LOGEN SOLUTIONS CubeMaster Load Optimization Whitepaper

VERSION 1.6 (UPDATE AT 6/1/2011)

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This document describes the concept and definition of the Load used int the VMS solutions.

If you want to know how to use CubeMaster, read the 'CubeMaster Desktop User's Guide' please.

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Load Optimization at a Glance

Load optimization maximizes the use of a container's volume or minimizes the number of containers used when three-dimensional rectangular boxes of different sizes are to be stowed in one or more rectangular containers. The number of boxes is provided and the maximum six loading orientations are permitted. The boxes should be stowed completely in the container so that their edges are parallel to the edge of the container, and the boxes cannot overlap.

Load optimization is widely applied in industrial fields. Main examples of this application include a vehicle loading plan in logistics, carton and pallet allocation in production, and delivery volume calculation in transportation at warehouses. Examples of the applications are as followings;

- ① Plan a loading of vehicles like trucks, sea and air containers
- 2 Calculate the optimal volume on the shipping and transport
- ③ Picking, shipping and vehicle allocation plan on the logistics
- ④ Forecast the minimum number of shipping cartons in 3PL and shippers
- 5 Forecast the best size of purchase orders
- 6 Calculate the optimal volume of packing materials in CSKD (Completely/Semi Knock Down)
- ⑦ Consolidation for cross docking system in warehouse
- 8 Maximize loading spaces and weight in cube
- 9 Determine the optimal measurement of new products and cartons
- 10 Build reports on loading and unloading in 3D graphics quickly
- ① Share the loading map and packing list over the Internet

See the real world examples of loading at following pictures. Following two pictures show a loaded pallet filled with shipping cartons and assembled with packaging materials-warpping, edge panel and top panel to protect the loads.



Loading a pallet with shipping cartons

Following two pictures show a container loaded with the pallets after moving the pallets by the forklift.

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Loading a container with loaded pallets

Inside of container filled with pallets

Following two pictures show shipping cartons filled with products.



Shipping cartons filled with products

Program Features Overview

This chapter explains features overview of CubeMaster and helps you to understand the concept of the program.

Load Planning and Optimization Software

CubeMaster is a versatile, cost-effective software solution to optimize the load on your trucks, air & sea containers and pallets quickly and efficiently. It reduces shipping and transport costs through intelligent loading and optimal space utilization.

With the CubeMaster, you can;

- Plan the loading of vehicles like trucks, sea and air containers
- Calculate the optimal volume on the shipping and transport
- Forecast the best size of orders
- Maximize the loading space and weight in cube
- Determine the optimal measurement of new products and cartons
- Build the reports on loading and unloading in 3D graphics quickly
- Share the loading map and packing list over the internet

Algorithm Overview

Vehicle Types: Sea-Container, Truck, Pallet, Carton, ULD, Air-Pallet cargo Types: Rectangular, Unit Load, Rolls



Load Types: CubeMaster provides 4 load types, Mix, Unit, Set and Multi-set load

Mix Load: Find the min number of vehicles needed to load different cargo types with different order quantities. In case of loading different types of cargos, you can calculate the minimum number of vehicles into which all cargos can be filled.



Unit Load: Find the max number of loads of single cargo type in a single vehicle. In case of loading one type of cargo into one container (or pallet), you can calculate the maximum number of the cargo type, which minimizes the wasted space in the vehicle.



Set Load: Find the max number of loads in a single vehicle to load different cargo types, for example refrigerator and audio sets, with different set ratio. This type is useful to CSKD or part suppliers.



Multi-Set Load: Find the min number of vehicles needed to load different cargo types, for example refrigerator and audio sets, with different set ratio and order quantities.



Load Rules: CubeMaster gives diverse load rule to allow you to build the best load for your condition.

2-Stages Loading: Make pallet loads with single or mix cartons and then load trucks and containers with them. You can mix the pallets and cartons together in a same load also.



Loading Sequence: Use the loading sequence to handle multiple stops and priority loading. The left figure shows loads where the blue, green and yellow are loaded sequentially with priorities.



Cargo Orientations: Permit the cargo orientations and control each orientation. You can use max stacks and markings on each orientation, and control to allow turning on the bottom of vehicle.



Orientations Priority: Even if all orientations are permitted, you can give a priority to them. Below picture shows the blue cargo is loaded with primary orientation in front spaces and others in rear spaces.



Grouping: Use the group to load according to drop off or with same order kept together. The left figure shows loads where Group 1 and 2 are separated (Group 1 is blue types and 2 is red).

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Stacking Orders: Control the vertical locations on stacking. Stacking order can be used to prevent heavy boxes from being put on top of light boxes.



Limit Load Weight and Volume: Control total loads not exceed the maximum weight and volume of the vehicle. It allows the user for example to equally divide the boxes among the available containers.

Limit cargo types per Vehicle: Control max number of cargo types when mix-load with different types of cargos. It allows the user to control the complexity of loads. Below 2 figures show the difference of max 4 and 3 types of cargos.

Balance Control: Use 4 rules to make full load into the remaining vehicles after initial load.

Loose Item: Breaks up pallet loads and loads the cargos as loose items to fill vacant space in the vehicle.

Partial Load through Locking: Lock loads or vehicles to prevent them from changing next load. Through this rule, you can make a partial loads and fleets plan.

Change Vehicle Type on the fly: Without reloading all vehicles, you can replace the specific vehicle with another type with just one-click.



Piece Count inside Cargo: Use the piece count for that specific cargo. For example, a new ship case called BOX has 12 cans inside. You will enter 12 as the piece count when defining BOX as a new cargo. When you add a quantity of 100 BOX to the load list, the total piece count will indicate 1200 cans.

No Turning Orientations on the Bottom of Vehicle: Even when all orientations permitted, control allowance of the turning orientations on the bottom of vehicle.



Axle Weight and Center of Gravity: Calculates axle weight and shows exact location of center of gravity for all loads.



Palletizing: CubeMaster gives you simple and powerful functionality to build palletizing with Load technology.

Pallet Types: Wood, Steel, Paper, Flat, 2-Ways, 4-Ways



Pallet Rules: Overhang, User Selectable Patterns, Packing Materials (Banding, Wrapping, Top & Angle Panel)

Single Pallet: Fill single cargo type on the pallet as many as possible.



Mixed Pallet: Load pallets with different cargo types as many as possible.

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Basic Load Optimization

This chapter explains the basic concept and elements of load optimization of CubeMaster.

Overview

Load optimization is a technique to solve the load optimization problem through the computer software. The CubeMaster provides most recent technology to allow you to make load optimization with diverse and powerful functionalities. It uses OptimizerG3 engine to generate the optimized load plan through the load data collected from the spreadsheet of CubeMaster.

The key components of load optimization are container, cargo, rules and type. Containers are all of the vessels including shipping carton, pallet, vehicles, sea-container and air-container, etc. Vehicle includes a truck and wing-body. Air-container is called as ULD (Unit Load Device) also in general that's shape is similar with the shape of the air plane.



Truck



Wing body



ULD



Sea container

Cargo is an object that will stowed into the containers. It may be called a product, cargo, item, model or merchandise. In some situation, a full loaded pallet is defined as a cargo when they should be stowed into the trucks or sea containers.

Load rules allow you to control the behavior of the OptimizerG3 and they affect the results of the Load. For example, if you decide to use the rule of load sequences, you may assign some value to the load sequence property of a cargo and then the OptimizerG3 will think the best load plan regarding the sequences. Thus, the calculation of the sequence rule is different with one without the sequence rule.

Load Type determines the input requirements and thus the results of the Load will be different depending of the type. The Load Type 'Unit Load' does not require the cargo quantity because the OptimizerG3 will determine this automatically from the calculation. In

other hand, the 'Mix Load' requires the quantity and the calculation will be affected by this value.

In this chapter, the key components of the Load will be explained as followings orders;

- Container
- cargo
- Load Rules
- Load Type

Container

Container is all of the vessels including box, pallet, truck, sea-container and air-container, etc. The properties of the container are as followings:

Type: Type of the container (selectable among 'pallet', 'truck', 'sea container', 'air container' and 'carton')



Name: Name for identifying the container (max. 50 characters)

Load dimension (inside dimension): Length, width and height of the loading space of the container (in general, this is the same with the inside dimension, unit: mm)

Weight: Weight of the container (unit: kg)

Limited weight: Maximum weight including the weight of the container (unit: kg). It will be the max payload if the type of the container is sea container.

Thickness of the pallet: Thickness of the pallet (only in case that the type of the containers is 'pallet', unit: mm)

Maximum load height: Maximum load height (only in case that the type of the containers is 'pallet', unit: mm)

Material of the pallet: Material of the pallet (selectable among 'wood', 'steeel', 'paper' and 'default'). This changes the shape of the pallet only in a graphics as following pictures.



Color: Color code for the graphic display in a Load (RGB)

Type of handling: Whether this container belongs to the basic or candidate container

The basic container is required at least one for the Load and the candidate containers are optional. The Load will load the basic container first and then use the candidate containers if the 'Enhancing' rule is defined. The 'Enhancing' rule defines the rule to handle the partially loaded containers including the last container. In general, the partially loaded container will be replaced with smaller containers to reduce the cost. For implement this rule in a Load, you should make the smaller containers as candidate containers and use the 'Enhancing' rule (for more detail, refer the 'rules' section).

Corner casting: Dimension of the corner casting area located at the top corner side in the sea-container (unit: mm)

Cargo

We define cargo as a "product, merchandise, skid, objects, box, carton and pallet, etc. to be stowed in the containers" in a load. They have the characteristic of the rectangular parallelepiped, different physical nature and loading method. If you like these characteristic must be applied to the load, you should specify these characteristics individually during defining the load. Think about one situation whene you load the container with 'palletized unitload' as a cargo. In this case the property of the 'orientation' of this cargo should be used to have the basic orientation only because it is not allowed to turn over on the container (to prevent the cargos in the palletized unitload from damage).

Some customized system will have 'package' instead of 'cargo'.

The available properties of cargo are as followings;

[BASIC]

Name: Name for identifying the cargo (max. 50 characters)

Cargo Style: Four types of cargo's are available:

Palletload: A palletload is a cargo that represents an entire unitload. It's beneficial to define a cargo as a unitload any time you want to show a single object loaded onto a pallet or slipsheet. For example, you might receive a complete palletload of product from a supplier. Rather then referring to the palletload as 50 cases of peanut butter, you can refer to it as one pallet of peanut butter. If you do want to show 50 cases of peanut butter loaded onto a pallet – and have some say in the pallet pattern used when building the unitload – define the cargo as a shipcase or drum, then create a unitload for the cargo.

Shipcase: A rectangular or square object to be referred to as an individual item.

Roll: A cylindrical object to be referred to as a single item.

Pre-pack Unitload: The Pallet cargo can only be created by saving a solution of the pallet load optimization via the Load | Save as Pre-pack Unitload at the Analysis window.

Dimension (length, width, height): Outside dimension of the cargo (unit: mm)

Quantity: The number of the cargo to be stowed (you may use the quantity of order or delivery as this property, unit: EA)

Set ratio: Ratio that makes complete set if the cargo is component part (you should use this property in case only the Load Type is 'Set Load' and 'Multiple Set Load')

Let's examine an example of set ratio. Suppose you have an air-conditioner 'S18K'. It is composed two cargo types, one is an interior module 'S18-IDU' and one is an exterior module 'S18-ODU'. If your customer puts order one hundreds of 'S18K', you have to ship 200 cargos that is a total of 100 'S18-IDU' and 100 'S18-ODU'. In this case, the set ratio of each cargo will be 1 and 1 respectively.

Another example is that you have an audio system 'A309' and it is composed three cargos, one main deck 'MD309', two speakers 'SP309' and one amplifier 'AMP309'. If your customer puts order 50 'A309', you have to ship 200 cargos that is a total of 50 'MD309', 100 'SP309' and 50 'AMP309'. In this case, the set ratio of each cargo will be 1, 2 and 1 respectively.

If you like to know of the maximum number of each cargo of the air-conditioner or audio system in one 40FT container, you should use Load Type of 'Set Load'. The Load will find the number of each cargo that is keeping the set ratio and assign the number to the Quantity property of each cargo. The following picture shows results of Load when you use this Load Type on the air-conditioner of the first example. As you can see, the number of each cargo is determined 307 respectively and the total number of load is 614.



Weight: Total weight of the cargo (in case of the cargo is a shipping carton, this should be the sum of the total weight of the contents and the weight of the carton itself, unit: kg)

Sequence: Load sequence of the cargo. The cargos with a low sequence will be loaded earlier than ones with higher sequence. For example, Sequence 1 will be loaded before sequence 2, which will be loaded in front of sequence 3.

<u>Notice</u>: In order to activate this property during Load, you should activate the rule 'Load by sequence'.

The following pictures show the difference of two loads with and without these properties applied. The left picture is a load of three cargos with sequence 1, 2 and 3 respectively and shows the placements are made according to the sequence. The right one shows they are placed regardless of the load sequence and the maximum use of the spaces are made in a container.



The type of data is the integer between -2147483647 and 2147483647.

Floor stack: Floor stacking rules are guidelines for how to load cargo's into a vehicle when they're not placed on a pallet (sometimes referred to as dead stacking). There are three options:

Bottom Only: Any solutions are disregarded in which the cargo is not placed on the floor.

No Bottom: Any solutions are disregarded in which the cargo is placed on the floor.

Best Fit: The two options above are disregarded and the cargos are placed where it's most efficient in relation to other items in the load.

<u>Notice</u>: In order to activate this property during Load, you should activate the rule "Floor stack".

Stack value: Stack value of the cargo. It can be used at following purpose;

- ① Preventing heavy boxes from being placed on top of light boxes
- 2 Putting a pallet on top of other with exactly same footprint
- ③ Stick two different boxes together vertically

Notice: In order to activate this property during Load, you should activate one of the rules "Higher stack values are placed bottom first" and "Stack allowed if both top and bottom stack values are same". The left in following pictures shows a sample of the first rule "Higher stack values are placed bottom first". Blue cargos of stack value 3 are placed on the bottom of the pallet and the red with stack value 2 are stacked on topside of the blues. Finally green cargos with stack value 1 are placed on the reds. Meanwhile the right picture shows a load where no stacking rules is applied to. In which the largest volumes are placed first from the pallet bottom.



Not always the 'Stacking Rule' use the property of stack value. The stacking order can be determined by the weight property of cargo in the case that you like to load cargos on top side of others according to the weight only.

The type of data is the integer between -2147483647 and 2147483647.

Group Name: Name of the group of the cargo (max. 50 characters)

cargos with the same group name will be handled as an identical group and the purposes of group are as following:

- ① Cargos in identical group will be placed together and different groups will separate in a container. The loading sequences of the groups will be determined automatically in regarding the maximum use of spaces in containers.
- ② A group will represent a complete set product composed several part components when they have set ratio in the Load Type of 'Multiple Set Load'.
- ③ cargos in different group can be stowed separately into the different container in the Load Type of 'Multiple Set Load'.

Notice: In order to apply these properties to a Load, you should activate the rule 'Keep same groups together'.

The following pictures show the difference of two loads with and without these properties and rules applied. The left picture is a load having two groups with name 'Group 1" and "Group 2" respectively and shows they stowed separately according to the group rule. The right one shows they are stowed regardless of the group and make the maximum use of the spaces in a container.



Alias1, 2: Description of the cargo, which does not impact on the result of the load and is just for the display in the screen and report (max. 50 characters).

Color: Color code for the graphic display in a Load (RGB)

[ORIENTATIONS]

These properties allow you to control the orientations and max stacks on each orientation of the cargo.

Orientations: Directions permitted to be stacked. As cargo shapes is a rectangular, it can be stacked in 6 different orientations in a load as following picture. You can combine each orientation to specify the permitted directions of a cargo.



The orientation #1 and #2 are called "basic orientations" because these orientations put the height of cargo vertical to the bottom of container which is manufacturing status, and the others are "turning orientations" because they wil put the length and width of cargo vertical to the bottom of container.

Let's examine a sample; a cargo "SR-29NXA" has dimension 620 x 664 x 800 and quantity 90. If you specify the basic orientations when you load a 20FT container, you can see the left load of the following pciture. If you allow turning orientations, it will make more efficient load as the right picture.



Max stacks: Maximum stacks allowed on each orientation

Each orientation can have a value of maximum stacks. For example if a cargo should be placed in a load less than 3 stacks at orientation #1 and 4 at orientation #2, the max stacks of the orientation #1 and #2 should be 3 and 4 respectively.

In the previous sample, if you give 1 to the max stacks of the basic orientations you will see the following load which makes 1 stack of the basic orientations on the bottom of container and maximum stacks of the turning orientations in the top of container.

If you don't apply this property, set a zero.



Min Stacks on the bottom of container: Minimum stacks allowed of the basic orientations on the bottom of container. This property allows the Load to make a stack on the bottom of container more than or same of the value specified at this property. The value should be in the range of 0 and the max stacks of the basic orientations. If you don't like to apply this property, set a zero.

Allow turning orientations on the bottom of container: Determines whether the Load puts the turning orientations on the bottom of container. If you allow this property, the Load tries to put the turning orientations on the bottom of container. The following picture gives an example when this property allowed.



[UNIT LOAD]

These properties allow you to control the rules to make a full loading container with this cargo.

Load Pattern: The pattern of your favorite on loading a container. To apply the favorite pattern, select among 5 types '1Block', '2Block', '3Block', 'Spiral', 'Auto detect from 4 patterns' and 'Multi-Surface'. This property might be applied in case of Unit Load Type (in other types of the Load, this property will be ignored).

[ADVANCED RULES]

Orientation Priority: the exceptional loading direction in case of Mix Load optimization

If there may be some first loading direction among [Placement Rules], the property, 'Try this orientation first', must be used.

If the exceptional direction will be allowed in the last spaces of the container, the property, 'try this orientation', must be used. If there may be some space in the last space of the container after loading to the specified direction, this property is recommended so as not to lower the space efficiency and be broken.

[PALLETIZE]

Palletize: the property used to palletize a cargo before loading a vehicle

In case of 2 stages load for the unitload system, use this property. If the property, Unitload, is set to the saved 'Unitload pallet', this cargo will be loaded into the container not in the form of box, but in the form of unitload. Cargo with the property of palletoad is restricted to the basic direction of the orientation rule (the turning direction will be unusable).

[EXTENDED]

Property1~10: the string to describe cargo, which impact on the result of the Load and is only for the graphic or report (max. 50 characters for each property).

Piece Qty: the property used when cargo is the cargo box with some contents

If the result of the Load could include the data of the number of the contents in the cargo box packed into the container, this property can be used. If not 0 in this property, the report will show the result that this pack quantity will be calculated together.

Departure time: the estimated time for the shipping of cargo

Description: the string to describe cargo (no effect on the result of the Load, the property that shows in the work order, max 50 characters)

Treat as: whether cargo is normal or candidate

The normal cargo must be used in the Load, and the candidate cargo is used only to 'improve the container'. The candidate cargo may not be used in the real Load but in the packing the empty space of the resulting container.

Think that the quantity of the real order has been loaded but the last container may be empty. The empty space of the last container must be packed with the other freight for improvement (this is called Consolidation). In this case the other freight must be set to the candidate cargo and the 'Placement Rules' in the Load rules must be used (for more detail confer to the 'Load Rule').

Load Rules (More Rules)

The Load rules are made up of various sub rules and constraints for the loading.

[BASIC]

Generate unit loads first on the mixload: When this rule is activated, the calculation generates containers filled with single cargos primarily and then the remaining quantities are placed in other containers.

Load by sequence (cargos with low sequences placed earlier): When a cargo is assigned a low sequence number; it will be loaded before a cargo with a high sequence number. Sequence 1 will be loaded before sequence 2, which will be loaded in front of sequence 3.

Keep same groups together: When this rule is activated, the calculation will keep the same groups together when loading. This rule is directly linked to the Group field in the cargo List. When you key in a group name, the system gives you the option to group cargos from the same group name together. If you do not choose to input group name, this field will be meaningless; activating the checkbox will not affect the placement of cargos within your manifest.

Limit the load weight (use the max weight of the container): When this rule is activated, the calculation will limit the weight of the container when loading. The calculation will utilize available spaces as much as possible in the container while making the total weight does not exceed the max weight of each container as the below formula.

Weight of the container + Weight of the contents <= Max weight of container

The worst case of the usage of this rule is that the even though the container has enough spaces to be filled, the calculation does not fill them with any cargos.

Allow splitting identical cargos: When this rule is activated, the calculation will spread the identical cargos in different spaces for higher space utilization.

The combination of not using this property and not using 'Keep sequences (load cargos with small sequence value before large ones)' property can be interpreted into "identical cargo should not split and the loading sequence should be decided automatically". So the system will automatically decide the loading sequences for the optimal efficiency of the space usage. You can decide automatically the distribution order at the shipping time, the picking order at the distribution center and the production order in the plant through this property.

The combination of using this property and using 'Keep cargos with same group together' property makes the Load build the load clustering. The load clustering is that the group of cargo is loaded sequentially and the each cargo is loaded sequentially in the group again. Through these property, the freight for the same distribution within the same distribution area will be loaded, which makes it possible to multi-drop at the stage of distribution.

Allow different groups in same container (Multiple Set Load only): When this rule is activated, the calculation will place the cargos of different group into the same container. It is available in case of the 'Multiple Set Load'.

Merge unused spaces: When this rule is activated, the calculation will merge the unused space and then loads some available cargo into the new space. In general, it has been known that the merge of the space makes it more efficient to use the space. But if the separation of the area is so definite due to the characteristic of the loading, this property must be kept unselected not to infringe over each area.



Loading direction: This rule tells the calculation which direction would be used while loading. Select among 'Front to back', 'Bottom to top' and 'Front to back (width spread)'. The difference between 'Front to back' and 'Front to back (width spread)' is that the one is basically to load some cargo from inside to outside and from bottom to top but the other is to load something from inside to outside and from right-side to left-side. As a result, it makes more stable the loading in width direction (from right-side to left-side).



If the type of container is pallet, 'Bottom to top' is recommended. After packing from the bottom of the pallet, the system will pack the other cargos onto the upper, which builds up as spiral shape and enables to get an adequate result for the palletizing.

Algorithm: This rule tells which algorithm will be used at the calculation.

Basic algorithm and optimization algorithm can be available. The adequate algorithm can be selected on the basis of the nature of the cargo and container.

The basic algorithm is recommended if the load should be quickly generated. When the efficiency of the Load is not satisfactory; the optimization algorithm must be selected instead. The optimization algorithm breaks down to the level 1, 2, 3 and 4, which trades off between the speed and the quality of the load result.

The level 1 calculates faster but poorer than level 4. Of course all of these 4 levels are slower and better than the basic algorithm. It is generally known that in the optimization theory, as

the search space becomes broader, the better results obtained. However the calculation time gets reversed. OptimizerG3 engine follows this rule.

The table following shows examples for variant load sizes such as the cargo to the container to be filled. The level 4 is recommended for big sized cargo such as the refrigerators, the level 2 is better for the smaller cargo vacuum cleaner and level 1 for the automotive parts.



* Refrigerator (large size to the container, little size difference -> level 4 recommended)

* Vacuum Cleaner (small size to the container, little size difference -> level 2 recommended)







[STACKING]

This rule can be useful when the relative position between two cargos. There are several rules as follows.

Floor stack: When this rule is activated, the calculation will utilize the floor stack properties of the cargos. Floor Stacking Rules are guidelines for how to load cargo's into a vehicle when they're not placed on a pallet (sometimes referred to as dead stacking). There are three options. For more about the floor stack properties of the cargo, please see the <u>Basic under the cargo</u>.

Follow the Stack Matrix: When this rule is activated, the calculation will utilize the Stack Matrix. The Stack Matrix allows you to define the relationships between two cargos. It can be defined as a square matrix (similar to a row and column spreadsheet such as Lotus 1-2-3 or Microsoft Excel); this matrix contains one row and one column for each cargo name.

When you define a cargo, the stack matrix initializes automatically. To work with the Stack Rules Screen, use these guidelines:

□ When a new cargo is define, a new row and column are added to the matrix. Each entry in the matrix is a box marked with a "Yes" or "No." The Yes/No indicate whether a cargo for the corresponding column can be placed on top of a cargo for the corresponding row.

□ The cargo across the top of the matrix (columns) are considered the "top" cargo, while the cargo along the side of the matrix (rows) are considered the "bottom" cargo.

□ Use the gray scroll bar or the arrow keys to move around the stack matrix.

□ To change a single Yes/No value inside individual cell, simply click on the checkbox.

Higher stack values are placed bottom first: When this rule is activated, the calculation will utilize the stack value of the cargos. When a cargo is assigned a high stack value number; it will be not stacked on a cargo with a low stack value. Stack value 3 will be loaded under stack value 2, which will be loaded under stack value 1.

Stack allowed if both the top and bottom stack values are same: When this rule is activated, the calculation will stack two cargos on each other only if the stack values are same.

Stack allowed if both the top and bottom foot prints are same: When this rule is activated, the calculation will stack two cargos on each other only if the footprints are same.

Heavier cargos are placed bottom first: When this rule is activated, the calculation will utilize the weight of the cargos for determining the stackability. When a cargo is assigned a high weight; it will be not stacked on a cargo with a low weight. Weight 300 Kg will be loaded under weight 200 Kg, which will be loaded under stack value 100 Kg.

[CORNER CASTING]

The container has the part at the front and back of the upper side to link with the carriage equipment. This is generally called as corner casting. Because this part penetrates through the inner of the container, nothing can be loaded. To apply this condition to the Load, select this rule.

If nothing should be loaded into the corner casting, select the 'Keep corner casting area empty'. Below figure shows the result of the Load applied with this rule.



[BALANCING]

After the calculation, in order to improve the space utilization in the containers, use this rule.

The available properties are as below.

Replace with candidate containers if possible: replace the LCL container with the different container. For example, if 40FT LCL container should be substituted to 20FT one, use this property.

Drop container if meets this condition: if LCL container should be dropped and cargo must not be shipped, use this property.

Fill unused spaces with candidate cargos: in order to pack and ship the other cargo into the LCL container, use this property. Therefore if cargo with different order number, destination or customer is selected to the 'candidate', this cargo can be consolidated into this LCL container.

Fill unused spaces with cargos existing in the container: this property enables to pack cargo into the empty space of the LCL container, which makes the actual quantity of the order expand.

The above properties are sequentially used and the order of them cannot be changed arbitrarily.

For more detail on the candidate cargo, confer to the 'Cargo > Extended'.

For more detail on the candidate container, confer to the 'Container'.

[AIRBAG]

This rule will be used to insert some airbag into the empty space in the container (this function will be supported from the version 6.0).

[CONTAINER NAMING]

This rule will be used to assign the name to the resultant container.

Load Type

Load Type determines the requirement of the load data and results. 5 types - single, mix, set, multiple Set Load and 2 stages loading are provided. We will examine the brief of each load type.

Mix Load: It finds the min number of vehicles needed to load different cargo types with different order quantities. In case of loading different types of cargos with exact order quantities, you can calculate the minimum number of vehicles into which all cargos can be filled.

Unit Load: It finds the max number of loads of single cargo type in a single vehicle. In case of loading one type of cargo into one container (or pallet), you can calculate the maximum number of the cargo type, which minimizes the wasted space in the vehicle.

Set Load: It finds the max number of loads in a single vehicle to load different cargo types, for example refrigerators and audio sets, with different set ratio.

Multi-Set Load: It finds the min number of vehicles needed to load different cargo types with different set ratio and order quantities.

Mix Load

This Load Type allow you to find the min number of vehicles needed to load different cargo types with different order quantities. In case of loading different types of cargos with exact order quantities, you can calculate the minimum number of vehicles into which all cargos can be filled.



INPUT VALUE:

Dimension(length, width, height) of each cargo and order quantity

Dimension of the container

OUTPUT VALUE:

The number of container required to stow all cargos

EXAMPLE:

In case that you like to know the number of 20FT containers required to stow 3 different types of cargos, K, KL and KW with order quantities 250, 623 and 450 respectively, you should use this Load Type.

The manifest list of the Load is as following table.

	SKU 이름	수량	길이	너비	높이
1	К	250	552.00	502.00	324.00
2	KL	623	552.00	251.00	324.00
3	KW	450	502.00	276.00	324.00

If you run the Load with this manifest list, you will find three containers resulted and loading pattern of each container is as shown in the following pictures.



Unit Load

It finds the max number of loads of single cargo type in a single vehicle. In case of loading one type of cargo into one container (or pallet), you can calculate the maximum number of the cargo type, which minimizes the wasted space in the vehicle.

Through this Load you can calculate how many one type of cargo are required to make a full container load.



INPUT VALUE:

Dimension of the cargo(length, width, height)

Dimension of the container

OUTPUT VALUE:

The number of each cargo that makes full container load

EXAMPLE:

In case that you like to know the number of 3 types of cargo such as K, KL, KW to make full load of 20FT container, you should use this Load.

The manifest list of the Load is as following table. Please notice that the quantities are not required in this table because it will be determined automatically after the Load.

	SKU 이름 △	길이	너비	높이	무게	
1	К	552.00	502.00	324.00	1.00	
2	KL	552.00	251.00	324.00	1.00	
3	KW	502.00	276.00	324.00	1.00	

If you run the Load with this manifest list, you will find out the number of 3 types of cargo is 308, 672 and 679 respectively. This means you can make a full load of the 20FT container with 208 K's, 672 KL's and 679 KW's.



Set Load

This Load is for finding the maximum number of single set-type cargo in single container. Set-type cargo is a product composed of several component cargos with each set ratio. Imagine the air conditioner that is composed of the outdoor and indoor unit. If certain model of air conditioner has 2 indoors and 1 outdoor, the indoor unit should be loaded 2 times outdoors into the vehicle when shipping this model.

Remember this type is for single container only. If you like to know about a Load for multiple containers for set-type cargo, refer the Load Type of 'multiple Set Load'.



INPUT VALUE:

Dimension of (component) cargo and set ratio

Dimension of container

OUTPUT VALUE:

The number of each component cargo to be loaded into one container

EXAMPLE:

In case that you load the 20FT container with the audio system – model name 'AV001' with three component cargos - the deck(K), turntable(KL) and speaker(KW) module with set ratio 1:3:2, you should use this Load Type to find how many component cargos could be loadable.

	SKU 이름	수량	SETH	길이	너비	높이	무게	색상
1	К	0	1	552.00	502.00	324.00	1.00	
2	KL	0	3	552.00	251.00	324.00	1.00	
3	KW	0	2	502.00	276.00	324.00	1.00	

If you run the Load, you will find that the result of Load shows the maximum number of K, KL and KW will be 91, 273 and 182 to make a full load of the container(the set ratio does not violate 1:3:2).



Multiple Set Load

This Load is for finding the minimum number of the containers into which all of more than 2 types of SET cargos could be loaded. Or it may be possible to mix-load at least 1 type of SET cargo and at least 1 type of SET cargo.

Unlike the Set Load, this Load will needs as input value the number of each cargo and show as output value the number of the containers into which all of these cargos will be packed.

And to identify more than 2 types of SET cargos, you should use the **Group Name**. In others words, you should make a group out of the same SET cargo with the same group name.

In case of mix-loading more than 2 types of SET cargos such as airconditioner and audio set, this Load will be useful to find the number of the containers into which all of these cargos could be packed. Or in case that you want to know the number of the containers into which 1 type of Audio set (SET cargo) and 2 types of Refrigerators(non-SET cargo) should be packed.

What you should keep in mind is that the SET ratio must be the same with the ratio of the number of each cargo as part of one SET cargo. For example, if the SET ratio is 1:3:2, the ratio of each number should be 100:300:200. Otherwise you should not expect an exact result of the Load.



INPUT VALUE:

Group Name, the dimension of the cargo (length, width, height), SET ratio, quantity

the dimension of the container

OUTPUT VALUE:

The number of container for the loading

EXAMPLE:

In case that you pack into the 20FT container 90 Audio sets (AV001 model) with deck (K001), turntable (KL001) and speaker (KW001), in each 1, 3, 2, and 80 Audio sets(AV002 model) with deck(K002), turntable(KL002) and speaker(KW002), in each 1, 1, 2, you should use this type of Load to find how many containers will be needed to load into.

	그룹명	이름	수량	SET HI	길이	너비	높이	무게	색상
1	A001	K001	90	1.00	552.00	502.00	324.00	1.00	
2	A001	KL001	90	3.00	552.00	251.00	324.00	1.00	
3	A001	KW001	90	2.00	502.00	276.00	324.00	1.00	
4	A002	K002	80	1.00	552.00	502.00	162.00	1.00	
5	A002	KL002	80	1.00	552.00	251.00	162.00	1.00	
6	A002	KW002	80	2.00	502.00	276.00	162.00	1.00	

You can see the result of the Load that AV001 will be packed into 3 containers and AV002 will be packed into 1 container by FCL and the remainers of AV001 and AV002 will packed into 1 container by LCL.

FCL of AV001	FCL of AV002	LCL	



Advanced Load optimization

This chapter explains how to make advanced load optimization.

2-Stages Loading

2-Stages Loading: Make full pallet loads with single or mix cargos and then load trucks and containers with them. You can mix the pallets and cargos together in a same load.

2-Stage loading is for the Unitload system, which you can load the cargos onto the pallet and then pack them into the container.

Unitload system means the standardization of many procedures in the logistics, which makes "the freight into the regular unit of weight or size and then makes of them the transportation method consistent with the mechanized unloading work". This implies that regardless of the type or size of the freight you can transport them by the truck or container, etc., with the fixed vessel (pallet).



For this Load, follow the below procedure.

- ① Making the loading pallet through the Load that uses the pallet as container
- 2 Saving as Unitload the above result of the Load
- ③ Start the new Load
- (4) Create the cargo from the saved file of (2)
- ⑤ Loading the above cargo, after selected the containers as container

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