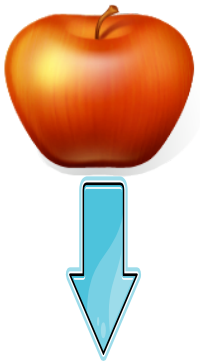
Scott Davis, Licensed under the GNU Free Documentation License
http://commons.wikimedia.org/wiki/Commons:GNU_Free_Documentation_License

Beam Bridge Forces

Quadell, Licensed under the GNU Free Documentation License
http://commons.wikimedia.org/wiki/Commons:GNU_Free_Documentation_License



Newton's Laws

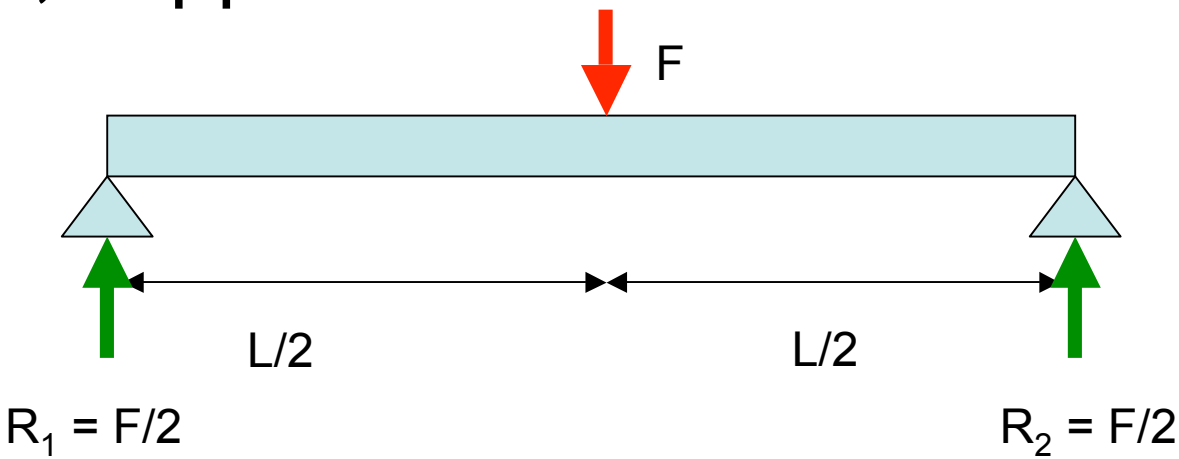
- Newton's 3rd law of motion:

  "For every action there is an equal and opposite reaction"

- This means that if a force is applied to something, there will be a reaction force (or forces) created
- All the forces will sum together to give an overall force of zero

What is a reaction force?

- Imagine a weight placed in the middle of a bridge; the reaction forces will occur in places where the bridge meets the ground – i.e. at the supports
- A simplified diagram is shown below of a beam, supports and forces



‘Seeing’ Reaction Forces

- The demonstration showed how reaction forces vary according to where the weight was placed on the beam

- The important factor to remember is:

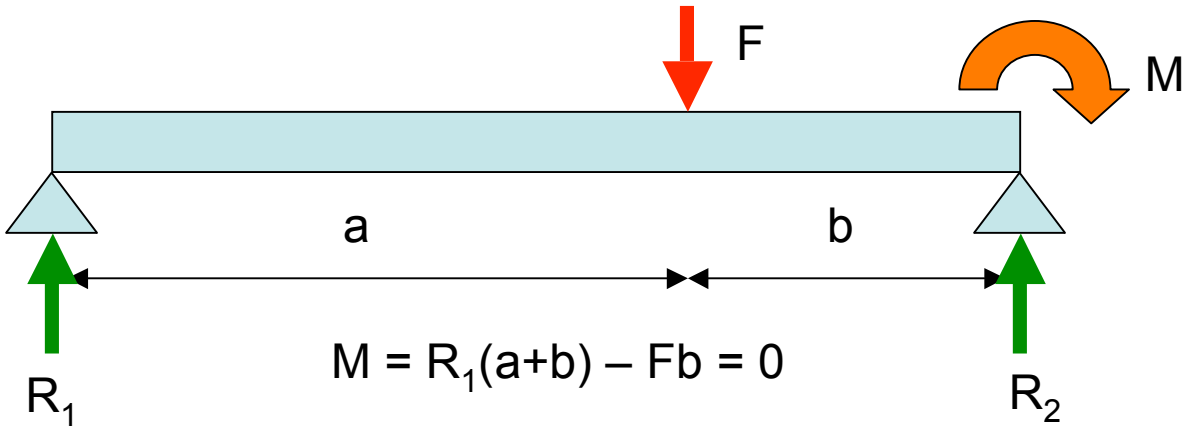
In equilibrium, all the forces add up to zero

$$R_1 + R_2 = F$$

Using Moments

- Since the reaction forces are unknown, and are not necessarily equal, moments are used to find them
- To find one reaction force, take moments about the point where the other reaction force acts. The moment at each end must be zero and

Moment = Force x perpendicular distance



$$M = R_1(a+b) - Fb = 0$$

Why Do We Do This?

- When structural engineers design and build buildings or bridges, they have to consider the applied loads and how the structure will behave under these conditions
- Calculations like these are key in determining answers like:
  - “Will this fall down?”
  - “Are the foundations strong enough?”
  - “Is the ground suitable to withstand these forces?”

Bridge Task

- Bridge foundations need to made strong enough to withstand the reaction forces created when the bridge is loaded
- Your task is to:
  - Find the reaction forces at each end of a beam bridge when loads are applied at different points
  - Test these experimentally to verify your results
  - Plot your results graphically
  - Find an equation which allows the reaction forces in the beam to be found when the load is applied at any point along the bridge