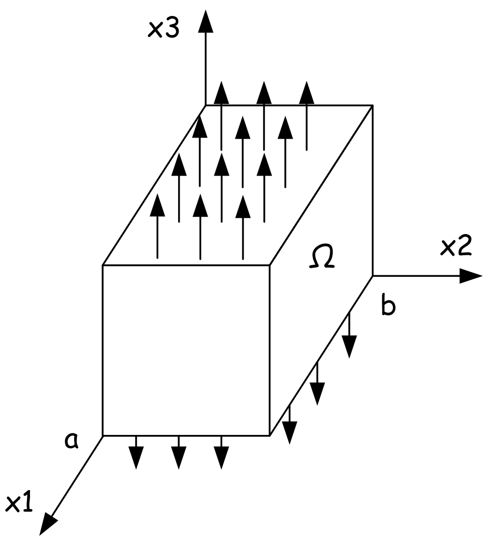
Practice on stresses and static admissibility

Let us consider the continuum body Ω in its present configuration where

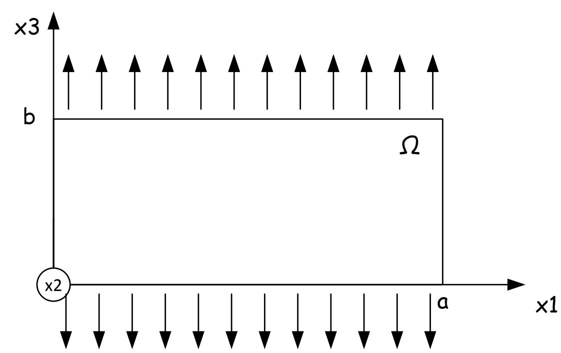
$$\Omega = \{0 \leq x_1 \leq a; 0 \leq x_2 \leq b; 0 \leq x_3 \leq b; \} \tag{1}$$

and $\partial\Omega$ is boundaries of the domain Ω.

Question 1: What are the surface tractions over the boundary $\partial\Omega$ when the stress state is $\underline{\underline{\sigma}} = a(\underline{e}_3 \times \underline{e}_3)$?



(a) 3D isometric view

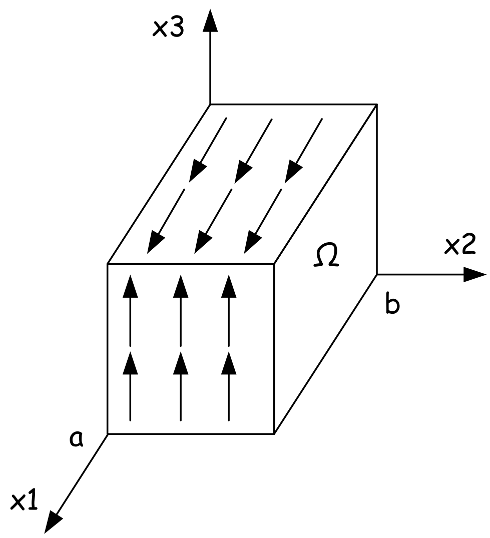


(b) x1-x3 plane view

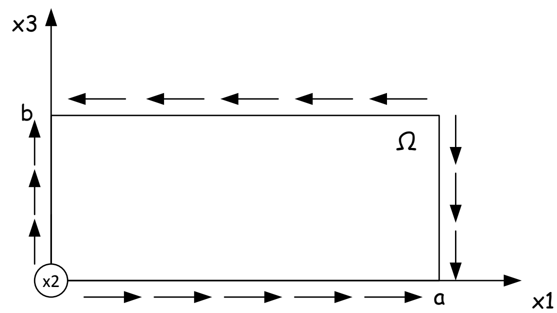
Figure 1: Parallelepiped subjected to $\underline{\underline{\sigma}} = a(\underline{e}_3 \times \underline{e}_3)$.

Answer 1: $\underline{\underline{\sigma}} = a(\underline{e}_3 \times \underline{e}_3)$ has a physical meaning that uniform traction of magnitude a about the axis 3. Normal surface traction over surfaces with normal $\underline{e}_3$. In this case, a is uniform to a pressure with unit Pa or MPa (see Fig. 1).

Question 2: What are the surface tractions over the boundary $\partial\Omega$ when the stress state is $\underline{\underline{\sigma}}(\underline{x}) = \tau(\underline{e}_1 \otimes \underline{e}_3 + \underline{e}_3 \otimes \underline{e}_1)$?



(a) 3D isometric view



(b) x1-x3 plane view

Figure 2: Parallelepiped subjected to $\underline{\underline{\sigma}}(\underline{x}) = \tau(\underline{e}_1 \otimes \underline{e}_3 + \underline{e}_3 \otimes \underline{e}_1)$.

Answer 2: $\underline{\underline{\sigma}}(\underline{x}) = \tau(\underline{e}_1 \otimes \underline{e}_3 + \underline{e}_3 \otimes \underline{e}_1)$ has a physical meaning that shear tractions over the surfaces with normals $\underline{e}_1$ and $\underline{e}_3$. Fig. 2 shows a parallelepiped under shear stress.