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
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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. 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:

What can an erector and engineer do when anchor bolts are too short and the nuts are not fully engaged?

There are two common methods available to make a short anchor bolt longer.

The first method consists of utilizing a thin-walled threaded coupler which is screwed onto the top of the anchor bolt and into which is screwed an adequate length of threaded rod. It may be necessary to "crater" the concrete around the anchor bolt in order to engage an adequate thread length. "Adequate" is defined as approximately equal to the bolt diameter.

The second method involves welding an adequate length of threaded to the top of the existing anchor bolt. The threaded rod extension is prepared for welding by machining the contact end to a point (45 degrees). Then the weld is applied using electrodes suitable to the material. A garbled area results, naturally, and it may be necessary to use plate washers of sufficient quantity to allow free rotation of the nuts.

With either of these methods it may be necessary to enlarge the holes in the column base plate. This can be done by burning, which is an acceptable method of enlarging base plate holes. (Chances are if the anchor bolts are set too low, they may also have been offset to the side.)

It is suggested that those interested obtain a copy of *Column Base Plates*, No. 1 of the AISC Design Guide Series. This treats the subject of column base plate design and construction in detail.

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Are both mechanical galvanizing and hot-dip galvanizing appropriate for bolts?

Mechanical galvanizing and hot-dip galvanizing are two methods of applying a sacrificial metal (zinc) to a base metal. The zinc will corrode, or sacrifice itself, to protect the base material. Both methods apply a zinc coating and are appropriate for galvanizing bolts and other hardware items. The difference between the two methods lies in the process itself. Following is a short description of each process as it pertains to hardware items.

HOT-DIP GALVANIZING: The hardware is first degreased and cleaned. This is done with a combination of caustic and acidic solutions. The parts are then rinsed and loaded into a basket. The basket is dipped into a tank of molten zinc for a specific period of time. The basket is then withdrawn and placed in a centrifuge where the excess molten zinc is spun off the parts. This process is more fully described in ASTM A153.

MECHANICAL GALVANIZING: The hardware is cleaned and rinsed as in the hot-dip method. The parts are then loaded into a multi sided barrel that resembles a concrete mixer. Also added to the barrel is a mixture of various sized glass beads and a predetermined amount of water. At various times in the process, as the barrel is turning, small amounts of chemicals and powdered zinc are added. The collisions between the glass beads, zinc and parts causes the zinc to cold weld to the part. Powdered zinc is added until the required thickness is attained. This process is more fully described in ASTM B695.

Mechanical galvanizing has several advantages over the hot-dip process. The following list describes these advantages:

- 1. The process is done at room temperature. There is no detempering of heat treated parts. Low temperature acidic cleaning also reduces the chance of hydrogen embrittlement.
- 2. Zinc is deposited in a generally uniform coating thickness. Coating thickness and uniformity is hard to control with the hot-dip process.
- 3. Because of the added zinc thickness to bolt threads, all galvanized nuts are required to have threads that are tapped oversize before galvanizing. Hot-dipped nuts need to be retapped after dipping to remove zinc from the threads. This step is usually not required with mechanically galvanized nuts.
- 4. Parts that are mechanically galvanized do not stick together as they sometimes do after hot-dip-

ping.

There is one potential problem with the mechanical process. The zinc coating may chip or flake off. Small chips in the coating are usually not a problem because the surrounding zinc protects the exposed area. Excessive chipping or flaking indicates that the parts were not properly cleaned or the process was not performed properly. Another potential problem with the mechanical process is part size. Typically long threaded rods or very heavy pieces are difficult to galvanize with the mechanical process.

Mechanical galvanizing and hot-dip galvanizing are both appropriate methods for depositing a protective layer of zinc on bolts and other small hardware items. Cost and availability is usually the determining factor when deciding what process to use. Part size, shape and quantity are other important considerations when specifying galvanized hardware.

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Can one weld to an existing structure? How does one determine if the steel is weldable?

My answer to this question would be, "Yes, in most instances." Structure, however, is a broad term referring to buildings, bridges, towers, etc. In some cases especially those involving tension members, dynamic loads or older materials welding may not be appropriate or economically practical. The following are some problems I have encountered that the Design Engineer and Erector should consider prior to using a welded connection.

- 1. What are all the codes and specifications which will govern welding on this particular structure? In some instances (especially involving the Department of Transportation) there may be state codes which are more stringent and supersede nationally recognized codes.
- 2. What are the loading conditions on the member to receive the weld and what will be the effect of heat application? It may be necessary to shore the member or remove the load prior to welding. Also, will the welded connection now be a likely source for future crack development?
- 3. What is the existing material and is it in a condition to be welded to? In older structures the type of material may be in question or may be exhibiting loss of section. Prior to erection the Design Engineer should be aware of the material properties and the Erector of the proper welding procedure. If the material in question is not prequalified by the applicable code it may be necessary to conduct a procedure qualification test. Very often a costly and time consuming process.
- 4. All things considered, is welding the best choice from an economic standpoint? It may be a requirement that an Inspector be present during welding and that the final weld receive nondestructive testing. Both of these items could add significant cost to a welded connection. Additionally there is a much greater chance for error in a welded connection verses a bolted one.

Determining the weldablility of a material is generally a fast and low cost procedure within the capability of most testing laboratories. Provided with a small sample of the material a chemical analysis can be obtained and a welding procedure developed. The American Welding Society is also very helpful in this area.

If the chemical properties are unknown it is likely that the physical properties are also in question. It has been my practice to also recommend a physical analysis so that the Design Engineer will have full knowledge of the material. The number and location of the test coupons would be determined by the scope of the project.

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New Questions

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. 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 the comments on End-Plate Moment Connections in the November 1992 Steel Interchange, in which it is stated that fatigue need not be considered when less than 20,00 load cycles, I have the following question:

Since seismic loading is even less likely to occur than the maximum wind loads, up to what maximum seismic zone level would be recommended that the connection could be used and steel be considered "static"? Also, could this connection be designed using either ASD or LRFD and why?

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