Referring now to Fig. 7.

The same method may be adopted by using Equation 20, and for Δ' substitute $(S_o - S') \frac{A}{2}$, finding S' by Equation 39.

Referring to Fig. 8.

Equation 21 must be used and for Δ' substitute $(S_o - S') \frac{A}{2}$, finding S' by Equation 43.

Transverse shear may be found as follows:—

Referring to Fig. 1. M = bending moment at centre of column. Then,

$$M = P\Delta. \quad \text{[Equation 29.]}$$

Total stress in one channel due to M is

$$(S_o - S_1) \frac{A}{2},$$

Therefore, $\frac{P\Delta}{D'} = (S_o - S_1) \frac{A}{2}$,

and $P\Delta = D' (S_o - S_1) \frac{A}{2}$. [Equation 30.]

Also, $m = Py$. [Equation 31.]

Substitute for y the value given in Equation 19, then

$$m = P\Delta \sin \pi \frac{x}{l}. \quad \text{[Equation 32.]}$$

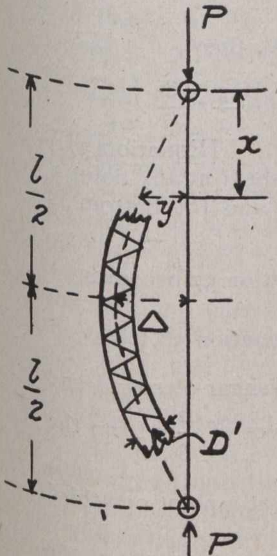

Fig. 1.
Round ends.
$n = 1$.

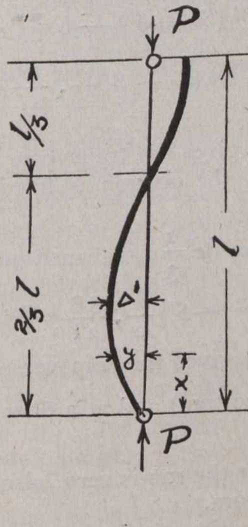

Fig. 7.
Top fixed,
bottom round.
$n = 3/2$.

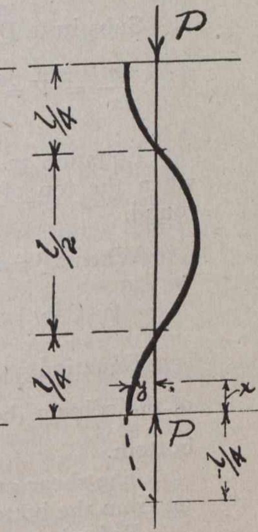

Fig. 8.
Both ends
fixed.
$n = 2$.

We know that $\frac{dm}{dx} = V$, where V is the shear. Differentiating Equation 32 we get

$$dm = P\Delta \cos \pi \frac{x}{l} \; \frac{\pi\, dx}{l}, \text{ or}$$

$$\frac{dm}{dx} = P\Delta \frac{\pi}{l} \cos \pi \frac{x}{l} = V. \quad \text{[Equation 33.]}$$

Equation 33 gives the transverse shear at any point x, and if $x = 0$, we get

$$V = P\Delta \frac{\pi}{l}. \quad \text{[Equation 34.]}$$

If, in Equation 34, for $P\Delta$ is substituted value found in Equation 30, then Equation 34 becomes

$$V = D' (S_o - S_1) \frac{A}{2} \frac{\pi}{l}. \quad \text{[Equation 35.]}$$

Equation 35 gives transverse shear; round ends.

Referring to Fig. 10, Cambria gives the following values with reference to axis 2-2:—

7″ channel	$D' = 6\frac{3}{4}$″	$r = 2.8$	$A = 5.7$
10″ „	$D' = 9\frac{1}{4}$″	$r = 3.83$	$A = 8.92$
12″ „	$D' = 11\frac{1}{4}$″	$r = 4.64$	$A = 12.06$
15″ „	$D' = 13\frac{1}{4}$″	$r = 5.61$	$A = 19.8$

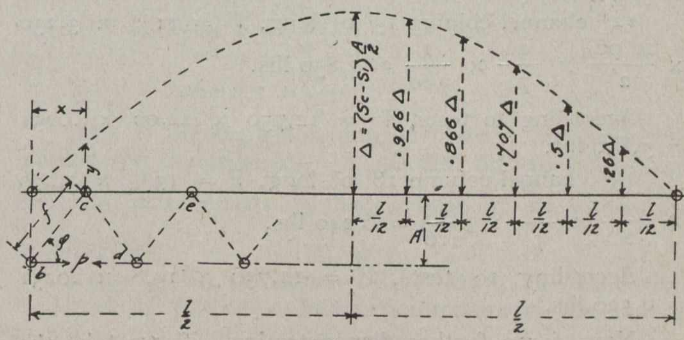

Fig. 9.

When $l = 9' \, 0''$, then for 7″ channel columns,

$$\frac{l}{r} = 38.6, \quad \frac{l^2}{r^2} = 1{,}490.$$

When $l = 12' \, 0''$, then for 10″ channel columns,

$$\frac{l}{r} = 37.6, \quad \frac{l^2}{r^2} = 1{,}414.$$

When $l = 15' \, 0''$, then for 12″ channel columns,

$$\frac{l}{r} = 38.8, \quad \frac{l^2}{r^2} = 1{,}465.$$

When $l = 18' \, 0''$, then for 15″ channel columns,

$$\frac{l}{r} = 38.6, \quad \frac{l^2}{r^2} = 1{,}490.$$

The above values for $\frac{l}{r}$ are very nearly what is given in Bulletin No. 44 for column No. 1, which was $\frac{l}{r} = 37.8$.

Substituting above values in Equation 23, the following is found for S':—

7″ channel column 9′ 0″ long, $S' = 12{,}730$;
therefore $(S_o - S_1) = 3{,}270$.
10″ channel column 12′ 0″ long, $S' = 12{,}850$;
therefore $(S_o - S') = 3{,}150$.
12″ channel column 15′ 0″ long, $S' = 12{,}750$;
therefore $(S_o - S') = 3{,}250$.
15″ channel column 18′ 0″ long, $S' = 12{,}730$;
therefore $(S_o - S_1) = 3{,}270$.

Substituting above values for D' and $(S_o - S')$ in Equation 35, we get for the transverse shear V, the following:—

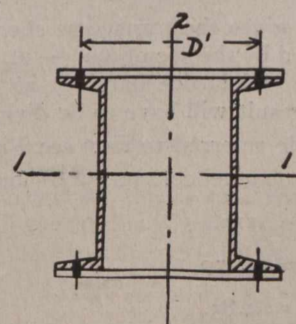

Fig. 10.

7″ channel column 9′ 0″ long, $V = 6\frac{3}{4} \times 3{,}270 \times \frac{5.7}{2} \times \frac{22}{7} \times \frac{1}{108} = 1{,}830$ lbs.