(f) In UHX-13.5.7 (Step 7), replace the formula for $Q_2$ with:

$$Q_2 = \left( \frac{\omega_2 R_s - \omega_2 p_t}{1 + \Phi Z_m} \right)$$

(g) In UHX-13.5.11 (Step 11), replace the equations for $\sigma_{s,b}$ and $\sigma_{c,b}$ with:

$$\sigma_{s,b} = \frac{6}{\ell_s^2} k_b \left[ \frac{\delta s}{E s} + \frac{a_s^2}{E s} R_s^2 \right] + \frac{6(1 - v^2)}{E_s}$$

$$\sigma_{c,b} = \frac{6}{\ell_c^2} k_c \left[ \frac{\delta c}{E c} + \frac{a_c^2}{E c} R_c^2 \right] - \frac{6(1 - v^2)}{E_c}$$

**UHX-13.9 Calculation Procedure for Simply Supported Fixed Tubesheets**

**UHX-13.9.1 Scope.** This procedure describes how to use the rules of UHX-13.5 when the effect of the stiffness of the integral channel and/or shell is not considered.

**UHX-13.9.2 Conditions of Applicability.** This calculation procedure applies only when the tubesheet is integral with the shell or channel (configurations a, b, and c).

**UHX-13.9.3 Calculation Procedure.** The calculation procedure given in UHX-13.5 shall be performed accounting for the following modifications.

(a) Perform Steps 1 through 10.

(b) Perform Step 11 except as follows:

1. The shell (configurations a, b, and c) is not required to meet a minimum length requirement. The shell is exempt from the minimum length requirement in UHX-13.6.4(a).

2. The channel (configuration a) is not required to meet a minimum length requirement.

3. Configuration a: If $\sigma_s \leq S_{PS,s}$ and $\sigma_c \leq S_{PS,c}$ the shell and channel are acceptable. Otherwise, increase the thickness of the overstressed component(s) (shell and/or channel) and return to Step 1.

   (c) Do not perform Step 12.

   (d) Repeat Steps 1 through 7 for the design loading cases, with the changes to Step 2, until the tubesheet stress criteria have been met:

   Configurations a, b, and c: $\beta_s = 0$, $k_s = 0$, $\lambda_s = 0$, $\delta_s = 0$.

   Configuration a: $\beta_c = 0$, $k_c = 0$, $\lambda_c = 0$, $\delta_c = 0$.

   (f) In UHX-13.10 Calculation Procedure for Kettle Shell Exchangers With Fixed Tubesheets

**UHX-13.10.1 Scope.** This procedure describes how to use the rules of UHX-13.5 when an eccentric cone and small cylinder exist between the large shell side cylinder and the tubesheet on both sides.

**UHX-13.10.2 Conditions of Applicability.**

(a) The two eccentric cones are identical in geometry and material.

(b) The small shell cylinders adjacent to the tubesheet are identical in geometry and material. They shall meet the length requirements of UHX-13.5.11(a) unless the simply supported rules of UHX-13.9 are applied. The rules of UHX-13.6 shall not be used. The rules of UHX-13.8 may be used only if the length requirements of UHX-13.5.11(a) are met by the small shell cylinders.

(c) This procedure applies only when $\theta_{ecc} \leq 30$ deg.

This procedure accounts for the stiffness and loadings in the shell of the eccentric cones used in the design of the tubesheet. This procedure does not evaluate the acceptability of the shell-to-cone transition. Other requirements in this Division pertaining to shell-to-cone transitions shall be satisfied [e.g., UW-3(b), 1-5, and 1-8].

(d) This procedure applies only when $0.5 \leq \frac{L_{ecc}}{D_{ecc,s}} \leq 1.5$.

(e) This procedure applies only when $D_{ecc,L} \leq 2.17D_{ecc,s}$.

(f) These rules assume that an expansion joint, if present, is located in the small shell cylinder.

(g) For cone-to-cylinder junctions without a transition knuckle, use the following for design cases (pressure-only cases) in 1-5. The cone-to-cylinder junctions do not need to be evaluated for the operating cases (cases including differential thermal expansion).

$$f_1 = f_1' + f_1''$$

$$f_2 = f_2' + f_2''$$

where

$$f_1' = \sigma_{ecc,L,mf_{ecc} \cos \theta_{ecc} - \frac{pD_{ecc,L}}{4}}$$

$$f_2' = \sigma_{ecc,S,mf_{ecc} \cos \theta_{ecc} - \frac{pD_{ecc,S}}{4}}$$

(h) For cone-to-cylinder junctions without a transition knuckle, use the following for design cases (pressure-only cases) in 1-8. The cone-to-cylinder junctions do not need to be evaluated for the operating cases (cases including differential thermal expansion).

$$f_1 = f_1' + f_1''$$