Future of Bridge Design - What Generative AI and related technology could mean for the design of bridges and the processes used to design them.

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Generative AI and related technologies are seemingly poised to revolutionize bridge design and the processes involved. These advancements can enable engineers to leverage AI-driven generative design tools, optimizing structures through rapid prototyping, parameter-based modeling, and exploration of innovative solutions. The automation of repetitive tasks such as drafting and structural analysis reporting will streamline workflows, freeing engineers to focus on creative and strategic problem-solving.

Al's integration into structural analysis and simulation can enhance accuracy and predictability, helping designers assess performance under diverse conditions, including extreme weather or load scenarios. Moreover, Al driven techniques can optimize material usage, reducing costs and improving sustainability. Al-powered tools also foster collaboration between engineers, architects, and contractors, enabling smoother communication and more efficient knowledge sharing.

In addition to design, AI offers significant benefits in lifecycle management and maintenance. Predictive maintenance, powered by real-time sensor data, can forecast repairs before critical failures occur, prolonging the life of a structure. AI can also drive innovations in bridge construction, such as robotic assembly and real-time monitoring during building phases, improving both precision and efficiency.

Challenges to adopting AI in bridge design include ensuring data security and developing interdisciplinary teams with expertise in both traditional engineering and advanced technologies. There is also the question of trust, how do we make use of the forefront of technology while still actually delivering what it is that our clients expect in the field of Bridges.

This paper outlines experiments, prototypes and AI led workflows that we have been running in this space, as well as a view of what are the most likely impacts (positive and negative) from the uptake of AI into the field of Bridge Design.