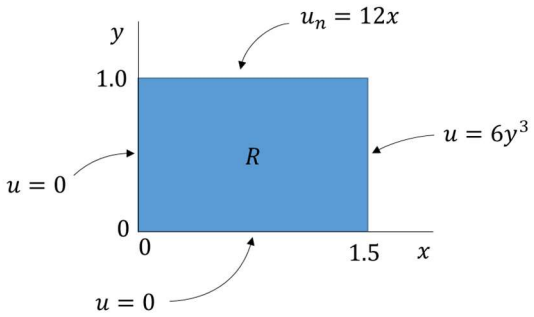
Compress all files as `(ID)_(name).zip`
It must include:
- `prob1.mph`
- `prob2_beam.mph`, and `prob2_solid.mph`
- `prob3_plate.mph`, `prob3_shell.mph`, and `prob3_solid.mph`

1. [PDE solving] Solve the mixed boundary problem for Poisson equation by Weak Form PDE (w) with dimensionless setting. (24 pts total)

   A. Draw a contour plot by using Surface (8 pts)

   B. Evaluate the values of u at points (0.5,0.5), (1.0,0.5), (0.5,1.0), (1.0,1.0) (16 pts)

$$\nabla^2 u = u_{xx} + u_{yy} = f(x,y) = 24xy$$



Dirichlet boundary:
$u(0,y) = u(x,0) = 0$
$u(1.5,y) = 6y^3$

Neumann boundary:
$u_n(x,1.0) = u_y(x,1.0) = 12x$

Hint:

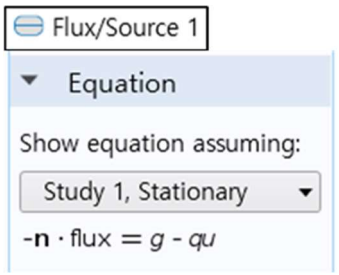
✓ Derivation of weak form PDE:

$$\int_\Omega (\nabla^2 u - f)v d\Omega = \int_{\partial\Omega} (\nabla u \cdot \mathbf{n})v d\Gamma - \int_\Omega (\nabla u \cdot \nabla v + fv) d\Omega$$

$$\Rightarrow \int_\Omega \left(u_x v_x + u_y v_y + fv\right) d\Omega = 0$$

⇒ - (ux*test(ux) + uy*test(uy) + f*test(u))

✓ Use "Flux/Source" for Neumann boundary condition:



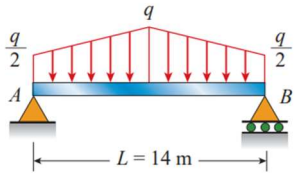
2. [Beam deflection] Solve the following problems. (40 pts total)

   A. Determine the maximum permissible load q based upon an allowable bending stress $\sigma_{\text{allow}} =$ 110 MPa by using 2D Beam (beam) module. (10 pts)

   B. Find the corresponding maximum deflection by using 2D Beam (beam) module. (10 pts)

   C. Repeat A and B by using 2D Solid Mechanics (solid) module. (20 pts)

   (Use **Extra Fine** discretization level.)

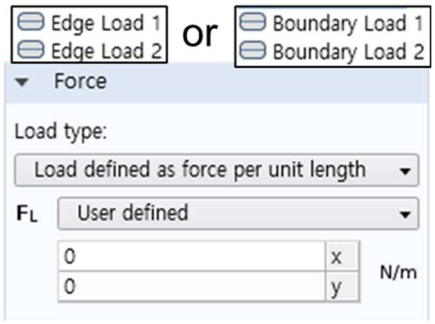


$E = 210$ GPa, $\nu = 0.3$

Beam cross section is a square with a side length of 500 mm.

Hint:

✓ Use Edge Load for 2D Beam and Boundary Load for 2D Solid Mechanics



-(q/L)*x - q/2

(q/L)*x - 3*q/2

✓ To determine the maximum permissible load q, try an arbitrary value for q and check the maximum bending stress.

✓ Use MAX Line Maximum for beam, and MAX Surface Maximum for solid to find maximum normal stress.

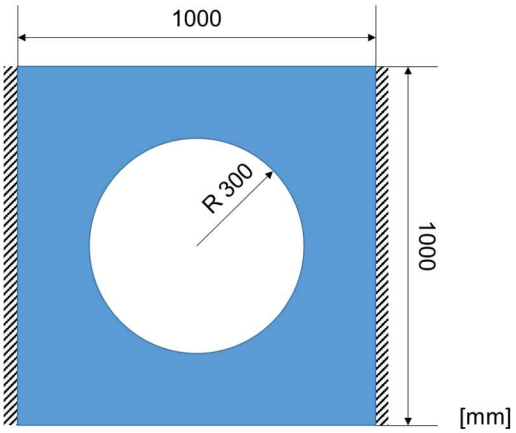
3. [Plate deflection] Find the maximum deflection δ of following plate with a hole (36 pts total)

   A. By using 2D Plate (plate) (12 pts)

   B. By using 3D Shell (shell) (12 pts)

   C. By using 3D Solid Mechanics (solid) (12 pts)

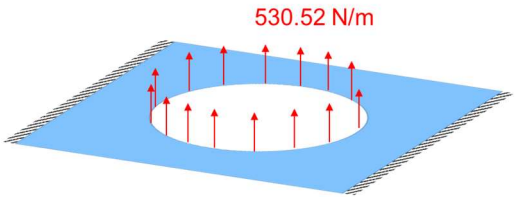
   (Use **Fine** discretization level.)



Fixed both sides

$E = 60$ GPa, $\nu = 0.3$

Thickness: 10 mm



That is 1 kN divided by the circumference of the hole.