

# **User's Manual for Semitrailer Truck FEM Model Web Site**

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## Executive Summary

### *Technical Approach*

The current state-of-the-art FEM crash models of vehicles are built using advanced CAD and FEM tools as a collaborative endeavor of engineers, modelers and computer specialists. The models have very detailed geometry discrimination, contain large number of sub-models, parts, components, and systems with complex properties, interaction, connectivity, spatial and functional relations. Describing and documenting such a model in detail becomes an equally complex undertaking. The emerging web-based technologies provide a framework that can assist in presenting the information contained in the model and thereby facilitate its distribution and wide utilization. Most of the current approaches to web-based documentation of the computational models are based on static information that primarily consists of document libraries, presentations, simulation results and model input files. Although they provide considerably more information compared to the conventional, printed documents, they do not fully take advantage of the potential offered by the new technology. One of the most powerful features of the interactive web is the ability to interlink the data in hypertext documents such that they mimic the relations that exist in the model. Navigating the interlinked data is then very similar to navigating the actual FEM model. The sequence of steps for model examination is not fixed, so that the user can have certain level of control how to examine the information and acquire the knowledge. The focus of the interactive documentation system is how to effectively utilize the technology and find the correct balance of simplicity necessary for a wide use and ability for in-depth inquiry into the model demanded from the expert users. Ideally, the system will provide an ability to configure access mode to match the level of user's expertise. It should also be able to support model development process such that the evolving changes to the model are documented and can be manipulated similarly to software development systems. Such capabilities are outside the scope of this project but are planned to be pursued in the future.

The web-based manual developed during this project is an attempt to develop such a comprehensive documentation system, albeit of a limited functionality commensurate to the project's scope. Although it started with an objective to document one vehicle model, the project resulted in several models for tractor and trailer, which can be combined into combination vehicles for crash simulations. The original approach for a web-based documentation was based on the interactive manual previously developed for a Single Unit Truck FEM model. That version was primarily developed using direct generation of the content and presentation programs by the developers. Such an approach obviously necessitates a lot of human effort bandit scales proportionately to the number of the models to be processed. As the models change during the course of their development, detecting, updating and tracking the differences becomes quite tedious and time-consuming. In order to deal with an increased number of models and their variations, we have decided to develop a system that can accommodate these requirements and can process the models in relatively short time. In doing so, we have started on a path towards a more general system for FEM model documentation that is relatively independent of the models under consideration.

A major difficulty in developing a more general interactive FEM model documentation system is the variety of existing file formats, model syntaxes, model building procedures and specializations within models for particular vendor's simulation software. Several efforts on standardization of FEM models have been initiated in the past and have resulted in some standardization primarily for geometric representation. However, connection and interaction

technologies such as Extensible Markup Language (XML), the Extensible Style sheet Language Family (XSL), and XSL Transformations (XSLT) bring forward new tools that can be used to simplify transformations between FEM models from different vendors and simulation types without a need to enforce common model syntax.

The web documentation system developed in this project consists of three major components. The first component is the underlying data model and relational database that describe the FEM model information and relations within the model. One of the possible approaches is to work directly with the Is-dyna crash files and dynamically extract its content as queried by a user. An obvious drawback is the size of the models, which if anything are going to grow as the model become more sophisticated. Therefore, some underlying condensation of information and simplification of the model is necessary if a system is to be reasonably fast. The second component is the multi-media content generation software to be used for presenting the characteristics of the model and relations within it. The last component is a web-based interface for querying and displaying the information. In the previous version of a web-based manual for the SUT model, all of these components were interwoven into one and could operate primarily on static information that was not easily extendable. In this new version, adding a new FEM model to the documentation system does not require any modification of the display system, rather it takes only generation of the model data and media, images, [Virtual Reality Modeling Language \(VRML\)](#), movies, etc., and their entry into the data model. In this way, the content is disassociated with the presentation engine and the two can be developed separately. In the following, the three components are described in more detail. The web documentation system can be tested at the provided web address.

### ***Data Model and Relational Database***

The most detailed examination of the tractor-trailer FEM Is-dyna model can be performed by using the commercial pre- and post- processors such as LSTC's software PrePost. However, that requires familiarity with the software and limits the model presentation to the expert group of users. Large-scale FEM models are usually developed as proprietary products for specific application and are not meant for wide distribution. On the other side, the FEM models developed by academia and government institutions are usually in public domain and their target audience is intentionally wide. World Wide Web technologies developed for variety of purposes can be adopted and applied to the documentation of FEM models. One of the most potent technologies is the [Extensible Markup Language \(XML\)](#), and related tools. Coincidentally with development of the markup languages, the syntax of FEM models was developing from strictly formatted numerical sequences (decks, with origins in card format), to the representation akin to markup languages. While some idiosyncrasies remain in the FEM model syntaxes (likely to be eliminated in new versions of the codes), the transformation from the current FEM model formats, such as KEYWORD format in Is-dyna, are relatively simple. Once a transformation to XML form is made, we have at our disposal an enormous toolbox for manipulating and transforming data. We have therefore selected the XML for the data model underlying the interactive documentation system. The relations existing in the model are encoded in the XML form and a relational database for the model is created. Data transformations are performed by a series of programs that extract from the FEM model file pertinent data, process that data, build cross-link references and links to media content (images and interactive 3D files), and finally store all that information in XML files. In essence these files represent a relational database stored in a format that can be viewed and edited in any text/word processor. This database is

such a system lacks management and security features provided by an integrated database management system such as [MySQL](#). Hence, care must be taken on the server side to guard this content from unauthorized access and tampering. Initially, the system was driven by a MySQL engine, but due to the desired portability of the system, the MySQL database has been entirely replaced by the XML. Future plans for development include revisiting the concept of separate database server and/or combinations of transformations and XML-based databases. However, the current implementation considerably improves upon the SUT manual design in flexibility and generality of the system. Multi-Media Content Generation

The wide spread of WWW have been driven in large part by the ability to effectively convey information using rich media content and describe relations within it by interactive, hyperlinked documents. Spatial relationships within the model are best described by images and 3D models, ideally to be manipulated by prospective user. User's multi-media expectations have also grown in proportion to increased communication bandwidth and capability of computer hardware, so that the amount of media to be generated and presented is an order of magnitude larger than what was common just few years ago. Weave developed computer programs to create image libraries and interactive 3D files for selected FEM model components. Additional structures on data may be imposed, such as grouping of parts into components and sub-systems as they are commonly grouped in the actual vehicles. The parts or part sets that may be grouped together by their physical association to a certain model component, or by utilizing specific material, section, or contact type.

A series of scripts have been written in various computer languages to generate images for the documentation. The programs used freeware programs, such as [Medit](#) and [Persistence of Vision Raytracer](#) to capture images of FEM model entities from different points of view and in different orientations. A series of images displaying the entity of interest both as standalone and as being a highlighted part of the model shows in detail what the entity looks like, and where it fits in the model. Another set of programs extracts from the FEM model data for creating the interactive 3D views. In order to reduce the size of the models, Level of Detail programs are used to minimize the number of polygons necessary for the display. We have also implemented graph presentation of data using public domain software and correlated visual and tabular representation of data to the exact location of their definition in the FEM model input file. Data retrieval and web display

The tractor-semitrailer web server was built on CGI interface that receive and process user requests, interact with the XML database type files and serve requested content. The available content is organized in six sections accessible through the horizontal navigation.

The [Home](#) section contains a summary of the project and excerpts from all chapters in the final report.

The display capability for the FE model offers model selection and includes briefs for the following LSDYNA keywords: PART, SECTION, MATERIAL, DEFINE, CONSTRAINED, AIRBAG, CONTACT, and SET. Addition of other Is-dyna keywords is relatively straightforward. This subset was selected as it describes the essence of the model. A user first needs to [select](#) the model for analysis from the available database of models. The subsequent database queries by selecting options and links in the browser are conducted on the selected model. The presented data is stored in tables and cross-linked appropriately. For example, user has a link to view all the parts that are modeled with the selected material model, or view parts that share common section model. etc. A more detailed data view of the selected entity offers the user an

Launch a popup window to view the excerpt of the FE model file that served as an information source;

View a series of static entity images (applicable for parts, sections, materials, contacts and airbags);

Use an interactive 3D application to get a more detailed model view (applicable for parts, sections, materials, contacts and airbags);

Launch a popup window to get curve graphs (applicable for tables and curves);

Launch a popup window to look at the LS-DYNA user manual for a particular keyword.

The [Simulation](#) section offers movies showing FE model simulations performed with individual tractors or tractor-semitrailer combinations. Cross-links offer speedy connections to downloadable models featured in the simulations.

The [Test](#) section displays movies showing recordings of actual crush tests performed with tractors and tractor-semitrailer vehicles.

The [Download](#) section offers links to tractor and tractor-semitrailer FE models. Cross-links enable speedy connections to simulations featuring these models.

The [About](#) section contains general information about the project and people that designed the web based interface as well as links to the web sites of the institutions that participated and financed this project.

This process results in a dynamic web server system that can continuously be updated as new versions of the FE model evolve, or enhanced display and inquiry

# 1. Tractor-semitrailer web site help

The contents of the tractor-semitrailer project web site are organized in seven logical units as follows:

[Home](#)

[Model](#)

[Simulation](#)

[Test](#)

[Download](#)

[Help](#)

[About](#)

Each unit can be easily reached through the horizontal navigation menu located below the banner. Current unit selection is highlighted in separate color.

## ***Home***

Pertinent information regarding the tractor-semitrailer project is displayed in the Home section. The web content structure mimics loosely the assembly of the final project. Excerpts from the project can be reached through the vertical navigation menu.

## ***Model***

The Model section is the principal part of the web site. Model selection and subsequent retrieval of pertinent data from available LS-DYNA input files can be accessed through a drop line menu accessible under the horizontal menu's Model tab. Specific information can then be reached through the vertical navigation menu.

## ***Simulation***

Access to FEM movie simulations of several crash scenarios implementing available tractor and tractor-semitrailer models can be reached through the Simulation tab located in the horizontal navigation menu. The vertical navigation menu further narrows the choice to viewing simulation movies with FE models containing only a tractor, or a tractor-semitrailer combination.

## ***Test***

Movies showing several orchestrated crash scenarios involving actual tractors and tractor-semitrailers can be accessed through the Test tab located in the horizontal navigation menu. The vertical navigation menu further narrows the choice to viewing movies in which the crash

or a tractor-semitrailer combination.

### ***Download***

The Download tab located in the horizontal navigation menu offers access to all source LS-DYNA FEM models that are the scope of this web site. Project reports can also be found in this section. The files are organized in logical groups that can be reached through the vertical navigation menu.

### ***Help***

The content under the Help tab offers assistance for navigating this web site. Detailed explanation for specific topics can be reached through the vertical navigation menu.

### ***About***

Basic information regarding institutional participants and supporters, as well as information about the people that developed this web site can be found under the About tab located in the horizontal navigation menu.

## 2. Tractor-semitrailer web site help: Home

The Home section contains the executive summary of the project and key excerpts from the final report. The web content is organized in seven units as follows:

[Executive summary](#)

[Introduction](#)

[Tractor](#)

[Trailer](#)

[Automated model modification](#)

[Web interface](#)

[Conclusions](#)

Each unit can be reached easily through the vertical navigation menu located at the left hand side of the page. Current unit selection is highlighted in separate color.

### *Executive summary*

**FEM Models for Semitrailer Trucks**

Home

Home Model Simulation Test Download Help About

**executive summary**

introduction  
tractor  
trailer  
automated model modification  
web interface  
conclusions

Notes:  
Info about the project

**Home**

**Executive Summary**

[National Transportation Research Center Inc.](#) (NTRCI) sponsored the research team of [Battelle, Oak Ridge National Laboratory](#) (ORNL) and the [University of Tennessee at Knoxville](#) (UTK) to conduct a three-phase research project with objective to enhance existing and develop new Finite Element Method (FEM) models for simulating tractor-semitrailer crash events involving roadside safety hardware such as bridge rails and median barriers. This site documents the work completed during the course of the project. The site also contains interactive manuals and documentation for the developed models.

The tractor-semitrailer vehicle FEM models developed in this project are currently the most advanced publicly available models of this vehicle class in terms of physical function, geometric detail and material property accuracy. The models are

The Executive summary section gives a brief overview of the project objective and



## ***Introduction***

Introductory information regarding finite element method (FEM) modeling of tractor-semitrailer vehicles for simulating crash events with barriers and roadside safety hardware can be found in the Home's introductory section. Links in the text navigate to additional information sources.

## ***Tractor***

The Tractor section contains particular information regarding the development of the FEM model of atypical tractor vehicle. Emphasis is placed on describing the enhancements of the original model intended for improving simulated vehicle response in impacts with roadside safety hardware.

## ***Trailer***

Detailed information regarding the development of the FEM model of a typical semitrailer vehicle can be found in the Home's Trailer section.

## ***Automated model modification***

Description of the procedure for automated dimensional adjustments to the basic tractor and semitrailer models is given in the Home's Automated model modification section. This procedure was developed with intention to build quickly valid FEM models of tractor and semitrailer vehicles with tractor wheelbases or semitrailer lengths that differ from the ones in the original FEM models. Following this procedure the FEM model (data) base was expanded to three tractor and two semitrailer models.

## ***Web interface***

An insight into the working behind this web presentation can be found in the Home's Web interface section. Overview is given about automated FEM model data extraction and archiving, automated generation of multi-media content, and pooling and displaying content on user's request. Multiple links in the text navigate to additional information sources.

## ***Conclusions***

An overview of the project conclusions can be accessed through the Home's Conclusion section.

### 3. Tractor-semitrailer web site help: Model

The Model section serves as a portal for accessing pertinent data about all available models. The web content is organized in nine units as follows:

[Select](#)

[Part](#)

[Section](#)

[Material](#)

[Define](#)

[Constrained](#)

[Airbag](#)

[Contact](#)

[Set](#)

Each unit can be easily reached through the drop line menu displayed on mouse over event on the horizontal menu's Model tab. Content specific to the selection from the horizontal menus is further partitioned in specific units that can be reached from the vertical navigation menu on the left-hand side of the page. Current selection is highlighted in separate color.

#### ***Select***

The opening section under the Model tab is labeled Selection. Here a model selection can be made from the list of available models. All subsequent model data queries are conducted on the selected model. Current model selection is indicated in the page title with the name of the FEM model source file name.

#### ***Part***

The Part section offers access to data briefs from the PART LS-DYNA keyword. Data queries are conducted on the [selected model](#). The name of the selected FEM model source file is indicated in the page title.

#### ***Section***

The Section unit offers access to data briefs from the SECTION LS-DYNA keyword. Data queries are conducted on the [selected model](#). The name of the selected FEM model source file is indicated in the page title.

## ***Material***

The Material section offers access to data briefs from the MAT LS-DYNA keyword. Data queries are conducted on the [selected model](#). The name of the selected FEM model source file is indicated in the page title.

## ***Define***

The Define unit offers access to data briefs from the DEFINE LS-DYNA keyword. Data queries are conducted on the [selected model](#). The name of the selected FEM model source file is indicated in the page title.

## ***Constrained***

The Constrained section offers access to data briefs from the CONSTRAINED LS-DYNA keyword. Data queries are conducted on the [selected model](#). The name of the selected FEM model source file is indicated in the page title.

## ***Airbag***

The Airbag unit offers access to data briefs from the AIRBAG LS-DYNA keyword. Data queries are conducted on the [selected model](#). The name of the selected FEM model source file is indicated in the page title.

## ***Contact***

The Contact section offers access to data briefs from the CONTACT LS-DYNA keyword. Data queries are conducted on the [selected model](#). The name of the selected FEM model source file is indicated in the page title.

## ***Set***

The Set section offers access to data briefs from the SET LS-DYNA keyword. Data queries are conducted on the [selected model](#). The name of the selected FEM model source file is indicated in the page title.

### 3.1 Tractor-semitrailer web site help: Model/Select

The Select section located in the drop line menu under the horizontal menu's Model tab offers model selection from the database of available models. Models are orderly displayed with appropriate images and labeled accordingly with a short title description and the FEM model source file name.

Current model selection is indicated in the page title with the name of the FEM model source file.



The screenshot shows a web interface for "FEM Models for Semitrailer Trucks". At the top, there is a 3D model of a truck and the text "FEM Models for Semitrailer Trucks" and "Select Model". Below this is a navigation menu with buttons for "Home", "Model", "Simulation", "Test", "Download", "Help", and "About". The "Model" button is selected, and a sub-menu is open with buttons for "Select", "Part", "Section", "Material", "Define", "Constrained", "Airbag", "Contact", and "Set". The "Select" button is highlighted. On the left, there is a vertical list of options: "part", "section", "material", "define", "constrained", "airbag", "contact", and "set". The "part" option is selected. In the center, the text "Current selection: Trailer\_48ft\_v100805.k" is displayed. Below this, there is a prompt "Select a model from the list below." and two model thumbnails. The first thumbnail is a tractor with a sleeper cabin, labeled "Tractor, sleeper cabin (file: Tractor\_Sleeper\_v100308.k)" with a "Download" link. The second thumbnail is a trailer, labeled "Trailer, length 48ft (file: Trailer\_48ft\_v100805.k)" with a "Download" link. At the bottom left, there is a "Notes:" section with the text "Select a model to view and press Submit button."

Model selection can be made by clicking first at the associate option button, image, or label of the desired model, and then by clicking the Submit Query button found below the model list.

**Note:** A click on the model itself is not sufficient to trigger a model change. The request must then be sent to the server by clicking the Submit Query button for the change to take effect.

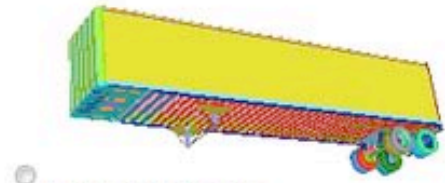
After selection, explore the model using menus above.

Names of menu sections correspond to Isdyna keywords.



Tractor, day cabin, wheelbase 194in  
(file: Tractor\_DayCab\_194in.k)

[Download](#)



Trailer, length 45ft  
(file: Trailer\_45ft\_v100621.k)

[Download](#)



Tractor, day cabin, wheelbase 181in  
(file: Tractor\_DayCab\_181in.k)

[Download](#)

Submit Query

Each model is accompanied with a link to the corresponding FEM model source file available for download.

The vertical navigation menu on the left-hand side of the page offers quick access to LS-DYNA keyword data briefs for the currently selected model.

## FEM Models for Semitrailer Trucks

Select Model

Home Model Simulation Test Download Help About

Select Part Section Material Define Constrained Airbag Contact Set

part  
section  
material  
define  
constrained  
airbag  
contact  
set

Notes:  
Select a model to view and press Submit button.

**Current selection: Trailer\_48ft\_v100805.k**

Select a model from the list below.

Tractor, sleeper cabin  
(file: Tractor\_Sleeper\_v100308.k)  
[Download](#)

Trailer, length 48ft  
(file: Trailer\_48ft\_v100805.k)  
[Download](#)

## 3.2 Tractor-semitrailer web site help: Model/Part

The Part section located in the drop line menu under the horizontal menu's Model tab offers data briefs from the PART LS-DYNA keyword. Data queries are conducted on the selected model. Current model selection is indicated in the page title with the name of the FEM model source file name. Model [selection](#) can be made through the Model's Selection tab.



The screenshot shows the website interface for "FEM Models for Semitrailer Trucks". The main navigation bar includes "Home", "Model", "Simulation", "Test", "Download", "Help", and "About". Below this, a secondary navigation bar has "Select", "Part", "Section", "Material", "Define", "Constrained", "Airbag", "Contact", and "Set". The "Part" tab is active. On the left, a vertical menu lists part groups: "all", "cabin", "engine", "drivetrain", "frame", "side rail", "front axle", "front wheels", "front suspension", and "rear axle". The "all" group is selected. The main content area displays "Part: Tractor\_Sleeper\_v100308.k" and a table of parts.

Part ID	Part Name	Section ID	Material ID	Group 1	#Contacts
<input type="checkbox"/> 2000001	F1-CB-FENDER	2000001	2300009	cabin	1
<input type="checkbox"/> 2000002	F1-CB-GRIL	2000002	2000002	cabin; engine	1

The parts are conveniently grouped into smaller units that can be easily reached from the vertical navigation menu located at the left-hand side of the page. Current unit selection is highlighted in separate color.

Each part group is visually presented with images and an interactive 3D display, which are accessible through corresponding image links located side-by-side in the main page area below the title.

### Group images

The left-hand side image leads to a popup window showing images of the part group alone, and of its setting in the model taken from different viewing angles. Images can be navigated by clicking inside the image on its left-hand and right-hand side, by clicking on the Previous and Next links that appear on mouse over the image event, by pressing the P and L letters on the keyboard, or by pressing the left and right keyboard arrows. The image window can be dismissed by clicking anywhere outside the image area, by clicking the Close link, or by pressing the C letter on the keyboard.

### Group 3D View

The right-hand side image, distinguishable by its faded VRML stamped background, leads to an interactive 3D display of the chosen part group in a new popup window. This option requires a proper 3D plug-in to show the chosen part group in its setting in the model. Plug-in dependent controls enable model interactivity (rotation, zoom, pan, etc.).

Home Model Simulation Test Download Help About

Select Part Section Material Define Constrained Airbag Contact Set

all

cabin  
**engine**  
 drivetrain  
 frame  
 side rail  
 front axle  
 front wheels  
 front suspension  
 rear axle  
 rear wheels  
 rear suspension

sprung  
 unsprung

steer axle  
 front drive axle

drivetrain  
**frame**  
 side rail  
 front axle  
 front wheels  
 front suspension  
 rear axle  
 rear wheels  
 rear suspension

sprung  
 unsprung

steer axle  
 front drive axle  
 rear drive axle

Notes:  
 Part groups can be selected from the menu above  
 Specific parts can be selected on the right

### Part: Tractor\_Sleeper\_v100308.k

This page contains information about model parts and their grouping.




#### Engine

	Part ID	Part Name	Section ID	Material ID	Group 1	#Contacts
<input type="checkbox"/>	<a href="#">2000002</a>	F1-CB-GRIL	<a href="#">2000002</a>	<a href="#">2000002</a>	cabin: engine	1
<input type="checkbox"/>	<a href="#">2000239</a>	F1-M-SRGTANK	<a href="#">2000239</a>	<a href="#">2000239</a>	engine	1



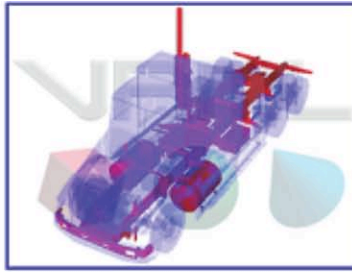
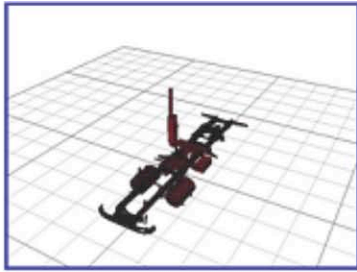

#### Frame

	Part ID	Part Name	Section ID	Material ID	Group 1	#Contacts
<input type="checkbox"/>	<a href="#">2000005</a>	F-CH-AIRPLATE	<a href="#">2000005</a>	<a href="#">2000005</a>	frame	1
<input type="checkbox"/>	<a href="#">2000006</a>	F-CH-AIRTANK	<a href="#">2000006</a>	<a href="#">2000006</a>	frame	1
<input type="checkbox"/>	<a href="#">2000007</a>	F-CH-BATTERYCASE	<a href="#">2000007</a>	<a href="#">2000007</a>	frame	1
<input type="checkbox"/>	<a href="#">2000008</a>	F-CH-CABGUIDE	<a href="#">2000008</a>	<a href="#">2000008</a>	frame	1
<input type="checkbox"/>	<a href="#">2000009</a>	F-CH-CABGUIDECYLINDER	<a href="#">2000009</a>	<a href="#">2000009</a>	frame	1
<input type="checkbox"/>	<a href="#">2000010</a>	F-CH-DRSHBK	<a href="#">2000010</a>	<a href="#">2000010</a>	frame: drivetrain	1

Essential part data is displayed in tabular format with each part filling one data row. The data is appropriately linked to related model content.

Part specifics can be reached by following the part identification number link, or by selecting the checkbox adjacent to the part identification number and then clicking on the Submit Query button located below the table. The latter approach is convenient for simultaneous selection of several parts.

- drivetrain
- frame**
- side rail
- front axle
- front wheels
- front suspension
- rear axle
- rear wheels
- rear suspension



- sprung
- unsprung

- steer axle
- front drive axle
- rear drive axle

Notes:  
 Part groups can be selected from the menu above  
 Specific parts can be selected on the right

**Frame**

	Part ID	Part Name	Section ID	Material ID	Group 1	#Contacts
<input type="checkbox"/>	2000005	F-CH-AIRPLATE	2000005	2000005	frame	1
<input type="checkbox"/>	2000006	F-CH-AIRTANK	2000006	2000006	frame	1
<input checked="" type="checkbox"/>	2000007	F-CH-BATTERYCASE	2000007	2000007	frame	1
<input type="checkbox"/>	2000008	F-CH-CABGUIDE	2000008	2000008	frame	1
<input type="checkbox"/>	2000009	F-CH-CABGUIDECYLINDER	2000009	2000009	frame	1
<input type="checkbox"/>	2000010	F-CH-DRSHBK	2000010	2000010	frame: drivetrain	1
<input type="checkbox"/>	2000011	F-CH-EXBARSP	2000011	2000011	frame	1

<input type="checkbox"/>	2000207	F-OB-WALL-H	2000207	2000207	cabin	1
<input checked="" type="checkbox"/>	2000208	F-OB-WALL-I	2000208	2000208	cabin	1
<input type="checkbox"/>	2000209	F-OB-WALL-J	2000209	2000209	cabin	1
<input checked="" type="checkbox"/>	2000210	F-OB-WALL-W	2000210	2000210	cabin	1
<input checked="" type="checkbox"/>	2000256	F1-OB-BUMPER	2000256	2300009	cabin	1
<input type="checkbox"/>	2000274	FEM-OB-LDOOR	2000274	2000274	cabin	1
<input type="checkbox"/>	2000350		2000350	2000350	cabin	1
<input checked="" type="checkbox"/>	2000351		2000351	2000351	cabin	1
<input type="checkbox"/>	2000352		2000352	2000352	cabin	1

Submit Query

In part specifics the essential data for the chosen part(s) is accompanied with access to:

- Excerpt from the FEM model source file ([Input Lines](#)),
- Numerous part [Images](#) (standalone and in setting),
- Interactive [3D View](#) of the part in its setting, and
- LS-DYNA's User's [Manual](#) displaying the chosen keyword entry.



**FEM Models for Semitrailer Trucks**

**Model Parts**

Home Model Simulation Test Download Help About

Select Part Section Material Define Constrained Airbag Contact Set

all

cabin  
engine  
drivetrain  
frame  
side rail  
front axle  
front wheels  
front suspension  
rear axle  
rear wheels  
rear suspension

**Part: Tractor\_Sleeper\_v100308.k**

This page contains information about model parts and their grouping.

**Part ID: 2000256**

Part ID	Part Name	Section ID	Material ID	Group 1	#Contacts
<input type="checkbox"/> 2000256	F1-OB-BUMPER	2000256	2300009	cabin	1

Input Lines Images 3D View Manual

<a href="#">4853-4857</a>	<a href="#">11</a>	<a href="#">1</a>	<a href="#">1971k_1.pdf</a>
---------------------------	--------------------	-------------------	-----------------------------

Submit Query

Excerpt from the FEM model source file containing the chosen part entry is accessible through the Input Lines link. A popup window shows the chosen part entry conveniently numbered such that numbers correspond to the FEM model source file lines.

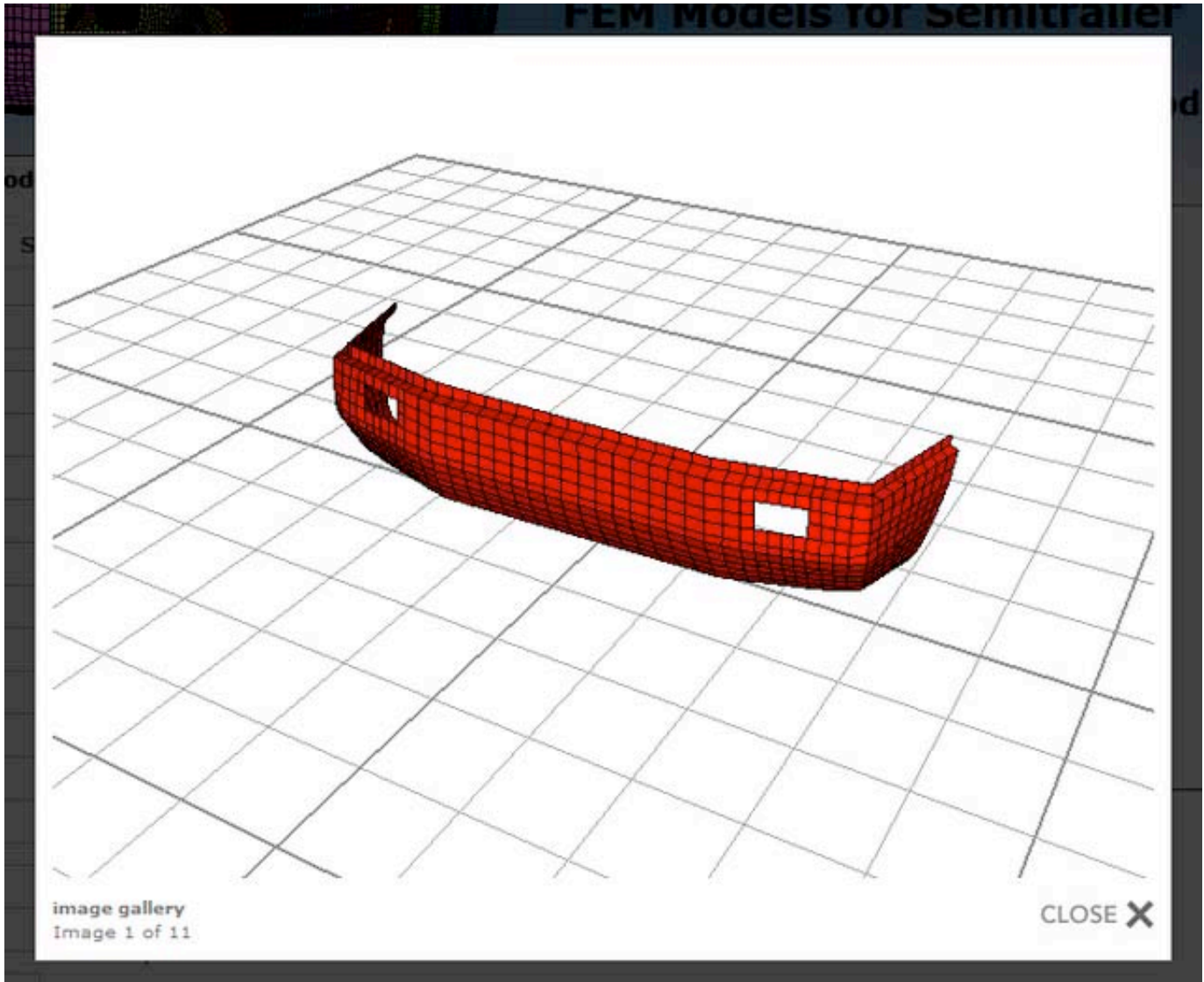
**Input File**

**Input File: Tractor\_Sleeper\_v100308.k**

Line Number	Line Content
4853	*PART
4854	\$# title
4855	F1-OB-BUMPER
4856	\$# pid secid mid eosid hgid grav adpopt tmid
4857	2000256 2000256 2300009 0 2000004

Input File

Numerous images of the chosen part can be viewed through the Images link. A popup window shows images of the part alone, and of its setting in the model taken from different

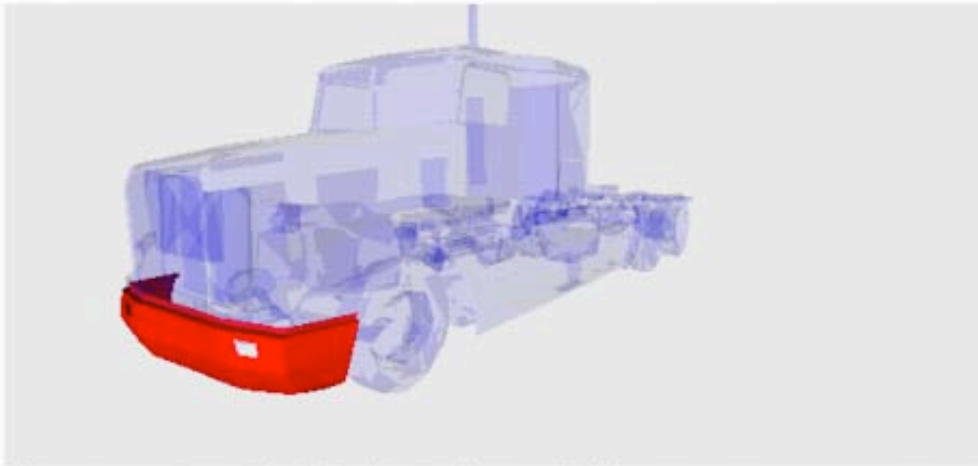


Images can be navigated by clicking inside the image on its left-hand and right-hand side, by clicking on the Previous and Next links that appear on mouse over the image event, by pressing the P and L letters on the keyboard, or by pressing the left and right keyboard arrows. The image window can be dismissed by clicking anywhere outside the image area, by clicking the Close link, or by pressing the C letter on the keyboard.

Interactive 3D display of the chosen part is accessible through the 3D View link. This option requires a proper 3D plug-in to show the chosen part in its setting in a new popup window. Plug-in dependent controls



## VRML Model

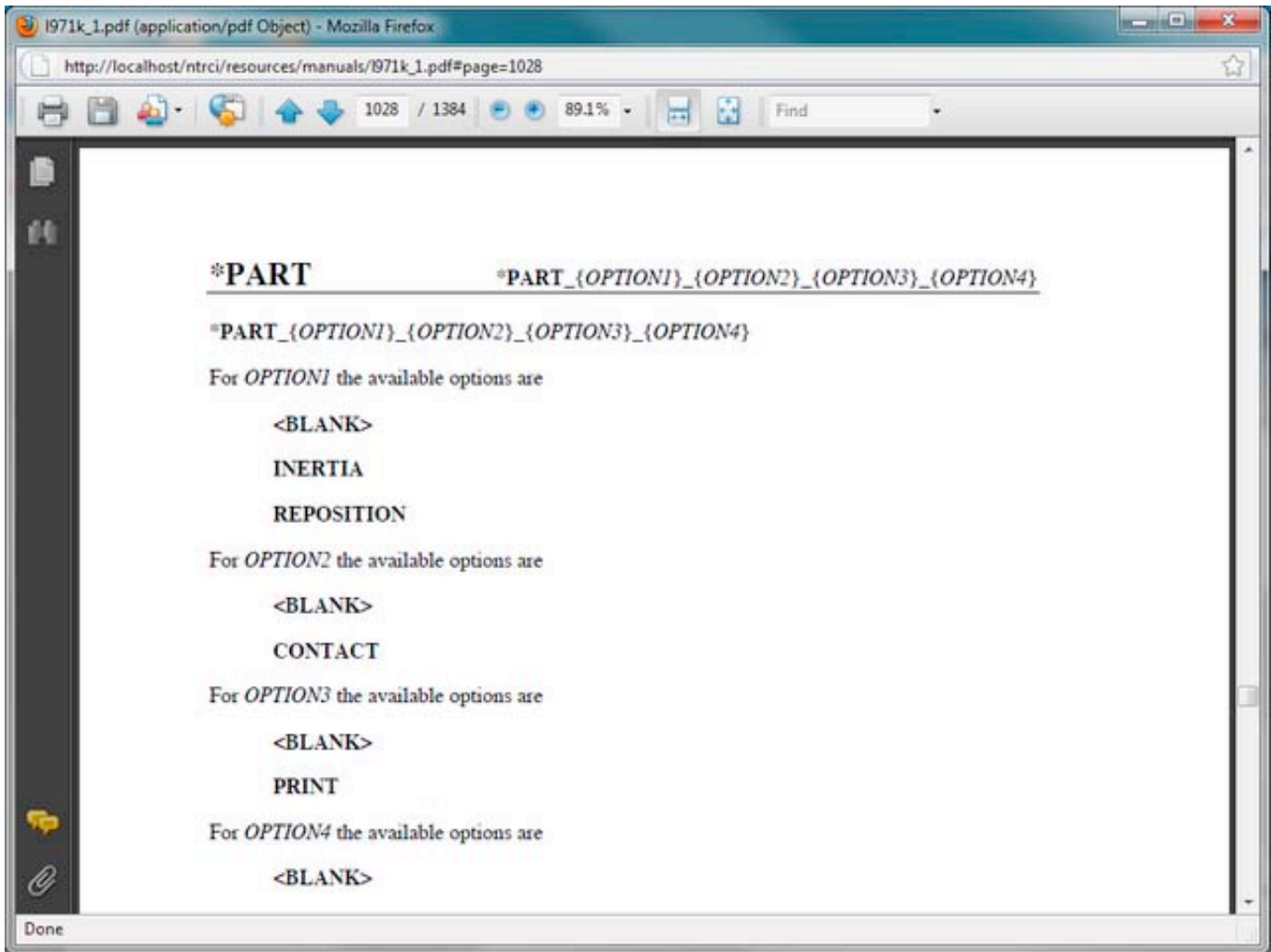


If you cannot see the 3D object above, click [here](#).

VRML

LS-DYNA 2014.1 USER'S MANUAL

Help from the LS-DYNA User's Manual can be reached through the Manual link. A popup window opens the manual at the specific keyword entry. A pdf reader is required for viewing.



### 3.3 Tractor-semitrailer web site help: Model/Section

The Section unit located in the drop line menu under the horizontal menu's Model tab offers data briefs from the SECTION LS-DYNA keyword. Data queries are conducted on the selected model. Current model selection is indicated in the page title with the name of the FEM model source file name. Model [selection](#) can be made through the Model's Selection tab.



The screenshot shows the website interface for "FEM Models for Semitrailer Trucks". The main title is "Element Formulations". The navigation menu includes "Home", "Model", "Simulation", "Test", "Download", "Help", and "About". The "Model" tab is active, and the "Section" sub-tab is selected. The page title is "Section: Tractor\_Sleeper\_v100308.k". A vertical navigation menu on the left lists element types: "all", "beam", "discrete", "shell", "solid", and "tshell". The "beam" type is currently selected. The main content area displays a table of beam sections with the following data:

Section ID	Type	Formulation	Shear Fact.	Quadrature	X-sec Type	#Parts
<input type="checkbox"/> 2000291	beam	1			1	4
<input type="checkbox"/> 2000296	beam	1			1	1
<input type="checkbox"/> 2000297	beam	1			1	1

Notes: Section (element) types can be selected from the menu above. Specific sections in each section type can be selected on the right.

The sections are conveniently grouped into smaller units according to their type. These units can be easily reached from the vertical navigation menu located at the left-hand side of the page. Current unit selection is highlighted in separate color.

Each section group is visually presented with images and an interactive 3D display, which are accessible through corresponding image links located side-by-side in the main page area below the title.

**Group images** The left-hand side image leads to a popup window showing images of all parts utilizing the selected section type. Images of the parts alone, and of their setting in the model are taken from different viewing angles. They can be navigated by clicking inside the image on its left-hand and right-hand side, by clicking on the Previous and Next links that appear on mouse over the image event, by pressing the P and L letters on the keyboard, or by pressing the left and right keyboard arrows. The image window can be dismissed by clicking anywhere outside the image area, by clicking the Close link, or by pressing the C letter on the keyboard.

**Group 3D View** the right-hand side image, distinguishable by its faded VRML stamped background, leads to a new popup window with an interactive 3D display of all parts utilizing the selected section type. This option requires a proper 3D plug-in to show the model chosen part group in its setting in the model. Plug-in dependent controls enable

Home Model Simulation Test Download Help About

Select Part **Section** Material Define Constrained Airbag Contact Set

all

beam

discrete

**shell**

solid

tshell

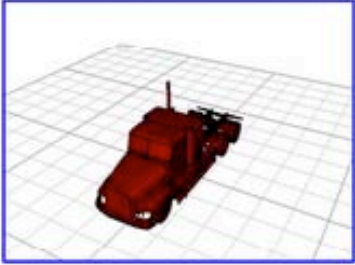

Notes:

Section (element) types can be selected from the menu above

Specific sections in each section type can be selected on the right

### Section: Tractor\_Sleeper\_v100308.k

This page contains information about finite element types used in a model.

### Shell

Section ID	Type	Formulation	Shear Fact	#Intgr Pts	Quadrature	Thick	#Parts
<input type="checkbox"/> <a href="#">2000001</a>	shell	16		5		2.3	1
<input type="checkbox"/> <a href="#">2000002</a>	shell	16		5		2	1
<input type="checkbox"/> <a href="#">2000003</a>	shell	16		5		3.556	1

Essential information about the finite element types used in the selected model is displayed in tabular format with each section filling one data row. The data is appropriately linked to related model content.

discrete

**shell**

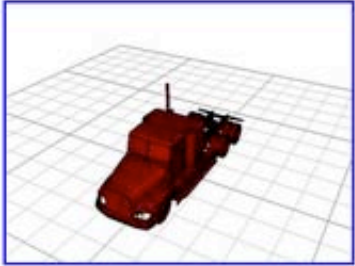

solid

tshell

Notes:

Section (element) types can be selected from the menu above

Specific sections in each section type can be selected on the right

### Shell

Section ID	Type	Formulation	Shear Fact	#Intgr Pts	Quadrature	Thick	#Parts
<input type="checkbox"/> <a href="#">2000001</a>	shell	16		5		2.3	1
<input type="checkbox"/> <a href="#">2000002</a>	shell	16		5		2	1
<input type="checkbox"/> <a href="#">2000003</a>	shell	16		5		3.556	1
<input type="checkbox"/> <a href="#">2000004</a>	shell	16		5		3.556	1
<input type="checkbox"/> <a href="#">2000005</a>	shell	16		5		2	1
<input type="checkbox"/> <a href="#">2000006</a>	shell	16		5		2	1

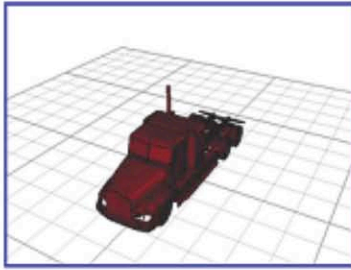
Section specifics can be reached by following the section identification number link, or by selecting the checkbox adjacent to the section identification number and then clicking on the Submit Query button located below the table(s). The latter approach is convenient for

shell
solid
tshell

**Notes:**

Section (element) types can be selected from the menu above

Specific sections in each section type can be selected on the right



**Shell**


Section ID	Type	Formulation	Shear Fact	#Intgr Pts	Quadrature	Thick	#Parts
<input type="checkbox"/> 2000001	shell	16		5		2.3	1
<input type="checkbox"/> 2000002	shell	16		5		2	1
<input type="checkbox"/> 2000003	shell	16		5		3.556	1
<input checked="" type="checkbox"/> 2000004	shell	16		5		3.556	1
<input type="checkbox"/> 2000005	shell	16		5		2	1
<input type="checkbox"/> 2000006	shell	16		5		2	1
<input type="checkbox"/> 2000007	shell	16		5		2	1

<input type="checkbox"/> 2200031	shell	16		5		14.5	1
<input checked="" type="checkbox"/> 2200032	shell	16		5		13.13	1
<input type="checkbox"/> 2200033	shell	16		5		11.14	1
<input checked="" type="checkbox"/> 2200034	shell	16		5		10.22	1
<input type="checkbox"/> 2200035	shell	16		5		10.41	1
<input type="checkbox"/> 2200061	shell	16		5		9	1
<input checked="" type="checkbox"/> 2200064	shell	16		5		20	1
<input type="checkbox"/> 2200071	shell	16		3		4	1

Submit Query

In section specifics the essential data for the chosen section(s) is accompanied with access to:

- Excerpt from the FEM model source file ([Input Lines](#)),
- Numerous [images](#) (standalone and in setting) of all parts featuring the chosen section,
- Interactive [3D View](#) of all parts featuring the chosen section, and
- LS-DYNA's User's [Manual](#) displaying the chosen keyword entry.



## FEM Models for Semitrailer Trucks

### Element Formulations

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Constrained
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---

### Section: Tractor\_Sleeper\_v100308.k


This page contains information about finite element types used in a model.

### Section ID: 2000004

Section ID	Type	Formulation	Shear Fact	#Intgr Pts	Quadrature	Thick	#Parts
<input type="checkbox"/> 2000004	shell	16		5		3.556	1

Input Lines	Images	3D View	Manual
<a href="#">403-407</a>	<a href="#">11</a>	<a href="#">1</a>	<a href="#">1971k_1.pdf</a>

**Notes:**  
 Section (element) types can be selected from the menu above  
 Specific sections in each section type can be selected on the right



## Input File

### Input File: Tractor\_Sleeper\_v100308.k

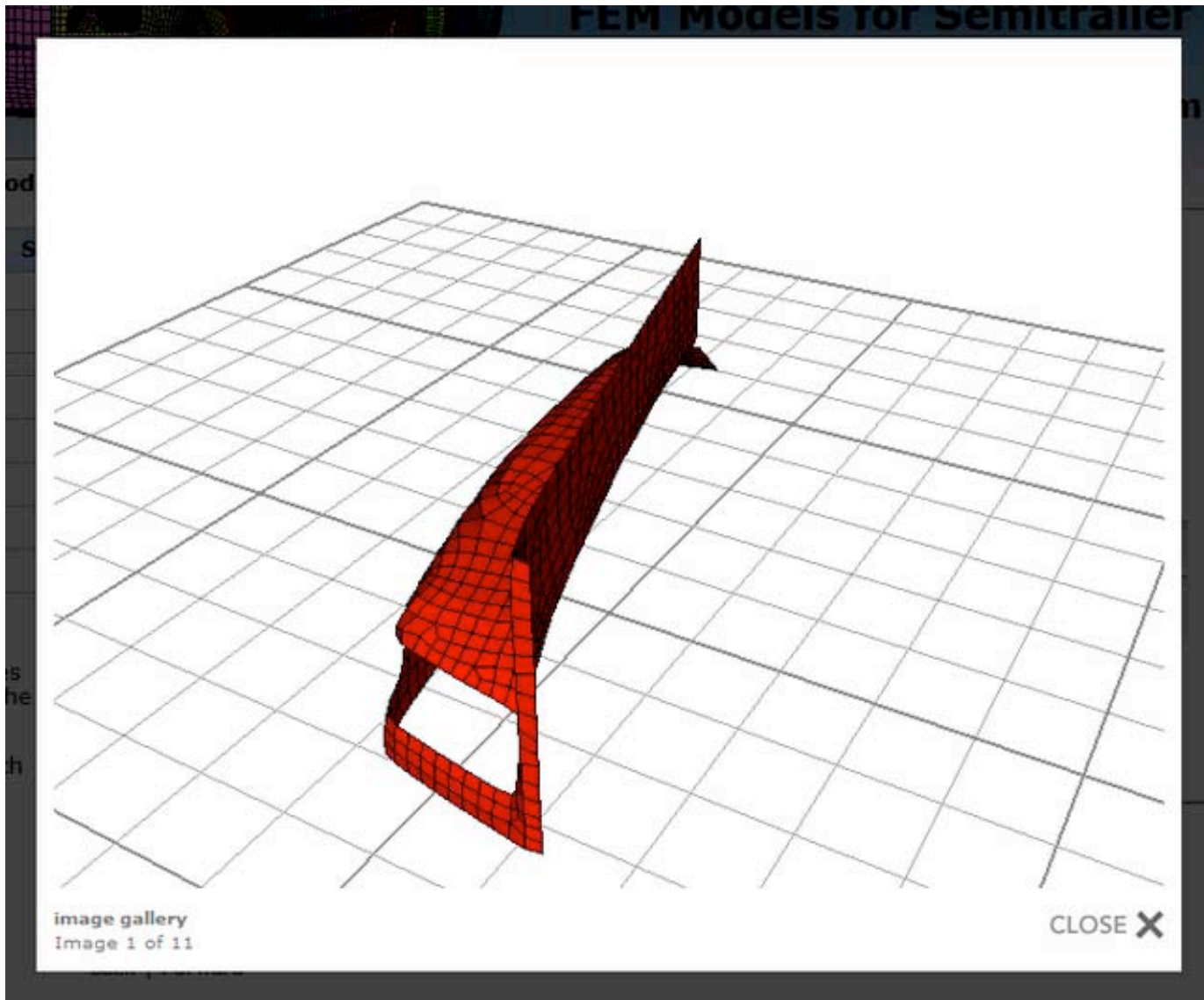
Line Number	Line Content
403	*SECTION_SHELL
404	\$\$ secid elform shrf nip propt qr/irid icomp setyp
405	2000004 16 0.000 5
406	\$\$ t1 t2 t3 t4 nloc marea idof edgset
407	3.556000 3.556000 3.556000 3.556000

Excerpt from the FEM model source file containing the chosen section entry is accessible through the Input Lines link. A popup window shows the chosen section entry conveniently numbered such that numbers correspond to the FEM model source file lines.

Numerous images of the parts featuring the chosen section can be viewed through the Images link. A popup window shows images of the parts alone, and of the parts setting in the model



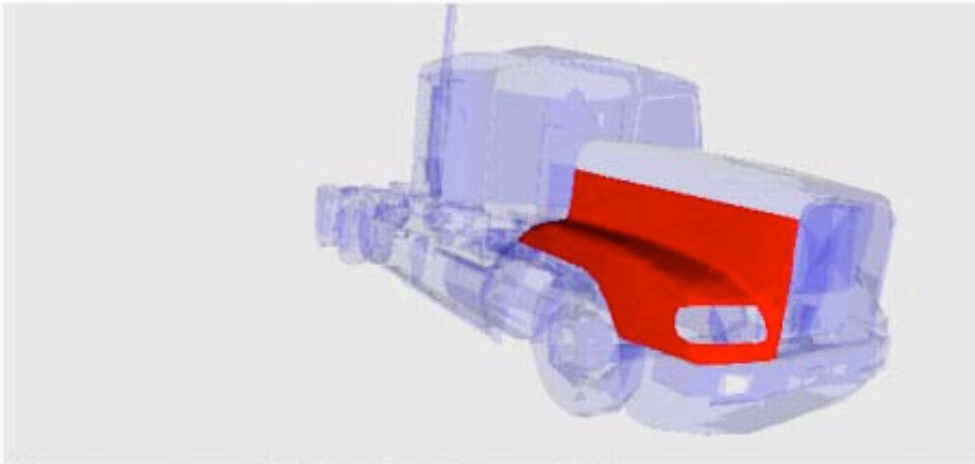
Images can be navigated by clicking inside the image on its left-hand and right-hand side, by clicking on the Previous and Next links that appear on mouse over the image event, by pressing the P and L letters on the keyboard, or by pressing the left and right keyboard arrows. The image window can be dismissed by clicking anywhere outside the image area, by clicking the Close link, or by pressing the C letter on the keyboard.



Interactive 3D display of the parts featuring the chosen section is accessible through the 3D View link. This requires a proper 3D plug-in to show the parts in their setting in a new popup window. Plug-independent controls enable model interactivity (rotation, zoom, pan, etc.)



## VRML Model



If you cannot see the 3D object above, click [here](#).

VRML

LS-DYNA USER'S MANUAL

Help from the LS-DYNA User's Manual can be reached through the Manual link. A popup window opens the manual at the specific keyword entry. A pdf reader is required for viewing.

I971k\_1.pdf (application/pdf Object) - Mozilla Firefox

http://localhost/ntrci/resources/manuals/I971k\_1.pdf#page=1112

1112 / 1384 89.1% Find

---

**\*SECTION** **\*SECTION\_SHELL**

**\*SECTION\_SHELL\_{OPTION}**

Available options include:

- <BLANK>
- ALE
- EFG

such that the keyword cards appear:

- \*SECTION\_SHELL
- \*SECTION\_SHELL\_ALE
- \*SECTION\_SHELL\_EFG

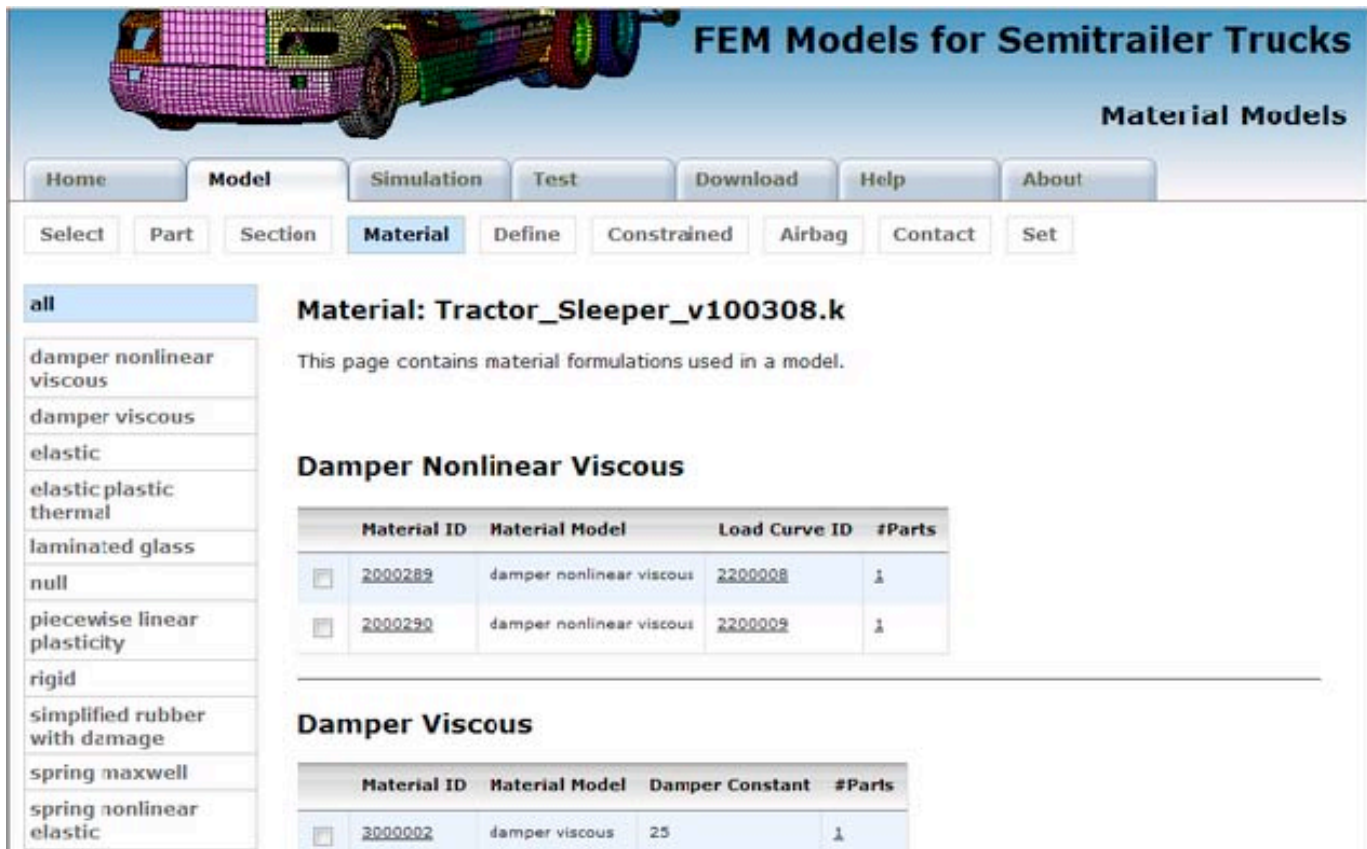
Purpose: Define section properties for shell elements.

Card 1	1	2	3	4	5	6	7	8
Variable	SECID	ELFORM	SHRF	NIP	PROPT	QR/IRID	ICOMP	SETYP

Done

### 3.4 Tractor-semitrailer web site help: Model/Material

The Material unit located in the drop line menu under the horizontal menu's Model tab offers data briefs from the MAT LS-DYNA keyword. Data queries are conducted on the selected model. Current model selection is indicated in the page title with the name of the FEM model source file name. Model [selection](#) can be made through the Model's Selection tab.



**FEM Models for Semitrailer Trucks**

**Material Models**

Home Model Simulation Test Download Help About

Select Part Section **Material** Define Constrained Airbag Contact Set

**all**

- damper nonlinear viscous
- damper viscous
- elastic
- elastic plastic
- thermal
- laminated glass
- null
- piecewise linear plasticity
- rigid
- simplified rubber with damage
- spring maxwell
- spring nonlinear elastic

**Material: Tractor\_Sleeper\_v100308.k**

This page contains material formulations used in a model.

**Damper Nonlinear Viscous**

Material ID	Material Model	Load Curve ID	#Parts
<input type="checkbox"/> 2000289	damper nonlinear viscous	2200008	1
<input type="checkbox"/> 2000290	damper nonlinear viscous	2200009	1

**Damper Viscous**

Material ID	Material Model	Damper Constant	#Parts
<input type="checkbox"/> 3000002	damper viscous	25	1

The materials are conveniently grouped into smaller units according to their type. These units can be easily reached from the vertical navigation menu located at the left-hand side of the page. Current unit selection is highlighted in separate color.

Each material group is visually presented with images and an interactive 3D display, which are accessible through corresponding image links located side-by-side in the main page area below the title.

#### Group images

The left-hand side image leads to a popup window showing images of all parts utilizing the selected material type. Images of the parts alone, and of their setting in the model are taken from different viewing angles. They can be navigated by clicking inside the image on its left-hand and right-hand side, by clicking on the Previous and Next links that appear on mouse over the image event, by pressing the P and L letters on the keyboard, or by pressing the left and right keyboard arrows. The image window can be dismissed by clicking anywhere outside the image area, by clicking the Close link, or by pressing the C letter on the keyboard.

#### Group 3D View

The right-hand side image, distinguishable by its faded VRML stamped background, leads to a new popup window with an interactive 3D display of all parts utilizing the selected material type. This

Option requires a proper 3D plug-in to show the model chosen part group in its setting in the model. Plug-in dependent controls enable model interactivity (rotation, zoom, pan, etc.).

Essential information about the material formulations used in the selected model is displayed in tabular format with each material filling one data row. The data is appropriately linked to related model content.

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Contact
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all

damper nonlinear viscous

damper viscous

elastic

elastic plastic

thermal

laminated glass

null

piecewise linear plasticity

rigid

simplified rubber with damage

spring maxwell

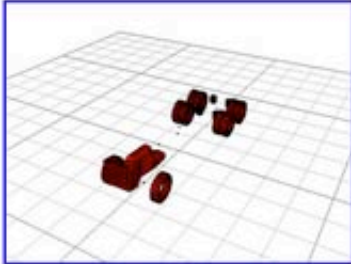
spring nonlinear elastic

Notes:

Material types can be selected from the menu above

### Material: Tractor\_Sleeper\_v100308.k

This page contains material formulations used in a model.




### Elastic

Material ID	Material Model	Density	E	v	#Parts
<input type="checkbox"/> <a href="#">2000023</a>	elastic	3.89e-09	2461	0.323	1
<input type="checkbox"/> <a href="#">2000024</a>	elastic	3.89e-09	2461	0.323	1
<input type="checkbox"/> <a href="#">2000032</a>	elastic	3.89e-09	2461	0.323	1

damper viscous

**elastic**

elastic plastic  
thermal

laminated glass

null

piecewise linear  
plasticity

rigid

simplified rubber  
with damage

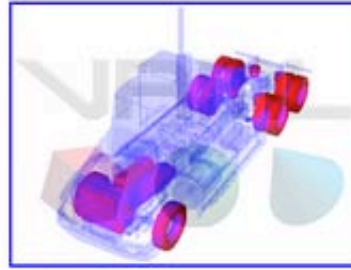
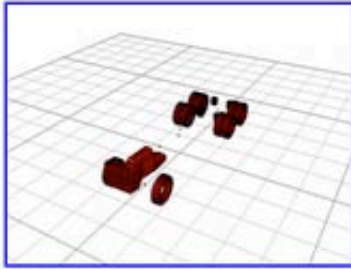
spring maxwell

spring nonlinear  
elastic

Notes:

Material types can be selected from the menu above

Specific materials can be selected on the right



### Elastic

	Material ID	Material Model	Density	E	v	#Parts
<input type="checkbox"/>	<a href="#">2000023</a>	elastic	3.89e-09	2461	0.323	1
<input type="checkbox"/>	<a href="#">2000024</a>	elastic	3.89e-09	2461	0.323	1
<input type="checkbox"/>	<a href="#">2000032</a>	elastic	3.89e-09	2461	0.323	1
<input type="checkbox"/>	<a href="#">2000051</a>	elastic	3.89e-09	2461	0.323	1
<input type="checkbox"/>	<a href="#">2000052</a>	elastic	3.89e-09	2461	0.323	1
<input type="checkbox"/>	<a href="#">2000057</a>	elastic	3.89e-09	2461	0.323	1
<input type="checkbox"/>	<a href="#">2000072</a>	elastic	3.89e-09	2461	0.323	1
<input type="checkbox"/>	<a href="#">2000083</a>	elastic	3.89e-09	2461	0.323	1

Material specifics can be reached by following the material identification number link, or by selecting the checkbox adjacent to the material identification number and then clicking on the Submit Query button located below the table(s). The latter approach is convenient for simultaneous selection of several materials.

damper viscous

**elastic**

elastic plastic  
thermal

laminated glass

null

piecewise linear  
plasticity

rigid

simplified rubber  
with damage

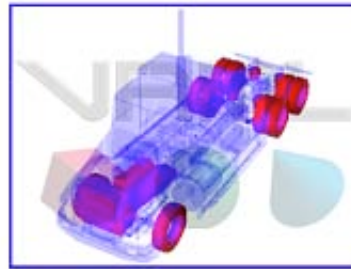
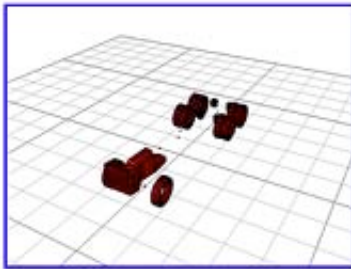
spring maxwell

spring nonlinear  
elastic

Notes:

Material types can be selected from the menu above

Specific materials can be selected on the right



### Elastic

	Material ID	Material Model	Density	E	v	#Parts
<input type="checkbox"/>	<a href="#">2000023</a>	elastic	3.89e-09	2461	0.323	1
<input type="checkbox"/>	<a href="#">2000024</a>	elastic	3.89e-09	2461	0.323	1
<input checked="" type="checkbox"/>	<a href="#">2000032</a>	elastic	3.89e-09	2461	0.323	1
<input type="checkbox"/>	<a href="#">20000</a> <a href="#">2000032</a>	elastic	3.89e-09	2461	0.323	1
<input type="checkbox"/>	<a href="#">2000052</a>	elastic	3.89e-09	2461	0.323	1

<input type="checkbox"/>	2000277	elastic	3.9e-09	200000	0.3	1
<input checked="" type="checkbox"/>	2000278	elastic	1.5e-09	200000	0.3	1
<input checked="" type="checkbox"/>	2000340	elastic	1.52e-09	50	0.45	1
<input type="checkbox"/>	2000366	elastic	5e-09	1000	0.3	1
<input checked="" type="checkbox"/>	2000368	elastic	1.5e-08	21000	0.3	2
<input type="checkbox"/>	2000392	elastic	2.52e-09	69000	0.4	2

Submit Query

In material specifics the essential data for the chosen material(s) is accompanied with access to:

Excerpt from the FEM model source file ([Input Lines](#)),  
 Numerous [images](#) (standalone and in setting) of all parts featuring the chosen material,  
 Interactive [3D View](#) of all parts featuring the chosen material, and  
 LS-DYNA's User's [Manual](#) displaying the chosen keyword entry.

**FEM Models for Semitrailer Trucks**  
**Material Models**

Home Model Simulation Test Download Help About

Select Part Section **Material** Define Constrained Airbag Contact Set

all

damper nonlinear  
viscous

damper viscous

elastic

elastic plastic  
thermal

laminated glass

null

piecewise linear  
plasticity

rigid

simplified rubber  
with damage

**Material: Tractor\_Sleeper\_v100308.k**

This page contains material formulations used in a model.

**Material ID: 2000032**

Material ID	Material Model	Density	E	v	#Parts
<input type="checkbox"/> 2000032	elastic	3.89e-09	2461	0.323	1

Input Lines	Images	3D View	Manual
925-927	11	1	1971k_2.pdf

Submit Query

Excerpt from the FEM model source file containing the chosen material entry is accessible through the Input Lines link. A popup window shows the chosen material entry conveniently numbered such that numbers correspond to the FEM model source file lines.

## Input File

### Input File: Tractor\_Sleeper\_v100308.k

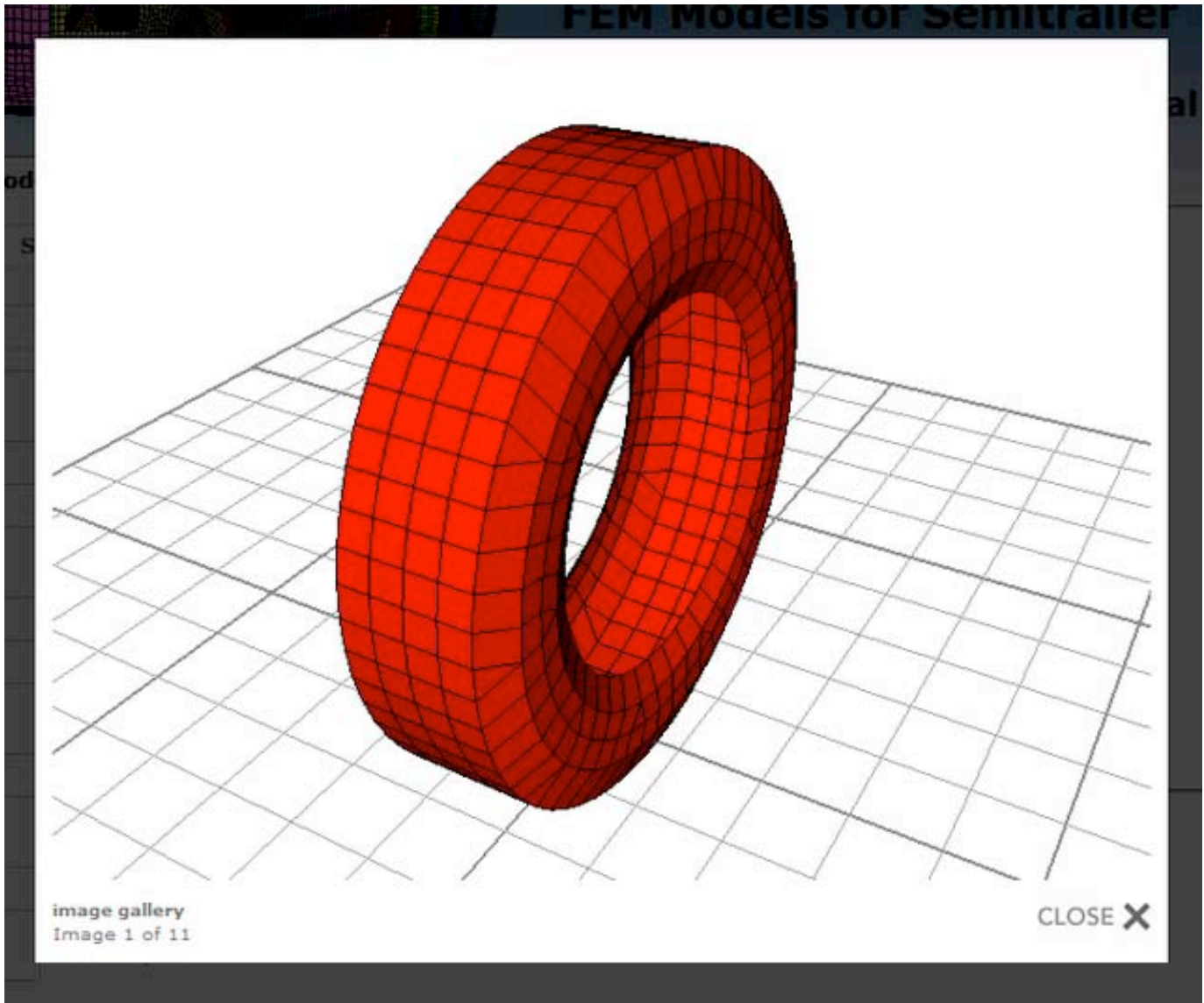
Line Number	Line Content
925	*MAT_ELASTIC
926	\$# mid ro e pr da dk not used
927	2000032 3.8900E-9 2461.0000 0.323000

Input File

Numerous images of the parts featuring the chosen material can be viewed through the Images link. A popup window shows images of the parts alone, and of the parts setting in the model taken from different viewing angles.

Images can be navigated by clicking inside the image on its left-hand and right-hand side, by clicking on the Previous and Next links that appear on mouse over the image event, by pressing the P and L letters on the keyboard, or by pressing the left and right keyboard arrows. The image window can be dismissed by clicking anywhere outside the image area, by clicking the Close link, or by pressing the C letter on the keyboard.

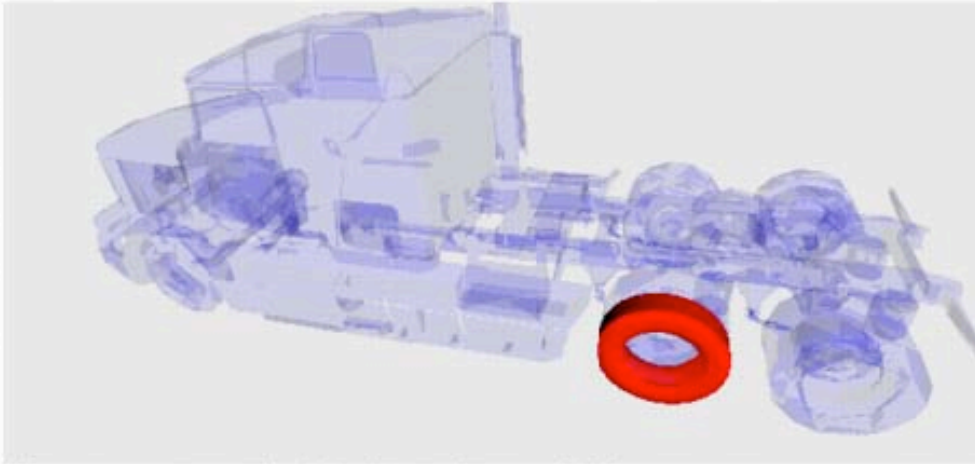




Interactive 3D display of the parts featuring the chosen material is accessible through the 3D View link. This option requires a proper 3D plug-in to show the parts in their setting in a new popup window. Plug-independent controls enable model interactivity (rotation, zoom, pan, etc.).



## VRML Model



If you cannot see the 3D object above, click [here](#).

VRML

LS-DYNA 4.11.0 (2011/01/11)

Help from the LS-DYNA User's Manual can be reached through the Manual link. A popup window opens the manual at the specific keyword entry. A pdf reader is required for viewing.

I971k\_2.pdf (application/pdf Object) - Mozilla Firefox  
 http://localhost/ntrci/resources/manuals/I971k\_2.pdf#page=34

34 / 822 89.1% Find

---

**\*MAT\_001** **MAT\_ELASTIC**

**\*MAT\_ELASTIC\_{OPTION}**

This is Material Type 1. This is an isotropic elastic material and is available for beam, shell, and solid elements in LS-DYNA. A specialization of this material allows the modeling of fluids.

Available options include:

**<BLANK>**

**FLUID**

such that the keyword cards appear:

**\*MAT\_ELASTIC or MAT\_001**

**\*MAT\_ELASTIC\_FLUID or MAT\_001\_FLUID**

The fluid option is valid for solid elements only.

Define the following card for all options:

Card	1	2	3	4	5	6	7	8
Variable	MID	RO	E	PR	DA	DB	K	

Done

### 3.5 Tractor-semitrailer web site help: Model/Define

The Defined unit located in the drop line menu under the horizontal menu's Model tab offers data briefs from the DEFINE LS-DYNA keyword. Data queries are conducted on the selected model. Current model selection is indicated in the page title with the name of the FEM model source file name. Model [selection](#) can be made through the Model's Selection tab.

**FEM Models for Semitrailer Trucks**  
Curves and Tables

Home Model Simulation Test Download Help About

Select Part Section Material **Define** Constrained Airbag Contact Set

**all**  
curve  
table

**Define: Tractor\_Sleeper\_v100308.k**

This page contains definitions of curves and tables used in the model.

**Curve**

Notes:  
Definition types can be selected from the menu above  
Specific curves and tables can be selected on the right

	Curve ID	SIDR	Scale X	Scale Y	Offset X	Offset Y	Data Type
<input type="checkbox"/>	<a href="#">2000001</a>		1	1			
<input type="checkbox"/>	<a href="#">2000002</a>		1	1			
<input type="checkbox"/>	<a href="#">2000003</a>		1	1			

Definition entries are grouped into curves and tables. Each group can be easily reached from the vertical navigation menu located at the left-hand side of the page. Current selection is highlighted in separate color.

Essential information about curve and table definitions used in the selected model is displayed in tabular format with each definition filling one data row. The data is appropriately linked to related model content.



# FEM Models for Semitrailer Trucks

## Curves and Tables

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Section

Material

Define

Constrained

Airbag

Contact

Set

all

curve

table

### Define: Tractor\_Sleeper\_v100308.k

This page contains definitions of curves and tables used in the model.

#### Curve

##### Notes:

Definition types can be selected from the menu above

Specific curves and tables can be selected on the right

	Curve ID	SIDR	Scale X	Scale Y	Offset X	Offset Y	Data Type
<input type="checkbox"/>	<a href="#">2000001</a>		1	1			
<input type="checkbox"/>	<a href="#">2000002</a>		1	1			
<input type="checkbox"/>	<a href="#">2000003</a>		1	1			

Definition specifics can be reached by following the identification number link, or by selecting the checkbox adjacent to the identification number and then clicking on the Submit Query button located below the table(s). The latter approach is convenient for simultaneous selection of several definitions.

Home Model Simulation Test Download Help About

Select Part Section Material Define Constrained Airbag Contact Set

all

**Define: Tractor\_Sleeper\_v100308.k**

This page contains definitions of curves and tables used in the model.

**Curve**

Notes:  
 Definition types can be selected from the menu above  
 Specific curves and tables can be selected on the right

Curve ID	SIDR	Scale X	Scale Y	Offset X	Offset Y	Data Type
<input type="checkbox"/> 2000001		1	1			
<input type="checkbox"/> 2000002		1	1			
<input type="checkbox"/> 2000003		1	1			
<input type="checkbox"/> 2000005		1	1			
<input checked="" type="checkbox"/> 2000265						
<input type="checkbox"/> 2000266						
<input type="checkbox"/> 2000267						
<input type="checkbox"/> 2300009		1	1			
<input type="checkbox"/> 2300010		1	1			
<input type="checkbox"/> 3000001		1	0.75244			
<input type="checkbox"/> 3000002						

Table ID	Curve ID List
<input checked="" type="checkbox"/> 2000264	2000265 2000266 2000267 2000268
<input checked="" type="checkbox"/> 2100001	2100002 2100003 2100004 2100005
<input type="checkbox"/> 2200001	2200002 2200003 2200004 2200005

Submit Query

In definition specifics the essential data for the chosen definition(s) is accompanied with

- Tabular presentation of definition entries ([Table](#)), and access to :
- Excerpt from the FEM model source file ([Input Lines](#)),
- Graphical presentation of the data ([Graph](#)),

Home Model Simulation Test Download Help About

Select Part Section Material Define Constrained Airbag Contact Set

all

curve

table

Notes:

Definition types can be selected from the menu above

Specific curves and tables can be selected on the right

### Define: Tractor\_Sleeper\_v100308.k

This page contains definitions of curves and tables used in the model.

#### Curve ID: 2000265

Curve ID	SIDR	Scale X	Scale Y	Offset X	Offset Y	Data Type
<input type="checkbox"/> 2000265						

Abscissa	Ordinate
0	385
0.024	420
0.05	458
0.1	499
0.14	518.5999756
0.5	550

Input Lines	Graph	Manual
<a href="#">7471-7480</a>	<a href="#">2000265</a>	<a href="#">1971k_1.pdf</a>

LS-DYNA's User's [Manual](#) displaying the chosen keyword entry.

Appropriate entries from the LS-DYNA DEFINE keyword are listed in tabular format:

**Curve definition:** the table contains abscissa and ordinate values defining the curve,  
**Table definition:** each table row is composed of a value and its matching curve.

## Define: Tractor\_Sleeper\_v100308.k

This page contains definitions of curves and tables used in the model.

### Curve ID: 2000265

Curve ID	SIDR	Scale X	Scale Y	Offset X	Offset Y	Data Type
<input type="checkbox"/> <a href="#">2000265</a>						

Abscissa	Ordinate
0	385
0.024	420
0.05	458
0.1	499
0.14	518.5999756
0.5	550

Input Lines	Graph	Manual
<a href="#">7471-7480</a>	<a href="#">2000265</a>	<a href="#">l971k_1.pdf</a>

---



## Define: Tractor\_Sleeper\_v100308.k

This page contains definitions of curves and tables used in the model.

### Table ID: 2000264

Table ID	Curve ID List
<input type="checkbox"/> <a href="#">2000264</a>	<a href="#">2000265</a> <a href="#">2000266</a> <a href="#">2000267</a> <a href="#">2000268</a>

Value	Curve ID
0.001	<a href="#">2000265</a>
0.1	<a href="#">2000266</a>
50	<a href="#">2000267</a>
4000	<a href="#">2000268</a>

Input Lines	Graph	Manual
<a href="#">7463-7470</a>	<a href="#">2000264</a>	<a href="#">l971k_1.pdf</a>

---

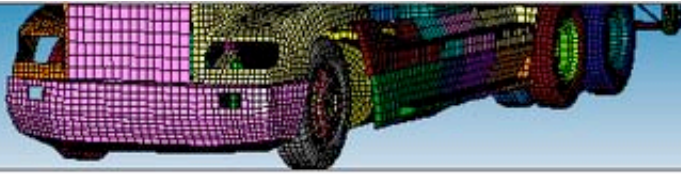
Excerpt from the FEM model source file containing the chosen definition entry is accessible through the Input Lines link. A popup window shows the chosen definition entry conveniently numbered such that numbers correspond to the FEM model source file lines.



# Input File

## Input File: Tractor\_Sleeper\_v100308.k

Line Number	Line Content
7471	*DEFINE_CURVE
7472	\$# lcld sidr sfa sfo offa offo dattyp
7473	2000265
7474	\$# a1 o1
7475	0.000 385.0000000
7476	0.0240000 420.0000000
7477	0.0500000 458.0000000
7478	0.1000000 499.0000000
7479	0.1400000 518.5999756
7480	0.5000000 550.0000000



## Input File

### Input File: Tractor\_Sleeper\_v100308.k

Line Number	Line Content
7463	*DEFINE_TABLE
7464	\$#    tbid
7465	2000264
7466	\$#                   value    loid
7467	0.0010000   2000265
7468	0.1000000   2000266
7469	50.0000000   2000267
7470	4000.0000000  2000268

Input File

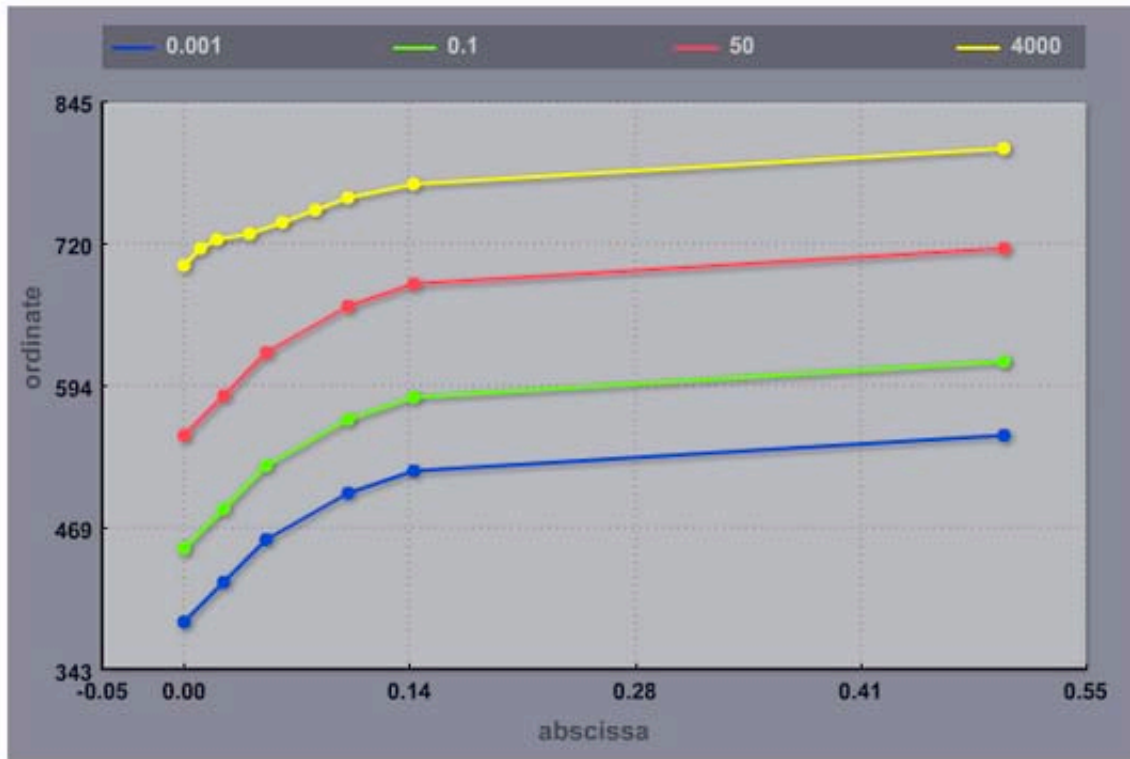
FILE | EDIT | COMMANDS | INPUT | OUTPUT

Graphical representation of a single curve or a set of curves grouped into a table definition can be reached through the Graph link. The graph appears in a popup window.





# Graph



Graph

LS-DYNA USER'S MANUAL

Help from the LS-DYNA User's Manual can be reached through the Manual link. A popup window opens the manual at the specific keyword entry. A pdf reader is required for viewing.

I971k\_1.pdf (application/pdf Object) - Mozilla Firefox  
http://localhost/ntrci/resources/manuals/I971k\_1.pdf#page=674

674 / 1384 89.1% Find

---

**\*DEFINE** **\*DEFINE\_CURVE**

---

**\*DEFINE\_CURVE\_{OPTION}**

Purpose: Define a curve [for example, load (ordinate value) versus time (abscissa value)], often referred to as a load curve.

Curves are discretized internally with equal intervals along the abscissa for fast evaluation in constitutive models. Discretized curves are not used for evaluating loading conditions. Also, see remark 1 below. To improve the accuracy of the discretized curves in later releases of version 970 changes were made in the discretization process. These changes had the unexpected effect of changing the results generated with validated models such as barriers and occupants. Consequently, *OPTION* was added to make available the old discretization if needed for the validated models.

Available options include:

- <OPTION>**
- 3858**
- 5434a**

which correspond to the first releases of version 970 and the 2005 release, respectively.

Since input errors and wrong results are sometimes related to load curve usage, a "Load curve usage" table is printed in the D3HSP file after all the input is read. This table should be checked to insure that each curve ID is referenced by the option for which the curve is intended.

Card 1      1      2      3      4      5      6      7      8

Done

### 3.6 Tractor-semitrailer web site help: Model/Constrained

The Constrained unit located in the drop line menu under the horizontal menu's Model tab offers data briefs from the CONSTRAINED LS-DYNA keyword. Data queries are conducted on the selected model. Current model selection is indicated in the page title with the name of the FEM model source file name. Model selection can be made through the Model's Selection tab.

The constraints are conveniently grouped into smaller units according to their type. These units can be easily reached from the vertical navigation menu located at the left-hand side of the page. Current unit selection is highlighted in separate color.

**FEM Models for Semitrailer Trucks**  
Model Constraints

Home Model Simulation Test Download Help About

Select Part Section Material Define **Constrained** Airbag Contact Set

**all**

extra nodes set  
generalized weld spot  
joint revolute  
joint spherical  
nodal rigid body  
spotweld

Notes:  
Types of constraints can be selected from the menu above  
Specific constraints can be selected on the right

**Constrained: Tractor\_Sleeper\_v100308.k**  
This page contains definition of constraints in a model.

**Extra Nodes Set**

ID	Constraint Type	Part ID	Node ID
<input type="checkbox"/> <a href="#">cns_1</a>	extra nodes set	<a href="#">2000250</a>	2001034
<input type="checkbox"/> <a href="#">cns_2</a>	extra nodes set	<a href="#">2000230</a>	2001035
<input type="checkbox"/> <a href="#">cns_3</a>	extra nodes set	<a href="#">2000232</a>	2001036
<input type="checkbox"/> <a href="#">cns_4</a>	extra nodes set	<a href="#">2000229</a>	2001037
<input type="checkbox"/> <a href="#">cns_5</a>	extra nodes set	<a href="#">2000051</a>	2001038

**generalized weld spot**

joint revolute  
joint spherical  
nodal rigid body  
spotweld

Notes:  
Types of constraints can be selected from the menu above  
Specific constraints can be selected on the right

**Generalized Weld Spot**

ID	Type	Node Set ID	t <sub>f</sub>	cP <sub>fail</sub>	S <sub>n</sub>	S <sub>s</sub>
<input type="checkbox"/> <a href="#">cns_44</a>	generalized weld spot	<a href="#">2001012</a>			263040	131520
<input type="checkbox"/> <a href="#">cns_45</a>	generalized weld spot	<a href="#">2001013</a>			263040	131520
<input type="checkbox"/> <a href="#">cns_46</a>	generalized weld spot	<a href="#">2001014</a>			324740	162370
<input type="checkbox"/> <a href="#">cns_47</a>	generalized weld spot	<a href="#">2001015</a>			324740	162370
<input type="checkbox"/> <a href="#">cns_48</a>	generalized weld spot	<a href="#">2001016</a>			324740	162370
<input type="checkbox"/> <a href="#">cns_49</a>	generalized weld spot	<a href="#">2001017</a>			324740	162370

Essential information about the constraints used in the selected model is displayed in tabular format with each constraint filling one data row. The data is appropriately linked to related model content.

selecting the checkbox adjacent to the constraint identification number and then clicking on the Submit Query button located below the table(s). The latter approach is convenient for simultaneous selection of several constraints.

generalized weld spot

joint revolute

joint spherical

nodal rigid body

spotweld

Notes:

Types of constraints can be selected from the menu above

Specific constraints can be selected on the right

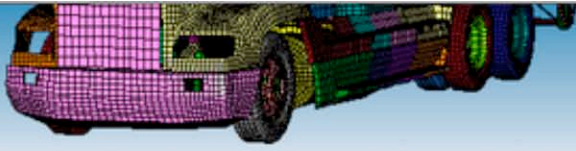
### Generalized Weld Spot

ID	Type	Node Set ID	$t_f$	$\epsilon_{fail}$	$S_n$	$S_s$
<input type="checkbox"/> <a href="#">cns_44</a>	generalized weld spot	<a href="#">2001012</a>			263040	131520
<input type="checkbox"/> <a href="#">cns_45</a>	generalized weld spot	<a href="#">2001013</a>			263040	131520
<input type="checkbox"/> <a href="#">cns_46</a>	generalized weld spot	<a href="#">2001014</a>			324740	162370
<input checked="" type="checkbox"/> <a href="#">cns_47</a>	generalized weld spot	<a href="#">2001015</a>			324740	162370
<input type="checkbox"/> <a href="#">cns_47</a>	generalized weld spot	<a href="#">2001016</a>			324740	162370
<input type="checkbox"/> <a href="#">cns_49</a>	generalized weld spot	<a href="#">2001017</a>			324740	162370
<input type="checkbox"/> <a href="#">cns_50</a>	generalized weld spot	<a href="#">2001018</a>			234630	117310
<input checked="" type="checkbox"/> <a href="#">cns_65</a>	generalized weld spot	<a href="#">2100020</a>	1e+20			
<input type="checkbox"/> <a href="#">cns_67</a>	generalized weld spot	<a href="#">2100021</a>	1e+20			
<input type="checkbox"/> <a href="#">cns_68</a>	generalized weld spot	<a href="#">2100022</a>	1e+20			
<input checked="" type="checkbox"/> <a href="#">cns_69</a>	generalized weld spot	<a href="#">2100023</a>	1e+20			
<input checked="" type="checkbox"/> <a href="#">cns_70</a>	generalized weld spot	<a href="#">2100024</a>	1e+20			

In constraint specifics the essential data for the chosen constraint(s) is accompanied with access to:

Excerpt from the FEM model source file ([Input Lines](#)), LS-DYNA's User's [Manual](#) displaying the chosen keyword entry.





## FEM Models for Semitrailer Trucks

### Model Constraints

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Part
Section
Material
Define
Constrained
Airbag
Contact
Set

- extra nodes set
- generalized weld spot
- joint revolute
- joint spherical
- nodal rigid body
- spotweld

Notes:

Types of constraints can be selected from the menu above

Specific constraints can be selected on the right

### Constrained: Tractor\_Sleeper\_v100308.k

This page contains definition of constraints in a model.

#### Constrained ID: cns\_47


ID	Type	Node Set ID	t <sub>f</sub>	ε <sub>Pfail</sub>	S <sub>n</sub>	S <sub>s</sub>
<input type="checkbox"/> cns_47	generalized weld spot	2001015			324740	162370

Input Lines

Manual

[13462-13464](#)
[1971k\\_1.pdf](#)

Excerpt from the FEM model source file containing the chosen constraint entry is accessible through the Input Lines link. A popup window shows the chosen constraint entry conveniently numbered such that numbers correspond to the FEM model source file lines.

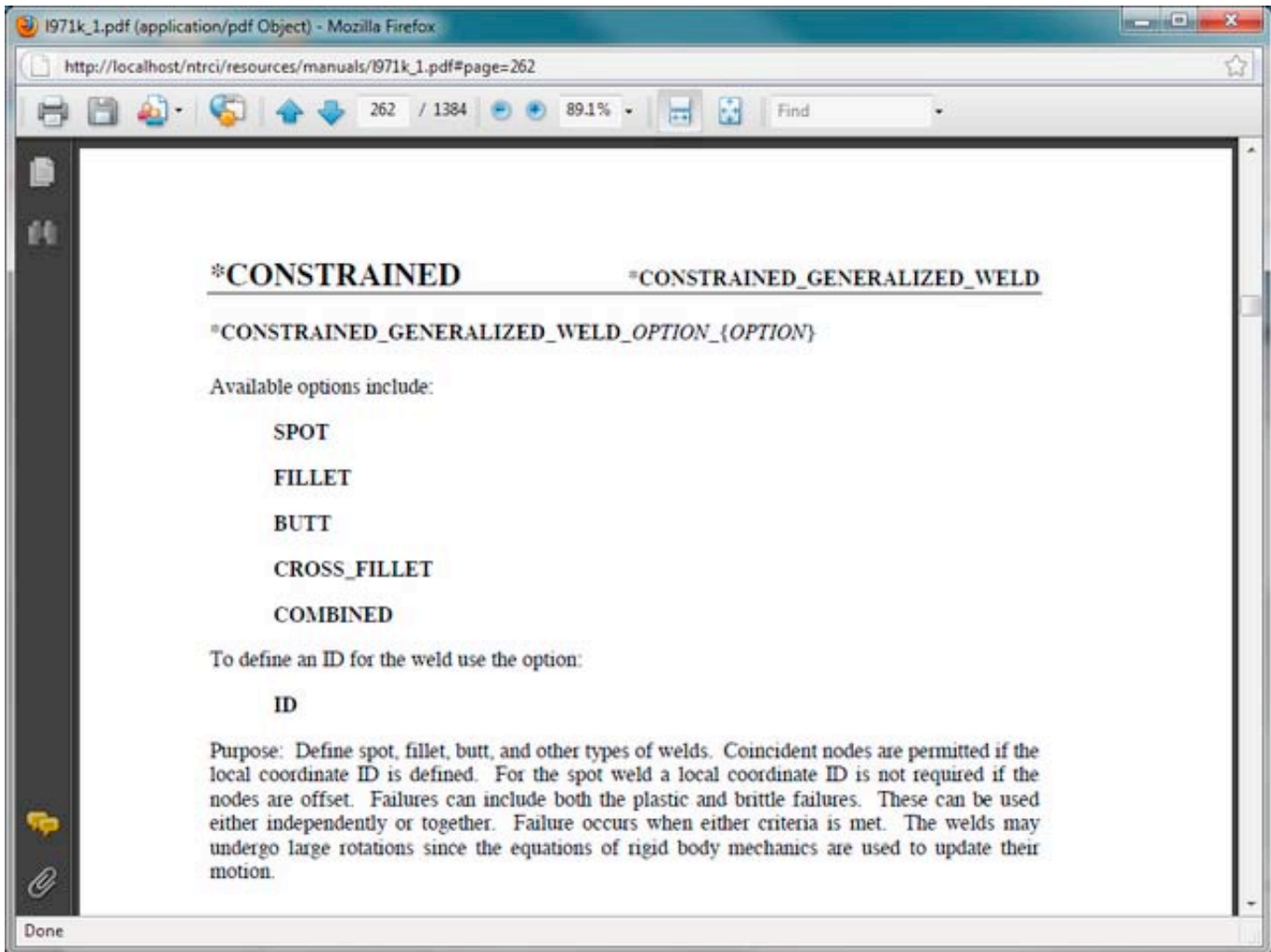


## Input File

### Input File: Tractor\_Sleeper\_v100308.k

Line Number	Line Content
13462	*CONSTRAINED_GENERALIZED_WELD_SPOT
13463	2001015
13464	0.000 0.000 3.2474E+5 1.6237E+5

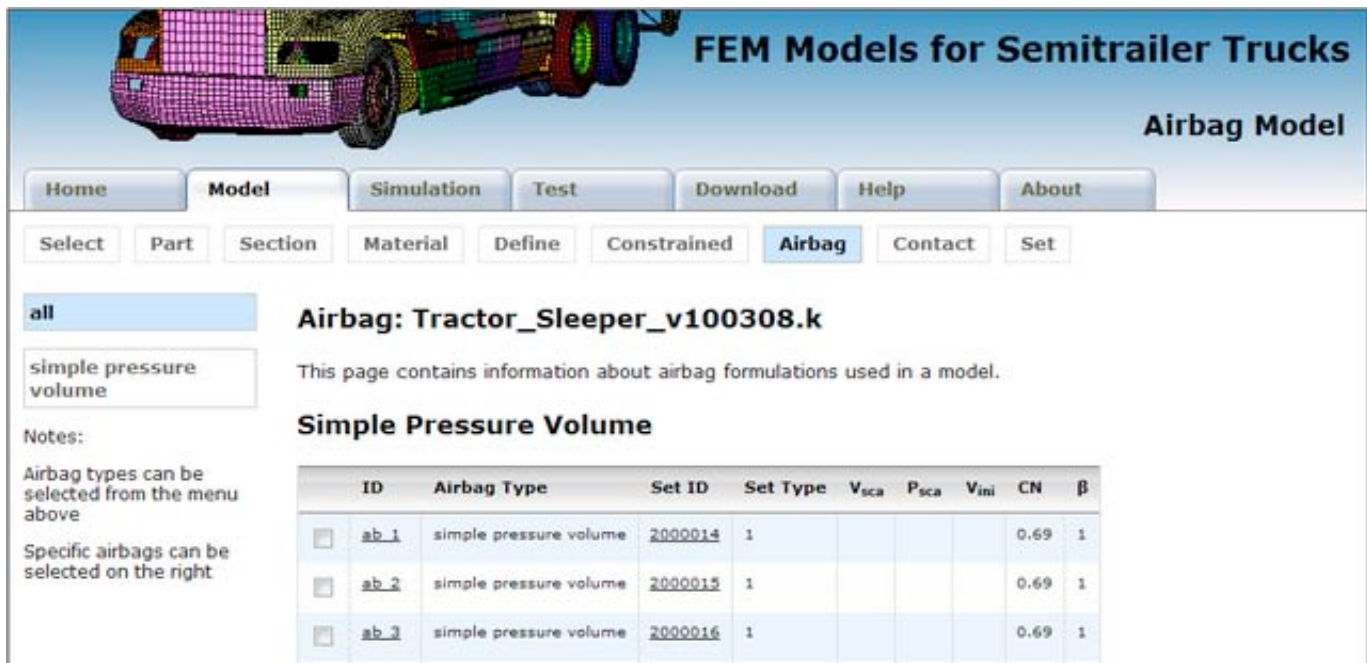
Help from the LS-DYNA User's Manual can be reached through the Manual link. A popup window opens the manual at the specific keyword entry. A pdf reader is required for viewing.



### 3.7 Tractor-semitrailer web site help: Model/Airbag

The Airbag unit located in the drop line menu under the horizontal menu's Model tab offers data briefs from the AIRBAG LS-DYNA keyword. Data queries are conducted on the selected model. Current model selection is indicated in the page title with the name of the FEM model source file name. Model [selection](#) can be made through the Model's Selection tab.

The airbags are conveniently grouped into smaller units according to their type. These units can be easily reached from the vertical navigation menu located at the left-hand side of the page. Current unit selection is highlighted in separate color.



**FEM Models for Semitrailer Trucks**  
Airbag Model

Home Model Simulation Test Download Help About

Select Part Section Material Define Constrained **Airbag** Contact Set

all  
simple pressure volume

**Airbag: Tractor\_Sleeper\_v100308.k**

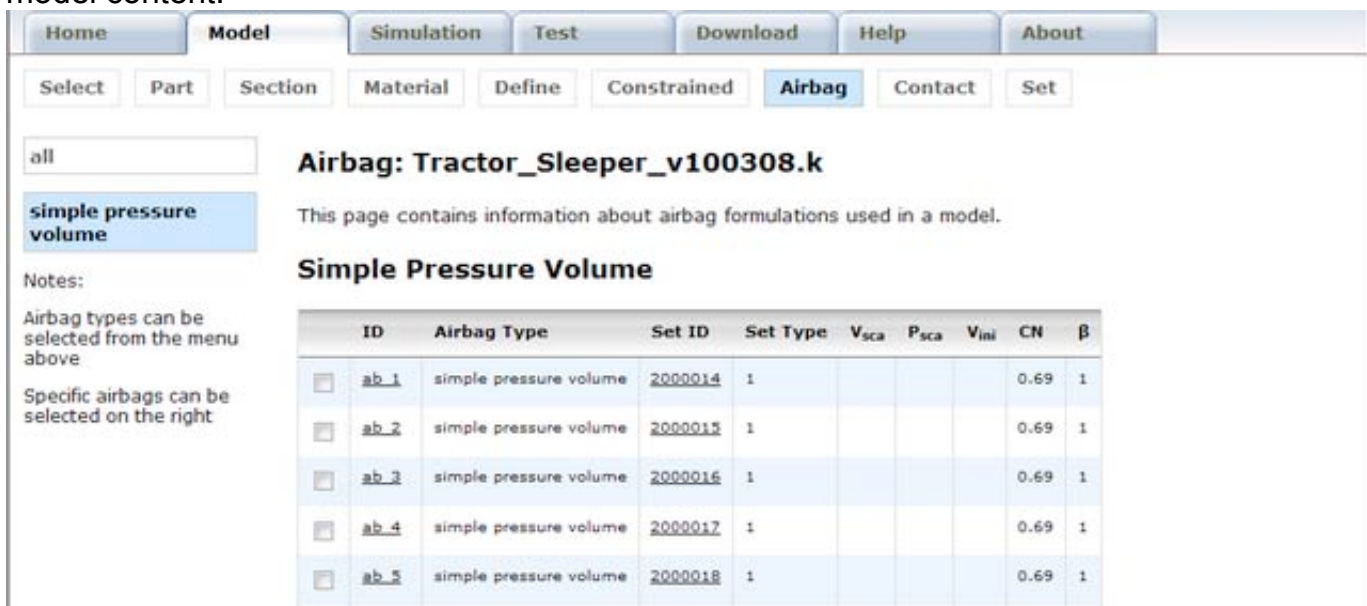
This page contains information about airbag formulations used in a model.

**Simple Pressure Volume**

Notes:  
Airbag types can be selected from the menu above  
Specific airbags can be selected on the right

ID	Airbag Type	Set ID	Set Type	V <sub>sca</sub>	P <sub>sca</sub>	V <sub>ini</sub>	CN	β
<input type="checkbox"/> <a href="#">ab_1</a>	simple pressure volume	<a href="#">2000014</a>	1				0.69	1
<input type="checkbox"/> <a href="#">ab_2</a>	simple pressure volume	<a href="#">2000015</a>	1				0.69	1
<input checked="" type="checkbox"/> <a href="#">ab_3</a>	simple pressure volume	<a href="#">2000016</a>	1				0.69	1

Essential information about the airbag formulations used in the selected model is displayed in tabular format with each airbag filling one data row. The data is appropriately linked to related model content.



Home Model Simulation Test Download Help About

Select Part Section Material Define Constrained **Airbag** Contact Set

all  
**simple pressure volume**

**Airbag: Tractor\_Sleeper\_v100308.k**

This page contains information about airbag formulations used in a model.

**Simple Pressure Volume**

Notes:  
Airbag types can be selected from the menu above  
Specific airbags can be selected on the right

ID	Airbag Type	Set ID	Set Type	V <sub>sca</sub>	P <sub>sca</sub>	V <sub>ini</sub>	CN	β
<input type="checkbox"/> <a href="#">ab_1</a>	simple pressure volume	<a href="#">2000014</a>	1				0.69	1
<input type="checkbox"/> <a href="#">ab_2</a>	simple pressure volume	<a href="#">2000015</a>	1				0.69	1
<input type="checkbox"/> <a href="#">ab_3</a>	simple pressure volume	<a href="#">2000016</a>	1				0.69	1
<input type="checkbox"/> <a href="#">ab_4</a>	simple pressure volume	<a href="#">2000017</a>	1				0.69	1
<input type="checkbox"/> <a href="#">ab_5</a>	simple pressure volume	<a href="#">2000018</a>	1				0.69	1

Home Model Simulation Test Download Help About

Select Part Section Material Define Constrained **Airbag** Contact Set

all

**simple pressure volume**

**Airbag: Tractor\_Sleeper\_v100308.k**

This page contains information about airbag formulations used in a model.

**Simple Pressure Volume**

Notes:  
Airbag types can be selected from the menu above  
Specific airbags can be selected on the right

ID	Airbag Type	Set ID	Set Type	V <sub>sca</sub>	P <sub>sca</sub>	V <sub>ini</sub>	CN	β
<input type="checkbox"/> <a href="#">ab_1</a>	simple pressure volume	<a href="#">2000014</a>	1				0.69	1
<input type="checkbox"/> <a href="#">ab_2</a>	simple pressure volume	<a href="#">2000015</a>	1				0.69	1
<input checked="" type="checkbox"/> <a href="#">ab_3</a>	simple pressure volume	<a href="#">2000016</a>	1				0.69	1
<input type="checkbox"/> <a href="#">ab_4</a>	simple pressure volume	<a href="#">2000017</a>	1				0.69	1
<input type="checkbox"/> <a href="#">ab_5</a>	simple pressure volume	<a href="#">2000018</a>	1				0.69	1
<input type="checkbox"/> <a href="#">ab_6</a>	simple pressure volume	<a href="#">2000019</a>	1				0.69	1

Airbag specifics can be reached by following the airbag identification number link, or by selecting the checkbox adjacent to the airbag identification number and then clicking on the Submit Query button located below the table(s). The latter approach is convenient for simultaneous selection of several airbags.

Notes:  
Airbag types can be selected from the menu above  
Specific airbags can be selected on the right


**Simple Pressure Volume**

ID	Airbag Type	Set ID	Set Type	V <sub>sca</sub>	P <sub>sca</sub>	V <sub>ini</sub>	CN	β
<input type="checkbox"/> <a href="#">ab_1</a>	simple pressure volume	<a href="#">2000014</a>	1				0.69	1
<input type="checkbox"/> <a href="#">ab_2</a>	simple pressure volume	<a href="#">2000015</a>	1				0.69	1
<input checked="" type="checkbox"/> <a href="#">ab_3</a>	simple pressure volume	<a href="#">2000016</a>	1				0.69	1
<input checked="" type="checkbox"/> <a href="#">ab_4</a>	simple pressure volume	<a href="#">2000017</a>	1				0.69	1
<input type="checkbox"/> <a href="#">ab_5</a>	simple pressure volume	<a href="#">2000018</a>	1				0.69	1
<input type="checkbox"/> <a href="#">ab_6</a>	simple pressure volume	<a href="#">2000019</a>	1				0.69	1
<input type="checkbox"/> <a href="#">ab_7</a>	simple pressure volume	<a href="#">2000020</a>	1				0.69	1
<input checked="" type="checkbox"/> <a href="#">ab_8</a>	simple pressure volume	<a href="#">2000021</a>	1				0.69	1
<input type="checkbox"/> <a href="#">ab_9</a>	simple pressure volume	<a href="#">2000022</a>	1				0.69	1
<input type="checkbox"/> <a href="#">ab_10</a>	simple pressure volume	<a href="#">2000023</a>	1				0.69	1

Submit Query

In airbag specifics the essential data for the chosen airbag(s) is accompanied with access to:

Excerpt from the FEM model source file ([Input Lines](#)),  
 Numerous [images](#) (standalone and in setting) of all parts featuring the chosen airbag,  
 Interactive [3D View](#) of all parts featuring the chosen airbag, and  
 LS-DYNA's User's [Manual](#) displaying the chosen keyword entry.



# FEM Models for Semitrailer Trucks

## Airbag Model

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Airbag
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Set

### Airbag: Tractor\_Sleeper\_v100308.k

This page contains information about airbag formulations used in a model.

#### Airbag ID: ab\_3

ID	Airbag Type	Set ID	Set Type	V <sub>sca</sub>	P <sub>sca</sub>	V <sub>ini</sub>	CN	β
<input type="checkbox"/> ab_3	simple pressure volume	2000016	1				0.69	1

Input Lines	Images	3D View	Manual
7851-7855	11	1	<a href="#">1971k_1.pdf</a>

---

#### Airbag ID: ab\_4


ID	Airbag Type	Set ID	Set Type	V <sub>sca</sub>	P <sub>sca</sub>	V <sub>ini</sub>	CN	β
<input type="checkbox"/> ab_4	simple pressure volume	2000017	1				0.69	1

Notes:

Airbag types can be selected from the menu above

Specific airbags can be selected on the right

Excerpt from the FEM model source file containing the chosen airbag entry is accessible through the Input Lines link. A popup window shows the chosen airbag entry conveniently numbered such that numbers correspond to the FEM model source file lines.



# Input File

## Input File: Tractor\_Sleeper\_v100308.k

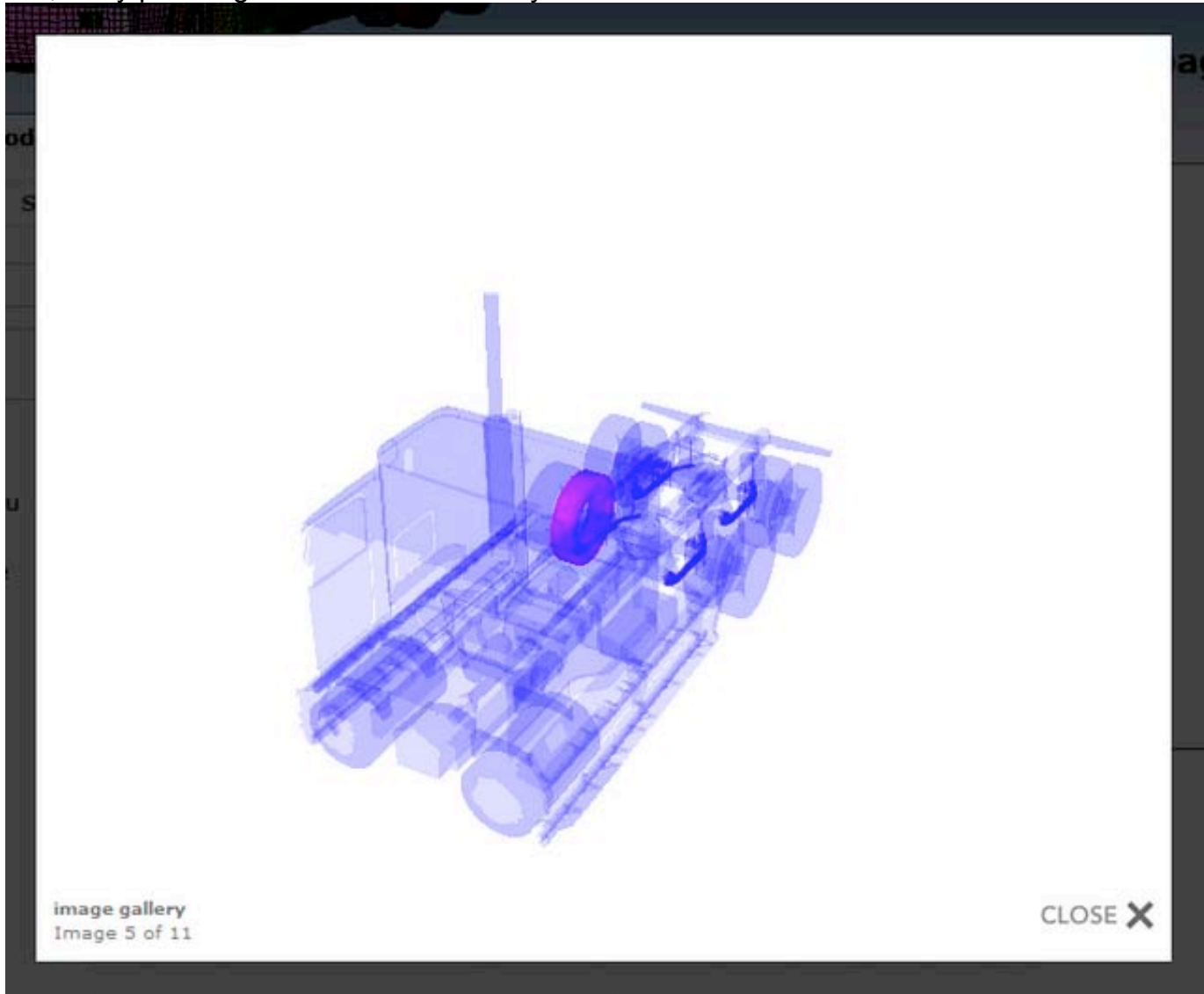
Line Number	Line Content
7851	*AIRBAG_SIMPLE_PRESSURE_VOLUME
7852	\$#    sid    sidtyp    rbid    vsca    psca    vini    mwd    epsf
7853	2000016        1
7854	\$#    CN    beta
7855	0.690        1.0

Input File

Numerous images of the parts featuring the chosen airbag can be viewed through the Images

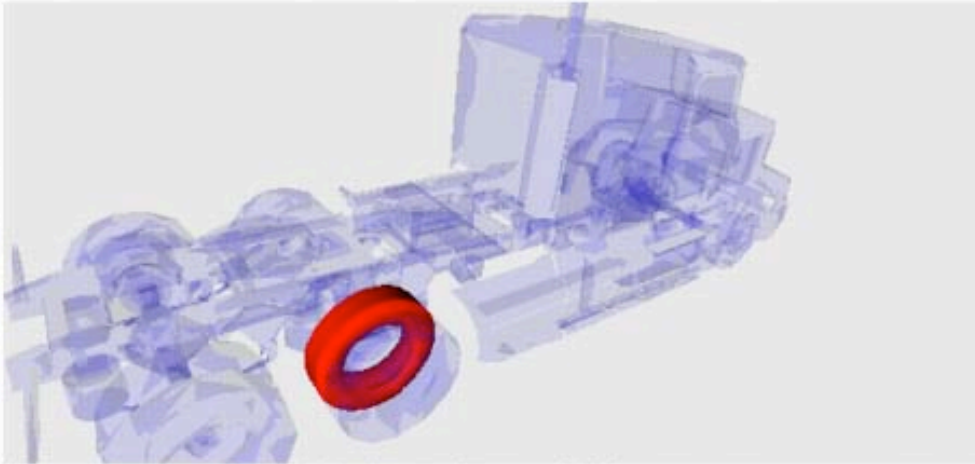
taken from different viewing angles.

Images can be navigated by clicking inside the image on its left-hand and right-hand side, by clicking on the Previous and Next links that appear on mouse over the image event, by pressing the P and L letters on the keyboard, or by pressing the left and right keyboard arrows. The image window can be dismissed by clicking anywhere outside the image area, by clicking the Close link, or by pressing the C letter on the keyboard.



Interactive 3D display of the parts featuring the chosen airbag is accessible through the 3D View link. This option requires a proper 3D plug-in to show the parts in their setting in a new popup window. Plug-independent controls enable model interactivity (rotation, zoom, pan, etc.).

## VRML Model



If you cannot see the 3D object above, click [here](#).

VRML

LS-DYNA USER'S MANUAL

Help from the LS-DYNA User's Manual can be reached through the Manual link. A popup window opens the manual at the specific keyword entry. A pdf reader is required for viewing.

I971k\_1.pdf (application/pdf Object) - Mozilla Firefox

http://localhost/ntrci/resources/manuals/I971k\_1.pdf#page=74

74 / 1384 89.1% Find

**\*AIRBAG** **\*AIRBAG\_SIMPLE\_PRESSURE\_VOLUME**

Additional card required for SIMPLE\_PRESSURE\_VOLUME option

Card	1	2	3	4	5	6	7	8
Variable	CN	BETA	LCID	LCIDDR				
Type	F	F	I	I				
Default	none	none	none	0				

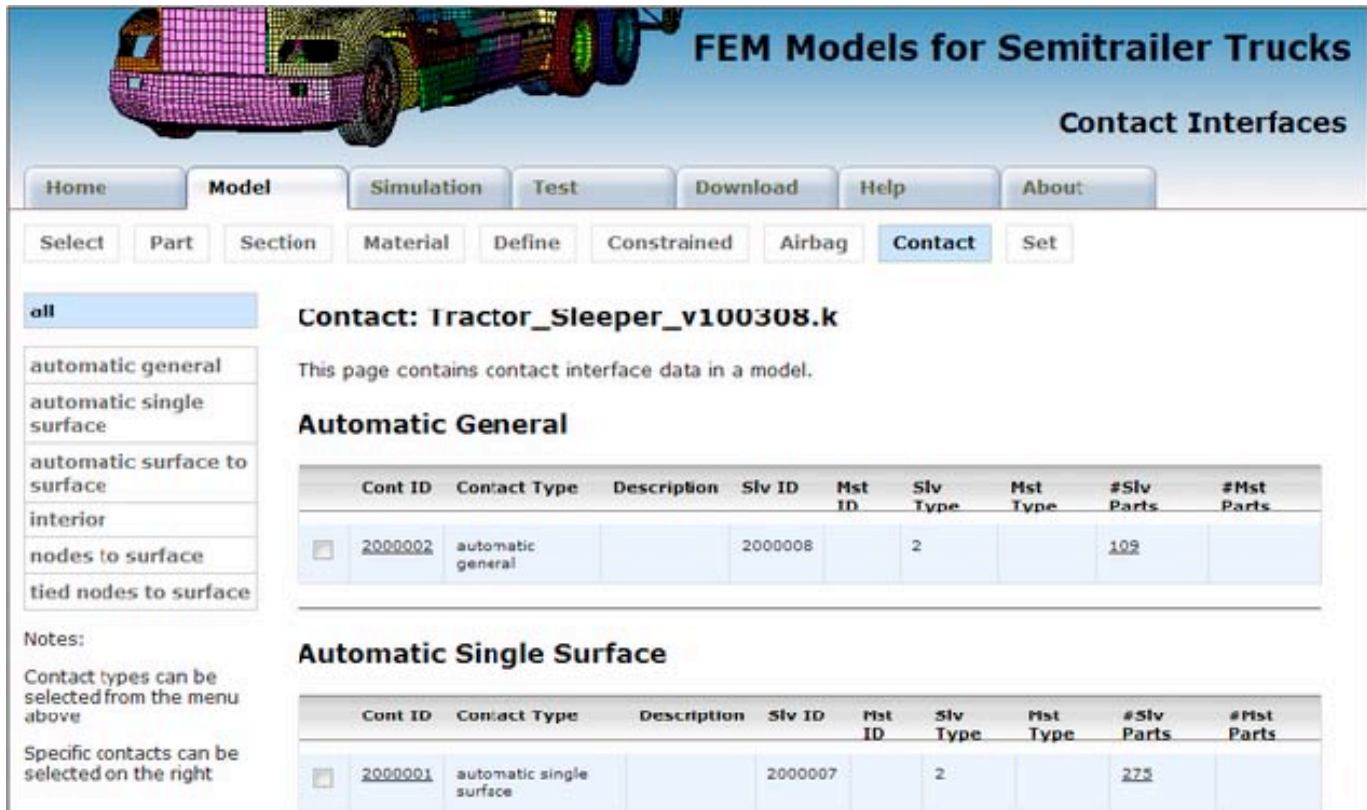
VARIABLE	DESCRIPTION
CN	Coefficient. Define if the load curve ID, LCID, is unspecified. LT.0.0:  CN  is the load curve ID, which defines the coefficient as a function of time.
BETA	Scale factor, $\beta$ . Define if a load curve ID is not specified.
LCID	Optional load curve ID defining pressure versus relative volume.
LCIDDR	Optional load curve ID defining the coefficient, CN, as a function of time during the dynamic relaxation phase.

Done



### 3.8 Tractor-semitrailer web site help: Model/Contact

The Contact unit located in the drop line menu under the horizontal menu's Model tab offers data briefs from the CONTACT LS-DYNA keyword. Data queries are conducted on the selected model. Current model selection is indicated in the page title with the name of the FEM model source file name. Model [selection](#) can be made through the Model's Selection tab.



The screenshot shows a web interface titled "FEM Models for Semitrailer Trucks" with a sub-header "Contact Interfaces". The main navigation bar includes "Home", "Model", "Simulation", "Test", "Download", "Help", and "About". A secondary navigation bar includes "Select", "Part", "Section", "Material", "Define", "Constrained", "Airbag", "Contact", and "Set". The "Contact" tab is active, displaying data for the model "Tractor\_Sleeper\_v100308.k".

On the left, a vertical navigation menu lists contact types: "all" (selected), "automatic general", "automatic single surface", "automatic surface to surface", "interior", "nodes to surface", and "tied nodes to surface".

Below the menu, a "Notes" section states: "Contact types can be selected from the menu above" and "Specific contacts can be selected on the right".

The main content area shows the model name and a brief description: "This page contains contact interface data in a model." It then displays two tables of contact data.

#### Automatic General

Cont ID	Contact Type	Description	Slv ID	Mst ID	Slv Type	Mst Type	#Slv Parts	#Mst Parts
<input type="checkbox"/> <a href="#">2000002</a>	automatic general		2000008		2		109	

#### Automatic Single Surface

Cont ID	Contact Type	Description	Slv ID	Mst ID	Slv Type	Mst Type	#Slv Parts	#Mst Parts
<input type="checkbox"/> <a href="#">2000001</a>	automatic single surface		2000007		2		275	

The contacts are conveniently grouped into smaller units according to their type. These units can be easily reached from the vertical navigation menu located at the left-hand side of the page. Current unit selection is highlighted in separate color.

Essential information about the contact interfaces used in the selected model is displayed in tabular format with each contact filling one data row. The data is appropriately linked to related model content.



# FEM Models for Semitrailer Trucks

## Contact Interfaces

Home Model Simulation Test Download Help About

Select Part Section Material Define Constrained Airbag **Contact** Set

all

- automatic general
- automatic single surface
- automatic surface to surface**
- interior
- nodes to surface
- tied nodes to surface

**Notes:**

Contact types can be selected from the menu above

Specific contacts can be selected on the right

### Contact: Tractor\_Sleeper\_v100308.k

This page contains contact interface data in a model.

#### Automatic Surface To Surface

	Cont ID	Contact Type	Description	Slv ID	Mst ID	Slv Type	Mst Type	#Slv Parts	#Mst Parts
<input type="checkbox"/>	<a href="#">2000005</a>	automatic surface to surface		2200061	2200060	3	3	1	1
<input type="checkbox"/>	<a href="#">2000006</a>	automatic surface to surface		2000126	2000127	2	2	2	2

Submit Query

...

[Back](#) | [Forward](#)

Contact specifics can be reached by following the contact identification number link, or by selecting the checkbox adjacent to the contact identification number and then clicking on the Submit Query button located below the table(s). The latter approach is convenient for simultaneous selection of several contacts.

#### Interior

	Cont ID	Contact Type	Description	Part Set ID
<input type="checkbox"/>	<a href="#">2000060</a>	interior		<a href="#">2200060</a>

#### Nodes To Surface

	Cont ID	Contact Type	Description	Slv ID	Mst ID	Slv Type	Mst Type	#Slv Parts	#Mst Parts
<input type="checkbox"/>	<a href="#">2000003</a>	nodes to surface		127	2000391	2	3	2	1
<input type="checkbox"/>	<a href="#">2000007</a>	nodes to surface		2200061	2200062	3	3	1	1

2000007

#### Tied Nodes To Surface

	Cont ID	Contact Type	Description	Slv ID	Mst ID	Slv Type	Mst Type	#Slv Parts	#Mst Parts
<input type="checkbox"/>	<a href="#">2000004</a>	tied nodes to surface		2200061	2000125	3	2	1	2

Submit Query

## Interior

Cont ID	Contact Type	Description	Part Set ID
<input type="checkbox"/> con_1	interior		2200060

## Nodes To Surface

Cont ID	Contact Type	Description	Slv ID	Mst ID	Slv Type	Mst Type	#Slv Parts	#Mst Parts
<input checked="" type="checkbox"/> 2000003	nodes to surface		127	2000391	2	3	2	1
<input type="checkbox"/> 2000007	nodes to surface		2200061	2200062	3	3	1	1

## Tied Nodes To Surface

Cont ID	Contact Type	Description	Slv ID	Mst ID	Slv Type	Mst Type	#Slv Parts	#Mst Parts
<input checked="" type="checkbox"/> 2000004	tied nodes to surface		2200061	2000125	3	2	1	2

Submit Query

In contact specifics the essential data for the chosen contact(s) is accompanied with access to:

Excerpt from the FEM model source file ([Input Lines](#)),  
 Numerous [images](#) (standalone and in setting) of all parts featuring the chosen contact,  
 Interactive [3D View](#) of all parts featuring the chosen contact, and  
 LS-DYNA's User's [Manual](#) displaying the chosen keyword entry.

Contact Interfaces

Home
Model
Simulation
Test
Download
Help
About

Select
Part
Section
Material
Define
Constrained
Airbag
Contact
Set

- automatic general
- automatic single surface
- automatic surface to surface
- interior
- nodes to surface
- tied nodes to surface

Notes:  
Contact types can be selected from the menu above  
Specific contacts can be selected on the right

### Contact: Tractor\_Sleeper\_v100308.k

This page contains contact interface data in a model.

#### Contact ID: 2000003

Cont ID	Contact Type	Description	Slv ID	Mst ID	Slv Type	Mst Type	#Slv Parts	#Mst Parts
<input type="checkbox"/> 2000003	nodes to surface		127	2000391	2	3	2	1

Input Lines	Images	3D View	Manual
<a href="#">258-272</a>	<a href="#">11</a>	<a href="#">1</a>	<a href="#">1971k_1.pdf</a>

---

#### Contact ID: 2000004

Cont ID	Contact Type	Description	Slv ID	Mst ID	Slv Type	Mst Type	#Slv Parts	#Mst Parts
<input type="checkbox"/> 2000004	tied nodes to surface		2200061	2000125	3	2	1	2

Excerpt from the FEM model source file containing the chosen contact entry is accessible through the Input Lines link. A popup window shows the chosen contact entry conveniently numbered such that numbers correspond to the FEM model source file lines.



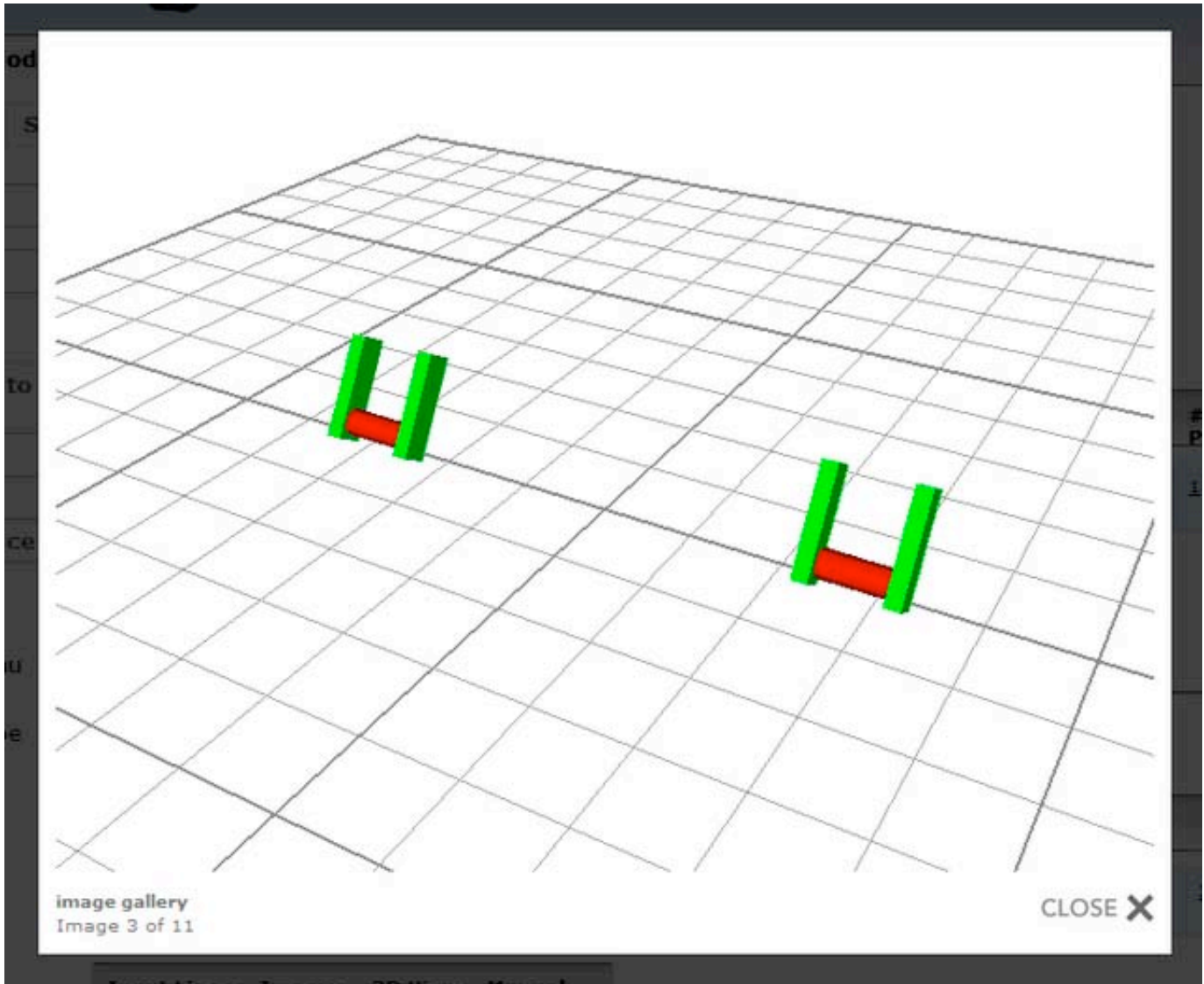
## Input File

### Input File: Tractor\_Sleeper\_v100308.k

Line Number	Line Content
258	*CONTACT_NODES_TO_SURFACE_ID
259	\$# cid title
260	2000003
261	\$# ssid msid sstyp mstyp sboxid mboxid spr mpr
262	127 2000391 2 3
263	\$# fs fd dc vc vdc penchk bt dt
264	0.100000 0.100000 0.000 0.000 20.000000
265	\$# sfs sfm sst mst sfst sfmt fsf vsf
266	0.000 0.000 2.000000 2.000000
267	\$# soft sofscl lcidab maxpar sbopt depth bsort frofrq
268	1
269	\$# nsmay rtkont shlthk anlog ienum i2d3d eldchk elderf

Numerous images of the parts featuring the chosen contact can be viewed through the Images link. A popup window shows images of the parts alone, and of the parts setting in the model taken from different viewing angles.

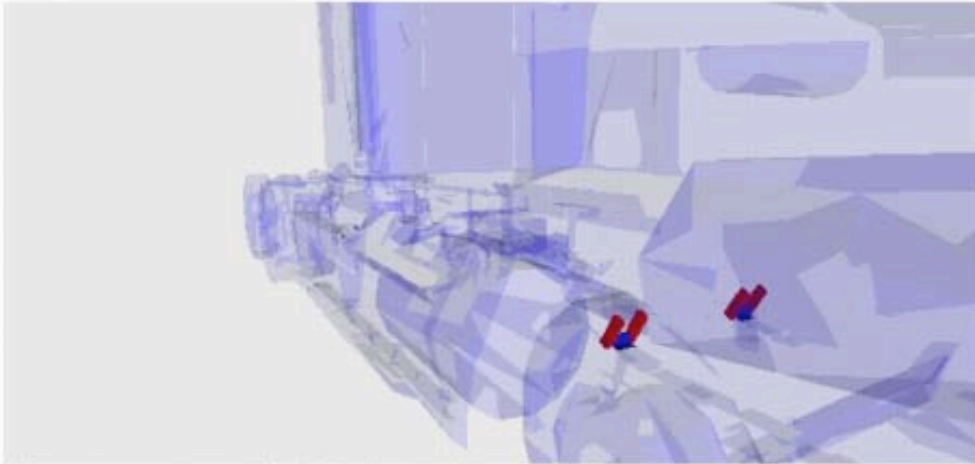
Images can be navigated by clicking inside the image on its left-hand and right-hand side, by clicking on the Previous and Next links that appear on mouse over the image event, by pressing the P and L letters on the keyboard, or by pressing the left and right keyboard arrows. The image window can be dismissed by clicking anywhere outside the image area, by clicking the Close link, or by pressing the C letter on the keyboard.



Interactive 3D display of the parts featuring the chosen contact is accessible through the 3D View link. This option requires a proper 3D plug-in to show the parts in their setting in a new popup window. Plug-independent controls enable model interactivity (rotation, zoom, pan, etc.).



## VRML Model

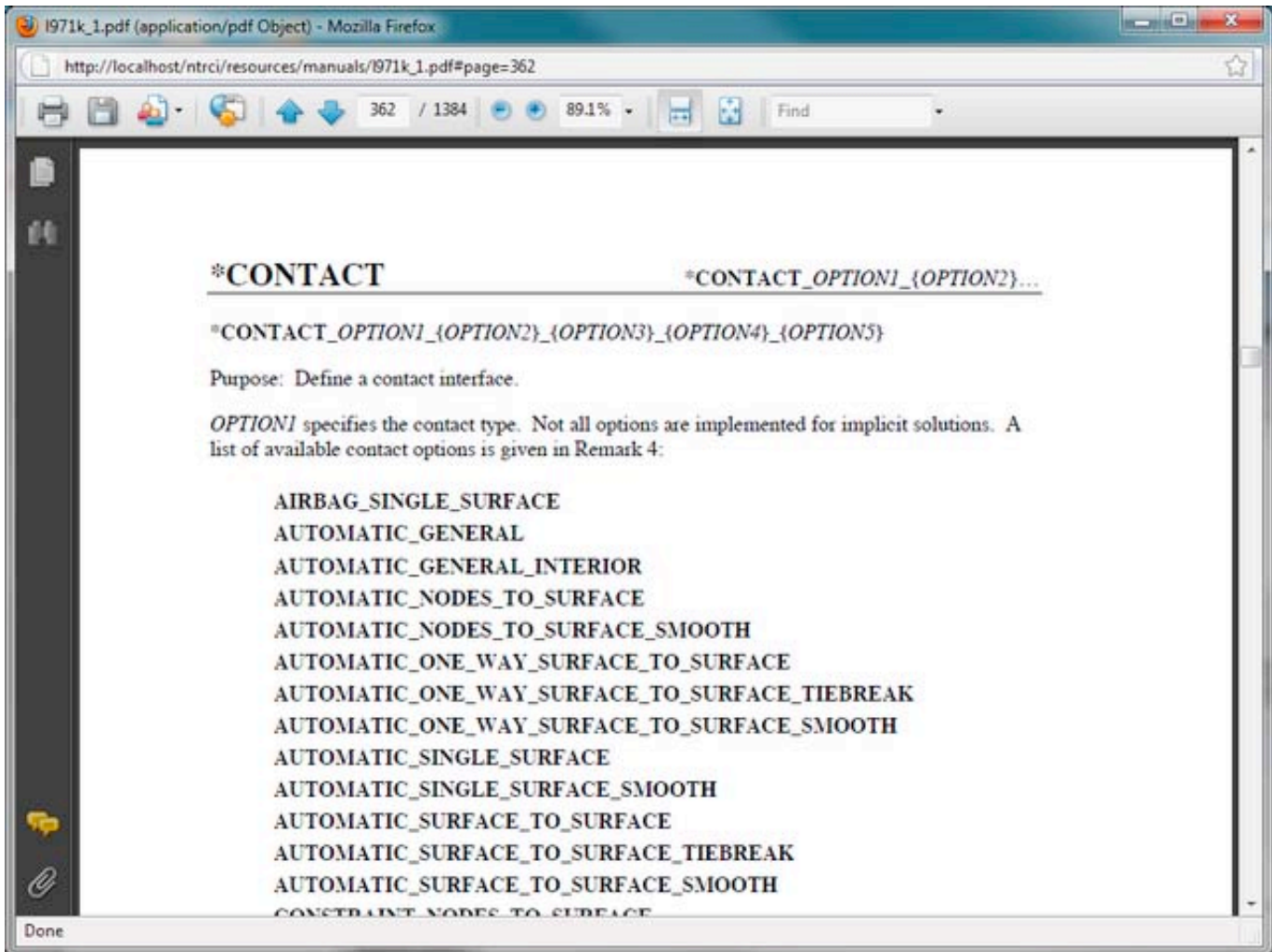


If you cannot see the 3D object above, click [here](#).

VRML

LS-DYNA 4.11.0 (2011-01-11)

Help from the LS-DYNA User's Manual can be reached through the Manual link. A popup window opens the manual at the specific keyword entry. A pdf reader is required for viewing.



### 3.9 Tractor-semitrailer web site help: Model/Set

The Set unit located in the drop line menu under the horizontal menu's Model tab offers data briefs from the SET LS-DYNA keyword. Data queries are conducted on the selected model. Current model selection is indicated in the page title with the name of the FEM model source file name. Model [selection](#) can be made through the Model's Selection tab.

The screenshot shows the 'Node List' page for the model 'Tractor\_Sleeper\_v100308.k'. The page title is 'Set: Tractor\_Sleeper\_v100308.k'. The navigation menu includes 'Home', 'Model', 'Simulation', 'Test', 'Download', 'Help', and 'About:'. The 'Model' tab is active, and the 'Set' sub-tab is selected. The left-hand side menu has 'all' selected, with 'node list' and 'part list' also visible. The main content area displays the title 'Set: Tractor\_Sleeper\_v100308.k' and a description: 'This page contains information about node and part sets in a model.' Below this is the 'Node List' table.

Set ID	Set Type	Description
<input type="checkbox"/> <a href="#">2000001</a>	node list	
<input type="checkbox"/> <a href="#">2000002</a>	node list	

The sets are conveniently grouped into smaller units according to their type. These units can be easily reached from the vertical navigation menu located at the left-hand side of the page. Current unit selection is highlighted in separate color.

The screenshot shows the 'Part List' page for the model 'Tractor\_Sleeper\_v100308.k'. The page title is 'Set: Tractor\_Sleeper\_v100308.k'. The navigation menu is the same as in the previous screenshot. The 'Model' tab is active, and the 'Set' sub-tab is selected. The left-hand side menu has 'part list' selected, with 'all' and 'node list' also visible. The main content area displays the title 'Set: Tractor\_Sleeper\_v100308.k' and a description: 'This page contains information about node and part sets in a model.' Below this is the 'Part List' table.

Set ID	Set Type	Description	#Contacts
<input type="checkbox"/> <a href="#">122</a>	part list		1
<input type="checkbox"/> <a href="#">2000001</a>	part list		
<input type="checkbox"/> <a href="#">2000002</a>	part list		
<input type="checkbox"/> <a href="#">2000003</a>	part list		
<input type="checkbox"/> <a href="#">2000004</a>	part list		
<input type="checkbox"/> <a href="#">2000007</a>	part list		1

Essential information about node and part sets used in the selected model is displayed in tabular format with each set filling one data row. The data is appropriately linked to related model content.



Set specifics can be reached by following the set identification number link, or by selecting the checkbox adjacent to the set identification number and then clicking on the Submit Query button located below the table(s). The latter approach is convenient for simultaneous selection of several sets.

**FEM Models for Semitrailer Trucks**  
Node and Part Sets

Home Model Simulation Test Download Help About

Select Part Section Material Define Constrained Airbag Contact **Set**

all  
node list  
**part list**

**Set: Tractor\_Sleeper\_v100308.k**  
This page contains information about node and part sets in a model.

**Part List**

Notes:  
Set types can be selected from the menu above  
Specific sets can be selected on the right

Set ID	Set Type	Description	#Contacts
<input type="checkbox"/> 127	part list		1
<input type="checkbox"/> 20127	part list		
<input type="checkbox"/> 2000002	part list		
<input type="checkbox"/> 2000003	part list		
<input type="checkbox"/> 2000022	part list		
<input type="checkbox"/> 2000023	part list		
<input checked="" type="checkbox"/> 2000125	part list		1
<input checked="" type="checkbox"/> 2000126	part list		1
<input type="checkbox"/> 2000127	part list		1
<input checked="" type="checkbox"/> 2200060	part list		

Submit Query

...  
Back | Forward

Home Model Set: Tractor\_Sleeper\_v100308.k

In set specifics the essential data for the chosen set(s) is accompanied with


Tabular presentation of all set [constituents](#), and access to:

Excerpt from the FEM model source file ([Input Lines](#)),

Numerous [images](#) (standalone and in setting) of all parts featuring the chosen set (for part sets only),

Interactive [3D View](#) of all parts featuring the chosen set (for part sets only), and

LS-DYNA's User's [Manual](#) displaying the chosen keyword entry.



## FEM Models for Semitrailer Trucks

### Node and Part Sets

Home
Model
Simulation
Test
Download
Help
About

Select
Part
Section
Material
Define
Constrained
Airbag
Contact
Set

### Set: Tractor\_Sleeper\_v100308.k

This page contains information about node and part sets in a model.

#### Set ID: 127

Set ID	Set Type	Description	#Contacts
<input type="checkbox"/> 127	part list		1


PID1	PID2	PID3	PID4	PID5	PID6	PID7	PID8
2100036	2200036						

Input Lines	Images	3D View	Manual
<a href="#">273-277</a>	<a href="#">11</a>	<a href="#">1</a>	<a href="#">1971k 1.pdf</a>

Notes:  
 Set types can be selected from the menu above  
 Specific sets can be selected on the right

Set constituents are listed in tabular format. Links to related model content are provided where applicable.

Excerpt from the FEM model source file containing the chosen set entry is accessible through the Input Lines link. A popup window shows the chosen set entry conveniently numbered such that numbers correspond to the FEM model source file lines.



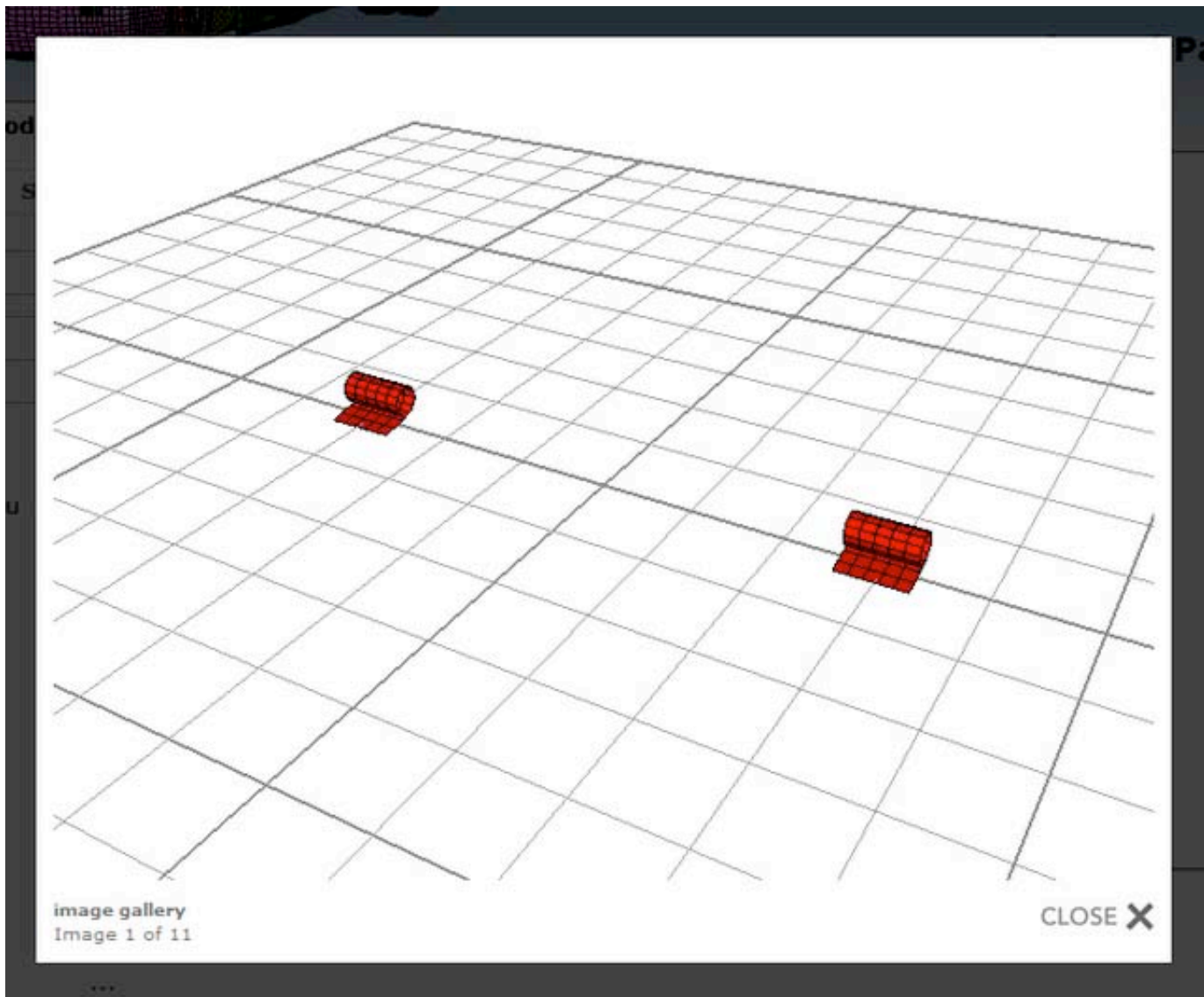
## Input File

### Input File: Tractor\_Sleeper\_v100308.k

Line Number	Line Content
273	*SET_PART_LIST
274	\$# sid da1 da2 da3 da4
275	127
276	\$# pid1 pid2 pid3 pid4 pid5 pid6 pid7 pid8
277	2100036 2200036

Numerous images of the parts featuring the chosen set can be viewed through the Images link. A popup window shows images of the parts alone, and of the parts setting in the model taken from different viewing angles.

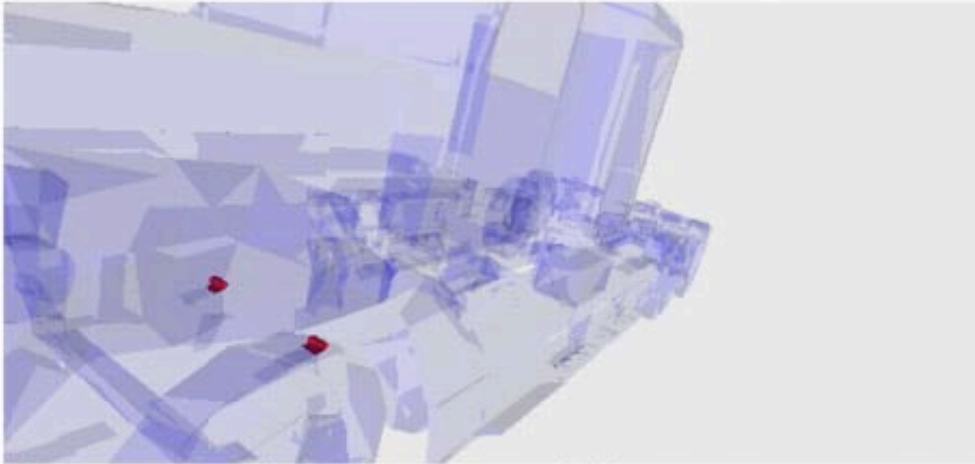
Images can be navigated by clicking inside the image on its left-hand and right-hand side, by clicking on the Previous and Next links that appear on mouse over the image event, by pressing the P and L letters on the keyboard, or by pressing the left and right keyboard arrows. The image window can be dismissed by clicking anywhere outside the image area, by clicking the Close link, or by pressing the C letter on the keyboard.



Interactive 3D display of the parts featuring the chosen set is accessible through the 3D View link. This option requires a proper 3D plug-in to show the parts in their setting in a new popup window. Plug-independent controls enable model interactivity (rotation, zoom, pan, etc.).



## VRML Model



If you cannot see the 3D object above, click [here](#).

VRML

LS-DYNA USER'S MANUAL

Help from the LS-DYNA User's Manual can be reached through the Manual link. A popup window opens the manual at the specific keyword entry. A pdf reader is required for viewing.



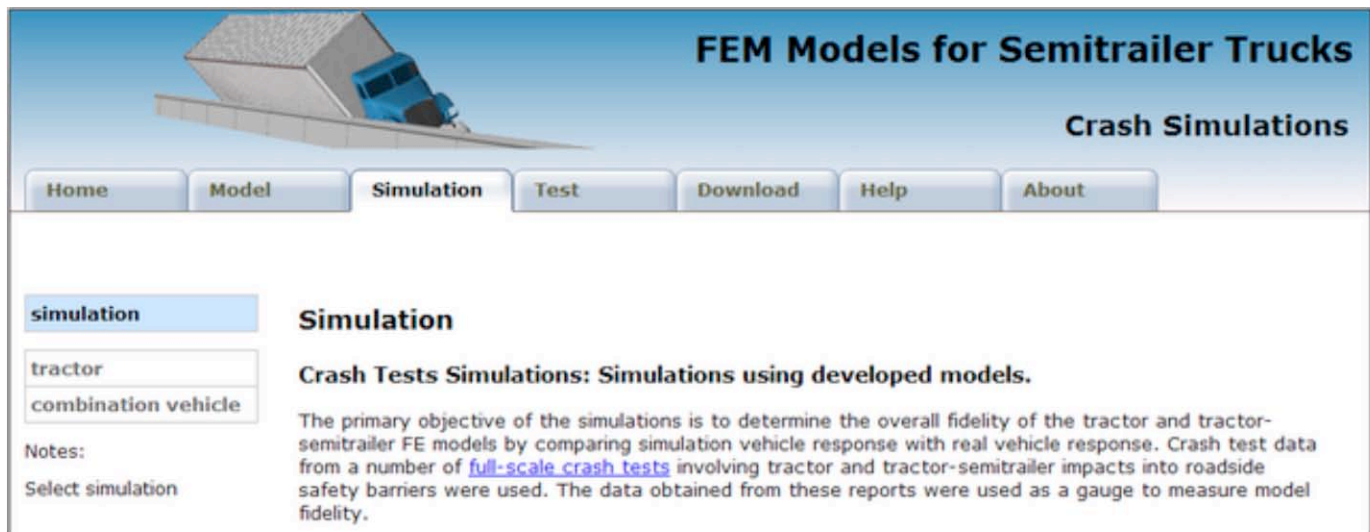
## 4. Tractor-semitrailer web site help: Simulation

Access to information regarding performed computer simulations using developed FE models of tractor and semitrailer vehicles can be obtained through the Simulation section. The web content is organized in three units as follows:

[Simulation](#)

[Tractor](#)

[Combination vehicle](#)



The screenshot shows a web page titled "FEM Models for Semitrailer Trucks" with a sub-header "Crash Simulations". The page features a navigation menu with buttons for "Home", "Model", "Simulation", "Test", "Download", "Help", and "About". On the left side, there is a vertical navigation menu with three options: "simulation" (highlighted in blue), "tractor", and "combination vehicle". Below this menu, there is a "Notes:" section with the text "Select simulation". The main content area is titled "Simulation" and contains the following text: "Crash Tests Simulations: Simulations using developed models. The primary objective of the simulations is to determine the overall fidelity of the tractor and tractor-semitrailer FE models by comparing simulation vehicle response with real vehicle response. Crash test data from a number of [full-scale crash tests](#) involving tractor and tractor-semitrailer impacts into roadside safety barriers were used. The data obtained from these reports were used as a gauge to measure model fidelity."

Each unit can be easily reached through the vertical navigation menu located at the left hand side of the page. Current unit selection is highlighted in separate color.

### **Simulation**

Overall fidelity of the tractor and tractor-semitrailer FEM models was determined by comparing simulated vehicle response with real vehicle response in identical crash scenarios. General information regarding the FEM models used in the simulations and the full-scale crash tests they emulate can be found in the Simulation's opening section. Model simulations are conveniently linked to their corresponding tests throughout the text.

### **Tractor**

Information regarding simulations performed with FEM models of tractor vehicles can be found in the Simulation's Tractor section. A brief description of the model and the crash scenario is accompanied with links to several movie clips showing the impact from different viewing angles. Left mouse click on any image launches a new window where the user's default media player displays the animation. The simulation content is also conveniently linked to corresponding source FEM model files available for download.

## Movies



[Front view \(0.5MB\)](#)



[Side view \(0.5MB\)](#)

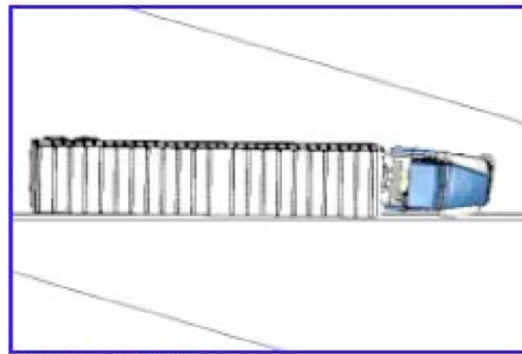
[Download](#)

## Combination vehicle

Information regarding simulations performed with FEM models of tractor-semitrailer combination vehicles can be found in the Simulation's Combination vehicle section. A brief description of the models and the crash scenario is accompanied with links to several movie clips showing the impact from different viewing angles. Left mouse click on any image launches a new window where the user's default media player displays the animation. The simulation content is also conveniently linked to corresponding source FEM model files available for download.



[Side view \(2.2MB\)](#)



[Top view \(2.2MB\)](#)



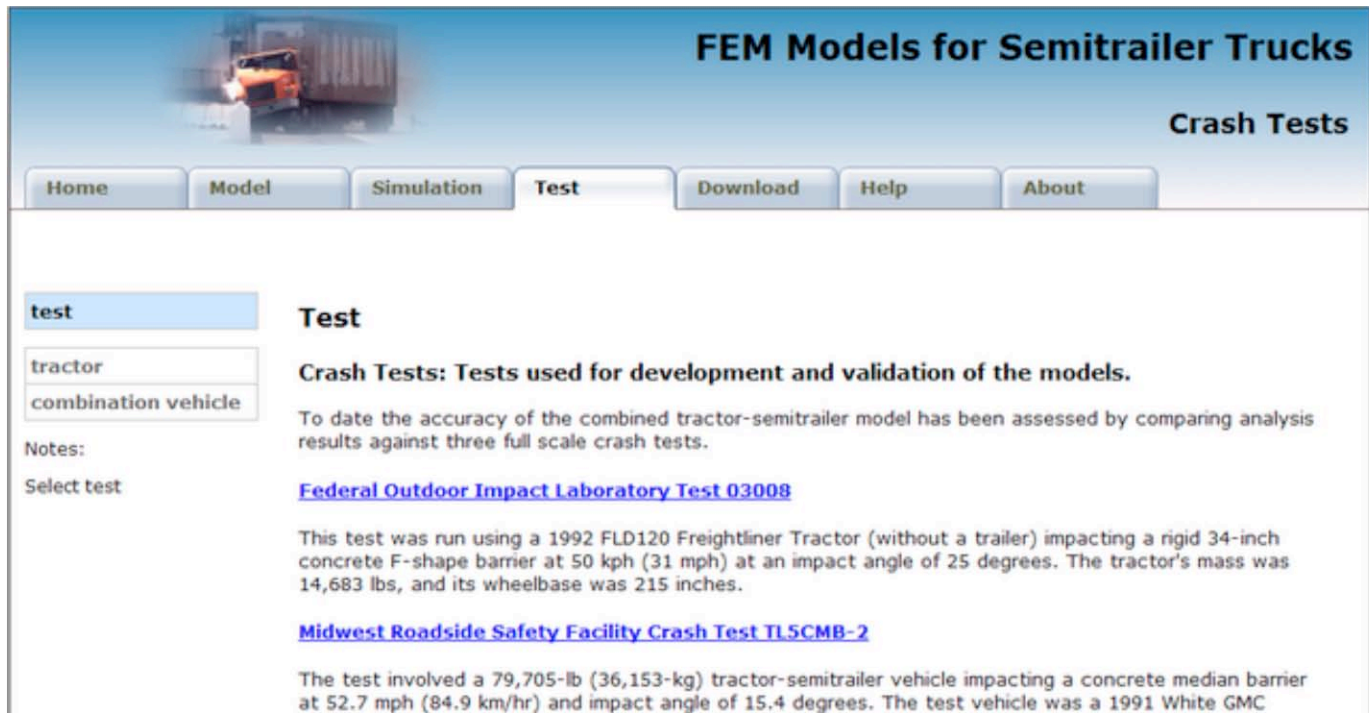
[Combined view \(0.3MB\)](#)

[Download](#)

## 5. Tractor-semitrailer web site help: Test

Access to information regarding actual full-scale test of tractor and tractor-semitrailer combination vehicles can be obtained through the Test section. The web content is organized in three units as follows:

[Test](#)  
[Tractor](#)  
[Combination vehicle](#)



**FEM Models for Semitrailer Trucks**

**Crash Tests**

Home Model Simulation **Test** Download Help About

**test**

tractor  
combination vehicle

Notes:  
Select test

**Test**

**Crash Tests: Tests used for development and validation of the models.**

To date the accuracy of the combined tractor-semitrailer model has been assessed by comparing analysis results against three full scale crash tests.

[Federal Outdoor Impact Laboratory Test 03008](#)

This test was run using a 1992 FLD120 Freightliner Tractor (without a trailer) impacting a rigid 34-inch concrete F-shape barrier at 50 kph (31 mph) at an impact angle of 25 degrees. The tractor's mass was 14,683 lbs, and its wheelbase was 215 inches.

[Midwest Roadside Safety Facility Crash Test TL5CMB-2](#)

The test involved a 79,705-lb (36,153-kg) tractor-semitrailer vehicle impacting a concrete median barrier at 52.7 mph (84.9 km/hr) and impact angle of 15.4 degrees. The test vehicle was a 1991 White GMC

Each unit can be easily reached through the vertical navigation menu located at the left hand side of the page. Current unit selection is highlighted in separate color.

### **Test**

Overall fidelity of the tractor and tractor-semitrailer FEM models was determined by comparing simulated vehicle response with real vehicle response in identical crash scenarios. General information regarding the actual full-scale crash tests can be found in the Test's opening section.

### **Tractor**

Information regarding real life full-scale crash tests of tractor vehicles can be found in the Test's Tractor section. A brief description of the vehicle and the crash scenario is accompanied with links to several movie clips showing the impact from different viewing angles. Left mouse click on any image launches a new window where the user's default media player displays the animation. The test content is also conveniently linked to the corresponding FEM model simulations



## Movies



[Front view \(2.6MB\)](#)



[Side view \(2.8MB\)](#)

## [Simulation](#)

### ***Combination vehicle***

Information regarding actual full-scale crash test of tractor-semitrailer combination vehicles can be found in the Test's Combination vehicle section. A brief description of the vehicles and the crash scenario is accompanied with links to several movie clips showing the impact from different viewing angles. Left mouse click on any image launches a new window where the user's default media player displays the animation. The test content is also conveniently linked to the corresponding FEM model simulations.

## 6. Tractor-semitrailer web site help: Download

The Download section enables access to LS-DYNA FEM model files and project reports. The web content is organized in five units as follows:

[Download](#)

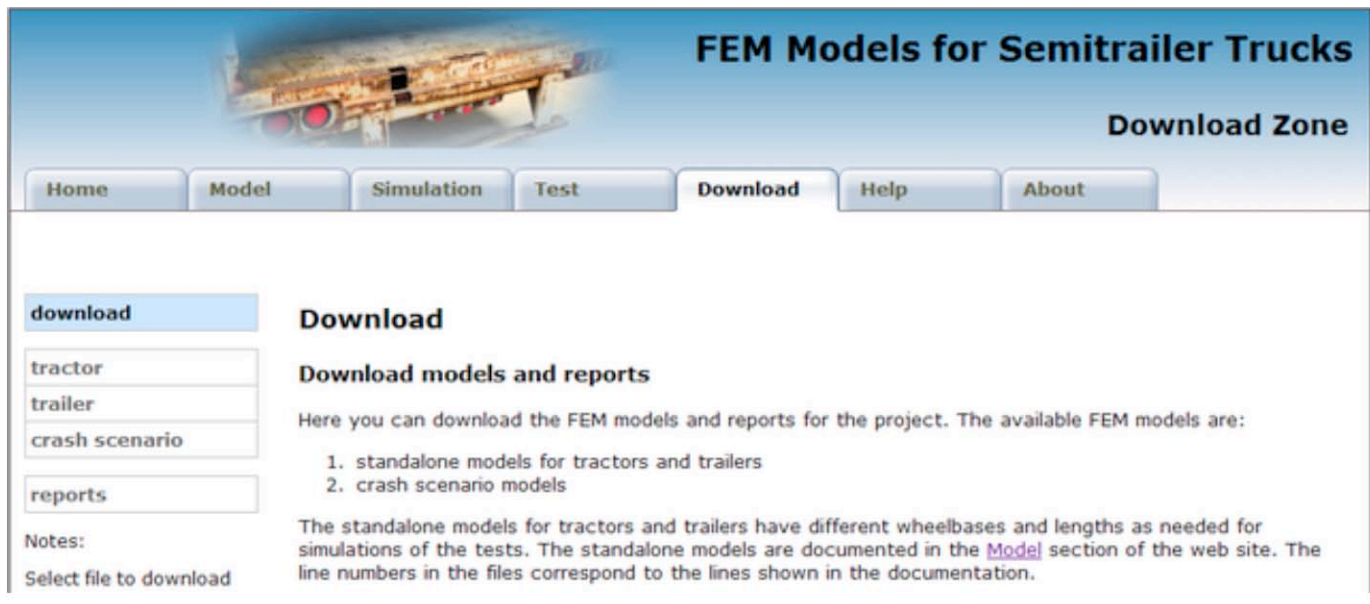
[Tractor](#)

[Trailer](#)

[Crash scenario](#)

[Reports](#)

Each unit can be easily reached through the vertical navigation menu located at the left hand side of the page. Current unit selection is highlighted in separate color.



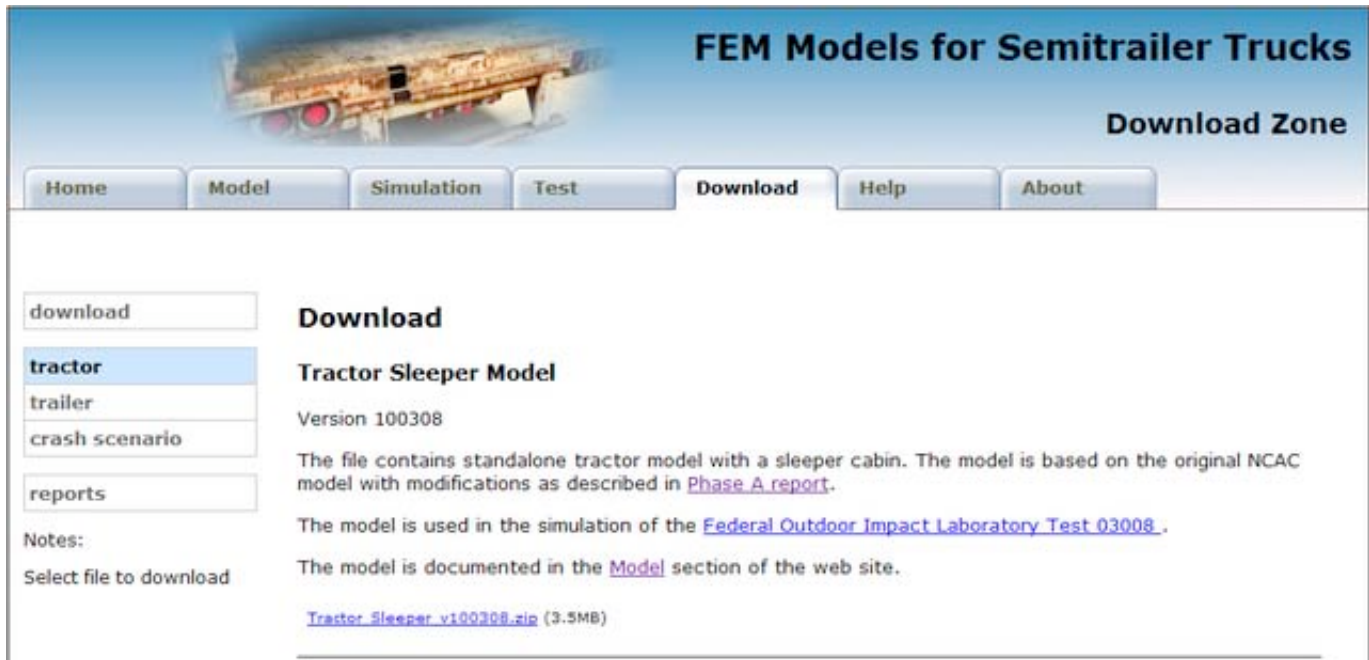
The screenshot shows the website interface for 'FEM Models for Semitrailer Trucks'. At the top, there is a header with a truck image and the title 'FEM Models for Semitrailer Trucks' and 'Download Zone'. Below the header is a horizontal navigation menu with buttons for 'Home', 'Model', 'Simulation', 'Test', 'Download', 'Help', and 'About'. The 'Download' button is highlighted. On the left side, there is a vertical navigation menu with buttons for 'download', 'tractor', 'trailer', 'crash scenario', and 'reports'. The 'download' button is highlighted. The main content area is titled 'Download' and 'Download models and reports'. It contains the following text: 'Here you can download the FEM models and reports for the project. The available FEM models are: 1. standalone models for tractors and trailers 2. crash scenario models'. Below this, there is a paragraph: 'The standalone models for tractors and trailers have different wheelbases and lengths as needed for simulations of the tests. The standalone models are documented in the [Model](#) section of the web site. The line numbers in the files correspond to the lines shown in the documentation.'

### **Download**

The Download's opening section gives inside into the organization of the material available to the general public for download. It also contains elementary instruction on how to set up downloadable FEM models for a simulated crash scenario with LS-DYNA.

### **Tractor**

Standalone tractor FEM models can be reached through the Download's Tractor section. Additional links navigate to the model description in one of the project reports, to the on-line model documentation, and to an actual full-scale crash test whose simulation was done in part with that particular FEM model.



The screenshot shows the 'Download Zone' section of the 'FEM Models for Semitrailer Trucks' website. At the top, there is a navigation menu with buttons for Home, Model, Simulation, Test, Download (which is highlighted), Help, and About. Below the menu, on the left, is a sidebar with a search box containing 'download' and a list of categories: tractor (highlighted), trailer, crash scenario, reports, and Notes: Select file to download. The main content area is titled 'Download' and features the 'Tractor Sleeper Model' section. This section includes the version number '100308', a description of the model based on the original NCAC model with modifications, and a link to a 'Phase A report'. It also mentions the model's use in the 'Federal Outdoor Impact Laboratory Test 03008' and provides a link to the 'Model' section of the website. At the bottom of the section, there is a link to 'Tractor Sleeper v100308.zip (3.5MB)'.

## Trailer

Standalone semitrailer FEM models can be reached through the Download's Trailer section. Additional links navigate to the on-line model documentation, and to an actual full-scale crash test whose simulation was done in part with that particular FEM model.

## Crash scenario

All necessary files required to run in LS-DYNA any of the performed simulations can conveniently be reached through the Download's Crash scenario section. Each crash scenario grouping includes tractor, trailer, ballast, barrier, tractor-semitrailer coupling, and gravity initialization files. A link at the top of each file grouping navigates to the corresponding full-scale test, while a link at the bottom of each file grouping navigates to the corresponding simulation.

[00Main500x.zip](#) (557B)

[01b Initial-stress.zip](#) (547KB)

[01c AirideTractor45psi.zip](#) (7.6KB)

[02a SemiTrailer45 10-0621 TTI7069-13.zip](#) (6.0MB)

[02c AirRideTrailer45psi.zip](#) (1.2KB)

[15TL-5 Median Barrier Elastic.zip](#) (1.4MB)

[15contact-trailer2.zip](#) (624B)

[01a Trac Sleepr 10-0308.zip](#) (3.0MB)

[01b initial-stress Tractor.zip](#) (547KB)

[01c AirideTractor60psi.zip](#) (7.6KB)

[02b TrailerMaterials 2010-0217.zip](#) (9.4KB)

[03Tractor2Trailer connection.zip](#) (743B)

[15contact-tractor2010-0304.zip](#) (764B)

[20control1.zip](#) (1.2KB)

## [Simulation](#)

## Report

obtained through the Download's Report section.

## 7. Tractor-semitrailer web site help: About

The About section contains information about the institutions and the people that developed this web site. The content is organized in several units as follows:

### [About](#)

[Institutional links](#): NTRCI Battelle ORNL UTK NCAC FHWA

### [People](#)

**FEM Models for Semitrailer Trucks**

Home Model Simulation Test Download Help **About**

**About**

NTRCI  
Battelle  
ORNL  
UTK  
NCAC  
FHWA

People

Notes:  
Institution links will navigate away from this web site.

**About**

The objective of this project was to evaluate, enhance and validate computer models of a heavy vehicle (tractor-semitrailer combination) that can be used in the design and evaluation of roadside safety hardware. The computer models were developed for [LS-DYNA](#) simulations.

This project was performed under the direction of the National Transportation Research Center, Inc. ([NTRCI](#)) for the U.S. Department of Transportation/Federal Highway Administration ([FHWA](#)) as a collaborative effort by:

- Battelle Memorial Institute ([BMI](#))
- Oak Ridge National Laboratory ([ORNL](#))
- The University of Tennessee ([UTK](#))

This project was funded by the [NTRCI](#) University Transportation Center under a grant from the U.S. Department of Transportation Research and Innovative Technology Administration (#DTRT06G-0043).

For more information about this web site, please contact [Srdjan Simunovic](#), [ORNL](#).

...

[Back](#) | [Forward](#)

Each unit can be easily reached through the vertical navigation menu located at the left hand side of the page. Current unit selection is highlighted in separate color.

### ***About***

The opening About section gives concise information on the project objective and the institutions that initiated and supported the realization of the project. Available links throughout the text navigate to external sources for additional information.

### ***Institutional links***

Institutional links grouped in a separate section in the vertical navigation menu navigate to the web sites of the institutions that were involved in the project realization.

### ***People***

the About People section.