Load Distribution

Description	Calculation of demand accounting for load distribution
Reference	PCI Manual for the Design of Hollow Core slabs and Wall, 3rd Edition MNL126-15

Givens:

Beam Length	$l_{beam} := 30\ ft$
Beam Width	$w_{beam} := 8\ ft$
Cross Section Area	$A := 692.6\ in^2$
Unit Weight	$w_c := 150\ lbf\ ft^{-3}$
Self Weight	$w_{sw} := A \cdot w_c = 0.7215\ \frac{kip}{ft}$
Midspan Concentrated Load	$P_{cl} := 15\ kip$

Two distribution factors are calculated, one for the center 50% of the beam and one for the ends of the beam. The end value varies linearely to be the center value over the first 25% of the member.

Midspan Distribution Factor	$factor_{center} := \frac{w_{beam}}{0.5 \cdot l_{beam}} = 0.5333$
End Distribution Factor	$factor_{end} := \frac{w_{beam}}{4\ ft} = 2$

End Shear:

Concentrated Load Shear	$V_{cl} := \frac{P_{cl}}{2} = 7.5\ kip$
Self Weight Shear	$V_{sw} := \frac{w_{sw} \cdot l_{beam}}{2} = 10.8219\ kip$
Modified Total Shear	$V_u := \frac{V_{sw}}{w_{beam}} + \frac{V_{cl} \cdot factor_{end}}{w_{beam}} = 3.2277\ \frac{kip}{ft}$
Base Total Shear	$V_{u.base} := \frac{V_{sw} + V_{cl}}{w_{beam}} = 2.2902\ \frac{kip}{ft}$
Change in Shear	$V_{\%.change} := \frac{V_u}{V_{u.base}} = 140.93\ \%$

Midspan Moment:

Concentrated Load Moment	$M_{sw} := \frac{w_{sw} \cdot l_{beam}^2}{8} = 81.1641\ kip\ ft$
Concentrated Load Shear	$M_{cl} := \frac{P_{cl} \cdot l_{beam}}{4} = 112.5\ kip\ ft$
Modified Total Moment	$M_u := \frac{M_{sw}}{w_{beam}} + \frac{M_{cl} \cdot factor_{center}}{w_{beam}} = 17.6455\ \frac{kip\ ft}{ft}$
Base Total Moment	$M_{u.base} := \frac{M_{sw} + M_{cl}}{w_{beam}} = 24.208\ \frac{kip\ ft}{ft}$
Change in Moment	$M_{\%.change} := \frac{M_u}{M_{u.base}} = 72.8912\ \%$