

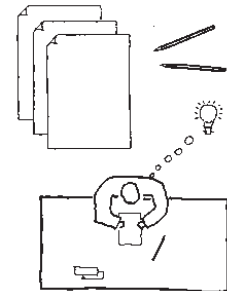
AN INTRODUCTION TO SUSTAINABLE HOUSE DESIGN AND CONSTRUCTION

BY PETER COWMAN BARCH

It is important to bear in mind, when thinking about designing your own home, that the house design field has few expert practitioners and that no dedicated 'school of house design' exists. This means that there is no standard house design methodology, no professional 'secrets' to be revealed. House designers might imply that such secrets exist but this is simply untrue.

This lack of house design methodology led me to initiate the 'Be Your Own Architect' Courses in 1989 and, as a result of the success of these, to write the Handbook of House Design & Construction. This set out a clear and practical house design methodology that allows a person to create their own 'architecture'. The move towards Sustainable Development that gathered momentum in the 1990's encouraged the evolution of 'Be Your Own Architect' Course & The Handbook into the present CD-ROM Course In Sustainable House Design & Construction.

We all have ideas about how houses should be designed, about their style, construction, layout and so on. All this knowledge is invaluable as one develops a unique design. However, it is important to have a method to follow as you do this, otherwise one can easily be overwhelmed by the range of issues that will come up for consideration. The method sets out here allows for the investigation of each aspect of the design as an individual topic while recognising that all the topics involved are interconnected. It is only when these topics have been thoroughly investigated and clear choices made that the 'plan' of the building is assembled. This is in contrast to normal design practice where the plan is the first thing that is created. This can lead to insurmountable problems, as can be witnessed in many professionally designed homes.

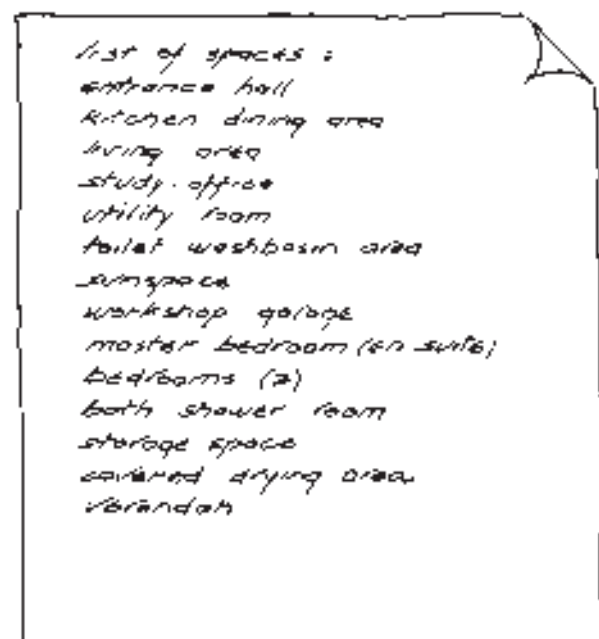


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It should be mentioned at this point that it is not necessary to have a site in order to create a design. In many ways it is better to create an 'ideal' design and then to find a suitable site for this. This is particularly true where one wants to gather solar energy and to avoid conflict with the Planning Office.

The starting point of any sustainable house design project is deciding what one wants. This takes the form of a list of the spaces that one wants to create. Such a list includes both 'inner' as well as 'outer' spaces. Inner spaces are those wholly enclosed by the building while outer spaces would be those enclosed by the site. Some spaces straddle the inner/outer boundary - for example covered areas such as verandahs.

In drawing up a List of Spaces take your time and be as generous to yourself as you want - there will be plenty of opportunity to scale back when this becomes necessary. What is most important is that you cater for the whole range of activities that you would like host in your home, particularly leisure, pleasure and, possibly, work and food production. The exercise of writing things down is intended to extract things out of your imagination and to place them in front of you in tangible form so that you can develop and refine them. They will not be perfect in the form that they emerge! The whole process of design is, in fact, the process of refinement of these emerging ideas. This has to take place in the physical world as opposed to in your imagination where anything seems possible! This work will become the foundation of the entire house design. This makes it crucial that you not only take your time but that you give plenty of thought to what you want your house to encompass.



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In order to help you visualise the type of spaces that you set out in your List of Spaces begin assembling photographs of rooms, facades, windows, doors, furniture, floors, decorative effects, kitchen units and so on, that appeal to you. Magazines will prove to be the greatest source of such images. This exercise will assist you in bringing into focus the general style you are aiming to achieve. It will also quickly bring your emerging design to life and, of course, raise many more questions! This, you will realise at this stage, is the 'rhythm' of the design process - lots of questions arising and they all need satisfactory answers.

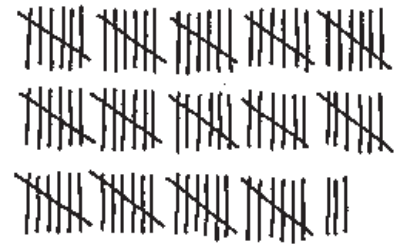


The 'rhythm' of the design process - lots of questions arising that all need satisfactory answers

Many of these answers can be found by analysing each space individually under the following headings Activities; Furniture & Equipment; Abstract; Location & Surfaces; The carrying out of such Analysis breathes life into the emerging design. Remember - it is easier to write something down and then to change it, rather than spend hours trying to come up with a perfect description of what it is you want.

Activities are the things you want to do in a space; Furniture & Equipment are the things you wish to put in a space; the Abstract qualities of space refer to the feeling you wish to endow the space with and its preferred orientation; Location is where you wish a space to be in relation to all the other spaces; and Surfaces are the walls, floors and ceilings that will eventually enclose each space, thereby forming the 'architecture' of the design.

Work your way through the analysis exercises slowly but steadily. Remember that you cannot possibly come up with all the right answers but even a wrong answer provides something that can be changed, as opposed to a blank that conveys nothing. It is critical that you plunge in as deeply as possible right from the start, rather than waiting for some sudden revelation that will clarify everything for you. Refining the analysis information is the revelation! Also, as you go about your daily business, keep your eyes open and look at the various buildings and spaces you experience.



Work your way slowly and steadily through the design exercise

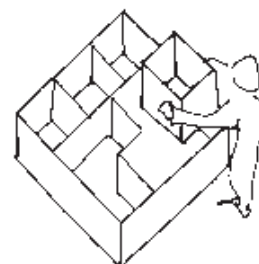
It is also essential to analyse particular Activities that will be carried out in the house on a regular basis. These would include cooking, clothes washing and, possibly, work and food production. By carefully examining how these Activities will be carried out, the house design can be shaped to suit these. This is particularly necessary if a home-based business is to be set up or if one wishes to incorporate creative activities and long-term adaptability into the design.

The assembly of this written and visual information will stimulate quite a degree of emotion. This is a consequence of being able to make choices as to how one lives one's life. Houses are pivotal to the success of this, enclosing as they do, all our deepest aspirations and fears. This physical/emotional aspect of architecture is a reflection of our own individual selves. Just like buildings we have an inside and an outside - an inner emotional world contained within an outer physical 'shell'. Aspirations towards creating sustainable house designs recognise this, creating a demand for buildings that satisfy us physically as well as emotionally. It is for this reason that no one can design a house for another person without really knowing them. Because emotions are non-physical, incorporating them into a sustainable house design requires a large degree of intuition. This can be thought of as the creation of a building for the living of one's life. This is the essence of the desire to build and live sustainably.



The assembly of written and visual information concerning a sustainable house design will stimulate quite a degree of emotion

Because most people have been educated and trained to consider life as a purely physical phenomenon, the consideration of feelings as part of the sustainable house design process will almost certainly open the flood gates of repressed emotions. This is one reason why a clear design methodology is essential, otherwise one can easily be swamped. It is also the reason why any design needs to be created initially on paper and then built in model form before attempting to construct the real thing full size.



Any building design needs to be created initially on paper and then built in model form before attempting to construct the real thing full size

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So, armed with one's List of Spaces and completed Space & Activity Analysis, the next matter up for consideration is the Budget. This will have a strong emotional aspect also! Write down the amount of money you have to spend or, the amount of money you will have to borrow. Borrowing money to build a house carries with it certain conditions which you should familiarise yourself with also. Bear in mind that if you are borrowing to build and will be working away from home that any restriction on the availability of petrol or diesel might adversely affect your ability to make your repayments. These are some of the critical issues which the design process raises, offering one the opportunity to consider them carefully and to craft practical solutions to these dilemmas. Alternatively, one might opt to forgo a mortgage altogether, building using whatever money one has even if this is only a modest amount.



Write down the amount of money you have to spend or, the amount of money you will have to borrow

When you have decided on your Budget figure you must then relate this to the estimated Floor Area of the building you wish to create. This is calculated in square feet or square meters. Work from your List of Spaces assigning to each space an estimated size. You can derive these by measuring the floor area of the spaces you presently live in, adding on or subtracting according to whether you want proportionally larger or smaller rooms. Care therefore needs to be taken carrying out this exercise. The general tendency is to make everything bigger than what one already has which can lead to quite a shock when the total Floor Area is calculated, particularly given that another 20% needs to be added to this to cover circulation areas, stairs and so on.

The exercise of relating Floor Area to Budget is quite straightforward. One simply divides the Floor Area into the Budget figure. The results of this should be greater than €100 per sqft/€1000 per sqm if one wishes to have someone else build one's house. If you are planning on self-building one can reduce these figures dramatically but only by doing a lot of the work oneself. It should be borne in mind that working full time and self-building cannot be carried on simultaneously.

If the figures simply do not add up for you it is necessary to re-examine your List of Spaces and to scale back your aspirations. To reduce your Floor Area dramatically you will need to drop some spaces altogether and to scale back others. While this might be traumatic it is still only a paper exercise and much less stressful than trying to pay for a completed building that has cost more than one can really afford. It is critical to bring Floor Area and Budget into reasonable balance before proceeding any further.

The next item up for consideration is the Environmental preferences that one wishes to achieve. It is very important that the healthiness of a building's 'environment' is recognised at this point. Environmental considerations encompass both physical as well as psychological issues. In other words, the building design that is being created must be seen as a 'living' thing, not merely as an assemblage of inanimate objects. Equally, the relationship of this living architecture to the 'outside world' must be considered as a living relationship. One can simply set out on paper one's preferences in this regard, noting, for example, that one wishes to create a health house free of toxins; that one wishes to avoid causing pollution; that one wishes to use particular natural materials and so on. Such preferences will guide the final selection of the heating system, materials, products and the choice of construction system to assemble these into a finished building.



The building design that is being created must be seen as a 'living' thing and the relationship of this 'living' architecture to the 'outside world' must be considered as a living relationship

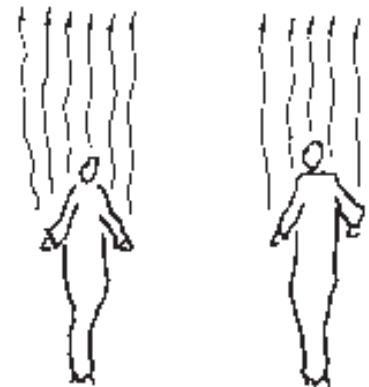
A major topic to be examined next is the heating system for the building. This, in many ways, is the most critical element in designing and building sustainably. One simple fact summarises what can be a complex subject. This is the fact that our bodies actually produce too much heat and are constantly shedding this to prevent overheating. This begs the question - what are we actually heating when we heat our houses? The answer to this is actually quite simple. When the fabric of a building - the walls, floor and ceilings - are made of cold materials the building occupants radiate their excess heat towards these surfaces at too fast a rate for bodily comfort. Consequently the heating system must heat the air within the building to 'pay back' the occupants for their excessive heat loss. However, if the walls, floors and

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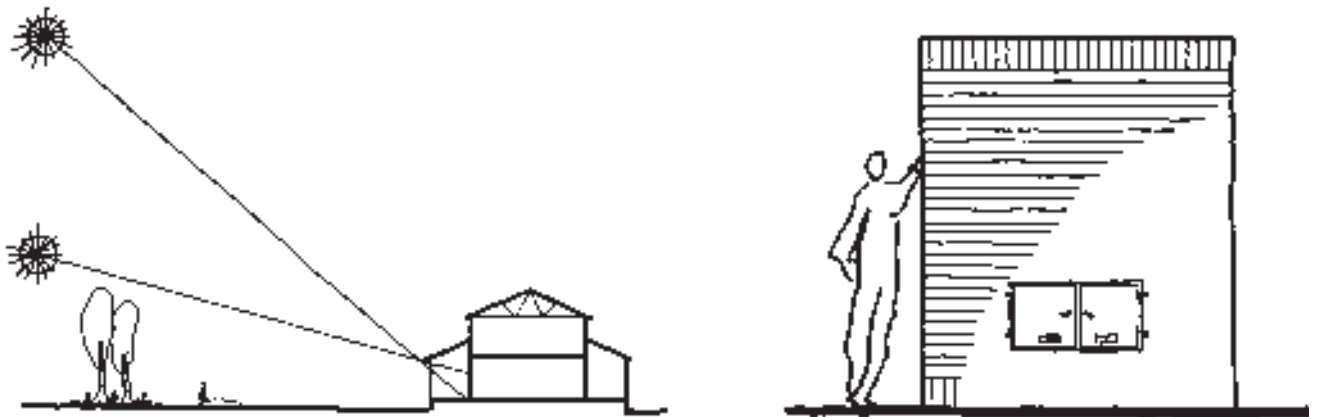
ceilings are made of materials that can easily be warmed, bringing them into balance with body surface temperature, radiant losses from the occupants can be eliminated, allowing the air to be cooler and fresher as a result. This heating of the building fabric can be achieved by utilising solar energy or by using low temperature hot water that is heated in some form of boiler. When generous amounts of insulation are used to protect such heat stored within the inner layer of the building the overall heating requirement can be quite small.

The amount of heat any building will need to create a comfortable and healthy internal environment will relate to its size and to the level of insulation installed. Such insulation need to enclose the entire building, including the floor. It is impossible to adequately insulate concrete floor slabs and arguments to the effect that such floors act as 'heat sinks' or as 'thermal mass' are erroneous. Any material that is cold to the touch is simply unsuitable for use on the inner layer of a building.

The choice of fuel for any heating system is one of the most puzzling dilemmas of the modern age. A reliance on fossil fuel is simply not a long term solution. The use of wood pellets will foster a reliance on producers and on suppliers who themselves will be relying on fossil fuels to get supplies to your door. Heat pumps are a form of electrical heating so one has to look honestly at how this electricity is produced. Low-tech solutions to the fuel problem, such as burning wood in stoves, are labour intensive and unsuited to the demands of consumers who require heating systems to 'kick in' as they rise from their beds or wearily make their way home from work. This goes to the heart of the desire to live sustainably. It is simply more demanding of one's time, time that is currently 'subsidised' by cheap energy. Overall, smaller, highly insulated buildings that gather solar energy with some form of wood burning system, preferably utilising coppiced timber grown on-site, will prove to be the most versatile.



Our bodies actually produce too much heat and are constantly shedding this to prevent overheating. This begs the question - what are we actually heating when we heat our houses?



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The next stage of the design process is to select materials and a construction system to assemble these into a finished building. Plumbing, drainage and electrical services also need to be examined. The effects of Planning and Building Regulations also need to be assessed and finally, if a site exists, this needs to be analysed in regards to access, orientation, views, ground conditions, exposure and so on. Finally, all this information needs to be assembled to form the completed design.

All of ones 'preferences' as outlined one's design brief will be subject to 'outside' influence. Such influence will range from Planning Office guidelines to bank or building society terms attached to mortgages. To properly manage the effects of these influences one must have clearly established one's 'bottom line' in regards to the 'sustainability' of one's design otherwise these outside forces will speak with the loudest voice. This will skew the design in the direction of what is considered to be 'normal' - the use of concrete, synthetic materials, plastics and so on. At this point it will become clear that the intention to create a truly sustainable dwelling runs counter to what the market economy might want one to do. If this is not realised endless frustration will result and the designer will be puzzled as to why their good intentions are so difficult

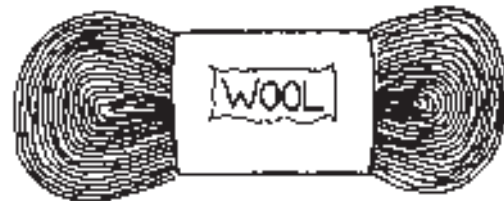
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to realise. These are philosophical questions as much as they are physical. Raised as they are by the design process, one has an opportunity to answer them according to one's true desires. This 'tug of war' between your desire to build and live sustainably and what the 'establishment' believes you should do must be clearly understood in order to fully realise one's ambitions.

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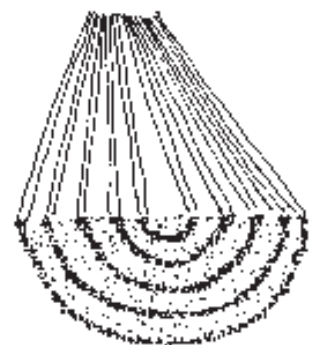


The choice of building materials, and a construction system to assemble these into a completed building, are primarily based on one's design intentions, particularly the method of heating the building. The selection of suitable insulating and heat storage materials is the first place to start. Both of these materials do exactly what their names imply. Insulation materials range from cellulose fibre, to sheep's wool to hemp. Heat storage materials include clay, sand and stone. The construction system of a building is based on assembling such materials into a strong and stable structure. Timber is most commonly used for this by creating a frame into which the insulation and heat storage materials are inserted. Such timber frame structures are lightweight and easy to construct. Solid structures can also be created though these are heavier and more cumbersome to erect. An important consideration when choosing materials is the external finish of the building. This will be subject to Planning Office and lender's guidelines and may, for example, discourage the use of timber cladding which is the simplest and most cost-effective external 'skin' for a well insulated timber framed building. This can oftentimes force the construction of a masonry external leaf to a timber frame, adding expense and detracting from the ethos of sustainability that one is committed to.



The selection of suitable insulating and heat storage materials is the first place to start

Timber frames are basically frameworks into which insulation and heat storage materials are inserted. As such they form the 'skeleton' of the building. The extensive use of timber in construction will oftentimes evoke strong reactions in people - lenders and borrowers alike. Lenders will oftentimes insist on toxic preservation methods when extending credit for timber frame constructions. Borrowers might be concerned about how long a timber frame will last and opt for toxic preservation also. Such a choice negates any intention to build sustainably and will compromise the healthiness of the internal environment of the finished building. When buying a timber frame 'off the shelf' from a timber frame manufacturer one inevitably will have to accept toxic preservation as part of the package. A good alternative to this is to construct a naturally preserved timber frame on-site.



The extensive use of timber in construction will oftentimes evoke strong reactions in people - lenders and borrowers alike

There are numerous 'recipes' for combining timber frames, insulation and heat storage materials. The simplest of these would consist of the construction of a 150mm deep frame into which sheep's wool or hemp insulation is inserted. The frame is then clad externally with timber and finished internally with a sand/lime render installed onto lathes. The internal render provides an excellent finish while at the same time as acting as a heat store. Another simple and effective way of combining timber frame and insulating material is to use hemplime. This combines the core of the hemp plant with lime to form a solid mass which is 'cast' around the timber frame. The beauty of this system lies in the fact that a rendered exterior results - something that the Planner's oftentimes insist on. The internal face of such a

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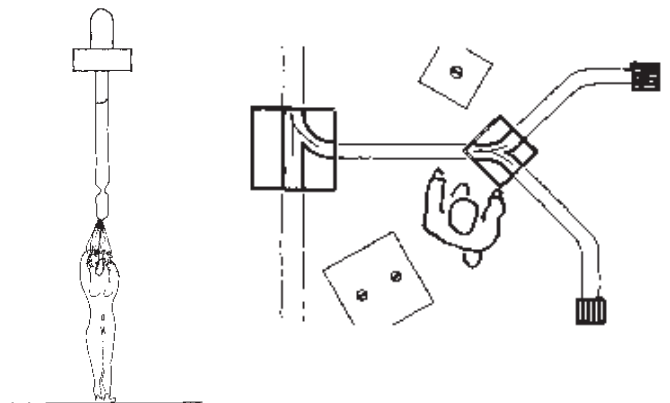
hemplime/timber frame can be finished with a sand/lime render. Any new dwelling should have a suspended timber floor as standard, avoiding the use of a concrete slab. Such an insulated floor will provide a pleasant and warm internal surface, which, combined with well insulated walls and a roof, will create a desirable cosy box with an efficient 'hearth' at its centre providing the necessary heat.

Apart from the materials with which to create such a cosy box, windows, doors and roofing materials have to be selected. Generally, as with all building materials and products, one has to look at the amount of energy that has gone into making them. This must include the energy used in transporting the items to their destination. Timber double glazed windows and doors will be found to be the most desirable to use in a sustainable dwelling. In terms of roofing materials, natural slates will overall be found to be the most sustainable even if that have to be transported over long distances. The finishes used both internally as well as externally in a building also need careful selection. Natural products will be found to be the most benign, particularly in regards the creation of a healthy internal environment. All building materials and products, and the method of assembling these into a finished building, must be scrutinised from the viewpoint of 'disassembly'. That is the process of taking buildings apart either to modify them or for some other purpose. How will unwanted materials and products be disposed of? This goes to the heart of sustainability - can such items participate in the recycling process without causing harm?



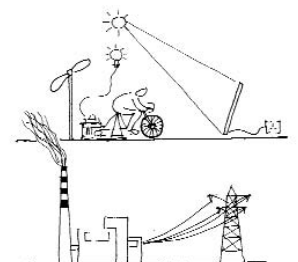
With all building materials and products one has to look at the amount of energy that has gone into making them. This must include the energy used in transporting the items to their destination

Before the process of planning the layout of a sustainable dwelling can begin one has to examine the plumbing, drainage and electrical services which will be required. Generally, one should pay close regard to minimising consumption of both water as well as electricity. This will naturally lead to the creation of a compact and efficient dwelling. Plumbing concerns itself with all the 'wet' services - both hot and cold water as well as any type of heating system which uses water. The nature of the water supply is critical to assess, particularly its suitability for human consumption. Harvesting rainwater is an option worth considering. Heating water can be carried out using solar panels which will be at their most efficient between April and September. The heating system can be used to provide hot water in wintertime. Drainage systems deal with the 'waste' water expelled from a dwelling. How this is done will largely depend on the nature of the ground that one is building on, though if there are public drains in the vicinity one can hook into these. In any event, what one puts down one's own drains should be non-polluting and capable of breaking down naturally. Where wastewater is being treated on-site it is the earth itself that is used to cleanse the effluent, though plants can assist in this where a wetland system is constructed. Plumbing and drainage systems are oftentimes inserted as afterthoughts in new buildings. Properly, one should consult experts well before the overall building design is finalised in order to create proper functioning, efficient and easily maintained systems.



One should pay close regard to minimising consumption of water. Also, what one puts down one's own drains should be non-polluting and capable of breaking down naturally.

Consideration of electrical services begins with a decision regarding supply. If ones opts to connect to the grid the reality of accepting nuclear generated power will have to be faced. If a choice is made to generate power on-site then considerable investment will have to be made in equipment and care taken to keep consumption to a minimum. In many ways this typifies the realities of moving to a sustainable way of life - one simply cannot buy this off the shelf.

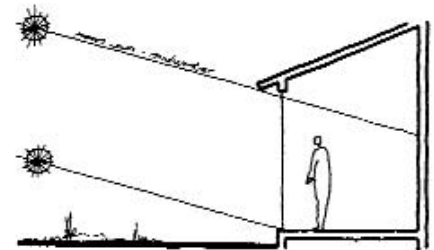


If ones opts to connect to the grid the reality of accepting nuclear generated power will have to be faced.

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Sustainability is something one lives and this inevitably means shifting out of the comfort zone that is part and parcel of the middle class way of life. Whatever the source of ones electricity supply is, a clear idea of requirements in terms of lighting and power points will be needed. This can be set out on a room-by-room basis. As with plumbing services, early consultation with an expert will assist in refining the overall system to be installed.

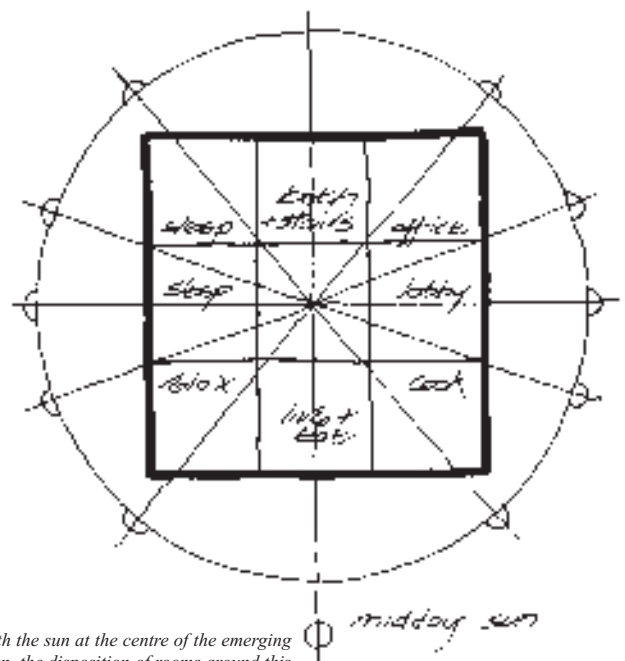
The regulatory issues surrounding the construction of a sustainable house are oftentimes foremost in people's minds when they embark on the task of creating a design. Of these, obtaining Planning Permission causes the most concern. Planning policy is set out in Development Plans on a county-by-county basis. It is essential to study the plan relevant to the area in which to intend to build in order to ascertain the Planning policy. Oftentimes Design Guidelines for houses are published by County Councils also. Again, familiarising oneself with these is essential. Basically these promote vernacular styles with simple pitched roofs and plastered walls. Generally, Planning Authorities are not 'up to speed' on the demands of sustainable house design and it can be difficult to obtain Planning Permission for designs that, for example, are intended to gather lots of solar energy. One way around this is to select potential sites carefully so that, at least, the south facade will be hidden from view. What this means in practical terms is the selection of sites with the road to the north or east. Because the Planners are mostly concerned with how a building will look from the road, these faces of the building can be made conform to the vernacular style fairly easily without compromising one's ability to gather solar energy. An application for Planning Permission should never be rushed. What one obtains permission for is what one is allowed to build, so any application should be well thought out and thorough in its attention to detail, particularly in regards to the drainage system.



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The other regulatory issue relates to the Building Regulations. These set out design and construction standards which must be adhered to, ranging from supplies of hot and cold water to kitchens and bathrooms to issues of structural stability. At a design stage one must pay close regard to the Building Regs where they effect the internal building layout and particularly the drainage system. At the construction stage, particularly where a mortgage is in place, a qualified person will be required to 'sign off' on the various construction stages, thereby certifying that the work is in compliance with the regulations.

It is only when the various design elements have been assembled that the task of creating a plan can begin. This is the reverse of normal practice where a plan is the first thing that is created. This approach immediately solidifies the design making changes and modifications virtually impossible. By dealing with each aspect of the design in turn, and by making independent choices and decisions in respect of these, a vibrant palette is assembled from which the overall design is composed. The orientation of the building becomes the driving force of the design at this stage. This facilitates the gathering of solar energy, an absolute requirement of any sustainable house design. With the sun at the centre of the emerging plan, the disposition of rooms around this imaginary centre can follow the sunpath in a natural progression. This will see bedrooms, entrance lobbies and breakfast areas assigned to the east with kitchen/dining/living spaces located to the south and west. Bedrooms can also have a western orientation while bathrooms and utility areas are best located to the north. Such an 'ideal' plan requires an appropriate



With the sun at the centre of the emerging plan, the disposition of rooms around this imaginary centre can follow the sunpath in a natural progression.

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site with road access from the north or east and views coinciding with the sunpath itself- to the east, south and west. The selection of a suitable site to facilitate such internal planning cannot be stressed enough. If proper preparatory work has been carried out the creation of a workable plan will be straightforward. By creating a harmonious internal layout the external appearance of the building will reflect this. Furthermore if the site is suitable, the building will 'sit' quite naturally on this. It is always a good idea to construct a scale model of any design before it is finalised. This will reveal the 3-dimensional quality of it, something that is not possible to see on paper.

The adaptability of any building layout will be critical as the future unfolds. Such adaptability might be required to facilitate normal life progression - children leaving home; parents coming to live and so on. However more radical changes in how we live and work might be demanded by the depletion of fossil-fuel reserves. If a home can accommodate such changes easily then the potential benefits to the occupants are obvious.

When a satisfactory plan has been arrived at, this can be 'drawn up' to be submitted for Planning Permission. It is important to carry out a realistic costing exercise before this is done. If the design proves too costly it can then be modified before being the application is made. Such applications require submission of a plan of each floor of the building; elevations of all its sides; a site layout; an outline of the materials to be used in the construction; details of the drainage system and a site location map along with appropriate newspaper and site notices. It is a good idea to clearly indicate that an application is for a sustainable dwelling and to note where this might coincide with any Planning policy set out in the local Development Plan. The Planning process itself takes a minimum of 8 weeks and at best one can hope to commence construction, after a Grant of Permission, 4 weeks later.

