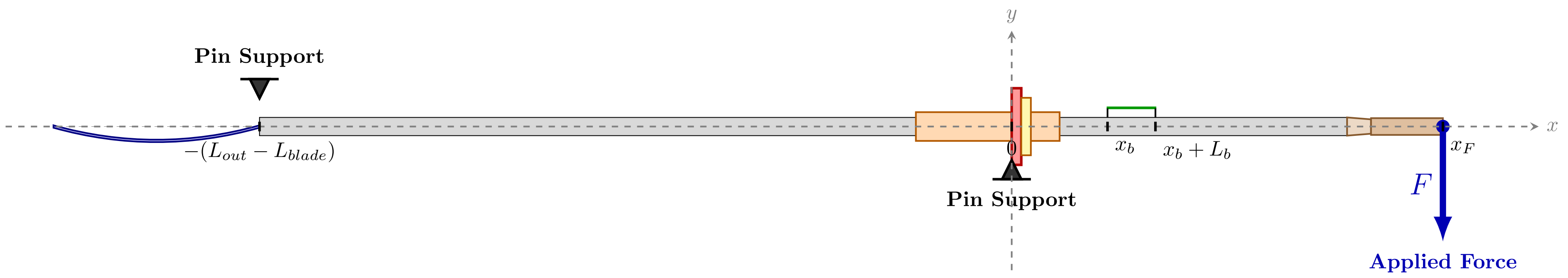
Theory 2: Boundary Conditions

Force at Handle, Pin Supports



Boundary Conditions - Theory 2

Description

A vertical force F is applied at the handle end ($x = x_F = 900$ mm). The oar is supported by two pin supports: one at the oarlock position ($x = 0$) and one at the end of the outboard shaft ($x = -(L_{out} - L_{blade}) = -1570$ mm).

Mathematical Formulation

Location	Condition	Description
$x = x_F$	$V_s(x_F) = -F$	Applied force (shear force)
$x = x_F$	$M_s(x_F) = 0$	Free end (no moment)
$x = 0$	$w_s(0) = 0$	No vertical displacement (pin support)
$x = 0$	$M_s(0) = 0$	No moment (pin allows rotation)
$x = -(L_{out} - L_{blade})$	$w_s(-(L_{out} - L_{blade})) = 0$	No vertical displacement (pin support)
$x = -(L_{out} - L_{blade})$	$M_s(-(L_{out} - L_{blade})) = 0$	No moment (pin allows rotation)

where:

- F = applied vertical force at handle [N]
- $V_s(x)$ = shear force on the shaft at position x [N]
- $M_s(x)$ = bending moment of the shaft at position x [N·mm]
- $w_s(x)$ = vertical deflection of the shaft at position x [mm]
- $\theta_s(x)$ = rotation angle of the shaft at position x [rad]
- x_F = 900 mm = handle position

- $L_{out} = 2000$ mm = total outboard length
- $L_{blade} = 430$ mm = blade length

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