AI in AEC Design

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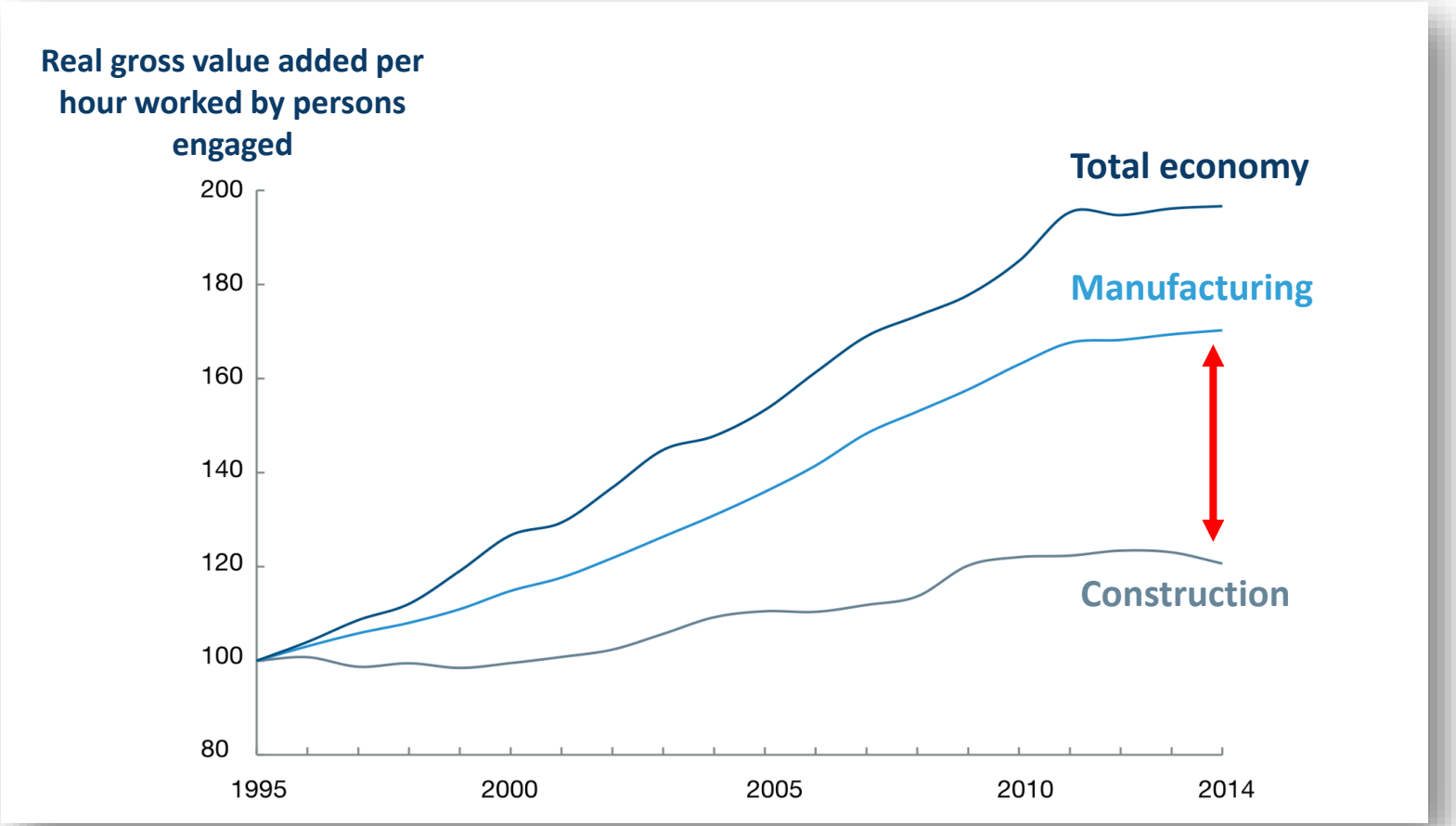
Construction industry is suffering from declining productivity

- Despite increasing digitalization, productivity in AEC has dropped by 17% in 25 years [1].

- This is because most tasks remain highly manual, resulting in increased errors, delays, and costly rework [2,3,4].



1- https://www.constructors.com.au/wp-content/uploads/2022/11/Disrupt-or-die_November-2022.pdf
2- https://www.autodesk.com/blogs/construction/construction-industry-statistics
3- https://www.constructionbriefing.com/news/us-construction-industry-short-half-a-million-workers-says-abc/8034797.article
4- https://gobridgit.com/blog/profit-margin-in-construction/#:~:text=However%2C%20according%20to%20industry%20experts,a%20notoriously%20low%2Dmargin%20business.

Fragmented and repetitive tasks are the key barrier to productivity

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- The tasks are fragmented and resistant to automation with traditional software and SaaS solutions.

- AI foundation models can revolutionize this by automating previously unmanageable tasks.

https://www.bain.com/insights/how-generative-ai-will-supercharge-productivity-snap-chart/

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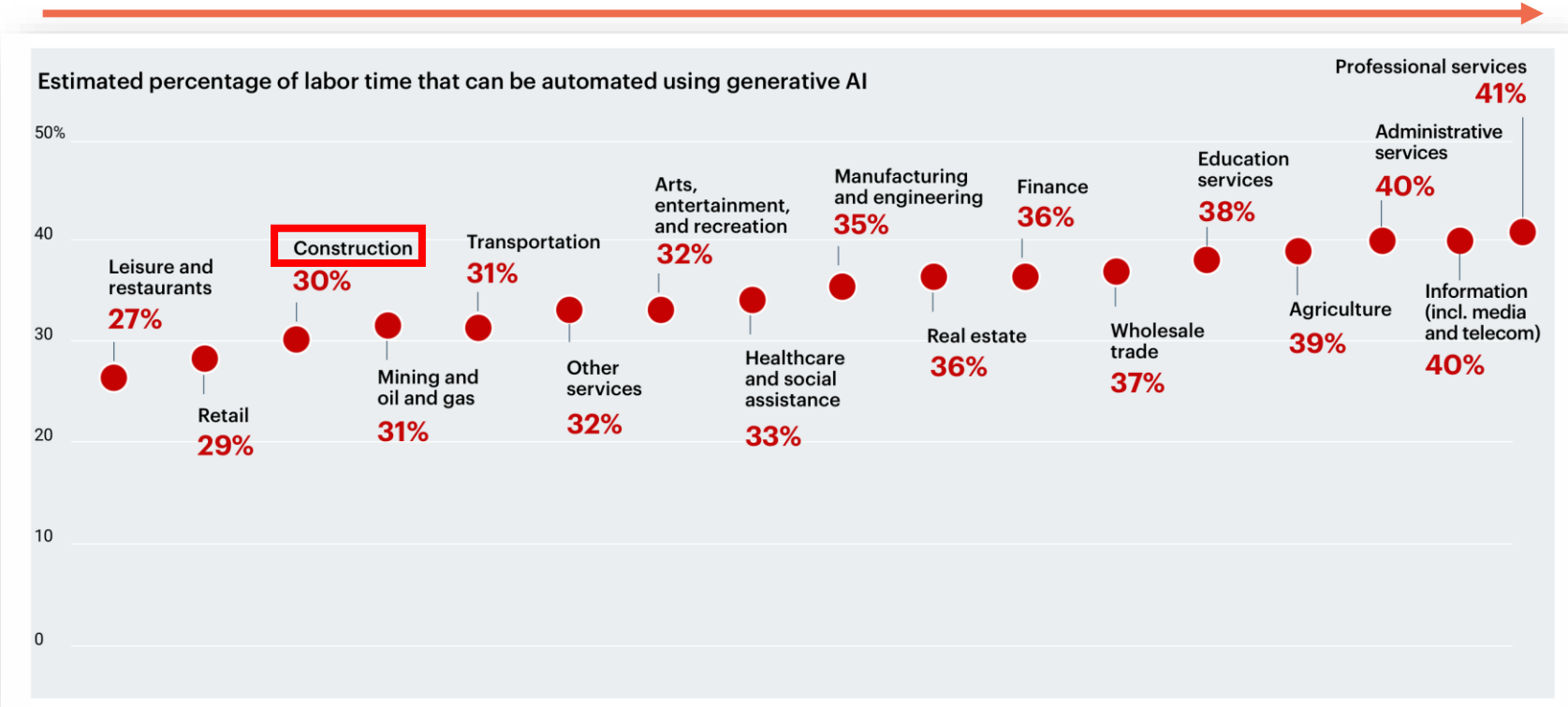
"Knowledge-based roles will see the greatest leap in productivity from generative AI."



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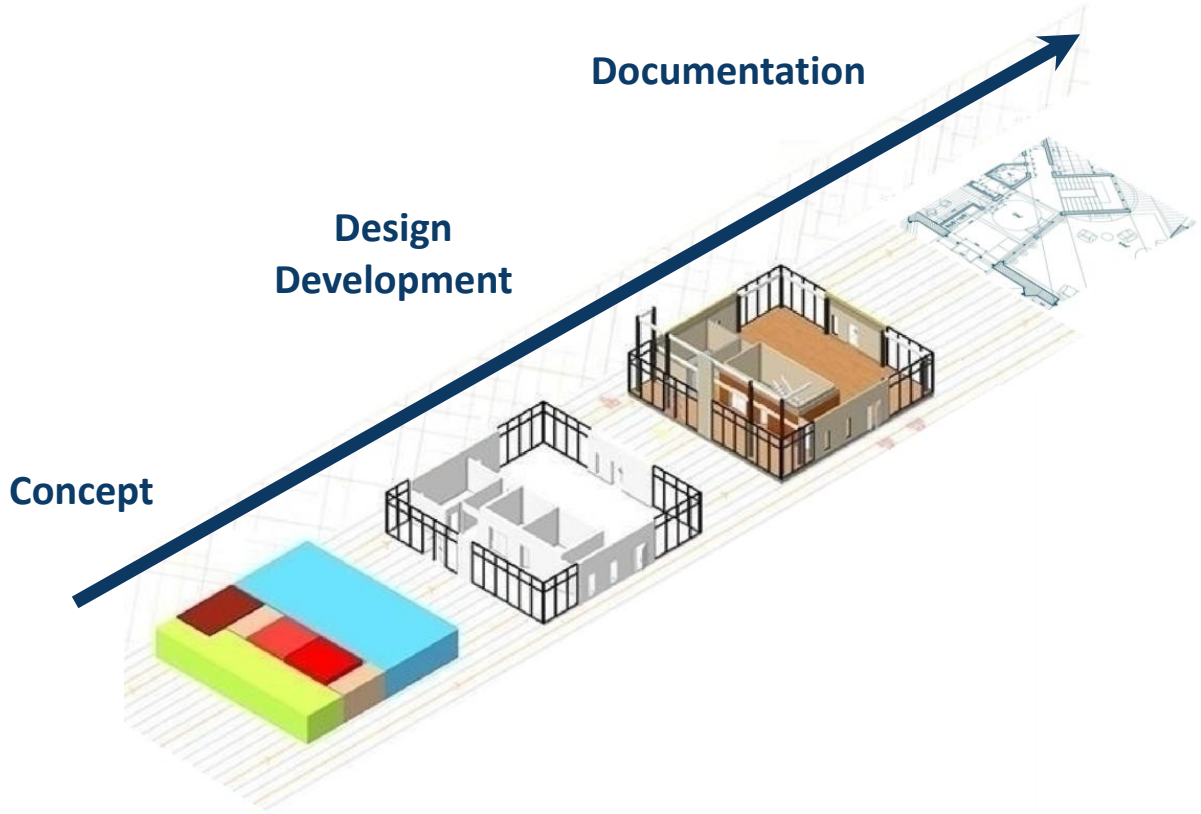
The three phases of design



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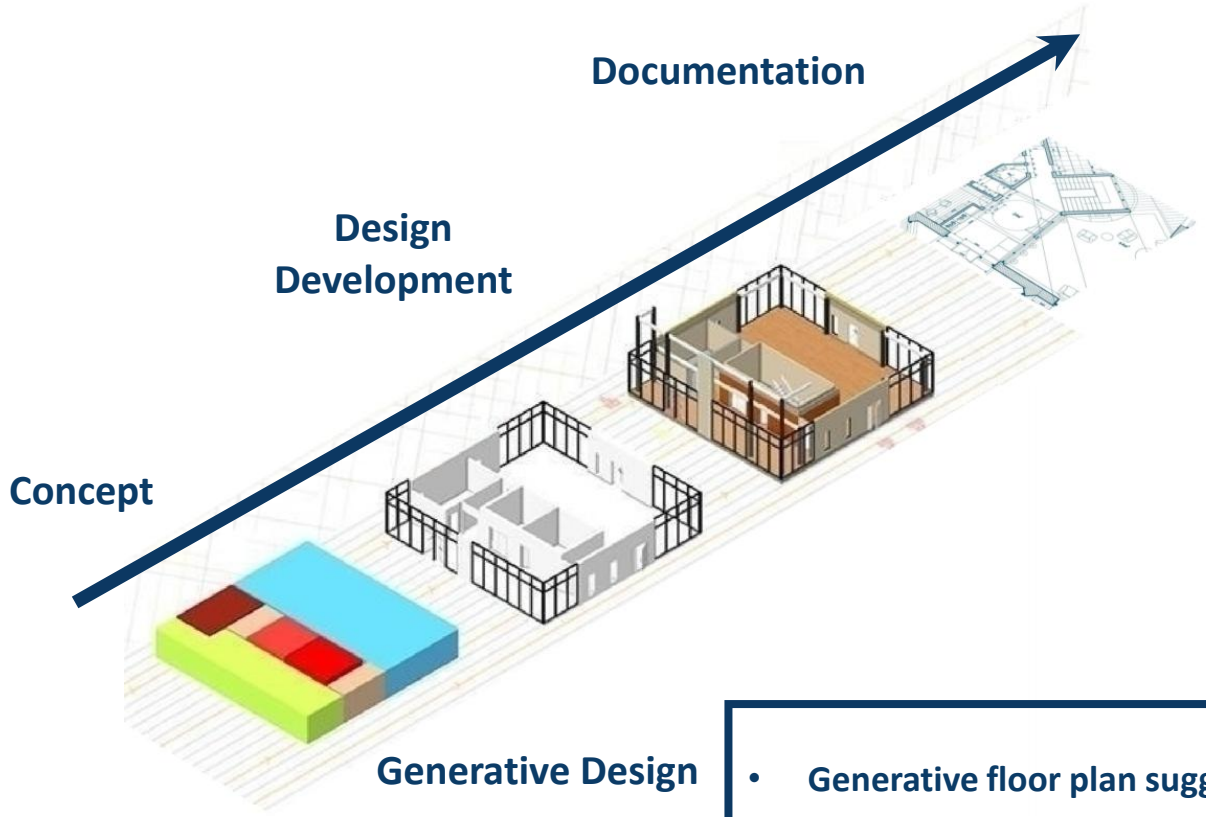
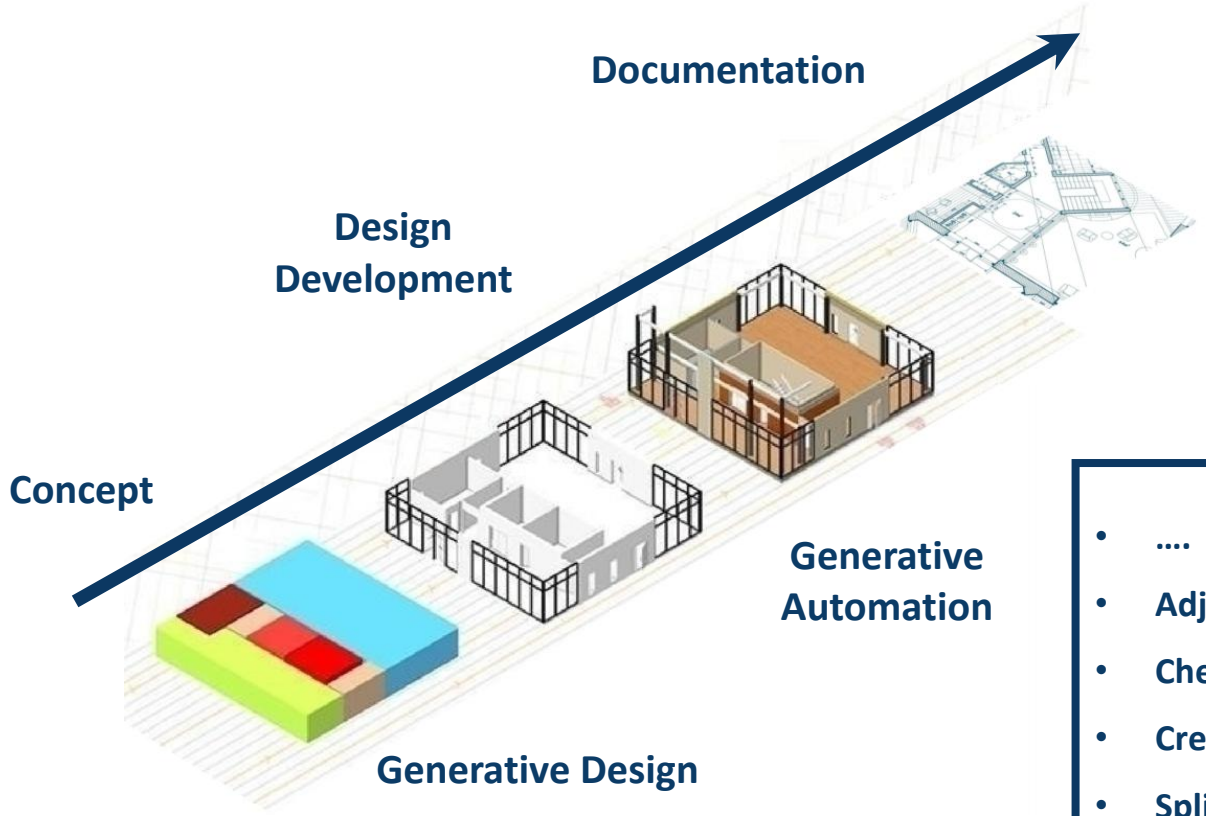


Generative Design

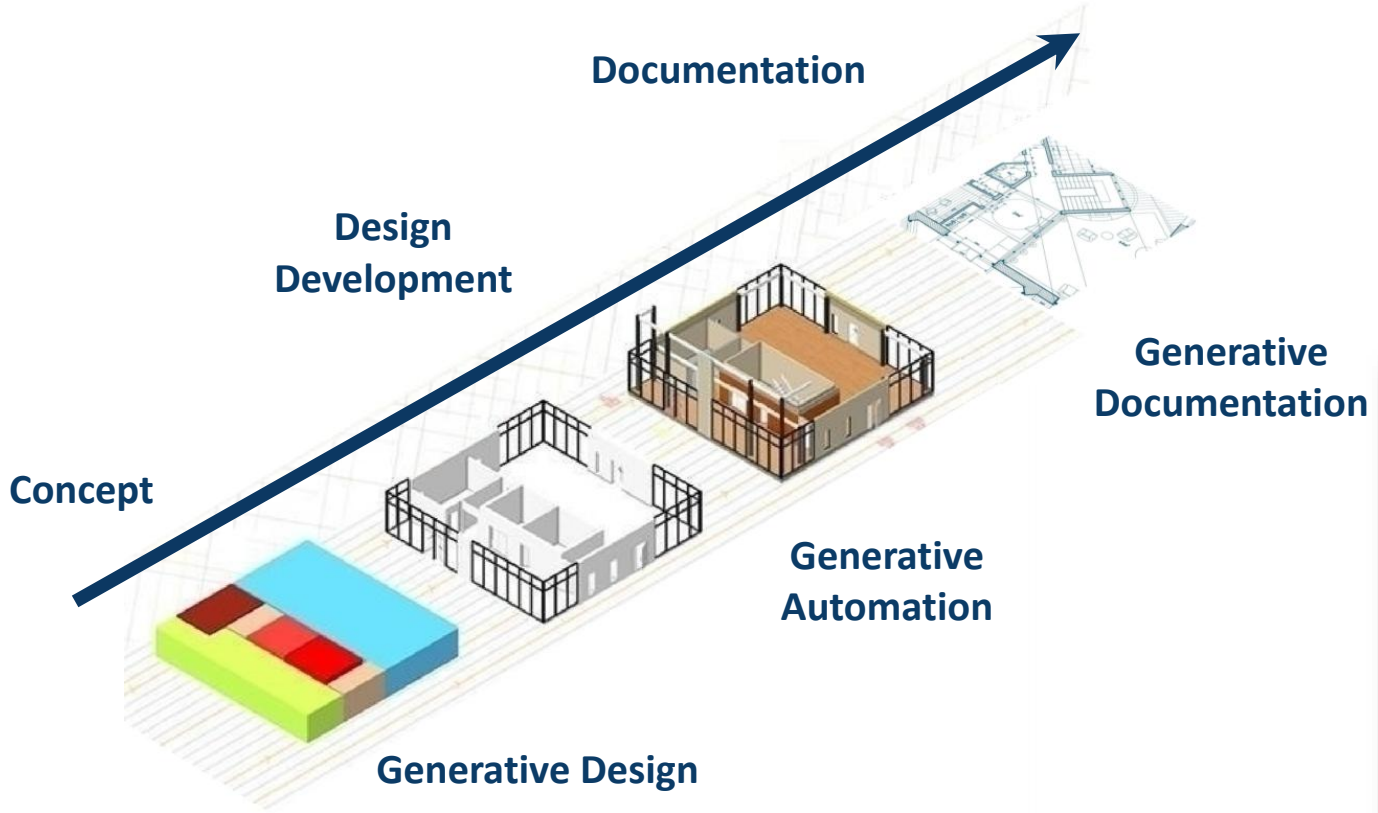
- Generative floor plan suggestions
- Style transfer for design inspiration
- Feasibility and cost estimation

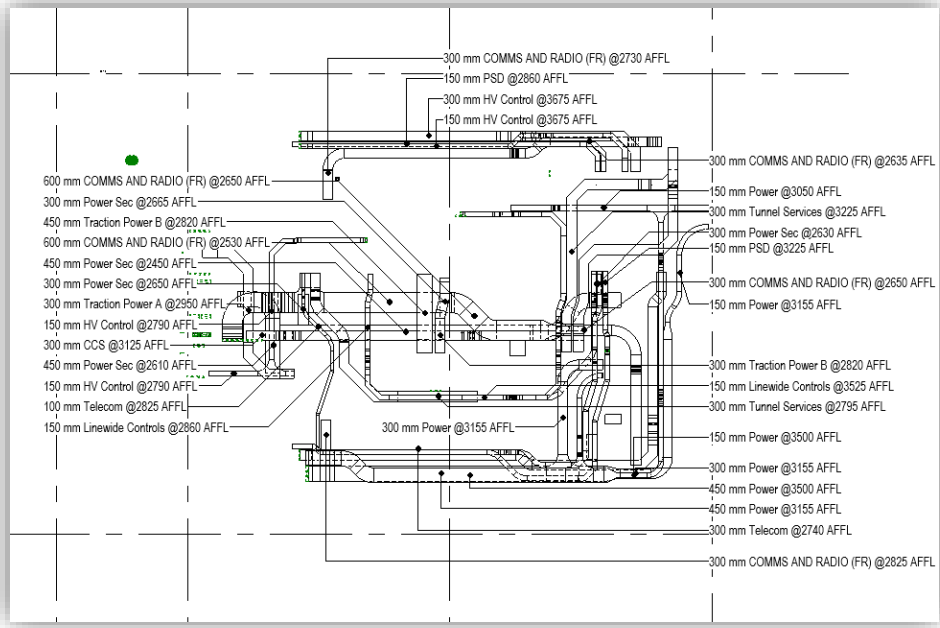
AI in AEC design



- ….
- Adjusting columns according to the sizes in Excel
- Checking if the airflow is correct
- Creating elevations
- Splitting the duct into standard pieces
- Importing the asset data from Excel
- ….

AI in AEC design





AI in AEC design

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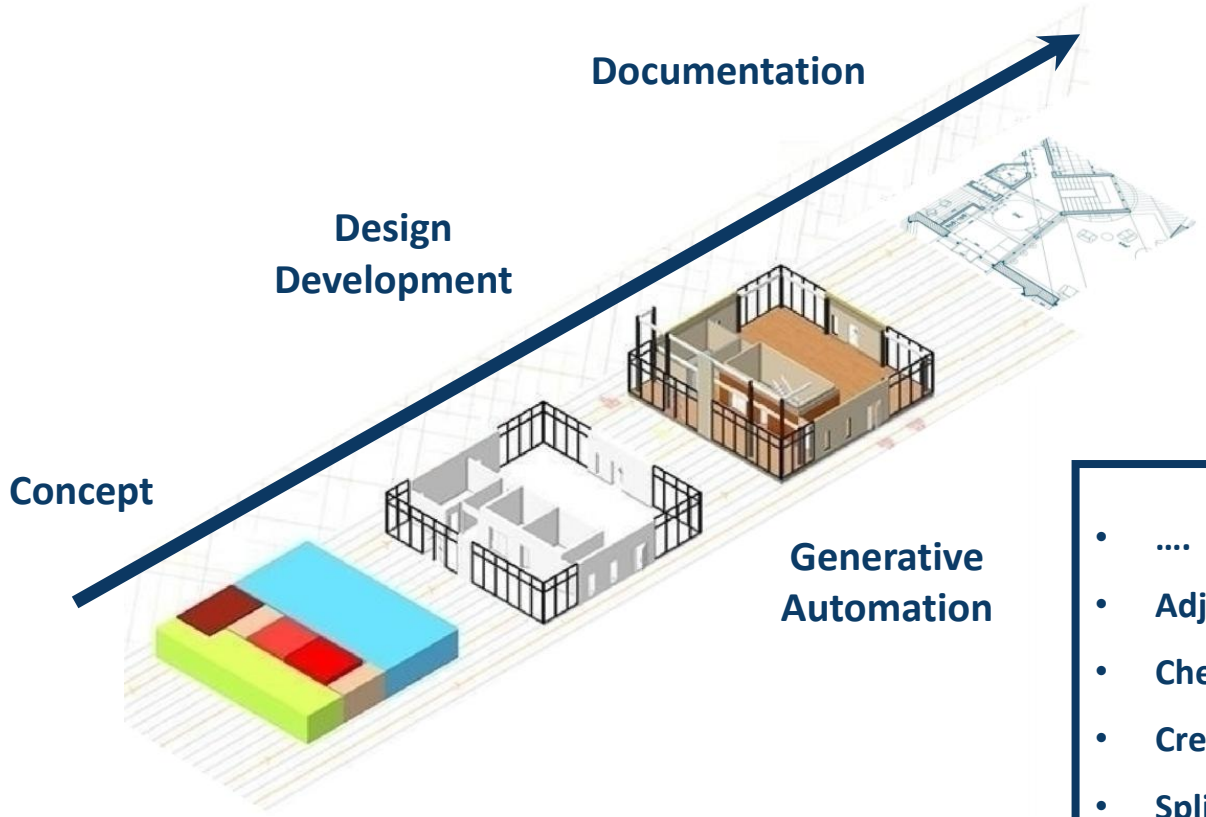

Software
Engineer

- ….
- Adjusting columns according to the sizes in Excel
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- Creating elevations
- Splitting the duct into standard pieces
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- ….

AI in AEC design

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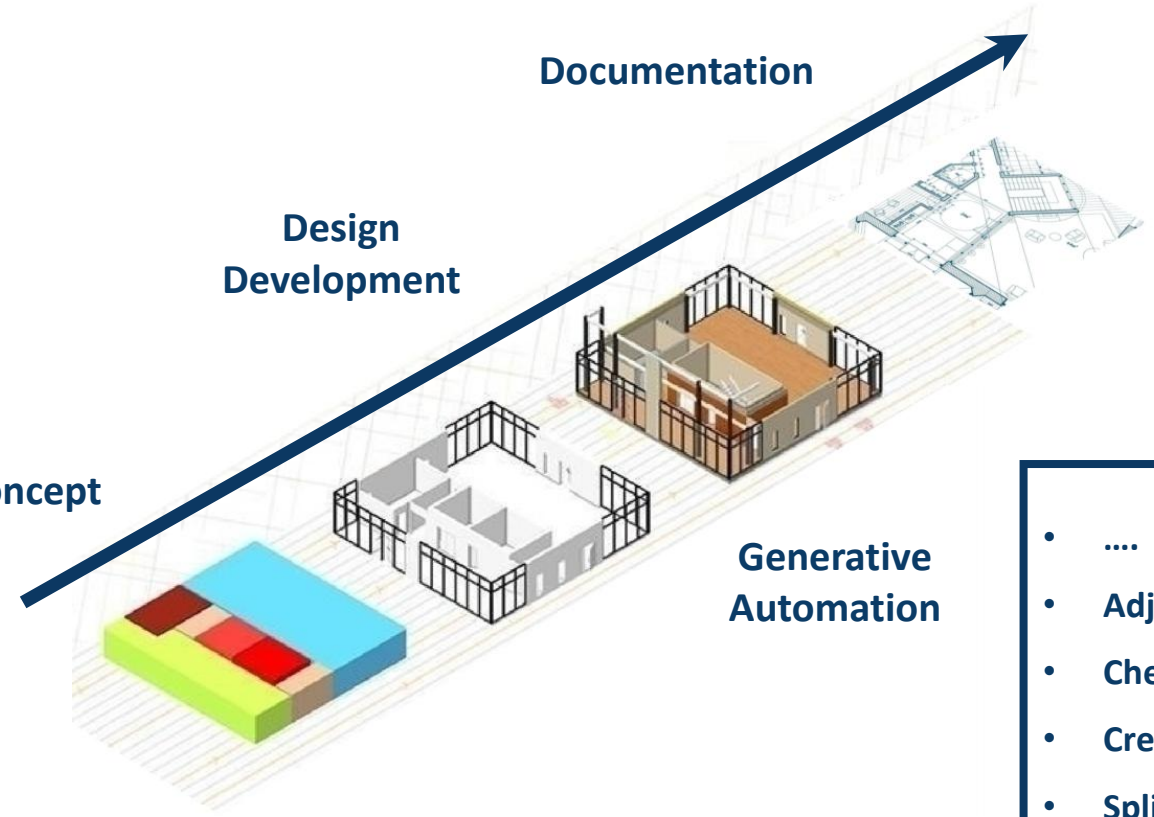

Code generation

- ….
- Adjusting columns according to the sizes in Excel
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- Creating elevations
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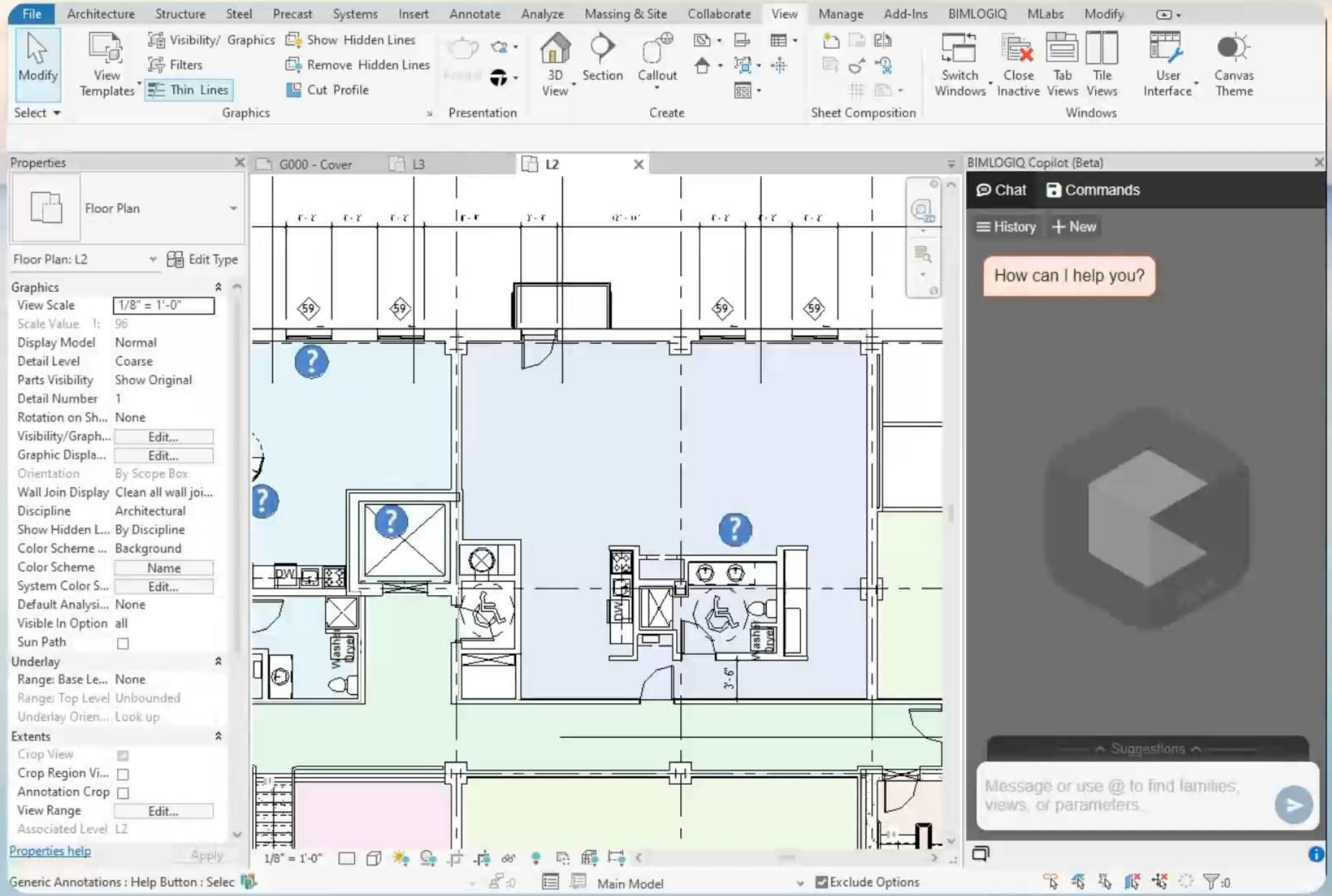
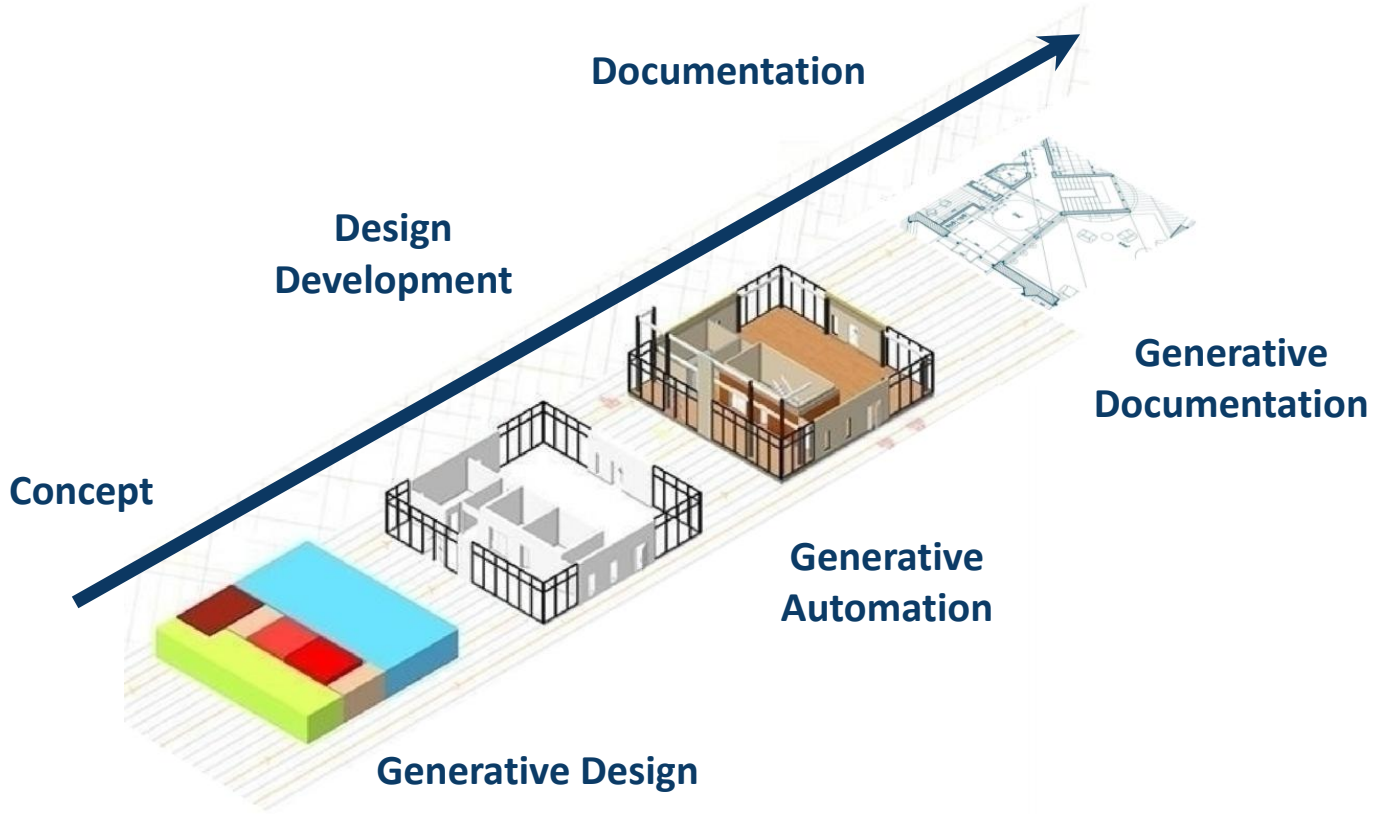
- ….


File
Architecture
Structure
Steel
Precast
Systems
Insert
Annotate
Analyze
Massing & Site
Collaborate
View
Manage
Add-Ins
BIMLOGIQ
MLabs
Modify
Modify
Select
View Templates
Visibility/ Graphics
Filters
Thin Lines
Show Hidden Lines
Remove Hidden Lines
Cut Profile
Graphics
Presentation
3D View
Section
Callout
Create
Sheet Composition
Switch Windows
Close Inactive
Tab Views
Tile Views
User Interface
Canvas Theme
Windows
Properties
Floor Plan
Floor Plan: L2
Edit Type
Graphics
View Scale 1/8" = 1'-0"
Scale Value 1: 96
Display Model Normal
Detail Level Coarse
Parts Visibility Show Original
Detail Number 1
Rotation on Sh... None
Visibility/Graph... Edit...
Graphic Displa... Edit...
Orientation By Scope Box
Wall Join Display Clean all wall joi...
Discipline Architectural
Show Hidden L... By Discipline
Color Scheme ... Background
Color Scheme Name
System Color S... Edit...
Default Analysi... None
Visible In Option all
Sun Path
Underlay
Range: Base Le... None
Range: Top Level Unbounded
Underlay Orien... Look up
Extents
Crop View
Crop Region Vi...
Annotation Crop
View Range Edit...
Associated Level L2
Properties help
Apply
G000 - Cover
L3
L2
1/8" = 1'-0"
BIMLOGIQ Copilot (Beta)
Chat
Commands
History
New
How can I help you?
Suggestions
Message or use @ to find families, views, or parameters...
Generic Annotations : Help Button : Selec
Main Model
Exclude Options

The three phases of design



AI agents in design

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Standards,
Codes,
Project documents,
Asset data,
....

Multimodal AI Agents

Generative Automation
Automation foundation model

Generative Documentation
Documentation foundation model

Generative Design
Design foundation model

Commands

Engineers
Architects
Drafters
...

CAD Software

Revit

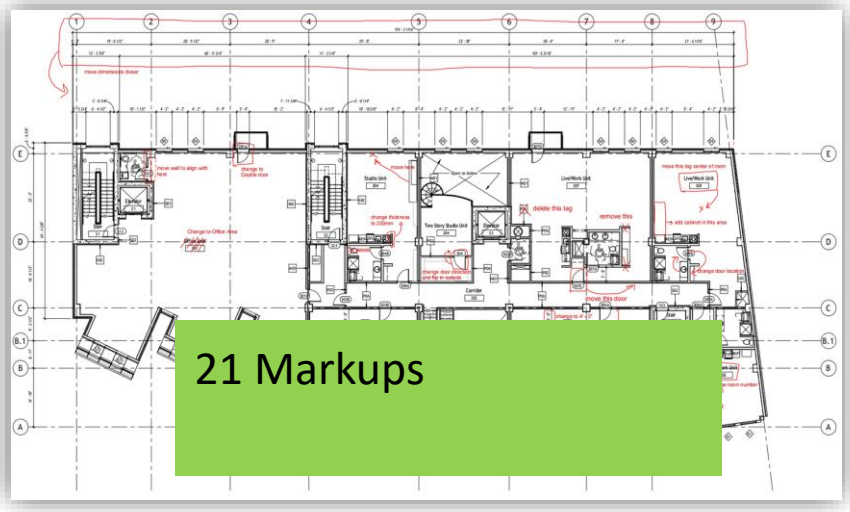
AutoCAD

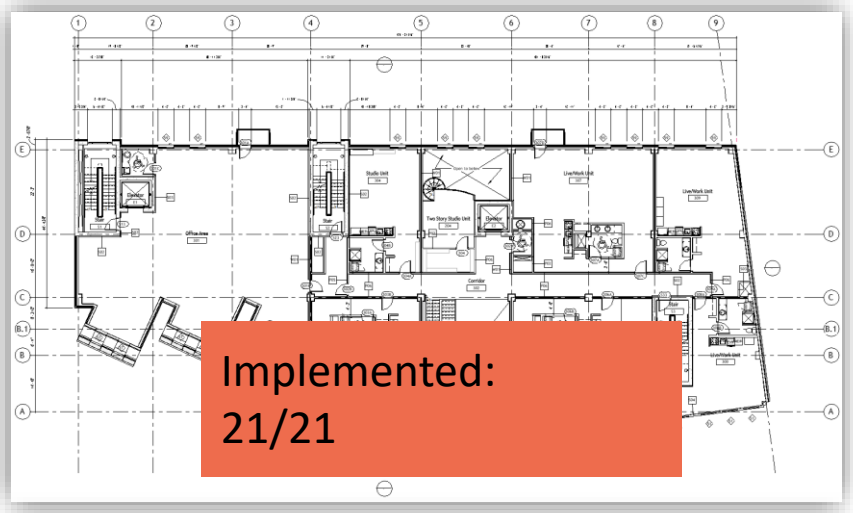
ArchiCAD

Civil 3D

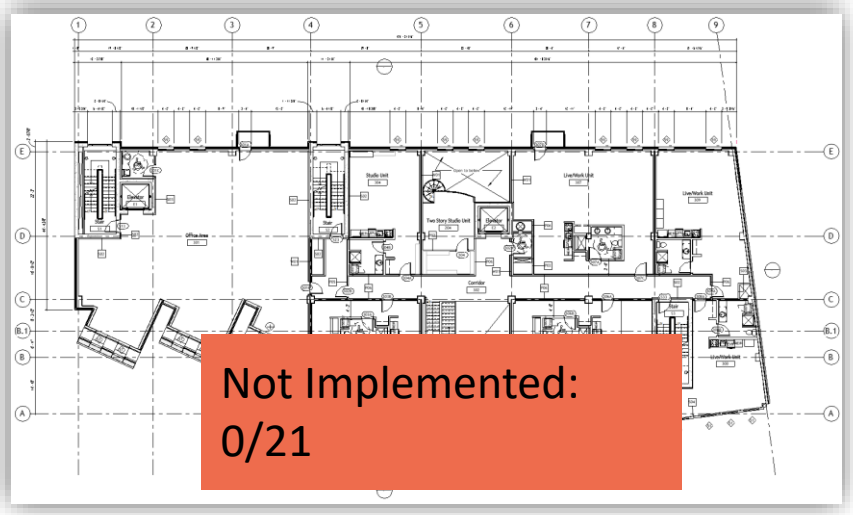
...

General-purpose AI models are poor in vertical domains



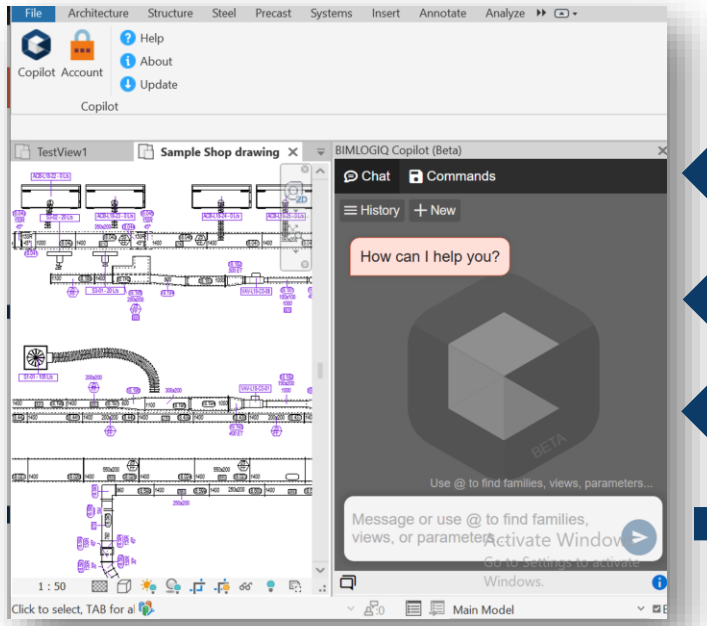


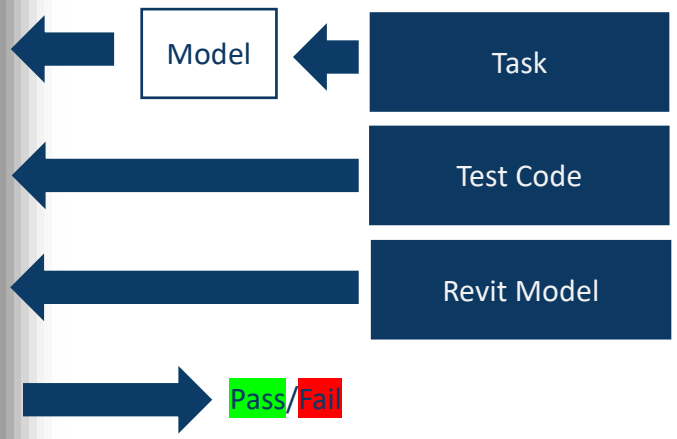
Claude: listed 18 out of 21 revisions and claimed that 1 out of 18 are implemented.

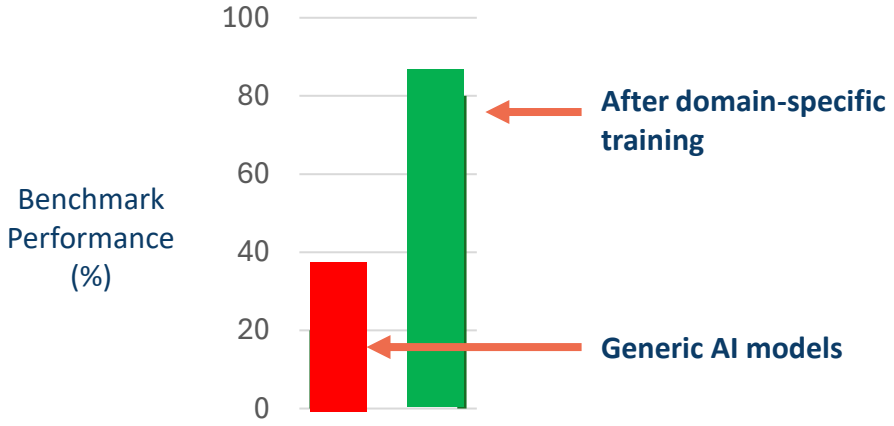


GPT4o: listed 21 out of 21 revisions and claimed that all are implemented.

Good news: Performance improves with domain-specific data







But, data collection is slow and expensive

Reinforcement learning is key to training models in AEC design

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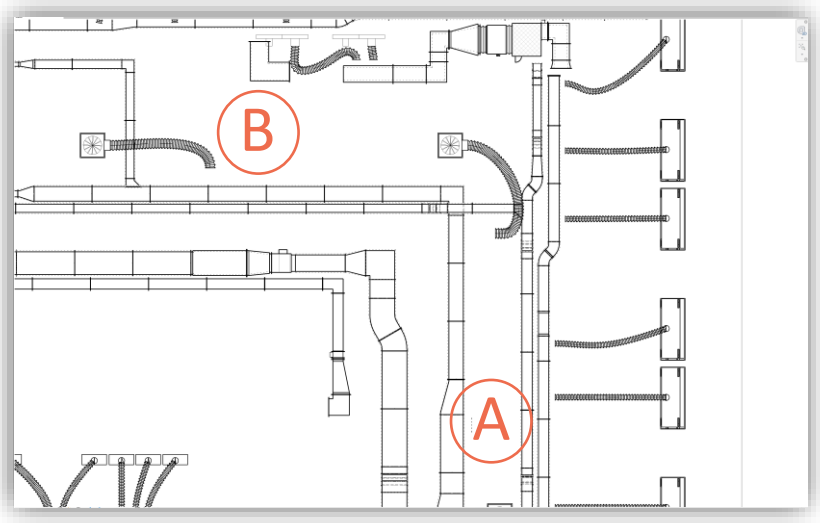
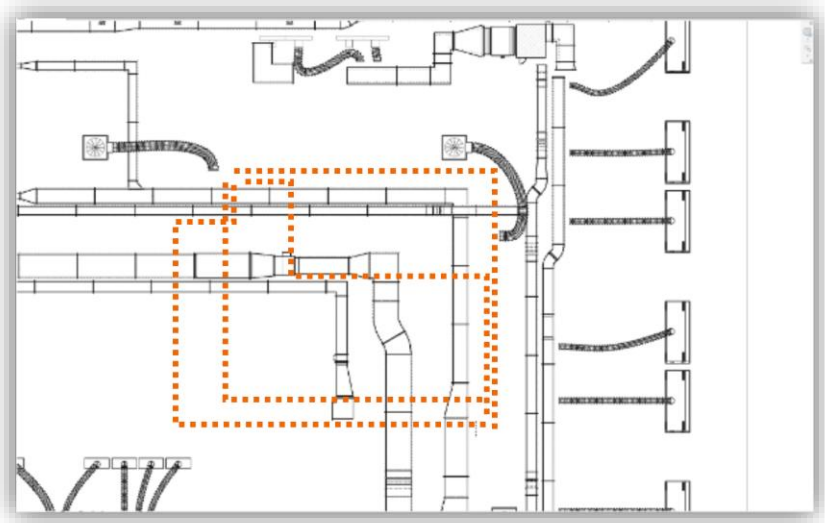
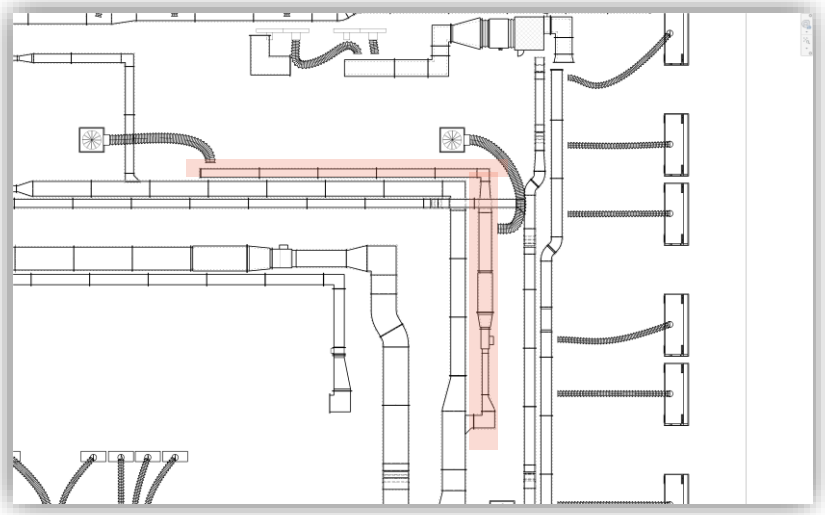




Evaluation of each option

Training the model to generate routes with better evaluations



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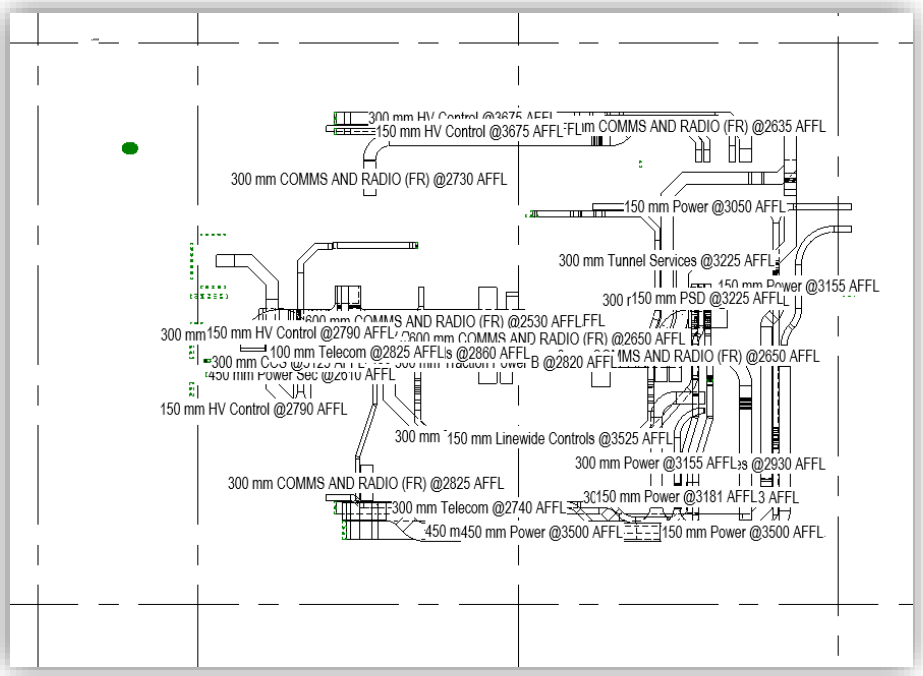
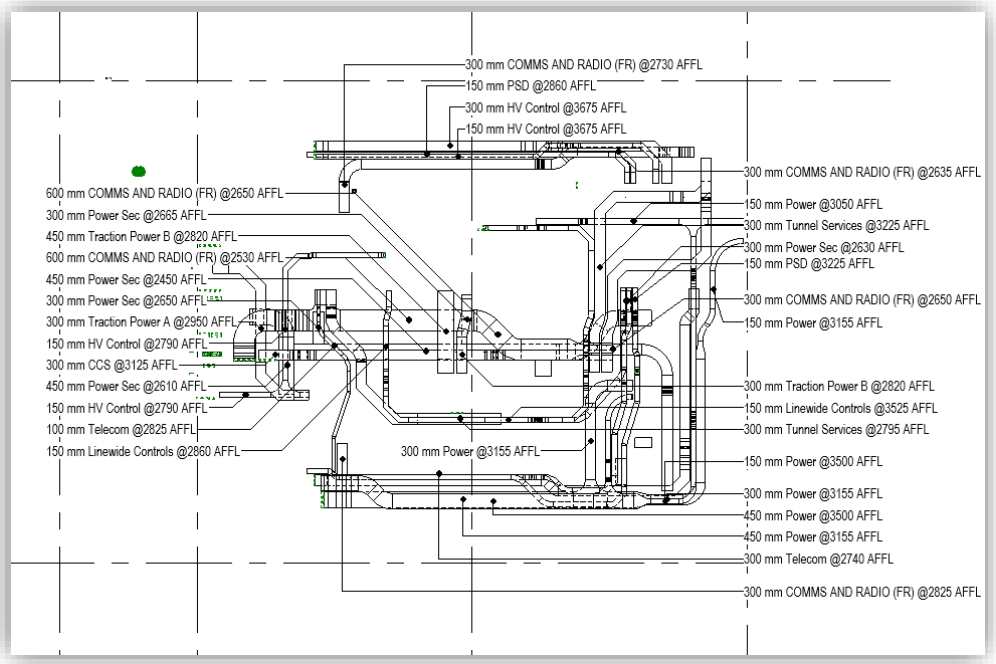


Training the model to place tags



Smart Annotation

Can we scale up reinforcement learning?

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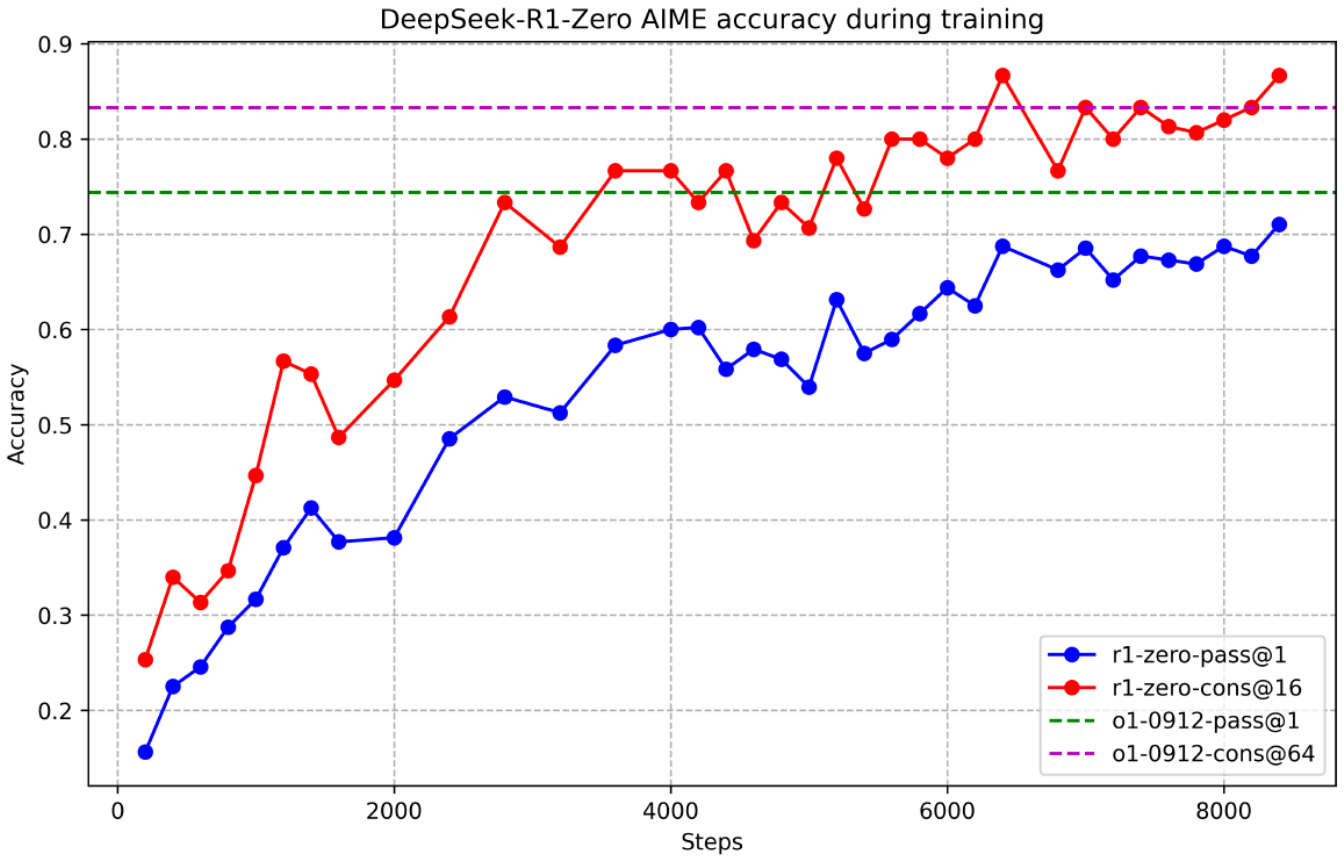

DeepSeek-R1-Zero is trained with reinforcement learning and can match closed-source models

Conclusion

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AI is Transforming Design

- Boosts productivity by automating repetitive, labor-intensive tasks.
- Reduces errors, minimizes rework, and ensures better project outcomes.

Scalable Solutions Are Within Reach

- Domain-specific data significantly improves AI performance.
- Reinforcement learning accelerates model training and adaptability.

Collaboration is Key

- Success depends on seamless integration with existing workflows and tools.
- Clear communication and shared goals across teams will drive adoption.

Acknowledgments

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