A Graphical Introduction to Beam Bending

By Ryan Gregory

Beams are structural members upon which the integrity of almost any man made structures rely.

Beams are structural members upon which the integrity of almost any man made structures rely.

The concept of using beams in structures is not new, nor is the study of how beams react to the loads they are subjected to.

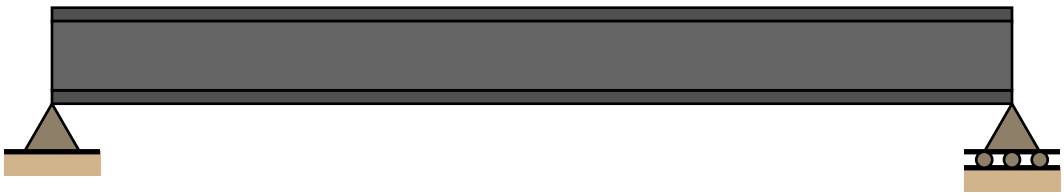
The 2 most common ways in which beams are supported are:

The 2 most common ways in which beams are supported are:

Cantilever Beam

The 2 most common ways in which beams are supported are:

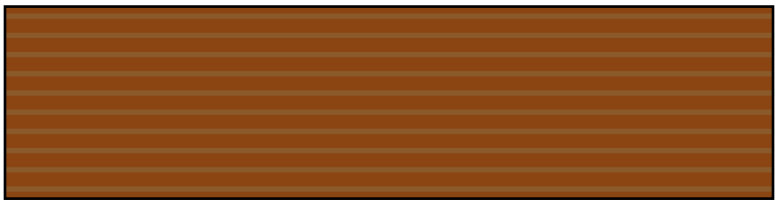
Cantilever Beam

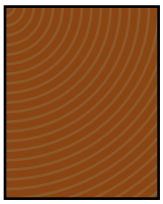


Pin & Roller Supported Beam

The materials used vary greatly from beam to beam, as does their length and cross-section

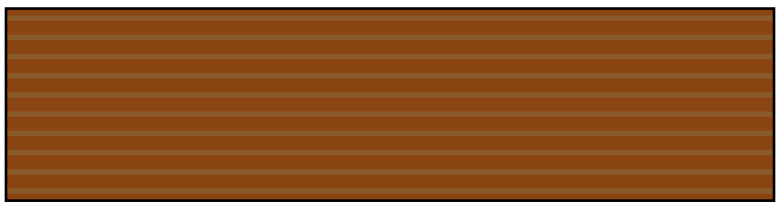
The materials used vary greatly from beam to beam, as does their length and cross-section.

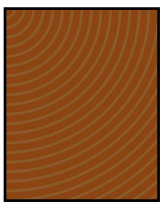




Wood

The materials used vary greatly from beam to beam, as does their length and cross-section.





Wood

Steel

Specific beam properties are chosen based on the loads the beam is expected to support.

Specific beam properties are chosen based on the loads the beam is expected to support.

There are 2 types of loads that make up the majority of loads encountered.

The first and simplest type of load is a Point load (P)

The first and simplest type of load is a Point Load (P)

A Point load is represented by a vector.

When a beam is subjected to a Point Load the beam deflects:

When a beam is subjected to a Load (P)
the beam deflects:

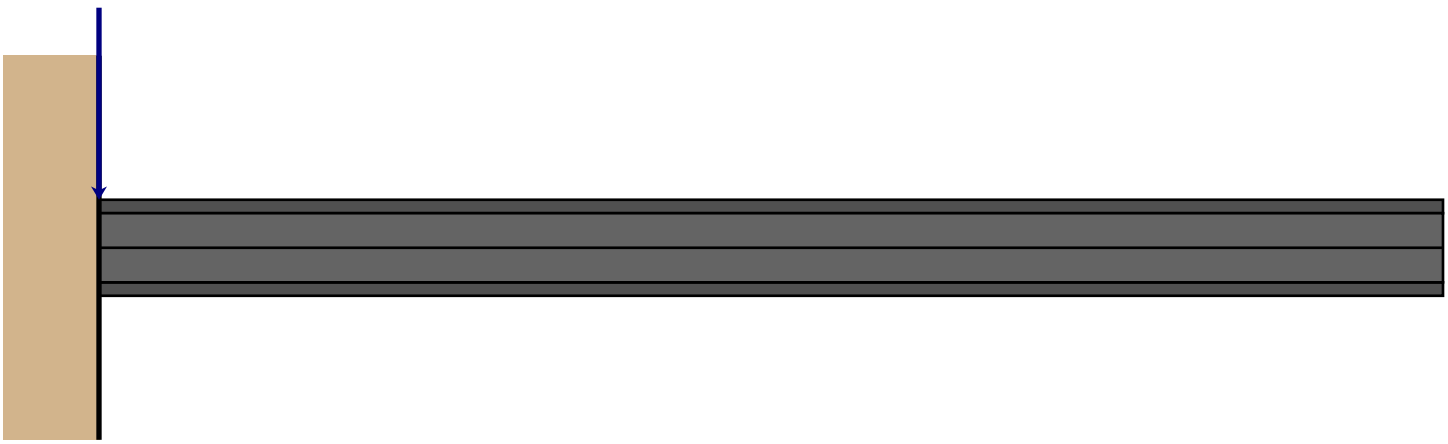
- in the direction of P

When a beam is subjected to a Load (P) the beam deflects:

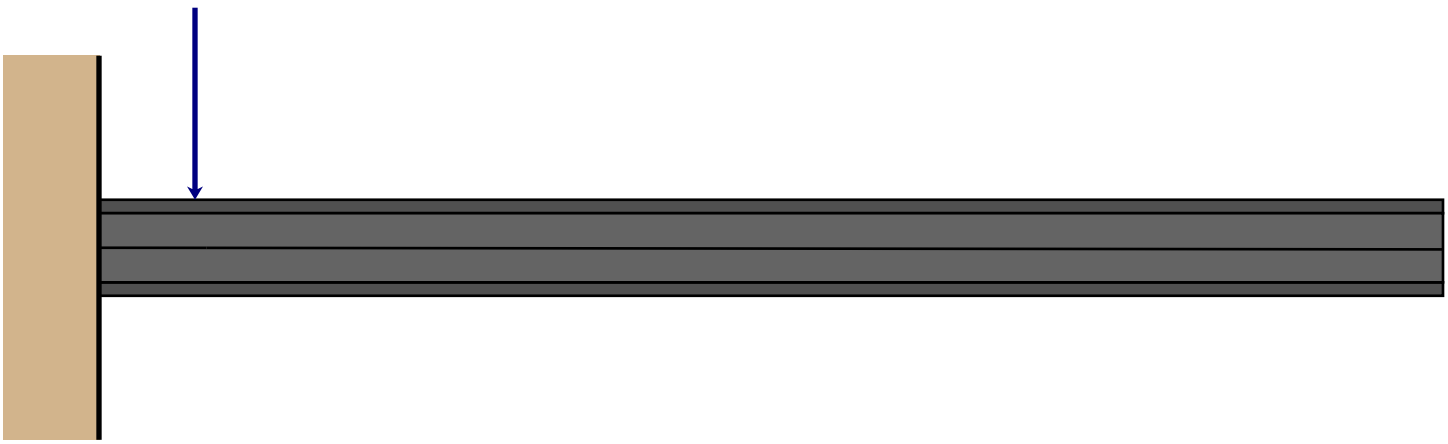
- in the direction of P
- by an amount proportional to the magnitude of P

For example, picture a cantilever beam that is subjected to a load P.

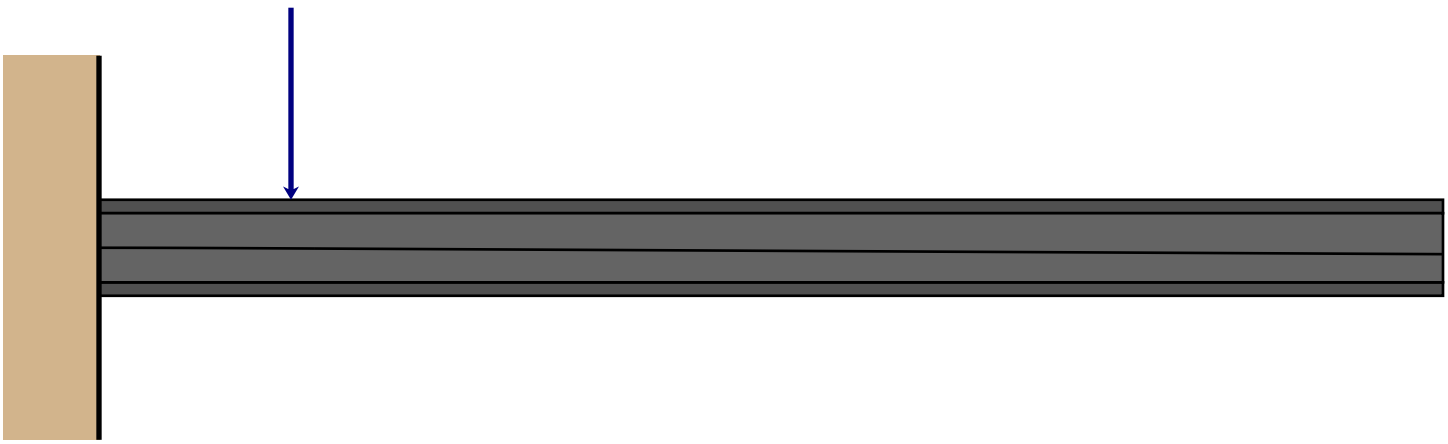
As P moves further from the wall support the central axis of the beam deflects by an increasing amount.



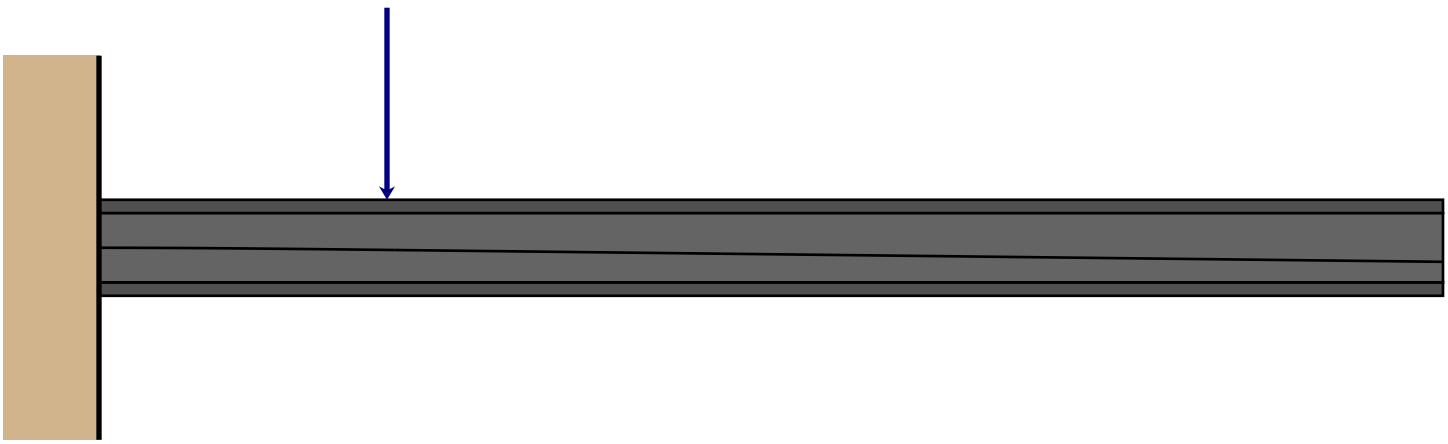
As P moves further from the wall support the central axis of the beam deflects by an increasing amount.



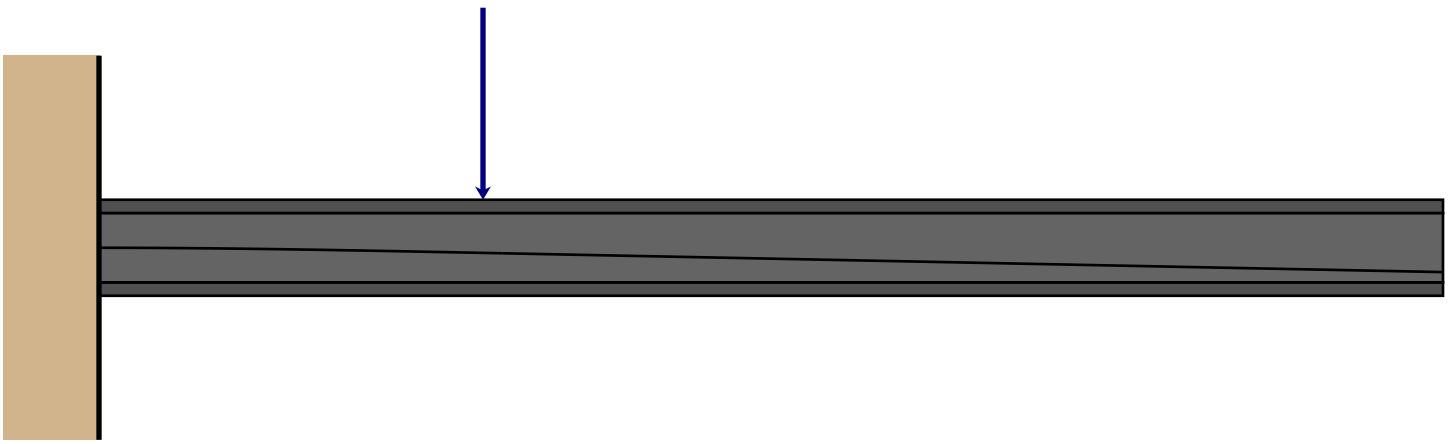
As P moves further from the wall support the central axis of the beam deflects by an increasing amount.



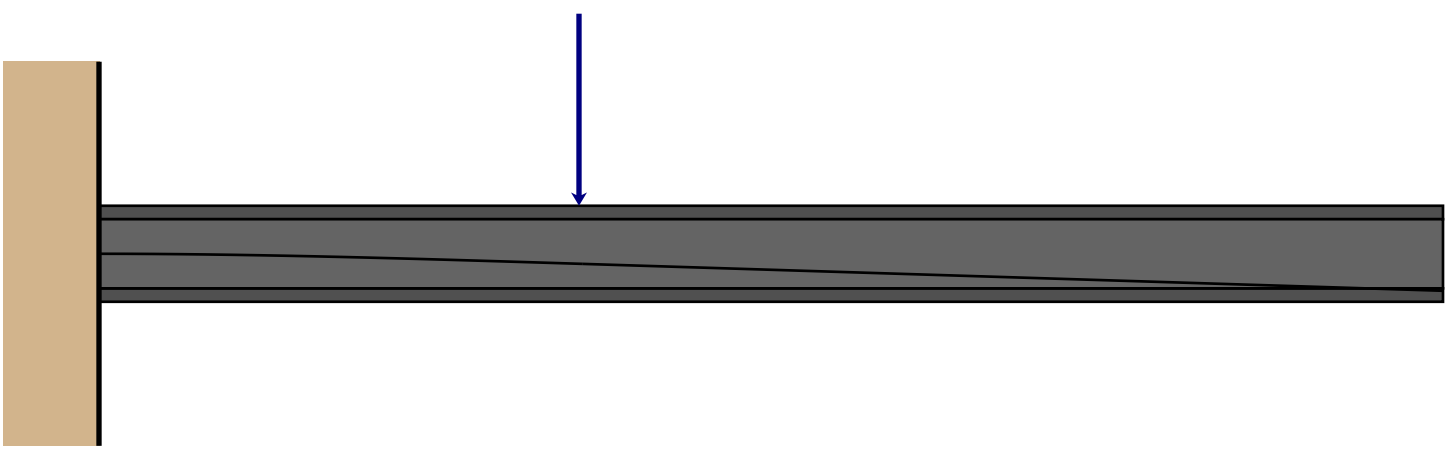
As P moves further from the wall support the central axis of the beam deflects by an increasing amount.



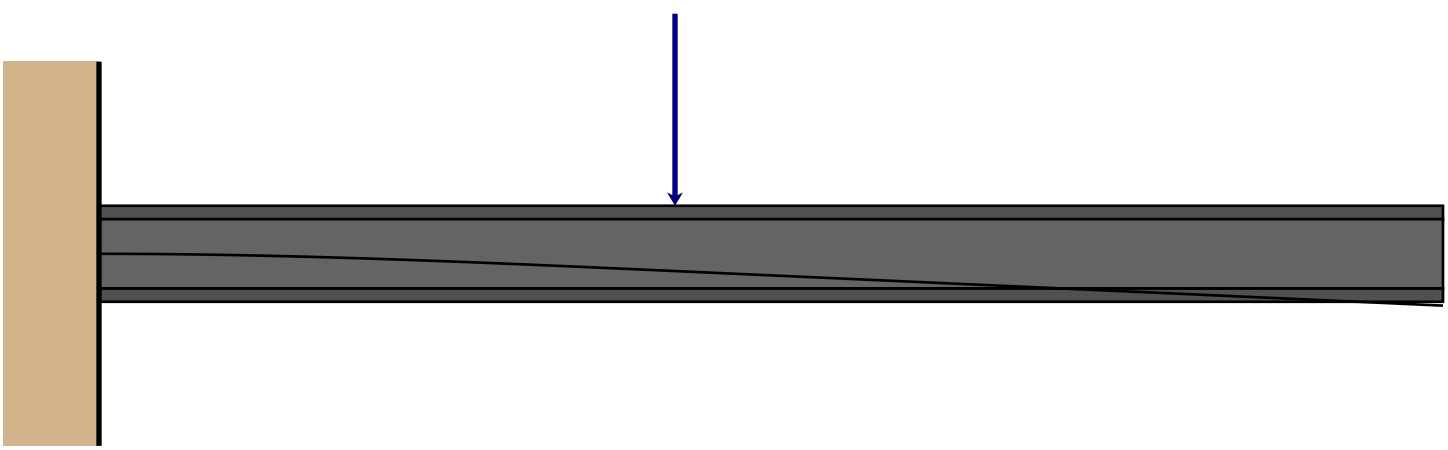
As P moves further from the wall support the central axis of the beam deflects by an increasing amount.



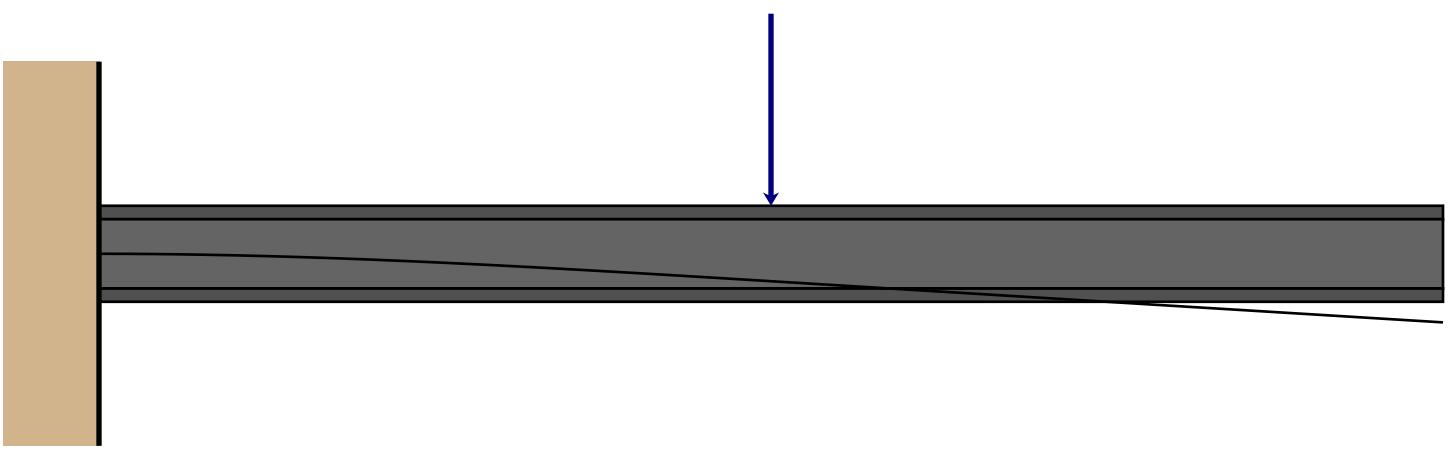
As P moves further from the wall support the central axis of the beam deflects by an increasing amount.



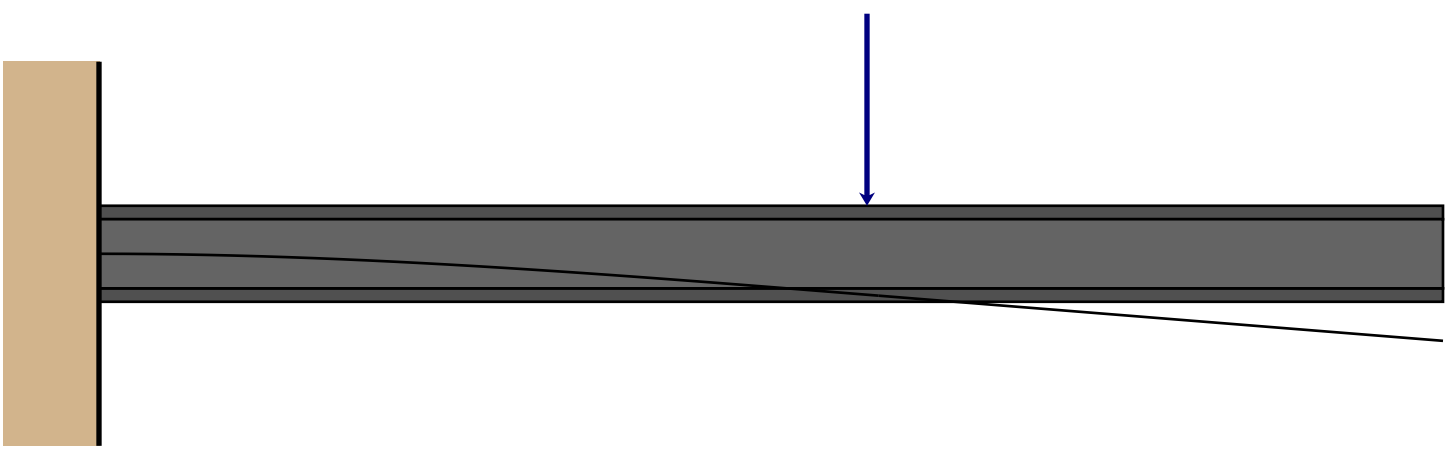
As P moves further from the wall support the central axis of the beam deflects by an increasing amount.



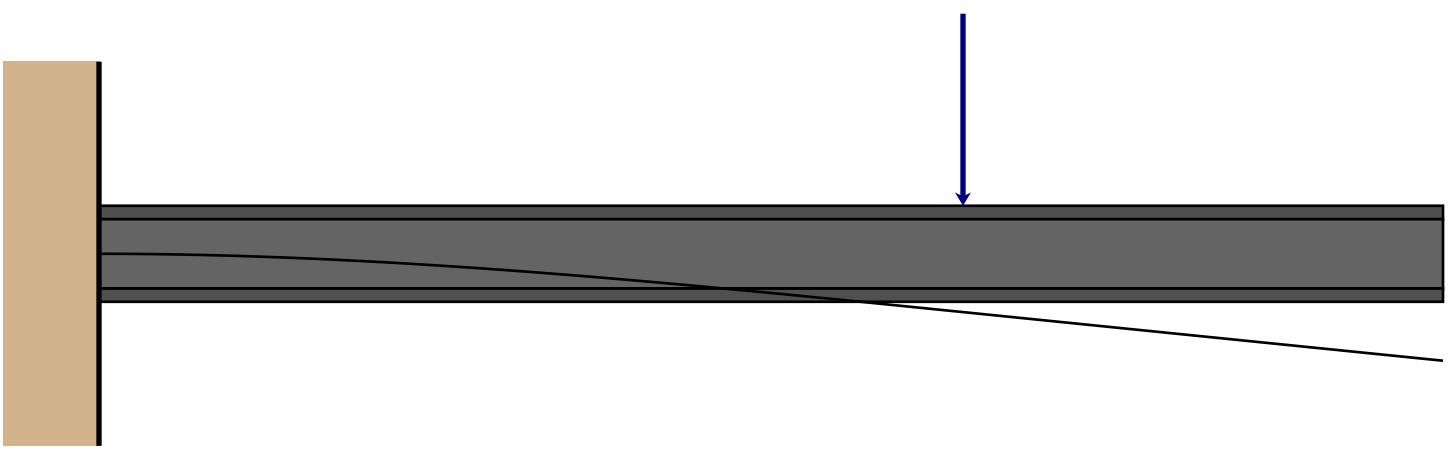
As P moves further from the wall support the central axis of the beam deflects by an increasing amount.



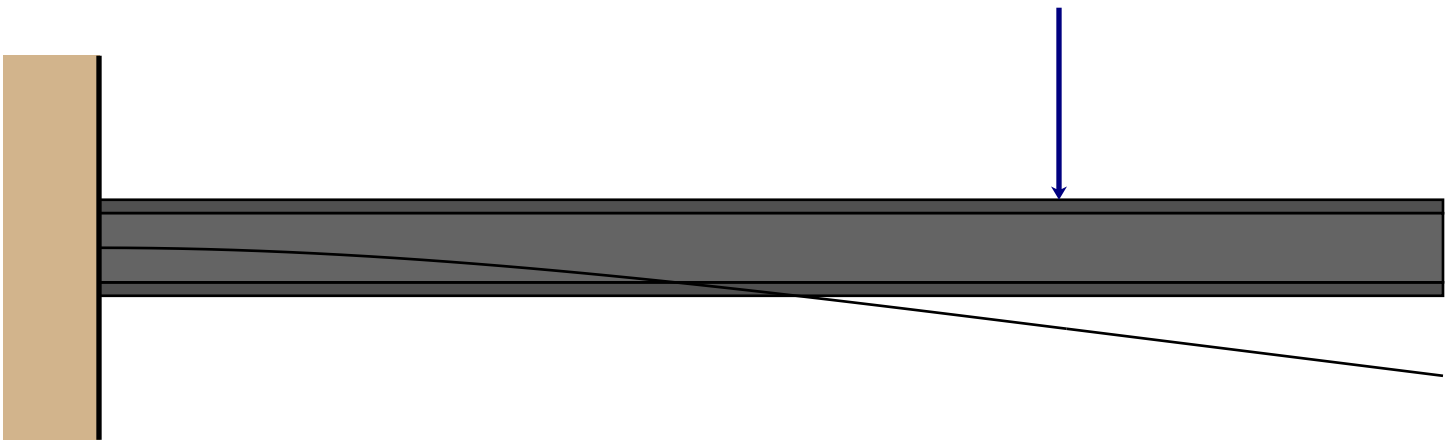
As P moves further from the wall support the central axis of the beam deflects by an increasing amount.



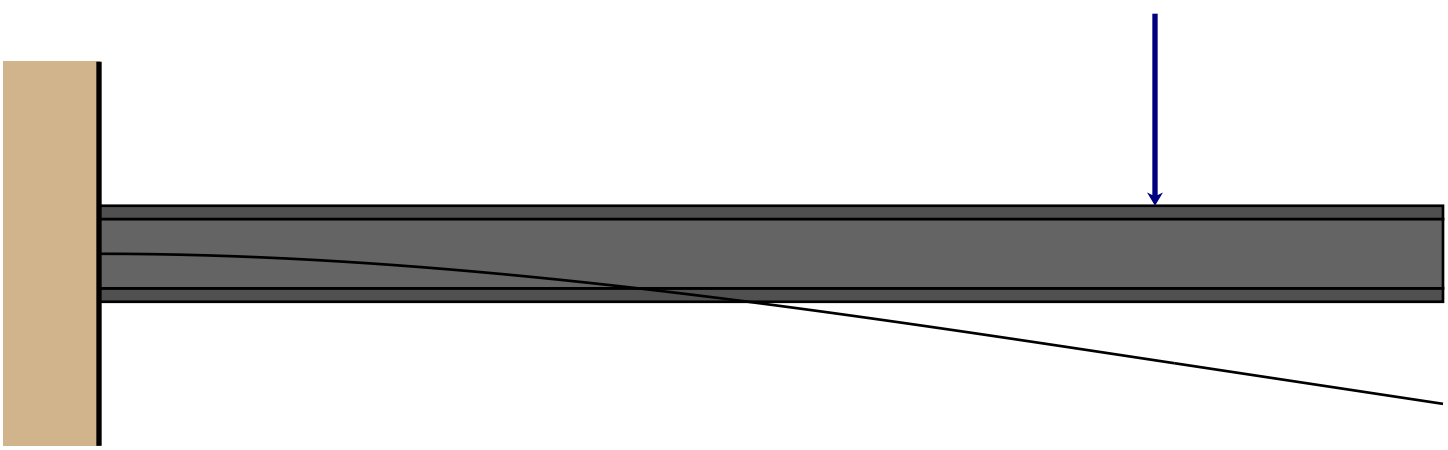
As P moves further from the wall support the central axis of the beam deflects by an increasing amount.



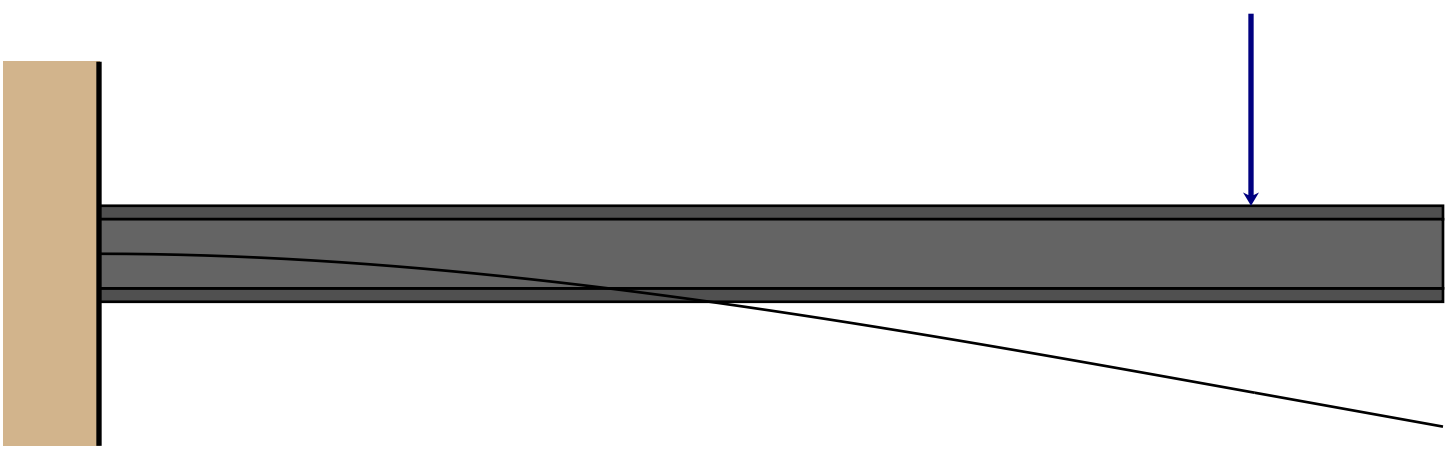
As P moves further from the wall support the central axis of the beam deflects by an increasing amount.



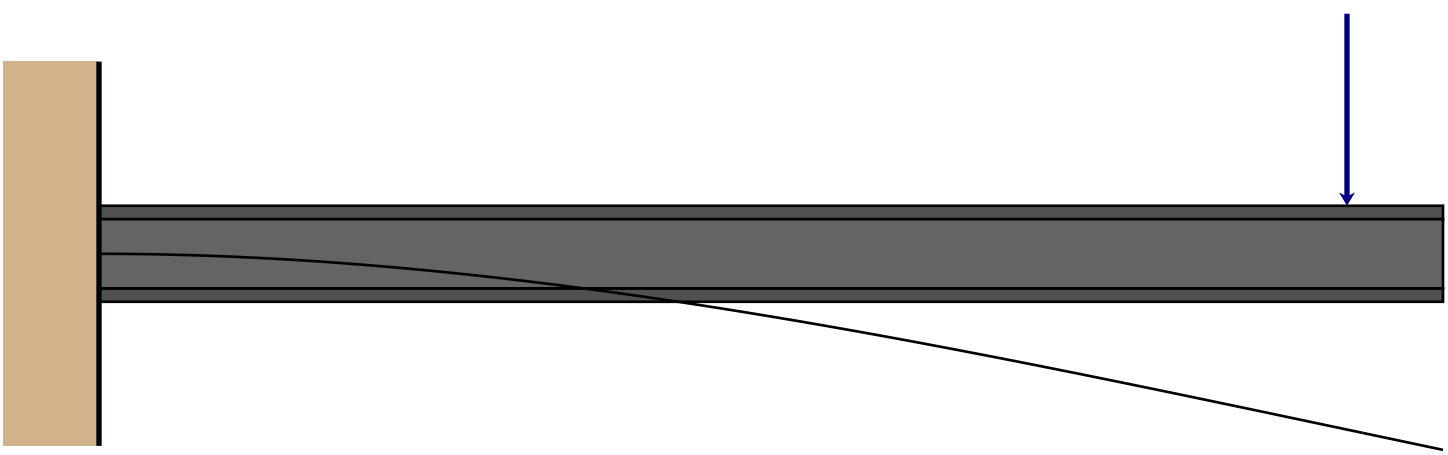
As P moves further from the wall support the central axis of the beam deflects by an increasing amount.



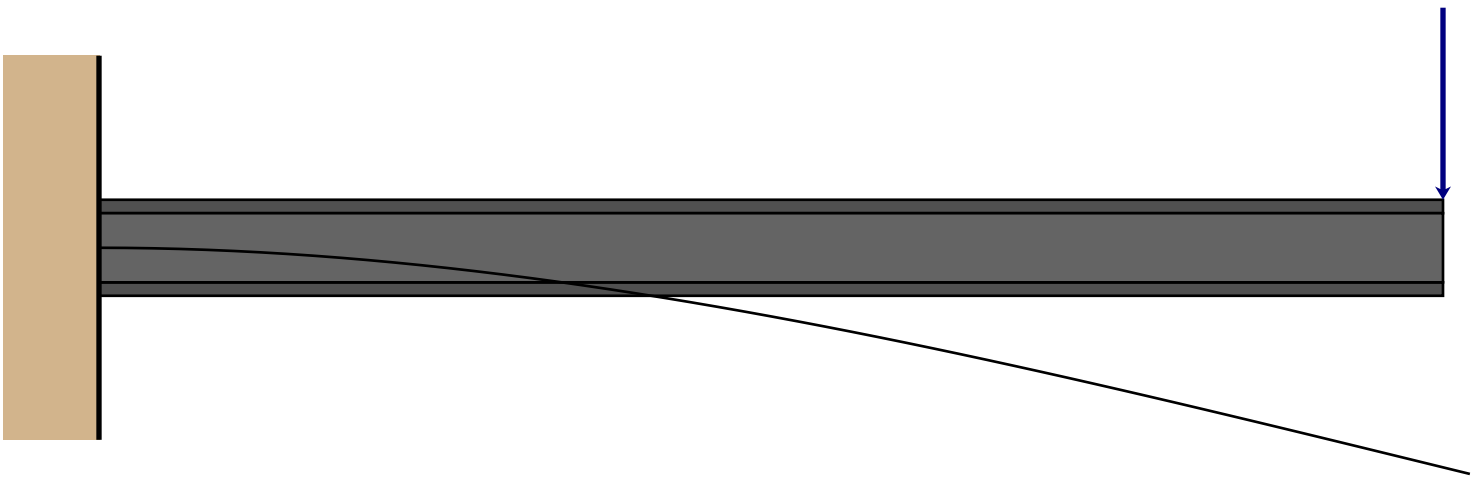
As P moves further from the wall support the central axis of the beam deflects by an increasing amount.



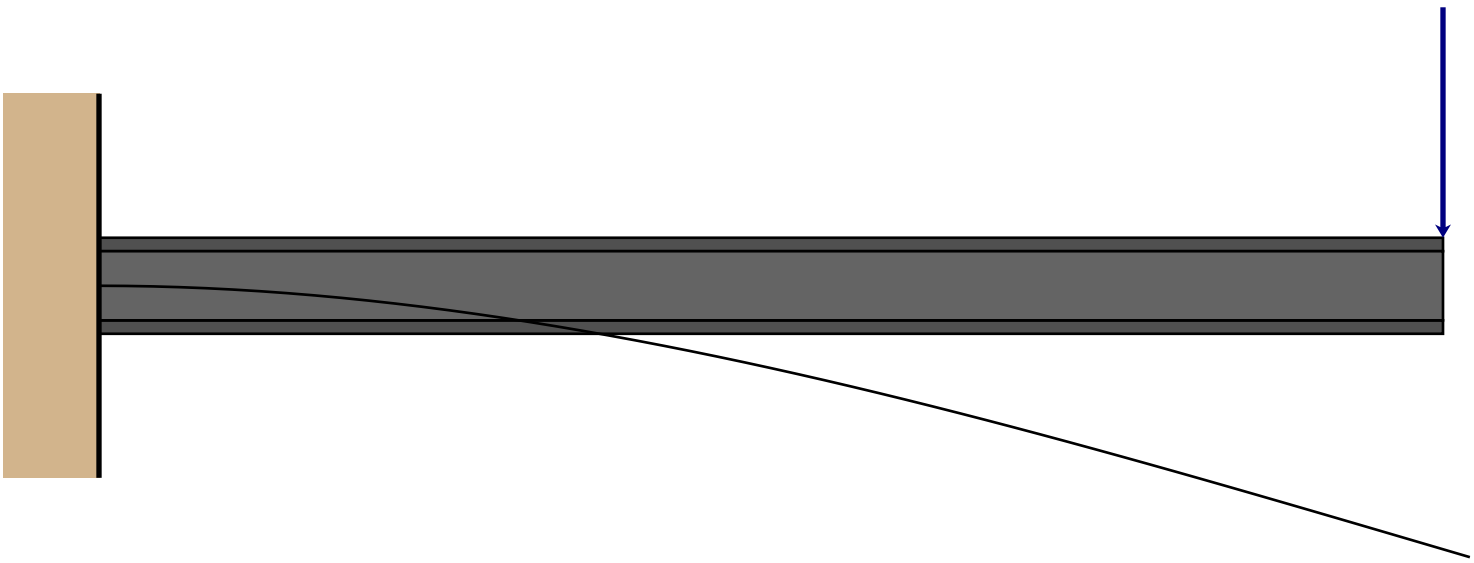
As P moves further from the wall support the central axis of the beam deflects by an increasing amount.



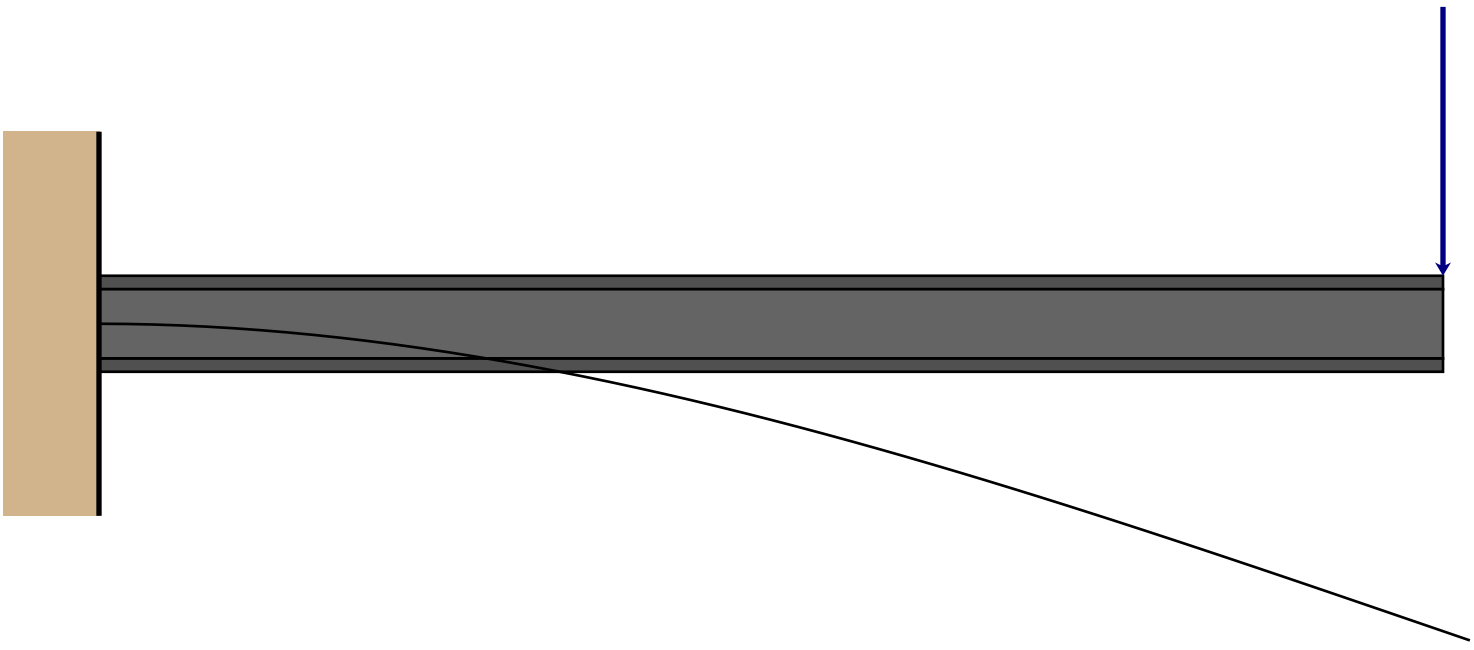
By not moving P but simply increasing it's magnitude, the deflection increases again.



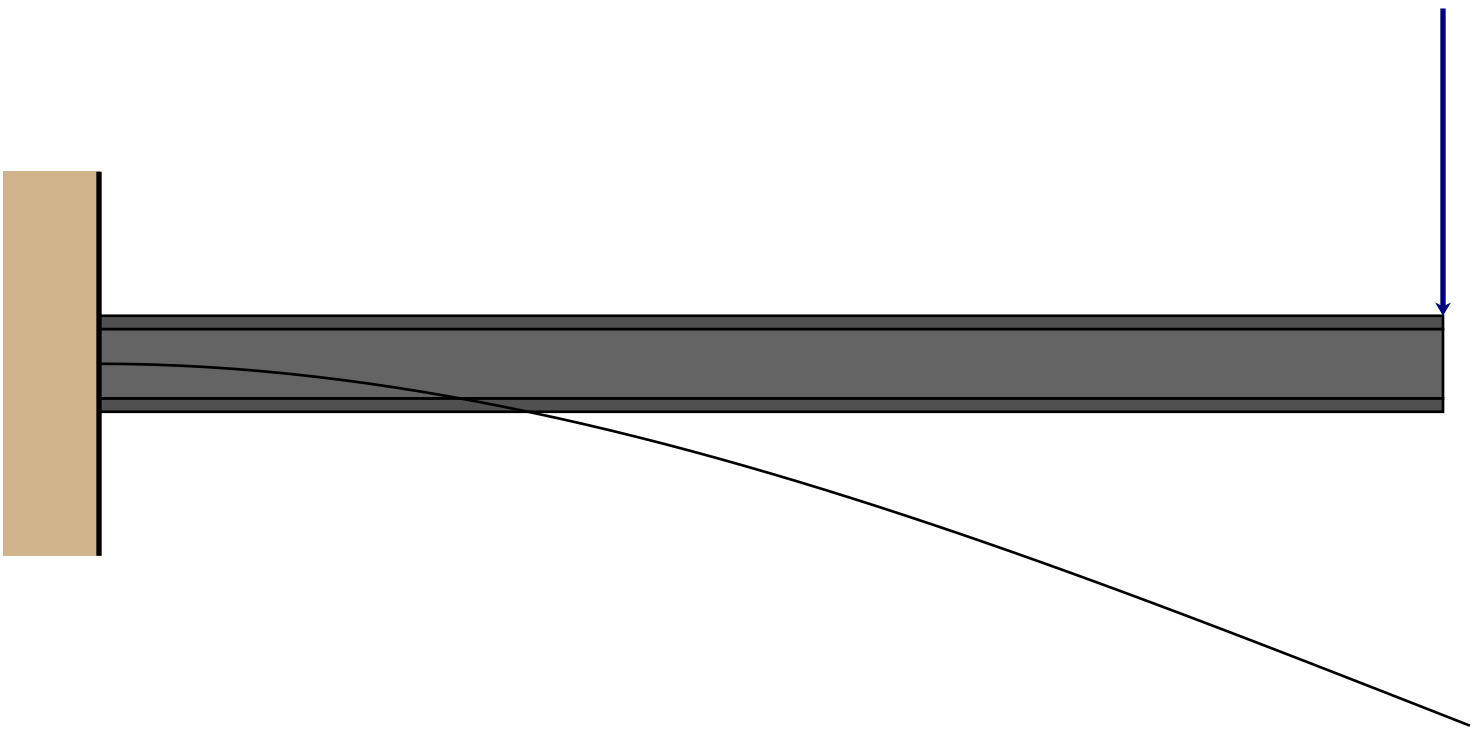
By not moving P but simply increasing it's magnitude, the deflection increases again.



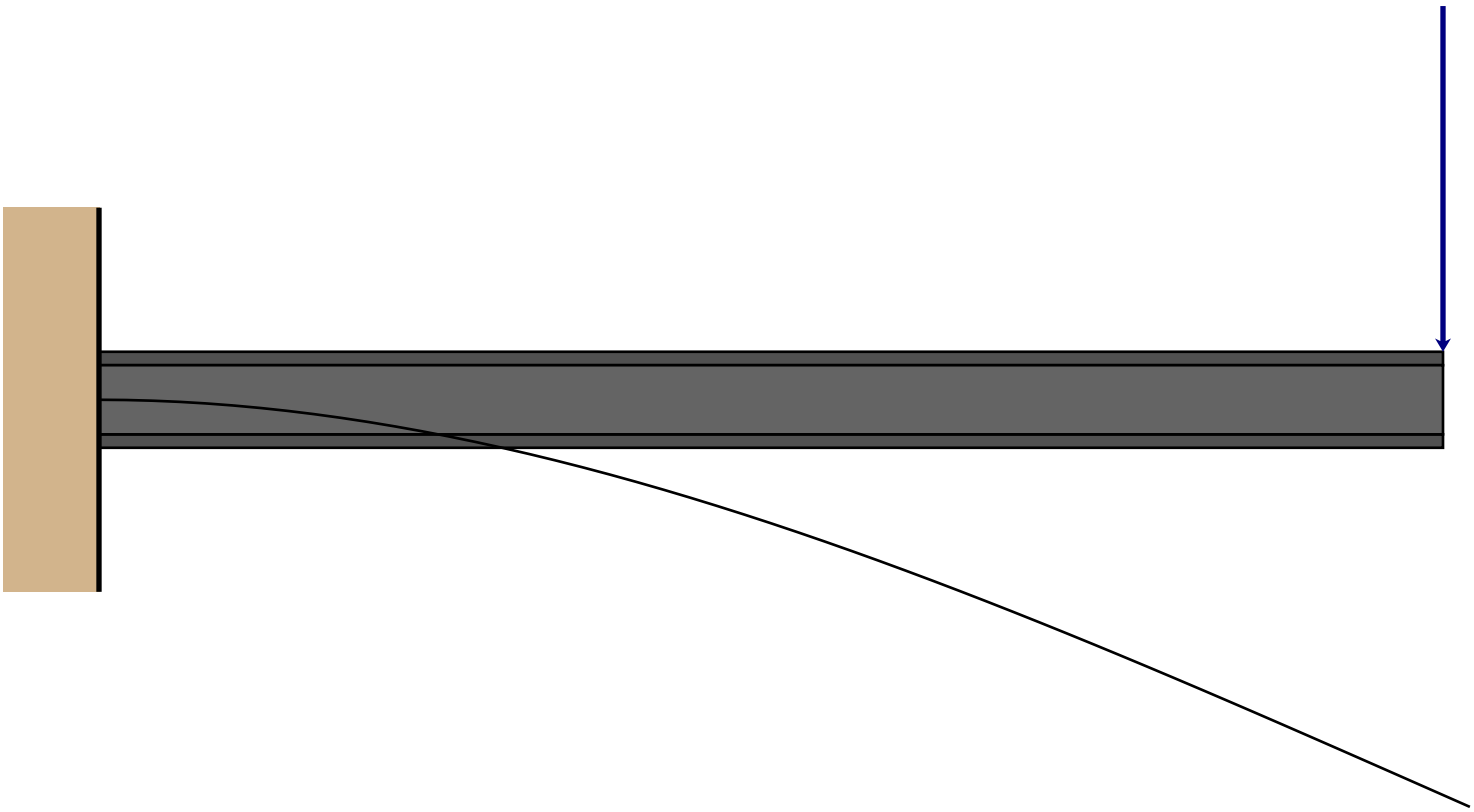
By not moving P but simply increasing it's magnitude, the deflection increases again.



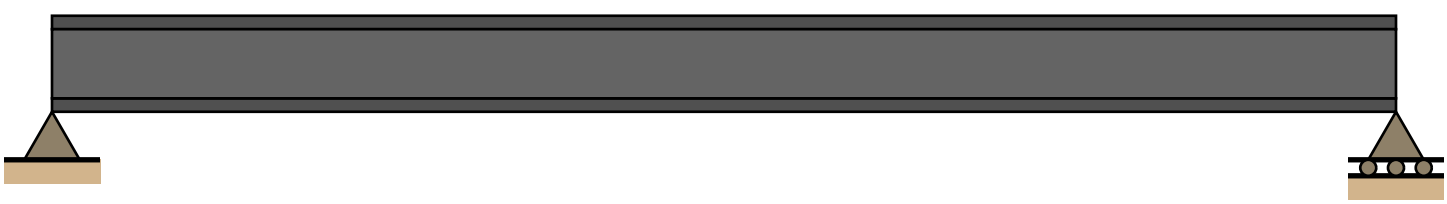
By not moving P but simply increasing it's magnitude, the deflection increases again.



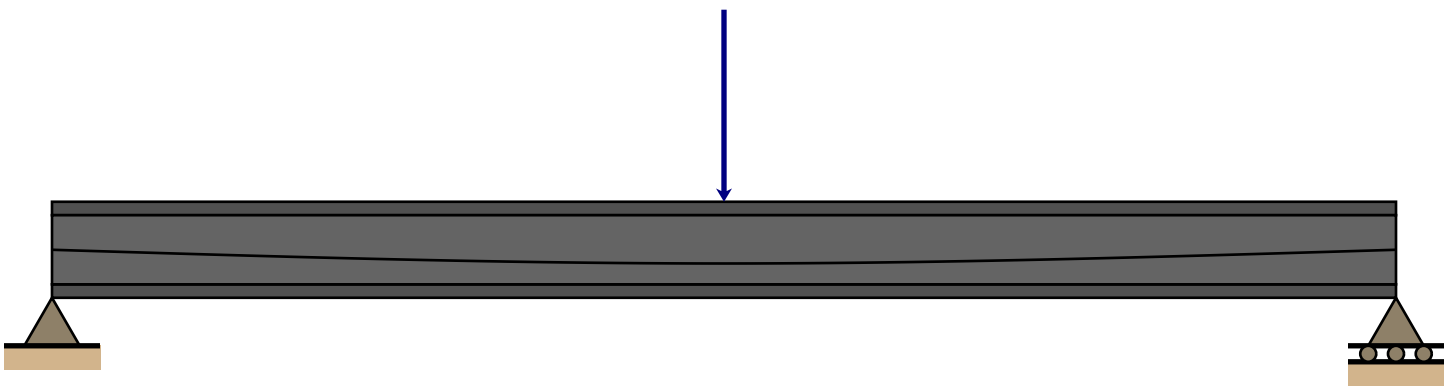
By not moving P but simply increasing it's magnitude, the deflection increases again.



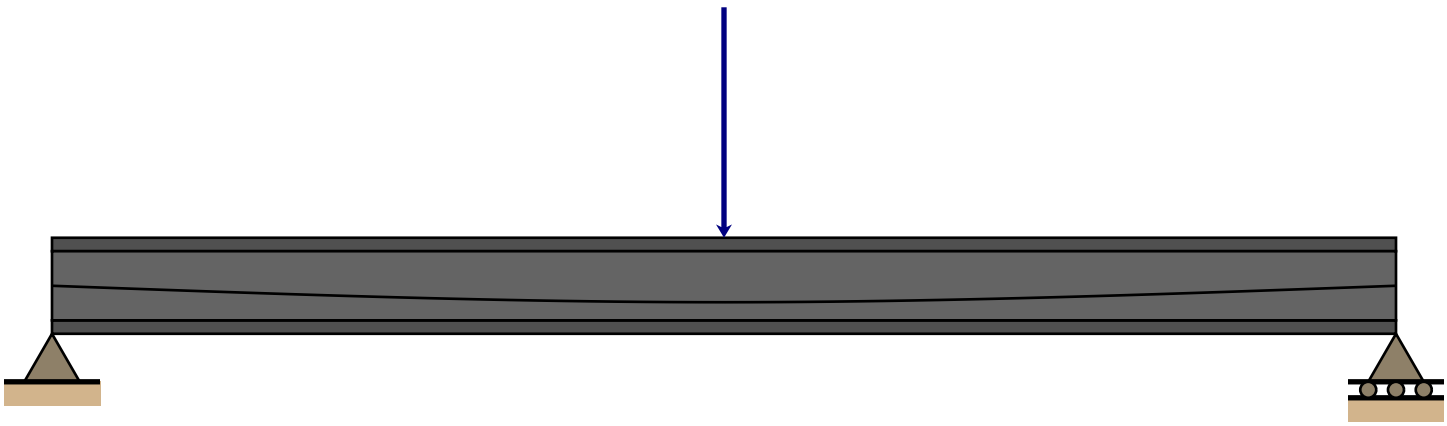
The same principles apply to a pin and roller supported beam.



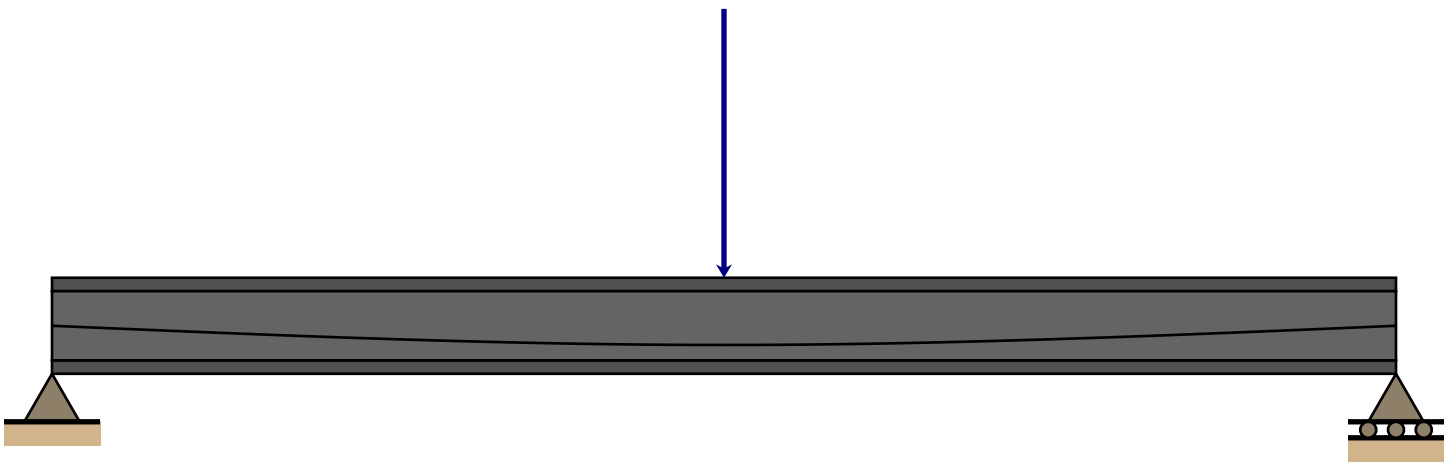
As P increases, the beam "sags" under the load



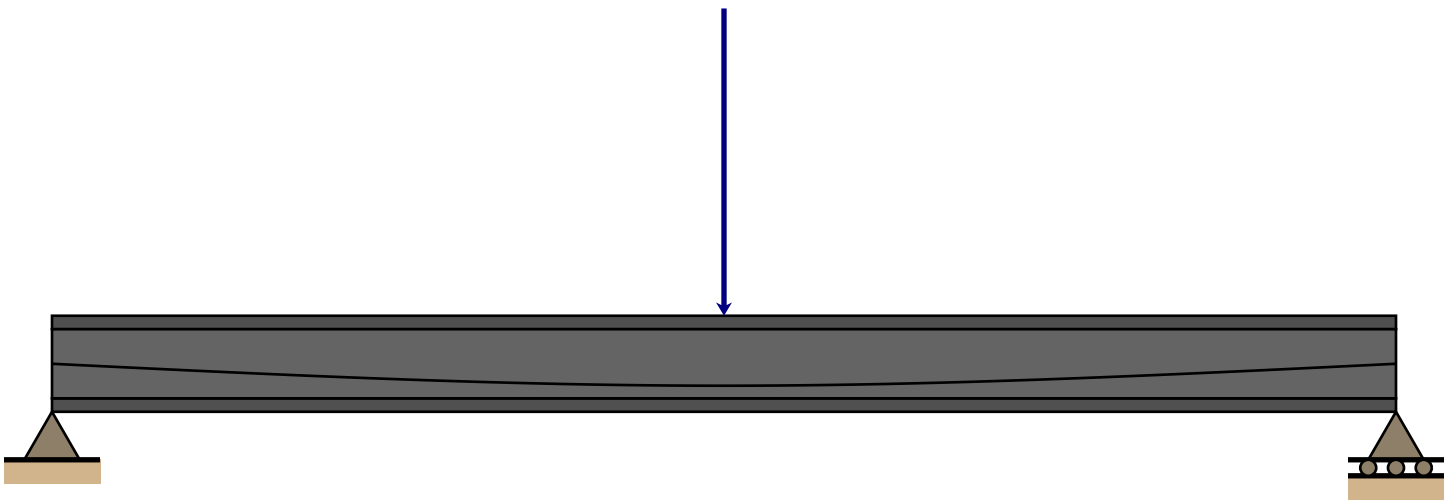
As P increases, the beam "sags" under the load



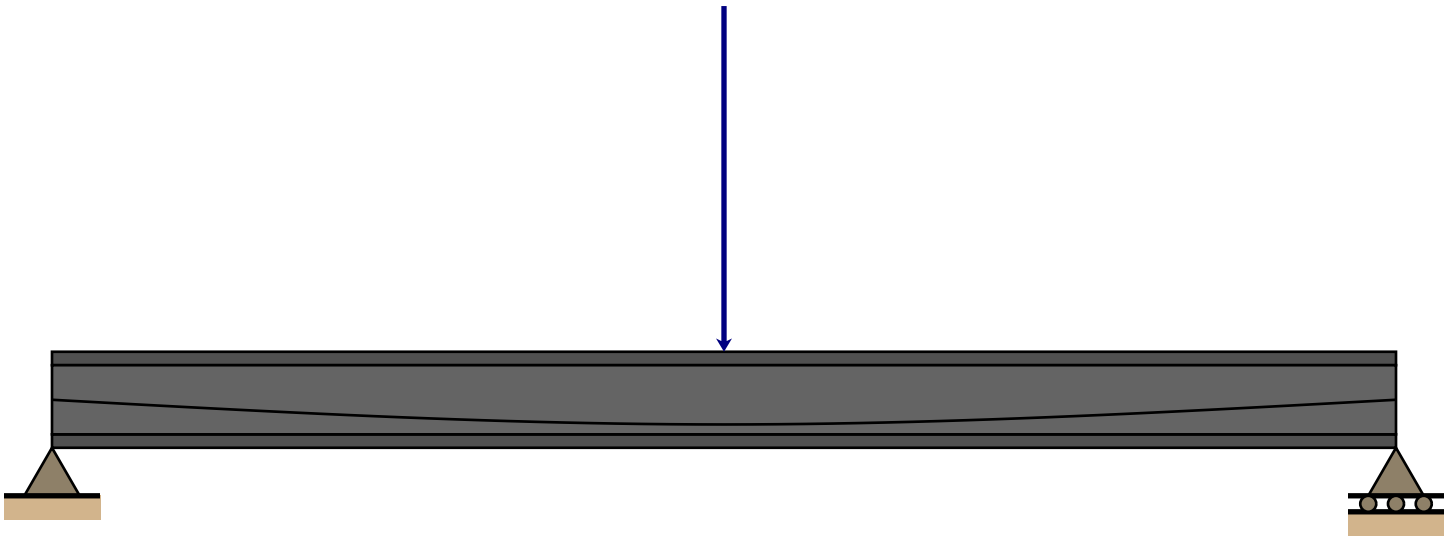
As P increases, the beam "sags" under the load



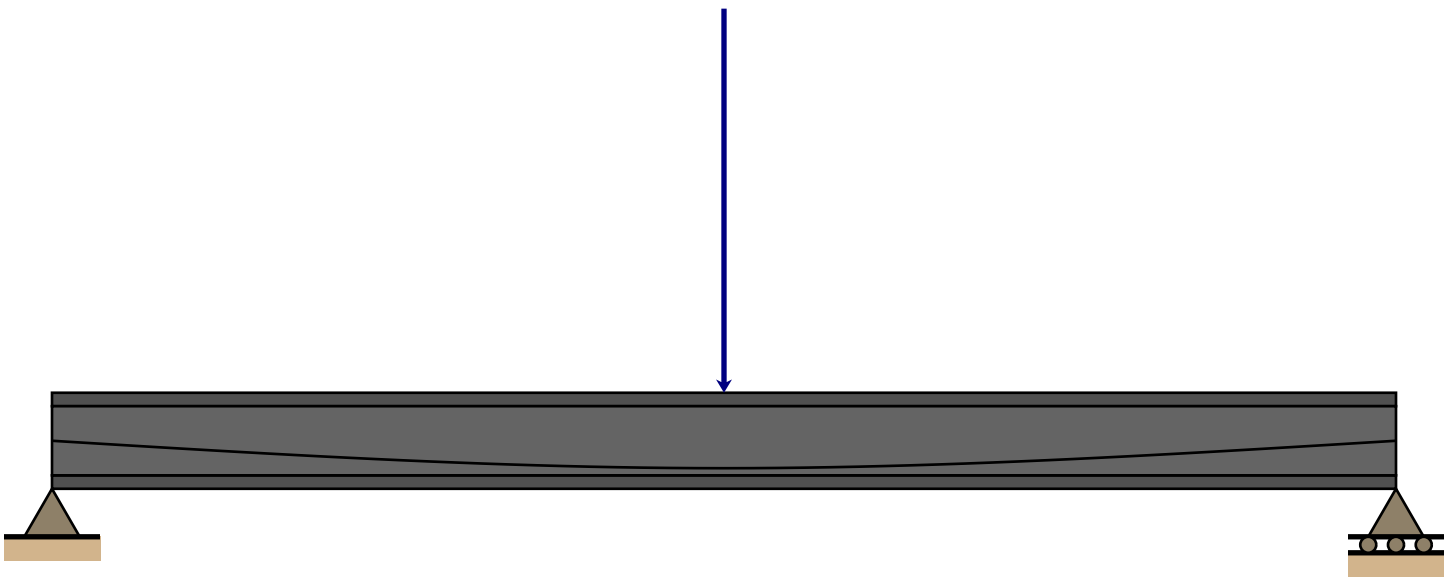
As P increases, the beam "sags" under the load



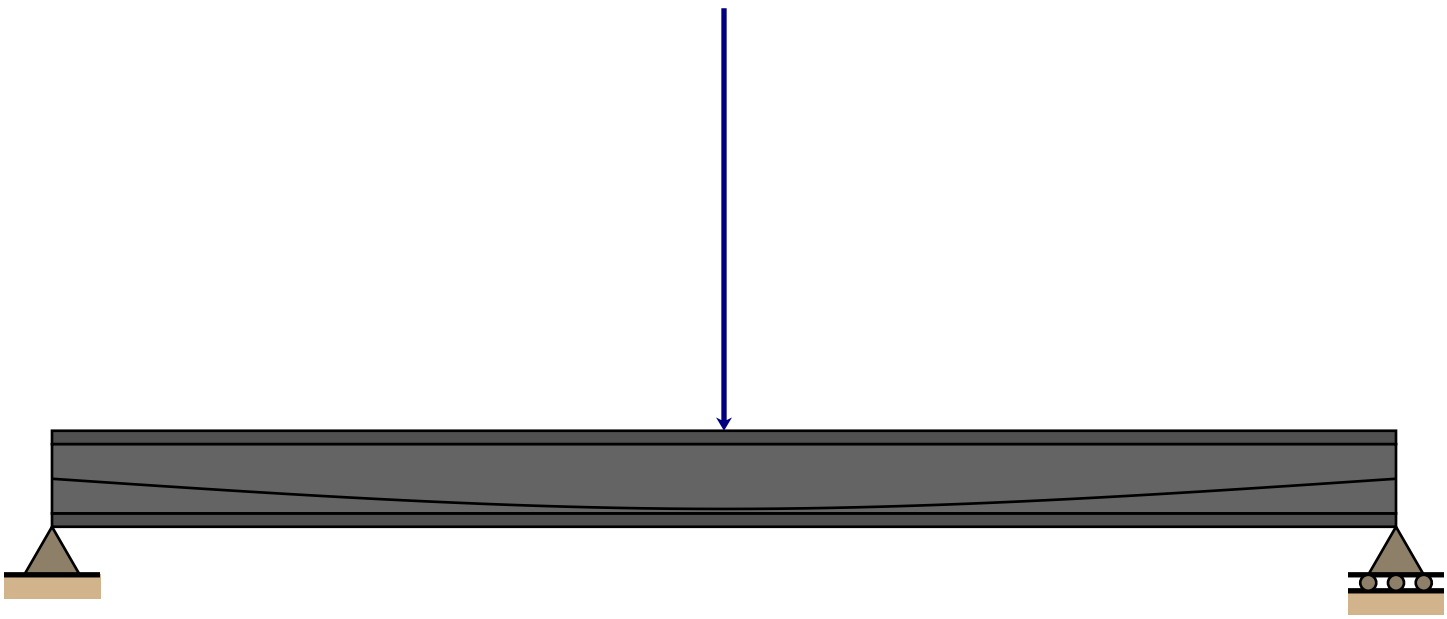
As P increases, the beam "sags" under the load



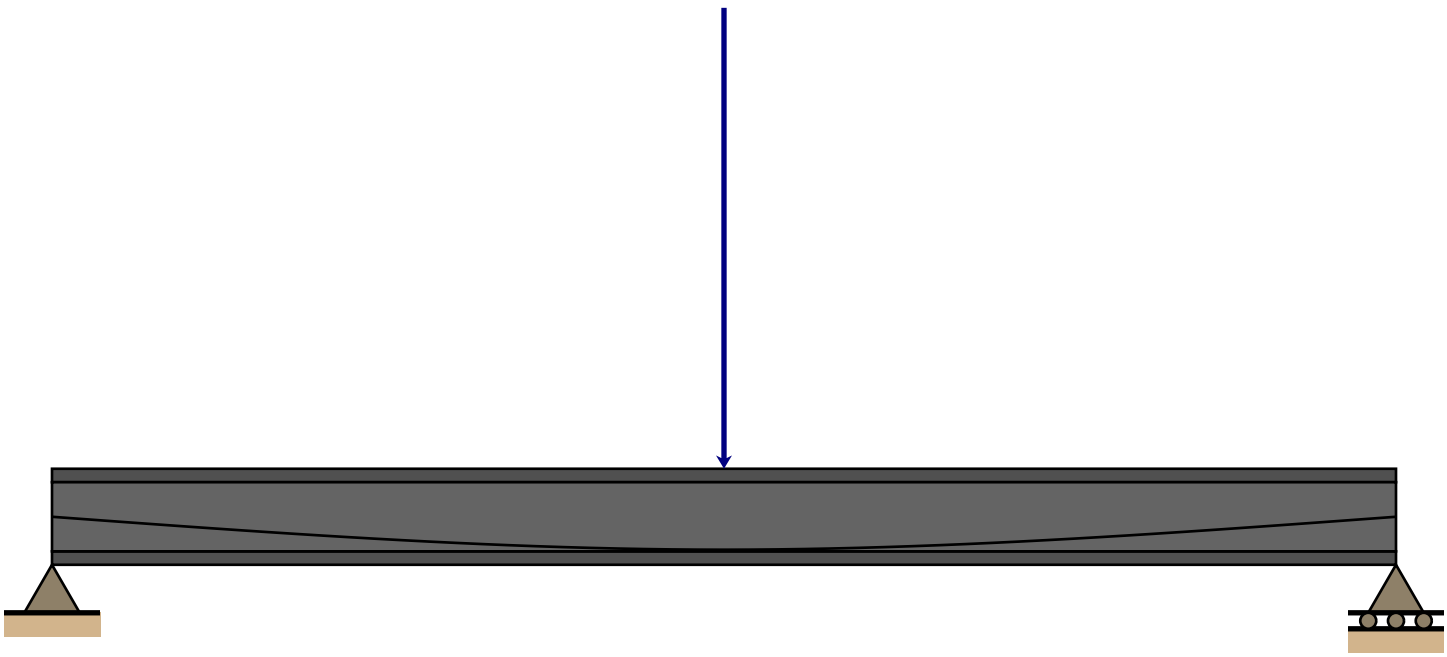
As P increases, the beam "sags" under the load



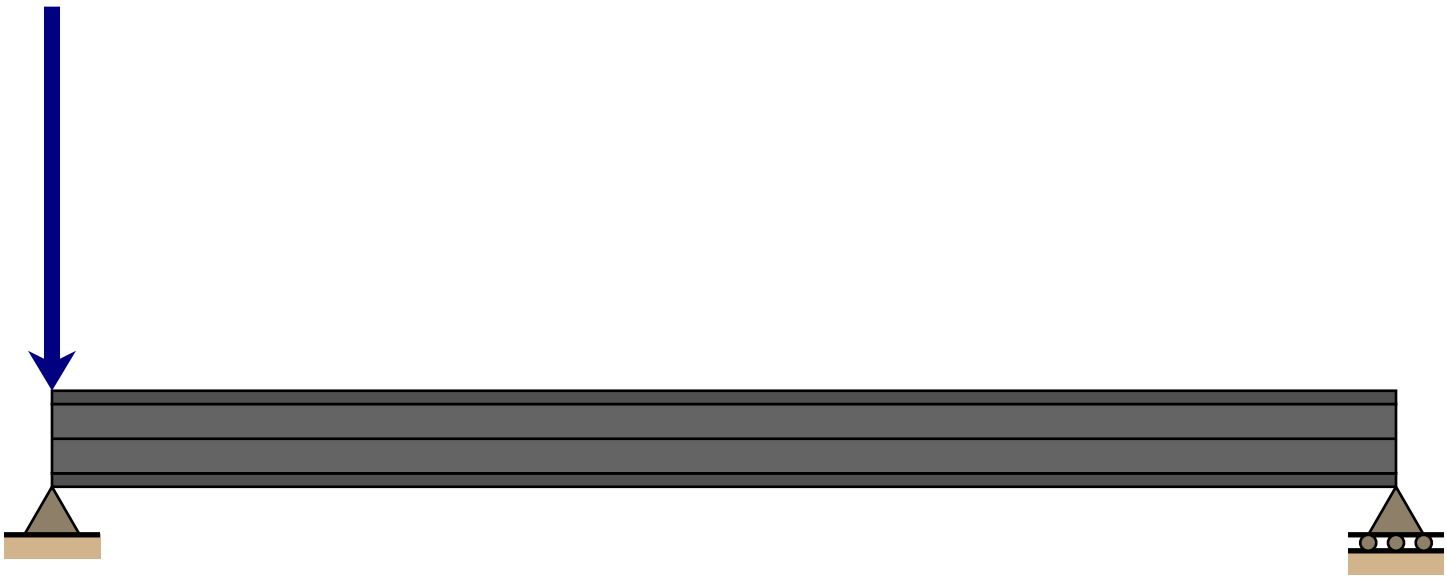
As P increases, the beam "sags" under the load



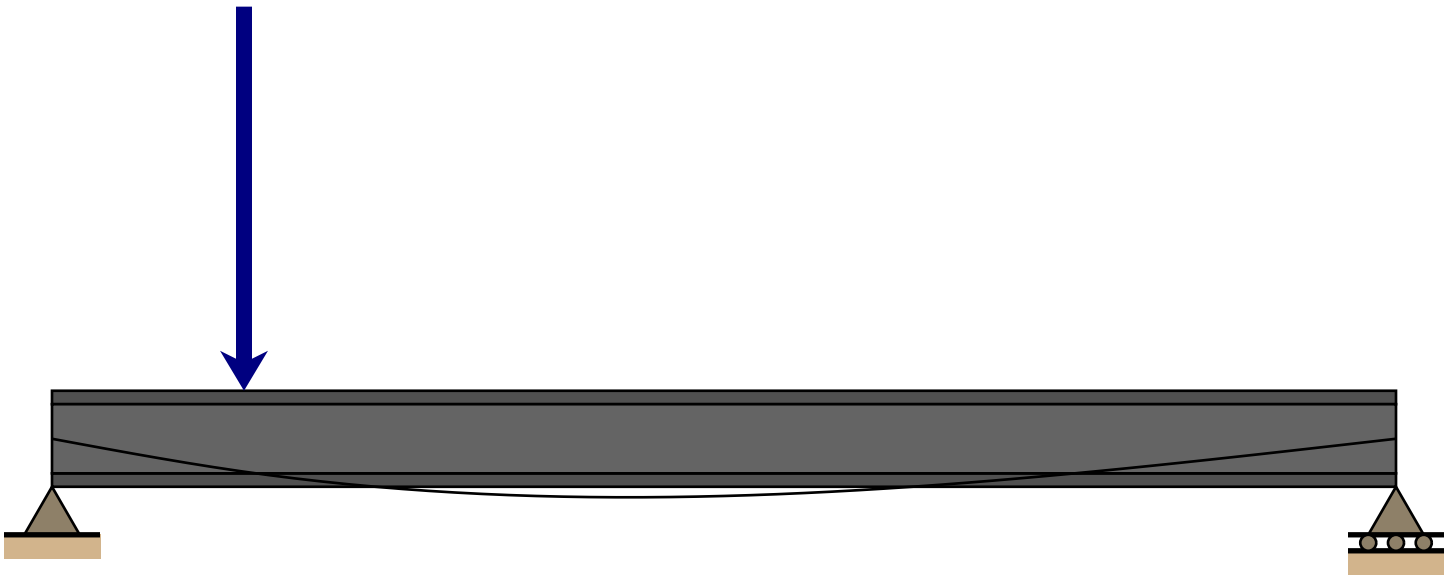
As P increases, the beam "sags" under the load



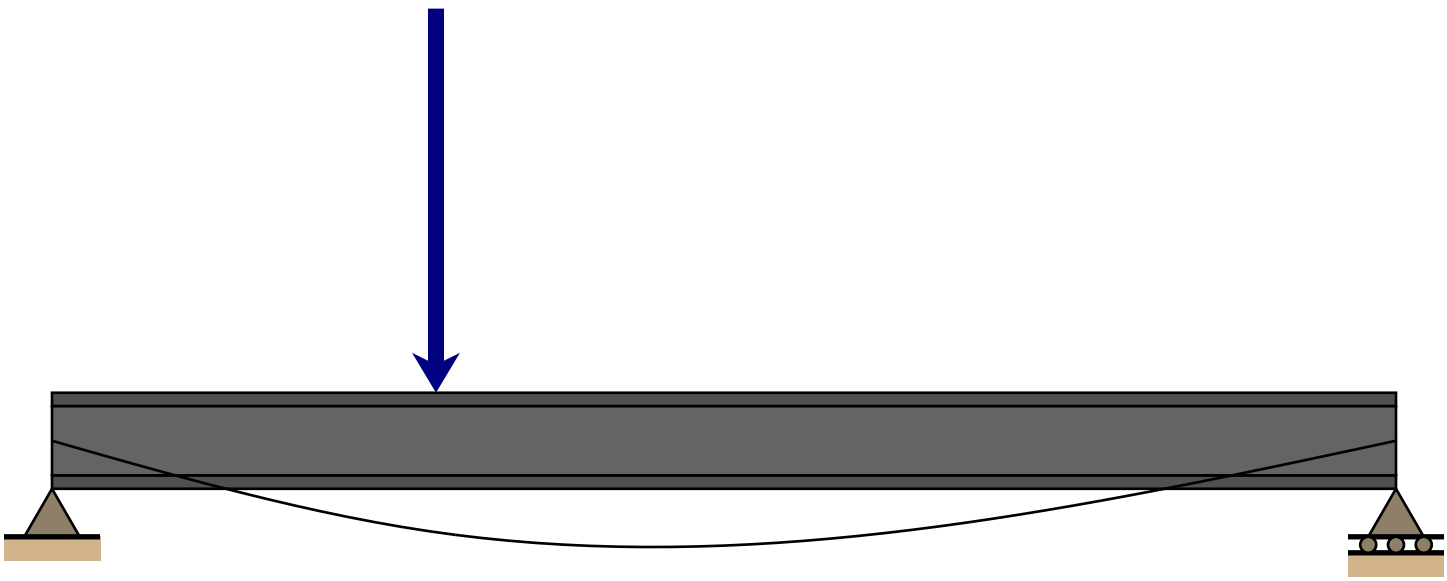
By moving P from one support to the next
you can observe the maximum deflection migrating.



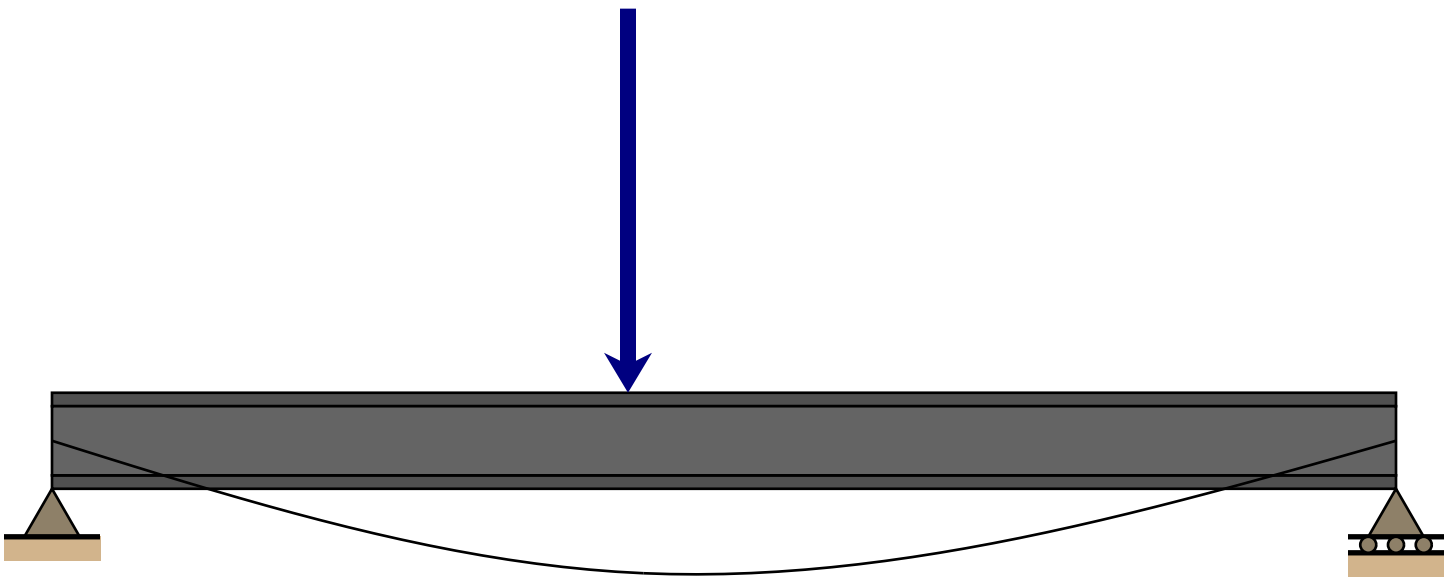
By moving P from one support to the next
you can observe the maximum deflection migrating.



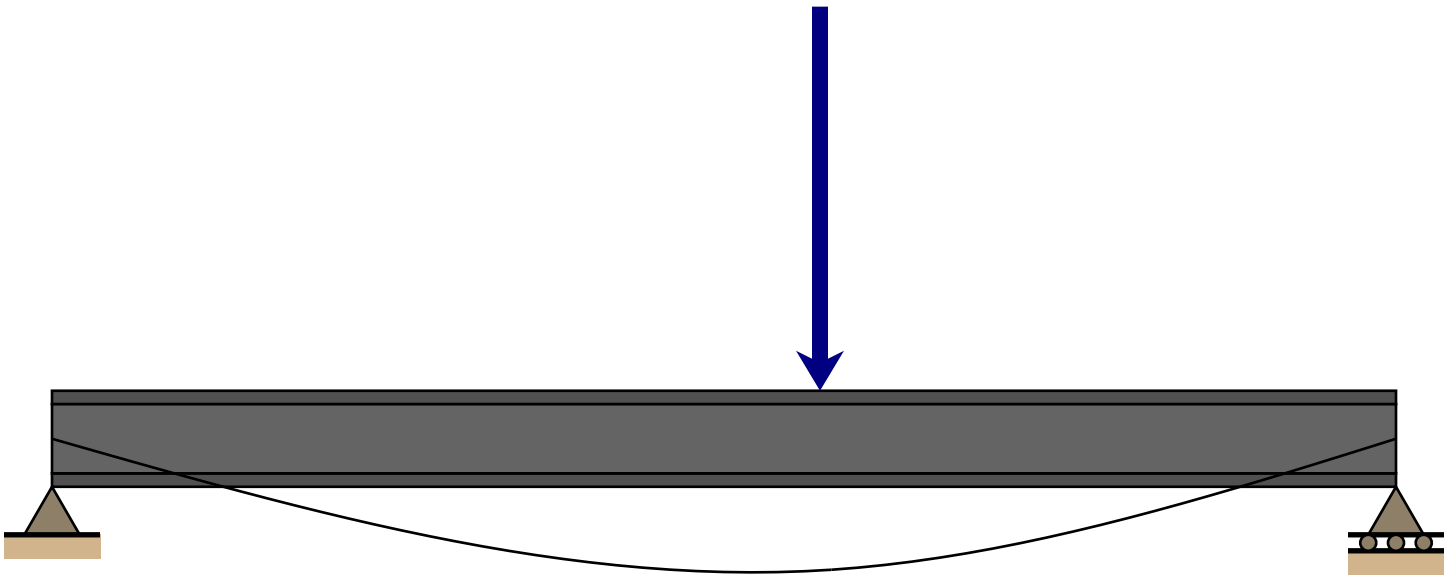
By moving P from one support to the next
you can observe the maximum deflection migrating.



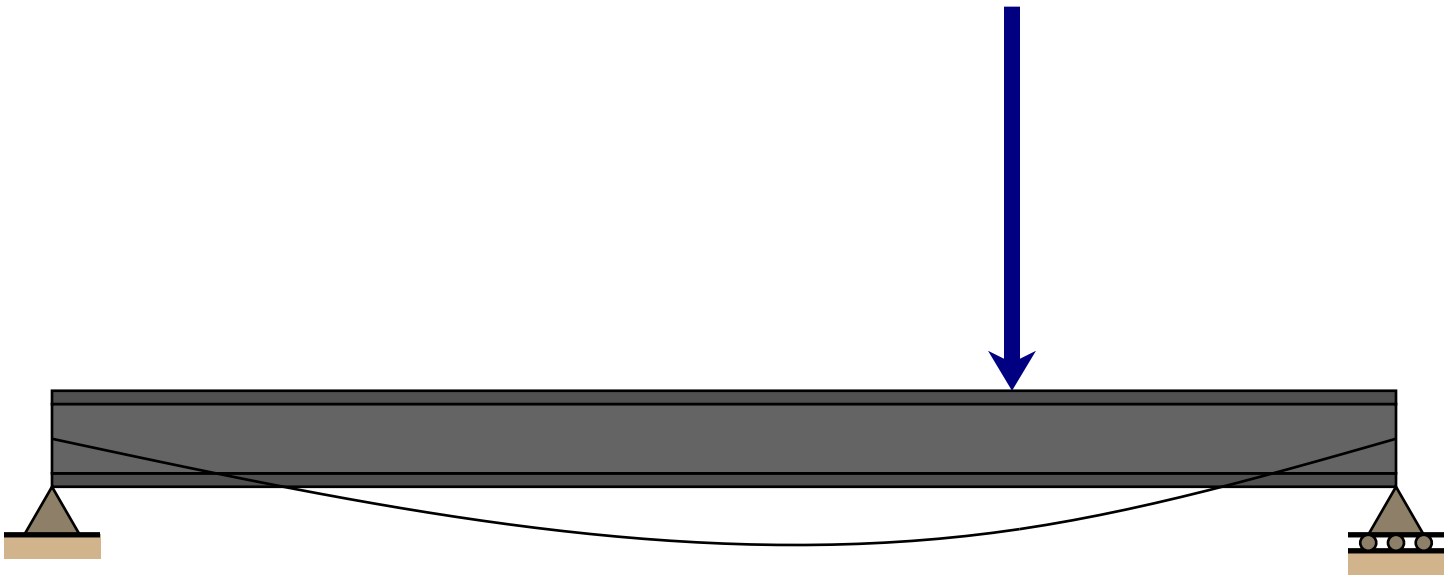
By moving P from one support to the next
you can observe the maximum deflection migrating.



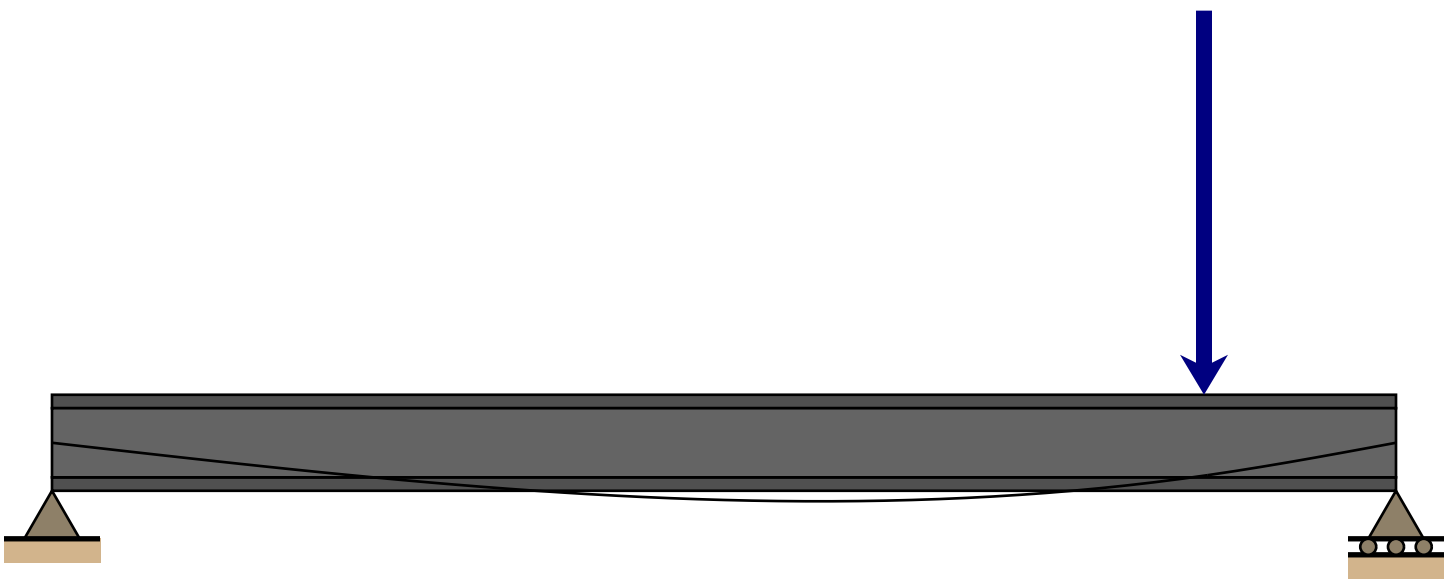
By moving P from one support to the next
you can observe the maximum deflection migrating.



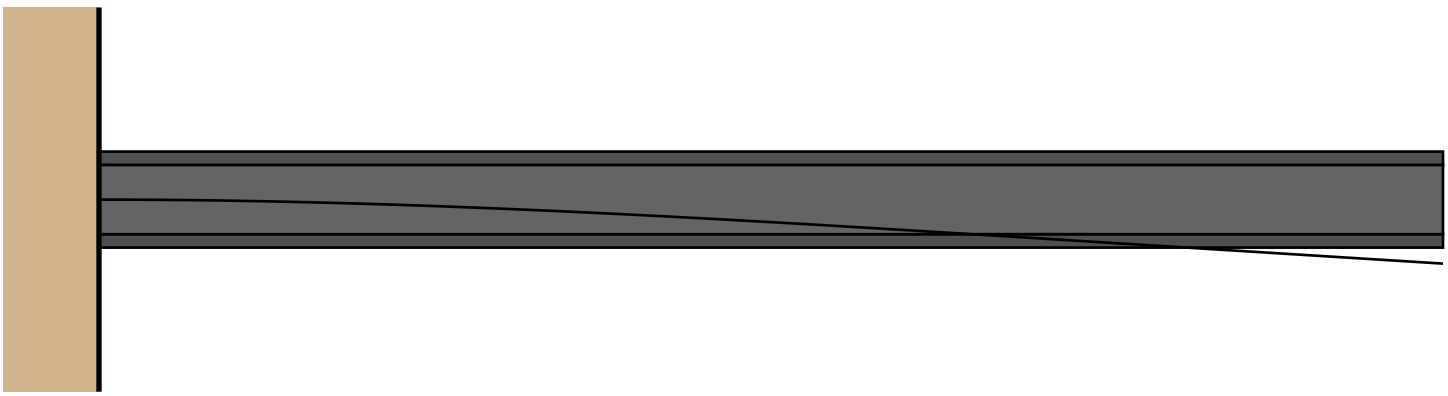
By moving P from one support to the next
you can observe the maximum deflection migrating.

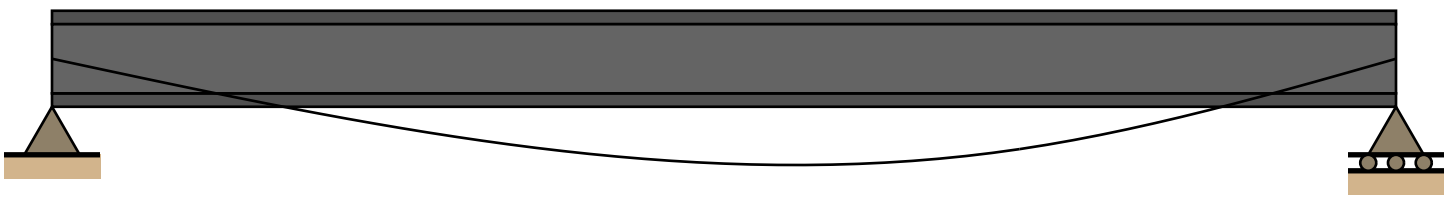


By moving P from one support to the next
you can observe the maximum deflection migrating.

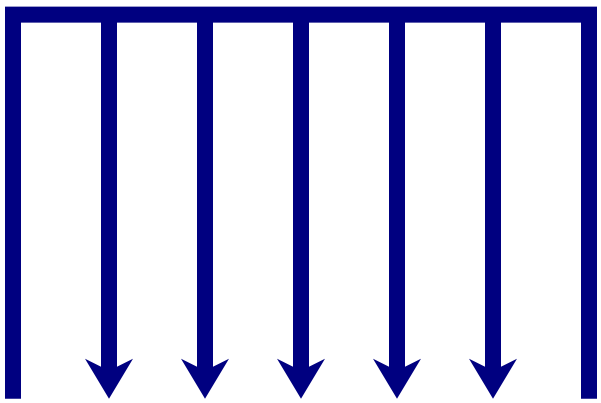


Notice that in both loading cases, the deflection is always 0 at the support/s.





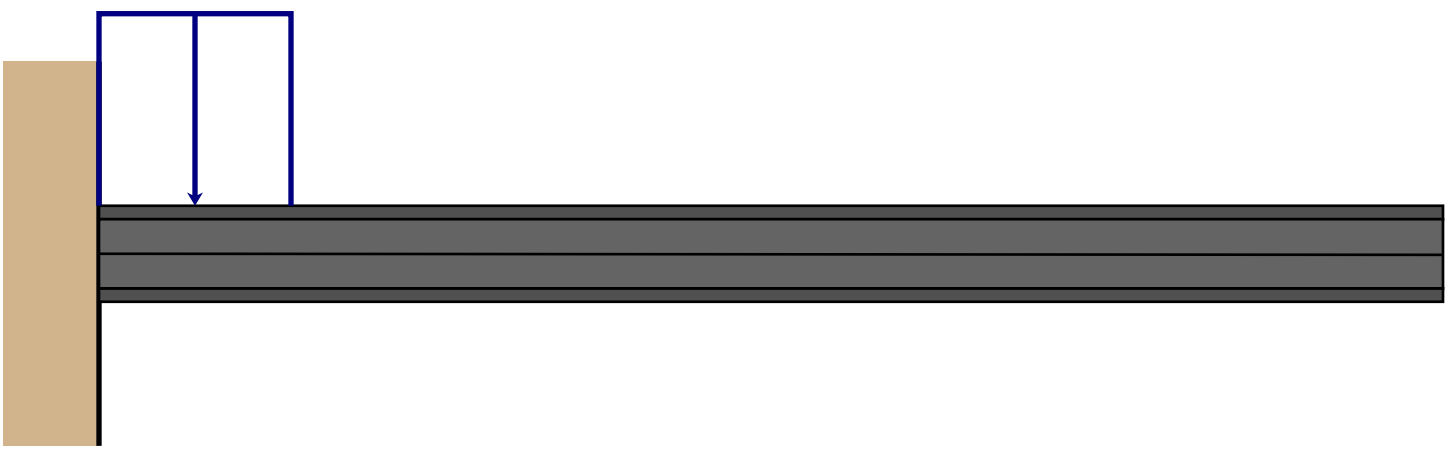
Now for the second loading type,
called Distributed loading (q).



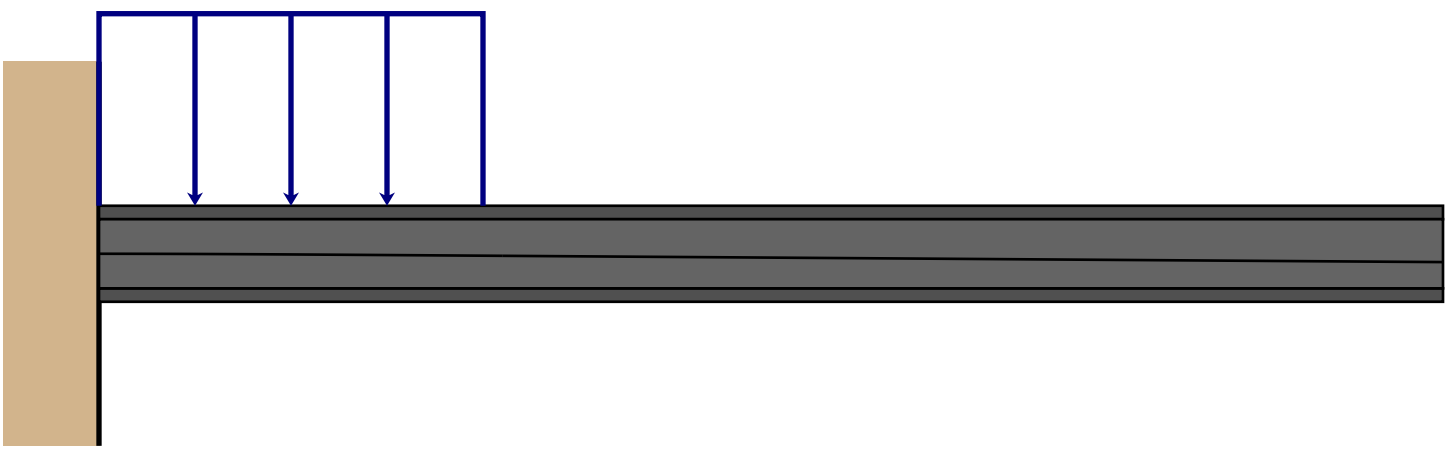
Distributed loads are similar to Point loads in that they are both vectors, only instead, they are spread over the length of the beam and therefore cause the beam to deflect in a different manner.

Picture a cantilever beam again, only this time bearing a Distributed load q per unit beam length.

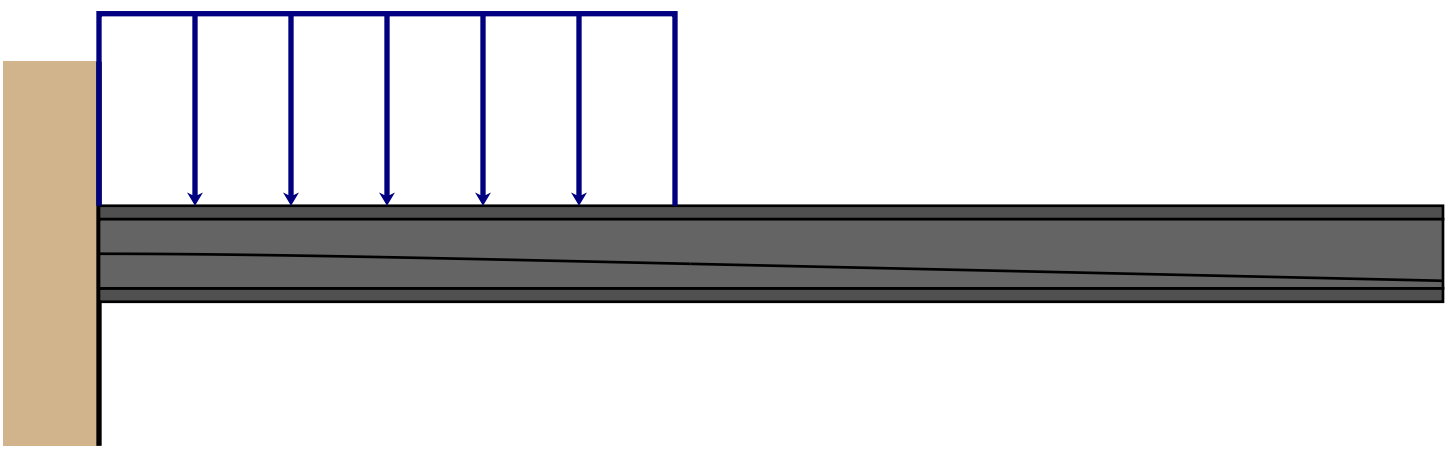
As q is extended along the beam, the deflection increases dramatically.



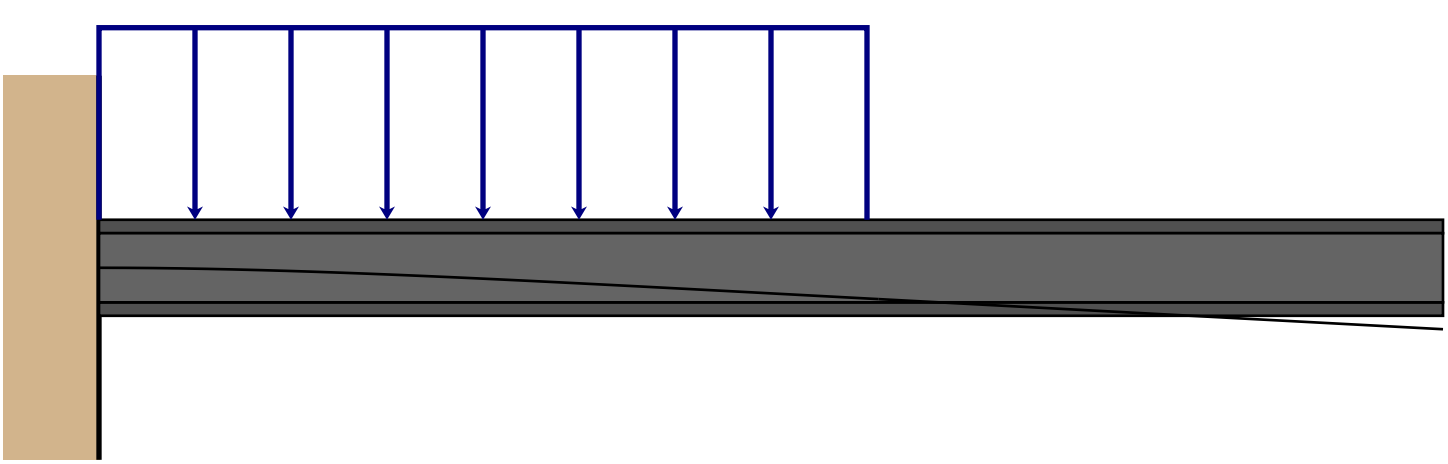
As q is extended along the beam, the deflection increases dramatically.



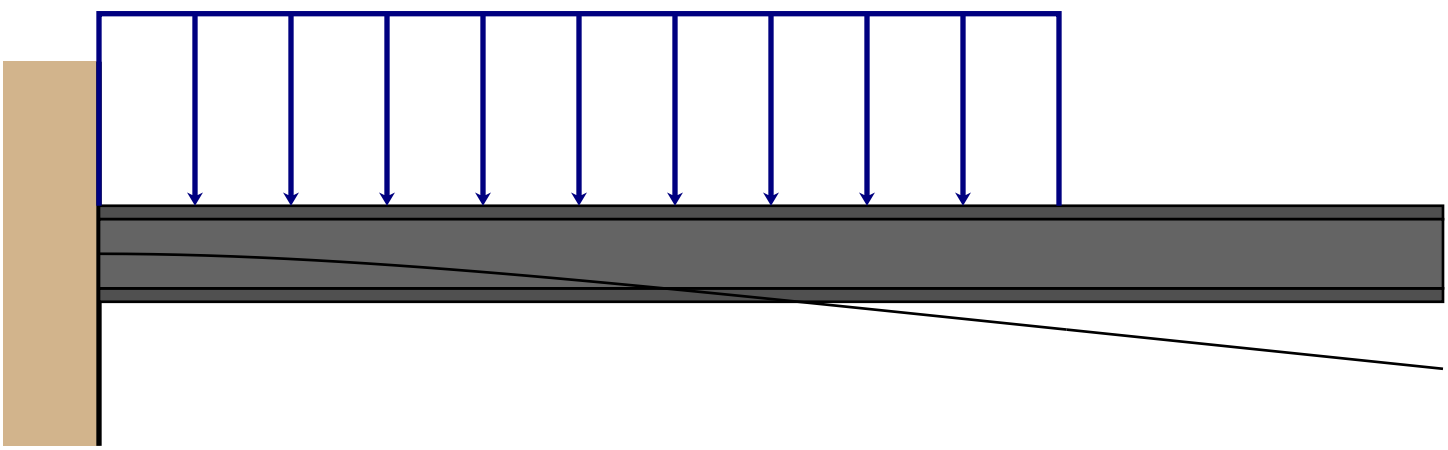
As q is extended along the beam, the deflection increases dramatically.



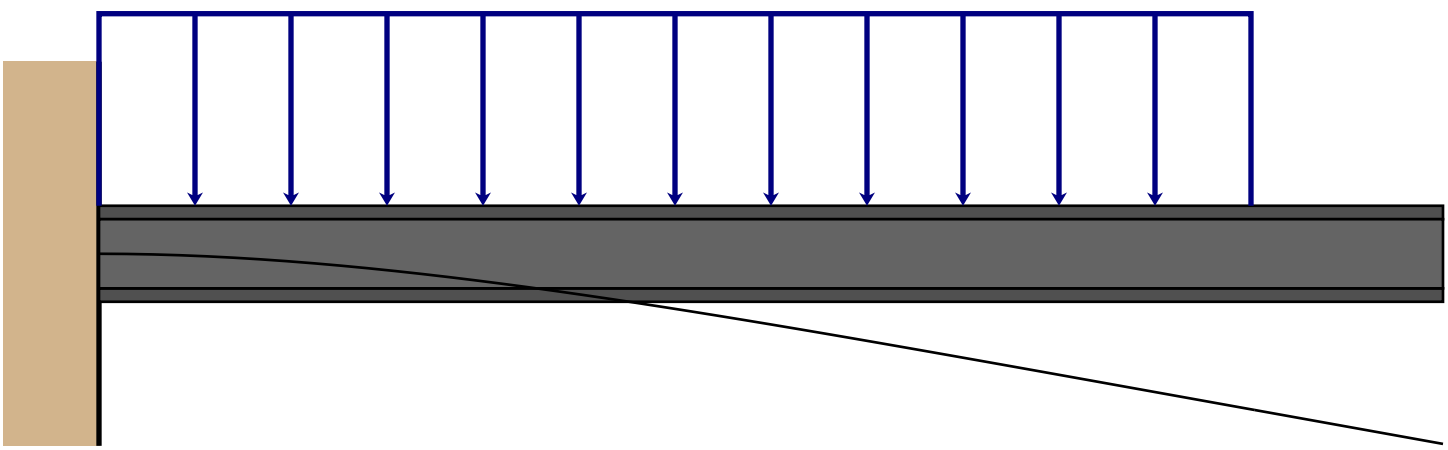
As q is extended along the beam, the deflection increases dramatically.



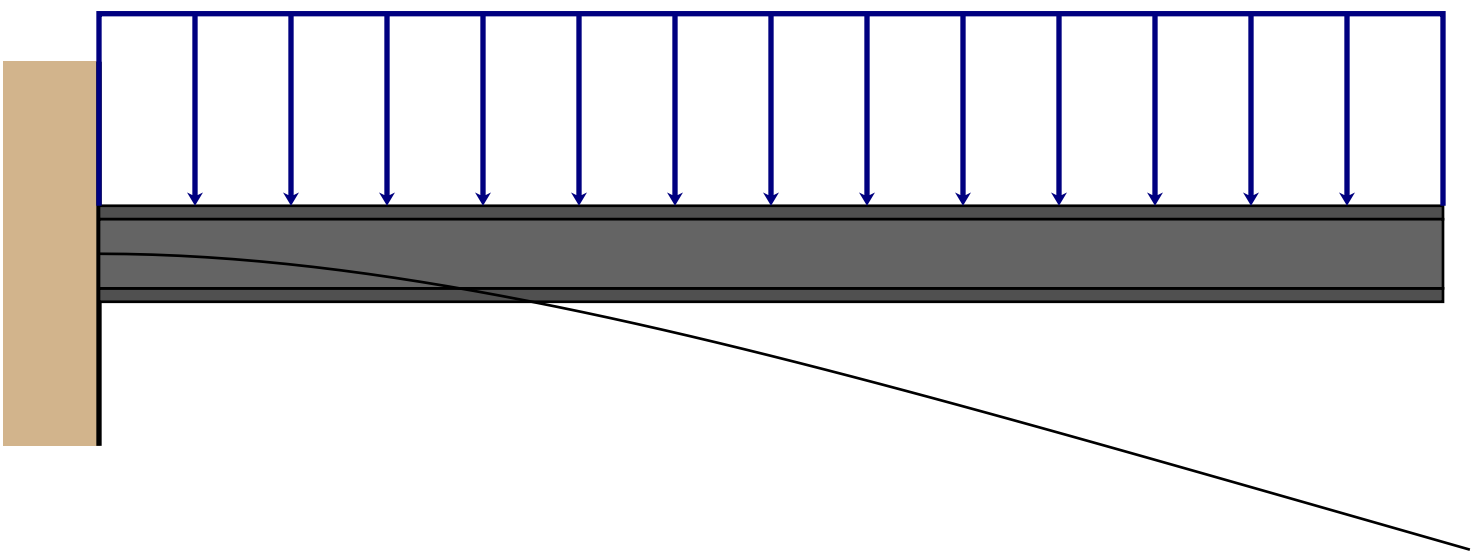
As q is extended along the beam, the deflection increases dramatically.



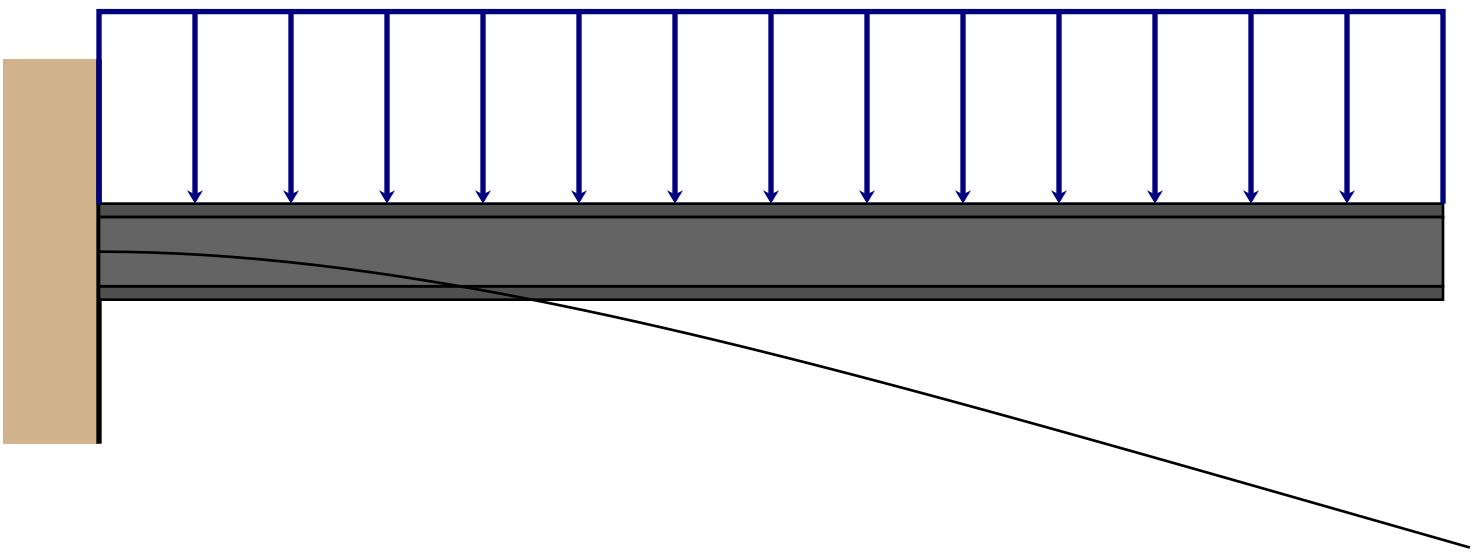
As q is extended along the beam, the deflection increases dramatically.



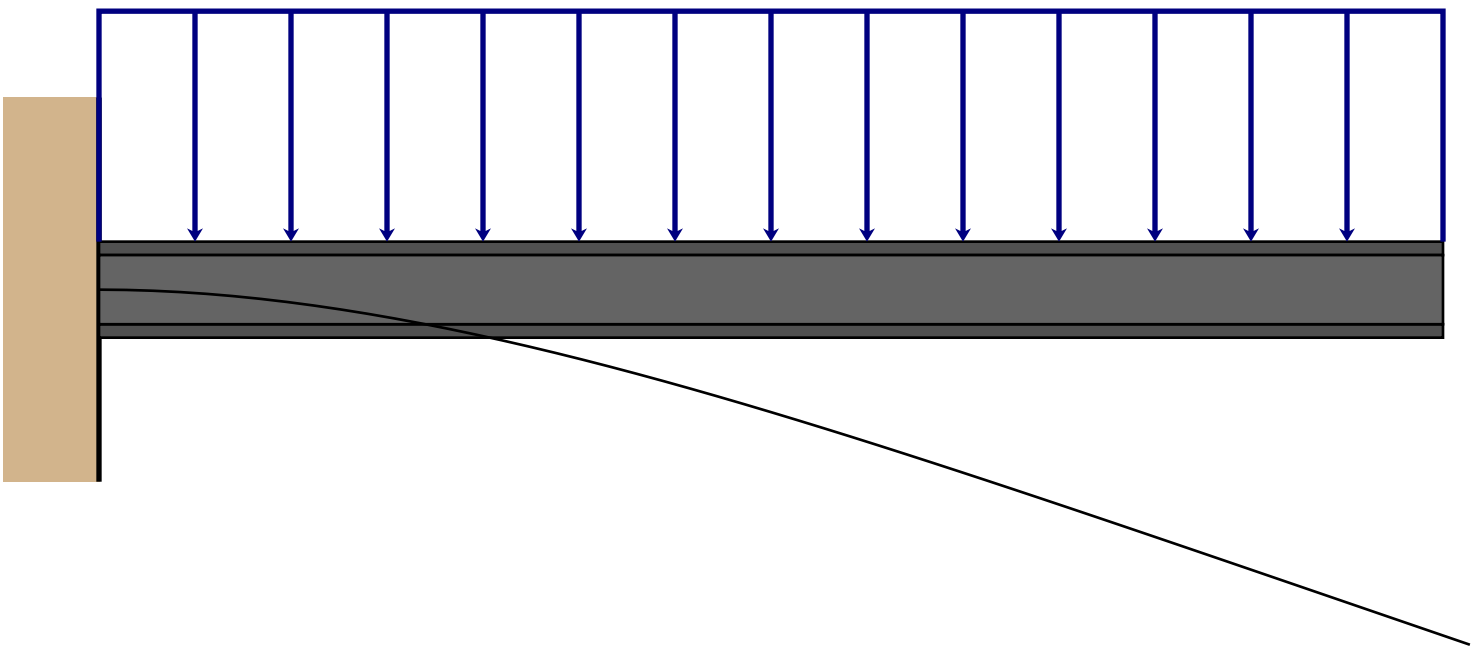
As q is extended along the beam, the deflection increases dramatically.



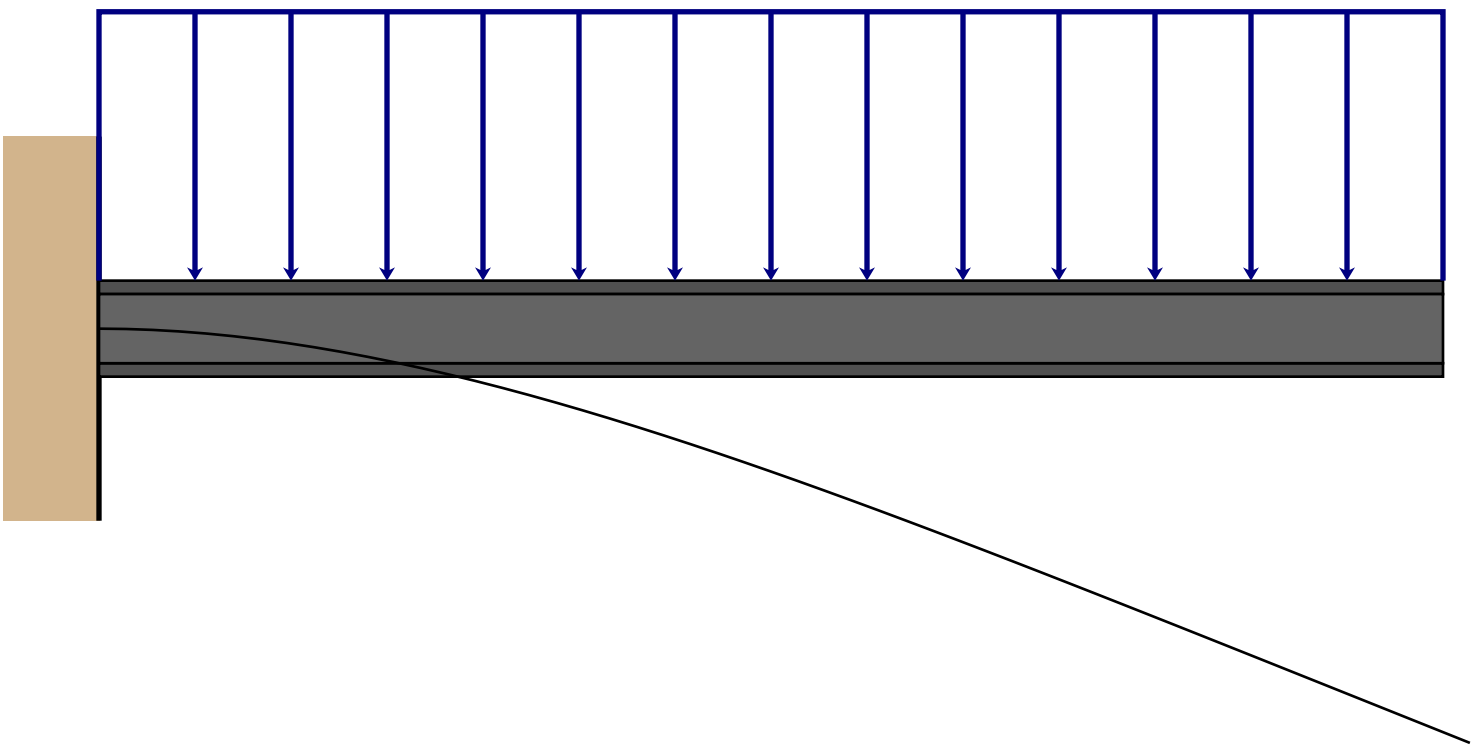
Increasing q also increases deflection.



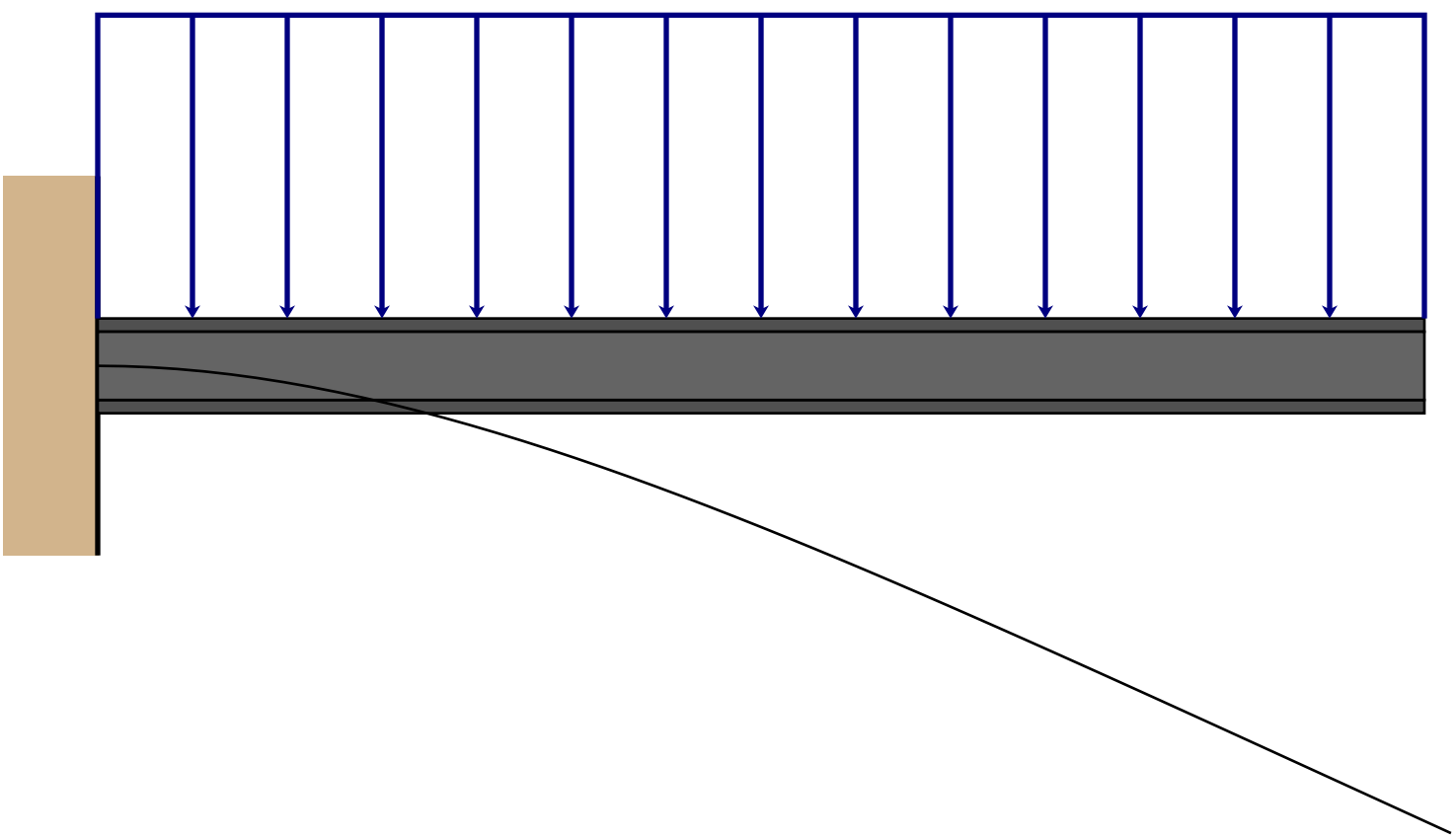
Increasing q also increases deflection.



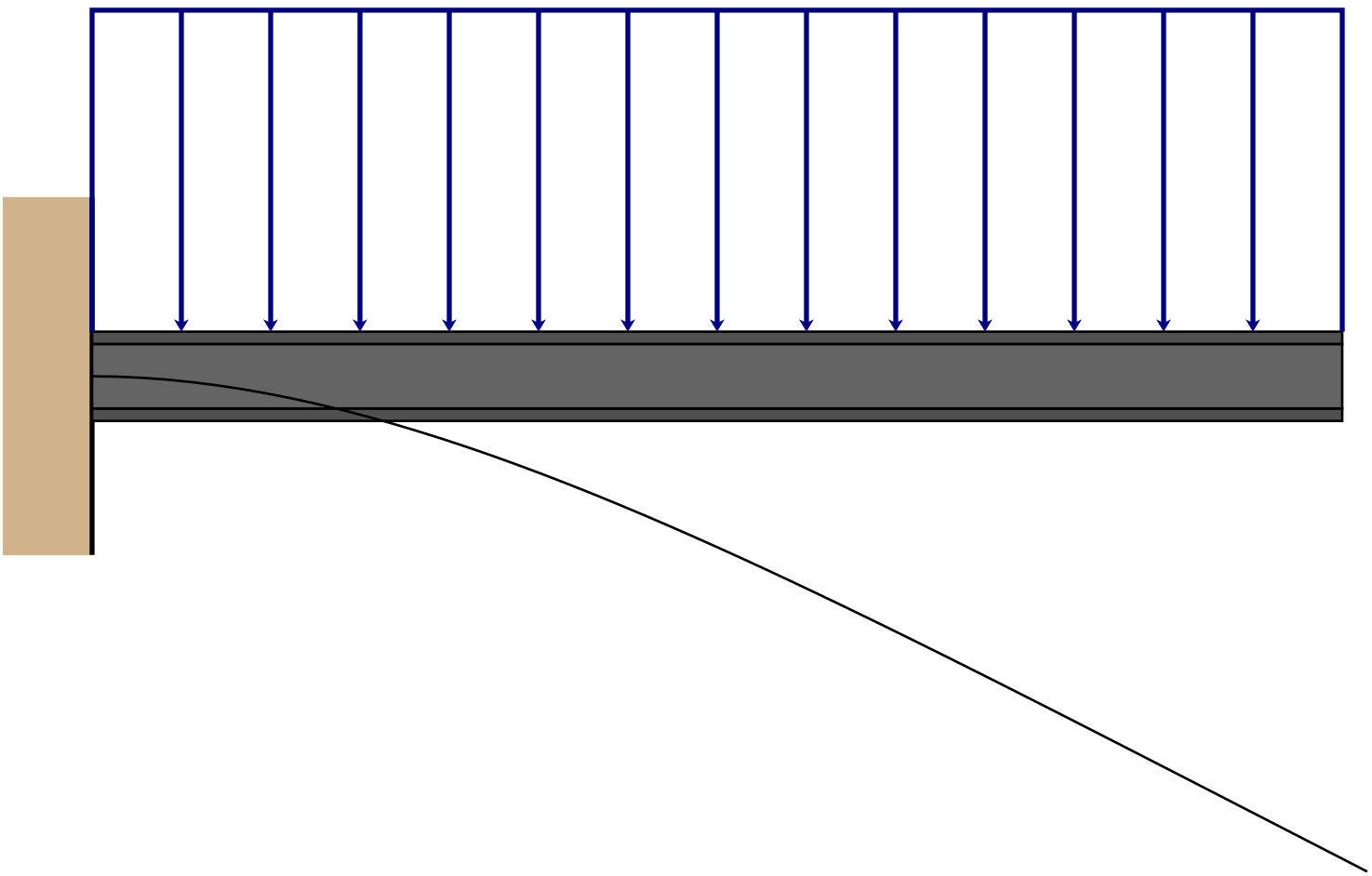
Increasing q also increases deflection.



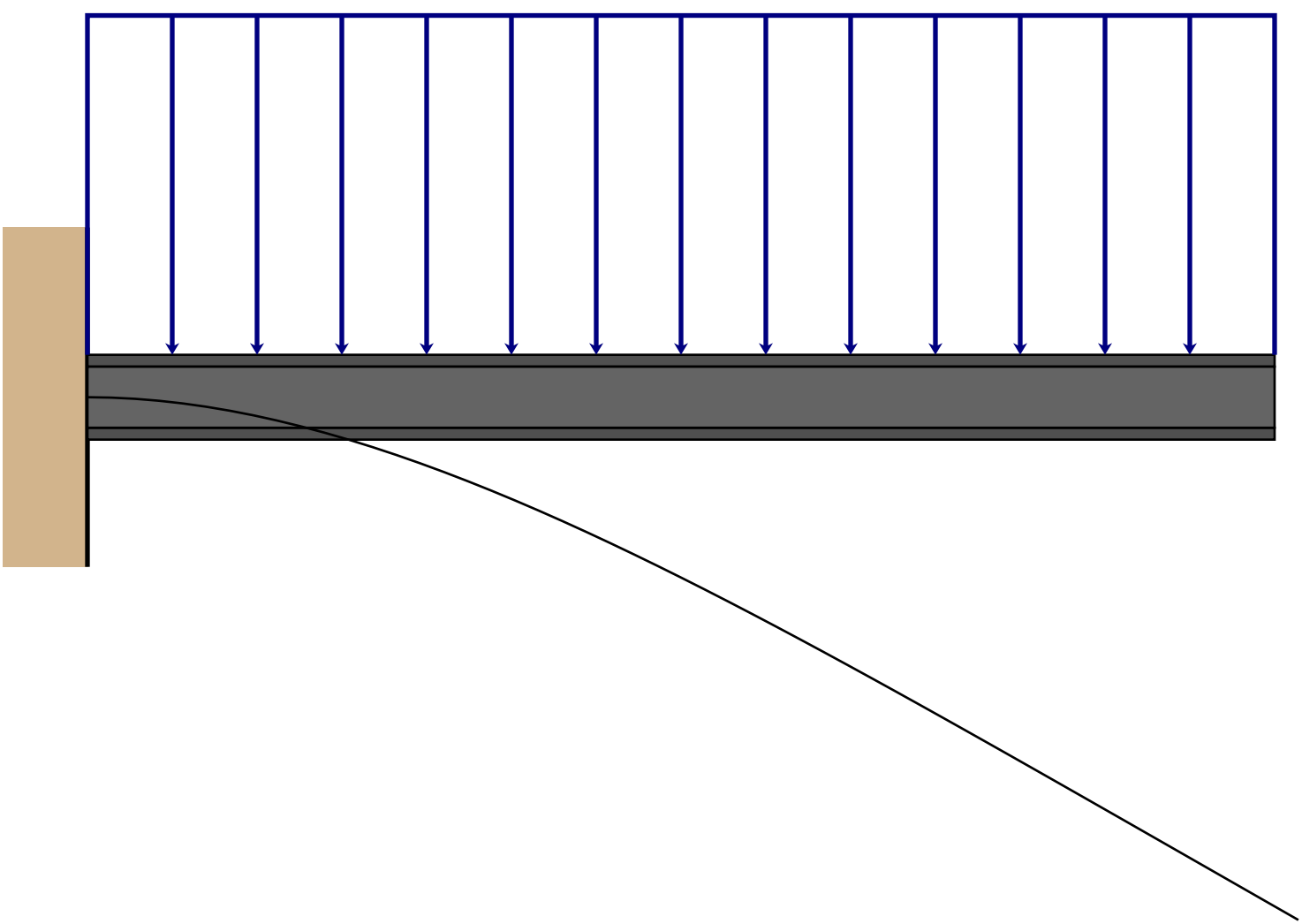
Increasing q also increases deflection.



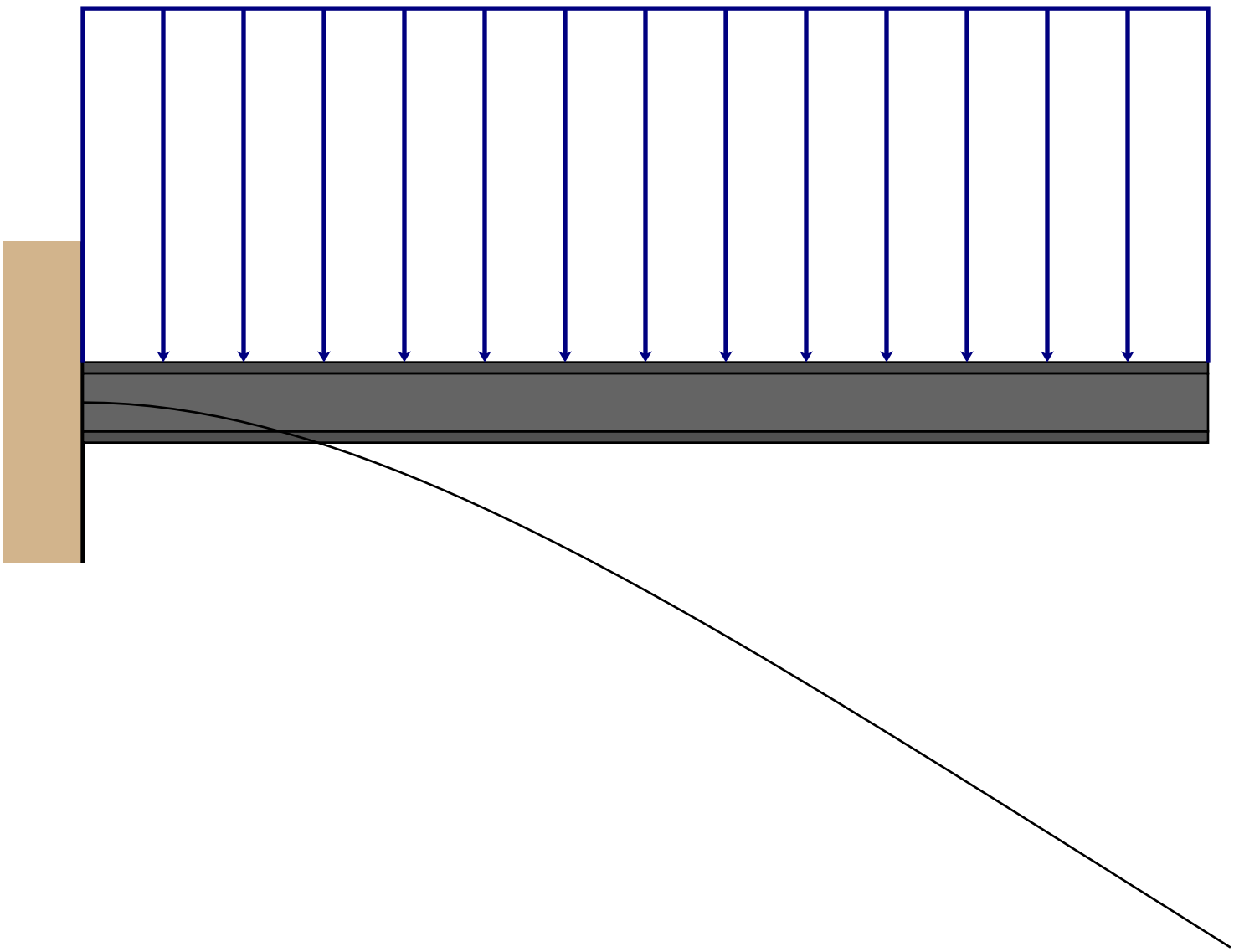
Increasing q also increases deflection.



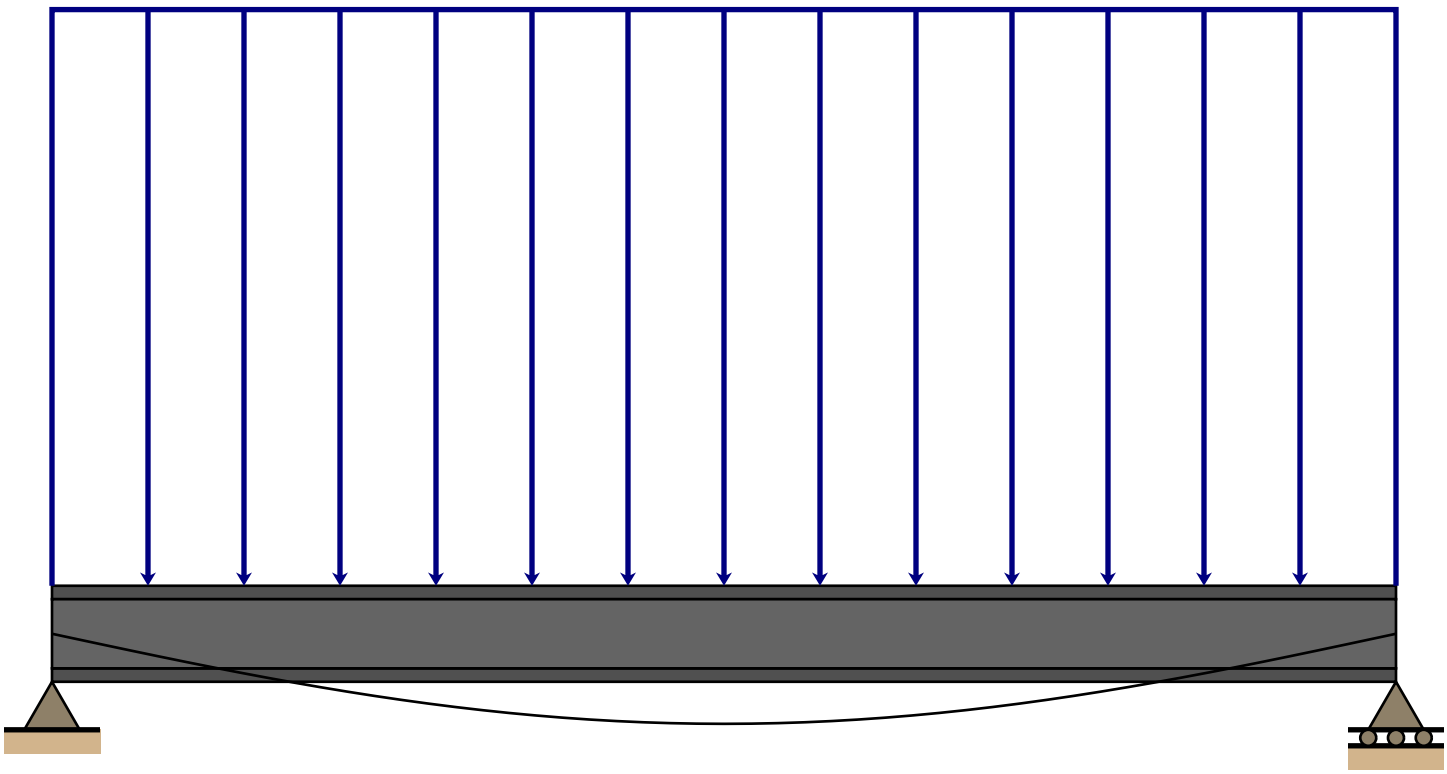
Increasing q also increases deflection.



Increasing q also increases deflection.



A pin and roller beam is supported at both ends and therefore has a lesser max deflection for the same load.



The End