Appendix I. Roof Beam and Girder Design

RB1 and RB2 Design:

$l_{RB1} := 35\ ft$

From Appendix C.

$w_{dead} := 19.8\ psf \cdot 4\ ft + (102\ psf + 39\ psf) \cdot (4\ in + 8\ in + 8\ in) = 314.2\ plf$

$w_{snow} := 23.1\ psf \cdot 4\ ft = 92.4\ plf$

$P_u := 1.2 \cdot w_{dead} + 1.6 \cdot w_{snow} = 0.525\ klf$

$VM\Delta$ Case 1

$Mu := \dfrac{\left(P_u \cdot l_{RB1}^{\ 2}\right)}{8} = 80.372\ ft \cdot kip$ $\quad L_{brace} := 0\ ft$ $\quad \therefore Z_X$

Try W12x19:

$\phi M_p := 92.6\ kip \cdot ft$ $\quad I_x := 130\ in^4$ $\quad \phi V_x := 86\ kip$

Check Self Weight:

$M_u := Mu + \dfrac{\left(0.019\ klf \cdot l_{RB1}^{\ 2}\right)}{8} = 83.282\ (kip \cdot ft) < \phi M_p = 92.6\ ft \cdot kip$

OK

Check Shear: $VM\Delta$

$Vu := \dfrac{1}{2} \cdot \left(\left(P_u + 0.019\ klf\right) \cdot 35\ ft\right) = 9.518\ kip < \phi V_x = 86\ kip$

OK

Check Deflection: $VM\Delta$

$\Delta_{ALL} := \dfrac{l_{RB1}}{240} = 1.75\ in$

$\Delta_{ACT} := \dfrac{\left(5 \cdot w_{snow} \cdot l_{RB1}^{\ 4}\right)}{384 \cdot E \cdot I_x} = 0.828\ in < \Delta_{ALL} = 1.75\ in$ OK

$\therefore$ Use W12x19, A992 steel for RB1/RB2

RG1 and RG2 Design:

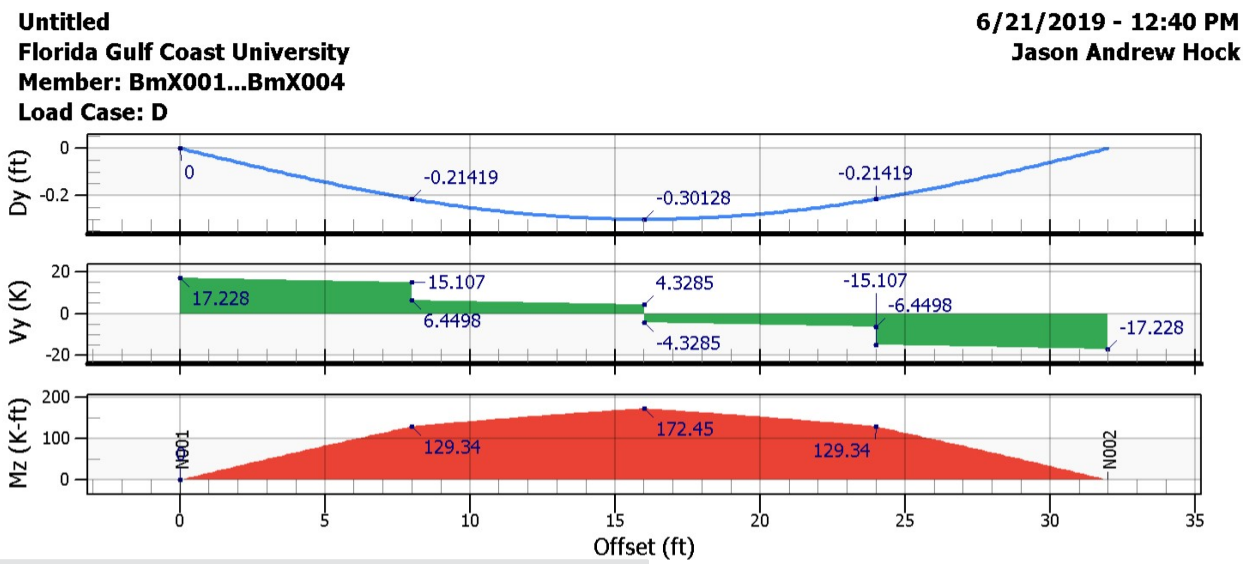
$$w_{RJ1} = 0.495\ klf \qquad l_{RG1} := 32\ ft$$

$$Point_{RJ1} := w_{RJ1} \cdot \frac{35}{2}\ ft = 8.657\ kip$$

From Appendix C. 4in, 8in, and 8in are the sizes of the parapet.

$$Parapet := (141\ psf) \cdot (4\ in + 8\ in + 8\ in) = 0.235\ \frac{kip}{ft}$$

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



–	–	–	–	–
$Lb\ (ft)$	8	8	8	8
$Mu\ (ft \cdot kip)$	129.34	172.45	172.45	129.34
Cb	1.14	1.14	1.14	1.14
$\frac{Mu}{Cb}\ (ft \cdot kip)$	113.46	151.27	151.27	113.46

Required strength from table:

$$V_u := 17.228\ kip$$

$$M_u := 151.27\ ft \cdot kip$$

Try W21x44: ϕM_n Z_X C_b $C_b := 1.14$

$$\phi M_n := 303\ kip \cdot ft \qquad \phi M_p := 358\ kip \cdot ft \qquad I_x := 843\ in^4 \qquad \phi V_x := 217\ kip$$

$$C_b \phi M_n := \phi M_n \cdot C_b = 345.42\ kip \cdot ft \ < \ \phi M_p = 358\ ft \cdot kip$$ OK

$$\phi M_p = 358\ kip \cdot ft \ > \ M_u = 151.27\ ft \cdot kip$$ OK

Check Self Weight: Minimum from above calculations + self-weight

$$M_u := C_b \phi M_n + \frac{1.2 \cdot \left(0.044\ klf \cdot {l_{RG1}}^2\right)}{8} = 352.178\ (kip \cdot ft)$$

$< \phi M_p = 358\ ft \cdot kip$

OK

Check Shear: $VM\Delta$

$$Vu := \frac{1}{2} \cdot \left(0.044\ klf \cdot l_{RG1}\right) + V_u = 17.932\ kip \ < \ \phi V_x = 217\ kip$$

OK

Check Deflection: From VA

$$\Delta_{ALL} := \frac{l_{RG1}}{240} = 1.6\ in$$

$$\Delta_{ACT} := 1.48\ in \ < \ \Delta_{ALL} = 1.6\ in$$

OK

∴ Use W21x44*, A992 steel for RG1/RG2

*Before W21x44 was selected, a W14x30, W14x34, and W18x40 were tested and failed the deflection test