

## Technical Session

Our Technical Session this time deals with a common task: simulating barrier collisions with *EDSMAC4*. Although there are several approaches, we'll illustrate the best approach – in terms of both the mechanics of the collision and the visualization.

The basic steps are as follows:

- Add the vehicle(s) and barrier(s) to the case
- Add the environment
- Set up and execute the *EDSMAC4* event

We see right away that the basic steps are the same for barrier collision simulation as for all other *HVE* simulations. We chose *EDSMAC4* over *EDSMAC* for three reasons: Our crash involves three vehicles and two barriers (*EDSMAC* is limited to one vehicle and one barrier; *EDSMAC4* has no such limitation). Second, *EDSMAC4* simulates objects with no wheels (e.g., barriers!). Third, the *EDSMAC4* collision algorithm has some features that better facilitate barrier collisions. The procedure for setting up and executing this simulation follows.

### Description of Crash

In our sample crash, two vehicles (a 1999 Volkswagen Jetta and a 2002 Chevrolet S-10 Extended Cab Pickup) sideswipe each other on a freeway, sending the Jetta spinning into the median barrier. After rebounding back into the traffic lanes, the Jetta is struck by a third vehicle, a 2001 Ford Expedition. The crash is illustrated in Figure 1. Let's build the *EDSMAC4* simulation.

### Adding Vehicles and Barriers

From the EDC Custom Vehicle Database, add the 1999 VW Jetta, the 2002 Chevrolet S-10 Extended Cab Pickup and the 2001 Ford Expedition. Then add two Generic SAE J850 Fixed Barriers (because of the length of vehicle-barrier contact, we'll use two barriers).

Next, edit the exterior dimensions of both barriers: Set CG to Front to 500 in; CG to Rear -500 in; CG to Right 200 in; CG to Left -200 in. These exterior dimensions make the barrier long enough to be struck by the spinning vehicle and wide enough to maintain its aspect ratio (see the March 2000 Newsletter Technical Session for further information regarding aspect ratio).

### Adding the Environment

Next, go to the Environment Editor and add an environment. Open the 3-D Geometry file browser and choose the geometry file we created for our environment. This 6-lane divided highway was created from a total station survey. It depicts a construction zone in which the traffic flow has been rerouted.

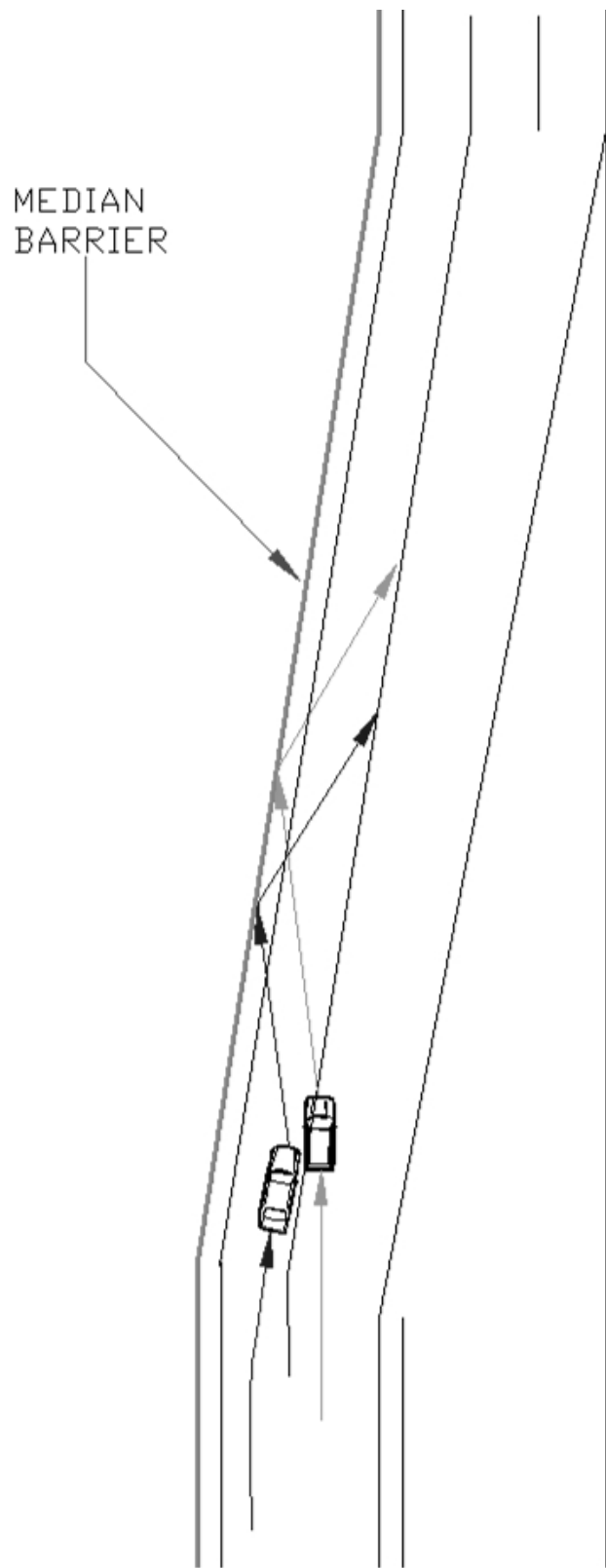


Figure 1 - Schematic of Crash Sequence



Figure 2 - 1999 Volkswagen Jetta 4-Dr



Figure 3 - Chevrolet S-10 Extended Cab Pickup



Figure 4 - Ford Expedition 4-Dr Sport-Utility

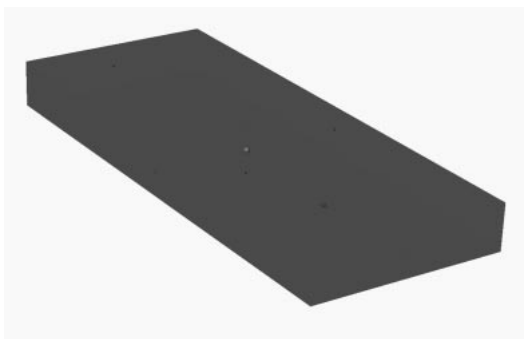


Figure 5 - SAE J850 Fixed Barrier (2)

### Setting Up and Executing

Now go to the Event Editor, select *EDSMAC4*, and add the vehicles and barriers. Position each of the vehicles and barriers, and assign velocities, as shown in the following table:

Vehicle Name	X (ft)	Y (ft)	Y (deg)	V <sub>tot</sub> (mph)
Volkswagen Jetta 4-Dr	480.2	20.4	180.0	55.0
Chevrolet S-10 Extended	512.0	9.4	180.0	65.0
Ford Expedition 4-Dr	570.0	20.0	180.0	60.0
SAE J850 Fixed Barrier	150.0	31.7	5.25	0.0
SAE J850 Fixed Barrier 2	66.5	24.1	5.25	0.0

Note the position of the barriers. Each was carefully positioned so its right side was coincident with the struck face of the median barrier (see Figure 6).

Next, assign driver controls for each vehicle. The steering and braking for the Volkswagen Jetta are as follows:

Time (sec)	Steering Wheel Angle (deg)	Braking (% Available Friction)			
		R/F	L/F	R/R	L/R
1.50	8.0	-	-	-	-
2.50	8.0	-	-	-	-
3.00	0.0	-	-	-	-
3.70	0.0	0.00	0.00	0.00	0.00
3.80	200.0	0.20	0.75	0.00	0.00

The steering for the Chevrolet S-10 is as follows:

Time (sec)	Steer Angle At Axle (deg)	
	R/F	L/F
4.0	0.0	0.0
4.1	0.0	25.0

Finally, the steering for the Ford Expedition is as follows:

Time (sec)	Steering Wheel Angle (deg)
1.5	0.0
2.5	8.0
3.5	8.0
4.0	0.0

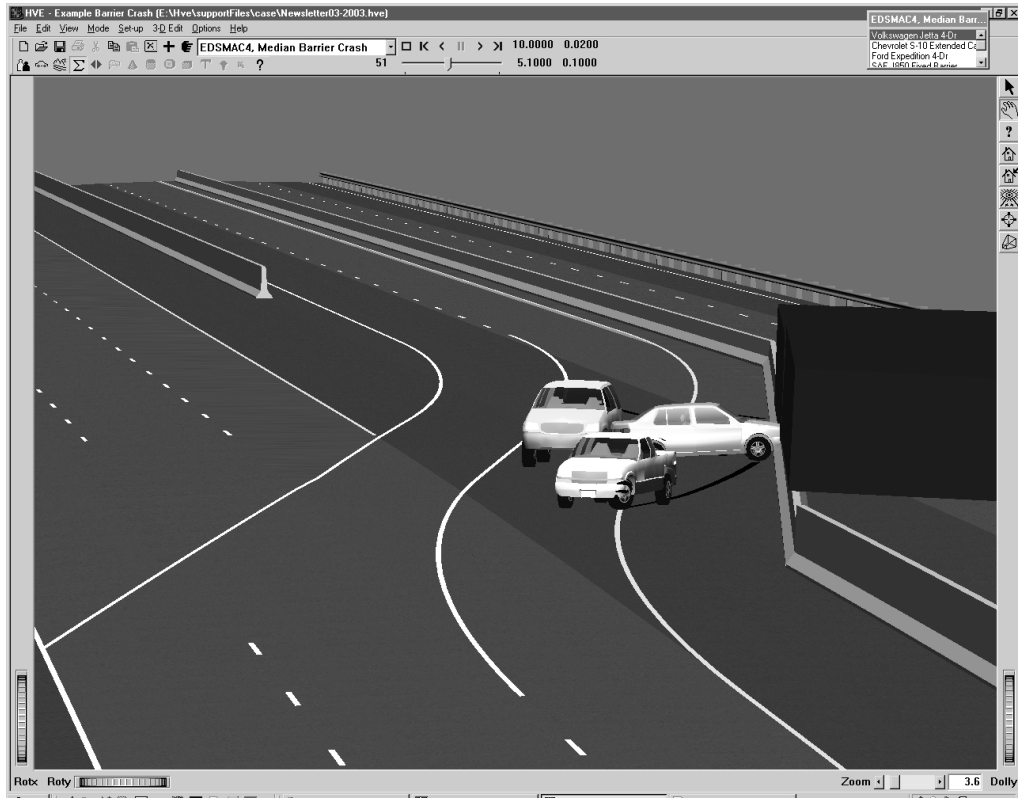


Figure 6 - Snapshot of barrier 3-vehicle barrier crash simulation. The fixed barrier is visible in this view

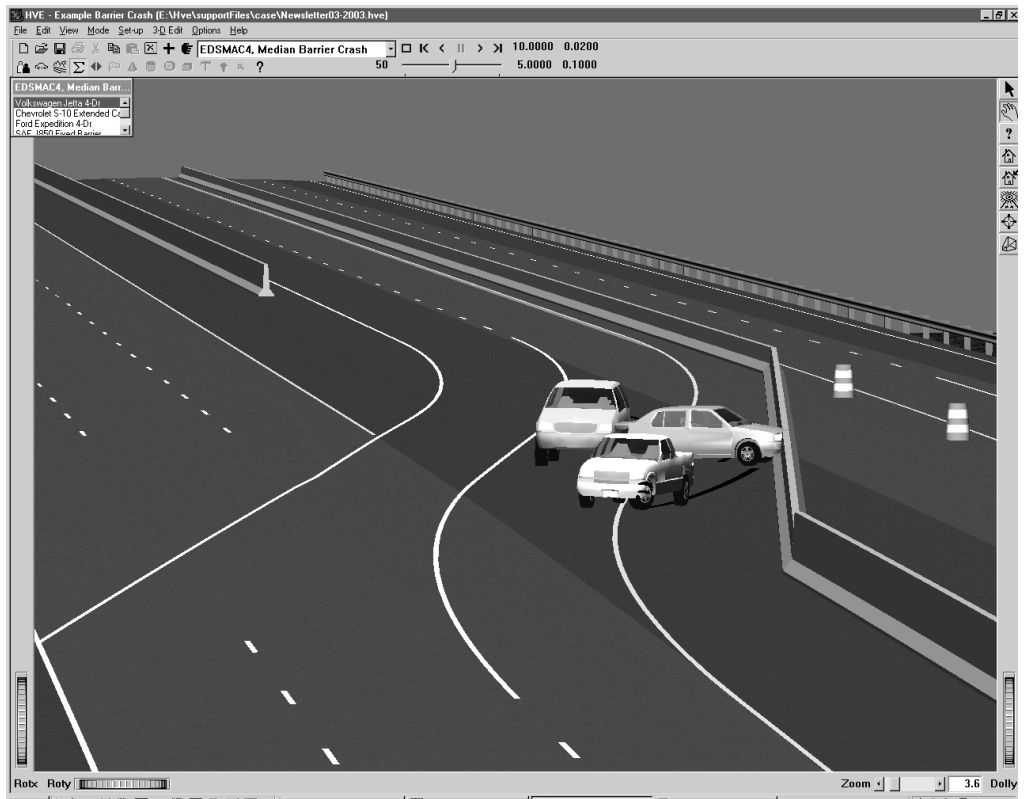


Figure 7 - Snapshot of barrier 3-vehicle barrier crash simulation. The fixed barrier's geometry has been removed in this view

Now execute the *EDSMAC4* event. A snapshot is shown in Figure 6.

But what if we don't want the Generic Barrier objects showing? After all, it's really the median barrier that was struck by the vehicles during the actual crash. There's a simple solution: Go to the Vehicle Editor. Add a Geometry File to each Generic J850 SAE Barrier, selecting NoBody.h3d (the name speaks for itself). Now, return to the Event Editor and reset the event. You'll see the Generic Barrier disappear (actually, the generic geometry has been replaced by NoBody.h3d). Execute the event. The resulting vehicle motion will be the same as before (see Figure 7). This is expected because the *EDSMAC4* collision algorithm is not using the geometry file in its calculations; the geometry is being shown for visualization purposes only.

Would you like to visualize this crash sequence? Go to [www.edccorp.com/support/examples.html](http://www.edccorp.com/support/examples.html) and use the link to download MedianBarrierCrashSimulation.mov.

If you would like to download the *HVE* case file and view and edit this crash sequence (i.e., play around – we won't tell anyone), use the links on the same web page as the movie file to download the *HVE* case file MedianBarrierCrashSimulation.hve.

Finally, if you would like a detailed tutorial describing the above process, use the link to download the file MedianBarrierCrashSimulationTutorial.pdf.

(Thanks to Baker-Sneddon Consulting, in Chicago, IL, for providing the 3-D environment geometry model.)

## Computer Recommendations

With the price of computers at record lows, many users have been calling EDC to determine if their *HVE* or *HVE-2D* software will run on a new computer they want to buy. Here is our basic recommendation:

"*HVE* and *HVE-2D* are fully compatible with Windows 98, Me, NT4.0, 2000 and XP operating systems. However, try to avoid computers that are configured with ATI Radeon graphics cards. The drivers for the Radeon cards do not provide robust support for OpenGL applications such as *HVE*, so you will have unexpected program behaviors and crashes."

If you have questions about a particular computer configuration or graphics card, please contact EDC Technical Support for assistance.

## *EDSMAC4* vs. *EDSMAC*

The Technical Session in this newsletter pointed out three reasons why a user may choose to work with *EDSMAC4*, instead of *EDSMAC*, for simulating vehicle collisions. Those reasons were that *EDSMAC4* supports more than two vehicles in a collision, supports objects without wheels (e.g. barriers), and has features that facilitate barrier collisions.

More detailed information about *EDSMAC4* can be found in SAE Paper 1999-01-0102, "An Overview of the *EDSMAC4* Collision Simulation Model". Here is a brief excerpt from that paper:

"This paper reports on an extended version of the *EDSMAC* program, called *EDSMAC4*. These extensions resulted in significant changes to major portions of the original code. In particular, the control routine logic was revised to allow:

- Simulation of any number of vehicles
- Simultaneous collisions with multiple vehicles
- Improved collision detection

The collision algorithm was extended with:

- an improved force-deflection model
- different stiffnesses for front, back and sides
- support for barrier crashes
- damage profile simulation/visualization
- support for articulated vehicle crashes

The vehicle dynamics model was extended with:

- support for tandem axles and dual tires
- calculation of load transfers
- support for wheel displacement during impact
- support for the tire blow-out model
- support for articulated vehicles"

A copy of the complete paper may be downloaded directly from the Technical Reference Library section of the EDC website. You can find this page at [www.edccorp.com/library/techref.html](http://www.edccorp.com/library/techref.html)

*EDSMAC4* has been available to *HVE* users since the late 1990's, and was introduced for *HVE-2D* users in December 2001. Many *HVE-2D* users have upgraded from *EDSMAC* to *EDSMAC4* to take advantage of its capabilities.

If you have questions or would like to add *EDSMAC4* to your *HVE* or *HVE-2D* software package, please contact EDC Sales for further assistance. Call 503.644.4500, or send an email to [sales@edccorp.com](mailto:sales@edccorp.com).