Heavy Movable Structures, Inc.

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Economical and Functional Steel Details

by

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ECONOMICAL AND FUNCTIONAL STEEL DETAILS

By Larry Welsh and Walter Gatti

The theme behind this paper and presentation is to show how the details and specifcations that are incorporated in the design plans can effect the costs and potential errors on a project.

We have arranged this presentation into 3 topics, the first topic involves the basic geometry and placement of members in the bridge.

BASIC GEOMETRY

1. Avoid crowns in the roadway. This adds to the cost and and complexity of both fabrication and erection.

   On structures where a cross slope is required due to drainage or other contract requirements and the bascule span has a crown in the roadway, it will be more economical to set the stringers normal to the cross slope and slope the top flange of the floorbeams in order to avoid beveled fills. This applies to spans where the stringers sit on top of the floorbeam.

In the case where the stringers frame into the floorbeam and connect to a stiffener this may also be a better detail since this sets the top flange of the stringer in the same plane as the roadway grid flooring eliminating the filling of the gap at the toe of the stringer flange.
Refer to the details shown on page A of this presentation.

2... The position of the floorbeams is another area where beveled fills can be eliminated. When the foorbeams are set normal to grade, the grid flooring can rest directly on the top flange of the floorbeam. Refer to the details shown on page B. The reason why we try to eliminate beveled fills is because a beveled fill is approximately 15 times more expensive per pound to fabricate. They add to the cost without providing any increased value.

3....The position of the lateral bracing plane can help in simplifing fabrication details. When the lateral plane is set relative to the bottom flange of the bascule girder, bent plates and beveled fills will be required in order to connect the bracing. Whenever possible it will make the details simpler if the lateral bracing plane is located at the bottom of floorbeam flange. Refer to the details on page B.

4... Since must bascules must be erected in their open position floorbeams and sidewalk brackets should always be placed on the toe side of the connection plate. This subject will be discussed in greater depth later in this presentation and there are some slides covering this issue.

CONSTRUCTION AND FABRICATION DETAILS

1 ... Since most connections on bascule bridges are either reamed or drilled assembled, the use of minimum edge distances must be avoided. All edges distances should be increased by at least $\frac{1}{8}$ inch and preferably $\frac{1}{4}$ inch.

Widths of connection plates should be calculated based on prefered edge distances and a minimum of $\frac{1}{2}$ inch clearance between the end of a member and the weld of connection plate it is connected to.

Try to keep stiffeners in $\frac{1}{2}$ inch width increments up 8" wide. This permits a fabricator to order flatbars cut to length only at 19 to 24 cents a pound versus a plate at 25 to 30 cents a pound, plus the labor to strip to width and cut to length.

Refer to page no. "C" for details.

2 ... The steel mills no longer roll plates in widths less than 48 inches which require the fabricator to nest and combine plates in order to economize and reduce scrap. This leads to the slabbing and stripping of flange plates. It is much more econimical to keep all the flange plates the same width for any one girder and vary the thickness instead.

Refer to page "D" for a typical sketch.

3 ... Generally all bascule spans are assembled and many connections are required by specification to be reamed or drilled at assembly. However there are numerous connections that do not fall into this catagory where the use of oversized holes should be allowed. For example; when stringers and sidewalk members rest on the top flange of floorbeams and brackets, and lateral bracing connections. In some cases the engineer may want to specify that a trial assembly be made of items which were not required to be ream assembled, such as approach spans , sidewalk sections and machinery platforms.

4... Where cantilever sidewalk brackets are required it would simplify the construction if the connection was designed with the web connection having enough capacity so a tie plate would not be required. Tie plate type connections require geometric control in three directions and can complicate the barrier connection and the girder grid flooring support bar, adding to the costs.
Refer to page no. "E" for details.

5... Floorbeam and counterweight girders require special attention when it comes to erection. Most of the problems we encounter during the process of preparing shop details relate to these members. All of these pieces have to be lowered and swung in from above since the leaf is usually in the upright position. This means the floorbeam must be on the toe side of the connection plate. In order to swing past adjacent stiffeners the length of the floorbeam may have to be shortened , which increases the width of the connection ℄ . Many times the cross girder connection has to be designed so the cross girder can be dropped in between the bascule girder flanges since there is insufficient clearance to swing the member past the trunnion or other details in the vicinity.

Floorbeams that are almost as deep as the girder may require a seperate knee bracket at the ends which could be erected prior to the floorbeam. This avoids a potential erection problem because the floorbeam could be deeper than the girder, since it swings in from the shallower side.

6...The specifications for the project should give the contractor and fabricator the option to ship all or portions of the structure shop assemblied. This would save duplication of effort in disassembling and then reassembling in the field. Typically the fabricator and contractor will work out these options prior to the bid.

7... When turned bolts are required the hole size specified should be in standard drill sizes, with the bolt being non-standard diameter, since the bolt must be specially machined anyway. When a non-standard hole size is shown the fabricator will have to custom order special drill bits at a cost of over 500 dollars apiece. This adds unnecessary costs to the project for no extra value.

8... Castings that have weld repairs should require stress relieving. The job specifications should clearly state the grade and class of relieving required.

9... Avoid unnecessary machining on openings for pieces that have additional machine tolerances built into them. A good example is on span lock casting openings.

10... Full penetration welds create heat, which then causes distortion and warping of the flange, so avoid the use of full penetration welding on the ends of stiffeners that bear against a flange on which a shoe or bracket connect to.

AASHTO gives the designer the option to mill to bear and fillet weld in lieu of a full penetration weld.

11... Painting systems today create more problems than any part of fabrication. The following items are ways that may relieve some of the problems.

A ... allow the use of weld thru primers.

B ... Do not specify painting the inside of holes of members that are shipped shop assembled, especially if preblast and prepainting is allowed.

C ... Avoid putting the final coat of paint on in the shop unless the structure is shipped shop assembled.

D ... avoid multiple or special coatings of counterweight blocks.

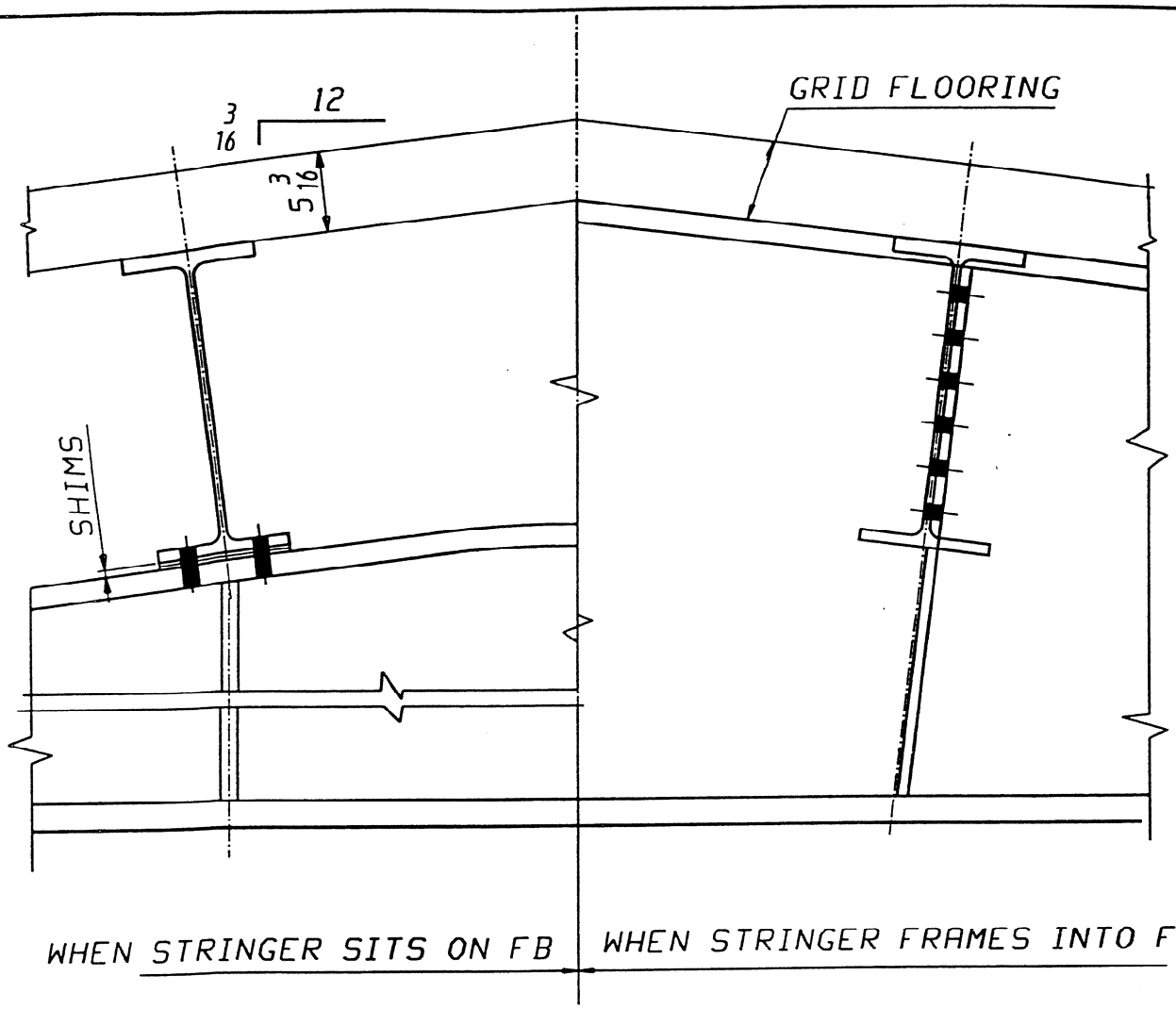
SHOP AND FIELD ALIGNMENT

One of the major problems confronting the fabricators today is the lack of consistency in the alignment tolerances from project to project, state to state and engineer to engineer. It is differcult to understand why the industry cannot establish a standard .

Once a structure has been assembled and has been checked on a daily basis, and is within the specified tolerances there should not be requirements for exact readings to check dimensions that have been previously checked. We recommend the use of a GO/NO GO type gage.

All check dimensions should be performed in the morning before the structure starts to move due to the increases in temperature as the day goes on. There is no way to control the movement of the assembly, so therefore any dimensions taken later in the day, may not be correct.

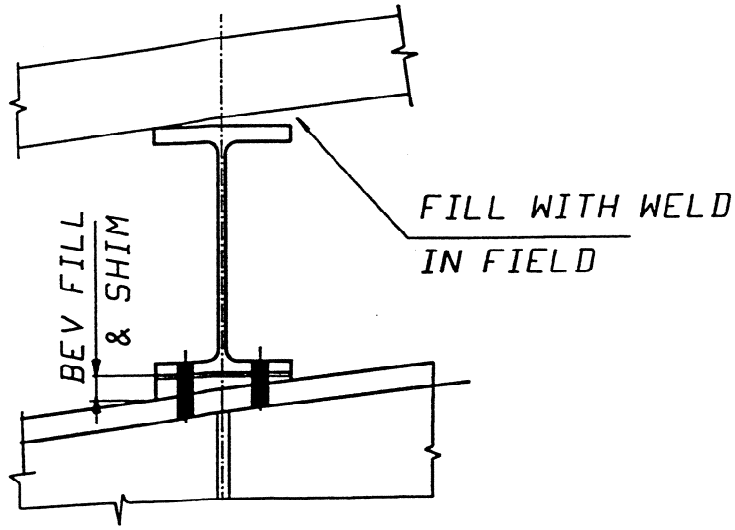
Last but not least when writing the specifications for a project do not go overboard in describing the exact methods and procedures to be used during the fabrication and assembly process. Every fabricator has methods which work best for their shop and since the final responsibility for the fit and operation belongs to the contractor and their subcontractors , the actual methods used must be left up to them providing it conforms to the specifications.



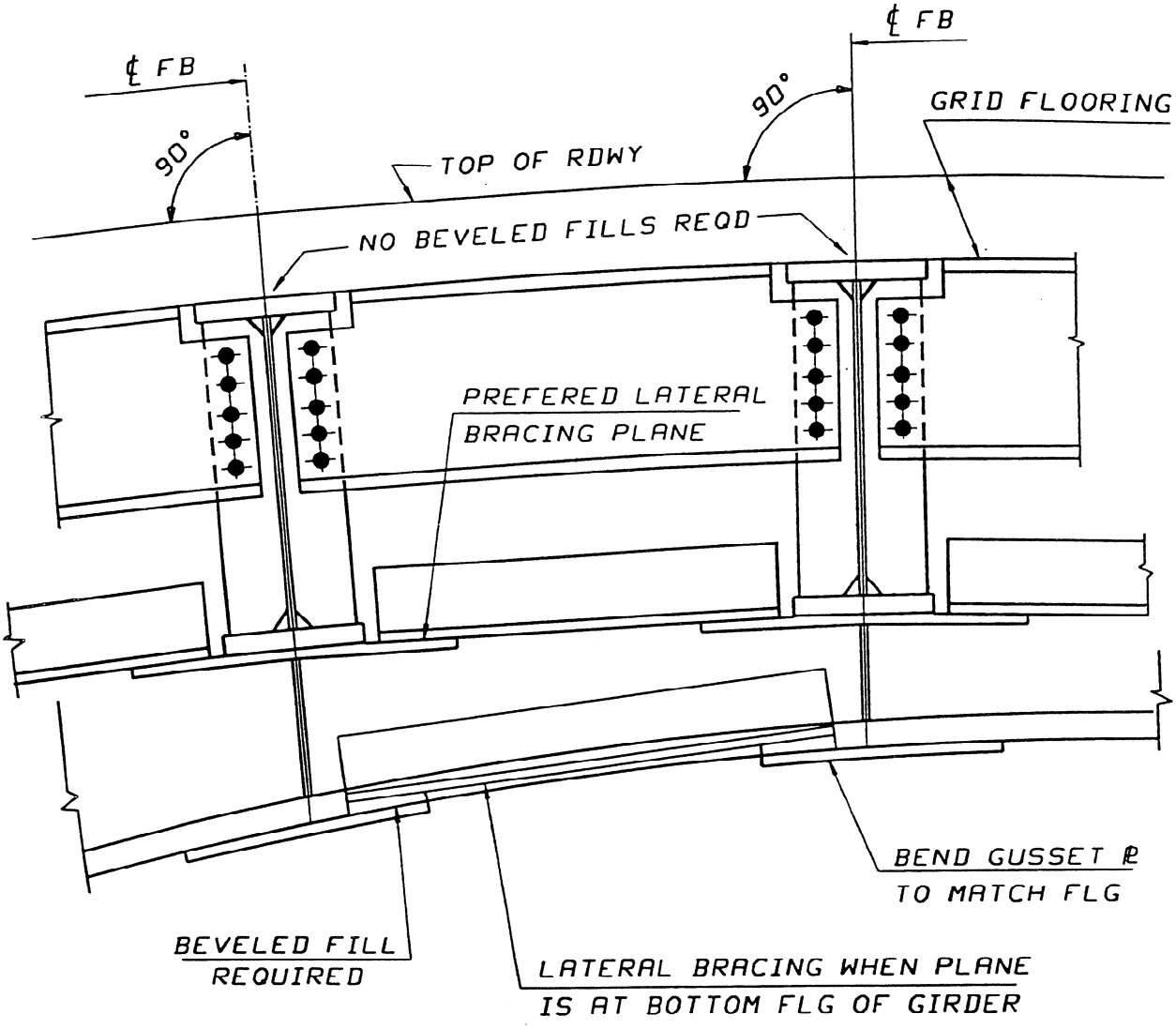
WHEN STRINGER SITS ON FB | WHEN STRINGER FRAMES INTO FB

WHEN BASCULE SPAN HAS A CROSS SLOPE

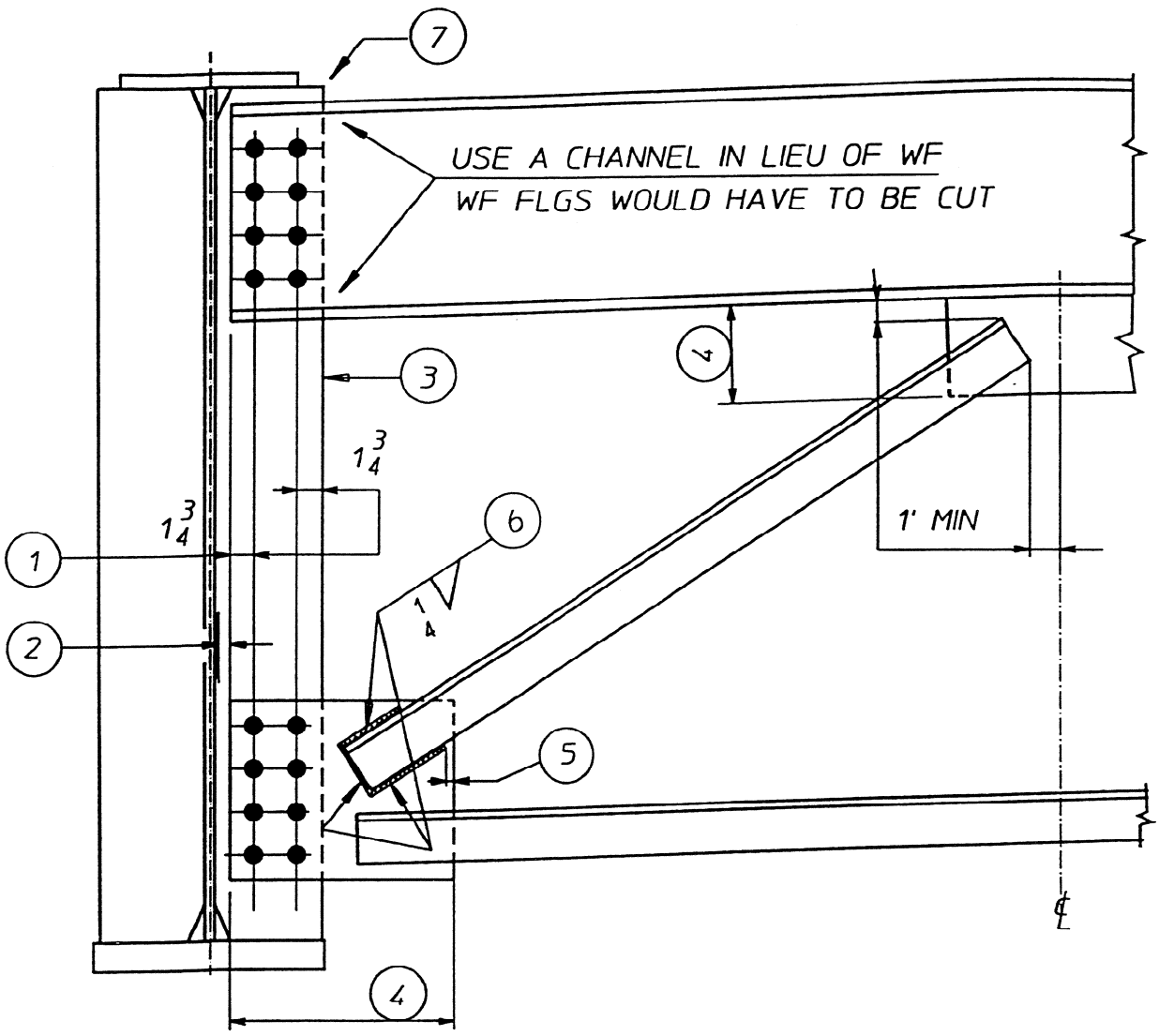
WHERE EVER POSSIBLE KEEP DECK LEVEL TRANSVERSELY WHICH WILL MAKE THE WEBS OF THE STRINGERS VERTICAL.



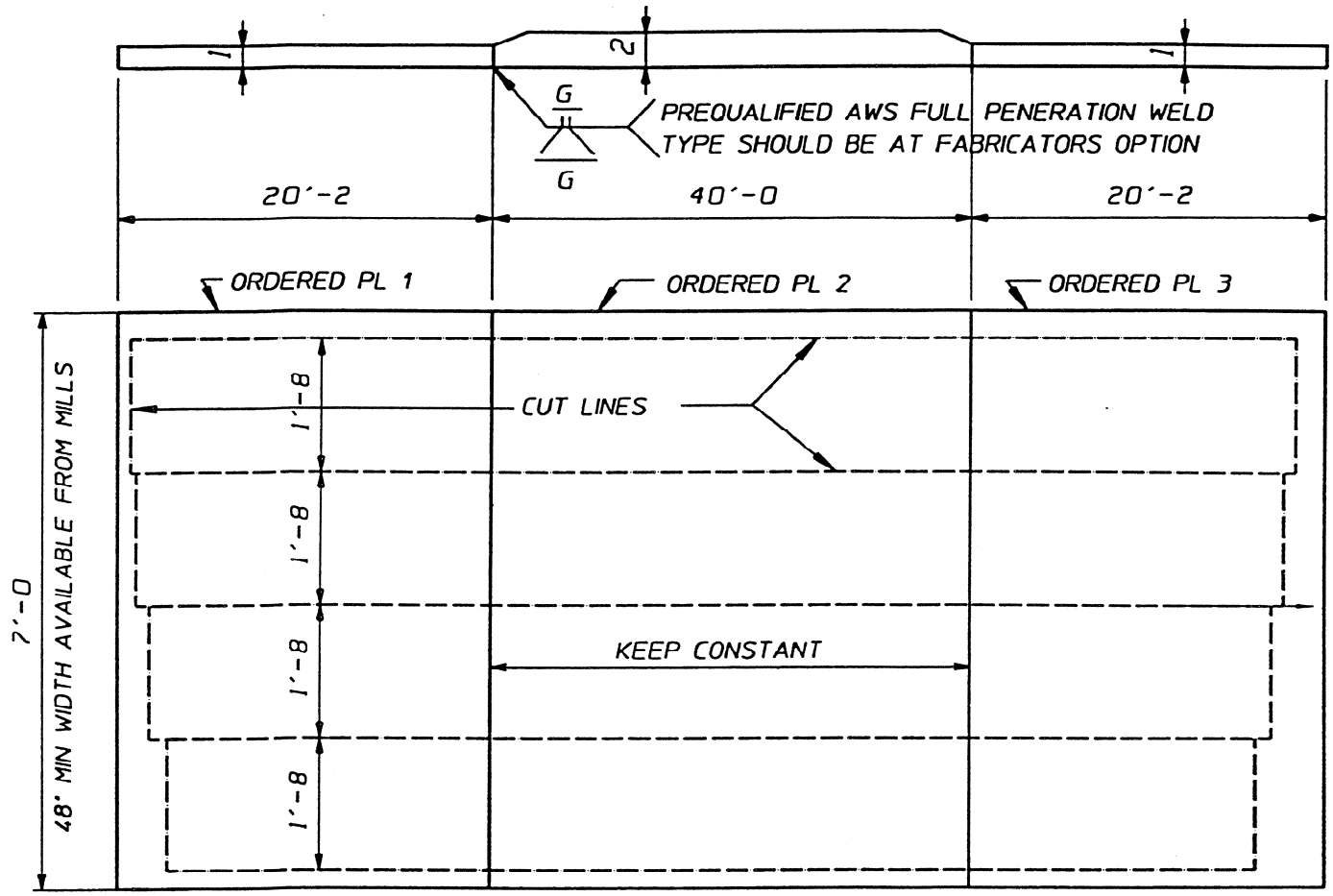
AVOID THIS DETAIL



WHEN THE FLOORBEAMS ARE SET NORMAL TO GRADE , BEVELED BILLS CAN BE ELIMINATED. THIS ALSO APPLIES TO THE LATERAL BRACING PLATES WHEN THE BRACING PLANE IS LOCATED AT THE BOTTOM FLANGE OF THE FLOORBEAMS.



1. PROVIDE FOR PREFERED EDGE DISTANCES EG: $1\frac{3}{4}$ FOR $\frac{7}{8}$ DIA BOLTS.
2. PROVIDE $\frac{1}{2}$" MINIMUM CLEARANCE FROM EDGE OF FILLET WELD
3. INCLUDE ALLOWANCES FOR NOTES 1 & 2 IN DETERMINING STIFFNENER WIDTH.
   NORMALLY A $7\frac{1}{2}$" WIDE STIFFENER IS REQD FOR THE CONNECTION SHOWN.
4. KEEP GUSSET PLATES RECTANGULAR
5. TERMINATE WELDS $\frac{1}{2}$" SHORT OF EDGE
6. AVOID ALL AROUND WELDS , OMIT WELD ON FAR SIDE.
7. AVOID CLIPS ON STIFFENER AND LOWER CHANNEL TO AVOID COPING.



SLABBING AND STRIPPING

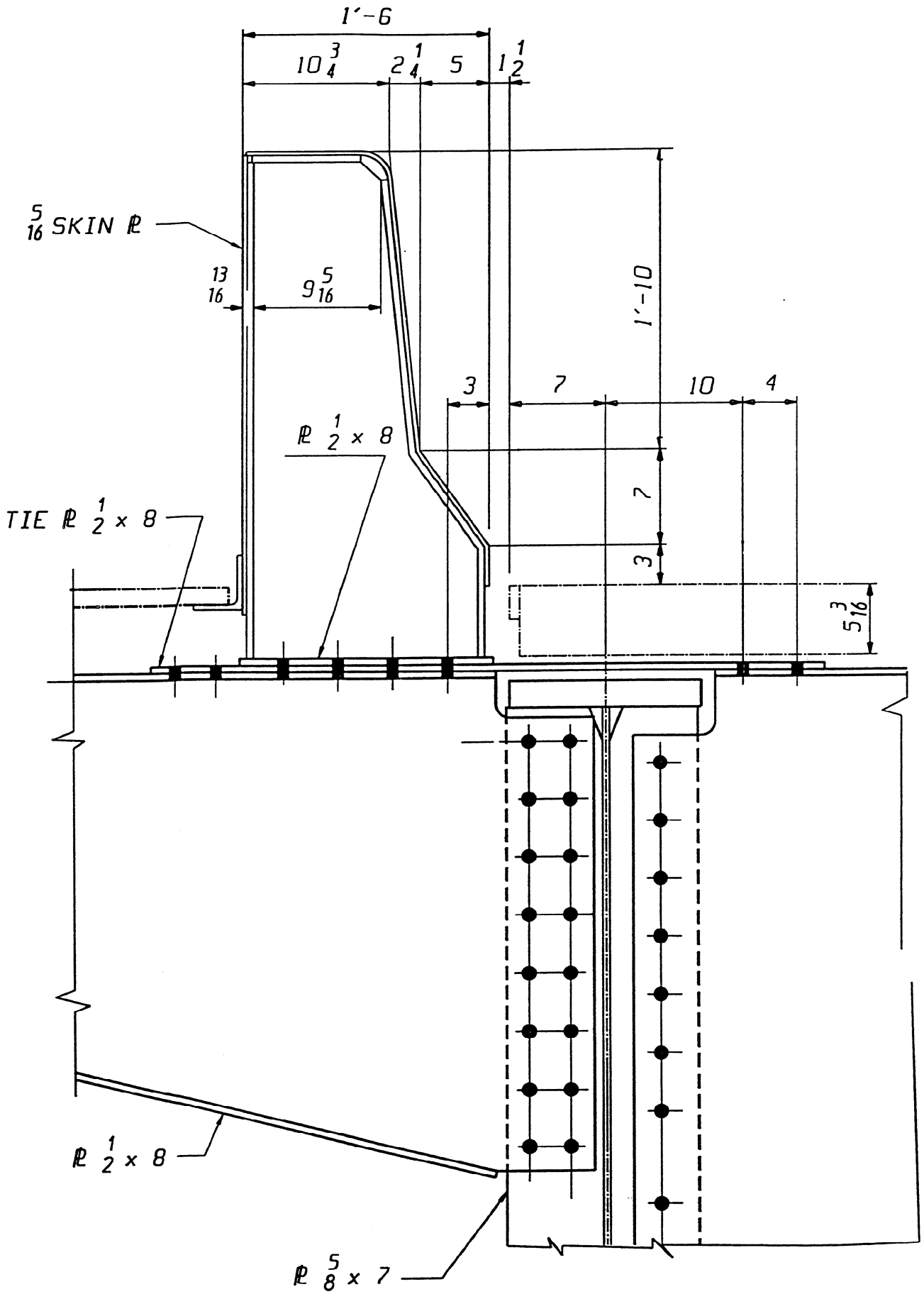
THE STEEL MILLS NO LONGER ROLL PLATES IN WIDTHS LESS THAN 48 INCHES. THE FABRICATORS ARE REQUIRED TO COMBINE PLATES AND NEST THEM IN ORDER TO ECONOMIZE AND REDUCE SCRAP.

THE ORDERED PLATE ENDS ARE PREPARED AND THEN WELDED TOGETHER . AS SHOWN . THE INDIVIDUAL FLANGE PLATE ASSEMBLIES ARE THEN FLAME CUT TO THEIR FINISHED WIDTHS BY MULTIPLE TORCHES. NON-DESTRUCTIVE TESTING IS PREFORMED PRIOR TO THE FLANGE PLATE ASSEMBLIES BEING WELDED TO THE WEB PLATES .

1 ~ AVOID TRANSITIONS IN FLANGE WIDTH IN ANY ONE GIRDER (VARY THICKNESS INSTEAD) THIS WILL ELIMINATE EXTENSION TABS AND RUN-OFF BARS.

2 ~ AVOID CHANGING FLANGE PLATE THICKNESSES . IT MAYBE MORE ECONOMICAL TO EXTEND THE THICKER FLANGE . THE COST OF A SPLICE MAY EXCEED THE MATERIAL COSTS.

IN THE ABOVE SKETCH THE COST OF SPLICING THE SLAB WHICH INCLUDES HANDLING, BEVELING, GRINDING AND TESTING, WOULD BE ABOUT 1000 DOLLARS LESS THAN FABRICATING ONE INDIVIDUAL FLANGE PL ASSEMBLY AT A TIME.


1'-6
10 3/4
2 1/4
5
1 1/2
5/16 SKIN PL
13/16
9 5/16
1'-10
3
7
10
4
PL 1/2 x 8
TIE PL 1/2 x 8
7
3
5 3/16
PL 1/2 x 8
PL 5/8 x 7

PAGE NO. "E"