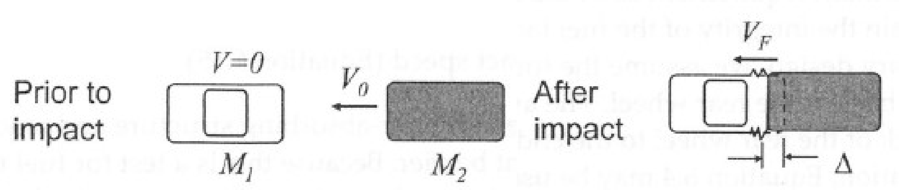
1. In the standard rear impact test, the stationary target vehicle is impacted by a moving barrier. The criterion for this test is to minimize fuel system leakage, so we are interested in absorbing the energy of the barrier by deforming structure rearward of the fuel system. If we could replace this impact with one between a moving vehicle and fixed barrier, we could apply the structure-sizing procedure developed for the front barrier case.

(1) Find the final moving barrier impact speed. (5 pts)

(2) Find the work of deformation during the moving barrier impact. (5 pts)

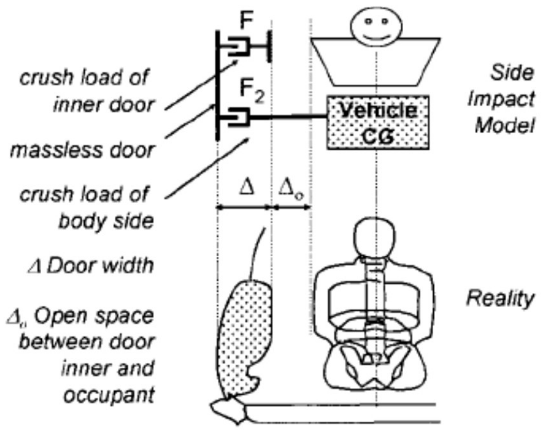
(3) Identify the equivalent impact velocity which would result in the same work of deformation to be done by structure. (10 pts)

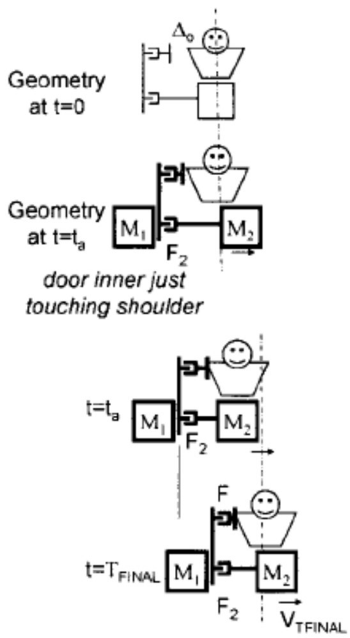


2. Consider the impact of the vehicle(M_2) by a moving barrier(M_1). We can model each as a point mass with the impact being perfectly plastic. In this linear model, we are looking at motions lateral to the vehicle and will consider the lateral component of the barrier velocity as the initial impact velocity.

(1) Sketch the velocity-time histories for the barrier, the vehicle and the occupant based on the following figures. Indicate t_a, t_{final} and t_f in the time axis and corresponding V_a, V_{final} and V_f in the velocity axis. (10 pts)

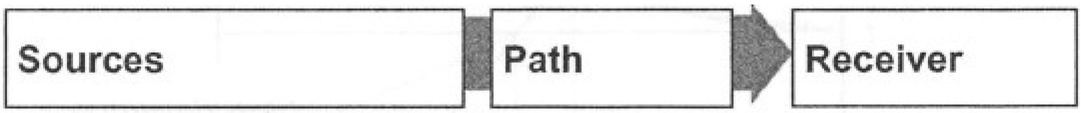
(2) Specify Δ_0, Δ and a_{occ} (acceleration of occupant) in the histories. (10 pts)





3. Describe the differences among size, shape and topology optimization in terms of three key elements to formulate the design optimization problem. (20 pts)

4. Describe the source-path-receiver model for the following vibration system.



(1) Powertrain-driven vibration (5 pts)
(2) Suspension-driven vibration (10 pts)

5. Describe three strategies for design for vibration and corresponding examples. (15 pts)

6. List example practices to reduce the noise and vibration of Japanese OEM(Original Equipment Manufacturer) explained in the class. (10 pts)