11-4)

In general,  $f = f_0 [v_{sound} + v_{listener}]/[v_{sound} + v_{source}]$ 

We need to do the problem in two steps. What frequency is 'heard' by the wall? That frequency can be considered to be re-emitted by the wall back at the bat and becomes our new  $f_0$  for the second part of the problem. So,

 $f'' = f' [v_{sound} + v_{listener}]/[v_{sound} + v_{source}] = f_0 [v_{sound} + v_{listener}]/[v_{sound} + v_{source}] [v_{sound} + v_{listener}]/[v_{sound} + v_{listener}]/[v_{soun$ 

 $= f_{o} [v_{sound} + 0]/[v_{sound} - v_{bat}] * [v_{sound} + v_{bat}]/[v_{sound} + 0] = f_{o} [v_{sound} + v_{bat}]/[v_{sound} - v_{bat}] = 2000 [344 + v_{bat}]/[344 - v_{bat}]$ 

Now since the frequency the bat hears reflected is clearly higher than the frequency it emits, and since the beat frequency is 10 Hz, the 'heard' frequency must be 2010 Hz, so  $2010 = 2000 [344 + v_{bat}]/[344 - v_{bat}]$   $2010 (344 - v_{bat}) = 2000 (344 + v_{bat})$   $3440 = 4010 v_{bat}$  $v_{bat} = 3440/4010 = 0.86 \text{ m/s}$