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Sustainable Small House living in the UK

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INTRODUCTION

Objectives: The argument

The crux of the debate is this: We are living beyond our means in more ways than one, in the use of the resources on the planet and also our life styles. 2008 was the start of a dramatic recession which was brought about by living beyond our financial means. How to review this excessive life style and move to a more sustainable way of living in the twenty-first century that is to the betterment of all, will be under question.

It will be necessary to look at the way we have developed small house living through a historical perspective and how through necessity and in times of crisis small houses have developed and functioned. Additionally, I will look at how in the UK the demographics of the family has changed and how the Government has had to develop its housing strategy to apply to the shrinking size of the family and an ageing populous and how is this working towards the development of new small housing. Through independent research the existing housing stock of a sample people will be taken, what they are looking for when possibly downsizing their home and what possibly they require and see as important in a new low energy home.

A review of the traditional way of thinking and how the philosophy of '*keeping up with the Joneses*'[1] is fuelling the excess culture, will also be of focus in the latter part, and how we draw ourselves back from the brink and live a more compact life style and still be happy.

How can we achieve a low energy, small footprint home? Live comfortably without resorting to high embedded energy that blight today's current housing stock.

Historical back ground to small house living

This chapter will consider the historical back ground to small living looking at nomadic peoples, vernacular architecture and the introduction of industrial processes that led to the manufactured and factory constructed system buildings of today. The intention was to see how this progression of man in forms of shelter as the worlds populous expanded. The idea that man uses the indigenous materials available to him and using the resources carefully in a sustainable way as the nomadic peoples understood, allowed their way of life to continue through many generations. The size of their accommodation would be limited by what they could transport easily. The design of these shelters has changed little over the centuries.

The idea of a small footprint for a house has been seen as a frugal way of living and that the more you can afford, the house increases accordingly. This also applies to the materials available and the

vernacular houses were limited to size by the materials available and the skill and the knowledge of the builder.
The introduction of factory component building has led to many innovations in house design and materials used. One of which is the prefabricated house that has seen many developments and some of the variations are discussed in this paper.

The industrialization of Great Britain at a similar time of global expansion saw a massive influx of people from the country to the towns and cities that were springing up due to the expansion of mechanical processes. The mechanization of producing building products such as brick manufacture, and the ease of transportation on canal, rail and road led to the decline of the use of vernacular materials.
Since the 1860's the size of households has been reducing from 4.5 people to 3.9 in 1930 this dropped to 2.9 in 1971 and finally to 2.4 in 2001. This has also been reflected in the size of dwellings the average size of a dwelling since 1850 has steadily reduced to approximately 80 and 100 square meters.[2]

Figure 1. Terraced Housing built in the 1900's shown in the1960's[3]

Modern developments

The austerity after the Second World War led to a great need for new homes mainly for returning forces and replenish the bombed out houses of the towns and cities. This lead to the introduction of small prefabricated component dwellings, commonly and affectionately known as the "prefab". This housing form was designed using the technology from the factories producing armaments for the war effort. The use of aluminium is the primary material from aircraft manufacturing technology. This design was called the 'aluminium temporary', designed to be fixed in four sections it had all services and fittings incorporated in the design.

Figure 2. prefabricated house built using 'war' technology[4]

Other types of prefabrication designs were also developed using the industrial processes of the war machine, such as the use of concrete, steel, timber and asbestos.

Prefabs were aimed at families, and typically had an entrance hall, two bedrooms a bathroom (a novel innovation for many British families at that time), a separate toilet, a living room and an equipped kitchen. Most of these systems were never intended to provide permanent housing with an expected life span of 10 years. It was felt that, as after the First World War, there was a shortage of materials and of skilled workmen. A more urgent provision of housing needed to be made instead of the traditional building forms which the industry struggled to cope with. The answer was thought to be to supplement traditional building methods with industrialised building techniques - the use of factory methods to produce houses, large parts of which could be prefabricated in factories and then erected, using relatively unskilled labour, on the site. The result of this was that, all over the country, estates of "prefabs" appeared. The prefabs had a floor space of approximately 60 square metres. Generally set out on estates, these were to become a very much loved home and despite being originally designed as temporary accommodation, some still survive today. The idea of a detached home with a garden surrounding each unit provided an identity for the occupiers and a space to call their own.

Figure 3. Prefab owners fight to stay in their homes[5]

Today owner occupiers are reluctant to relinquish their homes but many UK councils are beginning to demolish the last surviving examples of World War II prefabs in order to comply with the UK government's Decent Home Standards.

House	Average Area in Sq Metres
Post WW 2 Prefabricated house	60
Terrace house	80
Average Semi detached	100
Average Detached house	150
Average Flat	60
Average Bungalow	70

[6]*Average sizes of dwellings post World War 2.*

Western cultures divide up their families with a family consisting of parents and children, older members of the family are looked after by a welfare system when too old to look after themselves. Rooms became an issue with separate bedrooms and division of living accommodation western housing reflects this diversification. Space increased accordingly as more space was demanded, by the introduction of internal personal washing and toilets in bathrooms. Size of accommodation has remained steady in the UK since 1860's somewhere between 80 and 100 square metres. For terrace houses and semi detached, flats have remained at approximately 60 sq metres.[7] The idea that generally small houses are below 80 square metres but by enlarge this is arbitrary dependent how many people the house is designed for. But a four person family could easily live in this sized accommodation.

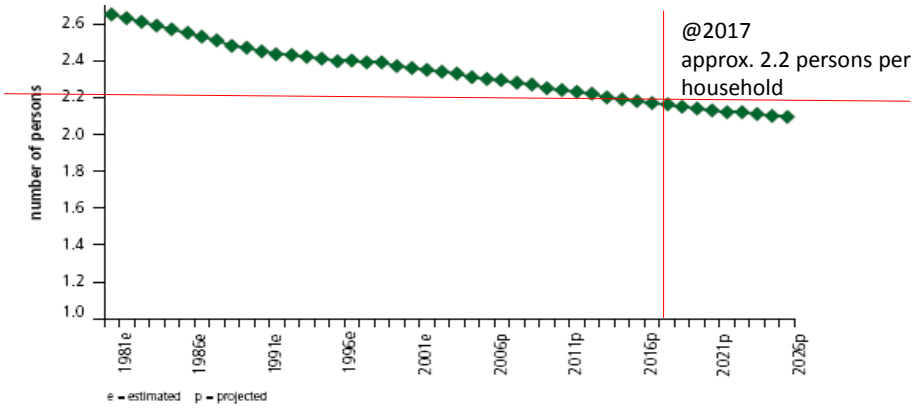
While small houses are designed and constructed in times of depression, war and disaster to house a homeless or influx of humanity, there is a pressing need to consider the requirement for small houses in times of population decline and in the changes in the nuclear family. The average number of people living in a household in England and Wales is 2.36 in 2001, down from 2.51 in 1991.[8] This statistic from central government also goes to on to say that less than forty per cent of houses is lived in by nuclear family and thirty-five per cent are occupied by people living alone. The overall decline in occupants in homes in Europe at present is at 2.2 and falling. Should this decline continue a radical rethink of how house design is developed in the UK and Europe? There is an urgent need to review our design strategy of housing need in the UK and Europe if we are keeping up with the demographic requirements. There appears to be a need for well designed and modern small dwellings in all guises, generally due to the lack of building sites within the confines of the United Kingdom.

SUSTAINABLE SMALL HOUSE LIVING IN THE 21st CENTURY.

The changing demographics of the family are requiring a rethink of modern housing. Many more single people and one parent families are requiring their own homes, with the prospect of an ageing population requiring housing to suit their needs. Small succinct design is required to reduce the land requirement the idea is to have a site density of sixty houses per hectare.

Government Housing Policy

The breakdown of the nuclear family in the developed world is due to population movement, small family sizes and marital breakdown.
The need is developing for smaller dwellings for single people and couples. There is a requirement to make this 'affordable housing'. There is a pressure on countries to provide housing for its ever increasing populations, and in Britain's case, an immigrant influx. The Government has a structure to build two and a half million new houses in the next ten years. This will put a great strain on our countryside as it planned that most will be built on greenbelt land. It is therefore imperative that the housing reflects on the requirement of the modern society. From the green paper 'Homes for the future: more affordable, more sustainable' [9]
The Government has issued various green papers on the need for sustainable housing and issued targets, but we face new challenges today. Demand for homes to buy or rent is growing faster than supply. As house prices have grown faster than wages, it is becoming increasingly difficult for young people to get a step on the housing ladder. The challenges of climate change mean we need to provide greener, better-designed housing for the future. The challenge set by the Government is to provide more homes.
Housing supply has increased substantially in the last few years and is now at its highest level since the 1980's, but supply is still not keeping up with rising demand from our ageing and growing population. [10]
While the housing stock is growing by 185,000 a year, the number of households is projected to grow at 223,000 a year, many of them people living alone.[11]

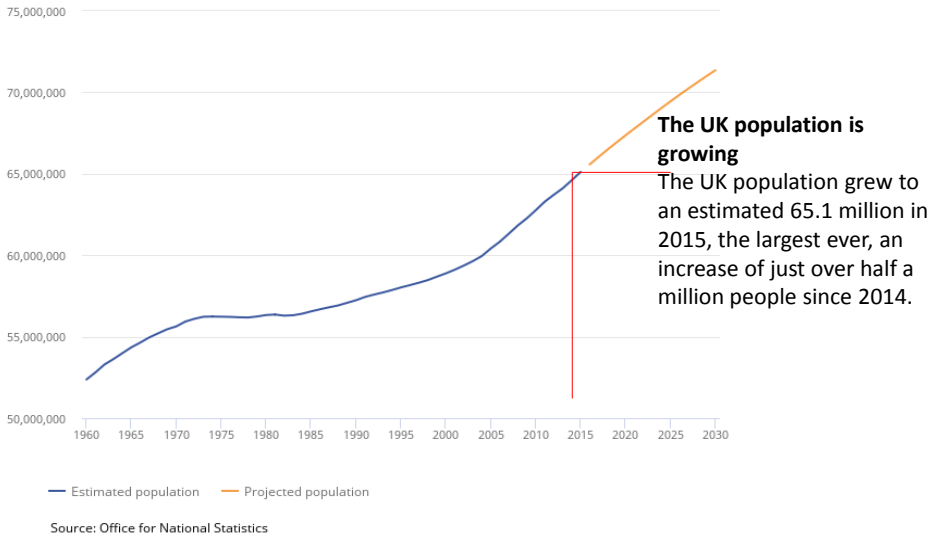


Predicted house hold size

DEPARTMENT FOR COMMUNITIES AND LOCAL GOVERNMENT (2007) *Homes for the future: more affordable, more sustainable.* Cm. 7191, London: HMSO (The Secretary of State for Communities and Local Government Report),

Figure 4. Predicted Household size[12]

Figure 1: UK population estimates and projections, 1960 to 2030



The UK population is growing
The UK population grew to an estimated 65.1 million in 2015, the largest ever, an increase of just over half a million people since 2014.

Figure 5. Actual & Predicted UK population growth[13]

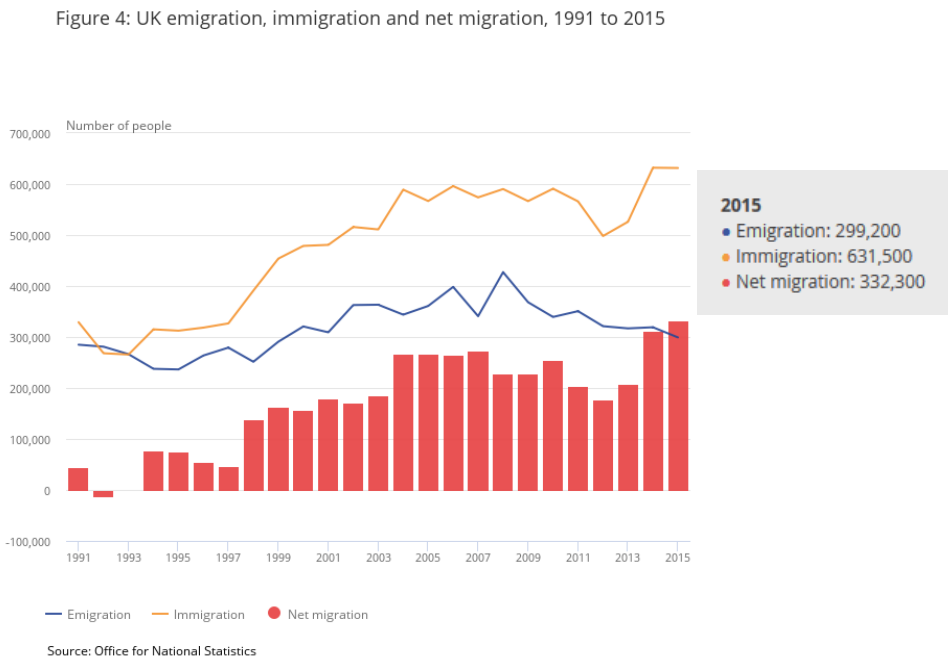


Figure 6. Net migration in 2015[14]

Estimates and projections of average house hold sizes

The estimated number of persons in a household has gone down from 2.6 persons in 1981 to a projected 2.2 in 2026. This is borne out by the United Nations statistics that Europe is now averaging 2.2 persons per household and falling. The predicted size of the average house hold decreasing in size will add to the pressure of demand.

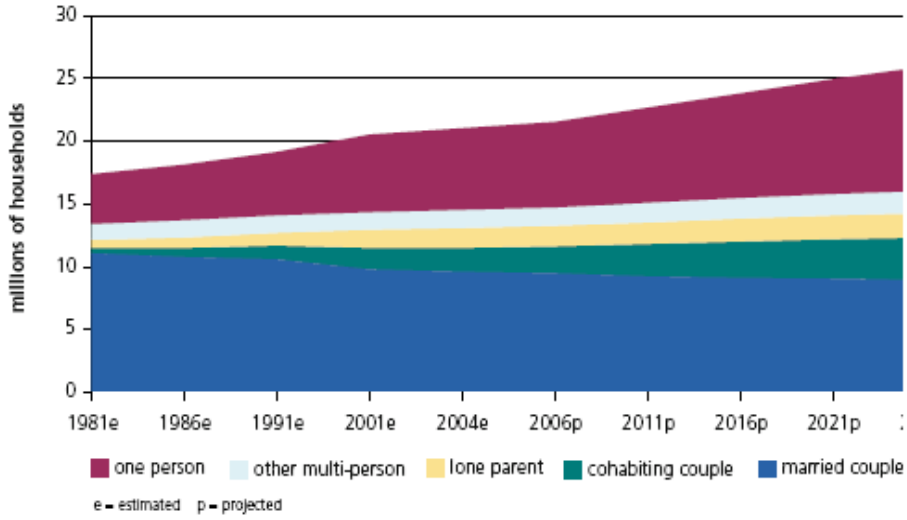


Figure 7. Estimates & projections of the number of households in England[15]

This graphic above illustrates that it is predicted demand for one person living will rise significantly in the next twenty years. The pressure on existing land requirements will be further exacerbated by the requirement of one person homes, from approximately 17 million in 1981 up to a projected 26 million

by 2021. This is by far the highest predicted social change in the UK. The prediction that married couple households will fall, but that cohabiting couples will remain static along with single family homes. Other multi person homes will rise slightly. While these are predicted changes it shows that single person living is a factor that the UK and initially Europe need to tackle.

Demographics: An Ageing Society

The UK has an ageing population and in the publication 'National Strategy for Housing in an Ageing Society' designed as a consultation document, stating that 30 per cent of households are headed by an older person. Over 60 per cent of over-85s live alone, and older people living alone account for a quarter of the total projected year on year household growth currently. In the future, there will be many older people requiring appropriate housing and services. For example, there will be 85 per cent more people over 85 by 2031. The ageing population is often more pronounced in rural areas. In the most rural local authority districts, almost half of residents will be aged 50 and over by 2028.[16]

The need is to build much more inclusive and flexible housing to meet future demand in an ageing society. In particular, we need to build homes that will be adaptable enough to match lifetimes changing needs. This can be achieved by building to Lifetime Homes Standard. (Fig 8.)

Lifetime Homes Standards are a set of simple home features that make housing more functional for everyone including families, disabled people and older people. They also include future-proofing features that enable cheaper, simpler adaptations to be made when needed. For example, they make getting in and around the home easy for everyone, whether they have small children or limited mobility. These guide lines are being used in housing developments today.

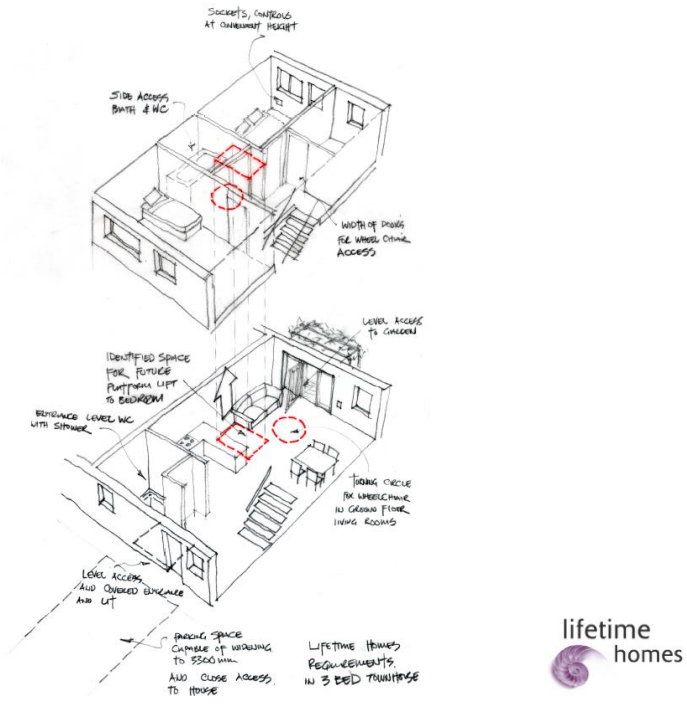


Figure 8. Lifetime homes adaptive housing[17]

THE CONCEPT SCHEME

Introduction

The idea is to produce a series of sketches that culminate in a concept scheme to show how a housing site can be developed to approximately Code 6 of the Code for Sustainable Homes Standard. The scheme represents the idea of Lifetime Homes and my idea that compact housing is possible and a housing site can accommodate families, couples and singles. The idea is that growing and shrinking families can move around the site or adapt their homes when time requires. Housing developments require some social binding for them to work.
The use of sustainable materials and renewable energy sources is also a major issue.

The site

The site is a Brownfield site previously a middle school and community centre in the small market town of Otley in West Yorkshire.
Otley is a Yorkshire market town of about 15,000 people, set on the banks of the River Wharfe. It is an ancient, picturesque town with a diverse commercial and community life, based around the farmers market. The town lies in the attractive countryside in of Mid-Wharfedale at the centre of the rural triangle between Leeds, Harrogate and Bradford. The sites orientation is north to south with a stepped slope from the north to the south. The area of the school buildings is relatively flat. There is a brook running to the west side of the site and public footpaths to the west and south. Mature trees form a divide between two playing fields as well as to the boundaries of the site in varying degrees. The site of the football pitch is a levelled space with a bank down to the community centre. (Fig 9)

St Martins Fields, Otley West Yorkshire Site Plan

https://www.google.co.uk/intl/en_uk/earth/

Figure 9. The site[18]

The previous occupation was a middle school with a large area of tarmac play ground a community centre and playing fields. (Fig 10) The Community centre remains and also the existing playing fields, they all are available to be incorporated into the scheme.

Figure 10. Brownfield site area[19]

Planning requirement is that the footprint of the school and playground be the only available land for housing development. The surrounding area of the site has a cottage hospital to the east and mixed housing some local authority owned as well as private to the other boundaries. The site is on an existing public transport route on Weston Lane. (Fig 10)

The Scheme

The idea of the scheme is to provide small affordable housing in three, two and one bedroomed town houses or apartments. The houses would be split and be available to both part purchase ownership and rental. The layout is designed to maximize the community spirit and encourage wildlife within the curtilage of the site. The football field would be turned into allotments for the residents. The playing field turned into a native species woodland and wild flower meadow. Encourage native bird species by adding nesting boxes. This would be continued into the housing site with facilities for swifts designed into the houses.[20] The addition of a pond will attract aquatic invertebrates. Also along the Sustainable Urban Drains (SUDS) that picks up the water from the porous paving and create a wildlife corridor among the houses. The idea also would be to use the water out of the pond in watering the allotments. The water would be pumped from the pond to an irrigation system when required. The design is very much based on the ethos of encouraging wildlife to the site. The Invertebrates Conservation Trust is known as '*Buglife*[21]' and they encourage wildflower meadows and living roofs, (on the community centre) which are proposed on this site. (Fig 10&11)

Figure 11. Overall Proposed site layout[22]

The house types are designed to be adaptable as Lifetime Homes and have a small footprint in Nett floor space. (Fig 13)

The Nett areas of the dwellings:

- Three-bed townhouse 80m². (Fig 13)
- Two-bed townhouse 67m².
- Two-bed apartment 58m².
- One bed apartment 46m².

The sizes of the dwellings are in line with the idea of small house living.

Figure 12. Housing area of the site[23]

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•Three bed townhouse 80m².
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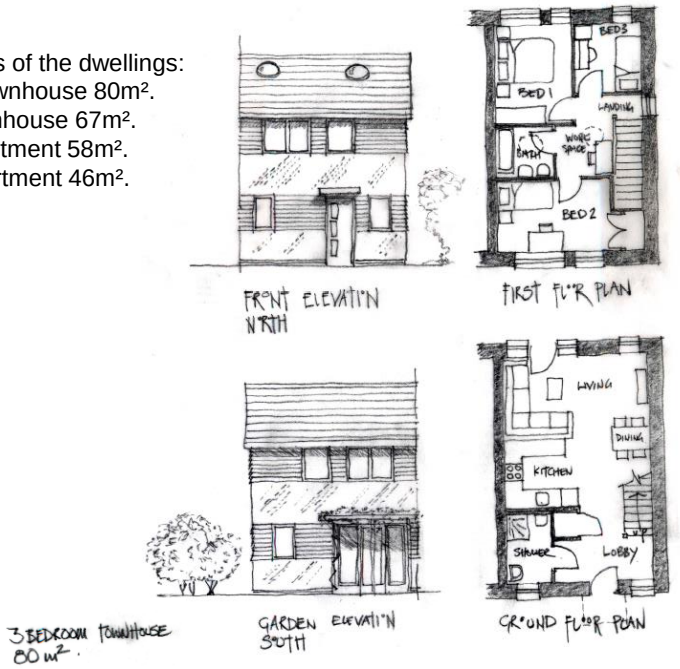

Figure 13. Typical 3 bedroomed house[24]

The materials play a major role in the design of the houses. The use of Hemp is the main external envelope material. The structure is a timber frame which will be from a local renewable source. The frame would be pre-manufactured away from the site and craned into position, with the interior permeable boarding attached along with the intelligent membrane fixed and sealed, requiring the final

sealing of the adjoining panels on site after the spray application of the hemp wall. This should allow for factory condition sealing to be carefully done especially around door and window openings.
The same operation would be carried out on the roof.
Super insulated homes that do not require space heating is the essence of the scheme along with low air permeability to Passivhaus standards using a highly efficient mechanical heat recovery system. (Fig 13) The problem is convincing the British public of the merits of permanent mechanical heat recovery. The building materials are very important in this and the walls are to be built up using timber frame as the structure and 500mm of blown hemp. Externally a 20 mm render finish and internally a 20mm lime plaster finish. The overall exterior wall is designed for a U value of 0.11 Wm^2/K, The roof a U value of 0.078 Wm^2/K.
The overall specification of materials is designed to meet the Building Research Establishments BRE Green Guide. At a level of C or above (the scale goes from A+ to E).[25]

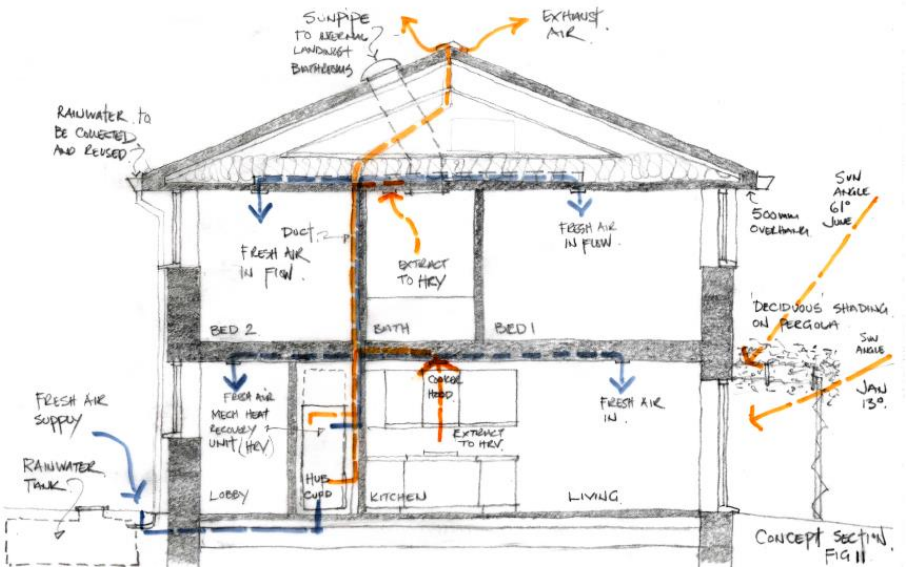

Figure 14. Typical house section.[26]

Summary and Conclusions

The thought process throughout this paper is think ‘small and simple’ I have tried to review the housing back ground and where we are going in terms of population.
Confusion reigns when discussing the size of houses. Clarity is required over square metre sizes (as used in Europe) to gauge the sizes and not by the number of bedrooms as we do in the UK.
The final section ‘concept scheme’ is an attempt at a Code for Sustainable Homes Code 6 development. As always the cost of achieving this and what is commercially viable is possibly some way apart.
The idea is that maybe we can all buy into the home, not been a status symbol of our wealth and success in life, and live more within our requirements the ‘keeping up with the Jones’ idea will all ways be prevalent, but the scheme is a possible way forward that like-minded people can move around a housing scheme as their needs change through life and be happy.

Commercial housing developers need to engage further in this dialogue of what the populous of the UK need and what presently is being offered.

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[14] Figure 6. Actual & Predicted UK population growth accessed on 10th May 2017 https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/datasets/deathsz4
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