Statement of Research Leadership

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1. Research Vision and Philosophy

My research vision centers on **advancing the science and sustainability of civil engineering materials** to address pressing global challenges such as infrastructure durability, resource scarcity, and carbon emissions. Over my 35-year academic and research career, I have sought to bridge fundamental materials science with real-world engineering applications, leading multidisciplinary initiatives that merge **sustainable materials development, corrosion science, and smart infrastructure technologies**. My philosophy has always emphasized *research with societal impact*—transforming waste into valuable resources, enabling resilient infrastructure, and inspiring the next generation of researchers through a collaborative and innovation-driven environment.

2. Areas of Research Leadership and Contribution

My leadership in research has evolved across several interconnected domains:

(a) Sustainable and Low-Carbon Construction Materials

A major focus of my work has been on **sustainability in concrete construction**, emphasizing the reuse of industrial and natural by-products such as **cement kiln dust, fly ash, red mud, limestone powder, and pozzolans**. My studies on **limestone calcined clay cement (LC3)** and **alkali-activated binders** have offered pathways for substantial CO_2 reduction while maintaining superior strength and durability. Papers such as *"Physicochemical properties of LC3 binders made using Saudi clays"* and *"Optimization of alkali-activated binders using natural minerals and industrial waste materials"* have contributed to the development of **eco-efficient, regionally adapted binders**.

(b) Durability, Corrosion Protection, and Service Life Extension

My early research laid the groundwork for **reinforcement corrosion modeling, diagnosis, and prevention**, and continues to influence international research in this area. Several highly cited works, such as *"Reinforcement corrosion in concrete structures—its monitoring and service life prediction"*, have received global recognition and awards for their high impact. Subsequent studies on **nanocarbon- and epoxy-based coatings**, **accelerated carbonation curing**, and **UHPC systems** have advanced corrosion protection strategies and extended service life prediction methodologies.

(c) High-Performance and Ultra-High-Performance Concrete (UHPC)

As the lead investigator on multiple funded projects, I have developed **UHPC mixtures** optimized for structural rehabilitation, impact resistance, and aggressive exposure environments. My group has pioneered applications of **UHPC layers and jacketing** for strengthening corroded RC beams, verified through both experimental and finite element modeling. These contributions, documented in *Engineering Structures*, *Structural Concrete*, and *Arabian Journal for Science and Engineering*, have positioned my research among the global leaders in UHPC innovation.

(d) Smart, Multifunctional, and Energy-Storing Materials

Recent work has expanded into **smart and multifunctional materials** capable of sensing, self-healing, and energy storage. Innovative studies on **carbon-coated sand**, **flash graphene–cement composites**, and **structural supercapacitors from red mud and jute stick waste** demonstrate a forward-looking approach that merges civil engineering with nanotechnology and energy science. These initiatives mark a paradigm shift toward **intelligent, self-sensing, and energy-harvesting concrete systems**.

(e) Waste Valorization and Circular Economy

A recurring theme throughout my research is **"from waste to value."** I have systematically transformed multiple waste streams, such as heavy fuel oil ash, cement waste-derived portlandite, and industrial red mud, into high-value construction materials. My works published in *Chemical Record*, *Case Studies in Construction Materials*, and *Journal of Building Engineering* have been recognized for their practical, environmental, and economic implications.

3. Impact, Recognition, and Mentorship

With **149 peer-reviewed journal papers** (61 in Q1 and 52 in Q2 journals) and over **6,700 citations (h-index 42)**, my research output reflects both depth and continuity. My publications in high-impact journals, such as *Cement and Concrete Composites*, *Construction and Building Materials*, *Corrosion Science*, and *Journal of CO_2 Utilization*, have collectively shaped new directions in sustainable and smart concrete technologies.

I have received multiple **Excellence in Research Awards** (KFUPM, 2011, 2016, 2021), **Highly Cited Paper Awards**, and the **Eng. Tarek Al-Kasabi Award (2022)** for outstanding research in Structural Engineering. I have been continuously listed among the **Top 2% Scientists Worldwide in Building & Construction** (Stanford University–Elsevier, 2021–2025).

As a research leader, I have **supervised or examined over 100 MS and PhD theses** and served as **Principal or Co-Investigator on 37 funded projects**, including collaborations with **Saudi Aramco, KACST, Neom, and SABIC**. My mentoring philosophy integrates rigorous scientific inquiry with practical engineering relevance, encouraging innovation in materials development, testing, and modeling. Many of my graduate students now hold academic and industry leadership positions internationally.

4. Collaborative Research and Institutional Leadership

As **Chairman of the Civil and Environmental Engineering Department (2021–2025)**, I guided the CEE Department through an unprecedented period of growth and academic excellence. Key achievements include:

- Raising the department's **QS Subject Ranking from 98 to 46 globally**;
- Achieving the **highest Scopus publication rate at KFUPM** (9.4 per faculty);
- Launching **new interdisciplinary programs** such as *MS in Sustainable Concrete Structures* and *BS Concentrations in Climate Change Adaptation and Resilient Marine Structures*;
- Expanding the Department's funded research portfolio and patent output (43 patents from 2019–2023).

These outcomes underscore my ability to translate individual research success into institutional advancement, fostering a research ecosystem that combines sustainability, innovation, and global collaboration.

5. Future Research Directions

Building upon this foundation, my future research agenda will focus on:

1. **Carbon-neutral and carbon-negative cementitious materials**, integrating mineral carbonation, waste valorization, and life-cycle optimization.
2. **Smart concrete systems** developing materials with integrated sensing, energy storage, and self-healing capabilities.
3. **Digital and AI-assisted materials design**, leveraging machine learning for predictive modeling of performance and durability.
4. **Sustainable infrastructure resilience**, coupling experimental insights with advanced simulation and life-cycle assessment tools.

Through these initiatives, I aim to contribute to **net-zero infrastructure development** and to position the region as a global hub for sustainable and intelligent construction technologies.

6. Concluding Statement

Throughout my career, I have strived to link **scientific rigor with societal relevance** transforming waste into resources, improving durability and safety, and leading innovations that align with global sustainability goals. My research leadership reflects a lifelong commitment to developing **smarter, greener, and more resilient infrastructure materials**, mentoring future researchers, and advancing civil engineering toward a sustainable and intelligent future.