Q&A

Here we try to answer five questions regarding pitch.

Q: "Why do we need a certain pitch on the blades?"

A: Pitch of the blade (an angle of leaning of the vertical axis of the blade, Figure 1) is needed, because during the first half of the drive the handle is much lower than the shoulders making it difficult for rowers to pull the handle horizontally. The force vector at the handle can be decomposed into two components: horizontal and vertical. When transferred through the oar as a first class lever, these components change magnitude (according to a gearing ratio) and direction (to opposite). The horizontal component creates a propulsive force at the blade and vertical component makes a downwards force, which sinks the blade. The pitch angle at the blade is needed to overcome this vertical force and allow the blade to move horizontally.

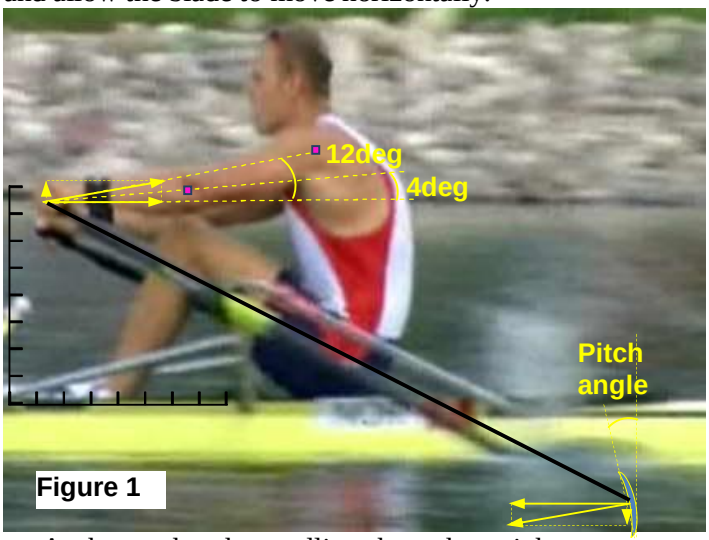


Figure 1

At the catch, when pulling through straight arms, an estimated angle of the force vector should be around 12 deg. If we set this pitch, than 20% of the total force will be directed vertically (sin(α)) and propulsive force will be decreased by 2.2% (1-cos(α)), which is a significant loss.

Rowers have another option: to bend ("grub") the arms and pull more horizontally towards the elbows, which would require less pitch on the blade. Usually, rowers use a combination of these two methods: they "grub" with the arms, but still pull at a small angle to horizon, which requires a small pitch. **In case of the most common pitch 4 deg, only 0.24% of the propulsive force is lost**(9 times less than at 12deg pitch) and the vertical component is 7%.

Q: "Does it make sense to set zero pitch and pull absolutely horizontally, but "grub" the arms more?"

A: It doesn't. It would require more energy from the muscles for a very small gain in propulsive force. Also, it would eliminate the vertical component completely, which plays a positive role because it pushes the boat upwards, reducing its vetted surface and, therefore, drag resistance.

Q: "Can we increase the handle (and the gate) height enough to eliminate "grubbing" arms?"

A: It is not possible for two reasons:

1. The higher a handle (from the stretcher), the lower handle force required to lift a rower from the seat (RBN 2002/05), so a higher handle would limit the force application at the catch.
2. At the finish, when arms are bending, the force vector is directed more horizontally: towards elbows at the level of the middle of the chest (Figure 2):

Figure 2

The most comfortable height of the handle decreases by 10-20 cm during the drive. The slope of the slides reduces this difference by 1-2 cm, but cannot eliminate it at all. It is not possible to increase the slope further because the rower will need to spend ~~a~~ significant energy for the climb, which would reduce propulsive power applied to the handle. Therefore, **the height of the handle (and gate) is defined mainly by a comfort for a rower at finish**.

Q: "Should we change the pitch, when changing gate height?"

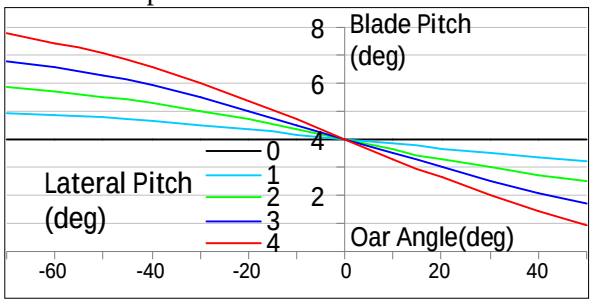
A: Change of the direction of the force vector ***dP***in degrees can be defined as:

$$dP = 180\ dH_g L_{oar} / \pi\ L_{arms}\ L_{out} \qquad (1)$$

where$dH_g$is the change of the gate height, L_{oar}- actual oar length, L_{arms}- length of the arms from shoulders to the handle, L_{out} - actual outboard length. For common values of above parameters, every 1 cm of decrease of the gate height makes the force vector 0.6 deg more vertical and vice versa. Therefore, **a lower gate height requires more pitch and more significant arms "grubbing and vice versa.** Remember that the handle height depends also on the boat height above water.

Q: "We know that some crews use lateral pitch of the pin. Does this make sense?"

A: Lateral pitch (leaning of the pin outwards) is useful to overcome the difference in comfortable height of the handle and maintain a more constant force vector, because it increases the blade pitch at catch and decreases it at finish:



We recommend a lateral pitch of 2-3 deg, which would increase the blade pitch up to 5-6 deg at catch (4 deg at the middle), and decrease it down to 2.5-3 deg at finish.

Contact Us:

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