Seismic factors

Per ASCE 7-05, Section 13.3.1 Seismic Design Force

$F_p(Max) = 1.6\ S_{DS}\ I_p\ W_p$

$F_p(Min) = 0.3\ S_{DS}\ I_p\ W_p$

Where $S_{DS} = \frac{2}{3} S_{MS}$ 11.4.3

and $S_{MS} = F_a S_s$ 11.4.1

- From Ch 20, Soil classification = C
  - Very dense soil and soft rock, Table 20.3.1

from table 11.4-1, $F_a = 1.2$ @ $S_s = 0.5$

so, $S_{MS} = 1.2 \cdot 0.5 = 0.6$

$S_{DS} = \frac{2}{3} \cdot 0.6 = 0.4$

Therefore:

$F_p(Max) = 1.6 \cdot .4 \cdot 1.5 \cdot W_p$

$= 0.96\ W_p$

$F_p(Min) = 0.3 \cdot .4 \cdot 1.5 \cdot W_p$

$= 0.18\ W_p$

(I_p, importance factor at 1.5)

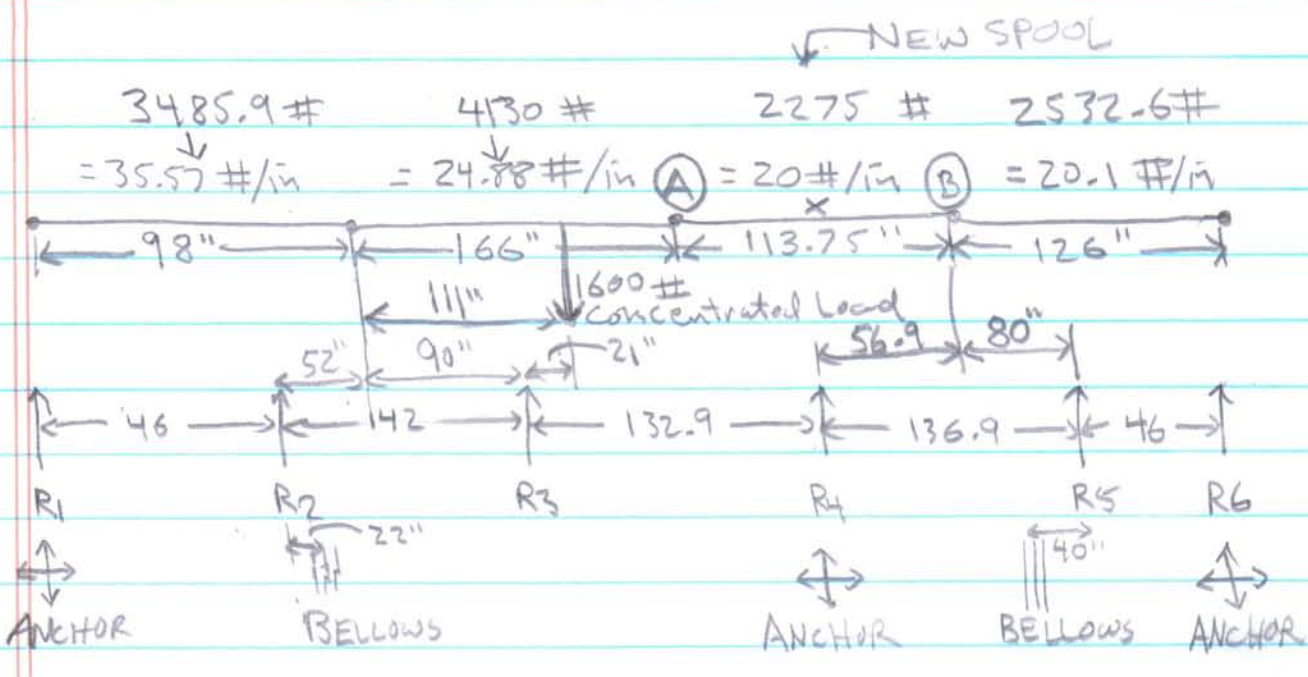
$V_{vert} = .2\ S_{DS} \cdot W_p = .08\ W_p$

factors: horiz = 0.96

Down = 1 + .08

up = .08

Beam Loads & Dimensions



REACTION R1 through R6 must be found, then loading at (A) and (B) (SPOOL Flanges) can be determined.

$$R_1 = 35.57 \times \frac{46}{2} = 818.1\ \#$$

$$R_6 = 20.1 \times \frac{46}{2} = 462.3\ \#$$

FOR R2: $\Sigma M_{R3} = 0 = (818.1 \times 188") + R_2(142") - 3486(139) - 4130(7)$

$R_2 = 2532.8$

FOR R3: $\Sigma M_{R4} = 0 = 818.1(320.9) + 2532.8(274.9) + R_3(132.9) - 3486(271.9) - 4130(139.9) - 1600(111.9)$

$R_3 = 5612.3$

FOR R_5: $\Sigma M_{R4} = 0 = 462.3(182.9) + R_5(136.9) - 2532.6(119.9)$

$R_5 = 1600.5$

ΣR_1 through $R_6 = 14024$ [Total Load]

$\therefore 14024 - 1600.5 - 5612.3 - 2532.8 - 462.3 - 818.1 = R4$

$R_4 = 2997.5$

LOAD A: Shear at A =

$R_1 + R_2 + R_3 - 3485.9 - 4130 - 1600$

$= 252.7$

LOAD B: Shear at B =

$R_5 + R_6 - 2532.6$

$= 469.8$

LONGITUDINAL FORCE:

Left Bellows to pt A = $35.57(30) + 4130 + 1600$

$= 6797\#$

Right Bellows to pt B = 804 #

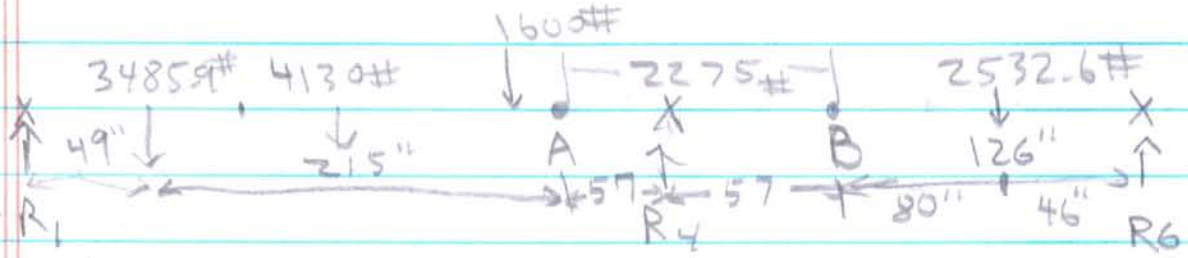
Assume PIPE ON OTHER SIDE of BELLOWS is Anchored.

LOAD A = $(6797 \times .96) + 1604 = 8129$

(Seis factor) (spring Bellows)

LOAD B = $(804 \times .96) + 1604 = 2376$

LATERAL FORCE



$\Sigma M_{R4} = 0 = R_1(321) - 3485.9(272) - 4130(140) - 1137.5(28.5)$
$-1600(111.9)$ $\therefore R_1 = 5414$ #

$\Sigma M_{R4} = 0 = R_6(183) - 2532.6(120) - 1137.5(28.5)$
$\therefore R_6 = 1838$

$R_4 + 5414 + 1838 = 3485.9 + 4130 + 2275 + 2532.6 + 1600$
$\therefore R_4 = 6772$

Load at A = shear at A
$R_1 - 3485.9 - 4130 - 1600 = -3802$ #

Load A + B = shear at B
$R_6 - 2532.6 = 4239.4$

With seismic factors:
A = $3802 \times .96 = 3650$ #
B = $4239 \times .96 = 4070$ #

Axial loading of Bellows - compressed

Working Spring rate = 1604 lb/in
Assume 1" compression at each bellows

Summary

Pt A	Pt B	
6797	804	Dead wt Load
6525	772	x .96 (seismic)
1604	1604	Spring Load
8129	2376	Long Total
252	470	Vertical load ↓
272	508	x 1.08 seismic
252	470	vertical load ↑
20	38	x .08 seismic
3802	4239	Lateral Load
3650	4070	x. 96 seismic