

RICS CPD DAY PERTH

25th February 2016

Presentation by
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Smith & Garratt

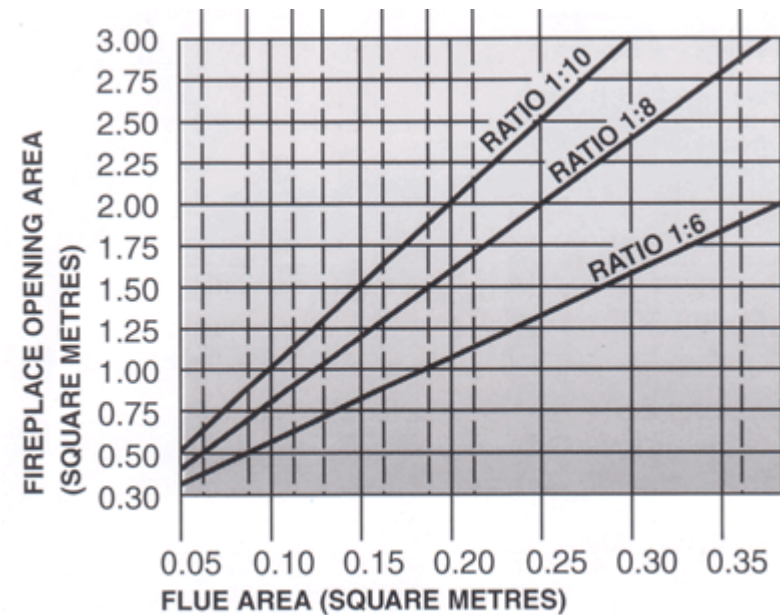
Maintenance and Repair of Historic and Listed Buildings

Today

We're going to look at the dozen most common areas of defect found in traditional buildings, plus a couple of specialist ones, and then talk through a case study on planning and procuring masonry works.

We don't have much time, so I will only give you the headlines for each topic and I'd like you to stop me whenever you want more detail, or ask questions at the end.

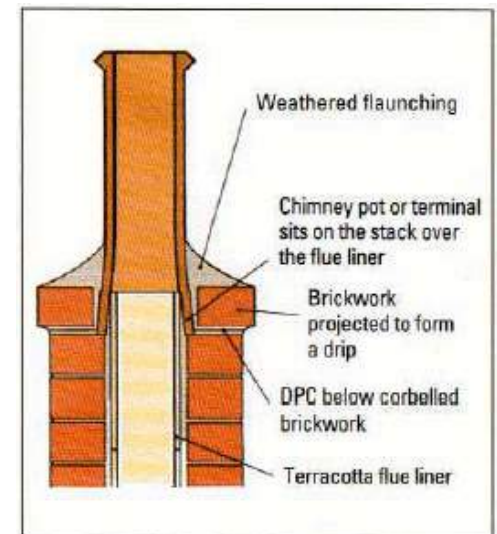
Fireplaces & Flues



Use ratio 1:6 for standard open fires with minimum flue height 4.50 metres.

Use ratio 1:8 for standard open fires with minimum flue height 6.50 metres.

Use ratio 1:10 for open fire with canopy, minimum flue height 6.50 metres.



Lead and Copper Work

- Mainly roofing, mainly rolled sheet.
- Flat roofs are not flat; minimum 3° slope.
- Coefficient of linear expansion at 20°C (10^{-6} K⁻¹) for lead is 29, copper 17 (compares with quartz 0.3, water 69).
- These materials **MUST** be allowed to move, so bay size is **CRITICAL**, as is a suitable underfelt slip-plane.
- Flat roofs must be either ‘vented cold roofs’ or ‘vented warm roofs’, the common factor is ... ventilation ... or interstitial condensation will arise.

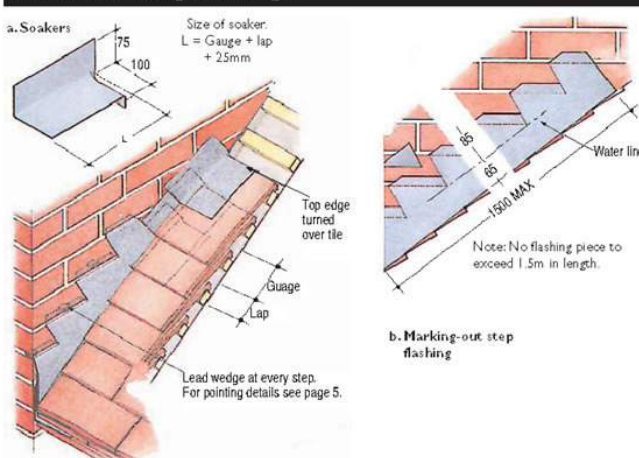
Maximum Recommended Sizes of Sections, Bays and Panels

Oversizing may cause failure. Compare sizes with this chart and page 3 Key to Uses

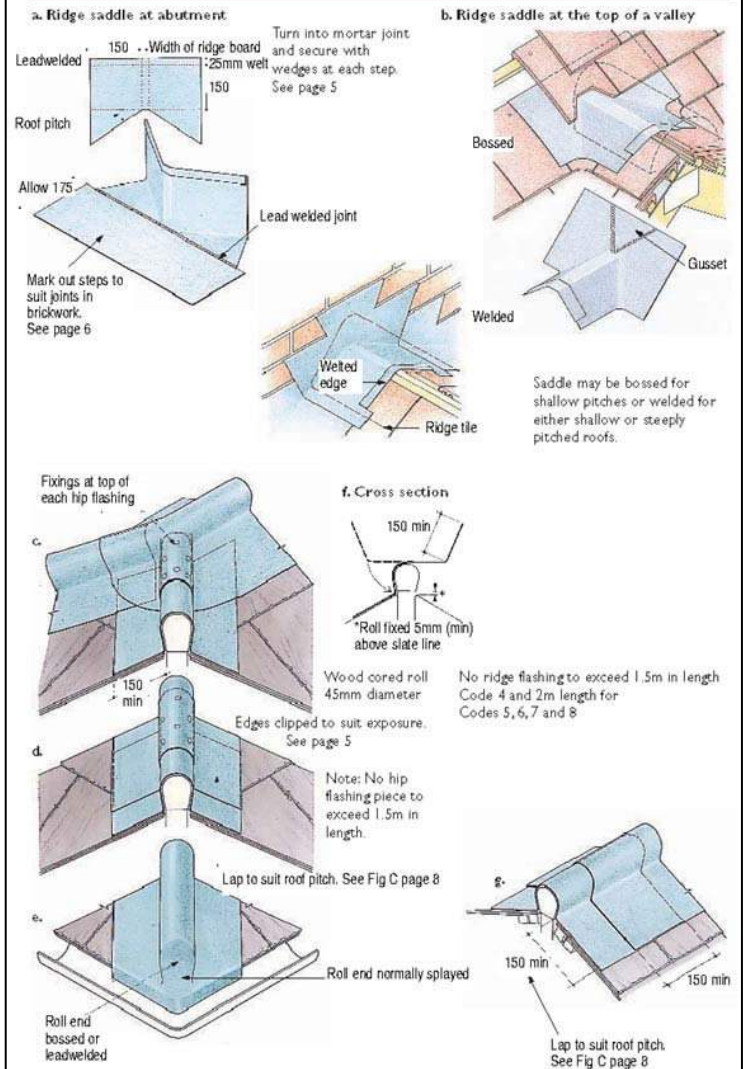
BSEN 12588: 2006	Code Number	4	5	6	7	8
		mm	mm	mm	mm	mm
FLAT ROOFS 10° or less						
Maximum spacing of joints with the fall		500	600	675	675	750
Maximum spacing of drips		1500	2000	2250	2500	3000
PITCHED ROOFS 11° to 60°						
Maximum spacing of joints with the fall		500	600	675	675	750
Maximum distance between laps		1500	2000	2250	2400	2500
PITCHED ROOFS above 60° and up to 80°						
Maximum spacing of joints with the fall		500	600	675	675	750
Maximum distance between laps		1500	2000	2250	2250	2250

The Lead Sheet Association

Soakers and Step Flashings



Ridges and Hips





Architectural Metalwork & Galvanic Corrosion

ALWAYS maintain rainwater goods.

Galvanic corrosion occurs when two dissimilar metals are electrically connected in a conductive environment. The more noble metal becomes a cathode, and is protected, whilst the more active metal becomes an anode and its corrosion is accelerated. This is particularly important to the conservation of wrought iron. Wrought iron is generally early – it has not been made for years – and is generally to be preserved. Repairs made with more noble metals, such as modern irons or steel, accelerate its decay ... so DON'T!

Where wrought iron must be repaired using a modern iron, introduce a sacrificial anode – anodic to both metals – such as zinc.

Exterior Paintwork

Consider ‘micaceous iron oxide’ for metalwork, especially cast iron gutters and down-pipes.

Paint for exteriors should be breathable and flexible. In order of preference:

- Timber – linseed-based paints, wood stain (such as Solignum), or technical system (such as Johnstone’s Storm Shield)
- Masonry – lime-based paints or technical system (such as Keim)

Slating and Tiling

Pay attention to:

- Pitch
- Head-lap
- Support - sarking v battens; tilting fillet
- Underlay and under-easing
- Margins
- Nails



Scotch slate – graduated beds, one copper nail per slate, laid on sarking
... should last 250 years.



Wet Rot

- Usually *Coniofora Puteana* fungus, requires 43% moisture. Dooks, window sills and jambs, end grain. Soft. Cracks follow the grain.
- There are other wet rot fungi ... and there are harmless fungi.

Dry Rot

- Fungus *Serpula Lacrymans*. Origin – Victorian plant collectors. Likes food and water in cool, still pockets; hates ventilation.
- Mycelium can grow at 4mm per day; 1 metre per year is normal.
- Fruiting body can emit 800,000,000 spores per day!
- Usually visible and detectable by smell. Breaks down cellulose, timber shrinks and cracks into cubes.
- ALWAYS THINK VENTILATION



Wood-Boring Insects ... and bats

- Common Furniture Beetle makes a 1-2mm diameter round flight hole.
- Death Watch Beetle makes a 2-3mm diameter round flight hole.
- House Longhorn Beetle makes a 6-10mm oval flight hole.
- Look for dust and dead insects.
- Treat with organic solvent or paste. Treatments don't last forever!
- All bats are protected. Bat droppings crush to dust whereas mouse droppings do not.
- If present, treat timbers when bats are active and specify bat-friendly materials.



Reading Cracks (including subsidence)

- Expansion – water content, freezing, rust, sulphates, vegetation
- Contraction – ‘fresh’ concrete, calcium silicate
- Shrinkage – roots, clay and peat, ground water, timber decay
- Settlement – loading, compressible ground, removal of support

Cracks (cntd. 1)

- Irregular – Differential support (e.g. behind stairs or tracing flues)?
Drying out? Cavity wall failure?
- Horizontal, high up – Roof spread? Parapet failure?
- Horizontal, repeated – Wall-tie failure?
- Horizontal, one-off – Materials differential, e.g. lintels? Timber failure? Metal corrosion? Slip plane? Thermal movement?
- Horizontal, low – Slip plane at DPC? Sulphates? Thermal movement? Moisture movement? Subsidence?

Cracks (cntd. 2)

- Vertical, near corners or spaced 7-10m – Thermal expansion? Moisture-related shrinkage?
- Vertical, at junctions and risband joints – Differential settlement? Water seepage?
- Vertical, interior corners – Roof spread? Differential settlement? Removal of support?
- Diagonal, often full height – Foundation failure? Ground failure? Clay shrinkage? Removal of support below (often broken drains)? Removal of lateral support? Impact damage? Vibration?
- Diagonal, with misalignment – Rotation on slope? Landslip or heave?

Pointing and Renders ... and the use of lime

This is too big a topic for the time allowed! The essential rules are:

- Pointing **MUST** be softer than the surrounding masonry. This rules out cement-based mortars for many types of stone and brick.
- Renders should be no thicker than is necessary, should finish at a bell-cast short of the ground, should be applied in layers to keyed surfaces, and be flexible and breathable. The last two make cement-based renders unsuitable for most traditional applications.

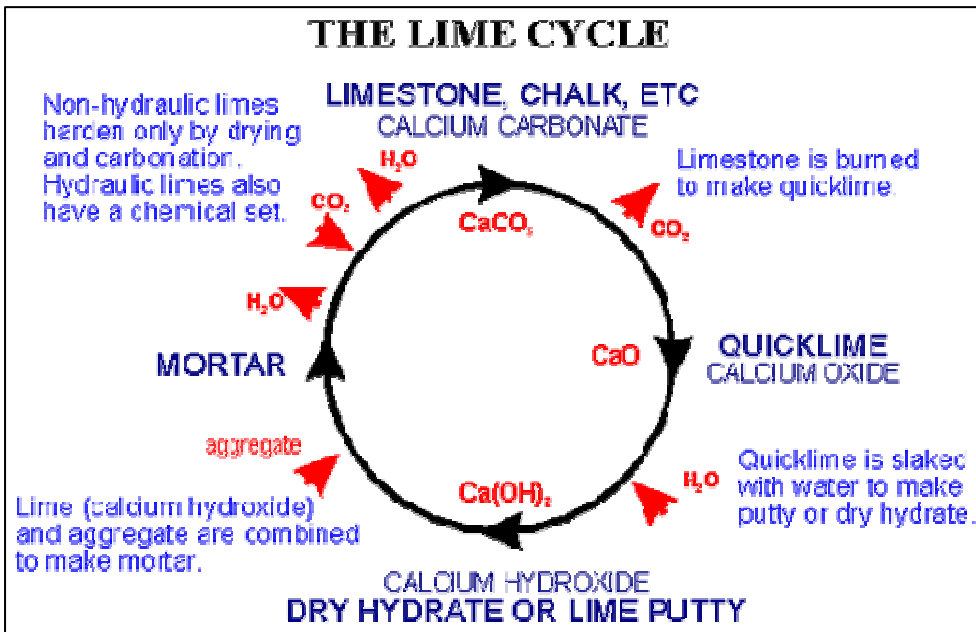


Introduction to LIME

“Lime is God’s gift to man for the construction of buildings”

- Lime is natural, flexible, breathable, and can be made soft or hard as required. It is close-grained, so is water-resistant in wet weather and wicks in dry weather.
- Understand the lime cycle and how to mature lime products.
- Understand how to mix lime, thence how to specify mixes.

The Lime Cycle and Introduction to Mixing



CaCO_3 , remove CO_2 = CaO , add H_2O = Ca(OH)_2 , add CO_2 = CaCO_3 again!

Aim – to coat each particle of aggregate in the mix with adhesive material, leaving no gaps.

- Take a known volume of dry aggregate; weigh it, then measure in water until it is covered. This is the volume of binder required to set the sample.
- Weigh the same volume of binder. Multiply up the respective weights to make the working mix.
- 3 buckets of mortar will require 3 buckets of sand plus the binder – 4 into 3 does go!
- NHL binders come in different strengths and with different relative bulk densities. Use stronger and denser limes as base coats and in more exposed work where it needs to go off faster.

Repairing Masonry – Analysis & Methods

Our case study concerns masonry, so this will be brief!

- Replacement stones?
- Indents?
- Plastic repairs?
- Silicone treatments?



Rising Damp

Water rising in masonry by capillary action. Rarely above 1 metre.

Absent physical barriers – DPCs and floor membranes:

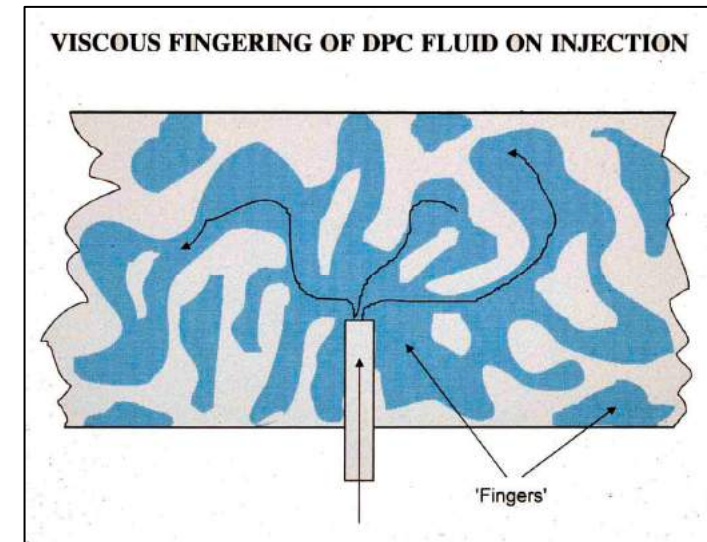
- Injected silicone DPCs?
- Electro-osmosis?
- Knapen syphons?
- Aromatherapy?

OR ...



Rising Damp (cntd.)

... USE YOUR BRAIN!



Minimise the water around/under the building, then

- 1. detach linings from damp masonry and allow to breathe;**
- and where that's impossible
- 2. devise a physical barrier.**





Other Damp

- Penetrating Damp – attend to everything we have spoken about so far and there won't be any!
- Condensation – rarely a problem to traditional structures unless inappropriate works have been undertaken, but ... minimise sources of moisture, minimise cold spots, increase air changes.

EXCEPT ...

Interstitial Condensation – with reference to reinforced concrete

We have already mentioned interstitial condensation with reference to ventilating flat roofs. It is a difficult issue in concrete structures.



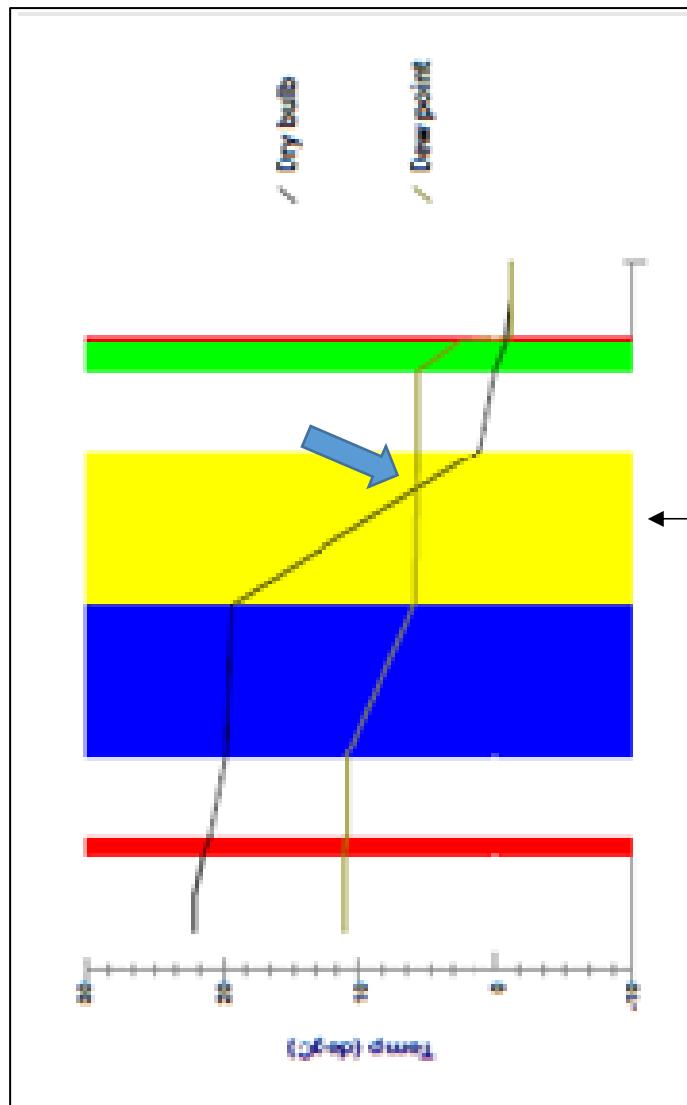


Figure 1

Lead Roof
Timber Deck
Vent. Void

Concrete

Insulation

Vapour Barrier

Ceiling

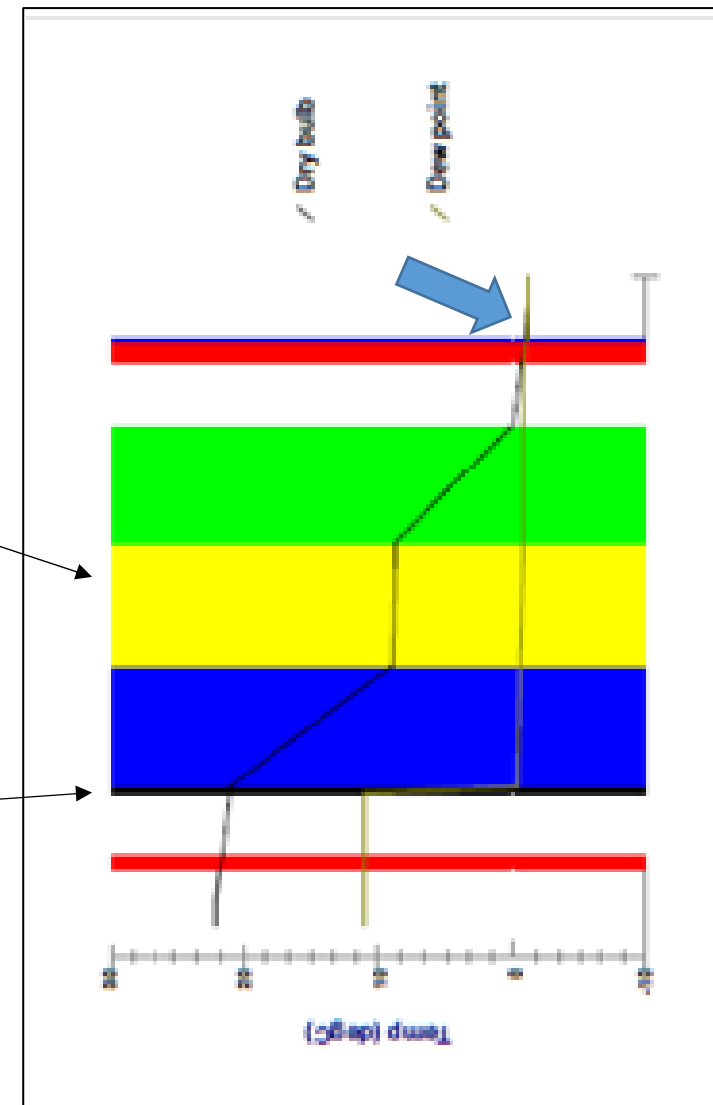
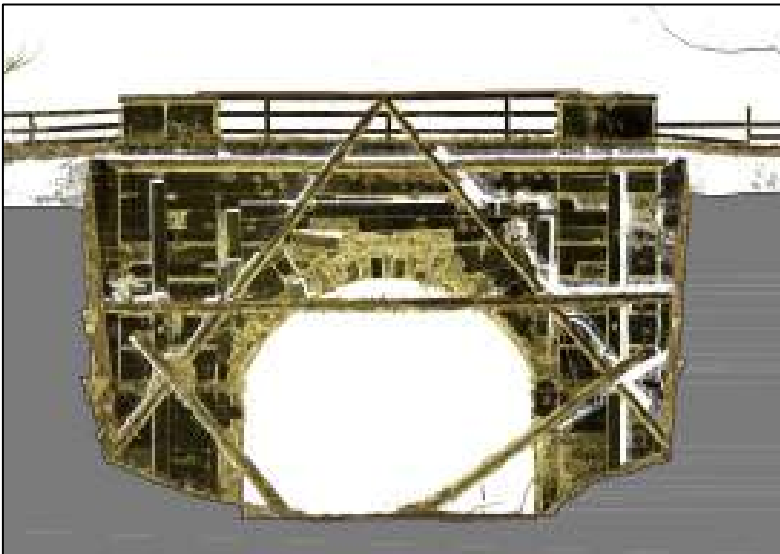
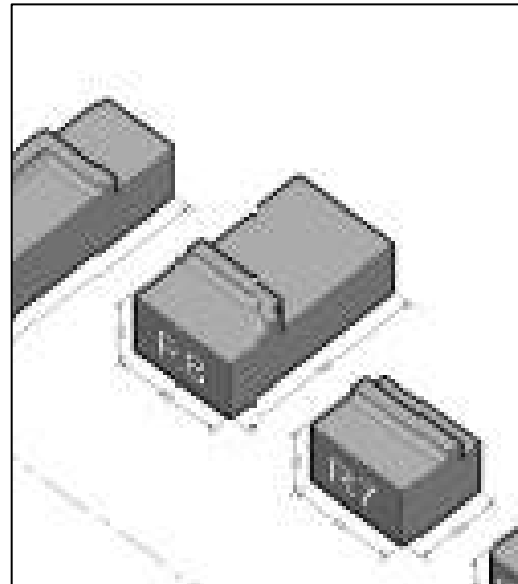
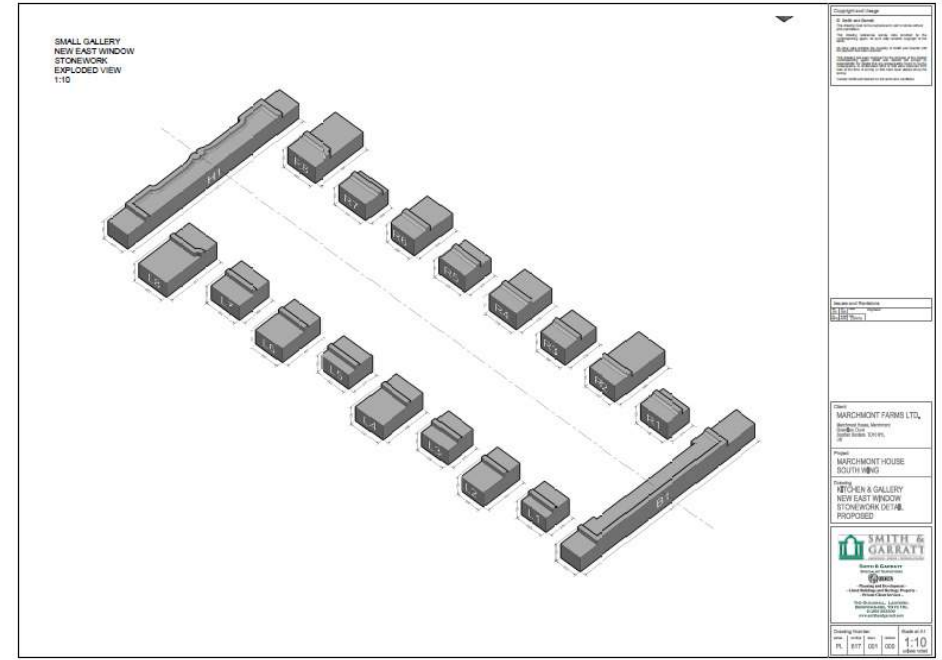
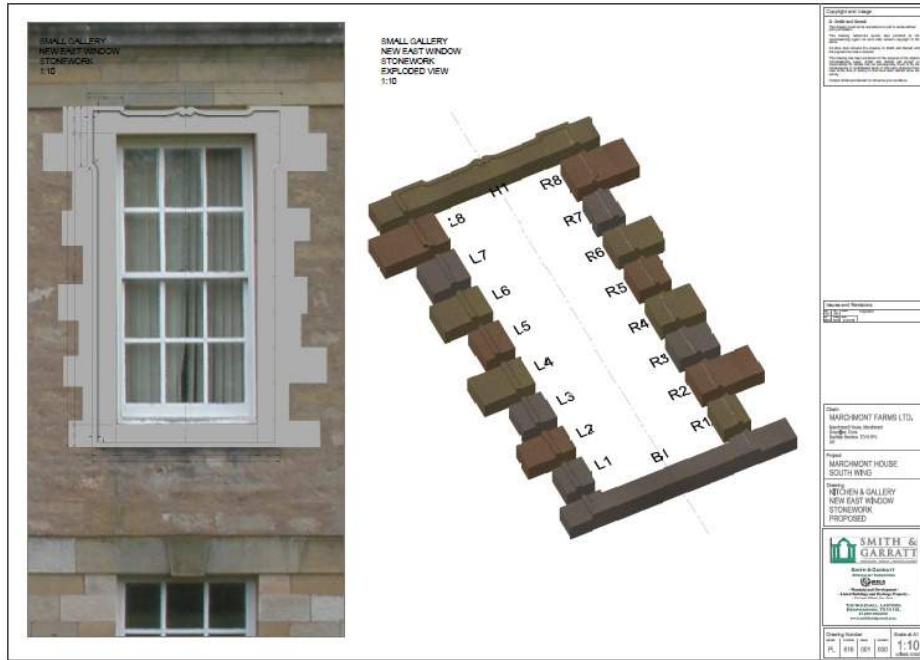


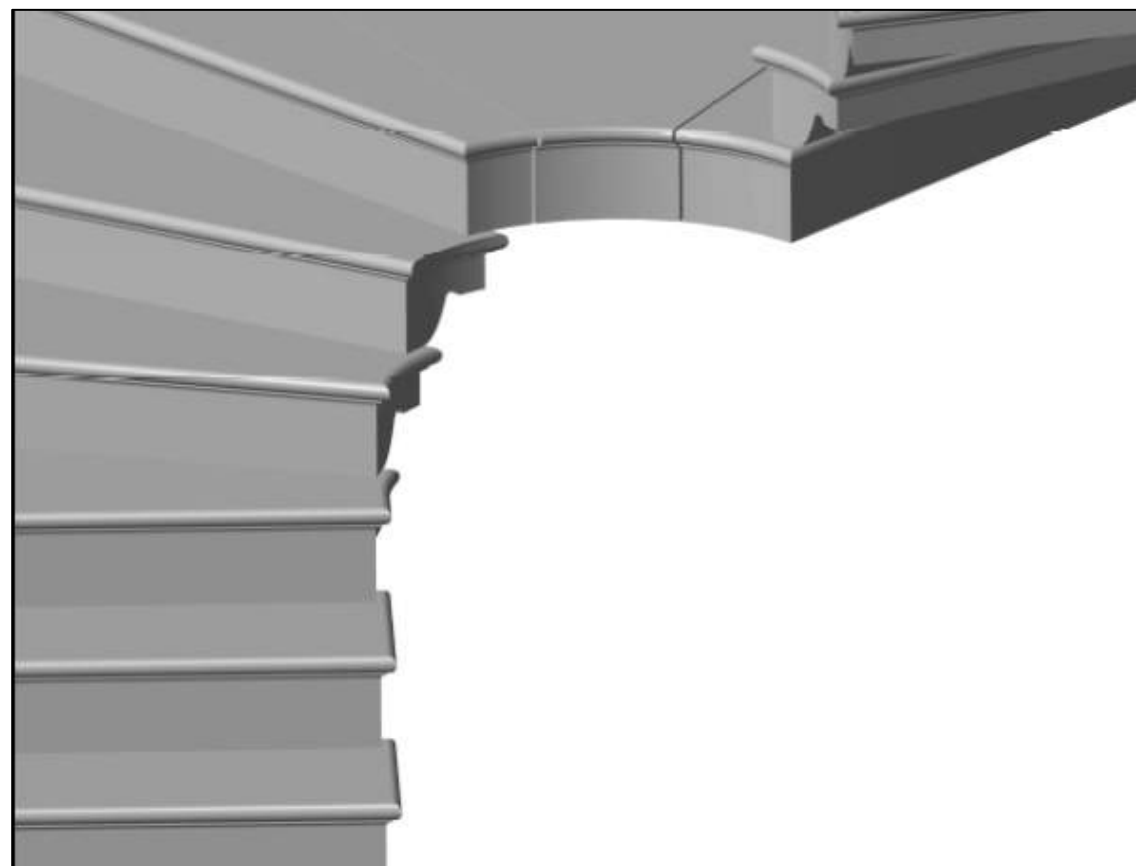
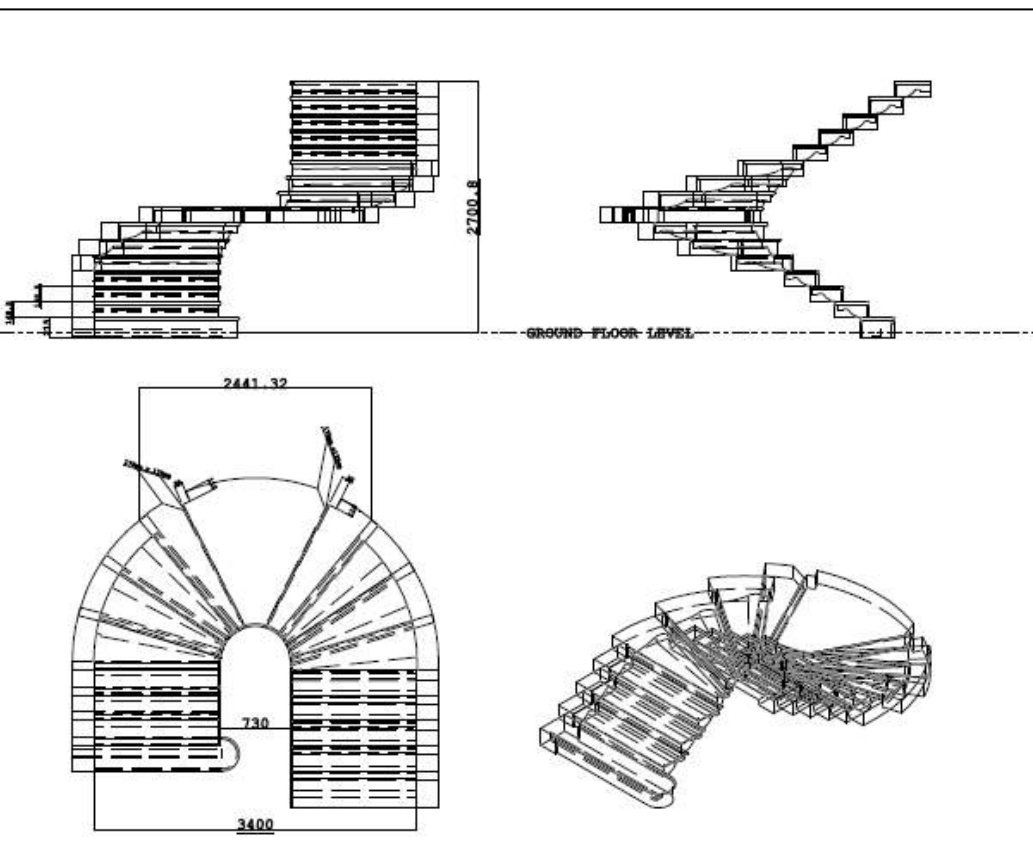
Figure 2

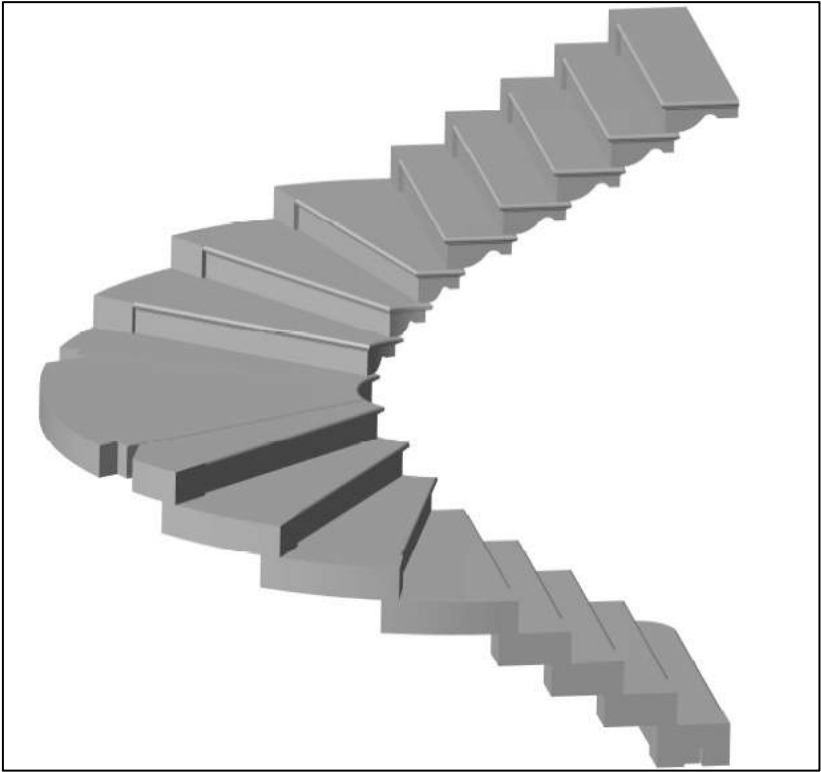
Case Study: Masonry Repairs









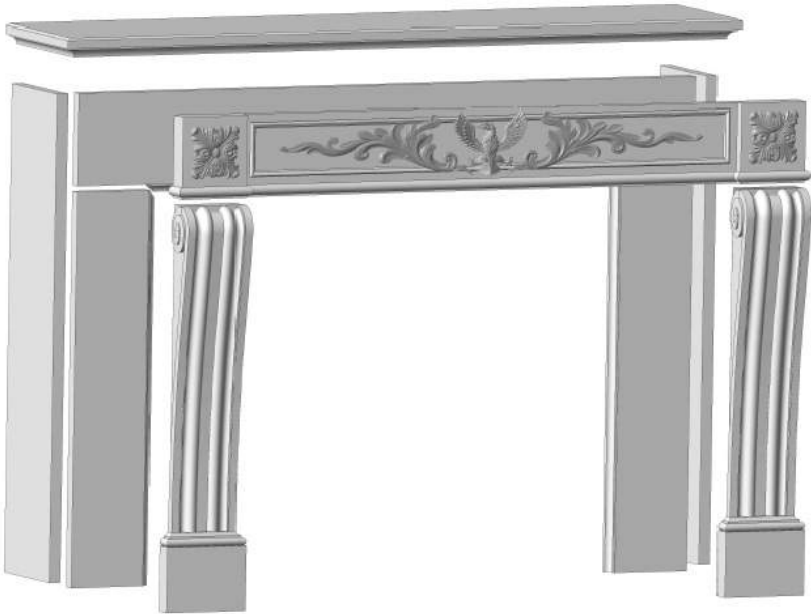


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EXPLODED DIAGRAM



Aim – to buy block and cutting time

- Scan the structure in 3D, high resolution
- Ortho-correct and prepare for CAD
- Use CAD to draw replacement stones
- Explode the drawings and make an STL file for each new stone
- Send to yards with CNC cutters for pricing
- Choose stone and purchase

Does not de-skill the crafts; enables scarce skilled labour to work on more structures per annum.



Elevation A



Elevation B



Elevation C



Elevation D

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