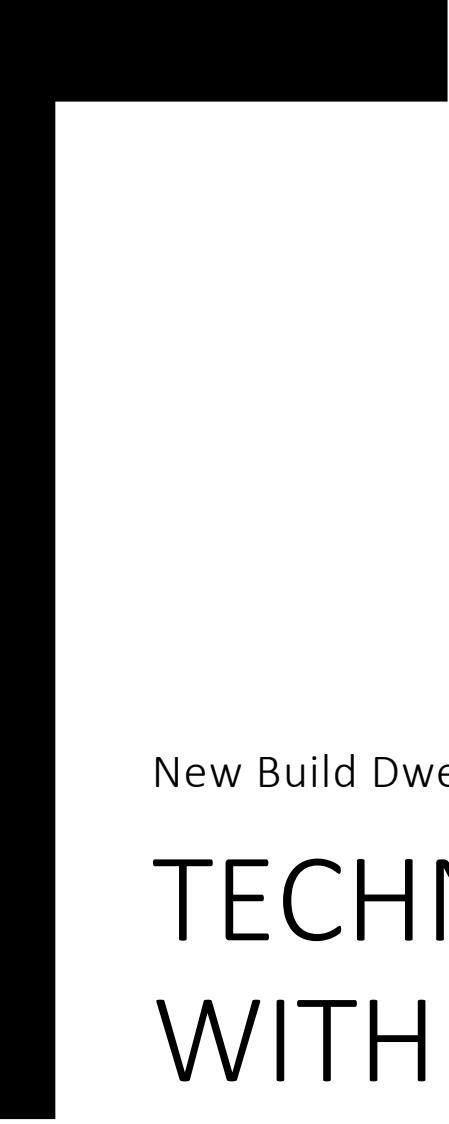




New Build Dwelling:

TECHNICAL REPORT WITH DRAWINGS.

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Introduction

A technical report to address some of the construction details required for a single, two storey detached dwelling. Detailed sketches are provided to support construction methods such as an insulated ground floor with underfloor heating, solid timber upper floors with tongue and groove flooring and roof structures with detailing. The proposed dwelling consists of a 140mm thick insulated timber frame with an inner skin cavity wall, an outer skin of stack bonded facing brick and block work with render finish. The report will include information regarding appropriate ventilation required for these construction methods on a domestic new build.

Ground Floor Construction Detail

To support the proposed plans; the recommendation for the ground floor would be beam and block construction with a raft foundation. A beam and block ground floor will be best suited as it has good loadbearing capacity and is appropriate for poor ground conditions, such as previously used agricultural land. The ground floor construction will include underfloor heating imbedded into a screed floor that will be insulated. The underfloor heating will be installed in the screed, above the vapour barrier and rigid insulation. The detailing and junctions must comply with Building Regulations Approved Document Part M and Building Regulations Approved Document Part L1A (Welsh Government, 2010). The specified construction of the ground floor joining the external walls should provide a potential U-Value of $0.20 \text{ W/m}^2\text{K}$ (Kingspan, 2021) overall which is under the highest possible U-Value of $0.21 \text{ W/m}^2\text{k}$ that is permitted as stated in Approved Document L1A (Welsh Government, 2014). Since the outer wall will consist of render finish it must comply with NHBC Standards and as stated “cannot be less than 16mm for sheltered moderate exposure zones; or 20mm for sever and very sever exposure zones” (NHBC Standard, 2020).

Stretcher bond stack brick work is recommended for the external walls. Stretcher bonds are both the fastest and easiest stacking method. With the use of C16 timber frame it is possible to insulate in between the framework for additional thermal protection. The permissible clear spans of the C16 timber frame must comply with BS 8103-3 (BSI, 2009). This would apply to both joist without partitions as well as joist with lightweight partitions. The PIR insulation would need to be a minimum of 100mm thick to ensure a lower U-Value within the cavity walls. This could result in a U-Value of $0.15 \text{ W/m}^2\text{k}$. This would allow air to ventilate within the inner walls and prevent large levels of condensation. Please see appendices for sketch detail in Figure 1: A.

First Floor Construction Detail

The first floor will be a suspended solid timber floor that must comply with Building Regulations Approved Document A (Welsh Government, 2010). The first floor would need to be secured against the external walls using some form of restraint. This can be achieved by attaching each individual beam to the external walls using a restraint's hanger. PIR can be installed in between the joists on the first floor for additional thermal insulation and sound damping. PIRs acoustic properties help to reduce the noise transfer between each level of the house. The tongue and groove flooring can then be laid directly over the prepared level ground. This flooring option can be glued or nailed down to secure it into position. However, this can cause issues if individual panels need repairing at a later date. Overall, tongue and groove flooring is an ideal flooring solution that can be installed with relative ease. Please see appendices for sketch detail in Figure 1: B.

Eaves Detailing & Roof Covering Detail

To comply with Building Regulations Approved Document Part H, the roof covering and eaves must allow water to drain from more than one edge (Welsh Government, 2010). In addition to this, it must also extend from the adjacent walls by at least 150mm. For the proposed dwelling it is recommended to use closed soffit eaves. Closed soffit eaves would allow for additional insulation; It is also possible to vent through the soffit to prevent condensation accumulating within the roof. The roof covering will require battens and counter battens for the installation of the overlay of OSB sheathing and must comply with BS 5534:2014 (+A2:2018) (BSI, 2018). A roof fitted with OSB sheathing boards with both battens and counter battens throughout can create a ventilation zone within the roof construction. Metal profile sheets are easy to install on site, offer large spans and are lightweight on a roof structure.

To ensure the roof structure and coverings also comply with Approved Document L1A, the roof must produce a lower U-Value than $0.15 \text{ W/m}^2\text{k}$ (Welsh Government, 2014). The best way to comply with this regulation is to use insulation in-between and over the rafters, keeping the rafter depths at 600mm and using insulation that is 140mm thick. Having these additional features in place will produce a U-Value of $0.14 \text{ W/m}^2\text{k}$ (Kingspan, 2021). Please see appendices for sketch detail in Figure 1: C.

Roof Structure Detail

As part of the Government guidance; a roof must have appropriate ventilation and be fully weatherproof, wind proof and strong enough to walk on according to Approved Document Part H (Welsh Government, 2010). For maximum strength and span it would be appropriate to use king post trusses with rafters. This would work well with the proposed plans by allowing an open ceiling affect for the first-floor rooms. The rafters will be fixed to the wall plates using nail plates to evenly distribute the load from the roof structure down through the external walls. Trusses are manufactured off site and then brought directly to the site. On site, they arrive with all junctions securely attached with nail plates. For a more traditional and authentic finish the trusses can be installed via nail and peg construction. This ties the junctions together with a more seamless finish. Please see appendices for sketch detail in Figure 1: C.

Roof

The roof structure will consist of trussed rafters with a metal profile sheet finish installed over OSB sheathing boards. The roof is a pitched hipped roof, whereby the use of trusses can have several advantages as well as disadvantages. Firstly, the trusses work well when required to cover a large span such as that of the proposed dwelling. Secondly, they can potentially lead to a faster construction time. This is due to their manufacture off site, ease of installation and minimal waste on site. By using trusses, it allows for fewer load-bearing internal walls, reducing additional stresses on the internal structure.

As with many other construction methods, the use of trusses may also restrict some aspects of the build. They are largely built off site, preventing any adaptations that may need to be made if the trusses are not suitable upon arrival. This may cause issues surrounding the trusses wind and rain load capacity. Trusses are large and heavy and can have up to a 15m span. Although using trusses for roof construction is the most effective method for the proposed project, it is worth noting that they will also restrict the amount of internal storage space available in the proposed dwelling.

An alternative construction method for the roof structure would be using traditional rafters and binders. Since the proposed dwelling consists of the loft doubling up as domestic areas, the use of trusses would likely restrict the available space. Due to their size and the manor of their construction, trusses take up a lot of the head room that would be essential for the rooms proposed in the plans. By using common rafters, you would be able to provide additional

strength with collars. This would also allow for a larger span and a higher ceiling height. However, this particular method does not fully allow for the open space required for the proposed design. The proposed dwelling consists of Velux windows which would need clear roof space to be installed. By using traditional rafters and binder the structure would take up a large amount of the roof span preventing the necessary space required for the installation. As well as this, any additional strengthening from collars would also restrict access to these windows. An open king post truss construction would give ample space for the windows and would provide additional aesthetic characteristics.

In addition to the structure, the roof will be finished with metal profile sheets covering the OSB sheathing boards. OSB boards can be produced in large quantities and delivered directly to the site, leading to faster a construction time. OSB boarding is stronger and far more dense than plywood making it a better option in conjunction with profile sheeting. Although all OSB sheathing comes with a water-resistant covering, this does not completely prevent water damage or swelling to any new edges on the boards, therefore it requires careful handling throughout installation. A metal profile sheeting overlay should prevent excess rain load on the roof and minimize any potential swelling of the OSB sheathing. There are several variations of metal profile sheets including the option to use pre-insulated sheets. This will assist in further insulating the home and provide a thicker layer between the external profile sheet and OSB boarding.

An alternative option for the roof finish would be concrete roof tiles. Concrete roof tiles are fire resistant and have low water absorption. They also provide better defence against British weather conditions and are a considerably cheaper method. Concrete roof tiles require more manual labour to install and do not provide any additional insulation compared to pre-insulated profile sheets. Unlike metal profile sheets, concrete roof tiles do not require additional machinery to be installed. The installation of concrete tiles depends on the desired tile type. With various options available from a classic smooth tile to double roman interlocking tile. Concrete tiles are laid on the battens of the roof structure and nailed down every 4th row. Each tile overlays the next, with some tile types interlocking with the next. It isn't necessary to consider counter battens with the use of concrete tiles. Further guidance on roof structures can be found on Building Regulations, Part H.

Ventilation

As stated in Building Regulations Approved Documents Part F, it is highly important for domestic new-builds to comply with the requirements for suitable ventilation and conservation of fuel power (Welsh Government, 2013). Correct ventilation is imperative in all buildings. Without proper ventilation throughout the building, it is likely the internal structure will be subject to interstitial condensation; this can lead to very expensive restoration works later on.

Condensation on a timber frame construction can lead to rotting of the wood and eventual decomposition of the structure. Condensation appears when warm and cold air collide on a surface. The moisture filled warm air reacts with the cool air and releases water droplets which can subsequently land on the surrounding surfaces known as the dew point. This can cause damage to construction fabrics and is especially dangerous for materials such as timber that are heavily relied on for the framework. It is vital to ensure that ventilation is considered when using a timber framework and an insulated cavity wall. Some insulation types will absorb water droplets which will turn the material soggy. PIR insulation is a better alternative over other materials such as mineral wool as it does not absorb water due to its closed cell structure (Sultanov, et al., 2020). For the proposed project the use of PIR would divert any potential condensation away from the insulation.

There are multiple techniques that can be used during construction to guarantee the ventilation is up to standard and prevent excess condensation. One of these methods would be to introduce a ventilation system or zone into the roof, below the metal profile sheet and leading out from the eaves. Introducing soffit vents will act as a vapour check in the roof and will reduce the risk of a dew point forming on the framework. This form of ventilation is a gentle form of venting used to prevent large pockets of condensation forming without causing excessive amounts of heat loss to the completed dwelling. Please see sketch Figure 1:D for details.

Conclusion

It is established that the methods of construction proposed for the single, two storey detached dwelling are sufficient and fully comply with Building Regulations Approved Document L1A. Provided are a range of suggestions for alternative construction techniques that could be utilized, as well as their advantages and disadvantages for the client to consider. Overall, the building is well designed and suited to the main purposes of a structurally stable, durable, well insulated and weather proof home.

Appendix

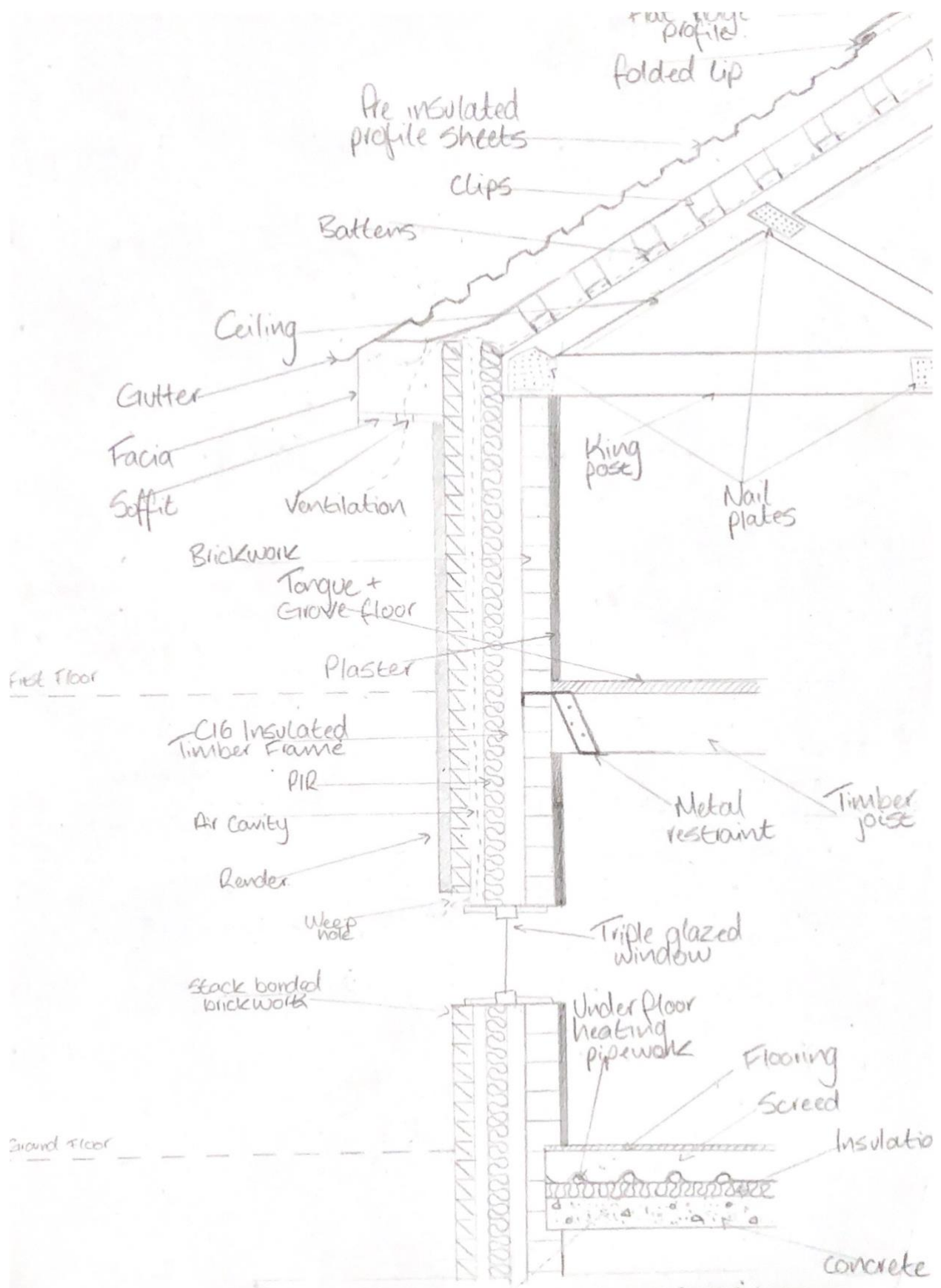


Figure 1:A

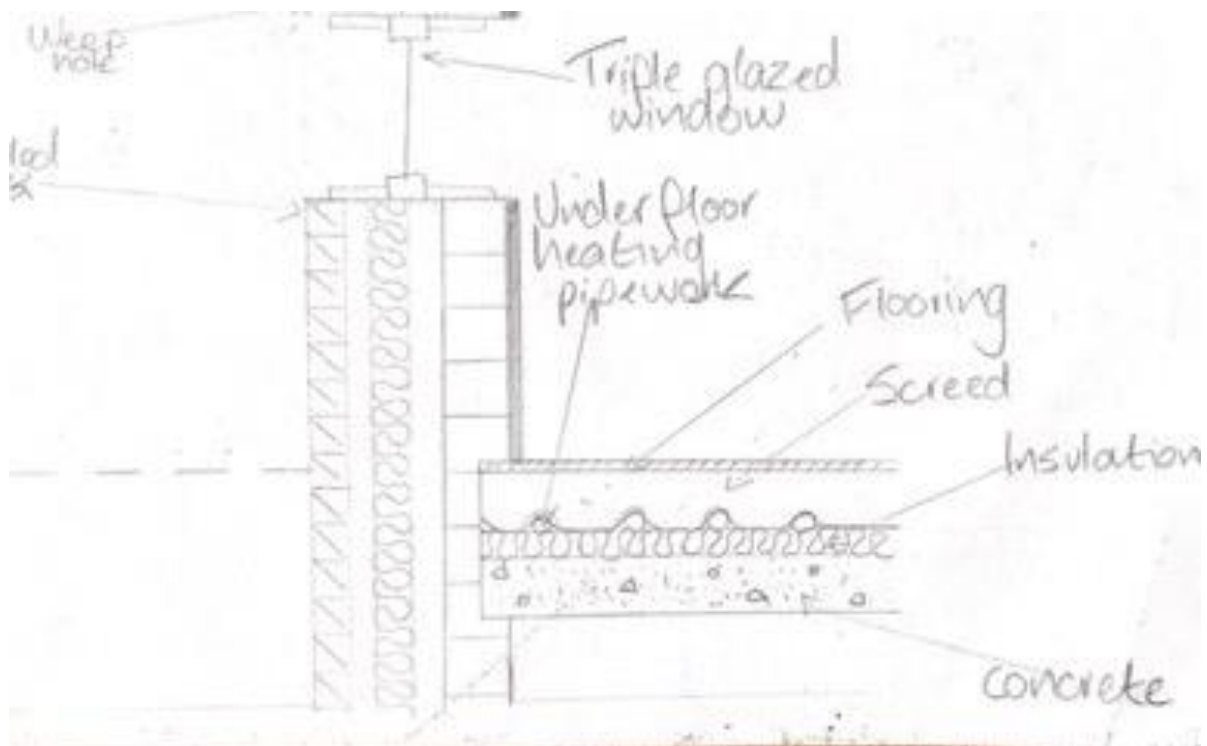


Figure 1:B

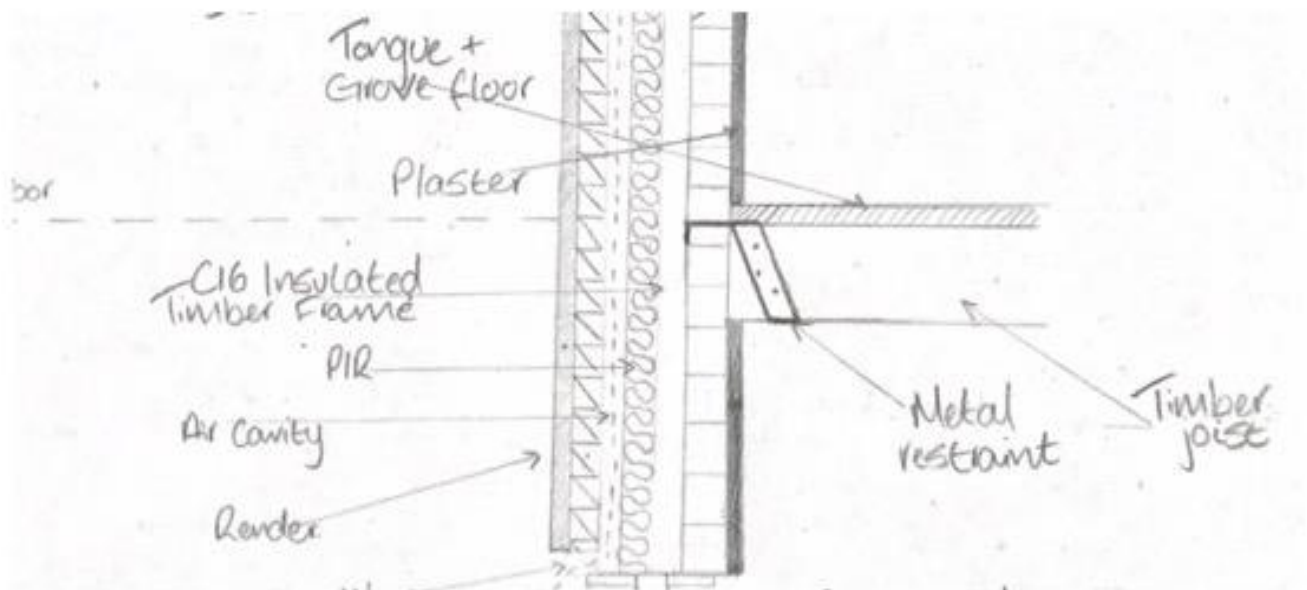


Figure 1:C

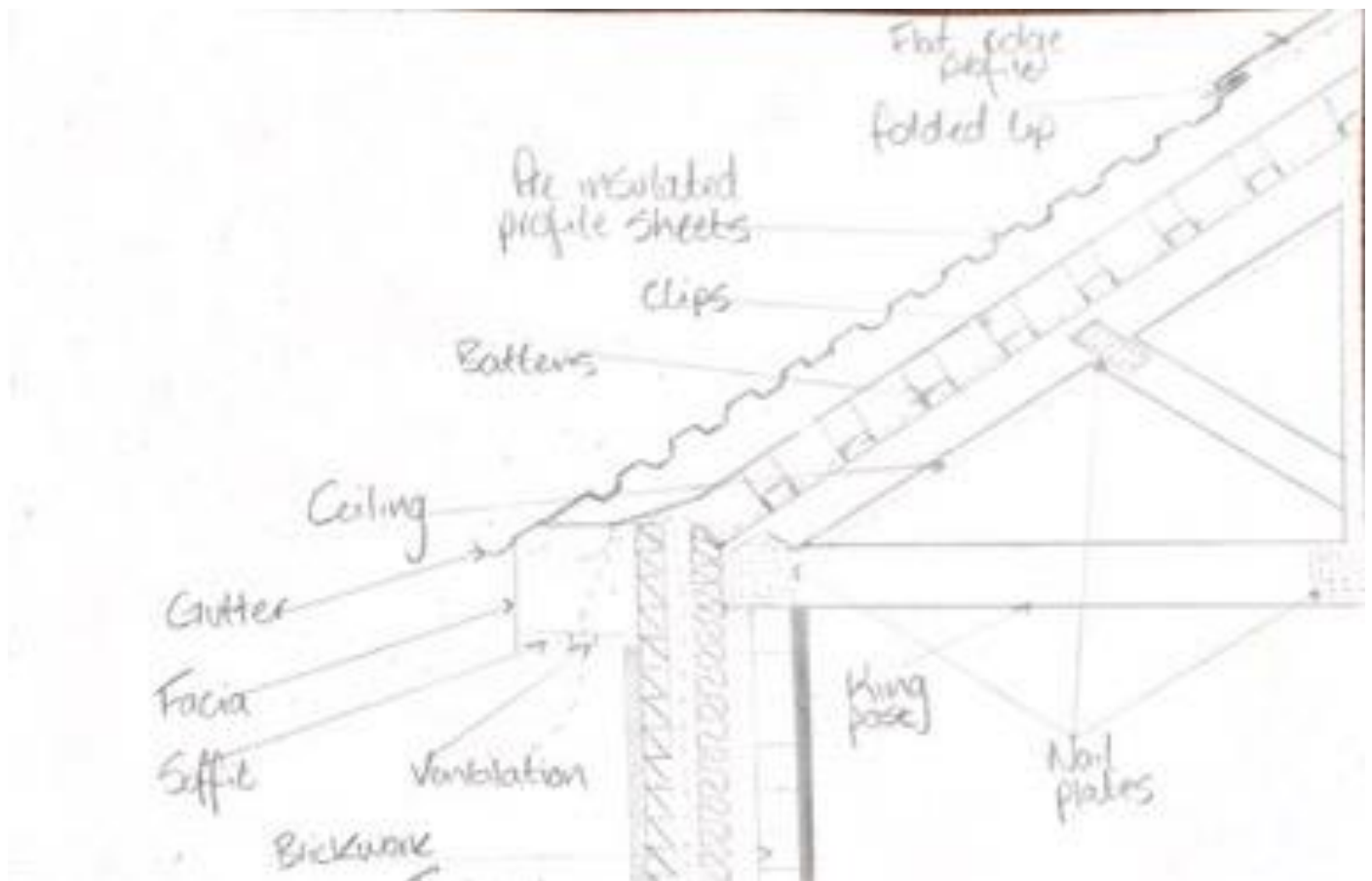
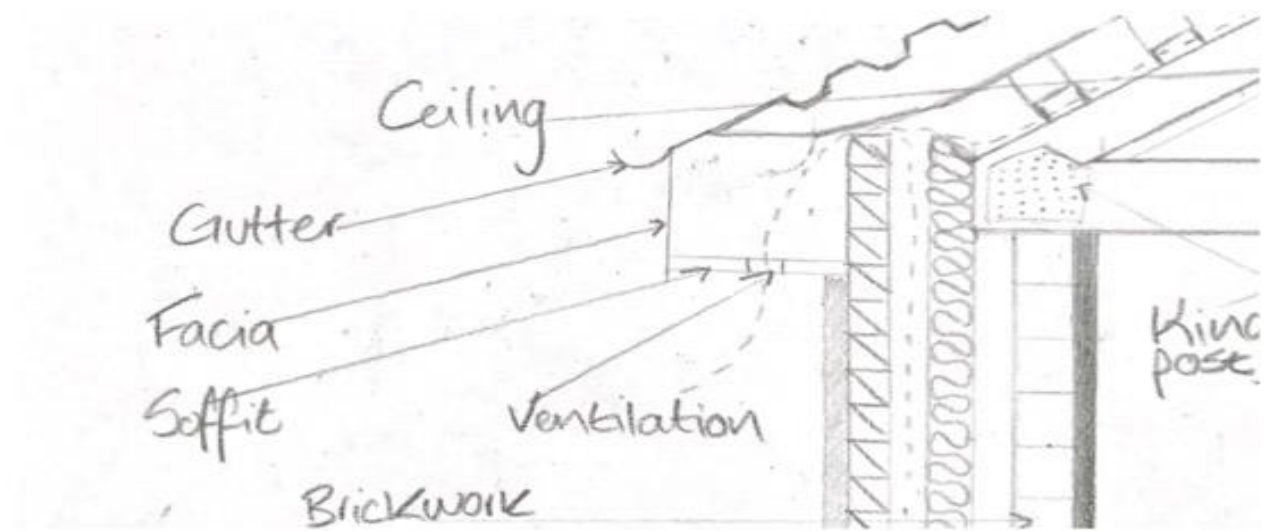


Figure 1:D



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