Investigation of the peculiarity of creation of cylindrical design elements for 3D printed heels

Rugilė Kemzūraitė, **Raimonda Cvilikaitė, Edita Gelažienė, Daiva Milašienė**

Kaunas University of Technology, Faculty of Mechanical Engineering and Design, Department of Production Engineering

Introduction

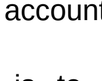
- Recently, shoe designs have become even more complex and unique in appearance.
- When creating a product with a more geometrically complex design, it is necessary to take into account the peculiarities and possibilities of 3D printing technology.
- The aim of this work is to investigate the influence of geometrical parameters of cylindrical design elements for footwear heels on the resistance to compressive loads.

Materials and Methods

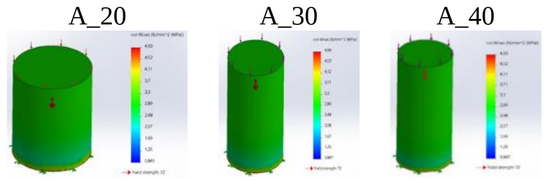
- The design elements that were investigated were designed using the "SolidWorks" software with “Simulation” function (static analysis).
- The polymeric material Polylactic acid PLA+ .
- Design elements were loaded with 600N, 800N, 1000N and 2000N force.
- The finite element mesh was created using element size of 1.25 mm, and a tolerance of 0.0625 mm.

Results

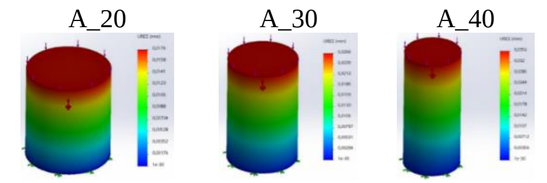
The investigated models of the created cylindrical design elements

Model marking		Height of a pillar, mm	View	The diameter of the pillar at the thinnest point, mm
Variant A: straight pillar	A_20	20		16
	A_30	30		
	A_40	40		
Variant B: concave pillar	B_20	20		12
	B_30	30		
	B_40	40		
Variant C: concave pillar	C_20	20		8
	C_30	30		
	C_40	40		

- A theoretical compression simulation was performed to examine how the investigated cylindrical design elements would respond to compressive loads during wear.
- The increase in pillar height from 20 mm to 40 mm does not influence the distribution of the von Mises stress.
- The values of the maximum displacements increase by about 50% when the column height increases by 10 mm and increase twice when the column height increases by 20 mm.

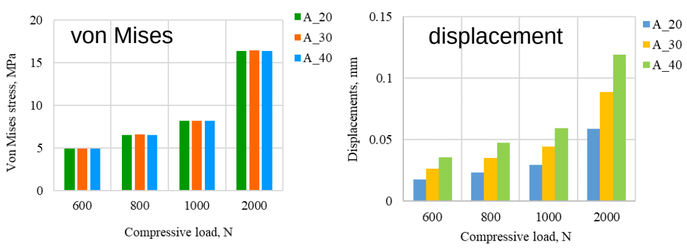


distribution of the von Mises stress

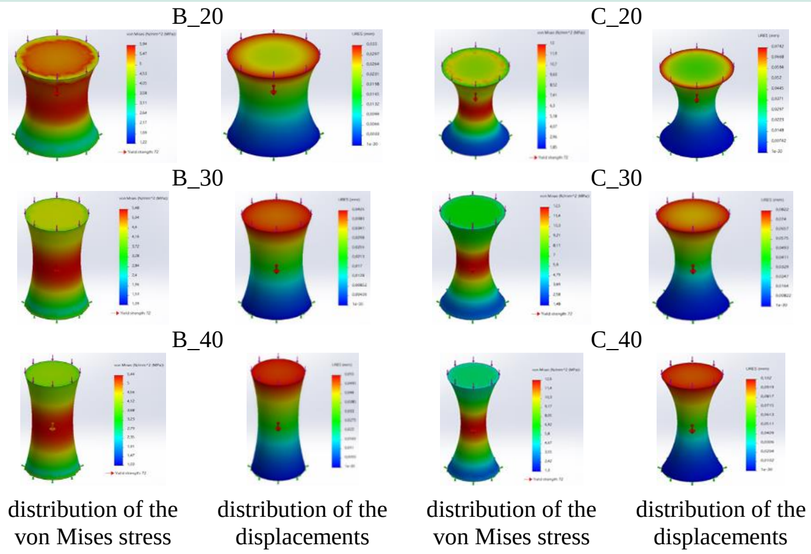


distribution of the displacements

Results of the static analysis of straight pillar (variant A) design elements for heels (the load force of 600 N) with different column heights

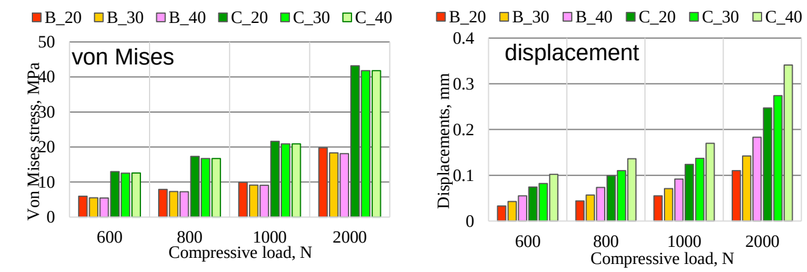


Influence of compressive load and pillar heights on the results of static analysis of straight pillar design elements (variant A)



distribution of the von Mises stress | distribution of the displacements | distribution of the von Mises stress | distribution of the displacements

Results of the static analysis of concave pillar design elements for heels (the load force of 600 N) with different column heights (20, 30, 40 mm)



Influence of compressive load on the results of static analysis of created pillar design elements of different heights and variants of pillar concave

- The distribution of both the highest stresses von Mises and the largest displacements in the concave models changes not only with increasing compressive load but also with changing the height of pillars.

Conclusions

1. This study showed that by creating cylindrical design elements for 3D printed heels, one needs to know that the influence of geometrical parameters on the values and distribution of the von Mises stresses and displacements differs in the case of straight and concave pillars.
2. It was found that in the case of concave models, both the height and diameter of the concave pillar at the thinnest point influence the zones of distribution of von Mises stress and displacements.

Industrial Design Engineering, E-mail: rugile.kemzuraite@ktu.edu