

Technical Newsletter

Available on-line in the EDC Library at www.edccorp.com

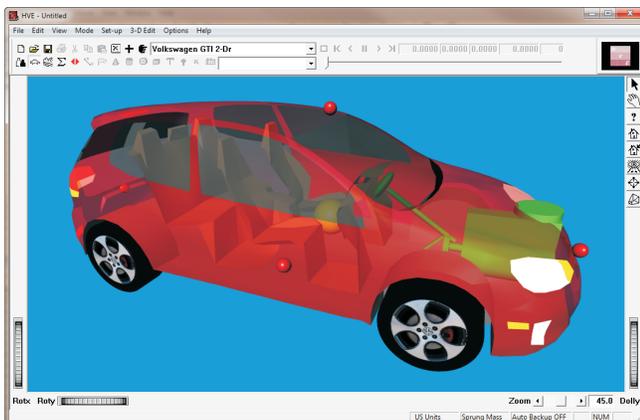
Ongoing Developments for *HVE*

HVE and *HVE-2D* users are encouraged to visit the Support Downloads section of the EDC website for additional updates to Version 9.12, including:

EDVDB Vehicle Database Update

HVE and *HVE-2D* Version 9.12 users can now download an update to their *EDVDB* vehicle database. Because it contains hundreds of vehicles ready to use in reconstructions and simulations, *EDVDB* provides users with the benefits of improved results, increased productivity and extensive time savings.

EDVDB is not just a set of basic vehicle dimensions and weights attached to a geometry found on the internet. Each vehicle in the EDC database requires more than 60 man-hours to build. An exhaustive effort is undertaken to digitize and create a 3-D mesh of the interior and exterior. Suspension rates are measured for each axle. Weights are obtained using platform scales at each wheel. Stiffness coefficients are calculated from NHTSA crash test results. Tire data for the specific tire size found on the vehicle are derived from actual tests performed at Calspan, UMTRI and other research facilities. Brake and steering system data are derived from direct measurement of components. And equally important, the source of every parameter is documented.



One of the vehicles available in the *EDVDB* update is the 2010 - 2013 Volkswagen GTI, shown here in the *HVE* Vehicle Editor. Note the detail provided by the interior and exterior geometry, plus the photo-textured wheel images.

***SIMON* Version 4.12 Patch**

This patch is only for *HVE* Users with Version 9.12. This update provides the following improvements to address issues found in *SIMON* Version 4.11:

- The ABS algorithm was changed to allow simultaneous braking and heavy throttle application. This has implications for simulating events involving possible unintended acceleration.
- The vehicle may have previously moved in reverse due to a negative drive torque if started at a very low speed and no throttle was applied.
- The sign of the brake torque output for user-assigned wheel damage was changed to be consistent with brake torque from normal braking.
- The brake torque calculation for slowly spinning wheels was changed to improve stability for stopped (or nearly stopped) vehicles.
- If the user edits the Maximum Tire Deflection greater than the tire Unloaded Radius, a warning message will be displayed when the *SIMON* event is initiated.

Further information about enhancements and bug fixes contained in this update is provided in the Release Notes accompanying the patch download.

***DyMESH* Wheel Impact Model Evaluation**

While not available directly from the Support Downloads section of the website, *HVE* users participating in the Beta evaluation of the *DyMESH* Wheel Impact Model can continue their testing and validation efforts in Version 9.12 by contacting EDC for a download link. This group of users includes those who have already signed up plus all those who participated in the Advanced *HVE* Workshops at the 2013 *HVE* Forum. Based upon the user experience and helpful feedback from this group, it is expected that the *DyMESH* Wheel Impact Model will be available to all *DyMESH* users in the upcoming *HVE* Version 10 release.

For the latest information regarding downloads, new simulation technologies, user assistance and training courses, be sure to visit the Weekly E-News posted on the EDC website at www.edccorp.com.

Technical Session

This Technical Session provides an in-depth look at the *HVE* Drivetrain Model: How does the user's input of % wide-open throttle produce torque that accelerates the vehicle?

Basic Drivetrain Components

The *HVE* Drivetrain Model has the following components:

Engine Data – This is the engine torque vs. engine speed table found in the Vehicle Editor by clicking on the vehicle's engine icon. See Drivetrain Dialog, Figure 1.

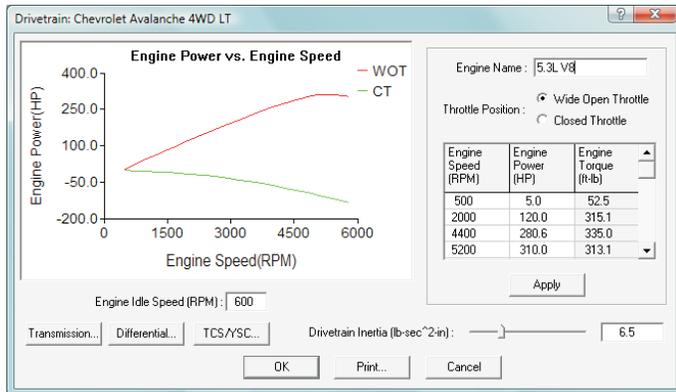


Figure 1 - Drivetrain dialog with engine data table

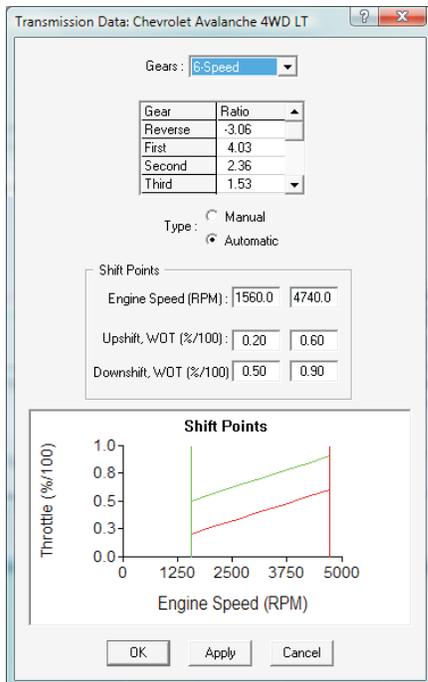


Figure 2 - Transmission gear ratio table

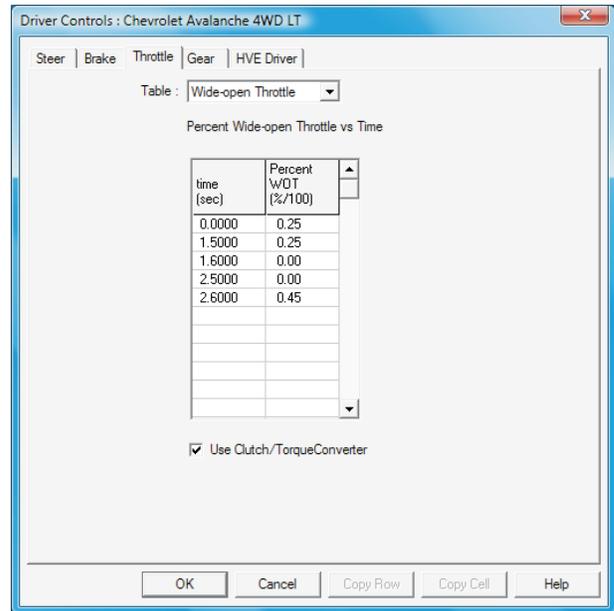


Figure 3 - Throttle table

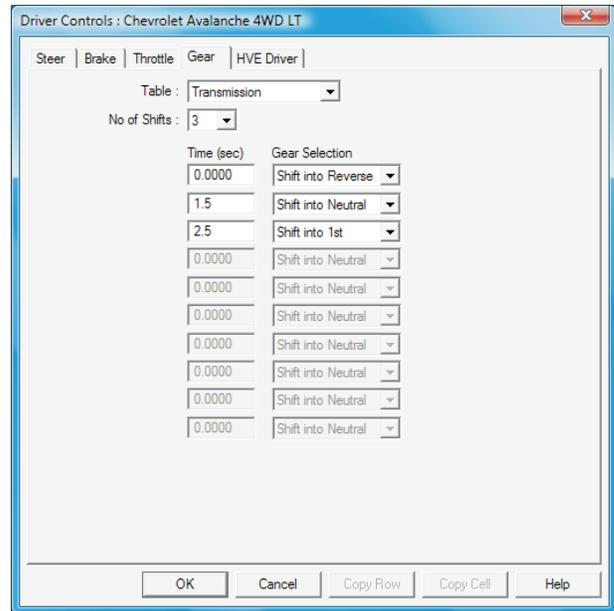


Figure 4 - Gear shift table (used only for manual transmissions)

Transmission and Differential Data – These are tables of gear ratios for the transmission and differential, and are included as part of the Drivetrain Dialog; see Figure 2.

Driver Controls, Throttle – This is the user-entered table of driver throttle inputs vs. time. Driver controls are supplied when setting up an event in the Event Editor. Throttle input is expressed as a percentage of wide-open throttle (% WOT). 0.0 represents no throttle input, i.e.,

closed throttle (CT). 1.0 represents full throttle (WOT). A typical throttle table is shown in Figure 3.

Clutch/Torque Converter – This is a checkbox that tells the Drivetrain Model to simulate a clutch (manual transmission) or torque converter (automatic transmission) when starting from a low speed in first or reverse gear, also shown in Figure 3.

Gear Shift Table – This is the table of user-entered gear shifts. See Figure 4. (This table is not required when the vehicle has an automatic transmission.)

NOTE: A detailed technical description for the HVE Automatic Transmission Model is presented in the Summer 2009 Technical Newsletter.

Calculating Drive Torque

The procedure for calculating drive torque is shown in the flow charts in Figures 5 and 6. The following provides the calculation details.

The current engine drive torque is determined, along with current steer, brake, throttle and gear selection values, using the driver control tables.

Let's define the following parameters:

- θ_{IDLE} = Engine idle speed (rad/sec)
- θ_{MAX} = Highest engine speed in engine torque vs. engine speed table (rad/sec)
- θ_{PEAK} = Engine speed in engine torque vs. engine speed table associated with the maximum torque (rad/sec)
- λ = Current value for throttle position (%/100)
0.0 = Closed Throttle (CT)
1.0 = Wide-Open Throttle (WOT)
- Ω_{AVG} = Average wheel spin velocity of all drive wheels (rad/sec)
- θ_{ROAD} = Engine speed based on average drive wheel spin velocity and transmission and differential ratios (rad/sec)
- θ_{CLUTCH} = Engine speed adjusted according to throttle position (rad/sec)
- θ_{ENG} = Current engine speed (rad/sec)
- ϕ = Clutch slip (%/100)
0.0 = no slip
1.0 = 100% slip
- TQ_{WOT} = Engine torque for WOT at current engine speed (in-lb)
- TQ_{CT} = Engine torque for CT at current engine speed (in-lb; will be negative)
- TQ_{ENG} = Current engine torque (in-lb)

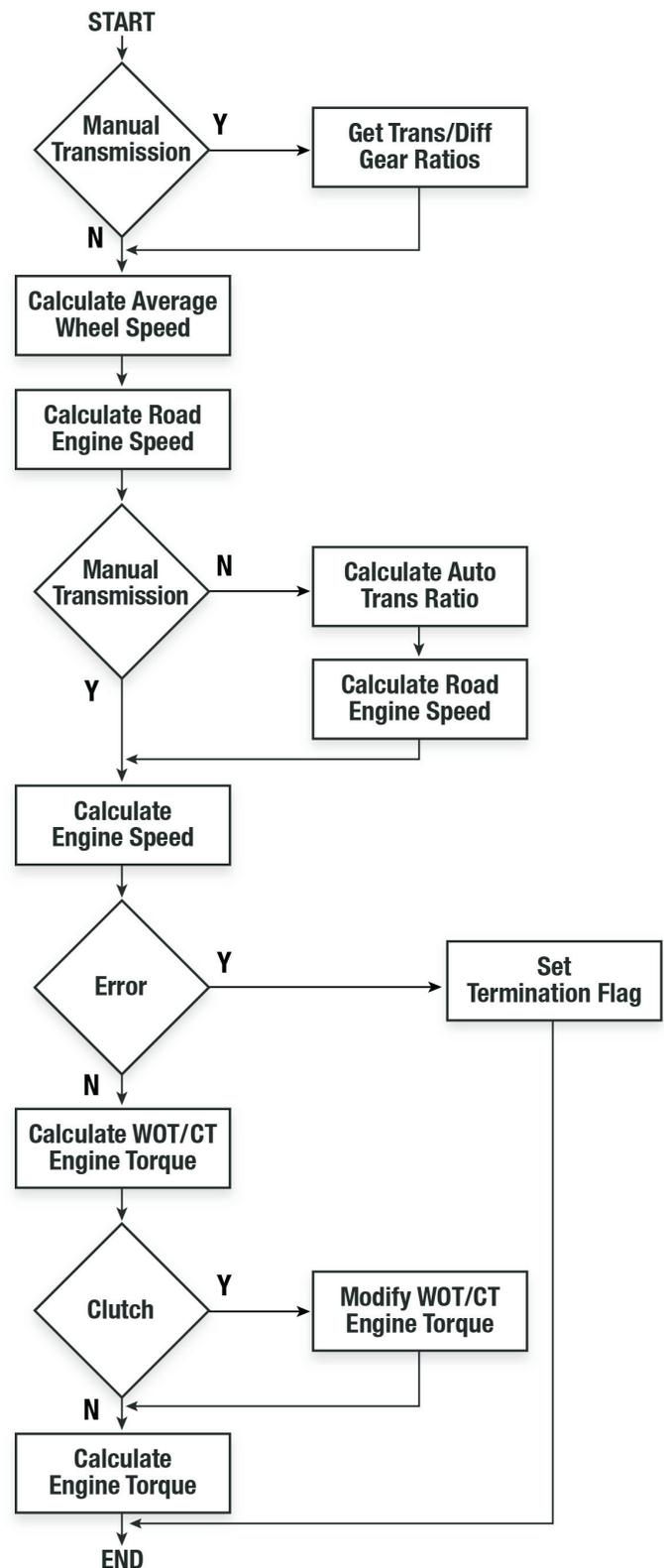


Figure 5 - Flow chart for drivetrain calculations

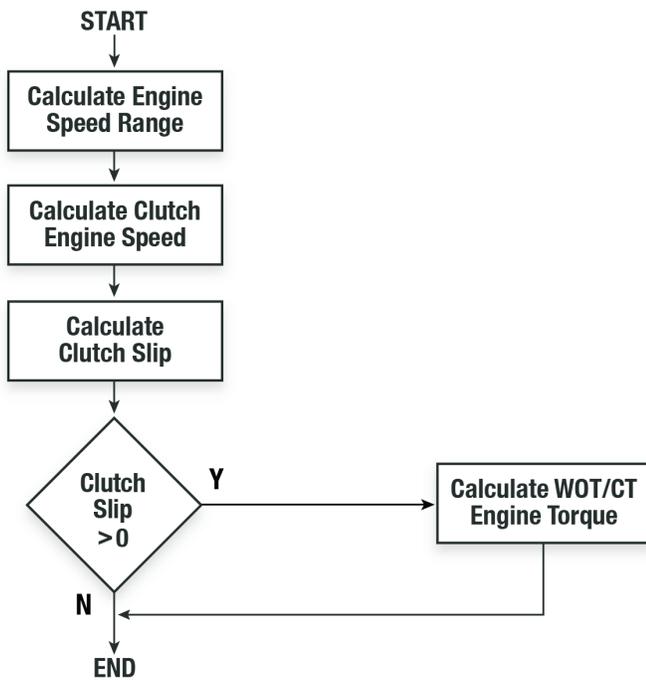


Figure 6 - Modify WOT/CT Torque

Referring to Figure 5, the first step is to get the current transmission and differential ratios (done only for manual transmissions; automatic transmissions are limited to a single speed differential). This is accomplished by a direct query of the gear tables for the current simulation time.

The next step is to calculate the average spin velocity of all drive wheels,

$$\Omega_{AVG} = \frac{1}{n} \sum_{i=0}^n \Omega_i$$

where n is the number of drive wheels.

Next, the engine speed associated with the average drive wheel spin velocity is determined,

$$\theta_{ROAD} = \eta_{trans} \times \eta_{diff} \times \Omega_{AVG}$$

where η_{trans} and η_{diff} are the current transmission and differential gear ratios, respectively.

If the vehicle has an automatic transmission, the current engine speed and throttle position are used to determine if the transmission needs to upshift or downshift (refer to the Summer 2009 Newsletter for a detailed description of the HVE Automatic Transmission Model).

The road engine speed is updated, if necessary, according to the new gear ratio.

Now that the current gear ratios are established, the engine speed is compared to the IdleSpeed,

$$\theta_{ENG} = \max(\theta_{ROAD}, \theta_{IDLE})$$

This ensures that the current engine speed is not less than the idle speed.

Next, the current engine speed is compared to the highest engine speed in the drivetrain engine table. If the current engine speed is greater, a termination flag is set (*Engine Speed Too High - You Threw a Rod!*), causing the event to terminate.

The WOT and CT engine torques are now computed for the current engine speed. This is performed by linear interpolation of the engine WOT and CT vs. engine speed table data.

If a clutch or torque converter is used (according to the check box in the Throttle Table), and the current gear is either reverse or 1st gear, the engine speed is increased (see Figure 6) according to the current throttle position and the engine speed associated with peak torque,

$$\theta_{CLUTCH} = \theta_{IDLE} + (\theta_{PeakTorque} - \theta_{IDLE}) \times \lambda,$$

and current clutch slip is computed,

$$\phi = 1.0 - \frac{\theta_{ROAD}}{\theta_{CLUTCH}}$$

If the calculated clutch slip, ϕ , is greater than 0.0 and less than 1.0, the current engine speed, θ_{ENG} , is set equal to the clutch (increased) engine speed, θ_{CLUTCH} , and the WOT and CT engine torques are modified (increased) according to the clutch engine speed, again using linear interpolation of the engine WOT and CT vs. engine speed table data.

Finally, the current engine torque is computed,

$$TQ_{ENG} = TQ_{CT} + (TQ_{WOT} - TQ_{CT}) \times \lambda$$

Inspection of the above equation reveals that at idle speed and closed throttle, the engine torque will be negative. Under this condition, the engine torque is set to zero.

The current engine torque is then distributed among the drive wheels. If there is no active electronic stability

control (ESC) or traction control (TCS), the torque at each drive wheel is distributed equally,

$$TQ_{WHEEL} = \frac{TQ_{ENG}}{n}$$

If an ESC or TCS system is active, the torque at each drive wheel is modified according to the ESC or TCS algorithm (a detailed description of the ESC and TCS models is provided in the Spring 2011 Technical Newsletter).

The net result of the clutch/torque converter is to apply drive torque at an engine speed that is greater than idle - just like the clutch or torque converter on an actual vehicle - resulting in the application of increased drive torque and higher potential acceleration from a standing start.

Rate This Tech Session

Please go to www.edccorp.com/TechSessionRating to tell us if you liked this Technical Session and to suggest other topics you'd like to see in future technical sessions. Thank you!

**2014 HVE Forum
February 24 - 28, 2014
St Petersburg, FL**

The 2014 HVE Forum offers a wide selection of training workshops for beginning, intermediate and advanced users, along with User's Group Meetings, HVE White Paper Session and more. Start making plans to attend this excellent opportunity to learn how to use the full features and capabilities of your HVE, HVE-2D or HVE-CSI software, while expanding your network of resources at the same time! Another great benefit is pre-approval for 20 - 35 ACTAR CEUs depending upon your workshop selection over a 3 or 5 day period.

Venue Location

Check out this perfect location for the 2014 HVE Forum:

Hilton St. Petersburg Bayfront
333 1st St South
St. Petersburg, FL 333701

Special Topic For 2014: Admissibility

A new workshop is being developed to provide a clear framework for HVE users wishing to have their HVE results admitted in state and federal courts. The focus of this workshop is on admissibility of HVE results, not on the more general subject of giving expert testimony.

The material covered in the workshop will include:

- Education of attorneys and judges
- Frye Test for the admissibility of scientific evidence
- Daubert Challenge of witness expertise

This session will be held on Wednesday during the lunch break to allow everyone at the 2014 HVE Forum the opportunity to attend. A box lunch will be provided.

Call For HVE White Papers

Interested in presenting a technical paper in the "HVE White Paper" session at the 2014 HVE Forum? Topics include HVE Case Studies, any application of HVE showcasing its capabilities, and innovative tips and techniques using HVE. Please submit your abstracts to EDC by September 30, 2013.

Workshop Registration

Workshop schedules, descriptions and registration forms will be available to download from the 2014 HVE Forum pages at www.edccorp.com/2014HVEForum.

Spring Training

2014 HVE FORUM
February 24-28, 2014
Hilton St. Petersburg Bayfront
St. Petersburg, Florida

WORKSHOPS

- Advanced HVE
- Advanced HVE-2D
- Admissibility
- Using DamageStudio
- Introduction to HVE-CSI
- DYMECH 3-D Collision Model
- EDCRASH, EDSMAC4, EDSVS and EDVTS Overview
- Creating Advanced Terrains
- Tractor-Trailer and Commercial Vehicle Simulation
- Advanced Multi-vehicle Simulation Using SIMON
- Importing 3-D Environments from Total Stations
- Theoretical and Applied Vehicle Dynamics
- Simulating Curbs, Potholes and Soft Soils
- Hydroplaning Simulation
- HVE, HVE-2D and HVE-CSI User's Groups
- Multi-Vehicle Collisions Using EDSMAC4
- Brake System, ABS and ESS Simulation
- Building Vehicles for HVE and HVE-2D
- Simulating Blow-outs and Rollovers
- Powerful Tips and Techniques
- High-Definition Video Output
- HVE White Paper Session
- Animation

EDC
ENGINEERING DYNAMICS CORPORATION
PHOTO: 780.236.2336 FAX: 780.236.0905
P.O. BOX 200000 TAMPA, FL 33620
RESEARCH. DESIGN. SIMULATION
www.edccorp.com

EDC Simulations

November 11 - 15, 2013

Coral Gables - Miami, FL

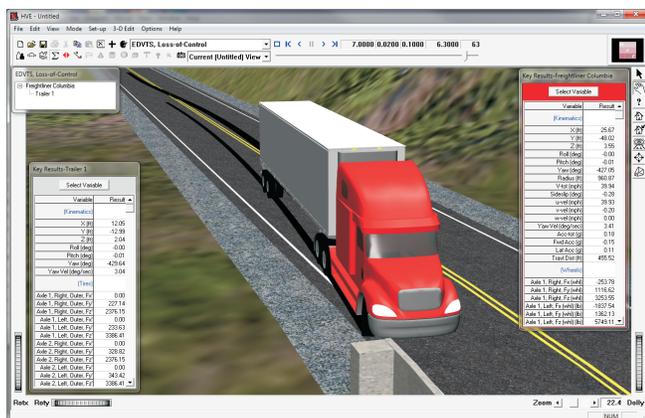
EDC Simulations offers the fastest way to learn how to efficiently use simulation to identify the cause of a crash and present your results with confidence. This course covers the following key concepts:

- How the *EDSMAC*, *EDSMAC4*, *EDSVS* and *EDVTS* simulation programs work.
- How to collect the input data from your real-world crash investigations.
- How to use the programs to thoroughly analyze a crash.
- How to present and defend your results.

This course has been pre-approved for 30 ACTAR CEUs. All course materials, including a handbook, training manual, software and temporary licenses will be provided.

Bring your scientific calculator and laptop computer as lectures are combined with hands-on exercises to enhance your learning experience. Computer simulation exercises include single vehicle and articulated vehicle-trailer loss-of-control and handling maneuvers, plus vehicle-to-vehicle collisions.

Links to download your course registration form and to make your hotel reservations at the Holiday Inn Coral Gables are available on the EDC Simulations page in the Training section of edccorp.com. Contact EDC at 888.768.6216 to take advantage of Summer Savings by signing up today!



One of the computer simulation lab exercises is a detailed tractor-trailer loss-of-control simulation, such as that in the EDVTS simulation screenshot shown above.



Vehiclemetrics Announces

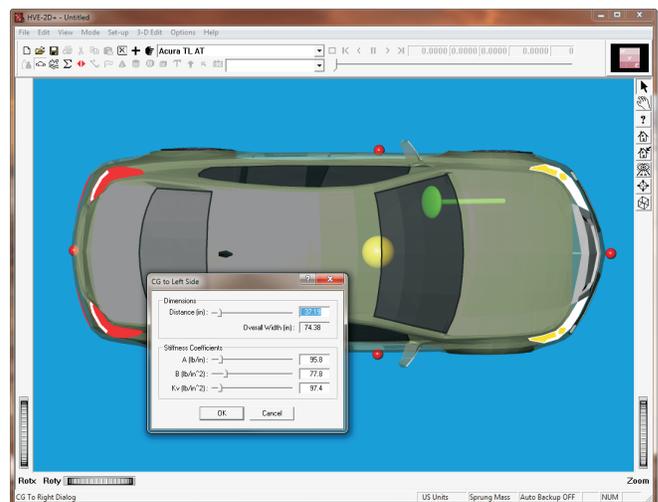
Vehicle Database for HVE-2D Users

An *HVE-2D* compatible version of the Vehiclemetrics vehicle database is now available. This database contains only the parameters necessary to perform a reconstruction or simulation in *HVE-2D* using *EDCRASH*, *EDSMAC* or *EDSMAC4*. The initial release of this database contains approximately 140 vehicles, which are not duplicated in the *EDVDB* vehicle database from EDC. This release allows *HVE-2D* users to enjoy the substantial benefits of the Vehiclemetrics database at a reduced price.

Some of the features of this database include:

- High quality vehicle geometry
- Large number of vehicles
- Vehicle datasheets that provide details about the input parameters for each vehicle.

Additional updates for the *HVE* and *HVE-2D* compatible Vehiclemetrics databases will be available in the near future. Visit www.vehiclemetrics.com or call 855.966.3377 for more information.



The Vehiclemetrics HVE-2D compatible vehicle database includes the 2009 Acura TL, shown here in the HVE-2D Vehicle Editor. Data parameters are readily available to edit directly in the usual dialogs as demonstrated in the CG to Right Side dialog displayed in the viewer.

HVE and HVE-2D F.A.Q.

This section contains answers to frequently asked questions submitted to EDC Technical Support staff by HVE and HVE-2D users.

Q. I'm using HVE-2D+ and I've imported a DXF format terrain model into the Environment Editor. It looks great as I've included some buildings that block the view of the driver of the bullet car as it approaches an intersection. However, when I create my EDSMAC4 event and try to set-up the initial position of the cars, they appear below the terrain model. I can't seem to get them to move up in vertical space to be on top of my terrain. How do I get them to drive on the surfaces of my model?

A. It sounds like you are taking advantage of the 3D-Viewers option in HVE-2D+ to position the camera at the drivers location so you can produce video showing the impaired visibility conditions of your case. One thing to remember though is that although you have the ability for 3D camera views, the physics programs are still planar analyses. Therefore, in HVE-2D, the tires of the vehicle will always drive on the X,Y plane at Z = 0. If your vehicles are appearing underneath your terrain model, it simply means your model is located above the Z = 0 plane. To correct this, you will need to go back to your CAD program and move the model so that it is at Z = 0 and then re-import it into the Environment Editor. Then when you position your cars, they will drive on the terrain model. Please note that in HVE-2D, although the vehicle tires will only drive on the Z = 0 plane, they do recognize the Friction Factor assigned to a surface in the vertical column above or below the Z = 0 plane.

Q. I'm simulating a collision involving two generic vehicles and using SIMON with the DyMESH 3-D collision model. No damage occurs during the collision and the vehicles do not behave as expected, as they appear to go through each other rather than engage and deform. What's wrong?

A. Generic vehicles have very few vertices (e.g., about 40); A typical custom mesh has well over 1000. DyMESH requires vertices to calculate the force and deformation. To simulate a collision involving generic vehicles using DyMESH, use the Event Editor's Tessellation option (see Set-up, Vehicle Mesh, Tessellation). The Tessellation option reduces the maximum space between vertices. The default value is 20 inches. A reasonable range is 10 to 20 inches; a smaller value potentially yields greater damage resolution, but takes longer for DyMESH to process during your collision simulation.

Q. I am using the new Trailer Separation feature in a SIMON simulation and I want to monitor the connection force between my truck and trailer so I can set the proper Breakaway Force. What do I do?

A. It's easy! Display the Key Results in the event and then for the trailer vehicle display, choose Select Variable, then the Connections Output Group, and then the Variables for Fx Conn, Fy Conn and Fz Conn.

Q. I've apparently made some incorrect edits to my language.rsc file because when HVE starts, I see that the data field descriptions in several of the dialogs are messed up. How do I fix this?

A. Rather than trying to go back through and identify which of your edits corrupted the format of the language.rsc file, the easiest solution is to visit the Support Downloads section of the EDC website and download the original language file for your installed version. Just replace the defective one with the replacement and your HVE will be back working as expected.

Q. I built my terrain model in 3DS Max and exported it using the VRML97 export feature. Being a VRML (.wrl) format model, it comes into HVE beautifully, with the colors, textures and details originally built into the model in 3DS Max. However, I have noticed one issue when selecting a surface in the 3D Editor. The Surface Editor dialog that I am used to seeing does not appear. Is this okay? What should I do?

A. The Surface Editor dialog in the 3D Editor allows the user to adjust specific geometric attributes of the selected surface, such as elevation, inclination, surface normal and vertex locations. This works perfect for surfaces built using the 3D Editor, those imported in DXF format and those in VRML 1.0 format. However, since your model is VRML 97/2.0 format, the vertex information is not editable, and the Surface Editor dialog will not appear when a surface is selected. You can still use the Objects Attribute dialog to change the Friction Factor, Type and Overlay, and also use the menu to change the color or apply a texture to the selected surface.

**Visit the Support section of
www.edccorp.com to download
software updates and to view more
FAQ's from the Knowledge Base**

EDC Training Courses

EDC Reconstruction & Simulations

EDC offers excellent one-week courses on the use of the *EDCRASH* reconstruction program and the *EDSMAC*, *EDSMAC4*, *EDSVS* and *EDVTS* simulation programs. The **EDC Reconstruction** and the **EDC Simulations** courses are designed to fully investigate the inner workings of the physics programs. Lectures are full of helpful hints gained from years of experience. During the course, students will use the physics programs to complete several workshops highlighting the capabilities of each program discussed in the course.

All users of *HVE* and *HVE-2D* agree that these courses are extremely beneficial and challenging. It's the fastest way to learn what you really need to know – how to effectively use the physics programs and get the right results. *Note: These courses focus on the physics programs, not on the user interface. For courses on using HVE, HVE-2D or HVE-CSI, check out the HVE Forum.*

HVE Forum

The **HVE Forum** offers numerous workshops designed to help *HVE*, *HVE-2D* and *HVE-CSI* users improve their modeling and application skills. By participating in workshops, attendees learn new techniques and also how to use the latest advancements in the software. The *HVE Forum* is also a great opportunity to meet other users and expand your network of resources.

Engineering Dynamics Corporation Training Course Schedule

EDC Simulations

Los Angeles, CA January 2015
Miami, FL November 11 - 15, 2013

EDC Reconstruction

Los Angeles, CA January 20 - 24, 2014
Miami, FL November 2014

Theoretical & Applied Vehicle Dynamics

Upon Request

2014 HVE FORUM

St. Petersburg, FL February 24 - 28, 2014

Vehicle Dynamics

The **Theoretical & Applied Vehicle Dynamics** course extends the scope of a general vehicle dynamics discussion by including several direct applications using the *SIMON* vehicle dynamics simulation program within *HVE* and providing a solid theoretical background for such simulations. The course is focused towards engineers and safety researchers with an interest in an understanding of vehicle dynamics and automotive chassis systems development.

Course Registration

To register for a course, download a registration form from the Training page at edccorp.com or contact EDC Customer Service at 503.644.4500 or by email to training@edccorp.com. All courses are eligible for Continuing Education Units and ACTAR credits.

HVE Training Partners

HVE, *HVE-2D* and *HVE-CSI* users looking to improve their skills, but unable to attend one of EDC's regularly scheduled courses, can contact an *HVE Training Partner* for assistance. *HVE Training Partners* are experienced *HVE* and *HVE-2D* users who offer introductory and custom training courses on the use of *HVE*, *HVE-2D*, *HVE-CSI* and compatible physics programs.

HVE Discussion Groups

Websites hosted by experienced *HVE* Users offer information about using *HVE* as well as moderated online discussions with other users. Be sure to visit:

AccidentReconOnline.com - Online training courses and also the DiscoverHVE video tutorials and discussion group hosted by Wes Grimes of Collision Engineering Associates.

Engineering Dynamics Corporation
8625 SW Cascade Blvd, Suite 200
Beaverton, Oregon 97008 USA
Phone 888.768.6216/ FAX 503.526.0905
Email: info@edccorp.com
Website: www.edccorp.com

EDCRASH, *EDSMAC*, *EDSMAC4*, *EDSVS*, *EDVTS*, *EDHIS*, *EDVSM*, *EDVDS*, *EDGEN*, *EDVDB*, *HVE*, *HVE-2D*, *HVE-CSI*, *HVE Brake Designer* and *GetSurfaceInfo()* are trademarks of Engineering Dynamics Corporation. All Rights Reserved.

SIMON, *DyMESH* (Patent number 6,195,625) and *DamageStudio* are registered trademarks of Engineering Dynamics Corporation. All Rights Reserved.

GATB, GBF, DiscoverHVE.com and PhotoIntoHVE are trademarks of Collision Engineering Associates, Inc.