

Unite! Innovative BIM Workflows for Industrialized Construction

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About the speaker

Soren Shen-Lung Lin

- Senior Architect at Nordic Office of Architecture
- Lead in Module Development
for the New Stavanger University Hospital project
- M. Arch. and M. Sc. in Built Environment
- Specializes in built environment analysis
and industrialization methodology



About the speaker

Bridget White

- Senior Architect / BIM Director
at Nordic Office of Architecture
- BREEAM AP
- Uses a wide range of Autodesk products
and implements new office workflows involving
complex analysis, virtual reality, industrialization,
integrated sustainability, and streamlining the flow
of information between architects and the building
industry.

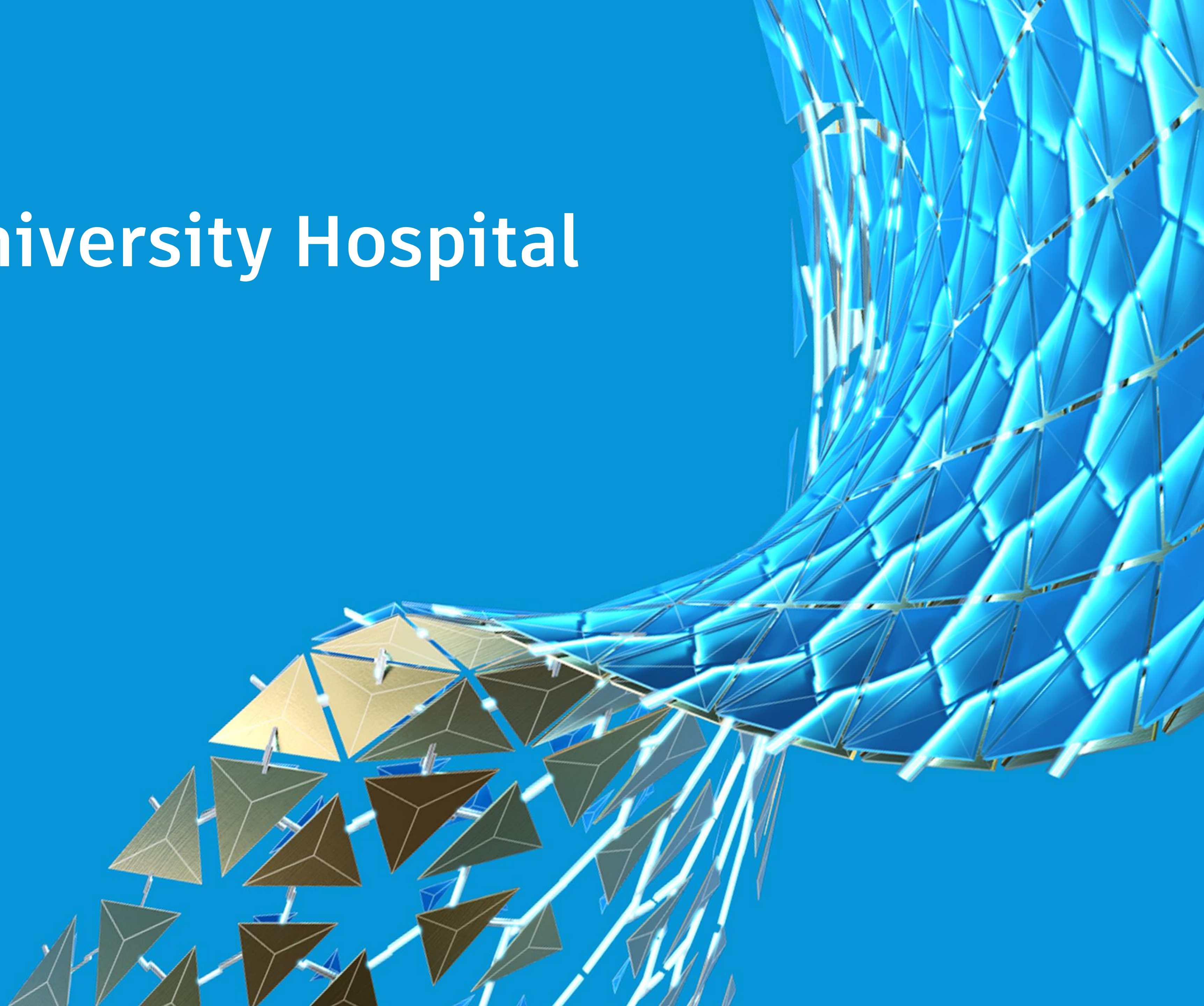


About the speaker

Steve DeWitt

- 20 years of experience in design software
- Certified Autodesk Revit® professional
- A contributor to several AEC groups:
- A founder of KitConnect

The New Stavanger University Hospital

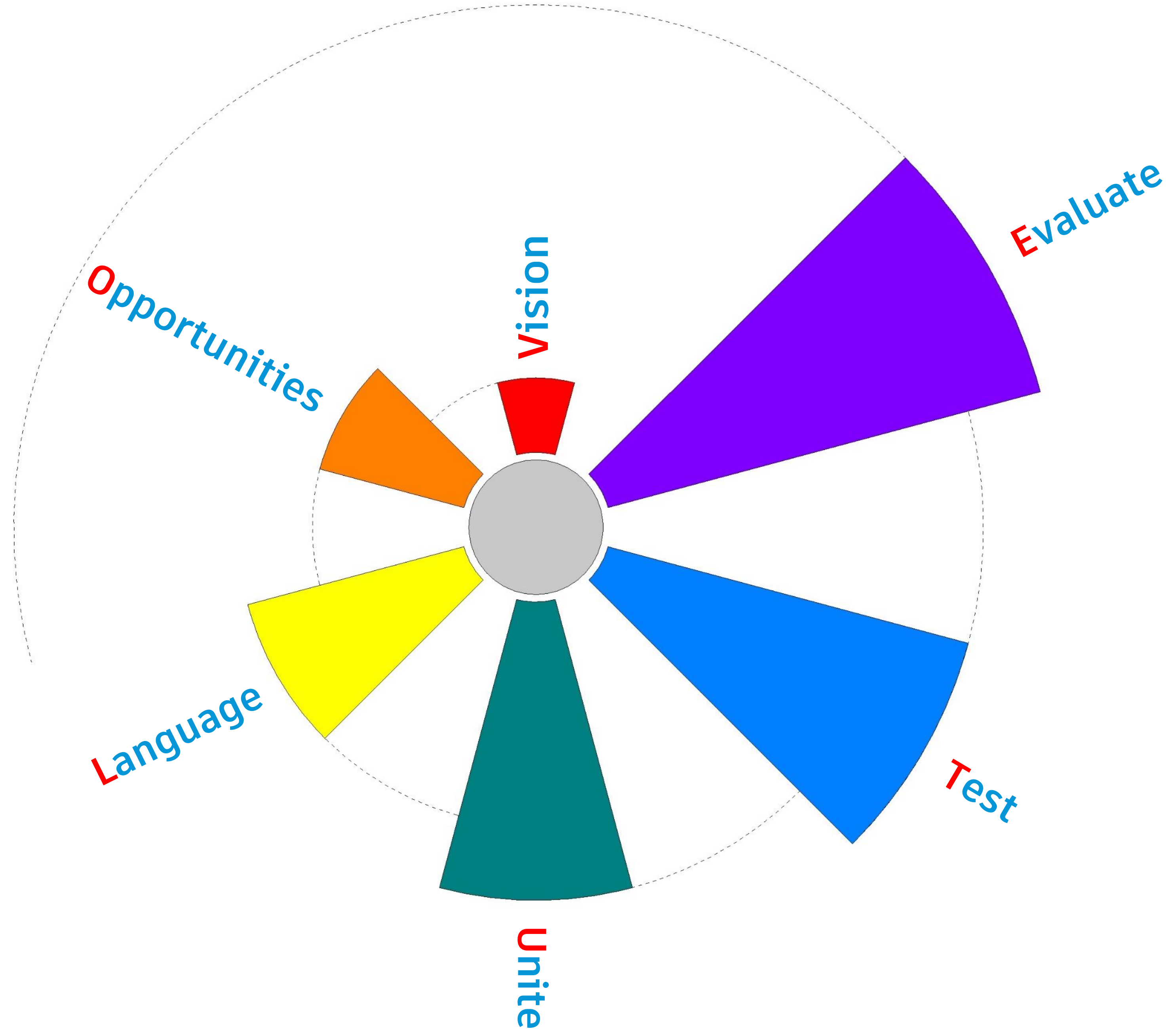


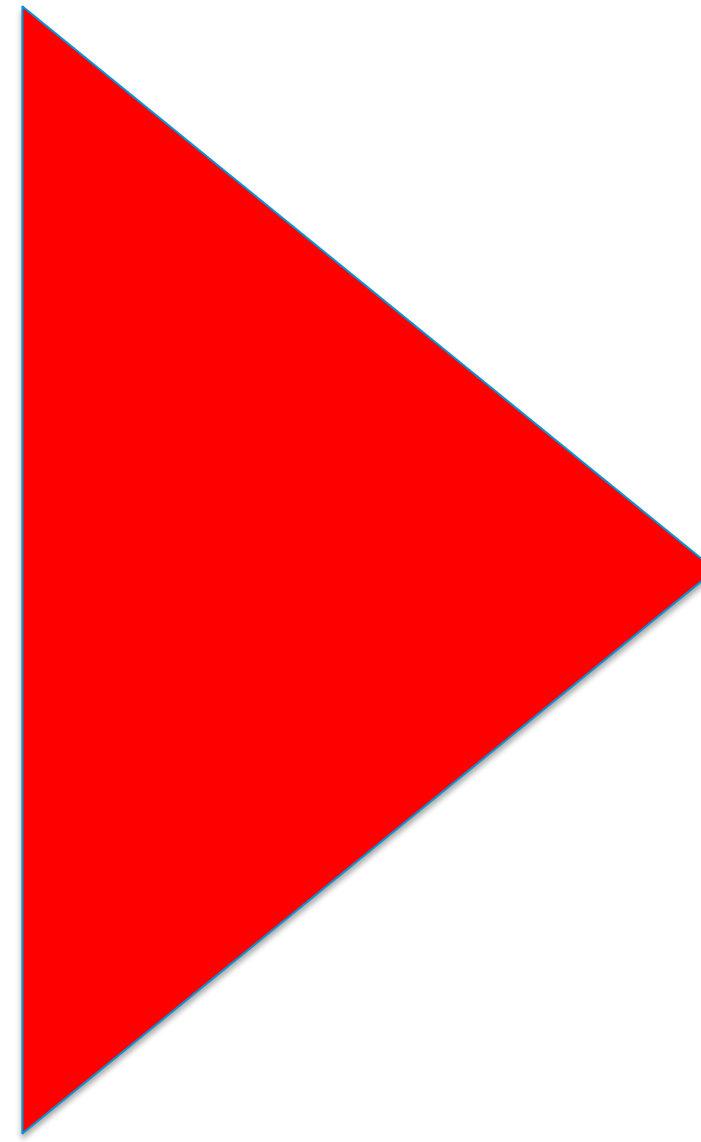


V.O.L.U.T.E. - A Step by Step Workflow

V.O.L.U.T.E.

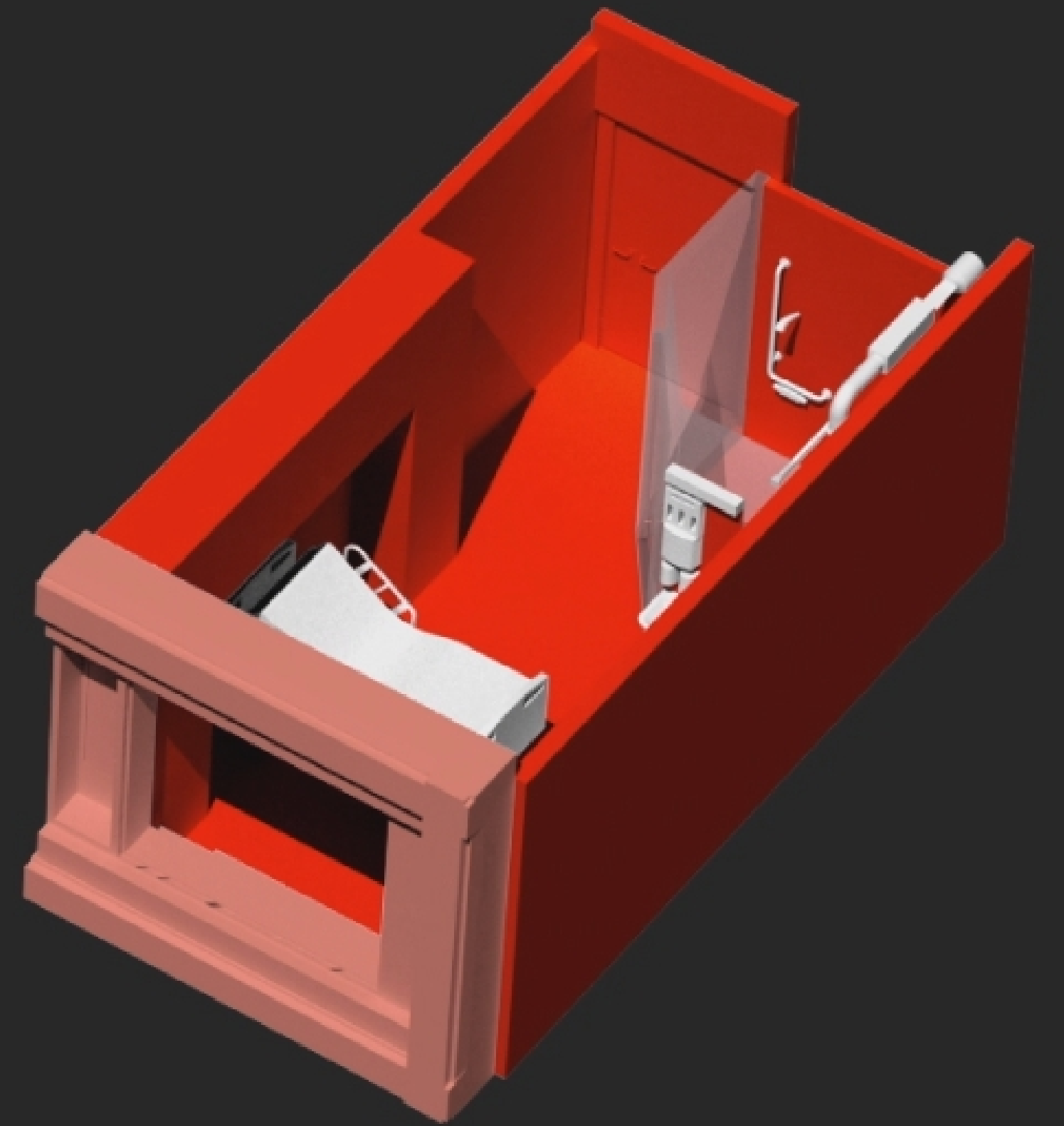
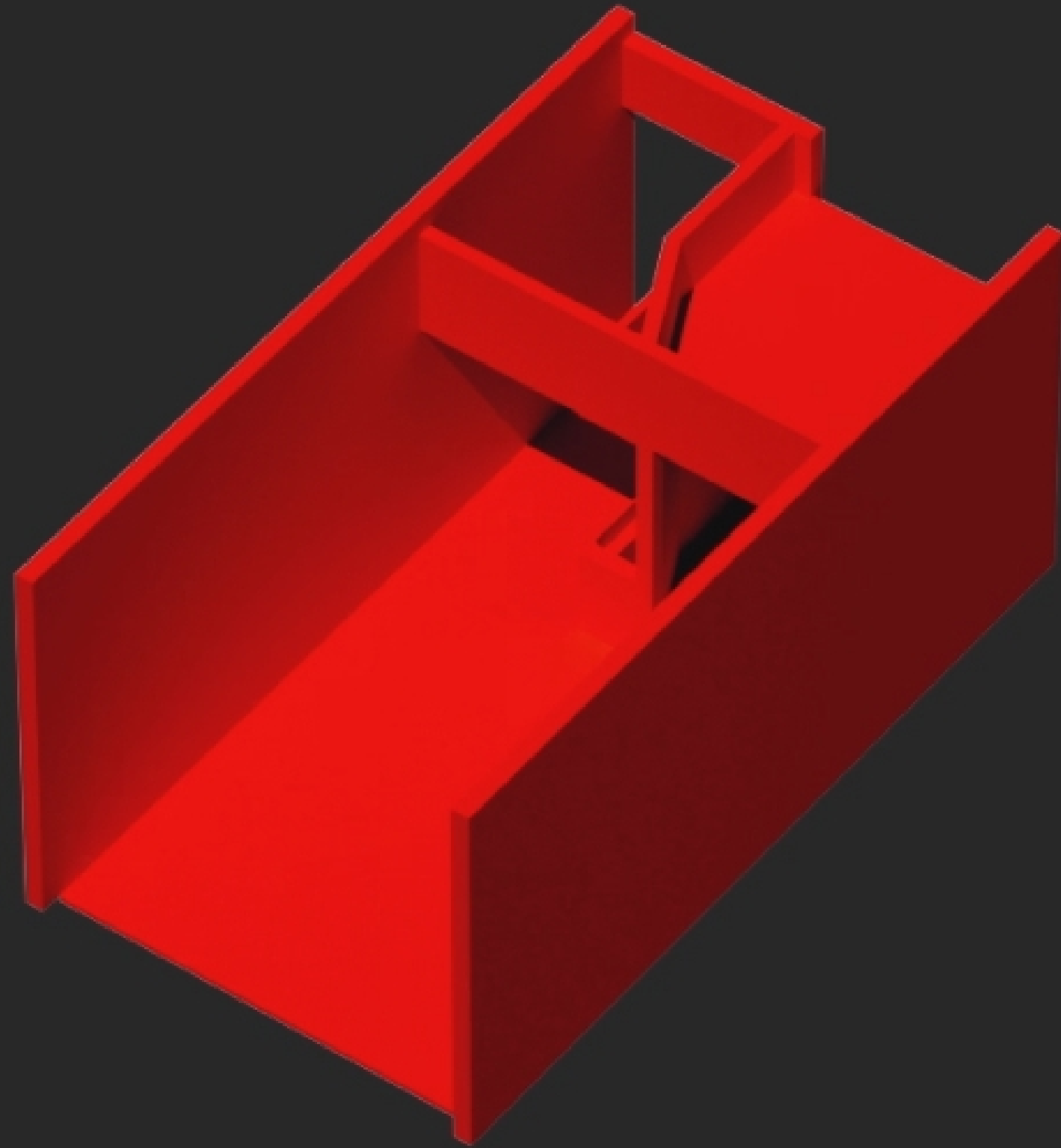
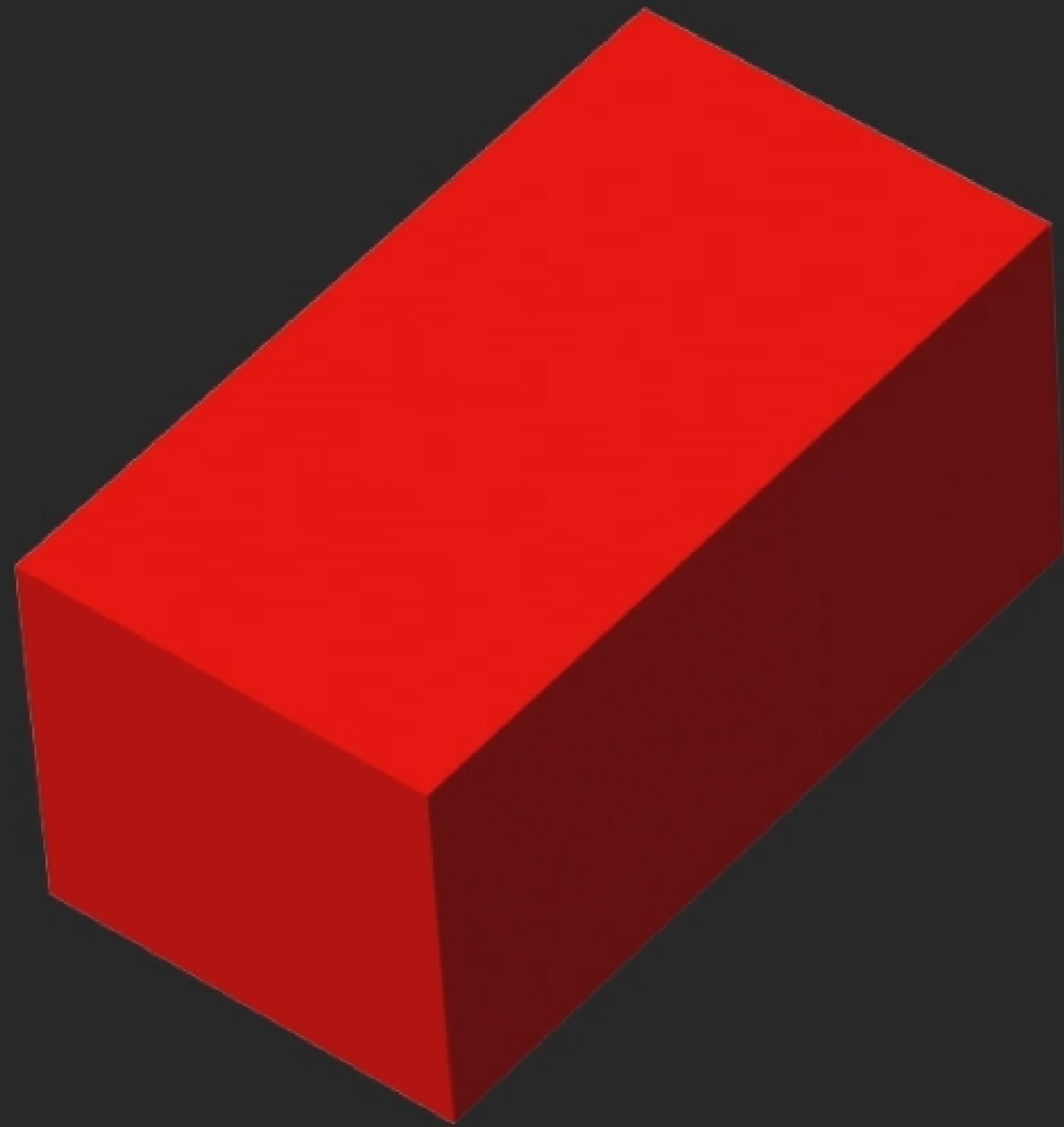
A step by step workflow

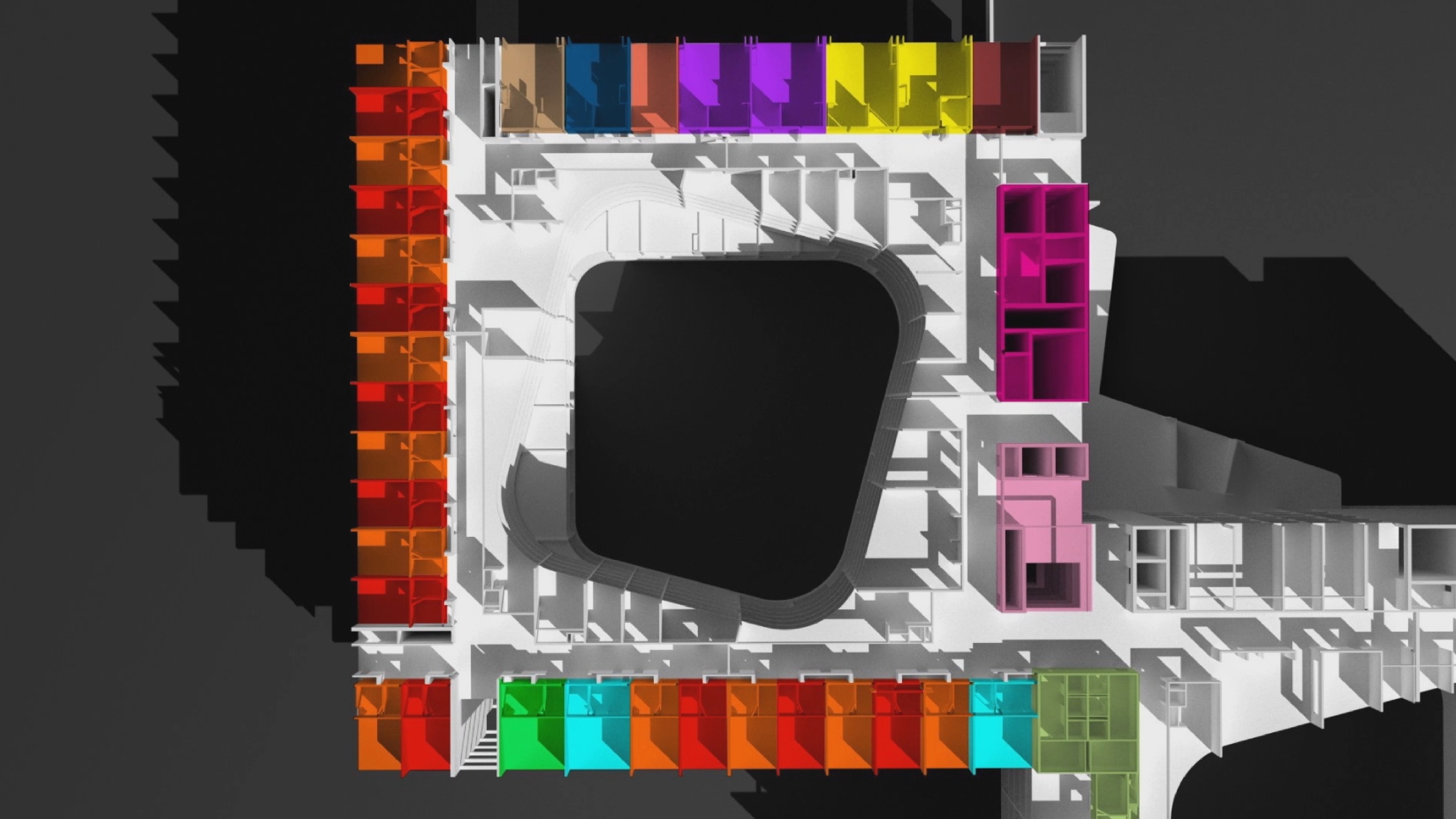


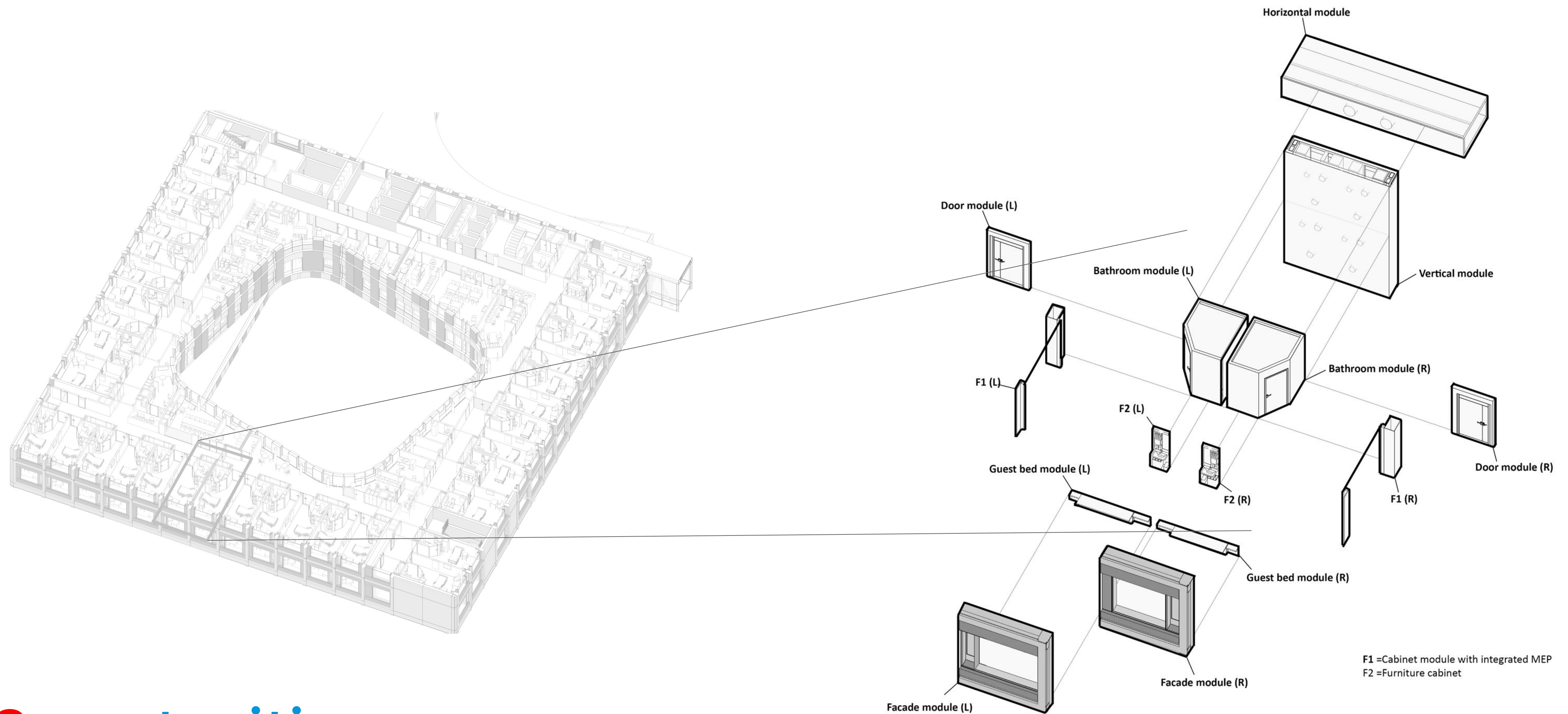


Vision

One click or few clicks to rule it all

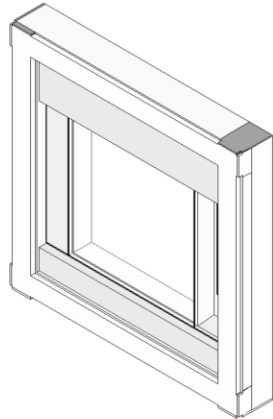

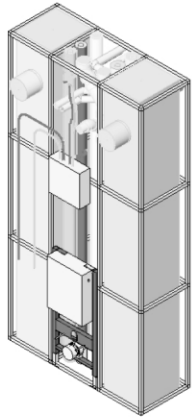

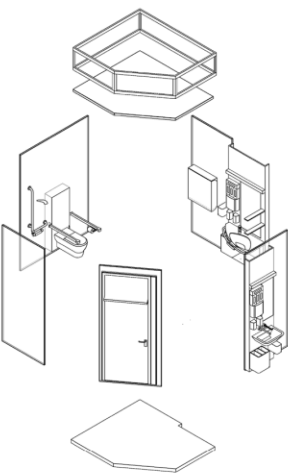

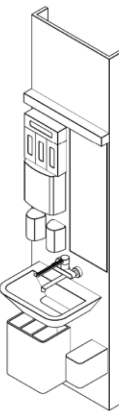

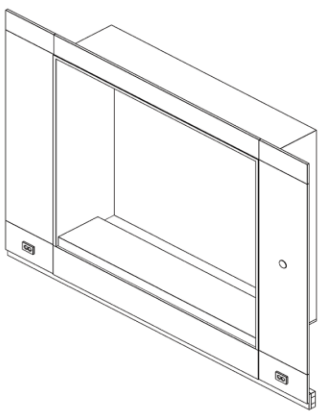

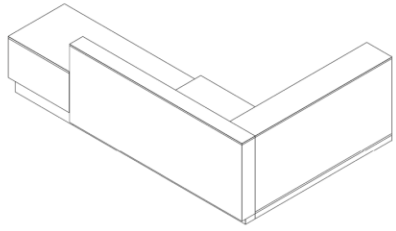





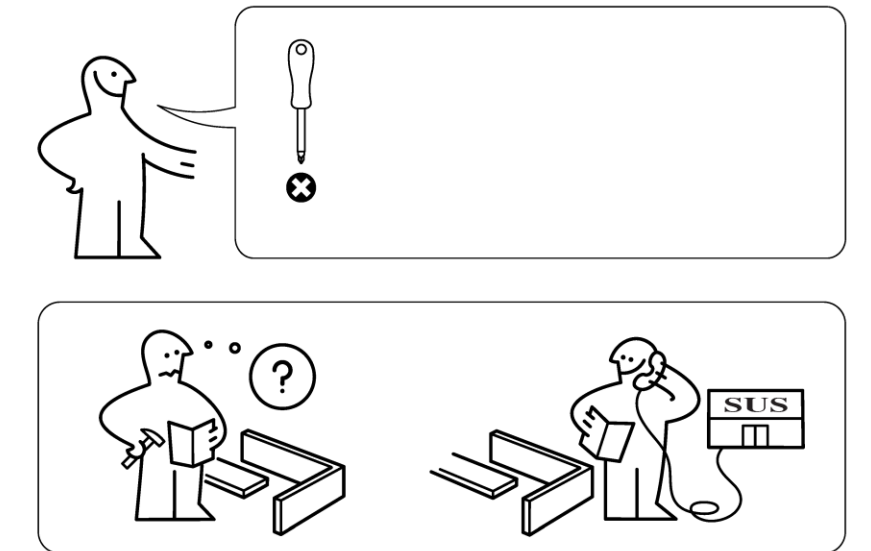
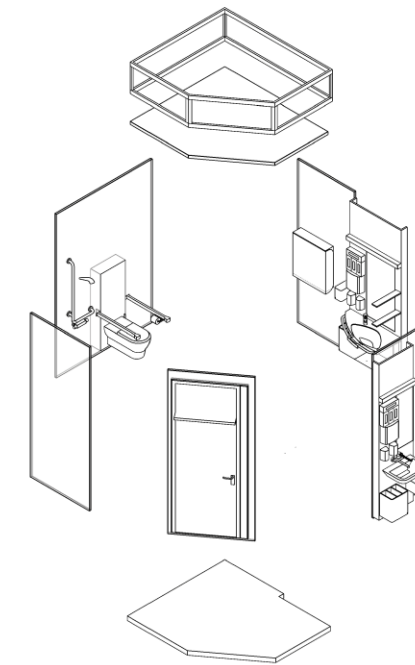


Opportunities

Analyze the opportunities in the project and systemize them.

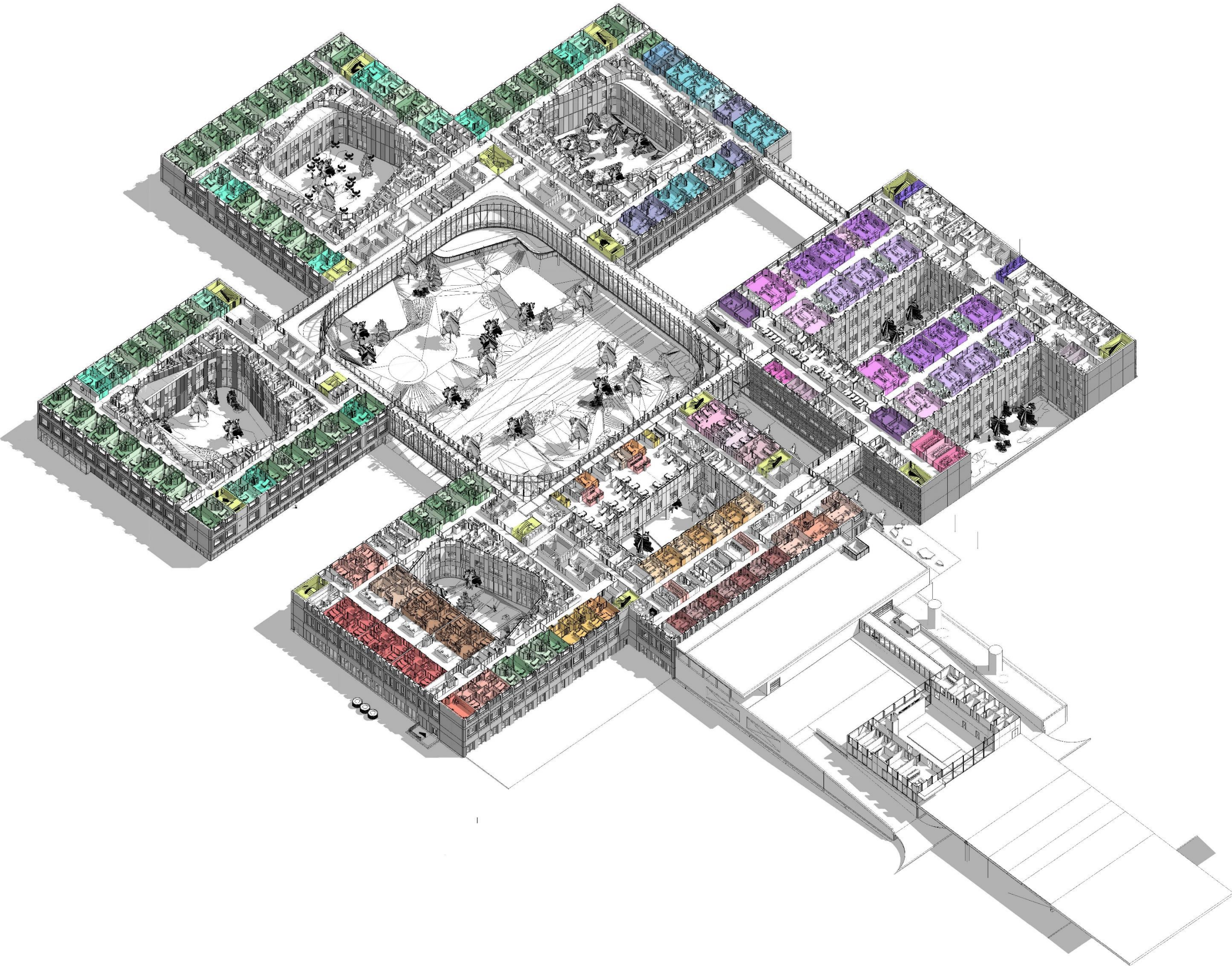
<p>FACADE MODULE</p>  	<p>V-MODULE</p>  	<p>BATHROOM MODULE</p>  	<p>737 Units</p> <p>589 Units</p>
<p>VANITY UNIT MODULE</p>  	<p>GUEST BED MODULE</p>  	<p>WORKSTATION MODULE</p>  	<p>2377 Units</p> <p>577 Units</p> <p>89 Units</p>

BATHROOM MODULE



Opportunities

Modules – For prefabrication



Standard Room	Building 81	Building 71	Building 21
Patient room	289	58	102
Workstation (inner)	53	14	17
Workstation (outer)	55	14	18
Disinfection room	42	11	20
.....

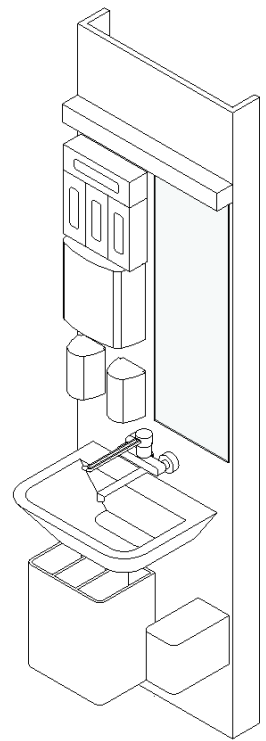
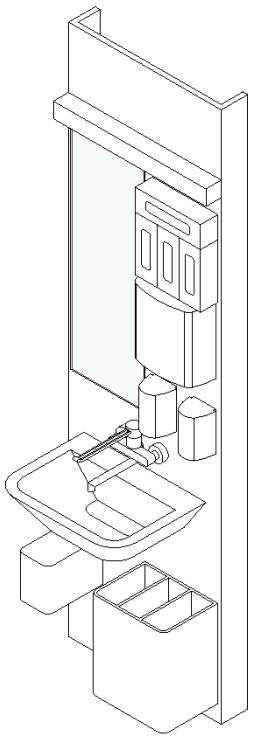
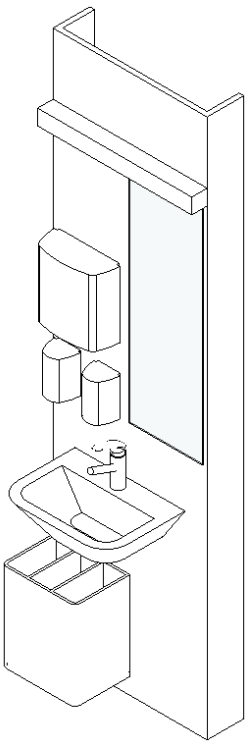
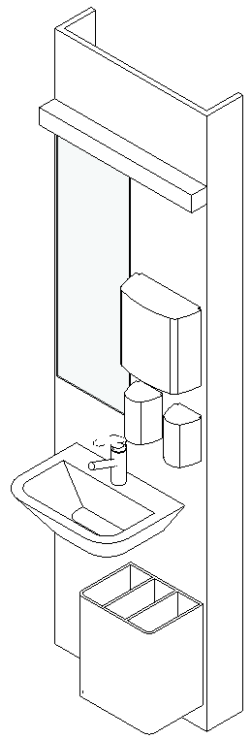
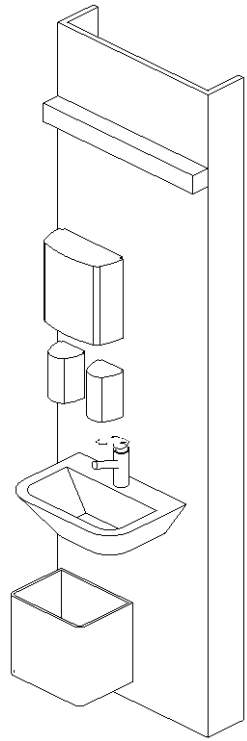
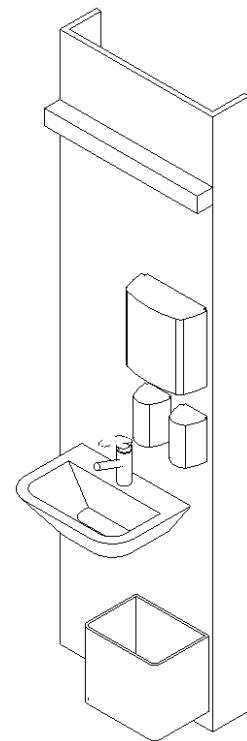
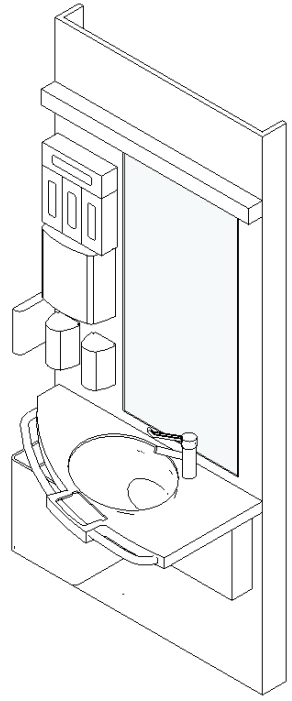
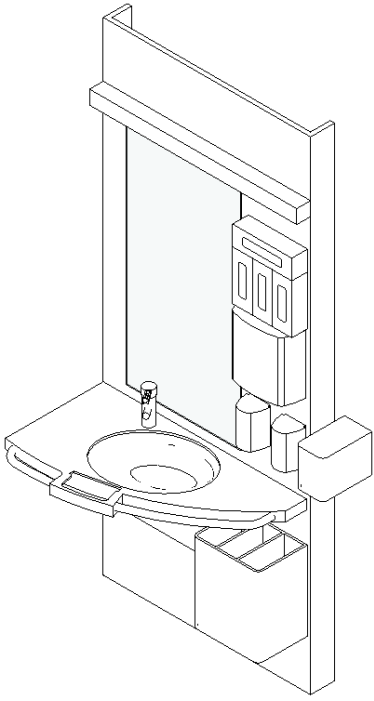
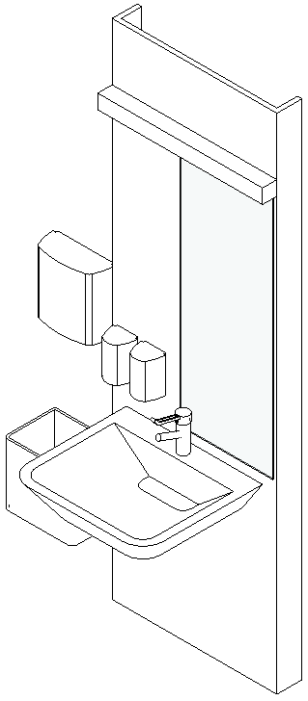
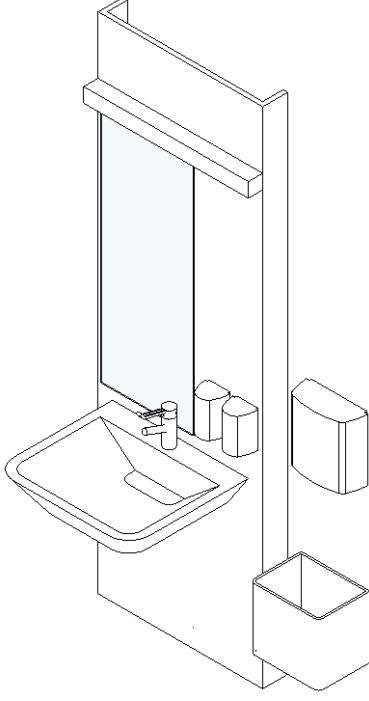
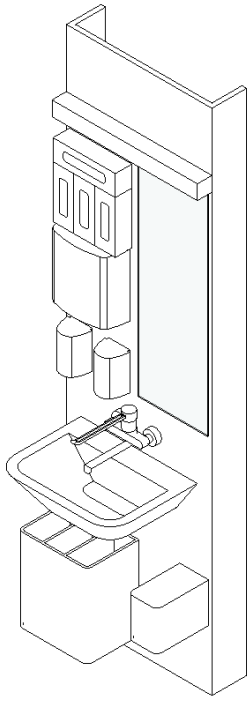
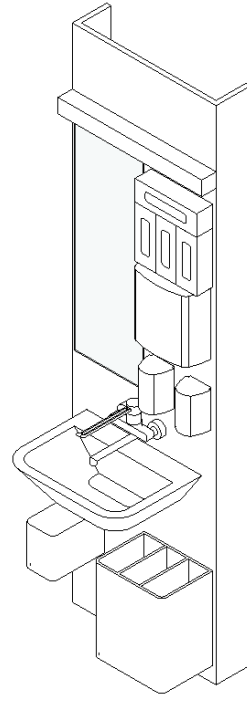
Opportunities

Design Repetitions – Not for prefabrication

	dRofus Main group	dRofus Undergroup 1		dRofus Undergroup 2		dRofus Undergroup 3		Auto generated serial number in dRofus
	Module Type							
	8 + Module Category	Type Running Number		Deviation		Orientation		Material / Colour
	8B=Bathroom Module	01=Type 01		A=Standard, No deviation		R=Orientation Right		001=Material / Colour 1
	8C=Cabinet Module	02=Type 02		B=Deviation B		L=Orientation Left		002=Material / Colour 2
	8D=Door Module	03=Type 03		C=Deviation C		N=Orientation Neutral		003=Material / Colour 3
	8G=Guest Bed Module	04=Type 04						...
	8H=H-Module	05=Type 05						
	8S=Vanity Unit Module	06=Type 06						
	8V=V-Module	...						
Module Code in dRofus	8X01 / 8X02 / 8X03	A / B / C	R / L / N	.	001 / 002 / 003 ...

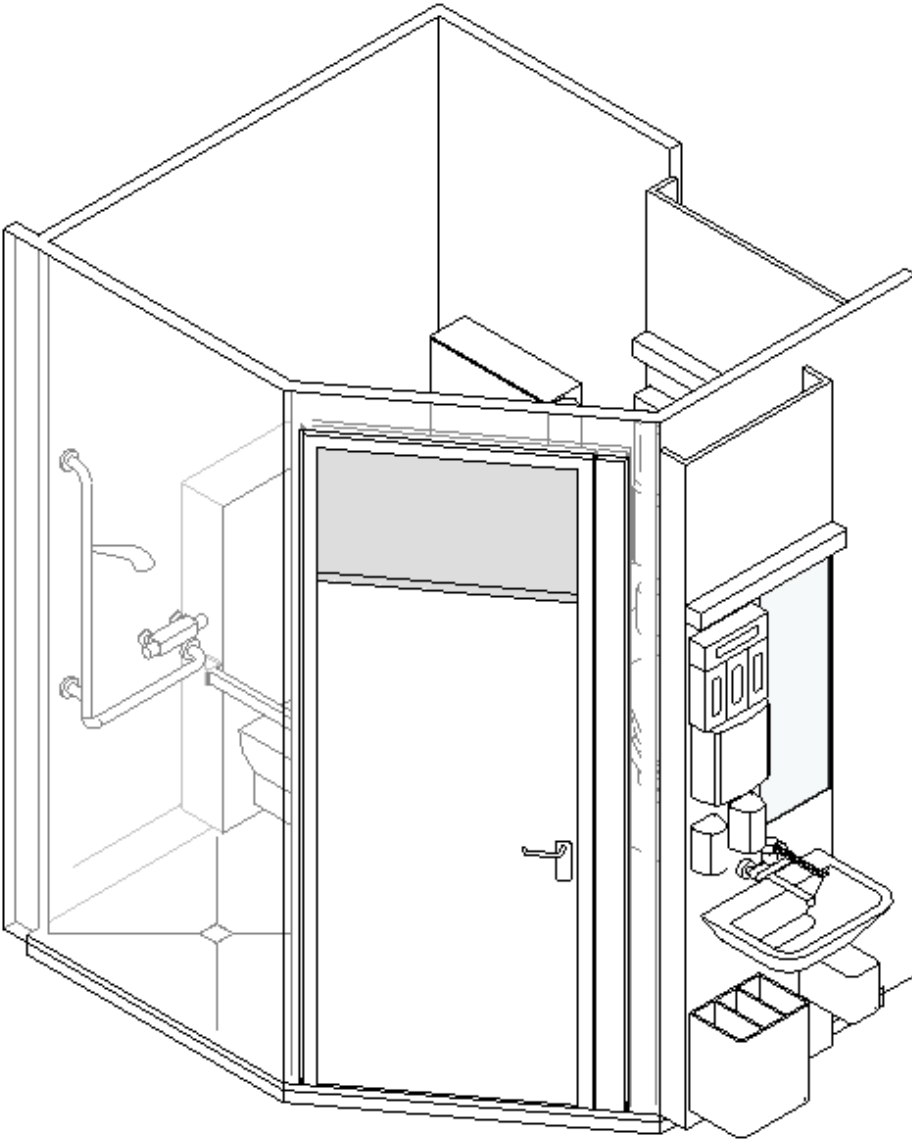
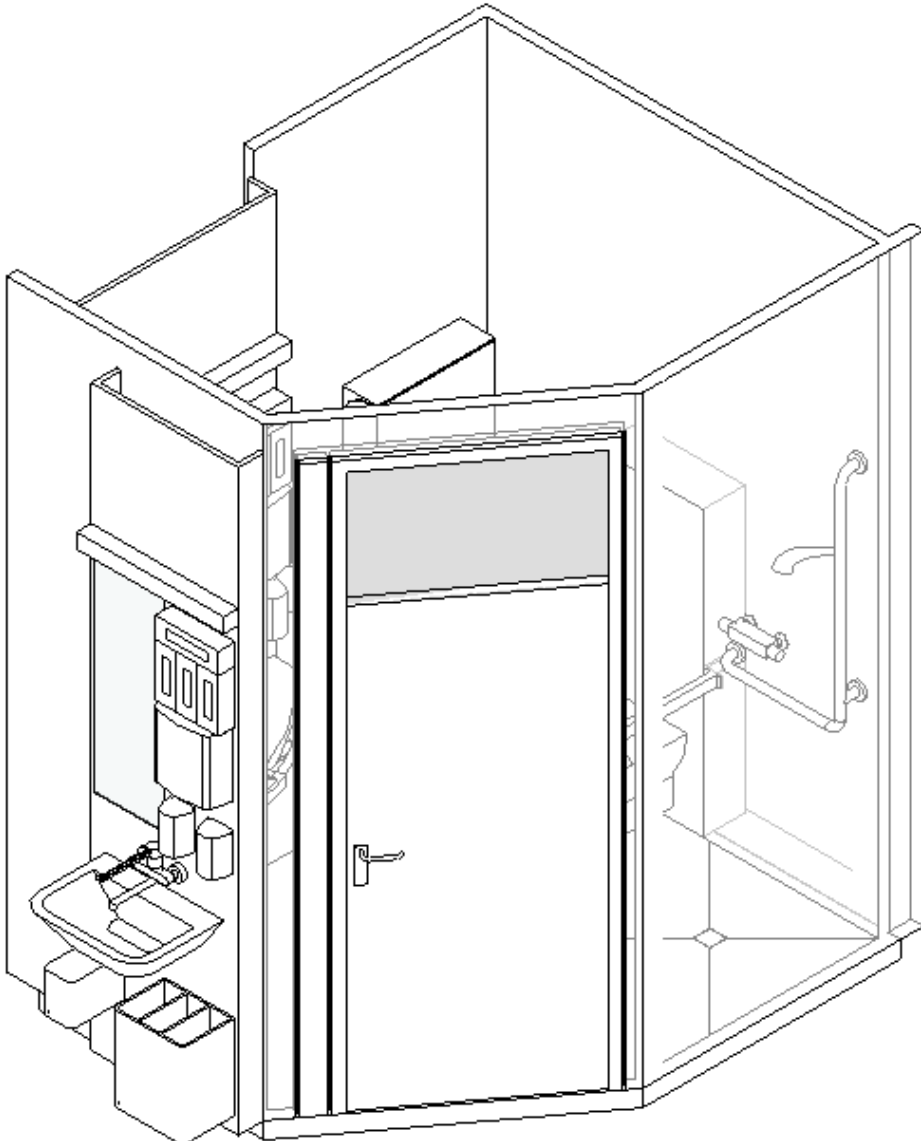
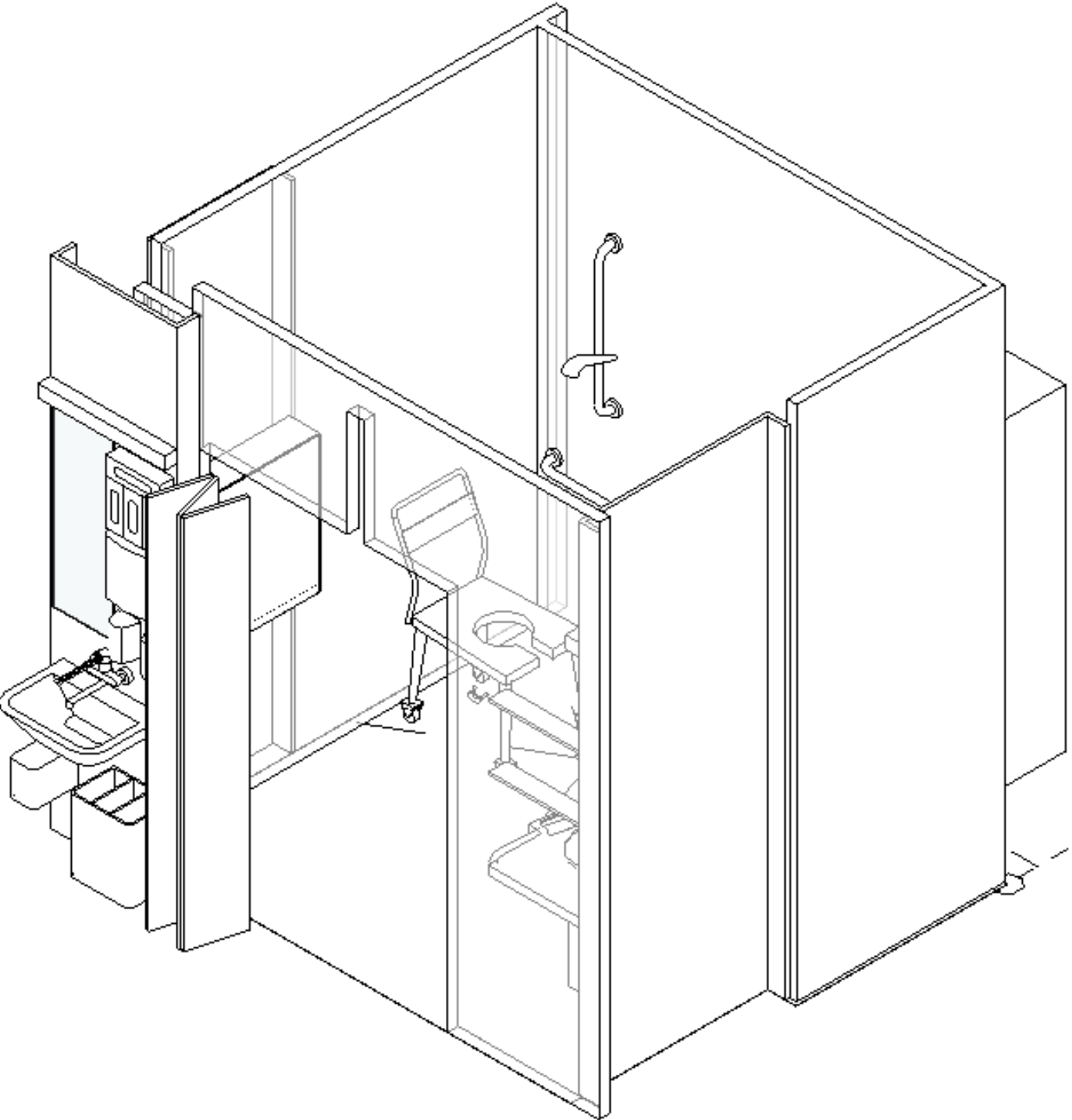
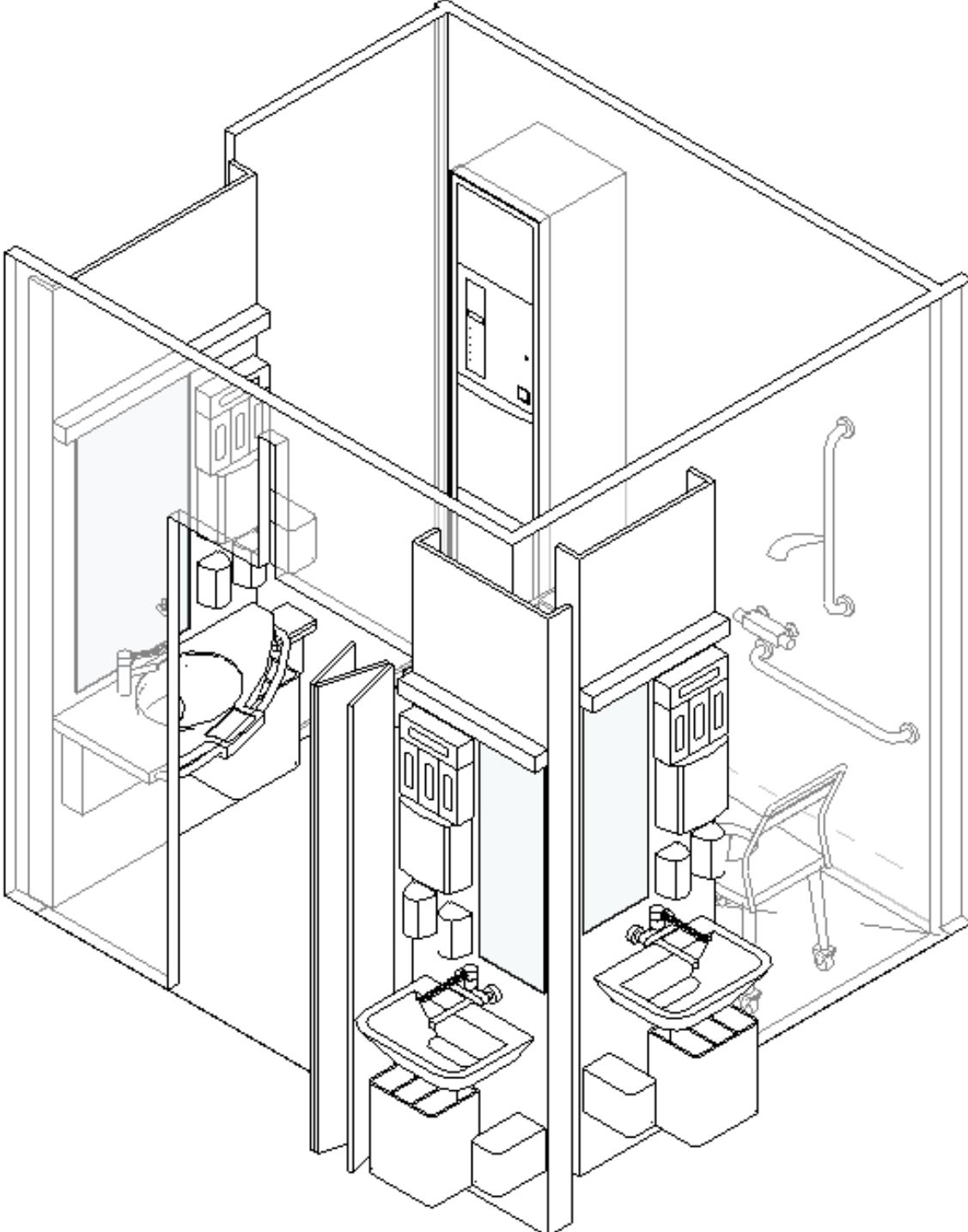
Language

A logical and cross-disciplinary coding system

					
8S01.A.L.001 Vanity Unit Module 01_ Patient Care_H=2400mm_Left	8S01.A.R.001 Vanity Unit Module 01_ Patient Care_H=2400mm_Right	8S02.A.L.001 Vanity Unit Module 02_ Administrative Area, WC_H=2400mm_Left	8S02.A.R.001 Vanity Unit Module 02_ Administrative Area, WC_H=2400mm_Right	8S03.A.L.001 Vanity Unit Module 03_ Operational Area_H=2400mm_Left	8S03.A.R.001 Vanity Unit Module 03_ Operational Area_H=2400mm_Right
					
8S04.A.L.001 Vanity Unit Module 04_Bathroom_H=2400mm_Left	8S04.A.R.001 Vanity Unit Module 04_Bathroom_H=2400mm_Right	8S05.A.L.001 Vanity Unit Module 05_HCWC_H=2400mm_Left	8S05.A.R.001 Vanity Unit Module 05_HCWC_H=2400mm_Right	8S06.A.L.001 Vanity Unit Module 06_ Patient Care with Manifold Cabinet_H=2400mm_Left	8S06.A.R.001 Vanity Unit Module 06_ Patient Care with Manifold Cabinet_H=2400mm_Right

Language

For Vanity Unit Modules and the variants

			
<p>8B01.A.L.001 Bathroom Module 01_ Standard Bathroom_H=3165mm_Left</p>	<p>8B01.A.R.001 Bathroom Module 01_ Standard Bathroom_H=3165mm_Right</p>	<p>8B02.A.L.00 Bathroom Module 02_ Large Bathroom_H=3165mm_Left</p>	<p>8B02.A.R.001 Bathroom Module 02_ Large Bathroom_H=3165mm_Right</p>

Language

For Bathroom Modules and the variants



Unite

Unite with the professionals like programmer and software developer to overcome the defined challenges.
Technology needs what we need to be developed in a right direction.

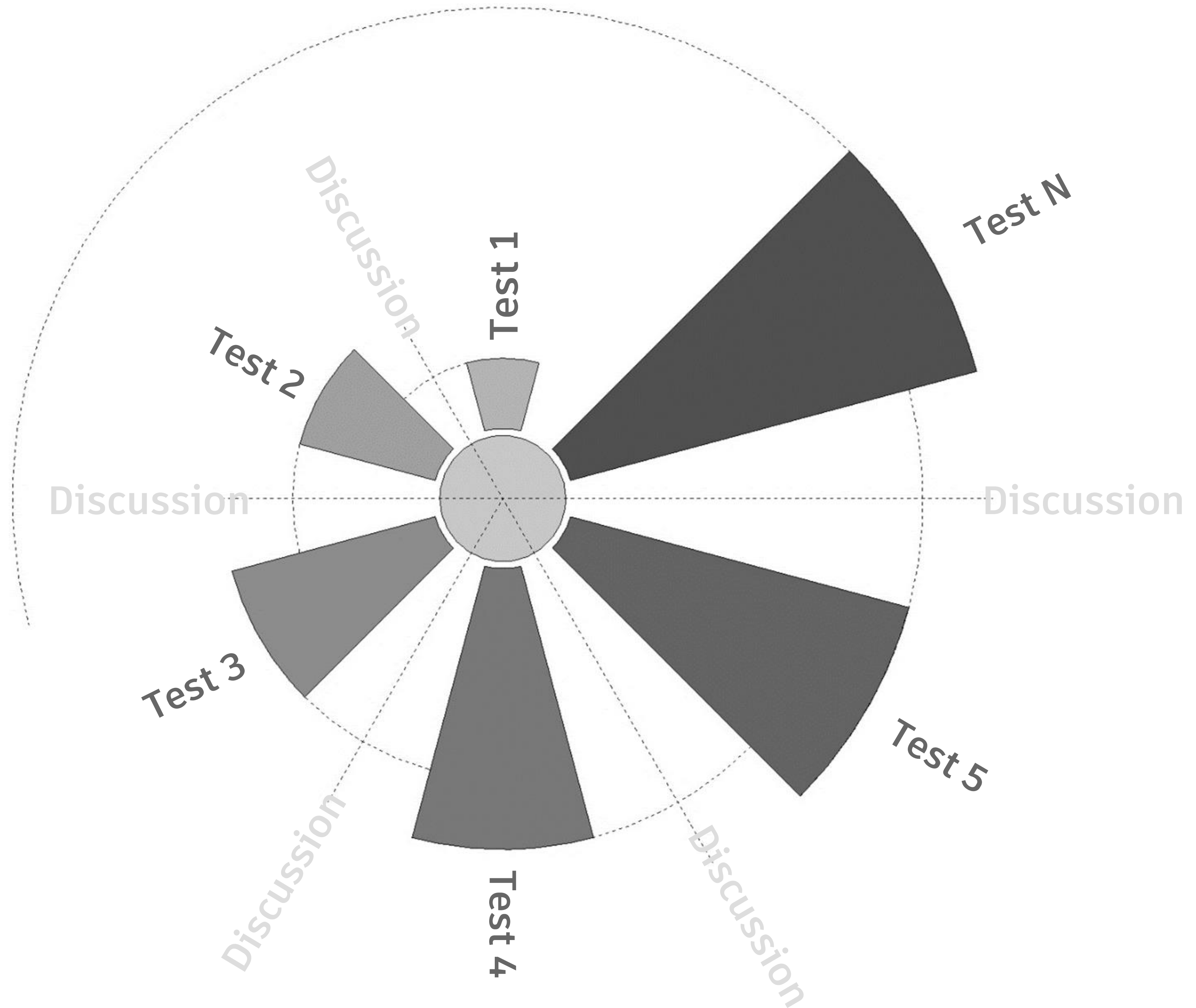
- How to audit changes and update them in all the building models at the same time?
- How to control mirrored type of a module?
- How to make cross-disciplinary modules instead of linking elements from other disciplines?
- How to take better advantage of duplication?
- How to switch a set of elements within a module (group or nested family) for making new types?

Unite

The defined challenges

Test

Tests and discussions





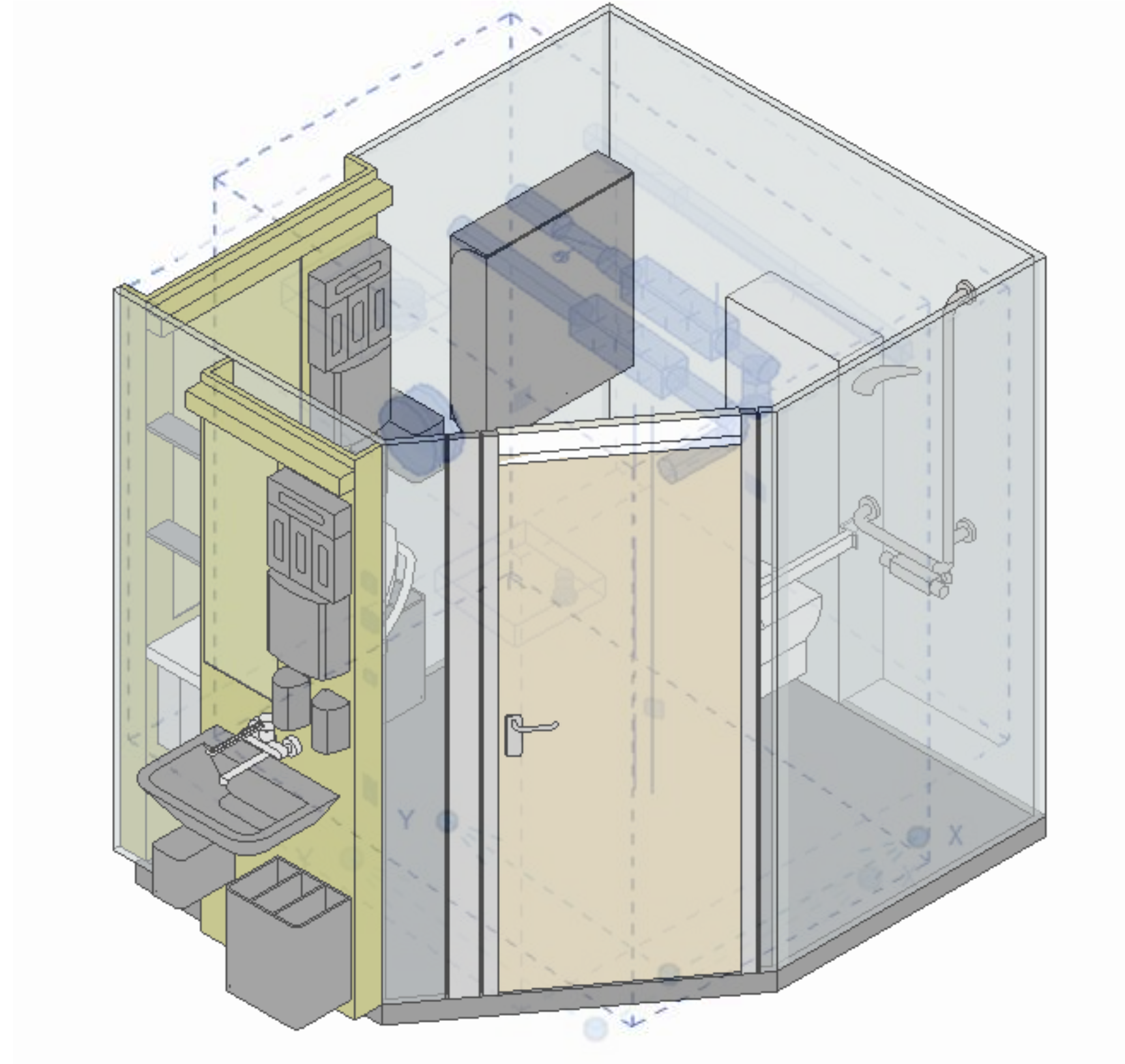
Evaluate

Workshop in Oslo

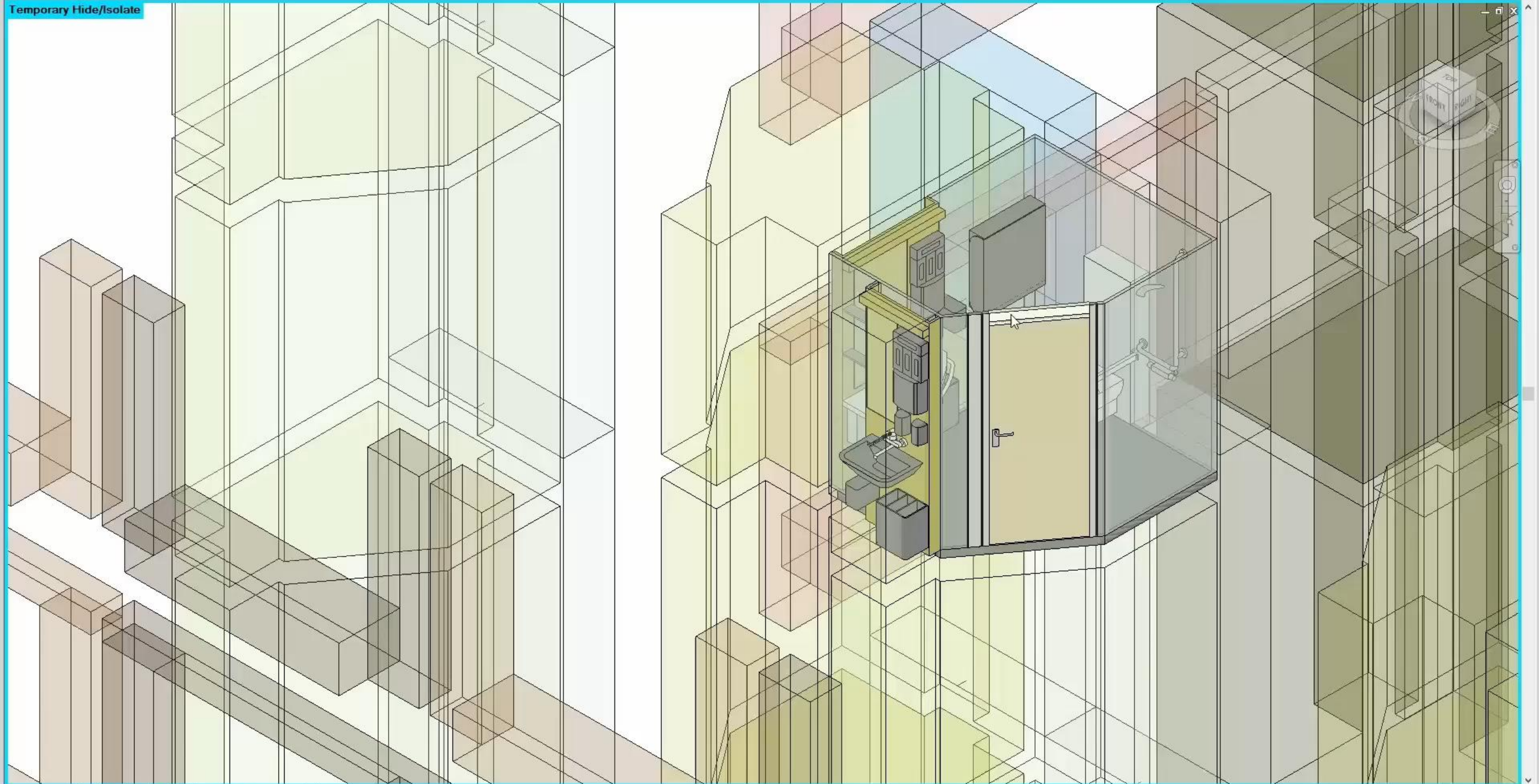
2 Custom-Made Plugins
COWI Tools + KitConnect

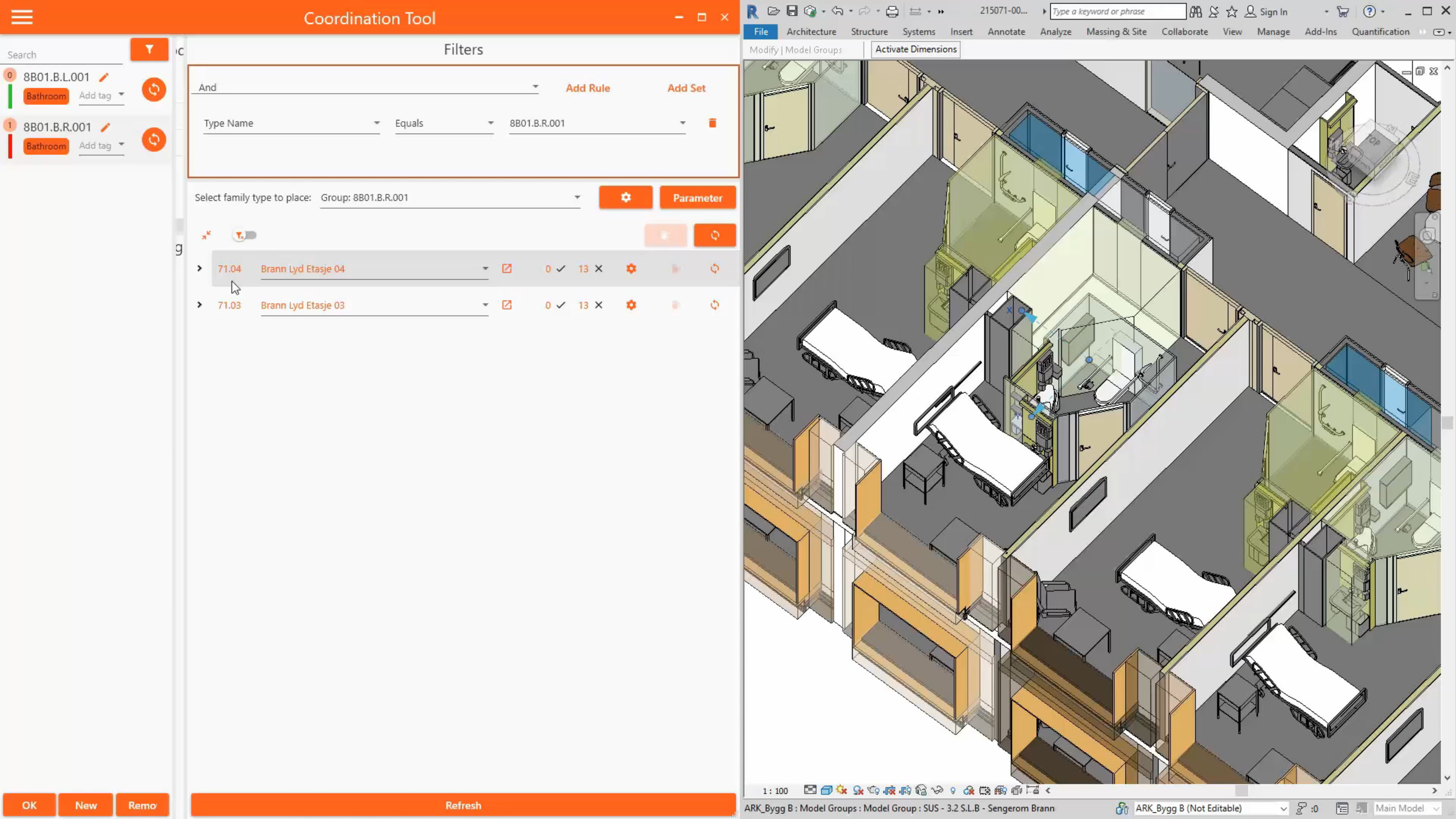
VOLUTE

COWI Tools

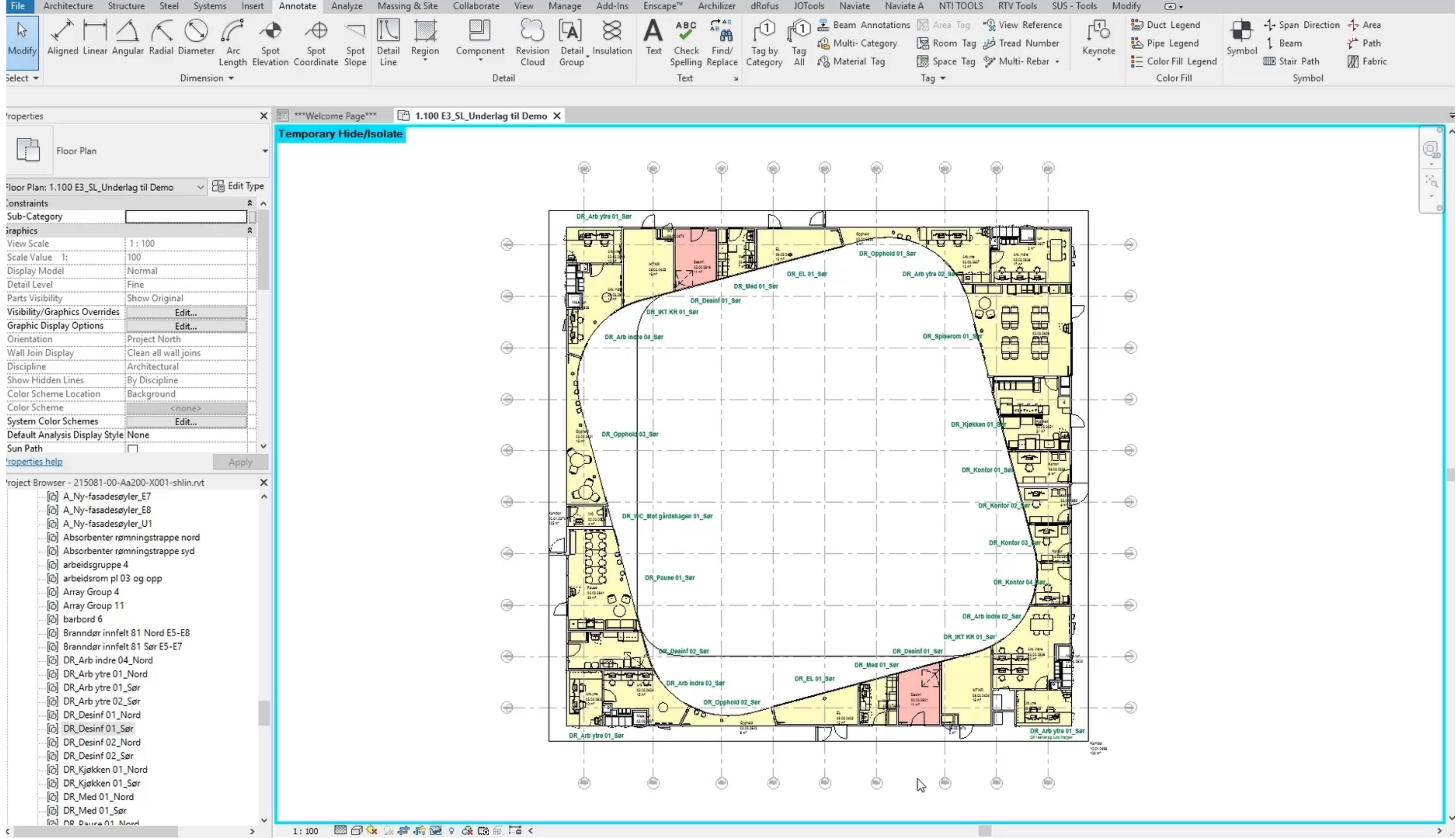


COWI Tools for Modules



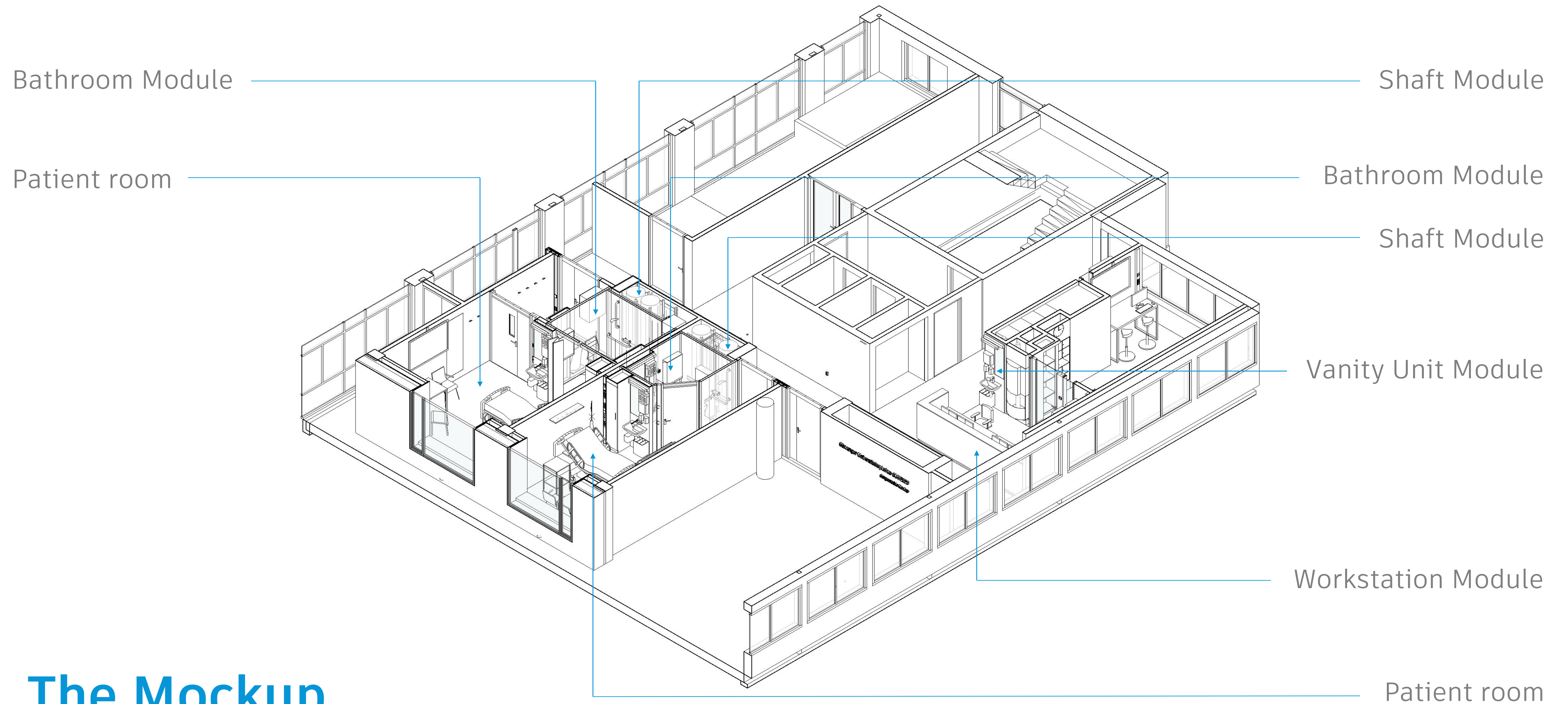


COWI Tools for Design Repetitions



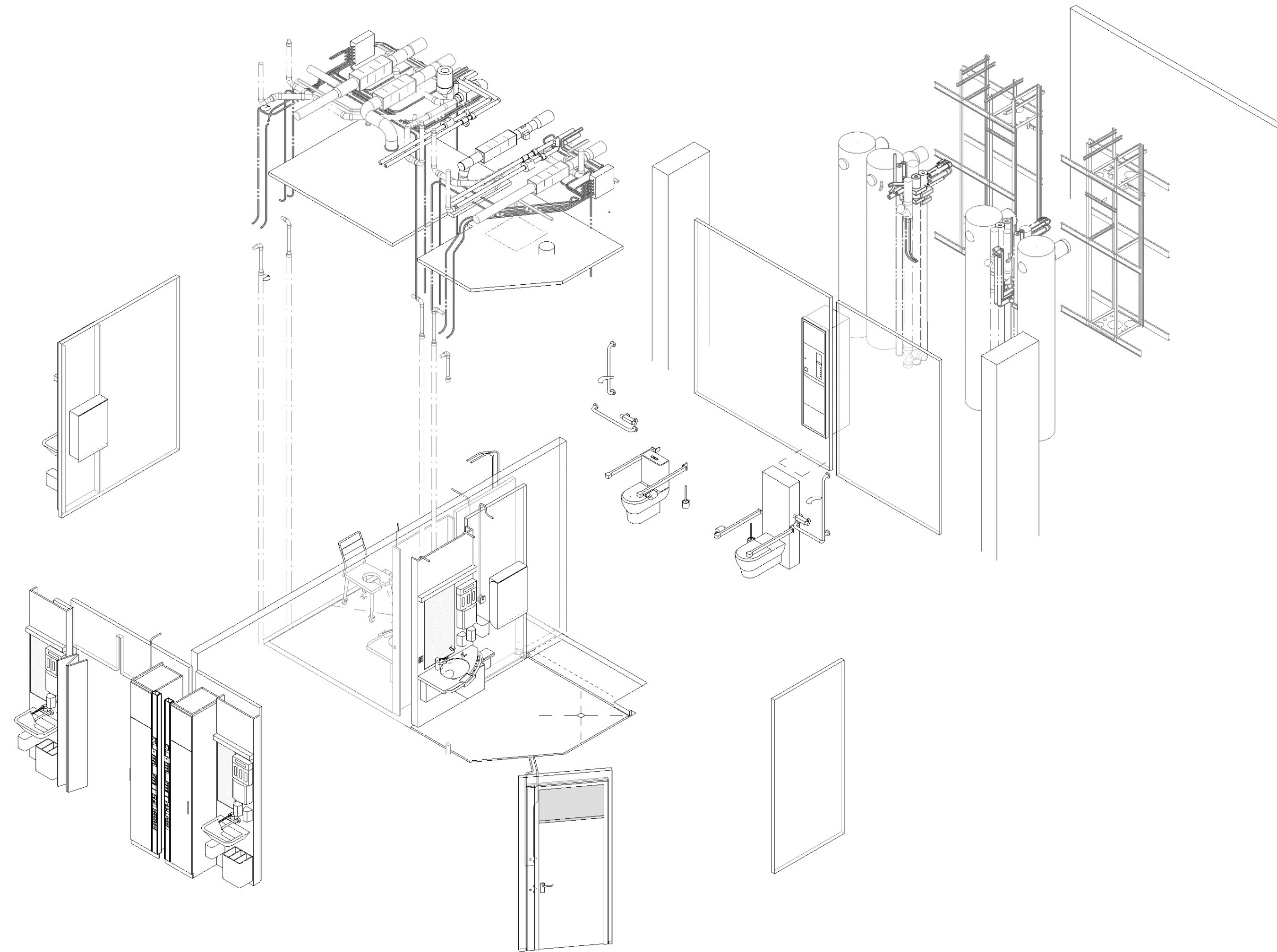
KitConnect

The Mockup



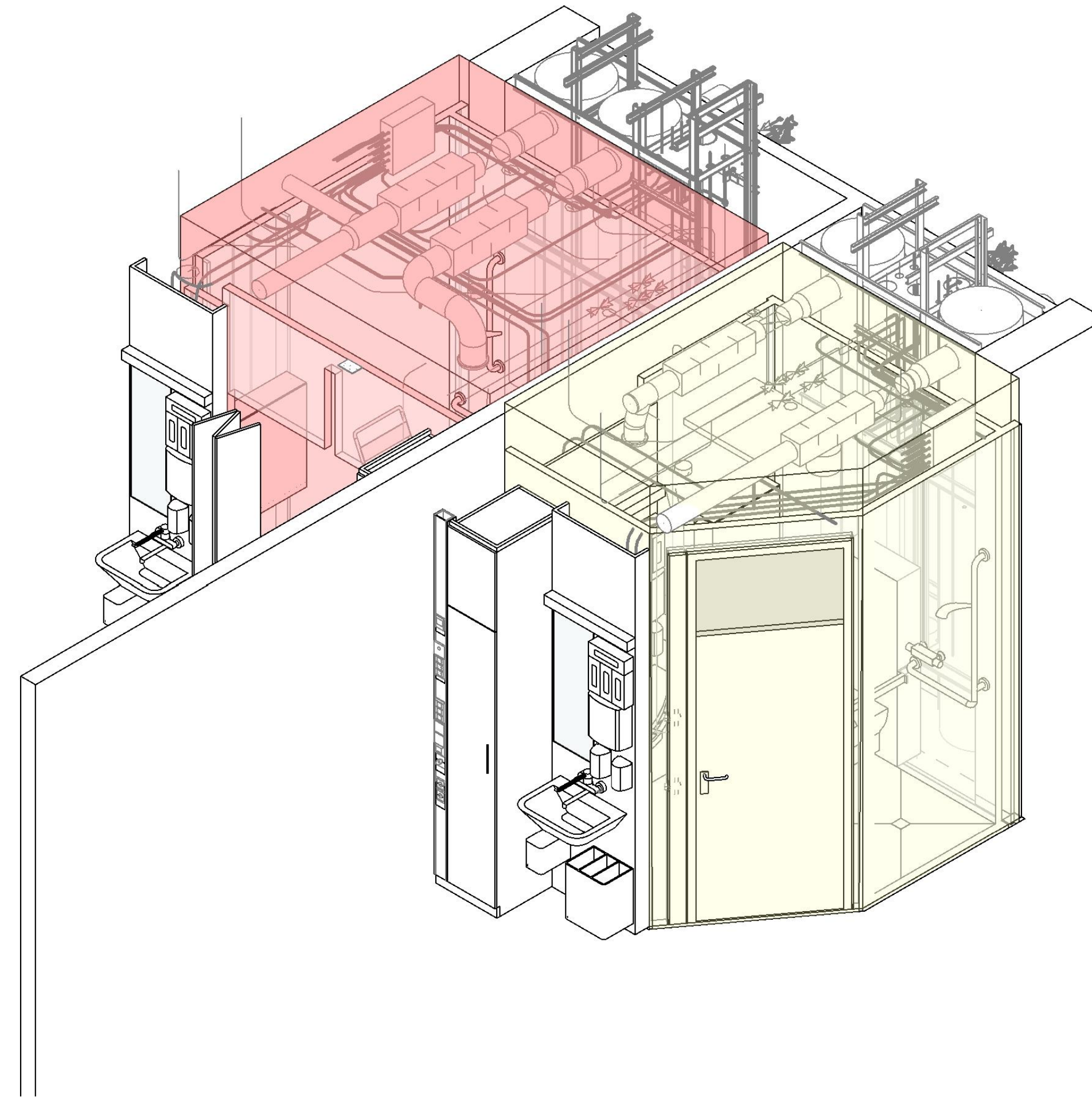
The Mockup

A test-ground for both modules and BIM workflows



Flat-Pack Modules

Exploded view



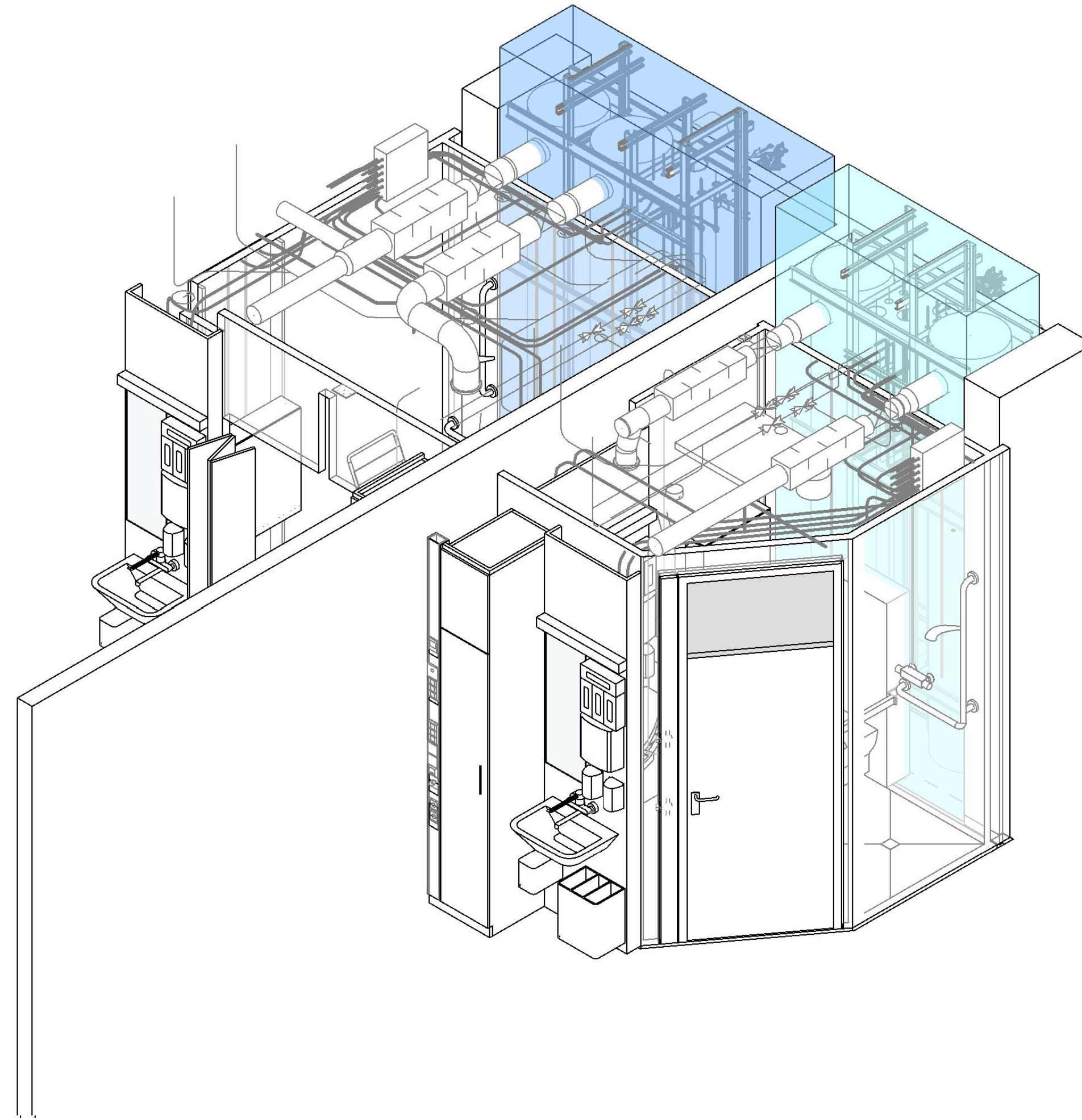
From model to product

Bathroom Modules in the Mockup model



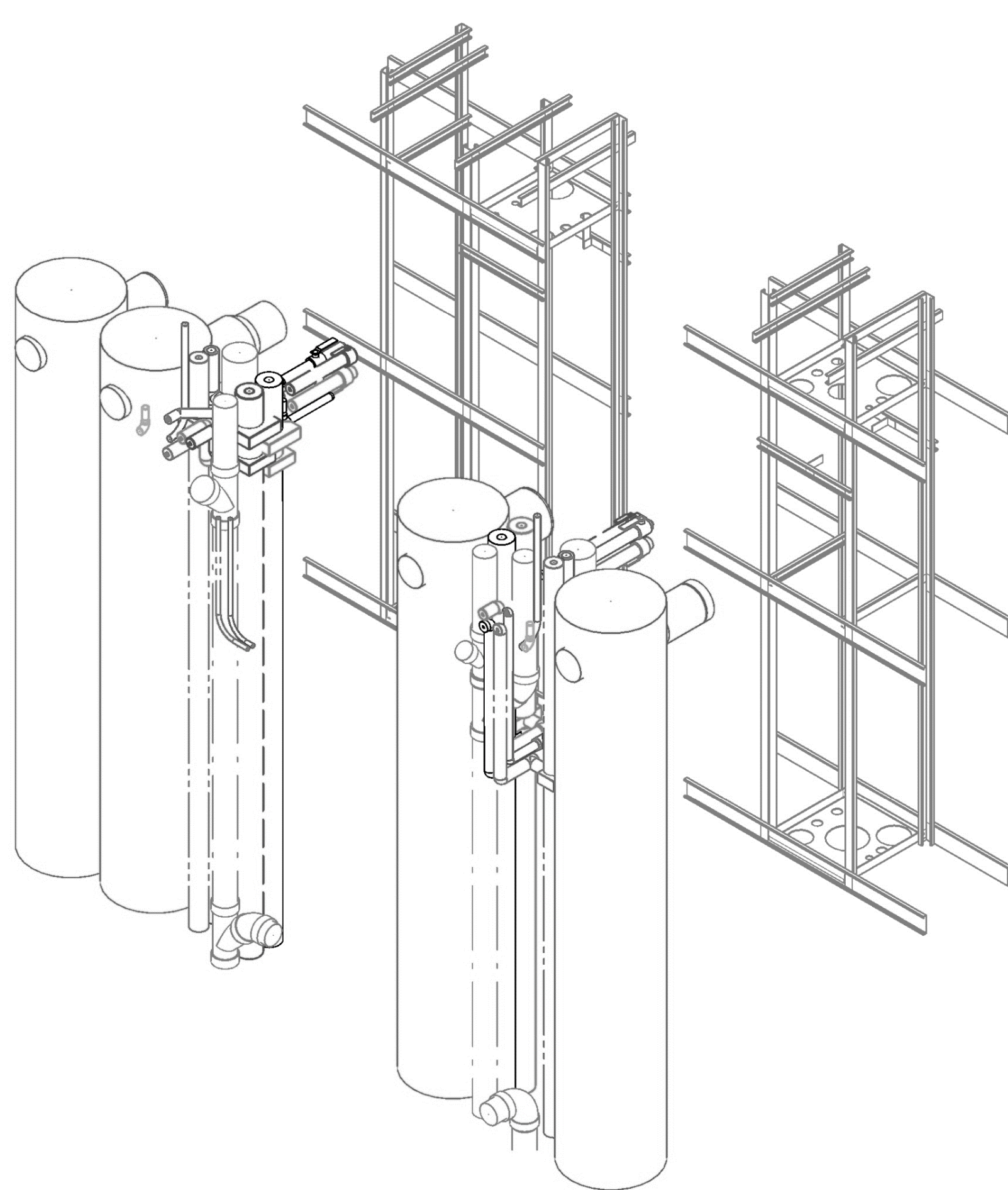
From model to product

Bathroom Modules in the Mockup on-site



From model to product

Shaft Modules in the Mockup model



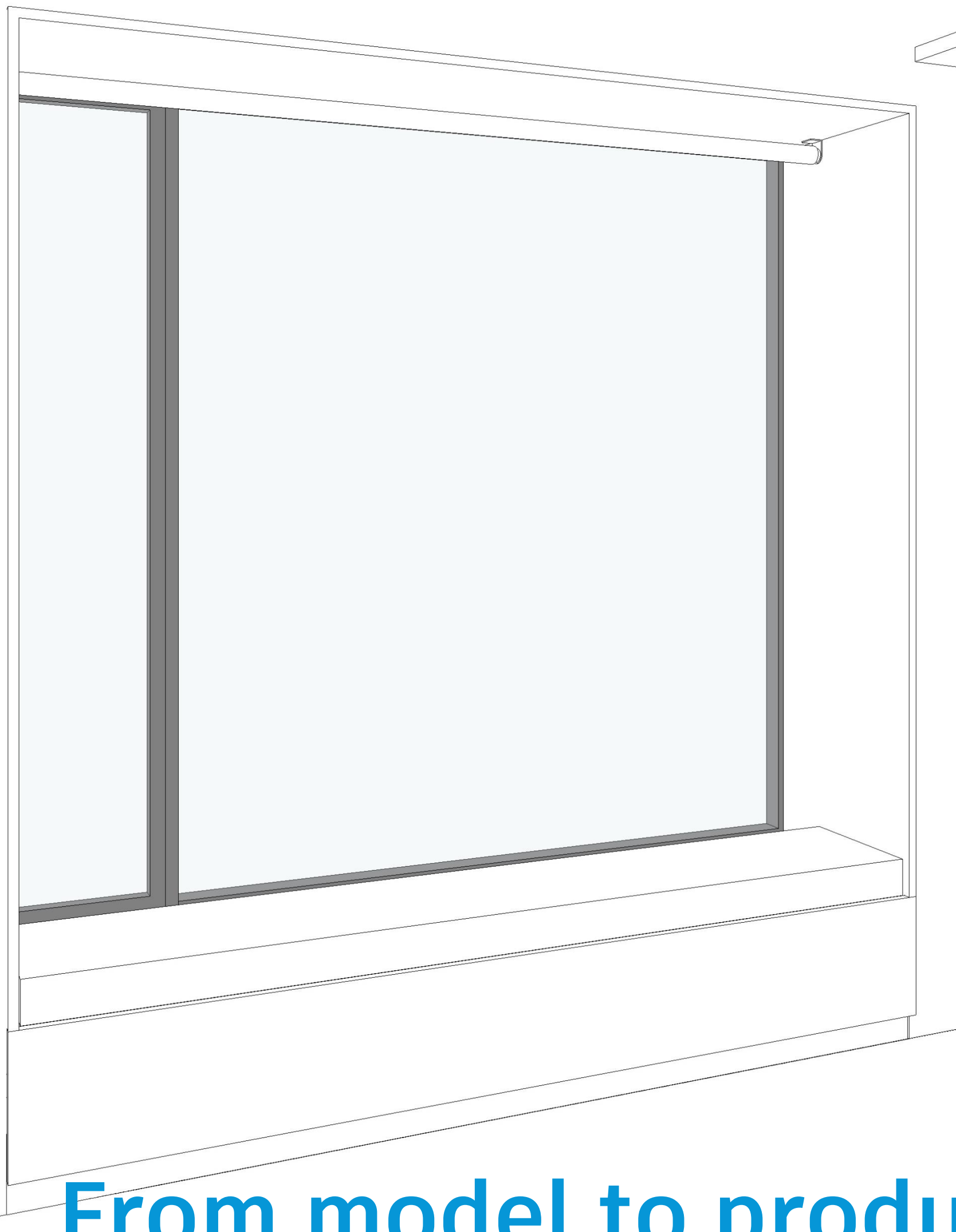
From model to product

Shaft Modules in the Mockup model and the Mockup on-site



From model to product

Workstation Module in the Mockup model and the Mockup on-site



From model to product

Guest Bed Module in the Mockup model and the Mockup on-site

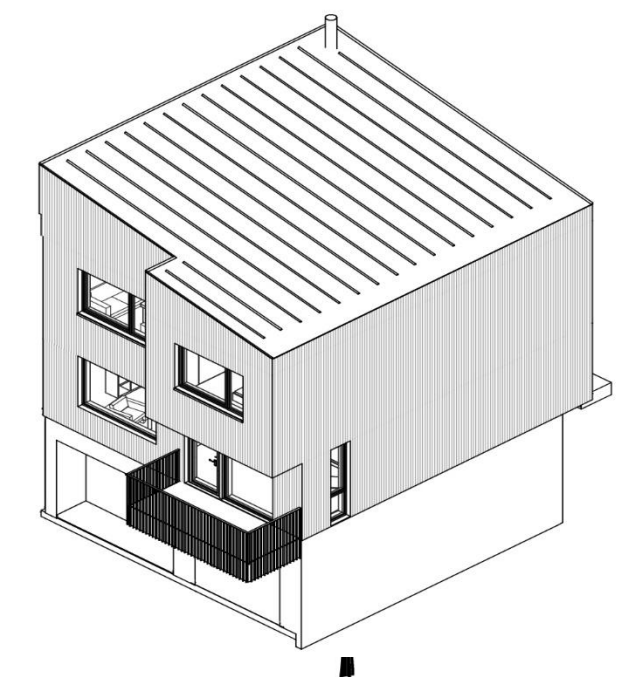
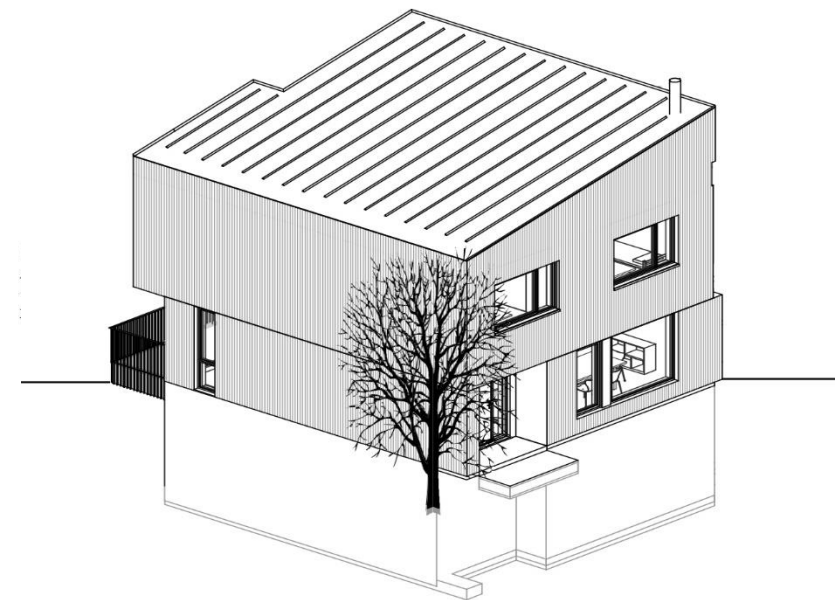
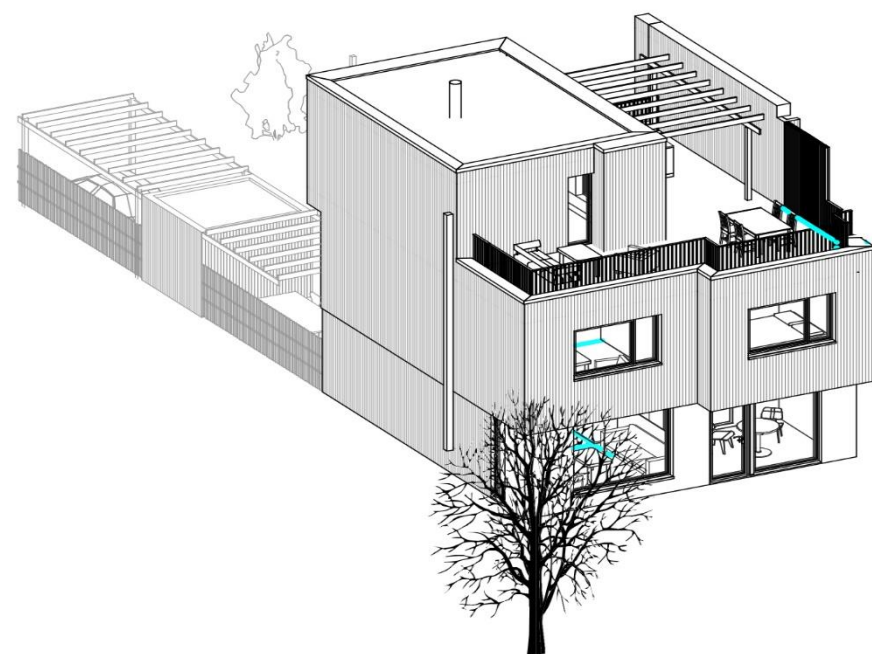
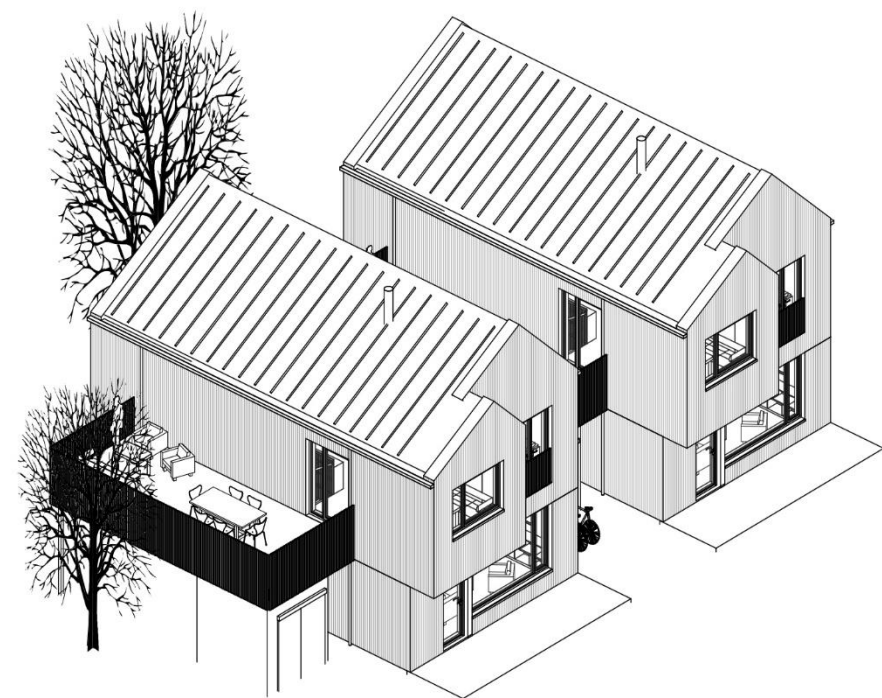
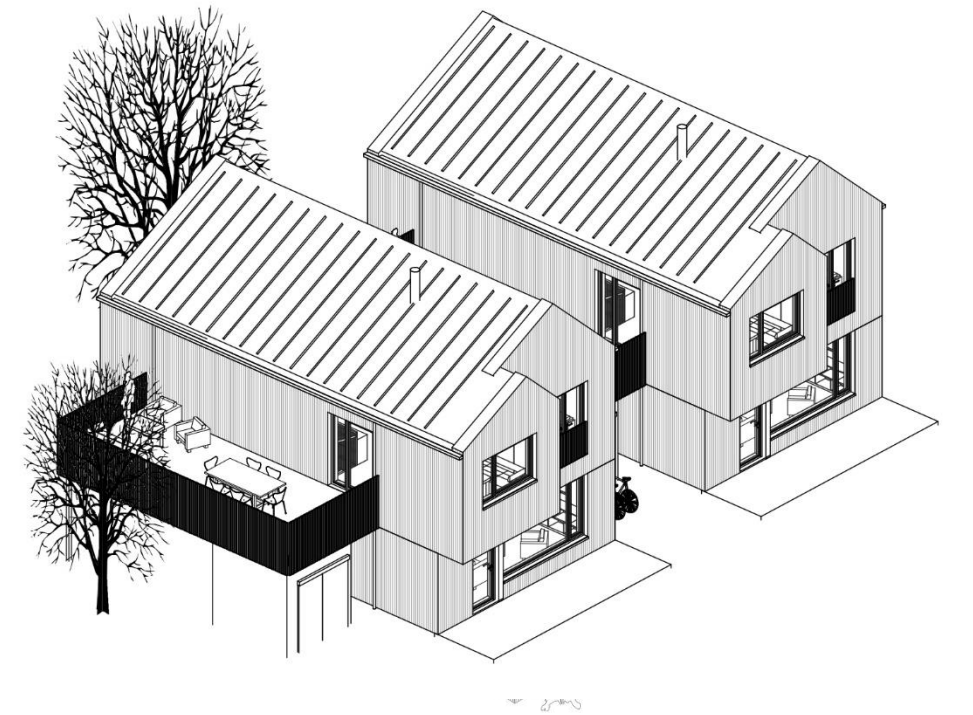
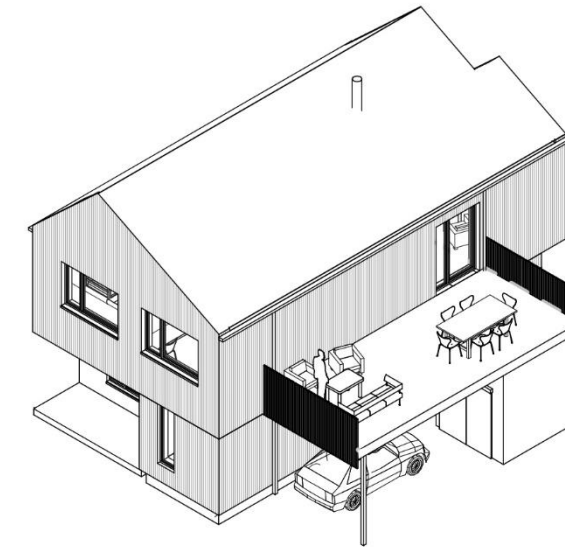
The Progress





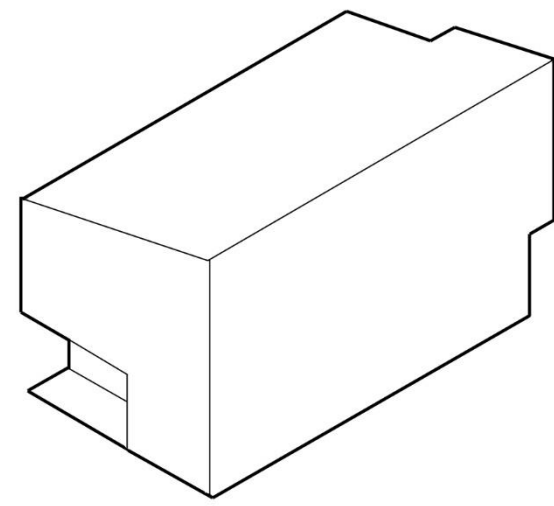
High Performance Housing Development Architects' Perspective



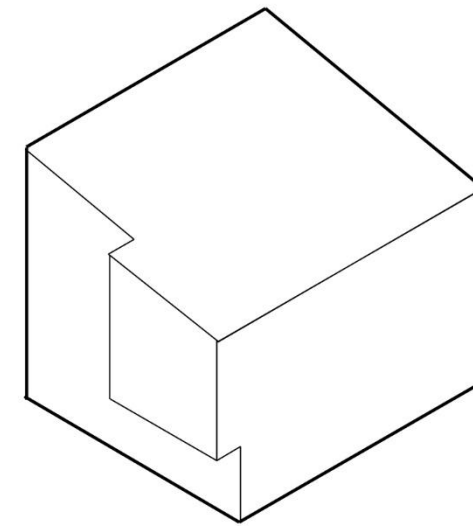




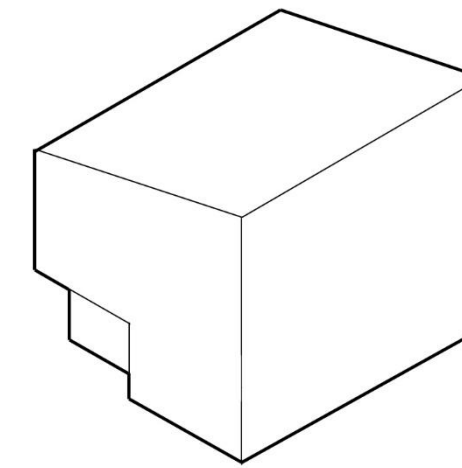
Base type examples



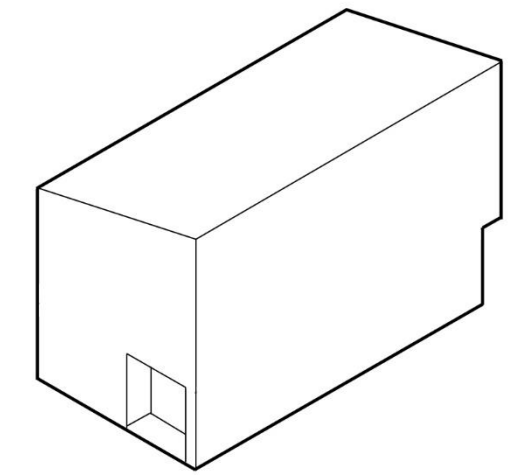
N1



N2



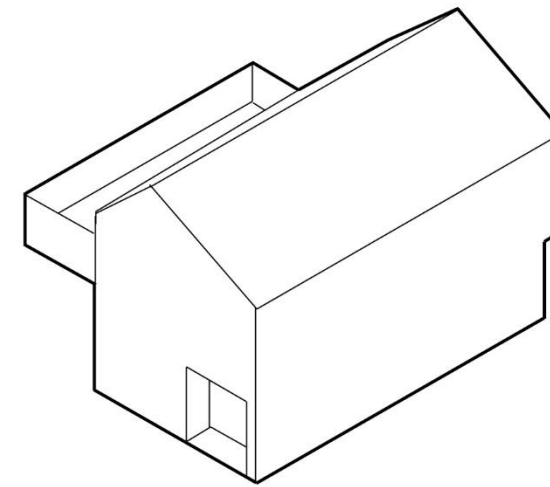
N3



N4

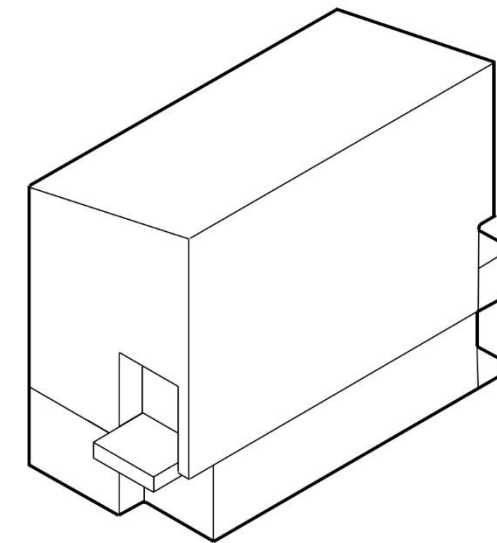
N4

Sub types

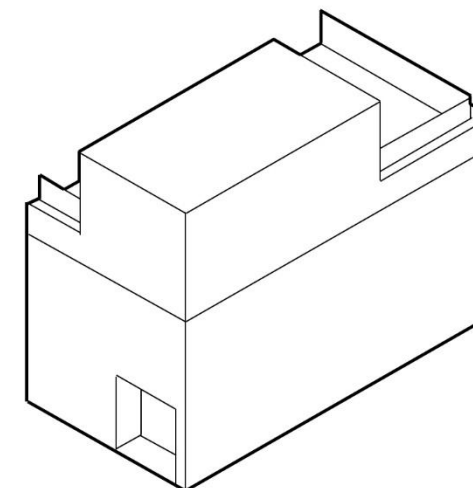


A

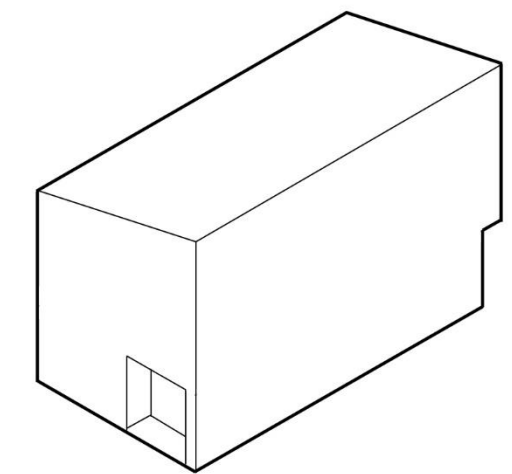
Carport



Kjeller
(Basement)



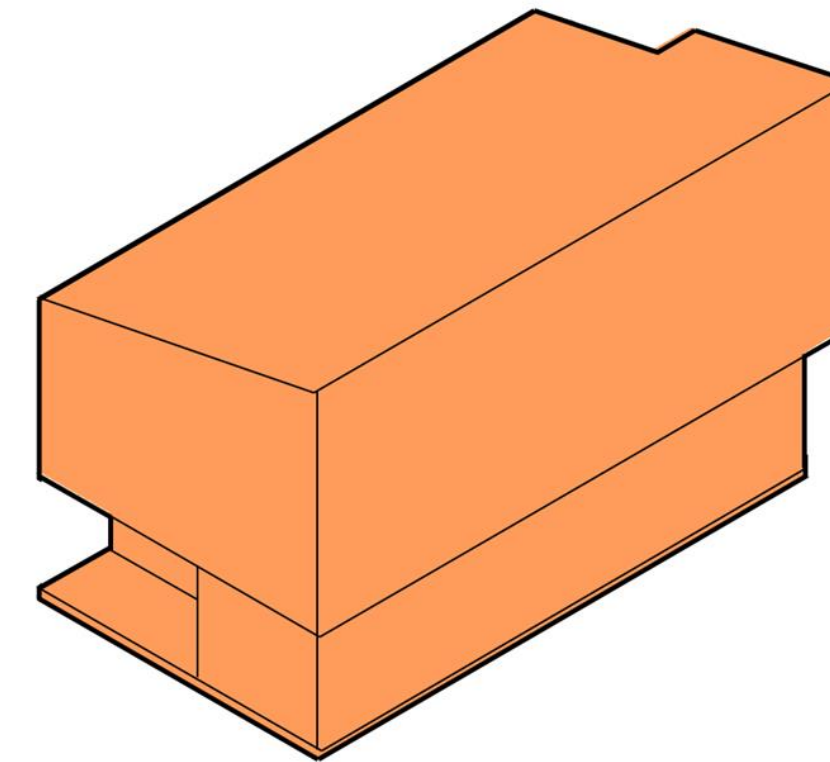
Terrasse
(Terrace)

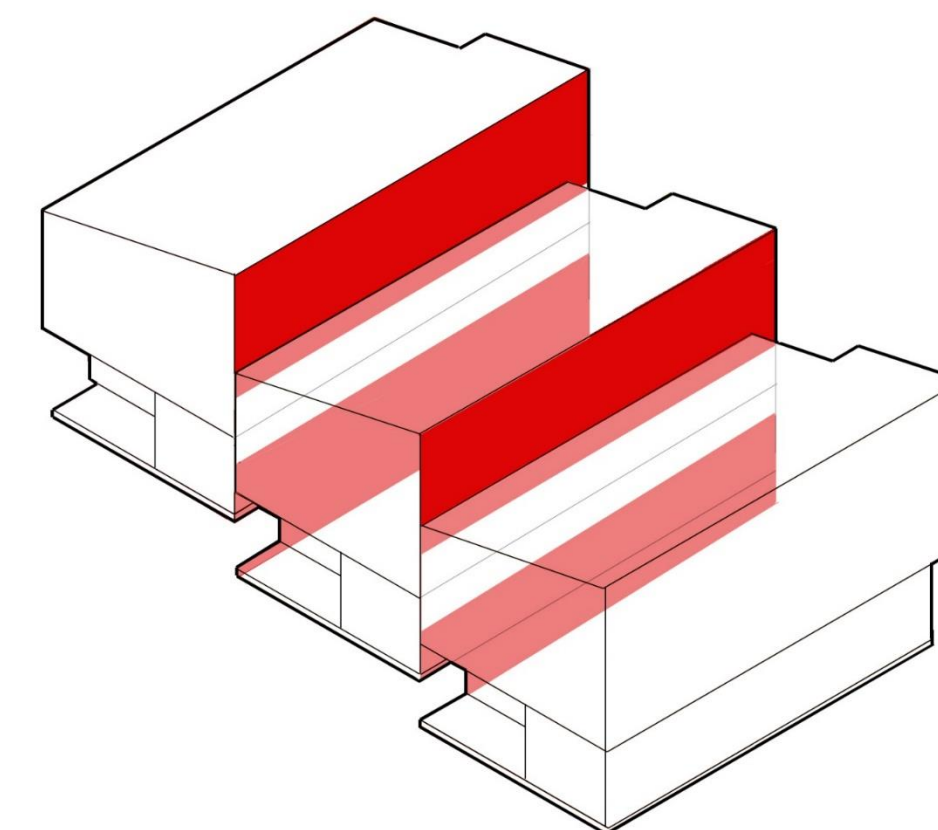
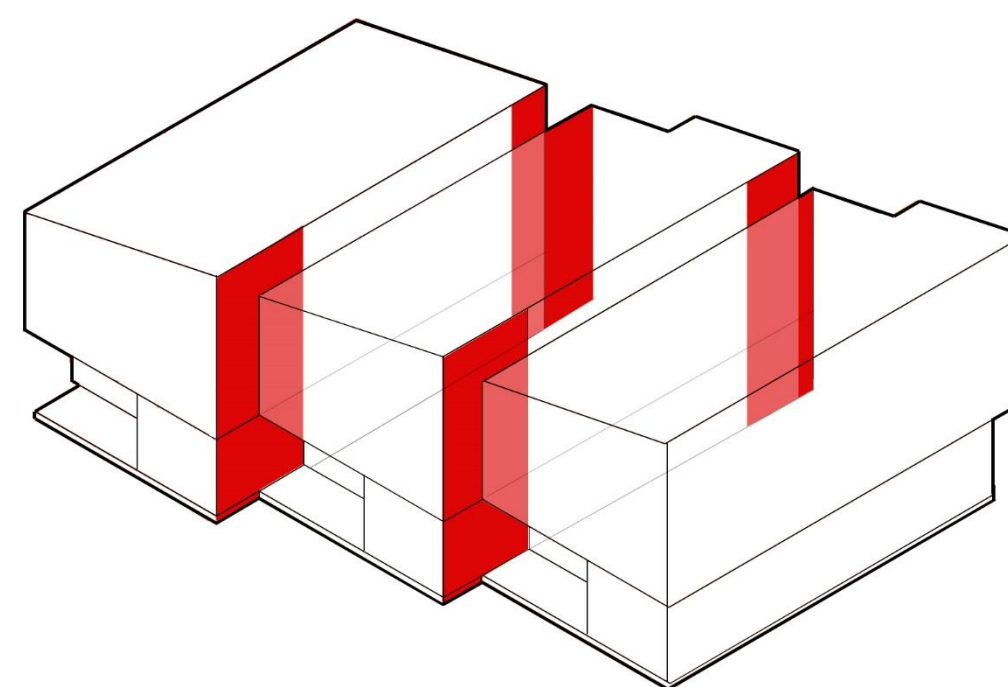
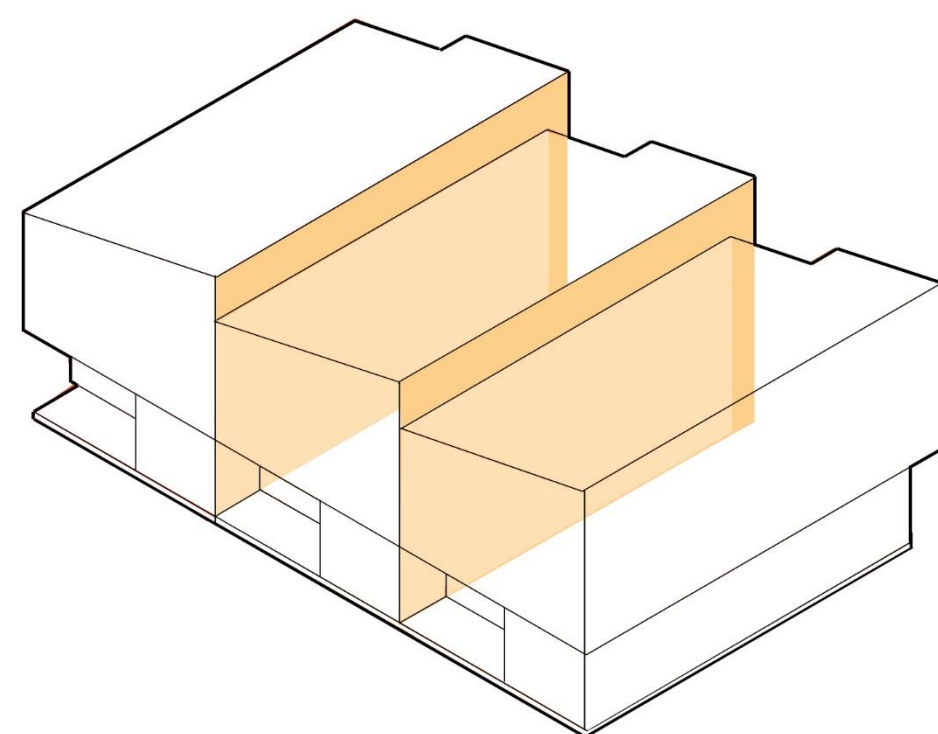


N4



Combinations





Deviating areas per house

Proposal to the client

Opportunities – find opportunities from evident duplication and identify areas that could be considered for industrialised construction or modulation.

Language – divide the different packages which were a result of the analysis phase. Find a robust system that can cope with eventual changes and developments in the project.

Form a coding system that can be used to describe the duplicated design or industrial packages which can also tolerate new types and deviations.

Unite + Test – Working with software companies to fine tune our workflow, integrate and test proposed methodology for improving project workflows associated with design repetition and industrialisation. (in this case new technology – kit connect - for the cloud based handling of geometry and data).

Evaluate – Compare the new workflow with the original workflows used previously and evaluate to form a list of pros and cons. Conclude a recommended way forward.

Vision

Opportunities find opportunities in duplicated design and identify areas that could be considered for industrialised construction or modulation.

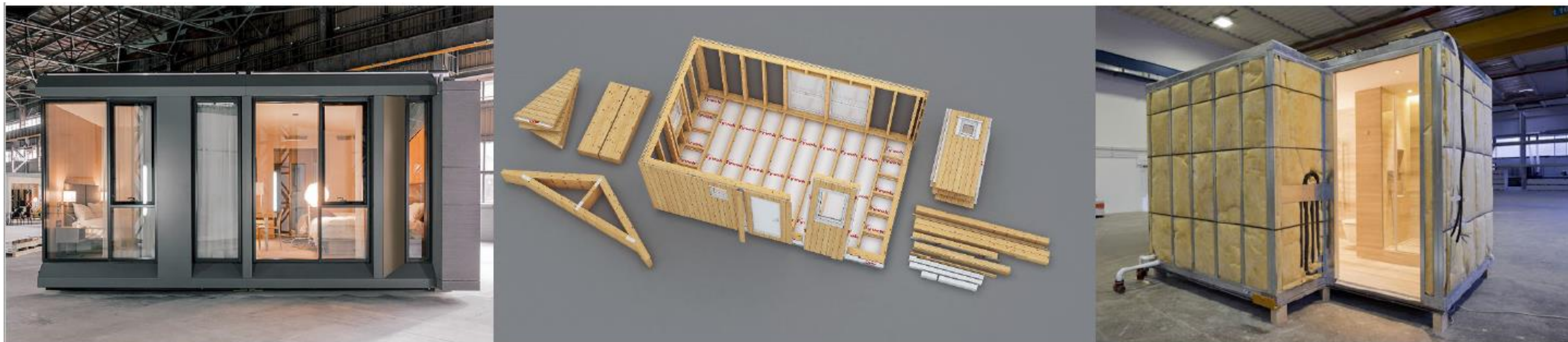
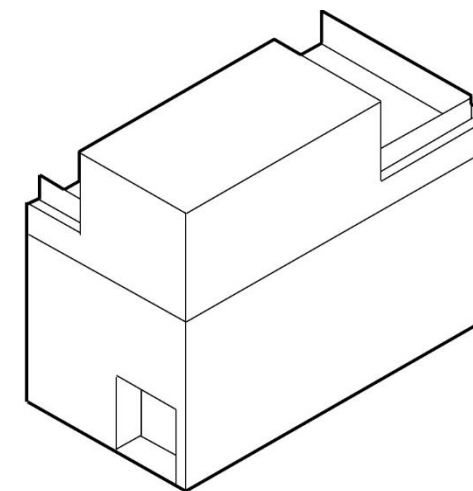
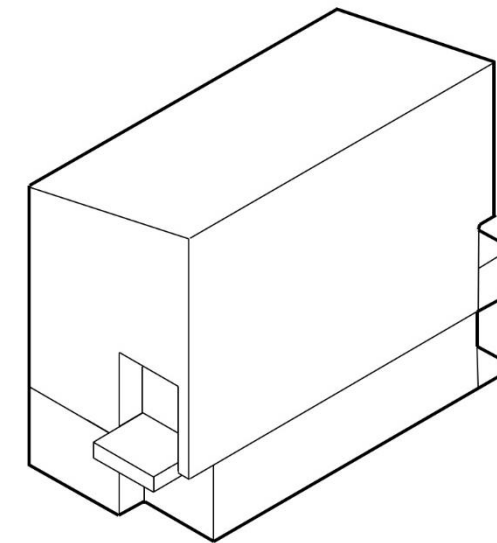
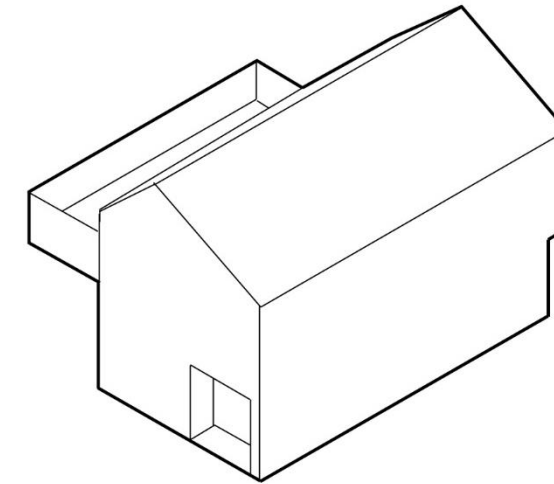
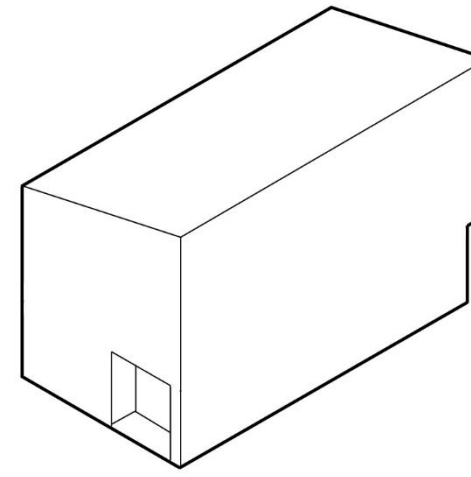
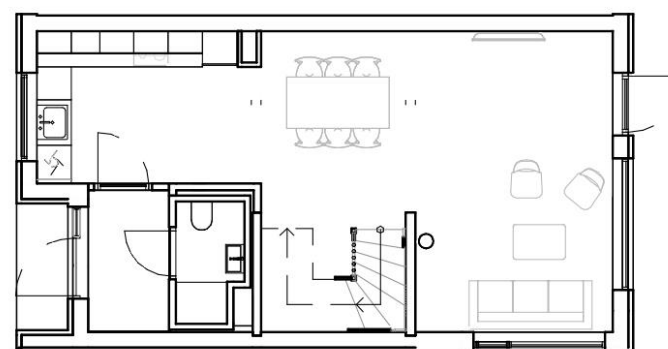
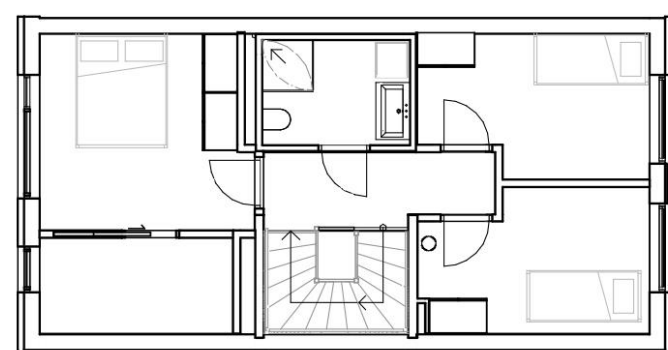


Photo credits:
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<https://mestergruppen.no/prosjektutvikling/>
<https://www.made-in-china.com/showroom/weizhengheng118/product-detailRKUxdOmTOlrg/China-Hotel-Use-Prefab-Modular-Bathroom-Pod.html>

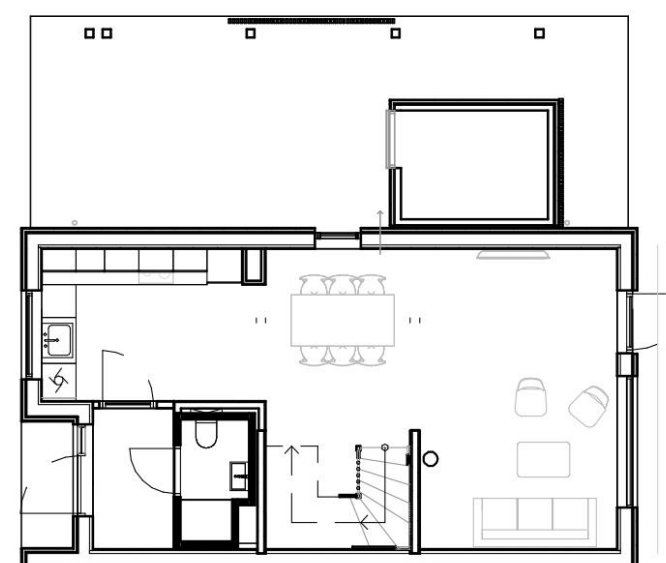
N4



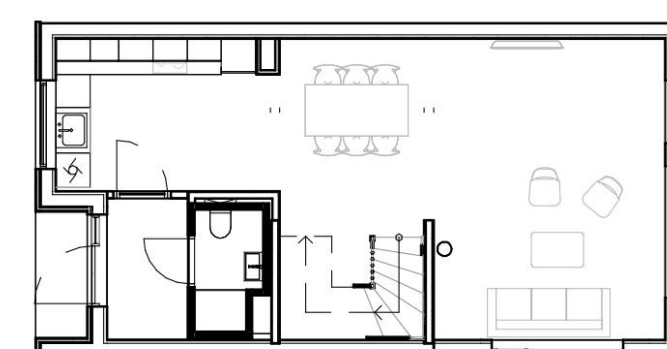
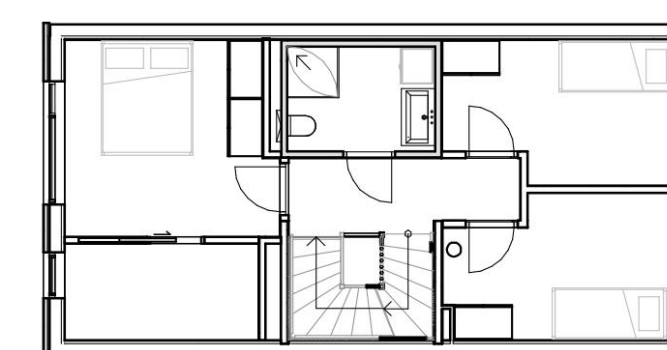
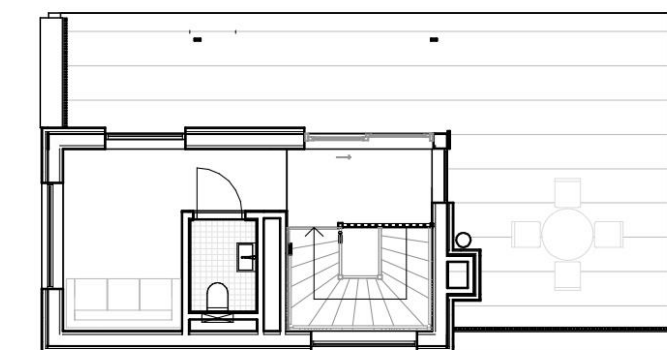
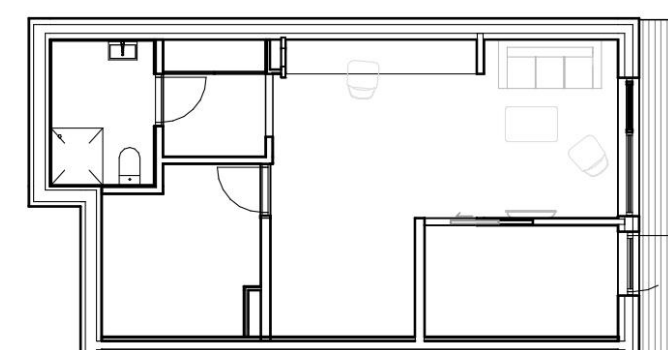
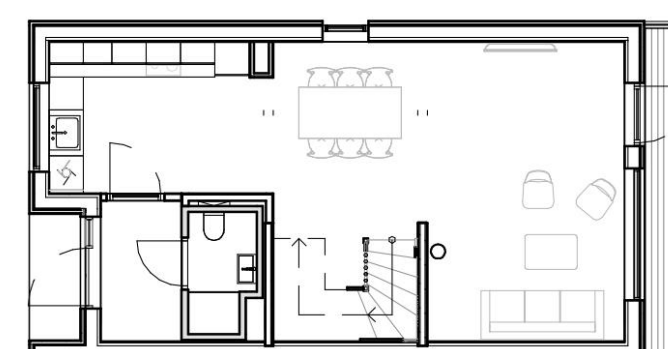
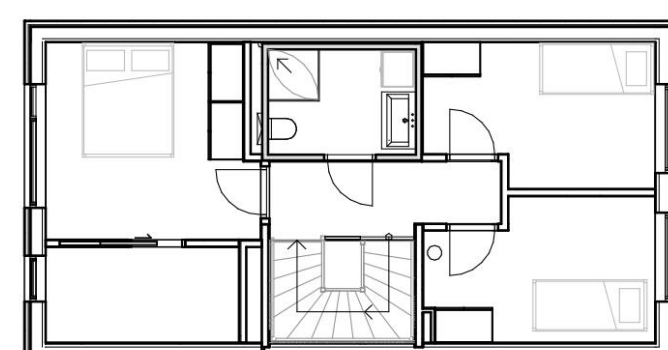
A



C

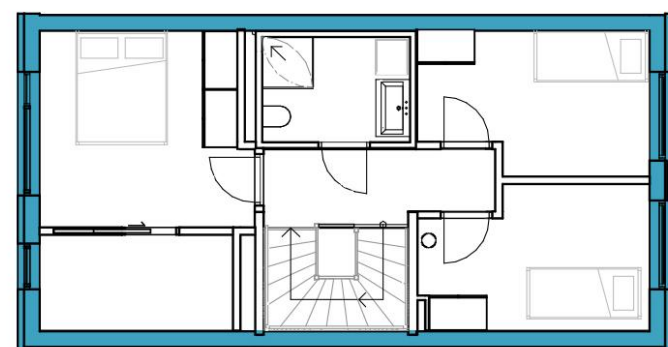


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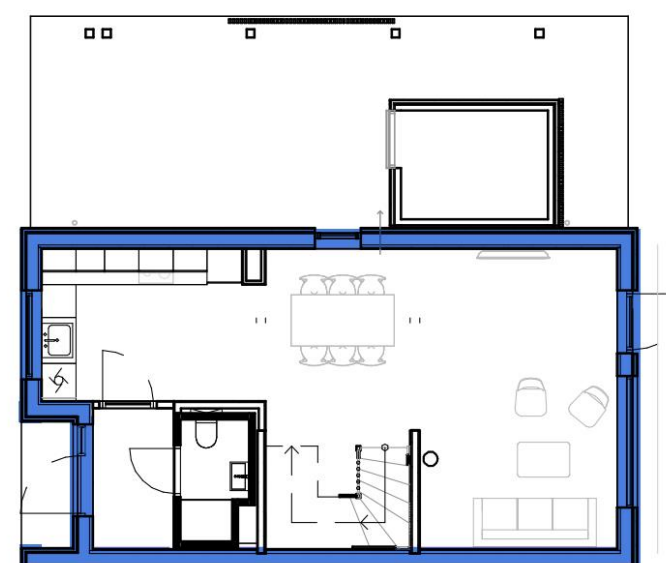


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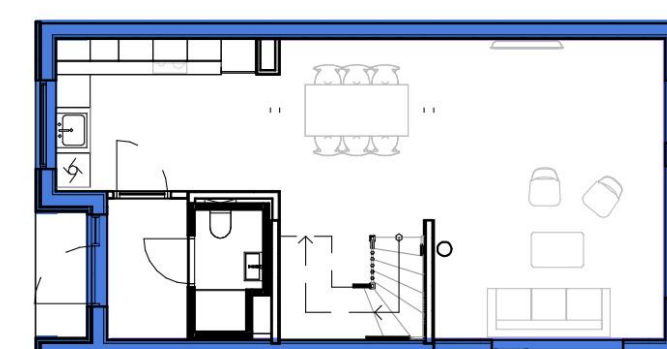
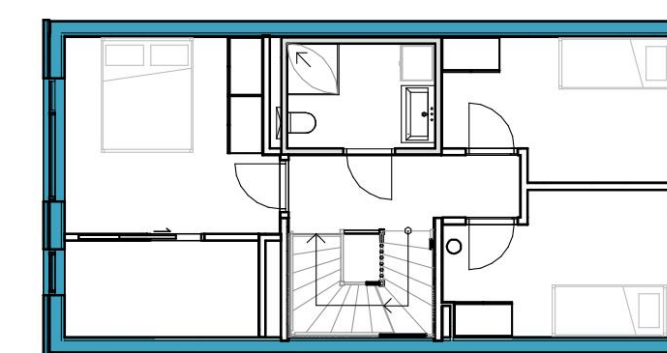
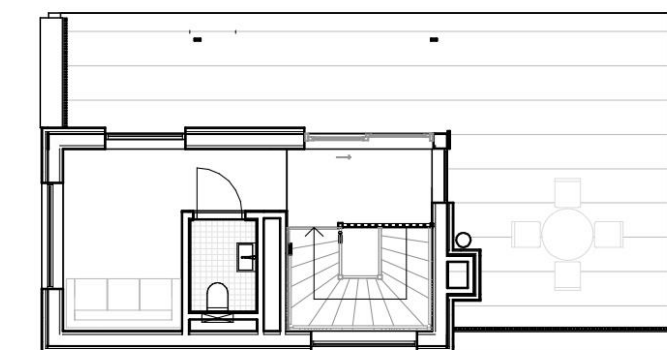
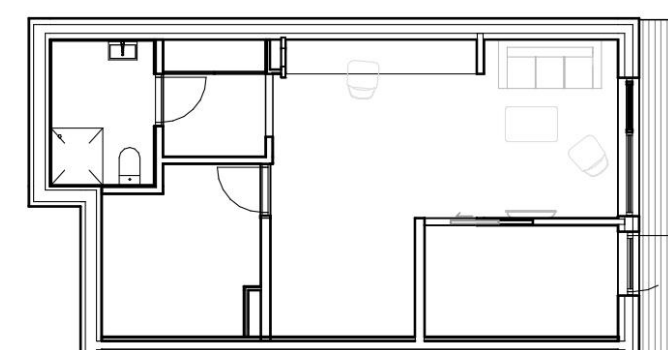
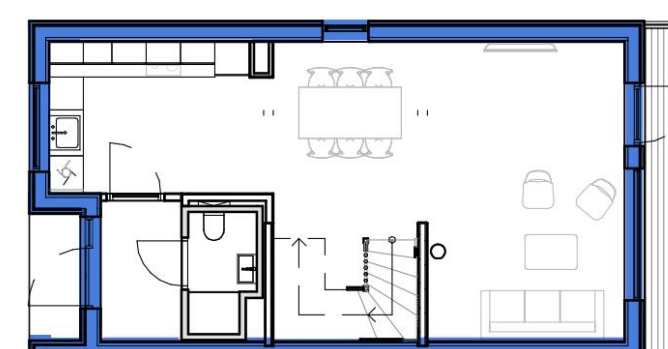
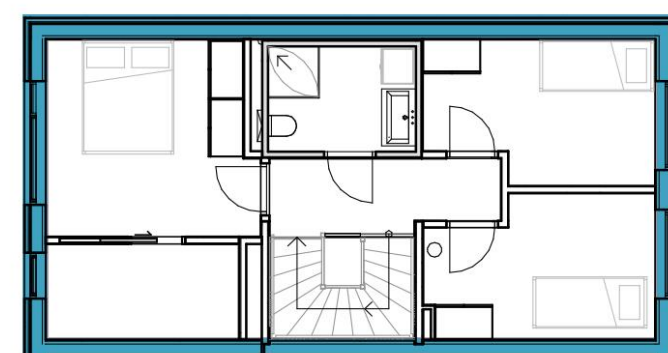
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C



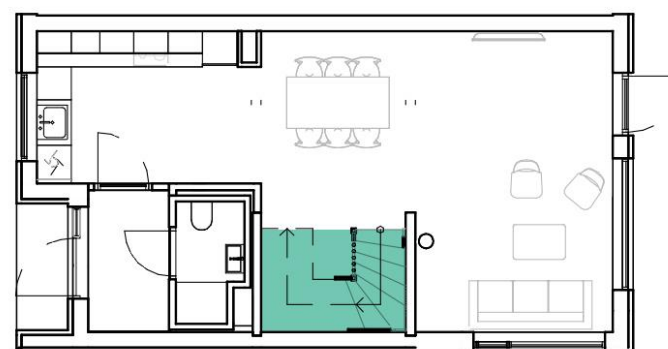
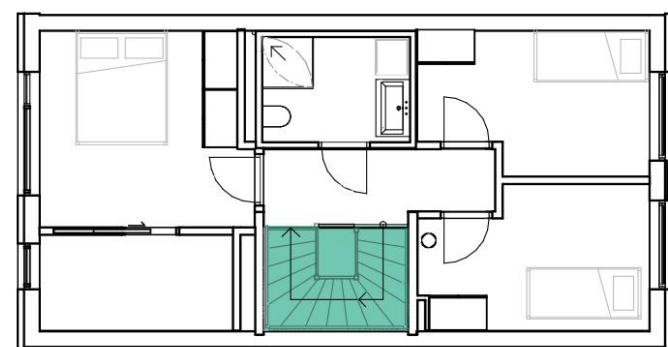
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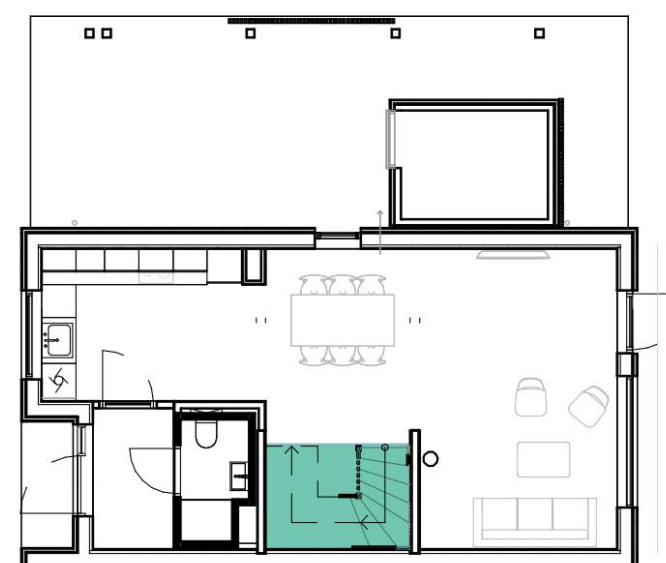
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Shell

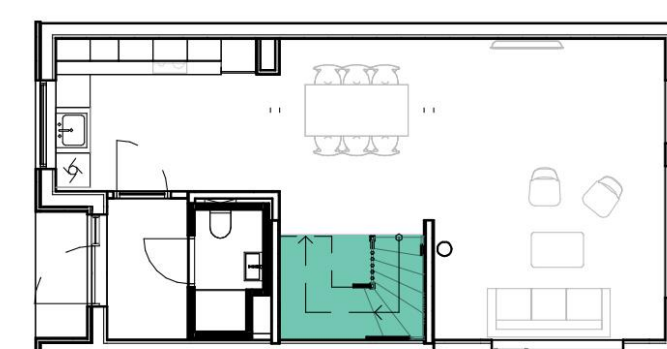
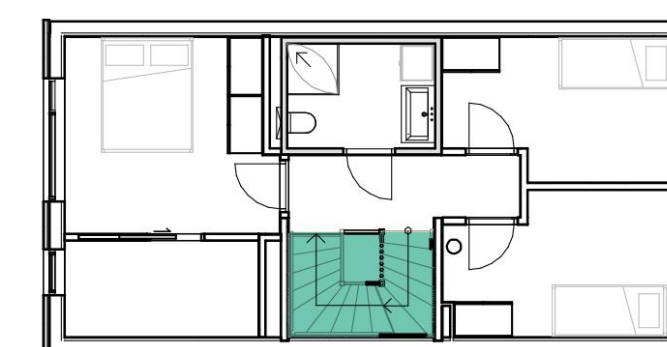
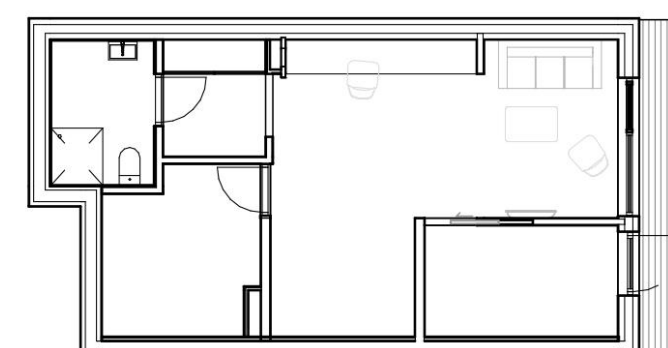
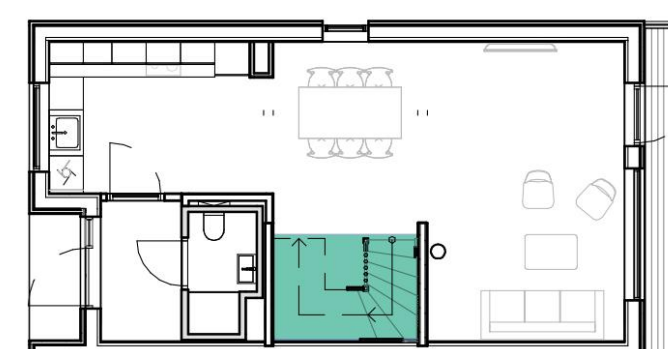
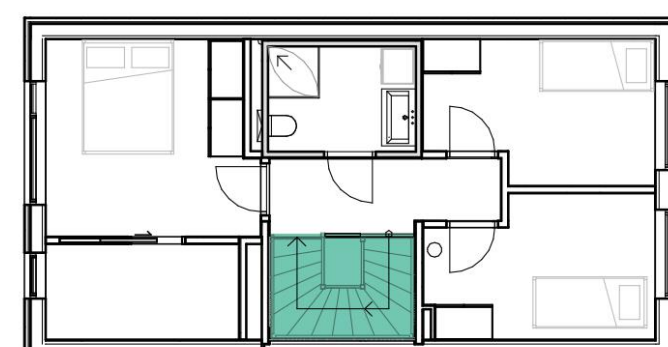
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C



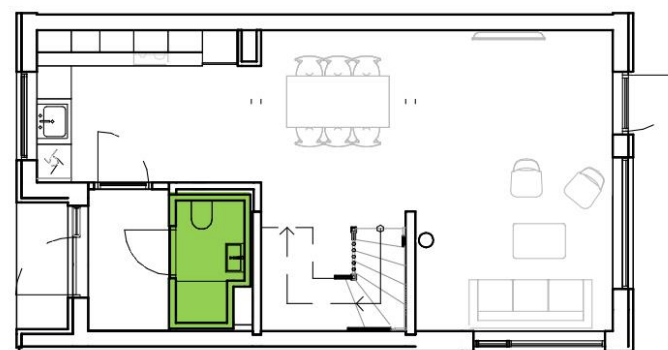
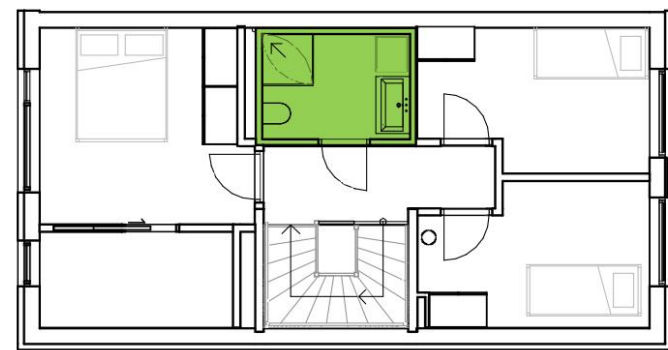
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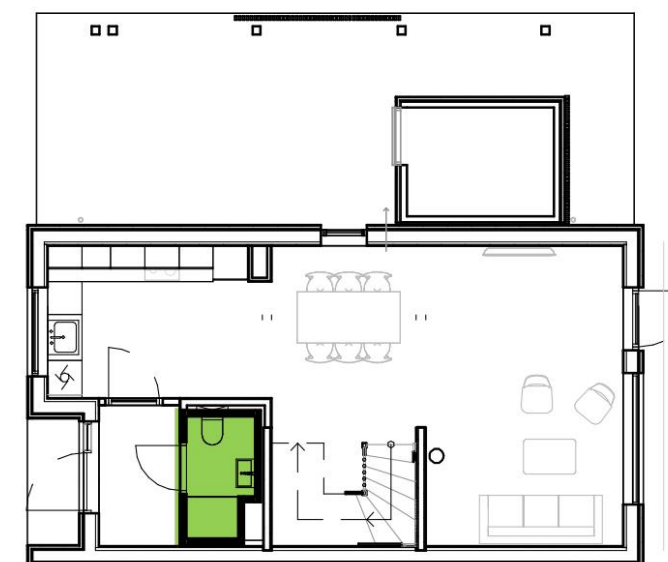
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Stair

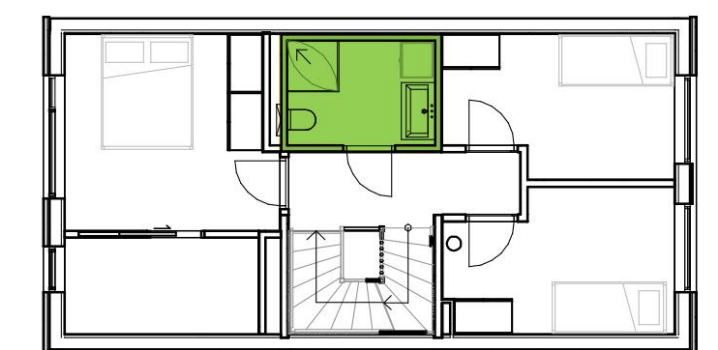
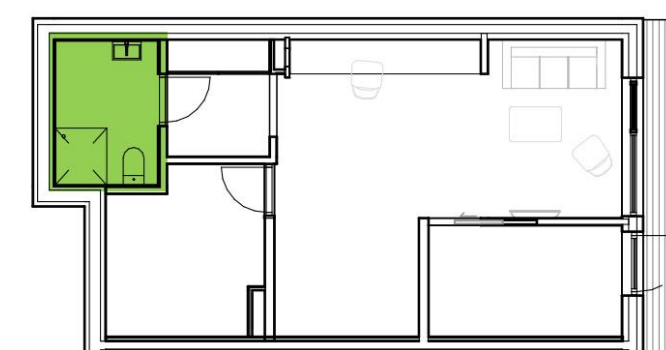
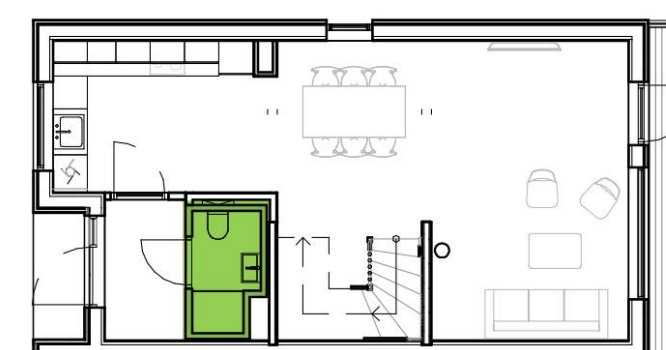
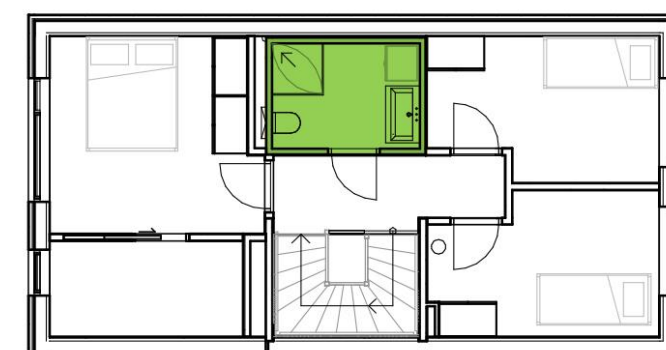
A



C



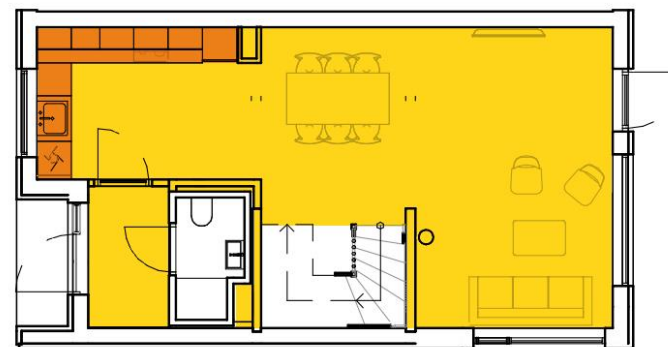
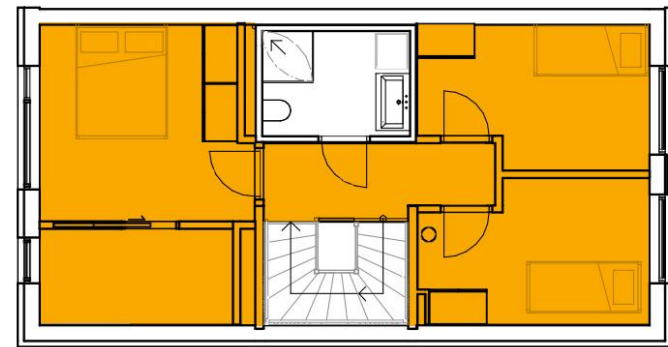
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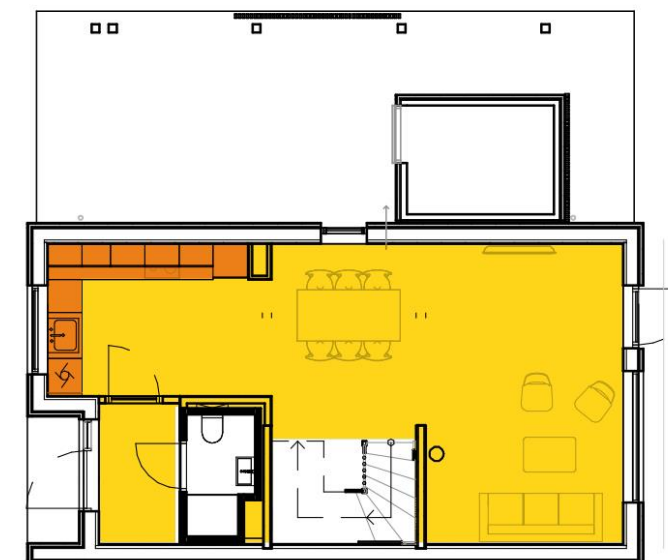
T

Bathroom

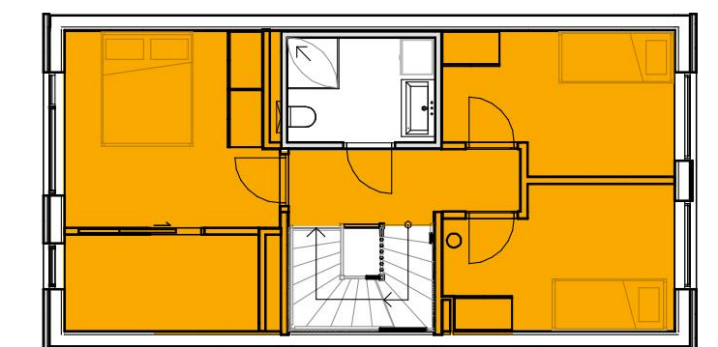
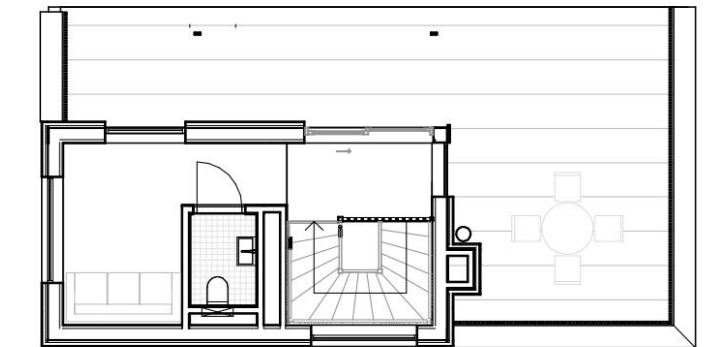
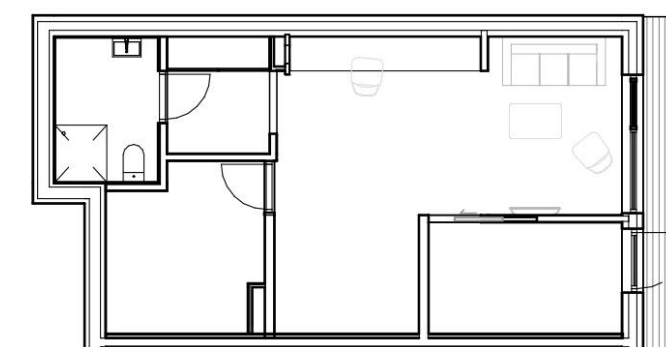
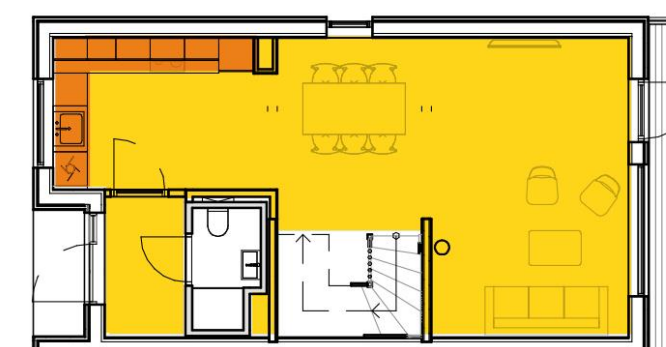
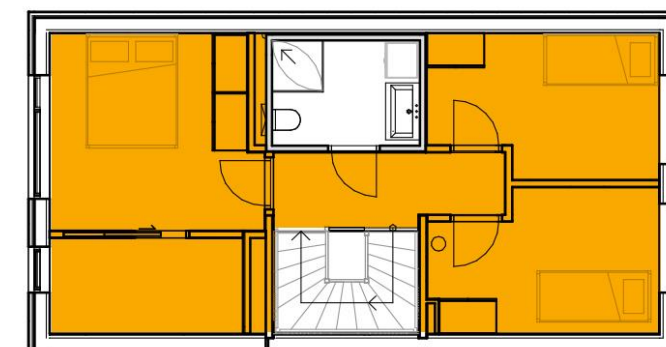
A



C



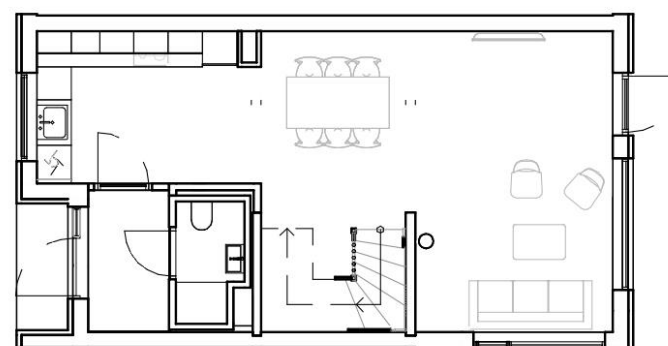
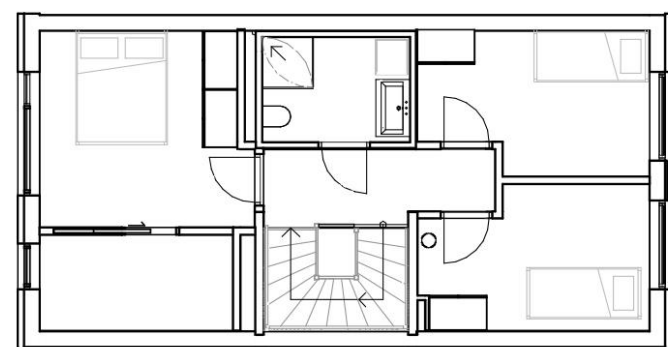
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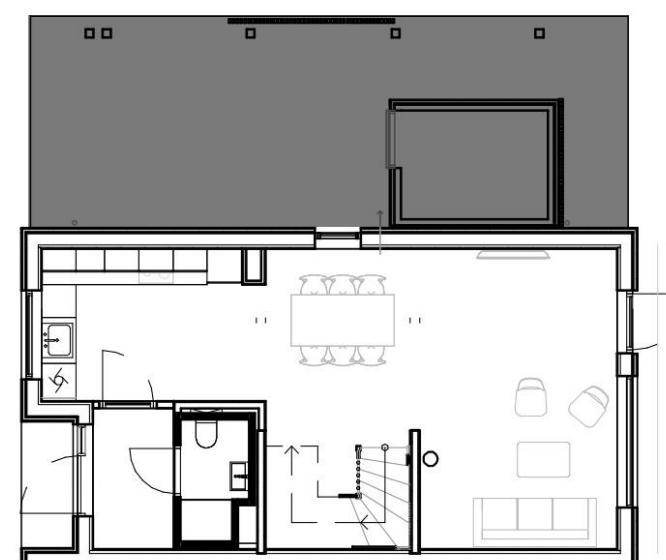
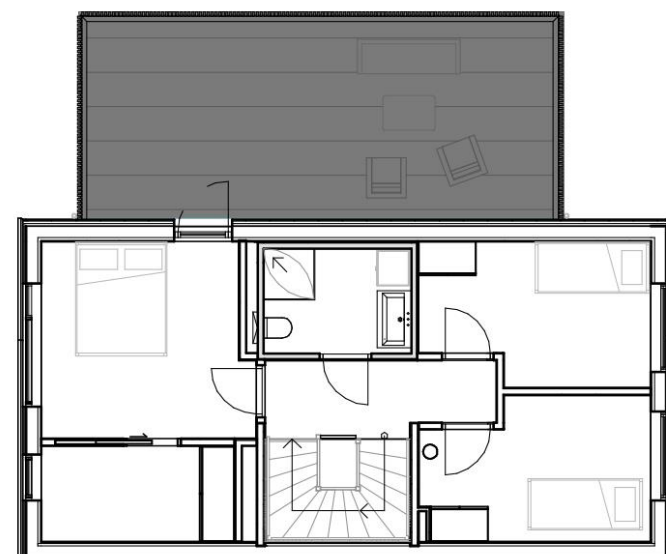
T

Interior + kitchen

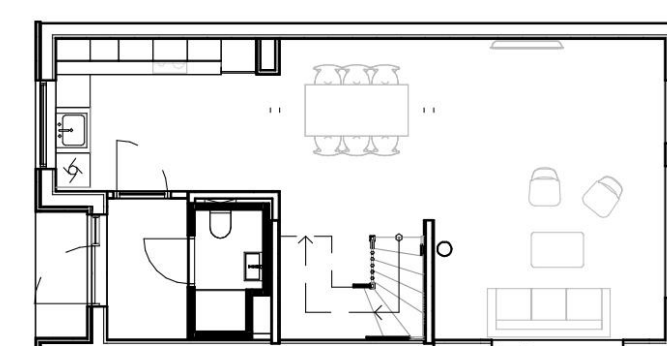
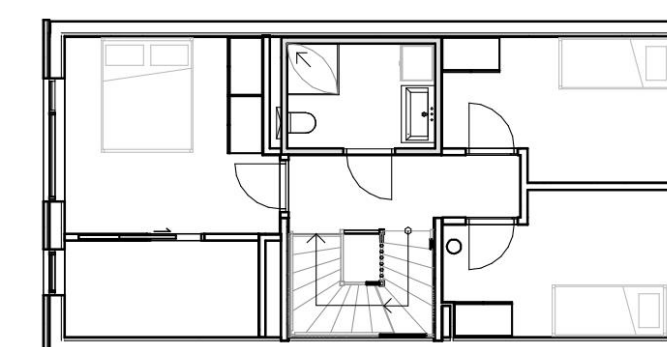
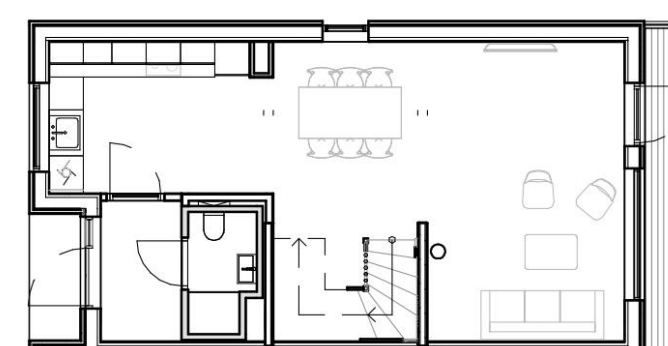
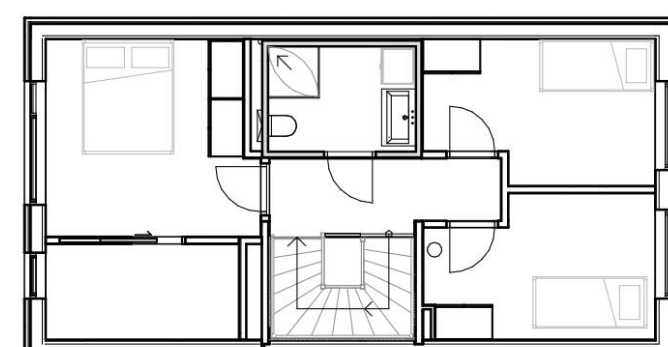
A



C



K



T

Carport + basement + terrace (roof)

Language - divide the different packages which were a result of the analysis phase. Find a robust system that can cope with eventual changes and developments in the project.

Modules



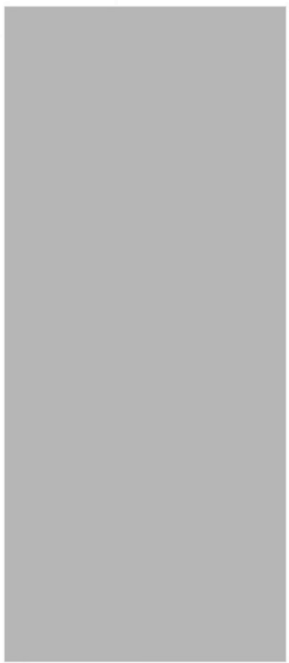
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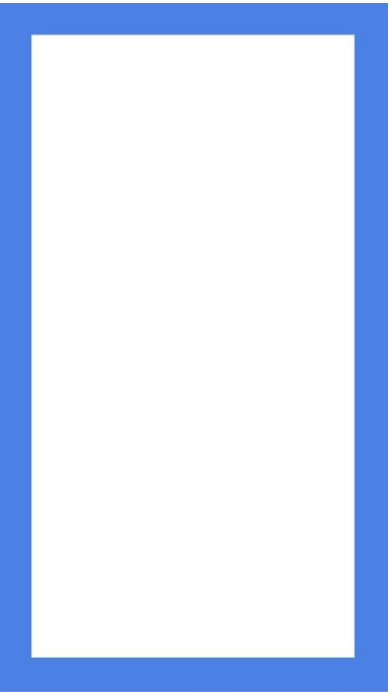
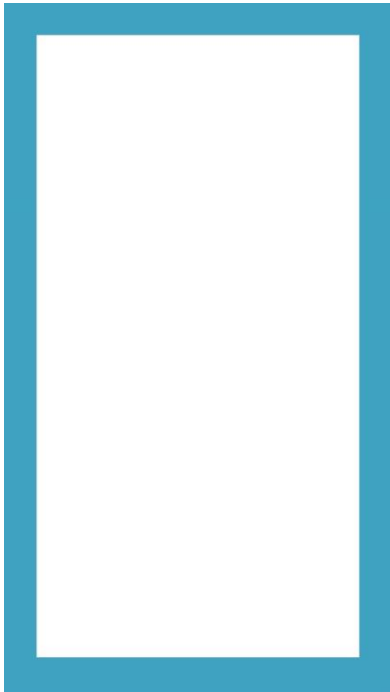
B



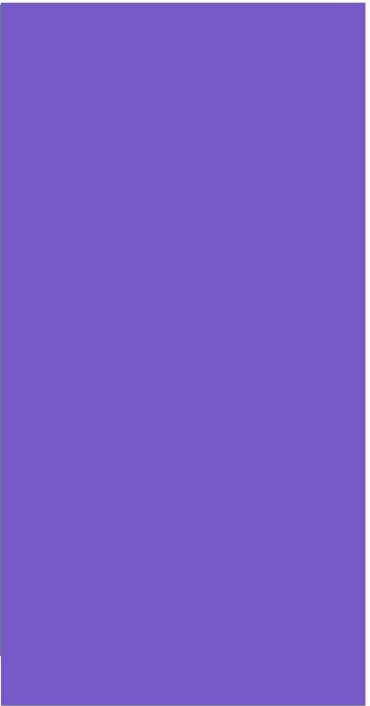
P



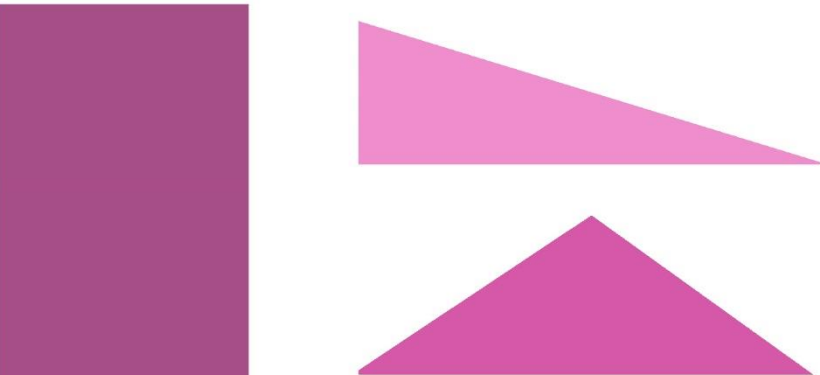
C



S

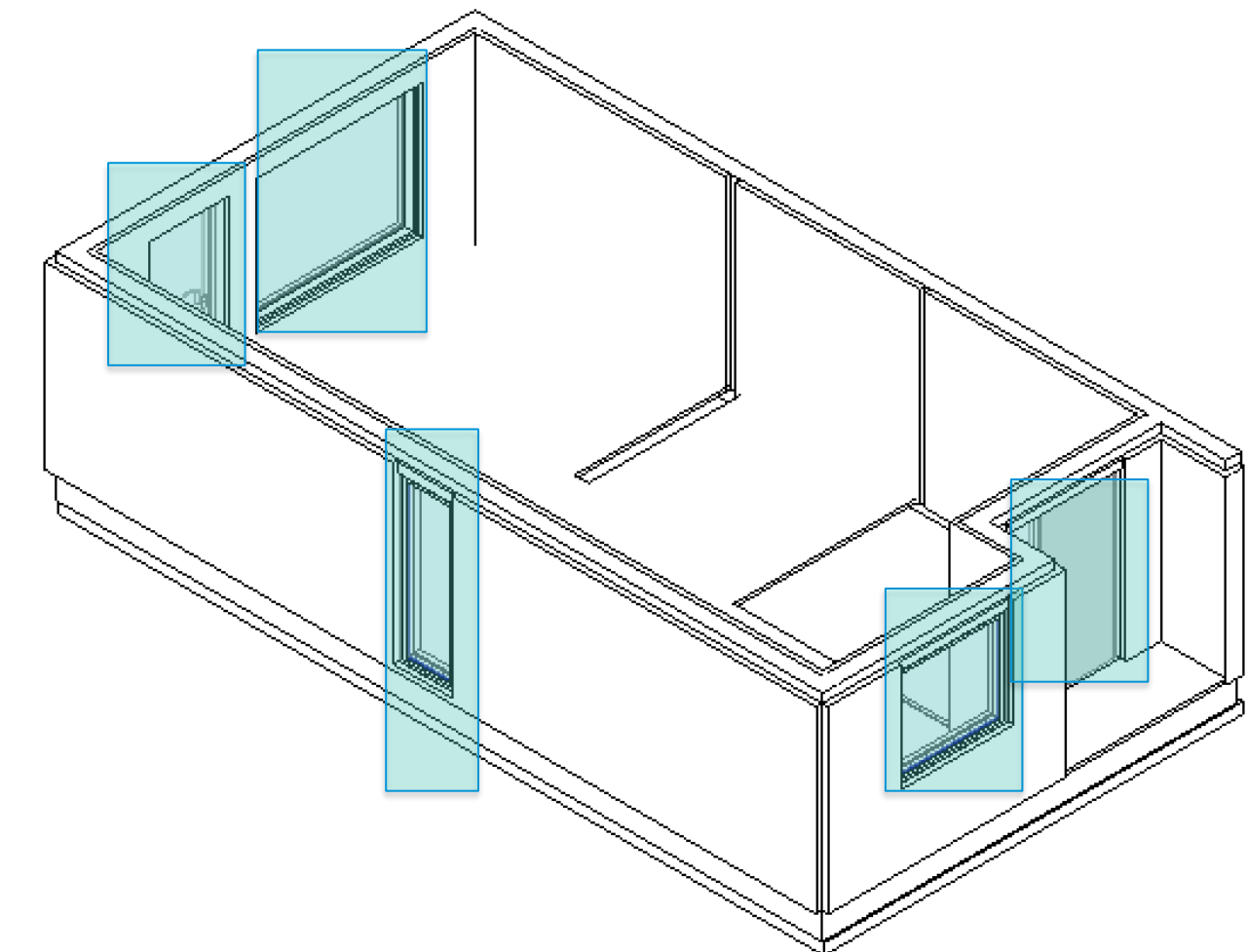
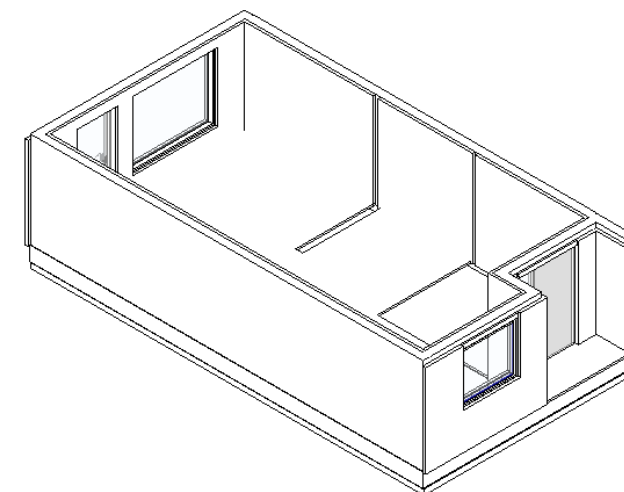
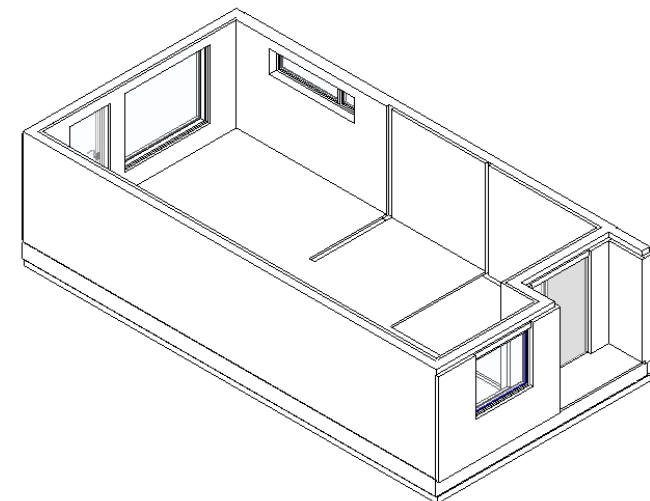
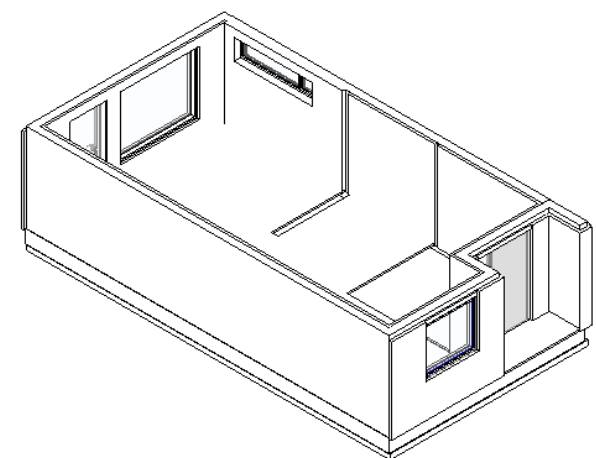
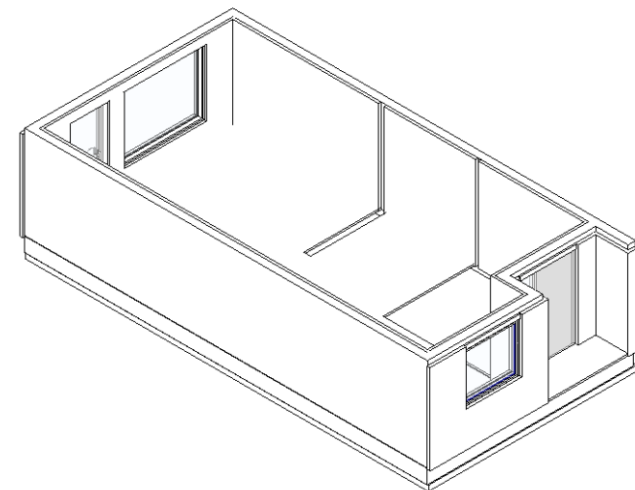
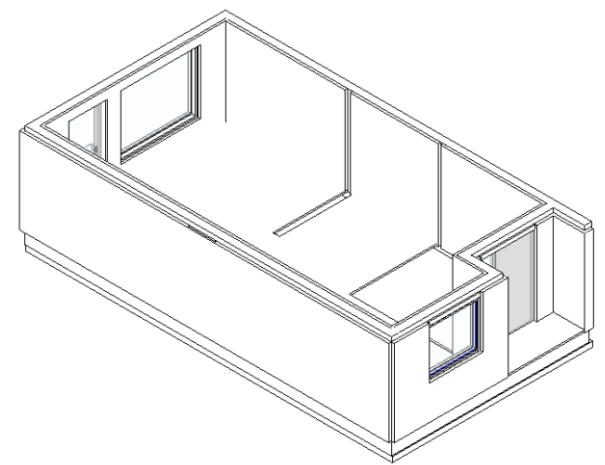
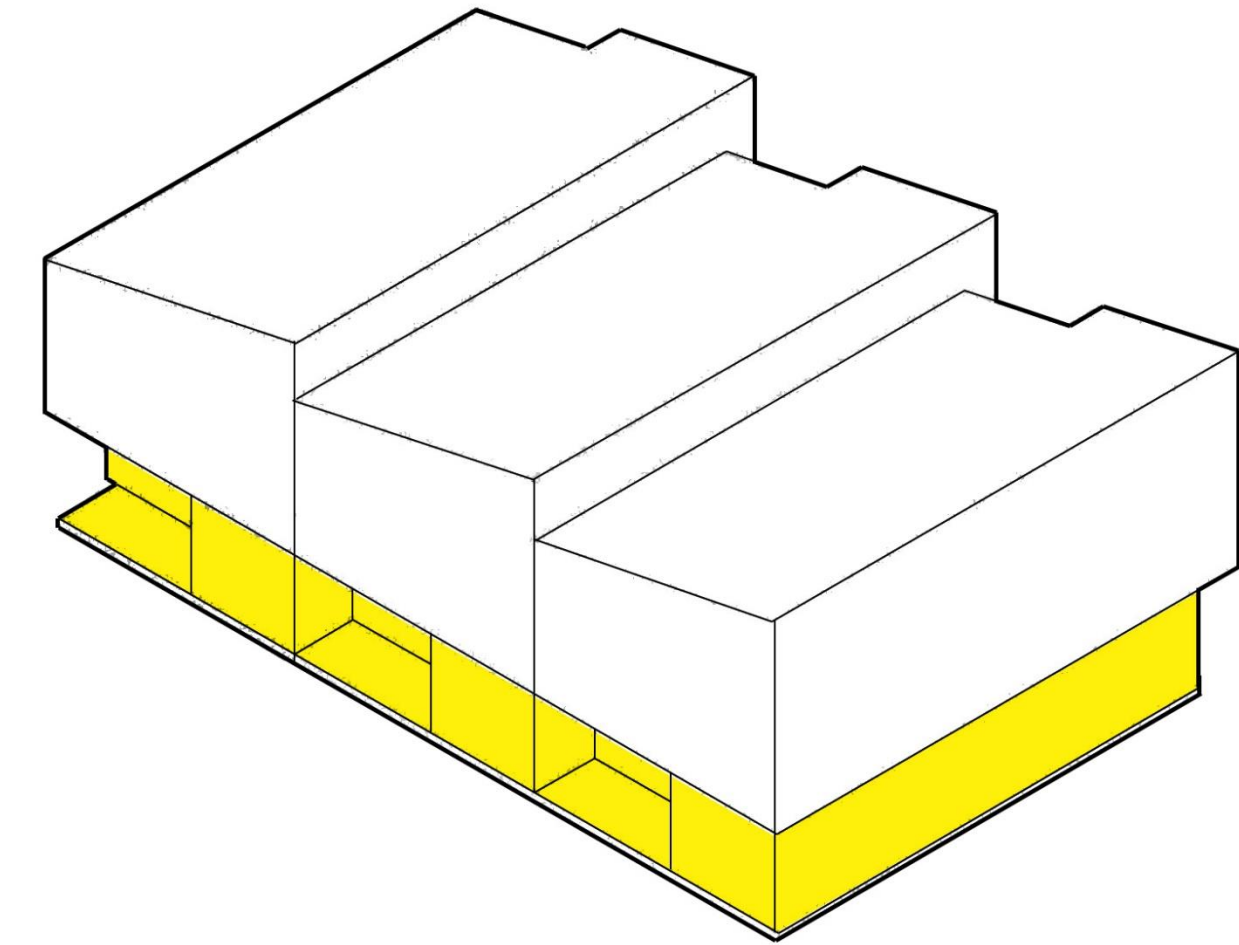
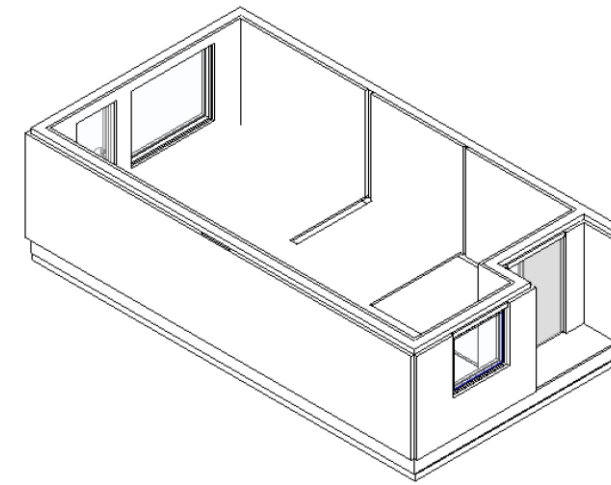
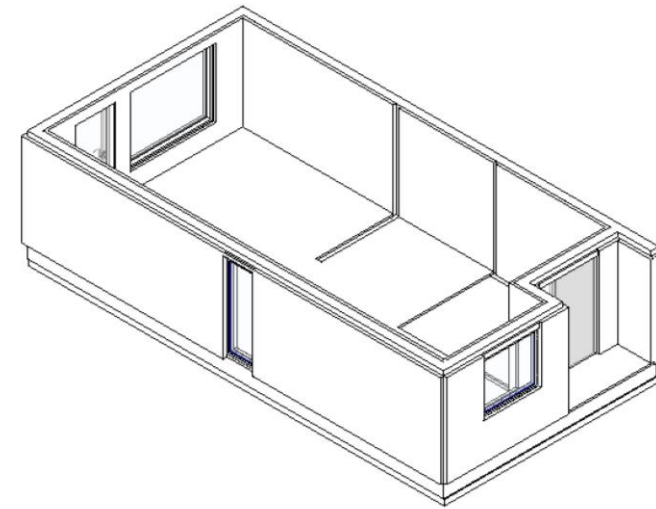
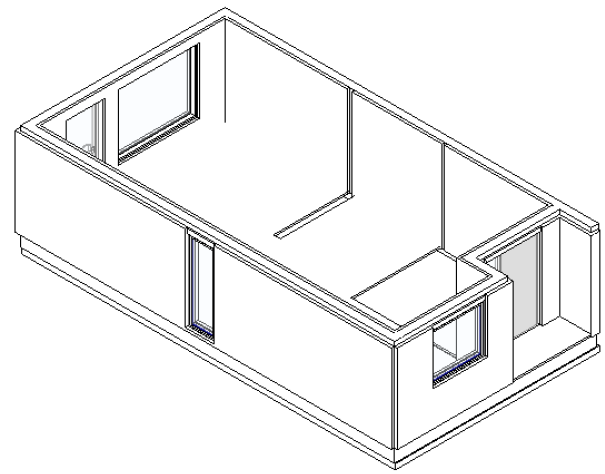


K

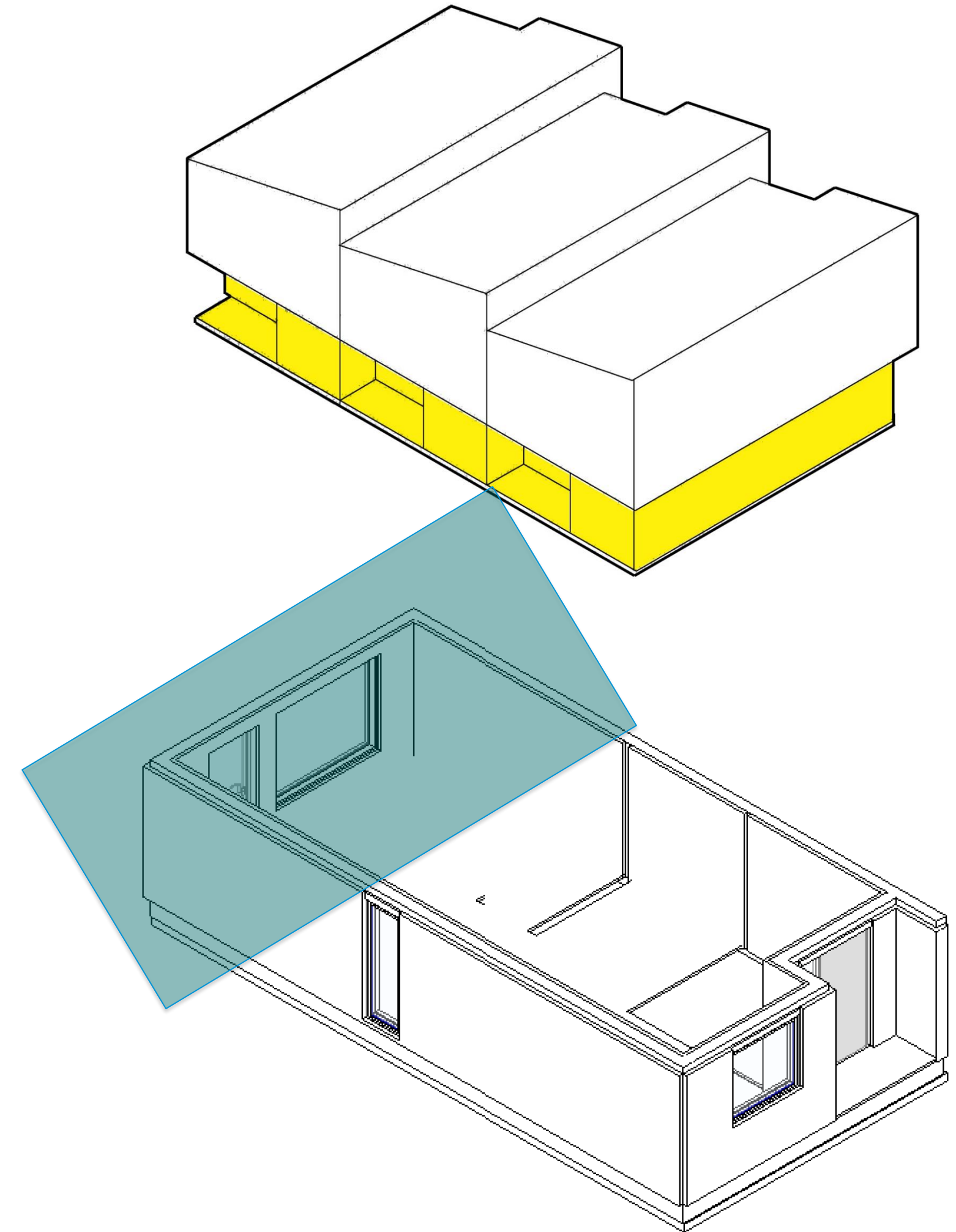
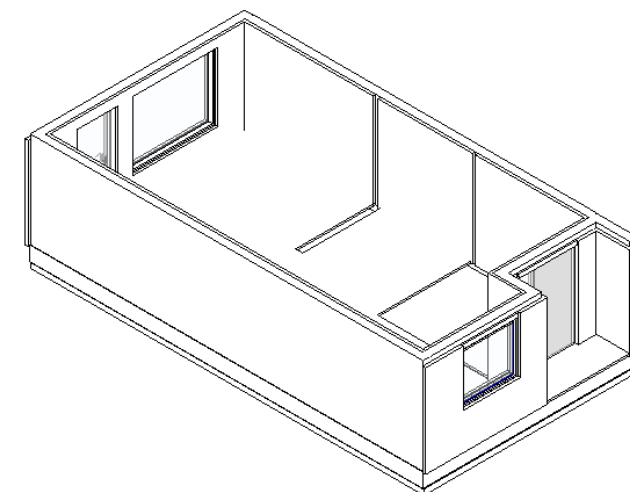
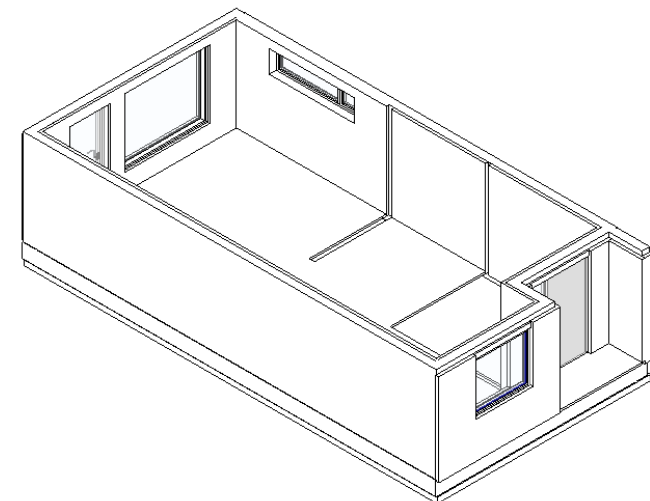
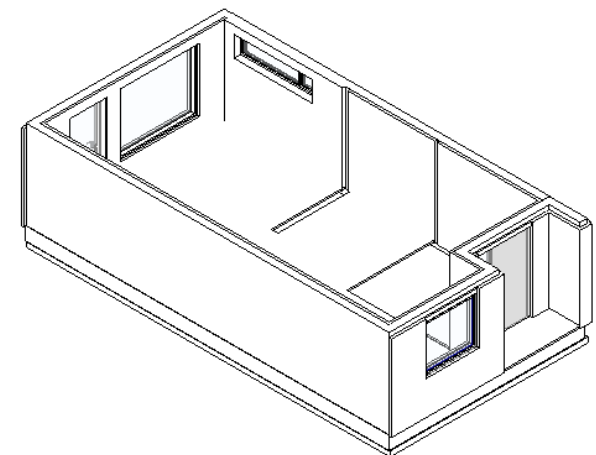
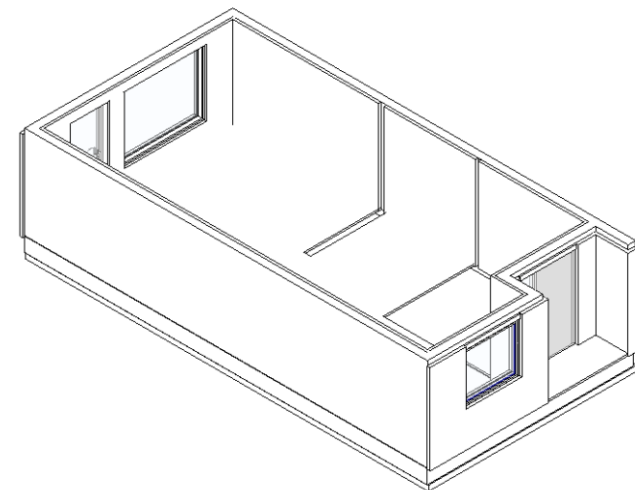
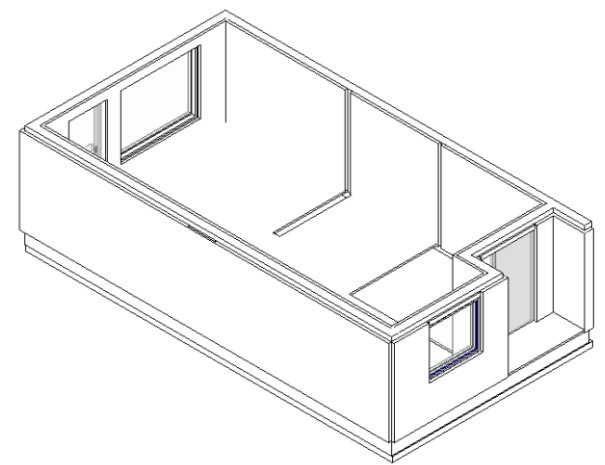
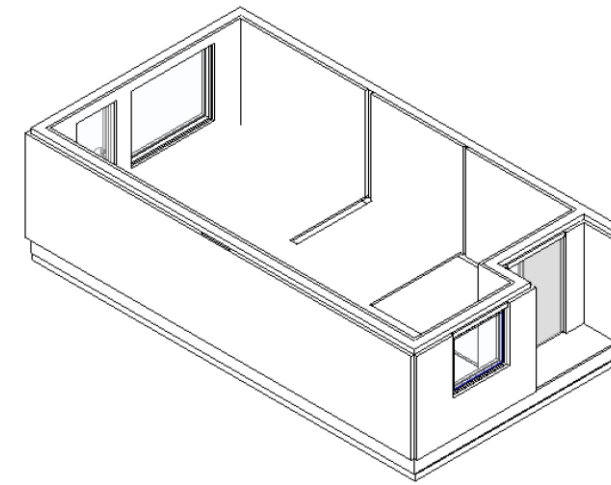
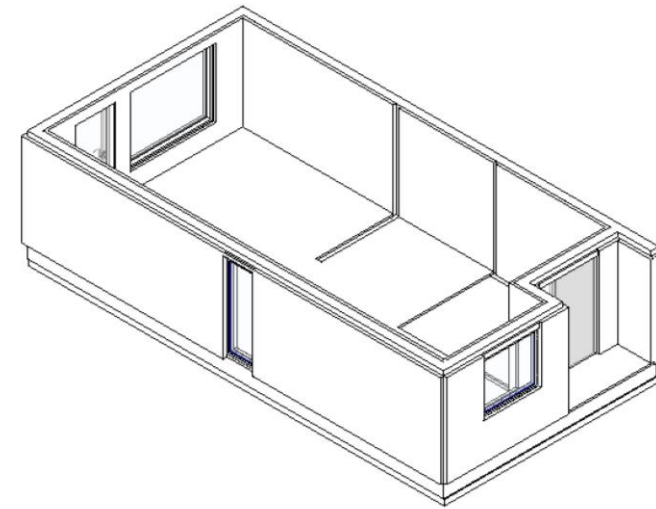
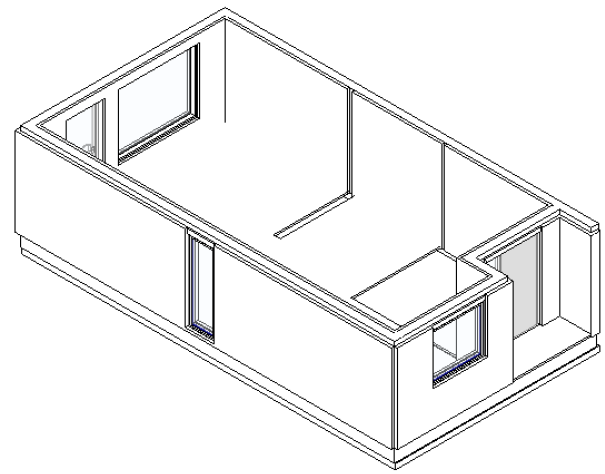


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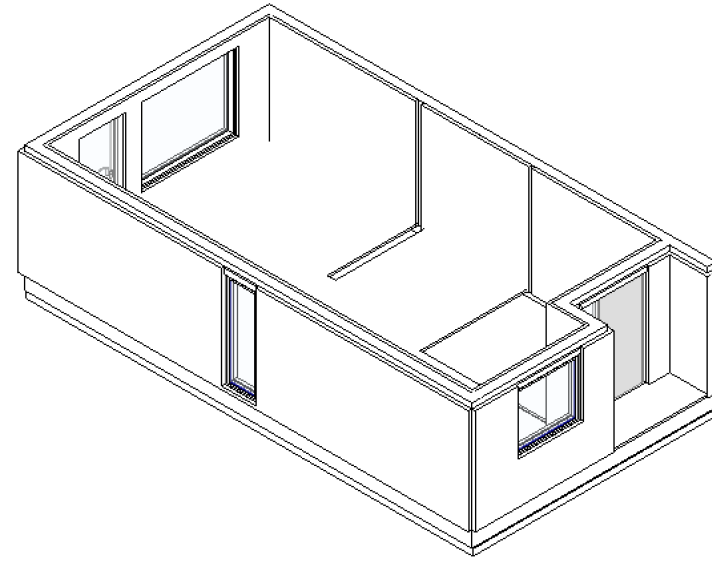
Language - make a code system that can be used to describe the duplicated design or industrial packages and which can tolerate new types and deviations.



Presets
SHARED + SWAPABLE



Presets
SHARED + SWAPABLE



Module _ Preset

Example:

S01 _ VSv

module name

type

size

deviation

DESIGN REPETITION

I: Interior

I01 Interior layout level 1

K: Basement

C: Carport

MODULE

S: Shell

S01 Shell module level 1

T: Tak

TF Flat roof

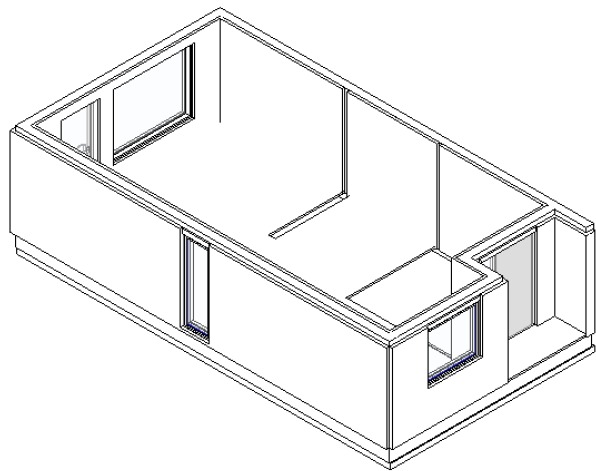
B: Bathroom

BA Bathroom module type A

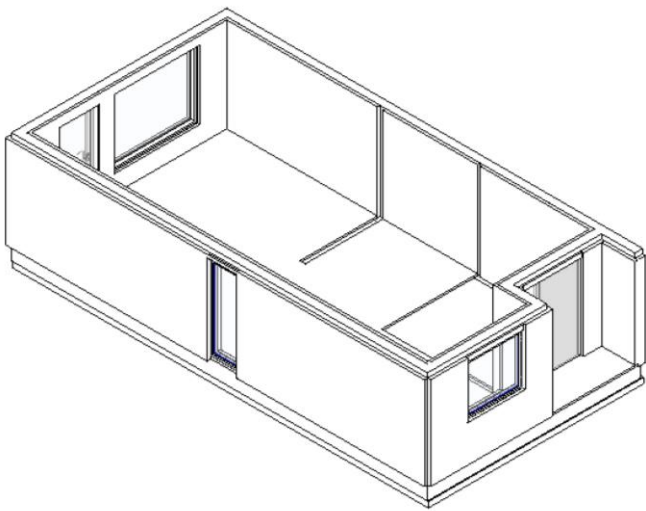
P: Stairs

J: Kitchen

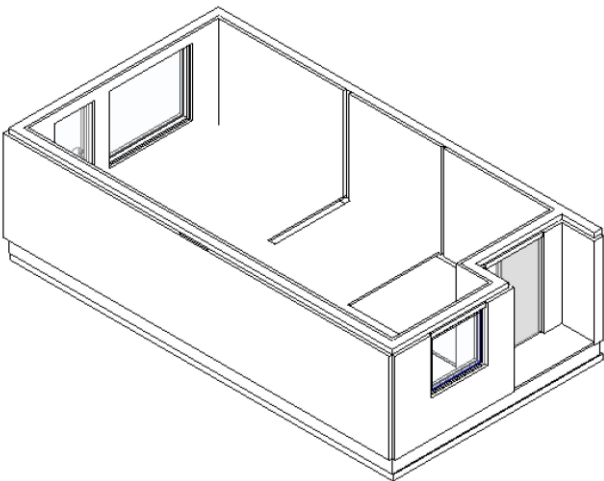
Example: S01



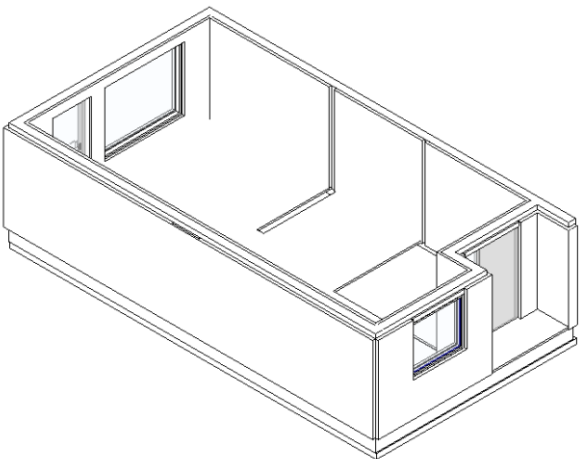
S01_VSv



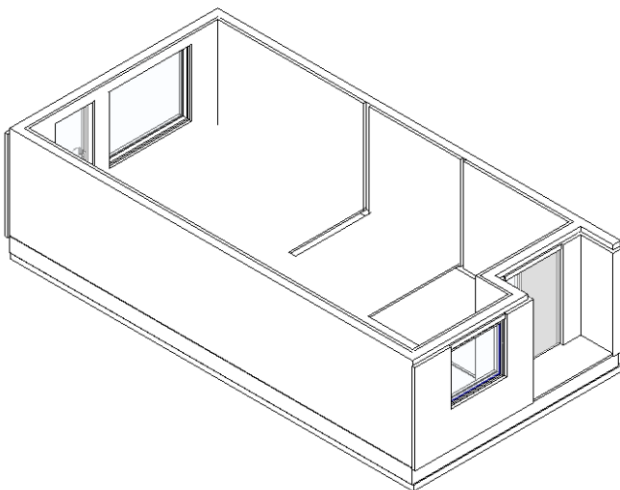
S01_VLv



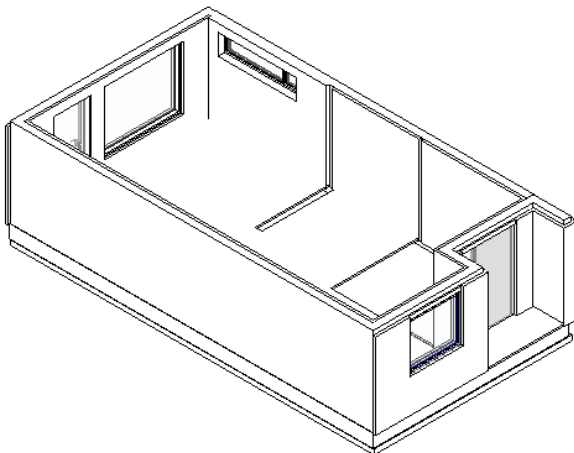
S01_VSt



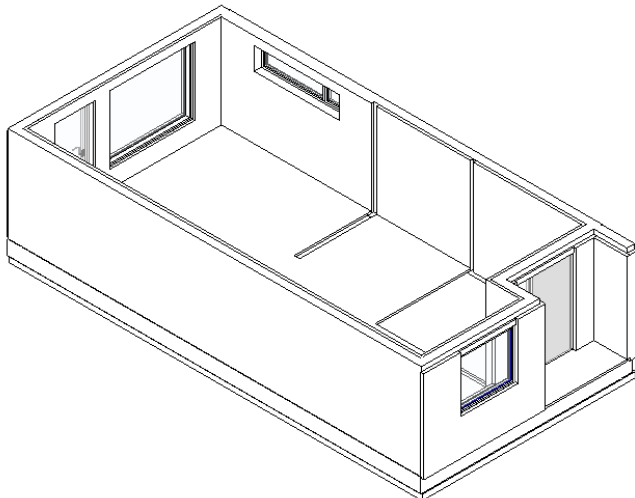
S01_MS



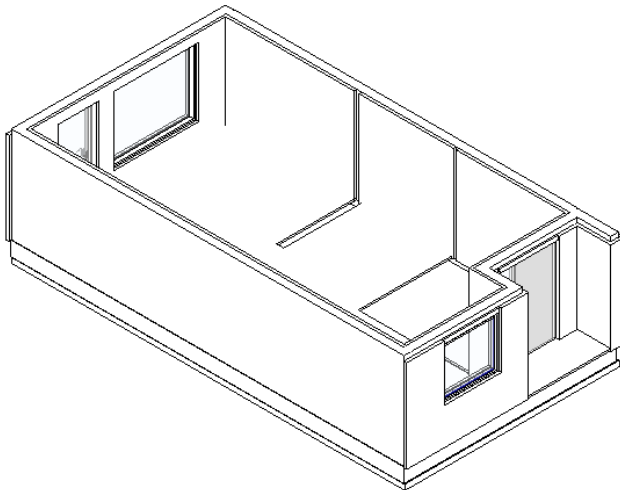
S01_ML



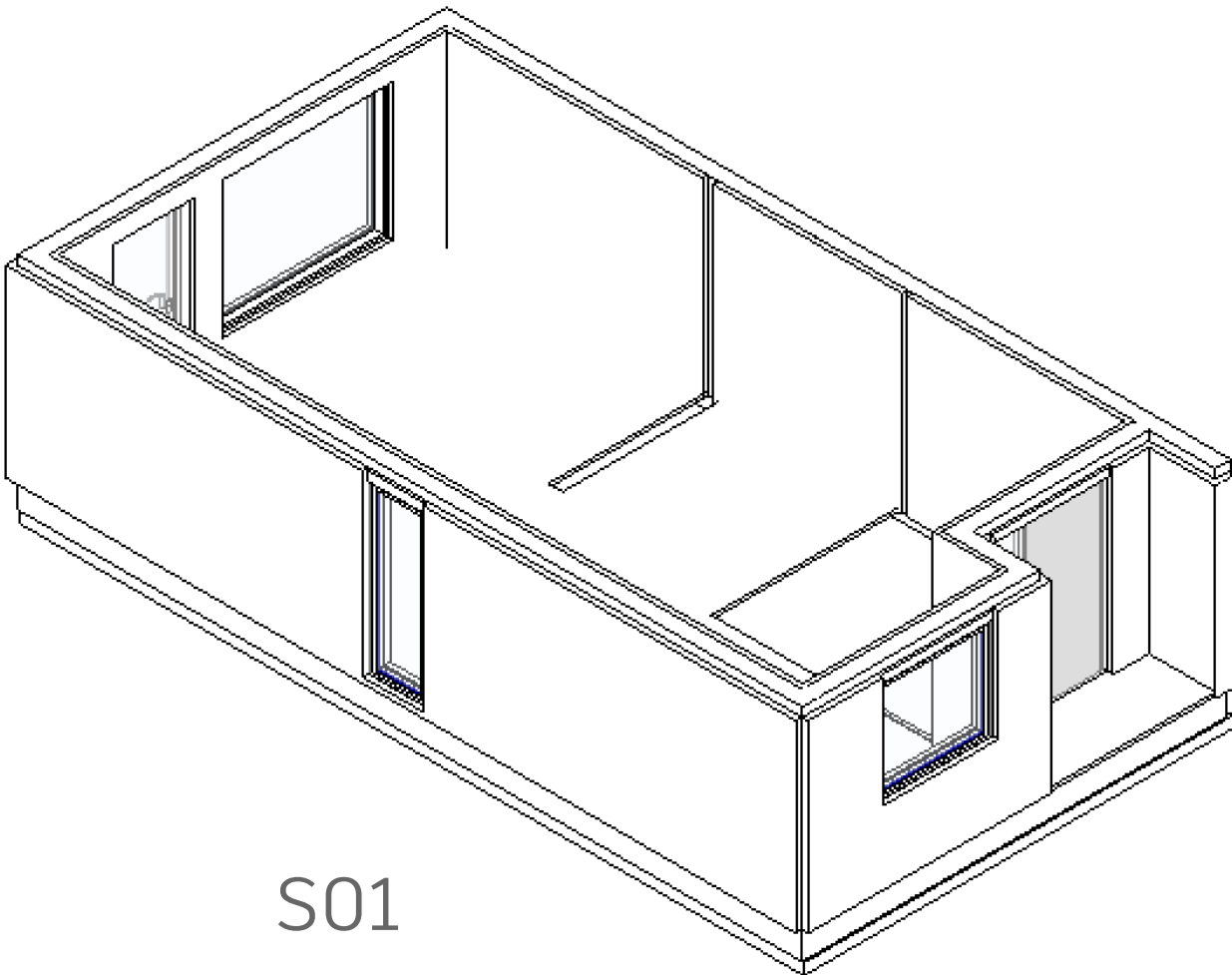
S01_HSv



S01_HLv



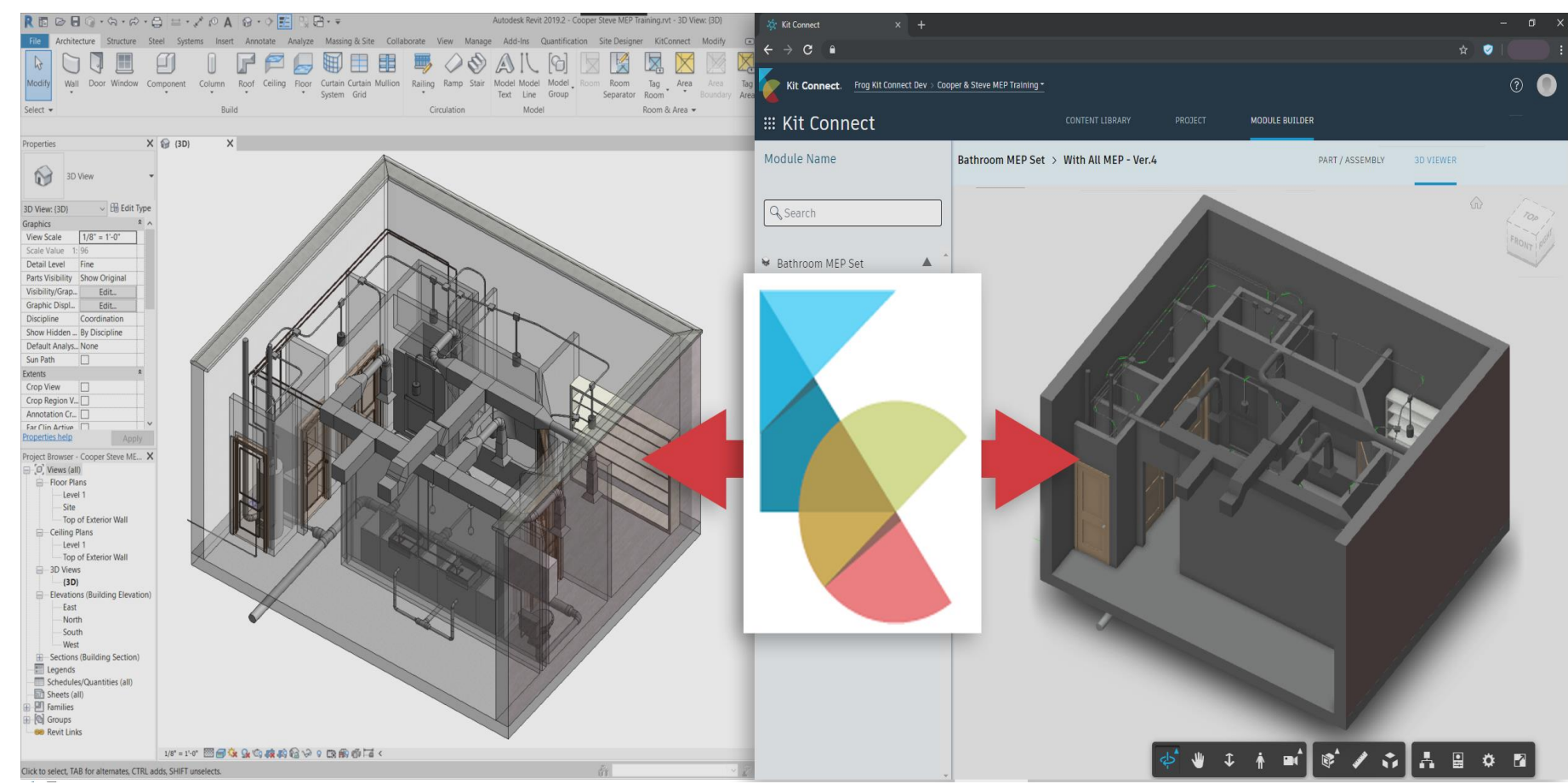
S01_HSt



S01

Presets

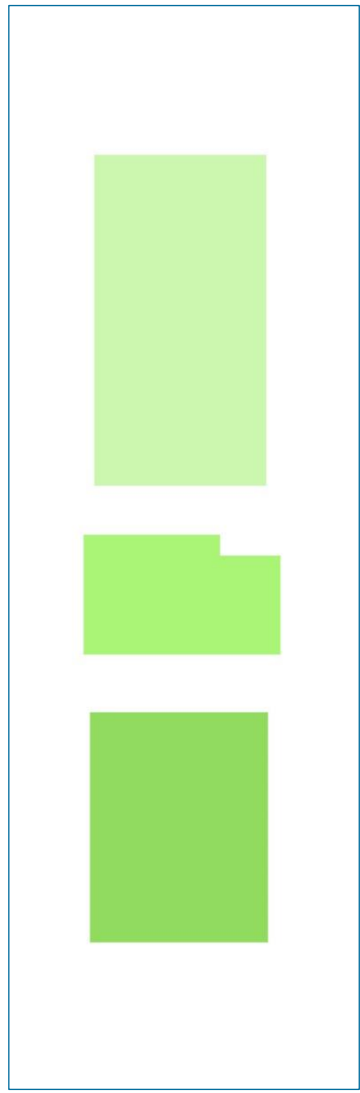
Unite and Test— Integrate and test proposed methodology for improving project workflows associated with design repetition and industrialisation. (in this case new technology – kit connect - for the handling geometry and data).



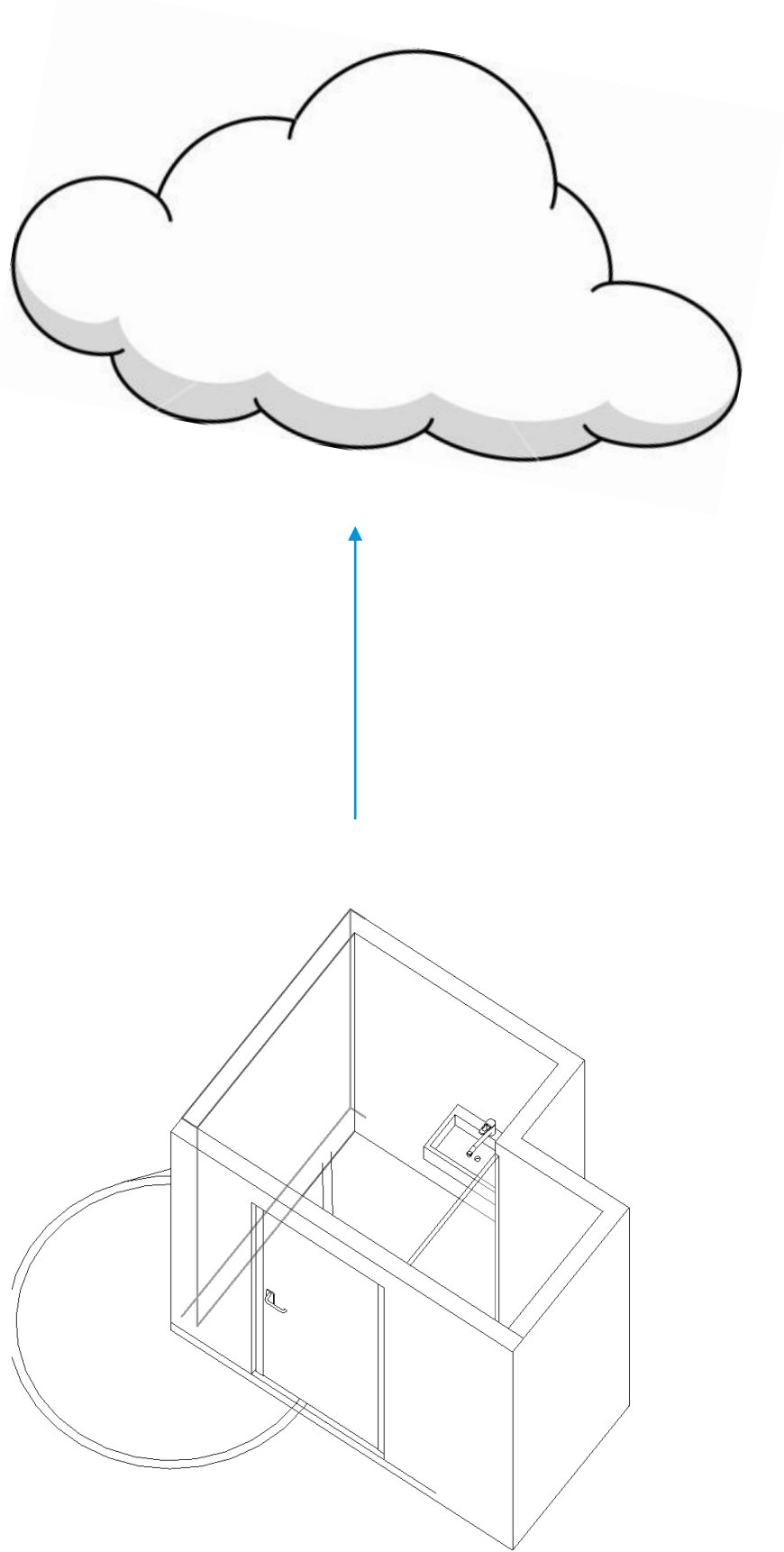
Revit Plug 

Web Applicati 

One source of truth



B



Publish to cloud
Cross dicipline
development in module
editor

Insert Module Preset

BATH X4

Preset 1 Default

View Settings

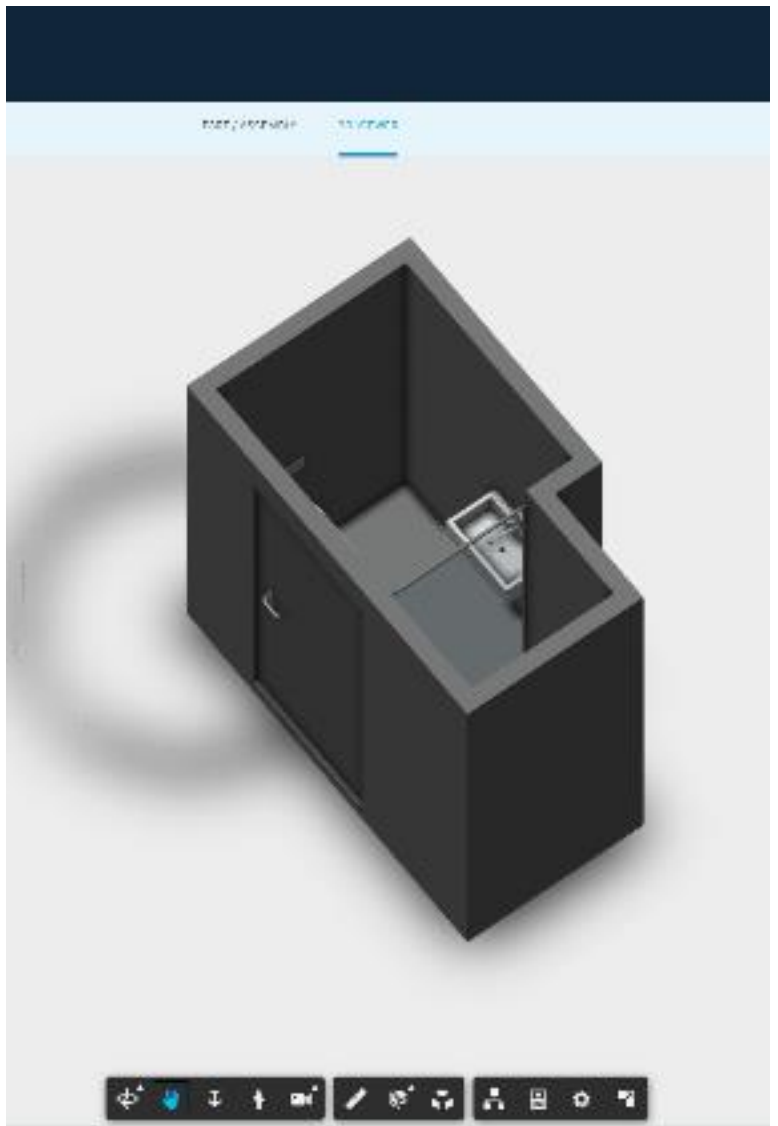
Parts BOM:

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244_01_Dar ENK_244.01.06_Innv. er	Innv. enkelt plate	244.01.06_Innv. er	Doors		<input type="checkbox"/>	<input type="checkbox"/>
315_Saniterutstyr - WC Vegghengt		Porselen	Plumbing Fixture		<input type="checkbox"/>	<input type="checkbox"/>
315_Vask baderom 5, 500 x 325		500 x 325	Plumbing Fixture		<input type="checkbox"/>	<input type="checkbox"/>

System Family Instances:

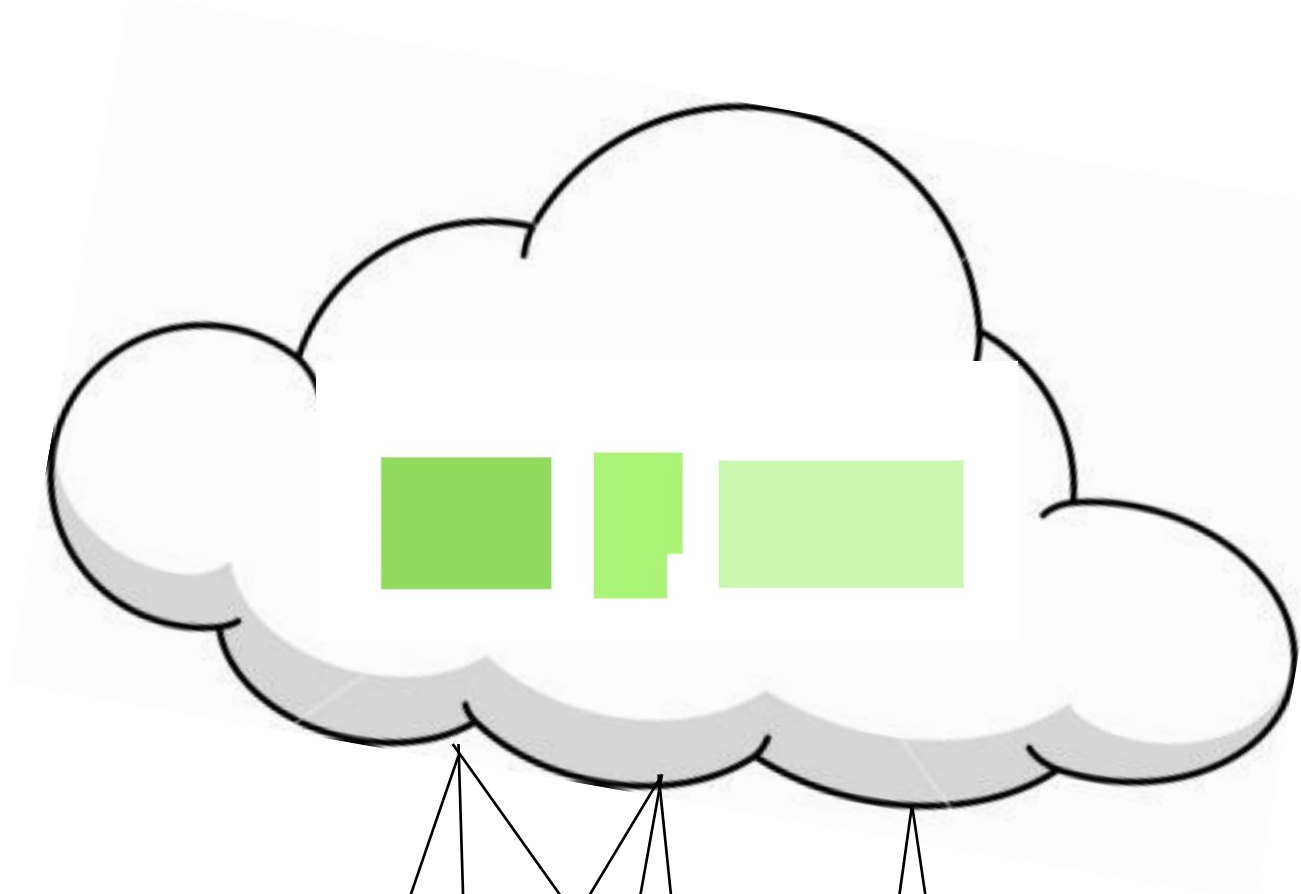
Name	Family Type	Category
FKC_Basic Wall_242-90_PV	242-90_PV	Walls
FKC_Basic Wall_242-90_PV	242-90_PV	Walls
FKC_Basic Wall_242-90_PV	242-90_PV	Walls
FKC_Basic Wall_241_Generisk 25mm	241_Generisk 25mm	Walls
FKC_Basic Wall_242-90_PV	242-90_PV	Walls
FKC_Basic Wall_242-90_PV	242-90_PV	Walls
FKC_Basic Wall_242-90_PV	242-90_PV	Walls
FKC_Basic Wall_242-90_PV	242-90_PV	Walls

Insert Module Cancel



Make presets
Bill of materials list and
3D visualisation

Quantative calculations
for example CO2



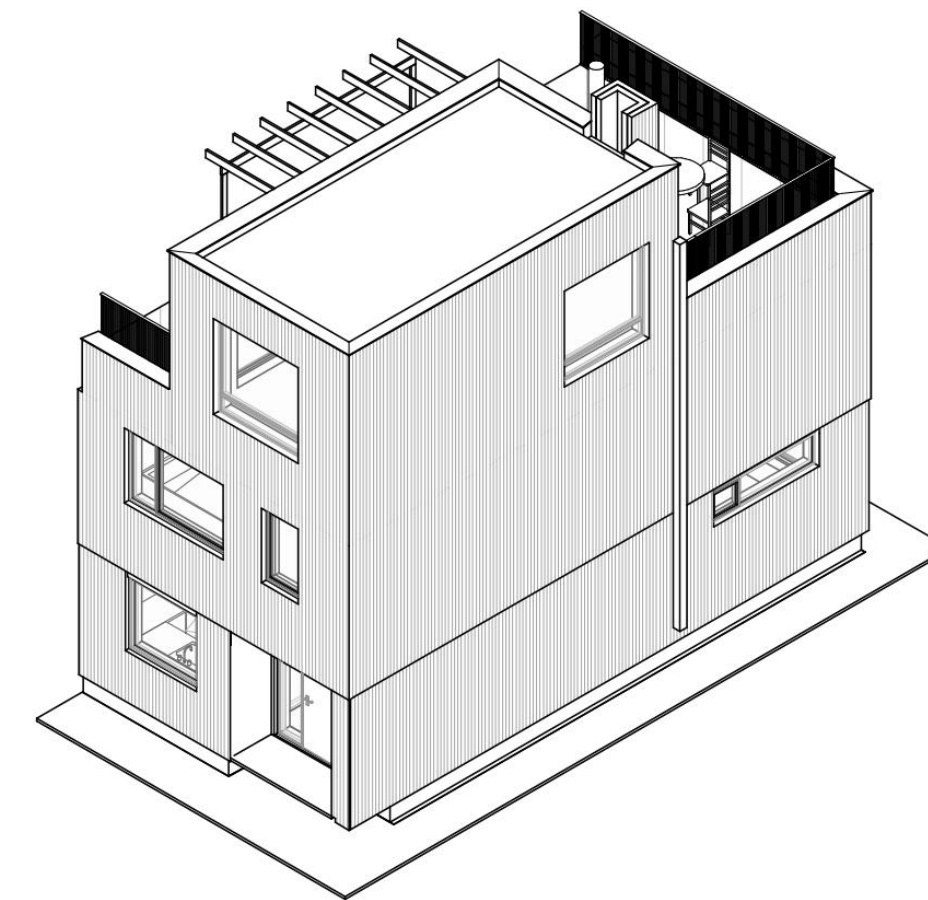
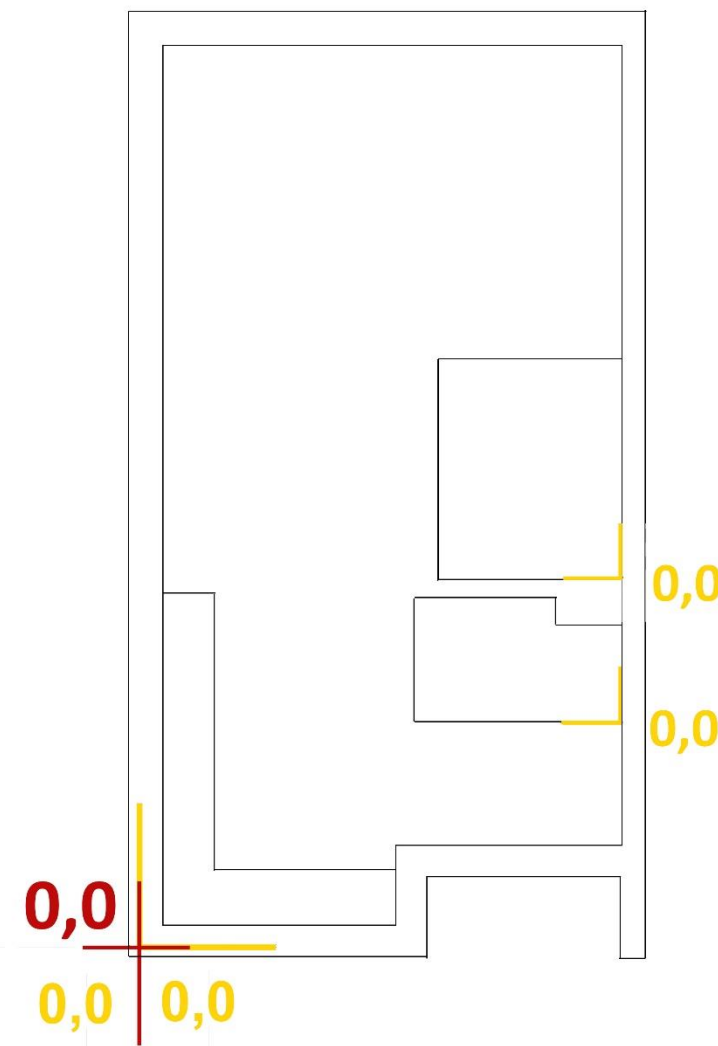
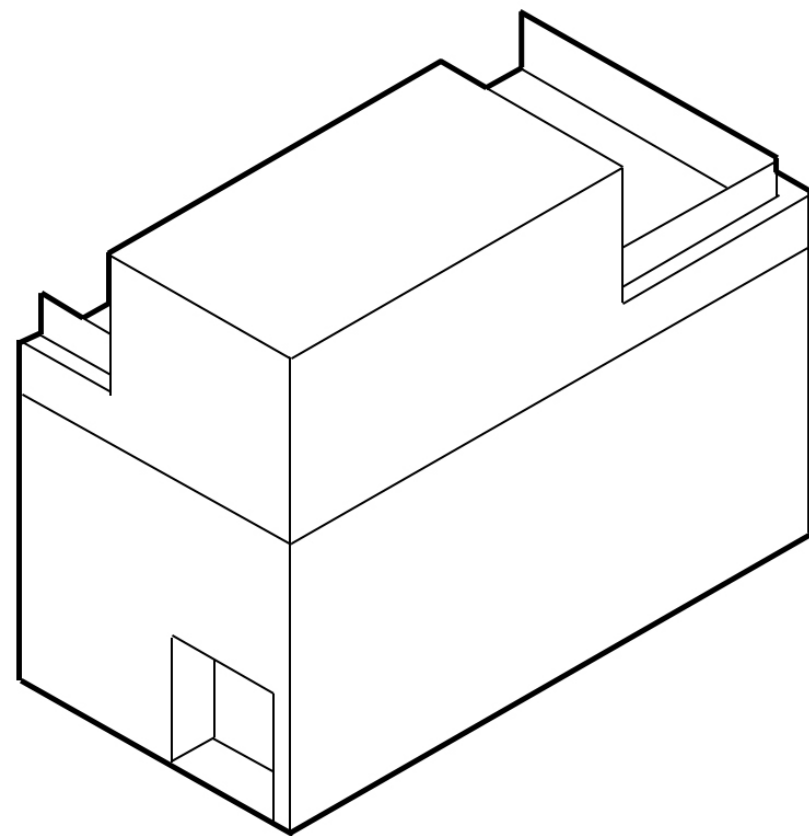
N4, N1

N1, N2

N1,N2,N3

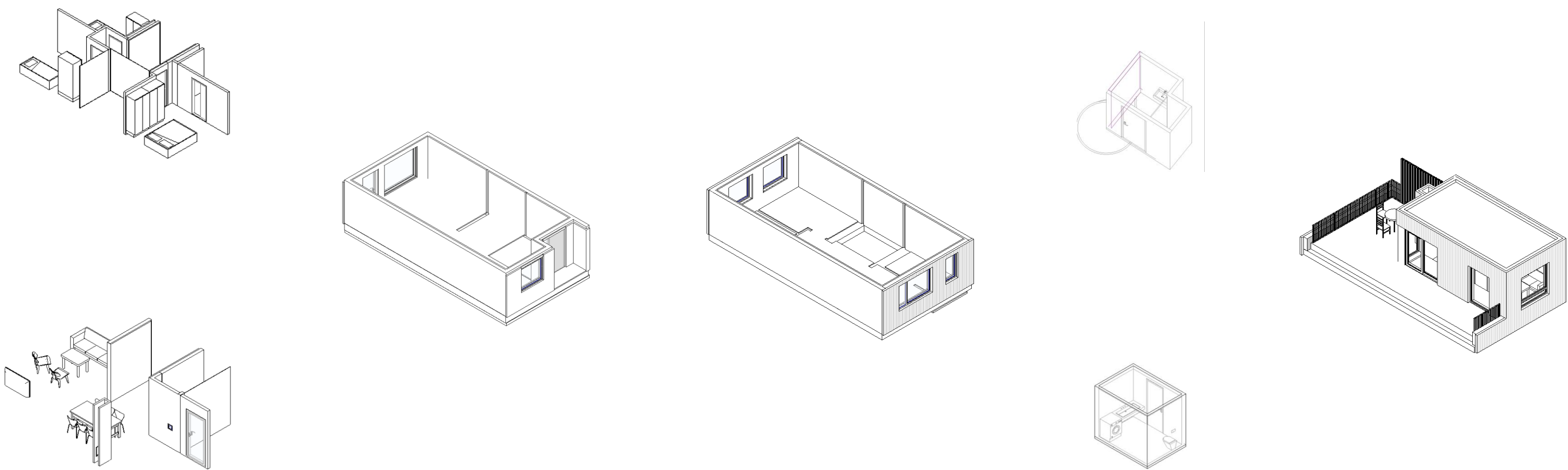
N2,N3,N4

Early visualization and simultaneous development

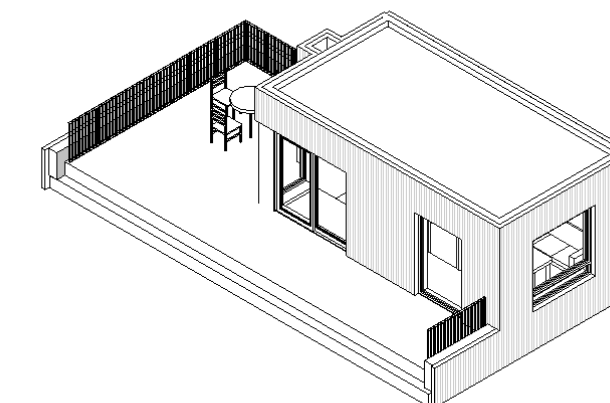
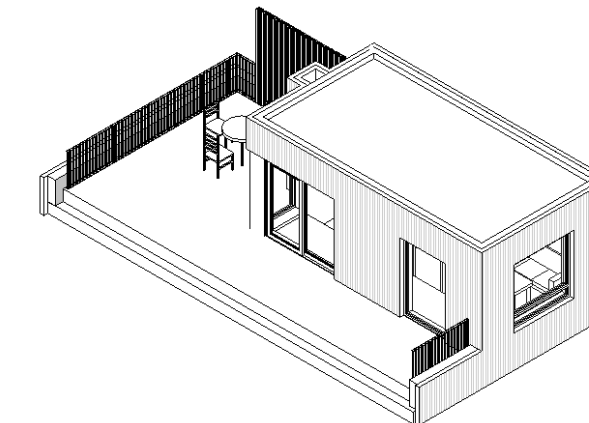
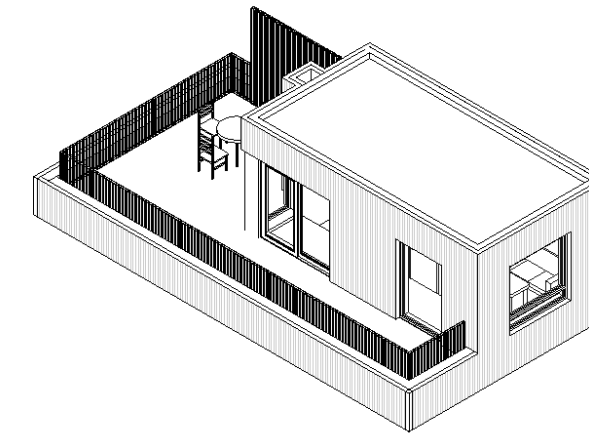
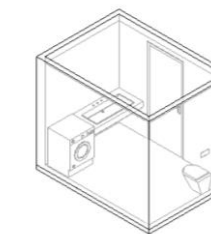
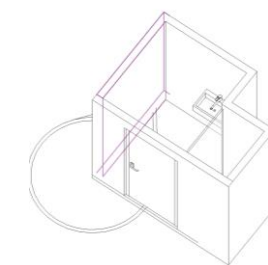
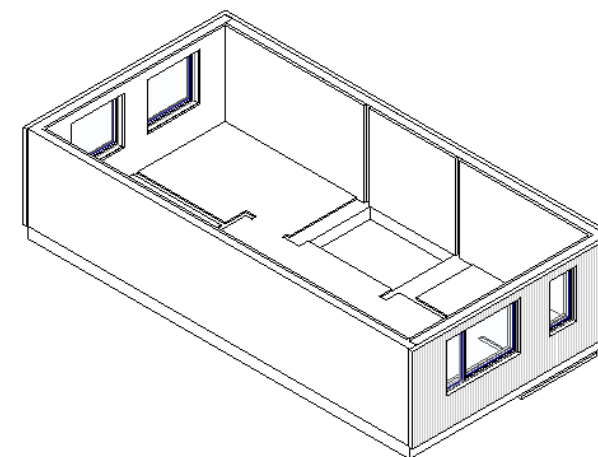
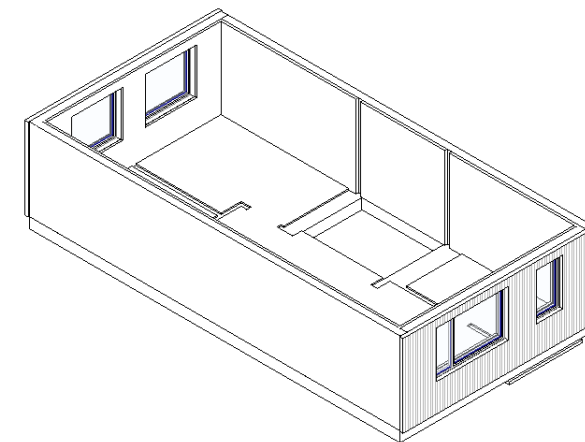
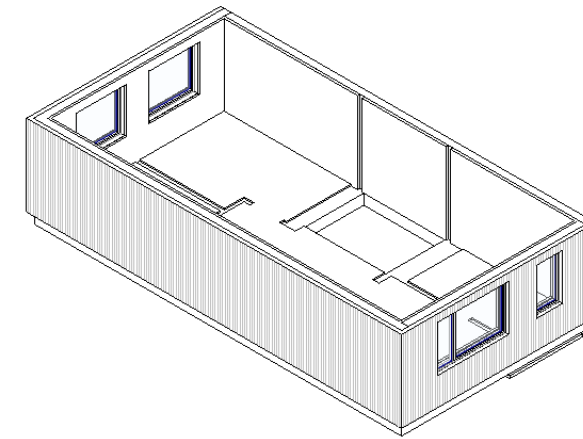
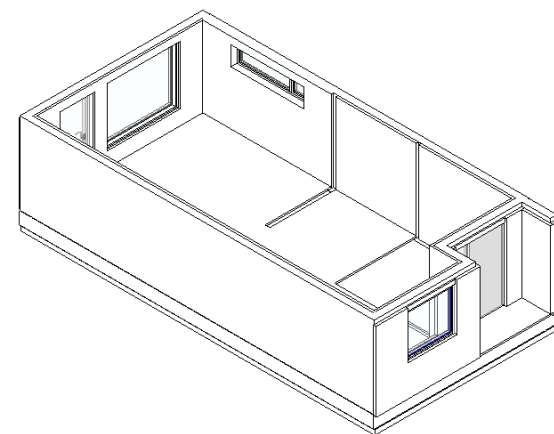
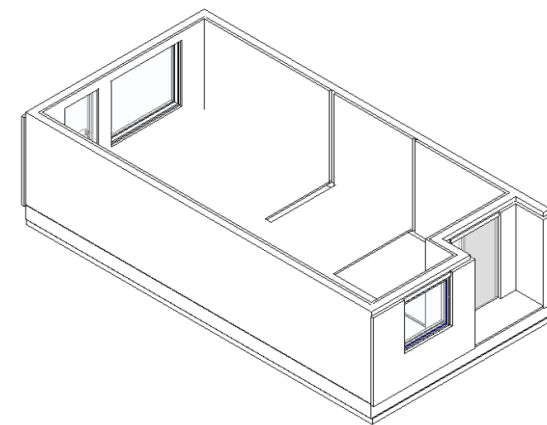
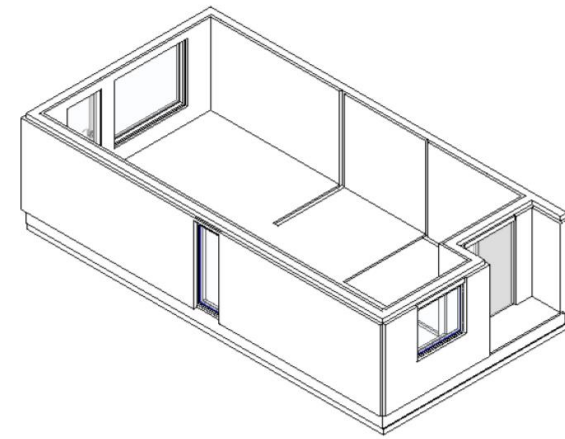
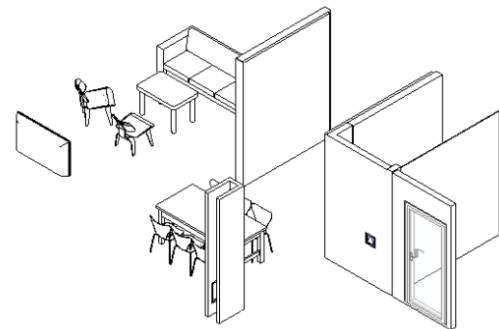
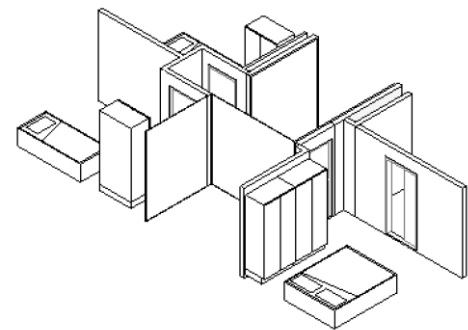


- + can choose volumetric vis or detailed vis
- + can swap modules in and out based on 0 point

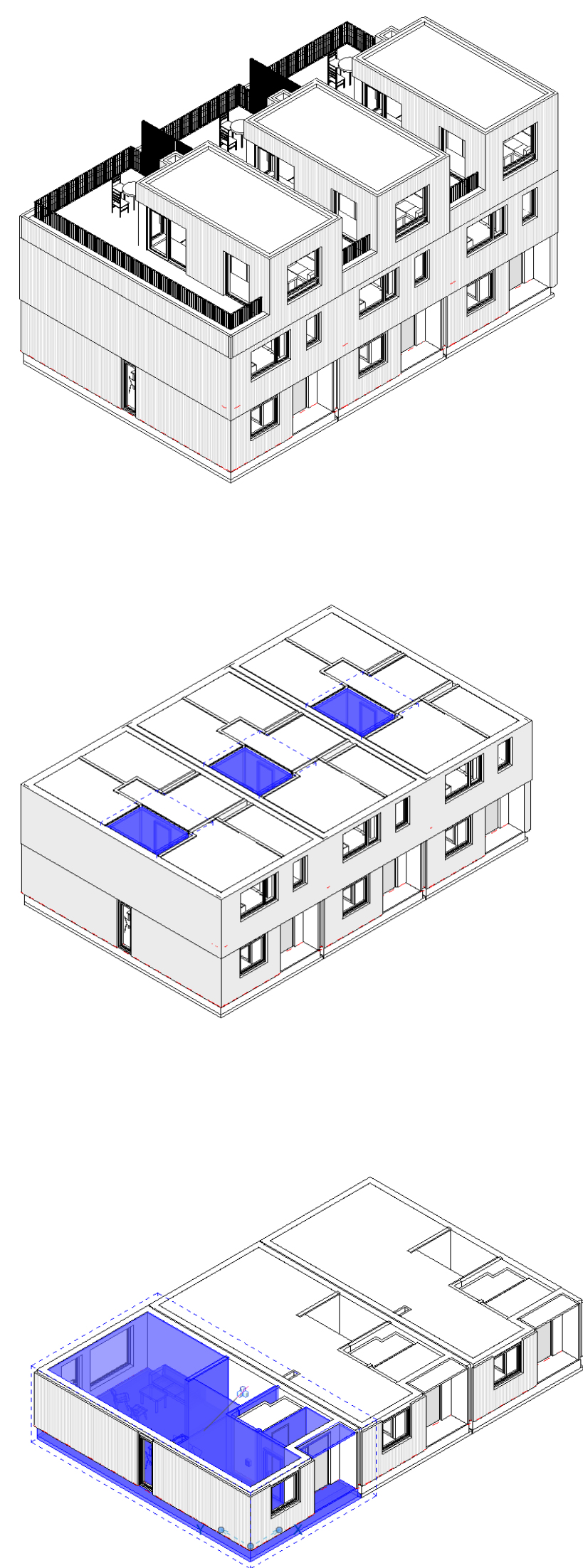
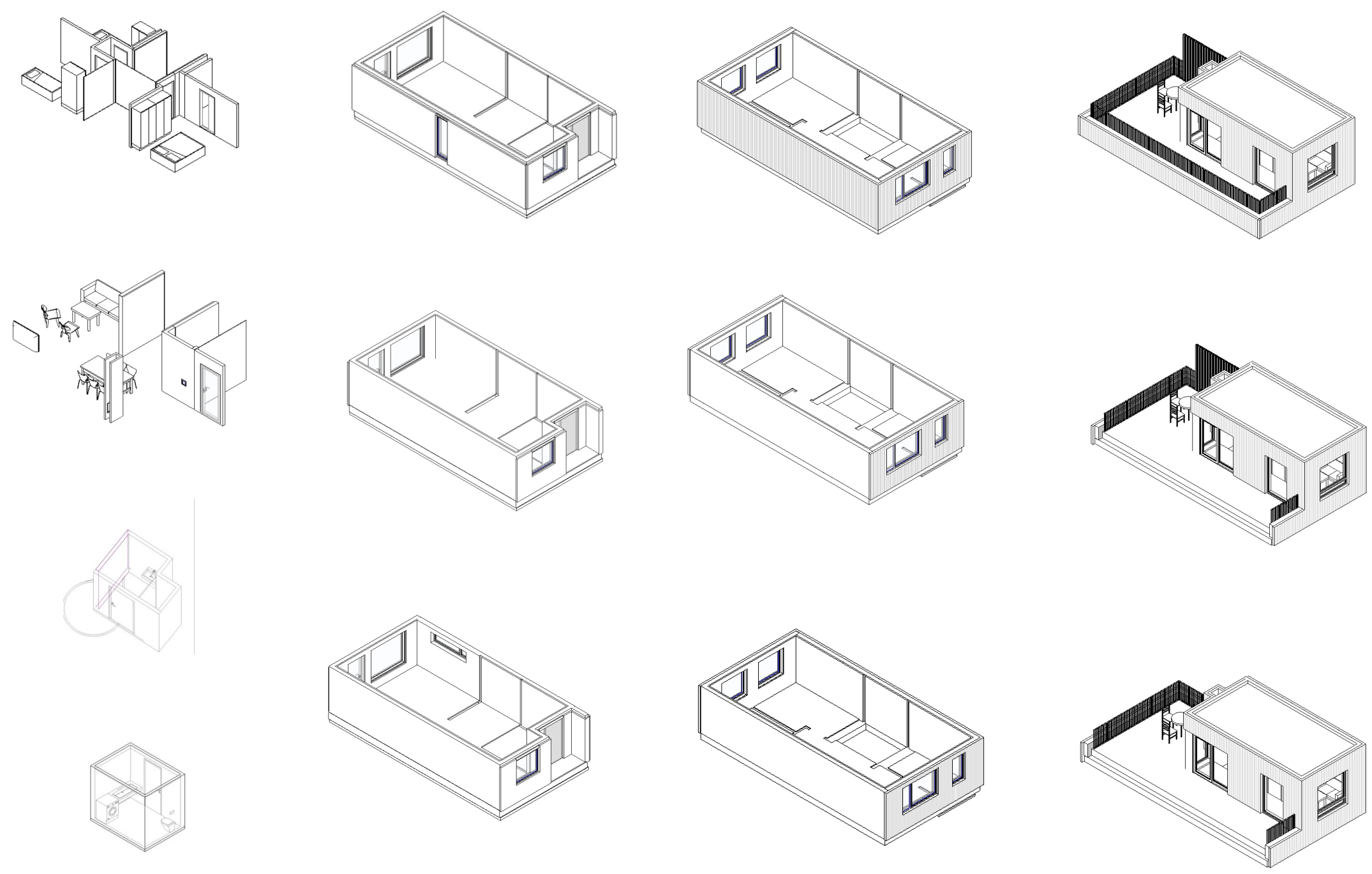
Modules



Presets



Project formation



Customisation

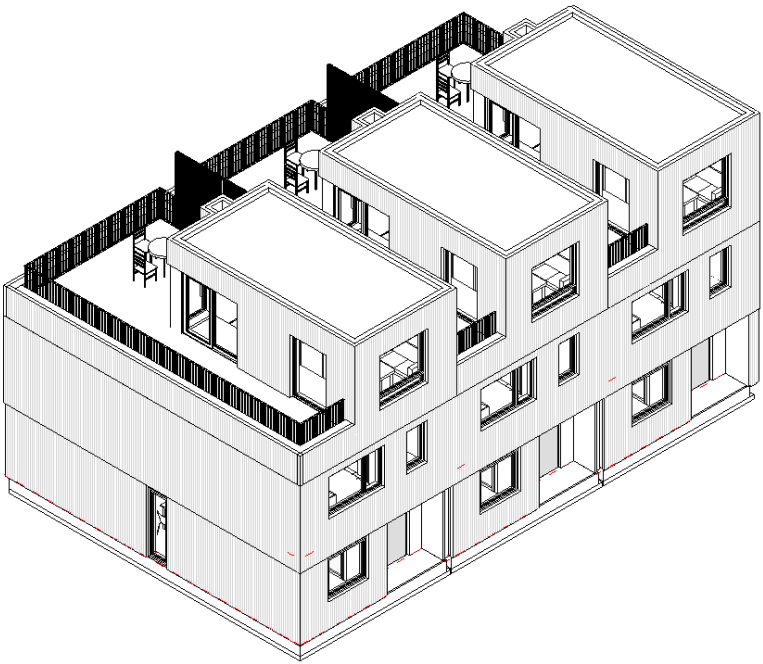
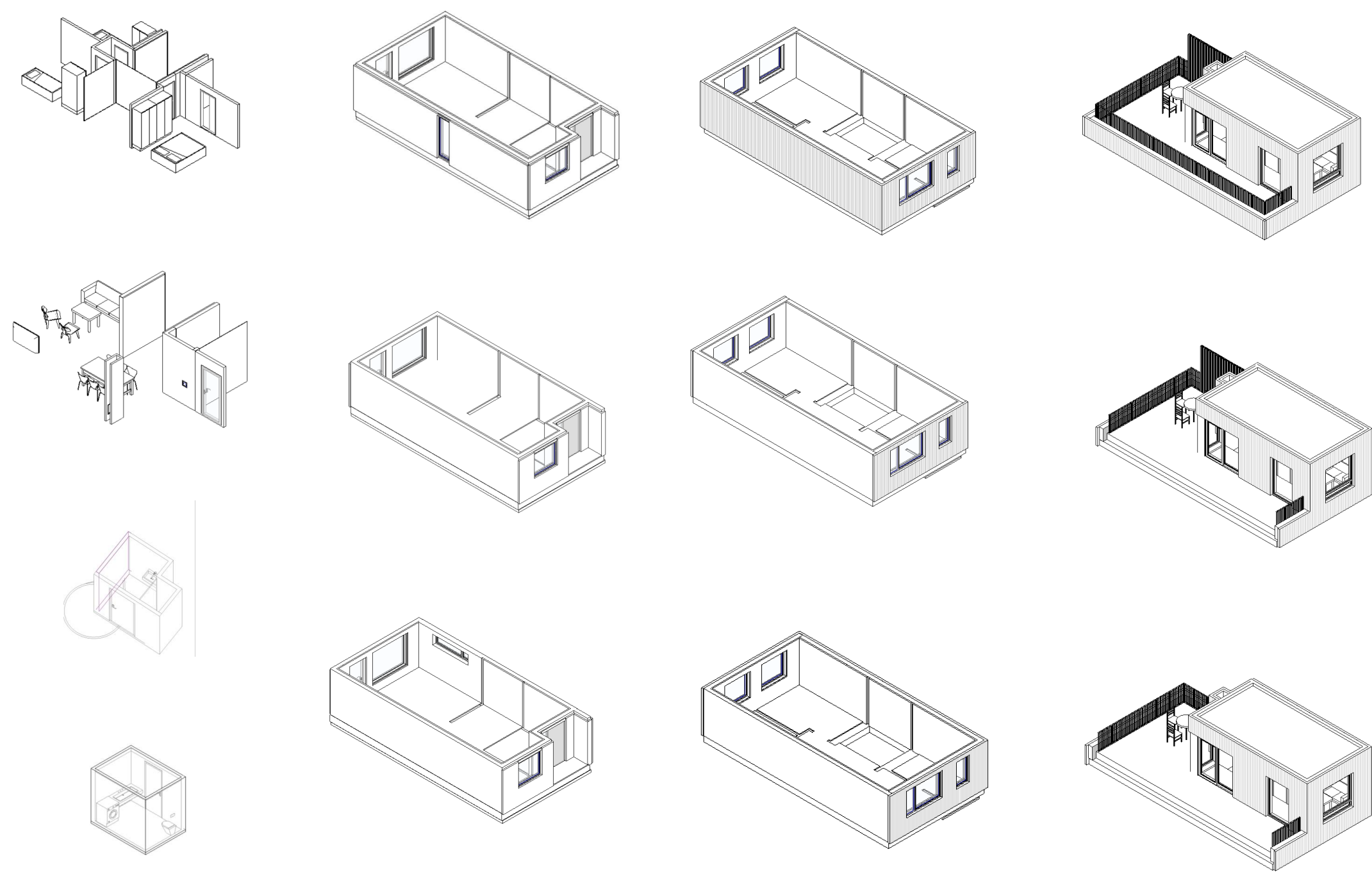


materials



quality

Project analysis + comparison



Cost : \$ X,000,000

Bill of materials : XXXXX
XXXXX

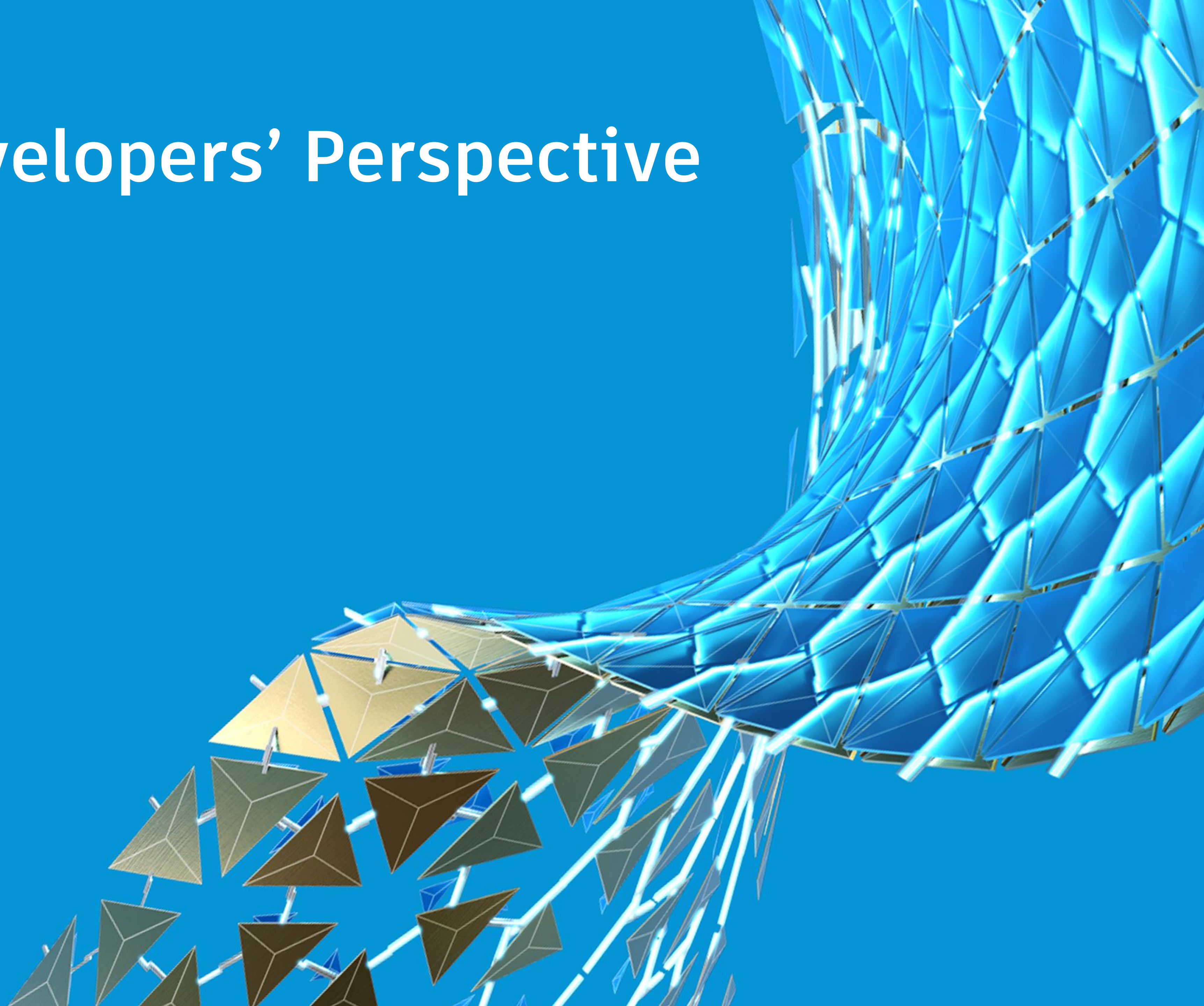
CO2 emission : XXXXXXXXX

Evaluate— Compare the new workflow with the original workflows and evaluate. Conclude a recommended way forward.

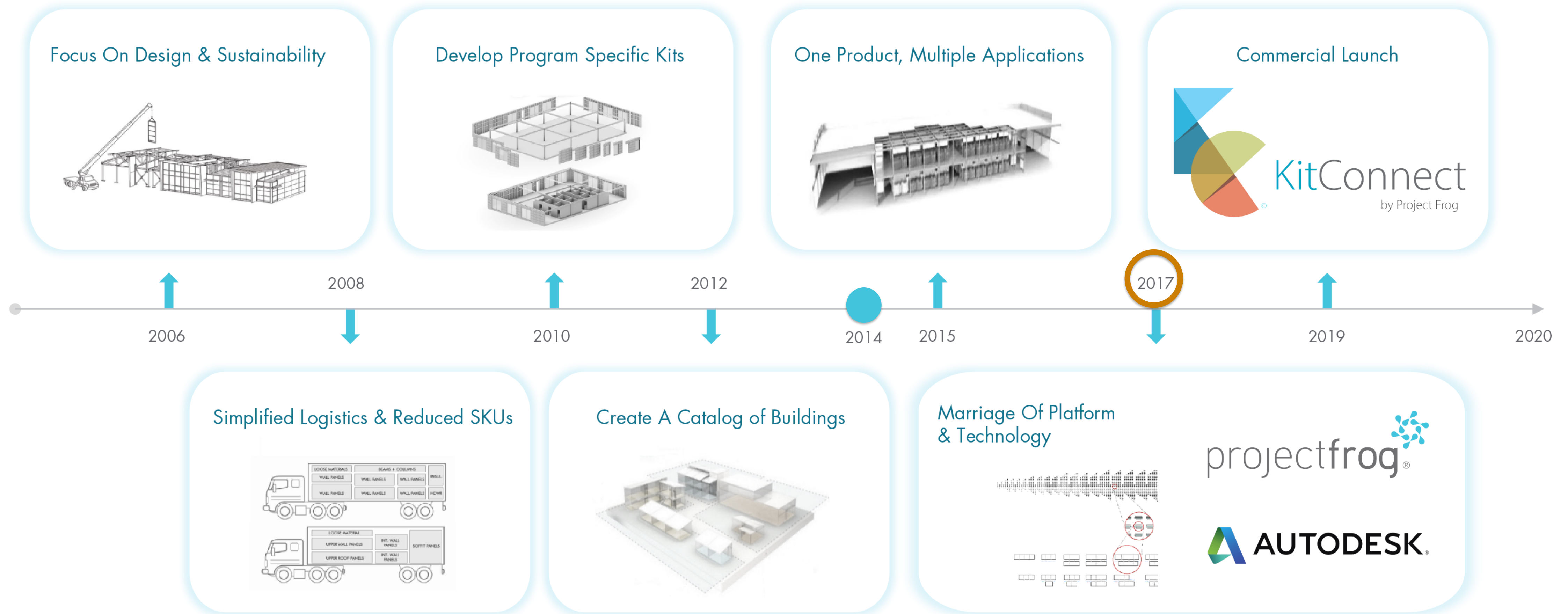
Criteria	LINKS	GROUPS	DESIGN OPTION	KIT CONNECT	
One source of truth	n	n	n	y	
Needs also a regenerated model from contractors	y	y	y	n	if collaborated on with contractor modules are edited in the module editor
Can work within one revit file	n	y	y	y/n	
Other diciplines can also work directly in the same model	n	n	n	y	
Works well wih repetition (smart updating - one updates all update)	y	y	n	y	
Works well with deviations - flexible	n	n	n	y	
Works well with alternatives (swap in swap out)	n	y	y	y	
Can be shown at different levels of detail (volume vs elements)	n	n	n	y	
Easy to export to IFC	n	y	n	y	
Extra costs involved	n	n	n	y	
Needs a coding structure and strategi for repetition	n	y	y	y	
Visial library of parts	n	n	n	y	
Can isolate modular information	y (parameter)	y (parameter)	y (parameter)	y	
Can attach special information for the use of contractors	n	n	n	y	
The system works well long term (team swapping new team members)	n	n	n	y	
Needs additional education (aside from revit usual use)	n	n	y	y	
Extra time used in start up process to build up a system	n	n	n	y	
Time saving in a long term sense (configuration on the site)	n	n	n	y	

positive answer based on userability

Software Developers' Perspective



Evolution of Project Frog



● Internal tools were built at Project Frog to aid in our I.C. process

○ Thanks to the Forge fund we were able to dedicate internal resources to build outward facing I.C. tools. The first team and project Autodesk wanted us to start with is our friends in Norway which kicked off our discovery process.



Assembly
or Module



Get All
Updates



Configure
Preset



Kit Connect
Web



Switch
Module Preset



Switch
Part



: Sync
BOM



Kit Connect
Web



Switch
LODt

Customer Name

Project Frog

Nordic
Cowi

Customer x

Customer y

Customer z

Customer..

Problem

Sharing arranged elements (KoP)

X

X

X

X

XXXXXX

Audit arranged content

X

X

X

X

X

XXXXXX

Constrain arranged content

X

X

X

X

XXX

User roles to edit content

X

X

X

X

XX

Communication to non-Revit users

X

X

X

X

XXXX

Part and configuration optioning

X

X

X

X

X

XXX

Multi trade collaboration

X

X

X

XXX

BOM/s

X

X

X

X

XXXX

I.C. logistics

X

X

X

XX

Level of Detail/Development

X

X

X

X

XXX

....

X

X

X

X

X

XXXXXX

How to begin

Create New Project

A KITCONNECT PROJECT IS CREATED (PROJECT OR ENTERPRISE LIBRARY)

Either the content is created from scratch or it's cloned from another library (via Content Manager)

Kit Roles

- ☒ Kit Manager
- ☐ Kit Designer
- ☐ Kit Participant

USERS GET ASSIGNED TO THE PROJECTS ARE ROLES ARE DESIGNATED

Kit Manager – they can do everything

Kit Designer – they can do everything but delete from the library

Kit Participant – no editing right, insert content , exercise rules enforced by KitConnect and created by KM/KD



REVIT FILE/S (.RVT) ARE CONNECTED TO THE KITCONNECT PROJECT LIBRARY

As many Revit files as a project needs can be connected

There are several ways to set up projects and KitConnect can work with all of them

Loadable families from each team participating

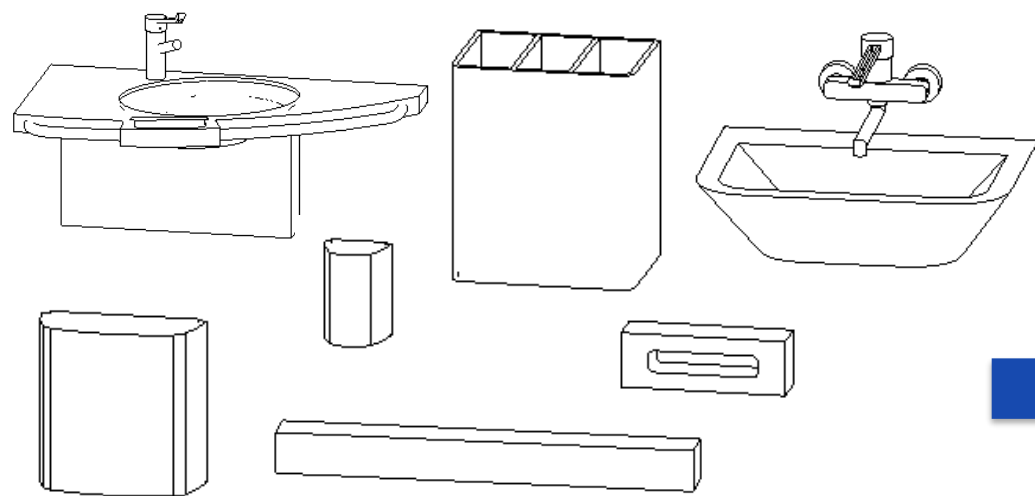
Users publish family's and system family's to be used
Building your content

Arrange elements, apply rules and constraints

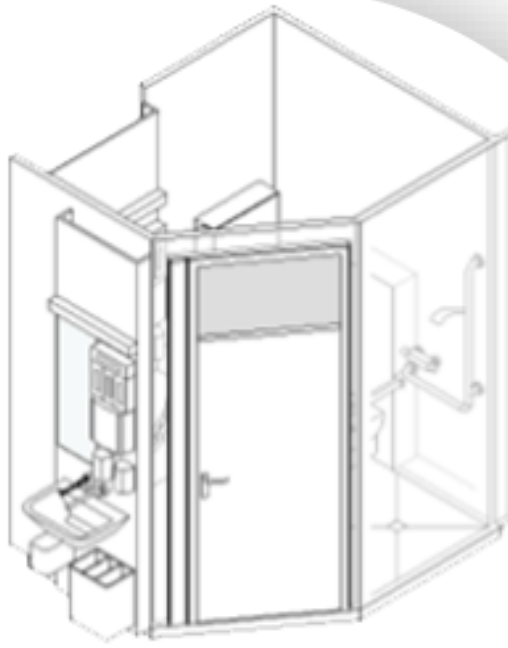
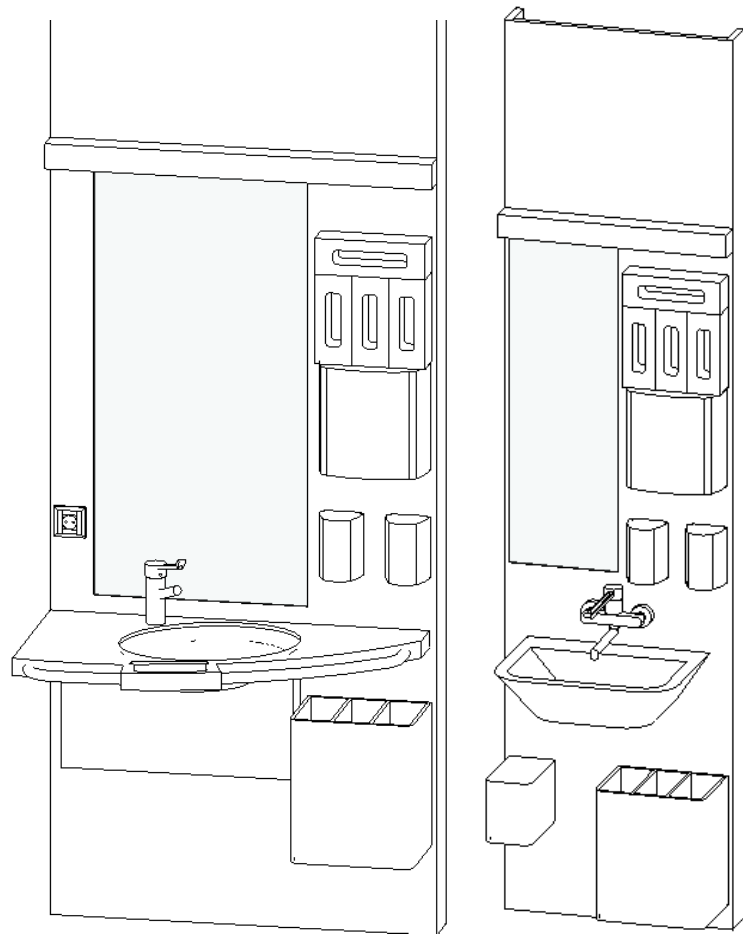
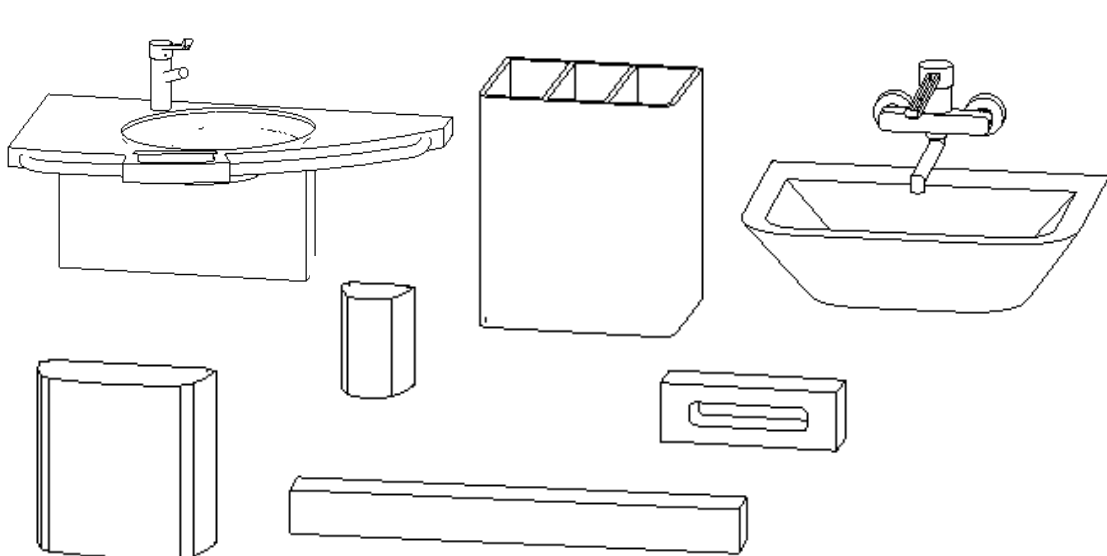


Arch design team
(Kit Manager or Kit Designer)

Arch system types



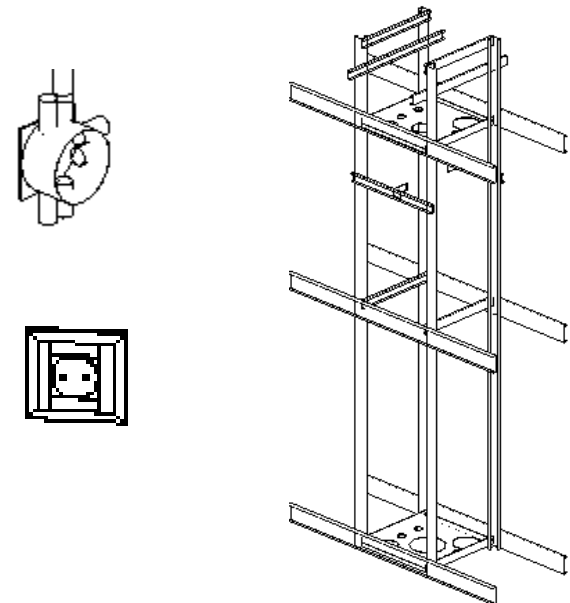
Arch system types



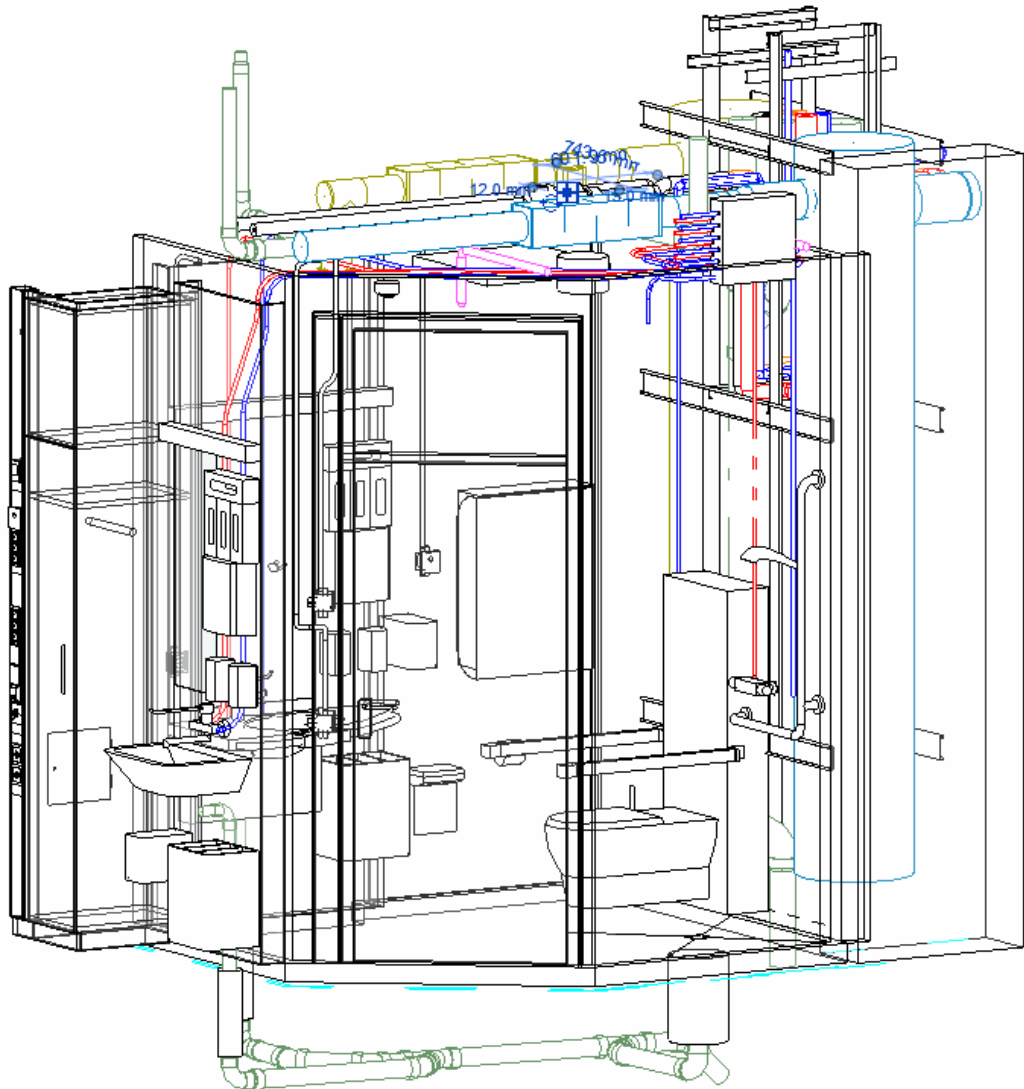
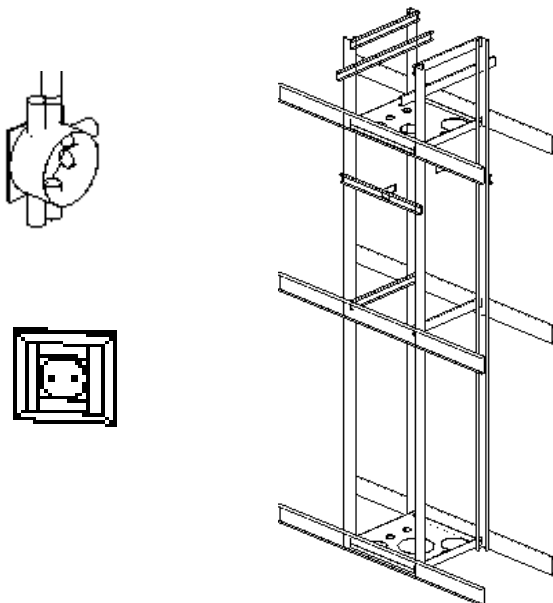


MEP design team
(Kit Manager or Kit Designer)

MEP system types

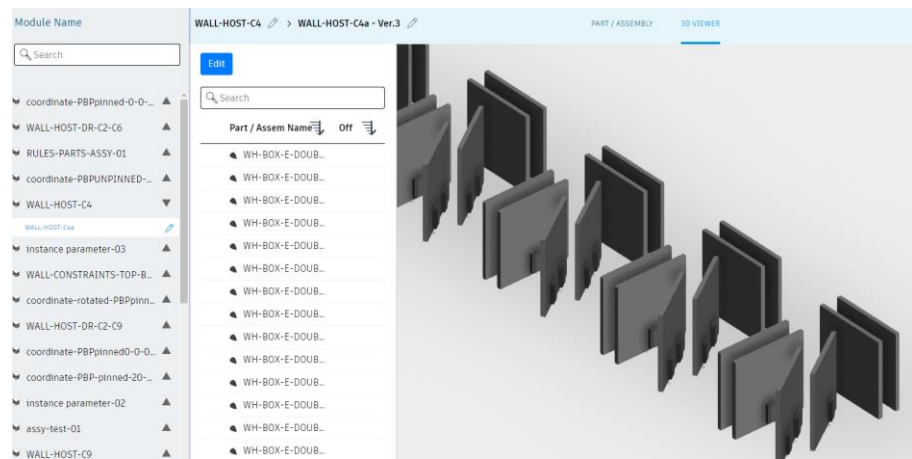
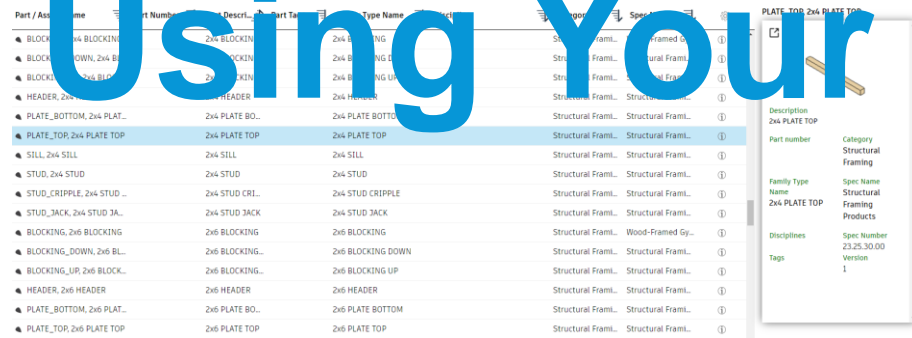


MEP system types



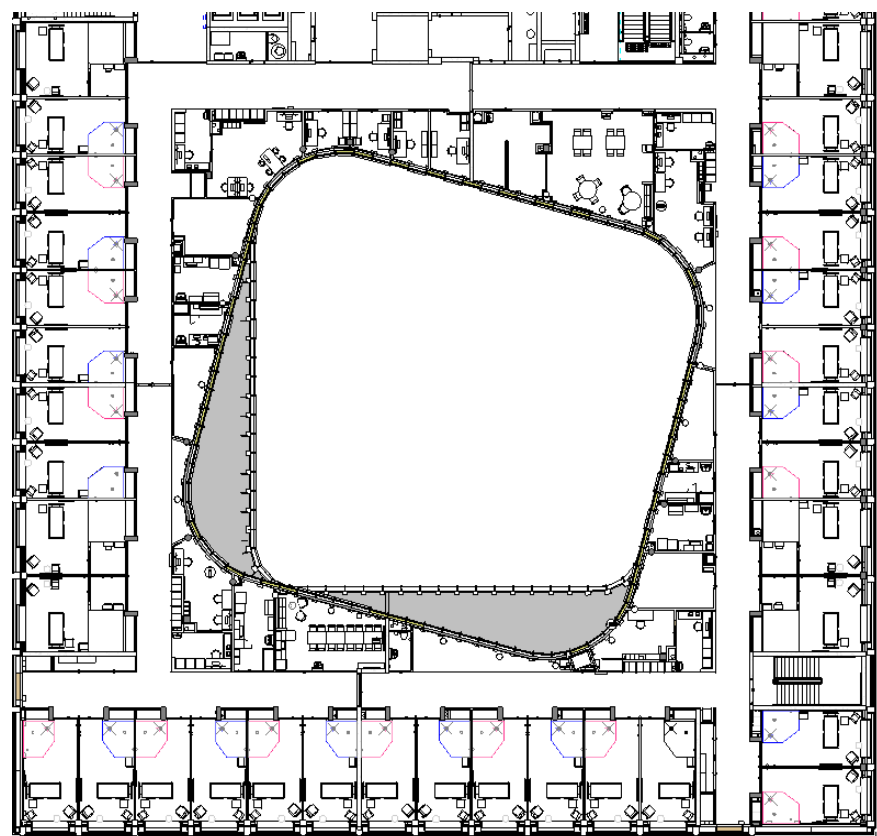
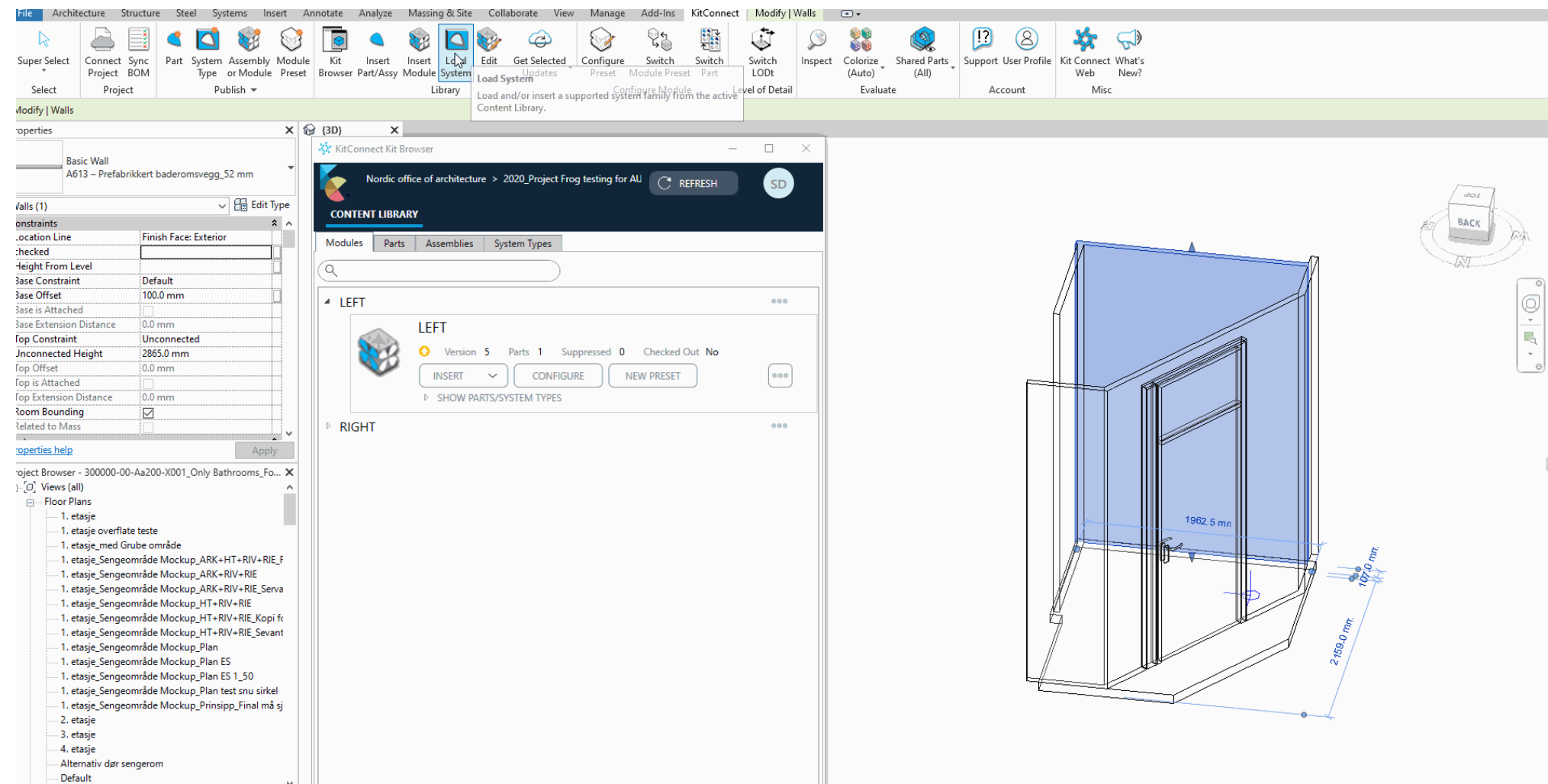
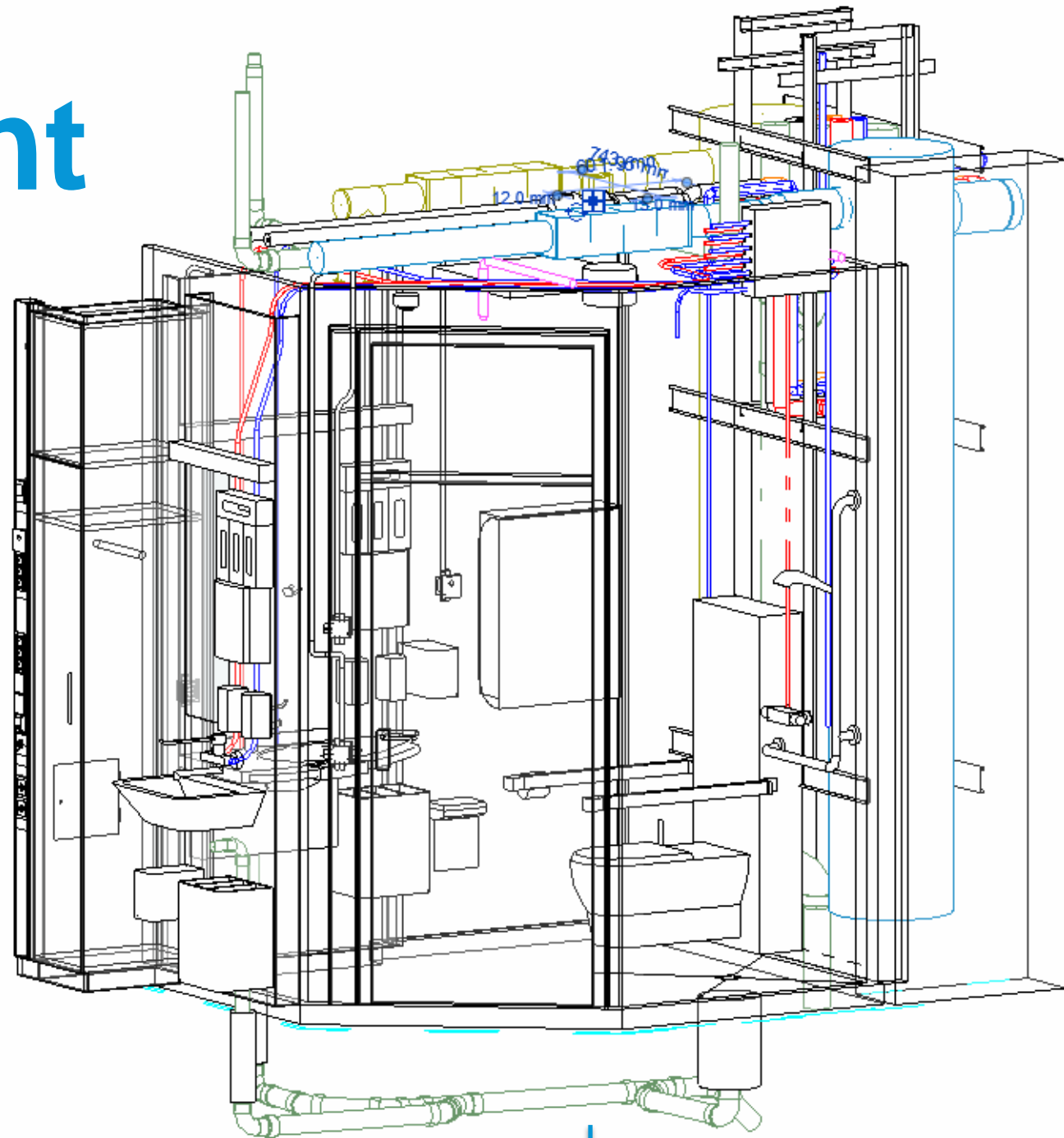
KitConnect Cloud

Using Your Content

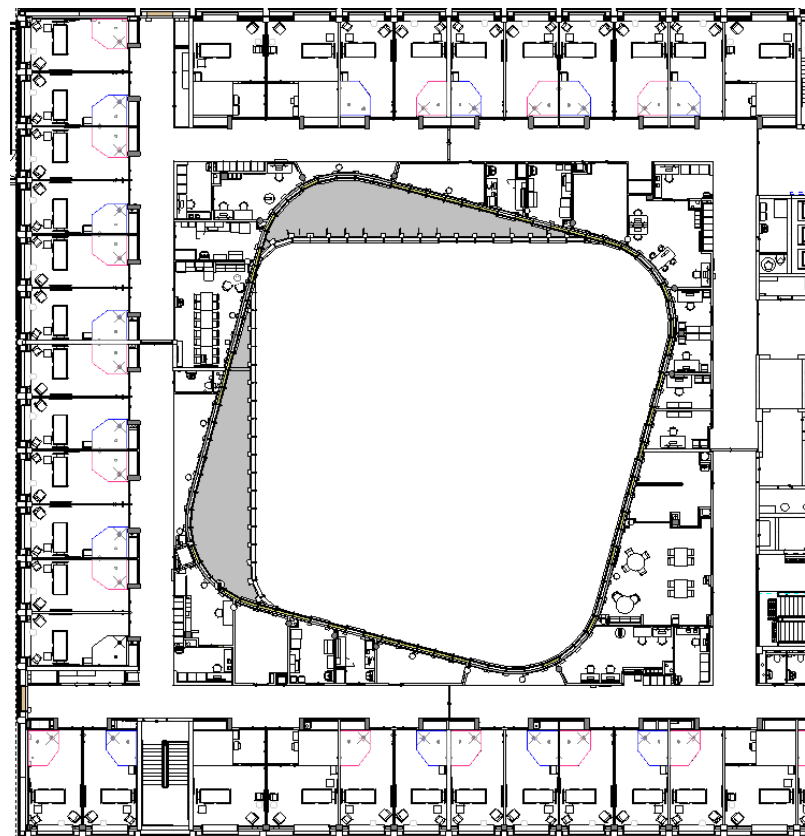


Web app

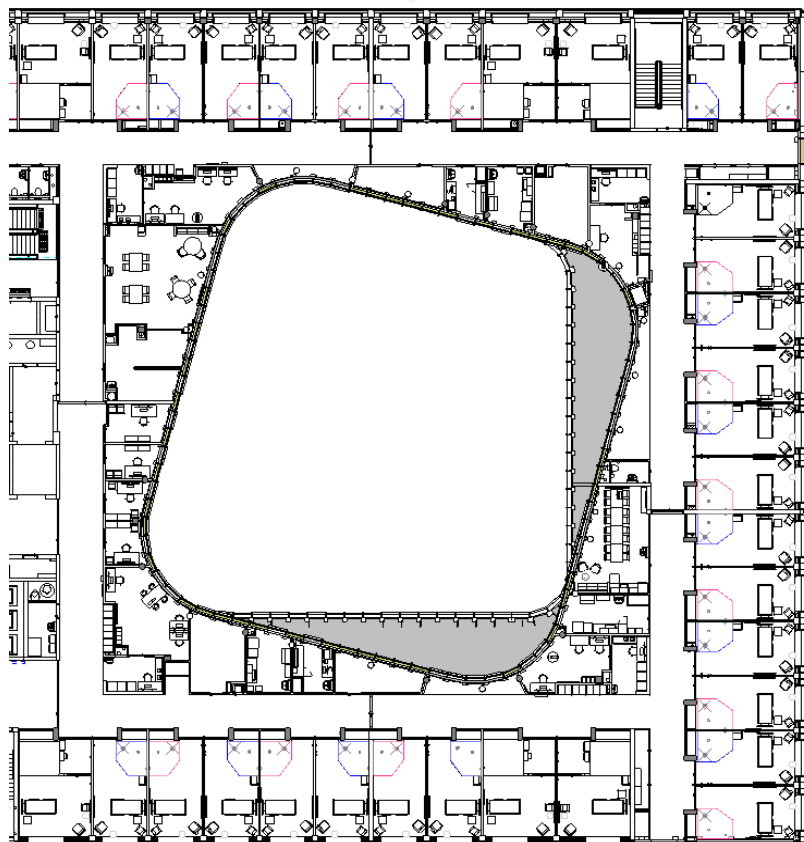
Name	Dim Name	Quantity	Part #	Description	Category	Spec Chapter No.	Part Tags	Spec Chapter No.
UNIT-A-1E		7						
UNIT-A-1E		8						
Supply Fan	N/A			Doors	23.75.70.21			Doors
Supply Diff.	N/A			Air Terminals	23.75.70.21			Diffusers, Registers,
Rectangular	N/A			Duct Fittings	23.75.70.24			Air Ductwork
Supply Diff.	N/A			Air Terminals	23.75.70.21			Diffusers, Registers,
Rectangular	N/A			Lighting Fixtures				
Rectangular	N/A			Duct Fittings	23.75.70.24			Air Ductwork
Rectangular	N/A			Duct Fittings	23.75.70.24			Air Ductwork
Door-Strip	N/A			Doors	23.75.70.21			Doors
Shower St.	N/A			Plumbing Fixtures	23.75.70.21			Bath/Shower Units
Lighting	N/A			Lighting Fixtures				
Rectangular	N/A			Duct Fittings	23.75.70.24			Air Ductwork
Rectangular	N/A			Duct Fittings	23.75.70.24			Air Ductwork



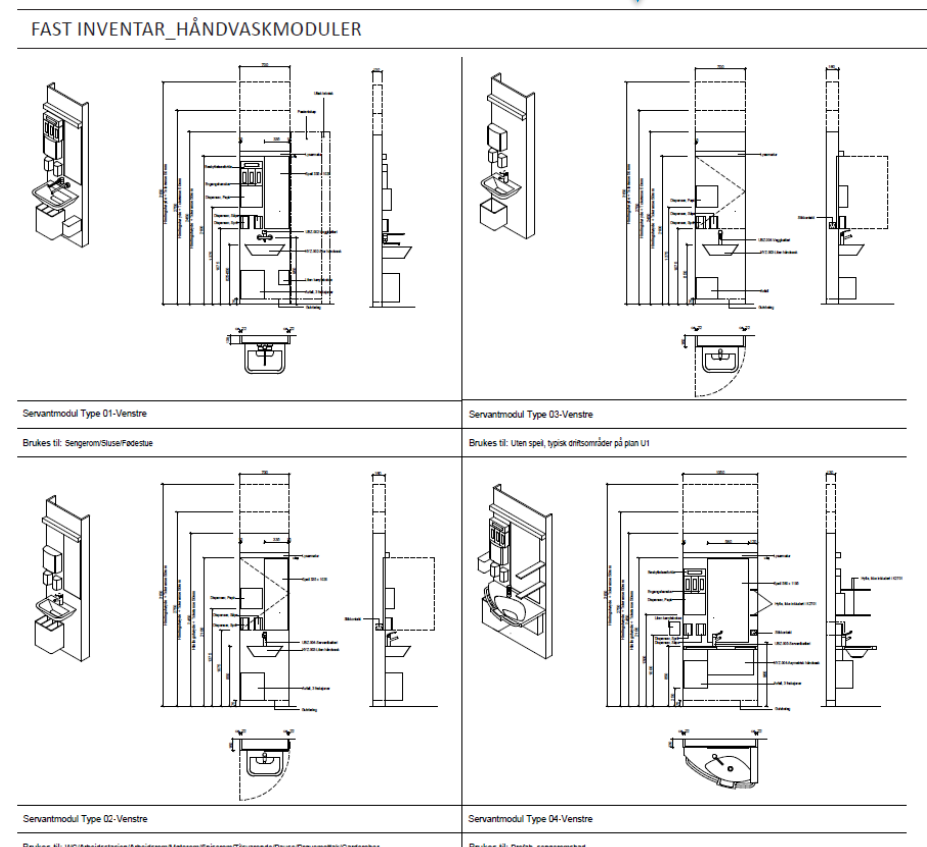
Building 2.rvt



Building 1.rvt



BUILDING X.rvt



Shop drawing 1.rvt



Shop drawing 1.rvt

Future state of KitConnect

We will continue reduce AEC workflow fragmentation by promoting manufacturing best practices in design

Improved data-exchange from BIM to manufacturing workflows with enhanced BOM support

Extend our tools for suppliers and manufacturers to share data up-stream in design

Really drive the “I” in BIM by connecting data across all AEC stakeholders, both BIM and non-BIM users – extend the data-flow beyond the file

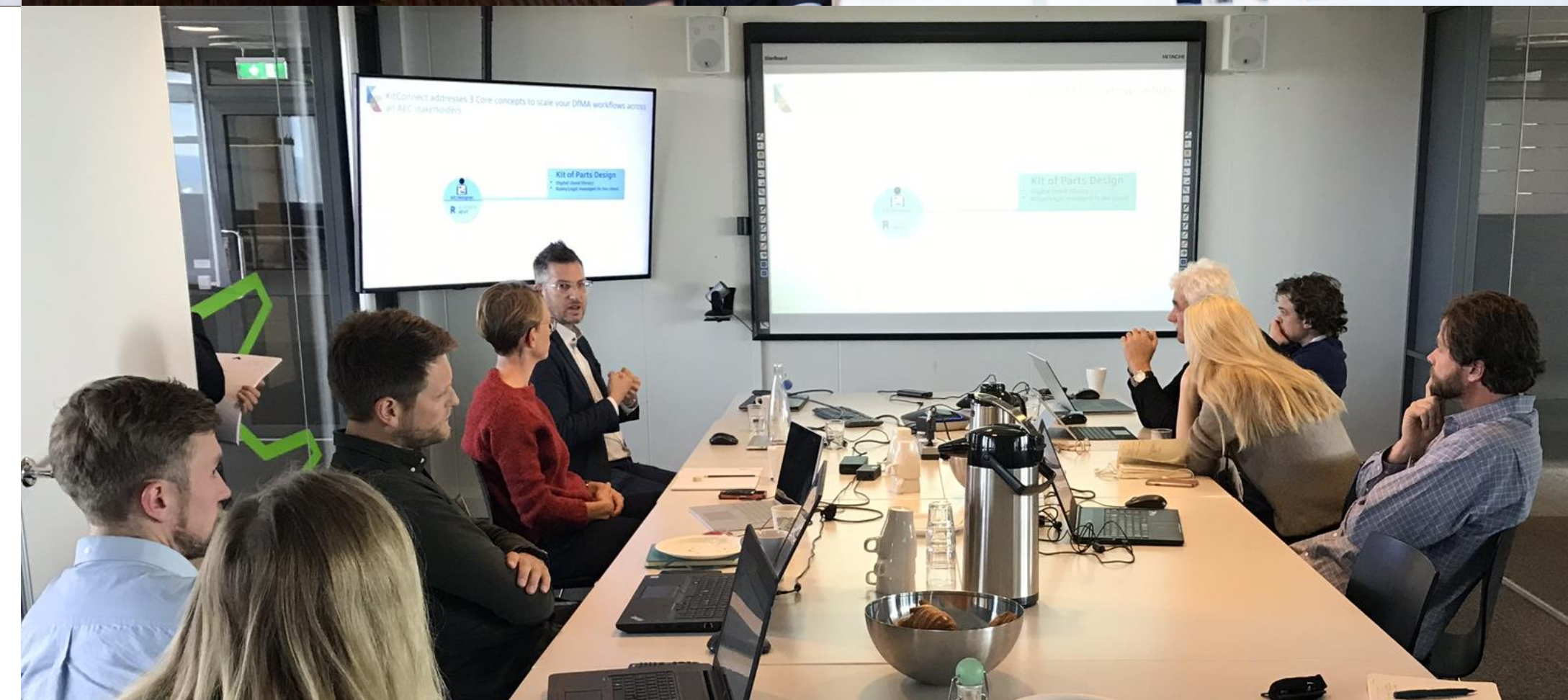
Conclusion





Unite!

And then you smile :)





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