TRANSLUCENT CONCRETE:

MECHANICAL PROPERTIES AND ILLUMINANCE

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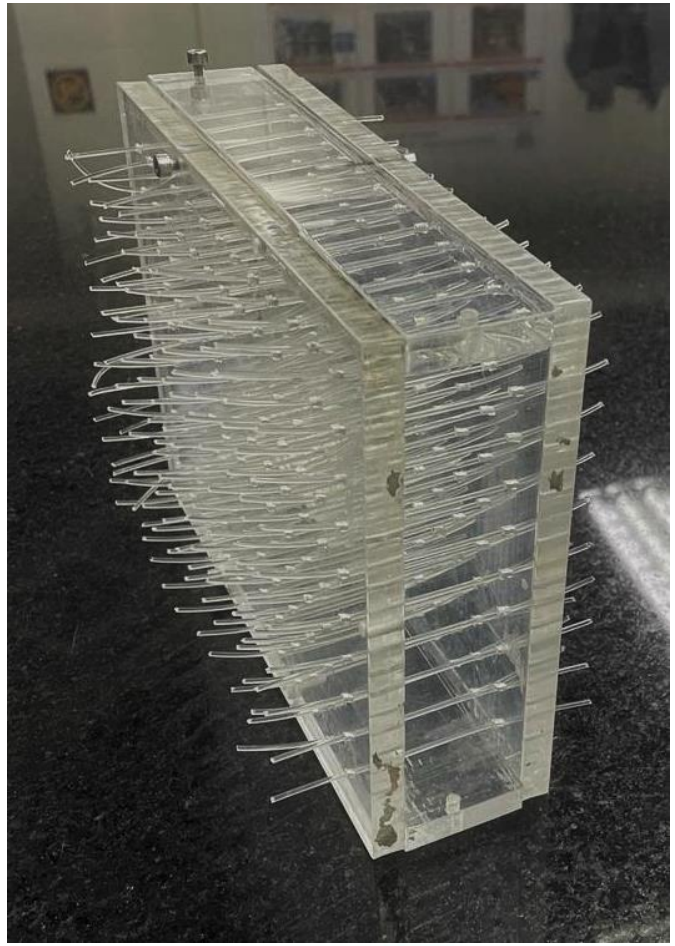
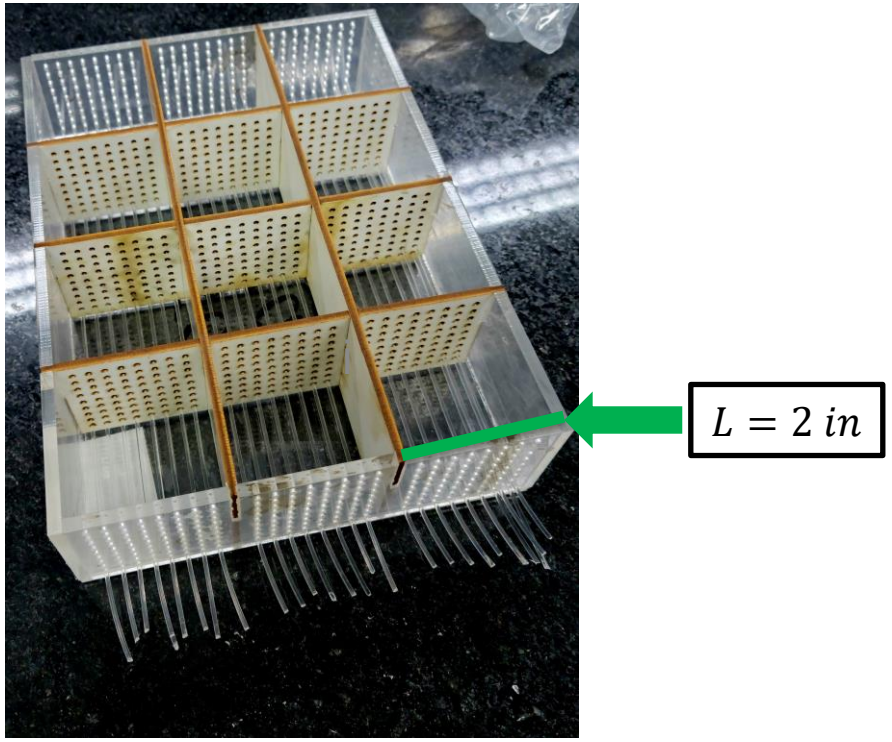
Objetives

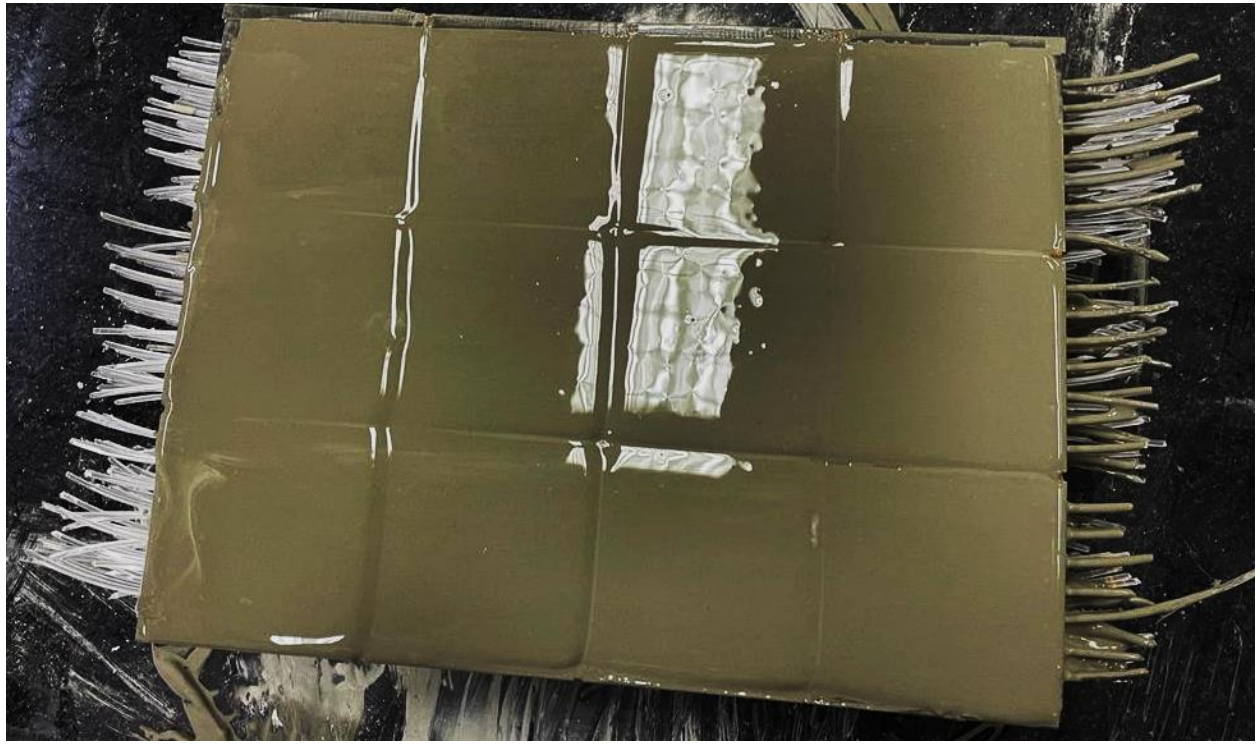
- Design a cement paste mixture embedded with different volumes of plastic optic fibers
- Design and make formwork for cubical and cylindrical specimens
- Measure uniaxial compressive strength, f'_{cr}, dynamic modulus of elasticity, E_{dyn}, and illuminance on plastic fiber optic cement paste specimens.



Methodology – Compressive Strength



(a)

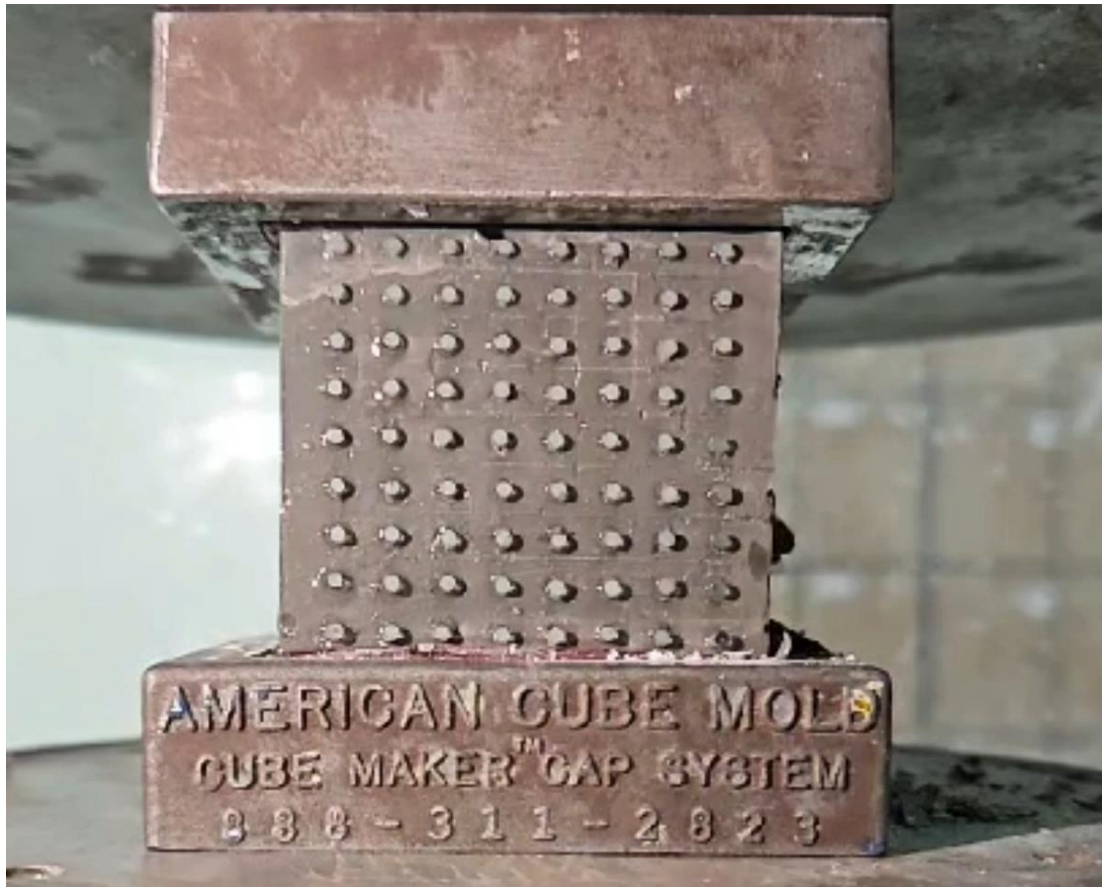


(b)

(a) Acrylic formwork for 12 cubic specimens with dimensions, $L = 2$ in – Cement and Concrete Lab. USFQ, (b) Casting cubes with cement paste w/c=0.45

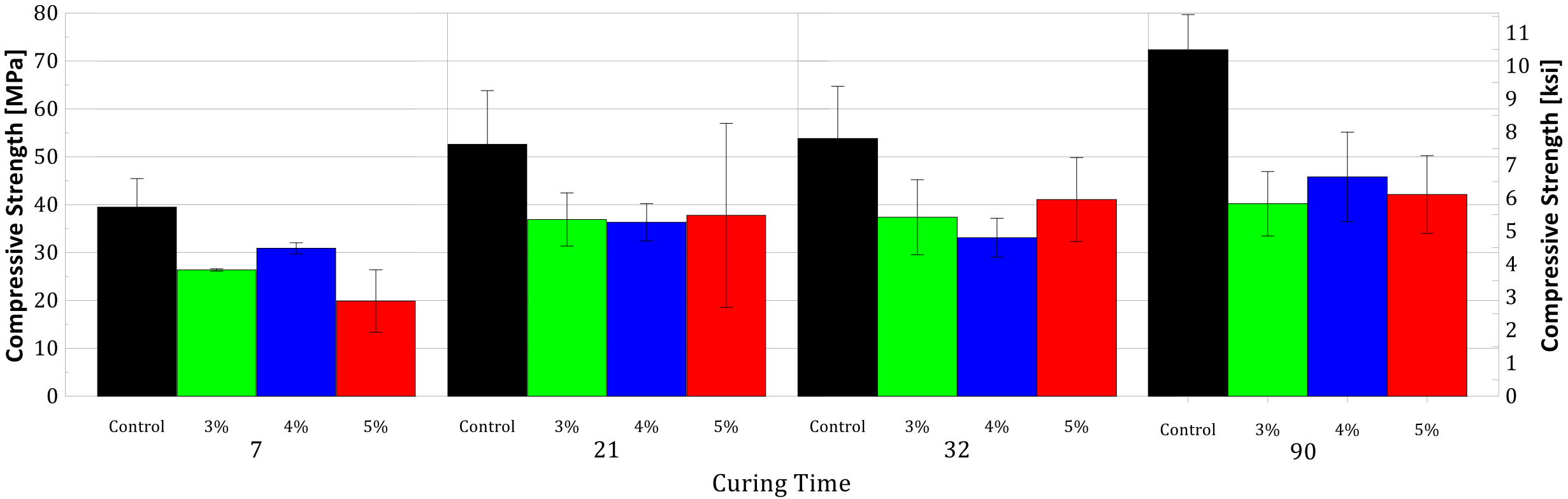
Methodology – Compressive Strength

Compressive strength setup with 3000kN capacity load and displacement controlled.

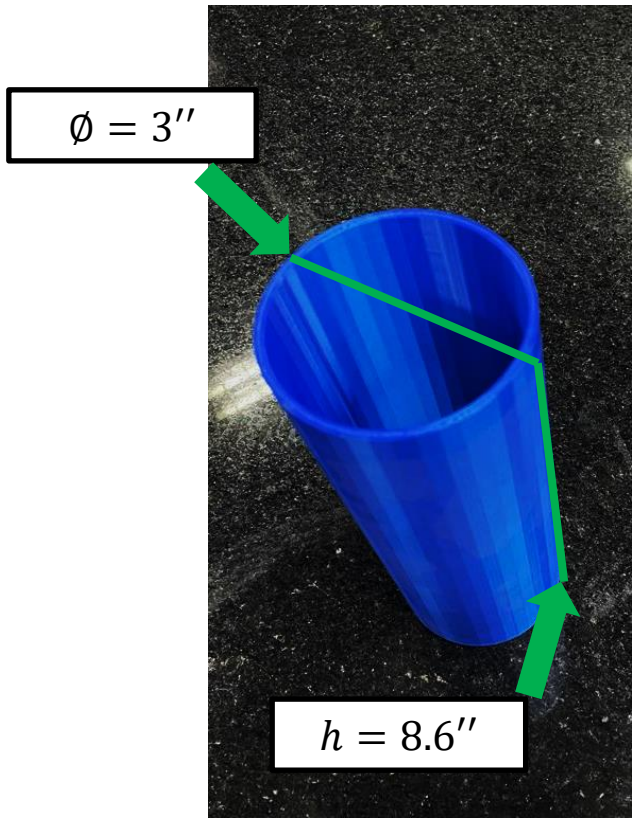


Compressive strength test with a cubical specimen with 5% of plastic optic fiber

Results – Compressive Strength

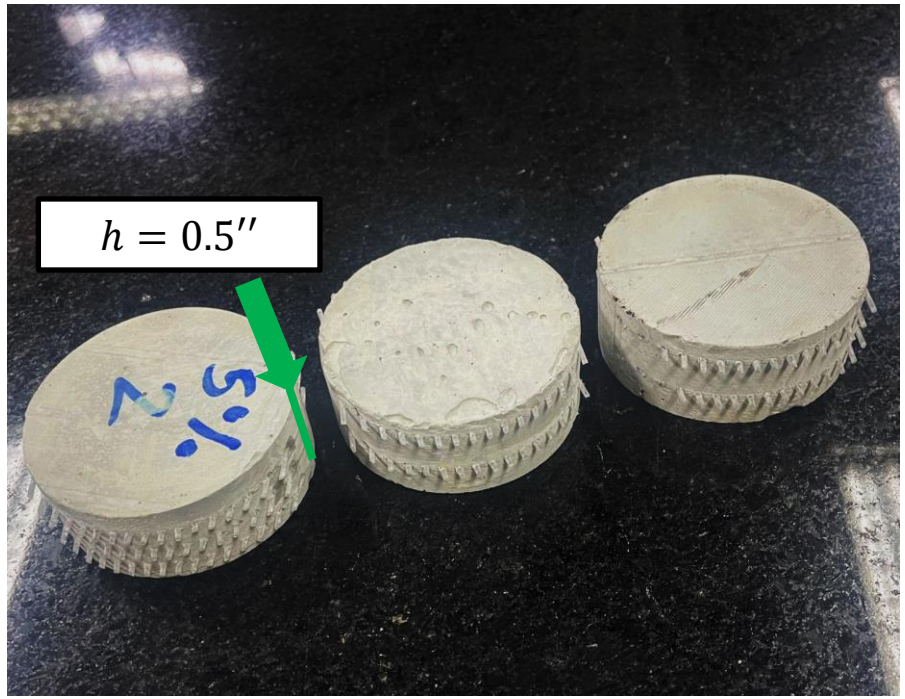


Methodology – Dynamic Modulus of Elasticity, E_{dyn}



(a)

(b)



(c)

a) 3D printed cylindrical formwork with dimensions $\emptyset = 3"$ and $h = 8.6"$ b) Drilling holes for plastic fiber optic to go through c) Disk shaped samples with dimensions $\emptyset = 3"$ and $h = 0.5"$

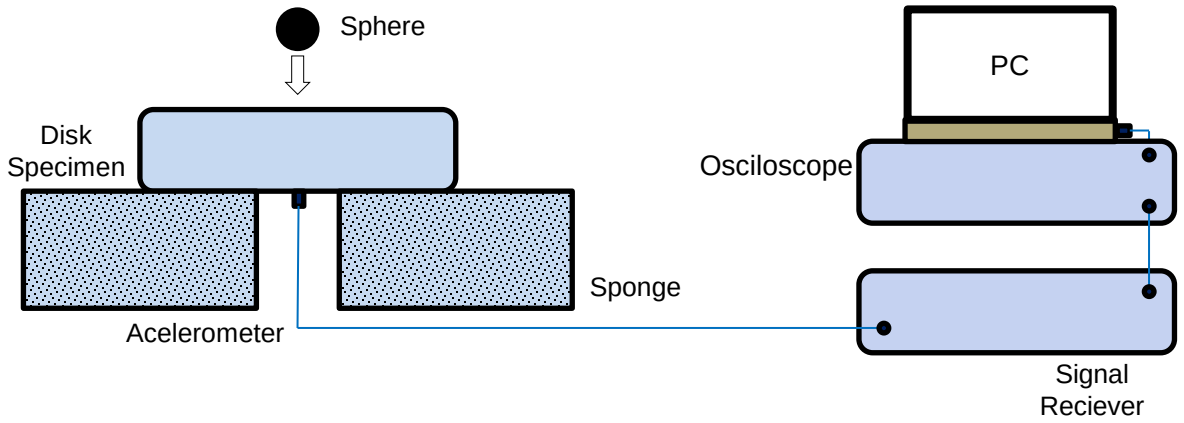
Methodology – Dynamic Modulus of Elasticity, E_{dyn}

- Hutchinson (1979)
- Michael Lemming, James Nau y J. Fukuda (1998)
- Juan José Recalde (2005)
- Reza Rashetnia (2016)

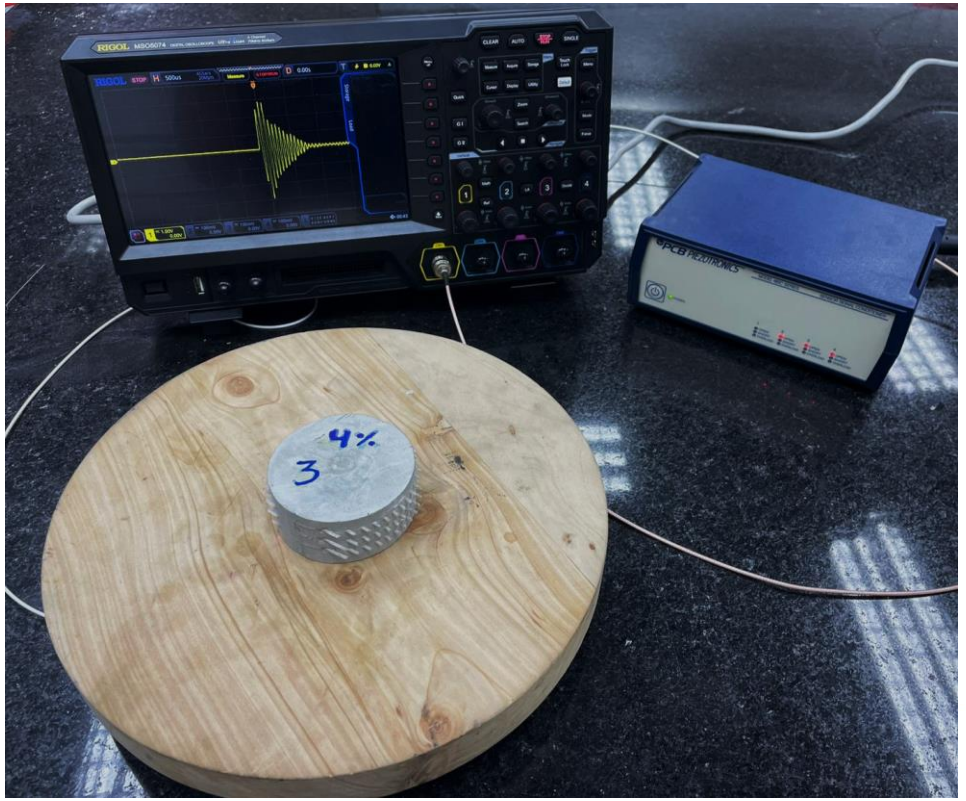
Source: Pixabay, 2014

Waves generated from an object dropped in a mass of calm water

Methodology – Dynamic Modulus of Elasticity, E_{dyn}

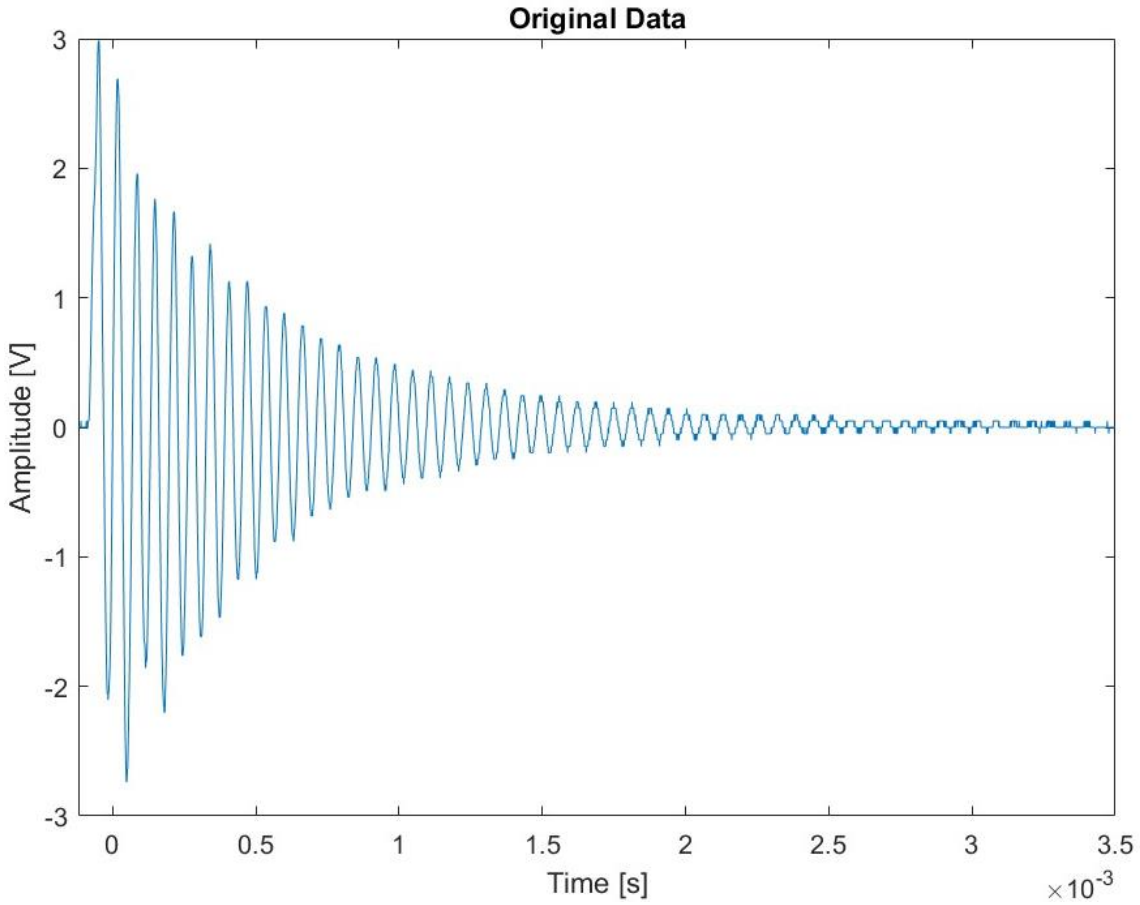


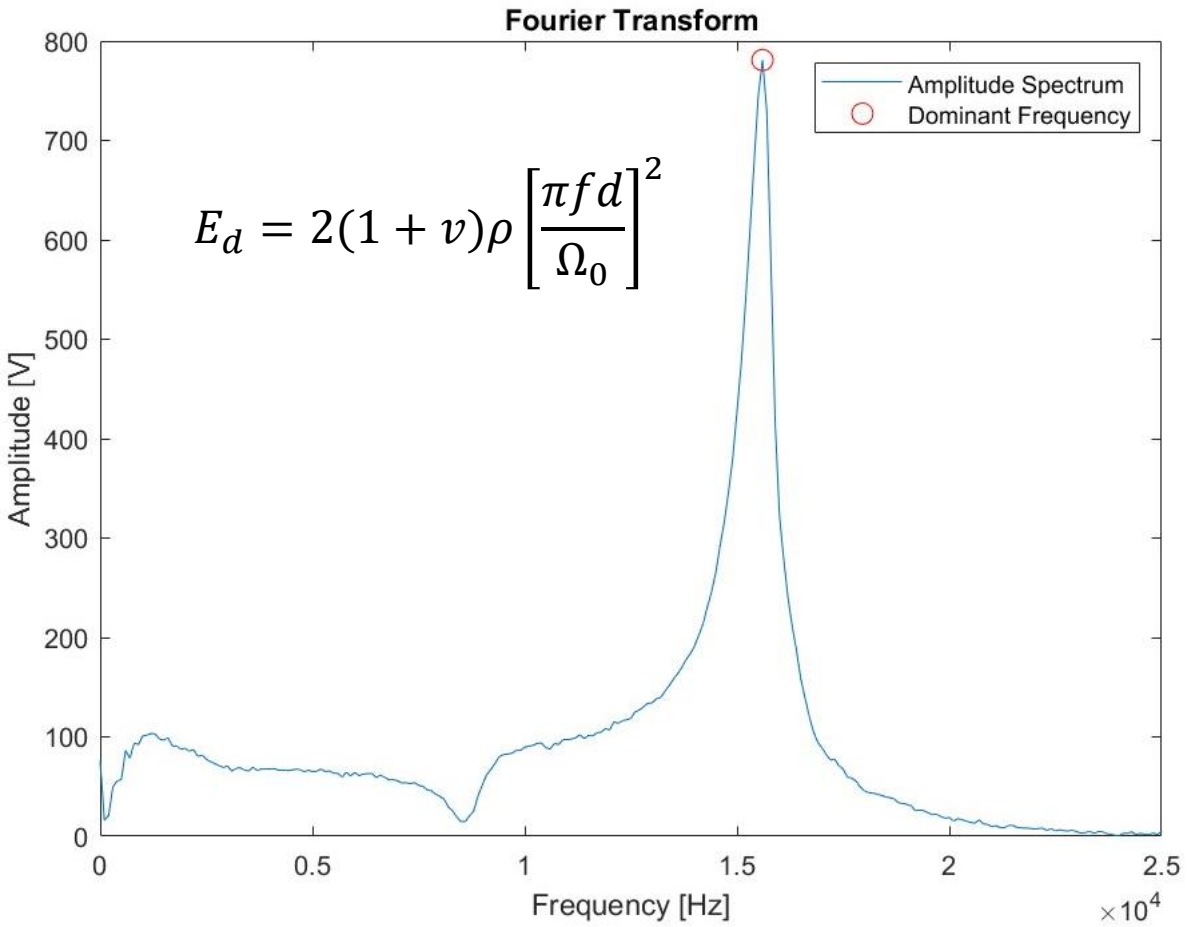
Dynamic Modulus schematics



Dynamic Modulus Setup

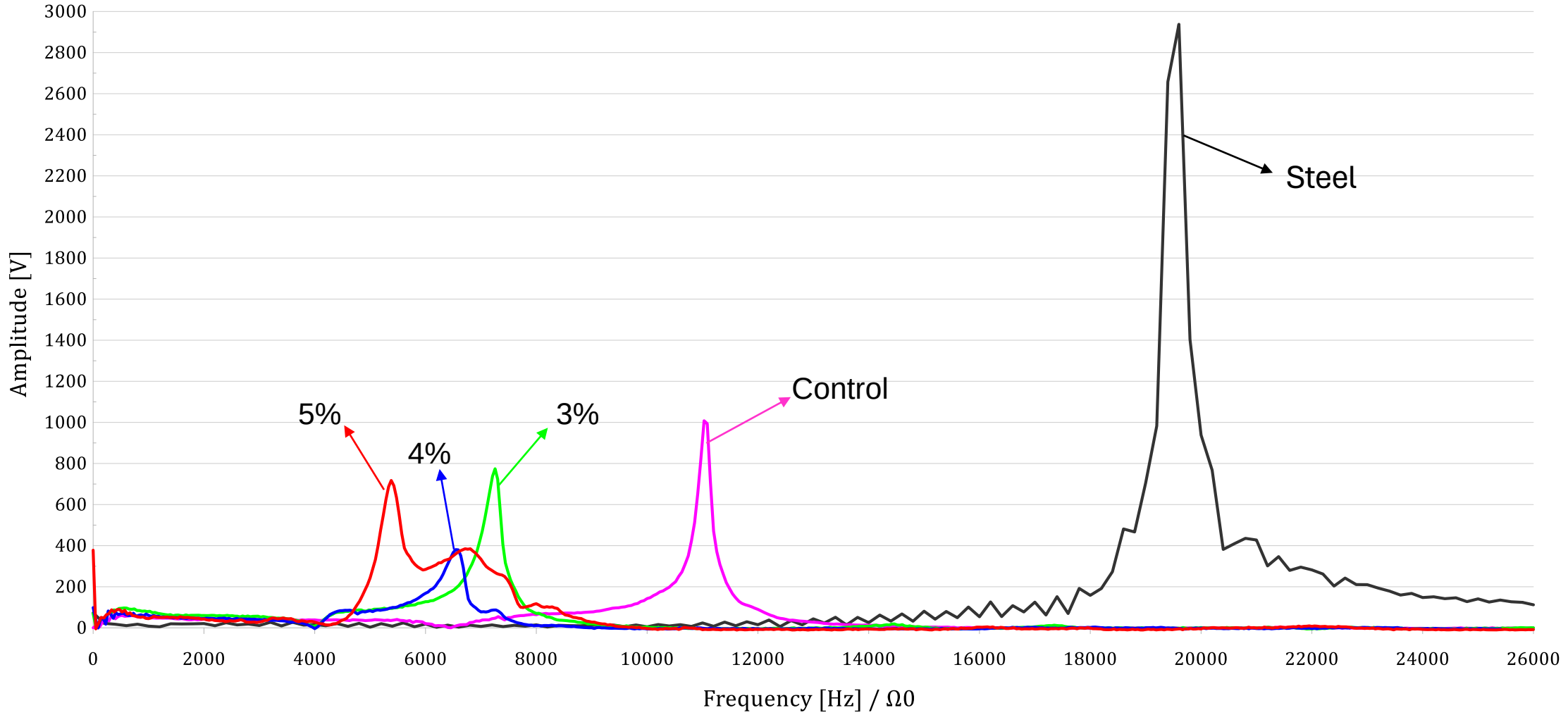
Results – Dynamic Modulus of Elasticity, E_{dyn}



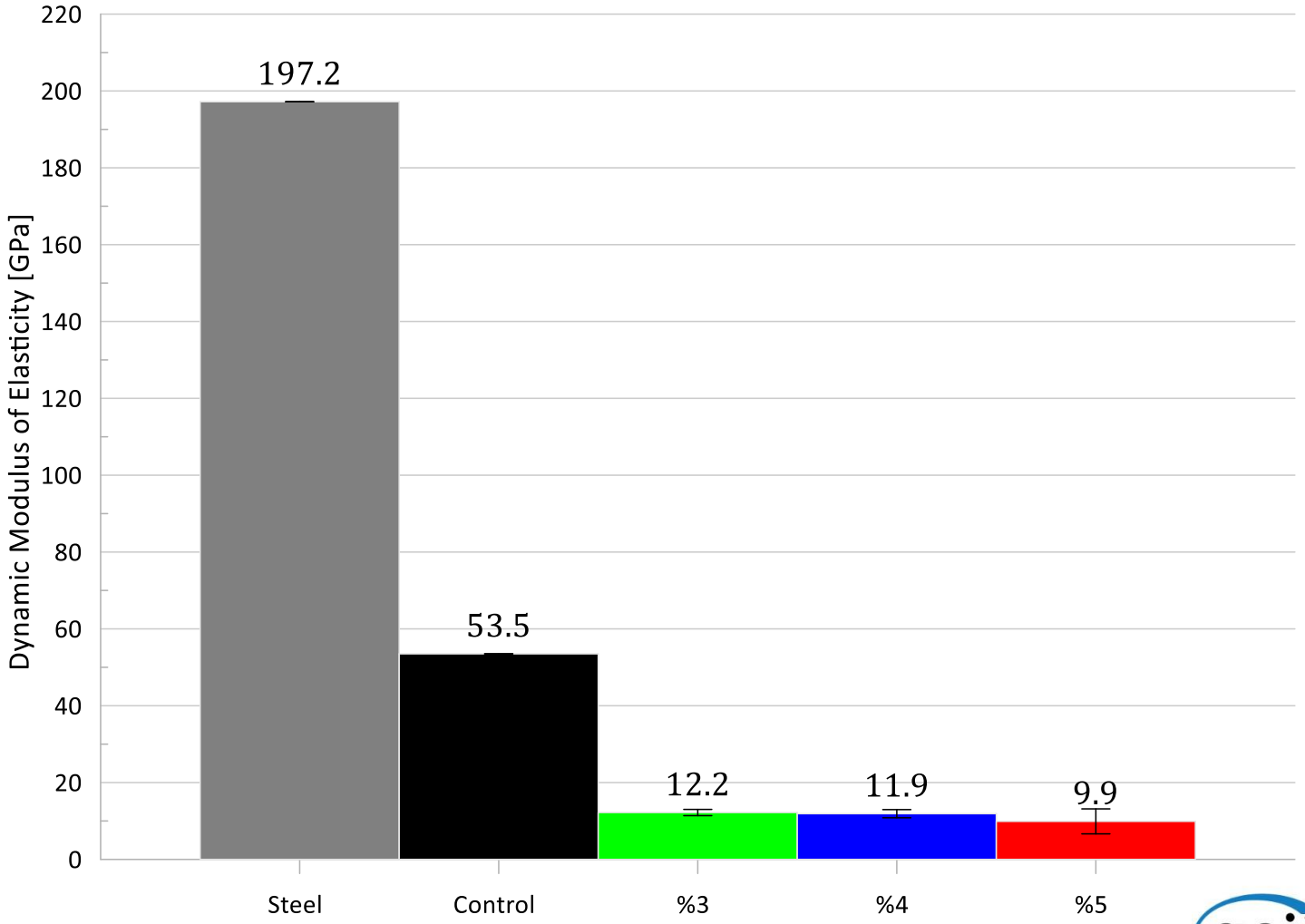


$$E_d = 2(1+v)\rho\left[\frac{\pi f d}{\Omega_0}\right]^2$$

Results – Dynamic Modulus of Elasticity, E_{dyn}

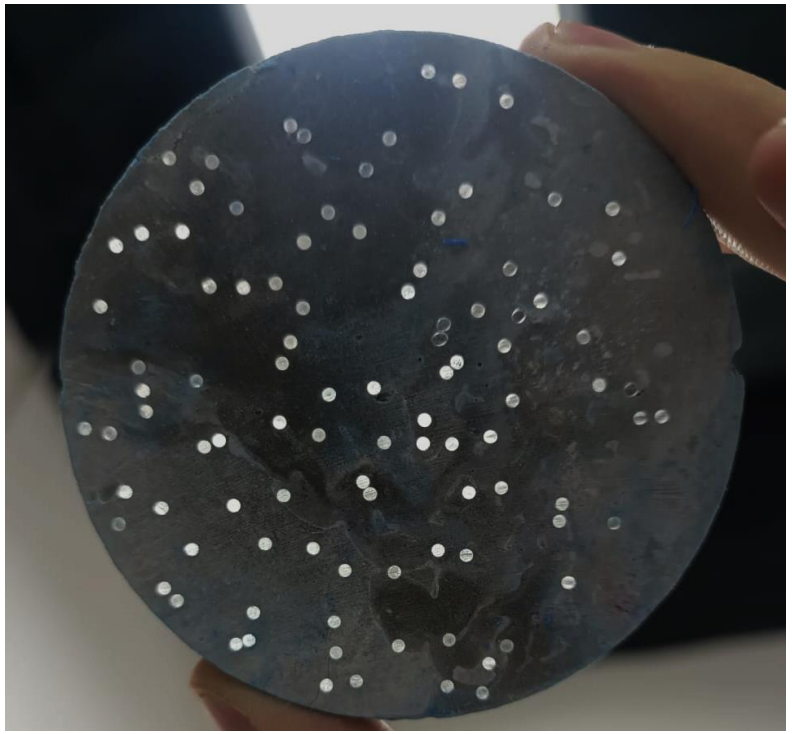


Results – Dynamic Elasticity Modulus

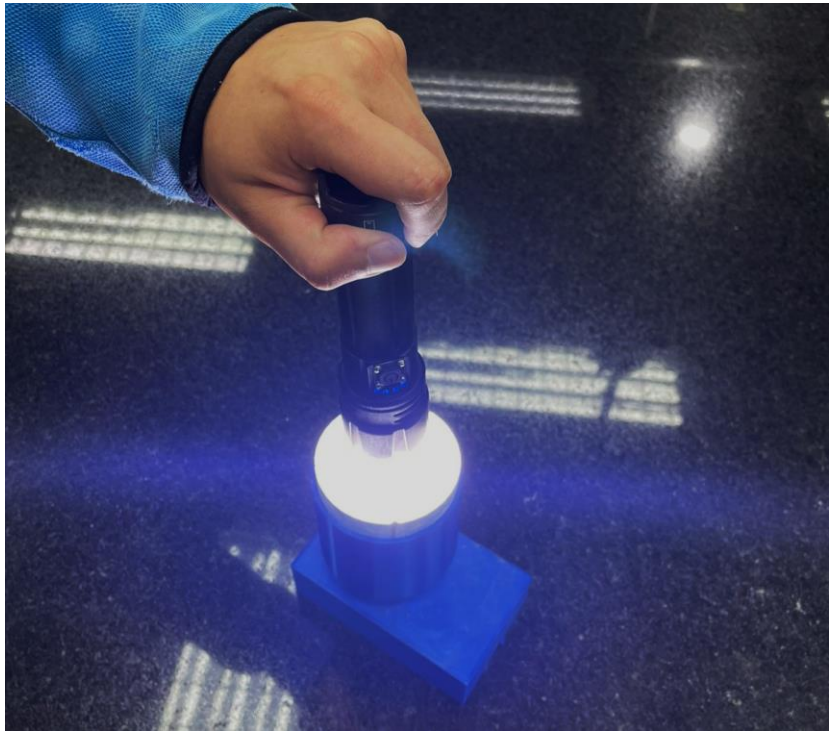


Methodology – Illuminance

(a)



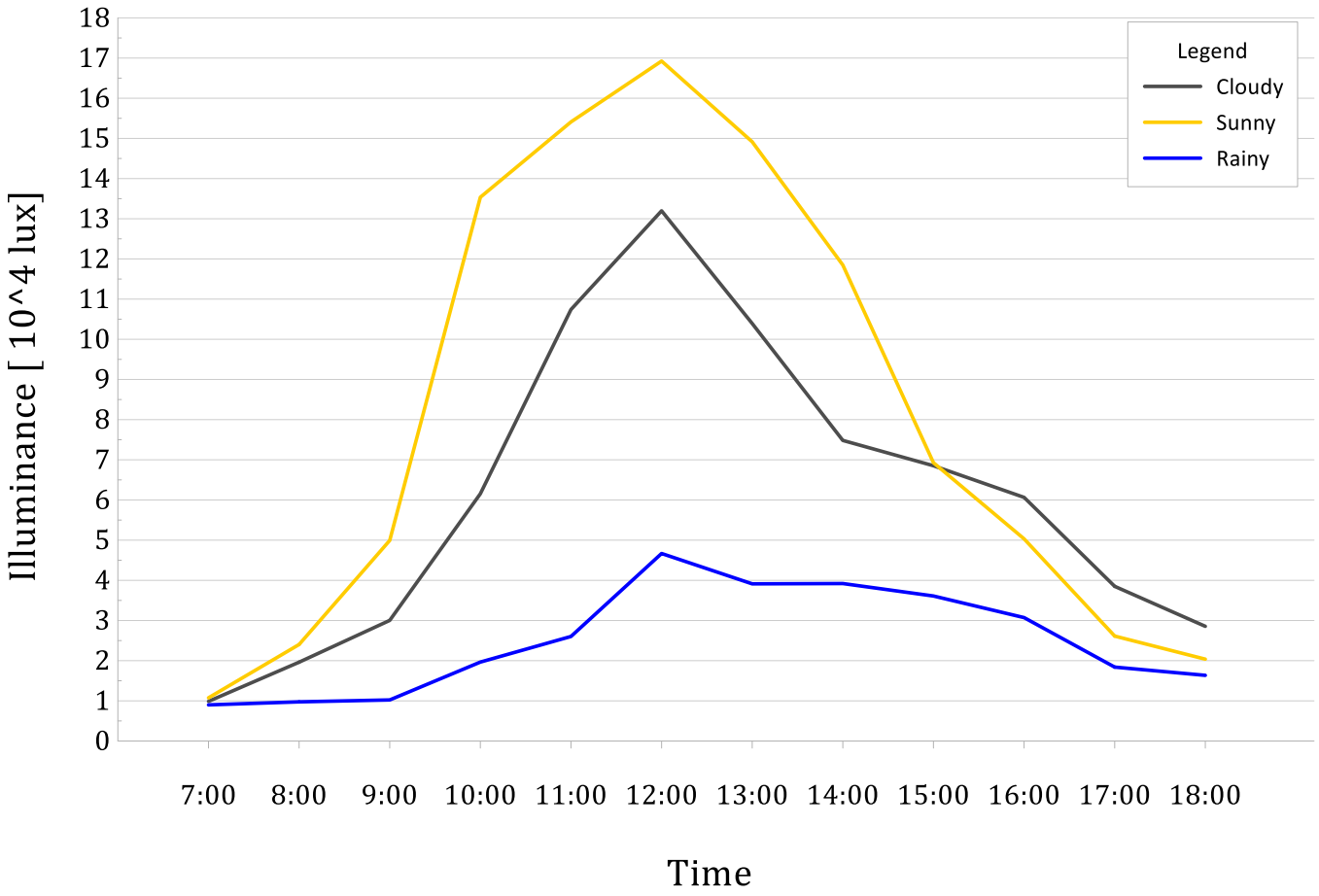
(b)

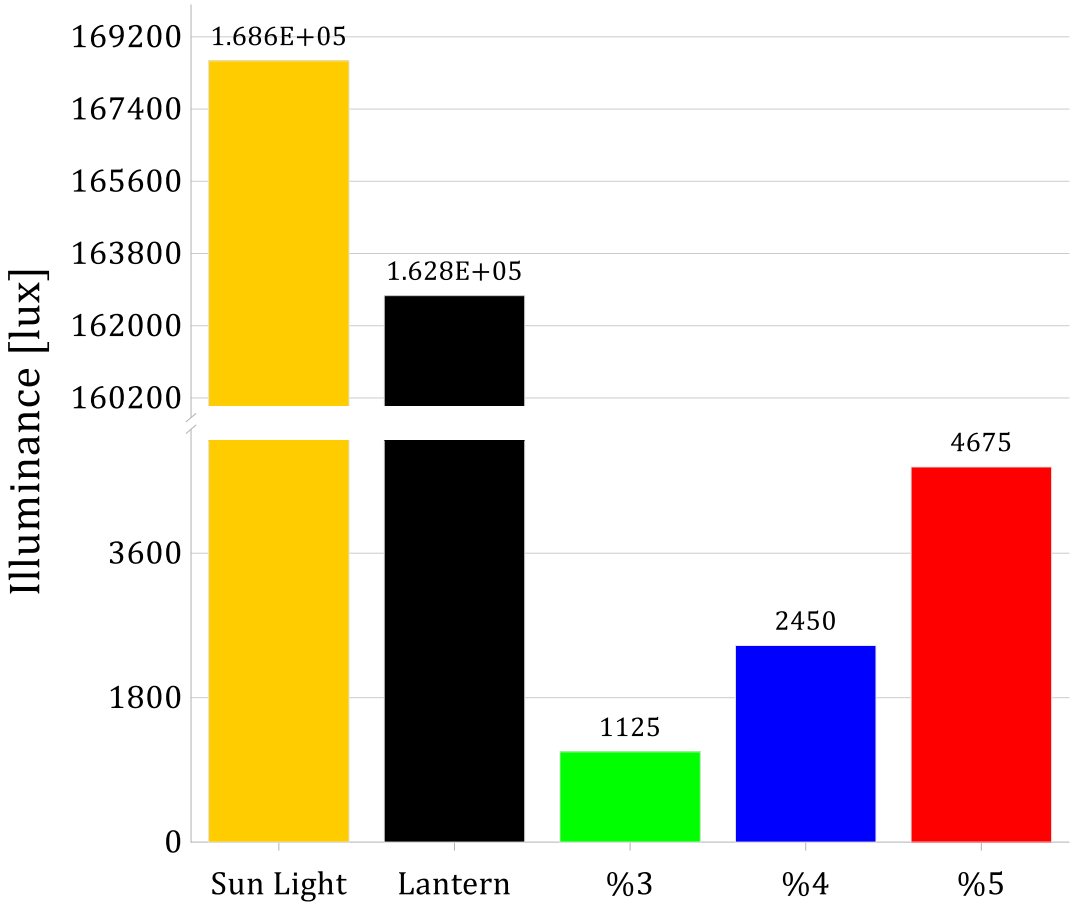


(c)

a) 3D printed cylindrical formwork with dimensions $\emptyset = 3"$ and $h = 8.6"$ b) Disk shaped sample with dimensions of $\emptyset = 3"$ and $h = 0.5"$ c) Illuminance test setup

Results – Illuminance





Conclusions

- Design a cement paste mixture embedded with plastic optic fiber with different volume percentages.
- Elaborate formwork for cubical and cylindrical samples
- Measure compressive strength, dynamic modulus of elasticity and illuminance