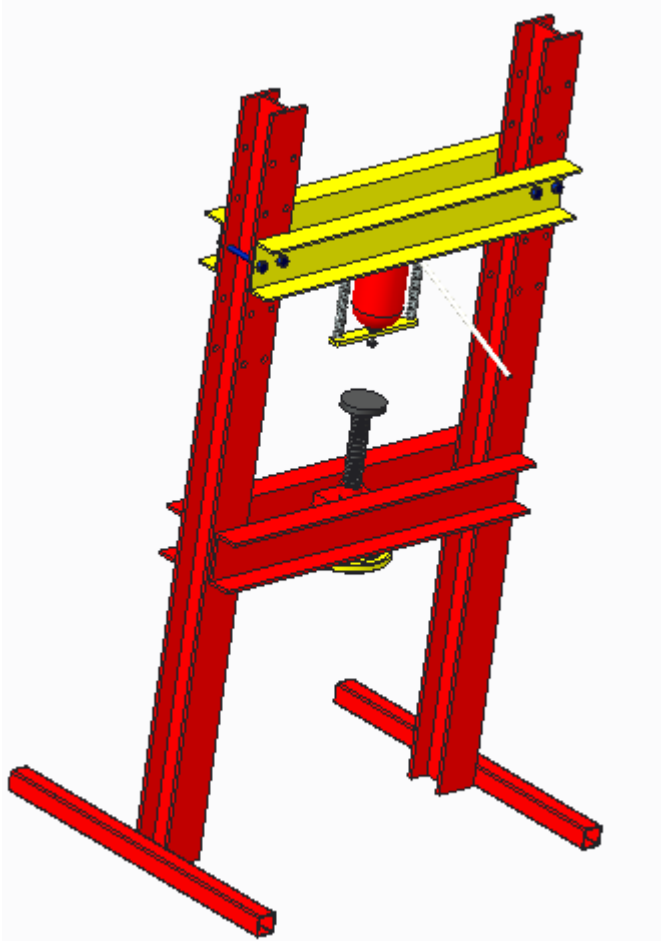
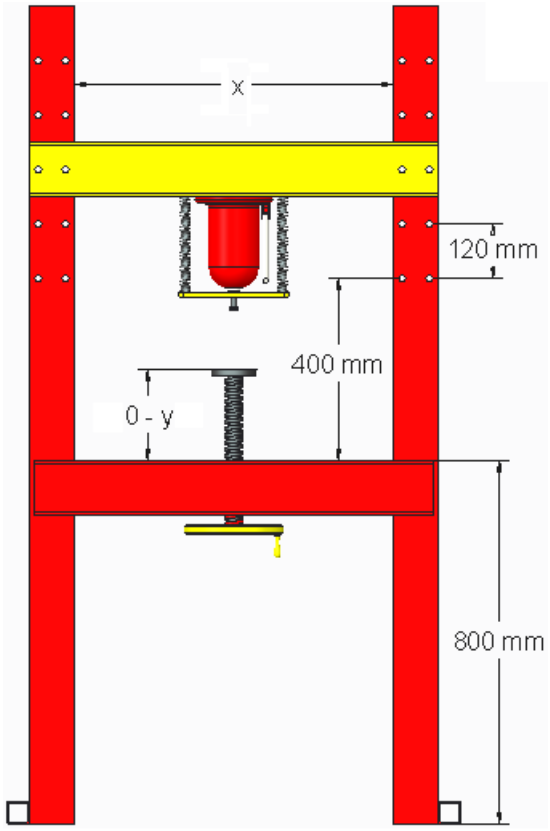
Design Project

Design of a Shop Press

The hydraulic shop press shown is typically used in machine shops for applications requiring high force. Presses are usually used to force two parts to fit inside each other under dimensional interference or to disassemble parts fitted under interference.





Design the shop press shown such that it meets the following constraints:

- It has ***20 ton*** capacity (***H200*** – *NIKE* bottle jack was selected *see specs and dimensions in the provided Technical Data sheet*).
- It meets the dimensional constrains shown in the figure.
- The crosshead elevation is adjustable (five positions) and it is locked in position using a minimum of two pins at each end.
- Two extension springs are used to retrieve the jack's piston after pressure is released and each of them is required to maintain a tension of *50 N* when the piston is fully retrieved.
- The power screw needs to be able to withstand the full load when it is at its highest position (*use fixed-free end conditions for buckling analysis*).
- Use the following design factors:
  - n_d = 1.5 for the power screw.
  - n_d = 1.2 for the extension springs (*when the piston fully extended*).
  - n_d for the structure, pins, and weldments is given in the table for each group.

- Use standard sizes for all components:
  - Standard structural profiles (*see the provided Tables*).
  - Standard thickness plates (*5mm thickness increments*).
  - Standard gauge wires for the springs (*Table A-28*).
  - Standard size metric bolts for the pins (*Table 8-1*).
  - Standard size for the power screw (*Table 8-3*).
- Available materials:
  - AISI 1030 HR steel properties for plates and structural profiles.
  - Heat treated AISI 1060 steel for the power screw (*you need to specify the heat treatment*).
  - AWS E80xx electrodes.
  - ISO classes 10.9 bolts.
  - Hard-drawn wires for the springs.
- Your design should meet all the requirements while maintaining a minimal cost.
- The group specific design requirements are given in the table:

Group #	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***	***12***
x (mm)	600	800	600	800	600	800	600	800	600	800	600	800
y (mm)	200	150	200	150	200	150	150	200	150	200	150	200
n_d	2	2.5	3	2	2.5	3	2	2.5	3	2	2.5	3

You can use the flowing information for calculating the total cost of the press.

- Structural profiles come in *6 m* long sections while the plates come in square or rectangular shapes with *0.5 m* length increments up to a size of *1 m × 2 m*.
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- The cost of steel (plates & structural profiles) is *0.6 JD/kg* while the scrap is sold at *0.3 JD/kg*.
- The cost for other components and manufacturing operations is as follows:
  - Hydraulic Jack: ***cost = 100 JD***
  - Paint: ***cost = 5 JD***
  - Power screw: ***cost = (D/10) + (D×L×6×10^{-4}) JD/screw*** *(dimensions in mm).*
  - *Extension springs*: ***cost = D×d×N ×6×10^{-4} JD/spring*** *(dimensions in mm).*
  - Fasteners: ***cost = D×L×2×10^{-3} JD/bolt*** *(dimensions in mm).*
  - Weldments: ***cost =t×L×2×10^{-4} JD*** *(dimensions in mm).*
  - Drilling: ***cost = 0.1 JD/hole***
  - Cutting;
    - structural profiles: ***cost = 0.2 JD/cut***
    - plates: ***cost = 1 JD/m***

Each group needs to turn in a technical report showing the design procedure and results. SI units must be used in the calculations and the report should include:

- ***Design procedure, equations, table of iterations (if applicable) for each component.***
- ***Final detailed design assessment for all components.***
- ***Detailed cost calculations.***
- ***Detailed engineering drawings for all components.***