

Degree of Freedom in kabe systems

Introduction

I am going to describe the motions of the 4 most widely used pin systems in Scottish coastal rowing. I will be doing this through the Standard X, Y and Z degrees of freedom and their corresponding degrees of rotations. There will be 6 degrees of freedom which will be considered in each case along with a brief description of how they are set up. Below is a picture of the Port Seton Skiff with the Axis shown beside it.

X axis; Longitudinal, (Forward and Aft along the boat)

Y axis; Horizontal, From Port to Starboard across the boat

Z axis; Vertical Axis (Depth), for this case we will assume $Z=0$ is at the Gunwale.



All Positive away from the Centre

Pins

The pin system is done by having a plate on the oar with a hole in it and a fixed pin through the gunwale usually held in place by a simple wedge. The oar is lifted onto the pin system and is then fixed around the x axis, y axis and is partially fixed in the z axis. (I.e. it can be lifted out but cannot drop down.) Rotationally the Pin system allows rotations around the x axis partially and Z axis fully but not the Y axis. (I.e. it can be Lifted in and out the water, and can be rotated theoretically 360 Degrees, However in practice personnel in the boat and other oars in the boat limit this to 180 degrees.

Kabes

Kabes follow a similar design to Pins except they are not fixed as tightly in the x Direction. The Kabes with the Humlibands use a thick pin at the foreside of the oar to stop the oar from moving in the x direction but use the humliband (bit of rope) to stop the oar from sliding backwards therefore allowing a small amount of play in this direction. The oar is also free to move in the Y direction but not allowed to move in the Z direction at all whilst the humliband is in place. In this case the rotational degrees of freedom allow a rotation along the Y Axis.

Double pin

This system is used by having two pins, one the foreside and one the Aft side of the oar, With a D collar holding the oar from sliding in and out (usually wrapped in leather). In this instance the oar is allowed to move in the Y and Z direction but is limited by the spacing in the X direction. Since none of the parts limit rotation the oar is free to be rotated around all three Axes.

Ullapool Design

This system is the only system in use which uses an additional part, it comprises of a wooden pin; Fixed to the Gunwale, The oar with different Slots and an L shaped type of bracket. This system is very similar to the Dynamics used in sliding seat rowing with the Gates and spacers. The oar is partly free in the Z direction again, usually held with a small bungee cord. It is fixed in the Y direction but can be changed along the slots to gear the oar. The oar is fixed in the X direction completely. It is free to rotate in the Z direction and partially in the X direction. The oar cannot be rotated in the Y direction.

Breakdown of analysis

The table below shows the breakdown of the movements of each oar, most oars are allowed to move partially in the x Axis, despite theoretically the suggestion that they do not. Therefore in this table I will assume the θ_x axis to be correct if the oar is able to rotate enough to touch the water.

I will also assume that the Z axis is fixed if the oar can only be removed by lifting the oar out. In practice the oars can move in the Z direction enough to come off the top of a fixed pin but this is a minor technicality which is unusual.

Degree of Freedom	X Axis	Y axis	Z axis	θ_x	θ_y	θ_z
Fixed Pin	Fixed	Fixed	Fixed	Free	Fixed	Free
Kabes	Fixed	Free	Fixed	Free	Free	Free
Double Pin	Fixed	Free	Free	Free	Free	Free
Ullapool	Fixed	Fixed	Fixed	Free	Fixed	Free

Conclusion

From the table above, what can be seen is that each system is independent of each other, however commonly it can be seen that the X axis is generally fixed the Y axis is split 50/50 and all the rotations are free except the rotation around the y axis in the fixed pin system.

Personal Comment

Having had this debate 2 years ago and many new designs have come along since then, I personally think that the Oarlock system should be left alone until more important issues are dealt with such as; Oar lengths, Weights, areas of blades, Hull weights and having a submerged rudder of the correct proportion. In general the majority of the power comes through the X axis and therefore as long as the X axis is not free then I see no problem in experimenting with new ways. People who wish to expand or continue to feather are open to by 3 different methods. However I would not like to see the SCRA put in a position every 6 months where a debate must come up to resolve issues about design unless it is proven that is an unfair advantage. On regards of Safety there are arguments which I agree with on each side, yes the pin system does not allow movement in the Y direction but can rotate well beyond any system which can slide. The kabes allow the oars to be slided inboard however this also means that the oar sticks out both sides of the boat. The pin system unlike most kabes systems also allows a degree of freedom in the Z direction as the oar can be lifted off the fixed pin quickly without having to undo any bungee straps or humlibands. To summarise I think that if people want to standardise the kabes we must standardise the whole lot because the difference in kabes systems is much less than any advantage of oars, hull weight or rudder design.

Many thanks

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On behalf of the SCRA