

## Orbiter Truss System v1.0

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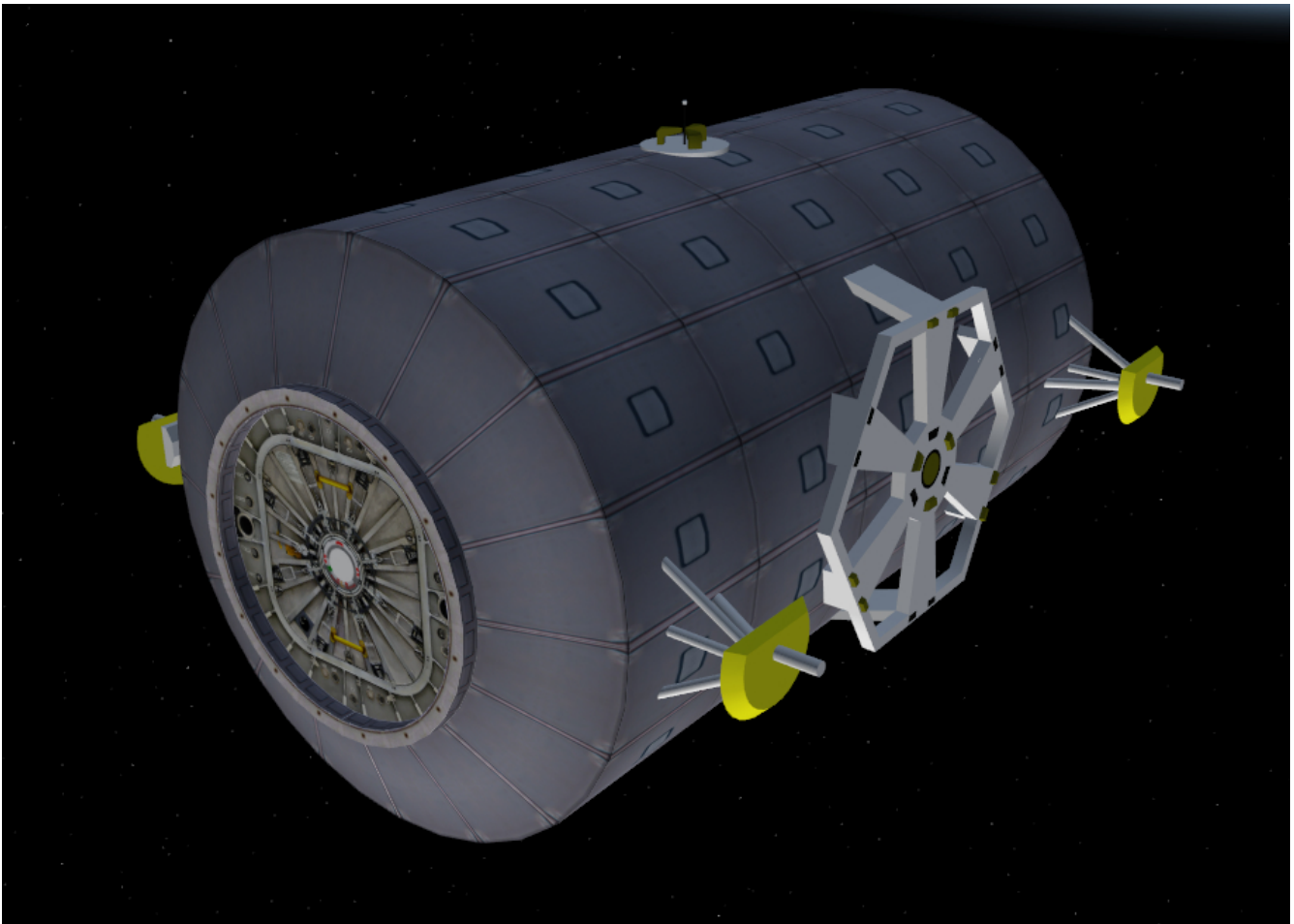
## Introduction

This package is designed to be a generic truss backbone for space stations built in the Orbiter Spaceflight Simulator. Primarily it consists of several “static” truss segments in 6m, 12m, and 18m lengths, a radiator truss, solar power truss, and pressurized adapter module. To support launching these pieces, there are several truss carriers designed to ease use on launch vehicles including the Space Shuttle. The static trusses however are not just for show, they each include several docking points for “pallets.” Pallets are intended to represent external attachments for experiments, or storage. Several example pallets are included, but the user is not limited to using only these.

## Trusses

### Pressurized Module

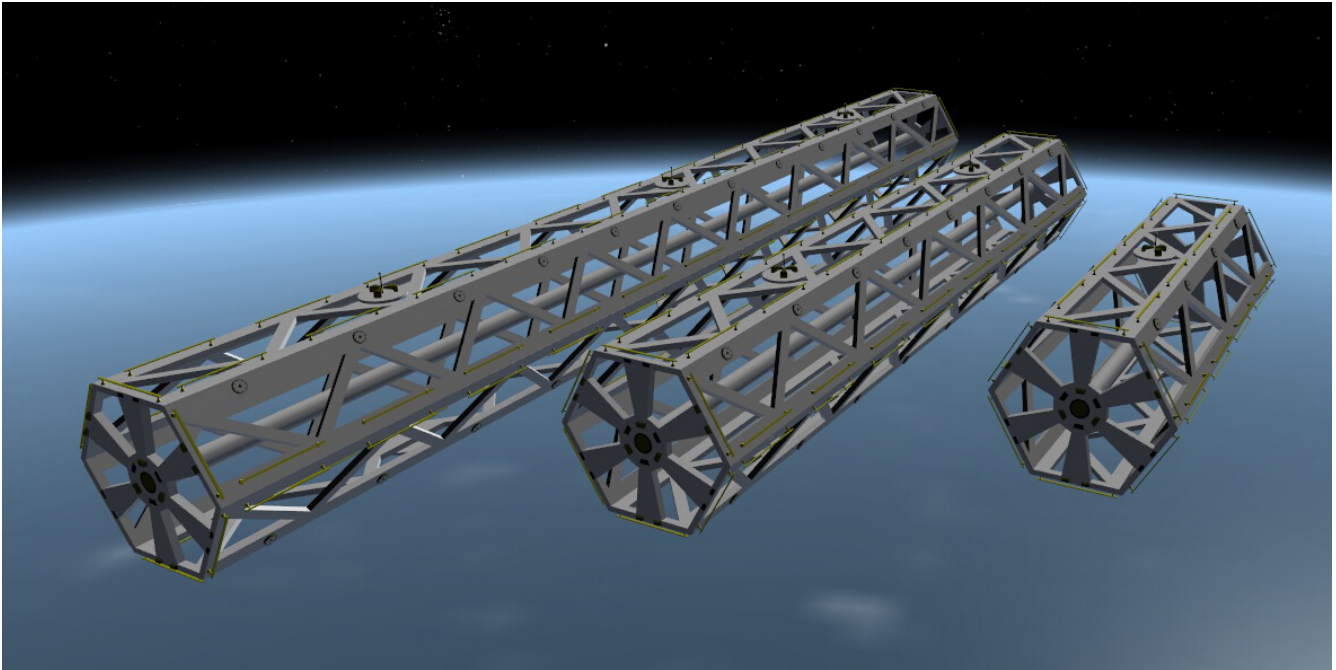
This package includes a simple pressurized adapter module with a CBM at each end. The pressure hull has an outside diameter of 3.5m, a width over the truss interfaces of 3.75m, and a length over the CBM rings of 6.2 meters. There are two truss interfaces centered in the Y-Z plane. This also has a grapple fixture on both the top and bottom of the module. With the inclusion of the STS keyword in the scenario file, this vessel will include trunnion pins and scuffplates for carriage via the Space Shuttle Orbiter.



Pictured above is the Pressurized Module with the STS option enabled.

## Static Trusses

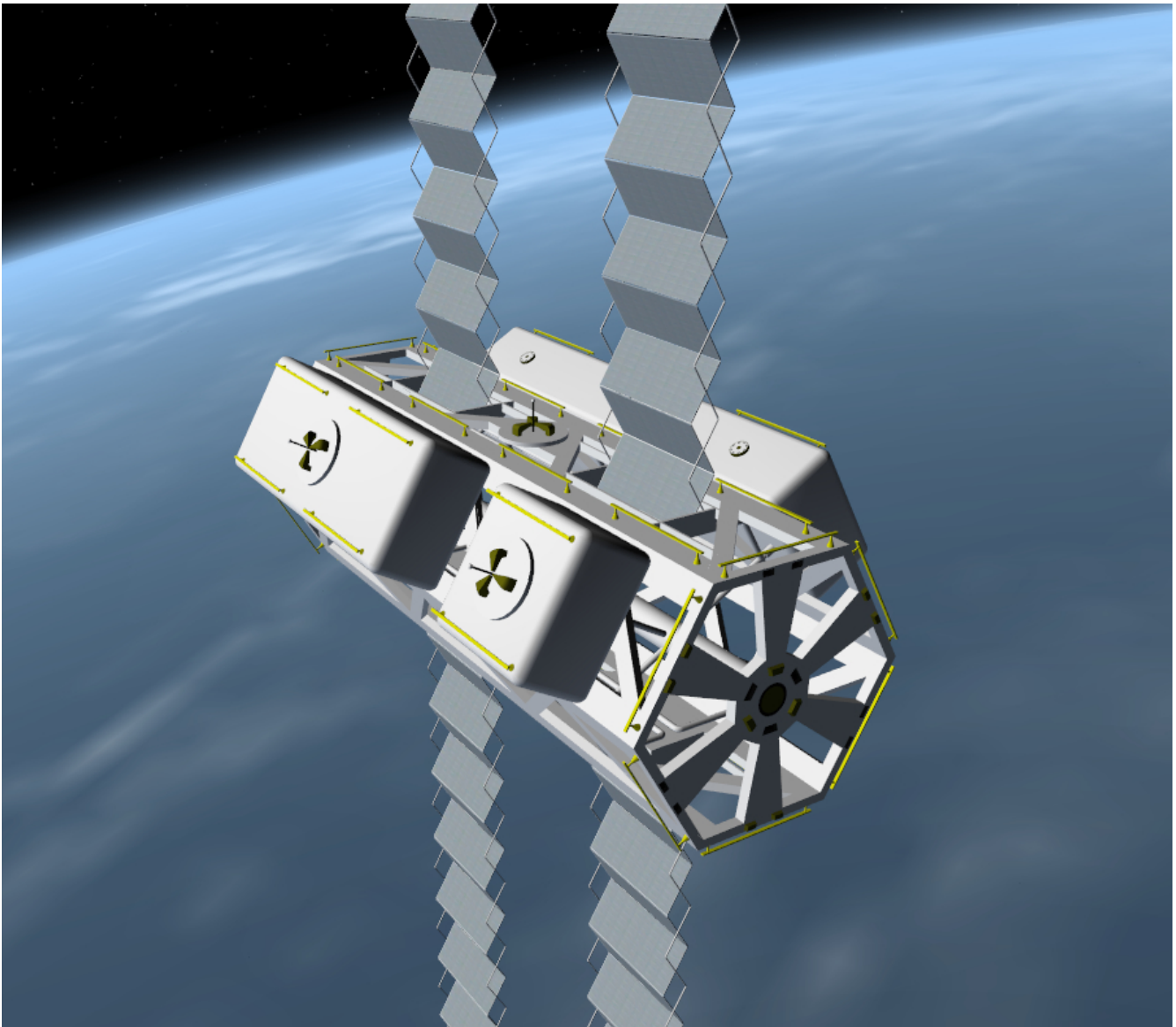
This package includes a 6m, 12m, and 18m truss segment which do nothing but add length, and pallet attachment points. The masses are 3,000Kg, 5500Kg, and 7900Kg respectively.



Pictured above from L-R are the 18m, 12m, and 6m static trusses.

## Radiator Truss

This truss segment is 6m long and represents a truss dedicated to providing cooling through radiator panels which can be extended and retracted. There are also 12 attachment points for coolant tanks implemented as docking ports for ease of use. Three different tank sizes are included, small medium, and large which have 1, 2, and 3 fluid connections respectively. Each tank includes a grapple point, and a pallet-style attachment point for attachment to the pallet carrier.

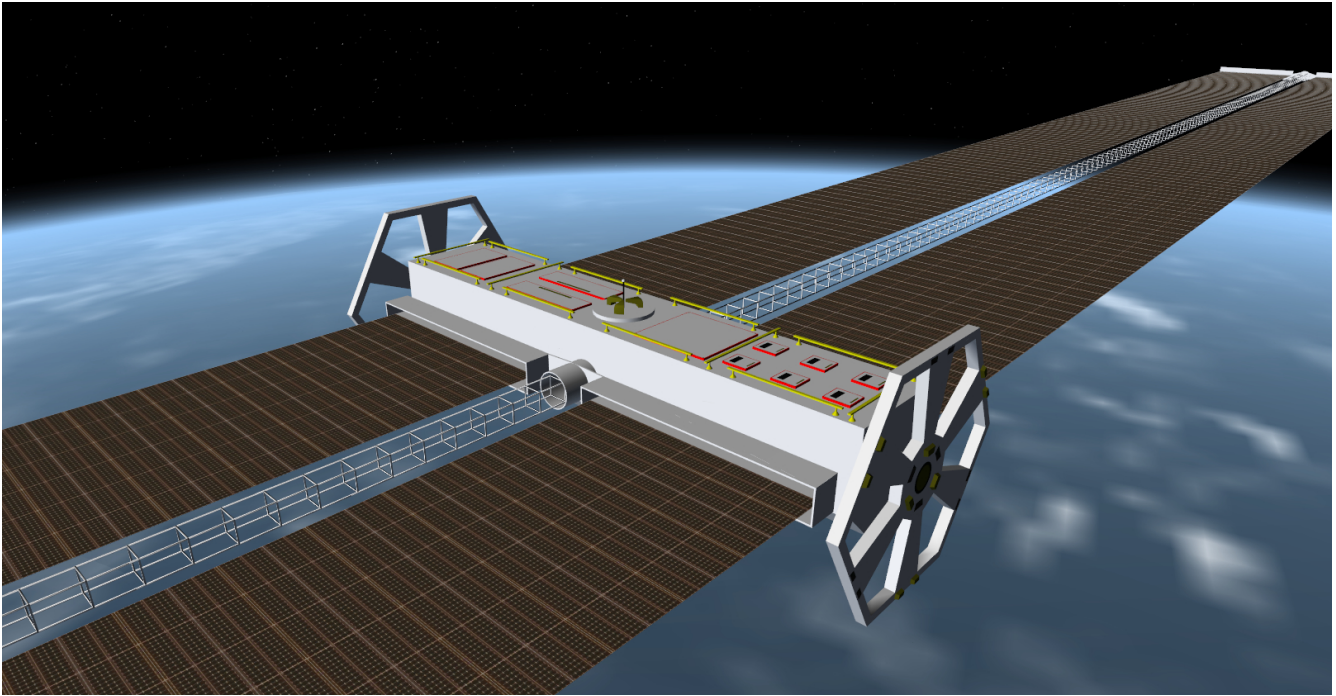


Pictured above is the radiator truss with all three types of coolant tanks attached.

## Solar Truss

This truss segment is 6m long and represents a solar array truss. The solar arrays feature full sun-tracking capabilities. Due to the numerous animations and segments involved, you may notice a strong framerate drop when the solar arrays are deploying or retracting.

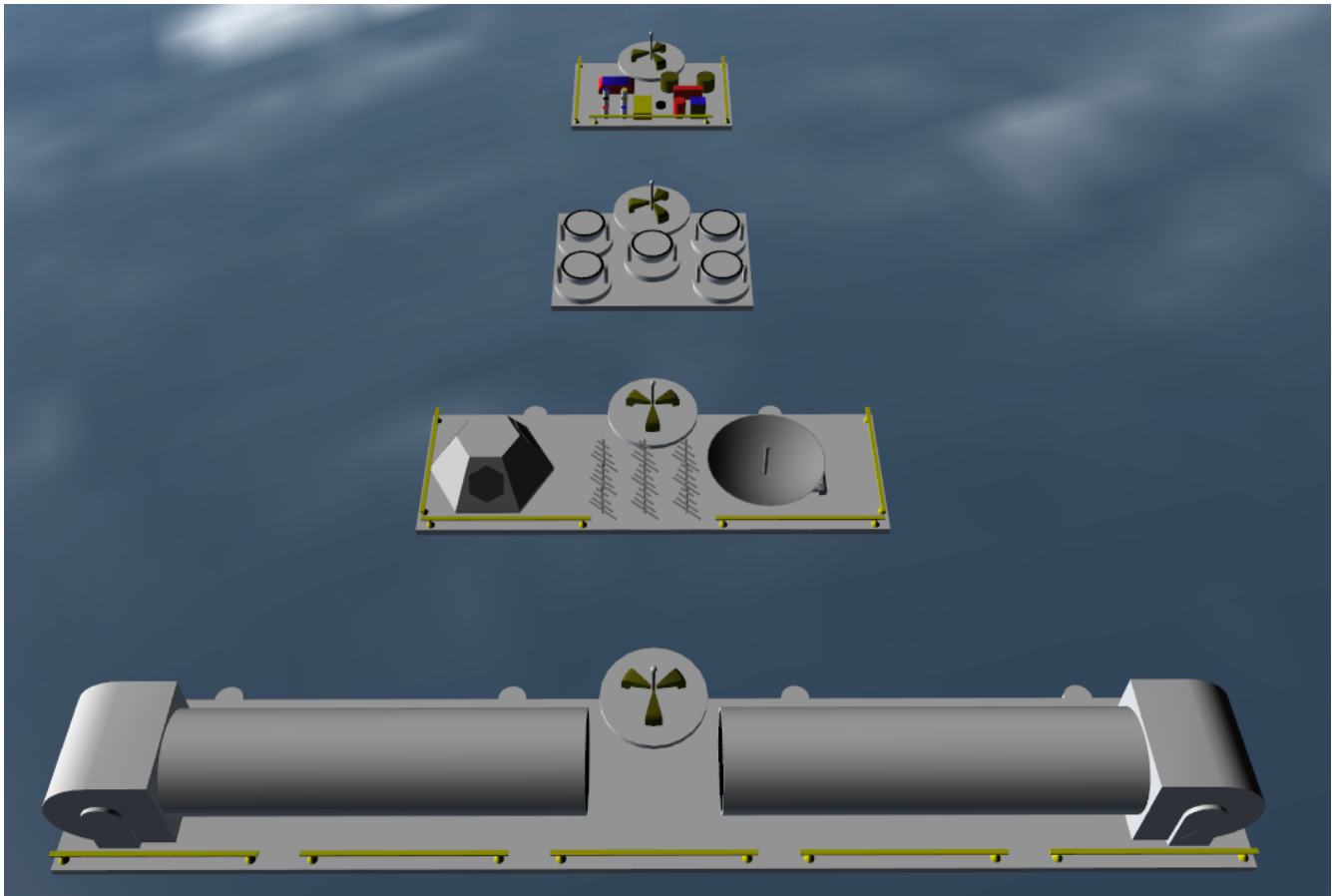




Pictured above is the solar truss segment with the solar arrays fully deployed.

## Pallets

A few example pallets are included as both simple eye-candy and to showcase the capabilities of the system. As such, these are not modeled, textured, or simulated to a very high quality. The capabilities are potentially endless. Models for pallets with 1, 2, and 4 attachment points are included for developers to build off of should they desire. Pallets are vessels themselves, and are simply docked to the various points along the trusses. It is recommended that developers write their pallets in such a way as to automatically undock from any vessel if they have been grappled by anything in order to ensure the pallet does not simply snap back to its previous position.



Pictured above are all four pallets included in this package. From top to bottom: materials pallet, spotlight pallet, communications pallet, and telescope pallet.

### Materials Pallet

This is a static pallet with one grapple point intended to represent a materials exposure pallet.

### Spotlight Pallet

This pallet consists of 5 spotlights which can be focused on a vessel or steered for night operations. The implementation is fairly basic.

### Communications Pallet

This consists of two static antenna arrays (phased array “pyramid” and 9 beam antennas) and one, animated dish antenna on a 2-span pallet.

### Telescope Pallet

This consists of two telescopes that have basic, unsynchronized movement, on a 4-span pallet. They serve no purpose other than as animated eye-candy. There may be a control system in a later release.

### Radiator Tanks

There are three tanks meant for docking to the radiator truss to simulate coolant tanks. Three sizes are

included, small, medium, and large. Each has a single grapple fixture. The small tank has a single docking point to the radiator truss, the medium has two, and the large tank has three. Additionally, there are pallet-style attachment points on each tank in order to attach to the pallet carrier for transport. The three carrier attachment points are indices 0 through 2 depending on the size of the pallet.

## Carriers

### Truss Carriers

There are several carriers designed to ease mating the trusses onto a launch vehicle. The variants are:

2 6m Trusses (STS)

4 6m Trusses (STS)

6 6m Trusses

2 12m Trusses (STS)

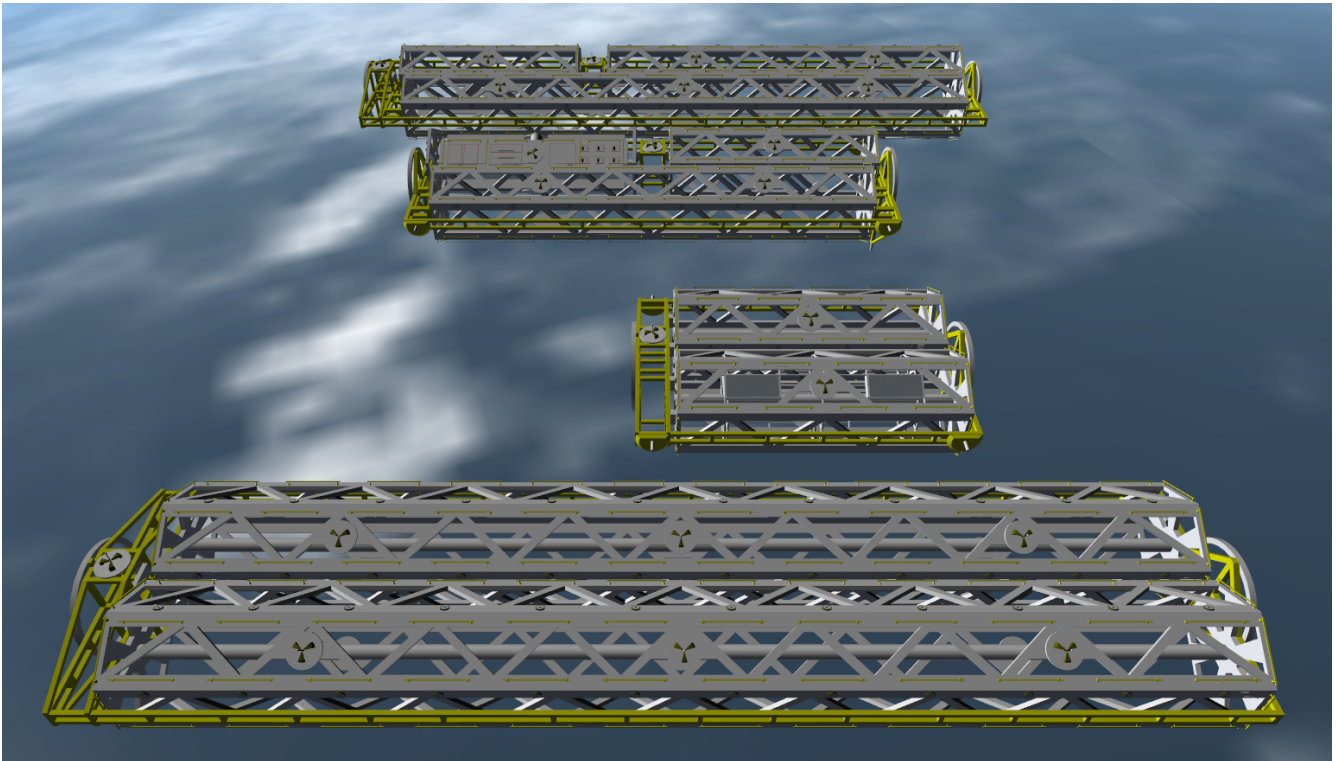
2 18m Trusses

2 6m, 1 12m Trusses (STS)

1 6m, 1 12m, 1 18m Truss

2 6m, 2 12m Trusses

The truss carriers listed with STS next to them have a variant designed explicitly for the space shuttle. The design differences include trunnion pins, and scuff plates. Each carrier has at least two grapple points, and two docking ports designed for docking to a Common Berthing Mechanism though they will function with any of Orbiter's docking ports.

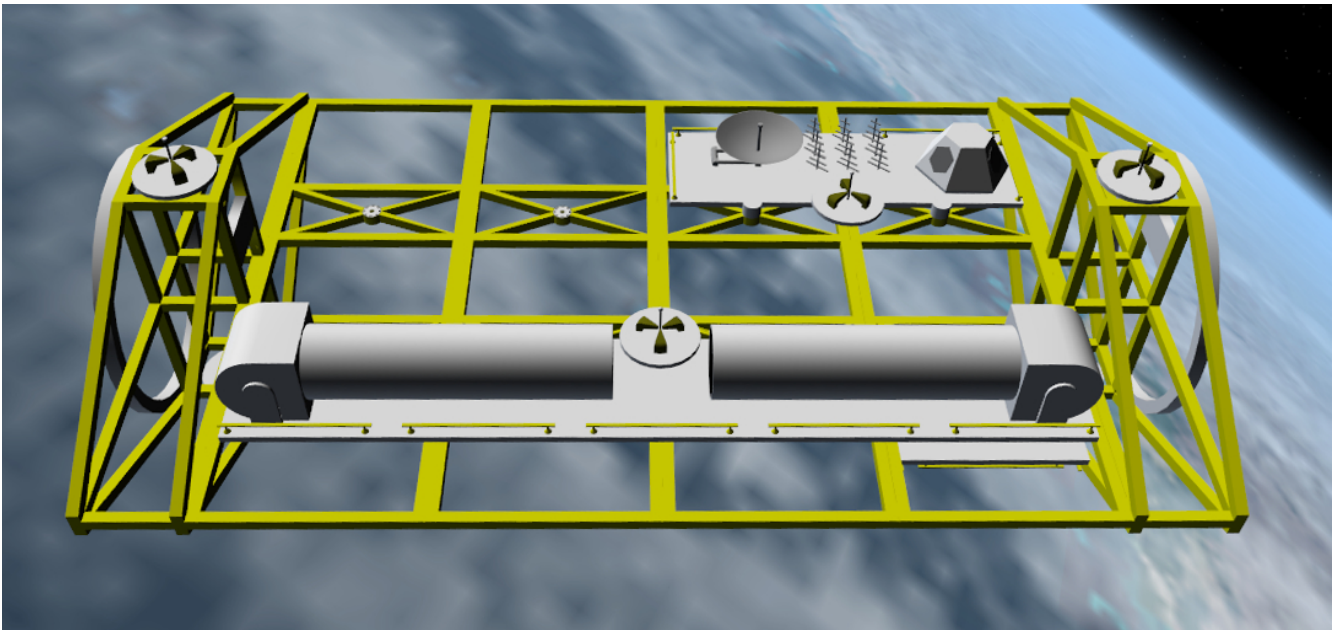


In the above image, a selection of truss carriers are shown with trusses. From top to bottom: 1 6m, 1 12m, 1 18m; 2 6m, 1 12m (STS), 2 6m (STS), 2 18m. This is not every possible variant.



## Pallet Carrier

The pallet carrier is a modular vessel. The basic configuration includes 4 pallet attachment points for up to 4 pallets or coolant tanks. A scenario file entry can extend the number of available attachment points, in increments of 4. There is no hard-coded limit to the number of segments. The main “platform” can be rotated to ease access to the pallets, particularly when mounted inside a payload bay. Like with the truss carriers, the Pallet Carrier can include hardware appropriate to mounting in the Space Shuttle Orbiter payload bay. The base mass is 1,890Kg and each segment adds 350kg of mass.



The image above shows a pallet carrier with 4 segments, holding a telescope pallet and communication pallet.

## Keys

### Trusses

CTRL+K

Deploy the solar arrays. Pressing this key while the solar arrays are deploying or retracting will halt the animation.

K

Retract the solar arrays. Pressing this key while the solar arrays are deploying or retracting will halt the animation.

D

Begin or end sun-tracking.

CTRL+U

Reset the sun-tracking animations to their original states.

## Truss Carriers

CTRL+SPACE

This key combination opens up a command entry box. Currently, this is the only way to release, and grapple truss payloads. A scenario editor page will be added in future releases. See next section for command details.

## Pallets

Communications Pallet:

K

This key rotates the dish antenna about its base.

J

This key raises the mast of the dish antenna to 90 degrees.

G

This key “pitches” the dish antenna itself.

The above keys will reverse animation direction when pressing CTRL plus the key.

Spotlight Pallet:

K

This key rotates the light bases.

J

This key rotates the the reflectors.

Telescope Pallet:

K

This key rotates the Telescope bases.

J

This key “pitches” the telescopes themselves.

The above keys will reverse animation direction when pressing CTRL plus the key.

## Pallet Carrier

K and CTRL+K

These keys rotate the main segments and the pallets it holds to enable access to both sides while still berthed inside a payload bay such as STS. Pressing once begins rotation in one direction, pressing either key stops movement. By default, movement will continue until stopped, or until segments have rotated 180 degrees.

CTRL+SPACE

This key combination opens up a command entry box. See next section for command details.

# Commands

## Truss Carrier

RELEASE <int>

When typed in all caps, plus a number, this command will release the payload attached at the given attachment point. If the attachment point does not exist, or there is nothing attached, simply retype the command or press ESC to exit.

GRAPPLE <string> <int> <int>

When typed in all caps plus a vessel name, parent attachment, and child attachment, this will attach the payload to the carrier. The normal attachment number for the trusses is 0. The attachment numbers for the truss carriers begin at the rear-right location, and increase forward, then come back to the rear-left location and again increase going forward. The carriers have a gray panel on the upper, rear part of several support beams to aid in orientation.

## Pallet Carrier

RELEASE <int>

When typed in all caps, plus a number, this command will release the payload attached at the given attachment point. If the attachment point does not exist, or there is nothing attached, simply retype the command or press ESC to exit.

GRAPPLE <string> <int> <int>

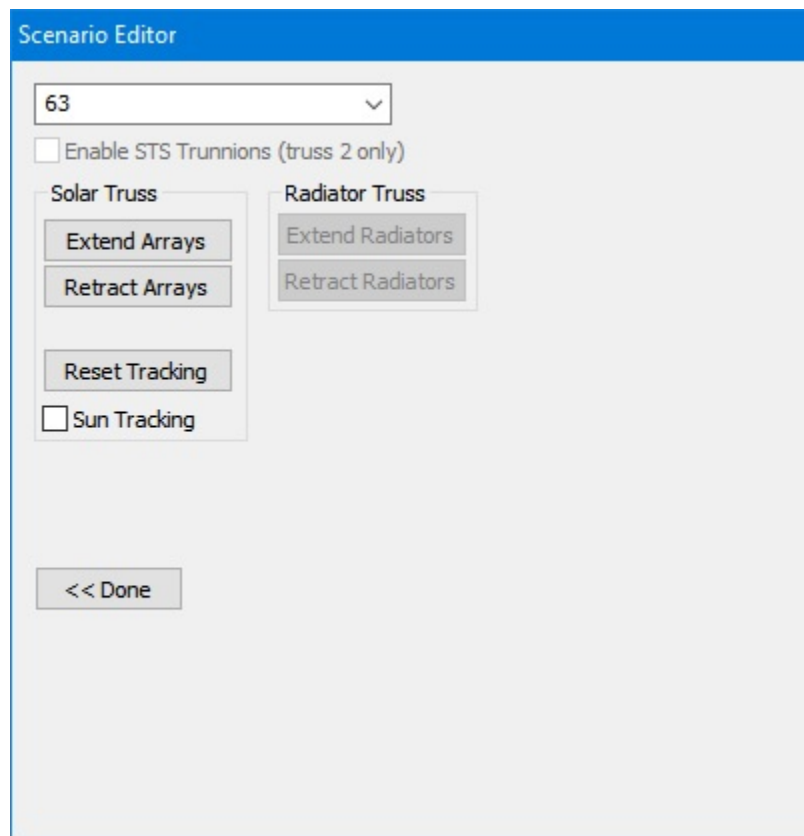
When typed in all caps plus a vessel name, parent attachment number, and child attachment number, this will attach the payload to the carrier. The normal attachment number for the included pallets is 1. The attachment numbers for the carrier begin at the right-most location on the segment, then move to the left, then the underside-right, then the underside-left. The carriers have a gray panel on the upper, rear part of both the fore, and aft main support structures to aid in orientation. Note that the attachment points will change if the segments are rotated.

## Scenario Editor

Each vessel class except the pallets has a scenario editor page to allow in-sim alterations. This is not intended to represent any realistic method of control or selection and is included merely for user convenience.

## Trusses

The truss scenario editor page includes the ability to change the type of truss. In the case of the pressurized module, it also includes the ability to add the trunnion pins for visual realism when used with the Space Shuttle Orbiter. For trusses that implement animations, selection of animation state is provided. As this page is intended for user convenience, the animations are of a binary nature: they are either at their smallest extent, or at their fullest extent.



The above image shows how the Truss scenario editor page will look when used with the Solar Truss. Controls not relevant to the currently-selected truss are disabled.

## Truss Carrier

There are two pages for this type. The vessel management page allows selection of the type, addition of trunnion pins for use with the Space Shuttle Orbiter, and alteration of the payload attachment point.



Scenario Editor

16112118 ▼

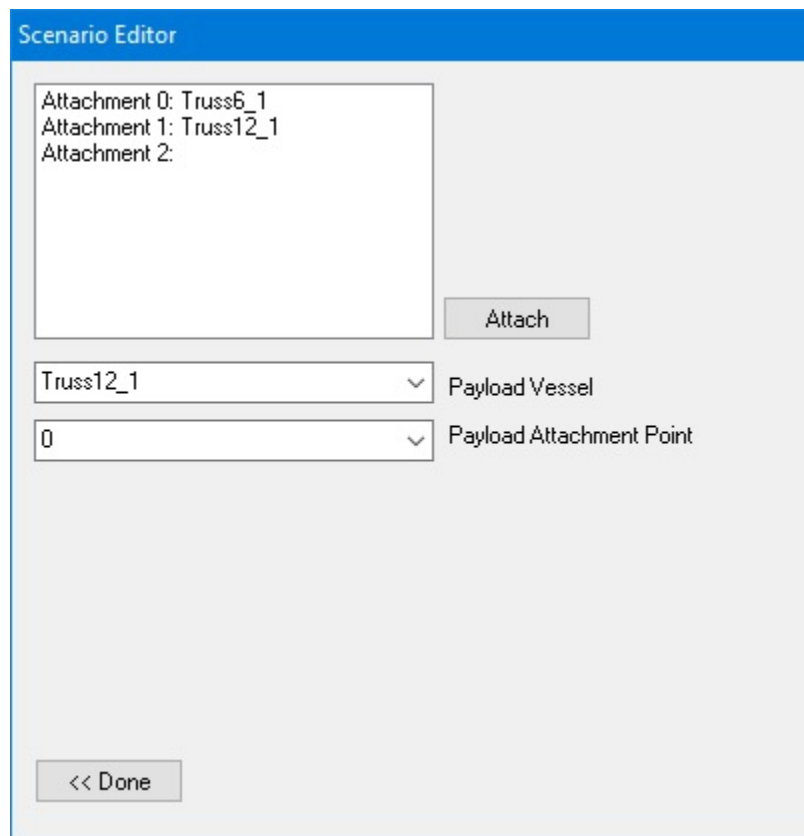
☐ Add STS Trunnions

0.000 ▲ ▼ ▲ ▼

0.000 ▲ ▼ ▲ ▼

0.000 ▲ ▼ ▲ ▼

The second page is the payload management page, used for attaching and detaching payloads.



In the above screenshot, two of the attachment positions are occupied by trusses and the third slot is not. To detach a payload, simply select the appropriate payload slot in the listview and the button will change from Attach to Detach. Clicking the button will detach the payload and update the listview as appropriate. To add a payload, select an empty slot, then select the target payload in the first dropdown, and the attachment point on the payload you wish to use in the second dropdown. The button will say “Attach” and pressing it will attach the payload. There is no limit to the range or type of payloads able to be added to a truss carrier.

## Pallet Carrier

There are two pages for this vessel, the first is like the other vessels, it controls aspects relating to the carrier, specifically the user can increase or decrease the number of segments, add or remove the trunnion pins, and alter the payload attachment point.

Scenario Editor

4   Number of carrier segments (this will detach all payloads!)

☐ Enable STS Trunnions

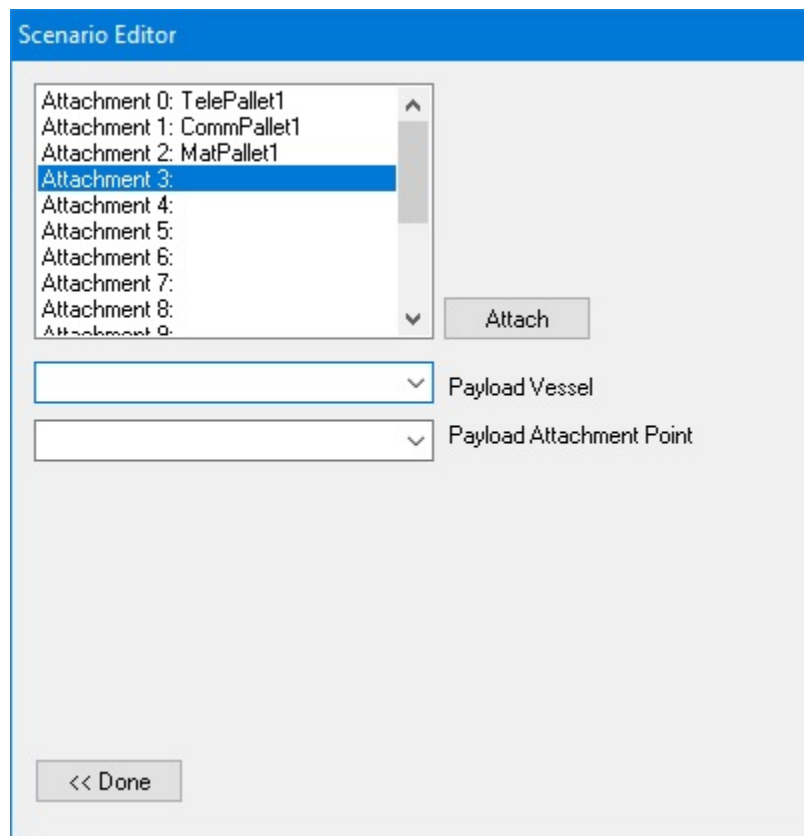
0.000   Payload Attachment X-Offset

0.000   Payload Attachment Y-Offset

0.000   Payload Attachment Z-Offset

<< Done

The second page is for attachment management.



In the above screenshot, three of the attachment positions are occupied by pallets and all other slots are unoccupied. To detach a payload, simply select the appropriate payload slot in the listview and the button will change from Attach to Detach. Clicking the button will detach the payload and update the listview as appropriate. To add a payload, select an empty slot, then select the target payload in the first dropdown, and the attachment point on the payload you wish to use in the second dropdown. The button will say “Attach” and pressing it will attach the payload. There is no limit to the range or type of payloads able to be added to a pallet carrier.

## Scenario File Entries

### Trusses

TYPE <int>

This specifies the type of truss to be created, options include:

2: Pressurized module

6: 6m Truss

12: 12m Truss

18: 18m Truss

61: Radiator Truss

63: Solar Truss

62 was/is reserved for a thruster truss that will not be included in the initial release.

If no type is set by the user, the default 6m truss will be created instead.

STS



When this flag is included along with the pressurized module, trunnion pins will be added to the visual model. This has no operational effect and is for visual realism only. This flag is only used with the pressurized module.

PLD\_OFS <float> <float> <float>

This specifies the location (x,y,z) of the primary child attachment point for attaching the pressurized truss to a vessel. Some vessels have a single payload attachment point, and it may be necessary to reposition the carrier vessel. This is not merely a visual repositioning.

## Truss Carriers

TYPE <int>

This specifies the type of truss carrier to be created. The integer format, is the number of 6m trusses, number of 12m trusses, and number of 18m trusses such as 26112 being 2, 6m trusses, and 1, 12m truss. If no type is set by the user, the default is the 46 type.

26: 2, 6m Trusses (STS)

46: 4, 6m Trusses (STS)

66: 6, 6m Trusses

212: 2, 12m Trusses (STS)

218: 2, 18m Trusses

26112: 2, 6m, 1, 12m Trusses (STS)

16112118: 1, 6m, 1, 12m, 1, 18m Truss

STS

When this flag is included in a vessel's scenario file, the carrier will attempt to load the version of the carrier for use with the Space Shuttle Orbiter. This has minimal operational effect and is primarily designed for a visually realistic carrier vessel. Most of the variants do however lose the ventral grapple point if this version is used.

PLD\_OFS <float> <float> <float>

This specifies the location (x,y,z) of the primary child attachment point for attaching the carrier to a vessel. Some vessels have a single payload attachment point, and it may be necessary to reposition the carrier vessel. This is not merely a visual repositioning.

## Pallets

TYPE <int>

This specifies the type of pallet to be created.

1: Materials Pallet

2: Spotlight Pallet

3: Communications Pallet

4: Telescope Pallet

## Pallet Carrier

SEGS <int>

This specifies the number of segments that will be created. Each segment can attach two single-attachment pallets per side. Pallets are mounted so the long axis would run parallel to the length of the carrier. There is no coded limit on the number of segments a user can attempt to include.

PLD\_OFS <float> <float> <float>

This specifies the location (x,y,z) of the primary child attachment point for attaching the carrier to a vessel. Some vessels have a single payload attachment point, and it may be necessary to reposition the carrier vessel. This is not merely a visual repositioning.

STS

When this flag is included in a vessel's scenario file, the carrier will load trunnion pins and scuff plants for use with the Space Shuttle Orbiter. This has no operational effect and is designed for a visually realistic carrier vessel. There is no coded-limit on the use of the trunnion pins unlike the truss carriers.

## Credits

Izack of the Orbiter-Forum for providing a workaround for a bug with the pallet dock rotational vectors and beta testing.

Douglas Beachy (dbeachy1) of the Orbiter-Forum specifically for help with an animation issue with the pallet carrier, and for much coding and troubleshooting help over the years.

Woo482 of the Orbiter-Forum for coding and troubleshooting help over the years.

Pablo49 of the Orbiter-Forum for beta testing.

Mustard of the Orbiter Francophone community for the original “Pack Nebulus” truss system which inspired the creation of this truss system.

The entire Orbiter Spaceflight Simulator community for providing help along the way throughout the years.

Most importantly, Dr. Martin Schweiger for creating the wonderful Orbiter Spaceflight Simulator for which these vessels are created for.

## Roadmap

Update to Orbiter 2016

MFD to control certain functions

CBM Adapter for trusses/CBM versions of trusses

Improve pallets to be more functional

Developing intersection trusses

Developing a different pressurized module

Developing a thruster truss

## Version History

170829 – v1.0 First full release (Orbiter 2010)

140106 – v0.7 second public beta release – includes solar and radiator trusses (Orbiter 2010)

131226 – v0.5 initial public beta release (Orbiter 2010)