

Benchmark cases

Case1: Freeslip boundaries and delta function density perturbation

Case2: Freeslip boundaries and smooth density distribution

Case3: Noslip boundaries and delta function density perturbation

Case4: Noslip boundaries and smooth density distribution

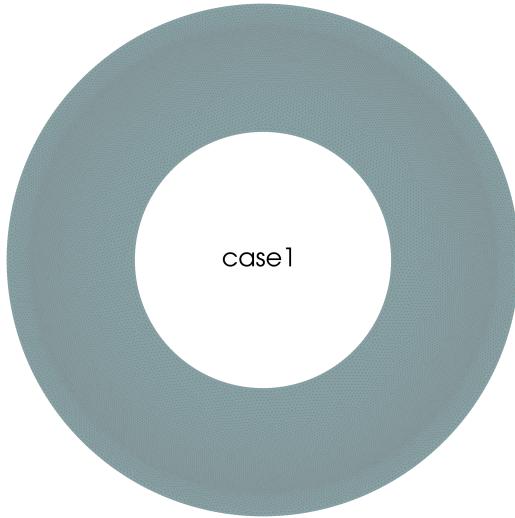
```
# defining rho fn
if delta_fn:
    rho = sympy.cos(n*th_uw) * sympy.exp(-1e5 * ((r_uw - r_int) ** 2))
        )
    stokes.add_natural_bc(-rho * unit_rvec, "Internal")
elif smooth:
    rho = ((r_uw/r_o)**k)*sympy.cos(n*th_uw)

# boundary conditions
if freeslip:
    if ana_normal:
        Gamma = mesh.CoordinateSystem.unit_e_0
    elif petsc_normal:
        Gamma = mesh.Gamma

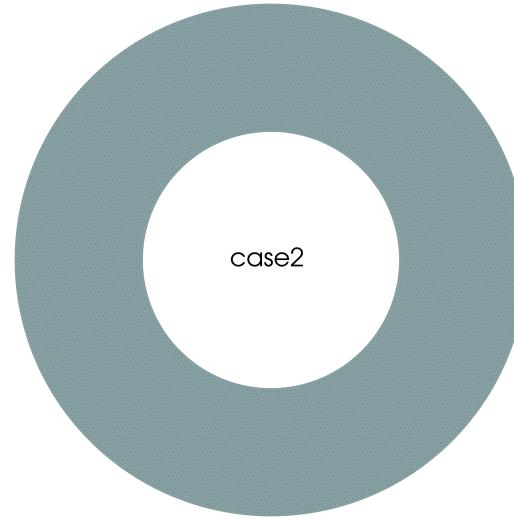
    # Gamma = norm_v.sym
    stokes.add_natural_bc(2.5e3 * Gamma.dot(v_uw.sym) * Gamma, "
                                Upper")
    stokes.add_natural_bc(2.5e3 * Gamma.dot(v_uw.sym) * Gamma, "
                                Lower")

elif noslip:
    stokes.add_essential_bc(sympy.Matrix([0., 0.]), "Upper")
    stokes.add_essential_bc(sympy.Matrix([0., 0.]), "Lower")
```

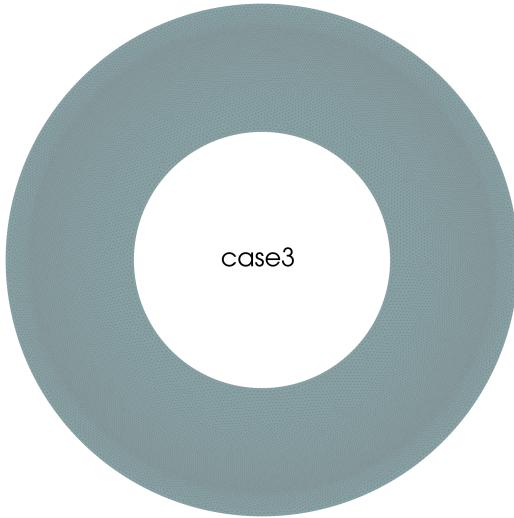
Mesh



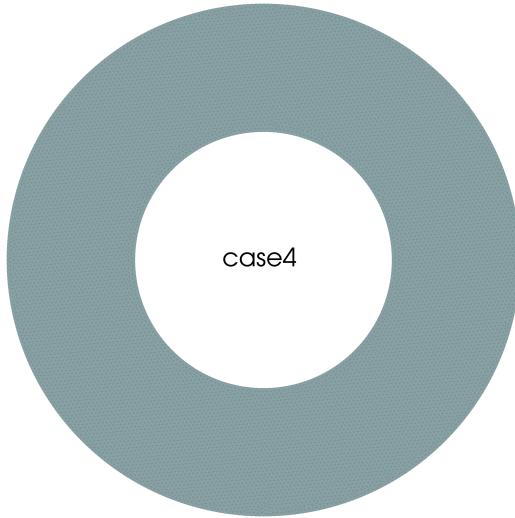
case1



case2



case3



case4

Density, Velocity, Pressure

