Personal Statement

Ever since I embarked on my academic journey, my passion for research and innovation within the realm of construction materials has continued to flourish. As I start a new chapter in my academic journey, I want to express my strong interest in the Ph.D. program in Civil Engineering at Columbia University and share the reasons that fuel my enthusiasm for this opportunity.

My journey in research of civil engineering began with an exploration of novel construction materials, a subject that has captivated my curiosity. During my previous academic experience, I focused on understanding the complexities of low-carbon cement. This experience gave me a profound appreciation for the significance of lowering carbon emissions in the construction industry, a sector that is crucial to modern society. My involvement in this research allowed me to delve into the intricate world of construction materials and their environmental impact, thereby laying the foundation for my academic and research interests.

As a current Master's student in Chemical Engineering at Columbia University, I possess a strong academic foundation in chemical engineering. This educational background equips me with the interdisciplinary knowledge necessary to approach the study of innovative construction materials from a comprehensive standpoint. An illustrative example of this interdisciplinary approach lies in the quest to enhance the carbonation degree of cement for increased CO_2 absorption. This challenge revolves around transport phenomena and reaction kinetics, domains rooted in chemical engineering principles. The seamless integration of these principles into construction materials research presents a unique opportunity to address pressing environmental issues and optimize material performance. This convergence of disciplines has ignited my passion for this field and reaffirmed my commitment to advancing it further.

While pursuing my Master’s degree at Columbia University, I engaged in two significant research projects aimed at addressing environmental challenges. In my first project, which began in June 2023 and is ongoing, I delved into the area of carbon-neutral cement development. This research extended beyond traditional Portland cement, as I explored alternative cement systems, including magnesium oxide cement and fly ash-substituted ordinary Portland cement, with a primary focus on carbonation curing. My investigations encompassed an intricate analysis of various parameters, such as mix design, and their influence on the physical properties and carbonation degree of the cement. To gain a comprehensive understanding, I learned and employed a range of mechanical testing machines to measure the physical properties of cement samples. I also learned and employed thermogravimetric analysis to quantify their mineral compositions. One of the most exciting outcomes of this project was the development of a mix design optimized for high CO_2 uptake, which holds great potential for reducing the carbon footprint in construction materials.

Simultaneously, I engaged in another research since May 2022, concentrating on the chemical stabilization of heavy metals within Waste-to-Energy (WTE) fly ash. The primary focus of this project was to find sustainable disposal solutions for WTE fly ash, aiming to make it safe for landfills or suitable for reuse in civil engineering applications. My work involved the exploration of the intricate reaction mechanisms associated with both inorganic stabilization and organic chelation to reduce the leaching of heavy metals. Through rigorous experiments, I uncovered the

effectiveness of various chemical agents in reducing heavy metal leachability, leading to the identification of optimal agents. Moreover, I developed cost-effective combinations of agents designed to efficiently stabilize heavy metals within the fly ash. I am drafting a comprehensive manuscript that encapsulates these findings, offering a transformative blueprint for sustainable waste management practices. My knowledge on WTE fly ash has enabled me to make a valuable contribution as the second author to a published review paper titled "Environmental Standards and Beneficial Uses of Waste-to-Energy (WTE) Residues in Civil Engineering Applications."

My research experiences have broadened my comprehension of sustainable construction materials and deepened my commitment to the environment and the pursuit of sustainable engineering practices. These endeavors have illustrated the pressing demand for innovative sustainable solutions, thereby fortifying my determination to pursue a Ph.D. program that would empower me to make a meaningful impact.

As I contemplate my future academic journey, I am excited by the prospect of joining Columbia University. The program's distinguished faculty, including Professor Kawashima, whom I have had the privilege of interacting with, embodies the kind of mentorship and collaborative spirit that I believe is essential for academic growth. Professor Kawashima's approachability and willingness to support new ideas resonate with my own aspirations for academic exploration and innovation.

Additionally, the extensive resources and facilities offered by Columbia University, coupled with its rich network of connections in both academia and industry, are particularly appealing. The Carleton Laboratory, with its state-of-the-art research space and testing equipment, represents an environment where I can realize my research ambitions. It is one of my dream places to work and contribute to cutting-edge research in construction materials.

In closing, my journey in research, my academic background in chemical engineering, and my commitment to sustainable construction materials have prepared me to embark on a Ph.D. program that aligns with my aspirations. I am eager to further my education at Columbia University and immerse myself in its vibrant academic community to explore novel frontiers in construction materials research, with a focus on carbon capture, utilization, and storage. I look forward to the challenges and opportunities for growth that this program offers and am excited to contribute to the ongoing efforts to create a more sustainable future for the construction industry.