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Frozen sand–concrete interface direct shear behavior under constant normal load and constant normal height boundary

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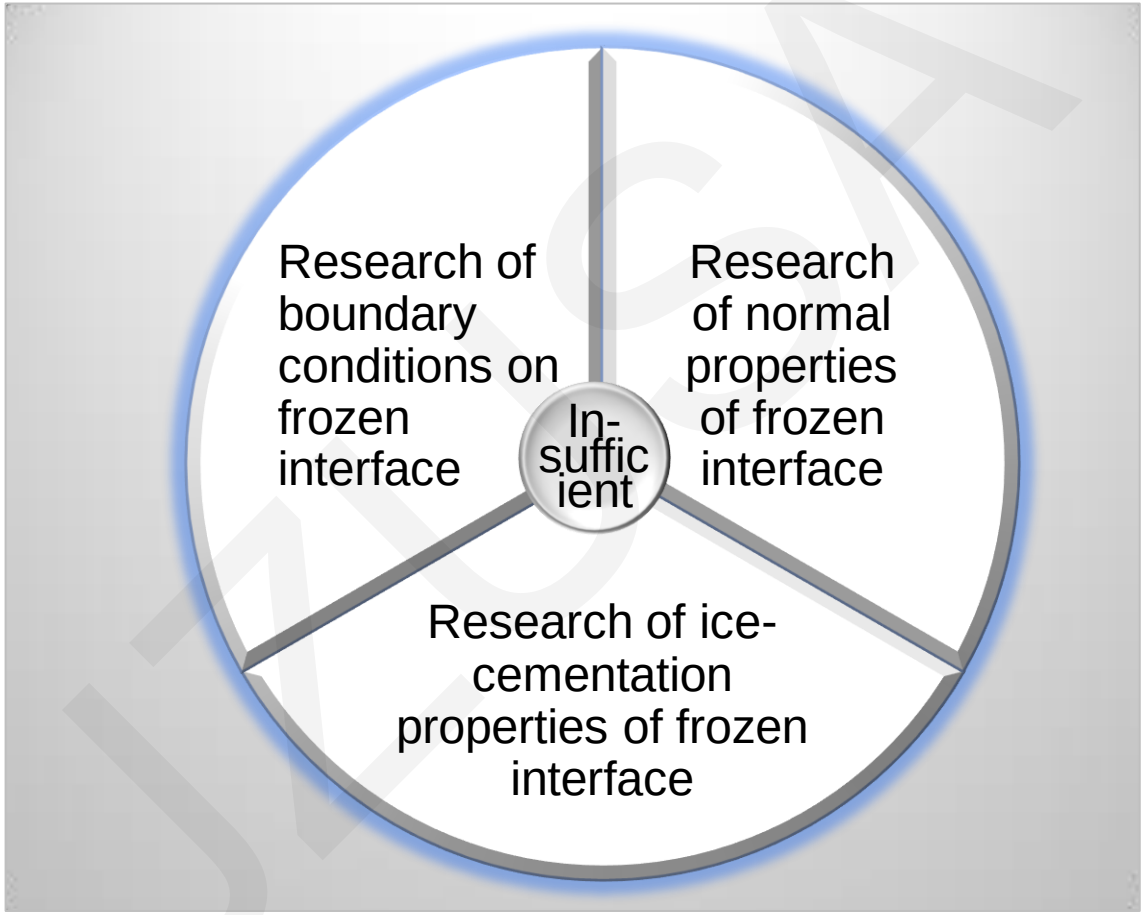
Research background



Test Case

Boundary conditions	Initial normal stress σ_n (kPa)	Temperature T (℃)	Moisture content (%)
Constant normal stress	100	-2	Saturated
	200	-5	
Constant normal height	300	-8	

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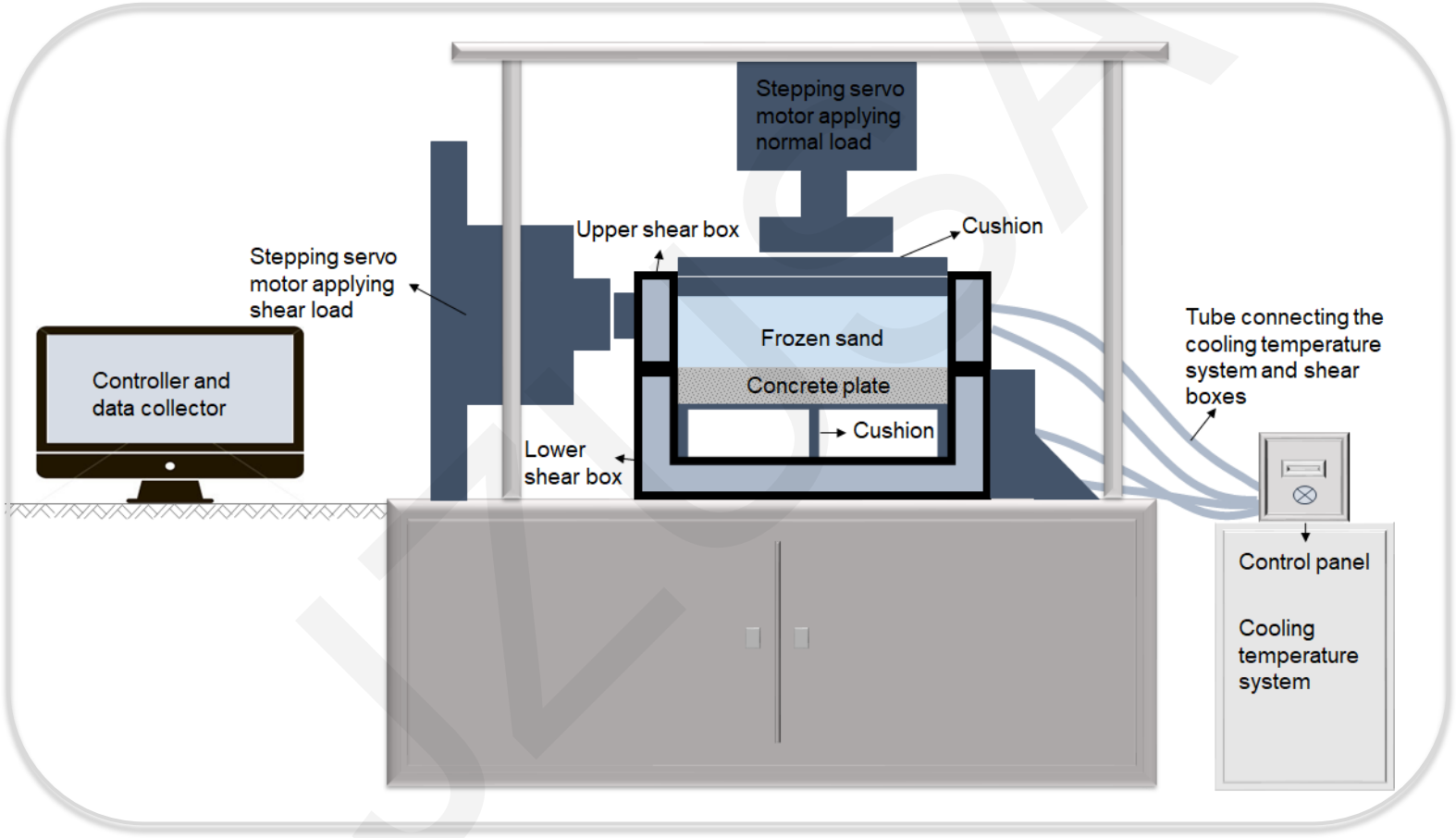
Test apparatus



Conclusion

- The development trends of shear stress-shear displacement under CNL and CNH were similar. The shear stress-shear displacement relationship displayed a significant softening at negative temperatures. Lower temperature and higher normal stress resulted in an increasing degree of strain softening.
- The normal stress-shear displacement relationship under CNH was dependent on the normal stress and temperature. The feature points were more apparent with higher normal stress and lower temperature.
- The elastic shear modulus showed a linear increase with decreasing temperature and increasing normal stress.
- The peak shear stress and critical shear stress showed a linearly increasing trend with increasing normal stress, which could be described by the Mohr-Coulomb failure criterion under CNL and CNH. The temperature had an appreciable effect on the cohesion of the peak shear stress and the friction coefficient of the critical shear stress.
- Under CNL and CNH, the value and percentage of peak ice-cementation in peak shear stress increased with decreasing temperature. The value of peak ice-cementation increased with increasing normal stress. Nevertheless, the percentage of peak ice-cementation in peak shear stress decreased with increase in the normal stress.
- The peak shear stress and ice-cementation were higher, and the critical shear stress was lower under CNH.