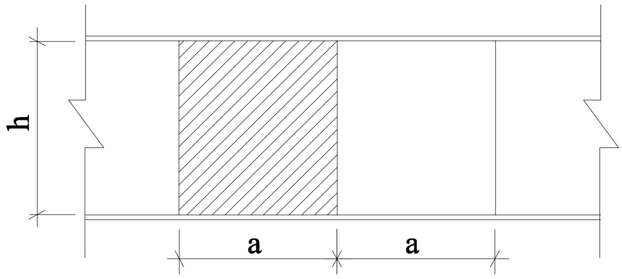
Design of Interior Panel of Built-Up Girder with Transverse Stiffeners Subjected to Shear Force



Materials

Grade:	SEL("Material/ASTM"; NAME;)	=	A36
F_y=	TAB("Material/ASTM";F_y;NAME=Grade)	=	36 ksi
E=			29000 ksi

Loads

The required shear strength at the start of this panel from the end , V_u:

V_u=	120 kips

Section Details

Depth, d=	36 in
Web thickness, t_w=	0.3125 in
Clear distance between stiffeners, a=	99 in
Upper flange width, b_{fc}=	12 in
Upper flange thickness, t_{fc}=	1.50 in
Lower flange width, b_{ft}=	12.00 in
Lower flange thickness, t_{ft}=	1.50 in

Shear Strength for this Panel

h=	$d-t_{fc}-t_{ft}$	=	33.00 in
ψ=	a/h	=	3.00
k_{v1}=	$5+(5/\psi^2)$	=	5.56

Based on AISC Specification Section G2.1, k_v=5 when a/h>3 or a/h>$[260/(h/tw)]^2$

λ_w=	h/tw	=	106
ψ_1=	$(260/\lambda_w)^2$	=	6.02
Use k_v=	IF(ψ>3 AND ψ>ψ_1;5;k_{v1})	=	5.56
λ_{w1}=	$1.10*\sqrt{(k_v*E/F_y)}$	=	74
λ_{w2}=	$1.37*\sqrt{(k_v*E/F_y)}$	=	92

Calculate C_v according to Eqns. G2-2, G2-3, G2-4 and G2-5:

C_{v1}=	IF($\lambda_w \le \lambda_{w1}$;1;IF($\lambda_w > \lambda_{w1}$ AND $\lambda_w \le \lambda_{w2}$;$\lambda_{w1}/\lambda_w$;$1.51*k_v*E/(F_y*\lambda_w^2)$))	=	0.60

Check the additional limits from AISC Specification Section G3.1 for the use of tension field action:

A_w=	$d*t_w$	=	11.3 in^2
η=	$\frac{A_w*2}{b_{fc}*t_{fc}+b_{ft}*t_{ft}}$	=	0.63
ν_{fc}=	$\frac{h}{b_{fc}}$	=	2.75
ν_{ft}=	$\frac{h}{b_{ft}}$	=	2.75
Check_TF=	IF(ψ>MIN(3;ψ_1) AND η>2.5 AND ν_{fc}>6 AND ν_{ft}>6;"1";"2")	=	2
Case=	IF(Check_TF="1";"NP";"P")	=	P

"P": permitted and "NP": not permitted

Calculate C_v and V_n, according to Section G3-2a and b:

C_{v2}=	$IF(\lambda_w\leq\lambda_{w1};1;(C_{v1}+\frac{1-C_{v1}}{1.15*\sqrt{1+\left(\frac{a}{h}\right)^2}}))$	=	0.71

Nominal shear strength:

V_n=	IF(Case="PERMITTED";$0.6*F_y*A_w*C_{v2}$;$0.6*F_y*A_w*C_{v1}$)	=	146 kips
Φ_v=			0.90
Φ_vV_n=	Φ_v*V_n	=	131 kips
Shear_safety=	IF($\Phi_v*V_n>V_u$;"Safe";"Unsafe")	=	Safe
Force_ratio=	Vu/Φ_vV_n	=	0.92

Design Summary

V_u=			120 kips
Φ_vV_n=	Φ_v*V_n	=	131 kips
Force_ratio=	Vu/Φ_vV_n	=	0.92
Shear_safety=	IF($\Phi_v*V_n>V_u$;"Safe";"Unsafe")	=	Safe