Supporting information

Sample dimensions

Sample dimensions for strut-only configurations are reported in Table 1. In Figure 1A the $\mathbf{S_{1a\text{-}1b}}$ and $\mathbf{S_{X30°}}$ structures are shown as example. $\mathbf{D_e}$ and $\mathbf{D_i}$ are the external and internal diameters of the cylindrical body respectively, **L** is its length; **d** is the diameter of the struts, **p** and **n** are the spacing and the number of struts along the cylinder and **α** is the inclination of criss-crossing struts.

Table 1. Samples dimensions for struts-only configurations.

Strut-only configurations							
Name	**D_e**	**D_i**	**L**	**d**	**p**	**n**	**α**
S_{1a}	20	17	66.67	2	3.37	20	-
S_{2a}	20	17	66.67	1.5	3.37	20	-
S_{3a}	20	17	66.67	1.2	3.37	20	-
S_{1a1b}	20	17	66.67	2	3.37	20	-
S_{2a1b}	20	17	66.67	1.7	3.37	20	-
S_{3a1b}	20	17	66.67	1.4	3.37	20	-
S_{2a2b}	20	17	66.67	1.5	3.37	20	-
S_{3a2b}	20	17	66.67	1.3	3.37	20	-
S_{3a3b}	20	17	66.67	1.2	3.37	20	-
$S_{45°}$	20	17	66.67	2	3.37	20	-
$S_{X30°}$	20	17	66.67	1.6	6.7	8	30
$S_{X45°}$	20	17	66.67	1.5	6.7	8	45
$S_{X60°}$	20	17	66.67	1.6	6.7	5	60

Samples dimensions for ridges-only configurations are reported in Table 2. In Figure 1B, the $\mathbf{R_{e\ 30°,20°}}$ structure is shown as example. As for struts-only configuration, $\mathbf{D_e}$, $\mathbf{D_i}$ and **L** are the external, internal diameter and length of the cylindrical body; **β** is the helix angle, **θ** is the spacing between helixes and $\mathbf{r_h}$ is the helix radius.

Table 2. Samples dimensions for ridges-only configurations.

Ridge-only configurations						
Name	**D_e**	**D_i**	**L**	**β**	**θ**	**r_h**
$R_{e\ 30°,20°}$	20	17	66.67	30	20	0.65
$R_{e\ 30°,45°}$	20	17	66.67	30	45	0.65
$R_{e\ 30°,90°}$	20	17	66.67	30	90	0.65
$R_{e\ 45°,20°}$	20	17	66.67	45	20	0.75
$R_{e\ 45°,45°}$	20	17	66.67	45	45	0.75
$R_{e\ 45°,90°}$	20	17	66.67	45	90	0.75
$R_{e\ 60°,20°}$	20	17	66.67	60	20	0.825
$R_{e\ 60°,45°}$	20	17	66.67	60	45	0.825
$R_{e\ 60°,90°}$	20	17	66.67	60	90	0.825
$R_{i\ 45°,20°}$	20	17	66.67	45	20	0.75
$R_{i\ 45°,45°}$	20	17	66.67	45	45	0.75

$R_{i\ 45°,90°}$	20	17	66.67	45	90	0.75
$R_{x\ 30°,90°}$	20	17	66.67	30	90	0.65
$R_{x\ 45°,90°}$	20	17	66.67	45	90	0.75
$R_{x\ 60°,90°}$	20	17	66.67	60	90	0.825

Samples dimensions for combined configurations can be obtained by combining the corresponding strut- and ridge-only designs.

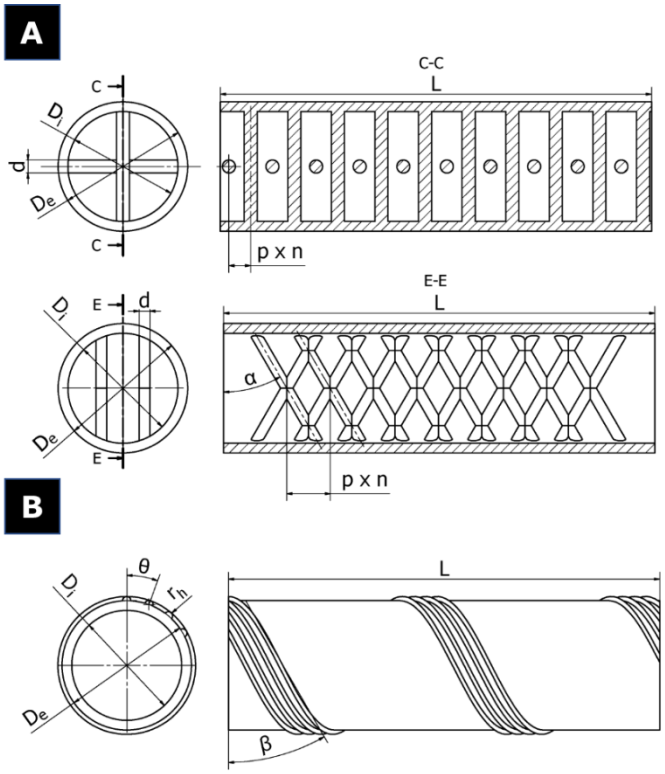

Figure 1. Samples dimensions for struts-only (A) and ridges-only (B) configurations.

Convergence analysis

Convergence analyses have been performed separately on strut- and ridge-only configurations with linear-elastic assumptions.

Starting from strut-only configurations, convergence analysis for three-point bending has been performed on the $\mathbf{S_{1a}}$ structure. Results are shown in Figure 2 A, in which the reaction force is plotted as a function of the number of elements. According to it, the approximate mesh size chosen is of 1 mm on the outer wall and of 0.5 mm on the inner side, where struts are present.

Concerning ridges-only configuration, the analysis has been carried out on the $\mathbf{R_{e\ 45°,90°}}$ configuration. Results are shown in Figure 2 B, in which the reaction moment is plotted as a function of the number of elements. The approximate mesh size chosen is of 1 mm on the wall where there are no ridges, and of 0.5 mm where they are present.

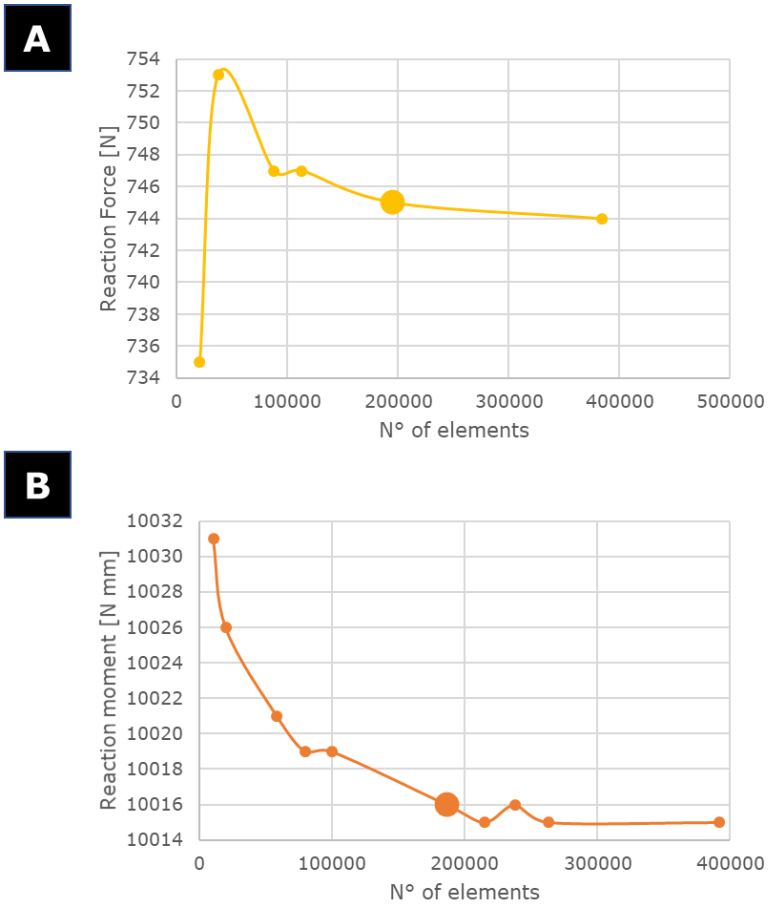

Figure 2. Convergence analysis results: reaction force as a function of the mesh size are reported for the S_{1a} structure (A) and for the Re 45°,90° configuration (B). The chosen mesh size is the one highlighted by the big solid dots.