

Anchor Rods

Can't live with 'em, can't live without 'em.

By Dan Swiatek and Emily Whitbeck with contributions from Victor Shneur, P.E.

Many common anchor rod problems are easier to avoid than you think!

In life there are a few things that are necessary evils, and anchor rods and column base plate connections seem to be one of them. These connections have caused problems on many building projects, but by looking at the challenges that others have faced and showing how these challenge have been successfully overcome, perhaps we can make the use of these important connections more bearable. This article will give

some guidelines on how you can prevent common problems in the design of anchor rods and base plate connections, and will help the designer to avoid expensive field repairs and schedule delays. Specifications and design guides are already in place to aid in the design of these connections for strength, but issues of constructability should be considered on every project, to ease the construction process. The following chart offers some

common challenges and easy solutions for how to improve everyday anchor rod and column base plate connection applications.

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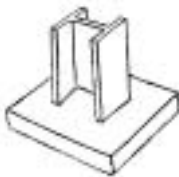





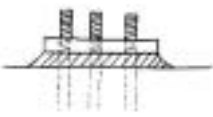
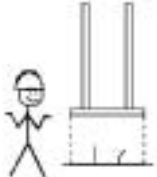
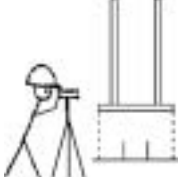
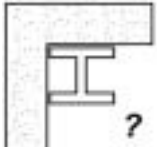
Solutions to 17 Common Anchor Rod and Base Plate Dilemmas

	Common Mistakes		Easy Solutions	
1	<p>Specifying ASTM A325 or A490 anchor rods Standard ASTM A325 and A490 bolts include defined threaded length and heading requirements and must be special ordered when their lengths exceed 9½ in. This can take up to four months.</p> <p style="text-align: right;">✗</p>		<p>Specify ASTM F1554 anchor rods This standard covers anchor rods with yield strengths of 36, 55, and 105-ksi, in hooked, headed, and threaded/nutted options.</p> <p style="text-align: right;">✓</p>	
2	<p>Assuming that all material are available It is possible that materials of different types and sizes will not be readily available for your project.</p> <p style="text-align: right;">✗</p>		<p>Contact a local fabricator for availability Even though most fabricators don't make their own anchor rods, they will still know about material availability or possible substitutions. It will save money and time on your project. If it is impossible to contact your fabricator, ASTM F1554 grade 36 anchor rods may be specified as a fail-safe option.</p> <p style="text-align: right;">✓</p>	
3	<p>Specifying many different anchor rod settings Specifying a different anchor rod setting pattern and base plate for every column size will end up leading to complications.</p> <p style="text-align: right;">✗</p>		<p>Reduce the variety of anchor rod settings Specify one anchor rod setting and base plate for all exterior columns, and one for all interior columns, based on the largest size. This will be conservative for lighter columns, but it will greatly simplify detailing and installation.</p> <p style="text-align: right;">✓</p>	
4	<p>Specifying many different anchor rod sizes Similarly to specifying settings, specifying many different sizes can lead to complications.</p> <p style="text-align: right;">✗</p>		<p>Limit anchor rod sizes to one or two This will be conservative in some cases but will reduce installation mistakes. Try to make sure the two sizes differ enough to avoid confusion and mistakes (at least ½-in. difference in diameter).</p> <p style="text-align: right;">✓</p>	

Solutions to 17 Common Anchor Rod and Base Plate Dilemmas (cont'd.)

		Common Mistakes		Easy Solutions	
5	<p>Specifying odd anchor rod settings Don't specify settings that are seldom used if you don't have to.</p> <p style="text-align: right; color: red;">✗</p>			<p>Specify doubly symmetric settings Keep it simple by making anchor rod settings and base plates doubly symmetric about column centerlines. Simplicity prevents problems.</p> <p style="text-align: right; color: green;">✓</p>	
6	<p>Specifying base plates that are too small This provides no room for errors that are likely to occur.</p> <p style="text-align: right; color: red;">✗</p>			<p>Provide sufficient plan dimensions This will allow for oversized holes and clearances. Field fixes to enlarge holes or to add plate washers will also be possible.</p> <p style="text-align: right; color: green;">✓</p>	
7	<p>Specifying standard oversized holes for anchor rods Foundation inaccuracies are common. Often, the standard oversized hole dimensions used for bolts are not sufficient because there is not enough tolerance available.</p> <p style="text-align: right; color: red;">✗</p>			<p>Use AISC anchor rod and base plate hole recommendations Use the recommended hole sizes for base plates shown in AISC <i>Design Guide 1</i>, or in Table 14-2 of the 3rd Edition <i>Manual</i>. This will allow for even more tolerance in the foundation for anchor rod placement. Make sure to use a heavy plate washer over the hole.</p> <p style="text-align: right; color: green;">✓</p>	
8	<p>Specifying grout holes in small base plates If the smaller dimension is less than 24 in., do not specify grout holes.</p> <p style="text-align: right; color: red;">✗</p>			<p>Only provide grout holes with large plates If more than one hole is required, grout holes need to be spaced approximately 18 in. apart. Grout holes should be 2 in. to 3 in. in diameter.</p> <p style="text-align: right; color: green;">✓</p>	
9	<p>Using anchor rods to transfer substantial shear Anchor rods cannot be expected to transfer shear forces due to their larger holes and the use of grout.</p> <p style="text-align: right; color: red;">✗</p>			<p>Consider a shear key or an embedded plate A shear key or embedded plate with welded side plates can be used to transfer a large horizontal shear force from the column base to the foundation.</p> <p style="text-align: right; color: green;">✓</p>	
10	<p>Welding all around the column and base plate Column web-to-flange fillets provide very little strength and may cause fabrication problems. Welding that wraps around the flange toes for a column and base plate connection creates unwanted stress concentrations.</p> <p style="text-align: right; color: red;">✗</p>			<p>Use one-sided fillet welds for gravity columns A typical gravity column only requires a fillet weld at the flange. Columns in framing systems that experience uplift and shear will require fillet welds on both sides of the flange and web.</p> <p style="text-align: right; color: green;">✓</p>	
11	<p>Specifying a CJP groove weld If a simple fillet weld can resist uplift or shear, then using a complete-joint-penetration groove weld for the connection between the column and base plate is unnecessary and expensive.</p> <p style="text-align: right; color: red;">✗</p>			<p>Specify a fillet weld if possible Use a fillet weld on both sides of a joint than a CJP groove weld, if possible. Remember that the fillet weld will benefit from the directional strength increase factor.</p> <p style="text-align: right; color: green;">✓</p>	

Solutions to 17 Common Anchor Rod and Base Plate Dilemmas (cont'd.)

Common Mistakes		Easy Solutions		
12	<p>Always using brackets at base plates If the column is subjected to uplift, specifying brackets or stiffener plates are not always necessary. These measures are not only expensive but also make field corrections impossible.</p> <p style="text-align: right;">X</p>		<p>Use thicker base plates This can eliminate the need for brackets or stiffeners at base plates and will result in much less labor to fabricate the columns.</p> <p style="text-align: right;">✓</p>	
13	<p>Specifying hooked anchor rods for axial loads Because a hook can straighten and pull out, hooked rods should not be used for axial loads. Exceptions include using them to prevent overturning caused by erection loads or collisions during erection.</p> <p style="text-align: right;">X</p>		<p>Use anchor rods that are headed or threaded at the end for axial loads Use rods that are headed or threaded at the end with a nut for anchorage. Because of the bigger shear cone, these have a greater pull-out strength.</p> <p style="text-align: right;">✓</p>	
14	<p>Welding the anchorage nut all around This includes both sides and the top. Welding the top can reduce the assembly strength.</p> <p style="text-align: right;">X</p>		<p>Tack weld this nut at the bottom Since the only purpose of this weld is to keep the rod from turning while the top nut is tightened, a tack weld is more than sufficient. You can also use a jamb nut.</p> <p style="text-align: right;">✓</p>	
15	<p>Assuming precise placement per design The placement of both the concrete and the anchor rods cannot guarantee perfect elevation according to the design or erection details.</p> <p style="text-align: right;">X</p>		<p>Know the tolerances for anchor rod placement ACI tolerances for anchorage are very liberal. Consider specifying the more stringent AISC Code of Standard Practice tolerances for use by the concrete contractor.</p> <p style="text-align: right;">✓</p>	
16	<p>Assuming anchor rods were installed perfectly It is very common for an anchor rod to be installed incorrectly. It is even more common for them to be damaged after installation by other construction work.</p> <p style="text-align: right;">X</p>		<p>Consider hiring a surveyor It might be a good idea to hire someone to inspect anchor rod installation, especially in a complicated or tightly-scheduled job.</p> <p style="text-align: right;">✓</p>	
17	<p>Assuming that walls will not be constructed It is very possible that walls or other constraints will be built before the column is installed.</p> <p style="text-align: right;">X</p>		<p>Construction sequence should be specified If there is a chance that the columns might be installed after a wall, make sure the correct order is specified before you design the anchor rods and base plates.</p> <p style="text-align: right;">✓</p>	