TITLE: rafter spacing

DATE: 11/20/06 revision 4
       11/11/06 revision 3
       10/26/06 revision 2
       6/13/06 revision 1
       5/1/06 revision 0

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PURPOSE: To provide for the design of rafter spacing with live load in excess of 25 psf and to allow rafter spacing up to 84''.

SOURCE: Inquiry by the sponsor at the Fall 2005 meeting during 'new business'.

BUSINESS IMPACT: Business impact is low. There will be slightly fewer rafters for 3/16'' plate/25 psf LL and more rafters as the loading is increased. Current rules do not address thicker roof plates, corrosion allowance, and load combinations.

RATIONALE: AWWA D100 introduced an equation for rafter spacing, allowing up to 84'' rafter spacing, 10 years ago. Also this same equation was used to create the grillage spacing equation in API 650 (addm 2005) section I.7.3. This equation can be used to account for heavier roof loadings and alternate roof thicknesses. It is appropriate for use on API 650 column-supported roofs.

Comments from May 2, 2006 PVT meeting:

The equation proposed at this meeting is the same as the equation already being used in I.7.3.1 (10th ed. Addm. 3). It was suggested that this equation, which is a uniformly loaded beam with fixed ends, be altered to be unitless and contain Fy and p to allow application of load combinations and multiple material types.

The original equation, \( f = (1/2) p (b^2/t^2) \) can be re-written as

\[
(2/3)(0.75)(p/Fy)(b/t)^2 \leq 1
\]

by setting f to be less than or equal to \((0.66)(3/4) Fy\).

Comments from October 31, 2006 SCAST-SGD meeting:

This agenda item was passed to publication as noted

1. B Mistry's negative ballot was withdrawn without changing the proposed wording after he joined into our discussion and we reached an understanding of everyone's concerns.
2. J McBride's editorial affirmative comment was added (add the word "by" after "multiplied") to M.3.3.
3. re-write the spacing equation, per R Kissell's positive comment, to be "dimensionless".

Review comment after october31, 2006 SCAST-SGD meeting:
1. The value 2133mm was revised to be 2100 mm to be consistent with metrification guidelines.

PROPOSED WORDING CHANGE:

3.10.4.4 Rafters shall be spaced so that, in the outer ring, their centers are not more than 0.6\pi \text{-m} \ [2\pi \text{-ft} \ (6.28 \text{-ft})] apart measured along the circumference of the tank. Spacing of the inner ring shall not be greater than 1.7 \text{-m} \ (5.12 \text{-ft}). to satisfy

\[
\frac{2}{(2/3)(0.75)(p/F_y)}(b/t)^2 \leq 1
\]

\[
b = t (1.5 F_y/p)^{1/2} \leq 2100 \text{ mm (84 in.)}
\]

where

- \(b\) = maximum allowable rafter spacing, roof plate span, measured circumferentially from center-to-center of rafters, and shall not exceed 2133 mm (84 in.), mm (in.).
- \(F_y\) = specified minimum yield strength of roof plate, MPa (psi).
- \(t\) = corroded roof thickness, which is nominal plate thickness minus corrosion allowance, if any, mm (in.).
- \(p\) = uniform pressure as determined from load combinations described in Appendix R, MPa (psi).

Remainder of paragraph 3.10.4.4 is unchanged.

ADD

M.3.3 For operating temperatures exceeding 90°C (200°F), the yield strength \(F_y\) in 3.10.4.4 shall be multiplied by the applicable reduction factor given in Table M-1.

Remumber existing M.3.3 thru M.3.8 (10th ed. Addm 4 #).

ADD

S.3.4 ROOF DESIGN AND ROOF MANHOLES

S.3.4.1 The yield strength given in Table S-5 shall be used for \(F_y\) in 3.10.4.4.

S.3.4.2 All stainless steel components of the roof manhole shall have a minimum thickness of 5 mm (3/16 in.).