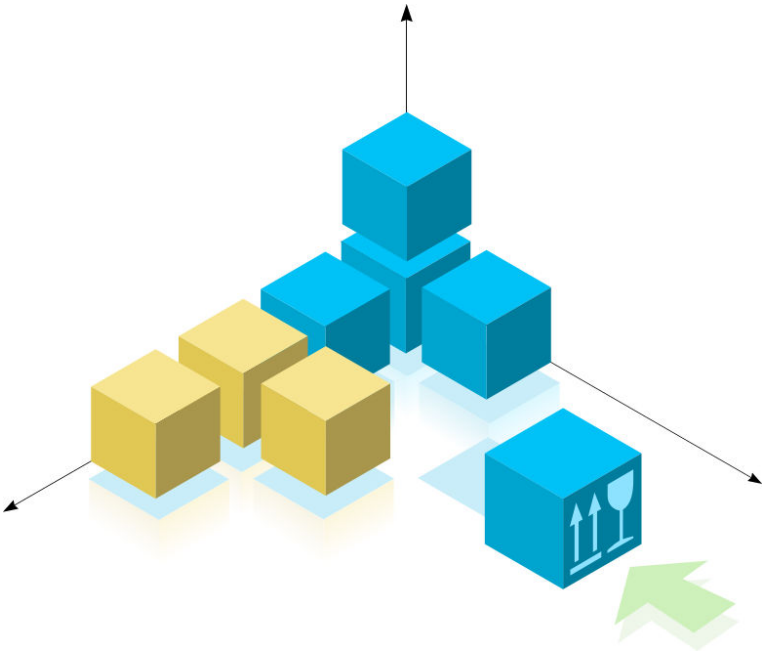
packer3d

Calculation of the optimal loading of goods into vehicles



User's Manual

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The documentation of the software solutions of packer3d ver 3.01

This file with documentation describes the rules of working with the program packer3d ver 3.01 in *mini*, *prof* and *corp* modifications.

The documentation contains general information about the program and its functionality, step-by-step tutorial for the user, and contextual help on the program's interface.

About the program

The program packer3d v3.01 is designed to calculate the optimum loading of a set of parallelepipeds (boxes) into a group of vehicles such as lorries, rail cars, containers and platforms. Each type of a vehicle is defined by its specific dimensions. The program is based on proprietary heuristic algorithms with the elements of neural networks and genetic calculations and is a result of theoretical and applied research in the fields of discrete mathematics, mathematical statistics and mathematical logic that began at the MATIS faculty of the department of Mechanics and Mathematics of Moscow State University named after M.V. Lomonosov.

The algorithm generates a set of 2D and 3D step-by-step diagrams that show a sequence of loading boxes into the given vehicle(s) that is close to optimal and can achieve 80 to 90% of volume utilization.

Main program optionalities:

During calculation of diagrams that shows a sequence of loading boxes into the given vehicle(s), the program takes into account

- *Loading in different types of vehicles:*
  - *Lorries/HGV;*
  - *Rail Cars;*
  - *Containers;*
  - *Platforms;*
- *the load capacity of vehicles;*
- *the maximum pressure on the axes of the given vehicle(s);*
- *direction of cargo compacting (to which side the cargo should be stacked to);*
- *additional loading into vehicles;*

- *generation of diagrams that show step-by-step instructions on loading/unloading;*
- *vehicle(s) can be loaded in the order specified by the client;*
- *loading boxes using pallets;*
- *additional optimization of the vehicle loading according to the value of the cargo (the most valuable cargo is loaded first);*
- *an option to load all goods together in a single vehicle (according to destination or type of goods) and guaranteed unloading of them as a group;*
- *stowage of the cargo depending on its frost-resistance;*
- *the fragility of a box and the maximum pressure that it can endure from the top and /or other facets;*
- *special conditions for transportation of cargo ("do not turn over" and so on) ;*
- *The boxes have to be loaded the required side up and cannot be turned over in any other way;*
- *cargo (box) that has to be placed only with its long side parallel to the direction of movement of the vehicle;*
- *the ability to view the loading diagrams in a 3-D way;*
- *step-by-step diagrams in different amount of detail, creation of own blueprints for reporting;*
- *export and import of data/information;*
- *And much more…*

Program restrictions

The following restrictions cannot be changed by the user:

- *the cargo (boxes) can only have shapes of parallelepipeds*
- *in each vehicle only the boxes that can fit through its doors are loaded*
- *the cargo (box) must fully fit in to the vehicle i.e. no bits can be sticking out of the doors*

System requirements.

For successful installation and use of the program your computer must have the following minimum system requirements:

- *Operation system - Microsoft Windows 98, NT, 2000, XP;*
- *a vacant USB port;*
- *at least 100MB of free disk space;*
- *For the installation of the program you must have a device that can read CD disks.*

Standard and other modifications of the packer 3D software.

The program "packer3d v.3.01" is an updated version of the well-known and successful program "packer3d Omega release". Taking into consideration customers' feedback the program's interface became more user-friendly, the speed and quality of the calculations has increased and new useful functions have also been added. "Packer3D v3.01" is released in several separate modifications that differ in their functionality, delivery options and costs. More information about on each modification can be found in the section "Functionality of different modifications of the program"

This User's Manual is universal for all modifications. If a function is applicable only to a specific modification, this will be highlighted.

We would appreciate if, after a month of use, you would kindly put any comments about the program onto this site: http://www.packer3d.com/modules/contact/. This would really help us in improving and perfecting "packer3d".

Installation

1. *Insert installation disk into a CD-reading device.*
2. *Run installation program (setup.exe) from the installation disk:*
    - *in the menu "Start" select the option "Run";*
    - *in the appeared window "Run" select option "Browse";*
    - *in the window "Browse" select "My Computer";*
    - *choose a drive with an installation disk;*
    - *select "setup" file and press "Open";*
    - *in the window "Program start" press "Ok".*
3. *Follow the instruction of the installation program.*
4. *At the end of the installation process insert supplied USB-key in a vacant USB port of the computer.*
5. *Remove installation disk from the CD reader.*

After successful completion of all these steps, the program packer3d is installed on your computer and ready to use.

If you have questions or require assistance with the installation, contact us at support@packer3d.com.

Functionalities of different modifications of the program

The program packer3d is available in several modifications, which differ by their functionality. In the family of modifications *nano-mini-prof-corp* each subsequent modification has an extended functionality in comparison to the preceding modifications. The junior modification is cheaper and offers fewer functions than its senior; each subsequent senior modification has all the functions of the preceding junior modifications.

List of available modifications of the program packer3d for calculation of the optimal loading:

- **Nano** – *modification with minimum functionality. Distributed as a shareware through Internet, requires registration, does not require USB key to run.*
- **Mini** – *modification with base set of necessary functions. Distributed as a «packaged product" and requires a USB key to run.*
- **Prof** – *modification with an extended set of functions that make the most of the capabilities of the used algorithm. Distributed as a «packaged product" and requires a USB key to run.*
- **Corp** – *multi-user solution realized in the client-server architecture. Offers a complete set of algorithm functionality, additional options for system integration and allows unlimited quantity of end user licences (requires a USB key for server).*
- **Omega** – *the first modification of the program, based on a different algorithmic foundation. Distributed on a CD disk and requires a USB key to run. Has been taken out of sale since September 2007.*

- **www** – *online-service to calculate optimal loading, accessed on www.packer3d.com site to non-registered users. This service is available for free.*
- **www+r** – *online-service to calculate optimal loading with extended functionality, accessed on www.packer3d.com site to the registered users. This service is available for free.*

Meaning of the used symbols:

- **-** - *the function is not available for this modification of the program and is not planned for realization in this modification.*
- **+** - *the function is available for this modification of the program*
- ** - the function is not available but planned to be included in new versions of a modification in question.*

	nano*	mini	prof	corp*	omega	www	www+r
General Information							
Version of the algorithmic foundation (versions 2 and 3 are based on different approaches to find optimal solution. The end results of the calculation using two versions of algorithmic foundation could differ. For example, the second version allows boxes to be placed only on the bottom of a vehicle or above a rectangular block of boxes, the third version allows placing on top of two boxes of equal height standing by each other)	3				2		
Mode of distribution	Internet	box			Is taken out of sale		www-site
Personal / multi-use	personal			network	personal		
USB-key to run the program (supplied together with the software)	Not required	required			required	Not required	
Functions of the algorithm							
Loading into the containers/lorries (option to calculate optimal loading of boxes into containers or lorries with the door located at the rear)	+	+	+	+	+	+	+
Load capacity of vehicle (option to calculate optimal loading taking into account weight of boxes, allows setting a restriction that the total cargo weight should not exceed a given load capacity of the vehicle)	+	+	+	+	+	+	+
Loading into rail cars (option to calculate	-	+	+	+	+	+	+

optimal loading of boxes into rail cars, with the door located in the middle)							
Axle pressure (option to calculate optimal loading with the condition that the pressure on the vehicle's axles does no exceed a given parameter, the directions of the vehicle's axles are defined by the user)	-	+	+	+	+/-	-	-
No-Tilt (option to calculate optimal loading with even pressure on vehicle's sides)	-	+	+	+	+	-	-
Fragility of cargo (option to specify cargo that dose not allow any other boxes to be placed above it)	-	+	+	+	+	-	+
Fragility of Cargo + (option to place no more than N boxes of a specified type on top of each other , no other types of boxes are allowed to be placed above, i.e. no heaping)	-	+	+	+	-	-	-
Fragility of Cargo ++ (option to set the maximum weight allowed to be placed above a specified box)	-	+	+	+	+	-	-
Do not turn over (option to set a requirement to keep specific box only in vertical position)	-	+	+	+	+	-	+
Do not turn over+ (option to define any side of a box as a bottom, i.e. define the vertical direction of a box)	-	-	-	-	+	-	-
Do not turn over++ (option to define «parallel to the move» direction, i.e. a certain side of a box is always placed along the road)	-	+	+	+	+	-	-

Optimization of loading sequence according to the value of the cargo (option to maximize not the volume of loaded cargo but its value, the value is not necessarily proportionate to the size of the cargo)	-	-	+	+	-	-	-
Use of pallets (option to load a vehicle with pallets, i.e. first calculate the optimal loading of cargo into individual pallets and then optimize the place of pallets in a given vehicle)	-	-	+	+	-	-	-
Loading order (option to specify loading order for each individual box, boxes of the first type will be loaded first, then second, etc., useful in cases when a vehicle is unloaded at various points and regrouping of boxes is not allowed)	-	-	+	+	-	-	-
Additional loading (option to add new boxes to already partially loaded vehicle)	-	-	+	+	-	-	-
Cargo grouping (option to divide cargo into non-separable groups so vehicle must contain all parts of the group, useful for transportation of un-assembled furniture)	-	-	+	+	-	-	-
Compacting (for incomplete loading of a vehicle, option to define where the main volume should concentrate, i.e. at the rear)	-	-	+	+	+	-	-
Compacting+ (for incomplete loading of a vehicle, option to set a requirement on the exact location of cargo, i.e. at	-	-	+	+	-	-	-

the front, rear or near side walls of a vehicle)							
Full search (option to slightly improve on the average the quality of the loading sequence but at the expense of using considerably more time for calculations)	-	-	+	+	-	-	-
Rules for cargo loading (option to set additional restrictions for the loading of the boxes, i.e. maximum empty distance between the boxes or difference in the height of boxes standing next to each other)	-	-	+	+	-	-	-
Functions of the interface							
Presentation of parameters in a table (the parameters of the vehicle and cargo are presented in a table, for modifications www and www+ only parameters of cargo are presented in a table)	+	+	+	+	-	+	+
Output of the calculations in a 3D format (option to receive the optimal loading output as a dynamic 3D view with the ability to rotate it, change its scale and view a step-by-step loading sequence)	+	+	+	+	+	-	-
Output of the calculations into a table (option to download the optimal loading sequence into a table without additional graphics)	+	+	+	+	-	-	-
Output of the calculations into a report (option to download results into a report showing a step-by-step loading sequence,	+	+	+	+	+	+	+

where each step is accompanied by text instructions and a graphical diagram)							
Reports with different degree of detalization (option to view loading diagram on different levels of detalization)	-	+	+	+	-	+	+
Editing and creation of templates of reports (option to edit and create new report layouts, where the user defines a desired level of textual and graphical detalization)	-	-	+	+	-	-	-
Printing of the report (option to print the report showing optimal loading sequence)	-	+	+	+	+	+	+
Export/Import of tables using an exchange buffer (option to copy through an exchange buffer the tables containing order parameters and results of the calculations into MS Excel and MS Word applications)	-	-	*	*	-	-	-
Input of own vehicles (option to define own vehicles with desired parameters for the calculation of their optimal loading)	+	+	+	+	+	-	+
Undo/redo (option to revert the changes done during creating a loading order)	+	+	+	+	-	-	-
Functions of integration							
Built-in standard database of the vehicles	-	-	+	+	-	+	+
Save/download in MS Excel format (option to save and download data for the order calculation (without results of the calculations) in the MS	-	-	*	*	-	-	-

Excel format)							
Additional modules of export/import (additional export/import modules for various information systems, e.g. «1C»)	-	-	*	*	-	-	-
Export / import of data in XML-format (option to save and download parameters of the loading order and results of the calculation in the XML-format, available for analysis or re-formatting by other programs, the distributive includes detailed description of the formats)	-	-	+	+	-	-	-
Saving the reports in HTML format (option to save generated reports in the HTML format)	-	-	+	+	-	-	-
Saving the reports in PDF format (option to save generated reports in the PDF format)	-	-	*	*	-	-	-
Running of the program in a background mode (option to run the program at a background when calculations are not projected to the graphical interface of an end user, at the end of the calculations the program saves the optimal loading sequence in a specified file and closes by itself, such mode is used for program that is built into the operational processes of a client)	-	-	-	*	-	-	-
Generation of reports in a background mode (option to run the program at a background to generate the optimal loading report of a	-	-	-	*	-	-	-

required type in the HTML format)							
Integration with user's databases (option to integrate the program with user's databases, in this case all parameters of the loading order and result of the calculations are downloaded and saved in the user's database)	-	-	-	*	-	-	-
Server mode (option to run the program in the server mode when the program automatically calculates loading for all new orders that appear in its database, such orders can be created by any program-client)	-	-	-	*	-	-	-
Program-client (a program that can be used by unlimited number of licensed users (and can be installed on different computers), the program can be used for generation of loading orders from a shared database, the results of the calculations can be viewed by different users)	-	-	-	*	-	-	-

Description of the Interface

This chapter contains detailed description of the elements of the interface of the program «packer3d v.3»

Actions

About program...

Information about the program «packer 3d»

Show/hide advanced

Sow or hide extended set of parameters of the given boxes

Show/hide advanced

Show or hide extended set of parameters of the given pallets

Show/hide advanced

Show or hide extended set of parameters of given vehicles

Build report

Generate an optimal loading report for a given set of boxes

Clear the list of boxes

Delete all the boxes from the optimization set

Clear the list of pallets

Delete all the pallets from the optimization set

Clear the list of vehicles

Delete all vehicles from the optimization set

Set settings as default

Use the current parameter of the algorithm as default parameters for a new loading order

Set boxes as default

Use the current set of boxes as standard for a new loading order

Set pallets as default

Use the current set of pallets as a standard for a new loading order

Set vehicles as default

Set the current set of vehicles as standard for a new loading order

Delete the box

Delete selected box from the set

Delete the pallet

Delete selected pallet from the set

Delete the vehicle

Delete selected vehicle from the set

Redo

Recover to the last deleted action

Undo

Delete the last actions

Exit

Exit from the program

Help

Show the help menu for the program

Contextual help

Show help for the selected element of the program

Load template

Select a new type of the presentation for a given report

New box

Create a new box in at a selected position

New group

Create a new group of boxes (set of boxes that should be all loaded in a specified vehicle)

New pallet

Create a new pallet at the selected position

New document

Create a new document for calculation of optimal loading

New vehicle

Create a new vehicle to run an order

Open

Open the file

Import algorithm settings

Import the given parameters of the algorithm in a file

Import of boxes

Import the set of boxes in a file

Import of pallets

Import the set of pallets in a file

Import of the results

Import all the results of calculations and reports in a separate file

Import of vehicles

Import of the set of vehicles in a file

Print report

Print a current report with the results of calculation of the optimal loading

Show/hide the Editor

Show or hide the options panel of the Report Editor

Show/hide the Tree

Show or hide the options panel for the Editor Tree

Rebuild the report

Generate a new Report after modification of the parameters

in HTML

Save the Report in the HTML format

Restore the Task

Restore parameters of the order for a current loading solution

Calculate

Run calculation for the optimal loading of boxes

into vehicle

Re-calculate

Re-run calculation of optimal loading after adding boxes to the existing loading diagram

Save

Save all the data in a file

Export of algorithm settings

Export the parameters of the algorithm into a file

Save as...

Save all the data in a specified file

Export of boxes

Export the set of boxes in a file

Export of pallets

Export the set of pallets in a file

Save the template

Save the current type of the report in a file (for use for different reports)

Export of the results

Export all the results and reports in a separate file

Export of vehicles

Export the set of vehicles in a file

Step Style

Choose a style of steps for a step-by-step view of

the loading sequence

Edit the text

Edit the text constants of the program

Show/hide the database

Show or hide the options panel of a database

Show/hide the toolbar

Show or hide the options panel for instruments

Report

New Report

Launches standard type of the report

Loading Direction

Direction for a step-by step show of the loading sequence

Info

General Information

Boxes's rest

Set of unloaded boxes

Boxes

Information about a single loaded box

Boxes list

Set of boxes to be loaded

Multi-blocks

Complex blocks of boxes made out of different types of boxes

Pallet's rest

Set of pallets not loaded

Pallets

Diagram that shows loading of boxes into pallets

Pallets list

Set of pallets that can be used for loading

Tiers

One horizontal layer of boxes of the same size standing next to each other

Rest

Information about unloaded boxes and empty vehicles

Settings

Parameters of the algorithm

One box

One step – one box, this type of the presentation of the loading sequence assumes that only one box is added during the next step of loading

Steps

Graphical representation of a loading sequence

Style of steps

A style of a step-by-step view of the loading sequence

Table

Presentation of the loading diagram as a table, without graphics

Task

Information about boxes and vehicles to be loaded

Unified blocks

Basic blocks made out of boxes of the same type

Rest of vehicles

Set of unused vehicles

Vehicles

Result of loading boxes into a vehicle

Vehicles list

Set of vehicles available for loading

X-direction

Loading sequence along the X-axe (length of a vehicle)

X-layers

Layers of similar boxes in the loading sequence formed along the X-axe (length of a vehicle)

Y-direction

Loading sequence along the Y-axe (width of a vehicle)

Y-layers

Layers of similar boxes in the loading sequence formed along the Y-axe (width of a vehicle)

Z-direction

Loading sequence along the Z-axe (height of a vehicle)

Z-layers

Layers of similar boxes in the loading sequence along the Z-axe (height of a vehicle)

Template Editor

Results

View

Rest

Document profile

Steps

Table

All boxes

All vehicles

Quantity

Number of used vehicles in a given loading solution

Used

Filled volume of a vehicle for a given loading solution (in %%)

Empty

Empty part of a vehicle for a given loading solution

(in %%)

Utilized boxes

Number of loaded boxes

Utilized types

Number of different types of loaded boxes

Weight

Total weight of the loaded cargo (in Kg)

Value

Total value of loaded cargo

Front Pressure

Pressure on the front axle of a vehicle

Rear Pressure

Pressure on the rear axle of a vehicle

Name

Name of a box or a block in the selected position

Min-x

Minimal x-coordinate of a box or a block for a selected position

Min-y

Minimal y-coordinate of a box or a block for a selected position

Min-z

Minimal z-coordinate of a box or a block for a selected position

Max-x

Maximal x-coordinate of a box or a block for a

selected position

Max-y

Maximal y-coordinate of a box or a block for a selected position

Max-z

Maximal z-coordinate of a box or a block for a selected position

Boxes-x

Number of boxes along x-axe in a selected block

Boxes-y

Number of boxes along y-axe in a selected block

Boxes-z

Number of boxes along z-axe in a selected block

Rest of boxes

Rest of vehicles

Progress

Cancel

Cancel the calculations of the optimal loading

Pause

Pause the calculations of the optimal loading

Calculate

Continue the calculations of the optimal loading

Detalization

Degree of detalization of the calculation

Progress

Progress of the calculations

Parameters of the algorithm

Axles

Take into account restrictions on the pressure on vehicle's axles

Bottom

Put pallets only at the bottom of a vehicle

Restrictions

Restrictions on loading (arbitrary non-zero parameters could result in boxes suspended in the air)

Filled Gap

Allowed difference in height of boxes, the gap is filled by placing another box on top or bottom of a shorter one.

Horizontal Gap

Allowed distance between standing next to each other boxes (the size of a gap that still allows to place another box on top of the boxes with a gap)

Vertical Gap

Allowed difference between the heights of boxes standing next to each other that allows placing a new box on top for them without filling the gap.

Compactness

Direction of increasing space utilization for loading.

Functions

On/off for functions of the algorithm.

Groups

Take into account groups of the boxes

Only

Load boxes only in pallets

Order

Take into account the loading order for boxes

Pallets

Load boxes in vehicles using pallets

Loading with pallets

On/off for functions of loading in pallets

Pressure

Maximum allowed pressure on the top (if equal 0 none of the boxes will be put on top of the pallets, if empty – no restrictions).

Value

Take into account the value of cargo.

Speed

Set the speed for the algorithm to generate a result, the longer is the time allowed for calculation, the better is the quality of the end result

Load capacity

Take into account the load capacity of a vehicle

Express

Quickest algorithm, all functions of the full search or multiblock combinations are turned off

Maxi

The slowest algorithm, all functions of the full search and multi-block combinations are turned on, not recommended for use for day-to-day operations

Normal

Normal speed of the calculations, all the functions of full search are turned off and some of the functions of multi-block combinations are turned on

Slow

Slow speed of calculations, all functions of multiblock combinations and some functions of the full search are turned on

Boxes

Color

A color of the box that is used for graphical representation of the loading sequence

Fragility

Fragility of a box:
- 0 – means no restriction on additional boxes that can be placed on top of the box,
- 1 – means that no other boxes can be places on top of the box,
- N>1 -means that no more than (N-1)
boxes of the same type can be place on top of the box in question

G-Quantity

Number of groups of this type that are available for loading in a vehicle

G-Size

Number of boxes in a group

Fixed top

Restriction that the box should always be placed vertically

Top Pressure

Maximum allowed pressure on the top when the height of the box is placed vertically

Height

The height of the box in mm.

I-Quantity

Number of boxes in a group

Fixed direction

Place along the route, the side (Length) of the box should be placed parallel to the direction of vehicle's movement

Side Pressure

Maximum allowed pressure on the top when the length of the box is placed vertically. This parameter is ignored if the function "Fixed Top" is turned on

Length

The length of a box in mm

Weight

The weight of a box in kg

Name

Name of boxes of a particular type. The name of a box does not affect the calculations, it is used only for information purposes

Order

The loading order for boxes. This parameter is used when a vehicle will be loaded and unloaded in different locations

Value

Value of a box. The parameter is used to maximize the value of the loaded cargo

Quantity

The number of boxes of a particular type that need to be loaded in a vehicle

Width pressure

Maximum allowed pressure on the top when the width of the box is placed vertically. This parameter is ignored if the function "Fixed Top" is turned on

Width

The width of a box in mm

Pallets

Height

The height of a pallet in mm.
This is the maximum allowed height of the loaded pallet including the support surface. If there is no restriction on the height of he pallet, use zero or empty value

Leeway

Distance form the pallet's borders (could be positive, negative or equal to zero). This parameter is used when the surface that can be loaded with boxes is larger or smaller than the pallet's pan. Thus, the loading surface that is used for calculations of loading into a pallet is equal to
[length-2*leeway] x [width-2*leeway]

Length

The length of a pallet in mm

Name

Name of pallets of a particular type. The name of a pallet does not affect the calculations, it is used only for information purposes

Height of the pallet's pan

Height of an empty pallet (support surface) for the pallets of a particular type

Weight of the pallet's pan

Weight of an empty pallet (support surface) in kg

Quantity

Maximum allowed number of pallets of a particular

type that needed to be loaded in a vehicle. If there is no restrictions, use zero or empty space

Load capacity

The load capacity of the pallet in kg. This parameter defines maximum allowed combined weight of cargo that can be loaded in the pallet of a particular type

Width

The width of a pallet in mm

Vehicles

Rear positions

Position of the rear of a vehicle. The parameter is used only for lorries. It defines the distance from the rear side of a vehicle to its rear

Rear load

Load capacity (maximum pressure) of the rear of a vehicle. The parameter is used only for lorries. If there is not restrictions on the load capacity of a vehicle, use empty space

D-Height

The height of the door of a vehicle. This parameter is used only for rail cars

D-Width

The weight of the door of a vehicle. This parameter is used only for rail cars

Front position

Position of the front of a vehicle. The parameter is used only for lorries. It defines the distance from the front side of a vehicle to its front

Front load

Load capacity (maximum pressure) of the front of a vehicle. The parameter is used only for lorries. If there is not restrictions on the load capacity of a vehicle, use empty space

Height

The height of a vehicle in mm

Type

The type of a vehicle

Length

The length of a vehicle in mm

Name

Name of vehicle s of a particular type. The name of a vehicle does not affect the calculations, it is used only for information purposes

Quantity

The number of vehicle available for transportation of cargo. If there is no restriction on availability of the vehicles, use empty space

Load capacity

The load capacity of vehicle in kg. This parameter defines maximum possible weight of boxes that can be loaded and transported in a vehicle of a particular type. If there is no restriction on the load capacity, use empty space

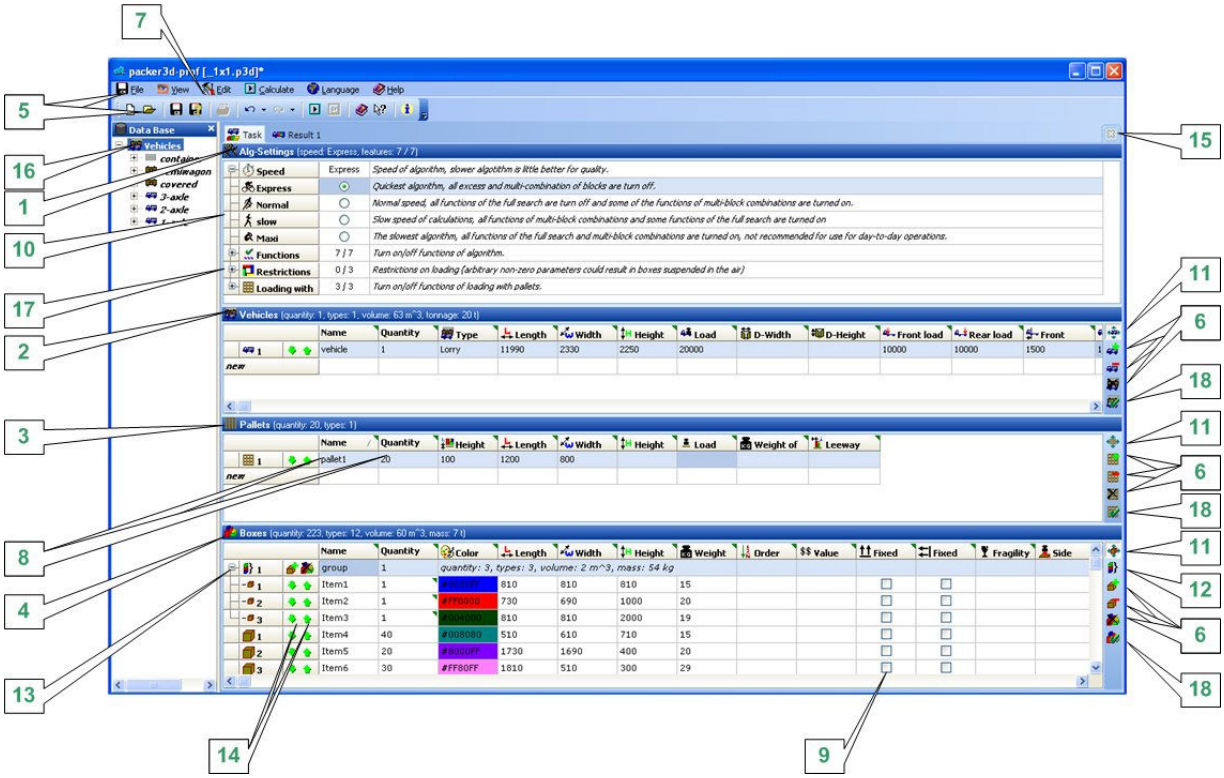
Width

The width of a vehicle in mm

Tutorial

The tutorial to use packer3d v3.01 software includes a demonstration of user's actions required to calculate the optimal loading using the program. The step sequence is not mandatory and is chosen to facilitate the user's understanding of various aspects of program's functionality.

Step 1: Setting the parameters of the order.



Parameters of the order can be set either by direct input into the corresponding order panels **[1]** , **[2]** , **[3]** , **[4]**, or downloaded from an existing file using input/output functions **[5]** *(menu "File")*.

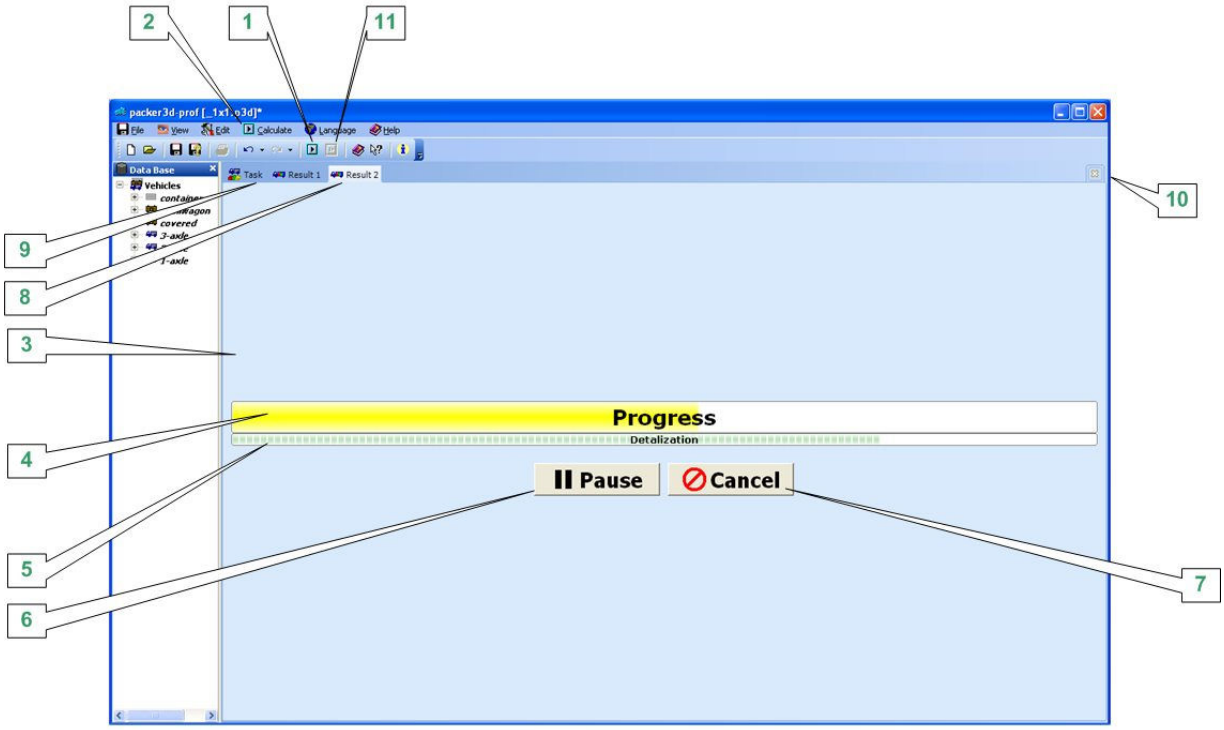
The parameters of the optimal loading order are *parameters of the algorithm* **[1]**, *collection of* vehicles **[2]**, *collection of boxes* **[4]**, that needed to be loaded in the given vehicles and collection of pallets **[3]**, if pallets are used for loading. Addition, deletion or cloning (addition of an exact copy of a given box, pallet or vehicle) of objects either by applying necessary actions to a given box, pallet or vehicle using *control buttons* **[6]**, or *menu Editor* **[7]**. Additionally, in modifications **prof** and **corp**, it is possible to drag and drop a new vehicle from the window "DataBase" **[16]** directly in the panel «Vehicles» **[2]** using a mouse. Every object of the order (vehicle, box or a pallet) is defined by its own set of parameters. To change the order, select a parameter that requires modification (left mouse click), and edit it directly in a *cell*, e.g.

[8] (by pressing ***ENTER***) and then input a new parameter using a keyboard. To simplify the input, some rarely used parameters of vehicles, boxes and pallets could be hidden /unhidden by a special button **[11]**. Some parameters (e.g., the “Fixed” parameter **[9]**), are the optional elements of the type YES/NO and in order to change them click mouse or press ***SPACE BAR***. Some of the elements of the panel (e.g. "Functions" **[10]**) cannot be edited. They are introduced for grouping of other parameters (it is possible to edit **sub**-elements of «Functions", that define the functions of the algorithm). The button New Group **[12]** allows the boxes to be grouped. After selecting the function of grouping in the panel «Boxes», a Group-Box **[13]** appears. In order to add, delete or clone boxes inside a group, put a cursor on a Group-Box or any box inside a group and use control buttons **[6]** or menu **[7]**. Alternatively, to add or delete boxes from a group, one can move the boxes with arrows **[14]** up/down accordingly in /out of the group. To hide/unhide the window click left mouse button on an appropriate window’s title **[1]**, **[2]**, **[3]** or **[4]**. The buttons **[18]** allow setting current list of items as a default for a new task. To close current tab use button **[15]**.

Note that for an order with pallets, the program automatically selects and fills the required number of pallets with boxes and load the pallets into vehicles.

WARNING. By defining non-zero parameters in the functional group "*Restrictions*" **[17]**, a user can "tweak" the algorithm. By changing these parameters, one can significantly improve the quality of the loading. But the program developer warns that the user can do this only on its own risk with full appreciation of the fact that the results of the theoretical calculations of a tweaked algorithm can differ from what can be achieved in real loading.

Step 2: Calculation of the optimal loading



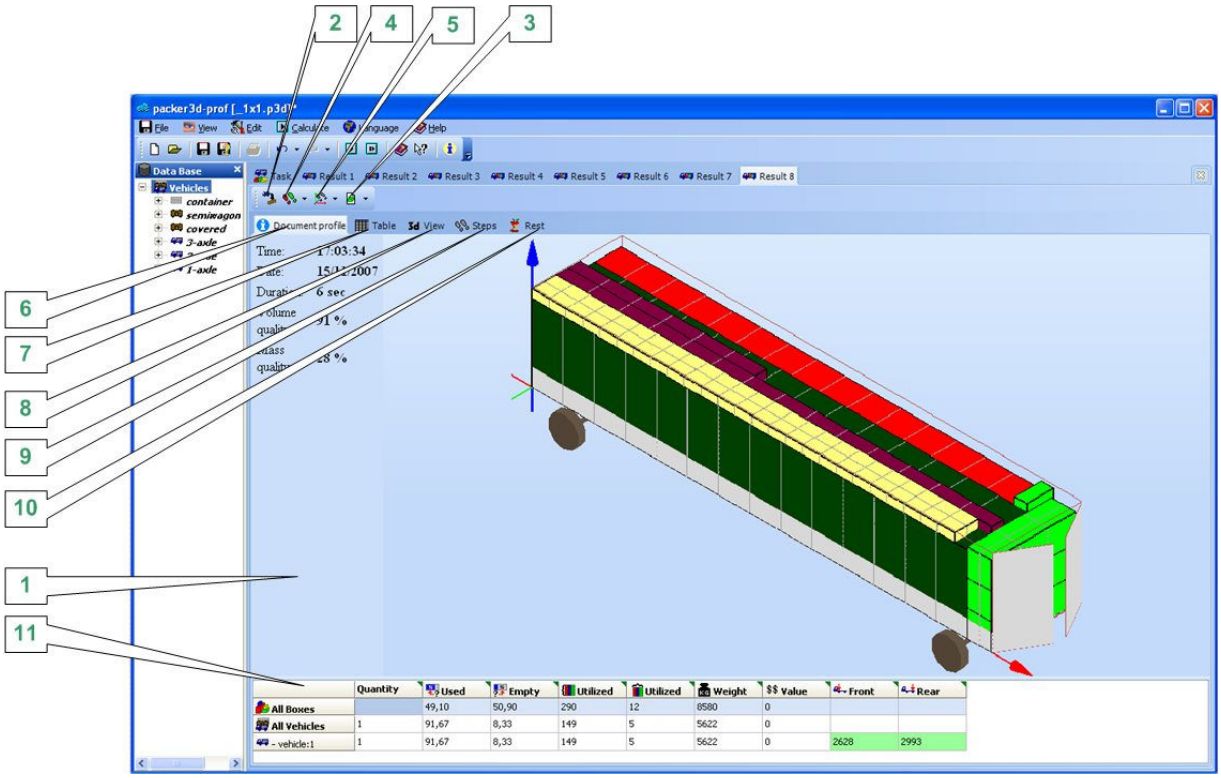
After all the parameters of an order are defined, the algorithm of calculating the optimal loading can be launched. To run the algorithm, press the *button «Calculate»* from the panel of instruments **[1]**, or run the corresponding command form the *menu «Run»* **[2]**.

After beginning of the calculation, the *process dialogue window* **[3]** appears that shows progress of the calculations **[4]** and indicator of the complexity of the algorithm's work for a given degree of detalization **[5]**. The calculations could be paused by pressing the *«Pause» button* **[6]**. To resume the calculations, press the *«Calculate» button* that will appear instead of the *«Pause» button*. To halt the process, press the *button «Cancel»* **[7]** in the *process dialogue window*. If the calculations are aborted, results are not saved. After the calculations are finished, the process dialogue window is automatically closed.

The calculations of loading can be run unlimited number of times with the same or modified parameters of the order. Start of

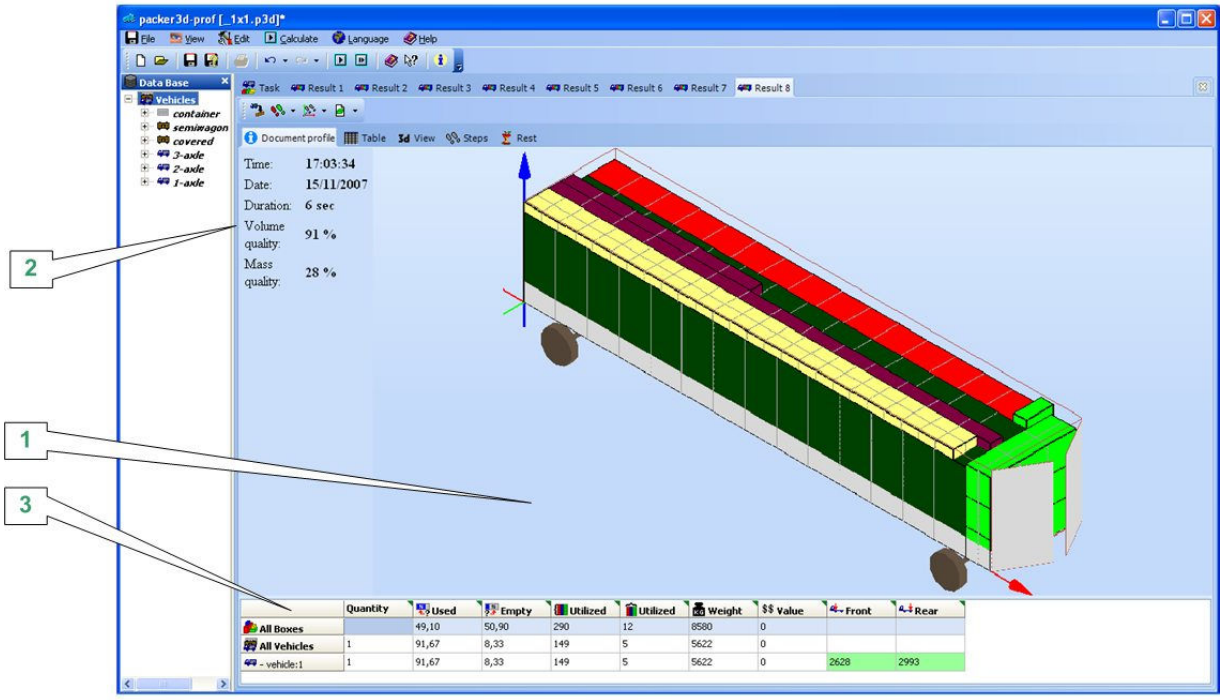
new calculations will not result in an automatic deletion of results of previous calculations but is shown in a new window **[8]** to the right of the results of the previous calculations **[9]**. The user can delete the results of the calculations by closing the active window by pressing the button "*Close*" **[10]**. By varying the input parameters, the user can run an unlimited number of calculations for a given order. The calculations could be run in a parallel mode. To switch from one calculation in progress to another, select an appropriate window, e.g. **[8]** or **[9]**. Before the order in progress is closed, it is always possible to restore the results of deleted calculations or deleted reports by selecting in menu "*Calculate*" sub-option "*Restore*" and then select the required deleted object from the list. The new function "*Re-calculate*" **[11]** can be selected from the window showing calculation results and allow adding new boxes to the already processed order. This function is useful when a vehicle is loaded in several locations. In this case, new boxes are loaded without redistribution the already loaded boxes.

Step 3: Analysis of the results of the calculations



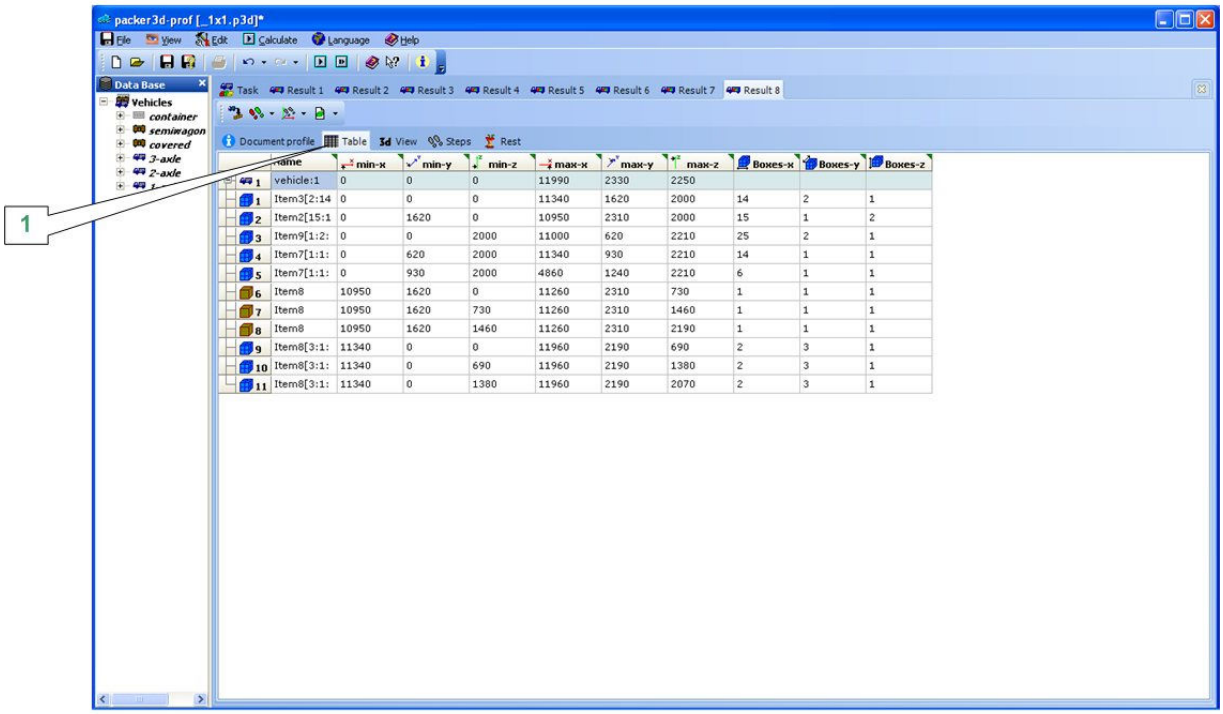
After the calculation process is finished, a window with the *calculations results* **[1]** is automatically opened. The window has 5 presentations of the calculation results **[6]**, **[7]**, **[8]**, **[9]**, **[10]** and *control panel* with four functions **[2]**, **[3]**, **[4]**, **[5]**. Such representation and functions allow the user to analyse results of the calculations in a simple way, modify parameters of the "Order" and select the optimal way of loading. For execution of loading, the results of the calculations are downloaded into a report (see a separate section on reports – Step 10).

Step 4: Analysis of the results of the calculations. Step-by-step result overview. Document Profile.



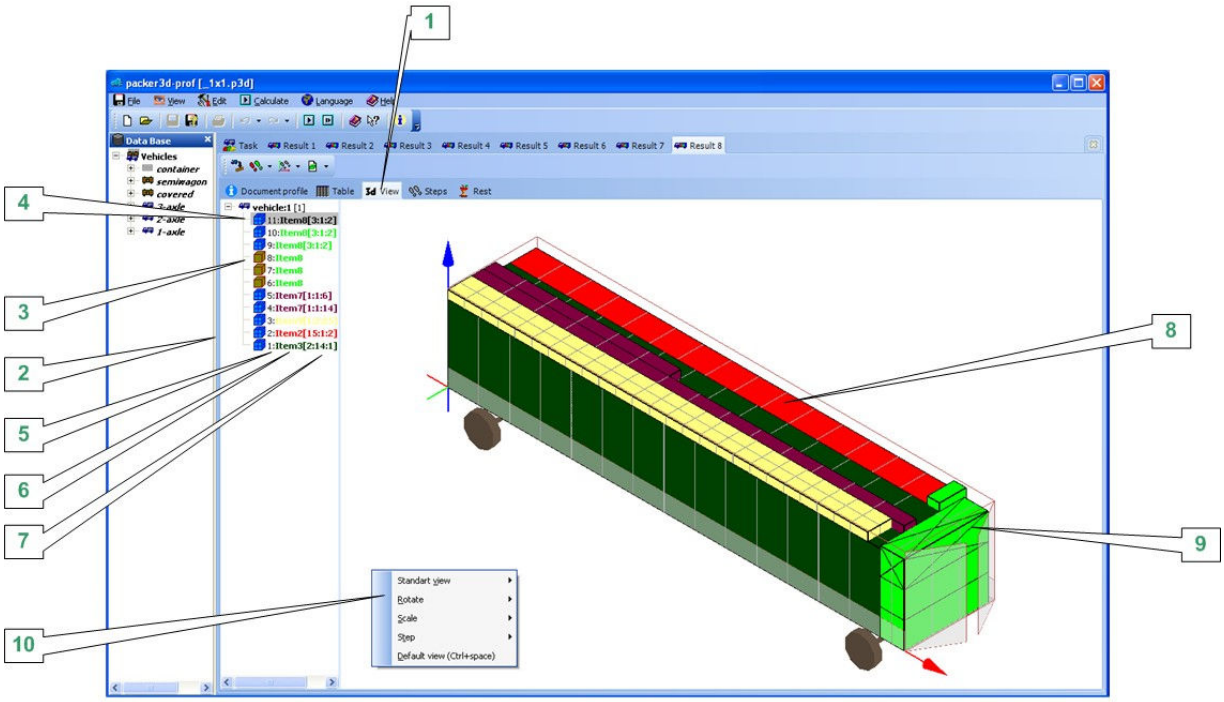
In presentation "*Document profile*" the central part of window is occupied by a 3D-view of a loaded vehicle **[1]**. The quality of loading as well as information about the date and duration of the calculations are shown in the table **[2]**. More detailed information about the way the vehicle is loaded can be viewed in the table **[3]**.

Step 5: Analysis of the results of the calculations. Step-by-step result overview. Table.



The presentation "*Table*" **[1]** contains information about step-by-step loading of a vehicle as a table. The rows of the table present steps of the loading sequence, the columns contain information about location (co-ordinates) of the boxes in the vehicle and any blocks formed of the same-type boxes.

Step 6: Analysis of the results of the calculations. Step-by-step result overview. 3D View.

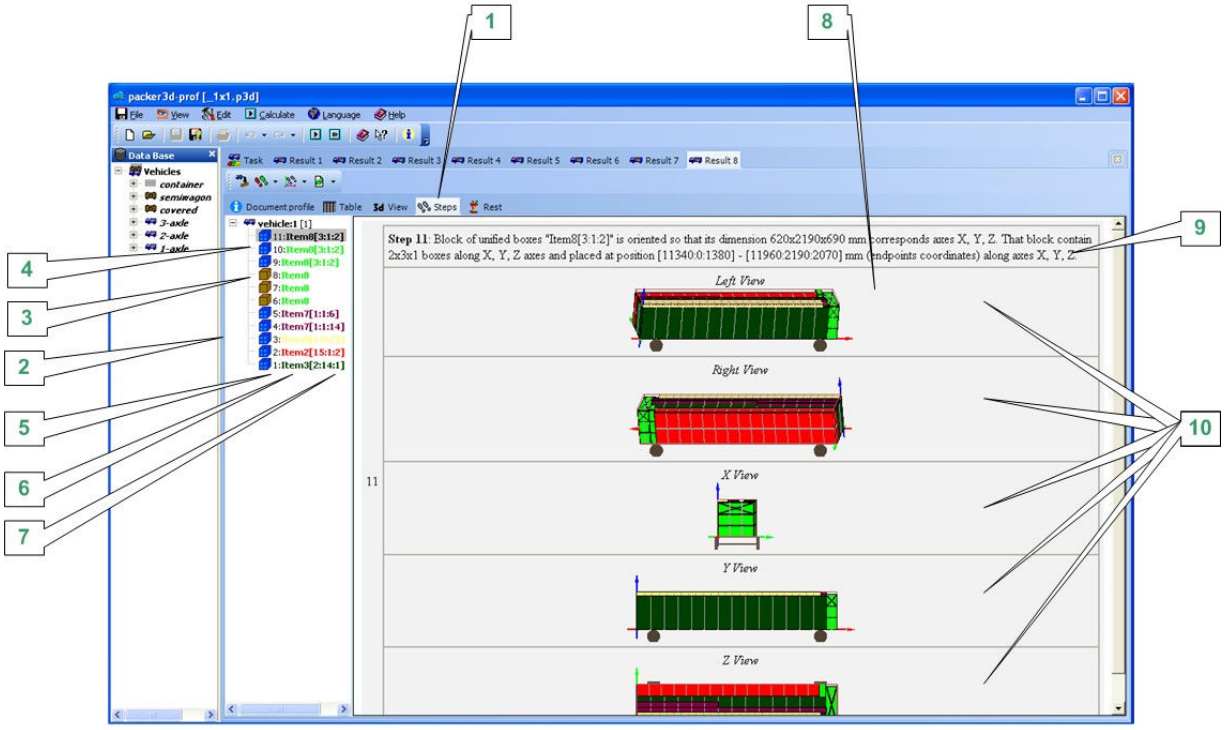


The presentation "*3D View*" **[1]** shows a step-by-step loading sequence of a vehicle in a 3D format. In the left corner of the window, the user can see a sequence of steps of the loading **[2]** and information about the boxes that are loaded at each particular step that includes:
- type of boxes. Loading of a single box is presented by a symbol **[3]**. Loading of a block formed of same-type boxes is presented by the symbol **[4]**;
- number of a step in a loading sequence **[5]**;
- name of a box **[6]**;
- for a block, the total number of boxes in the block formed of same-type boxes with their co-ordinates **[7]**.

With the left mouse click or using arrows on a keyboard, the user can identify on a loading sequence **[4]** for a vehicle **[8]** the boxes that are loaded at this particular step, such boxes will be shown diagonal lines **[9]**.

The 3D scheme could be rotated in all directions and its scale could be changed. Rotation is achieved by pressing together the left button on the mouse and key ***CTRL*** on a keyboard. Scaling is done with the wheel of the mouse. The user can also select extended 3D View control menu for 3D presentation **[10]**, by positioning the mouse above the 3D scheme and making the right click.

Step 7: Analysis of the results of the calculations. Step-by-step result overview. Steps.



The presentation "*Steps*" **[1]** shows steps of a loading sequence of a vehicle in format of projections. In the left corner of the window, the user can select a particular step of a loading sequence [**2**] and see information about the boxes that are loaded at this particular step that includes:

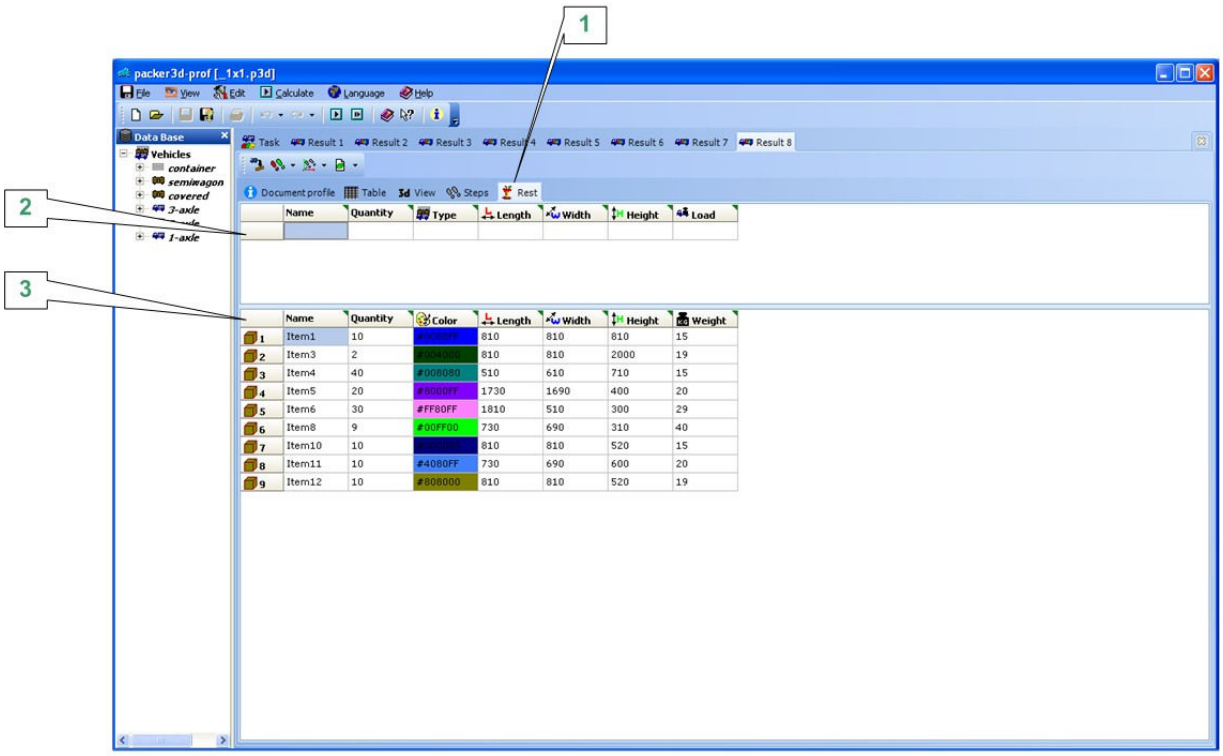
- Type of boxes. Loading of a single box is presented by a symbol **[3]**. Loading of a block formed of same-type boxes is presented by the symbol **[4]**; - number of a step in a loading sequence **[5]**;
- name of a box **[6]**;
- for a block, the total number of boxes in the block formed of same-type boxes with their co-ordinates **[7]**.

Switch the left mouse click or using arrows from the keyboard of the loading step **[4]**, the user can see in the right window **[8]** the following information about the boxes that are loaded at this particular step:

- textual information **[9]** about this step of the loading sequence;
- loading of the boxes **[10]** in five different projections.

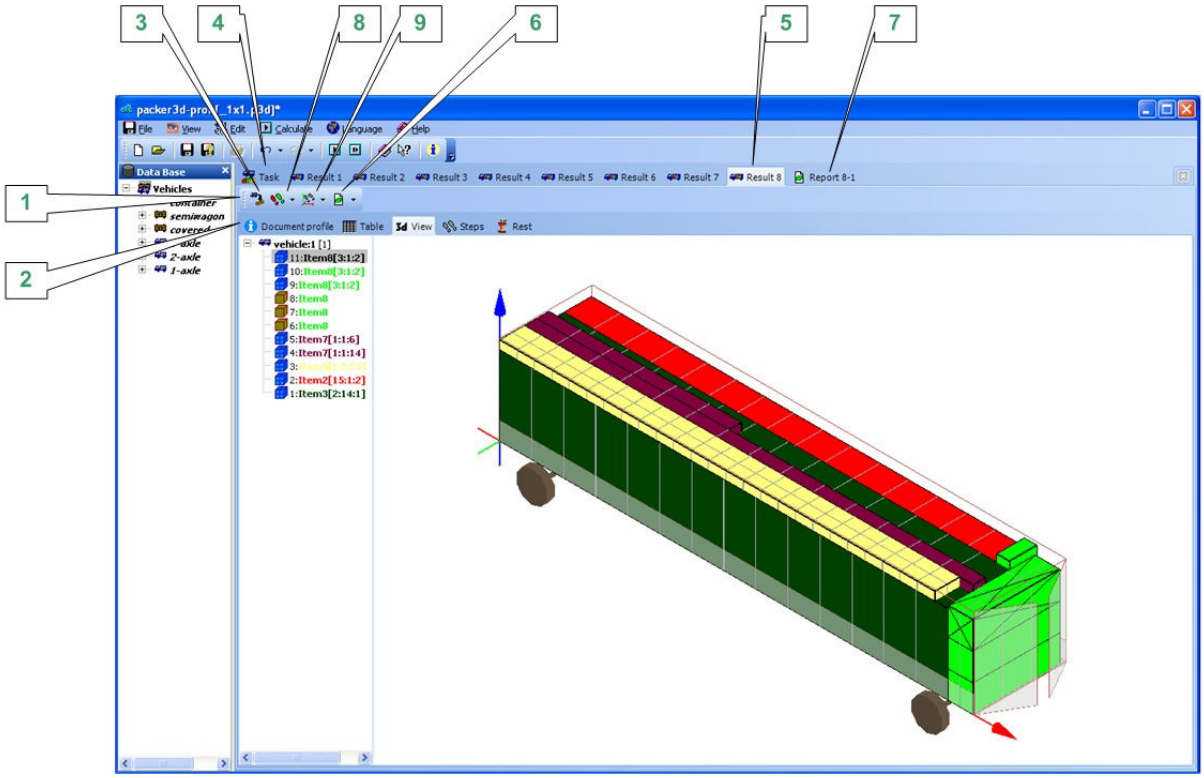
In contrast to "*3D View» presentation, «Steps»* shows *only* boxes that are loaded at a particular step!

Step 8: Analysis of the results of the calculations. Step-by-step result overview. Rest.



The presentation "*Rest*" **[1]** shows the boxes that left unloaded for a given set of vehicles.
The information contains a table with vehicles **[2]** and the list of left boxes **[3]**.

Step 9: Analysis of the results of the calculations. Control panel for a step-by-step result overview.



The control panel for a step-by-step calculation results overview **[1]** allows with a single click to change the type of a step-by-step view of the calculation results on the spot **[2]**. The panel contains four following buttons:

- "*Restore the parameters of the order for optimal loading for this result*" **[3]**.
  The user can run unlimited number of calculation by modifying some input parameters of the «*Order*" **[4]** to achieve the desired optimal result. Results of all such calculations are stored in a sequence **[5]**, but the field "*Order*" does not contain all modifications and when parameters are modifies, the original ones are erased.

  Suppose a user performed 20 calculations and realized that the best result was achieved on the 13th calculation.

But the field "Order» reflect the last, 20th calculations. In order to restore the parameters of the 13th result, the user selects 13th result and press the button «*Restore the parameters of the order for optimal loading for this result*" **[3]**. All the parameters and results of the 13th calculations are copied in the field "*Order*". After this, the remaining 19th calculations can be deleted and the program file can be saved.

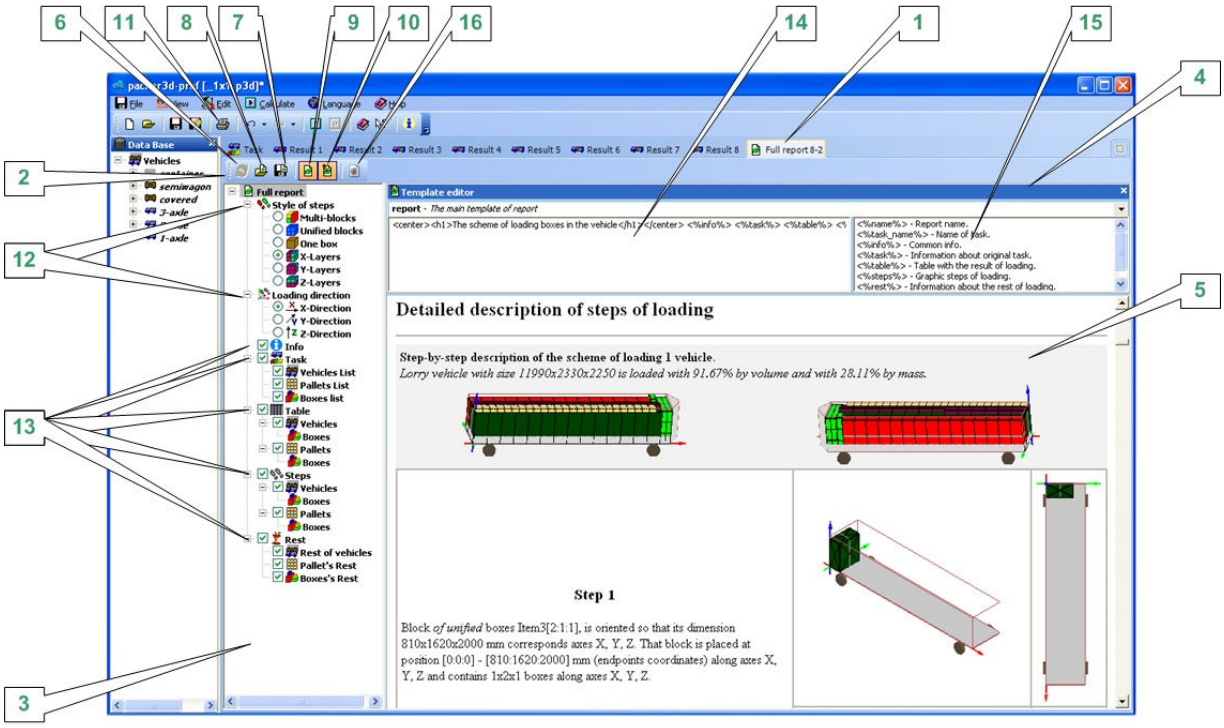
- "*Generate a report for the current result of loading boxes*" **[6]**.
  This command generates a static report in a separate window **[7]** for it to be printed and distributed to workers. See the detailed description of working with reports in the Step 10 of the tutorial section.
- "*Step Style*" **[8]**.
  This button allows selecting a style of a set-by-step calculations result. There are six following styles:
  - "*Multi-blocks*". Each step reflects loading of a Multiblock that consists of DIFFERENT boxes. Such presentation is useful for a quick analysis of the result for a manager responsible for a loading of a vehicle. This style has minimum number of steps and not very informative. The presentation can only be generated if the slowest algorithm for calculation of the optimal loading of a vehicle was used.
  - "*Uni-blocks*". Each step of loading shows loading o a Uni-Block that consists of THE SAME boxes, when possible. This style reduced the number of steps without loss of informativity.
  - "*One Box*". Most popular style of a step-by-step result review. One step – one box. High informativity but contains a lot of steps.
  - "*X-layers, Y-layers, Z-layers*". Overview of a loading sequence depending on the chosen

direction of the loading. For example, the user is loading a lorry from the cabin to the rear door. By choosing one of the sub-styles, there could be a situation when the loading of a lorry will be almost completed and the last step will consist of loading layers of small boxes near the roof of a lorry. In real life such loading is close to impossible. Choosing an *X-layer* loading sequence, the loading order will be formed layer by layer from the cabin to the door. The *Y-layers* and *Z-layers* will generate loading also layer by layer – from one side to the other or form the bottom to top accordingly.

- "*Direction of loading*" **[9]**. This button allows changing the *order* of loading of a vehicle depending on *the direction* of the loading. The direction is selected according the axes "X (red), Y (blue), Z (green)"accordingly. Consider the following situation. Suppose the user is loading a lorry without the tent. There are two loading options – through the door or using a crane from the open top. The number of boxes and their location is calculated by the algorithm and does no depend on the loading direction, but the order of loading will differ. For such a situation, this button allows the user to choose the loading sequence according to his preferences. The loading order is defined by selecting a corresponding axe under this button.

Note that during a step-by-step result overview, the computer could run slowly because in contrast to the static report, the pictures for each step are generated «on the spot». If the control panel is not changed, the second review of the same step will be done without a delay, because the picture will be downloaded from cash memory and not generated on the spot.

Step 10: The vehicle Loading Sequence Report.



The window of the vehicle loading sequence Report **[1]** contains control panel **[2]**, blueprint tree **[3]**, blueprint editor **[4]**, and the window with generated static step-by-step loading sequence **[5]** ready to be printed. Each of these elements is described in details in this section.

- The *report control panel* **[2]** contains important control element:
  - *Generate a new report after parameters were modified* **[6]**. This element will generate a new report;
  - *Save the BLUEPRINT of the current report in the file (for further use in other reports)* **[7]**. Allows to safe BLUEPRINT of the report and not the report itself;

- *Load another blueprint for a current report* **[8]**. Allow to load already saved blueprint of a report but not the report itself;
- *Hide /show blueprint tree* **[9]**. Hide / Show the panel **[3]**;
- *Hide/ show the editor of the report blueprint* **[10]**. Hide / Show the panel of the blueprint editor **[4]**;
- *save the report in HTML format* **[16]**;

- The *tree for blueprint calculations* **[3]** contains the elements of control of the report generation that can be classified in two types:
  - *Elements for choosing the step styles and loading direction* **[12]** that directly affect the order and type of loading steps. In details these elements were described in the *Step 9. Analysis of the results of the calculations. Control panel for a step-by-step result overview*. of the Tutorial Manual
  - *information elements* **[13]**, by flagging them it is possible to include in the report for printing **[5]** corresponding additional information of the loading of a vehicle;
- *Window of the blueprint editor* **[4]** allows editing the blueprint of the report in a «low level». By choosing the corresponding part of the report in *the tree of blueprint calculations* **[3]**, the left window of the blueprint report editor **[14]** will contain a HTML code for the formatting of the current part of the report, and the right window **[15]** will contain the description of parameters (sub reports) used in the left window **[14]**. To move a parameter from the right window [**15**] into the left window [**14**] double click the left button on the mouse on the parameter in the right window - it will be moved on the position of the cursor. The user can independently

change the HTML code and create its own unique blueprint report that suits his needs.

- *Window of the generated static step-by-step vehicle loading sequence report* **[5]** is the final product of the program. It contains the information about loading of a vehicle in a form that is designed by the user. The report is ready to be printed and distributed to workers. To print the report press the button **[11]** or “hot key" CTRL+P. This will initialize the window of system dialogue **[5]**.

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