

Ce479

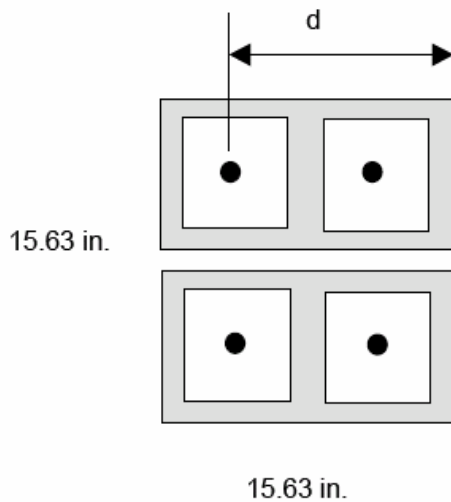
Assignment #4

Solution

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Check the column cross section below for the given combination of axial load and moment.

$$\begin{aligned} f_m &:= 1500 \text{ psi} & A_{st} &:= .88 \text{ in}^2 & A_{stot} &:= 1.76 \text{ in}^2 & f_y &:= 60000 \text{ psi} \\ h &:= 15.625 \text{ in} & b &:= 15.625 \text{ in} & d &:= 11.47 \text{ in} & P_u &:= \frac{22000}{\phi} & P_u &= 24444 \text{ lbs} \\ & & & & & & M_u &:= \frac{48137}{0.9} & M_u &= 53486 \text{ (in - lbs)} \end{aligned}$$



$$\begin{aligned} \text{web thickness} &= 1 \text{ in.} \\ \text{cell width} &= (15.63 - 3) / 2 = 6.32 \text{ in.} \\ d &= 15.63 - 1 - 6.32 / 2 = 11.47 \text{ in.} \end{aligned}$$

1. Calculate the pure axial load capacity:

$$P_{no} := f_m \cdot 0.8 \cdot [(h \cdot b) - A_{stot}] \quad P_{no} = 290857 \text{ (lbs)}$$

2. Calculate the pure flexural capacity:

$$w := \left( \frac{A_{st}}{b \cdot d} \right) \cdot \left( \frac{f_y}{f_m} \right) \quad w = 0.196$$

$$M_{no} := w \cdot b \cdot d \cdot d \cdot f_m \cdot (1 - 0.63 \cdot w) \quad M_{no} = 530679 \text{ (in - lbs)}$$

3. Calculate the axial load and bending moment corresponding to the balanced condition:

Locate neutral axis, c:  $ecm := 0.0025$      $ey := \frac{fy}{29000000}$      $ey = 2.069 \times 10^{-3}$

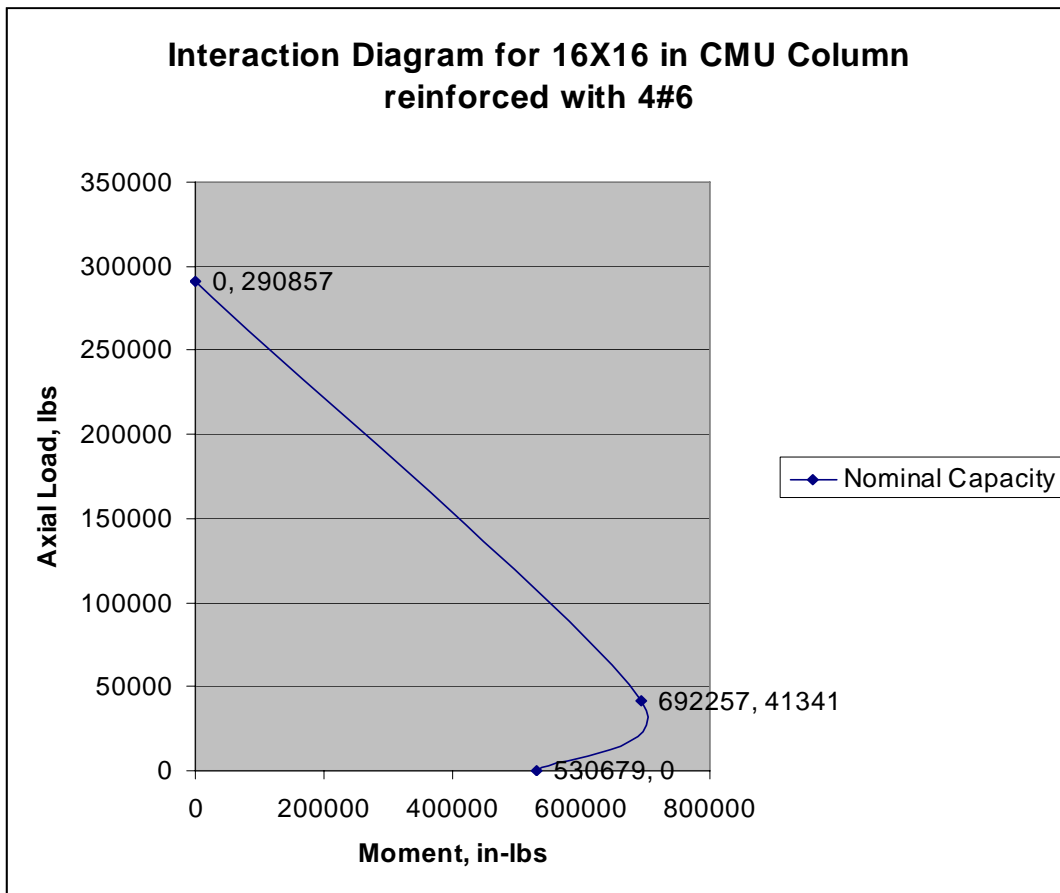
$c := d \cdot \left( \frac{ecm}{ecm + ey} \right)$      $c = 6.276 \text{ (in)}$

Calculate internal tension (Ti) and compression (Ci) forces:

$Ti := Ast \cdot fy$      $Ti = 52800 \text{ (lbs)}$

$Ci := .8 \cdot fm \cdot .8 \cdot c \cdot b$      $Ci = 94141 \text{ (lbs)}$      $Pb := Ci - Ti$      $Pb = 41341 \text{ (lbs)}$

$Mnb := Ti \cdot \left[ d - \left( \frac{h}{2} \right) \right] + Ci \cdot \left[ \left( \frac{h}{2} \right) - \left( .8 \cdot \frac{c}{2} \right) \right]$      $Mnb = 692257 \text{ (in - lbs)}$



Column section as given has much more capacity than required