

Wave Interference

When two waves meet, the displacements of the particles from each individual wave are added together to create one wave form.

This is called the Superposition principle.

constructive interference

destructive interference

Reflection of Fixed and Free Ends

fixed end

wall

string

reflects inverted "out of phase"

free end

A Special Case of Interference

Consider what happens when a wave is incident on a fixed end. The reflected wave will interfere with the incident (incoming) wave.

<http://www.walter-fendt.de/ph14e/stwaveref1.htm>



The resulting wave is called a Standing wave

Notice that the wave alternates between moments of constructive interference and destructive interference.

Both the troughs and the crests are twice as high as the original wave. (Thus, the amplitude is twice as large.)

$L = \frac{1}{2}\lambda$ or $\lambda = 2L$

$v = f\lambda$
 $v = f(2L)$
 $f = \frac{v}{2L}$

Let's say $L = 8 \text{ m}$
 $v = 8 \text{ m/s}$
 $f_1 = \frac{8}{2(8)} = 0.5 \text{ Hz}$

$f = \frac{v}{\lambda}$
 $f_2 = \frac{v}{\lambda}$

$f_1 = \frac{v}{2L} = \left(\frac{1}{2}\right)f$
 $\therefore f_2 = 2f_1$

$f_3 = \frac{v}{\lambda}$
 $\frac{3}{2}\lambda = L$
 $\lambda = \frac{2}{3}L$

$f_3 = \frac{v}{\frac{2}{3}L} = \frac{3v}{2L} = 3f_1$

Resonance

→ All objects have a natural resonance frequency at which a standing wave will be produced

The vibrations produced are amplified. This is called mechanical resonance.

TACOMA NARROWS BRIDGE COLLAPSE

Length of center span 2800 ft

Width 39 ft

Depth of stiffening girders 8 ft

Start of construction Nov. 23, 1938

Opened for traffic July 1, 1940

Collapse of bridge Nov. 7, 1940

