

The domain is a unit square. Free slip boundary conditions are prescribed on all sides. The resolution is fixed to  $64 \times 64 Q_1 \times P_0$  elements. The flow is isoviscous and the buoyancy force is given by

$$f_x = 0 \quad (1)$$

$$f_y = \rho \alpha T(x, y) \quad (2)$$

with

$$T(x, y) = \cos(kx)\delta(y - y_0)$$

where  $k = 2\pi/\lambda$  and  $\lambda$  is a wavelength, and  $y_0$  represents the location of the buoyancy.

One can prove [?] and refs. therein that there is an analytic solution of the surface stress  $\sigma_{zz}$ :

$$\frac{\sigma_{yy}}{\rho \alpha g} = \frac{\cos(kx)}{\sinh^2(k)} [k(1 - y_0) \sinh(k) \cosh(ky_0) - k \sinh(k(1 - y_0)) + \sinh(k) \sinh(ky_0)]$$

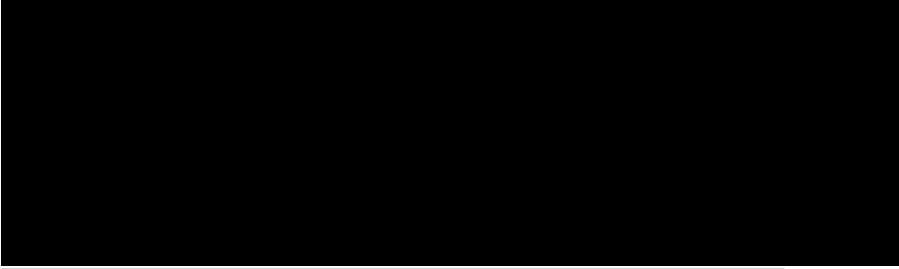
We set  $\lambda = 1$  and explore  $y_0 = \frac{63}{64}, \frac{62}{64}, \frac{59}{64}$ . Zhong et al. report for measurements at  $x = 0$ :

Method	$y_0 = 63/64$	$y_0 = 62/64$	$y_0 = 59/64$
Analytic solution	0.995476	0.983053	0.912506
Pressure smoothing	1.15974	1.06498	0.911109
CBF	0.994236	0.982116	0.912157

We are then interested in numerically computing this quantity:

$$\sigma_{yy} = -p + 2\eta \dot{\epsilon}_{yy}$$

and we start with the trivial measurement in the middle of the elements forming the top row of the mesh.



#### features

- $Q_1 \times P_0$  element
- incompressible flow
- mixed formulation
- isothermal
- isoviscous
- analytical solution
- pressure smoothing
- consistent boundary flux