

Assessment 2: Fundamentals of Construction Technology

New Build Dwelling:

Technical Report With Drawings

Ben Jeffs 2110628

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Drawings are proportionate but scanning and positioning has removed any attempts to accurately scale.

text: Aerial 12, justified, 1.5 spacing

word count; 1860 plus drawings & labelling

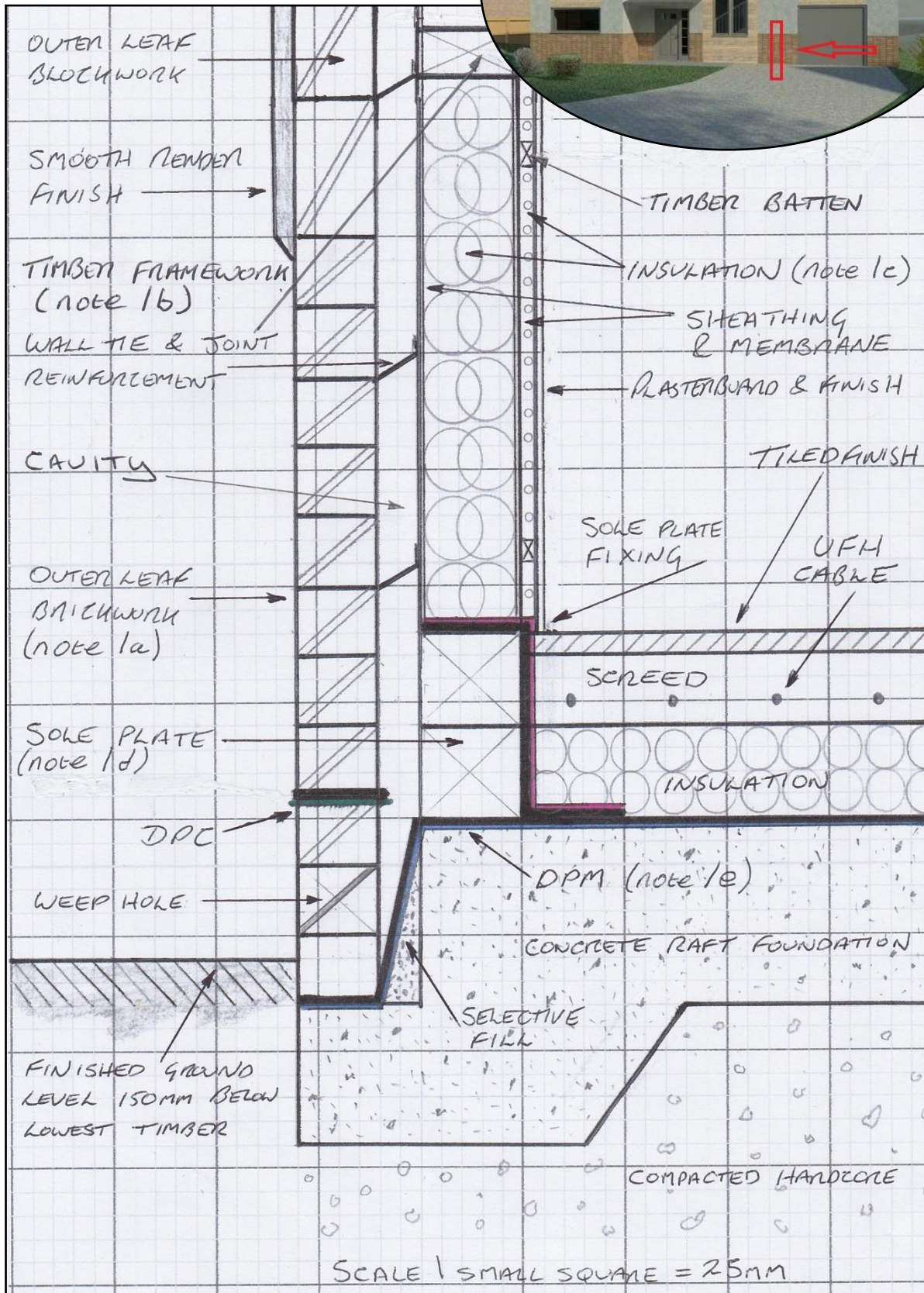
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Note – legislation and codes of practice.

The following is a technical report to assist the client in their understanding of the detail associated with the proposed construction of a platform type timber frame dwelling. The applicable Building Regulations are taken from relevant legislative acts and are applied to the creation of the dwelling. (Build Regs, 2010). ‘How to create’ the dwelling is further derived from the many specific industry codes of practice. The British Standards Institute (BSI) provide many of these as do the International Standards Organisation and other expert organisations. (BSI, 2022).

1. Drawings

1.1. Ground floor



Note 1a: Outer leaf - Outer leaf brick and blockwork is stack bonded, this is a weak bond that requires additional joint reinforcement and wall ties. These are set at an increased minimum frequency of every third bed joint.

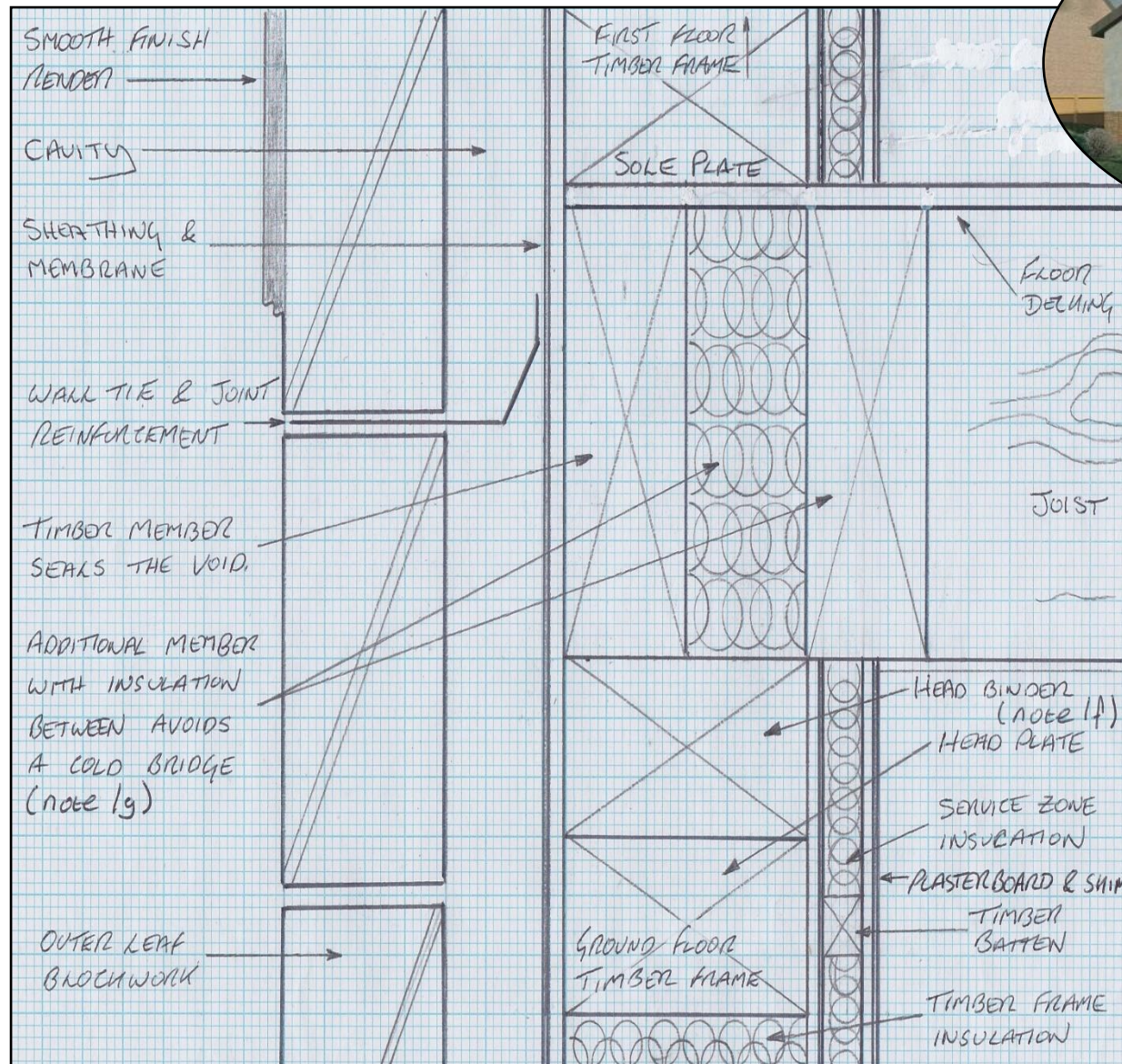
Note 1b: Timber frame – The Timber Research and Development Association have played a major role in developing timber frame dwellings. Built in accordance with the Building Regulations Approved Document A – Structure and B - Fire Safety. Constructional kiln dried timber to C16 specification as found in BS5268. 150MM width provides the cavity for insulation. (TRADA, 2022) (BSI, 2022) (Build Regs, 2010).

Note 1c: Insulation - Timber frame cavity has 140mm Rockwool Timber Frame Slab; enclosed within 11mm structural oriented strand board (OSB) with an outer breathable polymer membrane. The inner service zone has 25mm Rockwool RWA45 Slab enclosed within 25mm timber batten studwork with inner leaf of 12.5mm plasterboard finished with skim coat. With reference to the Building Regulations Approved Document L – Conservation of fuel and power; the maximum permitted heat loss (U Values) for a dwelling wall is 0.3 W/m²K. The Rockwool U Value calculator tool shows the wall as having an overall U Value of 0.22 W/m²K. The floor fitted with 100mm Rockwool thermal 'Rockfloor' Slab calculates at 0.24 W/m²K. The roof is insulated horizontally at joist level thus the term cold roof is applied, the Rockwool calculator tool shows the roof insulation utilising 300mm Rockwool Rollbat between and above joists, having an overall U Value of 0.16 W/m²K. These figures comply with the Building Regulations but fall short of the notional values provided therein. (Rockwool, 2022) (McMullan, 2007).

Note 1d: Sole plate - The sole plate is secured to the raft, set on the damp proof membrane, it is bedded on cement mortar to provide a firm level base for attaching the frames wall panels. (TRADA, 2022)

Note 1e: Damp proof membrane (DPM) - With reference to the Building Regulations Approved Document C2 - Resistance to Moisture. Piercing or damage to the membrane is to be avoided. Selective fine backfill may be used to support the membrane where it tucks below the damp proof course (DPC) at outer termination. The cavity is vented between the DPC and DPM by weep hole bricks. (Build Regs, 2010).

1.2. First floor

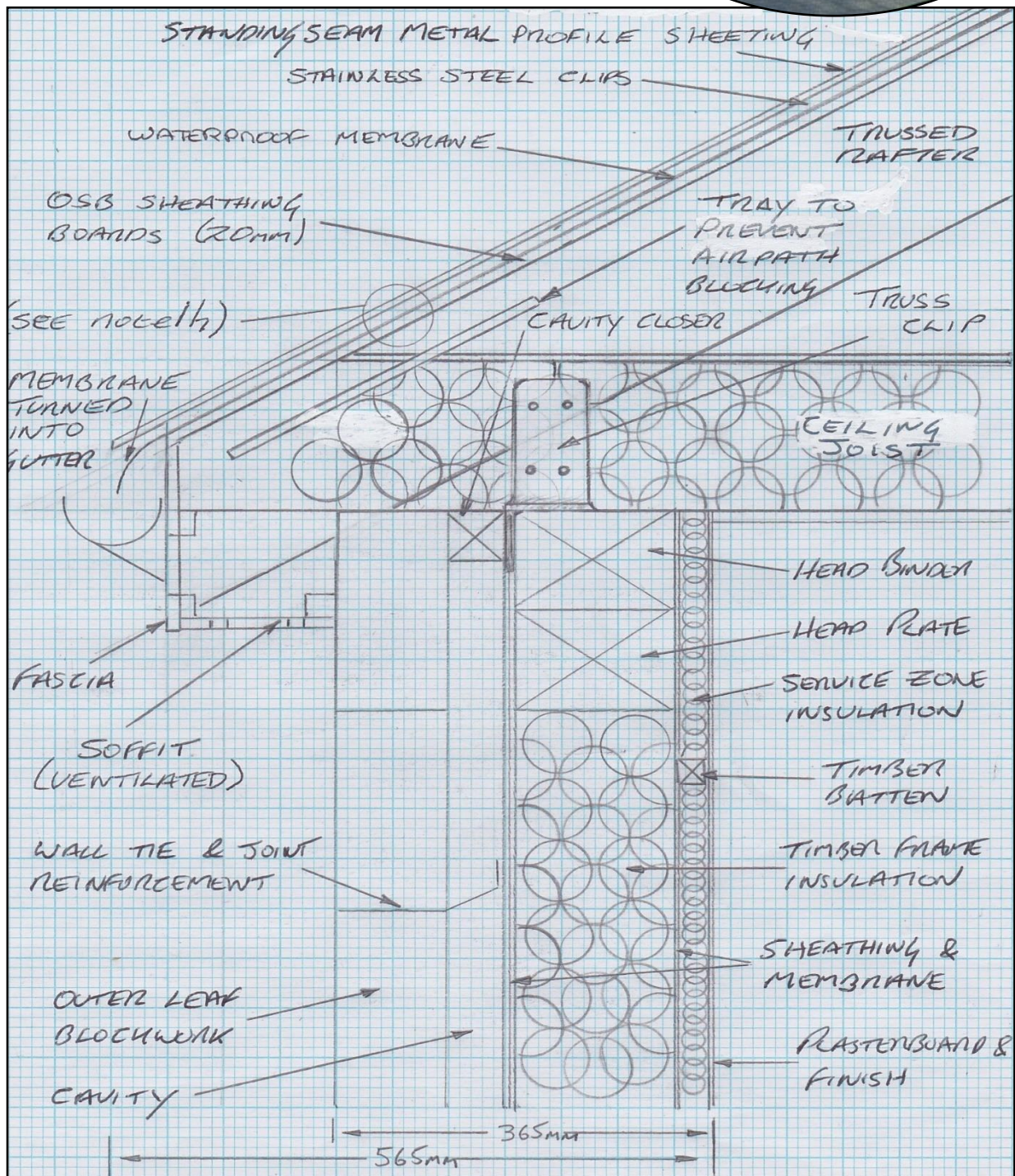


note 1f: Floor connection - floor joists bear directly onto the head binder of the lower wall panel. A double rail is formed by the use of a head binder and head rail, giving extra support for joists. The floor joist runs through, up to the frames outer sheathing. (Build Regs, 2010) (BSI, 2022).

note 1g: Floor completion - Joists are fitted at intervals of 600mm, a timber member, or header joist, is fitted between spaces to close the floor. An additional member with 75mm insulation between them avoids cold bridge in the wall. Floor decking is then laid to the floor joist edges thus providing a level platform for the next level. (TRADA, 2022)

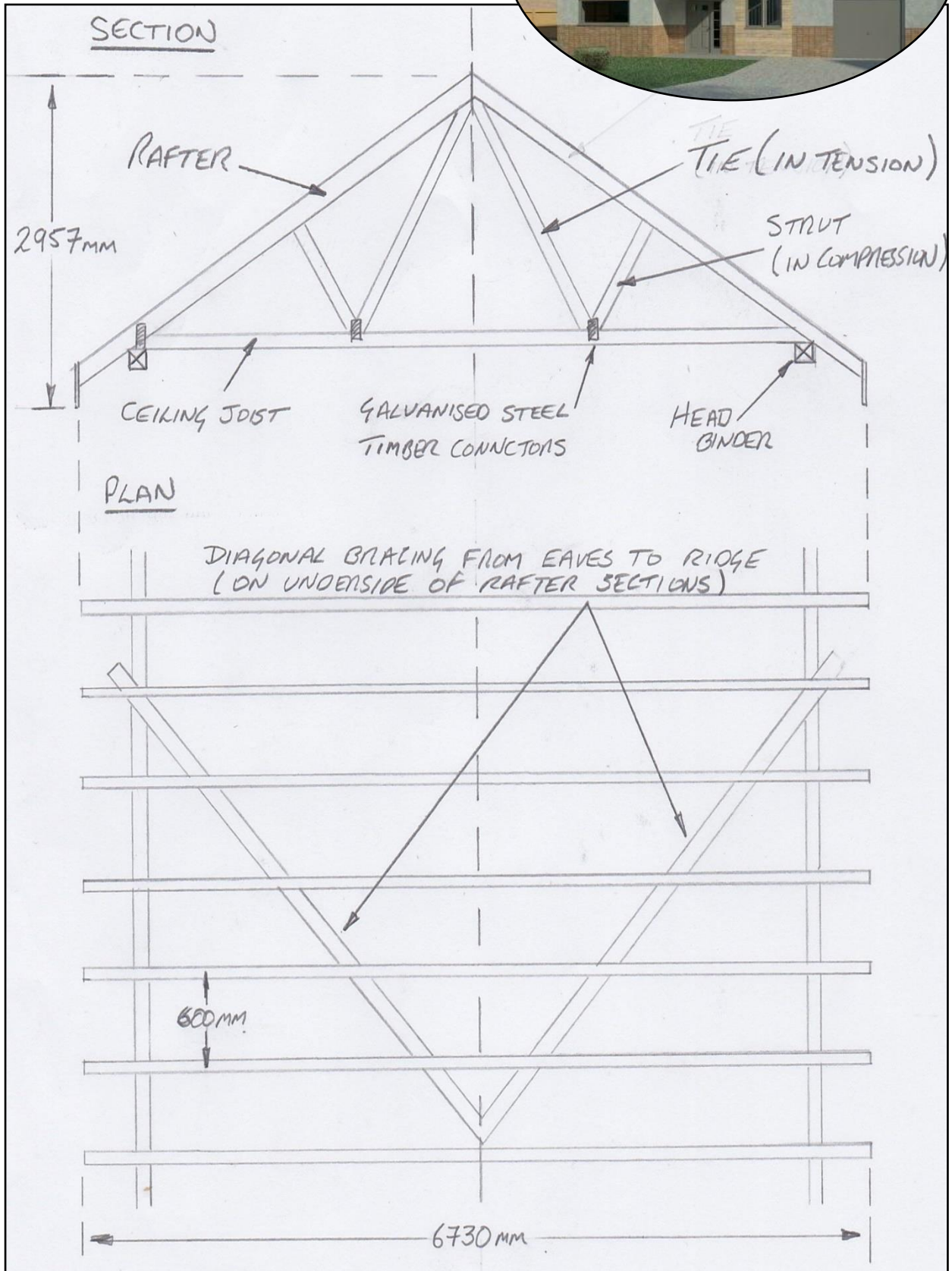
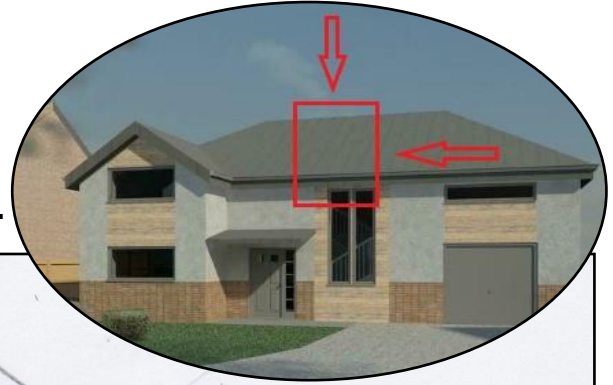
1.3. Eaves and roof covering. (cold-roof type)

Note 1h: Roof Cover – The waterproof membrane is stapled to the sheathing, with 150mm laps. The 454mm width standing stream metal profile sheeting is fitted over stainless-steel clips, each connected via an overlap/underlap system. (Vieo, 2022).

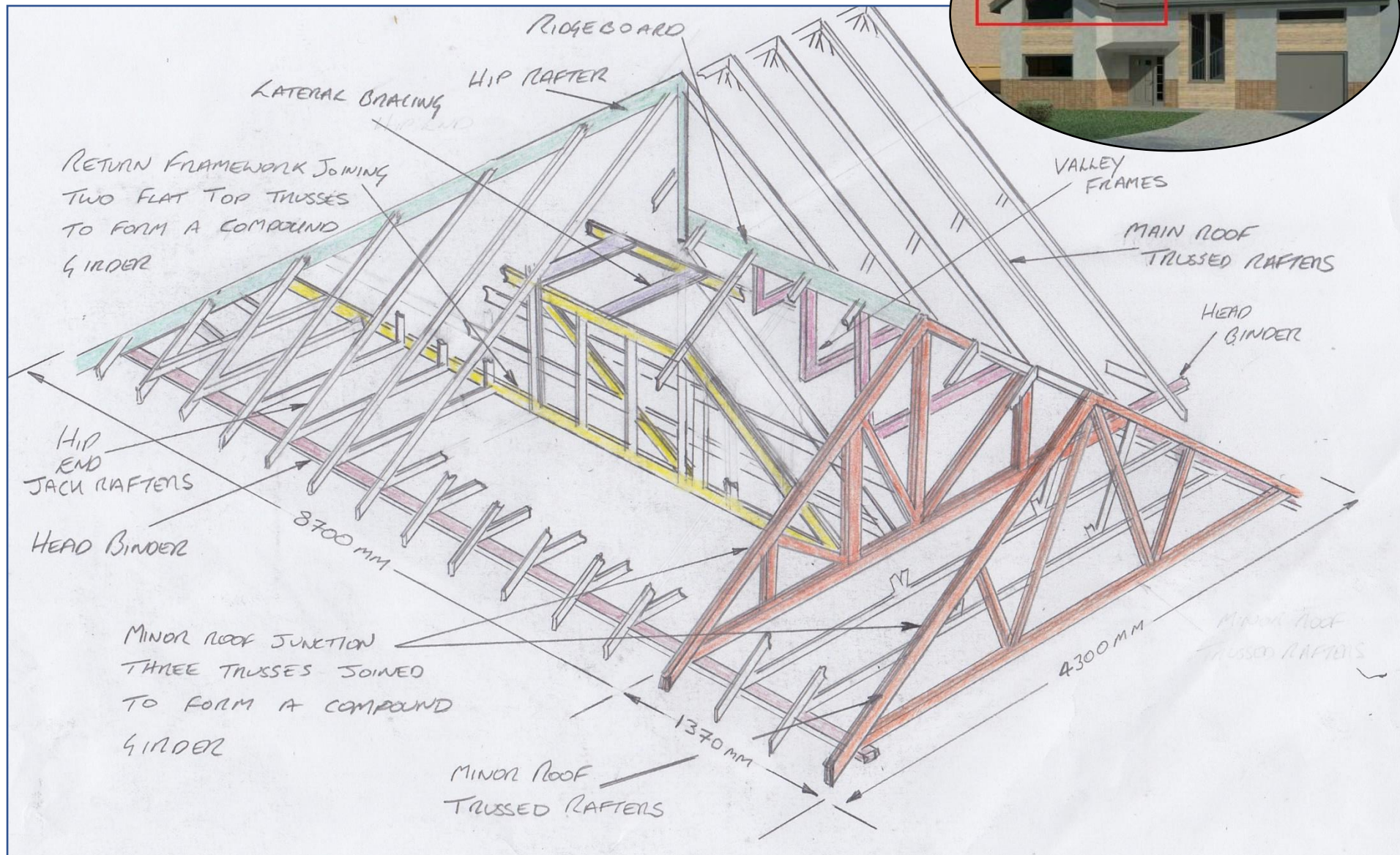


1.4. Roof structure

1.4.1. Main roof, trussed rafters (fink type).



1.4.2. Roof, hip and return – isometric sketch (TRADA, 2022)



2. Roof type analysis. 2.1 Specified roof - advantages and disadvantages.

Modern and now most common in the UK, the specified roof structure comprises a trussed rafter structure (fink type) manufactured off-site. Upon which sheathing, membrane and standing stream metal profile sheeting provide the finish. (Chudley & Greeno, 2013),

Advantages	Disadvantages
Holistic – Off-site manufacturer provides roof components of light section, stress graded, accurately cut to shape and joined with galvanised steel connectors, plus the design and layout, including structural calculations and on-site support.	Flexibility - Reliance upon a single off-site service provider. Planning is critical, the structure must arrive from the off-site manufacturer at the right time. Its bulk means a 'just in time' approach is needed. It must be properly stored or could warp.
Simpler - Design eliminates the heavy purlin and ridge boards. Structural roofing expertise is not needed at site. Large spans can be achieved without support from loadbearing partitions.	Site work - Trussed rafters still require bracing on site; diagonally from eaves to ridge and longitudinal ceiling binders. Problems on-site may require manufacturers assistance.
Quicker - Multiple components may be assembled at ground level and mechanically lifted into place. Lighter components can be quickly erected by as few as two manual operatives.	Space - The design allows no roof space, so there is no potential for additional rooms. A tighter roof space can pause some restrictions to internal maintenance.
Finish - Metal profile sheeting is modern in appearance; it is sold as a low maintenance solution.	Finish – metal profile sheeting is relatively new and has not stood the test of time. Specialists may be required for maintenance.
Economics – the trussed rafters is a cheaper solution in terms of material and labour costs, however; the metal profile sheeting is more expensive than other, more traditional finishes. The cost to rectify potential future problems could be higher.	

2.2 Alternative roof - advantages and disadvantages

Rafters and purlins are a traditional alternative to that specified, most common up until 1970. It is manufactured on site from individual timbers. Purlins are heavy horizontal timbers that support the rafters, struts or vertical timber connection (hanger) to the ceiling joist below, the purlin may be built into brickwork. Upon which a roofing felt membrane and battens are fixed to accommodate plain interlocking concrete tiles. Again, a cold roof with 300mm Rockwool Rollbat between and above joists.

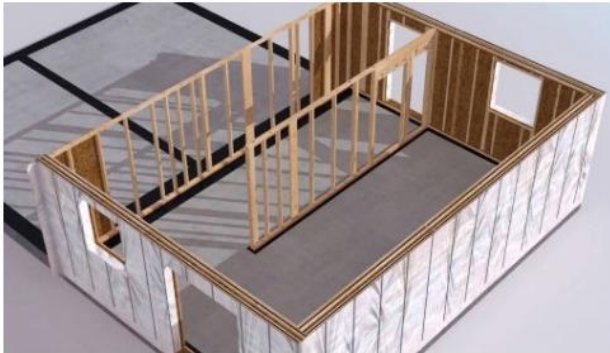
Advantages	Disadvantages
Space – a rafters and purling roof provides a useful space which is often used for storage or additional rooms.	Slower – assembling individual timber components on-site and in-situ is a slow process and elongates project timescales.
Complicated – the design can appear quite complicated to the untrained eye. Potentially there is more to go wrong.	Support – the design is unable to achieve major spans without further support from internal loadbearing partitions.
Flexibility – use of individual timbers allows flexibility of on-site activity and project planning. Additionally, problems can be rectified quicker by internal skilled operatives.	Skill – skilled on-site operatives significantly increase labour cost. Availability of such skilled operatives may also create problems.
Finish - traditional concrete tiles on battens are a proven finish, able to resist UK weather they are also fire resistant. Easily maintained by local roofing companies.	Finish – traditional, old fashioned aesthetics of concrete tiles may not fit well into modern architecture.
Economics – rafters and purlings are a more expensive solution in terms of material and labour costs, however; the traditional concrete tiles on battens finishes are available in all shapes, colour and sizes and are the cheapest of all roof finishes. The cost to rectify potential future problems could be lower. (Riley & Howard, 2018)	

3. Offsite construction

3.1. Description

Off-site construction - is a method that adds substantial value to a product via the manufacture and pre-assembly of components, elements or modules in a factory, before installation into their final location. These can be made out of any typical construction material: concrete, steel, timber or hybrid.

Panelised systems



Volumetric systems



Sub-assemblies and components



Hybrid systems



Benefits include; a cleaner and safer place of work in a factory environment, the production is more efficient and performance are enhanced, with consequent reductions in costs. A higher quality with more predictable product behaviour, is expected. Optimising the use of materials and the opportunity to carry some operations at the same time allows for time savings and reduction of waste. Additionally, the use of BIM and automation ensures flexibility. **There are four main categories of off-site construction.** (Gavin Traylor, 2022)

3.2. Categories of off-site construction

Category	Description (Gavin Traylor, 2022)	Project example
Panelised systems	A planar unit which may or may not have a structural function. • Open: usually non-insulated with the structural elements and sheeting on one side • Closed: include insulation, sheeting on both sides and a service zone; can be furtherly enhanced with the addition of internal lining, external cladding, windows and doors and services. • SIPs (Structural Insulated Panels): variation of closed panels; solid insulation 'sandwiched' with two layers of OSB.	The timber frame internal walls will be offsite manufactured for this project.
Volumetric systems	Are three-dimensional units that enclose usable space. • Typically, are fully finished internally and can also be finished externally • Can also be non-structural – pods: used for bathrooms, plant rooms etc.	These have a non-structural presence at the project providing construction phase site offices, and welfare facilities.
Sub-assemblies and components	Pre-manufactured elements that don't fall in the previous categories • Stairs • Doors • Windows • I-joists • Steel elements	The stairs, doors, windows and sunroom components will be off-site manufactured for assembly on-site.
Hybrid systems	A generic term covering a wide variety of construction techniques, particularly where different systems and/or materials are used in combination to fulfil a specific function	The garage, complete with doors and matched with the timber frame garage walls could be a hybrid off-site system.

4. List of references

(All references were accessed April 2022) (in alphabetic order)

(BSI, 2021) British Standards Institute, various codes of practice, available at <https://www.bsigroup.com/en-GB/standards/>

(Build Regs, 2010) UK Building Regulations, Approved Documents, available at <https://www.gov.uk/government/collections/approved-documents>

(Chudley & Greeno, 2013), Construction Handbook, Abingdon, Routledge.

(Gavin Traylor, 2022) UWTSD notes from lectures and presentations, Superstructure

(McMullan, 2007) Environmental Science in Building, London, Palgrave Macmillan.

(Riley & Howard, 2018), House Construction 1, Basingstoke, Palgrave.

(Rockwool, 2022) mineral wool insulation product data, available at <https://www.rockwool.com/uk/>. Also: U Value Calculator available at <https://www.rockwool.com/uk/resources-and-tools/tools/u-value-calculator/>

(TRADA, 2022) Timber Research and Development Association, available at <https://www.trada.co.uk/>

(Vieo, 2022). Euroclad Vieo, Standing Stream Metal Profile Sheetting, available at <https://www.eurocladgroup.com/products/profiles/roof-profiles/vieo>