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DECLARATION BY THE CANDIDATE

I, **Mayank Nishant**, certify that the work embodied in this thesis is my own bonafide work and carried out by me under the supervision of **Dr. Suresh Kumar**, from **Jan 2019 to June 2025** at the **Department of Civil Engineering, Indian Institute of Technology (BHU) Varanasi**. The matter embodied in this thesis has not been submitted for the award of any degree/diploma. I declare that I have faithfully acknowledged and given credits to the research workers wherever their works have been cited in my work in this thesis. I further declare that I have not wilfully copied any other's work, paragraphs, text, data, results, etc., reported in journals, books, magazines, reports, dissertations, thesis, etc., or available at websites and included them in this thesis and cited as my own works.

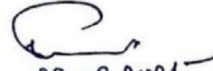
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DEDICATED TO

Baba, Iya, Maa,

And my family.

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Mayank Nishant

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NOTATIONS AND ABBREVIATIONS

NOTATIONS

English symbols

| | |
|-----------|------------------------------------|
| A | Total area within the unit cell |
| A_{GC} | Area of the granular column |
| A_r | Area replacement ratio |
| c | Cohesion (kPa) |
| d | Diameter of granular column |
| D_e | Effective diameter |
| D | Diameter of the loading plate |
| e | Void ratio |
| E | Modulus of elasticity |
| E_{oed} | Oedometer modulus |
| f | Cyclic loading frequency |
| G | Shear modulus |
| G_{ag} | Specific gravity of aggregates |
| G_s | Specific gravity |
| I_D | Relative density |
| I_p | Plasticity index |
| IF | Improvement factor |
| K_o | Passive earth pressure coefficient |
| K_{pc} | Passive earth pressure coefficient |
| l | Length of granular column |
| l_e | Length of encasement |

| | |
|-----------|--|
| n | Stress concentration ratio |
| N | Number of loading cycles |
| P | Train axle load |
| P_{exc} | Excess pore water pressure |
| q_c | Cyclic loading amplitude |
| q_{ult} | Ultimate bearing capacity of a granular column |
| s | Spacing of granular columns |
| S_u | Undrained shear strength |
| t | Thickness of the geogrid |
| w | Water content |
| W_L | Liquid limit |
| W_P | Plastic limit |

Greek symbols

| | |
|---------------|---|
| σ_{GC} | Stress in the granular Column |
| σ_S | Stress in the surrounding soft soil bed |
| γ_d | Dry unit weight |
| μ | Poisson's ratio |
| σ_d | Vertical cyclic stress on the subgrade |
| α | Speed coefficient |
| ϕ | Angle of internal friction |
| ψ | Dilatancy angle |
| σ | Normal stress |
| τ | Shear stress at failure |
| γ | Shear strain |

ABBREVIATIONS

| | |
|--------|-------------------------------------|
| ABS | Acrylonitrile Butadiene Styrene |
| GC | Granular Column |
| PGC | Plastic Granular Columns |
| EGC | Encased Granular Columns |
| GT | Geotextile |
| GG | Geogrid |
| USCS | Unified soil classification system |
| UCS | Unconfined compressive strength |
| OMC | Optimum moisture content |
| CSR | Cyclic stress ratio |
| PPT | Pore Pressure Transducer |
| E1, E2 | Earth Pressure Sensors |
| FL | Floating |
| EB | End bearing |
| PP | Polypropylene |
| PE | Polyethylene |
| PET | Combi-grid encased granular Columns |
| PVC | Polyvinyl Chloride |
| HDPE | High density polyethylene |
| LDPE | Low density polyethylene |
| FEA | Finite element analysis |
| FEM | Finite Element Method |