TU831 TECH1106 TDS

Project 2 Part A: Wall Type Analysis

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Construction Principles of Walls

Environmental Protection	Construction work should be environmentally friendly and pollution free.
Safety	Construction work has to be carried out in safety and comfort, with a method that implements the highest safety criteria.
Speed	Construction work should be completed in the shortest possible period of time.
Economy	Construction work must be done rationally with an inventive mind to overcome all constraints at the lowest cost.
Aesthetics	Construction work must proceed smoothly and the finished product should portray cultural and artistic flavour.

https://www.giken.com/en/vision/five_construction_principles/

Wall Type 1: 20th Century Partial Fill Cavity Wall Construction

Materials Used

- Internal Plaster: Gypsum Plaster – Chalk like material, combination of calcium sulphate and water.
- Concrete Block: Cement, Lightweight Aggregates
- Cavity
- Insulation: Expanded Polystyrene
- Clay Brick: Grounded Clay mixed with water

Water Permeability

- Gypsum Plaster – Water absorption rate found to be higher than 30%
- Concrete Block – Quite permeable as it is porous
- Expanded polystyrene – 2.0-3.8 (Vapor Permeability Rating, from 2-5 is acceptable.
- Clay Brick - Water absorption rate of 12% to 20%

Size and Thickness

- Internal Plaster: 13mm
- Concrete Block: 440mm x 215mm x 100mm
- Insulation: 100mm
- Clay Brick: 215mm x 102.5mm x 65

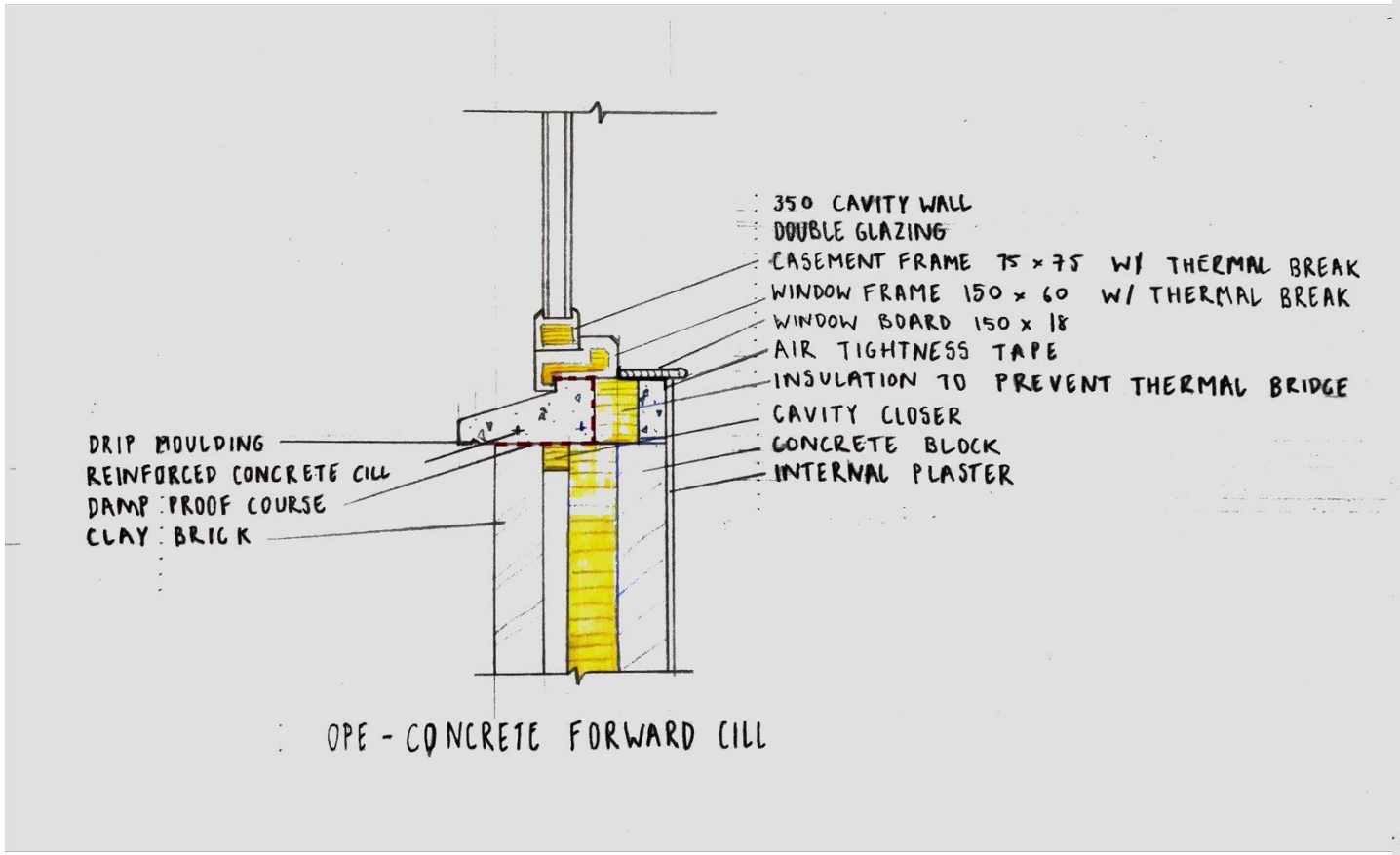
References

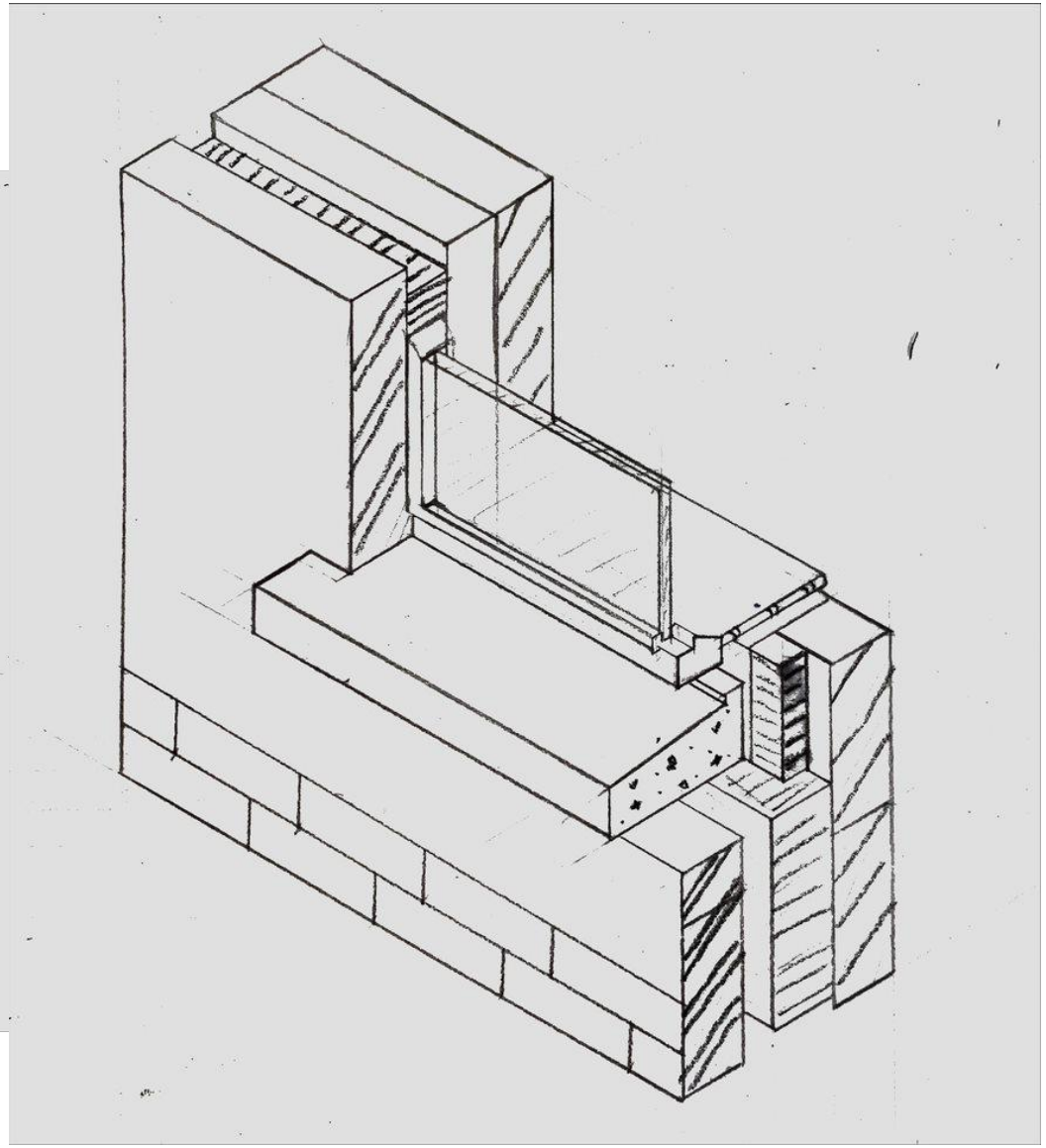
- *Barrys Introduction to construction of buildings*
- *https://www.epsindustry.org/building-construction/moisture-resistance*

Calculation of U-Value

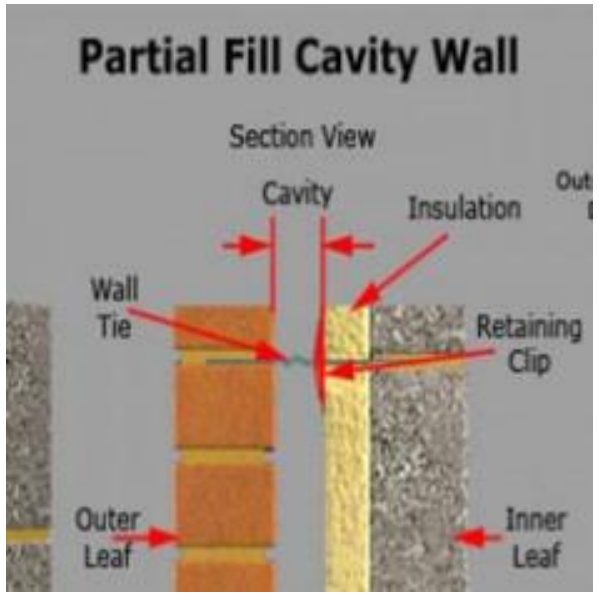
	Thickness (in metres, d)	**Thermal Conductivity (W/mK, λ)**	**Thermal Resistance (m^2K/W) R = d/λ**
In. Surface	-	-	0.120
Plaster	0.013	0.18	0.073
Block	0.100	0.11	0.91
Cavity	0.50	0.16	0.180
Insulation	0.100	0.02	2.5
Brick	0.100	0.84	0.17
Ex. Surface	-	-	0.06
External surface	-	-	0.060
Total Resistance (ΣR)			3.833
U-Value = 1/ΣR			0.26(W/m^2K)

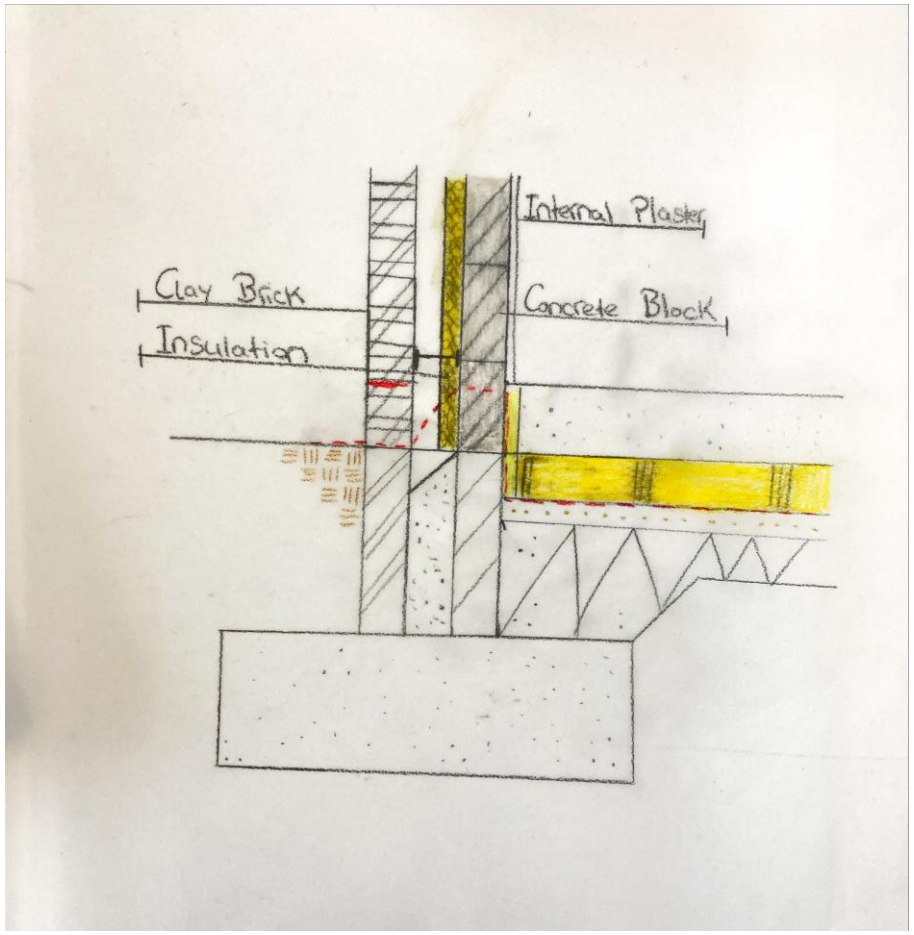
Window Details

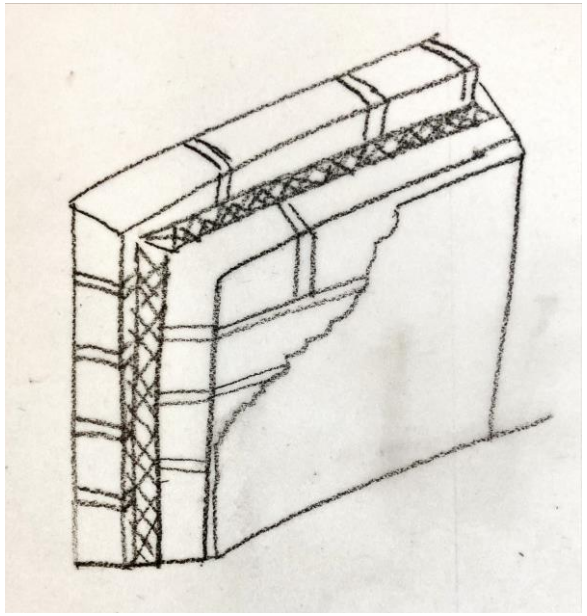




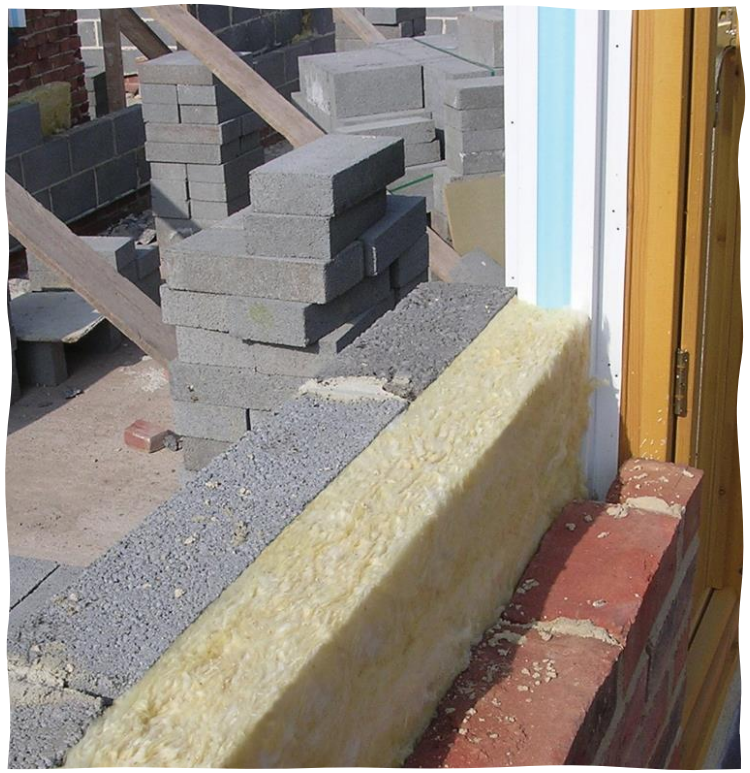
Partial Fill Cavity Wall Details



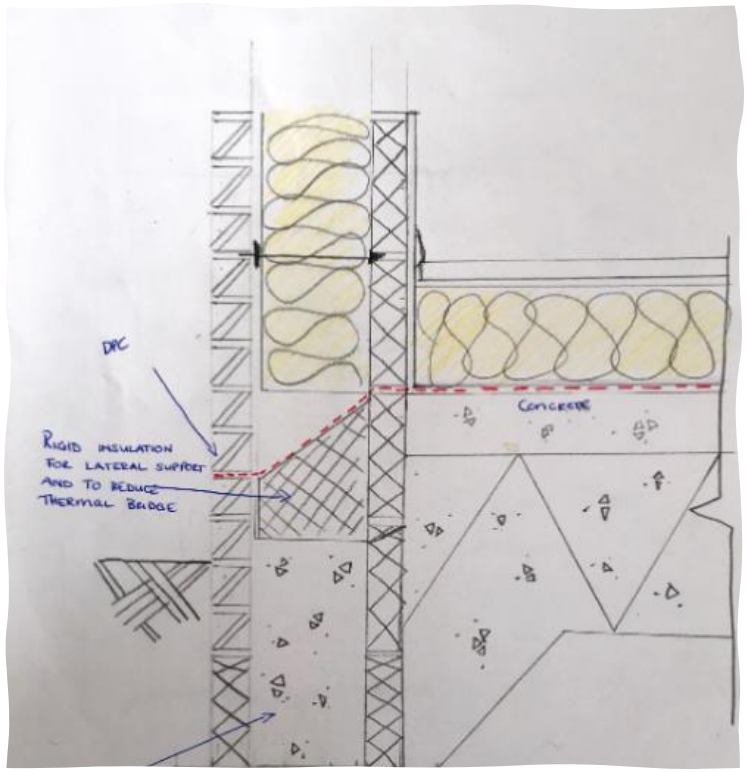




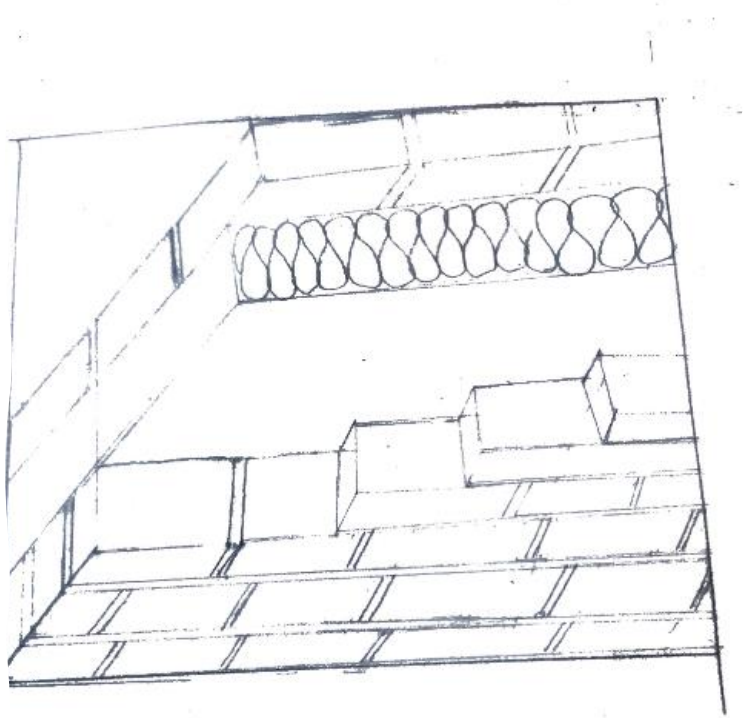
Full fill cavity wall



https://www.bing.com/images/search?view=detailV2&ccid=aAfMjaC%2f&id=D0B2FCC76FFC2E738024D12D0C0D29009BF31D63&thid=OIP.aAfMjaC_3GJwiJviQDCVVwHaHV&mediaurl=https%3a%2f%2fwww.insulationsuperstore.co.uk%2fuser%2fu%2fprod%2fl%2fisover-cavity-wall-slab-situ-41463-2.jpg&exph=792&expw=800&q=full+fill+cavity+wall&simid=608014245328783650&ck=C59B610589930C226177AA00A711D226&selectedIndex=3&FORM=IRPRST&ajaxhist=0



Full fill cavity wall
Scale 1:10



3D view of a full fill cavity wall

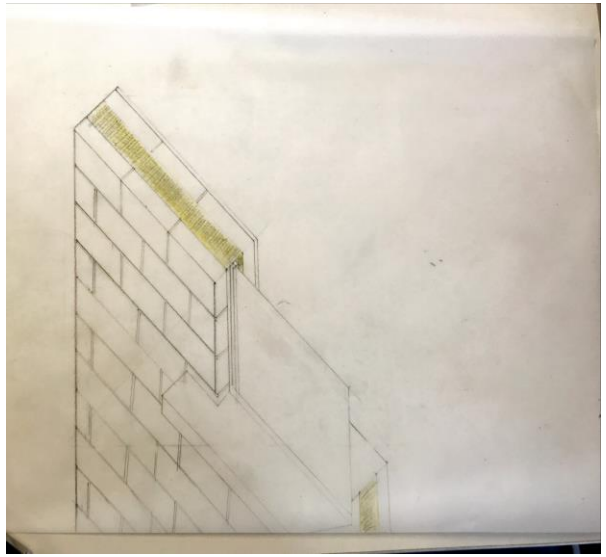
Full Fill cavity wall

- Full fill simply means that when you’re building the wall, you’re fully filling the cavity between the inner and outer leaf rather than leaving an air space between the insulation and the external leaf.

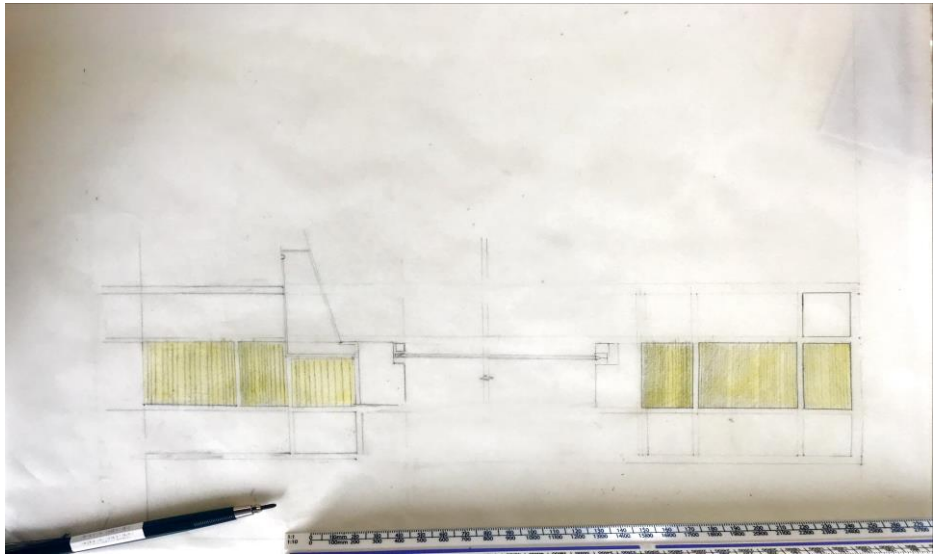
- In a cavity wall the inner and outer leaves are tied together using wall ties .

- You can tell if your property is a cavity wall by looking at any exposed brickwork if all brick are even length then most likely you have a cavity wall.

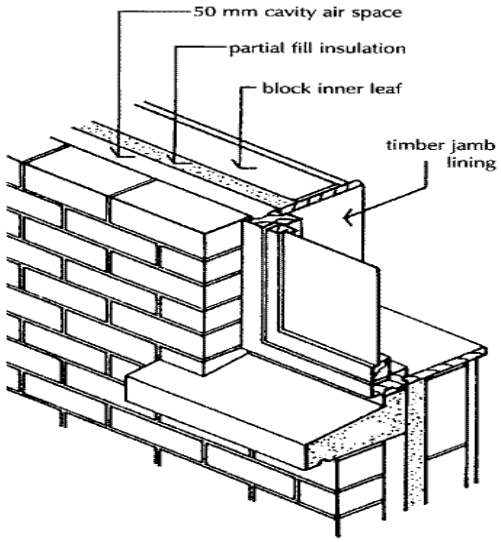
Full fill wall cavity window detail



Full cavity wall window detail 3D drawing
Scale 1:10



Full cavity wall window detail
Scale 1:5

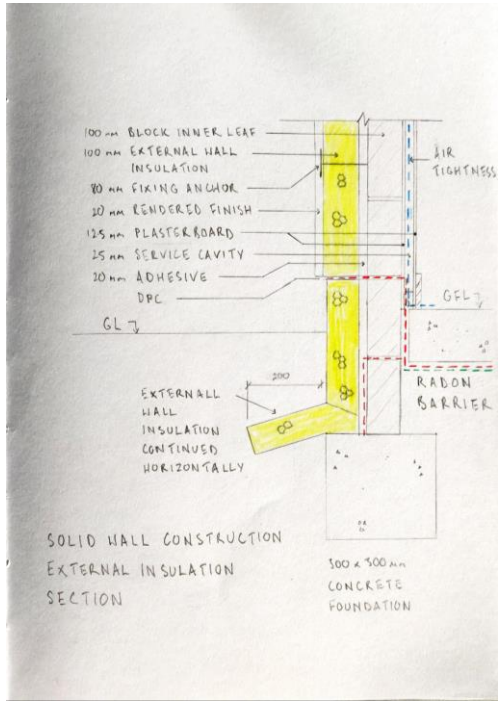


http://civilconstructiontips.blogspot.com/2011/06/cills-and-thresholds-of-openings-walls.html?m=1

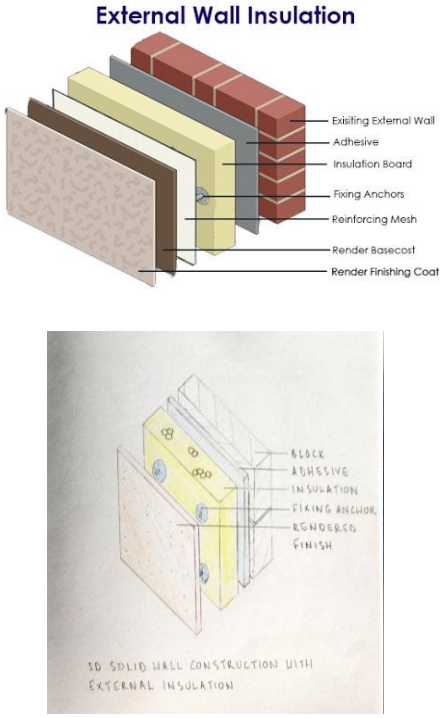
Wall Type 3: 21st Century Solid Wall Construction

- Typically comprised of plasterboard, service cavity, plastered concrete block inner leaf, external insulation and a rendered outer finish.
- The modern standard for new build houses and retro-fit.
- New buildings are well insulated with a high Building Energy Rating (BER) using these type of walls.
- Improves BER of older buildings through retro-fitting.

Examples of Solid Construction Walls



Section of a Solid
Wall Construction (1:10).



Axonometric 3D view of a
Solid Wall Construction (1:10).

Tony's house walls with external
insulation slabs.

http://www.plastererscork.ie/external-wall-insulation/

Calculation of Thermal Performance

	Thickness (in metres, d)	Thermal Conductivity (W/mK, λ)	Thermal Resistance (m^2K/W) $R = d/\lambda$
Internal surface	-	-	0.120
Plasterboard	0.0125	0.21	0.060
Air gap (service cavity)	-	-	0.180
Plaster lightweight	0.0125	0.16	0.078
Blockwork	0.100	0.11	0.909
Adhesive	0.020	0.5 – 1.0	0.02 – 0.04
External insulation	0.06	0.020	3
External surface	-	-	0.060
Total Resistance (ΣR)			4.427 - 4.447
U-Value = $1/\Sigma R$			0.226 (W/m^2K)

http://dl.booktolearn.com/ebooks2/engineering/civil/9781118977163_Barrys_Introduction_to_Construction_of_Buildings_4th_Edition_0961.pdf

https://www.kingspan.com/irl/en-ie/product-groups/insulation-boards/kooltherm/kooltherm-k5-external-wall-board

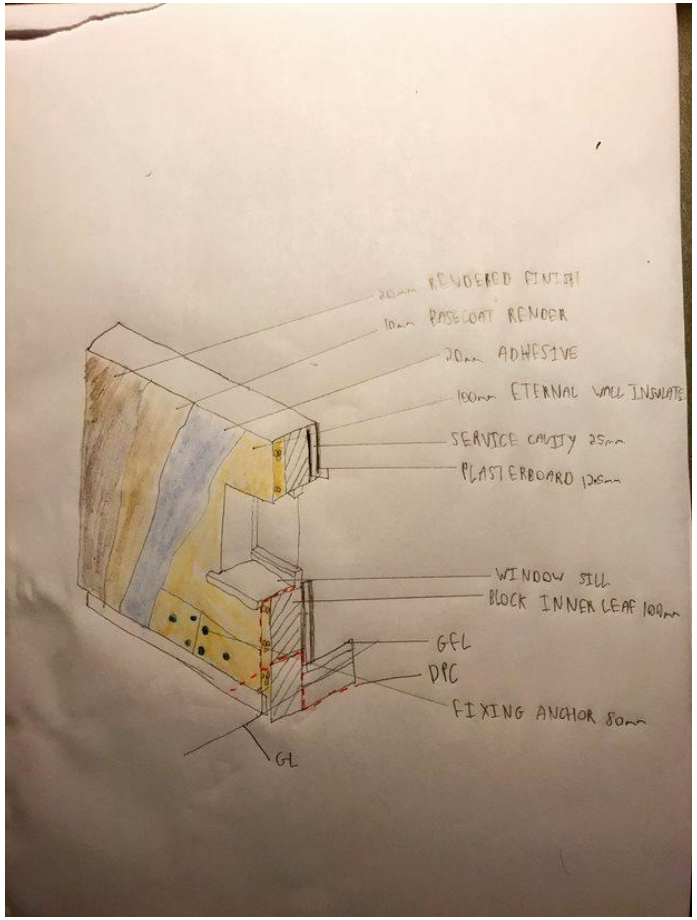
The BAU Show Munich 2019

Steico *protect* wood fibre insulation	Thickness (in metres, d)	Thermal Conductivity (W/mK, λ)	Thermal Resistance (m^2K/W) R = d/λ
External Insulation	0.06	0.048	1.25
Total Resistance (ΣR)			2.677 – 2.697
U-Value = 1/ΣR			0.371(W/m^2K)

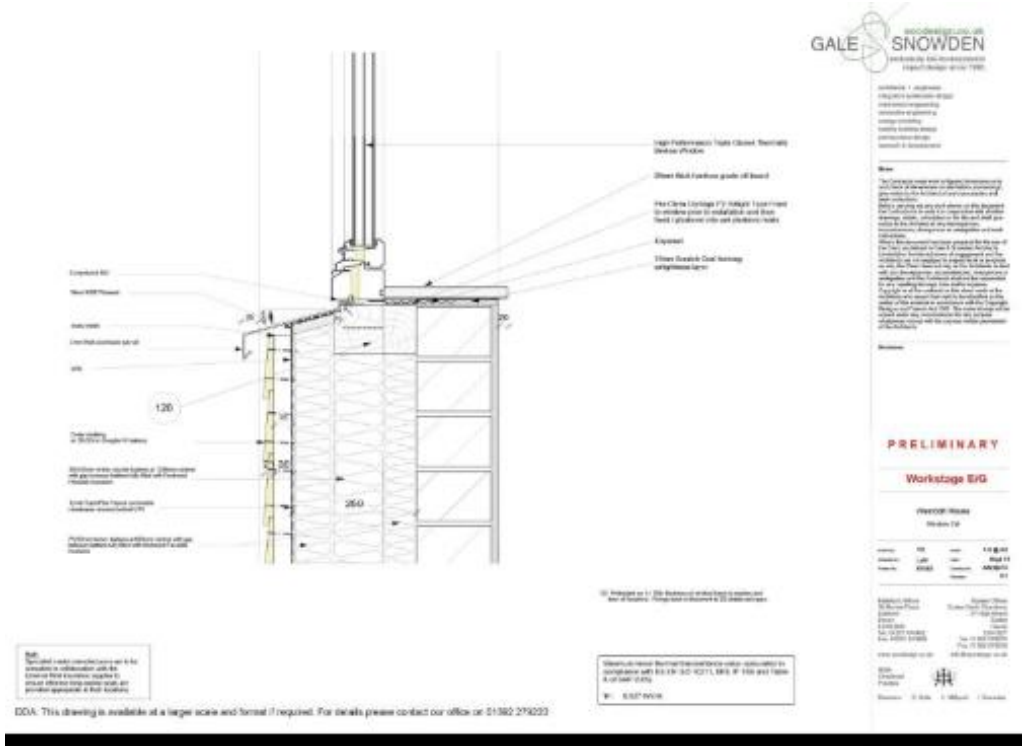
https://www.steico.com/en/products/wood-fibre-insulation/steicoprotect/overview/

https://www.steico.com/fileadmin/steico/content/pdf/Marketing/UK/Product_information/protect/STEICOprotect_en_i.pdf

Example of window within wall



3D view of window placement in a solid wall. (scale 1:10)



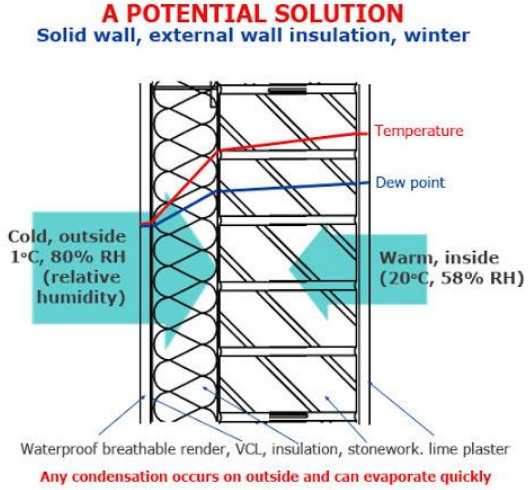
Example of window section for retrofitting on an extension.

https://passivehouseplus.ie/magazine/upgrade/granite-hewn-victorian-home-upgraded-to-phi-low-energy-standard

Permeability

Material	
Rendered finish (20mm)	Breathable material. Prevents water penetrating the walls
External insulation (100mm)	Slows air transfer in and out of the house through the wall.

The wall is water resistant and breathable due to the use of a breathable render. The wall will be warmer from the internal heat which means the moisture within the walls will pass through easier so that it can evaporate. This is because water vapour passes through building materials quicker and easier than water in liquid form.



https://www.acaraconcepts.com/wood-fibre-insulation/insulating-historic-buildings/#:~:text=External%20Solid%20Wall%20Insulation%20(EWI)&text=Also%20the%20wall%20will%20be,than%20water%20in%20liquid%20form.

Embodied energy

Material	PER embodied energy MJ/kg
Concrete blocks	1.5
Plasterboard	4.4
Expanded polystyrene insulation	88.6

https://www.yourhome.gov.au/materials/embodied-energy

Thanks for listening

- Any questions?