

Executive Summary: Desing Statement & Technical Solutions

Matters in relation to Fire Safety (*Regulatory Reform (Fire Safety) Order 2005*)

The original structure of the building before modification in the early 2000s would have required little works to bring it to an applicable standard of regulatory reform however, the building fabric of the party wall was modified by the previous owners and the adjoining building via the partial demolishment of the gable end. This not only made the structure unstable and dangerous, there was no longer a fire stop between the buildings. This reduced the capability of compartmentation via the demolition of the gable end and a roof extension between the building of 59 to 63.

Building Regulations 2010 B (Wales): Section 6: Compartmentation

6.1 The spread of fire within a building can be restricted by sub-dividing it into compartments separated from one another by walls and/or floors of fire-resisting construction.

6.7 Compartment walls that are common to two or more buildings should run the full height of the building in a continuous vertical plane.

Due to the lack of compartmentation between both buildings, and the open area where there is plenty of oxygen and fuel sources to engulf both building in little to no time to form an effective means of escape. There is a high chance that all persons staying in both properties will succumb to fire related death should such event occur. To reduce the likelihood in line with legislation and regulations, the building must have the following in addition to the above:

Building Regulations 2010 B (Wales): Section 9.1 Provisions are made in this section for the external walls of the building to have sufficient fire resistance to prevent fire spread across the relevant boundary.

Unfortunately due to the lack of wiliness of the adjoining property given reasons of historic 150 year old shop shelves, there is no disposition to address urgent structural issues and it's impossible to resolve as a civil matter for now 3 years. This alternative resolution of building another gable end in front as, the parties belonging to number 59 have refused permission and willingness to rebuild the failed party wall between both building and taking into account they are listed as local historical importance, there is no feasible and economical way of supporting both buildings without running the risks of the structures collapsing into the highway and the low risk controlled option of building another party wall alongside outweighs any objections and both parties and the community will benefit of retaining a buildings of local importance.

The safest and viable solution will be to excavate the old tradesman's entrance being the alleyway between 59 (servient tenement) and 63 (dominant tenement) and design a foundation with C40 structural concrete and 9" flat blocks to run the full height of the building in a continuous vertical plane. This not only will allow retention of the ally way, it will provide the building with structural support that can save both buildings of historical importance with the added benefit of being compliant with the requirements of Fire Safety order 2005 to reduce the likelihood of fire or smoke spreading between both section of the building with the capability to resist fire and smoke in excess of 60 minutes and keep its structural properties. Also, complying with building regulations Wales

2010B Section 9.1, 6.1,6.7 and further. This was the end solution of structural Engineers and builders that were consulted and is the most feasible, economical and practical way of resolving the technical issues and reduces the associated risks with the buildings.

The building will also be sub divided into the original building blocks being the forward section, and the aft section of the building. The previous owners of the building demolished the mid section between two large fireplaces and thus caused a further issue with the building. The same metric has been designed and used to reduce the likelihood of fire spreading between both section of the building with the capability to resist fire and smoke in excess of 60 minutes and keep its structural properties.

Further matters in relation to Fire safety have been summarised in the table below:

Archived Fire safety obligations summarised: Likely to change and are separated documents	
Fire Risk Assessment	Conducted a fire risk assessment of the building to identify potential fire hazards, assess the risk of those hazards, and implement measures to reduce or eliminate the risks.
Means of Escape	Ensured that the building design provides adequate means of escape in case of fire, including appropriately designed exit routes and fire exits. Action plan ready to regularly inspect areas of escape and means of successfully compartmentalising smoke and fire.
Fire Detection and Warning Systems	Planned to install a L1 system throughout the building and sub dividing into zones. The system was designed with a maintenance contract to fill our obligations for fire detection and warning systems, such as smoke alarms, fire alarms, and emergency lighting, in accordance with said regulations.
Fire-resistant Construction	Enhanced use of fire-resistant materials and construction methods in certain parts of the building, especially in areas where the risk of fire spread is higher has been addressed in excess of 60 min for smoke and fire. The removal of previous building materials has been being removed for inert materials where possible.
Compartmentation	Implemented compartmentation measures to prevent the spread of fire and smoke within the building subject to Building Regulations 2010 B (Wales): This included the wall between both 59+63 and rear buildings that can prevent smoke and fire in excess of 60min. Further compartmentation has been accomplished in the design specification and there is sufficient fire guard of 60min between suits in the building and further between both buildings. The design includes automatic

	shutting of ventilation systems and opening of the sky hatch to reduce smoke on the stair way.
Fire Doors and Exits	The design of the fire doors on each suite will provide 60min protection from fire and will be correctly installed and maintained, and that exits are easily accessible and not blocked. There will be CCTV in the common areas and any offending party will be told to remove said blockages or will be reprimanded for holding a fire door open with a fire extinguisher.
Emergency Planning	Developed a plan based on successful previous works with Swansea CC and Wales and West Fire and Rescue these emergency plans, including evacuation procedures, and ensure that building occupants are aware of these plans before use and suitable signage in key locations.
Fire Safety Training	Plans in place to provide fire safety training for building occupants, including regular drills to ensure everyone is familiar with evacuation procedures. This is vital as occupants need to know what is acceptable and what is not acceptable and a risk to life. This has previously proven effective with foreign occupants undermining fire safety in Swansea.
Accessibility	With intention not to discriminate between persons with hidden or undeclared disabilities to ensure they can safely evacuate the building in case of fire. Flashing beacons will be used in every room and suite D will have a multi spectrum alarm and call point to a person on duty that can assist with the evacuation of the building.
Record Keeping	Digital records and written records of maintenance will be visible in common areas these will provide everyone with records of fire safety measures, inspections, and tests conducted in the building.

Urgent works needed due to settlement and failure of the party wall

The buildings being of 59-69 redevelopment is critical due to the failure of party wall subjected to differential settlement. The party wall was subject to load transferring from overlaying beam, which was difficult for the soil under the wall with small step footing area of foundation to bear the load. Figure 1 show the failure of the party wall.



Figure 1. Differential settlement of the party wall

The new proposed plane is to remove the load from party wall and transfer it to newly constructed gable end Wall using 6" 10n blocks laid flat to form a 9" wall. The load is being transfer through two 9.5 m long simply supported steel beam having maximum bending moments of 111.86 KN-m. Figure 2 show the proposed plane of gable wall. Figure 3 show the locations of steel beams transferring the load to gable wall.

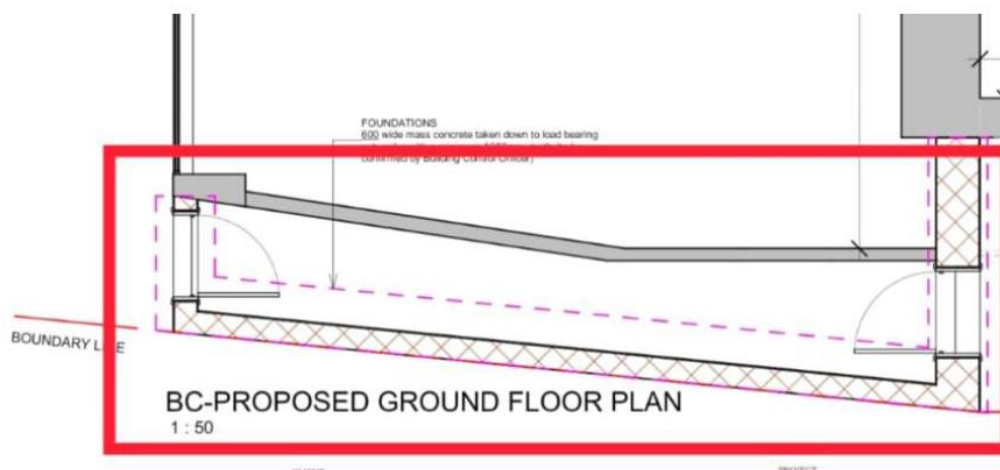


Figure 2. Proposed plane of gable wall and underneath footing

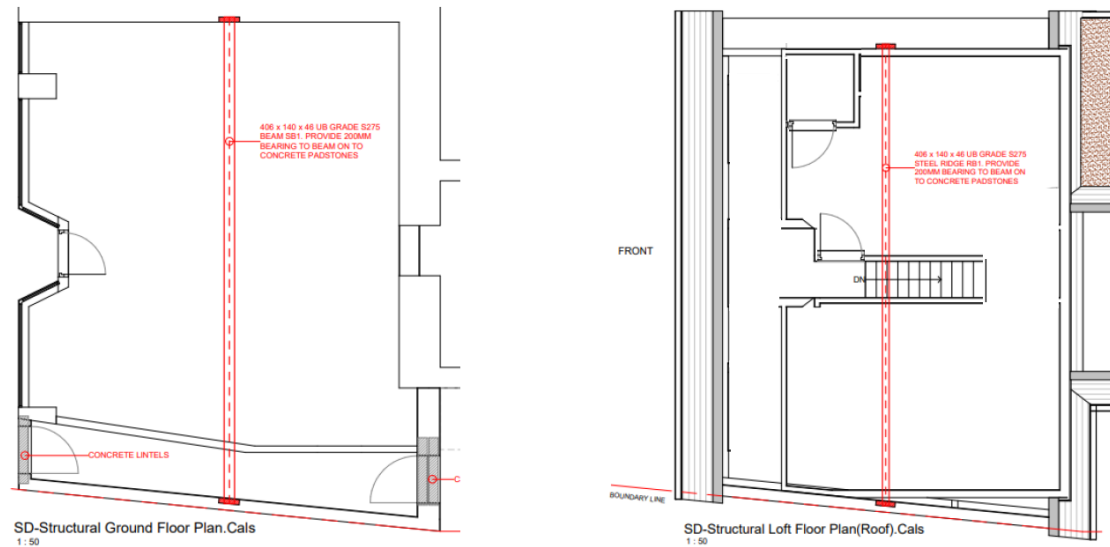


Figure 3. locations of steel beams transferring the load to gable wall

To prevent the gable wall from producing identical outcomes of differential settlement, the footing is needed to be design with more care. The proposed footing for this project is 7.5m long, 0.735-1.02m wide, and 1 m deep wall footing under gable end with concrete C40 Structural (RC32/40 Material code 39250, cement CIIIA) and Fibrin XT fibers at the dosage of 0.9 kg/m³. Figure 5 show the dimensions of proposed footing.

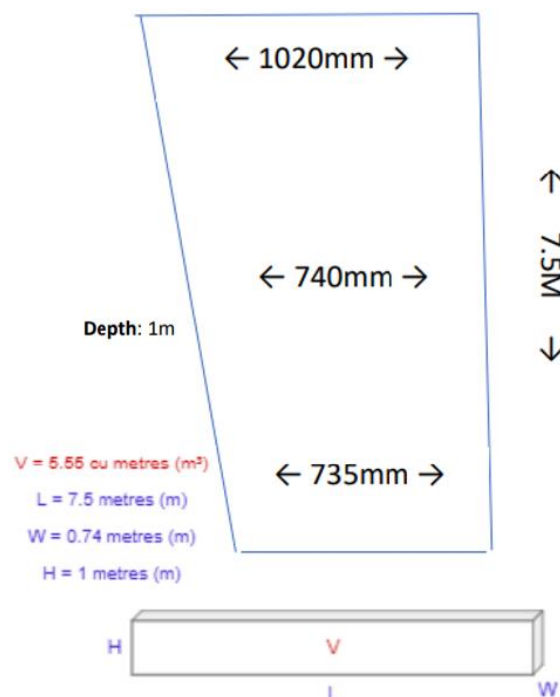


Figure 4. Dimensions of proposed foundation

The design objectives were to evaluate the proposed foundation's performance and safety under the specified loading conditions.

Structural Analysis

The Analysis was conducted using linear and non-linear Finite Element Analysis. The material properties, loading from steel beams, and boundary conditions are discussed below:

Material properties

The footing for this project is 7.5m long, 0.735-1.02m wide, and 1 m deep wall footing with concrete C40 Structural and Fibrin XT fibers. Table 1. Show the Calculated and assumed properties of Concrete used in foundation. Table 2. Show the properties of Fibers used.

Table 1. Properties of C40 concrete.

Concrete	Specifics	Elastic Modulus	Poisson's ratio	Stress-strain curve in Compression & Tension
C 40	RC32/40 Material code 39250, cement CIIIA	30 GPa	0.3	

Elastic modulus of C40 is calculated using BS 8110: Part II 1985 equation $E_c = k_{0.2} + 0.2 f_{cu}$, Poisson's ratio is assumed to be 0.3, and stress- strain curve is obtained from Mander's model and tensile as per minimum modulus of rupture recommended by British standards.

In all kind of footings, there will always be flexural stresses in the cross-section. To resist flexural stresses, we needed some minimum tensile capacity to cater these stresses no matter what the size of cross-section we are using. If the tensile capacity is zero, which in real is not the case, the footing will always fail with any size of cross-section.

In Performance-based evaluation of proposed footing, incorporation of minimum modulus of rupture (as tensile capacity) in stress-strain was mandatory for taking tensile stresses generating due to flexural loads. The use minimum modulus of rupture can also be considered reasonable due to addition of Fibrin XT fibers that will show some sort of bridging action in

concrete mix. Although, manufacture has clear declared that the use of Fibrin XT fiber will only be used to control creep and shrinkage issue and will not give additional stress. In short, footing will always give failure if we strictly compile to code but in performance-based design, that will more accurately mimic the actual behaviour, can allow us to use the proposed size and material characteristics for given set of loadings.

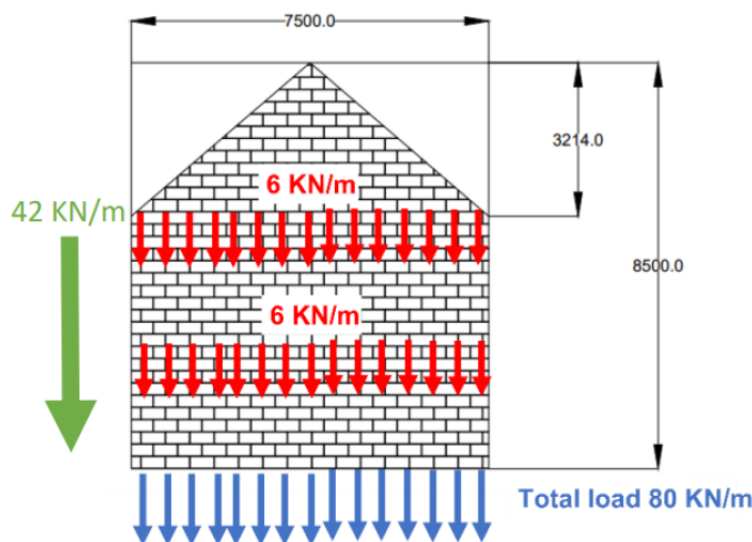
Table 2. Properties of Fibrin XT fibers

Fibers	Type	Specifications	Dosage
Fibrin XT	polypropylene monofilament	22 µm dia 13 -19 mm length	0.9 kg/ m ³

The shrinkage, creep, and thermal stresses in concrete are another reason why the code advises to use minimum amount of steel reinforcement. The problem is also disregarded with use of Fibrin XT fiber that will control the thermal, creep and shrinkages changes in concrete.

Loading on footing without considering the additional transfer measures

The total load on the footing will be the load of wall constructed using 6" 10n blocks (unit weight of 22 KN/m³) and the load through two steel beams. The calculation of the total load is as following:



$$\begin{aligned}\text{Load of wall} &= 0.225\text{m} \times 8.5\text{m} \times 22 \text{ KN/m}^3 \\ &= 42 \text{ KN/m}\end{aligned}$$

$$\begin{aligned}\text{Load from steel beams} &= 2 \times \left(\frac{112 \times 8}{9.5 \times 2 \times 7.5} \right) & : \text{Maximum bending moment} &= 112 \text{Kn-m} \\ &= 12 \text{ kN/m}\end{aligned}$$

$$\text{Total load on footing} = \text{FoS } (42+12) = 1.5(42+20) = 80 \text{ KN/m}$$

Finite Element Analysis

Most of these processes are described using Partial Differential Equations (PDEs). To solve these PDEs numerical techniques have been developed over the last few decades and one of the prominent ones, today, is the Finite Element Analysis. A numerical technique that cuts the structure of an object into several elements, and then reconnects the elements at points called nodes. The FEM creates a set of algebraic equations which engineers, developers can use to perform finite element analysis.

For the analysis of this foundation the linear FEA on CSI SAFE and Non-linear FEA on ABACUS is performed with given material, boundary and loading conditions.

The linear analysis was performed on commercially used software CSi SAFE version 2016. The analysis was conducted by modelling the geometry of the footing. The material for C40 was defined as per the properties defined in the Table 1. The loading of the footing was applied on the footing modelling the load as static uniformly distributed load. The bearing capacity was assumed to be 200 KN/m² and the soil was modelled in the software by providing modulus of subgrade corresponding to 25mm deflections as recommended by BS standards.

The nonlinear analysis was performed in ABAQUS. The profile and geometry of the foundation was initially defined. The nonlinear material model was defined using the concrete damage plasticity (CDP) for both compression and tension. The CDP parameters are summarized in table 4 and 5.

Table 4. Parameters of CDP model

Dilation angle	Eccentricity	f_{bo}/f_{co}	K	Viscosity parameters
40	0.1	1.16	0.667	0

Table 5. The plastic parameters of CDP

COMPRESSION CONCRETE PLASTICITY MODEL (CDP)					
σ_c	ϵ_c	d_c	ϵ_{oc} elastic	ϵ_{oc} inelastic	ϵ_{oc} plastic
0	0	0	0	0	0
26.87966637	0.001075129	0	0.001075129	0	0
39.07290547	0.002689569	0	0.001562832	0.001126736	0.001126736
38.28855753	0.003108618	0.020001	0.00153146	0.001577158	0.001545902
36.85088465	0.003851153	0.056798	0.001473956	0.002377197	0.002288437
35.15593951	0.004373266	0.100181	0.001406162	0.002967104	0.00281055
33.52688949	0.004814526	0.141876	0.001341004	0.003473522	0.00325181
31.44066546	0.005468998	0.195273	0.001257559	0.004211438	0.003906281
29.94025157	0.006020469	0.233677	0.001197546	0.004822923	0.004457753
12	0.007	0.692859	0.000479974	0.006520026	0.005437284

TENSION CONCRETE PLASTICITY MODEL (CDP)					
σ_c	ϵ_c	d_c	ϵ_{oc} elastic	ϵ_{oc} inelastic	ϵ_{oc} plastic
0	0	0	0	0	0
3.5	0.000138942	0	0.000139992	0	0
0.146793519	0.001469832	0.958058995	5.87143E-06	0.001463961	0.00132984

Alongside, the soil profile was also modelled in ABAQUS by using the parameters defined in table 3. The soil was assumed to be uniform to a depth of about 1m. The soil was assumed to be dry and the water table being way below the surface. The loading was applied on the footing as described above in section 5.2. The load was applied as static, and the model element was kept as 3D stresses. The non-linearity was considered using meshing at a distance of about 100 mm

Conclusions

A detailed linear and nonlinear FEA was conducted on a footing and from that following conclusions were made:

The footing is safe with given gravity loads applied from the wall and beams.

- The footing can support the applied gravity load with additional double factor of safety. Which means if loads exceed the considered value (80KN/m) then members like steel beam will fail but not the footing.
- As per moment demand and moment curvature curves the footing is safe against gravity load by considering the tensile capacity of concrete

- The footing constructed is not as per code guidance as it recommends the minimum reinforcement for this case, but however considering a minimum of 3MPa tensile capacity of concrete this gravity load can easily be resisted.

Recommendations

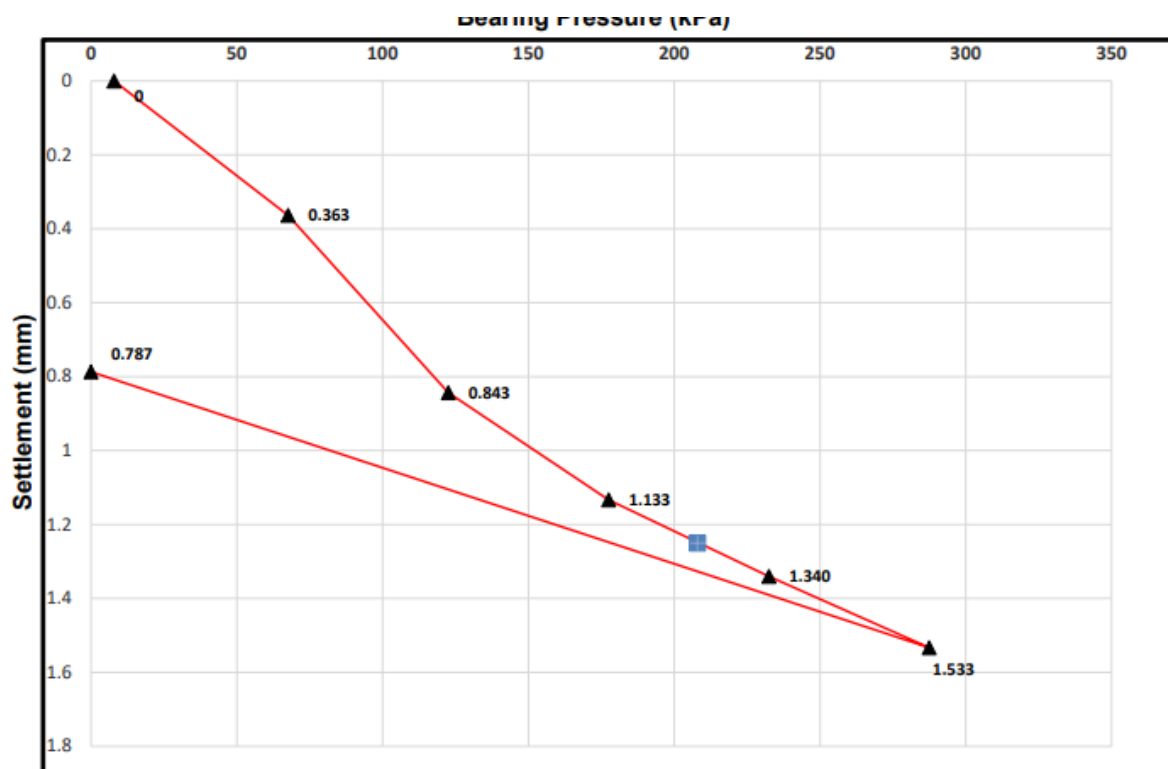
The footing is safe under given condition, however following recommendations are proposed to the client.

- Detailed geotechnical and material testing shall be conducted to ensure that the values are greater than those assumed in this investigation. Also, if the values are lower, then footing may be vulnerable to failure and should be redesigned

Additional Testing

This was undertaken by GSTL a UKAS testing lab. 2788

 GEOTECHNICAL SITE & TESTING LABORATORIES	Determination of the Vertical Deformation Tests BS 1377: Part 9: 1990 Clause 4.8	Contract Number	66559
		Client Reference	0
Client	RAPID IT	Test Date	17/05/2023
Site Location	63 Heol Cae Gurwen, Gwaun Cae Gurwen, Ammanford, Neath Port Talbot, SA18 1HG	Test Location	Plate 1
Soil Description	Brown silty sandy fine to coarse GRAVEL	Test Depth (m)	GL
		Kentledge Type	Tracked Excavator



Maximum Applied Pressure (kn/m ²)	287.48
Maximum Deformation (mm)	1.53
Plate Area (m ²)	0.07163
Modulus of Subgrade Reaction (k762)	73.9 (kN/m ² /mm)
CBR Value	11 (%)
Assumed Poissons Ratio	0.25
Remarks	

CBR Values calculated in accordance with Highways Specification Document IAN 73/06 at the pressure at 1.25mm settlement

Test Operator	Checked and Authorised by		Shaun Thomas	
Ashley Davies	Date	30/05/2023		



The soil bearing capacity shows that the footings can hold the gable end without additional measures to distribute the loads, no further action is required as the Abaqus report shows little to no sign of stress and sufficient.

This solution was the only possible way of saving both buildings of historical importance to keep as much of the character as possible. Should the buildings be not of historical importance then, the design of the building would have been different being the demolition of the existing gable end of the party wall and new footings and a new gable end. This action would have destroyed the property original features

Visual Desing

Front facing views.

Windows

The front of the building has changed visually in the last 25 years, being its original Georgian style sash windows being replaced by single plain windows that were economical at the time are badly damaged and rotten beyond repair and salvage. An effort will be made to recover as many glass shards as possible and use it internally in the building as a design feature. To improve the visual appearance of the building from the roadside, the sash windows can be restored to the building to retain the original period with A+ rated glass to improve the thermal efficiency and safety and an internal guard rail to prevent slips and trips from the window internally. See below:

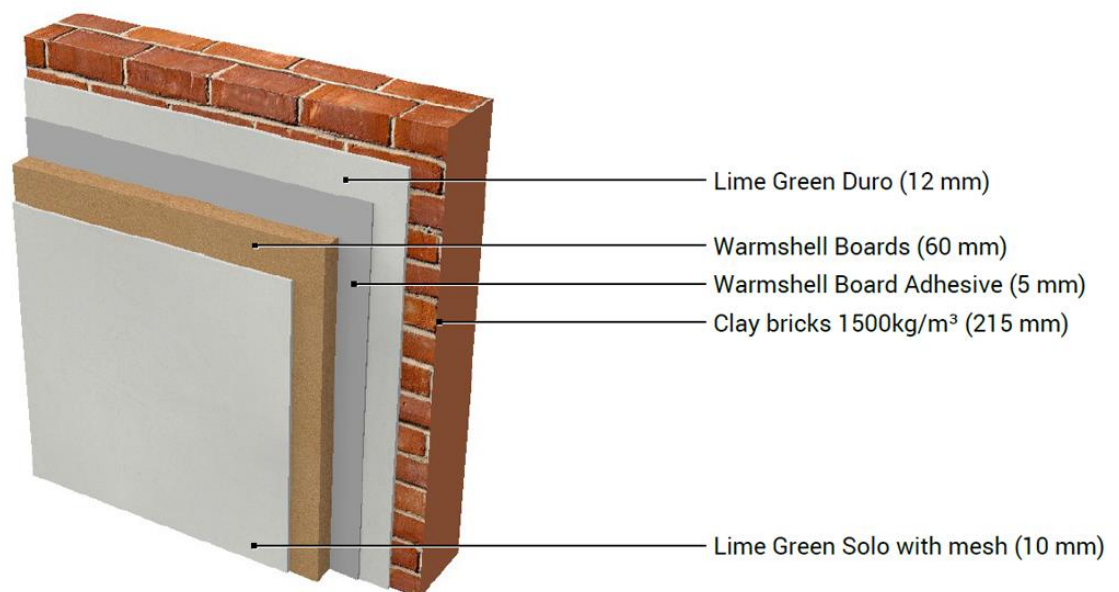


Rendering

The cracked front concrete render of the building is not the original render and was replaced by a concrete render in the late 80's and thus has not allowed the kiln-dried bricks to breathe and has historically held water. The proposed alternative is to restore it back to brick and repoint the render and lime wash the building back to white. The lime wash will protect the bricks from the elements and help the building breathe and will reduce the likelihood of damp. This hydrophobic material prevents water absorption, ensuring that the walls remain dry and free from water damage.

Another alternative has been considered, with regards to exterior insulation however it will damage the external appearance of the building and will be a future option when the technology will allow the materials to insulate the building without damaging the visual appearance of the building. Therefore another proposed technical solution has been identified from insulation within the building.

Internal post lime washing will use a Warmshell insulation, this system of woodfibre board and Solo lime plaster is suitable for solid-wall masonry. The breathable system uses natural materials that will maintain a healthy internal climate. The Woodfibre Internal Wall Insulation System is designed and tested to allow solid walls to stay dry, while offering modern levels of insulation and ease of application. The boards are in thicknesses of 100mm and are applied with Warmshell Adhesive to the flat surface and the Solo plaster is applied in two passes with and embedded fibre mesh. (see the illustration for internal space)



Key benefit explained: U Values w/ m2k

U Values are a number showing how much heat 'leaks' through an element like the floor, the roof, or a wall and in this case the external wall not facing the sun. The lower the number the better, however it's not reasonably practical to reach zero. This proposed material will add and improve the thermal insulation and reduce the energy required to heat the building and the retention of heat. This proposed material will allow the traditionally built building to breathe and reduce the likelihood of damp. The table below demonstrates the benefits of the system.

Proposed Warmshell Woodfibre board thickness
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9" brick wall	U value	1.65
	% Improvement	0%
9" brick wall with +100mm of proposed materials	U value	0.32
	% Improvement	80%

This proposed solution will increase the thermal efficiency of the building without the need of external cladding and change the front features and look of the property, keeping it to original specification as possible to enhance the character of the area.

The below example is the intended original look of the building with the original natural hydraulic lime render:



Visual facia (front)

The front of the building currently has a rare surviving 18-19th century front face that has been modified over the history of the building and damaged. The intention is to restore the building to match the building next door, replacing existing rotten plywood covering a previous layer of wood work with the original features.

The building is currently being protected by a temporary metallic shutter to protect from the elements and further criminal damage. This will be removed at the final phase of the building when the front facia will be restored to drawings as found on St Teilo Street, Pontarddulais.

(photos redacted due to copyright and GDPR)

Visual facia roof (Street facing)

The roof previously benefited from a Welsh slate roof that was removed in the early 2000's by the previous owner and was subject to enforcement and replaced with concrete Marley roof tiles that were too heavy for the construction fabric of the building. It is proposal would restore the beauty of the building and keep the historic ethos of the building.

Visual facia Side (visible from street level)

Original materials sourced from doner buildings.



Externa Dormer extension (Rear)

In order for the proposed changes to blend in with the buildings character, it is proposed to use the same materials as original dormer extensions would have been developed. This will involve the blending of Welsh slate matching the roof.



The rear Dormer windows will benefit from the same style of windows pictured and used in the front of the development. Note the front and side of the building will be rendered using natural hydraulic materials not tiled like illustrated.

Front facing Victorian shop

Keeping the building external fascia as original as possible using traditional materials. The existing Victorian shop front will be fully restored to match the rare surviving example of early Victorian shop fronts.

The front of the existing shop was damaged in the early 90's by the previous owners in attempt to modernise the building. This damaged the character of the building and it lost its cultural heritage from the building next door being the shop of 59.

Through extensive research and sourcing, the missing façade from a similar property can be carefully sand blasted and varnished to match the lost original features of the shop front. (see below images of perspective doner parts for the missing sections of the building)



All internal cavities from the façade will be filled with a fire stop material such as a Intumescent Acoustic Mastic, a one-part intumescent acrylic mastic for sealing gaps around fire doors, this will

both prevent fire from the internal spaces and prevent the spread of fire, it will add an acoustic benefit to reduce sound waves and noise to inside the building.

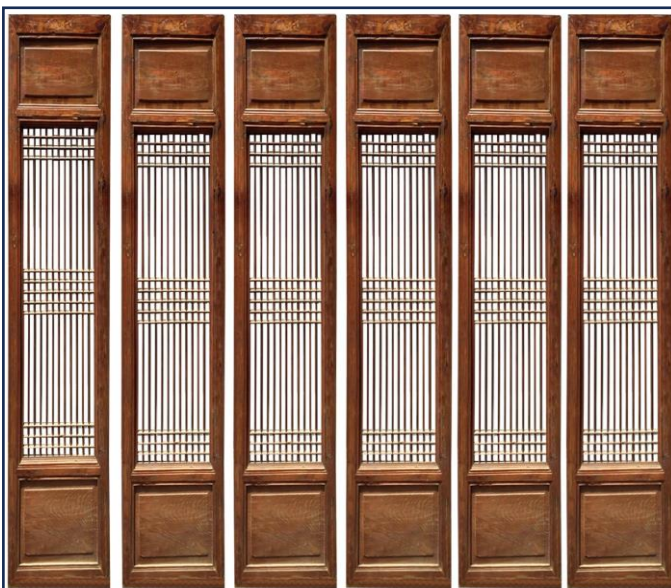
Views from shop window to internal

The existing glass was recently damaged within the last 5 years of being an unoccupied building, the proposed change will be a like for like replacement with a change to enhance the U level to reduce the loss of heat with A rated windows by rebuilding the internal frames. These windows will have a removable frosting to blend with the building as not to appear freshly glazed.

Following the rebuilding of the internal frames, the inner view will compromise of plantation blinds similar to the original Victorian louverett window shutter screens. These will ensure that privacy is maintained and there is sufficient natural light and will be floor standing.



This will restore the character of the building to the original specifications, see illustration of the original shop period window blinds from the external view.



see illustration of the original period window blinds from the Internal perspective.



See the original period window configuration with the original canopy and pillars that survived until 1967. Note, this photo does not show the left hand door or the adjoining chapel now demolished or the tradesman's entrance in the now alleyway.



Vehicle car park

The existing car park layout as defined by the SPG parking document will stay as is however, should the car park be damaged beyond repair during the construction phase then, these plans will require separate approval by the Councils Engineering Service acting in its SuDS Approving Body (SAB) before any work begins.