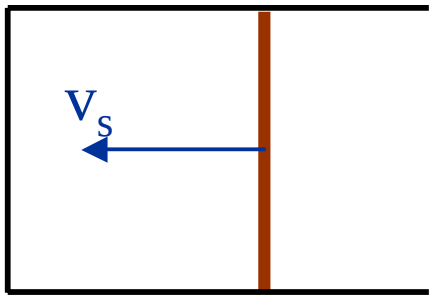
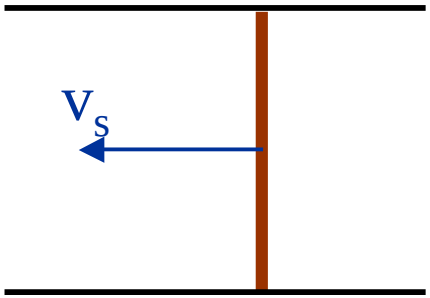
Reflected Normal Shocks

- What happens when moving shock **runs into a boundary**, e.g.,
  - closed wall
  - open end of a pipe



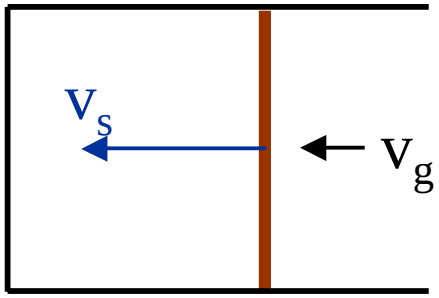
- Change in boundary conditions must be transmitted back to flow

  $\Rightarrow$ **reflected waves**
  - compressions or expansions

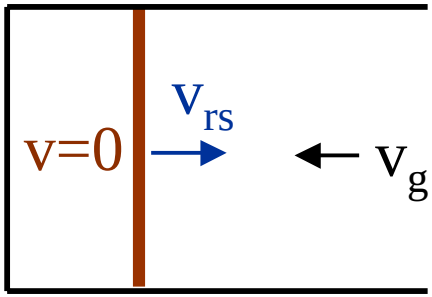


Closed Tube

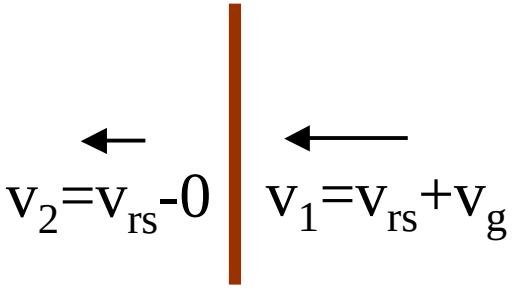
- While (incident) shock is heading towards wall, there is flow behind it
  - but closed boundary, so no flow can go through wall



- Must generate reflected wave that stops oncoming flow
  - flow is slowed down; p, ρ increase
    ⇒compression⇒**reflected shock**



- *In lab reference frame*, v=0 behind reflected wave
  - *shock ref. frame* ⇒ $\mathbf{v_{rs}=v_2}$
    (use this + known v_g and shock relations to find $\mathbf{v_{rs}}$)



Open Tube

- Now boundary condition is constant pressure at open end
  - same as initial pressure p_1
- But $p_1 < p_2$

  $\Rightarrow$ **reflection is expansion**
- No expansion shocks, so reflection is smooth (continuous) set of expansion waves