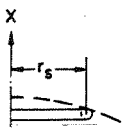
Predicting Flow Induced Vibration

in U Bend Regions of Heat Ex

changers: An Engineering Solution

It is now generally recognized that the liquid flow induced vibrations are


X
r_s

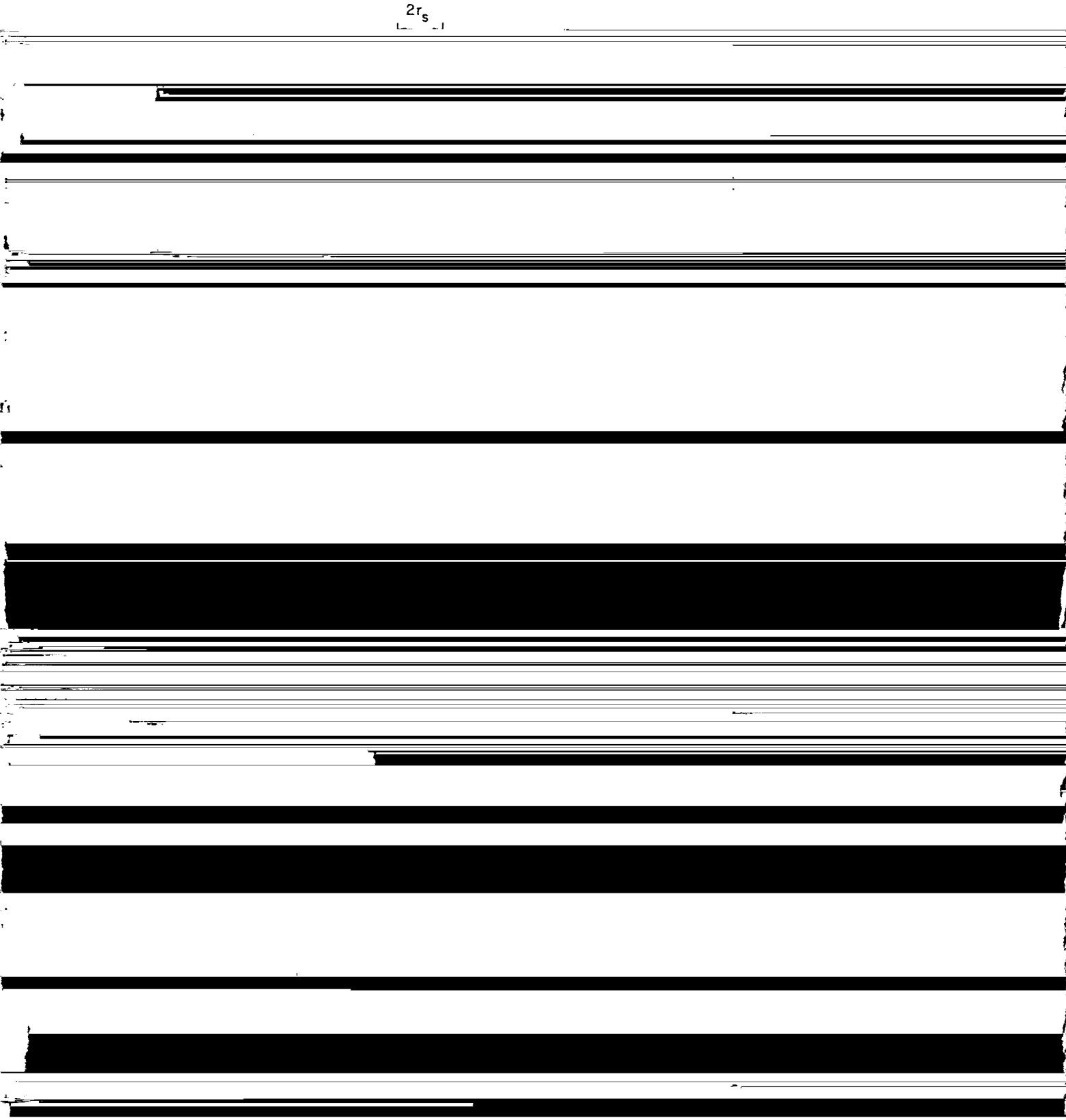


FIG. 3. Double segmental baffle shapes.

R is the outer bundle radius, η is the perforation coefficient of the bundle surface defined as

$$\eta = \frac{p-d}{p} \tag{11}$$

where p and d are the transverse tube pitch and tube O.D., respectively. A_{ss} is

the surface area of a semi-circular cylinder of radius r_s, and length $2(R_s - x')$, where R_s denotes the inside radius of the shell. Substituting for a from Eq. (9)

where

$$\xi = \frac{R_s}{} \qquad (22)$$

ξ is close to 1 for most practical designs. Equation (21) determines C. The velocity profile follows from Eq. (9), which cast in a more direct form below.

$$q = \frac{C}{\left[1 + \omega\chi(N-1)\left(1 - 1\right) + \omega\left(1 + 1\right)\right]^{1/2}} \qquad (23)$$

where q is the volumetric flow rate through a stratum of unit width, and outer radius y. Hence, the velocity $V(y, r)$ at bend radius r in the stratum of outer radius y is given by

where

$$\alpha = \sin^{-1} \rho \tag{33}$$

or

$$Q = 2\pi R^2 V^* [0{\cdot}5\eta\{\alpha + 0{\cdot}5 \sin 2\alpha\} + \frac{1}{\chi}\{\xi - (1-\chi^{-2})^{1/2}\}]. \tag{34}$$

Equation (34) determines V^*.

IV. Example

In terms of S, the vortex shedding frequency is given by

$$f = \frac{SV}{d} \tag{35}$$

where V is the corresponding flow velocity, and d is outside tube diameter. The

flow velocity at $R = 11.8$ in. is found to be 70.1 in./sec. Hence Eq. (35) yields

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