



Digital Engineering and Advanced Construction at NRIC: The Digital Threads Impact in Nuclear Lifecycle Optimization

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Changing the World's Energy Future

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Digital Engineering and Advanced Construction at the National Reactor Innovation Center: The Digital Thread's Impact in Nuclear Lifecycle Optimization

From digital engineering tools to embedded structural sensors, the use of modern tools to democratize the data and sensor fusion to inform health and maintenance decisions for the reactor and facility.

Agenda

- Digital Engineering At INL
 - Overall implementation
- Digital Engineering At NRIC
 - NRIC DOME & LOTUS implementation
- Advanced Construction Technology Initiative (ACTI)
 - Digital Twin
 - Digital Thread

Digital Engineering at the INL

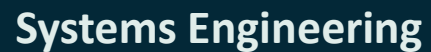
We want to fully establish:

- Early Systems Engineering investment to lay groundwork for the right data-driven engineering process, and begin cultural transformation
 - Combine with software integration to realize “NRIC Digital Engineering Ecosystem”
-
- Continue Windchill Momentum and Instantiate Production Environment (FY 23-24)
 - Solidify existing software integrations and package capabilities as NRIC DEN: Digital Engineering for Nuclear for broader industry use (FY24-25)
 - Improve and Expand the use of DOORS requirements management.
 - Continue to expand the interconnected tools across INL functions via Deep Lynx

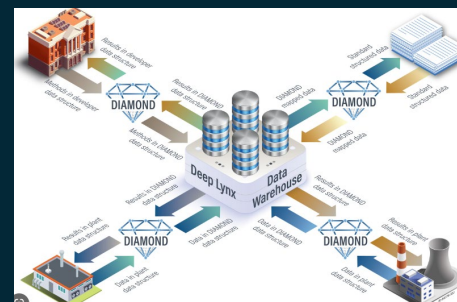


- Automatic 3D Building Generation from MBSE (FY 24-25)
 - Encourage the use of systems planning & architecture
 - Automate transformation of 2D planning schematics into 3D building models
- Build the first nuclear facility-scale digital twin (FY24-26)
 - Real time visualization of facility and reactor status & behavior to support operations
 - Facilitate demonstrator interaction with real test bed information and performance

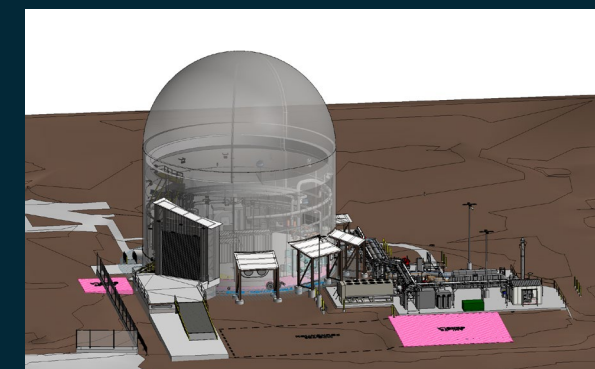




3D CAD Digital Twin



Data Warehouse: Deep Lynx



3D BIM Digital Twin



Construction Management

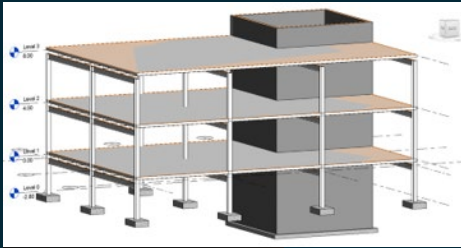


INL Asset Suite

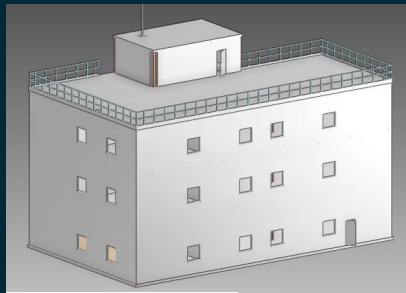


Structural Analysis





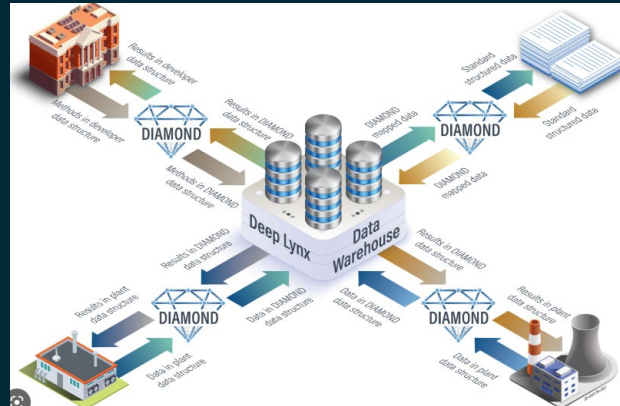
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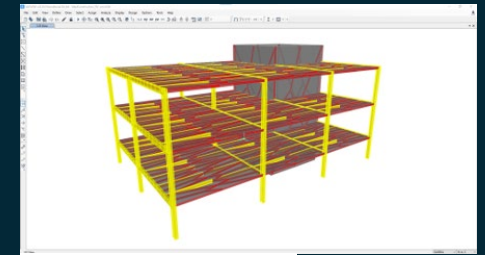
**AVEVA
EVERYTHING3D**



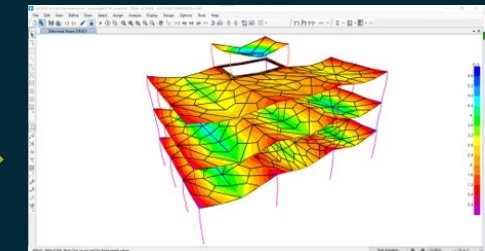
**GRAPHISOFT
Archicad®**



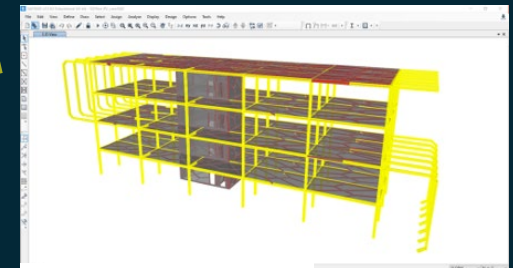
**Data Warehouse:
Deep Lynx**



SAP2000



SAP2000



SAP2000



Project Systems Engineering



MBSE



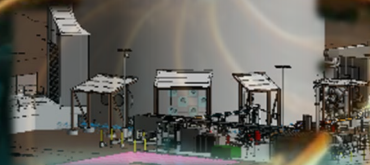
Plant Layout, Design,
and Planning



System / Component Design



Assy & Test



Construction



Reactor Design



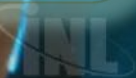
Manufacturing



Digital Procurement



System Analysis





Project Systems Engineering



MBSE



Plant Layout, Design,
and Planning



System / Component Design



Assy & Test



Construction



Reactor Design



Manufacturing



Digital Procurement



System Analysis

Construction of the testbed and installation and commissioning of the experimental reactors will be performed through a combination of our PLM system and Procore, a construction specific digital collaboration tool, with the Engineering Procurement and Construction (EPC) company. Procore will connect with Windchill and EDMS to allow for the constructor to work quickly on field issues while also maintaining control of the design engineering documentation.

Using the Digital Thread : Connecting Engineering, Manufacturing, and Construction

Manufacturing Engineering



Issue new equipment specifications, new drawings, new requirements for components.

Design Engineering



Issue new equipment specifications, new drawings, new requirements for installations, systems, and interfaces.

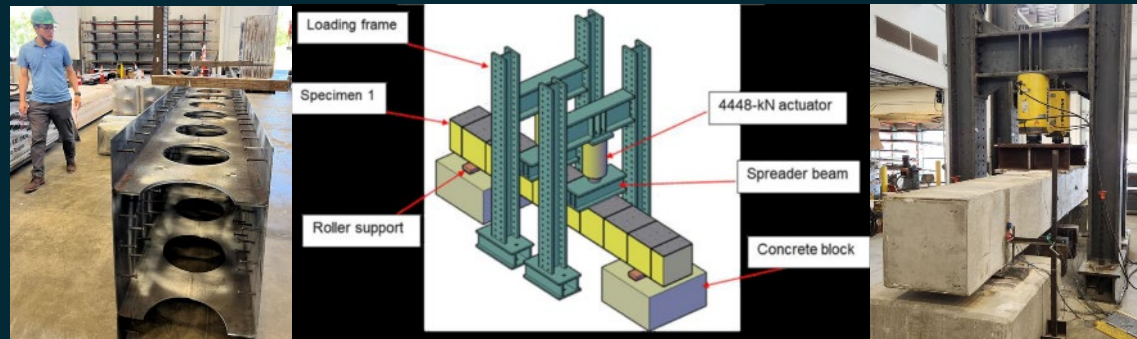
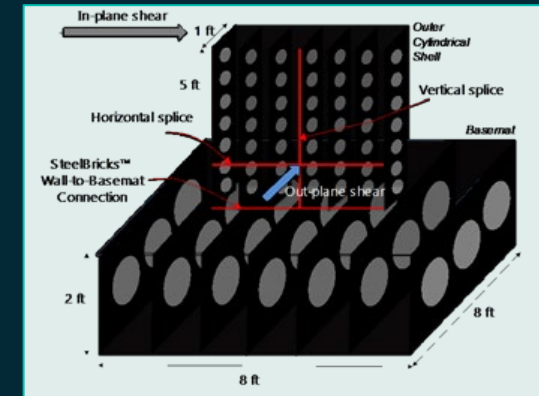
Field Engineering



Advanced Construction Technology Initiative (ACTI) Phase I – In-Progress

“Demonstrate Technologies to Significantly Reduce the Cost and Schedule for Construction of Advanced Reactors.”

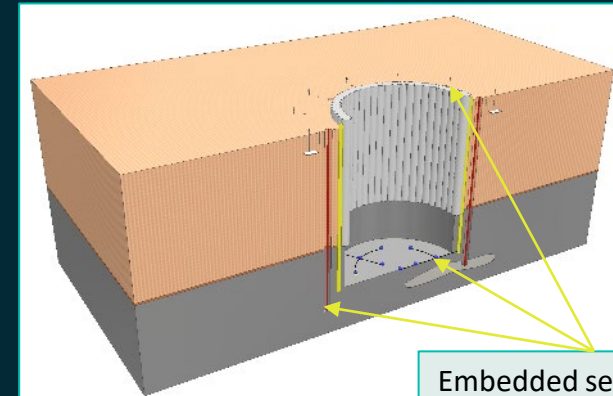
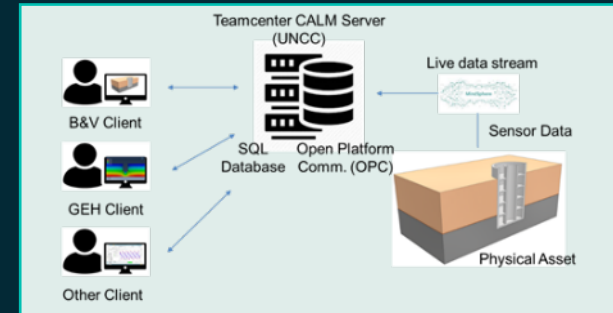
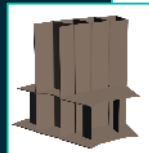
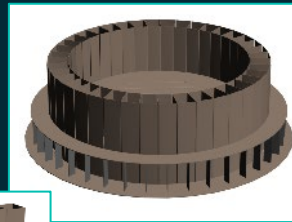
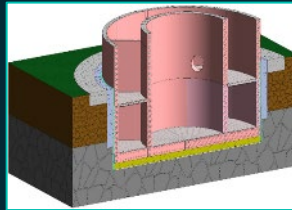
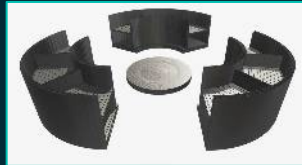
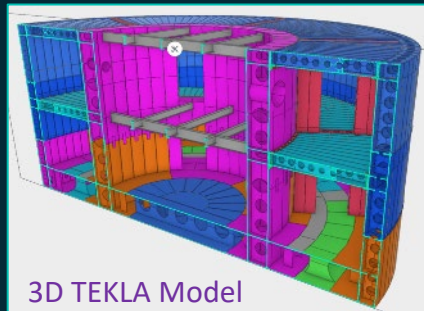
- Steel Brick™ demonstration of structural capability.
- Prototype developed, constructed, and tested.
- No test failures. Exceeded all expectations.



Advanced Construction Technology Initiative (ACTI) Phase II - scaled, in-field demonstration

These images are for illustration purposes only.

1. Steel Bricks™ system, next generation SC modules, for Seismic Category 1 structures including containments and novel techniques to integrate the modules into the basemat to avoid conventional structural attachment problems (e.g., AP1000 construction at Vogtle).
2. Advanced condition and performance monitoring techniques for implementing construction and in-service surveillance programs to address 10 CFR 50.65 Regulatory Inspection and Monitoring requirements as part of the Reliability Integrity Management (RIM) plan
3. State-of-the-art Digital Twin replica of the structure to integrate sensor data, artificial intelligence, machine learning, and data analytics. Provides real time feedback to the digital twin models for analysis and validation.



Embedded sensors and streaming data.