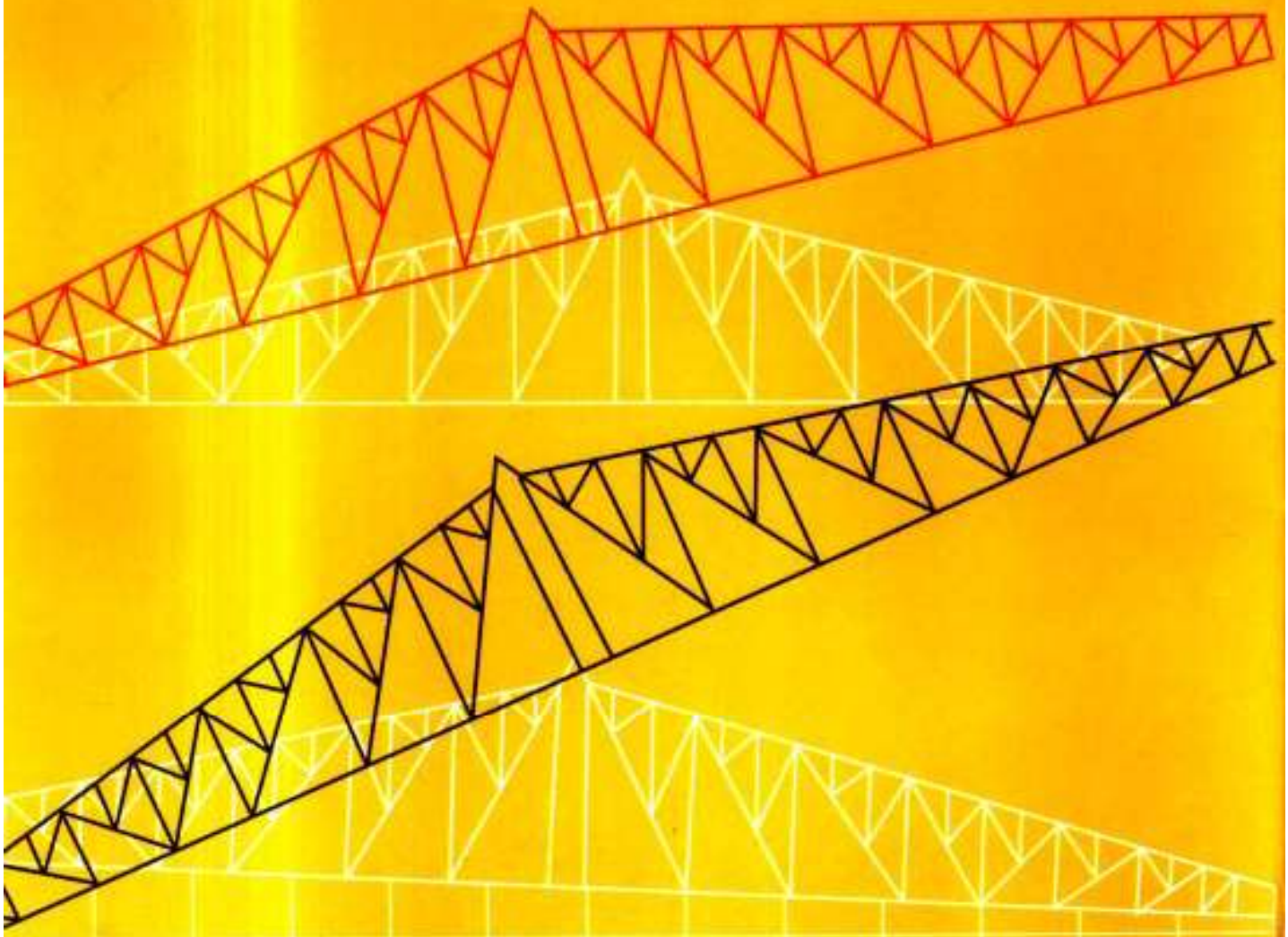

HANDBOOK OF TYPIFIED DESIGNS FOR STRUCTURES WITH STEEL ROOF TRUSSES

(WITH AND WITHOUT CRANES)

(BASED ON IS CODES)

BUREAU OF INDIAN STANDARDS

HANDBOOK
OF
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(WITH AND WITHOUT CRANES)
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0. FOREWORD

The Department of Science and Technology set up an Expert Group on Housing and Construction Technology in 1972. This Group carried out in depth studies in various areas of civil engineering and construction practices followed in the country. During the preparation of the Fifth Five-Year Plan in 1975, the Group was assigned the task of producing a Science and Technology Plan for research, development and extension work in the sector of housing and construction technology. As a result of this and on the recommendation of the Department of Science and Technology, the Planning Commission approved the following two projects which were assigned to the Bureau of Indian Standards (BIS):

a) *Project B-7* — Development Programme on Code Implementation for Building and Civil Engineering Construction; and

b) *Project B-8* — Typification of Industrial Structures.

BIS has set up a special committee (SCIP) consisting of experts to advise and monitor the execution of these projects. A Working Group for Project B-8 overseas the work of the project.

In a developing country like India, the capital outlay under each Five-Year Plan towards setting up of industries and consequently construction of industrial buildings is very high. It is, therefore, necessary that the various parameters of industrial buildings be standardized on broad norms so that it will be feasible to easily adopt prefabricated members, particularly where repetitive structures could be used.

The standardization of parameters for industries by itself will be, no doubt, a difficult task as it will not be possible to specify the requirements of each industry. The layout including height will vary from industry to industry, for it depends on the process of manufacture and end products. However, a little more detailed analysis of the requirements indicates that the problem may not be as difficult as it appears. Although it would not be possible to specify any constraint on the parameters, a broad norm can be given within which most industries could be accommodated.

The object of the project B-8 is to typify at national level the common forms of industrial structures used in light engineering industries, warehouses, workshops and storage sheds, and to obtain economical designs under these conditions. Even if an industrial complex is classified as heavy industry, it need not necessarily mean that all the industrial structures coming within the complex should be heavy industrial structures and that many structures could be from the typified design.

The main objective of typification of industrial structures is to reduce the variety to the minimum and provide standard prefabricated designs so that the structures could be easily mass produced and made available to the user almost off the shelf. In doing so, there will be tremendous saving in time in putting up an industry into production and hence increased production. This would indirectly increase the overall economy of the country. This would also help in the orderly use of source materials like steel and cement. This would be of immense use to structural engineers as well, since it would relieve them, to a large extent, from the routine and repetitive calculations. Thus the engineers time could be used to look at more innovative and economical alternatives.

The project on typification of industrial structures involved the following three main tasks prior to preparation of typified designs:

a) Task I — Survey and classification of industrial structures into different types;

b) Task II — Identification of industrial structures repeated a large number of times in the country, which are amenable to typification from the classified list prepared during Task I; and

c) Task III -- Specifying the elements of the industrial structures to be typified taking into consideration a number of parameters, such as structures with cranes and without cranes, span, length, height, support conditions, slope of roof, wind and earthquake forces, spacing, field and shop connections, material (steel, reinforced concrete), etc.

The data regarding physical parameters like span, spacing, roof slope, column heights, crane loading, etc, of existing structures has been obtained from several public sector enterprises through Bureau of Public Enterprises (BPE). Some information from private industries has also been collected by BIS.

The typified design for the following types of industrial structures in steel and reinforced concrete is envisaged to be brought out based on appropriate Indian Standards:

a) *Steel Structures*

1) Structures with steel roof trusses (with and without cranes)

2) Structures with steel kneebraced trusses (without cranes)

3) Structures with steel portal frames (without cranes) (SP : 40)*

4) Structures with steel portal frames (with cranes)

5) Structures with steel lattice frames (without cranes)

b) *Reinforced Concrete Structures*

1) Structures with RCC roof trusses (with and without cranes)

2) Structures with RCC portal frames (without cranes)

3) Structures with RCC portal frames (with cranes)

In each case of structures with cranes, the maximum capacity of crane considered is limited to 20 tonnes, normal range in light industries.

This Handbook deals with typification of structures with steel roof trusses (with and without cranes) having A-type as well as lean-to roof type trusses supported on columns. In structures with cranes, crane columns are build-up cantilever columns to resist wind and transverse crane loads. The roof trusses which are the same for buidlings with and without cranes have been designed both as angle trusses and tubular trusses.

Some of the points to be noted regarding analysis and design of these structures are as follows:

a) Typified design have been given for the following parameters:

Span lengths (metres): A-type	= 9, 12, 18, 24 and 30
lean-to roof	= 9, 12 and 15
Spacing of trusses (metres)	= 4.5 and 6.0
Roof slopes	= 1 in 3, 1 in 4 and 1 in 5

Span	*Column Height* (m)	
(m)	A-Type Truss	Lean-to Roof Truss
9.0	4.5, 6.0	4.5, 6.0
12.0	4.5, 6.0, 9.0	4.5, 6.0, 9.0
15.0	—	4.5, 6.0, 9.0
18.0	6.0, 9.0, 12.0	—
24.0	9.0, 12.0	—
30.0	9.0, 12.0	—

Crane column height (metres)	= 4.5 and 6.0
Crane capacities (tonnes)	= 5, 7.5, 10 and 20
Minimum clear head room (metres)	= 3.0
Minimum side clearance (metres)	= 0.5
Wind zones (*see* IS : 875-1964)	= I, II and III
Earthquake zones (*see* IS : 1983-1984)	= I, II, III, IV and V

*Printed.

In general use of 1 in 3 slope is recommended as this may not pose any fabrication problem. Flatter slopes may be adopted after taking due precautions for fabrication of trusses. In case of flatter slopes, the end laps between adjacent sheets shall be correspondingly inereased over that of 1 in 3 slope and/or the joints suitably sealed in accordance with the manufacturer's recommendations.

b) The analysis has been made using a computer programme based on the stiffness method of analysis. The member properties required in the stiffness analysis have been assumed on the basis of a preliminary design.

c) Trusses have been designed both as angle trusses and tubular trusses. The structure with steel roof trusses have been designed following the provisions of IS : 800-1962 for hot-rolled sections and IS : 806-1968 for tubular sections. There will be some variation in the permissible stress in case IS : 800-1984 is used for design of hot-rolled sections. However, it is felt that the design results presented in the Handbook will not be much different from those obtained by using IS : 800-1984.

d) The internal pressure/section specified in IS : 875-1964 for buildings with normal permeability (± 0.2) has been considered in design.

e) The joint details have been included to illustrate the method of detailing and they should not be considered as the only available method for detailing.

f) The typified design results are given for purlins, girts, trusses and columns. Design of other elements such as column cap plates, base plates and fasteners are also covered. Typified design of gantry girders for various crane loads and spacing of columns is also given in the Handbook. Bracing and foundation designs have not been typified because of varying design parameters. However, a typical example of bracing design and footing design is included.

g) A detailed design example in the design office format is given in the Handbook illustrating the use of analysis and design information presented.

h) On the basis of typified designs for different spans, spacings, roof slopes, etc, some conclusions regarding the more economical designs is covered in the Handbook.

j) The Handbook is not to be used for design of structures intended for process/heavy industries. The Handbook may be used only for design of industrial sheds meant for storage purposes or light industrial structres. Use of cranes will be limited to light duty according to the classification No. 1 of IS : 807-1976.

k) Minimum section specified for internal web members in trusses with angle sections is equal angle ISA $40 \times 40 \times 6$. However, for larger A-type trusses with spans of 24 and 30 m, this minimum angle may be replaced by angle ISA $50 \times 50 \times 6$, wherever there is any chance of distortion or deformation taking place during transportion or erection of truss.

m) The Handbook is intended to be used by qualified engineers only.

The Handbook is based on the work done by Structural Engineering Laboratory, Department of Civil Engineering, Indian Institute of Technology (IIT), Madras. The draft was circulated for review to the University of Roorkee, Roorkee; National Projects Construction Corporation Limited, New Delhi; Engineer-in-Chief's Branch, Army Headquarters, New Delhi; Gammon India Limited, Bombay; Association of Consulting Engineers (India), New Delhi; Tata Consulting Engineers, Bombay; Metallurgical and Engineering Consultants (India) Limited; National Industrial Development Corporation, New Delhi; Research Designs and Standards Organization, Lucknow; S. R. Joshi and Company Limited, Bombay; Food Corporation of India, New Delhi; Engineers India Limited, New Delhi; National Hydro-Electric Power Corporation Limited, New Delhi; National Thermal Power Corporation, New Delhi; Western Railways, Bombay; Braithwaite and Company Limited, Calcutta; Tata Iron and Steel Company Limited, Jamshedpur; B. G. Shrike and Company, Pune; City and Industrial Development Corporation of Maharashtra Limited, Bombay; Stup Consultants Limited, Bombay; Bharat Heavy Electricals Limited, Ranipet; Housing and Urban Development Corporation Limited, New Delhi; Hindustan Steel Works Construction Limited,

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CONTENTS