Docket #: S19-149

Concrete Durability Modeling Software for Building Information Models

Stanford researchers have integrated concrete durability modeling software into building information models (BIM) for better management, repair, and assessment of structural elements like roads, bridges, dams, buildings, etc.

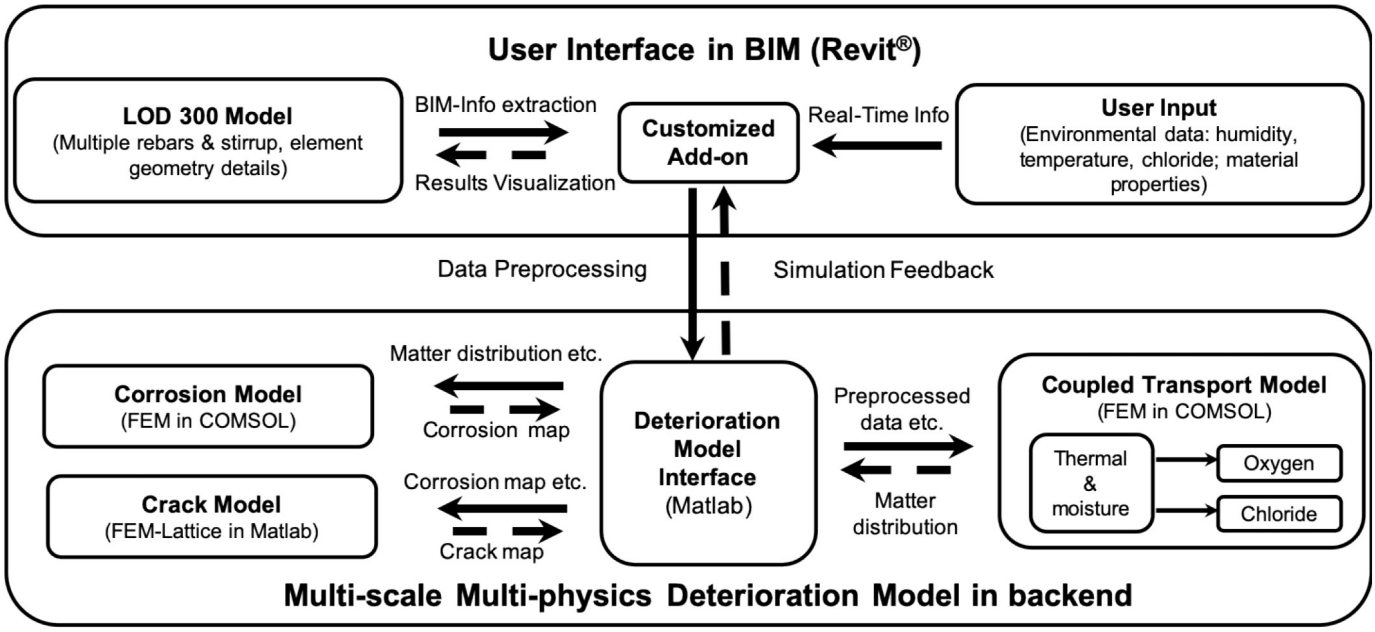
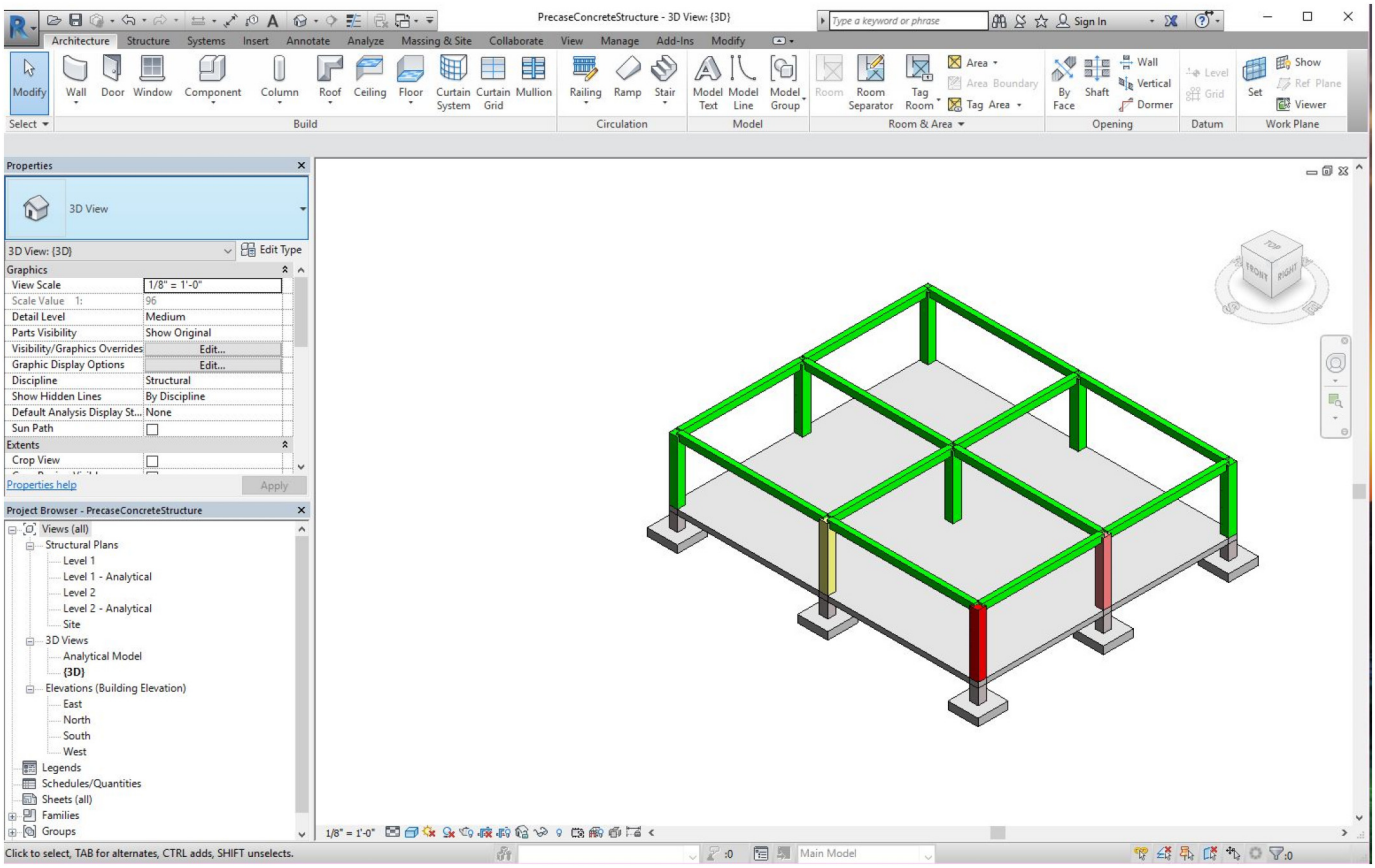


Image courtesy of Blume Lab.

The multi-physics deterioration modeling software extracts building element environment data from typical BIM software such as Autodesk Revit™, automatically establishes deterioration models of the elements, runs necessary deterioration simulations, performs decision analysis and displays graphic feedback in the BIM software or output files to support decision makers, such as financiers of infrastructure, municipalities, utilities, and transportation departments. These

visualizations of future risk can be used by decision-makers to guide repair and maintenance planning to improve facility life cycle performance (i.e., more efficient budget allocations, reduced life cycle carbon dioxide emissions and other environmental impact).



Future deterioration display risk map of parking structure. In this example, colors indicate increasing deterioration risk - i.e., the probability that each element will exhibit corrosion-induced surface cracking 25?years in the future (red shading indicates highest probability, pink shading indicates medium probability, yellow shading indicates minor probability, and green shading indicates low probability of surface cracking). Image courtesy of Blume Lab.

This software is the first to incorporate environmental data with a science-based, data-driven model for multiple modes of reinforced concrete decomposition, which gives a more detailed and accurate prediction of structural performance, and extends the use of BIM into the post-construction phases of a facility.

Stage of Development – Prototype
The framework currently supports chloride-induced corrosion of reinforced concrete elements. Other deterioration mechanisms (e.g. cyclic fatigue, freeze-thaw, and other chemical deterioration) are being researched and added constantly. In addition, more complex geometry will be supported as research progresses.

Applications

- **Building Information Modeling** - to support infrastructure asset managers, financiers, infrastructure/building designers by conveniently and easily predicting the long-term durability performance of concrete structures subject to deterioration over time.

Advantages

- **More accurate, long term prediction** and modeling that **links to actual environmental sensors**, making efficient and direct use of distributed sensing networks.
- **Convenient, accessible, and easy to understand** - integrates into commercial BIM software to predict durability without requiring the user to understand complicated physical phenomenon.
- **Extends the use of BIM** into post-construction phases of a facility.

Publications

- Wu, Jie, Michael D. Lepech. " Incorporating multi-physics deterioration analysis in building information modeling for life-cycle management of durability performance." *Automation in Construction* 110 (2020): 103004.

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