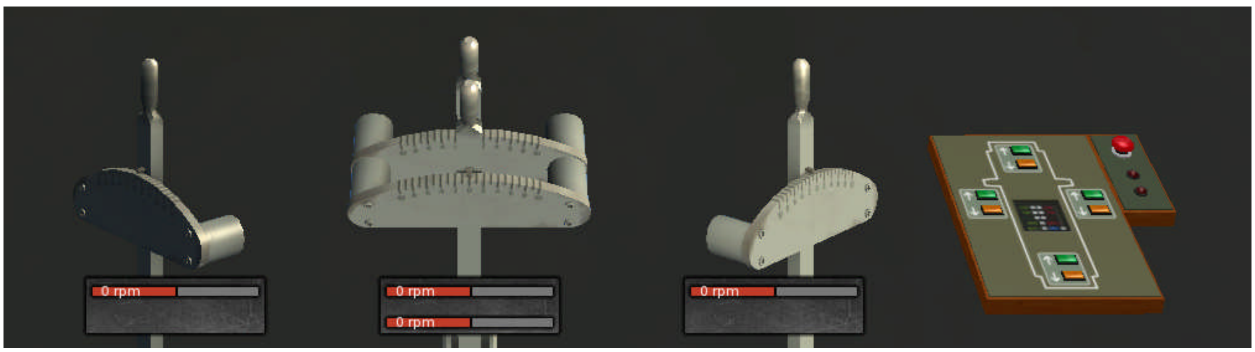
Driving the Maassluis Ferry

V1.3.0

The Maassluis ferry, like the Red Eagle, has fore & aft Voith-Schneider propellers.
Unlike Red Eagle, which has wheels to control the VSP in thrust magnitude and azimuth, this ferry has levers that cause the VSP to push in the direction that the lever is pushed.

Each VSP has two levers: A longitudinal lever that controls the fore & aft thrust along the centerline, and a transverse lever that controls the port & starboard thrust.
The VSP pushes in the same direction that the lever is pushed. The center position is zero thrust.

Overlay Controls



The **C** key shows/hides the overlay controls. From left to right they are:

1 The stern VSP transverse thrust. Drag left to push to port.
2 The longitudinal thrust levers. The lever in front is for the stern VSP; the one behind it is for the bow. Drag the lever to the right to push toward the bow.
3 The bow VSP transverse thrust. Drag right to push to port.
4 The controls for the ramps. Green raises the ramp; amber lowers the ramp.

The bow is the end of the ferry with the two side ramps.

Helm Position—Camera 2

The #2 button takes you to the helmsman's position—seated at the control stand facing to port. The bow is on your right; the stern is on your left.
The levers are arranged as they are in the overlay controls.

A transverse lever on the side of the control stand makes its respective VSP push in the same direction that the lever is pushed.

The longitudinal levers on the front of the stand also make the VSP push in the same direction that they are pushed.

Bow View from Helm

A second press on the #2 key takes you to a view looking past the control stand toward the bow. The clinometer above the window identifies this as a view toward the bow.

This view is also useful as a stern view if you rotate 180 degrees and use the overlay controls.

Stern View from Helm

A third press on the #2 key takes you to a view looking past the control stand toward the stern. This view is also useful as a bow view if you rotate 180 degrees and use the overlay controls.

Thrust Direction Indicators

The upper indicators show the magnitude & direction of thrust along the centerline of the ship. The lower indicators show the magnitude & direction of thrust at right angles to the centerline of the ship.

Thrust Direction Indicators

Ramp control

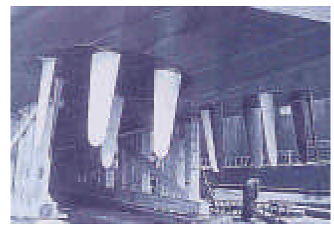
To **lower** a ramp: Move the mouse over the corresponding amber button to get the small white dot. Left-click and hold until the ramp has lowered all the way.
To **raise** a ramp: Move the mouse over the corresponding green button to get the small white dot. Left-click and hold until the ramp has risen all the way.
If the ramp controls on the control stand do not respond, use the overlay controls.

The Voith-Schneider Propeller

The VSP is old, mature technology dating from 1928 when the first prototype was installed on the launch Torquero.

Although it pushes the ship in a manner similar to a Z-drive or azimuthing thruster, it does it in a very different way. Its operating principal is more like that of a helicopter than any other ship propulsion system.

A large, horizontal, rotating disc is set flush with the hull and turns at constant speed in a single direction.
A number of large blades—usually 5—hang vertically from the disk. The length of the blade is usually 65% of the blade circle diameter. For a size 36 VSP the blade circle (the orbit of the blades) has a diameter of 3.6 meters with a blade length of 2.3 m.

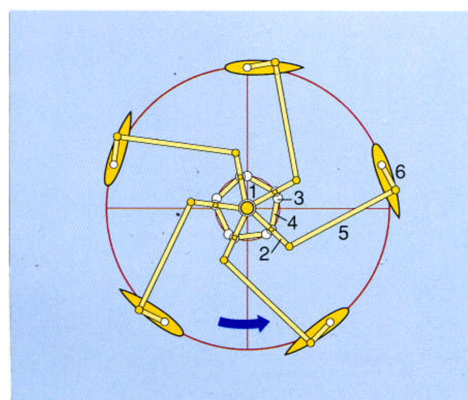


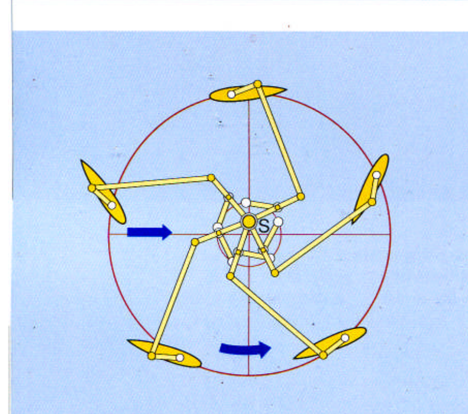
Helgoland 1939

For shallow draft operation, smaller units can have blade lengths only 40% BSD.

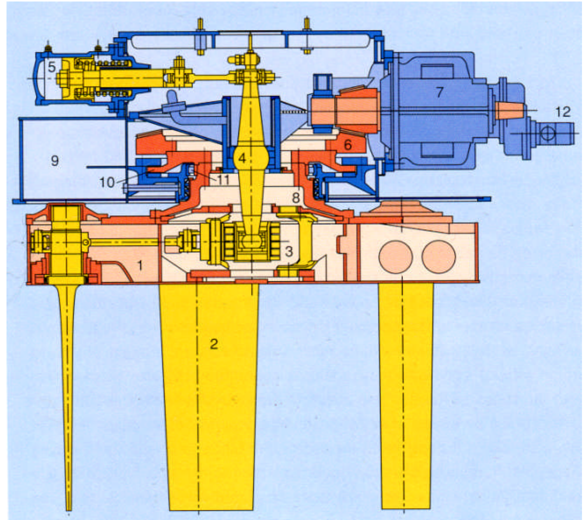
The blades have a shape similar to an airfoil and produce thrust in a manner similar to the way a wing produces lift. As the blades orbit the disc, they rotate on their own axes so they all produce thrust in the same direction relative to the ship centerline.

The angle of each blade is controlled by a very complicated linkage of arms and cranks.
The far ends of all linkages are connected to a common bearing near the center of the blade disc. When that bearing is at center, no thrust is produced. As the bearing is moved farther from the center, more thrust is produced. The direction of thrust is determined by the azimuth of the bearing.





Here are two diagrams looking down at the blades and a simplified representation of the Schubkurbelkinematik:
The top diagram shows the blades in the zero thrust position. Any thrust developed by a blade is balanced by thrust diametrically opposite. Note that the steering center—the center bearing in the kinematics—is directly over the center of the blade circle.
In the lower diagram, the steering center has moved away from the center of the blade circle, and thrust is developed toward the right.



The *Steering Center* bearing [3] is moved by a vertical arm [4] that has 3 ball joints, one at each end and one near the center. The middle ball is held in a fixed socket, the lower ball is held in the kinematics bearing, and the upper ball is moved by two hydraulic cylinders [5] at right angles to each other. The hydraulic cylinders can be controlled in different ways, including by joysticks through a computer. Control stands like the ones on Red Eagle usually do so by electric telemotors. On Red Eagle, the side wheels move the kinematics in a radial direction from center to control the amount of thrust. The top wheels move the kinematics in a circle around the blade disc center to control the direction of thrust. The wheel inputs must be translated into the X/Y coordinates for the hydraulic cylinders. This is usually done in the valve assembly on top of the drive. That unit also constrains the motion of the kinematics to avoid extreme blade angles.

Crank kinematics is the latest (as of 2000) refinement of the mechanism that varies the angle of each blade as it orbits the blade disc. Since 1927 there have been seven different kinematics developed, each one represents a refinement of the hydrodynamic theory, and a major engineering effort to design a mechanism to implement the mathematical pitch profile.
SKK was used on 1,921 propellers as of year 2000, about as many as all of the previous six kinematics totaled.

"Kinematics" is used both to refer to the mechanical linkage assembly, and to refer to the mathematic equations governing the blade angle.

A Note on Realism

On the present model one can set both the longitudinal and transverse thrust levers to maximum at the same time. This is clearly as impossible for a VSP to achieve as it would be for an Azipod—but for a different mechanical reason.

With the longitudinal thrust set to maximum, no transverse thrust is possible. Likewise, to produce maximum transverse thrust requires that the longitudinal thrust be set to zero.

In most installations employing this lever control arrangement, the levers are mechanically linked to constrain their movement:

If **L** and **T** are the fractions of longitudinal and transverse thrust in the range from -1 to +1, then $\mathbf{L}^2 + \mathbf{T}^2$ cannot exceed 1. The maximum distance from the center of the *blade circle* to the *steering center* bearing must be the same at all angles.