

# Summary: Castigliano solution process

For an indeterminate structure:

1. Equilibrium equations. Draw a free body diagram of the structure. Be sure to include all reaction loads. Write down the  $N_{eqn}$  equilibrium equations.
2. Choose redundant loads.
  - Count the number of unknown reactions,  $N_{react}$ , in your equilibrium equations.
  - Determine the number of redundant reactions,  $N_R$ :  $N_R = N_{react} - N_{eqn}$ .
  - Choose your  $N_R$  “redundant” reactions:  $R_i ; i = 1, 2, \dots, N_R$ . Your choice is arbitrary.
  - Using the equilibrium equations from above, write the non-redundant reactions in terms of the redundant reactions.
3. Strain energy function. Write down the strain energy function for each component *in terms of the redundant reactions and applied loads*. Add these together to get the total strain energy,  $U$ , for the structure.
4. Castigliano's theorem:
  - Apply Castigliano's theorem:  $0 = \partial U / \partial R_i ; i = 1, 2, \dots, N_R$
  - Solve these equations for the redundant reactions.
  - Use the equilibrium equations to solve for the non-redundant reactions.
5. Stress analysis. Determine the internal reactions and determine the resulting stress components.