

Technical Newsletter

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

HVE & HVE-2D - Ongoing Developments

New Ad Campaign

In the 2009 editions of the *Accident Reconstruction Journal*, *Accident Investigation Quarterly* and *Collision Magazine*, full page ads present different scenarios (e.g. loss of control, collision or other interesting event) that show off the true capabilities of *HVE* and *HVE-2D*. Each ad includes a description, a table of issues with answers directly from the simulations, and a link to the EDC website for the presentation of a detailed, menu-driven reconstruction of the event. This includes descriptions of procedures, screenshots of vehicle and environment models, events and outputs, along with simulation movies of the scenario from various viewpoints.

To view the latest scenario on the back cover of the March/April issue of *Accident Reconstruction Journal*, please visit www.edccorp.com/bullitt.

CRASH SITE EVIDENCE A 1968 Mustang GT, driven by Lt. Frank Bullitt, is chasing a 1968 Dodge Charger R/T, driven by a man known only as "The Killer," down Taylor Street on Russian Hill in San Francisco.

For a full reconstruction of this 46 second chase sequence, visit www.edccorp.com/bullitt

HVE directly answers the following questions using Newton's laws of motion:

Questions	Answers
Speed on Taylor St.	30 - 37 mph (both vehicles)
Driver Inputs	Mustang: 2-3 lb brake pedal force, 200 deg left steer onto Filbert, then 25-65 %WOT Charger: 3-5 lb brake pedal force, 175 deg left steer onto Filbert, then 70-75 %WOT
Maximum Undercarriage Impact Force	Mustang: $F_x = -1730$ lb, $F_y = -13$ lb, $F_z = -2120$ lb Charger: $F_x = -8610$ lb, $F_y = -120$ lb, $F_z = -11100$ lb
Maximum Suspension Force	Mustang: 4330 lb @ L/F; 3270 lb @ R/R Charger: 4810 lb @ R/F; 3530 lb @ L/R
Hubcaps Lost	Mustang: N/A (American Racing Mags) Charger: Five

Other software may claim to answer these questions. Have you closely evaluated their claims and the basis for their results?

To learn more about *HVE* and all of the available tools for crash investigators, call 503-644-4500 or visit www.edccorp.com. Our professional sales staff will help you get started using *HVE* today!



KNOWLEDGE = POWER

Engineering Dynamics Corporation • 8225 SW Cascade Blvd., Suite 200 Beaverton, OR 97008 USA • Phone (503) 644-4500 • www.edccorp.com

New Updates Program

During Opening Remarks at the 2009 *HVE* Forum, EDC announced a new internal program that will increase the frequency of updates. Rather than focusing on a major update, the effort will be on producing routine updates containing current fixes and functionality regularly throughout the year. Users can expect to receive more interim updates, such as Version 6.20 described below.

Version 6.20: Now Available

As part of the New Updates Program, EDC is pleased to announce that Version 6.20 is now available! New features include:

- A new tire model has been developed with better fidelity at high slip angles. This tire model, called the EDC Semi-empirical Tire Model, Version 2, is now the default for new *SIMON* events. In-house validations have shown there are small differences in the results (i.e., about 1 to 2 ft per 100 feet of trajectory length) when comparing the results from Version 1 and Version 2.
- Improvements in handling of the selection and manipulation of vehicle and human positions during event set-up which previously may have led to program crashes depending upon the state that the case file was in when last saved.
- A new vehicle has been added to the *EDVDB* vehicle database. A 2004 - 2007 Yamaha Rhino 660 is now available as a Sport-Utility Vehicle in the Vehicle Editor.

Version 7: Available July 2009

Also during the Opening Remarks at the 2009 *HVE* Forum, EDC unveiled several major enhancements planned for Version 7. These include: a new way to manage camera views (you'll love this!), a Vehicle Wizard™ to quickly assign common vehicle dimensions, a built-in tool for measuring the distance between any two points, a very cool automatic transmission model, and a Speed-Follower option to further enhance the *HVE* Driver Model. More details will be posted on the EDC website as they become available.



Technical Session

Our Technical Session this time shows you a sure-fire way to improve the modeling quality of your simulations: Use the Wheel Setup options. Many of these options are available for both *EDSMAC4* and *SIMON*, so both *HVE* and *HVE-2D* users can take advantage of this capability.

The Wheel Setup options are applicable to four modeling issues:

- Blow-out
- Wheel Damage
- Brake Damage and Maladjustment (*SIMON* only)
- Tire-terrain (*SIMON* only)

Because these issues are common for vehicles involved in loss of control and/or collision, it makes sense to use these options whenever circumstances dictate their use. In addition, they are for the most part easy to use and result in an improved simulation.

To use the wheel setup options in your *EDSMAC4* or *SIMON* simulation, simply select a vehicle and choose Wheels from the Setup menu. The Wheels Setup dialog is a tabbed dialog that displays the four options (see Figure 1). Click on the tab to display the page for the desired option.

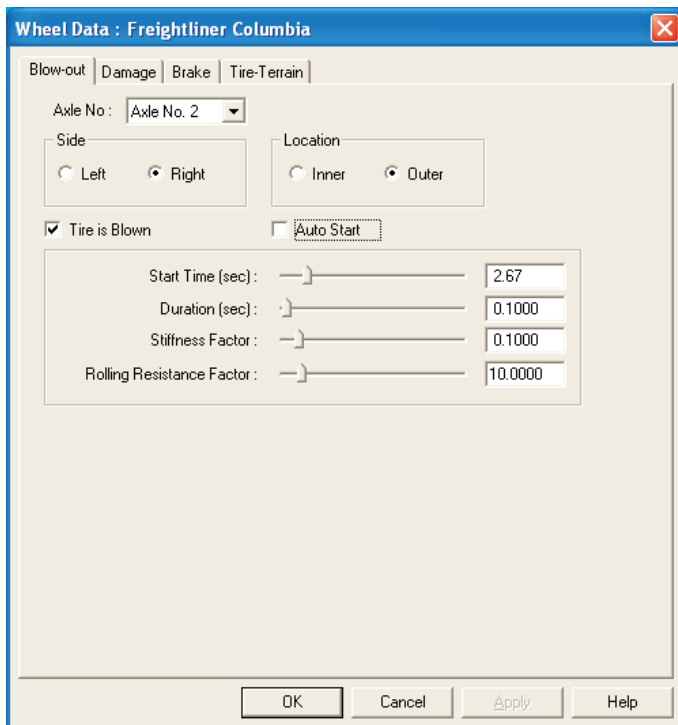


Figure 1 - Set-up, Wheels Dialog, Blow-out Page

Blow-out

Tire blow-out or debanding often occurs during a crash sequence. The *HVE* Tire Blow-out Model allows users of *EDSMAC4* and *SIMON* to simulate the effects of this phenomenon.

To simulate an air loss at one or more tires, first select the desired vehicle, then choose Set-up, Wheels, to display the Wheels dialog for the selected vehicle. Tire Blow-out (see Figure 1) is the default page for the Wheels dialog.

The Blow-out page includes two sections. The top section allows the user to select a tire location, and the bottom section allows the user to activate the *HVE* Tire Blow-out Model and edit the independent parameters. These parameters are:

- Tstart - The simulation time at which the tire blow-out begins. The AutoStart check box tells *SIMON* or *EDSMAC4* to start the blow-out at the beginning of a collision.
- Duration – The time interval required for the tire properties to change from 'normal' to 'blown.' A tire blow-out typically occurs very quickly; the default is 0.10 seconds.
- Stiffness Factor - Multiplier for tire cornering stiffness, camber stiffness and radial stiffness. By default, these properties will have 1/10 of their original values after the tire is blown.
- Rolling Resistance Factor - Multiplier for tire rolling resistance. By default, the tire will have 10 times more rolling resistance after it is blown.

Wheel Damage

Collision deformation often causes damage to one or more wheels. This can affect a vehicle's trajectory in two ways: First, body parts impinging on the tire can produce additional drag, increasing force at the tire-road interface. Second, the wheel may be displaced from its original location; tire force at the displaced tire results in different moments about the vehicle CG, thus affecting vehicle rotation. These issues can obviously affect the post-impact trajectory.

To simulate wheel displacement at one or more wheels, first select the desired vehicle, then choose Set-up, Wheels, to display the Wheels dialog for the selected vehicle. Then, click the Damage tab. The Wheel Damage page is displayed (see Figure 2).

The Wheel Damage page includes two sections. The top section allows the user to select a wheel location, and the bottom section allows the user to activate the

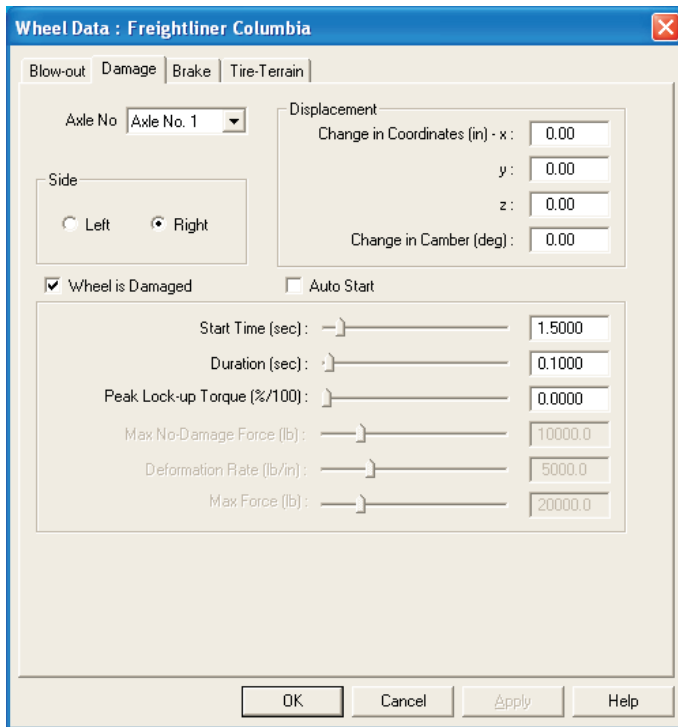


Figure 2 - Set-up, Wheels Dialog, Wheel Damage Page

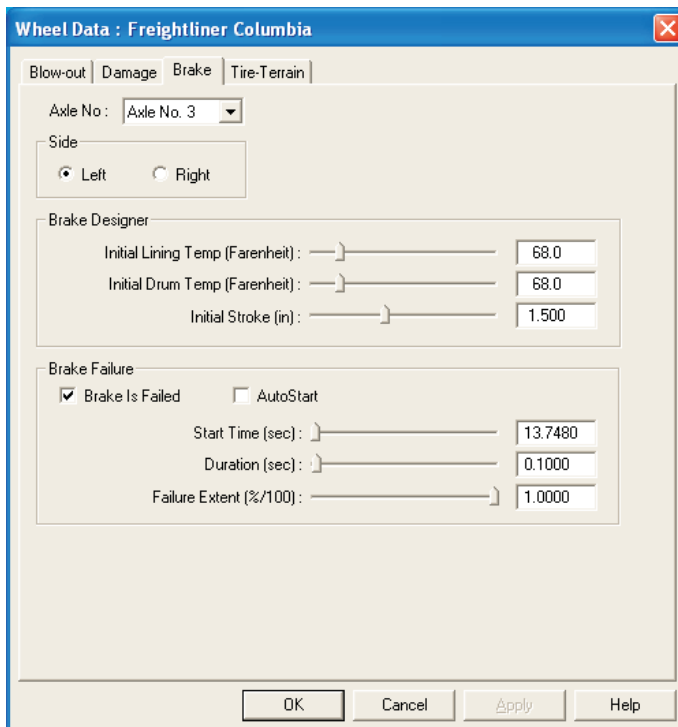


Figure 3 - Set-up, Wheels Dialog, Wheel Brakes Page

independent parameters that displace the wheel and apply a damage-induced wheel lock-up torque. The dependent parameters are:

- Tstart – The simulation time at which the simulated wheel damage begins. The AutoStart check box tells SIMON or EDSMAC4 to start the damage at the beginning of a collision.
- Duration – The time interval required for the wheel to move from it’s original location to the damaged location, and for the damage-induced wheel lock-up to occur. The default duration is 0.10 seconds, approximating the duration of the collision pulse.
- Wheel Displacement dx,dy,dz Coordinates – The vehicle-fixed displacements of the wheel center resulting from damage.
- Wheel Camber – The vehicle-fixed change in camber resulting from damage.
- Percentage of Total Lock-up – The external torque applied to the wheel as a result of impingement by adjacent vehicle structures (wheel well, bumper, etc.).

Brake Damage and Maladjustment

Brake failure can play a role in loss of control. The Brake page allows the user to simulate two types of brake failure. The first type is caused by out of adjustment slack adjusters, and applies only to S-cam brake assemblies found on most heavy trucks. The second type of failure is a mechanical failure of the brake assembly. This could be an interruption in brake pressure at the wheel or a failure of the shoe/drum or pad/rotor assembly.

To simulate brake damage or maladjustment at one or more wheels, first select the desired vehicle, then choose Set-up, Wheels, to display the Wheels dialog for the selected vehicle. Then, click the Brake tab. The Brake page is displayed for the selected vehicle (see Figure 3).

The Brake page is comprised of three sections. The top section allows the user to select a wheel location, and the bottom two sections allow the user to activate the independent parameters that provide initial conditions for the brake temperature and adjustment, and to set the degree of brake failure at the selected wheel. The dependent parameters are:

- Initial Lining Temperature – The temperature of the lining at the start of the simulation
- Initial Drum Temperature – The temperature of the drum at the start of the simulation
- Initial Adjustment – Initial (cold) stroke for air brake systems

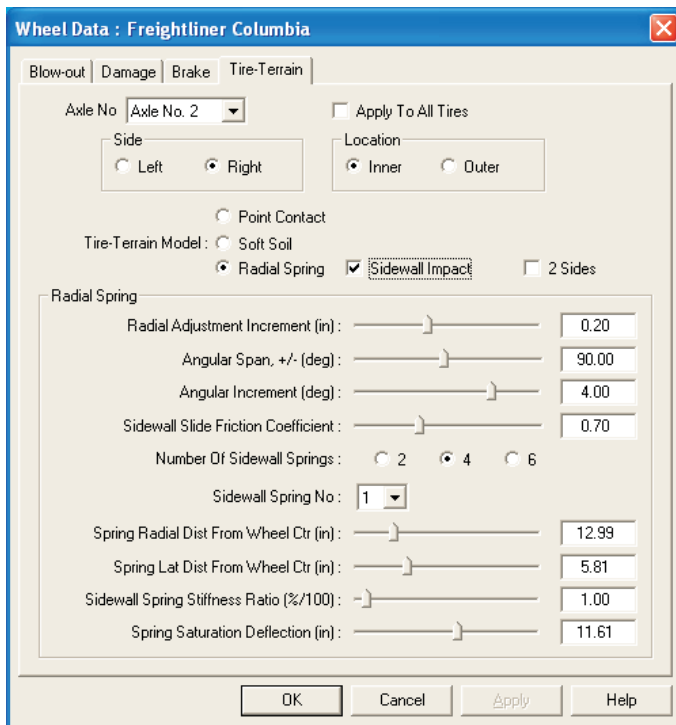


Figure 4 - Set-up, Wheels Dialog, Tire-Terrain Page

The user can also simulate a brake failure at the selected wheel. The independent parameters are:

- Tstart – The simulation time at which the simulated brake failure begins. The AutoStart check box tells *SIMON* start the brake failure at the beginning of a collision. (Because *EDSMAC4* does not include a brake system model, brake failure is not enabled for *EDSMAC4*.)
- Duration – The time interval required for the brake capability to change from its original state to the failed state. The default duration is 0.10 seconds, approximating the duration of the collision pulse.
- Failure Extent – The percentage of nominal brake torque after failure. Total failure would be entered as 100%.

Tire-Terrain

The standard tire model assumes that point contact occurs between the tire and the terrain beneath the tire. However, that is not always the case. Take, for example, a tire traveling over a pot hole or mounting a curb. Consider a tire sliding sideways into a curb.

Consider a tire traversing deep sod or sand. In each of these cases, significant forces are applied at multiple locations on the surface of the tire. The Tire-Terrain page allows the user to model these cases.

To simulate the conditions described above, first select the desired vehicle, then choose Set-up, Wheels, to display the Wheels dialog for the selected vehicle. Then, click the Tire-Terrain tab. The Tire-Terrain page is displayed for the selected vehicle (see Figure 4).

The Tire-Terrain page consists of three sections. The top section allows the user to select a wheel location. Next, the user selects the desired Tire-Terrain model. The three options are:

- Point Contact (default)
- Soft Soil
- Radial Spring

The Radial Spring model includes the Sidewall Impact option. That option allows the user to simulate tire sidewall interaction with curbs (i.e., curb-tripped rollover) and pavement edges. The 2 Sides option allows the user to simulate tires traveling over ruts in the pavement.

Depending on the selected model, the remaining fields allow the user to assign the required independent parameters. For the Radial Spring Tire-Terrain model, those parameters are:

- Radial Adjustment Increment – The incremental change in the length of a radial spring used for calculating tire force
- Angular Span, +/- – The angular range between which radial springs are included
- Angular Increment – The angle between each individual radial spring

If the Sidewall Impact option is selected, the following additional parameters are available:

- Sidewall Friction Coefficient – The coefficient of friction between tire sidewall and the terrain
- Number of Sidewall Springs – The number of sidewall (lateral) springs attached to each radial spring (2, 4 or 6)

For each sidewall spring, the following parameters are also used:

- Spring Radial Distance from Wheel Center – The location for each sidewall spring

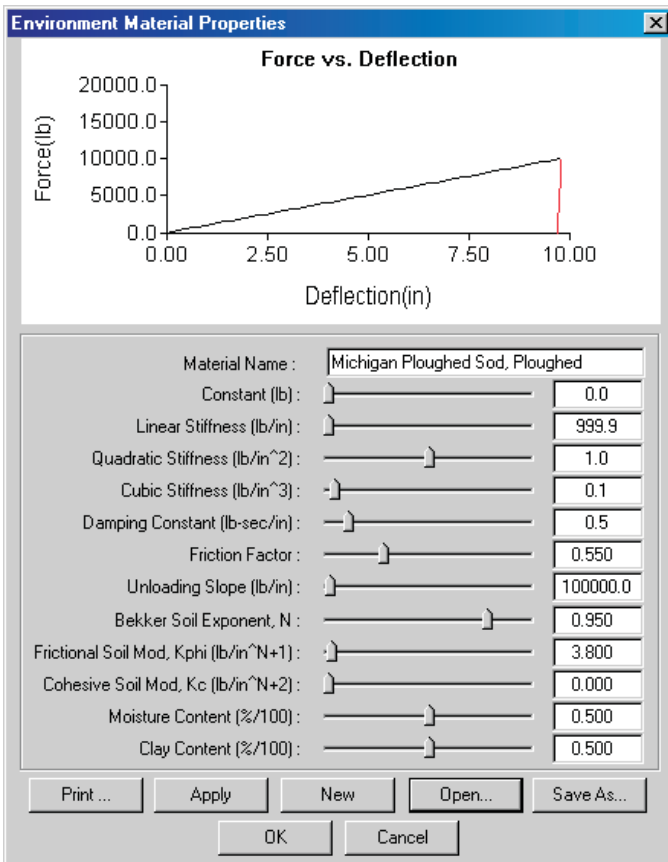


Figure 5 - Environment Material Properties dialog, used for assigning soil parameters used by the Soft Soil model.

- Spring Lateral Distance from Wheel Center – The distance from the tire centerline to the sidewall (simulated width of the tire)
- Spring Stiffness Ratio – The stiffness of the sidewall, assigned as a ration of the radial stiffness
- Spring Saturation Deflection – The maximum allowable deflection of an individual sidewall spring

The Soft Soil option has no parameters that are assigned in the Tire-Terrain page. Rather, the Soft Soil model uses the point contact model and detects the soil parameters associated with the terrain beneath the tire. Since the terrain is part of the environment, these parameters are assigned using the Environment Material Properties dialog (see Figure 5). The three empirically derived parameters are:

- Bekker Soil Exponent – Soil deformation exponent
- Frictional Soil Modulus – Soil frictional exponent
- Cohesive Soil Modulus – Soil cohesive exponent

HVE includes a library that includes eight soils, ranging from dry sand to compacted sod to lean clay. Use of the Soft Soils model typically requires matching via trial and error the simulated and actual tire rut depths (also called sinkage).

For more information, see *HVE* White Paper number WP-2005-6 and the Summer 2006 Newsletter's Technical Session.

Call For *HVE* White Papers For The 2010 *HVE* Forum

HVE users interested in presenting a technical paper in the “*HVE* White Paper” session at the 2010 *HVE* Forum are invited to submit an abstract for consideration. This session is an opportunity for you to showcase your skills to other *HVE* users as well as to non-*HVE* users who may wish to hire you as a consultant.

The following subjects are being considered:

- *HVE* Case Studies
- Innovative Tips and Techniques Using *HVE*
- Any Application of *HVE* Showcasing its Capabilities (especially events with important 3-dimensional vehicle behavior)

If you are interested in presenting a white paper, please submit your abstract of 100 to 250 words in length to EDC Customer Service before August 1, 2009. Please include complete contact information for the lead author with each abstract submission.

After each year's *HVE* Forum, all *HVE* White Papers are made available for download from the EDC website library. Recent additions include:

WP-2008-1 “Application of *HVE SIMON* to the Analysis of Lateral Wind Loadings on High-sided Vehicles”, William Blythe, P.E., Ph.D., William Blythe, Inc.

WP-2008-2 “Validation of Collision Reconstruction Opinion Utilizing *EDSMAC4*”, Steven Day, California Highway Patrol.

WP-2008-3 “Computer Simulation of Staged Motorcycle-Vehicle Collisions Using *EDSMAC4*”, Eric Deyerl, Dial Engineering; Louis Cheng, Applied BioMechanics.



2009 HVE Forum Recap

Attendees to the 2009 HVE Forum in Orlando, Florida, clearly had great things to say about the quality and content of the workshops offered this year. Here are a few comments directly from the evaluation forms:

"The Forum was an excellent opportunity to learn from the creators of HVE and interact with some of the most knowledgeable users in the field." - Roman Beck

"As an HVE-2D user, I enjoyed the open discussions during the 2009 Forum which provided an opportunity to learn from the instructor and fellow classmates."
- Heath Spivey

"Every user of HVE needs to attend the annual HVE Forums. You always will pick up "nuggets" that make it worthwhile." - Dr. William Blythe

Workshops were offered for all levels of users, from the Introduction to HVE-2D and physics programs, all the way up to real-world case studies in the Advanced HVE workshops. Attendees were encouraged to ask questions of instructors and of each other while using the programs, helping them to not only understand how the software can be used, but actually how to use it.

In addition to the workshops, users met in focused groups to discuss suggested improvements they would like to see in future updates. The Top 10 Wish Lists were provided to EDC directly after the group meetings.

2010 HVE Forum San Antonio, Texas March 1 - 5, 2010

Attendees of the 2009 HVE Forum voted to take the 2010 HVE Forum back to San Antonio! Make plans now to come to the 2010 HVE Forum at the Hotel Contessa in San Antonio, Texas, on March 1 - 5, 2010. The 2010 HVE Forum is **the** event that every user of HVE and HVE-2D should attend. Just ask your colleagues who attended the 2009 HVE Forum!

New Workshops for 2010

With all of the new features and enhancements currently underway for Version 7, there are exciting plans for new workshops at the 2010 HVE Forum:

- Advanced 3-D Workshop - Building the Bullitt case file. We will discuss exactly how this case was built, and attendees will actually build their own Bullitt case file.
- Automatic Transmission Model - Applications for the Real World. We will describe how it works and how much easier it is to use than manually entering a gear table (really, most vehicles *do* have an automatic transmission!).
- HVE Driver Model (with Speed Follower) - Applications for Accident Reconstruction. Again, a thorough description of the model and its use, combined with the new Automatic Transmission Model, for studying real-world reconstruction issues.

Workshop schedules, descriptions and registration materials will soon be available to download from the 2010 HVE Forum page of the EDC website. See you in San Antonio!

Extended Payment Options Now Available

EDC now offers an Extended Payment Option Plan for purchasing HVE and HVE-2D. This plan allows you the flexibility to purchase your software using 3, 6 or 9 equal monthly payments. The only requirement to participate in this plan is that each payment is due at the beginning of the month and is billed automatically to a credit card.

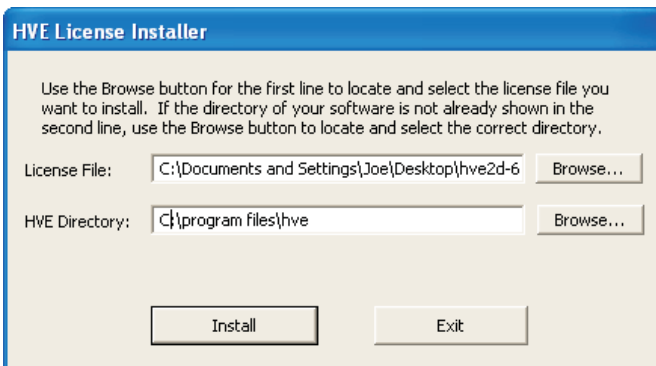
To receive a personalized quotation for HVE or HVE-2D, please contact Joe Canova directly at 503.644.4500 ext 118 or by email to jcanova@edccorp.com.

Quickly Install A New License File

Have you ever added a new physics program, replaced your *EDKEY*, or installed patches to your current version of *HVE* or *HVE-2D*? If you have, then you probably had to go through a manual procedure to install a new license file without having to entirely reinstall your software. This manual procedure would require you to save the new license file into your *HVE* or *HVE-2D* folder and rename it to be *lserverc*, without dot or extension in the filename. This process usually went smoothly, but every now and then renaming the file properly could present quite a challenge.

To make it much faster and easier to install a license, a new utility program was added to the Programs list for your *HVE* or *HVE-2D* installation, starting with Version 6.00. To use this program, select *Start, Programs* and then on your *HVE* or *HVE-2D* program list, select the *Install License File* utility. The program dialog that appears will allow you to select your new license file and to confirm your installation location, as shown in the image below. You'll also find helpful instructions within the dialog to guide you through the actions needed to use the program. After you've selected the License File and the Installation Directory, you press the *Install License* button and the program will automatically put your new license file into place. That's all the effort it takes and you're ready to use your *HVE* or *HVE-2D*!

NOTE: *This license installation utility should only be used if you are installing a new license particular to your current installed version of software. If this is a new installation, or an official CD based update, then please use the license installation utility integrated into the HVE Installation program.*



HVE License Installer program dialog identifying the selected new license file and the current installed path for HVE or HVE-2D.

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. In a SIMON simulation, how is the rear differential modeled on a 2-wheel drive vehicle?

A. The torque is applied to the wheel with the least traction. There is no posi-traction or limited slip behavior currently modeled in a *SIMON* simulation.

Q. In a SIMON simulation, how is the torque and/or drive shaft speed distributed between front and rear in a 4-wheel drive vehicle?

A. In a *SIMON* simulation, torque is distributed equally among all drive axles. Drive shaft speed is calculated based upon the average speed of all drive wheels multiplied by the differential ratio.

Q. In a collision simulation, such as a two-car event using EDSMAC4, what is the value of the Inter-Vehicle Friction value set for the interaction of the Vehicle Meshes represent in real-world behavior?

A. Inter-Vehicle Friction is essentially the same as Coulomb friction. In other words, the two vehicles do not actually lock together during the collision phase of the simulation, but rather, Inter-Vehicle Friction behaves more like slide friction between the two vehicle geometries.

Q. When saving a custom tire into my user.db, why do I occasionally receive the following error message: "supportFiles\db\user.db contains an invalid path"?

A. This is a situation that occurs whenever a user attempts to save a custom tire into the *user.db* from within an existing case file. It is a known issue that will be fixed in a future release. The workaround so that you can continue with your case requires you to restart *HVE*, then add any vehicle and fit it with your tire of choice. Then you can edit and save this new tire into your *user.db*. As long as you do not save the casefile you are working in, you can edit and save repeatedly into *user.db*. Once completed, simply go back into your existing cases and fit your vehicles with the tires you previously saved into the *user.db*.

Visit the Support section of www.edccorp.com for the latest Downloads and answers to F.A.Q.'s.

EDC Training Courses

EDC Reconstruction & EDC Simulations

EDC offers an excellent training course on the use of the EDC reconstruction program, *EDCRASH*. Both new and long-time users of *EDCRASH* agree that the *EDC Reconstruction* course is extremely beneficial and challenging.

EDC also offers an excellent training course on the use of EDC simulation programs, such as *EDSMAC*, *EDSMAC4*, *EDSVS* and *EDVTS*. The *EDC Simulations* course offers the fastest way to learn what you really need to know – how to efficiently use the program and get the right results.

These one-week courses are designed to fully investigate the program's inner workings. Lectures are full of helpful hints gained from years of experience. During the course, students will use the programs (e.g. *EDCRASH*, *EDSMAC4*) in either the *HVE* or *HVE-2D* simulation environment to complete several workshops highlighting the capabilities of the programs.

HVE Forum

The *HVE* Forum is an excellent opportunity for *HVE* and *HVE-2D* users to jump to a new level of ability. By participating in workshops, attendees brush up on their present skills, learn new techniques, and learn how to use the latest advancements in the software. The *HVE* Forum also presents 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 2011
Miami, FL November 9 - 13, 2009

EDC Reconstruction

Los Angeles, CA January 18-22, 2010
Miami, FL November 8-12, 2010

Theoretical & Applied Vehicle Dynamics

Upon Request TBA

2010 HVE FORUM

San Antonio, TX. March 1 - 5, 2010

Vehicle Dynamics

Theoretical and Applied Vehicle Dynamics extends the theory of the basic SAE course and includes direct applications using several vehicle simulation programs (e.g. *SIMON*, *EDVSM*) within the *HVE* simulation environment, as well as a solid theoretical background for such simulations. The course is focused towards vehicle design engineers and safety researchers with an interest in a greater understanding of vehicle dynamics and automotive chassis systems development.

Hands-on Training

Intensive hands-on training on how to use your *HVE* or *HVE-2D* system software, physics programs and databases is available. Contact EDC Customer Service for more information about bringing this two-day on-site course to your office.

Course Registration

You may register for a course by contacting EDC Customer Service at 503.644.4500, or by email to training@edccorp.com. You can also visit the Training pages on our website and download a registration form. All courses are eligible for Continuing Education Units and ACTAR credits. See you at our next course!

DiscoverHVE.com

Collision Engineering Associates has launched a website where subscribers can learn more about using *HVE* by viewing basic, intermediate and advanced video tutorials. Members can also participate in on-line discussion groups covering various topics such as tire side-wall impacts, video output, importing vehicles and scenes, using humans in *HVE*, and known issues or work-arounds. Visit www.DiscoverHVE.com or contact Collision Engineering Associates at 480.655.0399 for more information.

Engineering Dynamics Corporation
8625 SW Cascade Blvd, Suite 200
Beaverton, Oregon 97008 USA
Phone 503.644.4500 / FAX 503.526.0905
Email: info@edccorp.com
Website: www.edccorp.com

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

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

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