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 you 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
One East Wacker Dr., Suite 3100
Chicago, IL 60601-2001

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 principals 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 from previous Steel Interchange columns have been received:

Serviceability is a particular concern for crane systems in industrial buildings but is not clearly covered in standard code literature. What are deflection limits for crane runway systems?

In Industrial Buildings, AISC Design Guide series No. 7, 1993 by James M. Fisher, deflection limits are given as follows:

- Vertical deflection of the crane beam due to wheel loads (no impact);
- L/600 for Light and Medium Cranes (CMAA Classes A, B, C, and D)
- L/1000 for Mill Cranes (CMAA Classes E and F)
- Lateral deflection of the crane beam due to crane lateral loads:
- L/400 for all cranes.

Hussain Shanaa, Ph.D., P.E.
AEC Engineering
Minneapolis, MN

Another response:

Excessive deflections cause steep slopes on the runway and are a serious operating obstacle. Sometimes a crane cannot climb the slope caused by this deflection and will become stuck in midspan. Conversely, the crane can increase speed dangerously on the downhill portion of the trip.

The Crane Manufacturers Association of America (CMAA) recommends vertical deflections (from dead load plus rated load) not to exceed 0.00125 inch per inch of span of bridge girders. This limit could be applied to runway girders as well.

Horizontal deflections are not so critical but excessive deflection can cause excessive wear on wheel flanges and on the rail. Horizontal deflection of girder should be limited to half the difference between width of rail head and the inside flange-to-flange dimension of the wheel. Expressed differently, the center-to-center dimension of runway rails must not vary more than the difference of the inside flange-to-flange wheel less the width of rail head.

Gerald A. Reed, P.E.
Kennecott Utah Copper Corp.
Bingham Canyon, UT

Another response:

There is no consensus among designers and engineers regarding crane runway deflection limits. However, there is general agreement that these limits should be considerably less than, for example, the L/360 deflection limit normally adhered to for members supporting plaster ceilings.

Deflection limits recommended in the literature vary from L/600 for light cranes up to L/1200 for heavy, fast cranes. Stone & Webster's procedures require runway vertical deflection limits of from L/800 to L/100. Generally, lateral deflection is limited to L/400. These limits may be marginally exceeded when re-rating existing runways. We have been using these criteria for simple span girders on cranes in CMAA Classes A1, A2, B, and C with no apparent problems.

The deflection limit is only one of several important aspect of crane runway design. There are many other concerns to be addressed by the crane runway designer. To note all of them is impractical in this type of response. A very good introduction to crane runway design is the article, *Tips for Avoiding Crane Runway Problems* by David T. Ricker, AISC Engineering Journal, 4th Quarter 1982.

G. Jeffrey Ashworth, P.E.
Stone & Webster Engineering Corp.
Boston, MA

Another response:

Excessive crane beam deflection is the underlying cause of many crane runway problems, such as: weakening and eventual fracture of the crane beam-to-column connections, bending in the crane column, cracking of the crane beam web, creeping of the crane rail leading to loosening of the rail clips or hook bolts, yawing of the crane bridge resulting in binding wheels with subsequent wear of rails, wheel flanges, and bearings, etc. Historically, stiffer crane beams have a better performance record. The design profession, however, is not in agreement as to the desired degree of stiffness. For example:

SOURCE	MAX. VERT. DEFL. (IN.)
F.S. Merritt	L/750
Gaylord & Gaylord	L/960 for light, slow cranes L/1200 for heavy, fast cranes
AISE Tech Report #13	L/1000
AISC Design Guide #7	L/600 for light & medium cranes (CMAA classes A, B, C, and D) L/1000 for mill cranes (CMAA classes E and F)

Since the benefits of crane beam stiffness far outweigh the costs of attainment this writer suggests using L/1000 for CMAA classes A, B, and C and L/1200 for CMAA classes D, E, and F. For all cranes lateral deflection should be limited to L/400.

As a word of caution, never use multi-span crane or knee braces as a means to reduce deflection. Crane beams should be designed as single spans.

David T. Ricker, P.E.
Payson, AZ

In a structure that has tubular columns, should weep holes be added at the bottom of the columns in order to drain any water in the column?

If water is present inside tubular columns, internal corrosion is likely. An ultrasonic thickness examination can be performed without removing the water. The Engineer can then determine the structural adequacy of the columns based on the amount of metal loss. From electrochemistry,

$$4Fe + 3O_2 + 2H_2O \rightarrow 2Fe_2O_3 \bullet H_2O$$

(iron) (air) (moisture) (hydrated red iron rust)

In the above expression, moisture (water or humidity) is required for steel to rust in the presence of oxygen (air). If one of the above elements or compounds is removed, the reaction will stop. For example, steel will not rust in dry air.

If a column is structurally adequate, it should be drained and seal welded airtight. Equilibrium between the air, moisture and rust will be reached and rust formation will stop. The exterior of the column can then be protected with an approved coating. If seal welding is not possible, vents should be added for drainage and the column protected with a properly designed cathodic protection system.

If a column is judged inadequate, there are two fabrication options available. A new column seal welded airtight and painted or a column with vents and hot dip galvanized for adequate interior corrosion protection. Special vent details and recommendations for proper drainage during the galvanizing process are available from the American Galvanizers Association. Vents in the base plate are undesirable when dry packing is specified.

Ron E. Campos, S.E.
La Habra, CA

New Question

Listed below is a question 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.

What is the best location for providing cover plates to strengthen a W section if the beam compression flange is fully braced:

- **a) At top flange before erection.**
- **b) At top flange after erection.**
- **c) At bottom flange before erection.**
- **d) At bottom flange after erection.**
- **e) Does not matter.**

A.Z. Piracha
Miami