An extension of PEERS element for quadrilateral elasticity mixed formulation

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1 Numerical example

1.1 Square problem

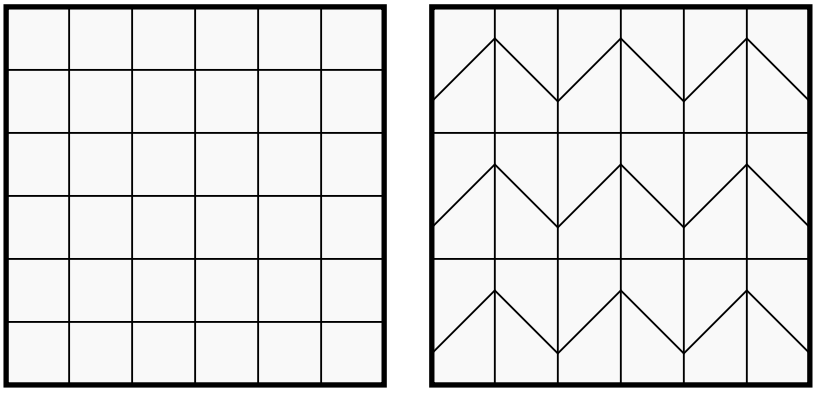
First example is a unit square domain with homogeneous Dirichlet boundary conditions and we the exact solution is

$$u_1 = \cos(\pi x)\sin(2\pi y), \quad u_2 = \sin(\pi x)\cos(\pi y). \tag{1}$$

The Lamé constant are fix to $\lambda = 123$ and $\mu = 79.3$. By imposition of the previously exact solution one obtain for the body force f

$$\begin{aligned} f_1 &= -\pi^2 \cos(\pi x)\sin(\pi y)\left(\lambda + \mu + 2\lambda\cos(\pi y) + 12\mu\cos(\pi y)\right), \\ f_2 &= -\pi^2 \sin(\pi x)\left(\lambda\cos(\pi y) + 3\mu\cos(\pi y) + 2\lambda\left(2\cos(\pi y)^2 - 1\right) + 2\mu\left(2\cos(\pi y)^2 - 1\right)\right) \end{aligned} \tag{2}$$

The problem is study using two type of mesh, first of all using a square mesh and before using a trapezoidal mesh. The two different types of meshes are shown in figures 2(a) and 2(b).

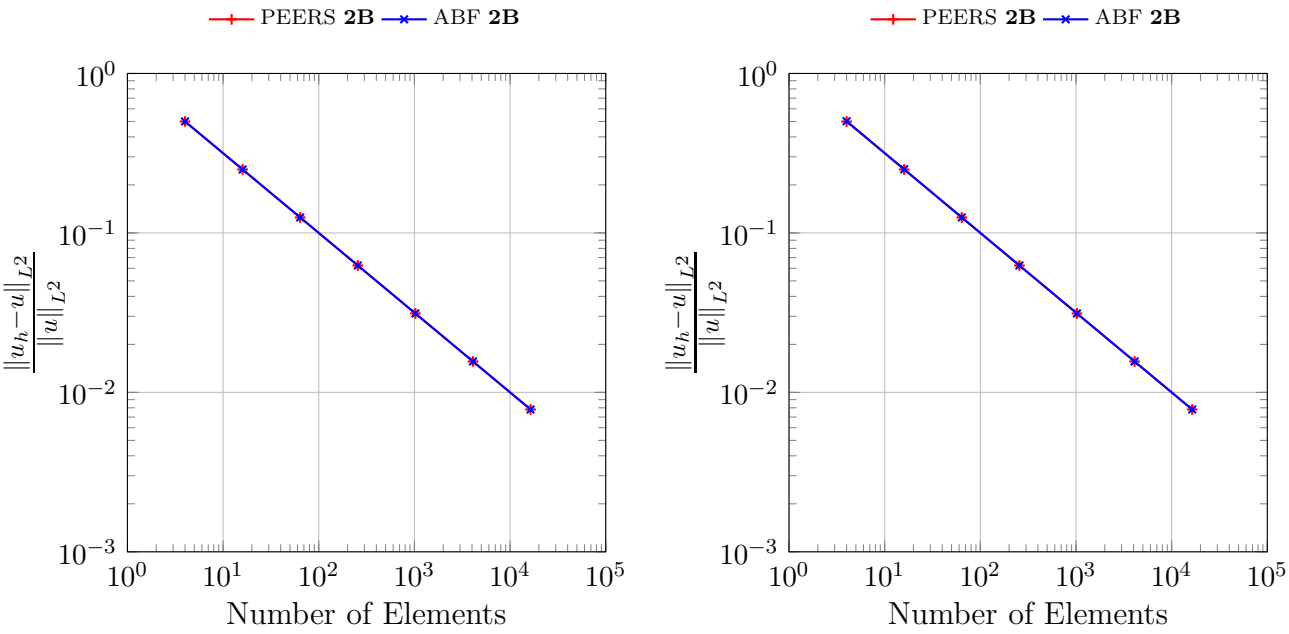


(a) Regular mesh (b) Trapezoidal mesh

Figura 1: Square Problem

1.2 Cantilever beam problem

1.3 Cook's membrane



(a) Regular mesh

(b) Trapezoidal mesh

Figura 2: Error in norm-L^2 of square problem

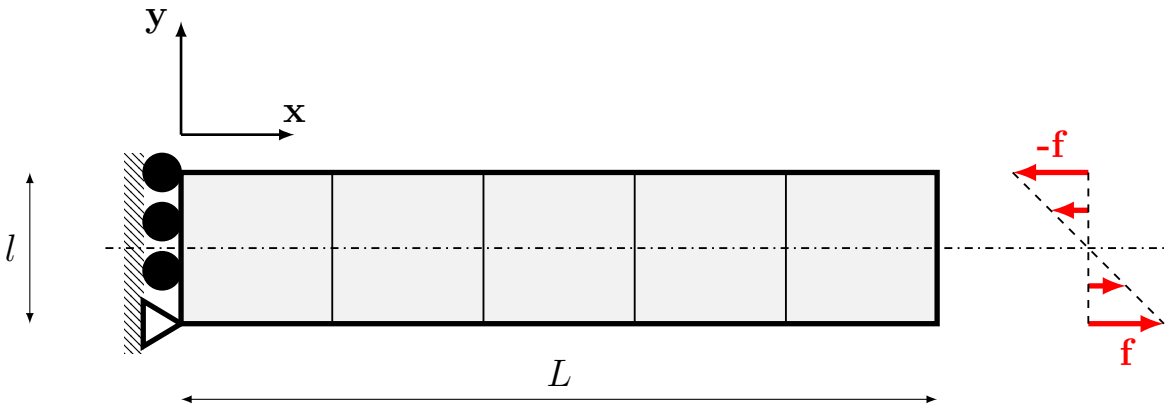


Figura 3: Cantilever Beam: Geometry problems

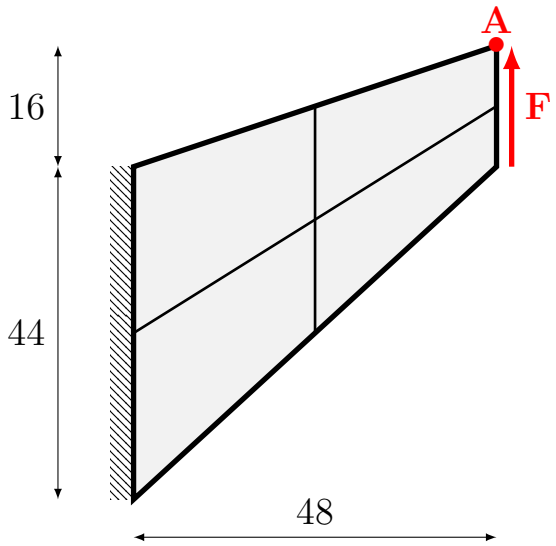
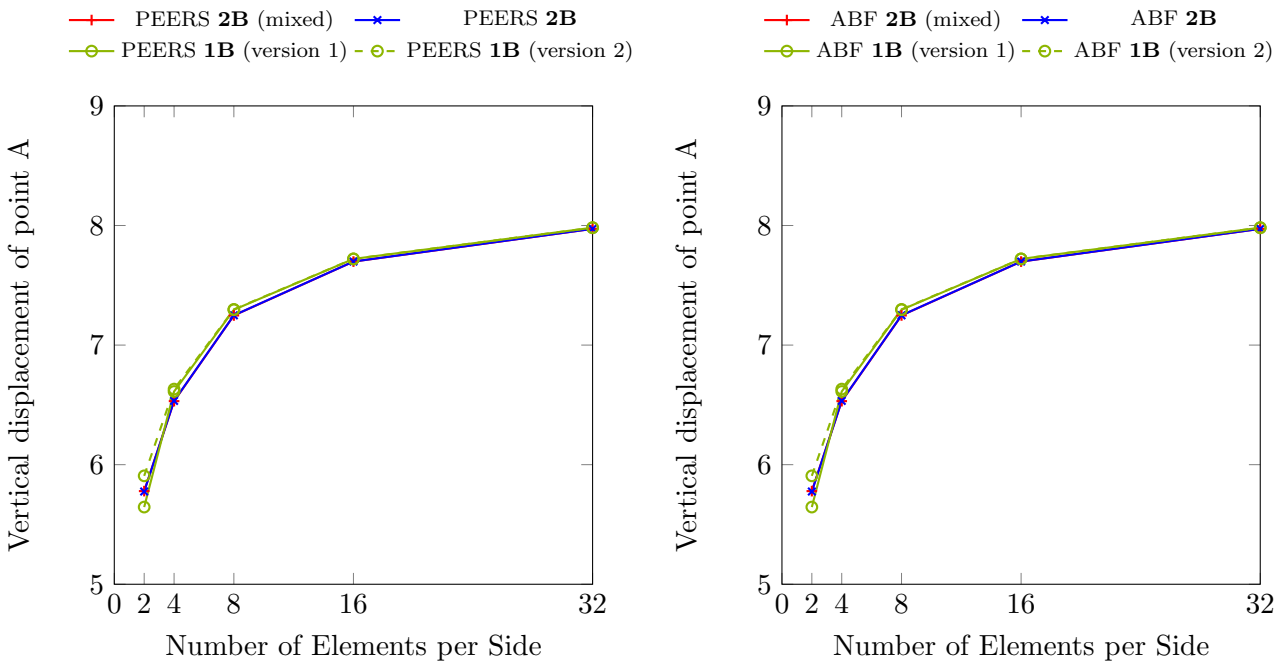


Figura 4: Cook's Membrane Geometry



(a) PEERS Element

(b) ABF Element

Figura 5: Cook's Membrane: Vertical Displacement of Point A vs. Element per Side