

# Print Geometry and Layering Method Alteration for Enhancement of Mechanical Properties of 3D Printed Elements

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Sooraj A.O. Nair

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Harshitsinh Chauhan

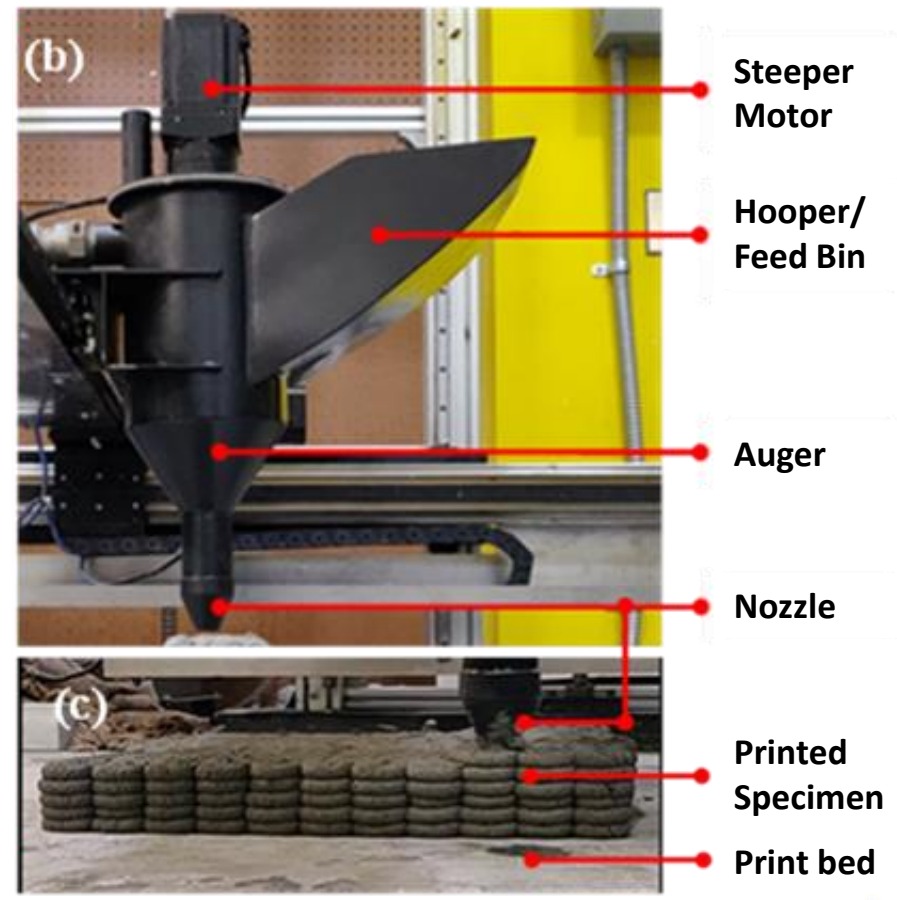
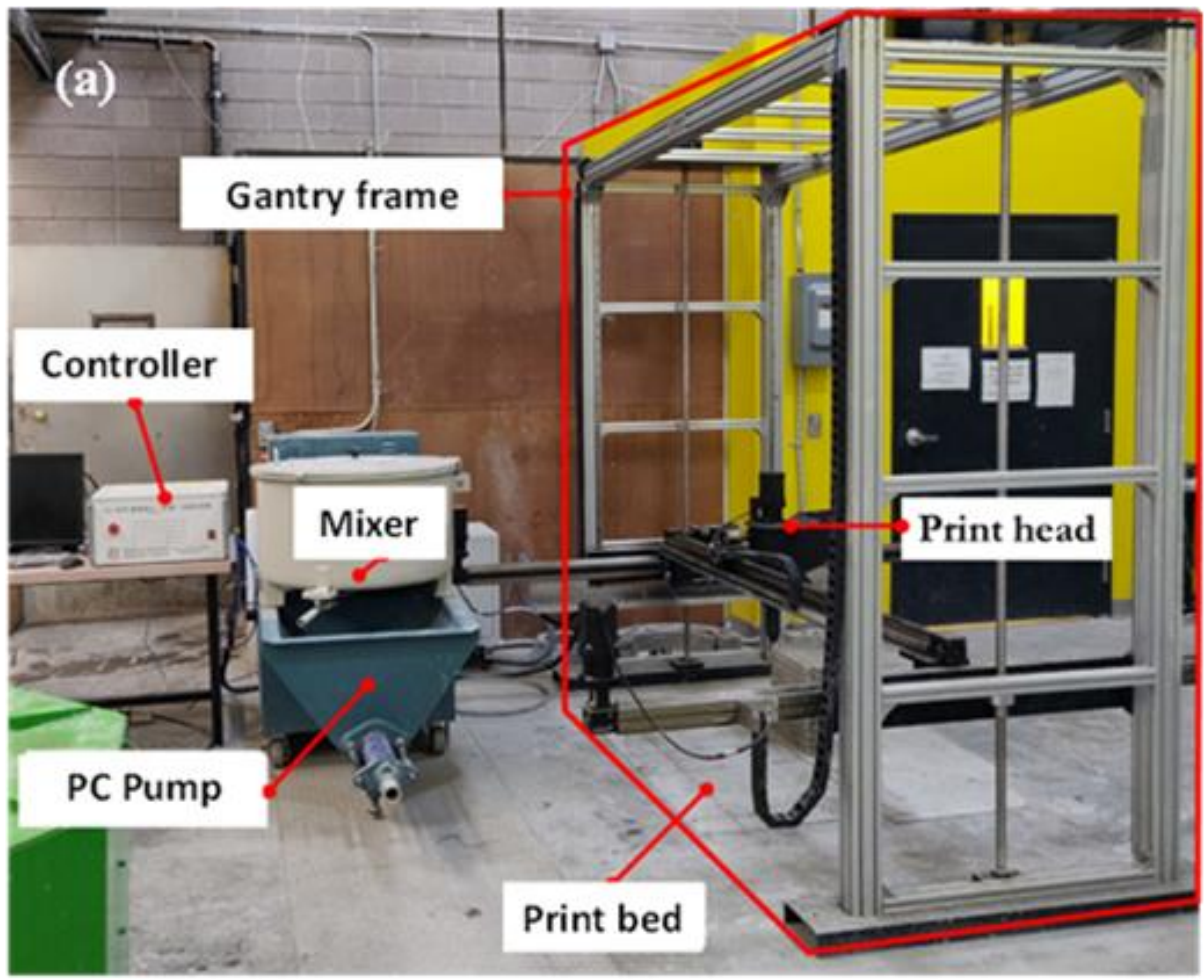
Project Engineer at Coreslab Structures (ARIZ) Inc., Phoenix, AZ. .

Narayanan Neithalath

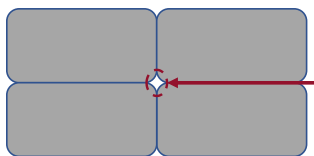
Professor, **Arizona State University**

<http://neithalath.engineering.asu.edu>; <http://3dconcrete.asu.edu>





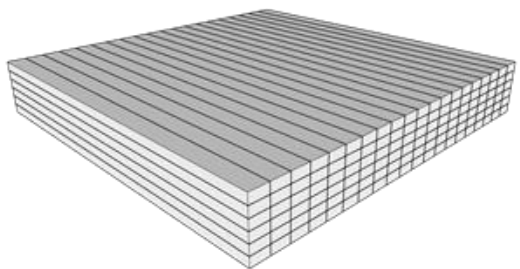




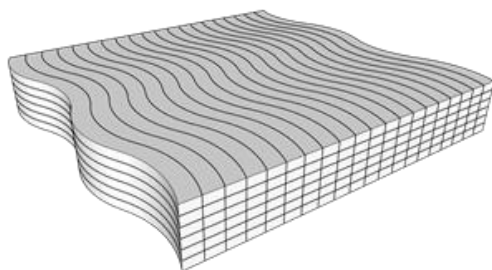
Void formation due to curved side of filament

Mixture ID	Mass Fraction of Ingredients			Chopped Steel Fiber (SF) <sup>+</sup>	Chopped Basalt Fiber (BF) <sup>+</sup>	Water-to-binder ratio (w/b) by mass	SP to binder ratio (SP%) by mass of the binder
	OPC	Limestone (L)	Sand (M)				
L <sub>30</sub>	0.35	0.15	0.5	-	-	0.35	0.25
L <sub>30-SF</sub>	0.35	0.15	0.5	0.28	-	0.35	0.35
L <sub>30-BF</sub>	0.35	0.15	0.5	-	0.28	0.35	0.35

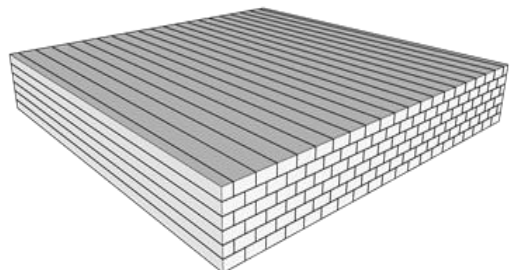
\*Percentage by volume of the mixture.



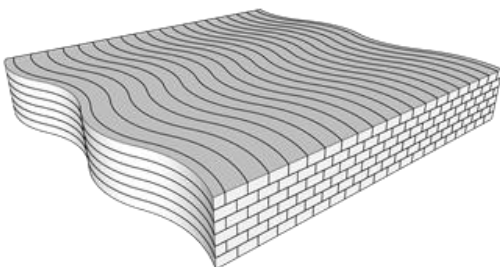
Linear Conventional (L-C)



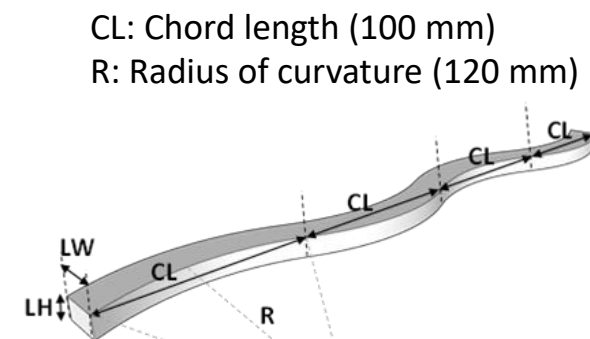
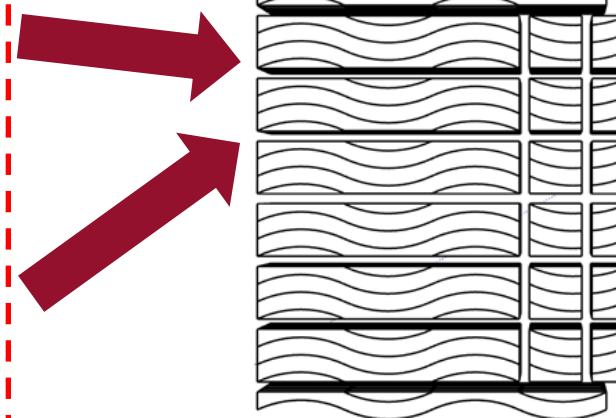
S-shaped Conventional (S-C)

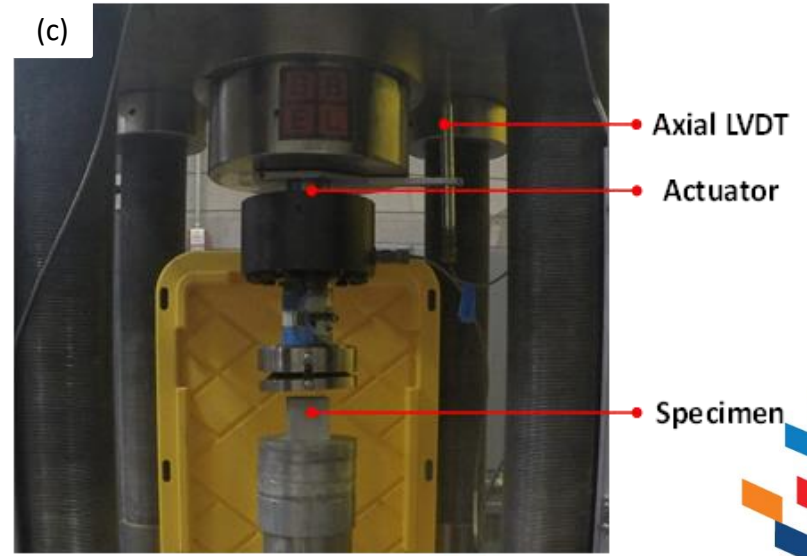
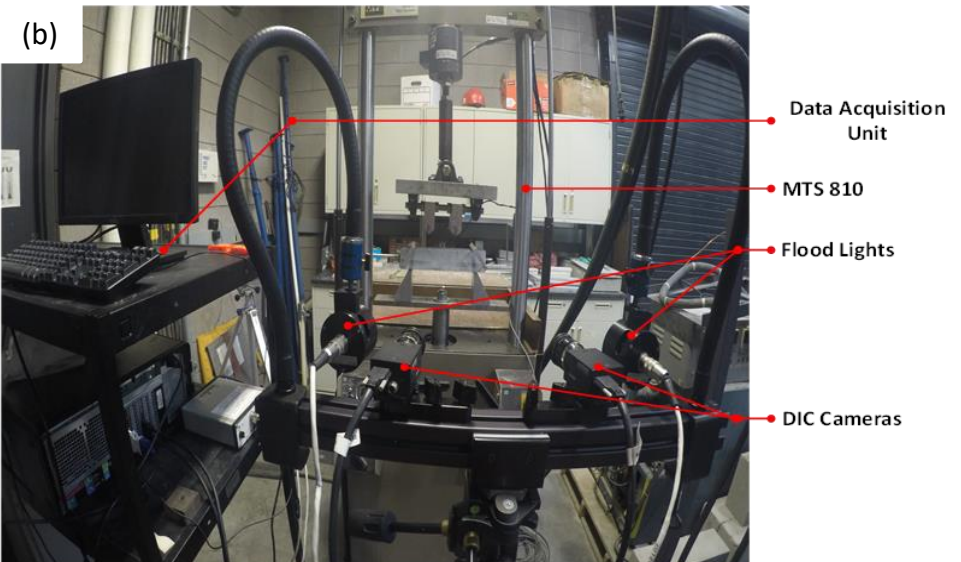
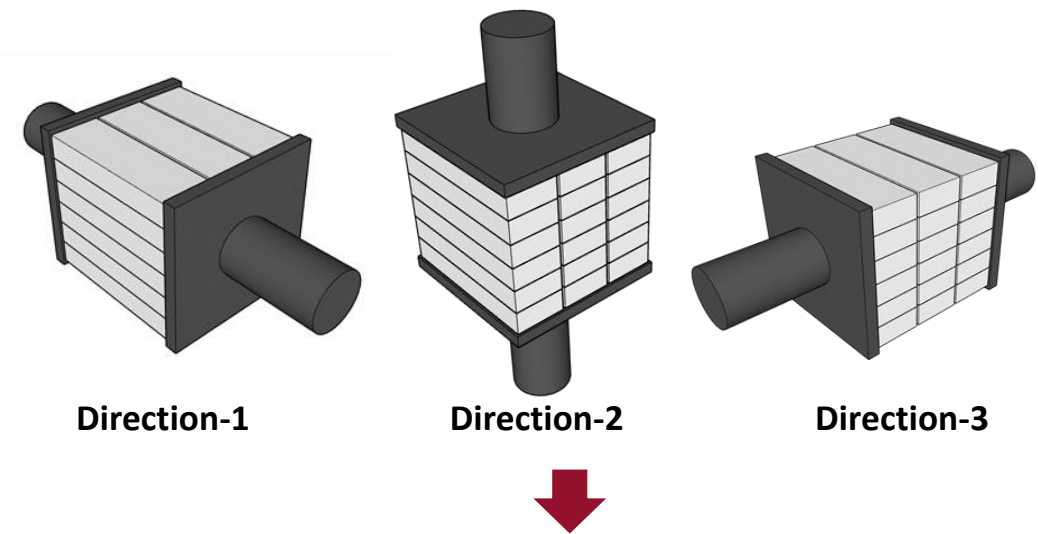
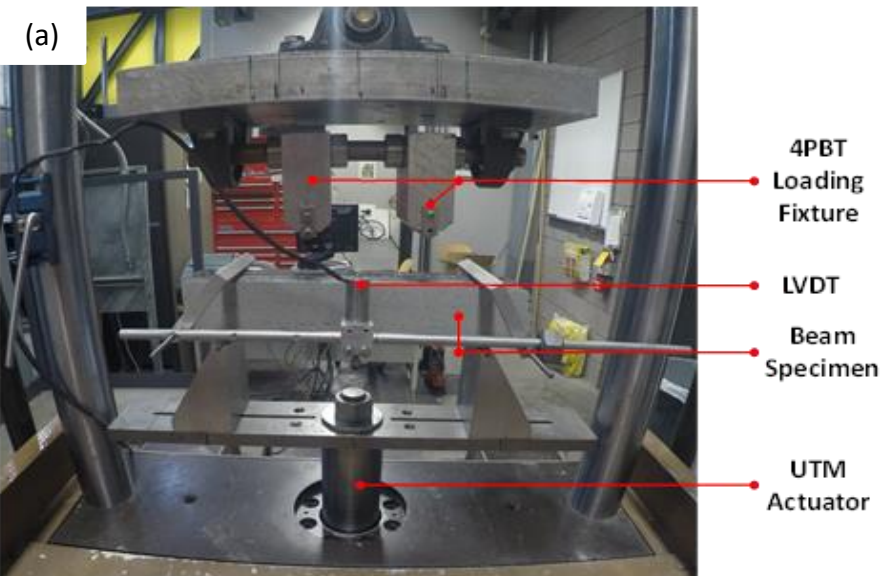


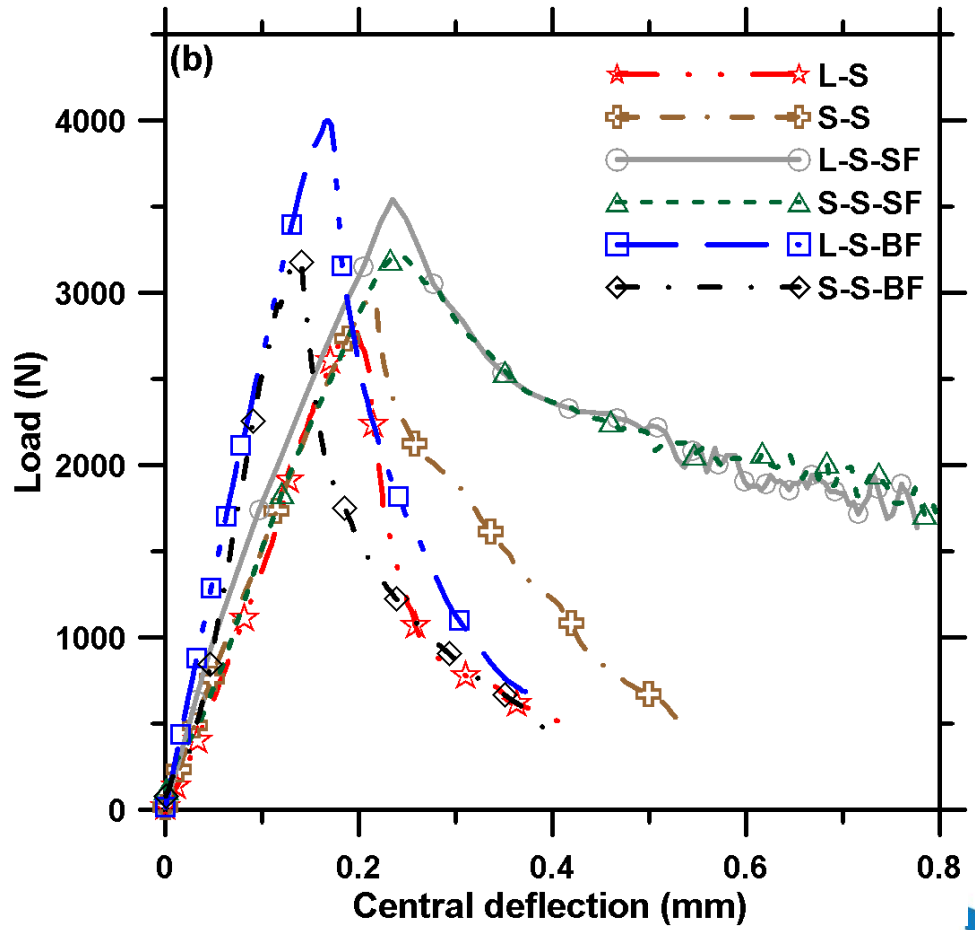
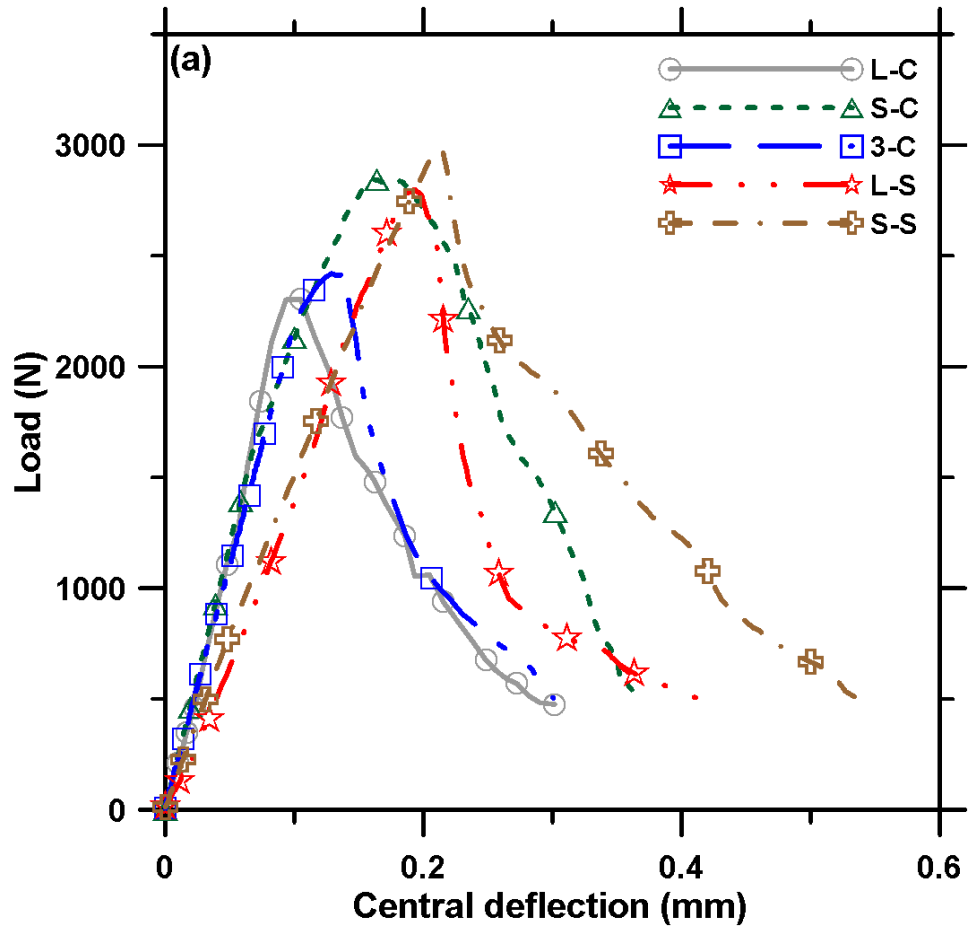
Linear Staggered (L-S)

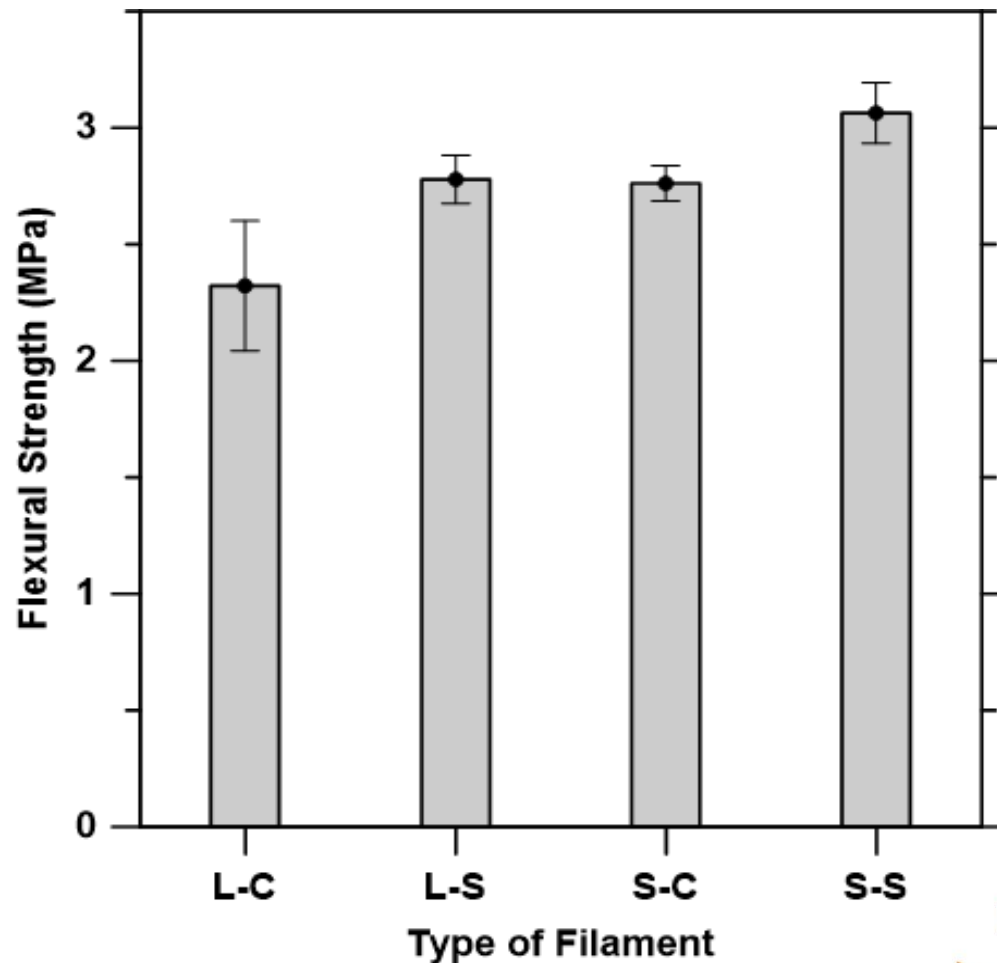
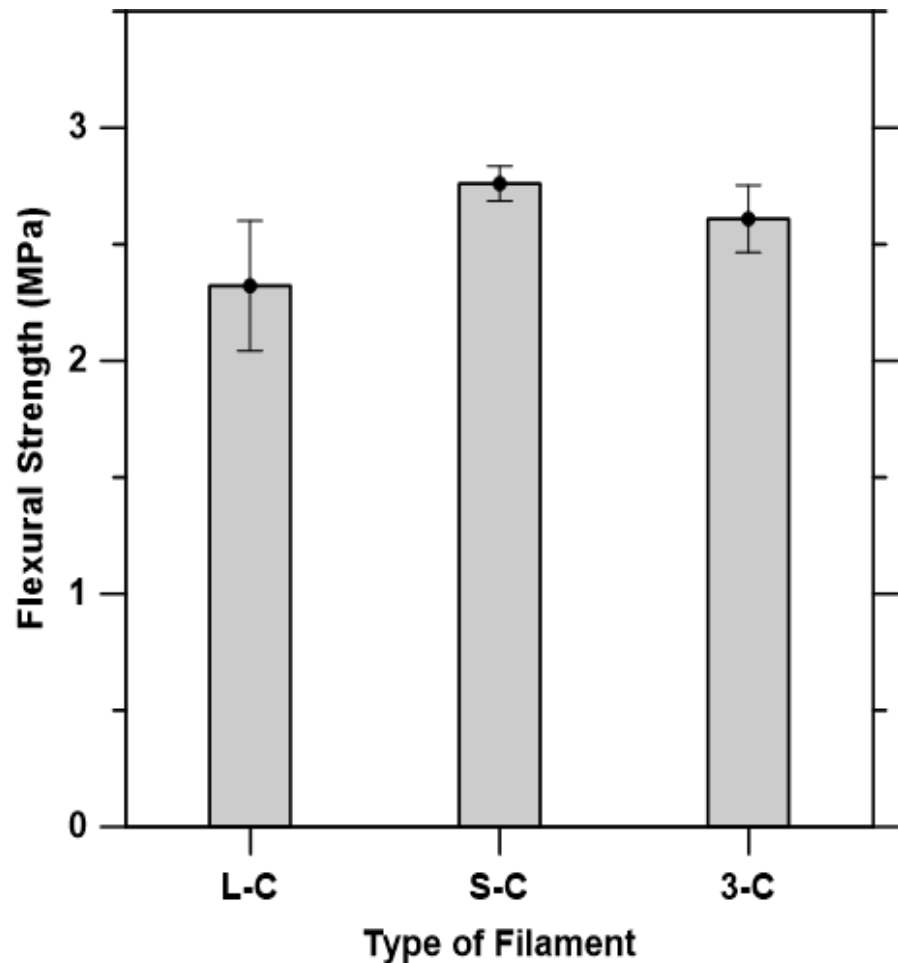


S-shaped Staggered (S-S)

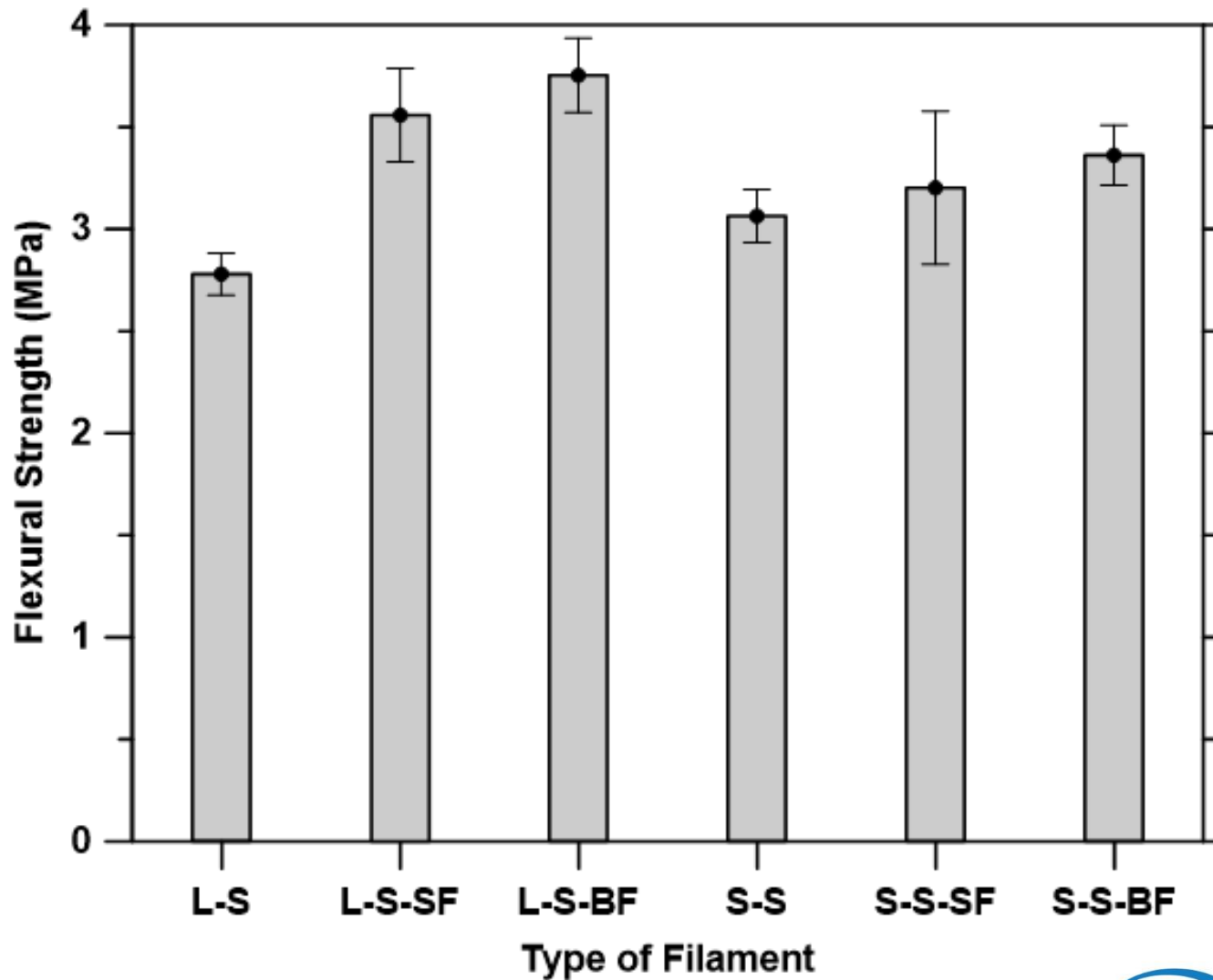






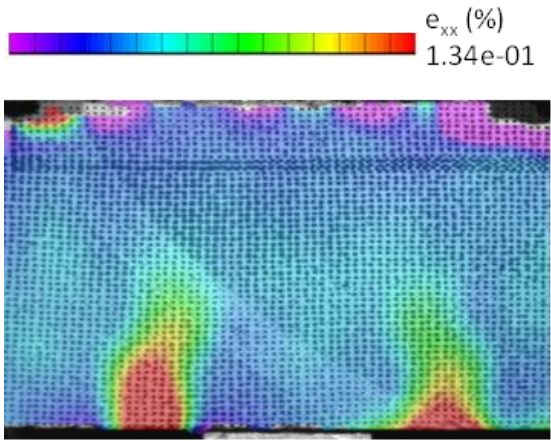




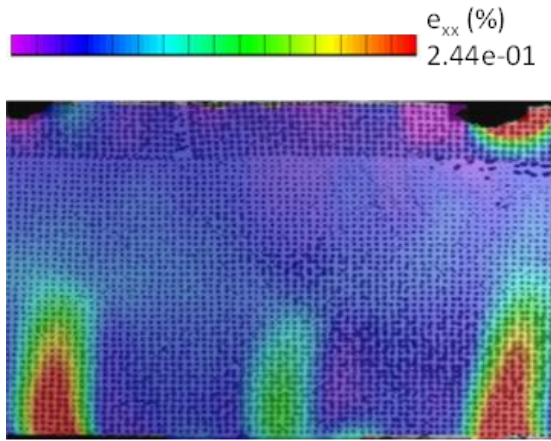




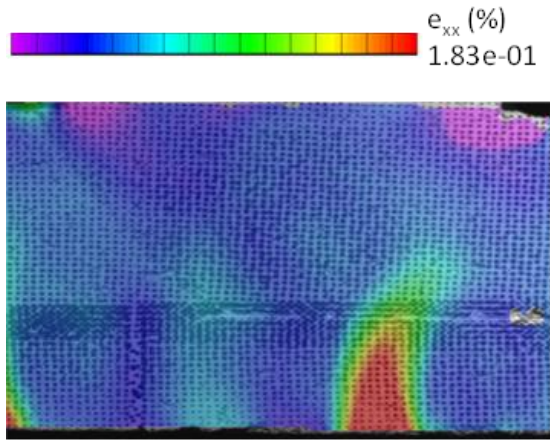
At peak load



Linear Conventional (L-C)

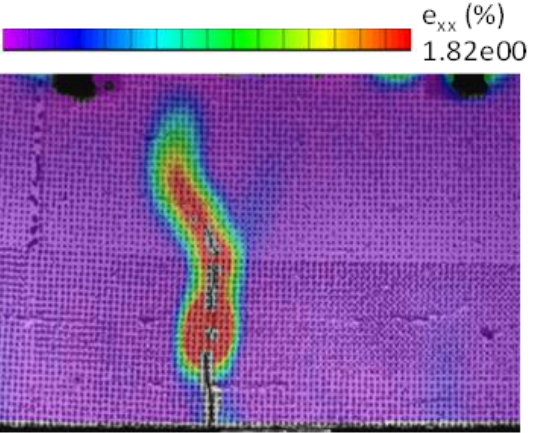


S-shaped Conventional (S-C)

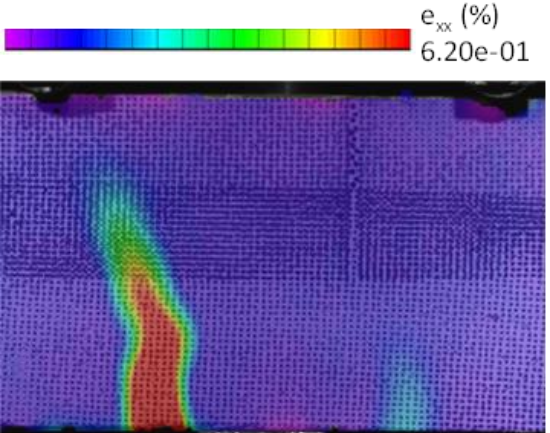


3-shaped Conventional (3-C)

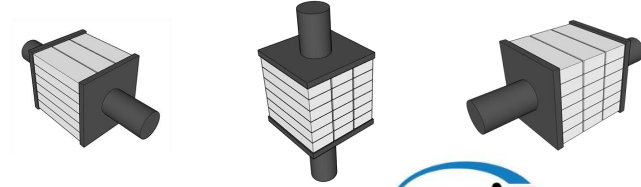
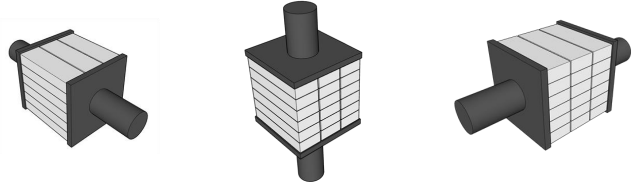
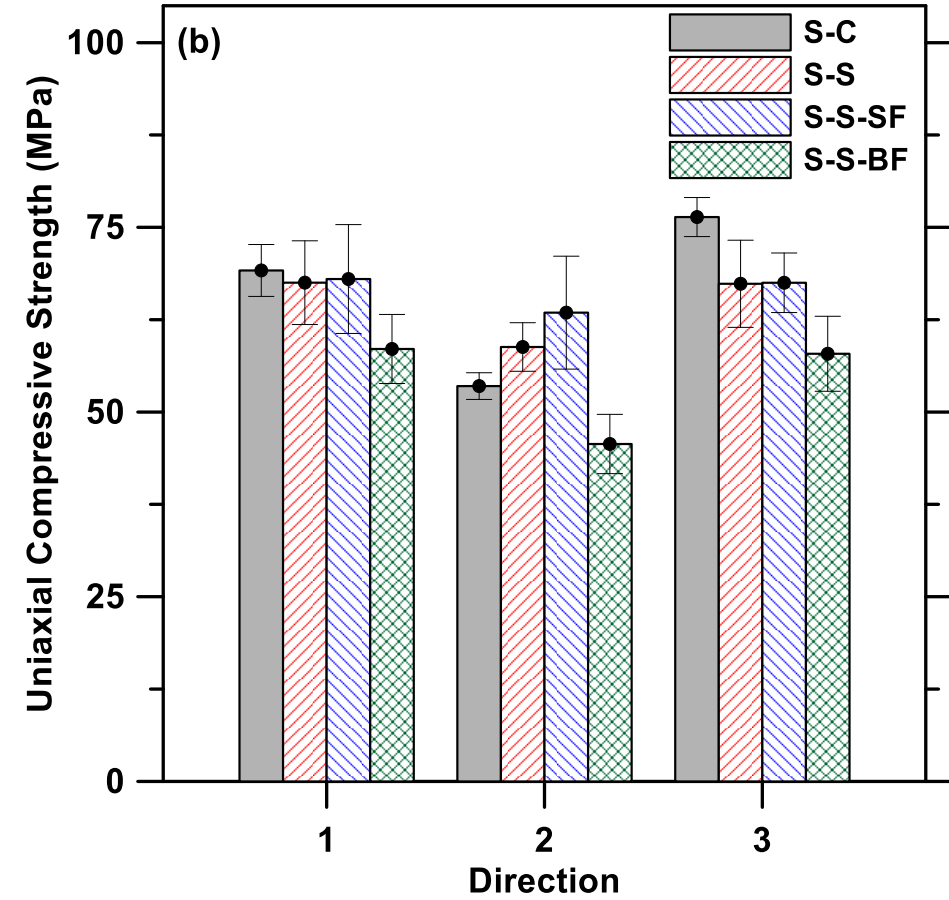
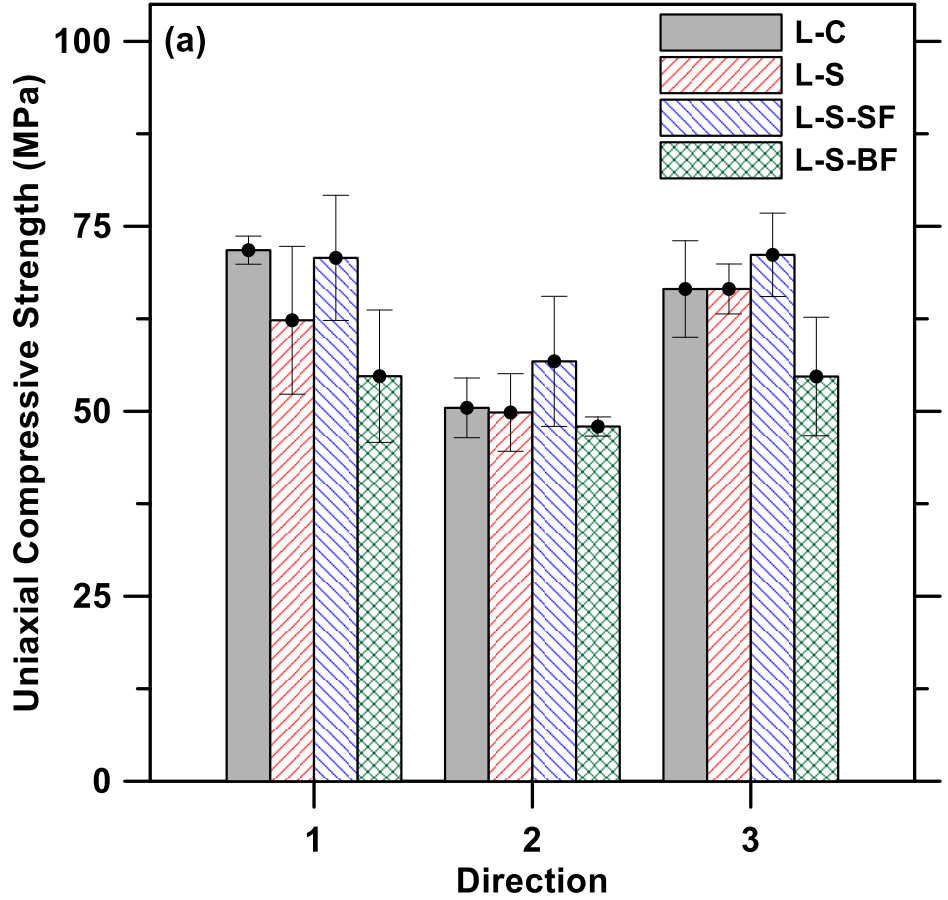
At 50% load reduction after peak

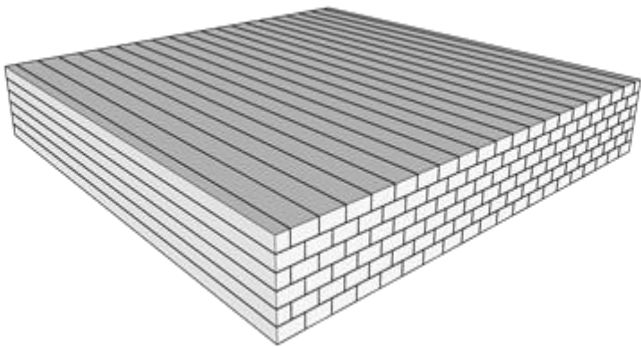


Linear Staggered Steel Fiber (L-S-SF)

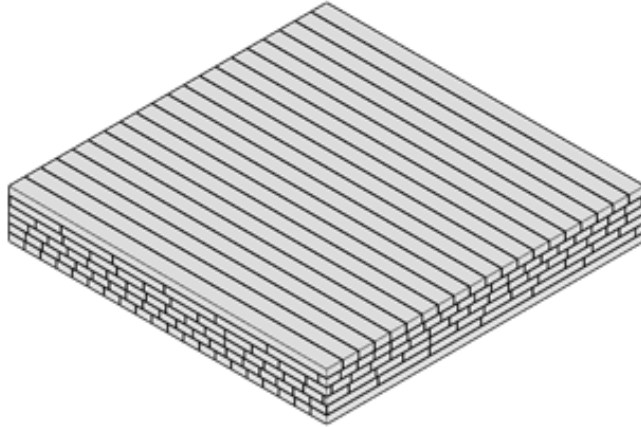


Linear Staggered Basalt Fiber (L-S-BF)



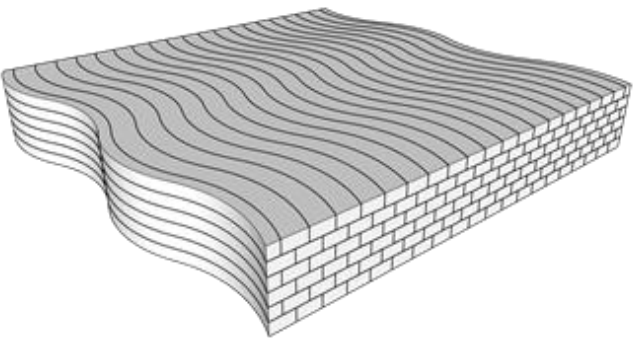


Linear Staggered (L-S)

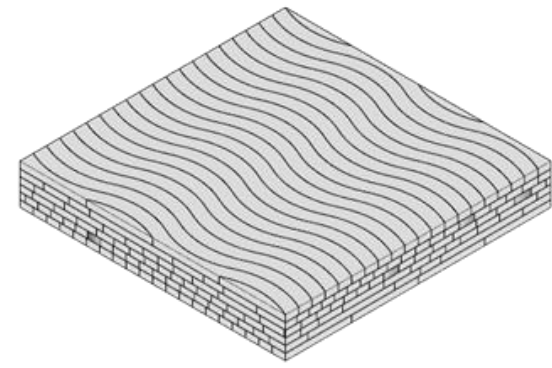


Linear [90/72/54/36/18/0]<sub>t</sub>

Top to bottom  
 $\Theta = 18^\circ$



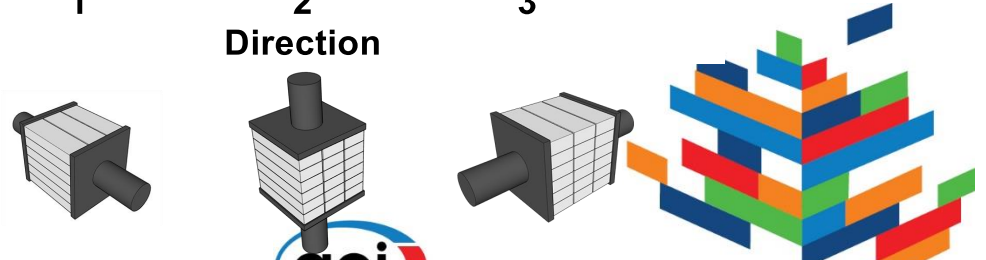
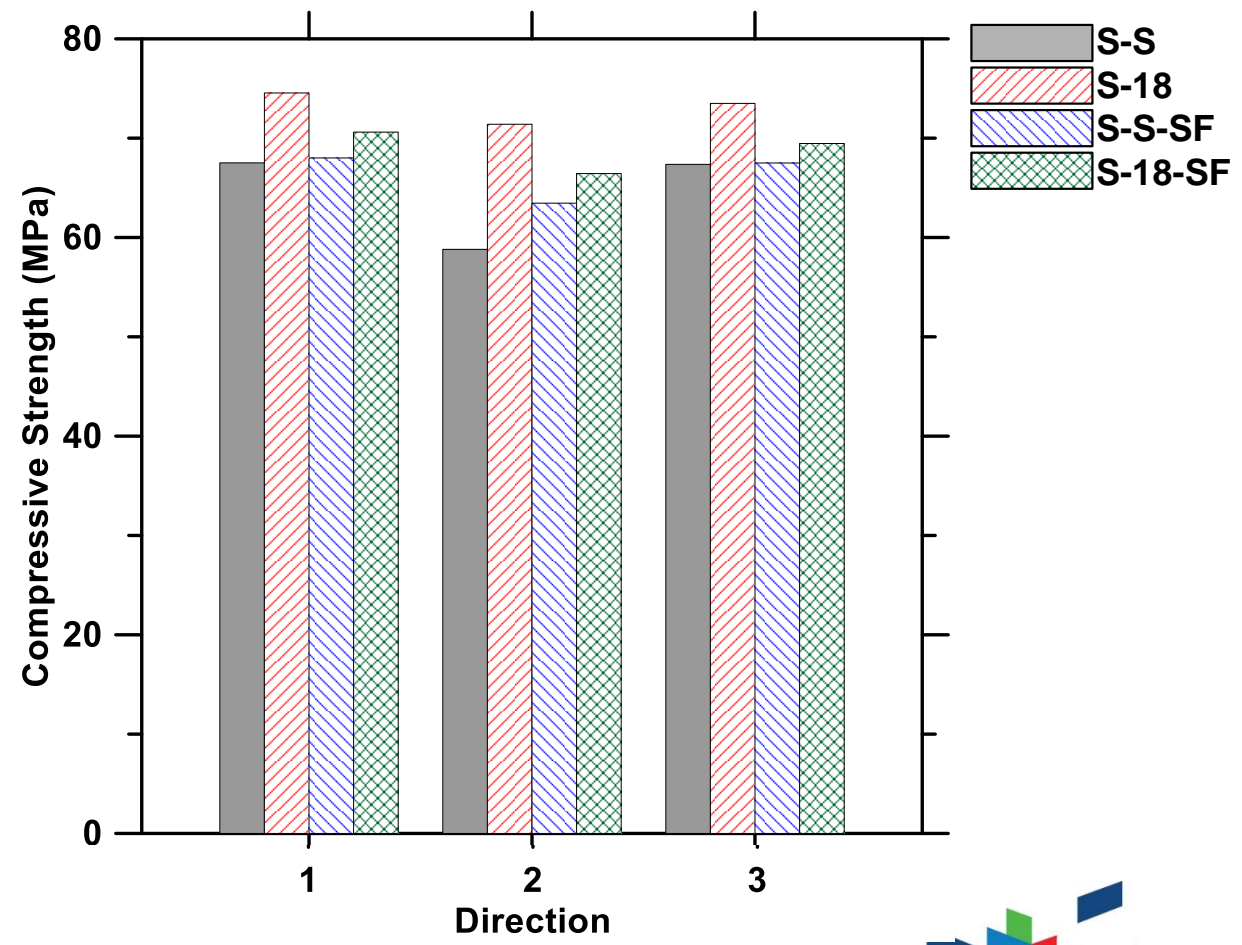
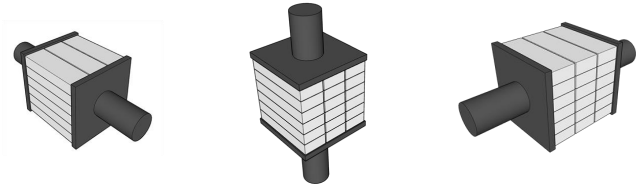
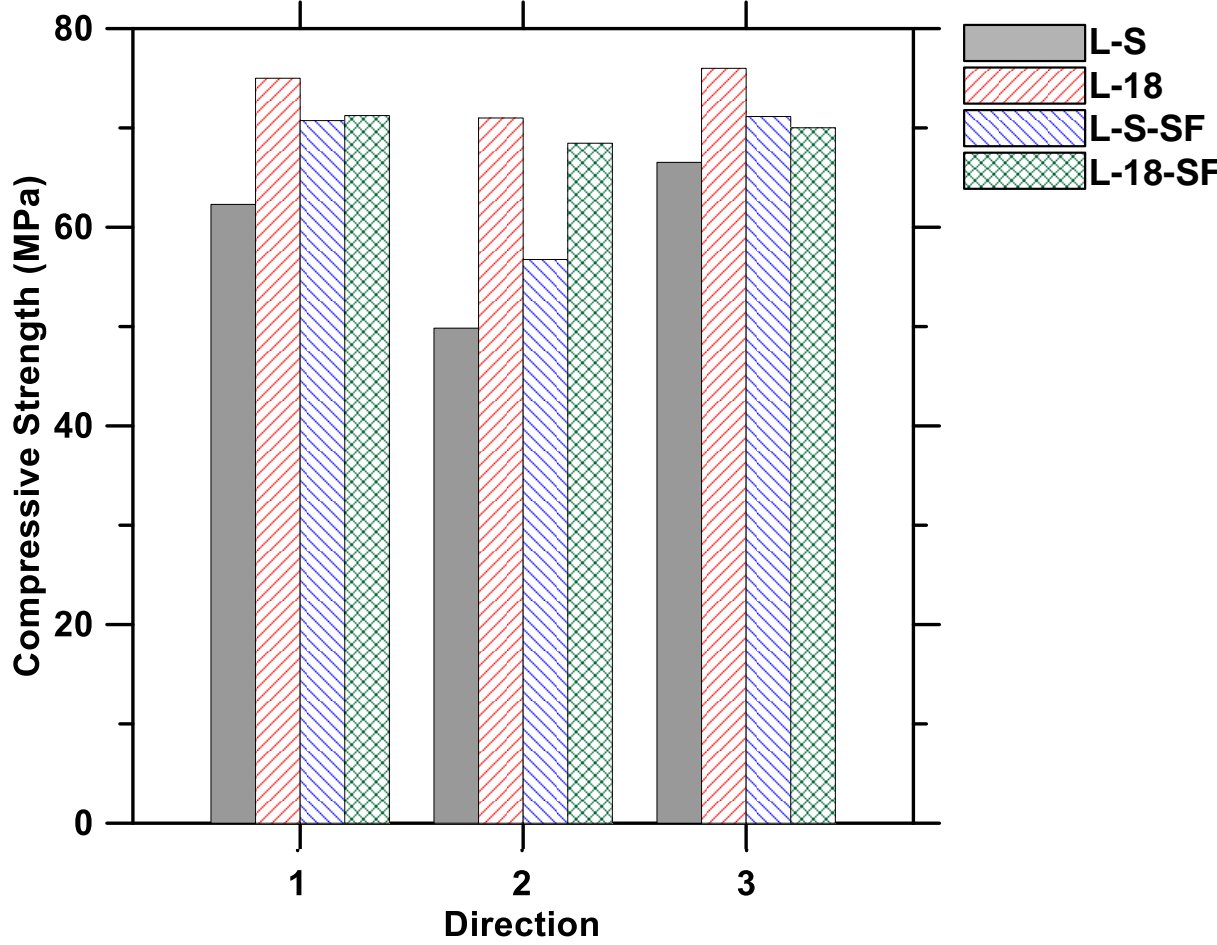
S-shaped Staggered (S-S)



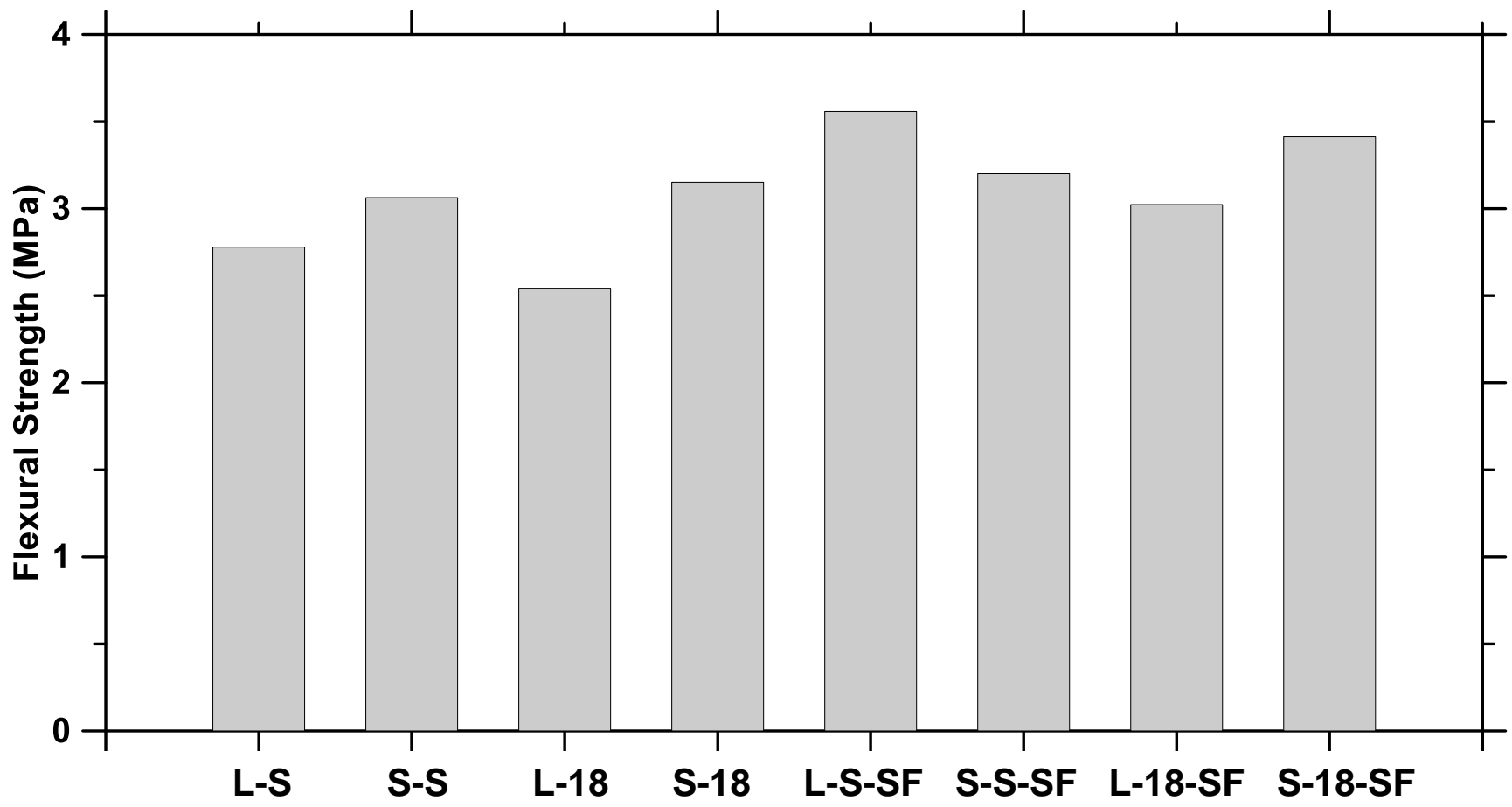
S-shaped [90/72/54/36/18/0]<sub>t</sub>





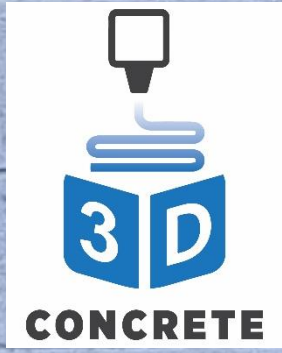








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An NSF AccelNet Collaborative Effort





# QUESTIONS?