Steel Interchange

Steel Interchange is an open forum for *Modern Steel Construction* readers to exchange useful and practical professional ideas and information on all phases of steel building and bridge construction. Opinions and suggestions are welcome on any subject covered in this magazine. If you have a question or problem that your fellow readers might help to solve, please forward it to *Modern Steel Construction*. At the same time feel free to respond to any of the questions that you have read here. Please send them to:

Steel Interchange
Modern Steel Construction
1 East Wacker Dr.
Suite 3100
Chicago, IL 60601

Answers and/or questions should be typewritten and double spaced. Submittals that have been prepared by word-processing are appreciated on computer diskette (either as a Wordperfect file or in ASCII format).

The opinions expressed in *Steel Interchange* do not necessarily represent an official position of the American Institute of Steel Construction, Inc. and have not been reviewed. It is recognized that the design of structures is within the scope and expertise of a competent licensed structural engineer, architect or other licensed professional for the application of principles to a particular structure.

Information on ordering AISC publications mentioned in this article can be obtained by calling AISC at 312/670-2400 ext. 433.

The following responses to questions from previous Steel Interchange columns have been received:

In the September 1, 1986 edition of the AISC *Code of Standard Practice*, the reference to bolts was deleted in Section 9.2, "Calculation of Weights." [This language is continued in the June 10, 1992 edition of the AISC *Code of Standard Practice*]. Was it, thus, intended that bolts not be weighed for payment, but instead be treated like weld metal or protective coatings?

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In the 1986 edition of the AISC *Code of Standard Practice*, Section 9.2.4 was modified by deleting any reference to rivets and to shop and field bolts, nuts, and washers. The reference to rivets was deleted because they were no longer in general use. The reference to the other items was modified because many alternative fastener designs and load indicating devices have been introduced for use since the 1976 edition of the AISC *Code of Standard Practice*. Many of these devices do not have corresponding tables of weights in the AISC *Manual of Steel Construction*.

As a result, Section 9.2.4 of the 1976 AISC *Code of Standard Practice* was split into Sections 9.2.4 and 9.2.5 in the 1986 Code. Section 9.2.4 is used for the weights of items shown in tables in the Manual, while Section 9.2.5 provides for the use of manufacturer's literature to determine the weights of items not shown in the Manual.

It is the consensus of the AISC Committee on Manuals, Textbooks, and Codes that all furnished items are intended to be weighed for payment unless specifically prohibited by AISC *Code of Standard Practice* Section 9.2. The new wording of these two sections is all inclusive of any furnished item and, thus, is not limited to fasteners. Fasteners, both shop and field, are weighed for payment accordingly; this remains unchanged in the current June 10, 1992 edition of the AISC *Code of Standard Practice*.

AISC Committee on Manuals, Textbooks, and Codes

How can one take into account blast effects in the design of steel structures?

Due to the high ductility characteristics of steel, steel structures provide a feasible solution to the potential loss of the owner' investment. The method for accounting of blast loads in the design of steel structures is achieved by evaluating stress levels in, and deformations of, the structure under the integrated effect of the blast overpressures and durations and the structure's dynamic response. This is done in an analysis of structure using the following simplified procedure.

a) Perform a design of the structure for all customary loads including equipment, wind and earthquake.

b) Establish the magnitude, duration and frequency of the impulsive (blast) overpressures. This is somewhat intensive and an equivalent static load (ESL) may be used. The ESL will result in higher material and construction costs.

c) Conduct the blast analysis of the structure. An analysis is generally performed of the previously designed structure, rather than designing members to withstand the blast load. The element analysis combines the natural frequencies of the elements and checks the capacity of the local members as they respond to the blast. Consideration must also be made of the global response of the structure to the blast. It is in this step that much of the cost saving is made over an equivalent static load approach. Checks for stress and instability are performed. Design iterations must be performed as significant changes in mass and stiffness occur.

d) Finally, deflections and ductility, including collapse mechanisms are checked to satisfy operational or functional requirements of the facility or other client placed requirements.

Steel Interchange

This is a very simplified approach; however, there are several excellent references available to guide the engineer.

Of steel structures analyzed under severe blast loadings, beams required approximately a 10% to 20% increase in weight and columns required approximately 20% to 25% above that required for the non-blast conditions. This, of course, will vary for each application.

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How can one take into account blast effects in the design of steel structures?

For blast-resistant design, element and connection ductility is essential and details should be similar to those used in structures subject to seismic loadings. Because of the brief duration of a blast and uncertainty in its time vs pressure characteristics, design should consider structure dynamic properties and the consequences of plastic strains in structural elements. For example, large deflections might be permitted in roof beams but not in rigid frame girders or columns if that frame provides lateral support to the structure.

Guidance on design of structures for external blast loads may be found in some textbooks, including, *Introduction to Structural Dynamics* by John M. Biggs (McGraw Hill). More detailed design information exists in ASCE Manual 42, *Design of Structures to Resist Nuclear Weapons Effects* (1985), and U.S. Army TM5-1300, *Structures to Resist the Effects of Accidental Explosions* (November 1990).

Relatively simple design guidance, including recommendations on design loadings, is given in the Manufacturing Chemists Association Safety Guide SG-22, *Siting and Construction of New Control Houses for Chemical Manufacturing Plants* (1978).

For blasts internal to a structure, current practice is to vent the pressure through low mass break-out panels, louvers, or similar devices. Some guidance exists in NFPA 68-1988, *Guide for Venting of Deflagrations.*

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New Questions

Listed at right are questions that we would like the readers to answer or discuss.

If you have an answer or suggestion please send it to the Steel Interchange Editor, Modern Steel Construction, One East Wacker Dr., Suite 3100, Chicago, IL 60601-2001.

Questions and responses will be printed in future editions of Steel Interchange. Also, if you have a question or problem that readers might help solve, send these to the Steel Interchange Editor.

In regards to "beams rolled the hard way" according to the ad by Whitefab, Inc. in the April issue of *Modern Steel Construction*, what special considerations are made for the end connections supporting such beams?

Also, if the beam is bent to a curve on the "Y-Y" axis such the "X-X" axis is level, would the end column connection be stronger if eccentrically loaded at the column due to the built-in torsion stress at the beam center being out of alignment with the centerline of the columns?

And would such a connection be any different whether attached to the column following the inside radius of the curve or the outside radius?

The above questions concern a circular building with a perimeter mezzanine, thus the curved beams are loaded to one side only.

Alan W. Bliek
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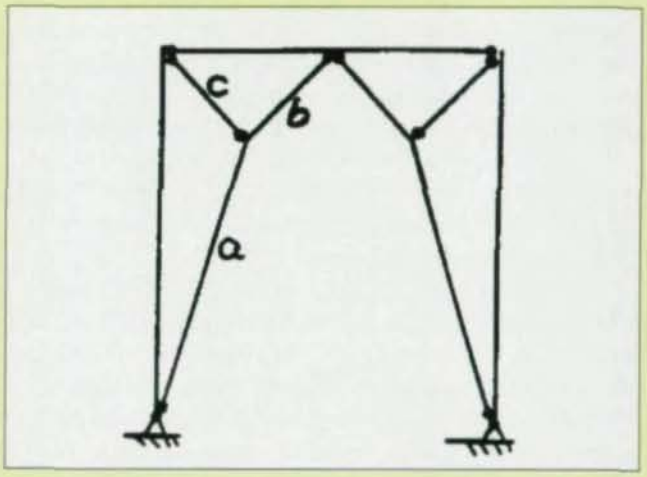

Due to some clearance requirement, a frame has the configuration shown. For out-of-plane buckling, what will be the unbraced lengths for members a, b, and c with the following conditions: (1) a and b are rigidly connected and (2) a and b are released at their ends?

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