Agenda Item:	650-1092

Title:	**Backing Bar Foundation Notches**	
Date:	November 13th, 2020	
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Purpose:	Inquiry INQ-650-D125 requested clarification as to whether a notch is required in a concrete ringwall or slab so that the backing bar does not come into contact with the concrete.	
Source:	INQ-650-D125	
Revision:	2	
Impact:	The business impact of this item is minimal, but would require foundation contractors to do additional forming during construction so that notches in the foundation will not support the back up bar, but will support the bottom plates.	
Rationale:	Although not addressed in the main body of API 653, Annex E – Section E.7.1.c specifically states for Self-Anchored tanks that are subject to seismic loading, uniform support of the tank bottom shall be provided by a)…, b)…. or c) **Using double butt-welded bottom or annular plates resting directly on the foundation. Annular plates or bottom plates under the shell may utilize back-up bar welds if the foundation is notched to prevent the back-up bar from bearing on the foundation.** Many tanks in the industry are being installed with an annular rings, whether required for seismic or high strength steel. When a butt welded bottom or annular ring is being required or requested by tank owner, uniform support of the tank bottom plates should be provided, not only for seismic consideration but for static loading. Back-up bars resting directly on concrete have caused excessive point loading on the top of ringwalls and slabs, and during expansion and contraction can even cause a groove to be worn in the concrete. Once a groove is worn, there is the possibly for "blow out" or "spalling" at the edge of the ringwall or slab due to horizontal forces being exerted on the top of the wall. Examples of this can be found at the end of the report. This agenda item is suggesting that notches that are the depth of the backup bar be utilized for butt welded bottoms or annular rings, with back-up bars, on ringwalls or slabs be required by API 650 main body.	
Proposal:	Add the following statement to API 650 Section 5.1.5.6. Since back up bars utilized in a complete butt welded bottom may not be "radial" where the shell bears on the tank bottom plates, modification to 5.1.5.5 is not recommended. If the back-up bars are placed in a notch, they could possibly cause radial loads due to expansion, so notching of a complete bottom would not be required in Section 5.1.5.5, similar to that of 5.1.5.6. **Current Wording**: 5.1.5.6 Bottom Annular-Plate Joints Bottom annular-plate radial joints shall be butt-welded in accordance with 5.1.5.5 and shall have complete penetration and complete fusion. The backing strip, if used, shall be compatible for welding the annular plates together. **Continued on next page.**	

Proposed Working In Red

5.1.5.6 Bottom Annular-Plate Joints

Bottom annular-plate radial joints shall be butt-welded in accordance with 5.1.5.5 and shall have complete penetration and complete fusion. The backing strip, if used, shall be compatible for welding the annular plates together.

Note: See Annex B, 4.2.4 for further commentary regarding resting tank bottoms under the tank shell directly on top of concrete.

Current Wording:

E.7 Detailing Requirements

E.7.1 Shell Support.

Self-anchored tanks resting on concrete ring walls or slabs shall have a uniformly supported annulus under the shell. The foundation must be supplied to the tolerances required in 7.5.5 in order to provide the required uniform support for Item b, Item c, and Item d below. Uniform support shall be provided by one of the following methods.

a) Shimming and grouting the annulus.
b) Using fiberboard or other suitable padding.
c) Using double butt-welded bottom or annular plates resting directly on the foundation. Annular plates or bottom plates under the shell may utilize back-up bar welds if the foundation is notched to prevent the back-up bar from bearing on the foundation.

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a) Shimming and grouting the annulus.
b) Using fiberboard or other suitable padding.
c) Using double butt-welded bottom or annular plates resting directly on the foundation. Unless item a) or b) above is being utilized, annular plates or bottom plates (with radial joints) under the shell may utilize back-up bar welds if the foundation is notched to prevent the back-up bar from bearing on the foundation.

Note: See Annex B, 4.2.4 for further commentary regarding resting tank bottoms under the tank shell directly on top of concrete.

	Annex B **B.4.2.4** Options under the shell. Considerations shall be given to the trapping of moisture under the tank bottom that can lead to underside corrosion. Refer to E.7.1 for additional seismic considerations. a) Place steel directly on concrete (See Note Below) b) 13 mm (1/2 in.) asphalt impregnated fiber board. c) Shimming and grout. d) Other suitable materials selected by agreement between the Purchaser and manufacturer. Note: Per E.7.1, the bottom plates under the tank shell are to be provided with a uniformly supported annulus. Per E.7.1 c), consideration for notching of the top of the concrete for radial butt welded tank bottom plates or annular plates should be considered, when utilizing back up bars. If a notch is utilized, the notch shall be equal to the depth of the back-up bar and the width plus ¼" to allow for installation tolerances. If notches are not utilized for lap welded bottoms, annular bottoms with back up bars and double butt welded bottoms (with minimal reinforcing on the bottom side), grooves can develop on the top of the concrete due to expansion and contraction. After the groove develops a "lip" near the outer edge, the bottom edges of the tank bottom can impart a load on the outside of the groove. These outward radial load can cause cracking or spalling of the tank foundation. Complete butt welded tank bottoms with non-radial back up bars should use grout or other suitable material to provide uniform support with consideration for forces resulting from thermal expansion of the tank bottom, in lieu of notches.

Figure 1 - Photograph shows a back up bar resting on a foundation without notches. This shows the groove that developed during construction due to thermal expansion and contraction.

Figure 2- This photograph shows the result of not having the ringwall notched. The groove worn during construction caused outside edge of the back-up bar to "catch" and when the bottom/tank expanded, it caused a lateral loading on the top of the ringwall, thus spalling a large area.