

Appendix J: Floor Beam and Girder Design

FB1 Design:

$$l_{FB1} := 35 \text{ ft}$$

$$w_{dead} := 60.1 \text{ psf} \cdot 8 \text{ ft} = 480.8 \text{ plf}$$

$$w_{live} := 150 \text{ psf} \cdot 8 \text{ ft} = (1.2 \cdot 10^3) \text{ plf}$$

$$LCC := 1.2 \cdot w_{dead} + 1.6 \cdot w_{live} = 2.497 \text{ klf}$$

VMΔ
Case 1

$$M_u := \frac{(LCC \cdot l_{RB1}^2)}{8} = 382.347 \text{ ft} \cdot \text{kip}$$

$$L_{brace} := 0 \text{ ft}$$

$$\therefore Z_X$$

Try W21x48:

$$\phi M_p := 398 \text{ kip} \cdot \text{ft} \quad I_x := 959 \text{ in}^4 \quad \phi V_x := 216 \text{ kip}$$

Check Self Weight:

$$M_u := M_u + \frac{(0.048 \text{ klf} \cdot l_{FB1}^2)}{8} = 389.697 \text{ (kip} \cdot \text{ft)} < \phi M_p = 398 \text{ ft} \cdot \text{kip}$$

OK

Check Shear:

$$V_u := \frac{1}{2} \cdot ((LCC + 0.048 \text{ klf}) \cdot l_{FB1}) = 44.537 \text{ kip} < \phi V_x = 216 \text{ kip}$$

OK

Check Deflection:

$$\Delta_{ALL} := \frac{l_{FB1}}{360} = 1.167 \text{ in}$$

$$\Delta_{ACT} := \frac{(5 \cdot w_{live} \cdot l_{FB1}^4)}{384 \cdot E \cdot I_x} = 1.457 \text{ in} > \Delta_{ALL} = 1.167 \text{ in} \quad \text{FAIL}$$

Deflection Fails So Redesign:

Try W21x62:

$$\phi M_p := 540 \text{ kip} \cdot \text{ft} \quad I_x := 1330 \text{ in}^4 \quad \phi V_x := 252 \text{ kip}$$

Check Self Weight:

$$M_u := M_u + \frac{(0.062 \text{ klf} \cdot l_{FB1}^2)}{8} = 391.841 \text{ (kip} \cdot \text{ft)} < \phi M_p = 540 \text{ ft} \cdot \text{kip}$$

OK

Check Shear: $VM\Delta$

$$V_u := \frac{1}{2} \cdot ((LCC + 0.048 \text{ klf}) \cdot l_{FB1}) = 44.537 \text{ kip} < \phi V_x = 252 \text{ kip} \quad \text{OK}$$

Check Deflection: $VM\Delta$

$$\Delta_{ALL} := \frac{l_{FB1}}{360} = 1.167 \text{ in}$$

$$\Delta_{ACT} := \frac{(5 \cdot w_{live} \cdot l_{FB1}^4)}{384 \cdot E \cdot I_x} = 1.05 \text{ in} < \Delta_{ALL} = 1.167 \text{ in} \quad \text{OK}$$

∴ Use W21x62, A992 steel for FB1

FG1 Design:

*LCC from FB1

$$LCC = 2.497 \text{ klf} \quad l_{FG1} := 32 \text{ ft}$$

$$(LCC + 62 \text{ plf}) \cdot \frac{l_{FG1}}{2} = 40.943 \text{ kip}$$

The above loads were applied to a simply supported beam in VA and recorded in the table below.

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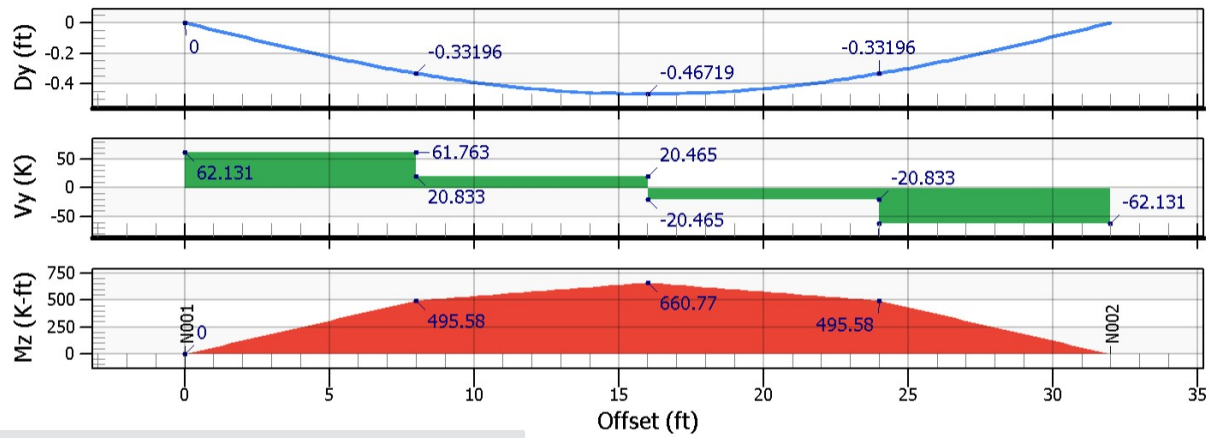
Florida Gulf Coast University

Member: BmX001...BmX004

Load Case: D

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Jason Andrew Hock



<u>Lb</u> (ft)	8	8	8	8
M_u (ft·kip)	495	660	660	495
C_b	1.14	1.14	1.14	1.14
$\frac{M_u}{C_b}$ (ft·kip)	434	579	579	434

Required strength from table:

$$V_u := 62.13 \text{ kip}$$

$$M_u := 660.77 \text{ ft} \cdot \text{kip}$$

Try W24x68: ϕM_n Z_X $C_b C_b := 1.14$

$$\phi M_n := 633 \text{ kip} \cdot \text{ft} \quad \phi M_p := 664 \text{ kip} \cdot \text{ft} \quad I_x := 1480 \text{ in}^4 \quad \phi V_x := 272 \text{ kip}$$

$$C_b \phi M_n := \phi M_n \cdot C_b = 721.62 \text{ kip} \cdot \text{ft} > \phi M_p = 664 \text{ ft} \cdot \text{kip} \quad \text{OK}$$

$$\phi M_p = 664 \text{ kip} \cdot \text{ft} > M_u = 660.77 \text{ ft} \cdot \text{kip} \quad \text{OK}$$

Check Self Weight:

$$M_u := M_u + \frac{1.2 \cdot (0.068 \text{ klf} \cdot l_{FG1}^2)}{8} = 671.215 \text{ (kip} \cdot \text{ft)} > \phi M_p = 664 \text{ ft} \cdot \text{kip} \quad \text{FAIL}$$

Self-Weight Fails So Redesign:

Try W30x99: $C_b := 1.14$

$$\phi M_n := 1151 \text{ kip} \cdot \text{ft} \quad \phi M_p := 1170 \text{ kip} \cdot \text{ft} \quad I_x := 3990 \text{ in}^4 \quad \phi V_x := 463 \text{ kip}$$

$$C_b \phi M_n := \phi M_n \cdot C_b = 1312.14 \text{ kip} \cdot \text{ft} > \phi M_p = 1170 \text{ ft} \cdot \text{kip} \quad \text{OK}$$

$$\phi M_p = 1170 \text{ kip} \cdot \text{ft} > M_u = 671.215 \text{ ft} \cdot \text{kip} \quad \text{OK}$$

Check Self Weight:

$$M_u := M_u + \frac{1.2 \cdot (0.099 \text{ klf} \cdot l_{FG1}^2)}{8} = 686.421 \text{ (kip} \cdot \text{ft)} < \phi M_p = 1170 \text{ ft} \cdot \text{kip} \quad \text{OK}$$

Check Shear: $VM\Delta$

$$V_u := \frac{1}{2} \cdot (0.099 \text{ klf} \cdot l_{FG1}) + V_u = 63.714 \text{ kip} < \phi V_x = 463 \text{ kip} \quad \text{OK}$$

Check Deflection: From VA

$$\Delta_{ALL} := \frac{l_{FG1}}{360} = 1.067 \text{ in}$$

$$\Delta_{ACT} := 1.01 \text{ in} < \Delta_{ALL} = 1.067 \text{ in} \quad \text{OK}$$

∴ Use W30x99, A992 steel for FG1