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 of 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 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 ls-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 ls-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 ls-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 ls-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

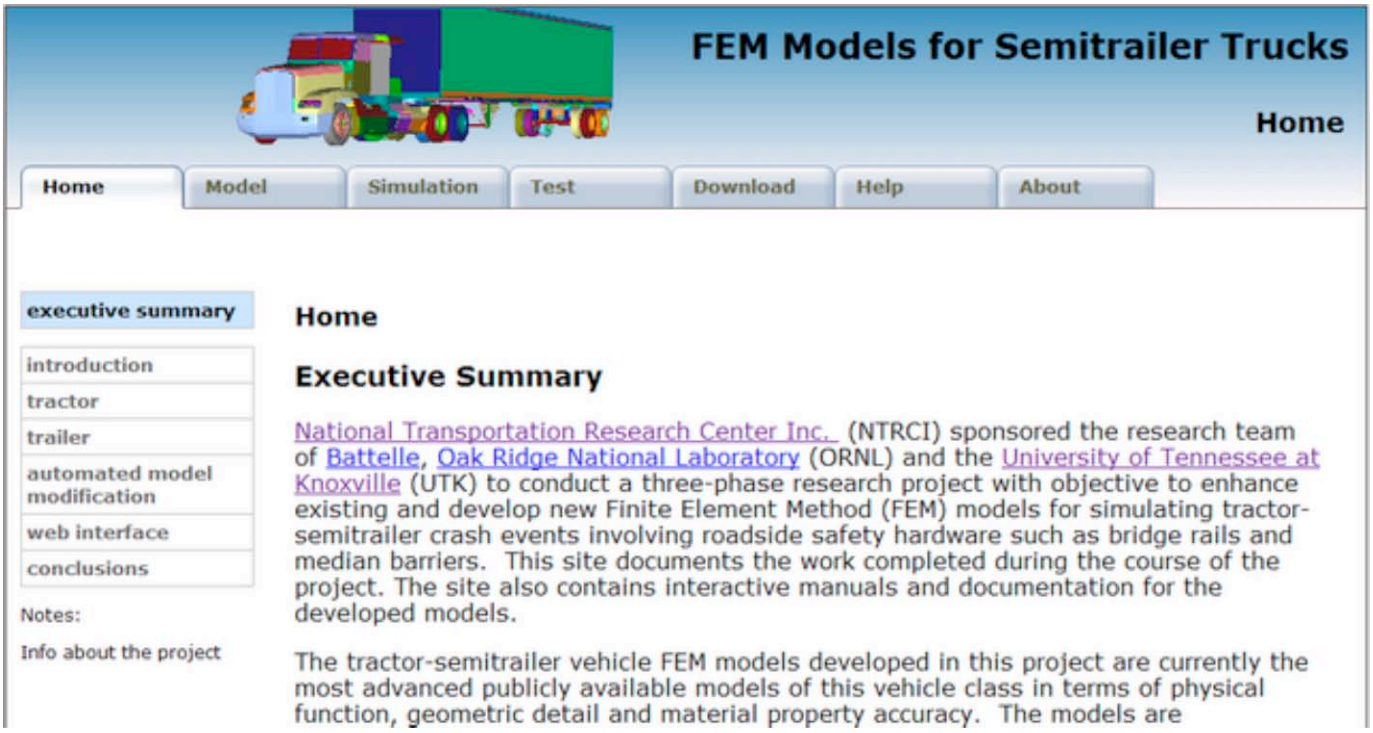
Automated model modification

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



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 trough 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 theist 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.

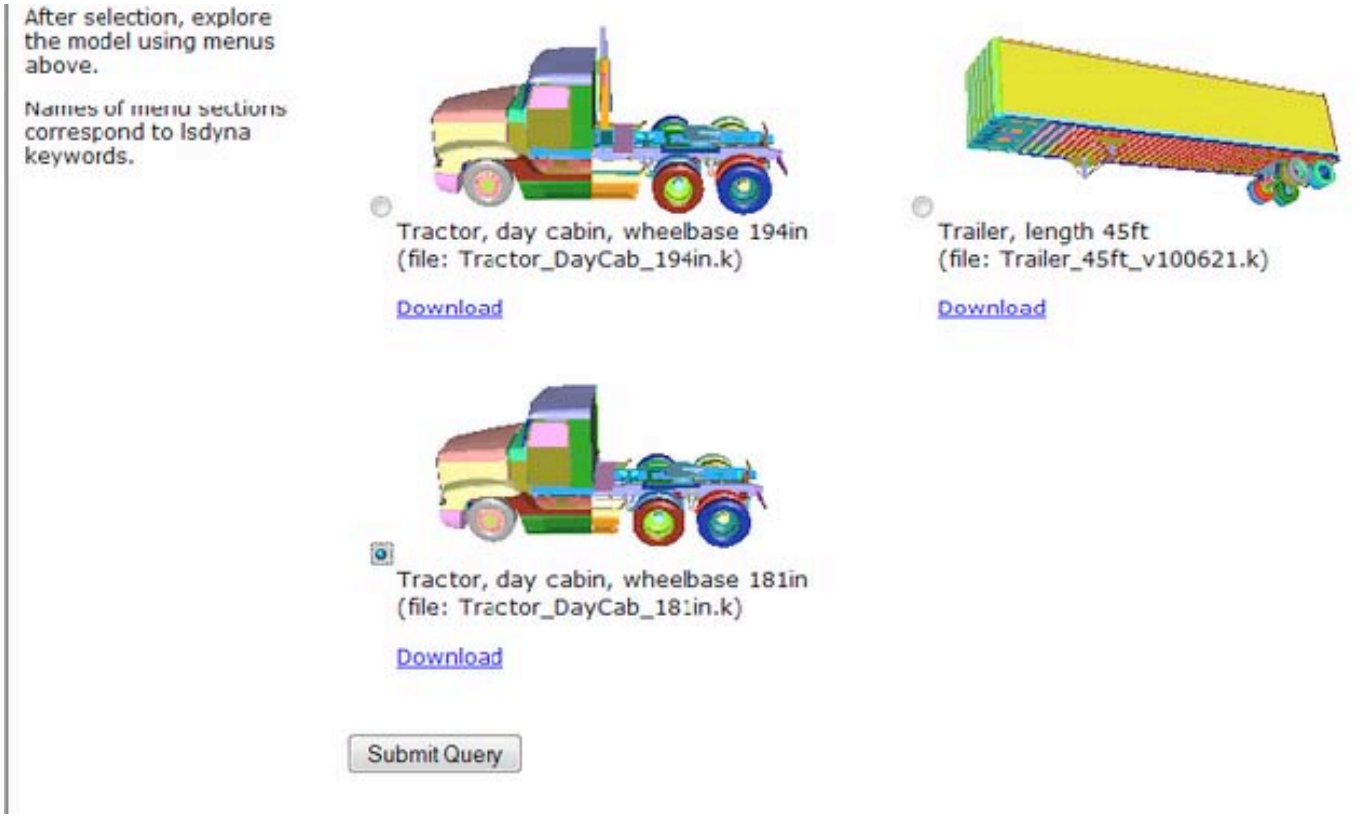
3.1 Tractor-semitrailer web site help: Model/Select

The Select section located in the drop line menu under the horizontal menu's Model tab offers model selecton 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.

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.



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.

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 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.

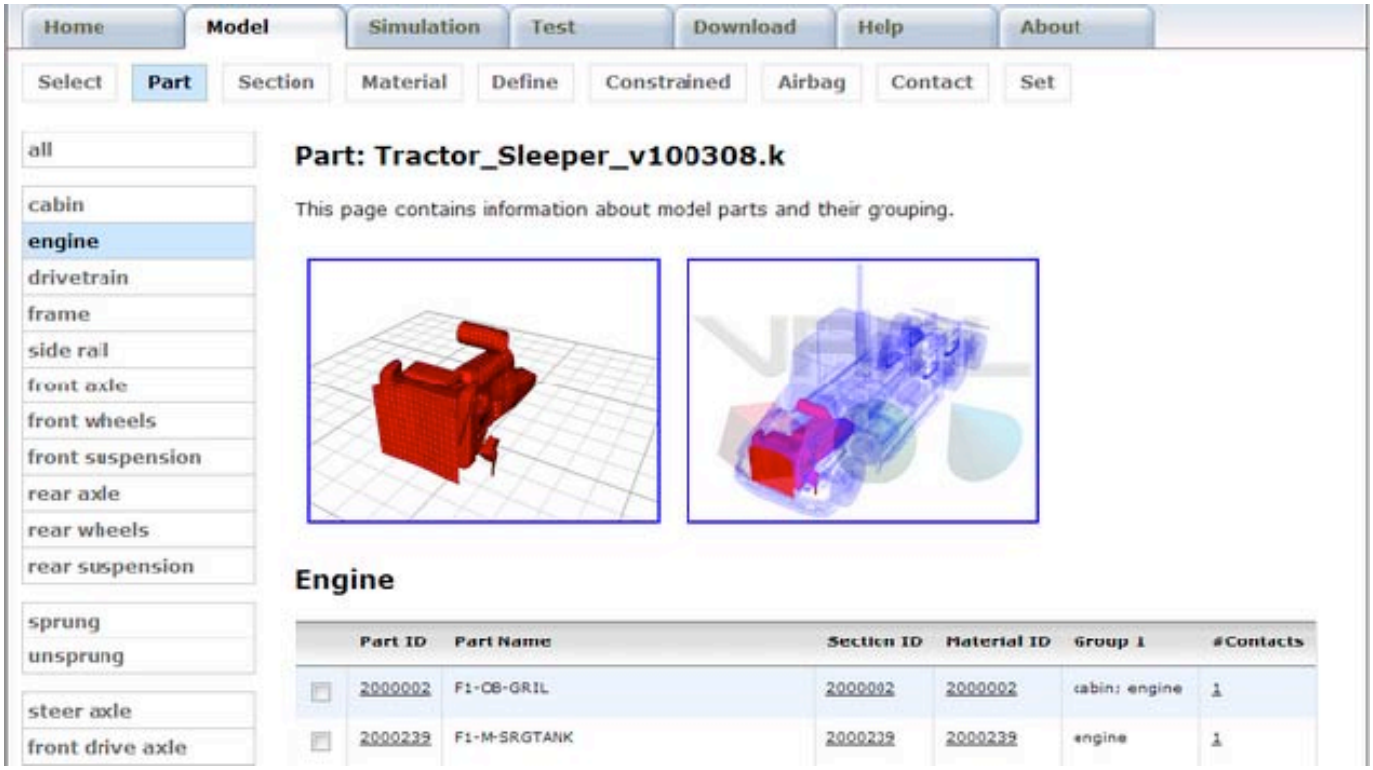
Each part group is visually presented with images and an interactive 3D display, which are accessible through corresponding image links located side-by-side in the main page area below the title.

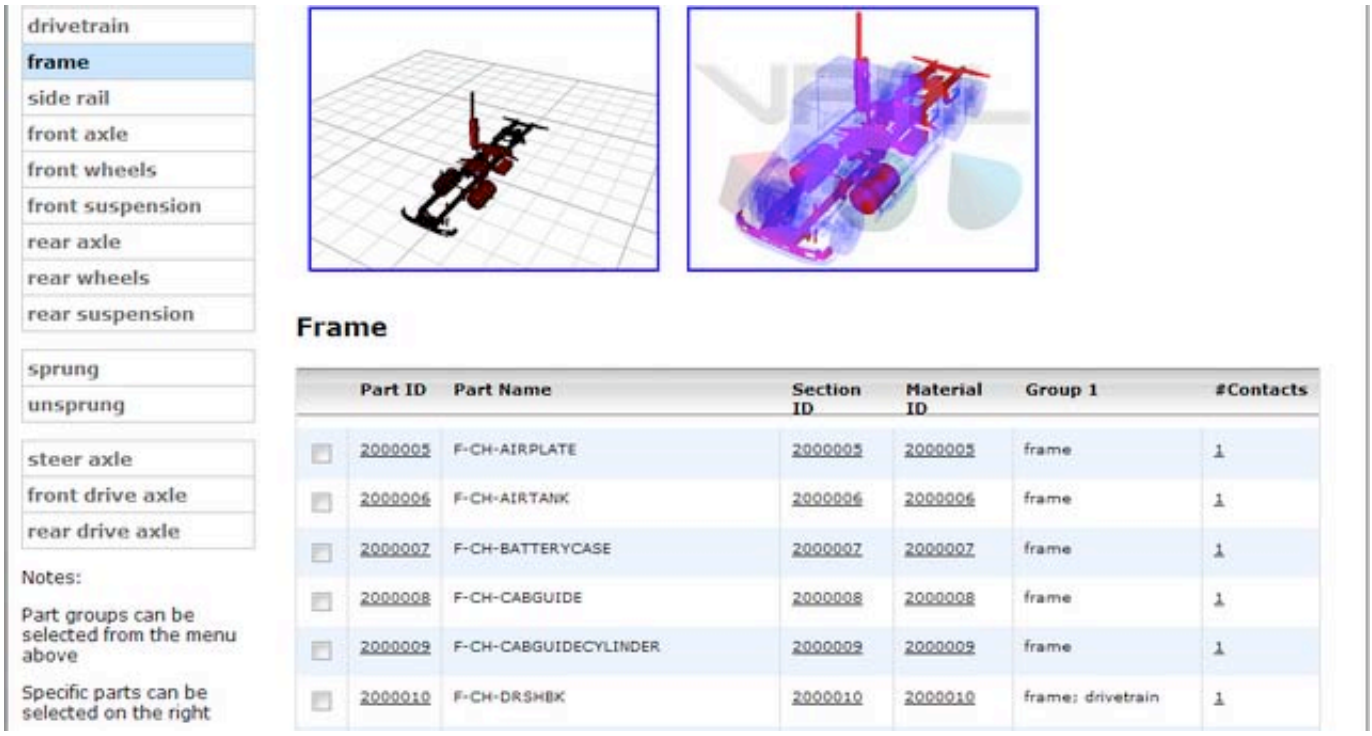
Group images

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

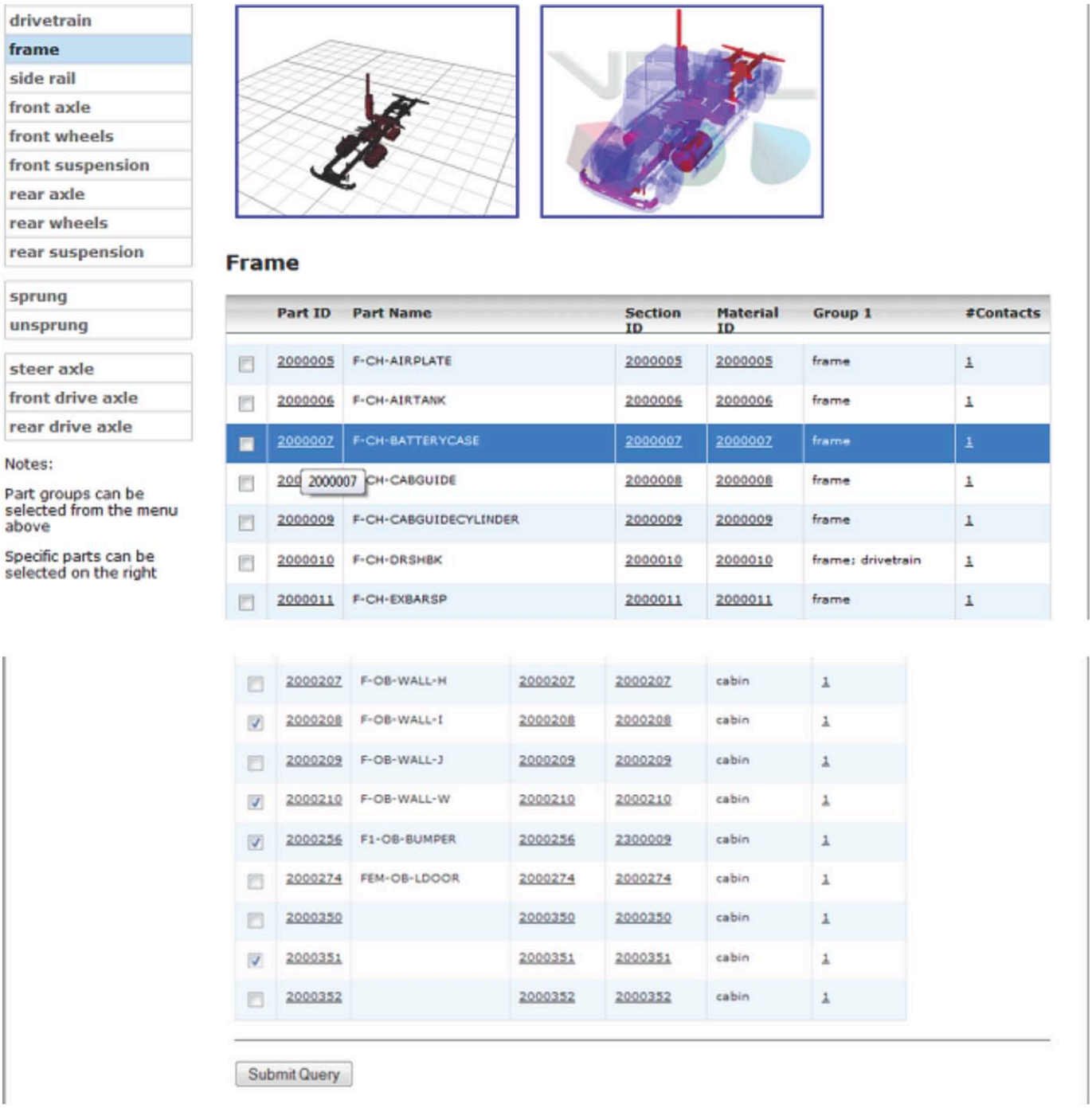
The right-hand side image, distinguishable by its faded VRML stamped background, leads to an interactive 3D display of the chosen part group in a new popup window. This option requires a proper3D plug-in to show the chosen part group in its setting in the model. Plug-in dependent controls enable model interactivity (rotation, zoom, pan, etc.).





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.

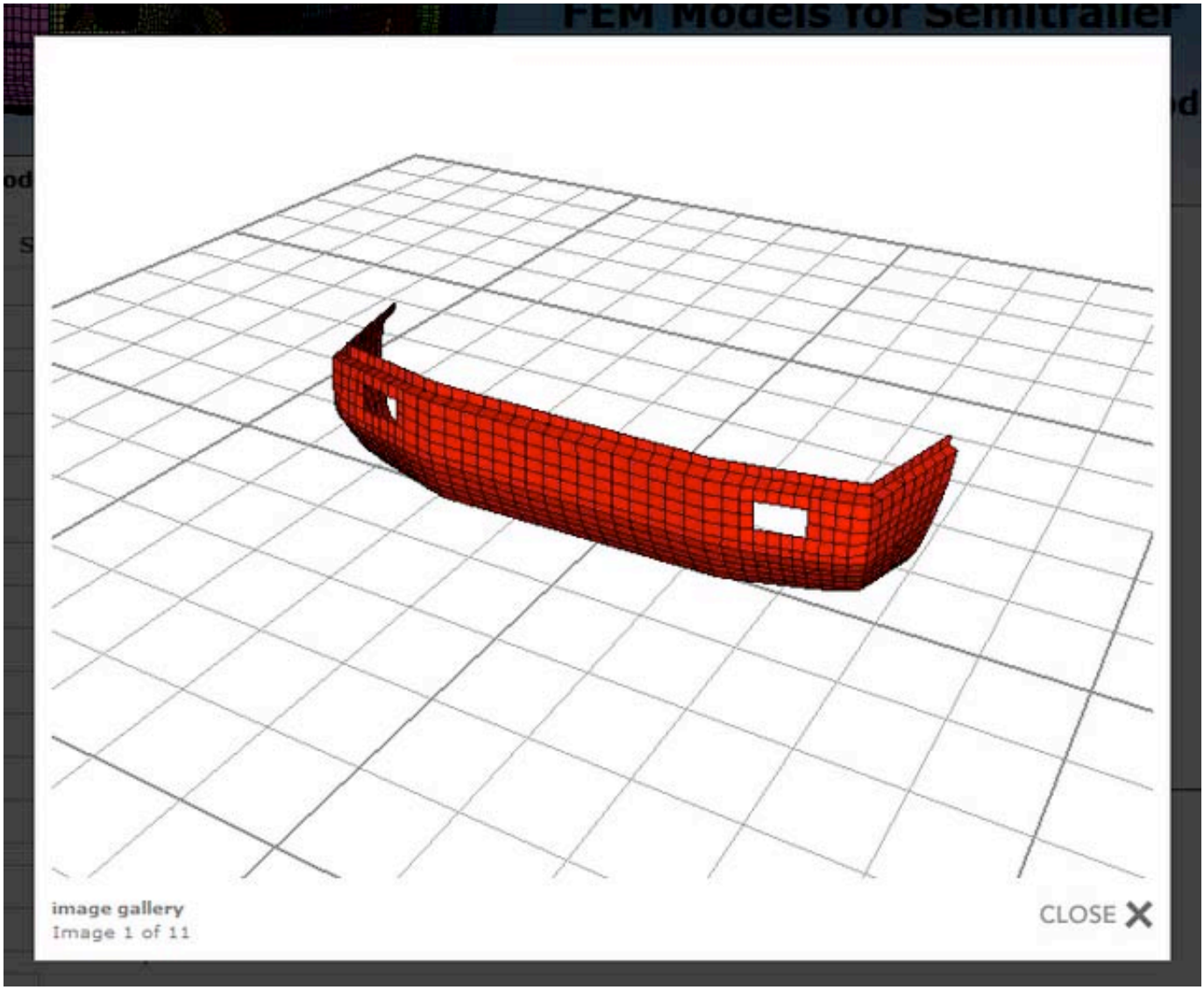


In part specifics the essential data for the chosen part(s) is accompanied with access to:

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.

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.

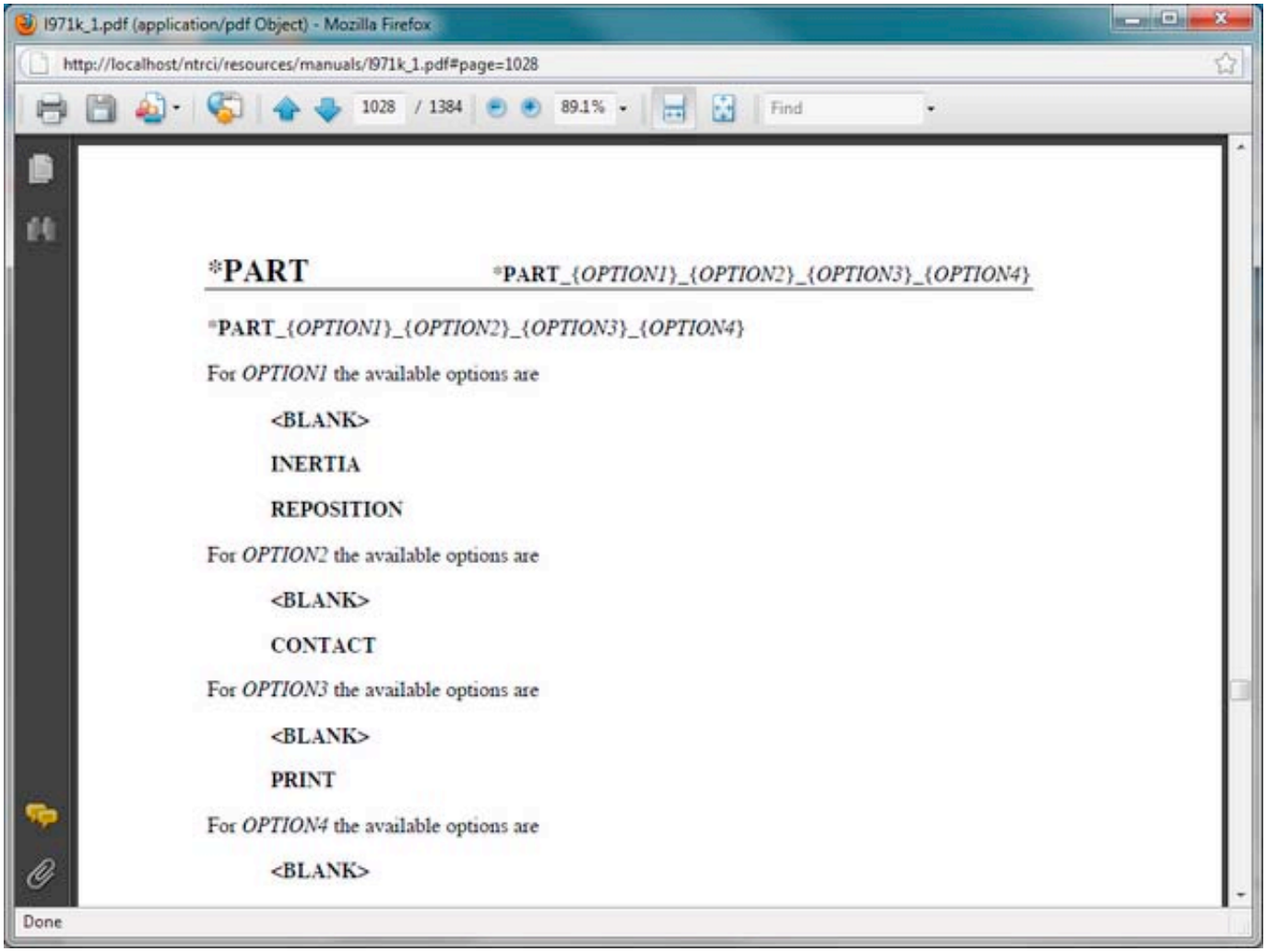
Numerous images of the chosen part can be viewed through the Images link. A popup window shows images of the part alone, and of its setting in the model taken from different



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

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.


l971k_1.pdf (application/pdf Object) - Mozilla Firefox
http://localhost/ntrci/resources/manuals/l971k_1.pdf#page=1028
1028 / 1384
89.1%
Find
*PART
*PART_{OPTION1}_{OPTION2}_{OPTION3}_{OPTION4}
*PART_{OPTION1}_{OPTION2}_{OPTION3}_{OPTION4}
For OPTION1 the available options are
<BLANK>
INERTIA
REPOSITION
For OPTION2 the available options are
<BLANK>
CONTACT
For OPTION3 the available options are
<BLANK>
PRINT
For OPTION4 the available options are
<BLANK>
Done

3.3 Tractor-semitrailer web site help: Model/Section

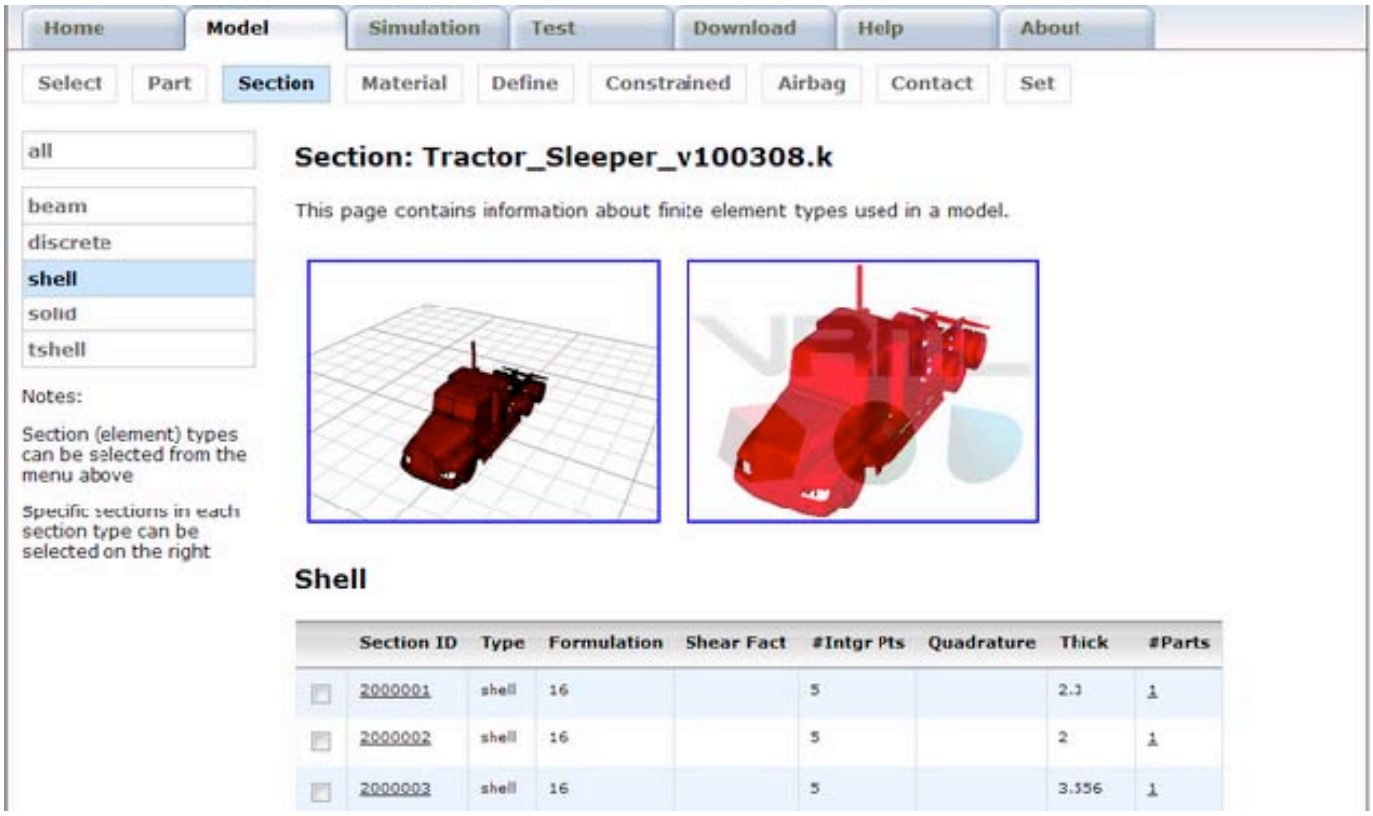
The Section unit located in the drop line menu under the horizontal menu's Model tab offers data briefs from the SECTION LS-DYNA keyword. Data queries are conducted on the selected model. Current model selection is indicated in the page title with the name of the FEM model source file name. Model selection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

The 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.

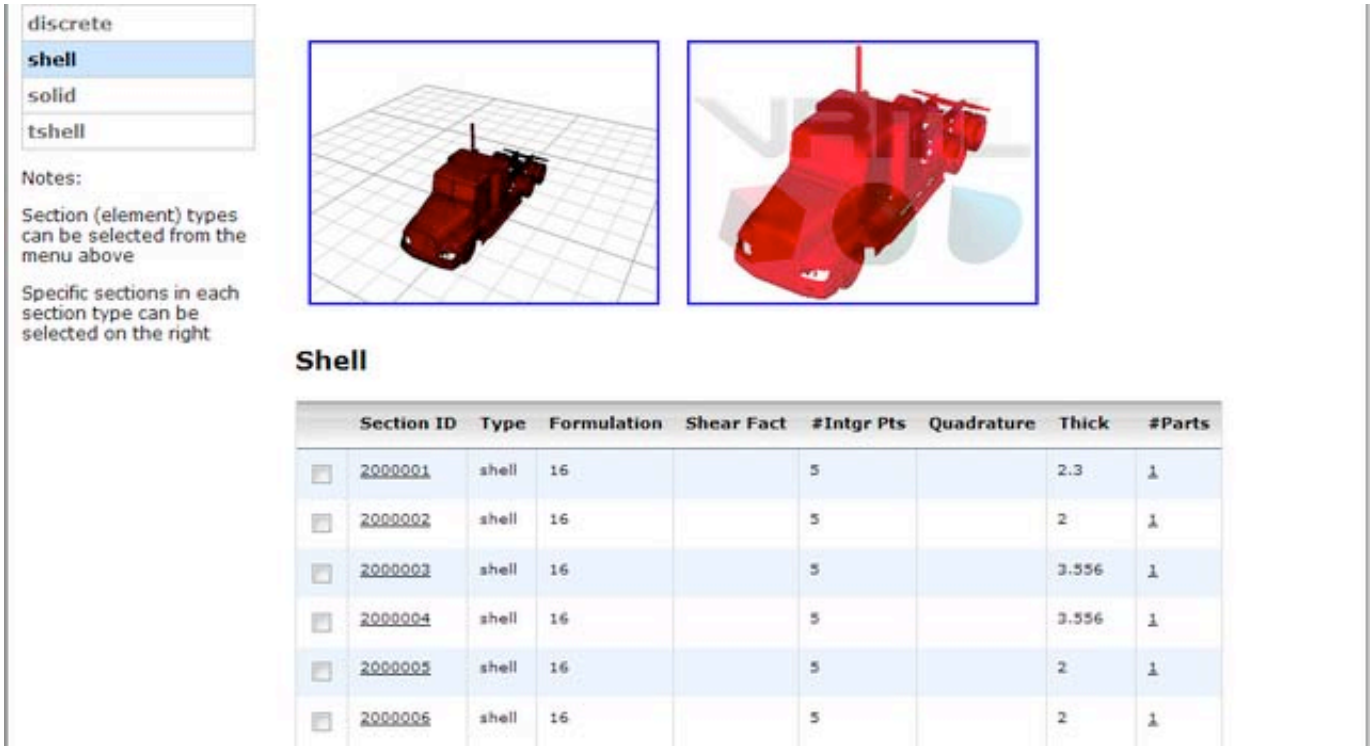
Each section group is visually presented with images and an interactive 3D display, which are accessible through corresponding image links located side-by-side in the main page area below the title.

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.

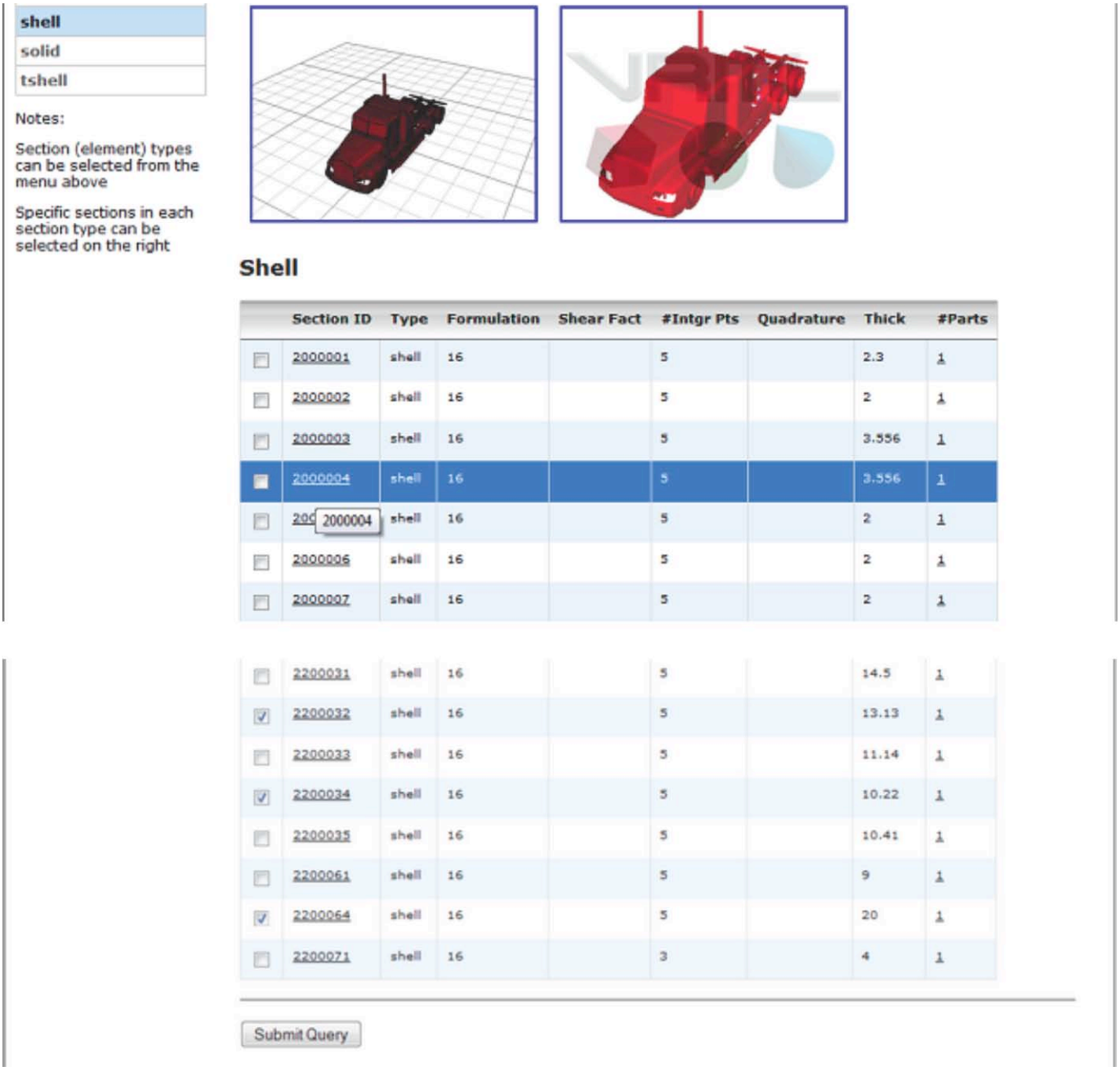
Group 3D View the right-hand side image, distinguishable by its faded VRML stamped background, leads to a new popup window with an interactive 3D display of all parts utilizing the selected section type. This option requires a proper 3D plug-in to show the model chosen part group in its setting in the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



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.

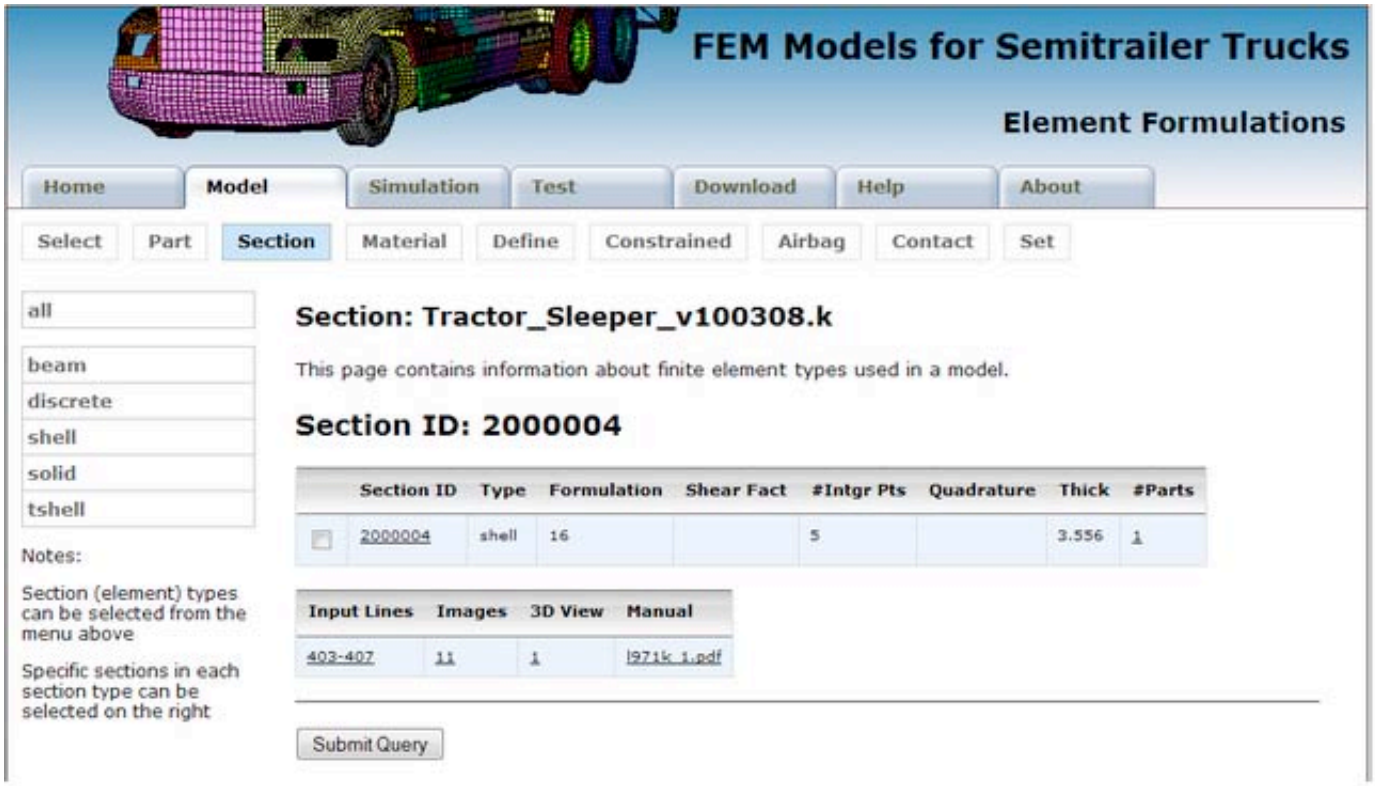


Section specifics can be reached by following the section identification number link, or by selecting the checkbox adjacent to the section identification number and then clicking on the Submit Query button located below the table(s). The latter approach is convenient for



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

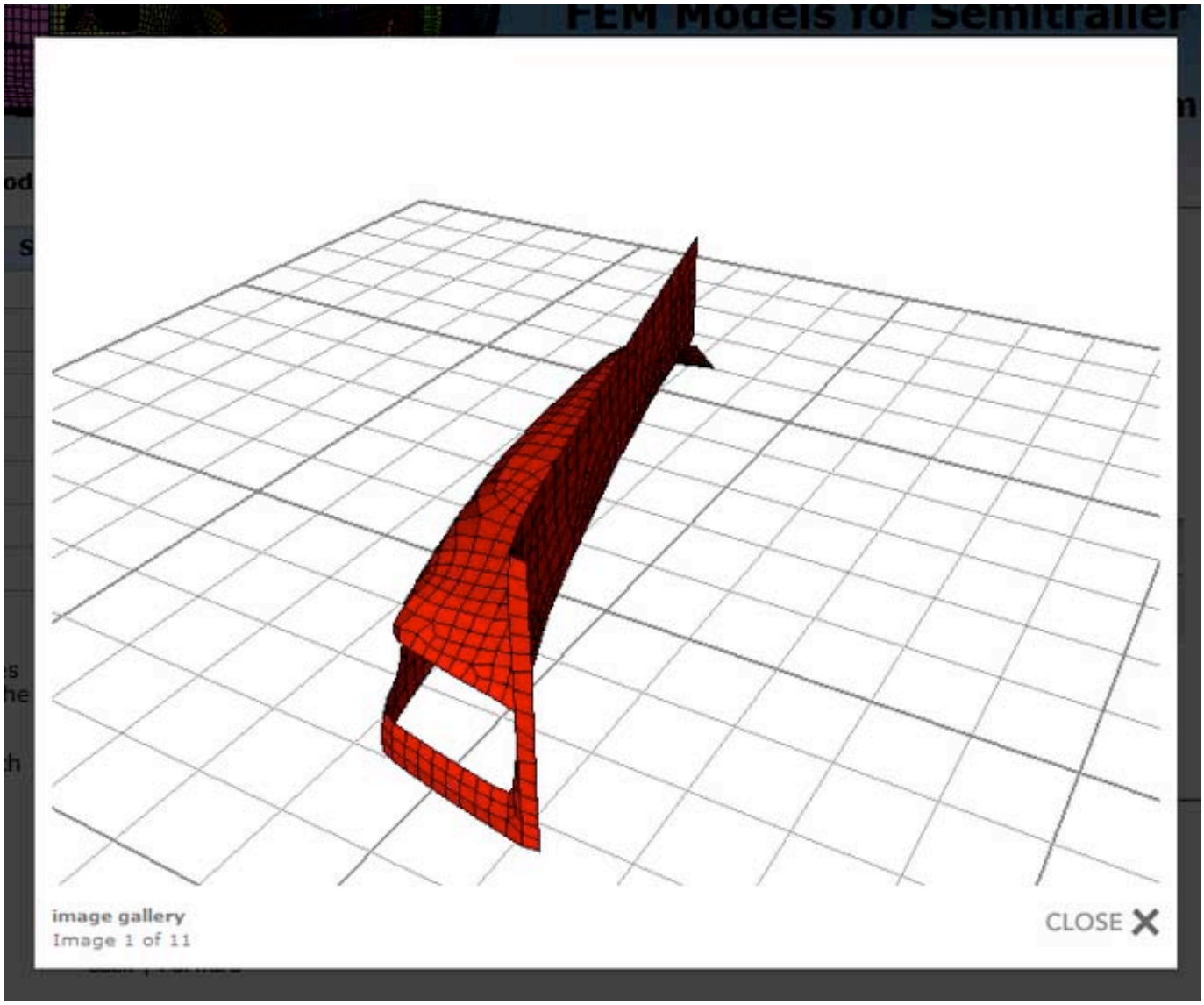
Excerpt from the FEM model source file (Input Lines),
Numerous images (standalone and in setting) of all parts featuring the chosen section,
Interactive 3D View of all parts featuring the chosen section, and
LS-DYNA's User's Manual displaying the chosen keyword entry.



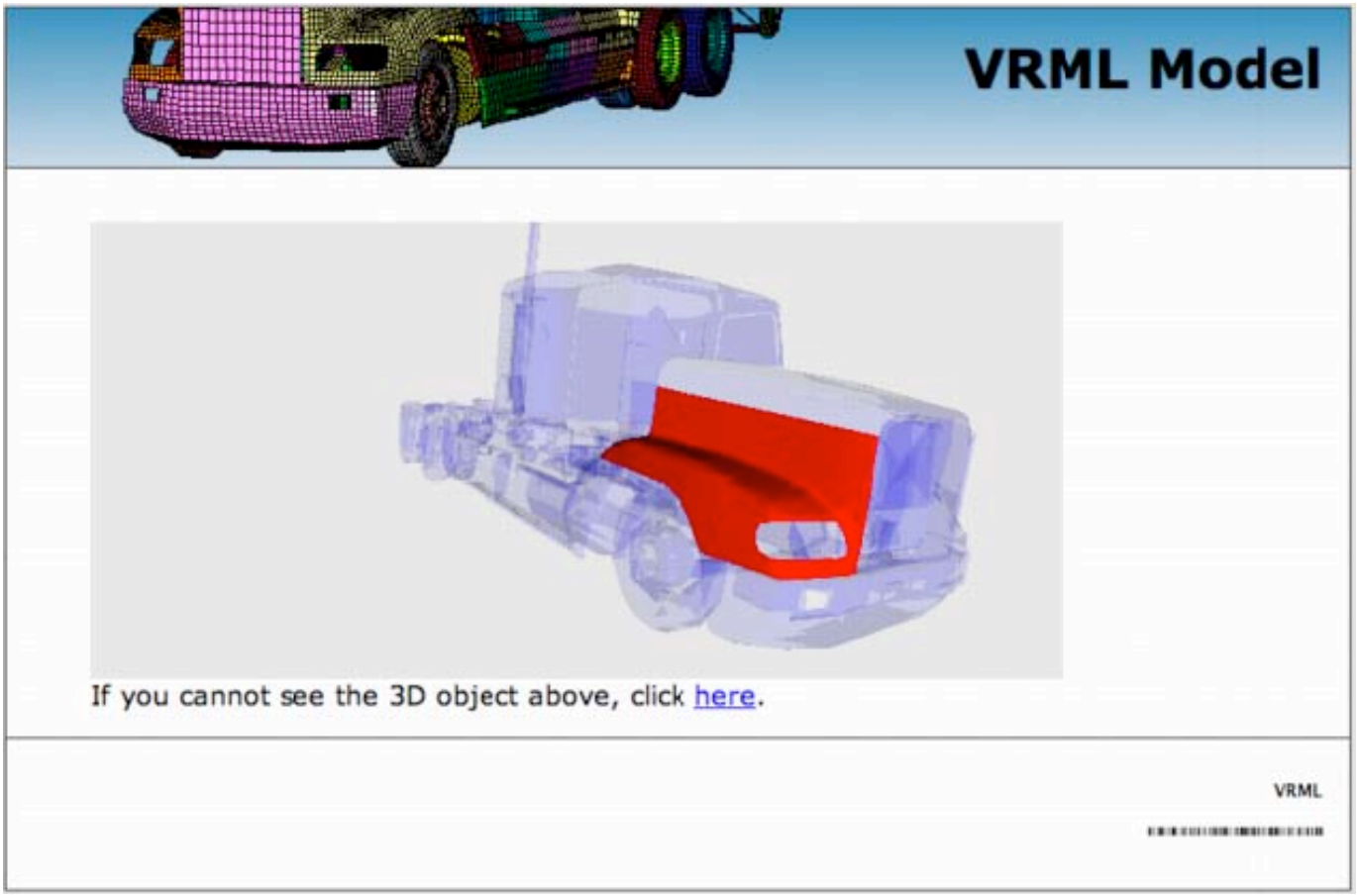
Excerpt from the FEM model source file containing the chosen section entry is accessible through the Input Lines link. A popup window shows the chosen section entry conveniently numbered such that numbers correspond to the FEM model source file lines.

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

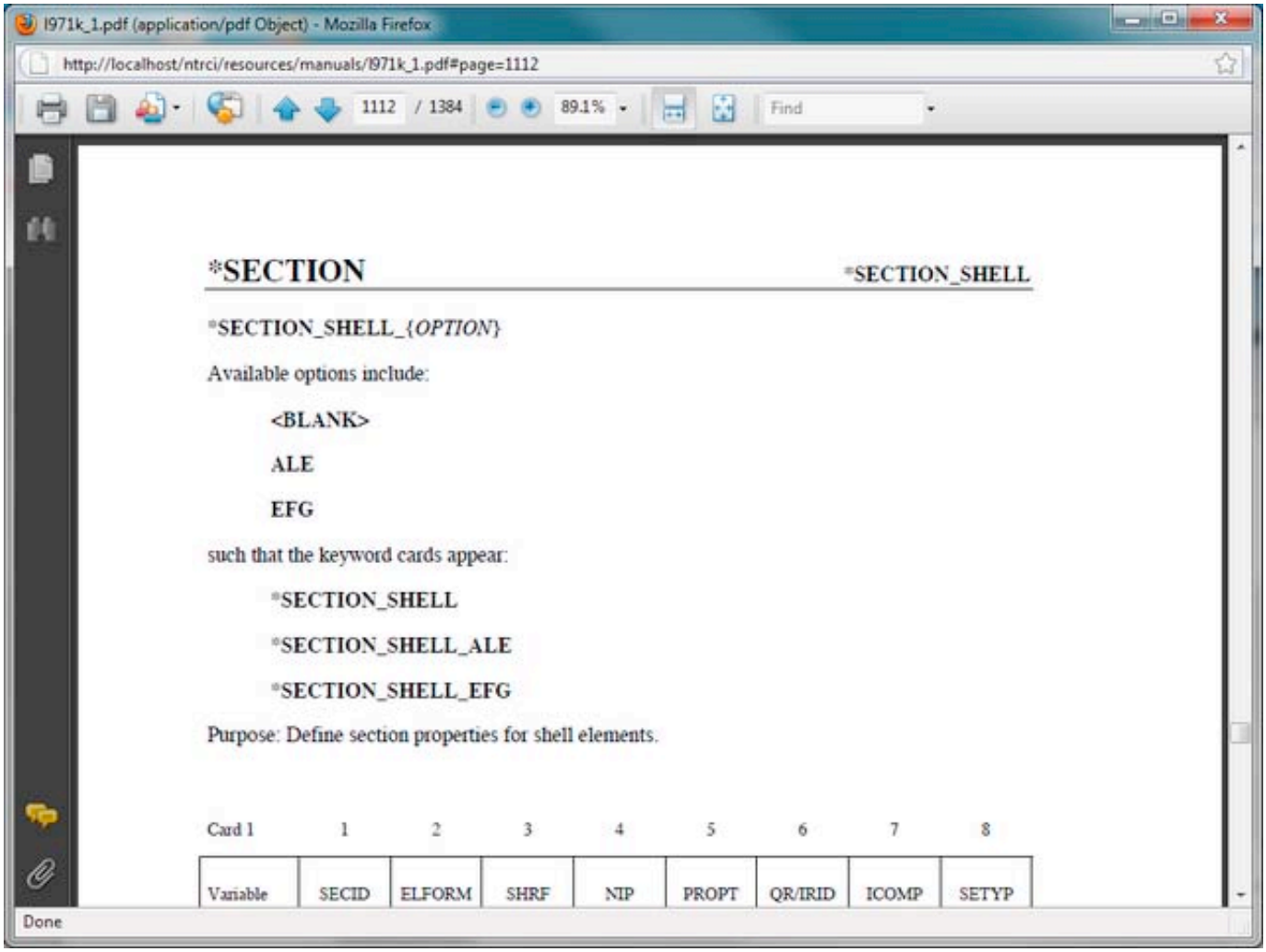
Images can be navigated by clicking inside the image on its left-hand and right-hand side, by clicking on the Previous and Next links that appear on mouse over the image event, by pressing the P and L letters on the keyboard, or by pressing the left and right keyboard arrows. The image window can be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

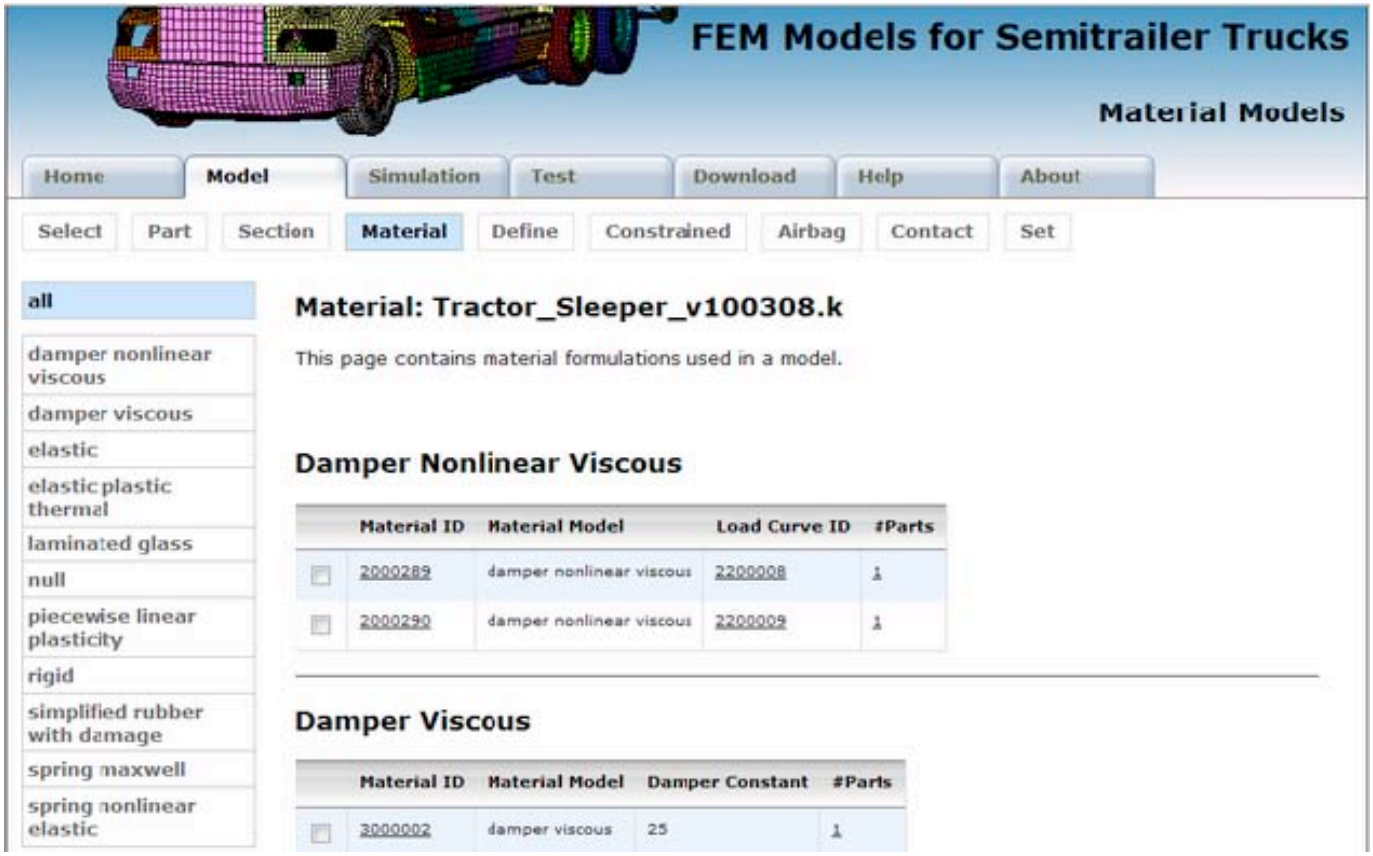


Help from the LS-DYNA User's Manual can be reached through the Manual link. A popup window opens the manual at the specific keyword entry. A pdf reader is required for viewing.


l971k_1.pdf (application/pdf Object) - Mozilla Firefox
http://localhost/ntrci/resources/manuals/l971k_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.



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.

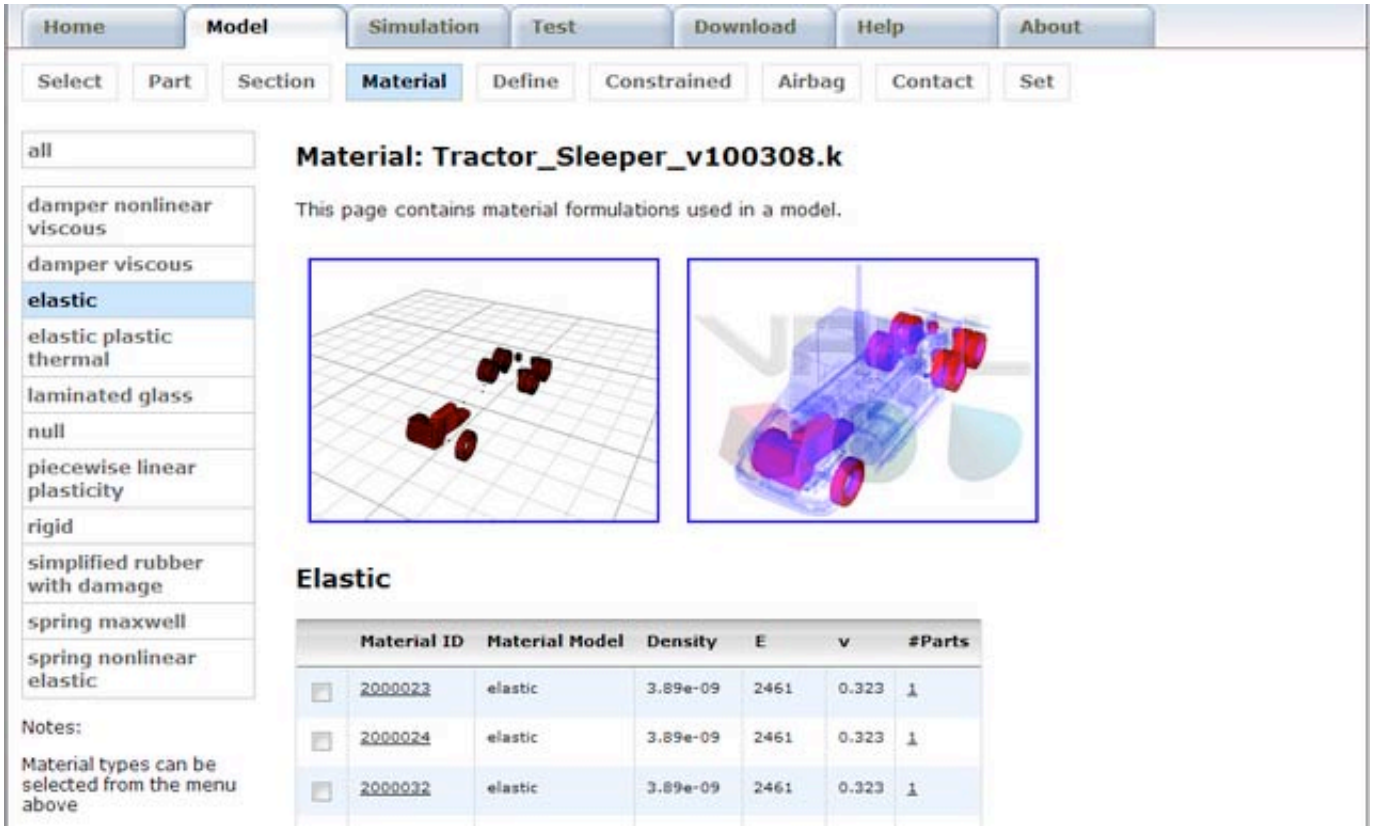
Each material group is visually presented with images and an interactive 3D display, which are accessible through corresponding image links located side-by-side in the main page area below the title.

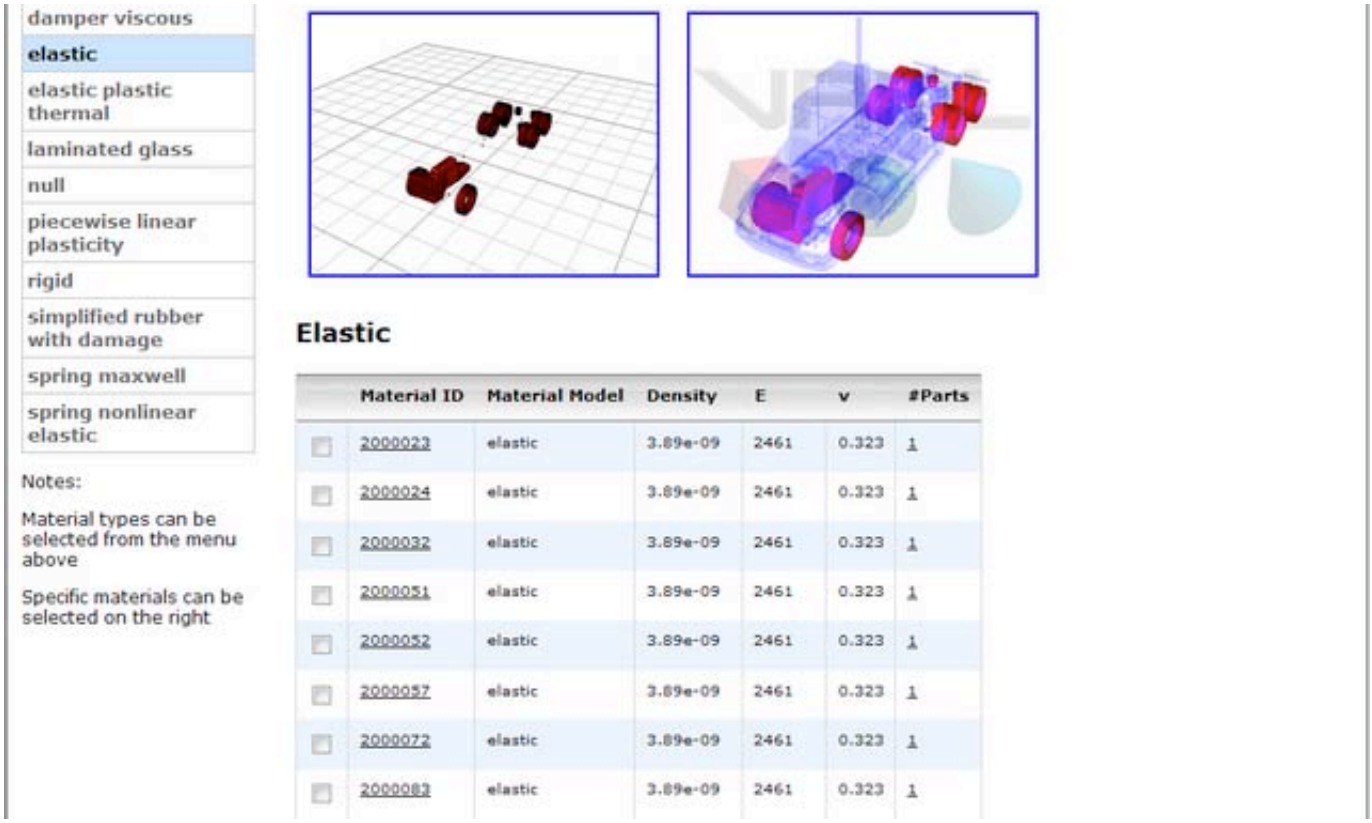
Group images

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.

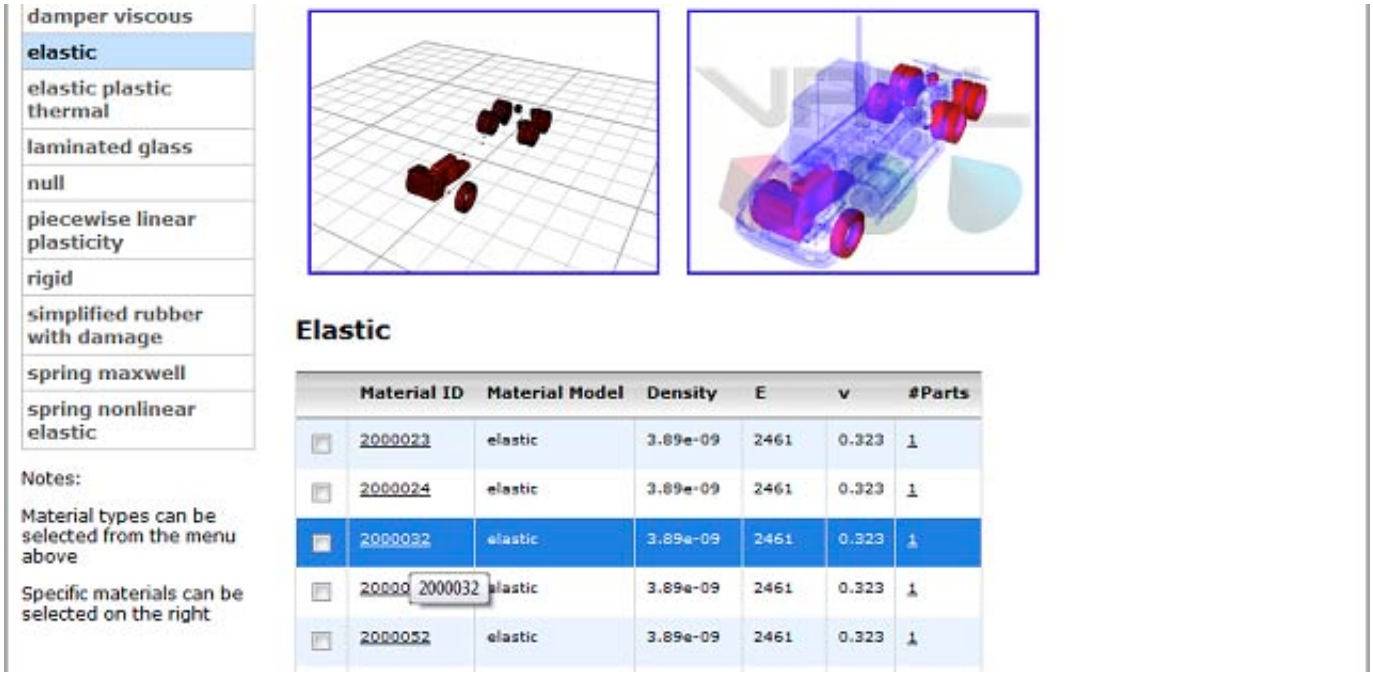
Group 3D View

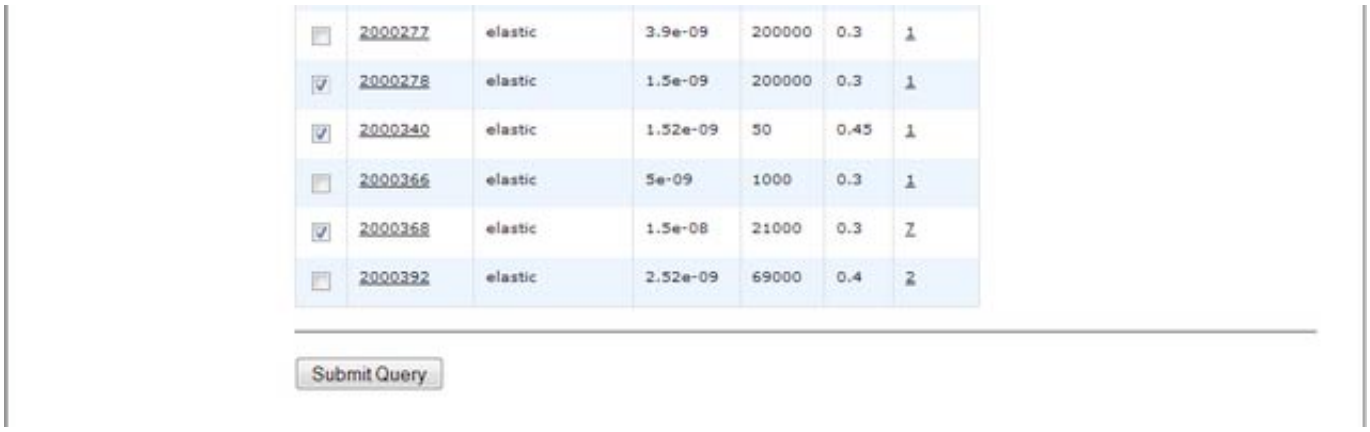
The right-hand side image, distinguishable by its faded VRML stamped background, leads to a new popup window with an interactive 3D display of all parts utilizing the selected material type. This
Option requires a proper 3D plug-in to show the model chosen part group in its setting in the model. Plug-in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





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.



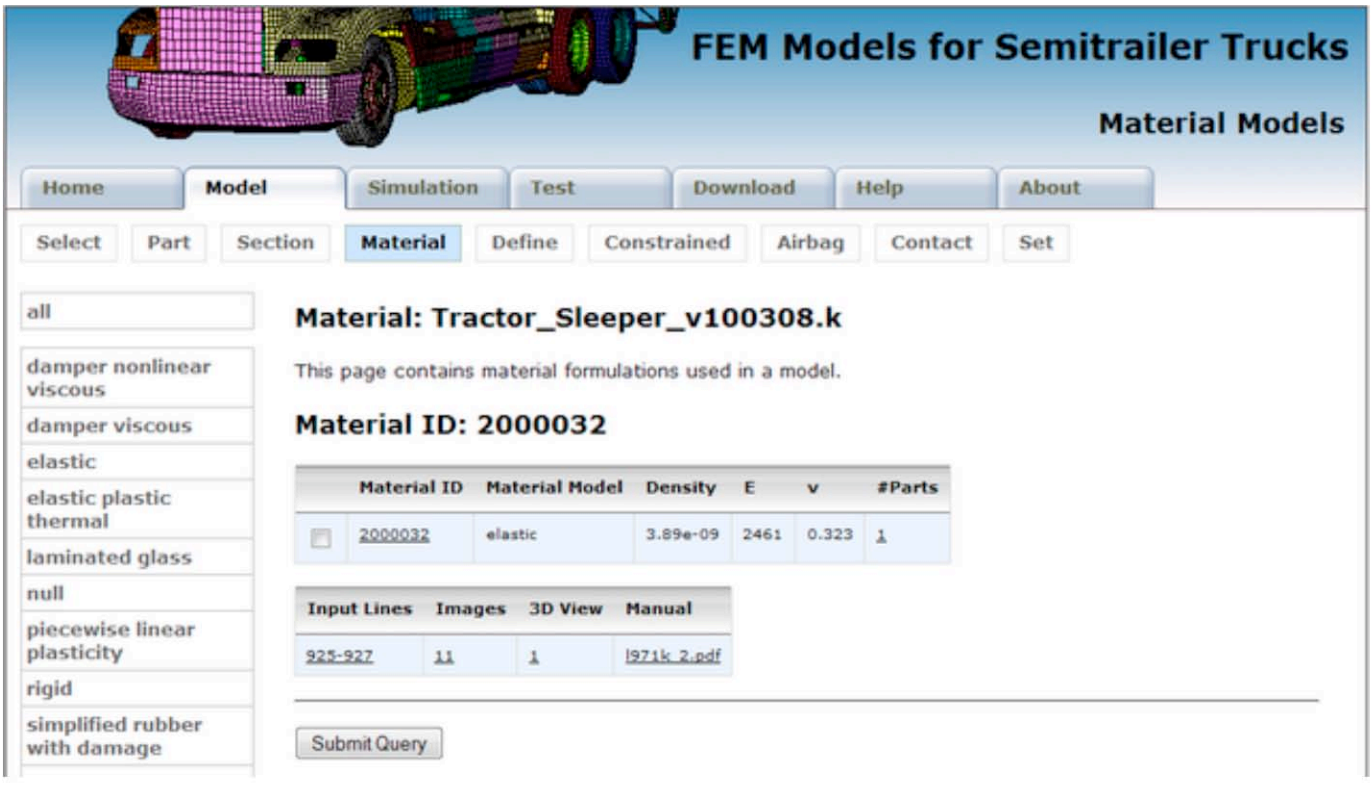


☐	2000277	elastic	3.9e-09	200000	0.3	1
☑	2000278	elastic	1.5e-09	200000	0.3	1
☑	2000340	elastic	1.52e-09	50	0.45	1
☐	2000366	elastic	5e-09	1000	0.3	1
☑	2000368	elastic	1.5e-08	21000	0.3	7
☐	2000392	elastic	2.52e-09	69000	0.4	2

Submit Query

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

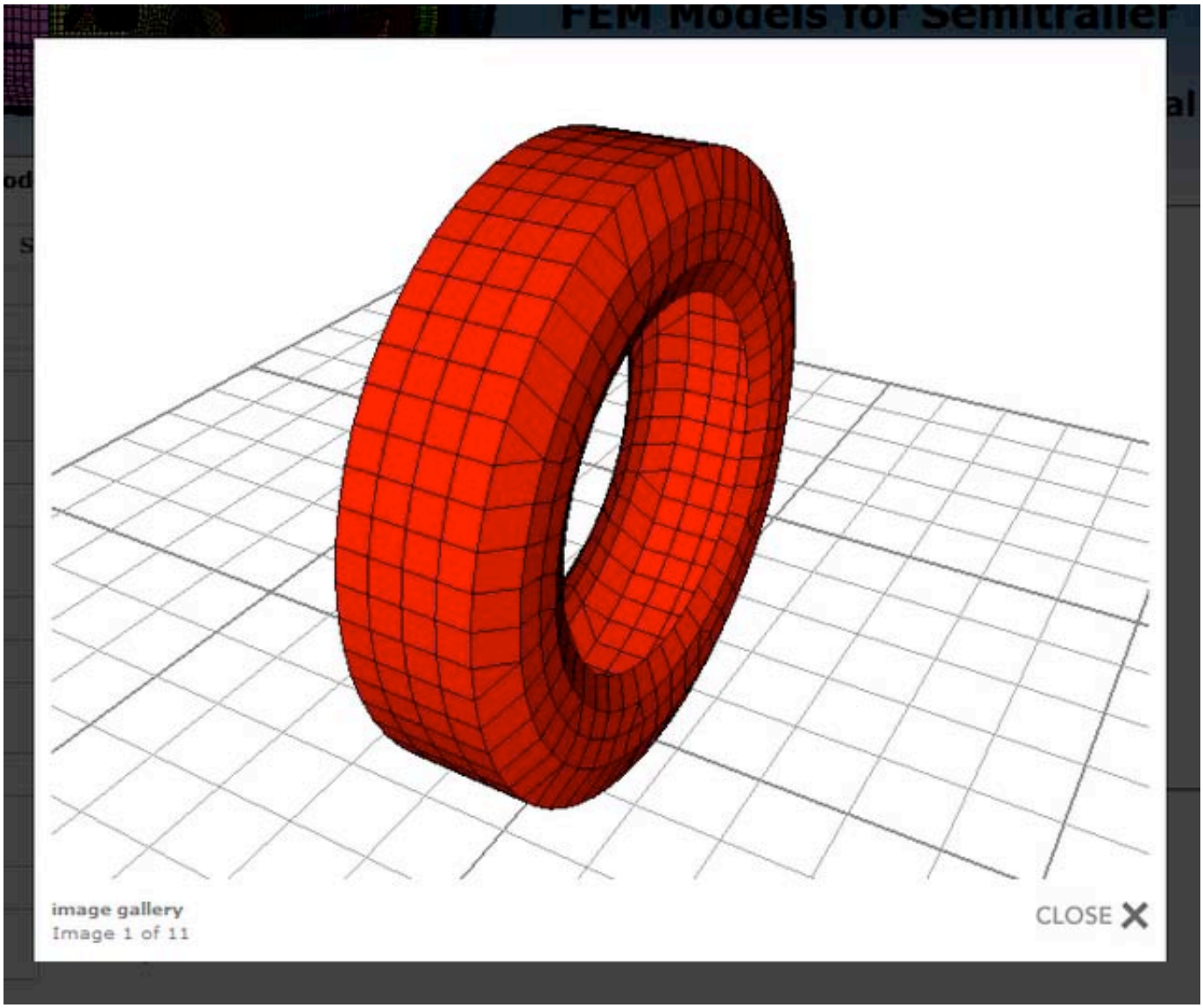
Excerpt from the FEM model source file (Input Lines),
Numerous images (standalone and in setting) of all parts featuring the chosen material,
Interactive 3D View of all parts featuring the chosen material, and
LS-DYNA's User's Manual displaying the chosen keyword entry.



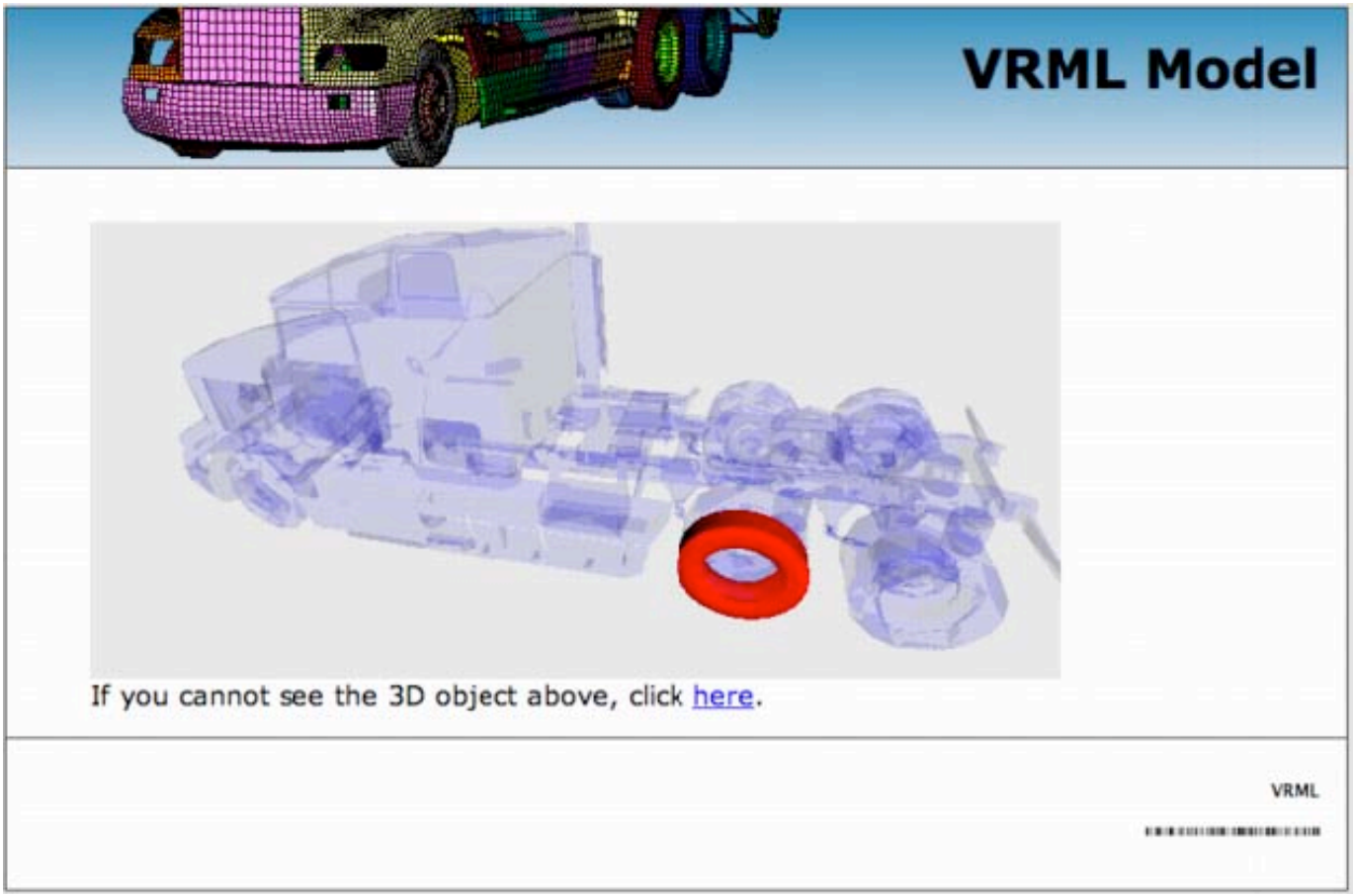
Excerpt from the FEM model source file containing the chosen material entry is accessible through the Input Lines link. A popup window shows the chosen material entry conveniently numbered such that numbers correspond to the FEM model source file lines.

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.

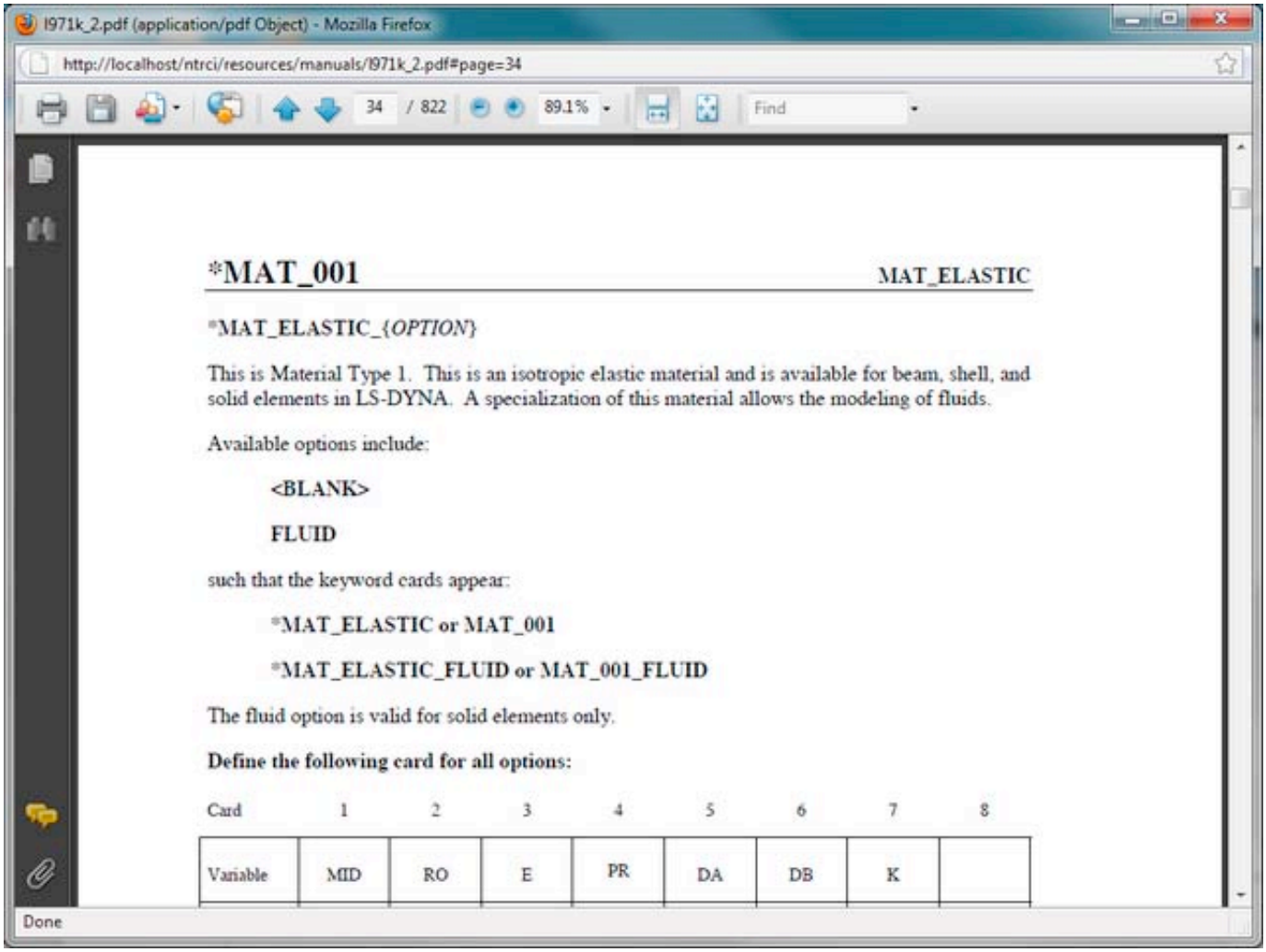
Images can be navigated by clicking inside the image on its left-hand and right-hand side, by clicking on the Previous and Next links that appear on mouse over the image event, by pressing the P and L letters on the keyboard, or by pressing the left and right keyboard arrows. The image window can be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

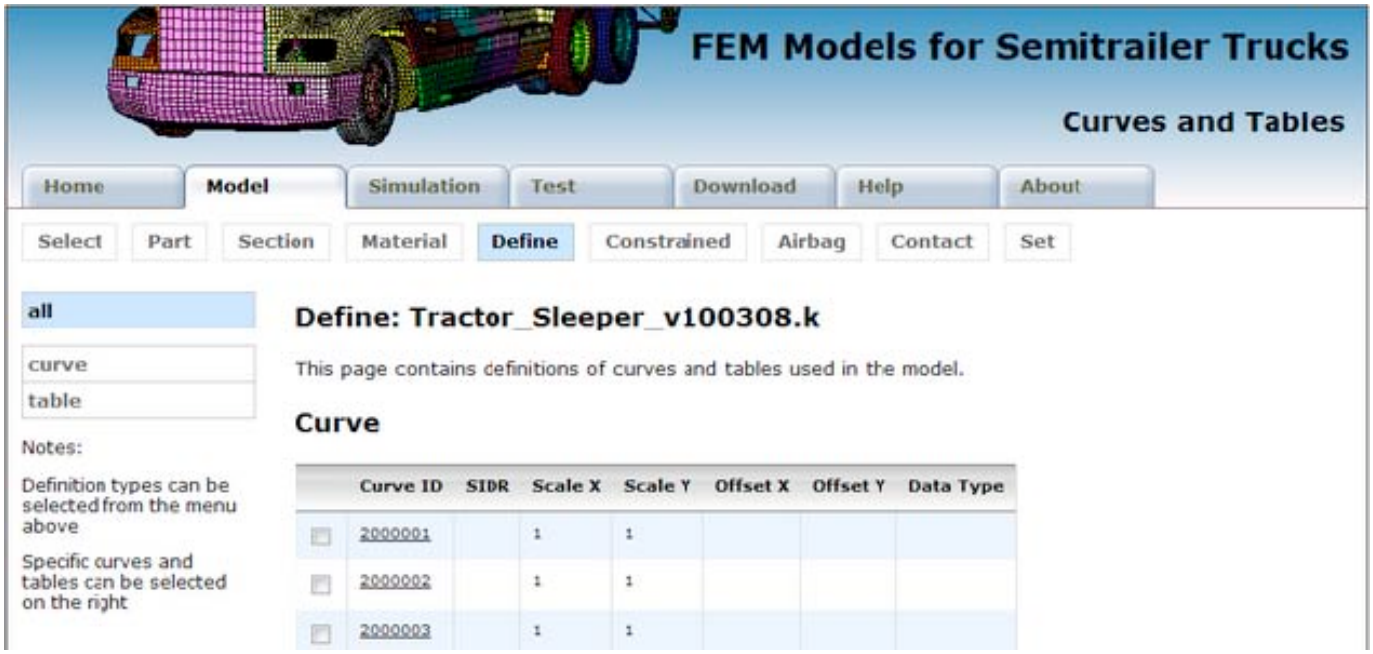


Help from the LS-DYNA User's Manual can be reached through the Manual link. A popup window opens the manual at the specific keyword entry. A pdf reader is required for viewing.


l971k_2.pdf (application/pdf Object) - Mozilla Firefox
http://localhost/ntrci/resources/manuals/l971k_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

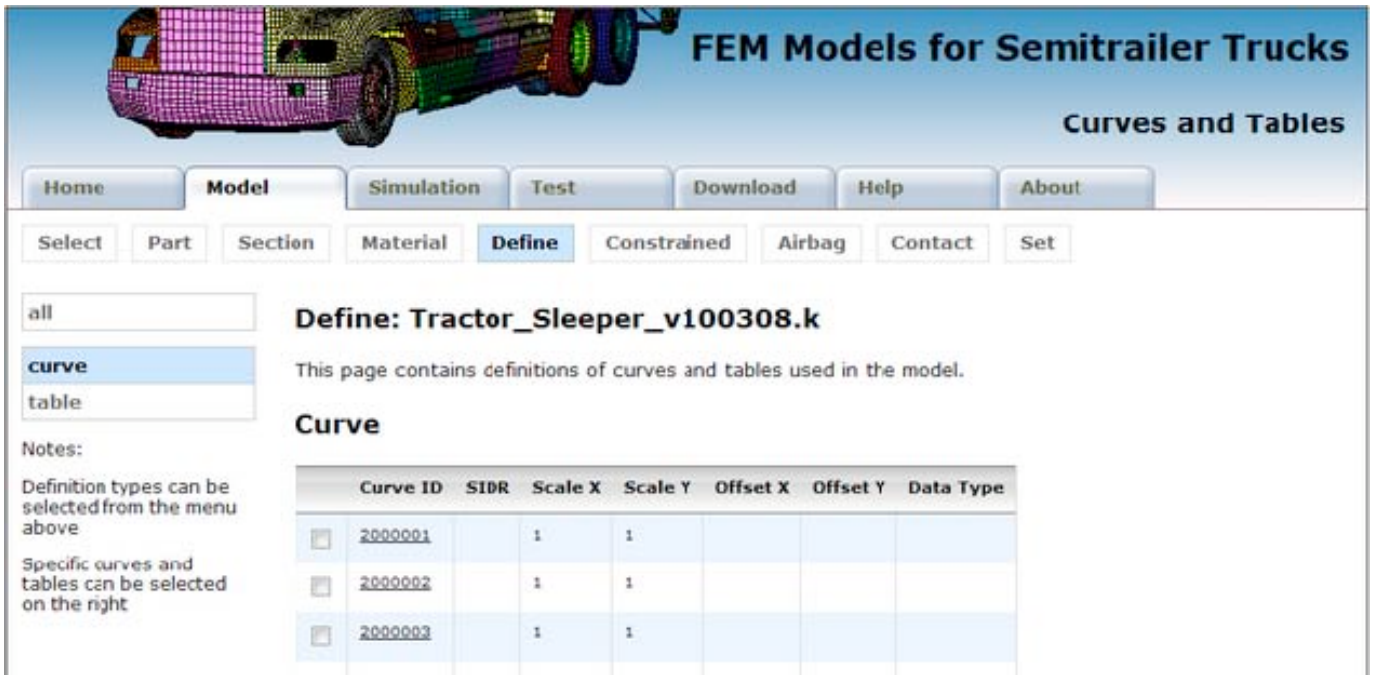
3.5 Tractor-semitrailer web site help: Model/Define

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.

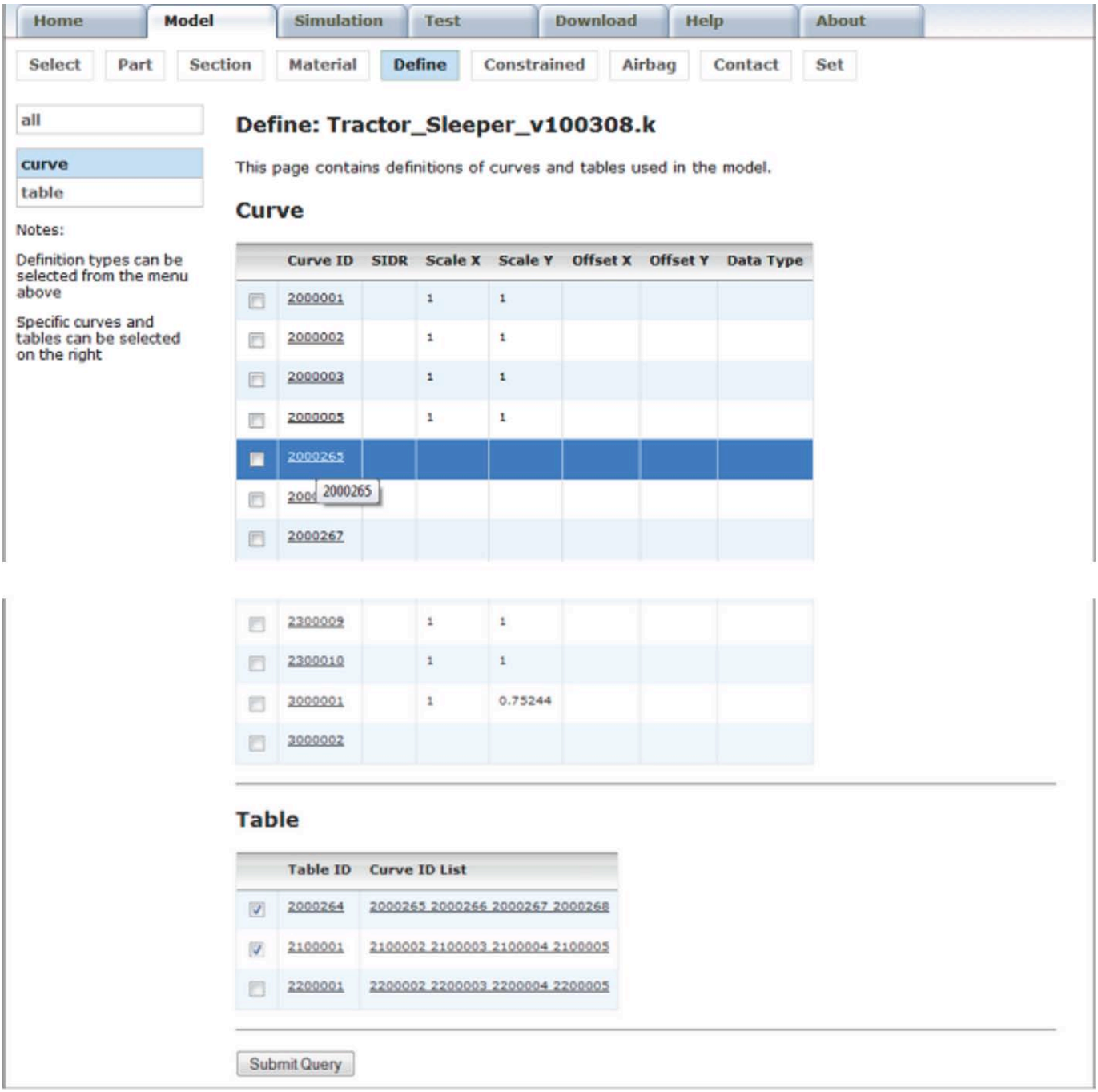


Definition entries are grouped into curves and tables. Each group can be easily reached from the vertical navigation menu located at the left-hand side of the page. Current selection is highlighted in separate color.

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.

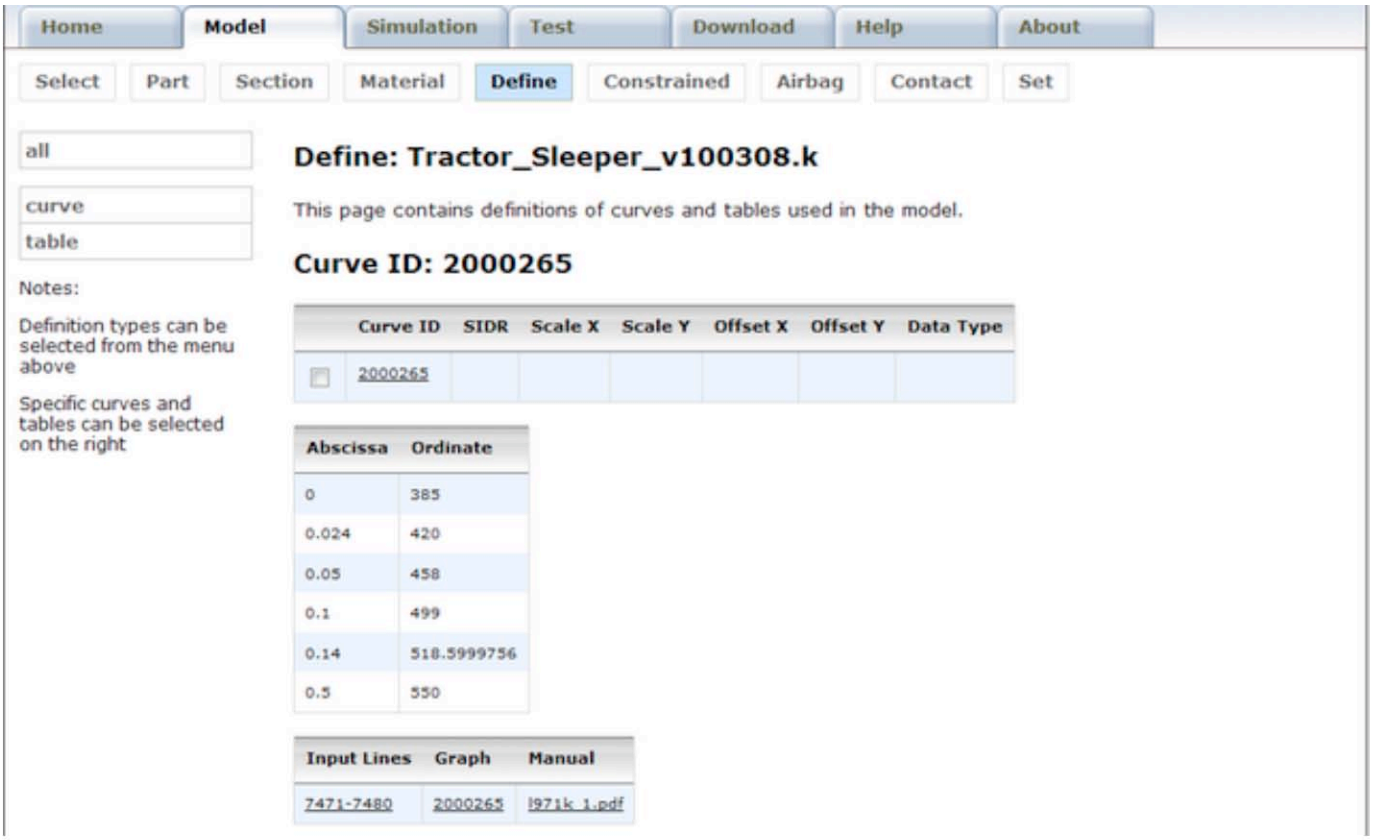


Definition specifics can be reached by following the identification number link, or by selecting the checkbox adjacent to the identification number and then clicking on the Submit Query button located below the table(s). The latter approach is convenient for simultaneous selection of several definitions.



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),



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
☐	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
7471-7480	2000265	l971k_1.pdf

Define: Tractor_Sleeper_v100308.k

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

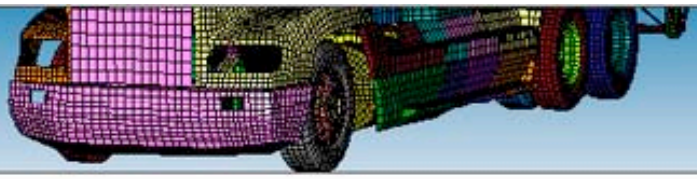
Table ID: 2000264

	Table ID	Curve ID List
☐	2000264	2000265 2000266 2000267 2000268

Value	Curve ID
0.001	2000265
0.1	2000266
50	2000267
4000	2000268

Input Lines	Graph	Manual
7463-7470	2000264	l971k_1.pdf

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.

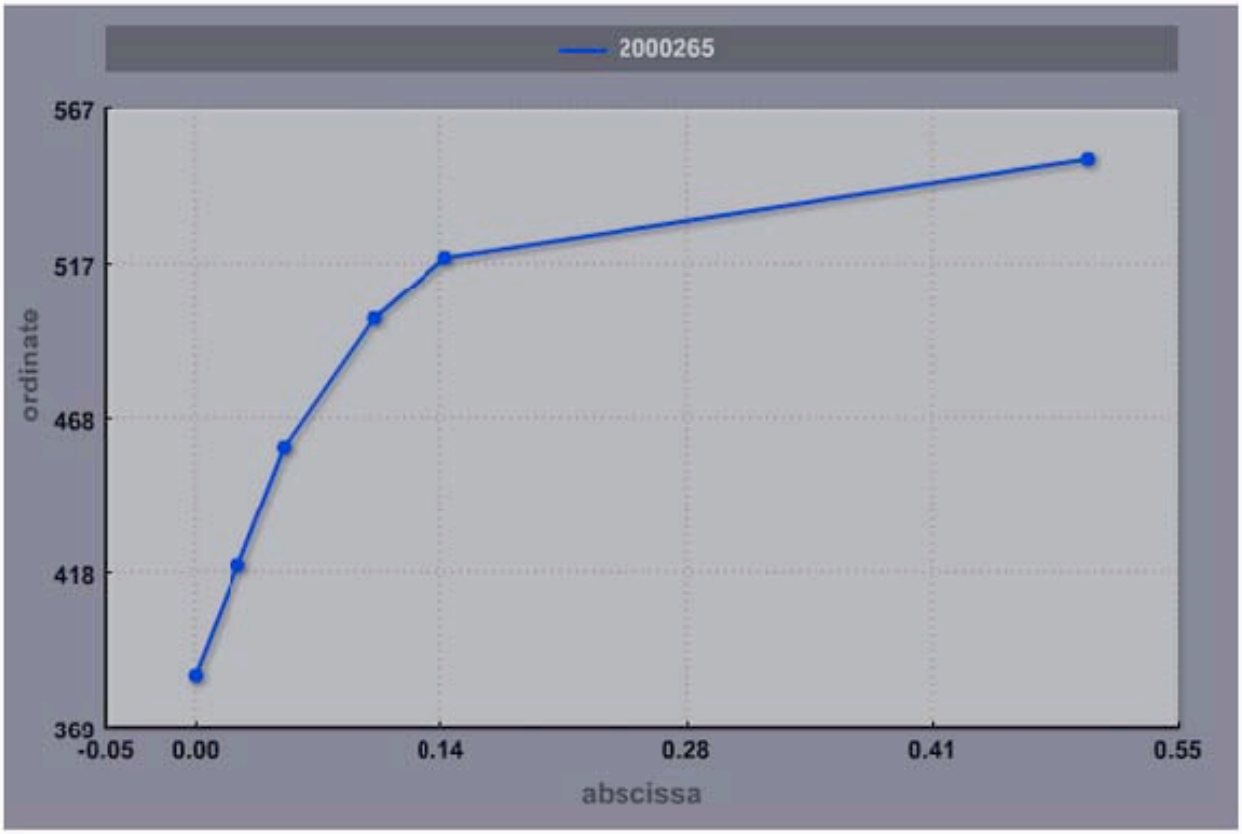


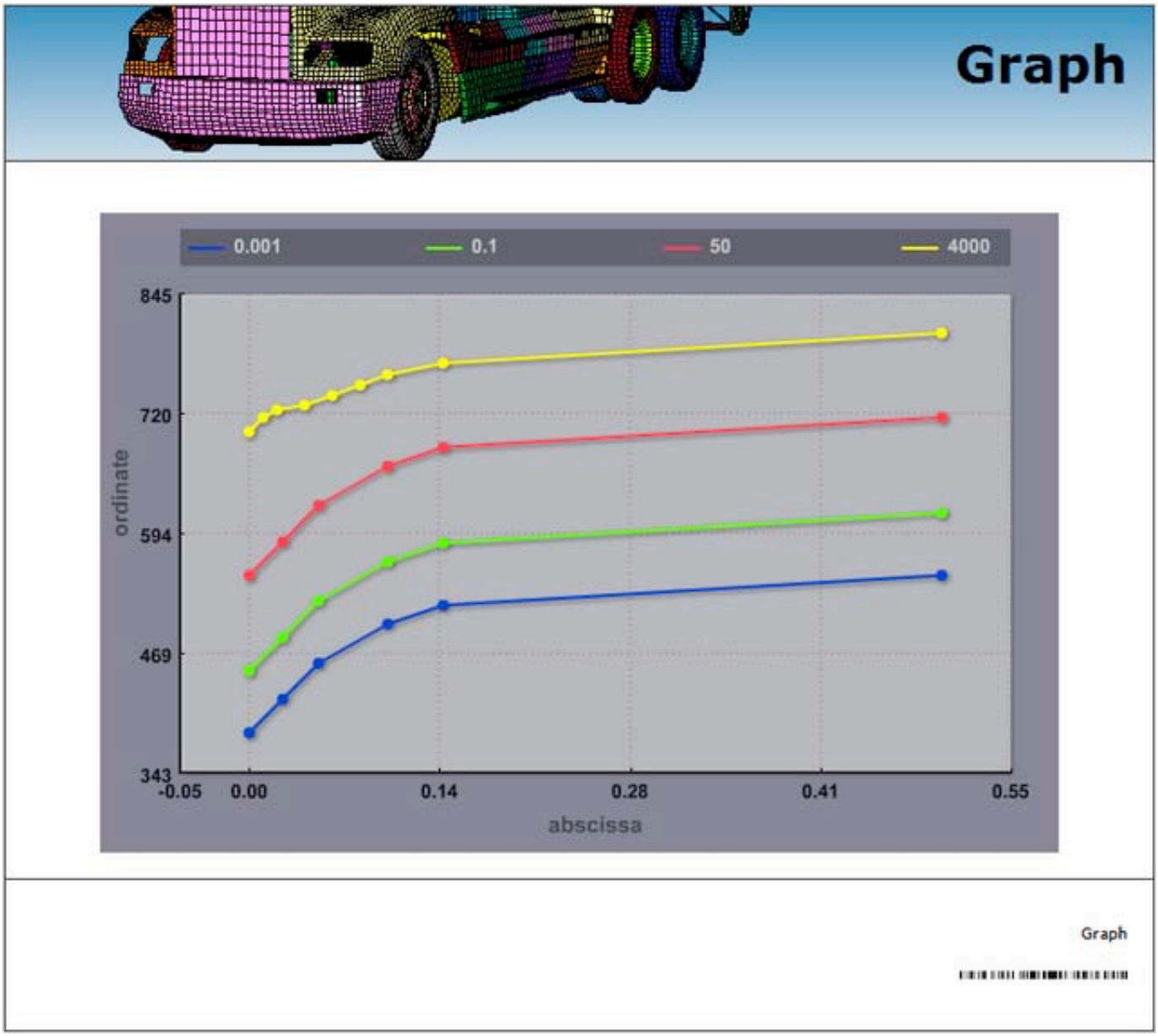
Input File: Tractor_Sleeper_v100308.k

Line Number	Line Content
7471	*DEFINE_CURVE
7472	$# lcid 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

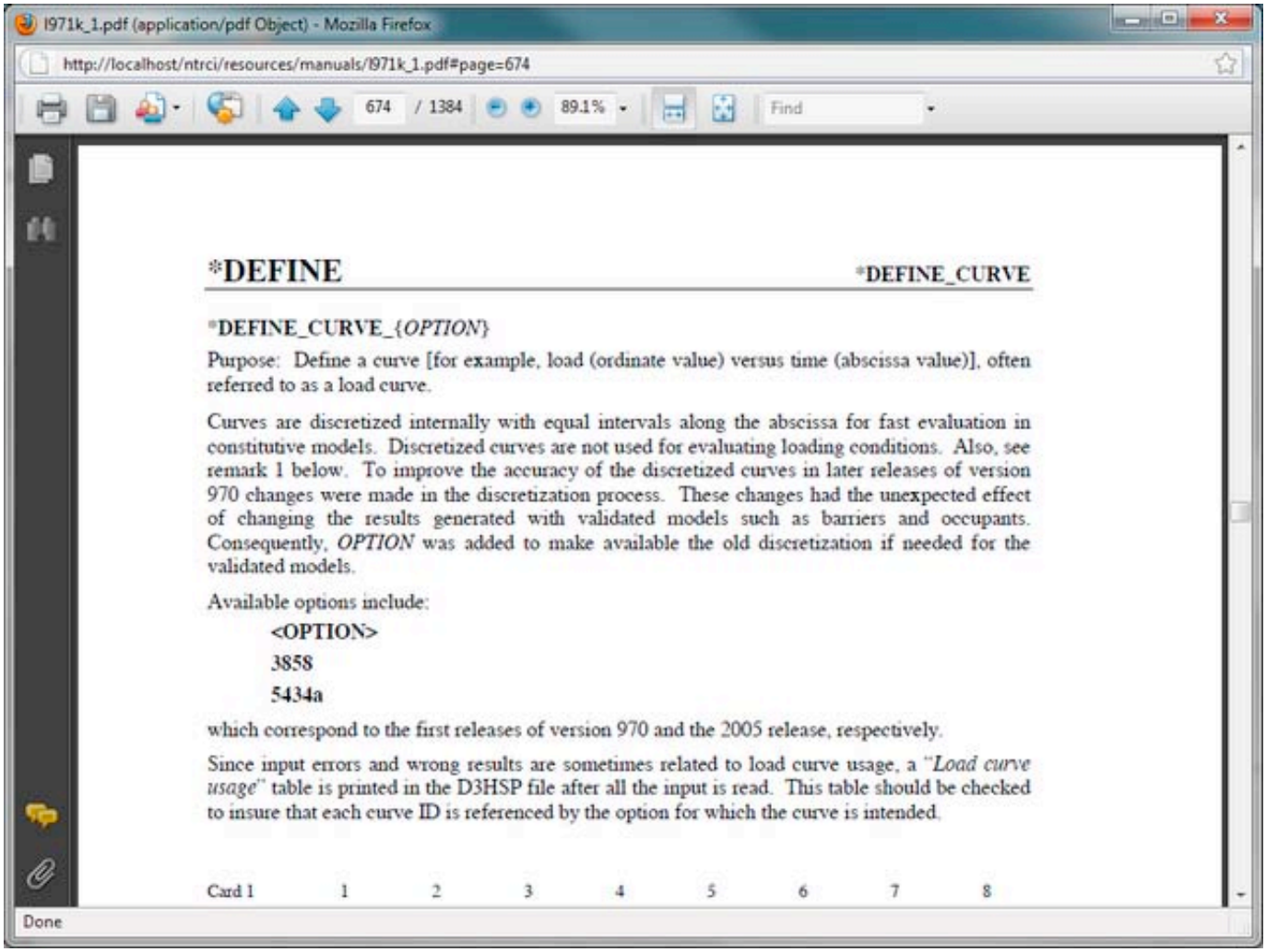
Graphical representation of a single curve or a set of curves grouped into a table definition can be reached through the Graph link. The graph appears in a popup window.

Graph


2000265
567
517
468
418
369
ordinate
-0.05
0.00
0.14
0.28
0.41
0.55
abscissa



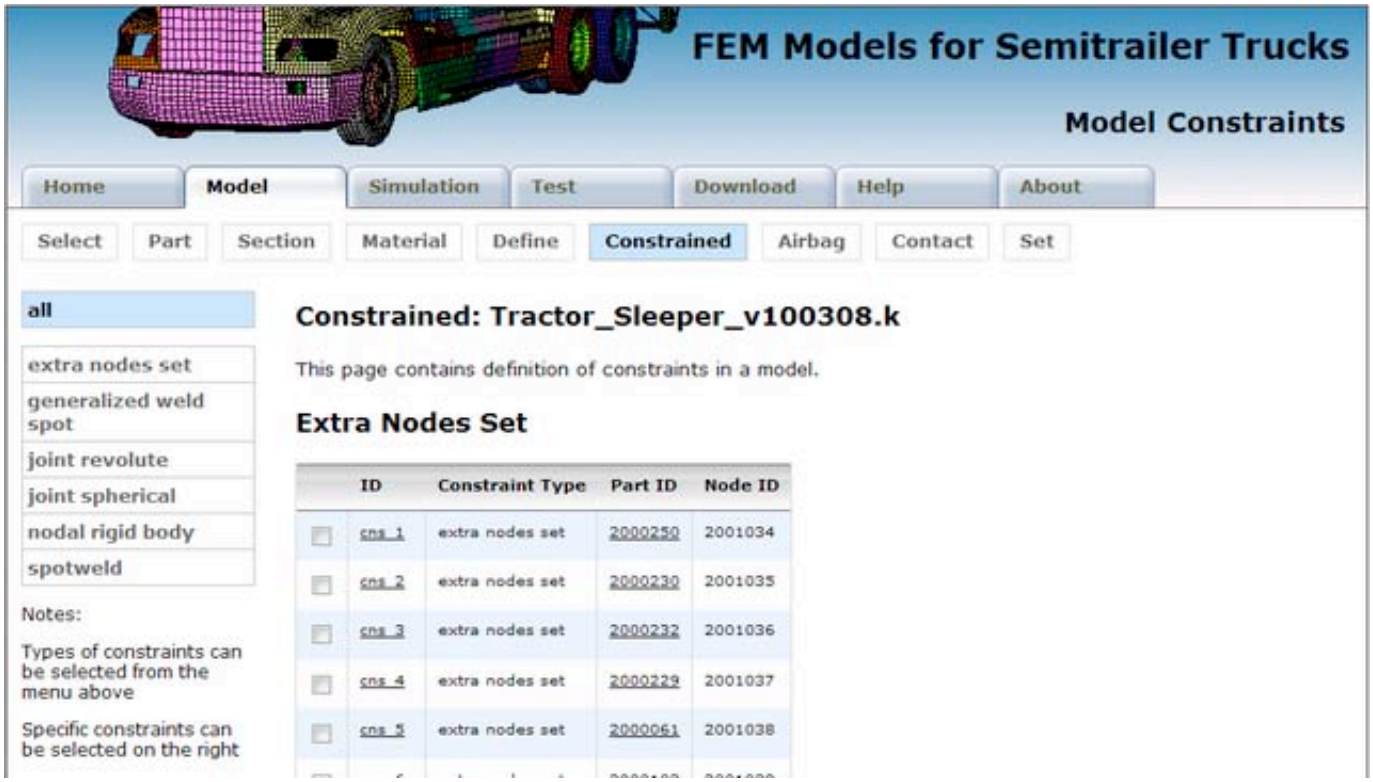
Help from the LS-DYNA User's Manual can be reached through the Manual link. A popup window opens the manual at the specific keyword entry. A pdf reader is required for viewing.


l971k_1.pdf (application/pdf Object) - Mozilla Firefox
http://localhost/ntrci/resources/manuals/l971k_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

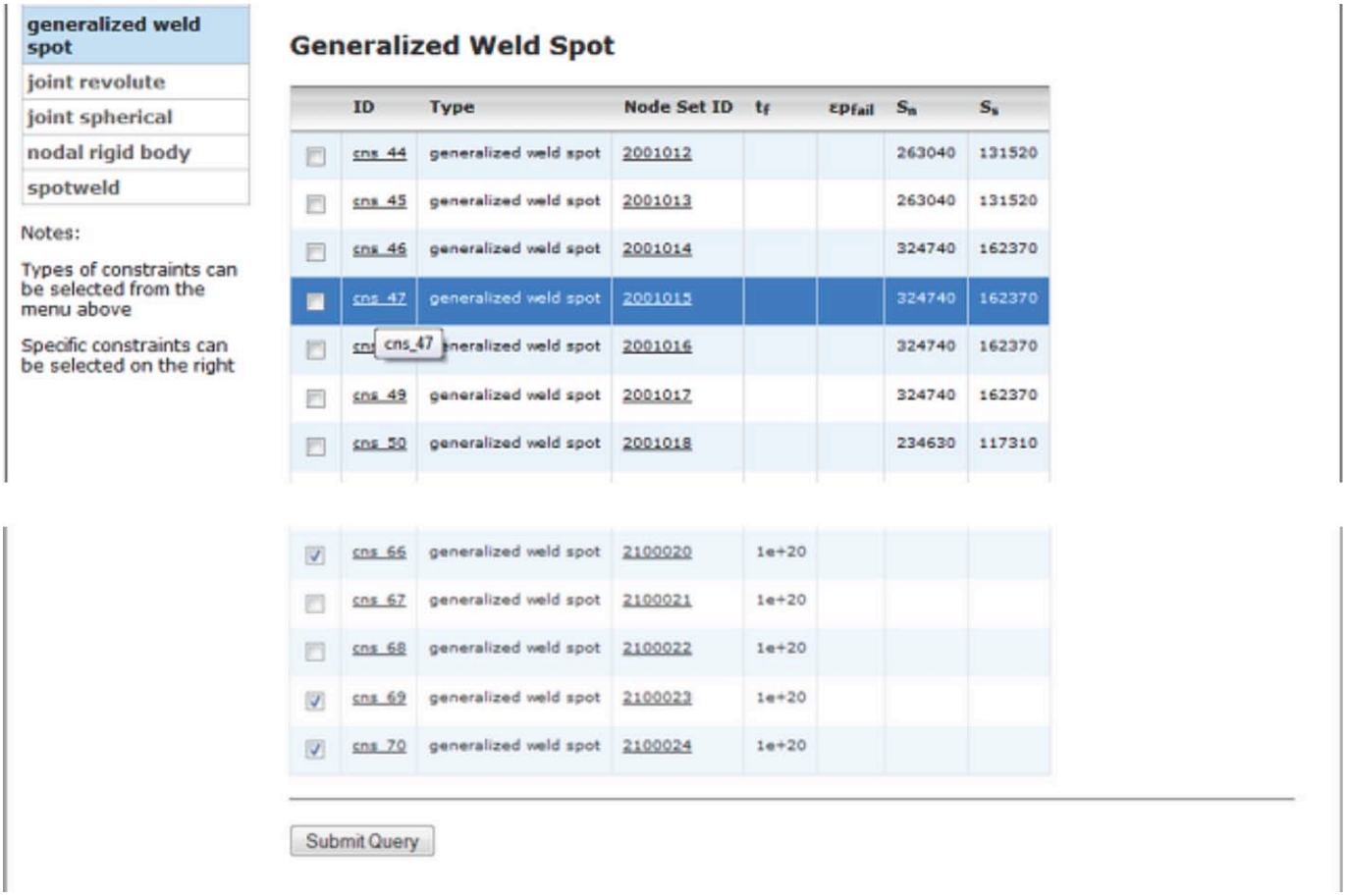
The Constrained unit located in the drop line menu under the horizontal menu's Model tab offers data briefs from the CONSTRAINED LS-DYNA keyword. Data queries are conducted on the selected model. Current model selection is indicated in the page title with the name of the FEM model source file name. Model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



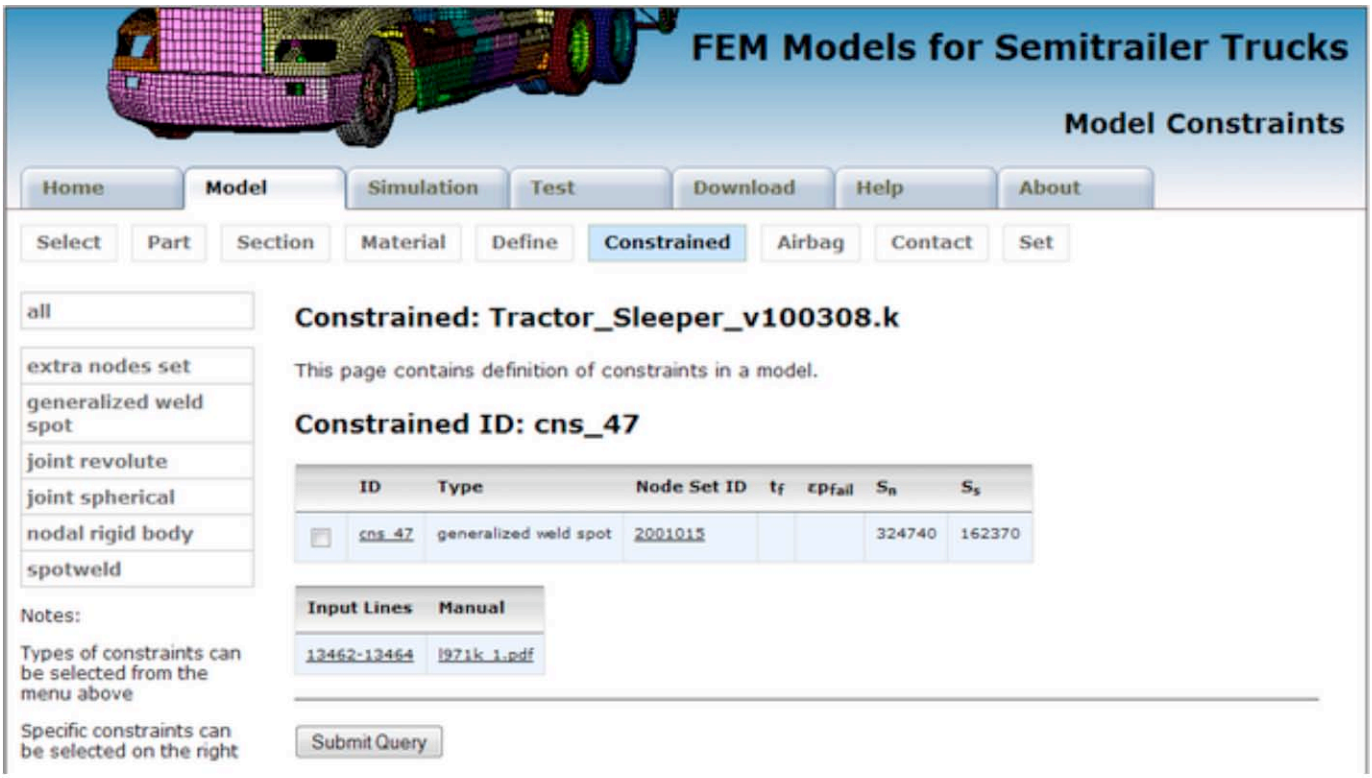
Essential information about the constraints used in the selected model is displayed in tabular format with each constraint filling one data row. The data is appropriately linked to related model content.

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.

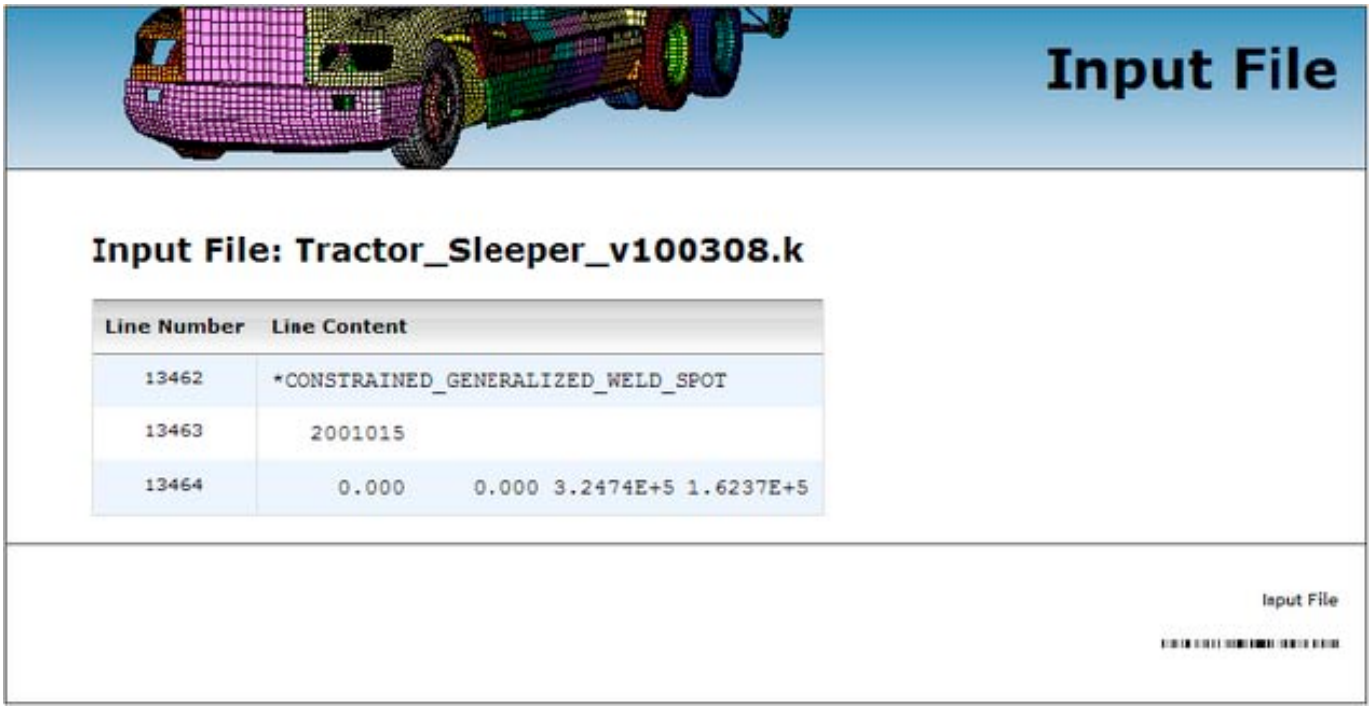


In constraint specifics the essential data for the chosen constraint(s) is accompanied with access to:

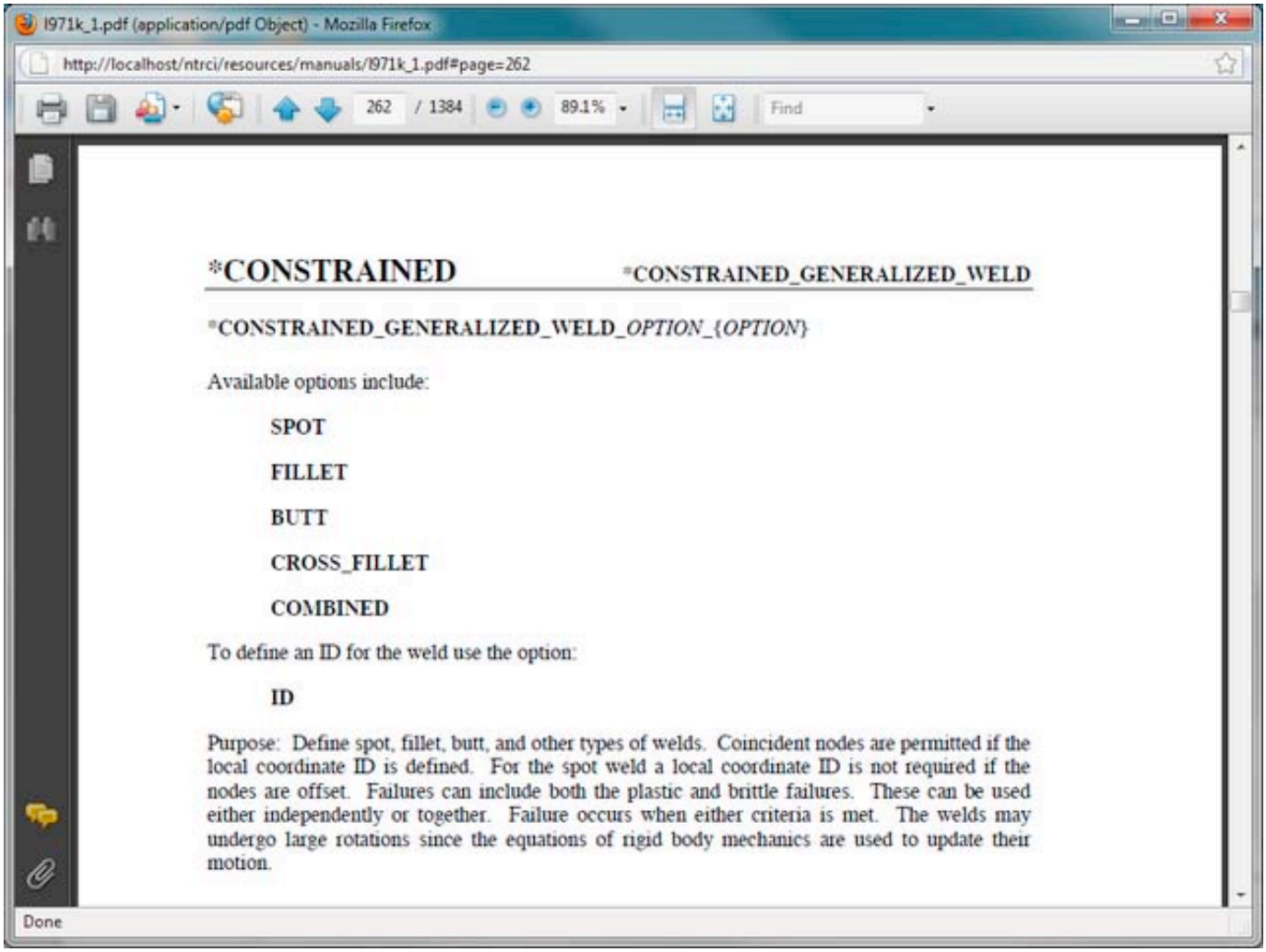
Excerpt from the FEM model source file (Input Lines),
LS-DYNA's User's Manual displaying the chosen keyword entry.



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.



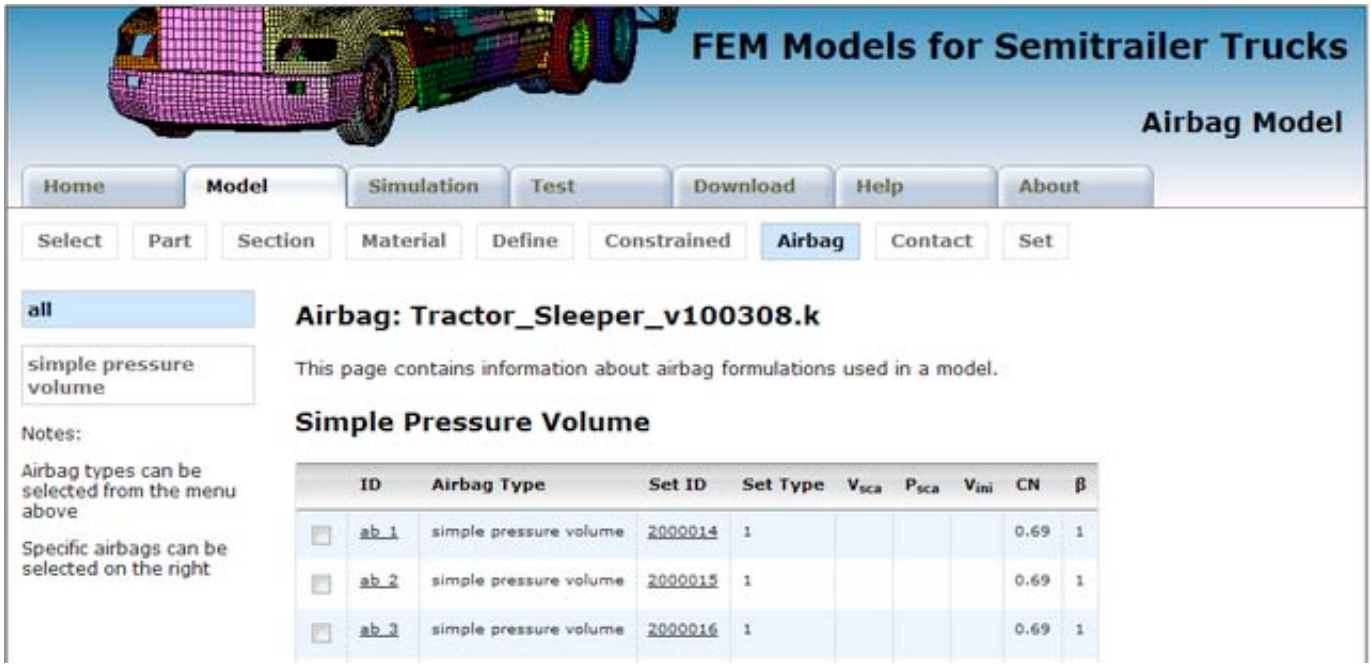
Help from the LS-DYNA User's Manual can be reached through the Manual link. A popup window opens the manual at the specific keyword entry. A pdf reader is required for viewing.


l971k_1.pdf (application/pdf Object) - Mozilla Firefox
http://localhost/ntrci/resources/manuals/l971k_1.pdf#page=262
262 / 1384
89.1%
Find
*CONSTRAINED
*CONSTRAINED_GENERALIZED_WELD
*CONSTRAINED_GENERALIZED_WELD_OPTION_{OPTION}
Available options include:
SPOT
FILLET
BUTT
CROSS_FILLET
COMBINED
To define an ID for the weld use the option:
ID
Purpose: Define spot, fillet, butt, and other types of welds. Coincident nodes are permitted if the local coordinate ID is defined. For the spot weld a local coordinate ID is not required if the nodes are offset. Failures can include both the plastic and brittle failures. These can be used either independently or together. Failure occurs when either criteria is met. The welds may undergo large rotations since the equations of rigid body mechanics are used to update their motion.
Done

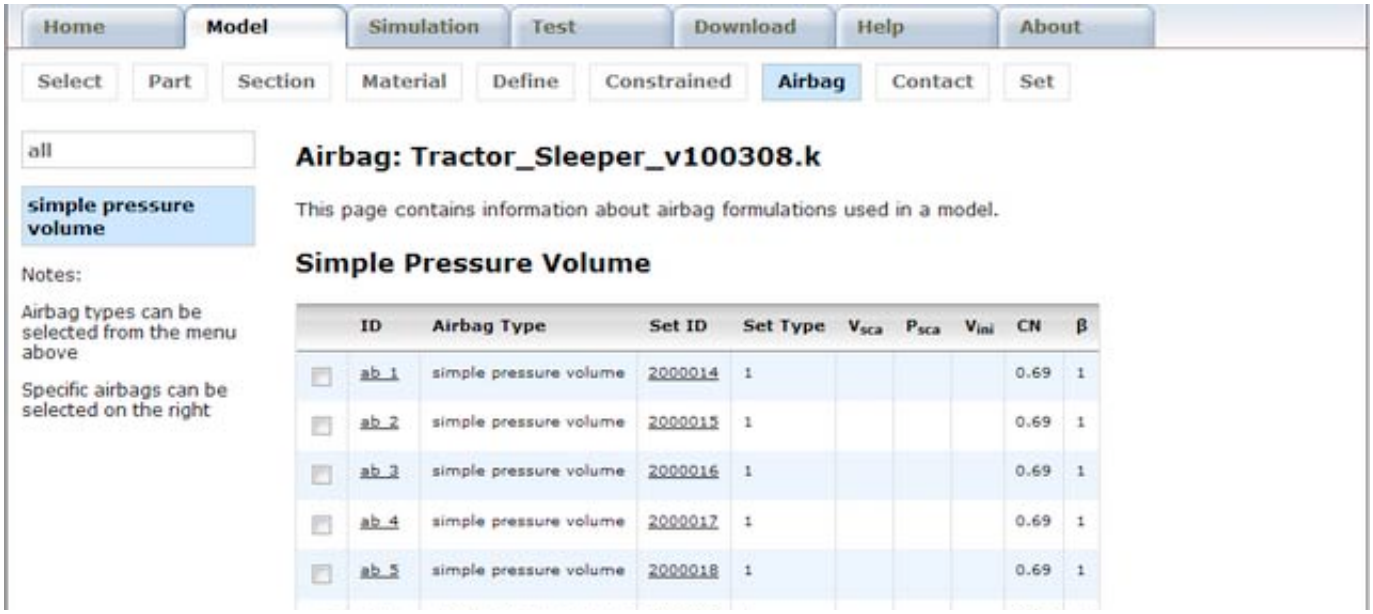
3.7 Tractor-semitrailer web site help: Model/Airbag

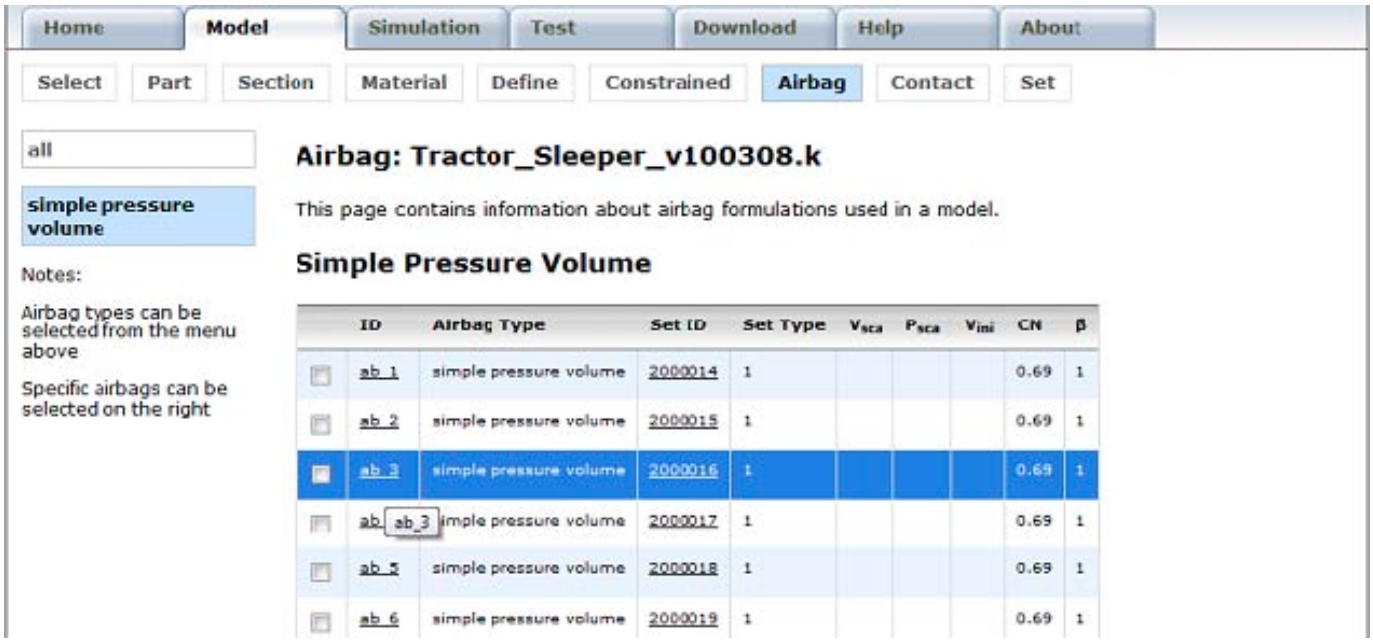
The Airbag unit located in the drop line menu under the horizontal menu's Model tab offers data briefs from the AIRBAG LS-DYNA keyword. Data queries are conducted on the selected model. Current model selection is indicated in the page title with the name of the FEM model source file name. Model selection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

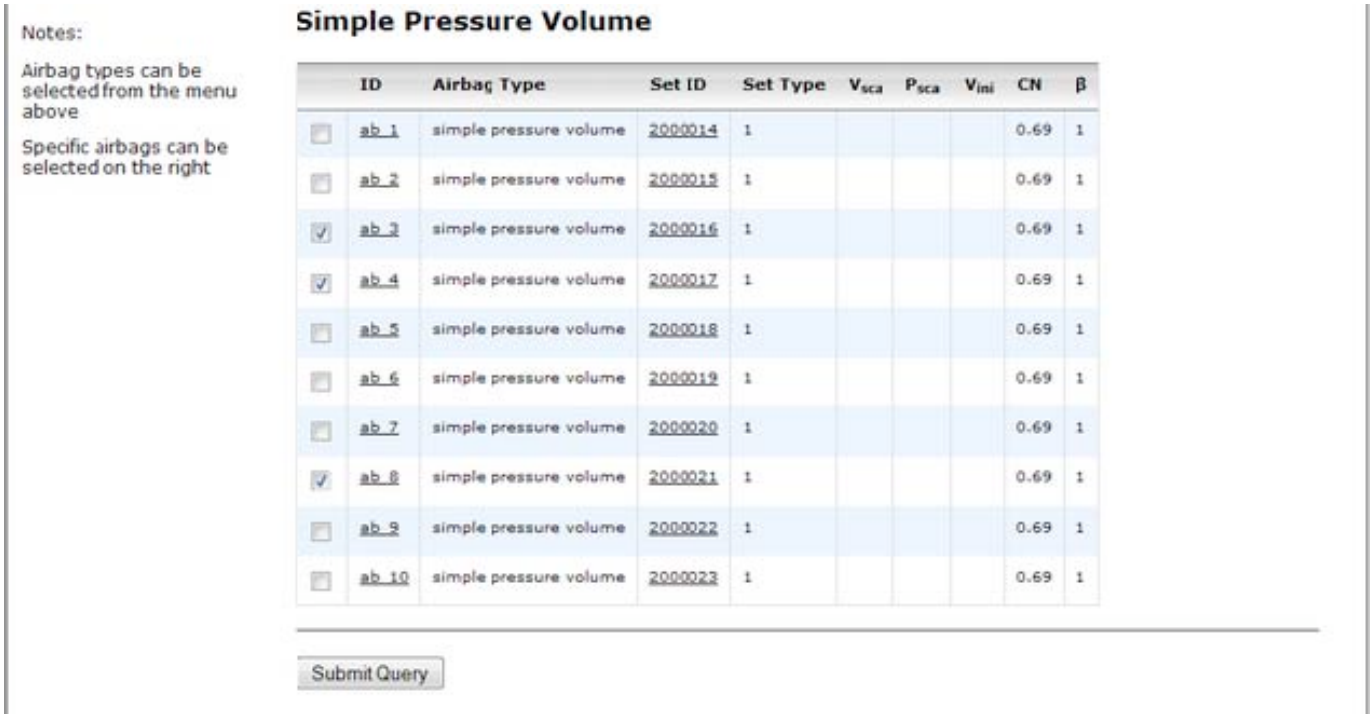


Essential information about the airbag formulations used in the selected model is displayed in tabular format with each airbag filling one data row. The data is appropriately linked to related model content.



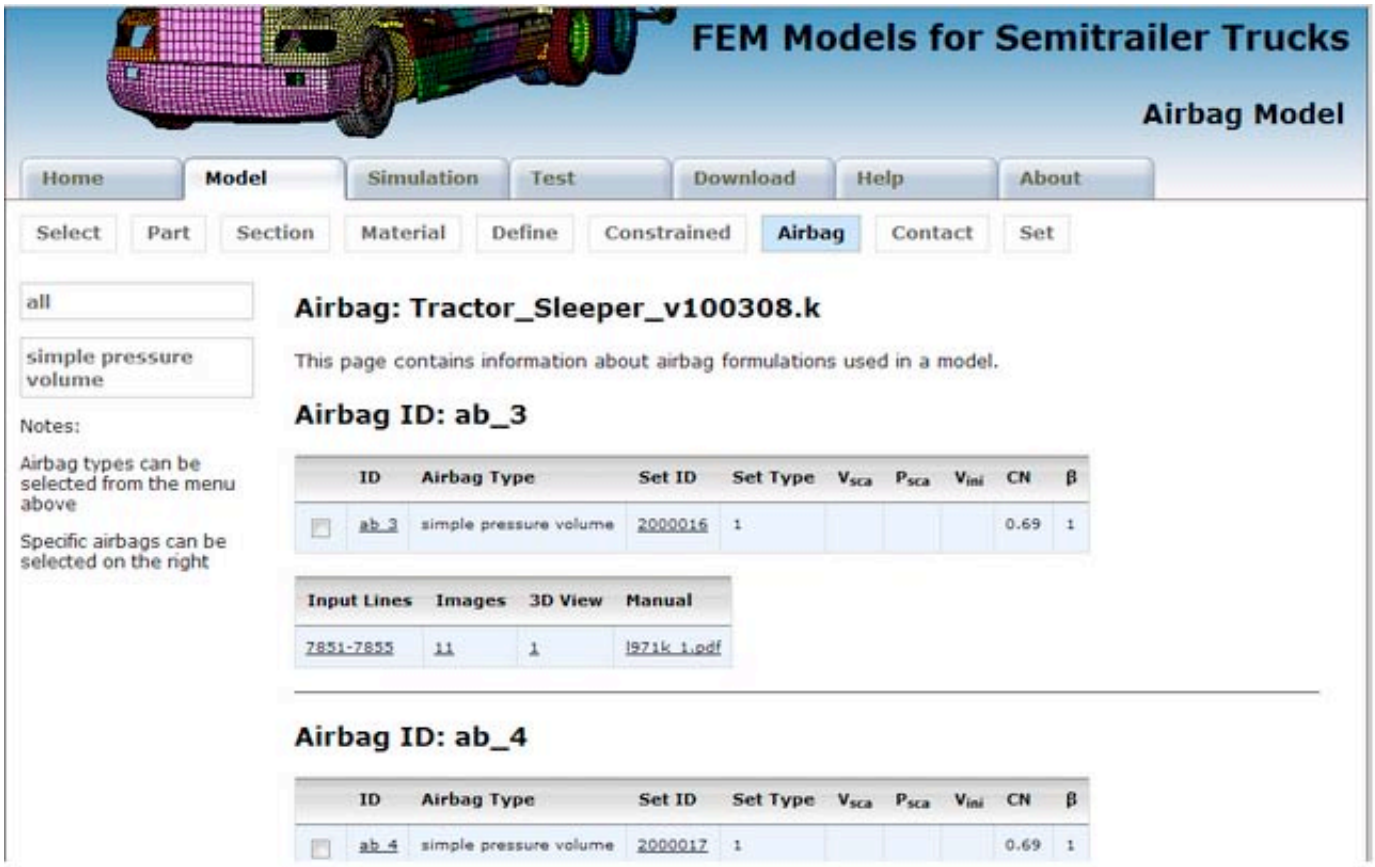


Airbag specifics can be reached by following the airbag identification number link, or by selecting the checkbox adjacent to the airbag identification number and then clicking on the Submit Query button located below the table(s). The latter approach is convenient for simultaneous selection of several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

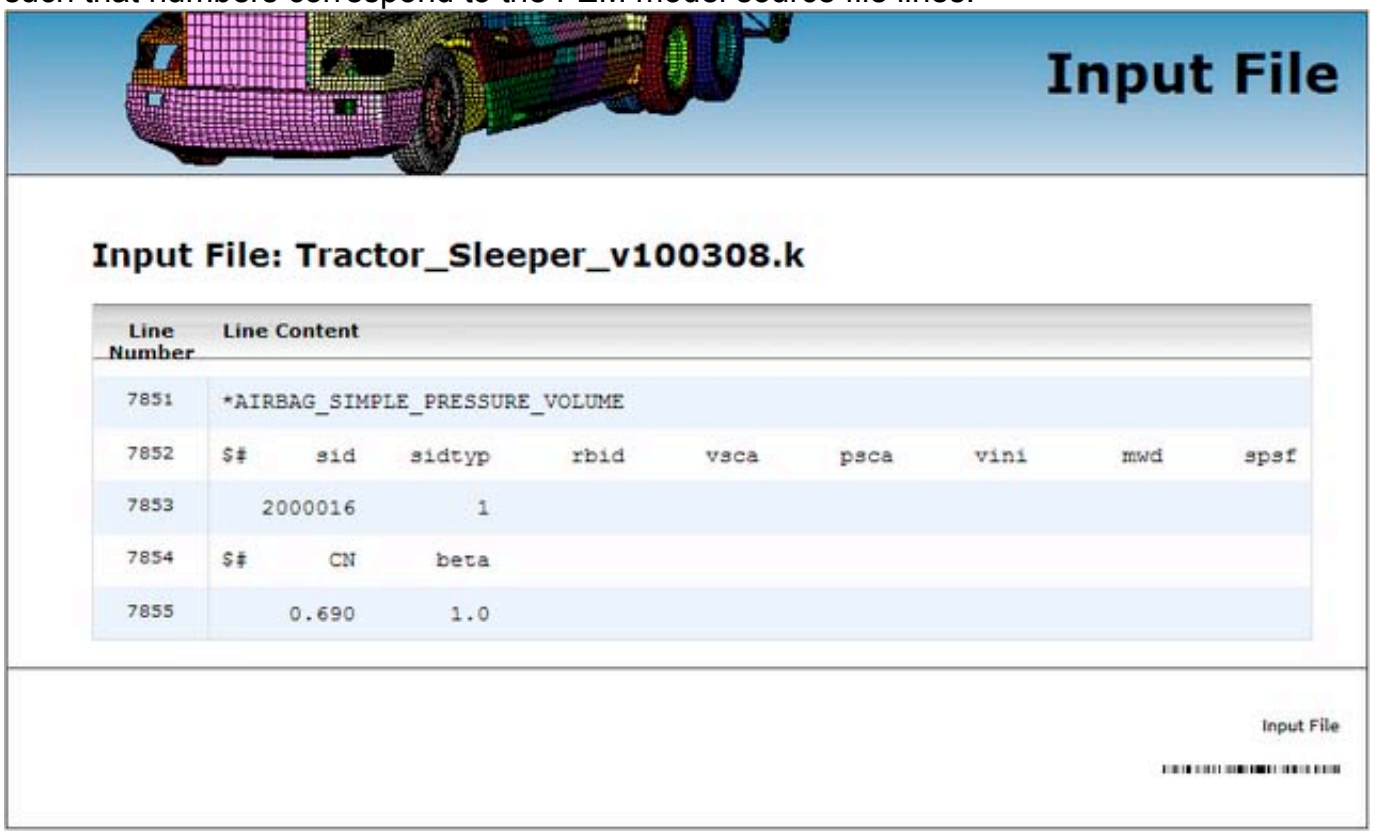


In airbag specifics the essential data for the chosen airbag(s) is accompanied with access to:

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.



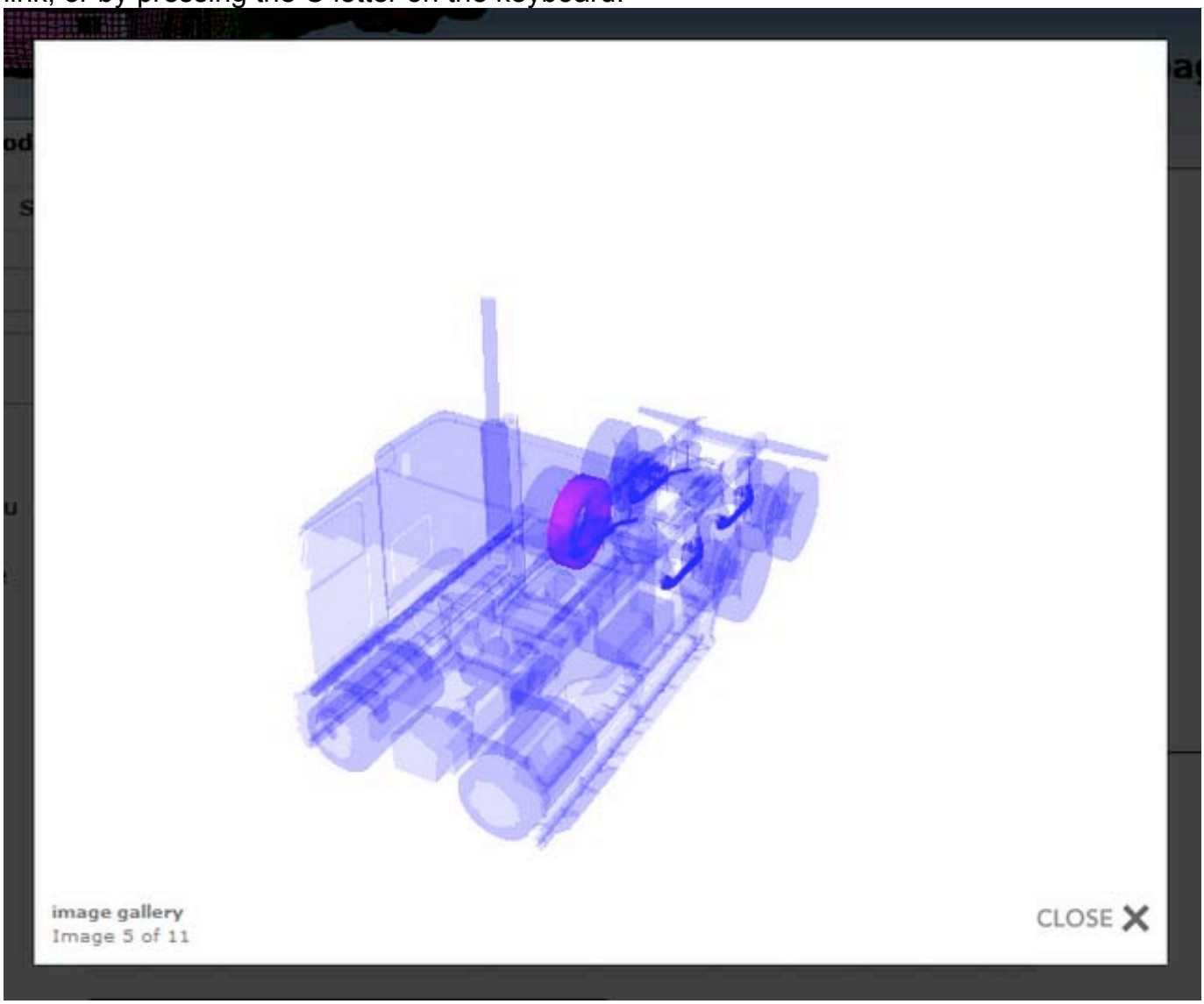
Excerpt from the FEM model source file containing the chosen airbag entry is accessible through the Input Lines link. A popup window shows the chosen airbag entry conveniently numbered such that numbers correspond to the FEM model source file lines.



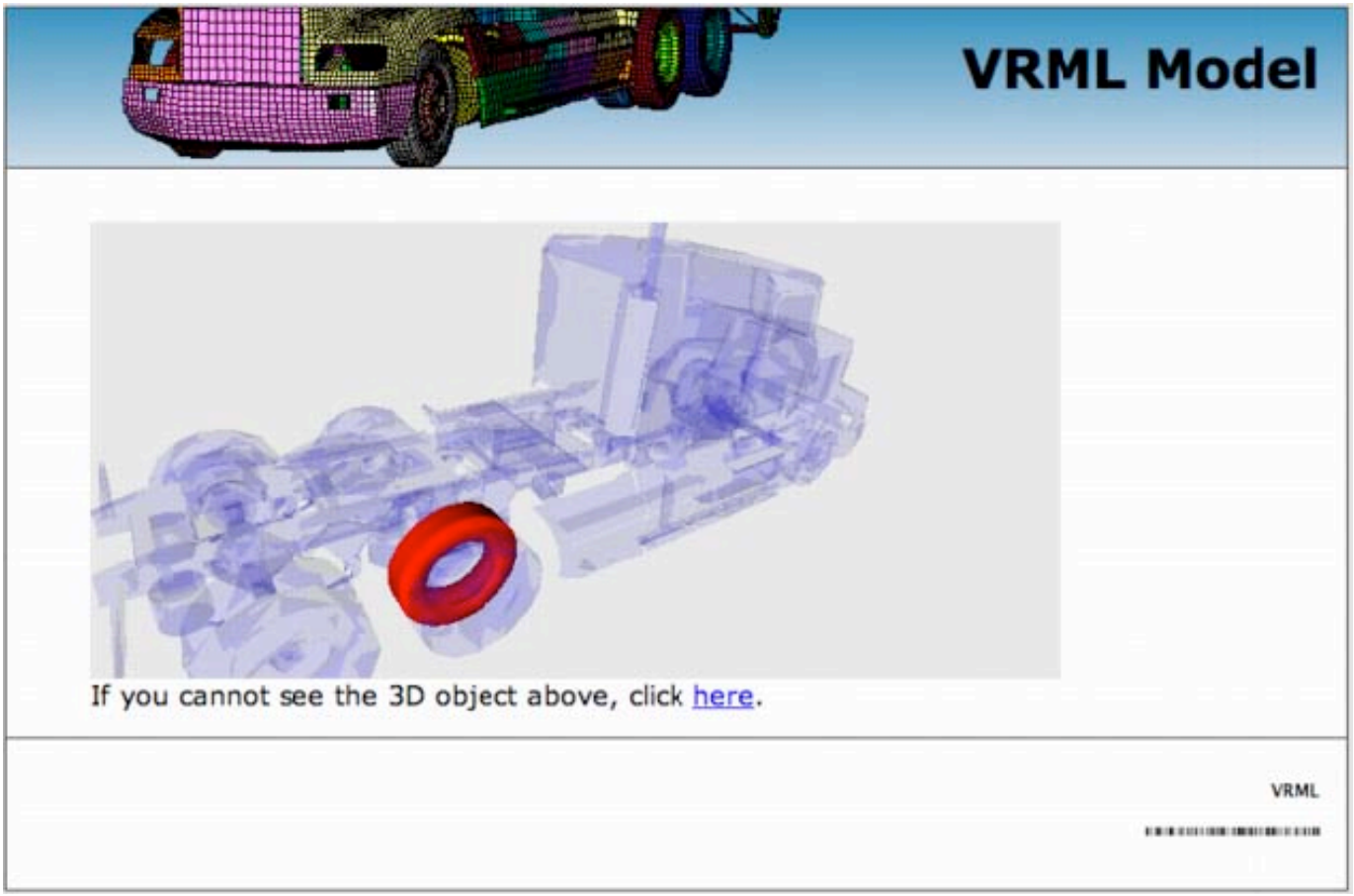
Numerous images of the parts featuring the chosen airbag can be viewed through the Images

taken from different viewing angles.

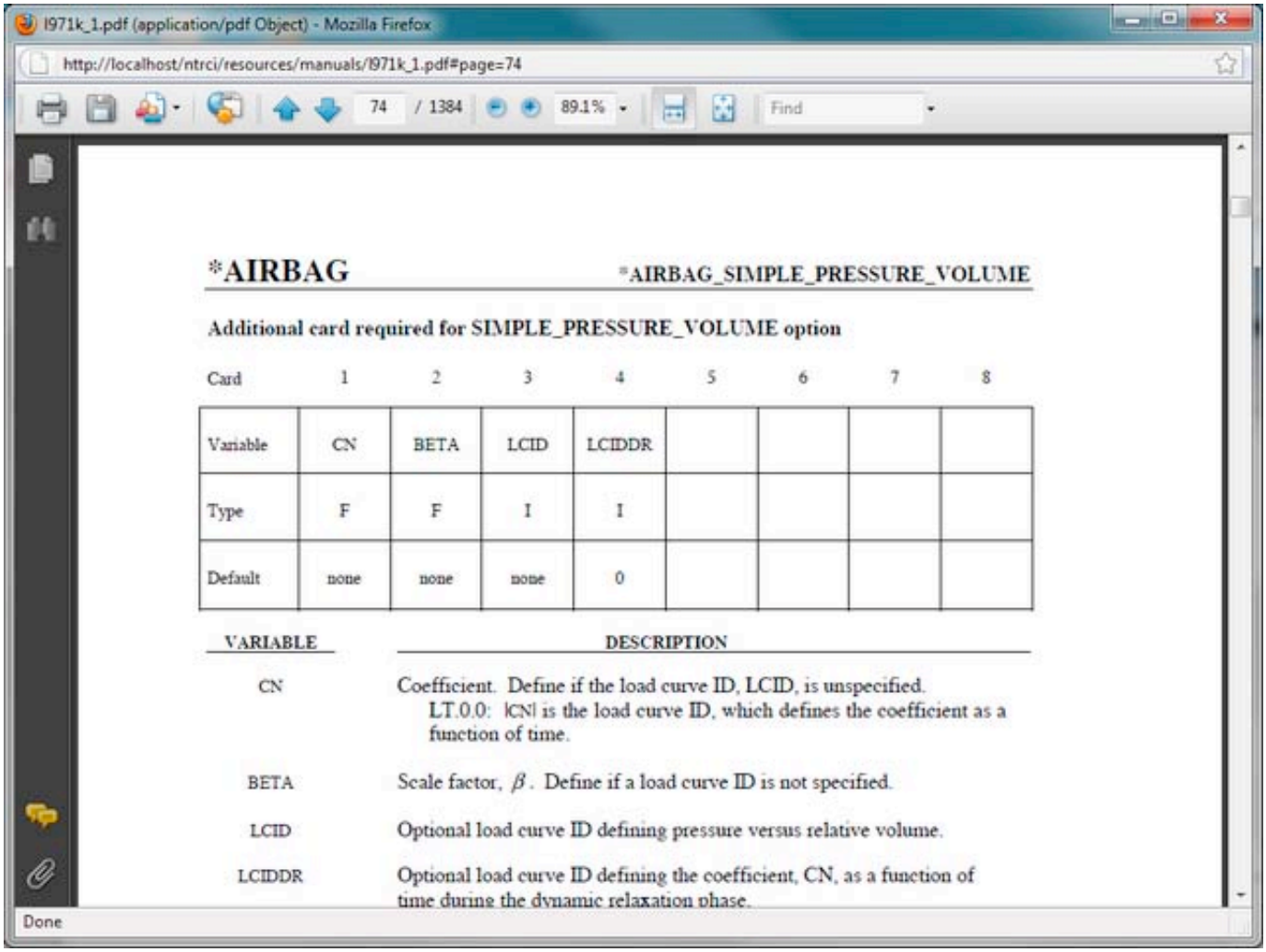
Images can be navigated by clicking inside the image on its left-hand and right-hand side, by clicking on the Previous and Next links that appear on mouse over the image event, by pressing the P and L letters on the keyboard, or by pressing the left and right keyboard arrows. The image window can be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



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.



*AIRBAG *AIRBAG_SIMPLE_PRESSURE_VOLUME

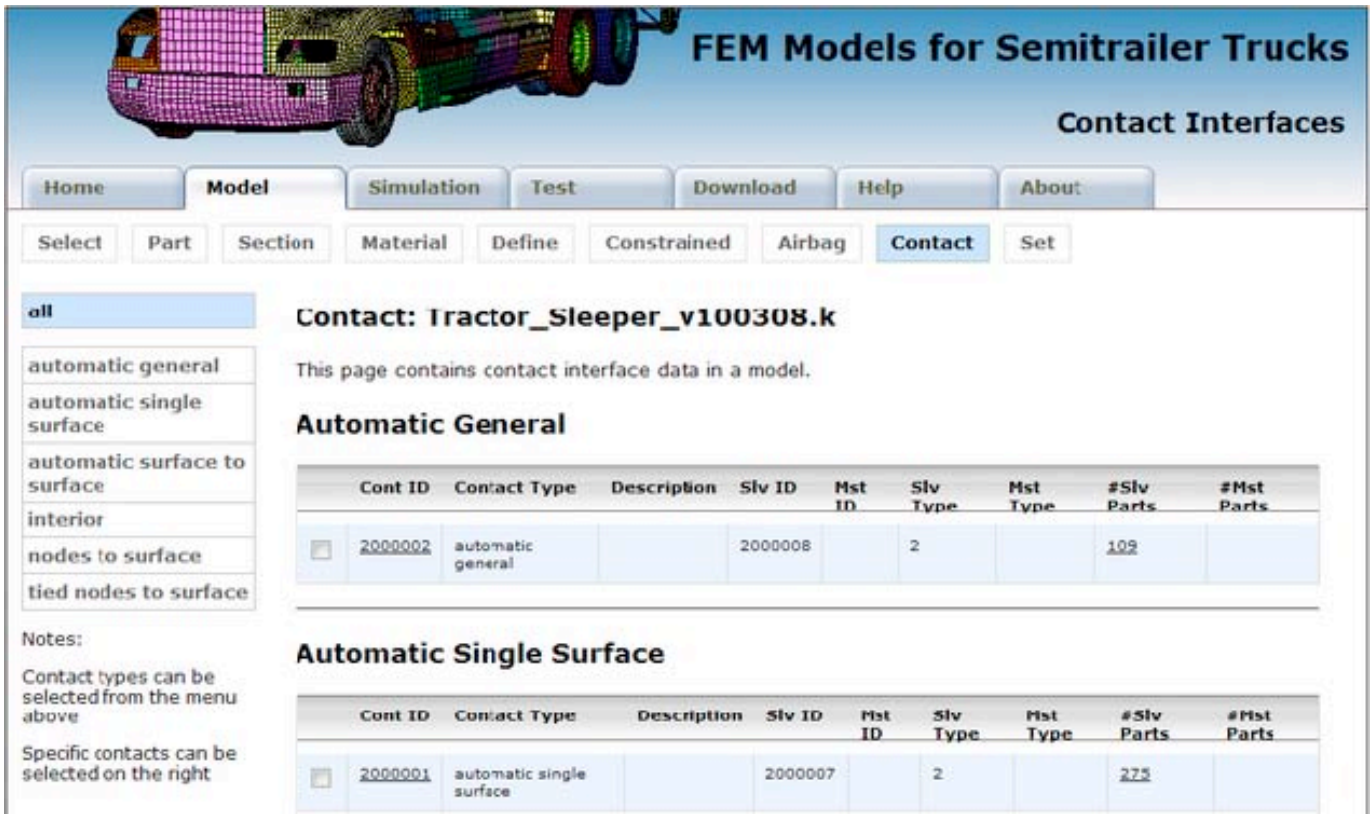
Additional card required for SIMPLE_PRESSURE_VOLUME option

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, β. 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.

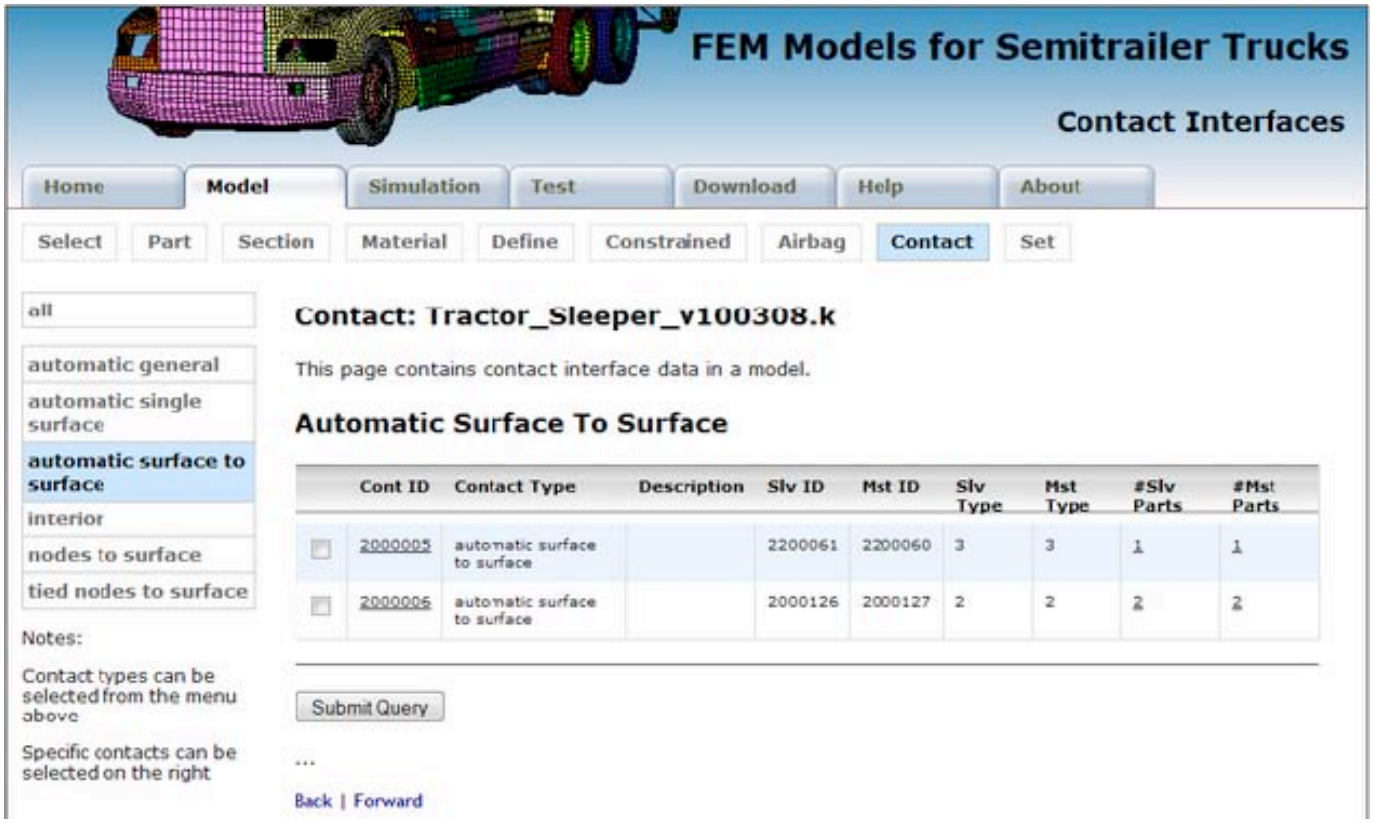
3.8 Tractor-semitrailer web site help: Model/Contact

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.

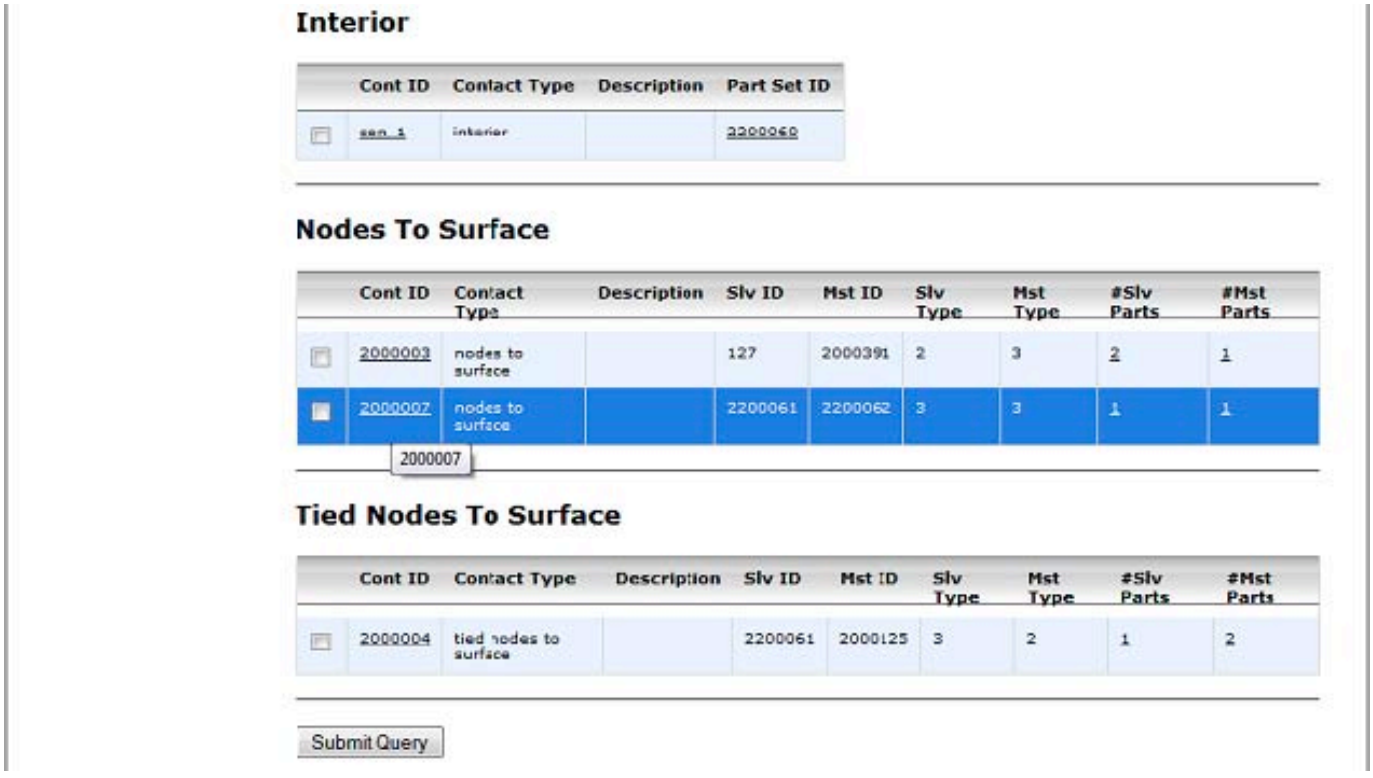


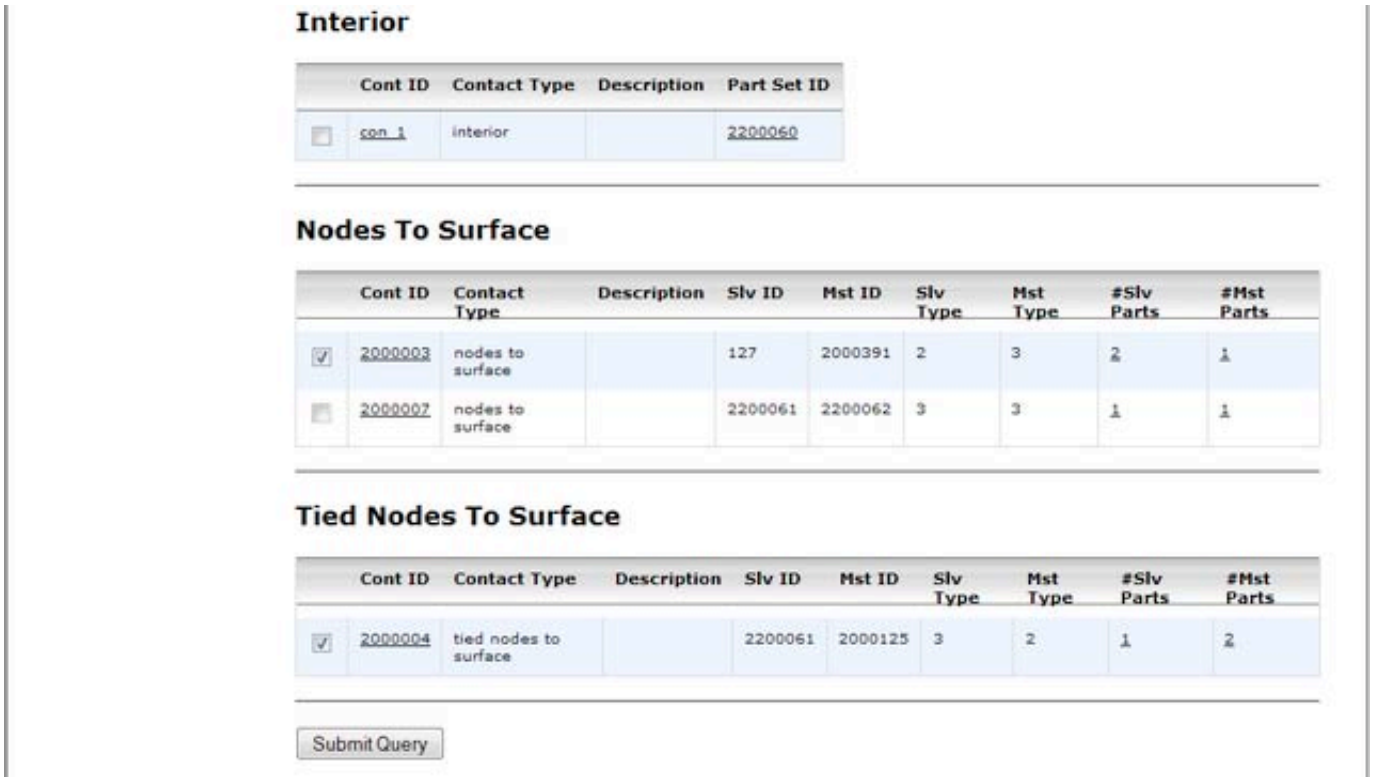
The contacts are conveniently grouped into smaller units according to their type. These units can be easily reached from the vertical navigation menu located at the left-hand side of the page. Current unit selection is highlighted in separate color.

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.



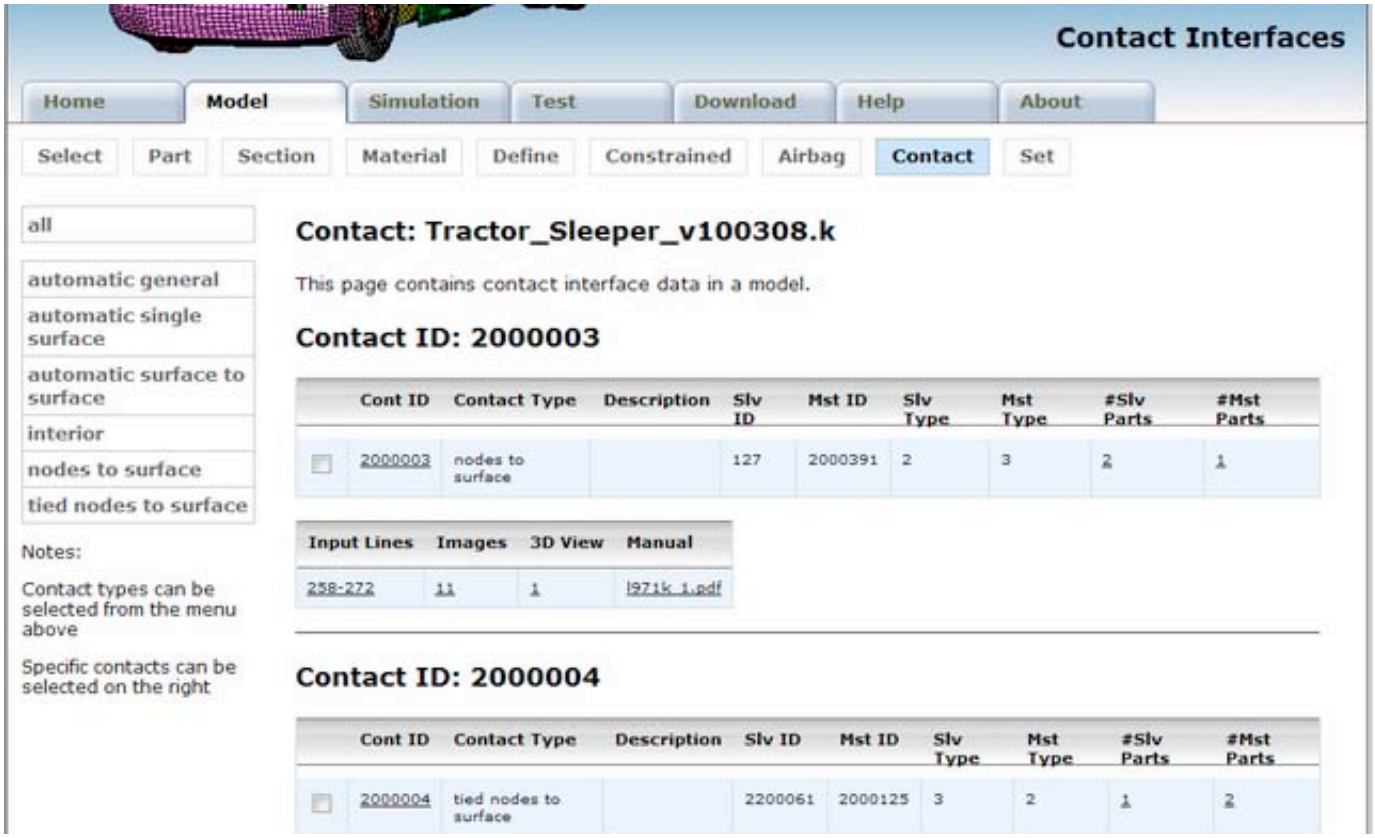
Contact specifics can be reached by following the contact identification number link, or by selecting the checkbox adjacent to the contact identification number and then clicking on the Submit Query button located below the table(s). The latter approach is convenient for simultaneous selection of several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





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.



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.

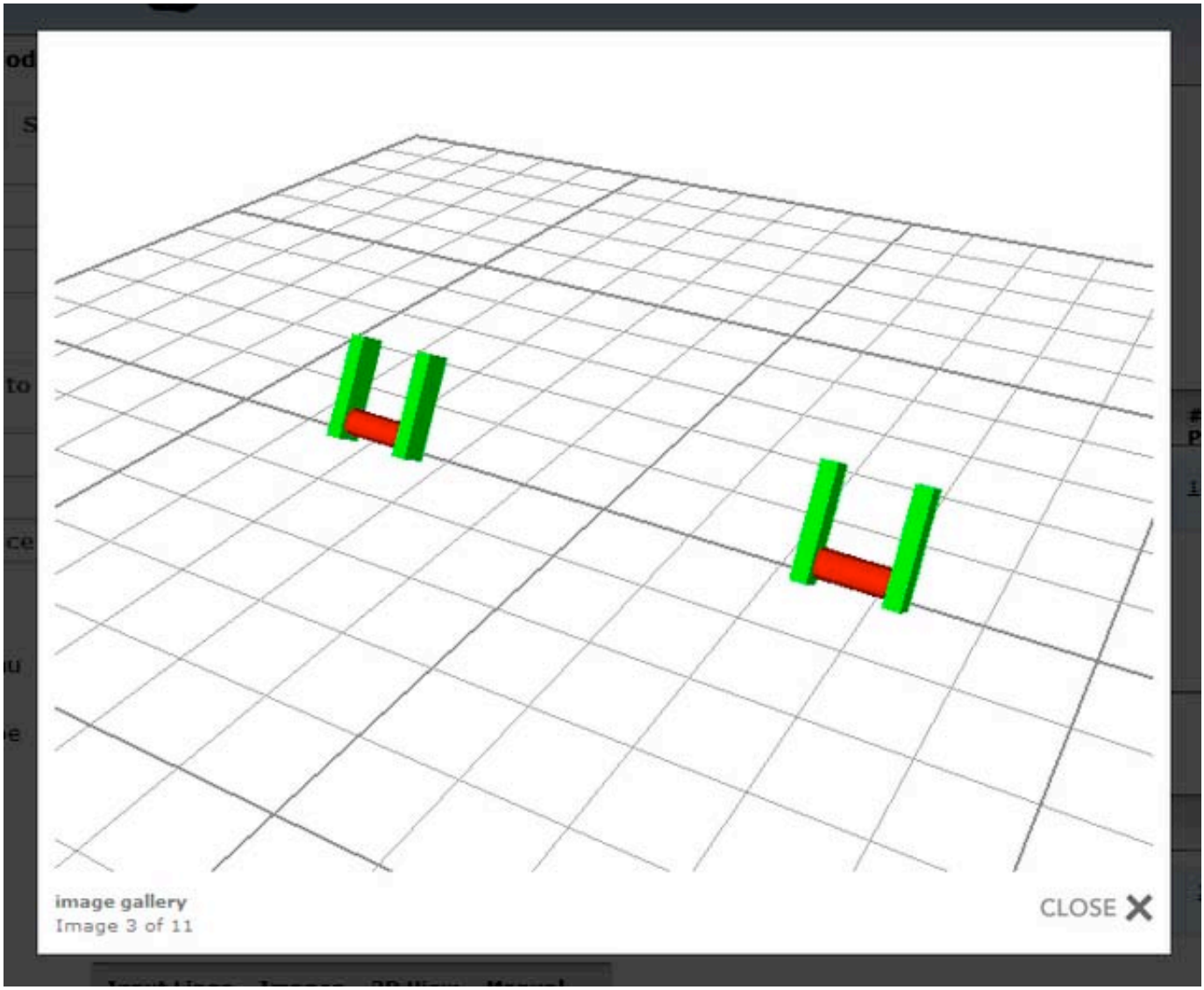
Input File

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	frcfrq
268	1							
269	$#							

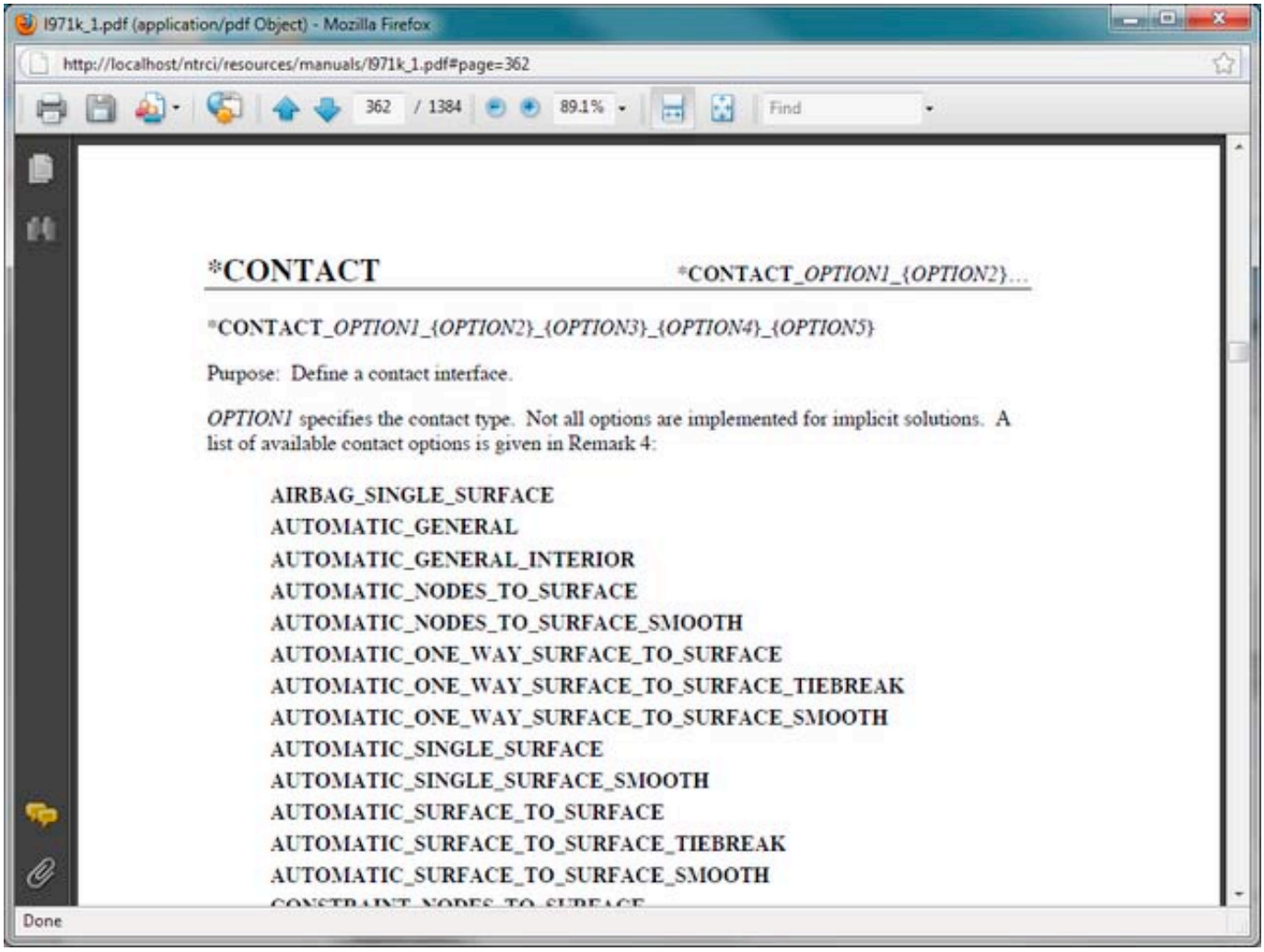
Numerous images of the parts featuring the chosen contact can be viewed through the Images link. A popup window shows images of the parts alone, and of the parts setting in the model taken from different viewing angles.

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.



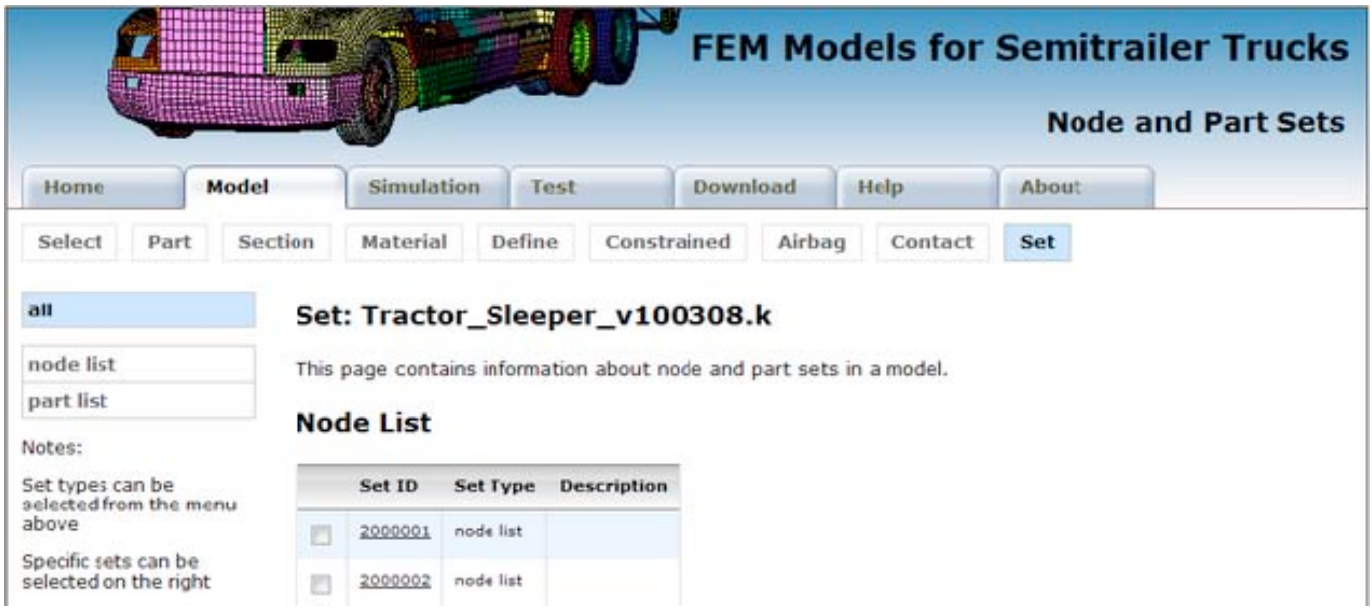
Interactive 3D display of the parts featuring the chosen contact is accessible through the 3D View link. This option requires a proper 3D plug-in to show the parts in their setting in a new popup window. Plug-independent controls enable model interactivity (rotation, zoom, pan, etc.).

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.

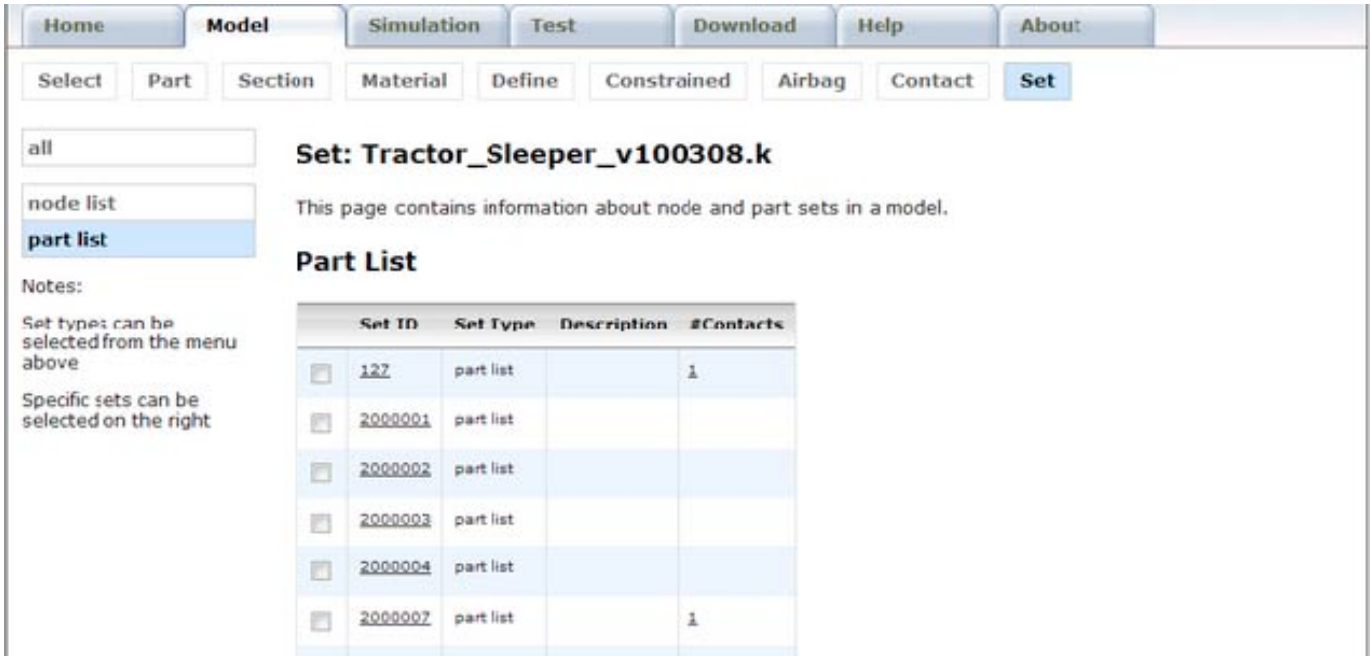

l971k_1.pdf (application/pdf Object) - Mozilla Firefox
http://localhost/ntrci/resources/manuals/l971k_1.pdf#page=362
362 / 1384
89.1%
Find
*CONTACT
*CONTACT_OPTION1_{OPTION2}...
*CONTACT_OPTION1_{OPTION2}_{OPTION3}_{OPTION4}_{OPTION5}
Purpose: Define a contact interface.
OPTION1 specifies the contact type. Not all options are implemented for implicit solutions. A list of available contact options is given in Remark 4:
AIRBAG_SINGLE_SURFACE
AUTOMATIC_GENERAL
AUTOMATIC_GENERAL_INTERIOR
AUTOMATIC_NODES_TO_SURFACE
AUTOMATIC_NODES_TO_SURFACE_SMOOTH
AUTOMATIC_ONE_WAY_SURFACE_TO_SURFACE
AUTOMATIC_ONE_WAY_SURFACE_TO_SURFACE_TIEBREAK
AUTOMATIC_ONE_WAY_SURFACE_TO_SURFACE_SMOOTH
AUTOMATIC_SINGLE_SURFACE
AUTOMATIC_SINGLE_SURFACE_SMOOTH
AUTOMATIC_SURFACE_TO_SURFACE
AUTOMATIC_SURFACE_TO_SURFACE_TIEBREAK
AUTOMATIC_SURFACE_TO_SURFACE_SMOOTH
Done

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.

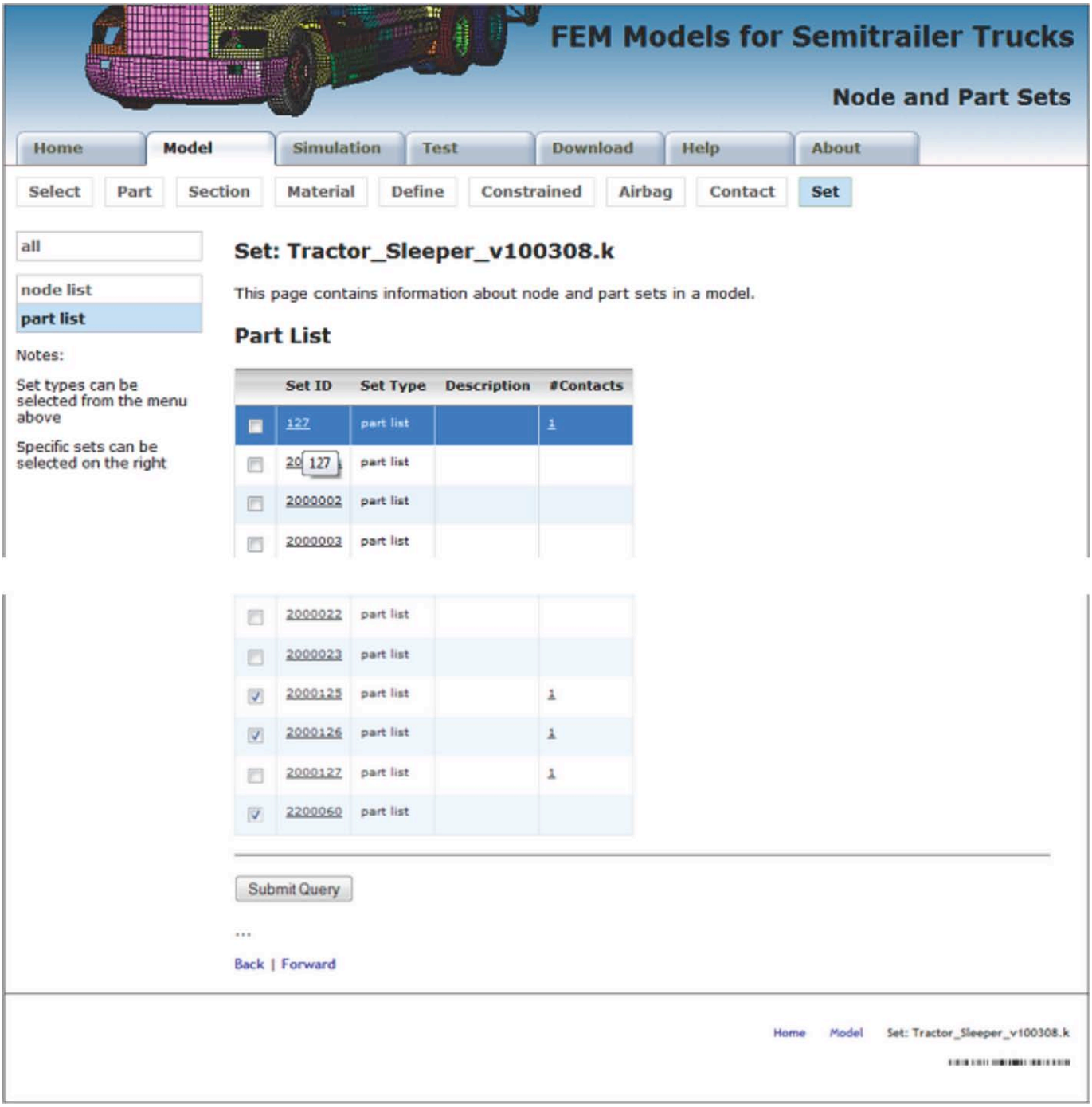


The sets are conveniently grouped into smaller units according to their type. These units can be easily reached from the vertical navigation menu located at the left-hand side of the page. Current unit selection is highlighted in separate color.



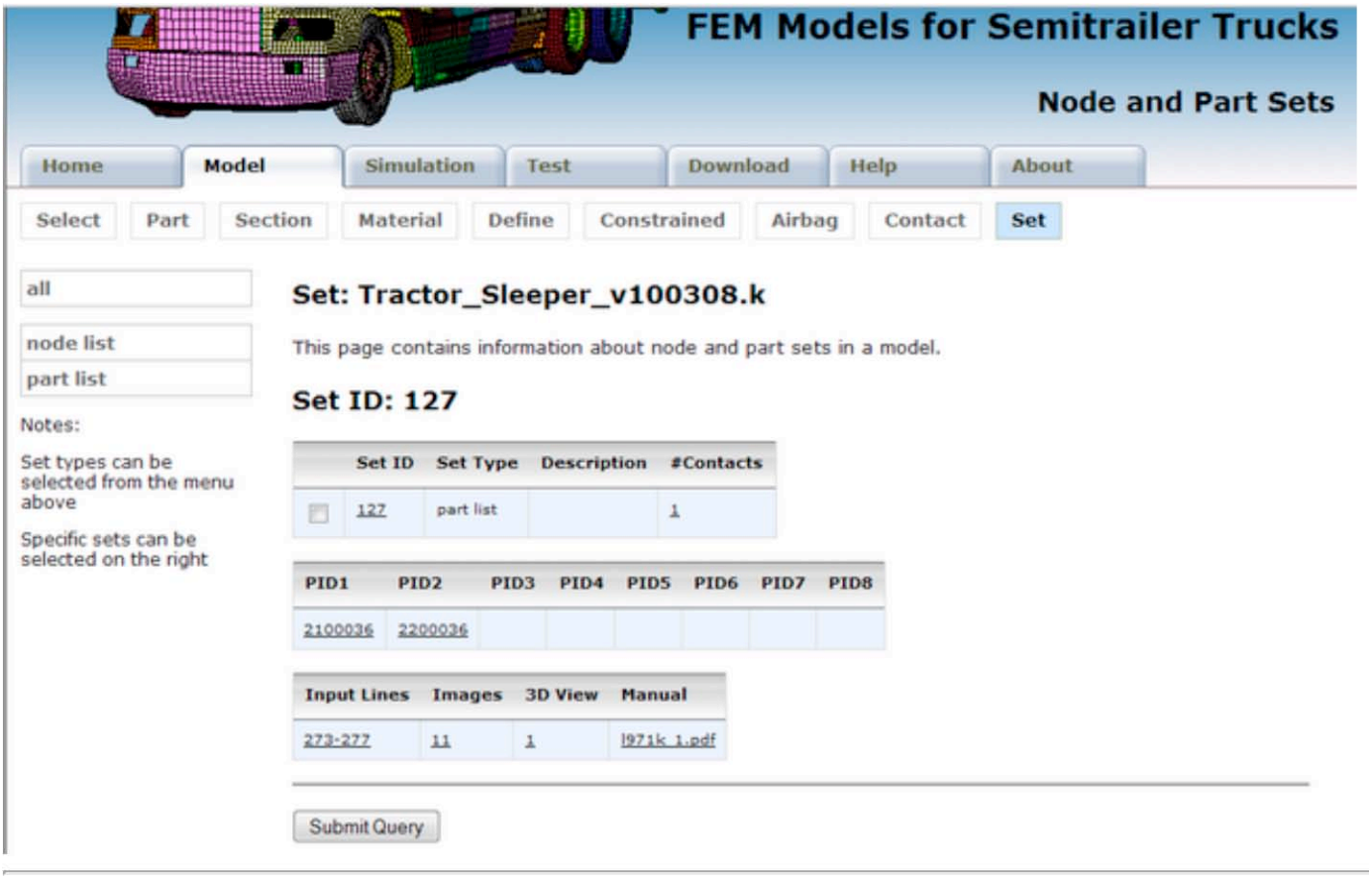
Essential information about node and part sets used in the selected model is displayed in tabular format with each set filling one data row. The data is appropriately linked to related model content.

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.



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.

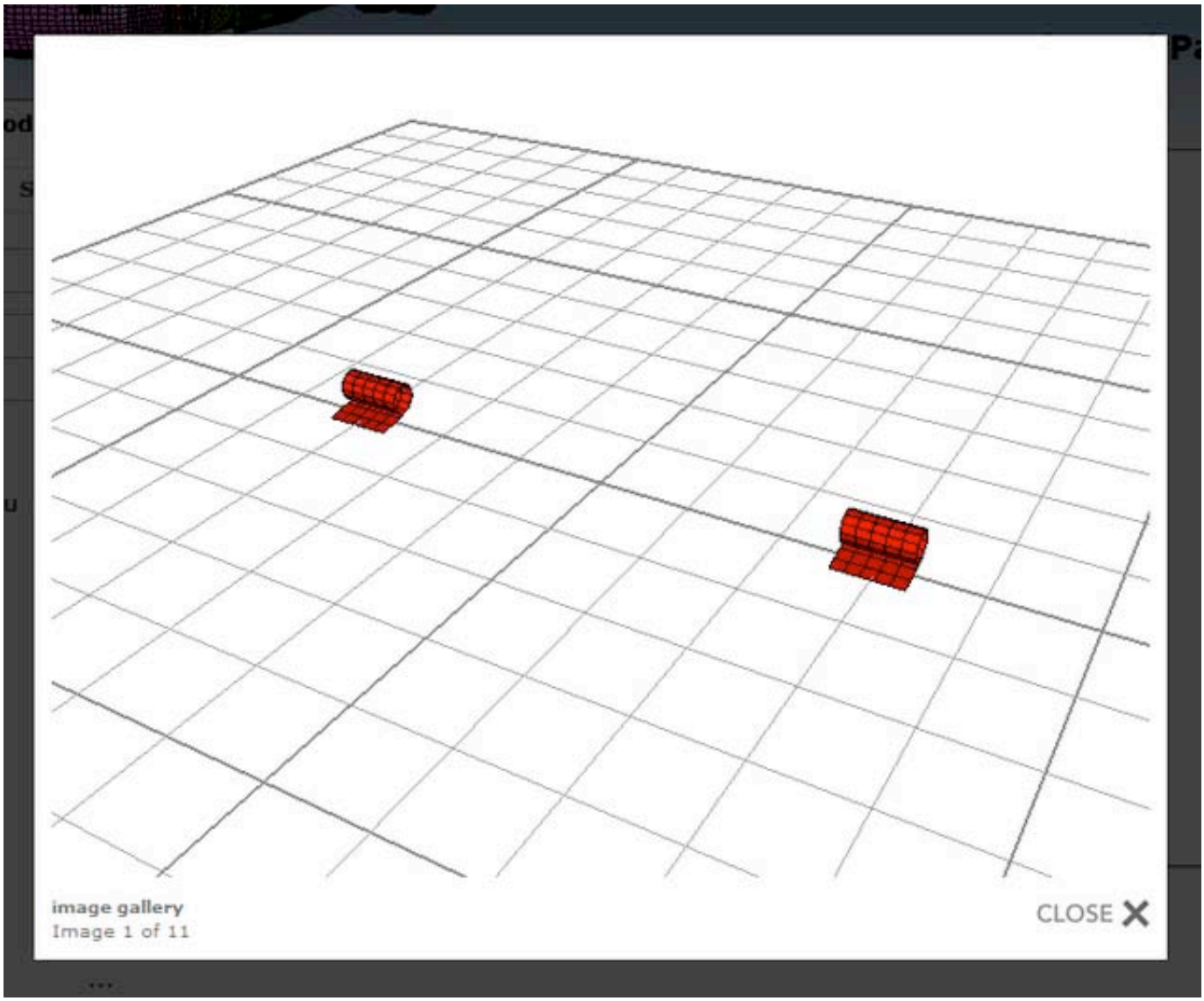


Set constituents are listed in tabular format. Links to related model content are provided where applicable.

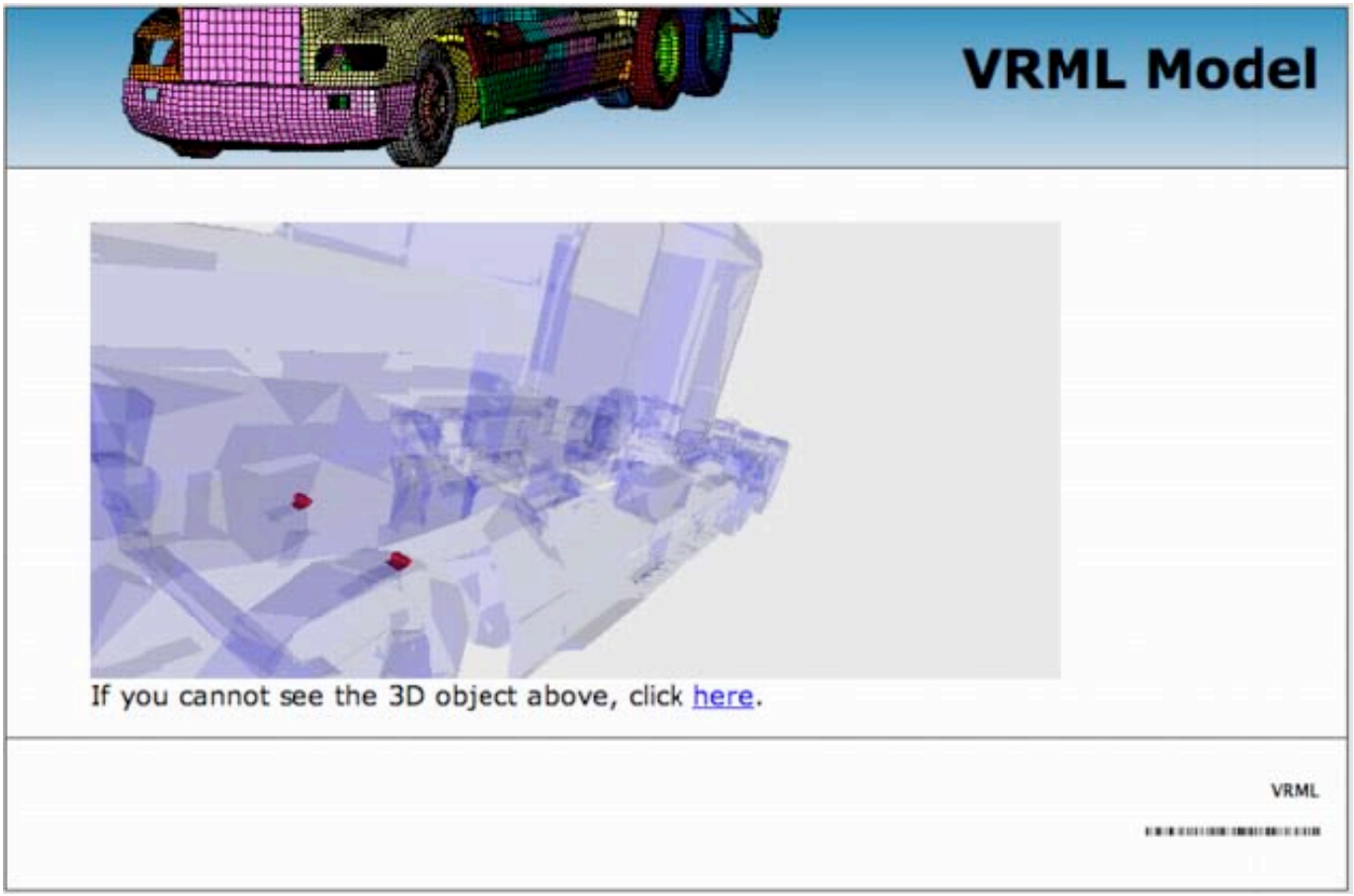
Excerpt from the FEM model source file containing the chosen set entry is accessible through the Input Lines link. A popup window shows the chosen set entry conveniently numbered such that numbers correspond to the FEM model source file lines.

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.

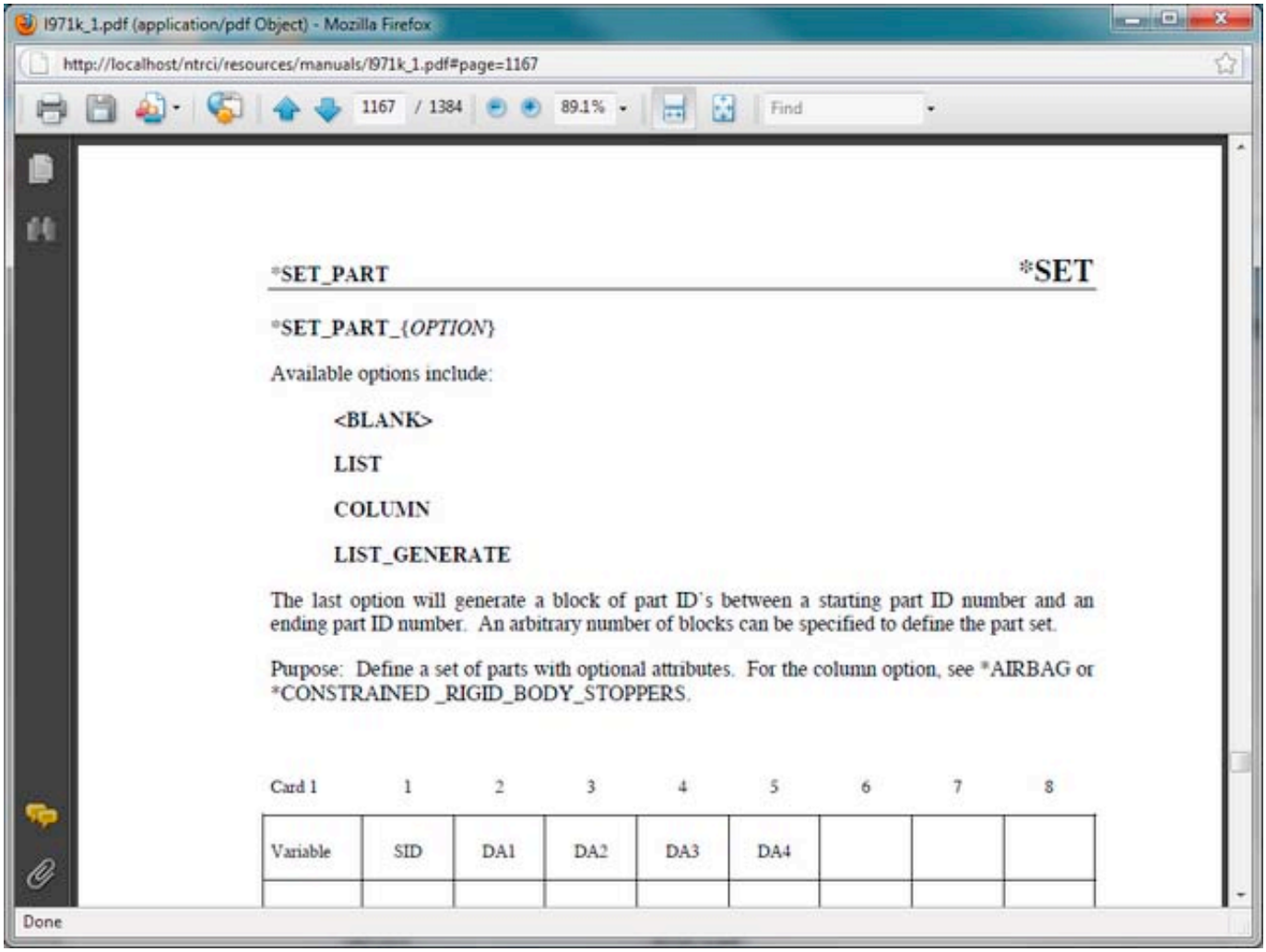
Images can be navigated by clicking inside the image on its left-hand and right-hand side, by clicking on the Previous and Next links that appear on mouse over the image event, by pressing the P and L letters on the keyboard, or by pressing the left and right keyboard arrows. The image window can be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



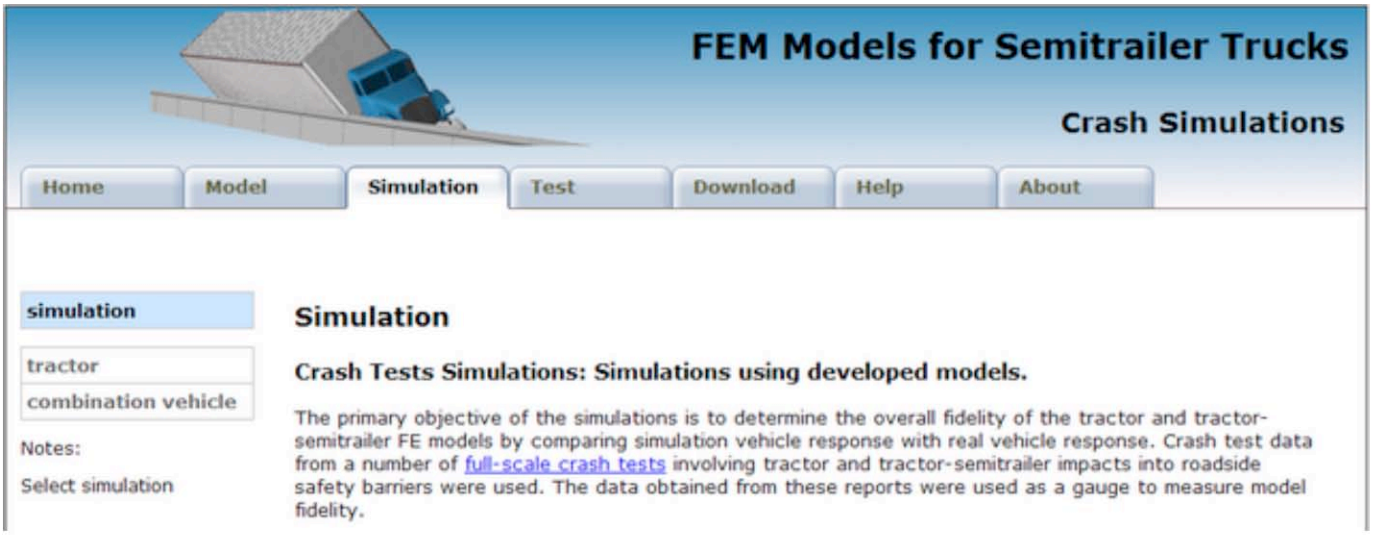
Help from the LS-DYNA User's Manual can be reached through the Manual link. A popup window opens the manual at the specific keyword entry. A pdf reader is required for viewing.


l971k_1.pdf (application/pdf Object) - Mozilla Firefox
http://localhost/ntrci/resources/manuals/l971k_1.pdf#page=1167
1167 / 1384
89.1%
Find
*SET_PART
*SET
*SET_PART_{OPTION}
Available options include:
<BLANK>
LIST
COLUMN
LIST_GENERATE
The last option will generate a block of part ID's between a starting part ID number and an ending part ID number. An arbitrary number of blocks can be specified to define the part set.
Purpose: Define a set of parts with optional attributes. For the column option, see *AIRBAG or *CONSTRAINED _RIGID_BODY_STOPPERS.
Card 1 1 2 3 4 5 6 7 8
Variable SID DA1 DA2 DA3 DA4
Done

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



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)

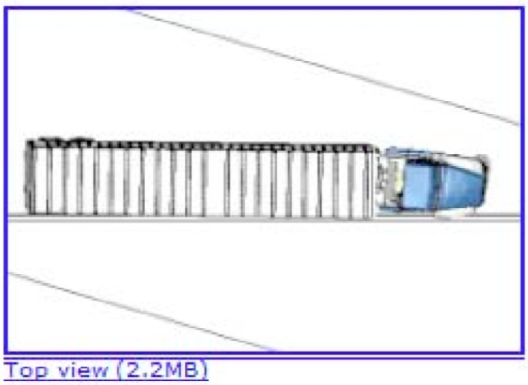
Side view (0.5MB)

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

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

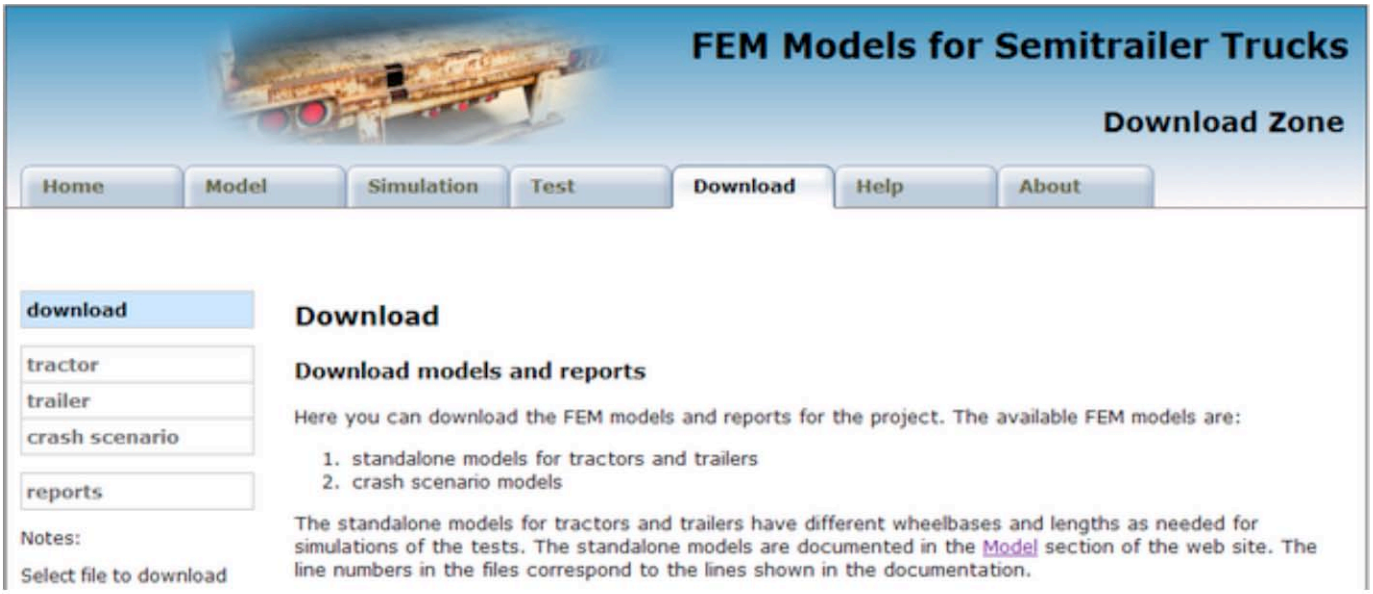
Tractor

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.

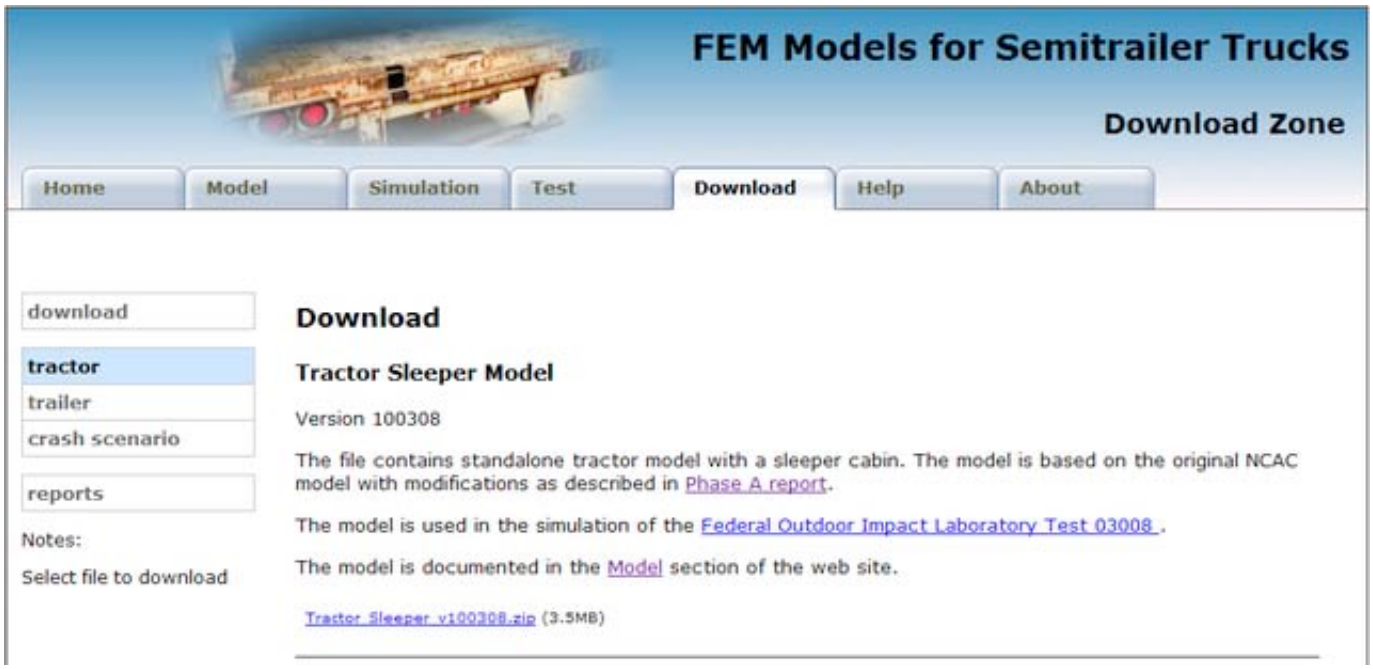


Download

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.



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 breached through the Download's Crash scenario section. Each crash scenario grouping includes tractor, trailer, ballast, barrier, tractor-semitrailer coupling, and gravity initiatialization 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)

01a_Trac_Sleepr_10-0308.zip (3.0MB)

01b_Initial-stress.zip (547KB)

01b_initial-stress_Tractor.zip (547KB)

01c_AirideTractor45psi.zip (7.6KB)

01c_AirideTractor60psi.zip (7.6KB)

02a_SemiTrailer45_10-0621_TTI7069-13.zip (6.0MB)

02b_TrailerMaterials_2010-0217.zip (9.4KB)

02c_AirRideTrailer45psi.zip (1.2KB)

03Tractor2Trailer_connection.zip (743B)

15TL-5_Median_Barrier_Elastic.zip (1.4MB)

15contact-tractor2010-0304.zip (764B)

15contact-trailer2.zip (624B)

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

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.