

Surface Intersecting the Free Surface

Example 0.1. A fuel oil tank is filled with HFO (specific gravity = 0.96) to a depth of 4.2 m. One wall, inclined at 60 degrees to the horizontal, is 8 m long. Calculate the force on the wall and determine its location.

```
import math

# Given data
SG = 0.96                # specific gravity
rho = SG * 1000          # density (kg/m^3)
g = 9.81                 # gravity (m/s^2)

h = 4.2                  # vertical depth of oil (m)
theta = math.radians(60) # wall inclination to horizontal (rad)
b = 8.0                  # wall width (m)

# Submerged length of the wall
L = h / math.sin(theta)

# Area of submerged wall
A = b * L

# Depth of centroid
h_bar = h / 2

# Resultant force
F = rho * g * A * h_bar

# Second moment of area about centroid
I_G = b * L**3 / 12

# Centre of pressure (vertical depth)
h_cp = h_bar + (I_G * math.sin(theta)**2) / (A * h_bar)
```

```
# Output
print(f"Resultant force = {F:.3e} N")
print(f"Centre of pressure = {h_cp:.2f} m below free surface")
```