

Construction Innovations for Future Generations



Integrating Computational Design into Structural Engineering Workflows to enhance Design Automation

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Presentation Overview

- Research Motivation & Objective
- Dynamo & Automation
- Automating a Structural Engineering Workflow
- Results & Conclusions









Research Motivation

Experienced Industry professionals working within Structural Design Consultancies

What's the Problem?

Duplication of Geometry and Modelling Effort

Frequently no direct link between Analytical Model and BIM Model

Can lead to errors in contract documentation



Figure 1: Typical design process today

Image Credit: From Revit to FEM and back - with use of Dynamo, Anders Hejnfelt, SWECO Denmark, Autodesk University





Research Objective

- 1. Investigate how Dynamo can be used to **Automate Structural Engineering Workflows**
- 2. Automate a parametrically controlled **Analytical Model** and **BIM model** for a **prototype building structure** through the use of Visual Programming
- **3. Develop a quantification phase** to the workflow using Visual Programming
- 4. Present **qualitative and quantitative** benefits and efficiencies through such an approach.







Dynamo & Automation









Computational Design Approach

Dynamo

Open source platform

Visual Programming/Computational Design Tool

Embedded within Revit since 2017





Image Credit: Dynamo Primer Paolo Emilio Serra Implementation Consultant, Autodesk



Dynamo & Automation

Manual Tasks can be automated

Dynamo

Enables Interoperability between different platforms

Working Smarter not Harder

Gathering 21 Construction Innovations for Future Generations













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Automating Structural Engineering Workflows





Computation Design Workflow



Master Model Approach

34th International Symposium on Automation and Robotics in Construction

Integrating Computational Design to Improve the Design Workflow of Modular Construction

Modular and Offsite Construction Conference 2018



Design Science Approach

"to develop knowledge that can be used by professionals in the field to design solutions to their field problems"





Computation Design Workflow















Defining a Structural Engineering Process







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Results





Analytical Modelling Time (min) - Manual Approach

BIM Modelling Time (min) - Manual Approach

Results



Manual Approach Vs Visual Scripting Manual Approach
Visual Scripting Approach 60min 50min 40min 30min 20min 10min 0min 0. Start 1. Analytical 2. Supports 3. Releases 4. Section 6. Apply 5. Loadcases Geometry Geometry Loads

Manual Approach Vs Visual Scripting



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Overall Results

Summary

MANUAL APPROACH Vs VISUAL SCRIPTING - COMPLETION TIMES (Mins)



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Conclusions







Conclusions

- Potential to improve structural engineering workflow efficiency and reduce project hours
- Ability to ensure Data completeness
- Enables Interoperability between different platforms (FEM, Excel)
- Ability to quickly test different concept designs





Reference: J. Kindregan (2019). Engineering Contributions to humanity through the ages and challenges for 2050 ISTRUCTE.