A6



# Homework #1

**Due Thu 9/3/09**

Team Number: 6

Names: Karolina Nowak, Joseph Michael, Calvin Smith, James Kristoff

Hand in this sheet (cover sheet) with your solution

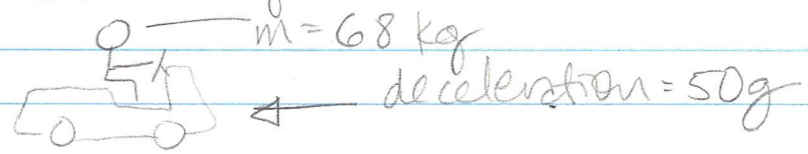
1. Conduct research and identify a mechanical design that you consider to be a "bad" design (and substantiate why). Then seek a solution or solutions that improve this design. These solution(s) could be in the form of improved products, as found on the market, claimed patented improvements or your own suggested design improvements. Clearly indicate your sources of information. Expected to write at least one double-spaced typed page. US patents (USPTO) can be accessed through Grainger's web site: http://search.grainger.uiuc.edu/top/.
2. Textbook Problem 1.27 (Introduction to Design).
3. Textbook Problem 1.47 (Introduction to Design).
4. Textbook Problem 3.9 (Review on Materials)
5. Textbook Problem 4.41 (Review on Static Body Stresses)

50/50

(1.27) Known: An automobile passenger experiences deceleration in a head-on crash.

Find: Force experienced.

Schematic and given data:




Assumption: Acceleration of gravity = $9.81\,m/s^2$.

Analysis: $F = ma$

$= (68\,kg)(50)(9.81\,m/s^2)$

$= 33{,}354\ N$

$= 33.354\ kN$

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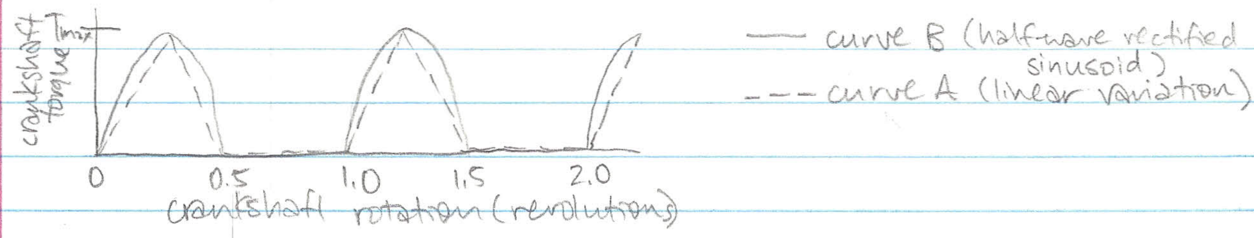
(1.47) Known: The crankshaft of a punch press rotates at a given rpm with the shaft torque fluctuating within a given range.

Find: Motor power required

a) with a flywheel adequate to minimize speed fluctuations

b) without a flywheel

Schematic and Given Data:

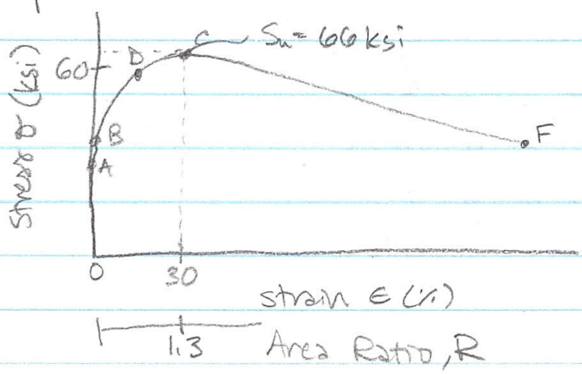



Assumptions:

1) Friction losses are negligible (motor power in = crankshaft power out)

(3.9) Known: An AISI 1020 steel specimen is loaded in tension to point C of figure shown. It is later unloaded and reloaded as a new specimen.

Find: $\sigma, \epsilon, \sigma_T, \epsilon_T$ when specimen reaches point C, and after unload/reload to C again.

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Analysis:

Initially: $\sigma = 60$ ksi

$\epsilon = 30\%$

$\sigma_T = \sigma(1+\epsilon) = 85.8$ ksi

$\epsilon_T = \ln(1+\epsilon) = 26.2\%$

Specimen is unloaded → permanent deformation.

└ stretched to $13/10$ of its original length

$\sigma = P/A = P/(A_0 \cdot 10/13)$

$= \sigma_0 / (10/13)$

$\sigma = 85.8$ ksi

since it's now in elastic region,

$\epsilon = \sigma / E$ where $E = 30 \times 10^6$ psi

$= (85.8\text{ksi}) / (30 \times 10^3 \text{ksi})$

$= 0.286\%$

$\sigma_T = \sigma(1+\epsilon) = 86.0$ ksi

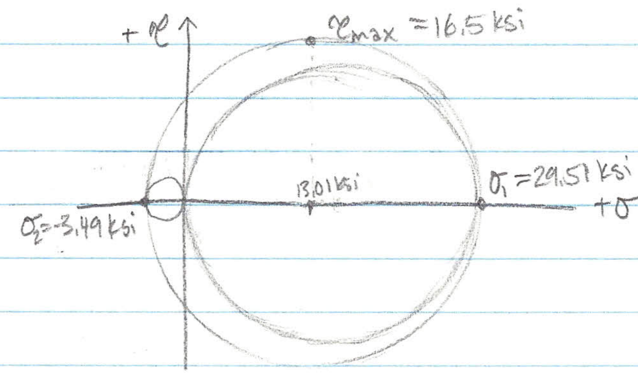
$\epsilon_T = \ln(1+\epsilon) = 0.28\%$

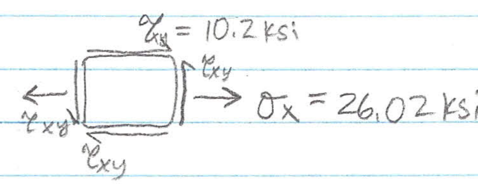
$$\tau_{max} = \pm\sqrt{\tau_{xy}^2 + \left(\frac{\sigma_x - \sigma_y}{2}\right)^2}$$

$$= \pm\sqrt{(10204.1)^2 + (26020.4/2)^2}$$

$$= 16534.5 \text{ lb/in}^2 = 16.5 \text{ ksi}$$

$$\frac{\sigma_x + \sigma_y}{2} = \frac{26.02}{2} \text{ ksi} = 13.01 \text{ ksi}$$ → distance from O to center of circle

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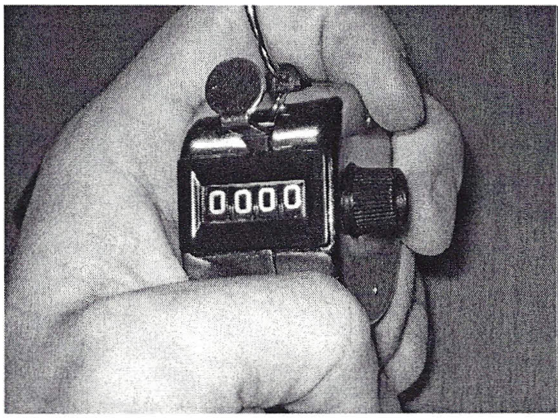
Nice story.

ME 371 HW1.1

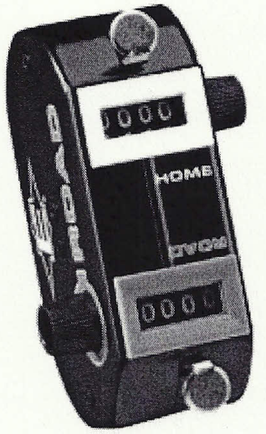
Team 6: Calvin Seith, Karolina Nowak, James Kristoff, and Joe Michael S. Downing

In our research of mechanical designs we found one that we believe could be improved. Door men at bars use a hand held mechanical odometer to count the number people in the bar to stay within fire code guidelines. The counter has a display of four digits to provide a range of 0000 to 9999. The operator presses a "button" above the display which rotates the lowest digit up to the next integer, and in cases where another digit is needed (ie from 0009 to 0010), pressing the button rotates both digits required. The counter works perfectly well for counting up as in the odometer of a car, however there is no way to subtract from the display. This means that in the case of door men at bars, they have to keep track of how many people leave the bar in order to keep the number accurate. The only way to reduce the number on the display is to reset the counter with a dial on the side of the mechanism that brings the display back to 0000 and then the person must start the count again. We feel that the counter can be improved by adding another button which would subtract from the display.




Here's the counter with the mechanism taken out of the case. Although it is difficult to see, in between the digits are "teeth" that face one way. There are "stops" that the teeth are pushed by and rest on. The stops are activated by pressing the button.

Switch 1st and 2nd text boxes


HOME

A6

Karolina Nowak
James Kristoff
Calvin Smith
Joe Michael

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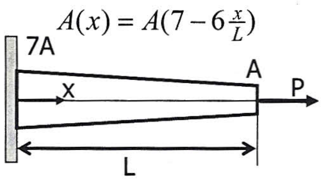
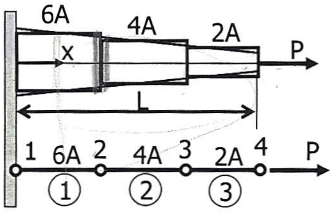
# In Class Problem - Discretization Error




(Fig 1a)




(Fig 1b)

- Compute the exact stress and displacement as a function of x (Fig. 1a)
- Using the three beam elements shown in Fig. 1b, compute the stresses and displacements at each node
- Compare these exact and approximate solutions at points 1, 2, 3 and 4.
- The beam is homogeneous, isotropic (E: Young's Modulus).

- $\sigma = \frac{P}{A} = \frac{P}{A(7-6\frac{x}{L})}$

$\varepsilon = \frac{\sigma}{E} = \frac{P}{EA(7-6\frac{x}{L})}$

$\varepsilon_x = \frac{du}{dx}$

$u = \frac{P}{EA}\int \frac{1}{7-\frac{6x}{L}}\,dx$

$= \frac{-LP}{6EA}\ln(7-\frac{6x}{L}) + c$, $u=0$ @ $x=0$

$u = \frac{-LP}{6EA}\ln(7-\frac{6x}{L}) + \frac{LP}{6EA}\ln(7)$

exact:

$\sigma_1 = \frac{P}{7A}$, $\sigma_2 = \frac{P}{5A}$, $\sigma_3 = \frac{P}{3A}$, $\sigma_4 = \frac{P}{A}$

$u_1 = 0$, $u_2 = \frac{-LP}{6AE}\ln(5) + \frac{LP}{6AE}\ln(7)$

$u_3 = \frac{-LP}{6AE}\ln(3) + \frac{LP}{6AE}\ln(7)$

$u_4 = \frac{LP}{6AE}\ln(7)$

- $\sigma_{①} = \frac{P}{6A}$, $\sigma_{②} = \frac{P}{4A}$, $\sigma_{③} = \frac{P}{2A}$

$\varepsilon_{①} = \frac{P}{6AE}$, $\varepsilon_{②} = \frac{P}{4AE}$, $\varepsilon_{③} = \frac{P}{2AE}$

$u_{①} = \frac{P}{6AE}x$, $u_{②} = \frac{P}{4AE}x$, $u_{③} = \frac{P}{2AE}x$

approx:

$\sigma_1 = \frac{P}{6A}$, $\sigma_2 =$

largest stress discrepancy is at the end where exact is $\sigma_4 = P/A$, and approx is $\frac{P}{2A}$, which is a 50% error for the approximation.

$u_1 = 0$, $u_2 = \frac{PL}{18AE}$, $u_3 = \frac{PL}{12AE} + \frac{PL}{18AE}$, $u_4 = \frac{PL}{6AE} + \frac{PL}{12AE} + \frac{PL}{18AE}$

0% error 0.9% error 1.6% error 5.8% error