

Cite this as: Li-feng Fan, Li-juan Wang, Guo-wei Ma, Peng-fei Li, Ming-jie Xia, 2019. Enhanced compressive performance of concrete via 3D-printing reinforcement. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, 20(9):675-684. <https://doi.org/10.1631/jzus.A1900135>

Enhanced compressive performance of concrete via 3D-printing reinforcement

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Key words: 3D-printing; Carbon-nanotube shaped reinforcement;
Latitude and longitude reinforcement; Reinforced concrete

Background



Seismic damage



Thermal cycling



Chemical corrosion



Loading damage



Traditional latitude and longitude reinforcement (LLR)

**Rectangular element is
not perfect for stress distribution
in the concrete**

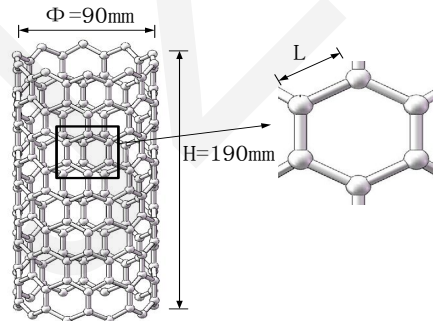
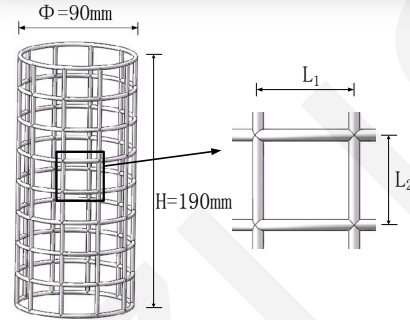
3D-printing Technology

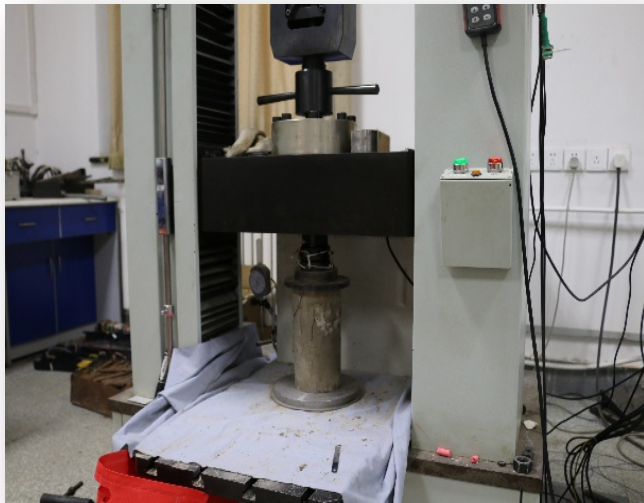


Traditional latitude and longitude reinforcement (LLR)



Carbon-nanotube shaped reinforcement (CSR)





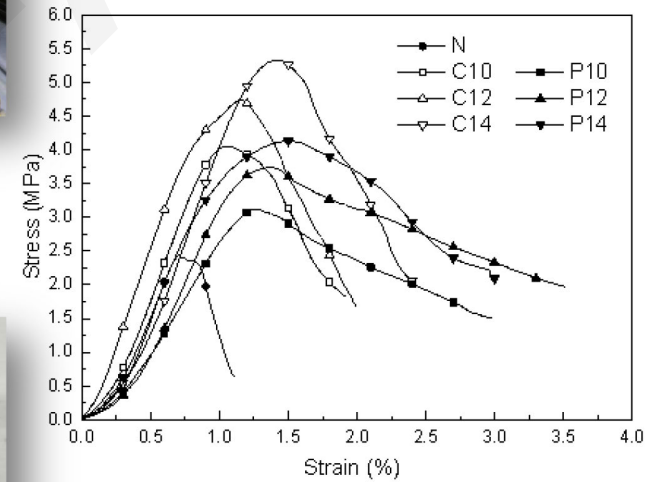
**Unconfined
compressive test**



Samples

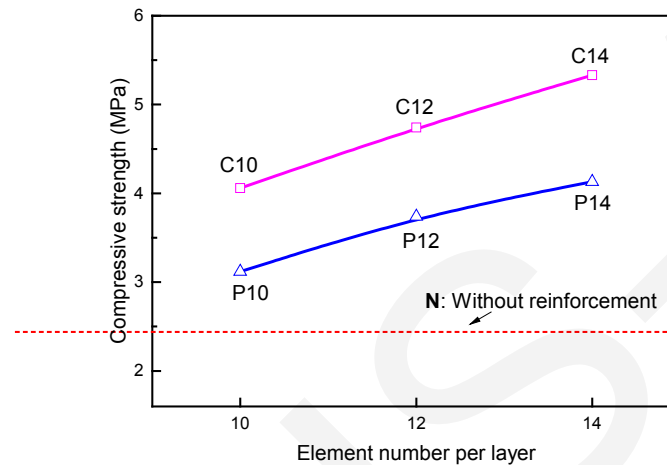


**Unreinforced samples
for comparison**



Test results

Results and discussion

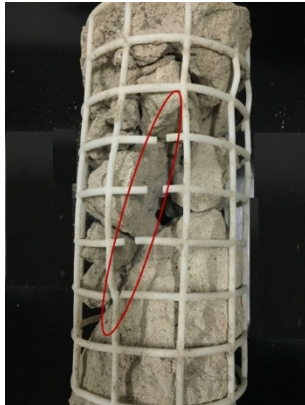


- ❑ The strength of the CSR reinforced specimen with 10, 12 and 14 elements per layer increases by 59.77%, 85.94% and 108.98% compared with the unreinforced specimen
- ❑ The strength of the LLR reinforced specimen with 10, 12 and 14 elements per layer increases by 24.22%, 46.88% and 68.75% compared with the unreinforced specimen

CSR is higher efficiency in compressive strength improvement than LLR

Results and discussion

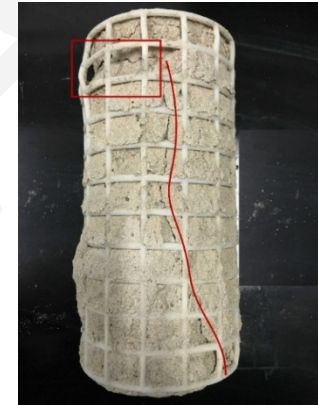
$n = 10$



$n = 12$



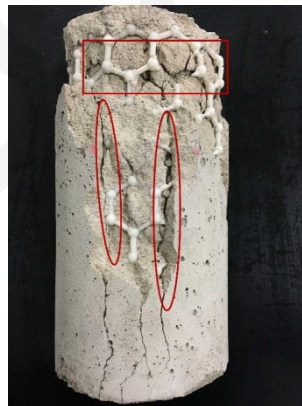
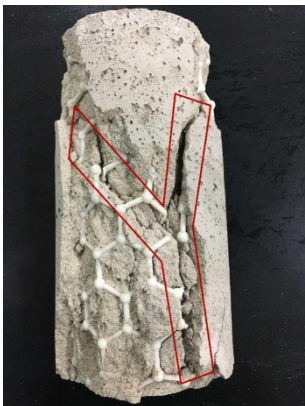
$n = 14$



LLR

Global failure + Dominate through crack

CSR



Global failure + Dominate through crack

Partial failure

- ❑ The mechanical properties of specimens with reinforcement are much better than those of specimens without reinforcement.
- ❑ The strength and toughness of specimens with reinforcement increase constantly with the increase of the reinforcement ratio in the appropriate reinforcement ratio range.
- ❑ The strength of specimens reinforced by CSR is greater than that of specimens reinforced by traditional LLR when the reinforcement ratios are close.

Thanks a lot!

