

How To 'Save A Fortune' Designing & Building "Super-Insulated" Homes ~ Quickly & Simply ~ Using The Best 'Tried & Tested' Methods!

The 'Essential Guide' To Achieving 'U' Values Down To 0.10 (& Lower) As Well As 'Airtightness' To Match 'Passivhaus' Standards!

So don't waste money on fancy product-based constructions; the best way to create 'super-insulated', airtight homes is also the cheapest and most ecologically friendly!

Few 'experts', let alone 'self-builders', appreciate how varying the method of construction can ~

- Halve or double BOTH the basic 'carbon-footprint' AND the basic 'building costs' of creating any "super-insulated" new home; without even needing to change the proposed design OR the quality and type of fittings and/or finishings, etc.!

You will once you've read this booklet! And you'll learn the simplest, cheapest and most eco-friendly way to create "super-insulated" houses that anybody can build!

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There are certain things that will always appeal to property owners and reducing or even removing 'heating bills' comes high on most people's lists. Of course; any reduction in 'space heating' also reduces the consumption of fossil fuels and the associated 'greenhouse gas' emissions; so there are advantages to be had all round!

- Unfortunately; judging by the typical architect-designed "super-insulated" self-build projects featured in the national magazines, this is yet another area where everybody, professional consultants included, has been 'brain-washed' into using the high-profile; i.e. commercially promoted products; to achieve the desired objective! Such ignorance is very expensive for clients!

Readers of the "An Insider's Guide" books and manuals will know that as an active "self-builder", I don't believe in needlessly complicating things or wasting money on something if there is a plain, effective, practical, common sense way to achieve the same objective at a fraction of the cost involved with using the proprietary product-based methods that get so prominently featured in catalogues and magazines!

- The good news for the 'package-kit' suppliers and buyers is that this particular common sense approach can be used with site-fabricated OR site-assembled 'package-kit' timber-frame houses!

HOW? Because the common sense approach to creating 'super-insulated' homes doesn't affect the structural design and/or framing of the houses at all; which also means that the minimum possible 'slim-line' foundations can also be used ~ reducing the need for the worst environmental polluter used in construction; i.e. cement; for the concrete footings and blockwork foundation wall(s).

"Super-Insulated" Walls

How To Save Even More Money Now & Forever More!

Aside from the fact that considerably less substantial foundations are needed under timber-framed houses than similar brick & block built versions; there isn't really much difference in the type of foundation or roof construction involved nor is there any particular difficulty with achieving 'super-insulated' standards of insulation for house floors and roofs. However; the same cannot be said about the walls, where the form and method of construction can have a major bearing upon the cost, thickness and practicality of achieving even basic statutory levels of insulation!

One of the acknowledged major advantages of timber-frame is that it is very much easier and cheaper to achieve high insulation levels than it is when building traditionally using brick and block. There is the further advantage that timber-frame will always require less wall thickness; than brick & block construction; in order to achieve any particular insulation value.

Although not essential in order to meet statutory requirements; the higher insulation levels now required for compliance with Building Regulations/Warranty standards are generally more easily met by simply increasing the timber-framing from 100 mm to 150 mm nominal thickness so that thicker insulation can still be accommodated within the depth of the structural wall-framing; rather than using much more expensive high-performance insulation materials in order to retain 100 mm nominal thickness framing.

(NB: A major part of the increased framing cost is frequently off-set because the higher strength of 150 mm framing usually allows lower-storey load-bearing walls to be framed at 600 mm centres instead of 400 mm centres.)

While speculative house-builders have traditionally been content to meet statutory regulations; few, if any, self-builders are prepared to settle for mere compliance levels of insulation for their new homes!

Whilst it is possible to achieve superior levels of insulation by varying the type of insulating material used; whatever insulation is used within the depth of the framing, the framing itself will always reduce its effectiveness to some extent due to so-called 'cold-bridging'. ('Cold-bridging' is simply the term applied whenever anything; less thermally efficient than the insulation; connects the inner and outer faces of the insulated wall; i.e. forms a less thermally-efficient 'bridge' from one side of the insulation to the other.)

- When high insulation values are required; it is usual to supplement the insulation (within the depth of the framing) by overlaying any cavity face with upto 50 mm thick sheet insulation, or upto 100 mm thick sheet insulation under 'single-skin' claddings, and/or overlaying the internal face with either sheet insulation under the dry-lining plasterboard or with pre-bonded insulated plasterboard. Whichever approach is used; it will help to 'nullify' the 'cold-bridging' effect because the sheet insulation will cover the entire surface including framing.

Apart from any cavity needing to be widened to 100 mm in order to maintain a 50 mm wide clear cavity; all these options allow the structural frame to be designed purely to meet the structural needs of the building! The real problem is when the house needs to achieve 'super-insulated' standards as this cannot really be achieved without significantly thicker insulation!

- Judging by the way that most "super-insulated" homes are being built in the UK; most designers seem to totally lose the 'plot' as soon as a client or builder mentions "super-insulated"!

The apparent problem is that designers have grown so used to timber-frame walls having the sheathing on the outside of the framing and dry-lining plasterboard on the inside that they think that it is the only way to construct timber-frame walls!

The fact is that there is NO structural reason that requires the dry-lining plasterboard to be attached to the structural framing; it is generally done that way simply because it is very convenient to fix the dry-lining plasterboard directly to the framing when it is already there. The mistake made by designers is that they assume that it has to be there; which for 'super-insulated' performance levels means that they proceed to increase the framing depth until it matches the required thickness of insulation!

- The ill-informed practice of designing the structural wall-framing to match whatever thickness of insulation is required; simply beggars belief! Not only does it make the structural framing incredibly expensive; it also requires foundation walls of matching thickness to support it ~ meaning even more totally unnecessary expense and a sharply increased 'carbon-footprint'.

Of course; manufacturers of 'I' joists for floor framing haven't been slow to grab the opportunity to push the use of 'I' joists as wall framing members either ~ given the likely wall width required for containing enough insulation to achieve 'super-insulated' performance levels! No doubt; readers will have noticed 'claims' that the relatively thin 'webs' reduce the 'cold-bridging'; compared to solid framing members; in both advertisements and prominently featured articles about 'super-insulated' self-build homes!

- What is never mentioned is that whether used as floor joists or wall framing members; 'I' joists are significantly (30% - 50%) more expensive than the solid members they replace! Furthermore; in the case of wall framing; they are also totally unnecessary because using a simple, common sense approach provides a much cheaper, practical solution with NO 'cold-bridging' at all!!!

Using the ProFrame[®] bespoke design system approach allows "super-insulated" homes to be constructed WITHOUT needing to change the structural design of timber-framed floors, walls or roof structures OR needing to increase the cost or 'carbon-footprint' of the timber-frame and/or the foundation walls beneath! It also manages to successfully AVOID all the expensive product-based construction methods and associated additional foundation costs that seem to afflict most of the 'super-insulated' homes that end up being featured in the self-build magazines ~ AND can achieve 'U' values below 0.10 if required!

- It can also eliminate virtually all 'cold-bridging' and achieve exceptional 'airtightness' levels that match 'Passivhaus' standards!

You can see from the illustrated notes below just how simple and cheap the “common-sense” way of creating “super-insulated” walls and buildings can be ~ once you decide to ignore all the fancy advertising designed purely to persuade you to purchase some expensive framing product or other!

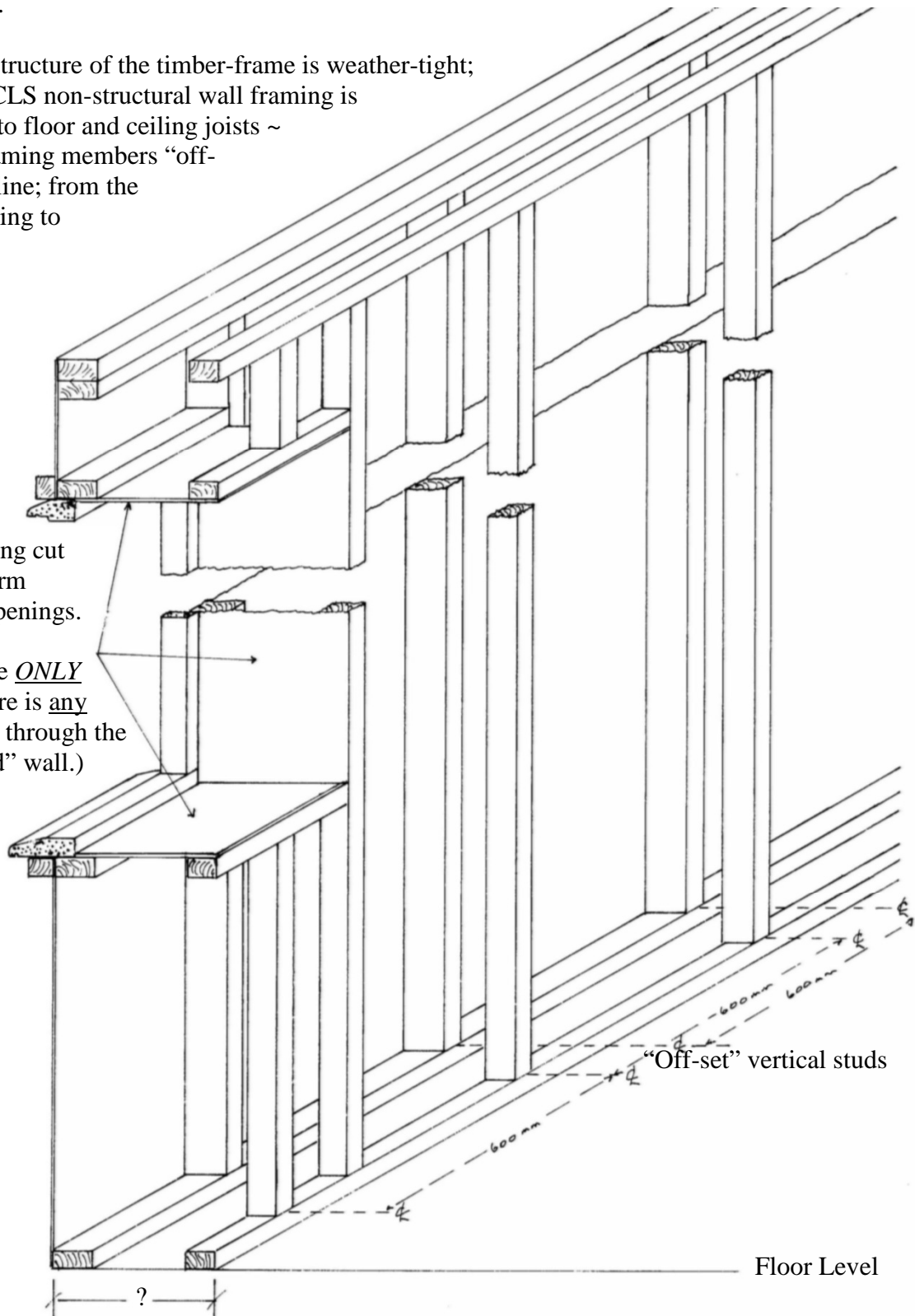
~~~~~ “Super-Insulated Wall Construction” ~~~~~

Standard external wall-panels; with 100 x 50 OR 150 x 50 (nom) CLS framing at 600 mm centres as per structural design requirements; with fire-stopping attached around openings and window/door frames all fitted as normal.

After the superstructure of the timber-frame is weather-tight; 75 x 50 (nom) CLS non-structural wall framing is erected ~ fixed to floor and ceiling joists ~ with vertical framing members “off-set”; i.e. out of line; from the wall-panel framing to avoid “cold-bridging”.

Exterior sheathing cut and nailed to form lining around openings.

(NB: This is the ONLY place where there is any “cold-bridging” through the “super-insulated” wall.)



**NB:** The wall thickness can be anything from 200 mm upwards ~ depending upon required ‘U’ value!

With insulation totally filling the void between the rear of the sheathing and the internal; i.e. plasterboard; face of the non-structural wall framing; and extending upwards around floor joists or roof trusses to the underside of the next storey's floor sheathing or the roof breather membrane and bonded to all those surfaces; creates an airtight "breathing wall" construction which is also totally devoid of 'cold-bridging'. Virtually any level of thermal efficiency can be achieved; by simply increasing the thickness of the insulated wall. There are NO 'knock-on' effects in terms of increased framing or wider foundations!

~~~~~ "Super-Insulated Wall Construction" ~~~~~

By combining such an approach to the wall insulation with similar floor and roof insulation; the end-result is that you create a virtually airtight, 'super-insulated', building structure that requires just the minimum necessary structural framing and only 'slim-line' foundations; i.e. at the lowest possible 'build' cost and smallest possible 'carbon-footprint'. **'U' values below 0.10 can be easily achieved; although that is unlikely to ever be required; because it is totally feasible to dispense with needing any form of heating system in a house without insulating to that level!**

The above method of construction; which ProFrame[®] has developed and used over several years; blows all the claims that 'SIPS' can achieve higher levels of airtightness and insulation, right out of the water; because they physically cannot achieve a higher degree of insulation or airtightness than is achieved by our simple and inexpensive, common sense methods.

Unlike 'SIPS'; using our approach with any normal timber-frame house; whether site-fabricated or assembled from a 'package-kit'; gives a totally seamless airtight insulation 'barrier' that isn't "crossed" wherever ('SIPS') panels butt up to each other ~ the insulation just goes straight across the inside of all panel junctions and joints completely sealing them!

- Incidentally; you can also ignore all the advertising implying that you have to use 'SIPS' in order to create an "open-plan space attic"; i.e. free of trussed rafters; that isn't true either!

Best of all; the way ProFrame[®] achieves these things is much, much cheaper (in fact 50%-60% cheaper) than using 'SIPS' and the whole process is much more environmentally friendly than the manufacturing and insulation processes used to construct 'SIPS'; plus it also avoids the 'knock-on' costs and hassles stemming from all the unnecessary double-handling, craneage and extra road haulage!

Although ultra-low 'U' values; i.e. below 0.10; are rarely cost-effective; using the ProFrame[®] system allows total flexibility to achieve whatever 'U' value is required through simply using the most cost-effective insulation option available ~ relative to its airtightness, thickness and installation cost! None of which affects the structural design of the building!

- Although it is normal practice to fix internal wall-linings directly to the structural frame; it is only done that way because it is convenient! Accordingly; when the required insulation levels make the overall insulated-wall thickness greater than the depth of the structural frame; **there is no need to make the structural frame deeper to match** ~ which also improves the insulation levels still further by completely removing any 'cold-bridging' between the wall-faces via the frame members!

The only area where the increased wall thickness is of consequence is at external door and window openings; partly due to the need to 'contain' the insulation at opening reveals during installation but mainly because the matching opening in the inner wall face needs to be attached to the structural framing for strength and rigidity!

As can be seen from the construction sketch; the simplest and cheapest solution uses 'narrow' panels cut out of wall sheathing plywood to line both sides, head and (window) sill; with one edge butted against the back of the window or door-frame and the two long edges of each panel nailed to the structural framing around the opening and the non-structural framing around the inner wall-face opening respectively.

Like the structural wall-panels; the inner wall-framing material is plain CLS and whilst it might look like a lot of extra work having an additional set of wall-framing to do; the inner non-structural wall-framing doesn't require sheathing which makes it very quick and simple to frame up and fix.

- Using 75 x 50 (nom) CLS; the author comfortably managed to frame up and erect all the internal partition walls for the six 86 m² (900 ft²) three-bedroom detached bungalows featured on the website in under six days; i.e. he completed one bungalow per day. Whilst that is more akin with the output achieved by North American carpenters than the leisurely work-rate assumed by all the UK Building Price Books for the "typical" British carpenter; you should remember that the author is simply a 'DIY' enthusiast and not a time-served carpenter!

With mounting concerns about the reliability of gas and oil supplies from abroad; particularly from Russia; and the obvious ongoing escalation of fuel costs ~ it makes sense to remove the need for central heating in any new home ~ especially as, when done properly, it will reduce the cost of building a house as well as removing a substantial and increasing part of the 'year-on-year' cost of living in it and removing the associated 'greenhouse gas' emissions!

Decisions and choices have to be made for every project. One of the major decisions that all timber-frame houses involve is the overall structural wall thickness. The simple, most economic solution (in order to meet statutory requirements) is to adopt 150 mm x 50 mm (nominal) CLS wall-framing members and to insulate within the depth of the framing.

- For superior levels of insulation; the wall-framing can be sized according to the structural needs of the house with either 100 mm x 50 mm or 150 mm x 50 mm (nominal) CLS framing; wall-panels can be overlaid with sheet insulation to either or both faces, which also removes the 'cold-bridging' effect of the framing in the process. 'Super-insulated' performance generally requires an overall thickness of insulation that exceeds the practical limits of simply overlaying the wall-panels.

There are various considerations involved in deciding the best way to meet the desired thermal performance levels.

(1) Any insulation material that doesn't self-bond to the surrounding sheathing and framing automatically lowers the achievable 'U' value because it allows air-movement at the edges of the insulation which, in turn, lowers the thermal efficiency!

- **NB:** Tests carried out in the USA have shown that a small (1/2") gap across the top of the insulation can actually reduce the overall insulation value of the wall by around 50%!

Statutory regulations take some account of the problem by requiring that '0.04' is added to the calculated 'U' value; i.e. a 0.20 'U' value automatically becomes a 0.24 'U' value; however that isn't an adjustment to mitigate for poor working practices; it still presumes that good working practices will be followed during installation.

(2) It is also very likely that any new house will have to be subjected to an 'airtightness test' to ensure that it meets statutory requirements regarding the air-permeability of the whole house.

Final Thoughts

Aside from complying with the 'letter' of statutory requirements; it doesn't make much sense to build in insulation that doesn't subsequently perform as expected.

- The use of mineral or glass fibre 'batts' needs close supervision and careful installation to ensure that the insulation isn't likely to 'sag' within the concealed framing cavities later ~ thereby

opening that critical ‘gap’! Accordingly; we never specify the use of mineral or glass fibre for wall insulation unless clients specifically choose to use it ~ subject, as always, to meeting the current statutory requirements.

- Rigid sheet insulation has the advantage that it won’t ‘sag’ after installation; but even if carefully cut to give a ‘force’ fit to all surfaces, it still needs all (four) edges sealing to the framing or it too will have its calculated ‘U’ value increased by 0.04!
- **NB:** All these comments also apply to insulating the entire external wall area within the depth of suspended joist floors!

The ‘standard’ ProFrame[®] approach to ‘super-insulated’ walls ensures that a continuous layer of self-bonding insulation fills from the lower floor surface to the underside of the next floor surface or roof membrane; extending right across the wall-framing and the depth of suspended joist floors or roof constructions above; which removes ‘cold-bridging’, totally eliminates air-movement and, depending upon which insulant is used, virtually makes the construction air-tight.

- A similar approach when insulating just the wall-framing depth also totally eliminates air-movement and achieves ‘similar’ levels of air-tightness ~ if the junction between wall-panels and floor deck is sealed; however it doesn’t eliminate ‘cold-bridging’ ~ unless the wall is overlaid with sheet insulation too. (When insulation is overlaid internally; it does help to provide ‘depth’ to accommodate electrical boxes, etc.)

Whereas rigid-sheet or ‘batt’ insulation can be kept thinner than the framing depth to create a services ‘cavity’ behind wall-finishings ~ lessening the potential ‘U’ value pro-rata to the reduction in thickness; self-bonding insulation is designed to be ‘raked-off’ flush across the face of the structural or internal wall framing which also maximises the potential ‘U’ value. The installation of services is normally within a separately created ‘cavity’ behind the wall-finishings.

Whenever services are to be installed within the depth of the insulation; they have to be designed and specified accordingly.

- In the case of electrical services, all cabling would need to be substantially upgraded; e.g. the 30-amp domestic ‘ring-main’ wiring would increase from 2.5 mm² twin & earth to (at least) 4.0 mm² twin & earth; in order to keep the electrical installation safe.

Obviously the choice of the actual wall-framing insulant will depend upon the relative cost; thermal and airtightness performance requirements, etc.

Unfortunately; achieving a high standard of ‘airtightness’ raises the ‘spectre’ of needing some form of electro-mechanical heat-recovery ventilation system ~ just when you may have successfully removed the need for a heating system; however the good news is that ‘airtightness’ is measured with all ‘trickle’ vents, windows, etc. firmly closed!

So if you prefer to minimize your dependence upon electricity supplies, or simply to minimize your future ‘utility bills’ and the associated ‘greenhouse gas’ emissions; all is not lost.

- ‘Fresh air’ is still free (at the time of writing) and ‘passive stack’ ventilation still complies with statutory requirements for kitchens, bathrooms and WC’s! Best of all; once it is installed, it costs nothing to use and it doesn’t stop working whenever power supplies get interrupted. Having **NO** power requirements means **NO** associated ‘greenhouse gas’ emissions either!
- Rainwater is also free (at the time of writing) and once suitable storage has been installed can actually save home-occupiers (on water-meters) money; by directly reducing the actual amount of

mains' water used and indirectly reducing 'sewerage charges' ~ which are 'calculated' upon the simplistic basis of how much mains' water is being used at the property!

Having learnt how to build superb timber-frame houses that can match the performance of anything produced in a 'factory' at considerably less cost and a much reduced 'carbon-footprint'; it makes little sense to 'stuff' a house full of expensive, power-hungry (and dependent), heating and/or ventilation systems. There are many tales of people paying out thousands of pounds to install under-floor heating systems in highly insulated homes that rarely, if ever, get turned on ~ it's a bit like having a car because it might get used once or twice a year. It would be much cheaper to use simple supplementary heaters for the rare occasions when internal temperatures dip. The annual 'running costs'; like the cost of an occasional taxi or hired car; would be negligible.

Author's Footnote

We often receive e-mails from readers of the 'Insider Guides' who are puzzled by the apparent contradiction that the sort of simple, inexpensive, common sense methods that I have tried and tested, for personal and professional use over the last 35 years or so; rarely get mentioned in the "self-build" magazines. The typical comment expressed is usually along the lines of "The methods seem very good but; if these methods are so much better; why don't I read about everybody else using them too?"

- The simple reason why such things don't get published is that there is no commercial value to be gained from telling people they don't actually need to buy something! In fact; it can be commercially damaging to publicise such things because keeping the buying public in blissful ignorance means they will keep buying the manufacturers' products and 'kits'! As a professional consultant; I don't have such 'vested interests' to protect!

The primary objective of any 'business' is getting people to spend as much as possible; even we need to have paying clients to undertake work for! "Self-build" magazines also have to operate profitably in the commercial world and highlighting inexpensive common sense methods to achieve exactly what their advertisers are trying to sell products to do isn't likely to encourage those advertisers to keep spending money with them! Similarly; irrespective of what the product is; manufacturers and suppliers are in business to maximize the amount of profit they can achieve from selling that product ~ not to save you money at their expense; so nobody with such vested interests is going to admit that there are better and/or cheaper alternatives to using their own product; e.g. When did you ever hear of a central heating firm telling people to 'super-insulate' instead of buying a heating system?

- Fortunately; as a professional consultant, I owe NO such allegiance and have NO such obligation to any commercial, vested interests and using my knowledge and experience to the benefit of my readers and/or clients is totally consistent with maintaining the high moral and ethical standards that all qualified members of the chartered professional institutes are supposed to maintain.

Unfortunately; what I have learned and practise isn't even practised by the so-called "self-build" experts on their own projects; being immersed in all the marketing 'hype' has kept them in 'blissful' ignorance of inexpensive common sense alternatives too. Eventually; they will read about such things, try them and possibly even start writing about them ~ if they can find a way to do it that doesn't upset the advertisers!

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**NB:** Everything I have referred to within this "Super-Insulated Homes Guide"; and all other "Insider's Guides"; is designed to save you money! ProFrame<sup>®</sup> is our "bespoke" integrated timber-frame design and construction 'CAD' software as developed and used by "Self-Build-Pro (Chartered Surveyors)" for handling clients' timber-frame projects within the UK & Irish Republic; i.e. throughout the British Isles.

Initial consultations are free of charge.



## ~ Further Reading ~

Apart from the “Insider’s Guides” that are being made available as “FREE” downloadable e-books from the website; there are currently two “An Insider’s Guide” books that have been published. They are both available in either printed or electronic versions. (**NB:** There are special ‘online’ discounted prices for the electronic versions and/or if you order both books together from [www.SelfBuildBooks.co.uk](http://www.SelfBuildBooks.co.uk)!)

**The “An Insider’s Design Guide” entitled “How To Design The House You Really Want (So It Can Be Built) For A Price That You Can Afford!” (ISBN No. 0 9543049 0 X) was first published in 2002. The revised edition was published in 2008.**

This book does exactly what it says in the title! It is a fully-detailed and illustrated, ‘step-by-step’ guide that shows you exactly how to ensure that you can afford to build the house you have always wanted. It shows you how to handle the design process and understand the effect of design decisions upon the eventual cost. There are chapters dealing with sourcing and buying your building plot; how to build a larger house that will cost the same or less than a smaller version; how to remove and avoid ‘hidden’ costs that add nothing to the house’s value but can cripple your budget; how to avoid fashionable ‘innovations’ that promise much but deliver much less; plus an essential guide to what you will need to include in order to get that all-important planning permission for your project!

**The “An Insider’s ‘Hands-On’ Construction Guide” entitled “How To Build Superb Timber-Frame Houses (The Professional Way To Match Package-Kits And ‘SIPS’ ~ Without The Huge Cost!) It’s Quick, Simple AND Amazingly Cheap!” (ISBN No. 0 9543049 1 8) published in 2008.**

This book also does exactly what it says in the title! Not many people realise that timber-frame is extremely simple ~ whether assembled in a factory as a ‘package-kit’ or fabricated ‘on-site’ ~ all it entails is pieces of timber cut to length and nailed together.

There are NO joints involved and virtually anybody; whether trades-people or ‘DIY’ enthusiasts, farmers or builders; can successfully do it and produce high-quality houses that match the highest standards anywhere.

The book is in full-colour and is comprehensively illustrated throughout.

The fully-detailed ‘step-by-step’ approach is packed with ‘Handy Hints’ learnt from having some 35 years of first-hand practical experience. From tackling the construction of the basic loading-bearing wall-panels that form the basis of all timber-frame houses; the book systematically covers everything you need to know about getting the foundations right; erecting the wall-panels; creating the upper floors; erecting and completing a weather-tight roof structure and finishing off the timber-frame with fire-stopping, windows, claddings, etc. There are also sections dealing with how to maintain efficient site practices with different size work-groups, how to ensure that everything is truly vertical and plumb without using spirit-levels or plumb-bobs, even how to fabricate and erect a whole house without needing to use lifting gear or scaffolding ~ even if working totally alone!

**NB:** Don’t confuse the “An Insider’s Guide” series of books with ‘self-build’ books carrying ‘generic’ titles that imply they will show you how to do things yourself but actually only show you who to employ to do such things for you! All “An Insider’s Guide” books tell you exactly what you need to know and/or do and how to save money doing it ~ whether you want to do things yourself or simply want to understand exactly what other people should be doing for you!

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