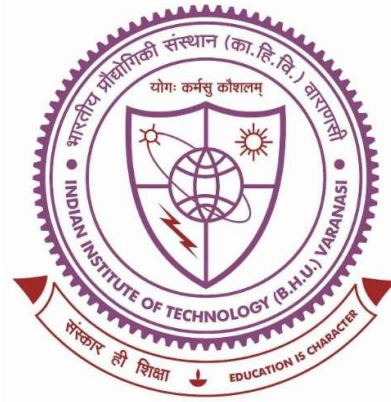


Coupled Effects of Mineral and Chemical Admixtures on the Properties of Mortar and Concrete: Experiments and Predictive Models



Thesis submitted in partial fulfilment

for the Award of Degree

Doctor of Philosophy

by

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2023

CERTIFICATE

It is certified that the work contained in the thesis titled "*COUPLED EFFECTS OF MINERAL AND CHEMICAL ADMIXTURES ON THE PROPERTIES OF MORTAR AND CONCRETE: EXPERIMENTS AND PREDICTIVE MODELS*" by *Mr. DHEERESH KUMAR NAYAK* (Registration No. 16061005) has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

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DECLARATION BY THE CANDIDATE

I, **DHEERESH KUMAR NAYAK**, certify that the work embodied in this thesis is my own bonafide work carried out by me under the supervision of **PROF. RAJESH KUMAR** from July 2016 to March 2023 at the Department of Civil Engineering of the Indian Institute of Technology (Banaras Hindu University) Varanasi. The matter embodied in this thesis has not been submitted for the award of any other degree/diploma. I also 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 willfully lifted 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 work.

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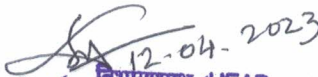

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It is certified that the above statement made by the student is correct to the best of my knowledge.


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ACKNOWLEDGEMENT

Although my name appears on the cover of this dissertation, I could not have completed this work without the support and guidance of many individuals. To all those who have played a role in making this thesis possible, I extend my heartfelt thanks and appreciation.

I begin my acknowledgments by offering my deep reverence to the sacred city of Varanasi, where the divine presence of **Kashi Vishwanath**, **Maa Ganga**, and **Sankat Mochan** has been a constant source of inspiration and strength throughout my academic journey. The spiritual energy of this holy land has helped me maintain good health, expand my knowledge, and develop the strength and resilience necessary to persevere through the most challenging times. I am humbled and grateful for the blessings and guidance of the divine, which have played a pivotal role in my success.

I would also like to express my deep respect and gratitude to **Bharat Ratna Mahamana Pandit Madan Mohan Malaviya Ji** for his visionary leadership in establishing this great historical institute of Banaras Hindu University, now Indian Institute of Technology (BHU) Varanasi. His tireless efforts in promoting excellence in education and knowledge have created a unique platform for students like me to expand their horizons and enhance their skills.

First and foremost, I would like to express my gratitude to, **Professor Veerendra Kumar**, for his exceptional guidance and encouragement during my postgraduate studies. His insightful comments, valuable feedback, and unwavering support have been instrumental in shaping my research and academic pursuits.

I would also like to thank my supervisor, **Prof Rajesh Kumar**, for his continuous guidance, support, and mentorship throughout my PhD journey. His patience, wisdom, and expertise have been invaluable in guiding me through the challenges and complexities of doctoral research.

I would like to thank my research committee members, **Dr. Kamlesh Kumar Pandey** (Civil) and **Prof. Ram Sharan Singh** (Chemical), for their valuable inputs, suggestions, and support during my research work. Their insightful comments and feedback have been instrumental in shaping my research and academic pursuits.

I would like to express my heartfelt gratitude to my friends, **Mr. Rahul Singh**, **Mr. Abhilash P. P.**, and **Mr. Gaurav Verma**, and my fellow friends **Mr. Vishal Kr Mourya**, **Dr. Ravinder Kr Agrahari**, **Mr. Gaurav Pandey**, and **Mr. Dharendra Patel**, who provided me with technical, moral, and emotional support during my research program. Their encouragement, guidance, and support have been invaluable in helping me navigate the challenges of research and complete this thesis.

I would also like to extend my sincere thanks to **Prof. Sasankasekhar Mandal**, Head of the Department of Civil Engineering, Indian Institute of Technology (BHU), Varanasi, for providing me with all the necessary facilities related to my research work. His support and encouragement have been instrumental in shaping my research and academic growth.

I am grateful to **Dr. P R. Maiti**, **Prof. K. K. Pathak**, **Dr. B. N. Singh**, **Dr. Rosalin Sahoo**, **Dr. Kshitij Kumar Yadav**, **Dr. Mahendra Kumar Pal**, **Dr. Vishwajeet Anand**, **Dr. Ayan Haldar**, **Dr. P Bala Ramadu**, **Prof Prabhat Kumar Singh**, **Prof Prabhat Kumar Singh Dikshit**, **Prof. Shyam Bihari Dwivedi**, **Prof Devendra Mohan**, **Prof Brind Kumar**, and **Dr. Suresh Kumar** for their unconditional support at every moment during the progress of my research. Their insights, feedback, and suggestions have been invaluable in shaping my research work.

I am also grateful to our laboratory staff, **Mr. Sharda Prasad**, **Mr. Vinod Kumar**, **Mr. Ramashankar** and **Mr. Yashwant Singh**, for the assistance extended by them from time to time during this research work. I would also like to thank **Mr. Suraj** for his constant assistance

throughout my experimental work. I am grateful to all the office staff and authorities of the Department of Civil Engineering for their kind help during the period of my stay to complete the thesis work.

I would also like to extend my heartfelt regards to all the faculty members of the Civil Engineering Department for their support and encouragement. Their guidance and expertise have been instrumental in shaping my academic and professional pursuits.

A very special thanks to **Mr. Shailendra Singh, Mr. Shailendra Chaudhary, Mr. Aditya Kumar Gupta, Mr. Nawneet Tiwari, Dr. S. P. Singh, Mrs. Sarita Singh, Dr. Rajesh Kumar Sharma,** and **Mr. Mikky Anand,** for their thought-provoking discussions, support, cooperation, and sincere help in many ways throughout my research program

I would like to give a special mention to some exceptional individuals who have played a significant role in my journey. Firstly, **Mr. Nitin Kumar, Mr. Bhoora Sharma, Mr. Sumit Mishra, Dr. Ravi Tripathi, Mr. Vikas Singh, Mr. Vikas Verma, Mr. Jitendra Patel, Dr. Bablesh Kumar Jha, Dr. Manish Kumar Mandal, Mr. Sarvesh Gupta, Dr. Shiwansu Shekhar, Dr. Satyajeet Mondal, Dr. Nitesh Gupta, Dr. Bhupendra Singh Rana, Mr. Anupam Singh, Mr. Rohit Mittal, Dr. Abhishek Sharma, Dr. Amiya Abhash, Dr. Arunabh Pandey, Mr. Rajneesh Upadhyay, Ms. Sivani Gond, Mr. Maharishi Pathak, Mr. Piyush Kakkar, Mr. Raghuvir Kalra, Mr. Neeraj Sharma, Mr. Vivek Kr Yadav** and my younger brother **Mr. Kavendra Nayak** for their constant encouragement, love, and moral support have been instrumental in keeping me motivated

The acknowledgment is not completed till I express my gratitude to my family members. My father, **Mr. Mahendra Kumar Nayak,** instilled in me the values of honesty and punctuality, which have been instrumental in shaping my character. He also encouraged me to prioritize my physical and mental well-being by engaging in regular exercise. My mother, **Smt.**

Vimla Devi Nayak, has been the pillar of support for me and my family. Her selfless care and sacrifices for our happiness are beyond measure, and I am forever grateful for her presence in my life.

My elder brother, **Mr. Veeresh Nayak** (BARC), and his wife, **Mrs. Eti Sharma**, have been a constant source of inspiration and motivation for me throughout this journey. My brother has always been my protector, and his unwavering support has given me the strength to pursue my dreams. My sister, **Mrs. Sandhya Nayak**, and my brother-in-law, **Mr. Sandeep Tripathi**, along with my niece and nephew, **Anubhawna Tripathi** and **Manas Nayak**, have also been a vital source of strength and encouragement for me. Their presence in my life has made me a better and stronger person, and I am grateful for their unwavering support.

I would like to acknowledge and express gratitude to **Mrs. Nidhi Nayak**, my very beloved wife, for her unwavering dedication, love, and support throughout this journey. Her constant encouragement, sacrifices, and understanding have been instrumental in helping me achieve my goals. I would also like to thank my son **Shivansh** for being the source of inspiration in my life and for always being my motivation to work harder and smarter. Their love and presence in my life have made this journey even more fulfilling and rewarding.

DHEERESH KUMAR NAYAK

Dedicated to
My Mentor
PROF. VEERENDRA KUMAR
&
My Grandfather
LATE SHREE SWAMI PRASAD DWIVEDI

ABBREVIATIONS and SYMBOLS

1. ACC - Accelerated Carbonation Curing
2. ACI - American Concrete Institute
3. ANFIS - Adaptive Neuro-Fuzzy Inference System
4. ASR - Alkali Silica Reaction
5. ASTM - American Society for Testing and Materials
6. BIS - Bureau of Indian Standards
7. BRT - Bagging Regression Tree
8. C – Cement
9. C - Control Concrete
10. CA – Coarse Aggregate
11. CB - Concrete with GGBS
12. CF - Concrete with fly ash
13. CH - Calcium Hydrate
14. CS – Compressive strength
15. CSH - Calcium Silica Hydrate
16. CM - Concrete with micro silica
17. CV - Cross Validation
18. DSS - Disodium Tetrapropenyl Succinate
19. ELM - Extreme Learning Machines
20. FS - Flexural Strength
21. FA - Fly ash
22. FA – Fine aggregate
23. FS – Flexural Strength
24. GA - Genetic Algorithm
25. GA-XGB - Genetic Algorithm eXtreme Gradient Boosting
26. GOT - Genetic Operation Tree
27. GGBS - Ground Granulated Blast Slag
28. GUI - Graphical User Interface
29. HPC - High-Performance Concrete

30. HSC - High Strength Concrete
31. HVAFC - High Volume Fly ash Concrete
32. ITS - Interfacial Transition Zone
33. LVLQFA - Large Volume Low-Quality FlyAsh
34. MARS-WCA - Multivariate Adaptive Regression Splines with Water Cycle Algorithm
35. MA – Mineral Admixture
36. MAE - Mean Absolute Error
37. MFA-ANN - Modified Firefly Algorithm-Artificial Neural Network
38. MK - Metakaolin
39. ML - Machine Learning
40. MLR - Multiple Linear Regression
41. MS - Micro Silica
42. Nm - Nanometres
43. NSFC - Naphthalene Sulfonate Formaldehyde Condensate
44. OPC - Ordinary Portland Cement
45. PCE - Poly Carboxylate Ether
46. PC - Poly Carboxylate
47. PEG - Polyethylene Oxide Phosphonates
48. PS - Polymelamine Sulfonates
49. R - Coefficient of Correlation
50. R^2 - Coefficient of Determination
51. RAC - Recycle Aggregate Concrete
52. RCA - Recycle Coarse Aggregate
53. REC - Regression Error Characteristic
54. RMSE - Root Mean Square Error
55. RHA - Rice Husk Ash
56. SEM - Scanning Electron Microscopy
57. SCC - Self Compacting Concrete
58. SCLWC - Self Compacting Light Weight Concrete
59. SP - Super Plasticizer

60. SPs - Superplasticizers
61. SSA - Specific Surface Area
62. STC - Susceptibility to Corrosion Index
63. STS - Splitting Tensile Strength
64. SVM - Support Vector Machine
65. SVR - Support Vector Regression
66. TC - Testing
67. TR - Training
68. UTM - Universal Testing Machine
69. V_f - Volume Fraction
70. w/b - Water to Binder Ratio
71. XGB - eXtreme Gradient Boosting
72. XRD - x-Ray Diffraction
73. k - Coefficient of Permeability
74. nm - Nanometres
75. ROC - Receiver Operating Characteristics