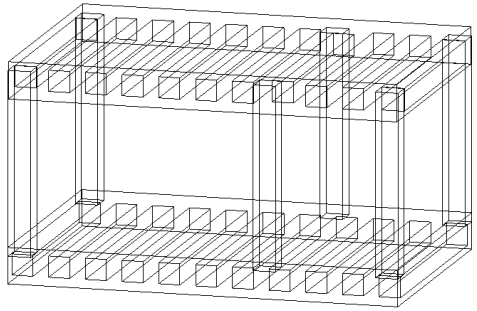
Volumetric/Modular Construction

How it works and what the Pros and Cons are



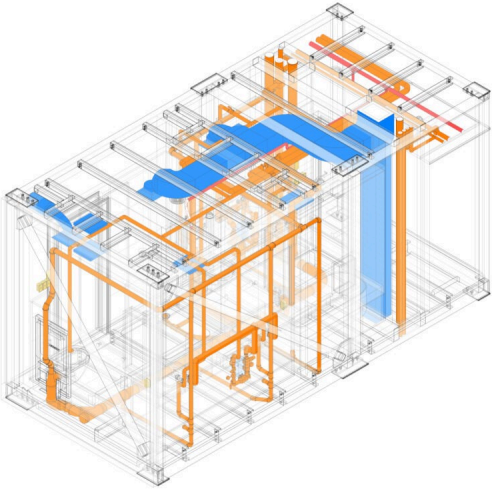
A type of modern method of construction, in which elements of a building are pre-built into multiple fully constructed sections off-site in specialised factories. The goal of volumetric building design is to achieve a convenient and quick production of high-quality developments that both saves money for developers and buyers and is less harmful to the environment.

Design Process

Volumetric buildings are normally designed using Cad or BIM Software as Volumetric construction and MMC are generally new concepts. The design process is similar to traditional building designs, the buildings will look the same in the final product but in the process of design it is broken up into sections, the sections will be the pods that are assembled on-site to make up the full building. Keeping in mind that modular constriction and pre-fabricated pods have slight restrictions in shape and size, it is still highly customisable, different manufacturers will have different sizes, materials and layouts.

Advantages

- Stronger than traditional construction methods
- Efficient and more organised
- Contemporary
- Better budgeting
- Less waste on site and waste of materials



Disadvantages

- Restrictions on module sizes due to transportation.
- Lack of positive public opinion, reducing resell value.
- Traditional buildings have better public opinion regarding quality.
- Harder to Fund

Materials

- Framing is usually made of timber and steel
- Internal and external fixtures and fittings put in place in the prefabricated process.
- Customisable elements such as insulation, wall/floor finishes, carpentry elements etc. will have their own chosen materials and be installed offsite.
- Modules are stacked on top of pre-cast concrete foundations

Volumetric/Modular Construction

Case Study - **The Clement Canopy**

Owner: United Venture Development (Clementi) Pte Ltd

Architect: ADDP Architects LLP

Structural Engineer: TW-Asia Consultants Pte Ltd

M&E Engineer: J Roger Preston (S) Pte Ltd

Main Contractor and PPVC Supplier: Dragages Singapore Pte Ltd

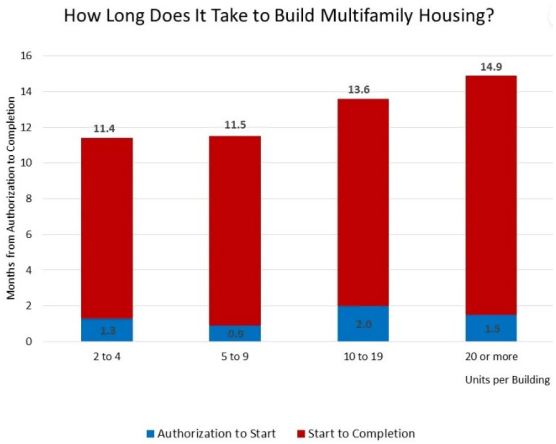
Location: 16 Clementi Ave 1, Singapore 129960

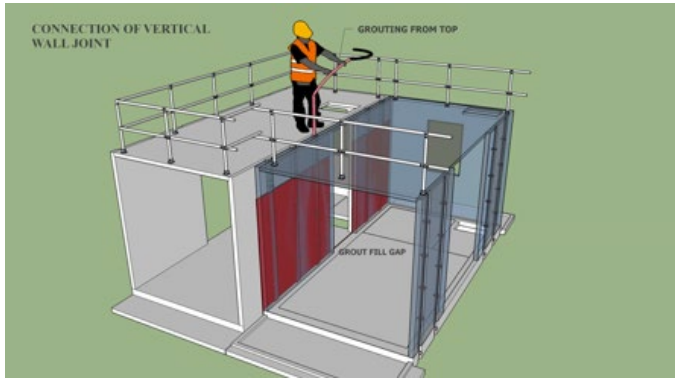
Construction & Performance

The Clement Canopy is a residential high-rise building, the carpark, Basement, Ground and First Floor were constructed in conventional methods, however, **Prefabricated Prefinished Volumetric Construction (PPVC)** was implemented from floor 2 up to floor 40.

With a total of 1,866 modules to assemble on-site, the contractor was installing them at a pace of 10-12 modules a day with a floor cycle of a week, the entire assembly took 6 months to complete.

Known as the tallest concrete PPVC building in the world; Volumetric construction was able to significantly reduce the time on site, helped produce higher quality workmanship, maintain a safer construction site and prevented the disruption of the nearby community.





Green Roofs

How Green Roofs work and their advantages

Green roofs are partially or entirely vegetation-covered roofs, planted on a growing medium/substrate, to allow further growth and water retention.

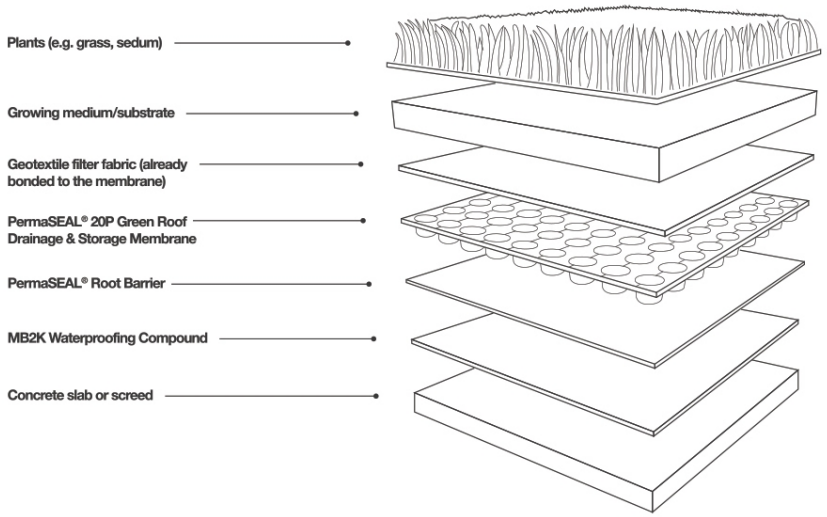
Pros & Cons

Green roofs are a relatively new method of SuDs (Sustainable urban drainage systems) that allow for the delay of rainwater run-off entering public sewage systems and the general retention of rainwater. Advantages of green roofs include:

- Improved conservation and biodiversity
- Provision of new wildlife habitat
- Improved thermal insulation of buildings
- Reduction of airborne particulates
- Reduced rainwater runoff
- Enhanced roof insulation properties
- Attractive visual appearance
- Provide green space in urban areas
- Reduction in urban heat island effect.

Disadvantages:

- Can be costly to implement.
- Interferes with warm roof designs.
- Can disrupt natural light paths



Green Roofs

Case Study – **The Forge**

Location: Upton Park, LB Newham

Client: Telford Homes

Architect: RM_A Architects

Green/Blue Roof Specialists: Radmat Building Products

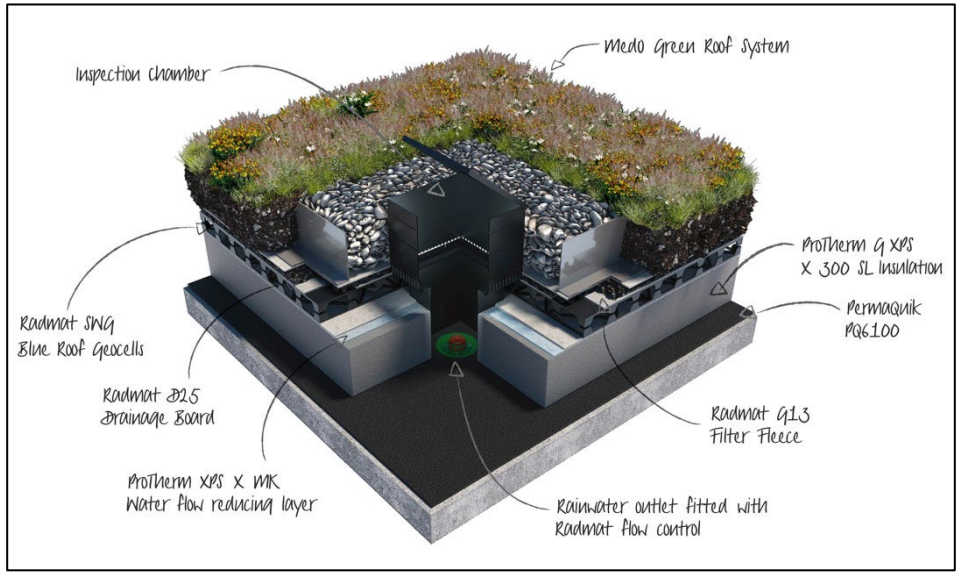
Construction & Performance

The forge was developed on the site of a former Bus Depot, constructed next to two other residential complexes, the area is a hotspot for residential developments, consisting of 192 dwellings, the massive complex features two communal outdoor areas, filled with greenery and other amenities, every house has its own private outdoor section and lastly one communal terrace.

For this development, Green roofs and other means of natural SuDS are vital, it provides:

- Water attenuation – this area of East London is relatively close to the Thames and surface drainage water from the development could contribute to flooding in extreme weather conditions
- High thermal performance with maximum insulation value in order to reduce energy use from heating and air conditioning.
- Amenity space for residents.
- Visually attractive – particularly where the roofs are overlooked.
- Habitat creation with particular attention to bees, butterflies and birds.

Radmat's blue roof storage reservoirs which sit beneath the green roof structure are designed to store excess rainwater and allow controlled release into the local sewerage systems, mitigating pressure on drainage systems and reducing the risk of flooding.



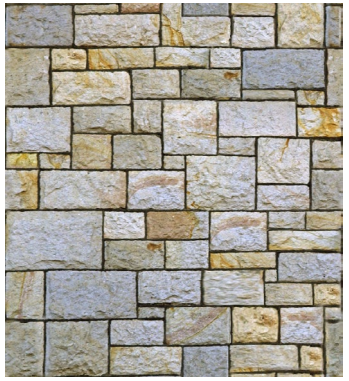
External Cladding

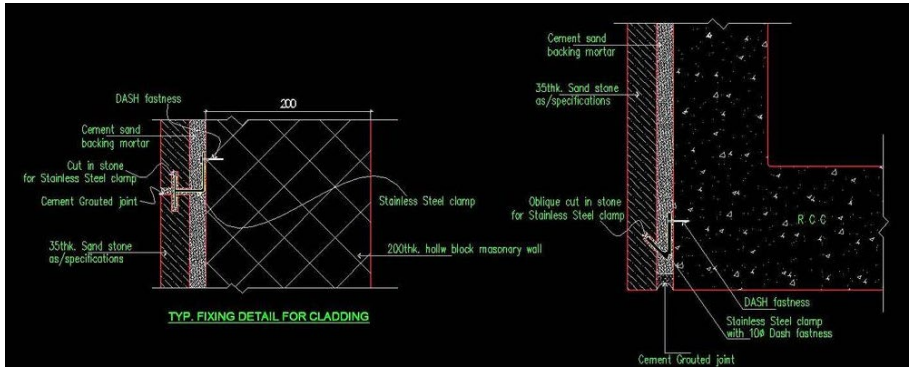
Different Cladding and their benefits

Stone Cladding

Stone Cladding is a popular material for dwelling facades in the UK, a natural material derived from the earth, very appealing for its organic nature, aesthetic imperfections and colour variation, a highly durable and versatile material that is overabundant in the UK. d

- Weather Resistant
- Durability
- Design Possibilities
- Less Maintenance
- Less heavy compared to traditional masonry.





Timber Cladding

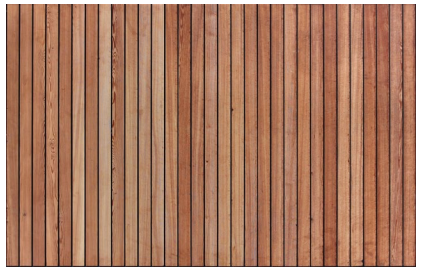
Timber cladding can be made from any type of wood but the most popular are Cedars and Firs. Usually, timber cladding is made up of thin timber boards and panel systems are applied to the exterior of a façade. Usually used in new or renovated construction replacing plywood. Timber is a renewable material if sourced from a sustainable plantation.

Pros:

- Has some insulation properties
- Sustainable
- Aids in temperature regulation
- Less Maintenance
- Aesthetic value

Cons:

- Relatively expensive
- Susceptible to decay in wet areas.



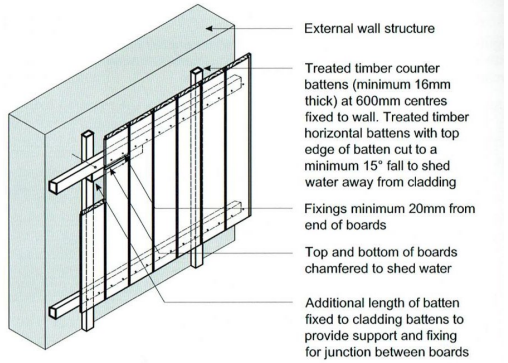


Figure 5.11: Vertical tongued and grooved boarding on horizontal battens and counter battens

Glass Cladding

Glass cladding and glass facades used in residential buildings are typically made from triple-glazed glass as other options will result in significantly higher levels of thermal conductivity, undoing net zero efforts of any other sustainability design or technology implemented.

Pros:

- Weather resistant
- Minimal maintenance
- Versatile in aesthetics
- Lighter than other cladding materials, can lessen the load on a building
- Allows for natural lighting and maximises solar heat retention when thermal conductivity is low.

Cons:

- Big glass cladding features can cause unwanted glare and light reflection
- Can result in higher costs making the building less affordable
- Glass is a very brittle material, even higher-end types of glass can be broken easily through the use of specific tools

External Cladding

Case Study – **The Stone House**

Name of building: The Stone House

Date completed: 2010

Building type: Residential

Location: Scotland's Housing Expo, Milton of Leys, Inverness

Architect: NORD

Client: Highland Housing Alliance / Robertson Highland

Stone type: Caithness stone

Main contractor / stone supplier: Robertson Highland Caithness Stone Industries, Wick

Anticipated lifespan: > 100 years

Construction & Performance

The development consists of 4 family sized houses, oriented around a private garden, the structure is clad with natural stone, locally sourced both for more aesthetic value as well as sustainability purposes. The main structure elements were pre manufactured off-site locally for quick assembly. The Houses are insulated to Passivhous standard.

Passivhous Technology

Different Passivhous technologies and their benefits

MVHR

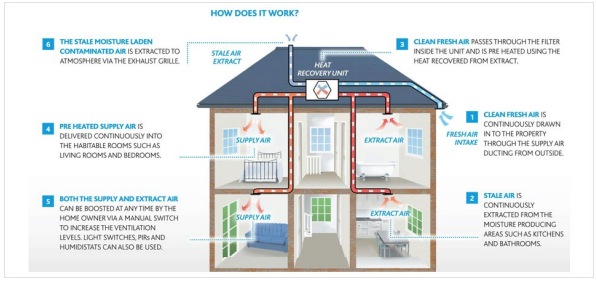
The Mechanical Ventilation Heat Recovery System is a centralised system that can be implemented to cover the span of the whole building. Allows for ventilation while also having the function to recover the heat from the expelled air to be able to maintain the temperature levels inside the building

Pros:

- Better air quality
- Lower levels of humidity and condensation
- Homogenous Atmosphere - Able to balance out heat levels throughout the building.

Cons:

- High cost.
- Level of airtightness required for MVHR to function properly is very high.
- Frequent costly maintenance.
- A Homogenous Atmosphere might not be the best option.



Pros:

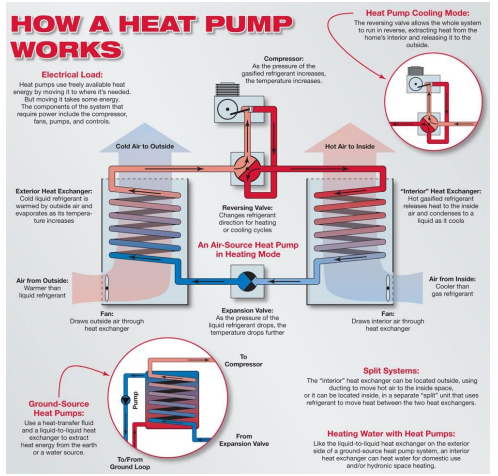
- Lower running costs
- Less maintenance
- Fewer carbon emissions
- Can provide cooling as well
- Can produce warm air & water

Cons:

- High upfront cost
- Difficult to install
- Carbon neutral
- Electricity usage will increase

Heat Pumps

Heat Pumps generate heat by extracting thermal energy from environmental sources like the air and the ground into a refrigerant fluid circuit, compression raises the fluid's temperature, and the useful heat is extracted. Heat Pumps generate more thermal energy than the amount of electrical energy it uses, so it is regarded as a renewable heat source. Their efficiency changes depending on the ratio of heat output to electrical power consumed. The heat output is distributed from the heat pump as warm air or as warm water. Heat pumps operate most efficiently when transferring heat at lower temperatures and may require the use of underfloor heating or low-temperature radiators that have larger heat exchange.



Biomass

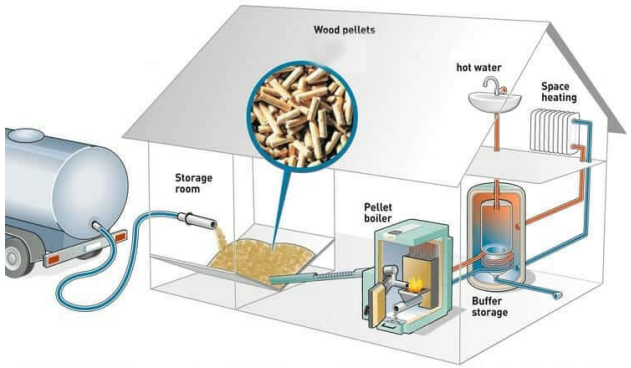
Biomass energy is generated through burning wood fuel that contains energy derived from recently living organisms to produce heating for dwellings. This method differs from fossil fuels as wood fuels do not require millions of years of processing time to be used. This means that sustainability can be reached as the production rate better matches the consumption rate. There is a debate on the concept of carbon neutrality regarding these wood fuels, as the carbon contained in the wood would only be recently collected therefore releasing it neutralises the carbon footprint, but this argument doesn't consider the fact the carbon generated from transport and processing of the fuel. Nonetheless, it is a better solution compared to fossil fuels.

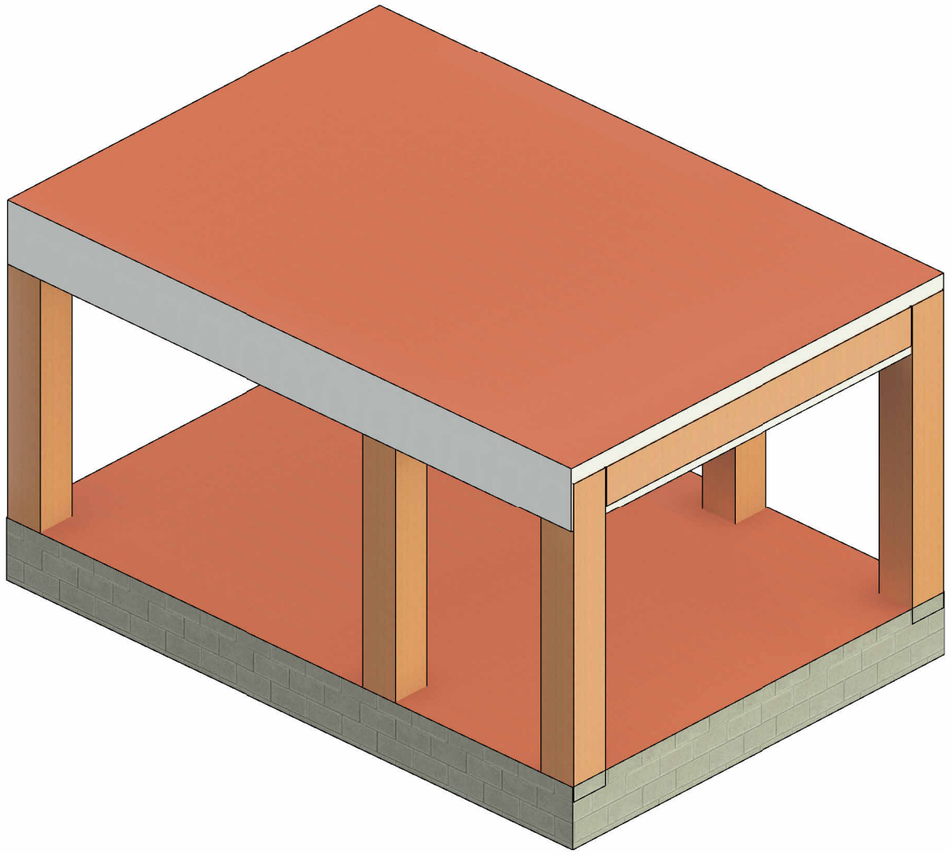
Pros:

- Biomass is a renewable resource
- Biomass helps reduce waste
- Biomass is a reliable source of electricity

Cons:

- High Cost
- Space requirements
- Adverse environmental impacts





Pod

No.	Description	Date

AUTODESK

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CODE	STATUS	SUITABILITY DESCRIPTION	PURPOSE OF ISSUE

PROJECT: Project Name

SHEET: Unnamed

CLIENT: Owner

Date	Project number	Scale (@ A3)
Issue Date	Project Number	

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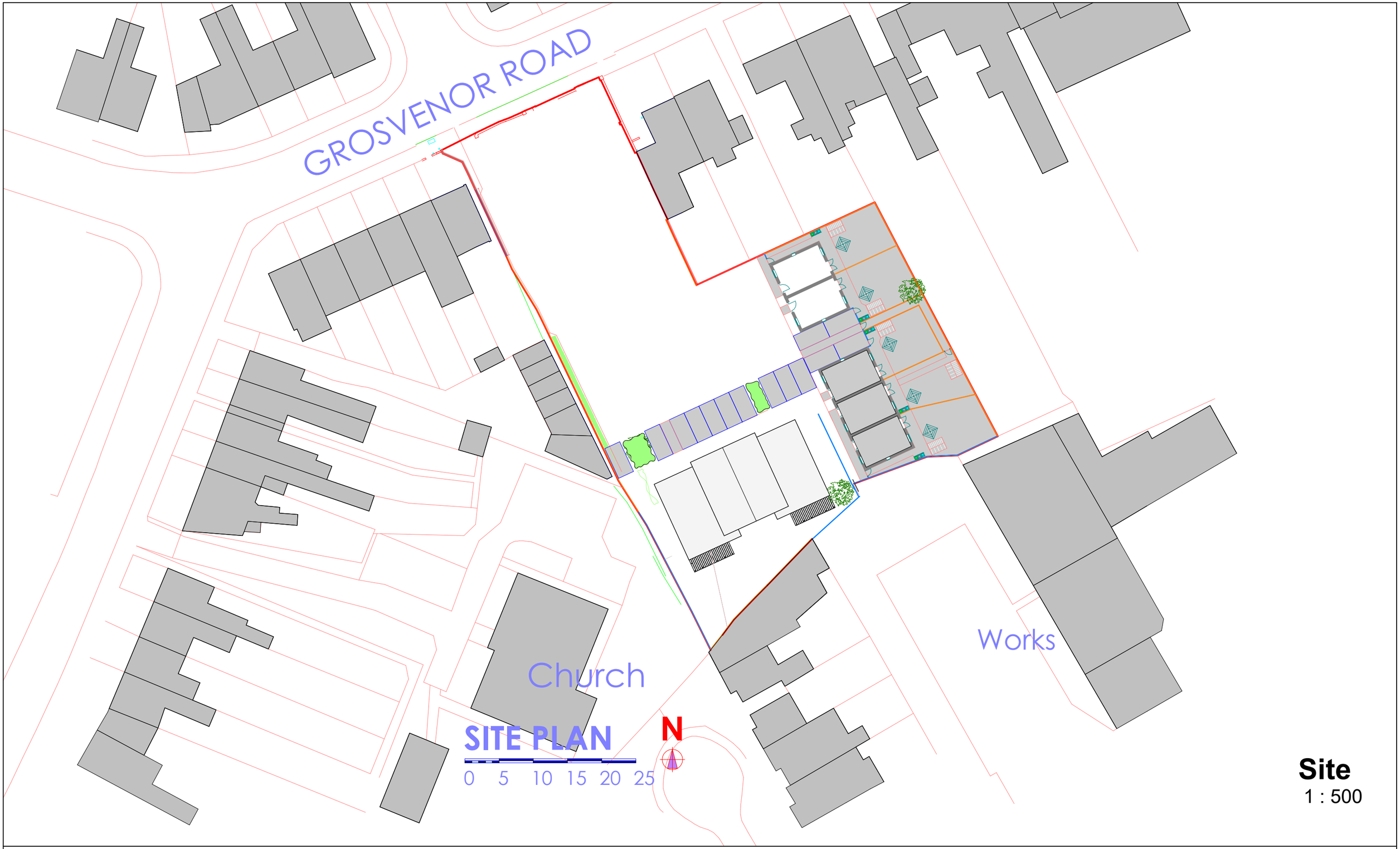

Site
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No.	Description	Date

AUTODESK
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CODE	STATUS	SUITABILITY DESCRIPTION	PURPOSE OF ISSUE

PROJECT: Project 80

SHEET: Site Plan

CLIENT: Owner

Date	Project number	Scale (@ A3)
Issue Date	Project Number	1 : 500

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South Technical

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No.	Description	Date

AUTODESK

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CODE	STATUS	SUITABILITY DESCRIPTION	PURPOSE OF ISSUE

PROJECT: Project 80

SHEET: South Elevation Technical

CLIENT: Owner

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Issue Date	Project Number	1 : 100
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South Realistic

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No.	Description	Date

AUTODESK

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CODE	STATUS	SUITABILITY DESCRIPTION	PURPOSE OF ISSUE

PROJECT: Project 80

SHEET: South Elevation Realistic

CLIENT: Owner

Date	Project number	Scale (@ A3)
Issue Date	Project Number	1 : 100

Drawn by	DRWAING NUMBER	REV
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Checked by: Checker

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North Technical

1 : 100

No.	Description	Date

AUTODESK

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CODE	STATUS	SUITABILITY DESCRIPTION	PURPOSE OF ISSUE

PROJECT: Project 80

SHEET: North Elevation Technical

CLIENT: Owner

Date	Project number	Scale (@ A3)
Issue Date	Project Number	1 : 100

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North Realistic

1 : 100

No.	Description	Date

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CODE	STATUS	SUITABILITY DESCRIPTION	PURPOSE OF ISSUE

PROJECT: Project 80

SHEET: North Elevation Realistic

CLIENT: Owner

Date	Project number	Scale (@ A3)
Issue Date	Project Number	1 : 100

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East Technical

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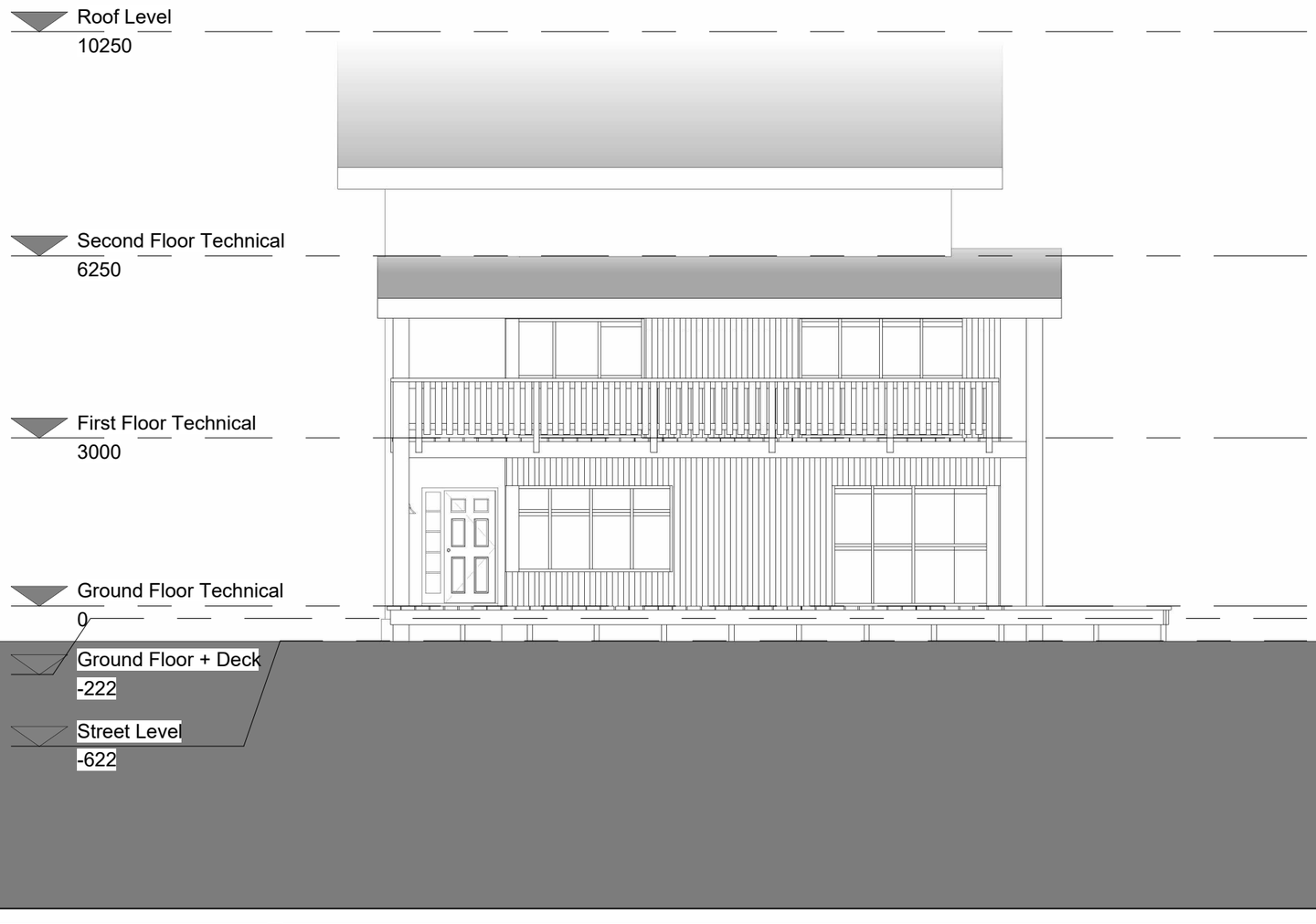

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PROJECT: Project 80

SHEET: East Elevation Technical

CLIENT: Owner

Date	Project number	Scale (@ A3)
Issue Date	Project Number	1 : 100

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Checked by: Checker

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East Realistic

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PROJECT: Project 80

SHEET: East Elevation Realistic

CLIENT: Owner

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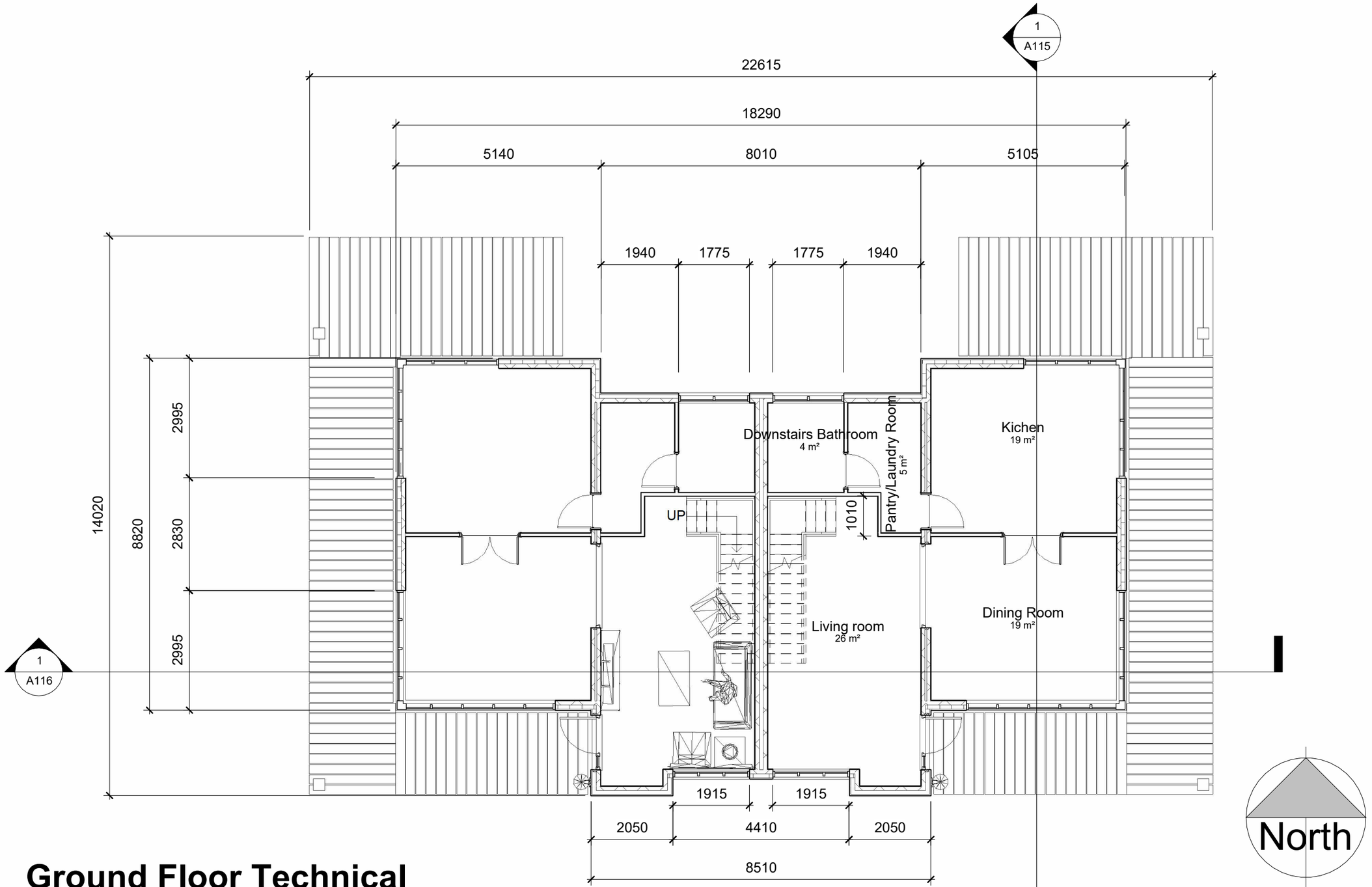

Ground Floor Technical

1 : 100

No.	Description	Date

AUTODESK

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PROJECT: Project 80

SHEET: Ground Floor - Technical

CLIENT: Owner

Date	Project number	Scale (@ A3)
Issue Date	Project Number	1 : 100

Drawn by	DRWAING NUMBER	REV
Author	A107	

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Ground Floor Realistic

1 : 100

No.	Description	Date

AUTODESK

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CODE	STATUS	SUITABILITY DESCRIPTION	PURPOSE OF ISSUE

PROJECT: Project 80

SHEET: Ground Floor - Realistic

CLIENT: Owner

Date	Project number	Scale (@ A3)
Issue Date	Project Number	1 : 100

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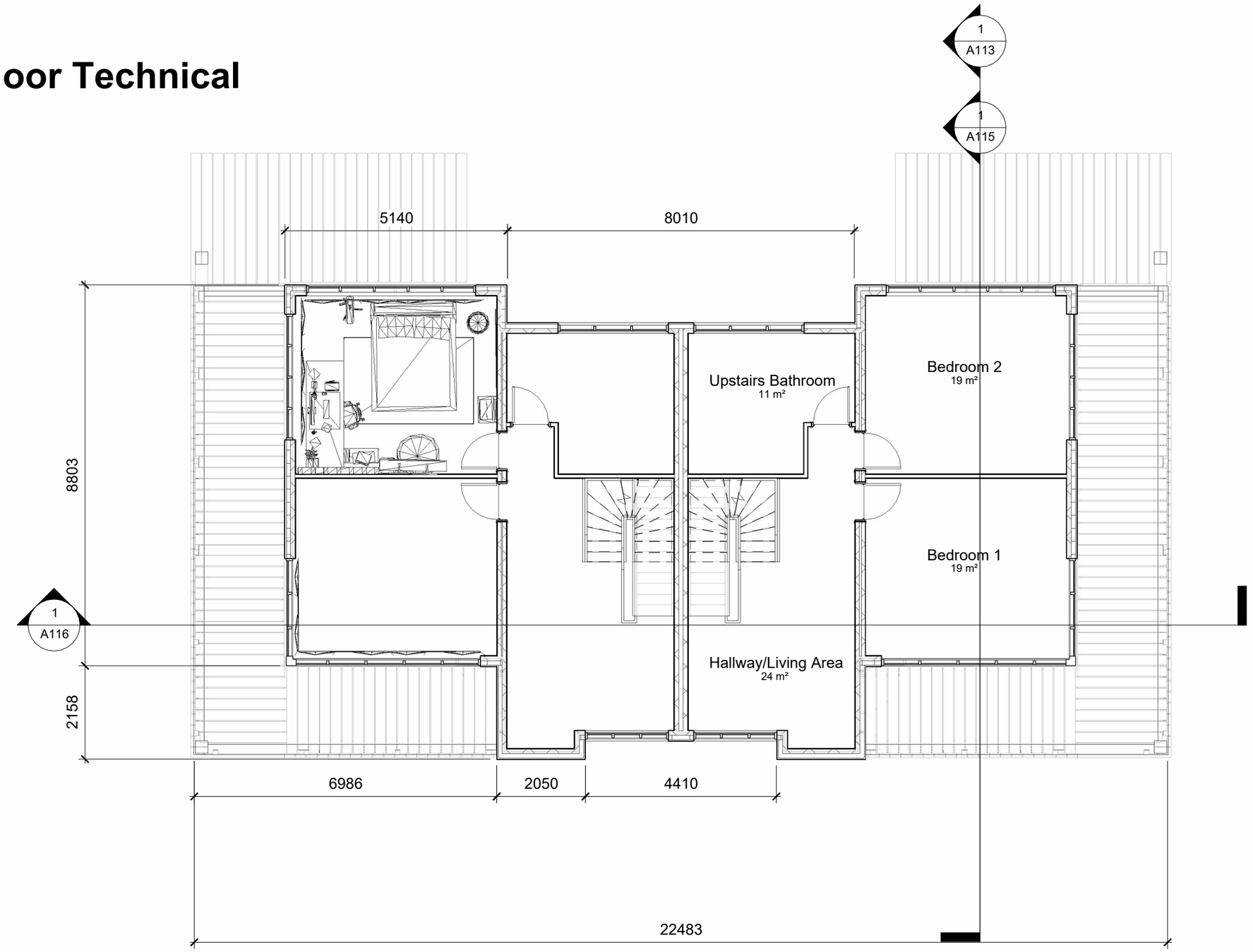

No.	Description	Date

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PROJECT: Project 80

SHEET: First Floor - Technical

CLIENT: Owner

Date	Project number	Scale (@ A3)
Issue Date	Project Number	1 : 100

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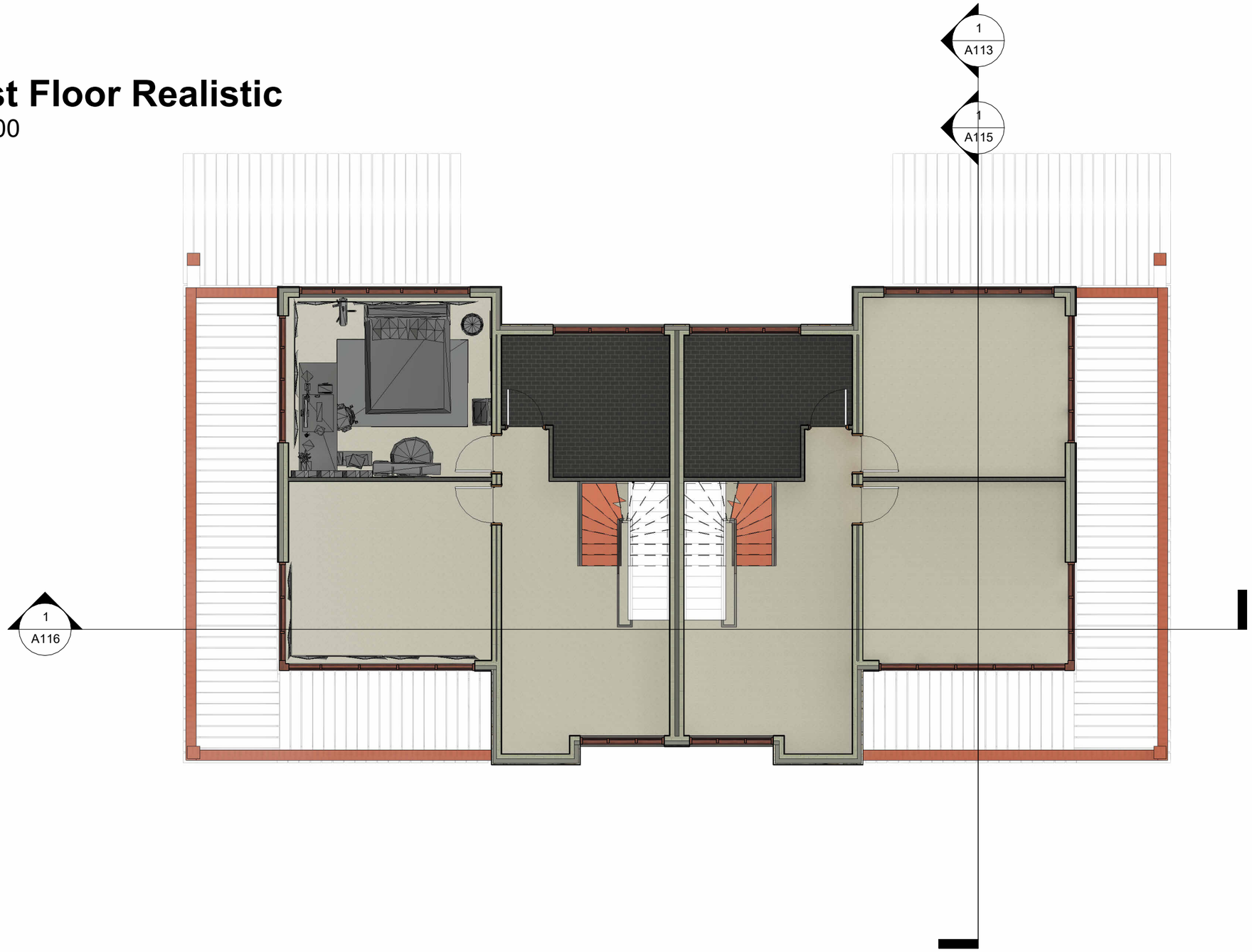

No.	Description	Date

AUTODESK

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CODE	STATUS	SUITABILITY DESCRIPTION	PURPOSE OF ISSUE

PROJECT: Project 80

SHEET: First Floor - Realistic

CLIENT: Owner

Date	Project number	Scale (@ A3)
Issue Date	Project Number	1 : 100

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Author	A110	

Checked by: Checker

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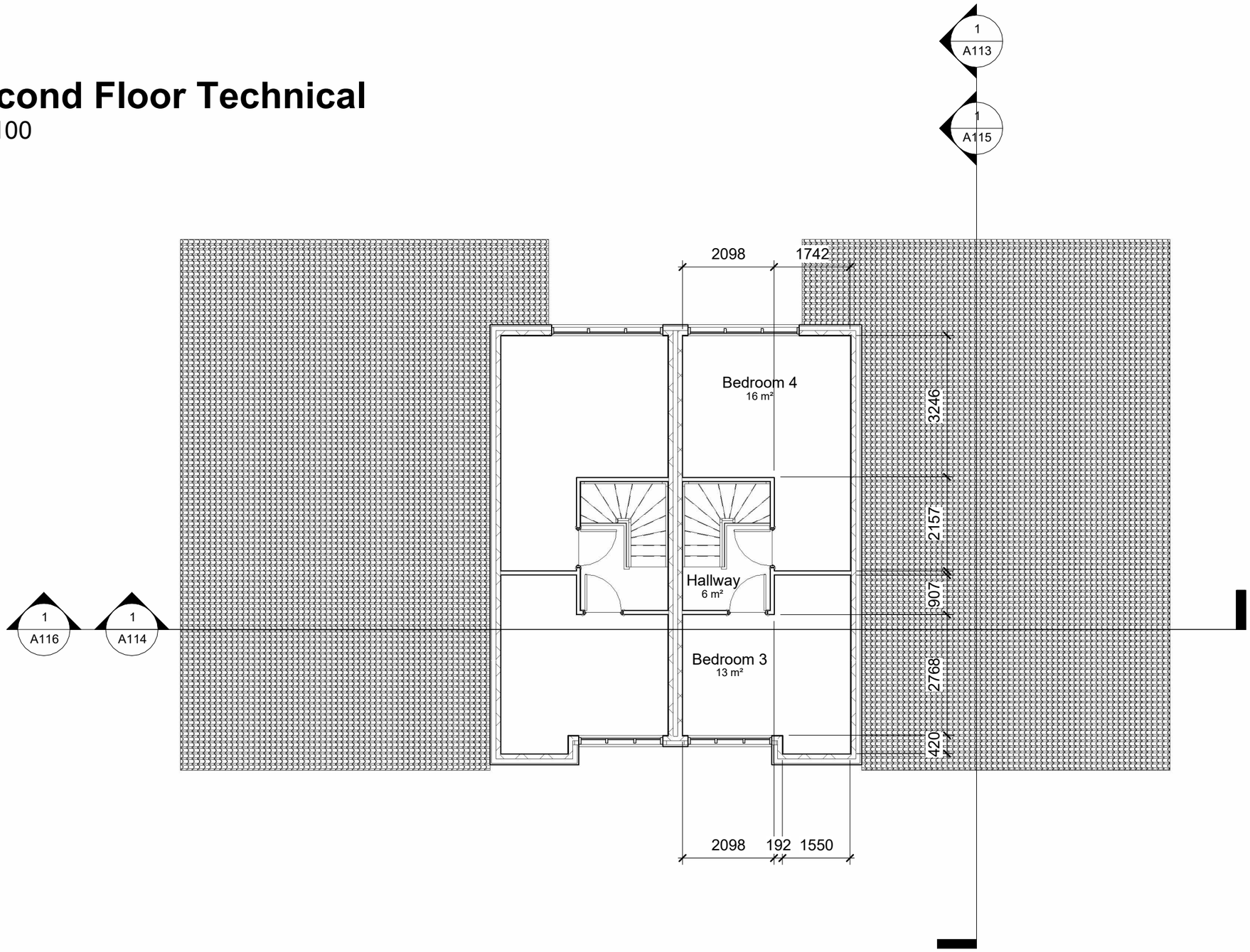
Second Floor Technical

1 : 100



No.	Description	Date

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CODE	STATUS	SUITABILITY DESCRIPTION	PURPOSE OF ISSUE

PROJECT: Project 80

SHEET: 2nd Floor - Technical

CLIENT: Owner

Date	Project number	Scale (@ A3)
Issue Date	Project Number	1 : 100

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Second Floor Realistic

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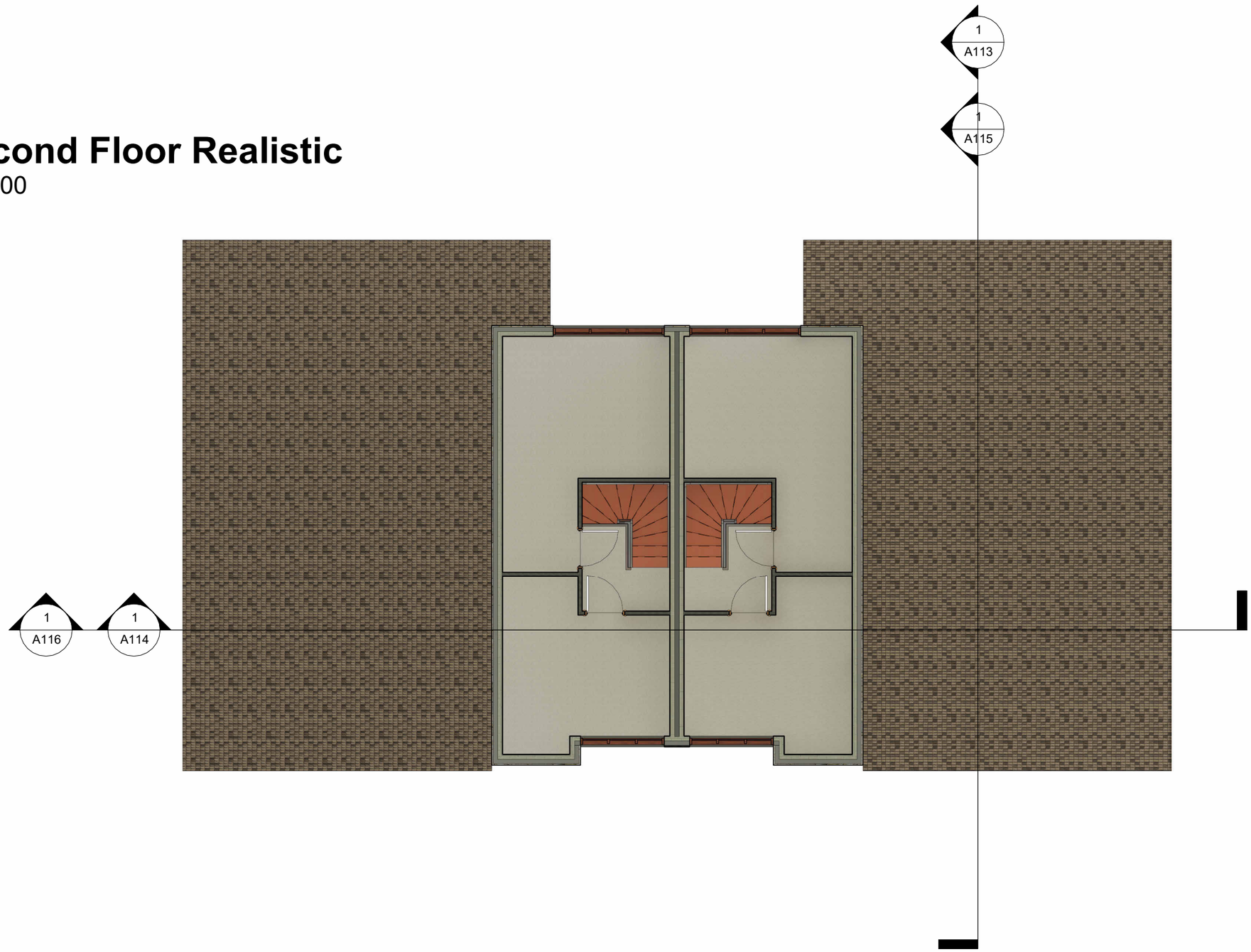

No.	Description	Date

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PROJECT: Project 80

SHEET: Second Floor - Realistic

CLIENT: Owner

Date	Project number	Scale (@ A3)
Issue Date	Project Number	1 : 100

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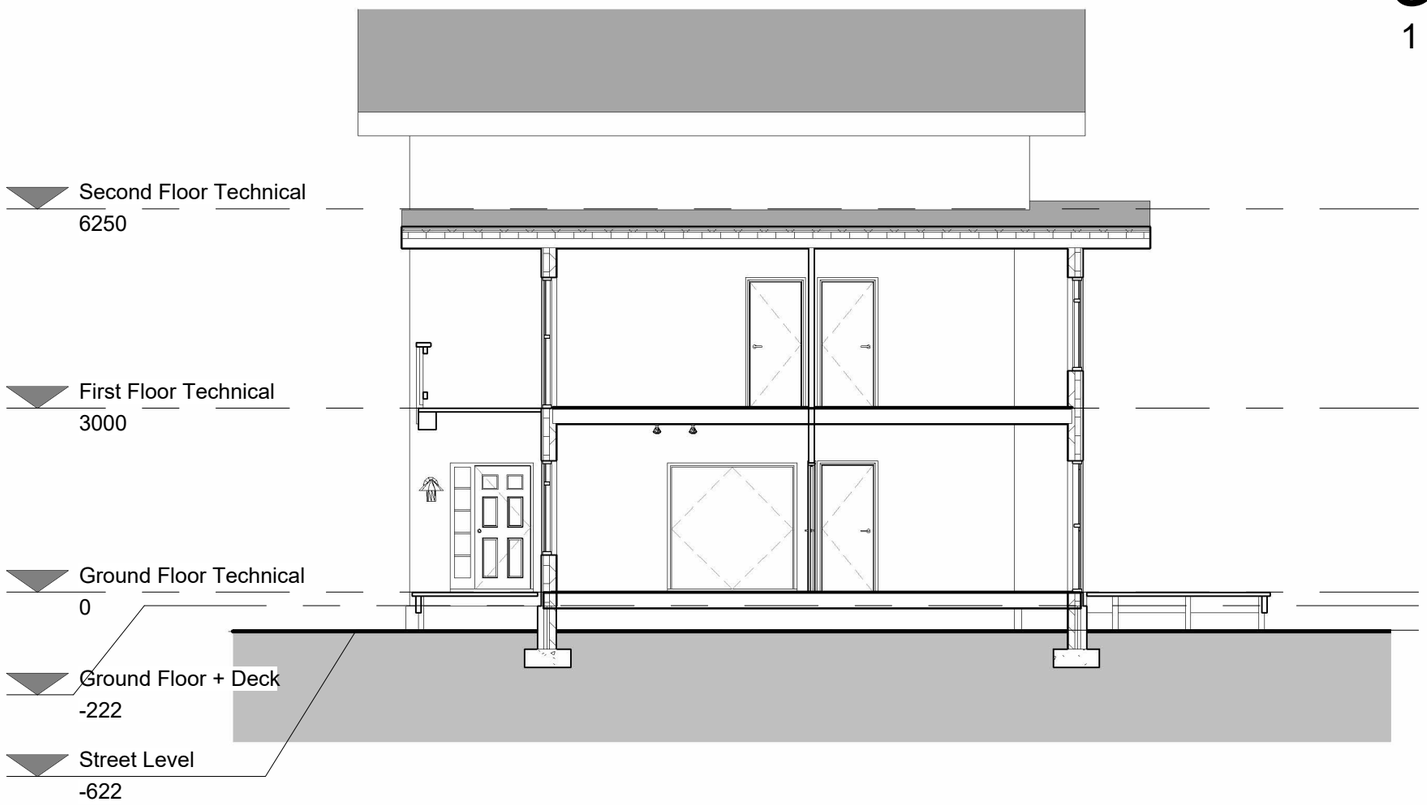

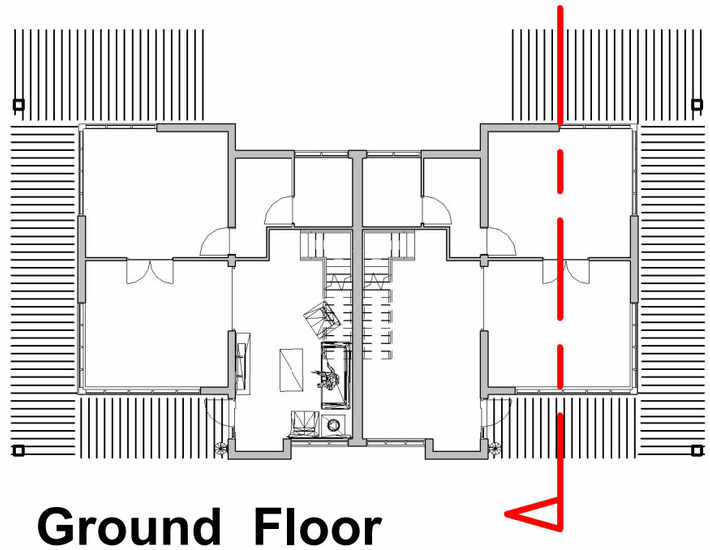

Ground Floor

1 : 200

No.	Description	Date

AUTODESK

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CODE	STATUS	SUITABILITY DESCRIPTION	PURPOSE OF ISSUE

PROJECT: Project 80

SHEET: Logitudinal - Technical

CLIENT: Owner

Date	Project number	Scale (@ A3)
Issue Date	Project Number	As indicated

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Checked by: Checker

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Lateral Section Technical

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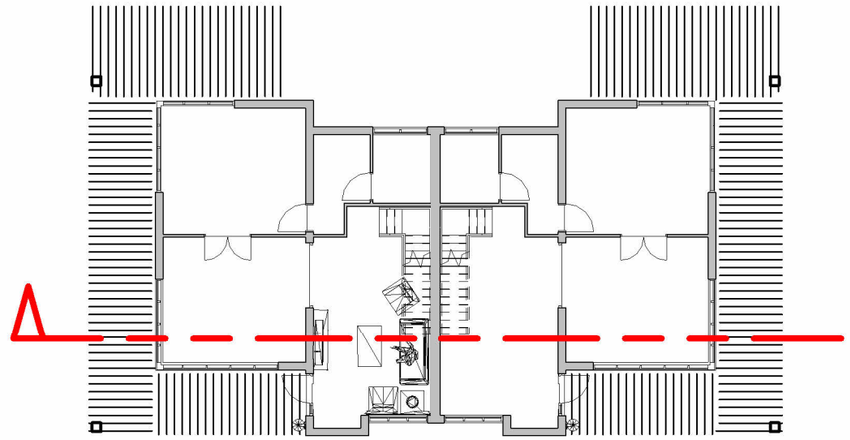

Ground Floor

1 : 200

No.	Description	Date

AUTODESK

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PROJECT: Project 80

SHEET: Lateral - Techincal

CLIENT: Owner

Date	Project number	Scale (@ A3)
Issue Date	Project Number	As indicated

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Author	A114	

Checked by: Checker

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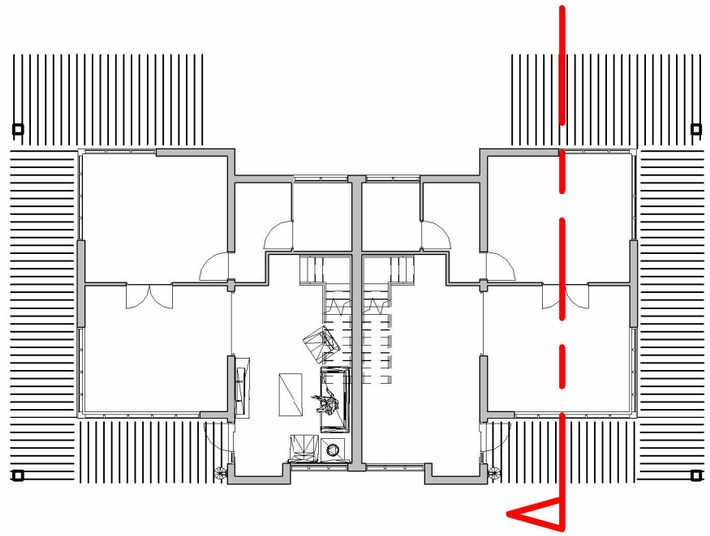

No.	Description	Date

AUTODESK

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CODE	STATUS	SUITABILITY DESCRIPTION	PURPOSE OF ISSUE

PROJECT: Project 80

SHEET: Logitudinal - Realistic

CLIENT: Owner

Date	Project number	Scale (@ A3)
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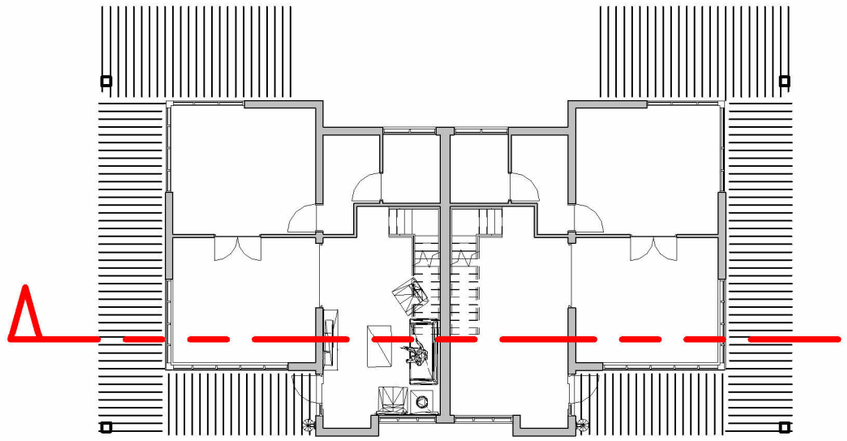

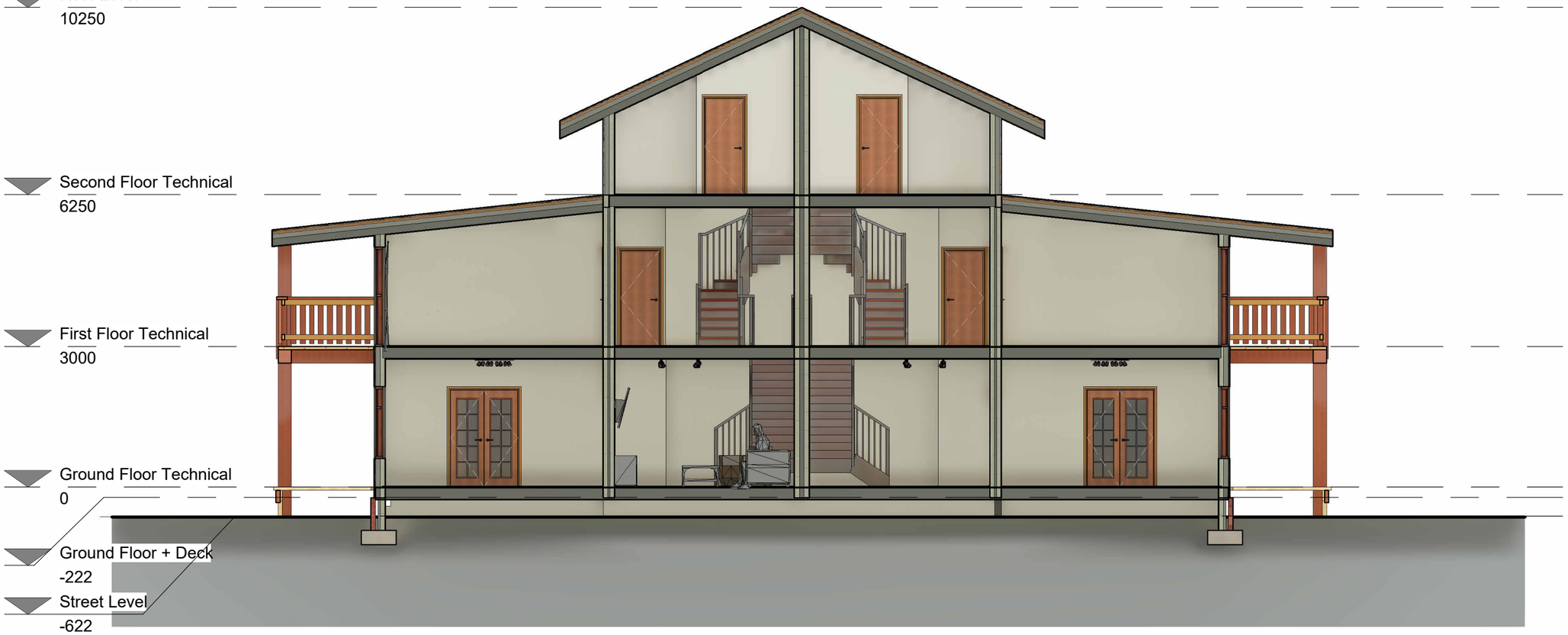

Lateral Section Realistic

1 : 100

No.	Description	Date

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CODE	STATUS	SUITABILITY DESCRIPTION	PURPOSE OF ISSUE

PROJECT: Project 80

SHEET: Lateral - Realistic

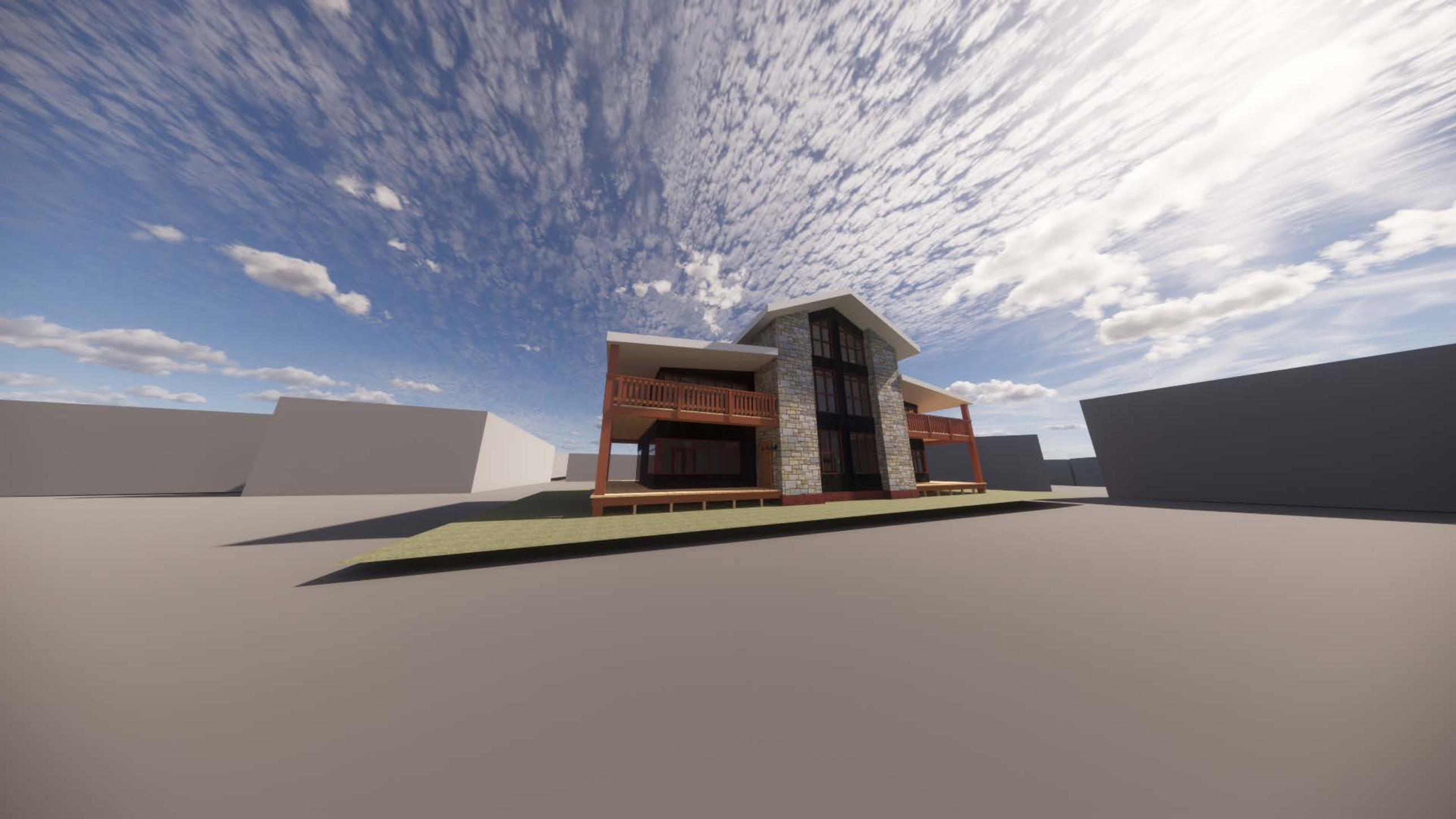
CLIENT: Owner

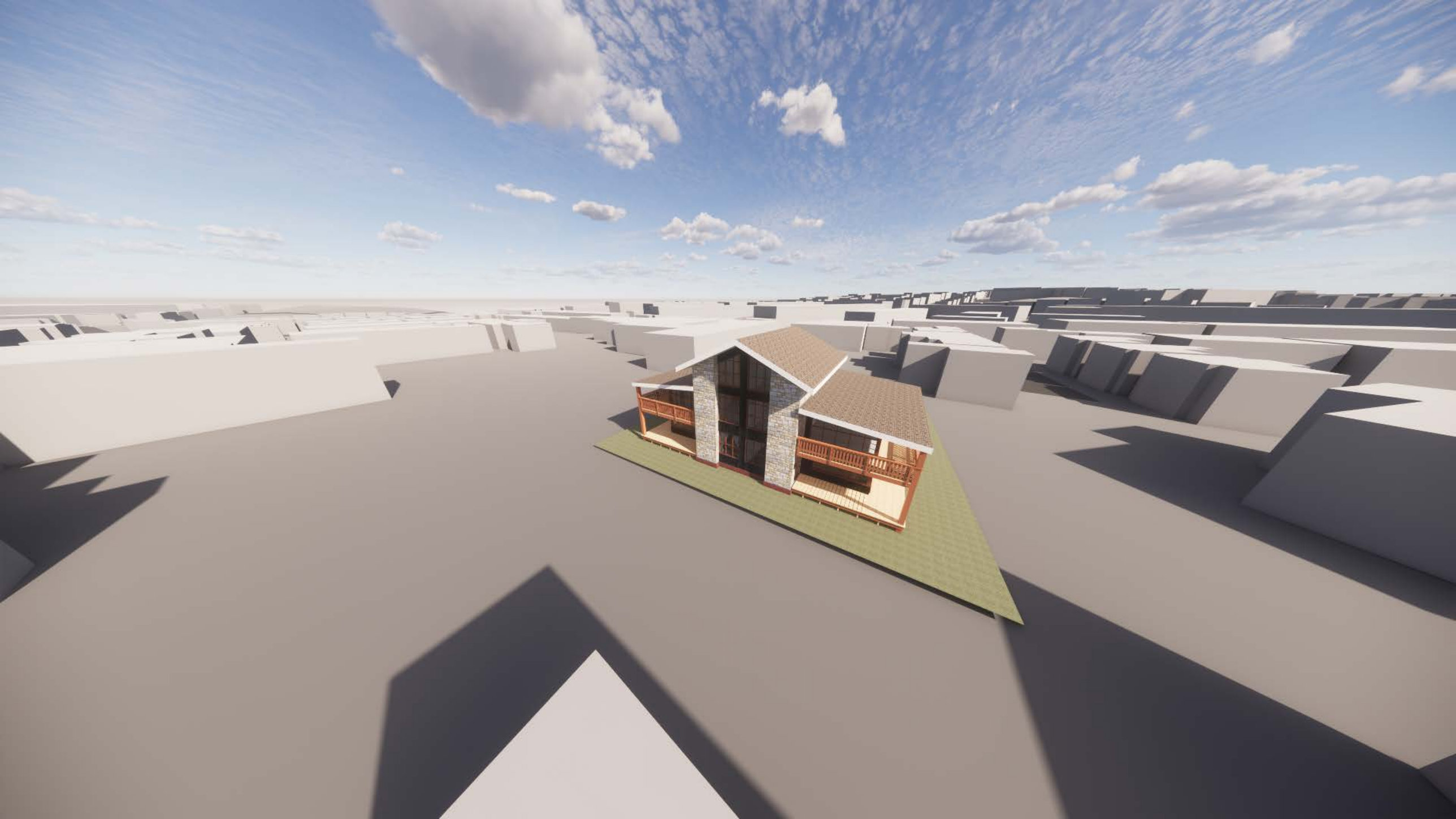
Date	Project number	Scale (@ A3)
Issue Date	Project Number	As indicated

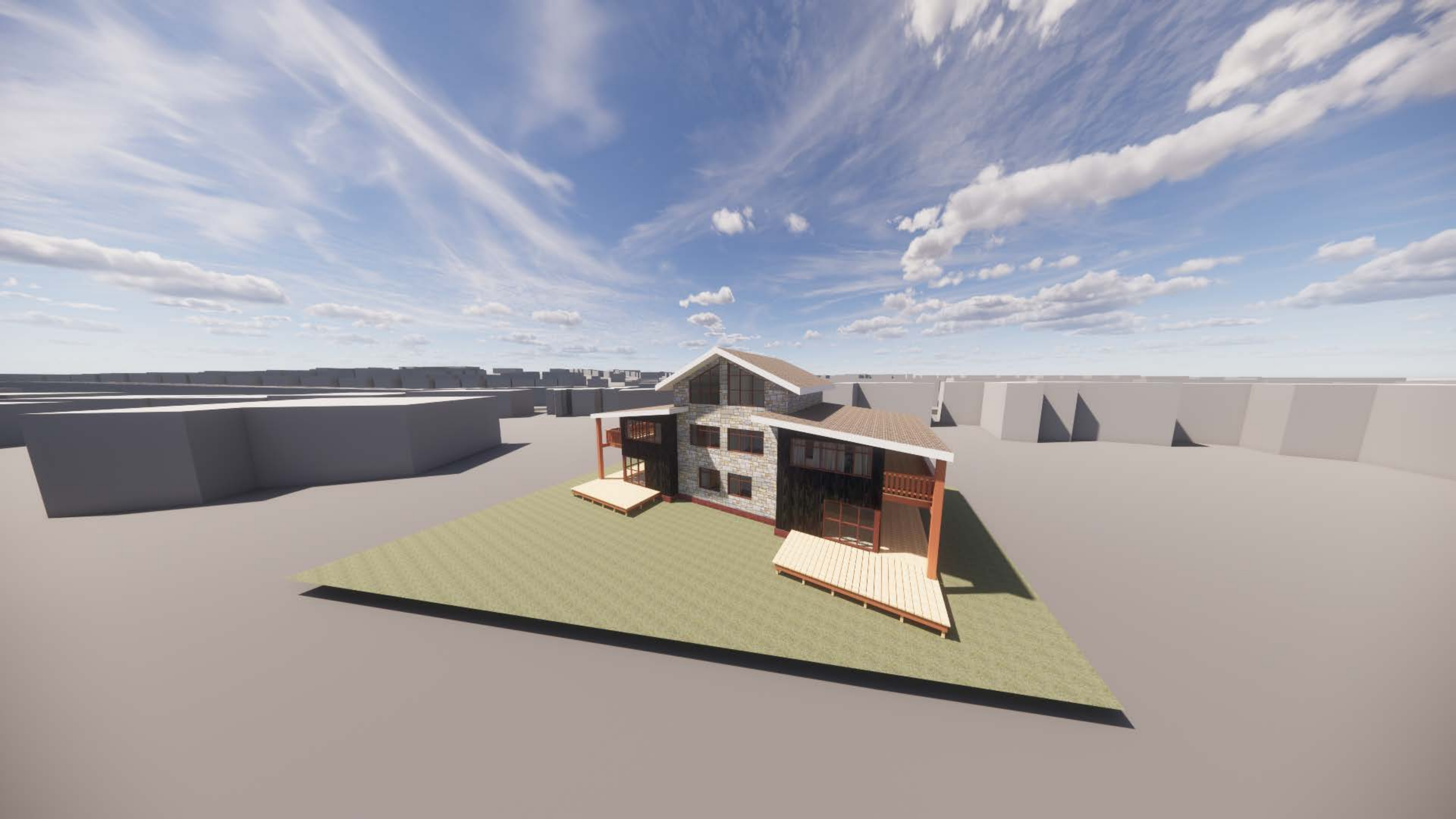
Drawn by	DRWAING NUMBER	REV
Author	A116	

Checked by: Checker

18/03/2023 18:26:51








SKYLIGHT D230