

Eco Teras The Terrace

Eco-Teras

Design description

- **Purpose.**

The terrace has been designed to accommodate four households. It has been designed to provide a working example of a high performance, low embodied energy building which could easily be replicated on a larger or smaller scale.

- **Design.**

- **Terrace Layout**

Access to the terrace houses is from the Northern corner of the field. A track lined with native new-plant woodland leads to a crossroads centered within a common garden. An east-west track provides access to the houses and plots 1-4. Each terrace unit has a utility garden on its North side, and looks out on its plot to the South.

The terrace has been designed on an east-west axis to maximise solar gain. The eco-terras is a timber-framed building with a sedum/ herb roof which is based on a repeating 4m by 4m bay system.

The southern arm of the crossroads is in fact a footpath leading to the shared fields. It passes through the middle of the building and divides the common utility area in two. This area will provide both heating and hot water to the four terrace houses.

Each house will have its own cooking facilities (for example in the form of custom made "rocket stoves"). These are essentially wood powered cookers.

- **Services.**

This area has been designed in consultation with Matt Hutchinson of PBE Renewables and is a hybrid solar/ biomass system loosely based upon the facility at *Coed Hills Rural Arts Initiative* near Port Talbot. On one side 16 tonnes of Miscanthus biomass will be stored. On the other will be a 20kW boiler which will be fed by a shredder/ hopper arrangement. Heat will be stored in two large super-insulated water tanks. One of these holds water at 45 degrees (to be used as underfloor heating). The other holds water at 80 degrees (to be used as a domestic hot water supply). The system is regulated and monitored by a computer. Residents will pay a unit price (per kW) for their hot water and space heating consumption. The revenue from this will be used to cover the cover running costs of harvesting the miscanthus and operating the terrace service area. The boiler will operate for an estimated 6

months of the year. During the summer hot water will be supplied with 20 square meters of solar water heating panels on the roof. The rainwater from the roof of the dwellings will be harvested and stored in ponds to serve as irrigation water for the plots. Domestic water will be provided from the ffynnon-deg spring. Each house will have its own compost toilet.

- **Electricity**

Electricity will be supplied to the terrace from the hydro turbine. Residents may choose to supplement this supply with photovoltaic panels (though Lamma does not expect this to be necessary)

- **Private/ Public Space**

The terrace design has been arrived at through a series of design meetings and discussions between the residents, consultants, designers, architects and structural engineers. It is in essence co-housing. It attempts to give residents all the advantages of a group of people living together and sharing facilities, whilst at the same time giving people a high degree of privacy and independence.

- **Materials.**

The structure is essentially a roundwood timber-frame structure using larch from the site. The external walls of the dwellings are strawbale on a stabilized earthbag stem wall. The floor is of rammed earth, which will provide a large thermal mass which will serve to regulate the internal temperature conditions. The loading on the roof will be carried by trussed rafters. The roof will be insulated using a combination of solid and loose hemp fibre insulation.

Materials are dependant on approval by building regulations.

Terrace Construction:

Element	Material	Reason	Role	Source
Foundations	Recycled Masonry Limecrete	Recycled Environment	Structural Structural	Local/ UK Calc ty Mawr lime, Wales
Floor	Recycled foam glass aggregate Rammed earth	Recycled Natural	Insulative Finish	Calc ty Mawr lime, Wales From site
Walls	Larch Frame Straw Bales Lime render Gypsum plaster Timber window frames Double glazing	From site Natural Environment Fire retardant Local Recycled	Structural Insulation Skin Skin Structural Lighting	From Site Local/ UK Calc ty Mawr lime, Wales Jewsons (made in UK) Home made using welsh hardwood or softwood recycled
Roof	Trussed joists Plasterboard Vapour barrier Hemp Insulation Larch boarding Butyl Membrane Soil Sedum/ Herb	Performance Fire retardant Performance Natural Performance Performance From Site From Seed	Structural Skin Membrane Insulation Structural Membrane Environmental Environmental	Manufactured on site Jewsons (made in UK) Jewsons (made in UK) Local/ UK From Site LBS (made in UK) From Site UK

- **Design**

The terrace has been designed using a modular scheme which allows for a high degree of flexibility in the design of the individual terrace units whilst specifying a common approach to the construction.

The main structural posts will be arranged on a 4meter by 4 meter grid. This will be complimented by secondary lines of posts at 2meter centers along the east/west external axes of the building (the external walls). Thus the internal space will be punctuated by a central line of posts (at 4meter centres). The posts will be capped by round-wood Larch beams running east/ west, providing structural support lines for the roof. Diagonal bracing will be incorporated into the terrace-dividing walls and intermittently within the individual terrace units as the designs allow.

On top of these beams will sit the rafters (l beams themselves) running from the wall beams to the (central) ridge beams. This principal has been adapted by the individual terrace designs to create a custom designed approach to each terrace unit.

The external walls will only support their own weight and will sit outside of the post and rail wall lines. The roof will sit on the post and beam structure and will be

integrated into the rafter space.

- **Construction**

The foundations will largely be minimal pad footings made from limecrete and recycled masonry (subject to building regulations approval).

The Service area will partially sit on a cast limecrete/ concrete slab in order to support the weight of the large water tanks.

The Larch posts will sit on the pad foundations. They will support Larch beams which will in turn support the roof. The floor will be insulated with recycled foam glass aggregate which will also provide a capillary barrier. The floor will be rammed earth.

The external walls will be straw bale with an external lime render. The internal finishes will be subject to the residents individual specifications, (for example, earth plaster, gypsum render).

The roof will be supported by trussed joists. These are lightweight timber I-section beams made from recycled woodchips. We have chosen them for their high performance and environmental specification. They will be constructed on site using Larch from the site. They will eliminate the need for a large section timber roof structure. The roof will be insulated with hemp fibre insulation and boarded with Larch planks. The internal ceiling will be lined with plasterboard to provide a fire retardant layer. An EPDM membrane will provide a waterproof layer for the 70mm deep sedum/ herb roof.

Glazing will be double or triple depending on aspect. Windows and doors will be either of softwood (fsc) or local hardwood depending on their aspect.

- **Reversibility.**

The building is reversible insofar as the site could be restored to its former condition with relative ease. After dismantling the structure the small masonry elements could be dug up and removed. The concrete slab would need breaking up and removing from the site. There would need to be some minor earthworks to return the site to its previous incline.

- **Passive Solar Design**

The terrace has been designed to maximise passive solar gain. The southern glazing will capture the sun's heat and this will then be stored in the massive floor.

- **Active Solar Design**

The roof of the biomass store will incorporate 20 m² solar water panels. This will be used to heat water for domestic use during the summer. Solar Water heating is technologically simple and works excellently to heat water in the summer. Water

Accumulators will store this solar heat. Thus Lammas expects the terrace to harvest all of its hot water needs for 6 months of the year from the sun.

- **Ventilation and Infiltration**

The terrace has been designed to minimise infiltration. The main entrances to the houses have been designed as airlocks. Ventilation is provided in all of the living rooms. In most cases this will take the form of openable windows and trickle ventilation.

- **Natural lighting**

All of the rooms have been designed to be light under ordinary daylight conditions.

- **Space/ Water Heating**

The terrace has been designed to be super-insulated and thus require minimum heating. Heating will be provided from the service room by means of under-floor heating. This will be sourced from a large super-insulated water tank.

- **Heating Fuel**

The southern shared field (3.6ha) will be used to grow Miscanthus (1.2 ha), SRC willow (01.2ha) as biofuels and LRC (1ha) as a long term resource



Miscanthus biofuel

Miscanthus is fast establishing itself as a viable energy crop in Wales. Lammas has chosen to use it for heating the terrace because of its adaptability to mechanization.

Lammas has been advised that to plant Miscanthus requires a field to be “sprayed” in October and again in December. (We are currently exploring alternative approaches to this). The Rhizome planting is done during a dry spell from February

to May and involves bringing in a specialized machine rather like a potato planter. PBE Bioenergy will plant on contract at £1800 per hectare (including stock).



Lower section of the eco-teras fuel field, allocated for Miscanthus production due to low gradient and sheltered position

The first years growth is fairly small (30cm). The second years growth is medium (1 meter). By the third year it is growing to full height (4 meters) and will continue to do so without any additional manure/ nutrient for a long time. The oldest UK plantation is 26 years old and still at full production.

The crop is harvested in early spring (Feb/ Mar) before the new growth. This is done using any standard tractor mower and bailer. Its moisture content at harvest is 20%. Current conservative estimates are that a harvest of about 13 tonne per hectare is normal. Many farms experience 25 tonne per hectare.

The crop is then stored dry and after about 3 weeks (moisture content 15%) it is ready to burn in a biomass boiler.

It will then be shredded by a specialized shredding machine before being put into the hopper which feeds the boiler direct.

Any excess harvest can be mulched or sold as an energy crop at about £50 a tonne.

If each house requires 3kW of hot water/ heat for 6 months of the year:

Boiler Size: 0.012 MW

Efficiency: 80%

Load Factor: 0.5 (6 months of year)

Boiler Requires 66 MWhr/yr

1 odt Miscanthus = 4750 kWh (Oil = 10500kWh)

Thus we would need 14 tonnes of Miscanthus biomass.

The equivalent of approximately 1.2 hectares.

14 tonnes of miscanthus biomass would require 151 cubic meters of storage (the equivalent of 952 small bales or 56 big rectangular bales).

The biomass storage area will be 8m by 8m.

The bales will be moved using a pulley system and placed into the shredder and then hopper. This process will be managed by the terrace residents and it is estimated that this will need attention every 48 hours or so.

Agricultural Set-up Costs

Description	Quantity	Cost £
Spraying	Contractor: £20 ha Spray £29 ha	118
Planting	1.2 hectares@£1800	2160
Total		2278

Agricultural Running costs

Description	Quantity	Cost £/ pa
Cutting	1.2ha	100
Baling	952 small bales@ 0.27	257
Carting	By Terracers	-
Total		357

- **Cooking Fuel**



Approximately 1.2 hectares of SRC Willow will be planted at the top of the southern shared field. Yields are estimated at 10 odt (oven-dried tonne)/ hectare. The crop is thus designed to produce 12 odt SRC Willow (3 tonnes per terrace household). The coppice stools takes 3 years to reach maturity and are cut on a 3 year rotation. The crop will be harvested by the individual households and stored for 12 months to reduce moisture content.

Each household require approximately 2 to 3 tonne of cooking fuel per year. To allow for seasoning each terrace house will provide about 8 – 12 cubic meters of storage space for this.



The top section of the eco-terras fuel field, allocated for SRC Willow production because of proximity to the dwellings coupled with flat access from terrace field

- **LRC Coppice**

The mid-section of the terrace fuel field has been allocated for Long Rotation Coppice. A variety of native species (hazel, ash, oak) of local provenance will be planted as a long term timber resource for the terrace. This section is 1 hectare in area.



The mid section of the terrace fuel field has been allocated for LRC. It is the steepest and least accessible part of the field.

Field margins and divisions between crops will be retained and managed as open rides for their conservation value and as access trackways (0.2 hectares).

- **Building Schedule and Costings**

There will be a whole range of skills and labour involved in building the terrace. A project manager will oversee the detailed design and construction process on a part time basis (2 days a week). In addition there will be professional/ consultation fees.

It is estimated that the build to rough finish will take approximately 18 months.

Schedule of works:

Phase	Description	Timescale	People	Labour Costs*
Phase 1	Groundworks	2 Months	Project Manager	2,880
Phase 2	Timber - Frame	2 Months	Project Manager (Residents)	2,880
Phase 3	Roof and Infill	6 Months	Project Manager Volunteers (Residents)	8,640
Phase 4	Windows and Services	4 Months	Project Manager (Residents)	5,760
Phase 5	Finish	4 Months	Residents	

*based on a 22 working day month

Volunteer labour on the terrace will take the form of carefully managed

volunteer days in which selected elements of the build will be taken forward within an appropriate framework.

Capital Costs estimate:

Phase 1	Architects fees	9,000	
	Consultants fees	4,000	Including structural engineers
	Building Regs	8,000	
	Labour	2,880	
	Materials	6,000	Foundations, underground service connections
	Hired Machinery	1,500	Estimated on 2 weeks of full size excavator and 6 weeks of mini excavator and dumper.
	Miscanthus planting costs	2,300	Spraying plus planting
Phase 2	Forestry costs	7,000	Extracting, milling and stress grading timber
	Labour	2,880	
	Materials	12,000	Fixings, trussed joists, boarding
Phase 3	Labour	8,640	
	Materials	34,000	Roofing membranes, straw, boarding, insulation
Phase 4	Labour	5,760	
	Materials	44,000	Windows, glazing,
	Heating	12,000	Boiler, accumulator tanks, shredder, hopper, underfloor heating
	Electrics	8,000	Based on residents laying electrics themselves and bringing in an electrician to certify
Phase 5	Materials	12,000	Finishings
Total		143,996	

It is estimated that the total build will cost about £150,000 (this works out at about £36,000 per household). The actual figures will depend on the choices and techniques which the individual self builders adopt.

Large Shared Field

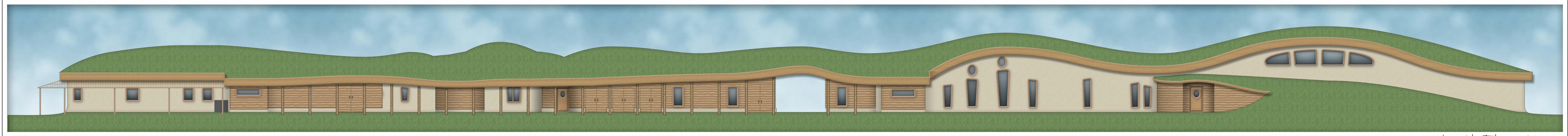
The 12 acre field through which the entranceway runs will be managed as a shared resource for the four terrace plots. It will be made available to each of them either as part of a shared enterprise or as an extension of their individual plot enterprises. In the short term it will be rented out as grazing either to other plot holders (should they need it) or to local

farmers. A provisional rate of £30 per acre per year will be charged, bringing in an annual income of £90 per year per terrace household.

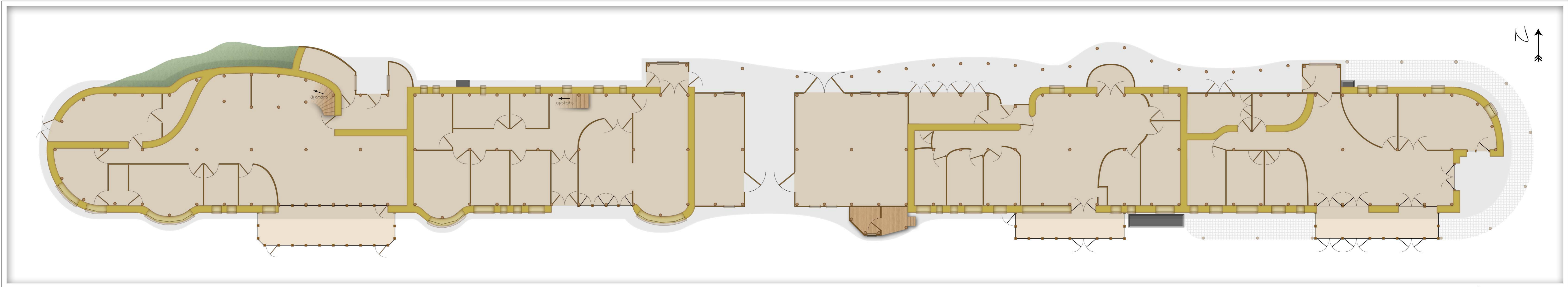
Overview

The terrace will be a co-housing low-impact opportunity which aims to explore the viability of a higher degree of sharing between households within a low-impact smallholding framework.

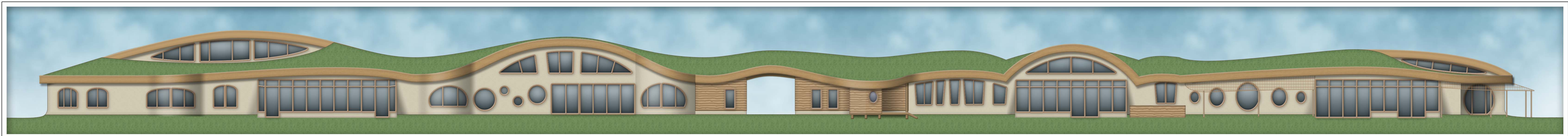
Laymas / Tir-y-Gafel Terrace Building
Plans and Elevations at 1:100



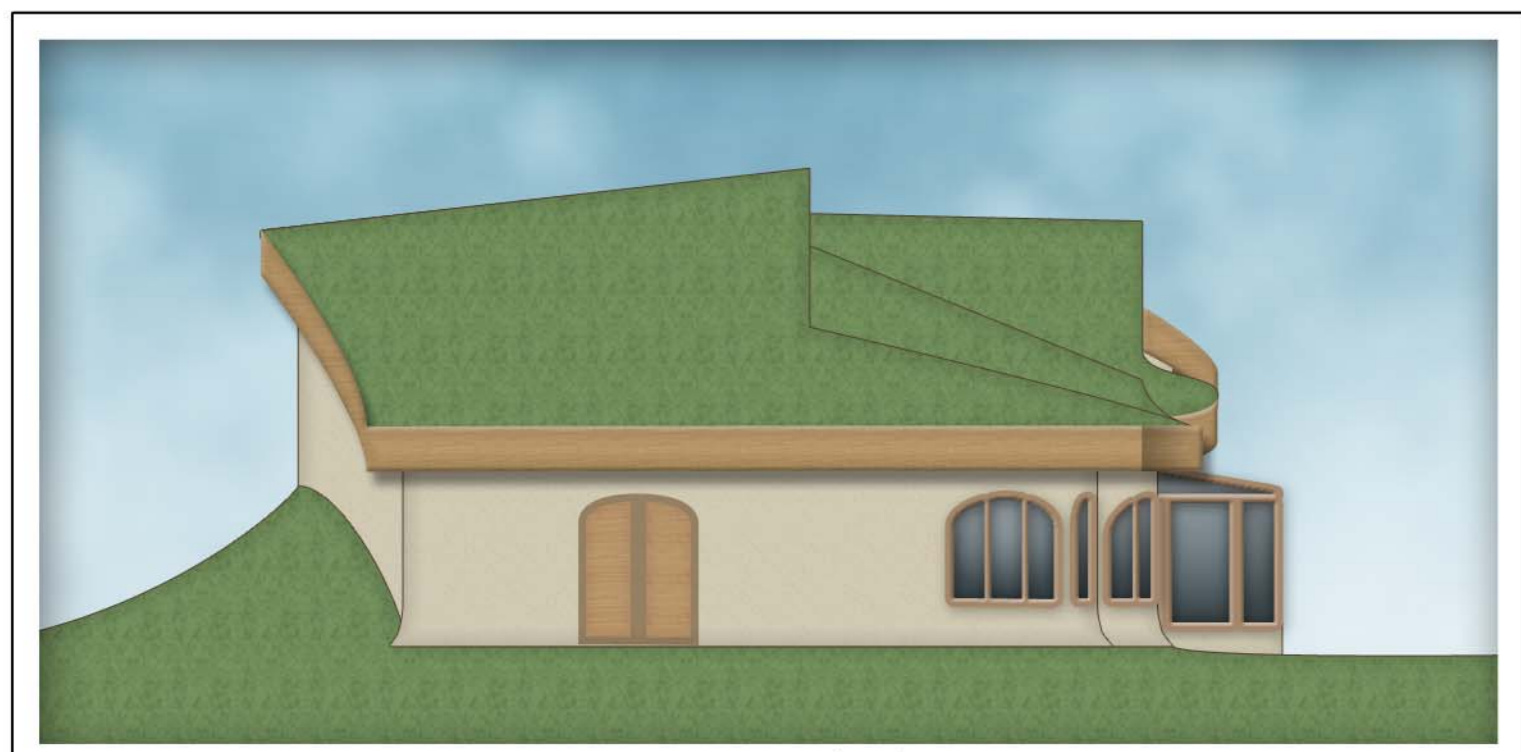
North Elevation



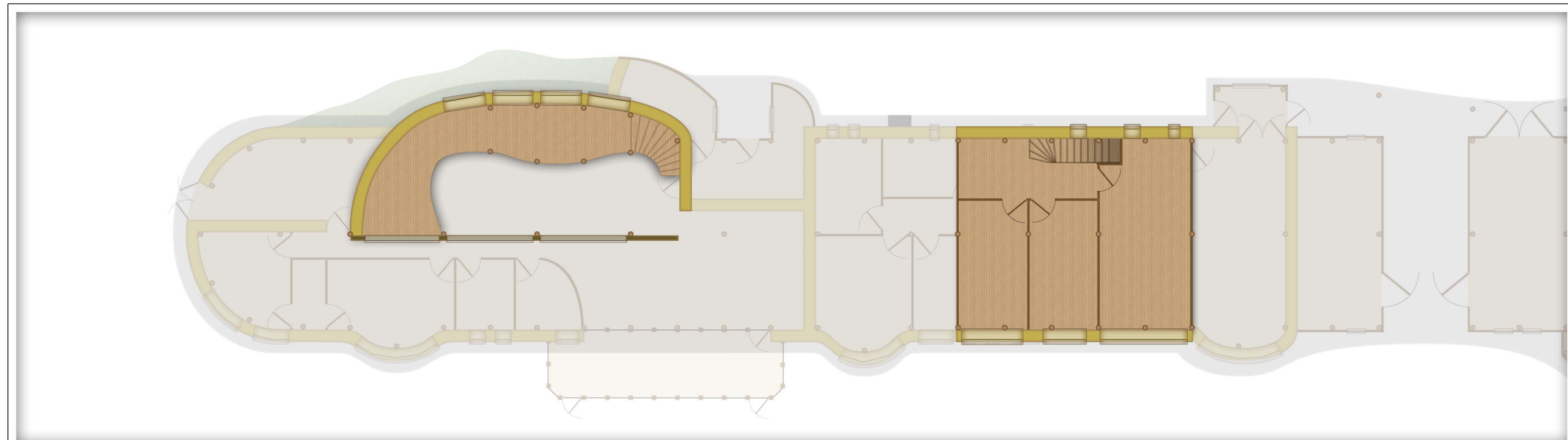
Ground Floor Plan



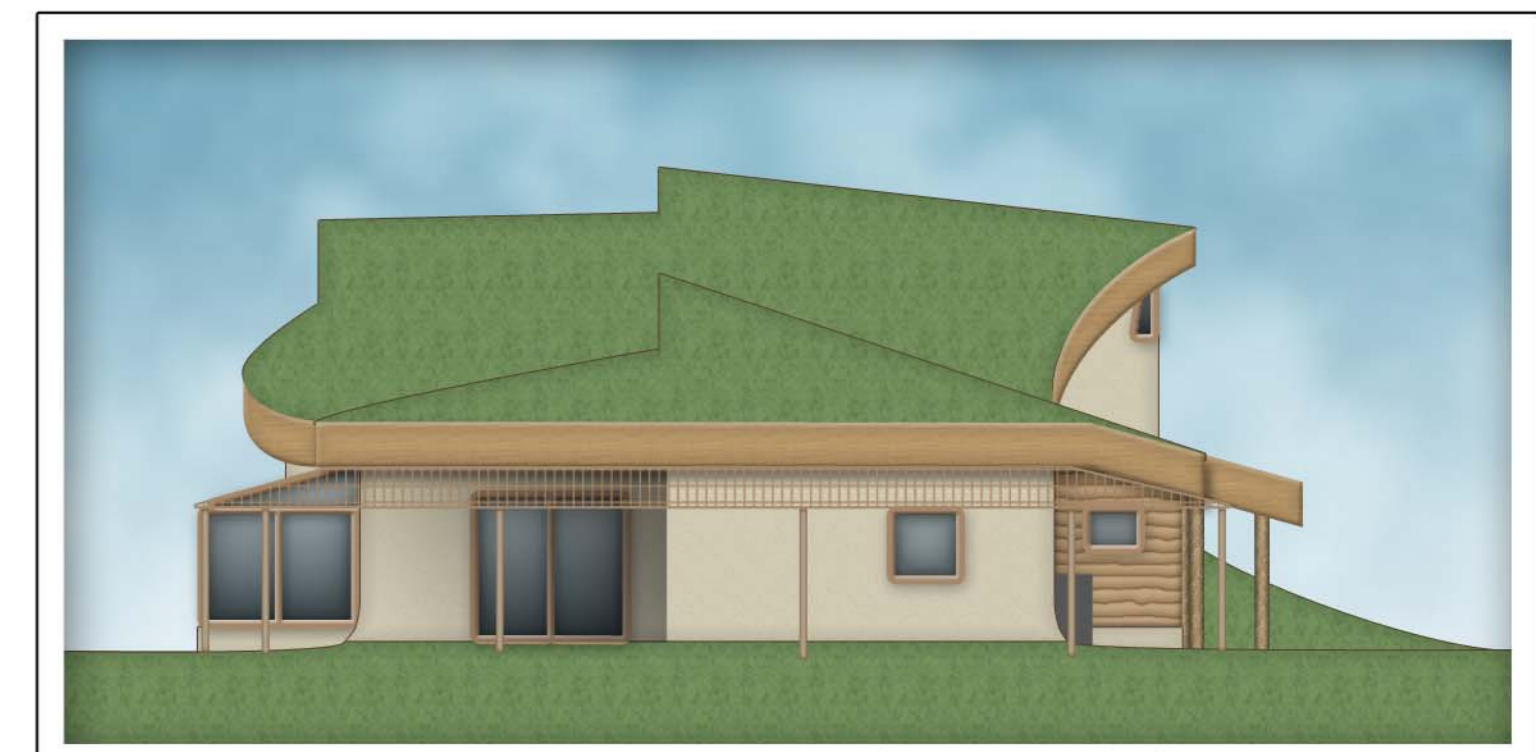
South Elevation



West Elevation



First Floor Plan



East Elevation

Siyon Dale / Laymas
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