Taking Stock
Fact sheet 2: Construction

Introduction

Cities have always been the hubs for their hinterlands, as those in the centre tend to organize and exploit those on the periphery. But the South East region is a unique case in the UK – the richest and largest region, the hinterland for Greater London, but also in many ways the 'edge city' for the conurbation, with better connections, faster growth, higher quality of life and so on. At the same time it is large and diverse, crowded and congested, beautiful and despoiled, with huge opportunities and problems in its built environment. What we see in this built environment – the urban form and fabric – is a direct result of these dynamics.

This factsheet looks at the practical issues in steering the construction of buildings towards reduced ecological footprint and greater sustainability. But the built environment is a complex thing, and with many environmental, economic and social angles to explore, we can sketch here only the key features at different scales. The starting point is the 'micro-scale' – the design, materials and material sources for the building fabric. This fits into its context at the 'macro-scale' – the location, density and form of urban areas and building types. There is also the issue of balance between the question of the construction or maintenance of buildings, and the question of how they perform throughout their lifetimes – whether it is better to replace older by newer buildings with improved energy efficiency.

Key facts

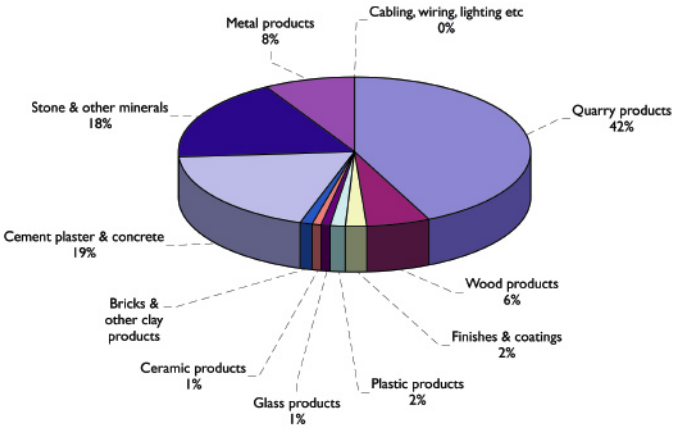
There are over 3 million dwellings in the SE region, and approx 300,000 other buildings. New housebuilding has recently been at a rate of 22,000 per year. A much greater rate of 28,000 per year, at a 1% per year expansion of the building stock, is proposed in the regional strategy and the government's 'Sustainable Communities' programme.

- Construction as a whole uses 50.5 million tonnes of materials directly (Direct Material Consumption or DMC), and 100 million tonnes in total material consumption (TMC). This equates to over 12 tonnes for every person in the SE region. Figure 1 shows the proportions of different construction materials.
- The construction industry is by far the most mass-intensive of any sector: the direct material consumption

is 57% of the regional total DMC from all activity: and the TMC is 47% of the total from all activity. However the bulk of this mass is not so energy intensive: construction activity produced 23% of the total CO_2 emissions, and 17% of the total ecological footprint from all activity in the SE region.

- Quarry products, including aggregates, sand, crushed rock and limestone, was by far the largest type of material flow, at 43 million tonnes, or 43% of the total material consumption (TMC).
- Cement, concrete and plaster products are the next largest, at 19 million tonnes TMC, followed by slate, bitumen, stone and other non-metallic minerals at 18 million tonnes TMC.
- Metal and metal products of all kinds, were 8 million tonnes, and wood / wood – based products are 6 million tonnes.

Figure 1: Total Material Consumption - proportion from different construction materials



There is an interesting comparison between the Ecological Footprint (EF) of construction of the built environment and the actual land area of the South East region, which is 1.9 million hectares. The construction footprint area ('real land' plus indirect 'energy land') is 5 times larger than the actual area of the region. Most of the EF is taken up with 'energy land', reflecting the high energy intensity of key construction materials (cement, bricks, glass and so on), and the small proportion of renewable materials.

- The total EF from all construction in the South East amounted to 9.5 million gha equivalent to 1.2 gha per person. This amounts to 17% of the total EF from all activity.
- The material making up the highest proportion of this was minerals, bitumen and mineral products with 41%, these being both heavy and energy intensive.
- Quarry products make up 22% of the construction EF, where most of the energy/emissions are involved with transportation, and 14% is taken by cement and plaster manufacture, which are particularly energy intensive.

Policy background

A key issue for the South East region is the effect of the rate of new building on the total Ecological Footprint, both now and into the future. One starting point is a comparison of construction EF to total lifetime EF for buildings. This is worked out for housing (public and private), and for services (public and commercial). Industry and infrastructure are accounted for in other consumption sectors.

The figures shown above are for construction as a whole. If we assume that material use is evenly spread by construction expenditure, then there is 25% in housing, 33% in commercial, 11% in public services, 12% in industry and 19% in infrastructure (this last category is likely to use much greater proportions of bulk materials, but regional data is not available).

The whole building stock consumes energy in use with an EF of 4700 gha in a year. This is twice the EF of the construction sector, which adds approx 1% of new housing and 3% of new commercial stock in the region every year. So the housing energy EF total is roughly similar to the housing construction EF, which constructs 1% of the housing stock each year.

So how long does it take before the energy in use is greater than the energy of construction? For housing under current specifications, about 50 years. For commercial stock, about 1/3 of that i.e. 15 years. This kind of calculation is important if we aim to optimise the investment in low energy / long life buildings. A key question for regional strategy concerns the possible effects of changing either the rate of new building, or reducing the EF in construction, or the EF of the direct energy in use in buildings. It is entirely possible to achieve massive reductions in energy and water use by using efficient/ ecological building techniques, even to the extent of creating 'zero energy' developments. (See Case Study)

Another key aspect of construction is to look the other end of the life-cycle at the end fate of the waste materials from construction, site preparation and demolition. At present, from the 50.5 million tonnes used in construction in the SE region each year, there are various waste streams:

- 6.4 million tonnes of mining waste from the extraction of quarry products
- 13.4 million tonnes of construction & demolition waste
- 0.3 million tonnes from the manufacture of construction products.

Taking off the waste component, the result is the 'net addition' to the stock of the built environment (houses, buildings, infrastructure) in the SE region of 37 million tonnes per year (4.6 tonnes per person).

There is potential for the re-use and recycling of much of the 13.4 million tonnes of construction and demolition waste, which arises both from construction practices on site and from larger scale demolition of older buildings. However the EF analysis shows that there is a large transport component, implying that the benefits of re-use or recycling will depend very much on how far the material has to travel to be sorted and re-distributed.

Possible future scenarios

In the full Taking Stock Project Report we consider four scenarios for each sector, ranging from high growth (Factor 0) through business as usual (Factor 1) to low growth (Factor 2) and finally a 'Factor Four' scenario which represents a more sustainable alternative involving more efficient use of resources and a reduced ecological footprint. The Factor Four scenarios are designed to achieve a 40% reduction in EF by 2020, and a 75% reduction by 2050, in line with the 'halving resource use – doubling efficiency' targets first set out in the book Factor Four published in 1997.

Possible future scenarios

High growth scenario (F-0)

Here there is unrestricted growth in urban development, with privatisation of infrastructure, and growing use of energy and materials. Housing shows polarisation of growth and decline based on access to hubs and services, so that prices in desirable areas are sky-high, and in others falling below zero. For commercial property, there is rapid turnover with increased fluidity and restructuring in skills, occupations, tele-work and job migration.

Business as usual scenario (F-1)

Continuation of current trends, with strict controls on land use, but increasing amounts of imported materials for buildings which tend to be larger, multi-storey and higher density. There is more strategic management of the balance of housing demand and supply, with sophisticated market intervention to ensure balanced provision of tenures, prices, types and fitness. Construction planning becomes more integrated, matching producers, consumers, locations and total values to society and the economy.

Low growth scenario (F-2)

This sees a decline in the rate of construction as a result of economic stagnation, social conflict and environmental hazards. Materials are increasingly expensive and environmental regulation is a luxury that few can afford. In towns and cities there is a managed retreat to major urban hubs which offer the best in controlled climate, sealed environments and continuous security, but among these there are steep price differentials. There are large inter-regional displacements of housing and jobs due to climate stress, and large flows outwards to rural new communities.

Possible future scenarios

Factor Four scenario (F-4)

This 'win-win' scenario sees the quality and overall efficiency of construction increase rapidly. The renaissance of city living allows large-scale re-development of brownfield sites, particularly around the estuary and former industrial / military sites. Affordable housing is managed through community owned housing associations and co-ops, exploiting the availability of old office space as the demand for this reduces, and there is a move towards more integrated community living.

In housing, majority lifestyles now favour the quality of space and proximity over the quantity of space, giving rise to new housing forms and tenures and involving co-operation on childcare, schooling and transport. In commercial property, the distribution of space for work and public services shows rapid changes, as specialised functions in warehouses and offices are replaced by generalised mixed functions organized at the local level. Offices are converted to housing in city centres, and vice versa in the suburbs, while increased manufacturing space is distributed to meet the needs of a more localised economy.

Policy implications

Generally the SE region is under more pressure than any other region to incorporate new housing on a massive scale. There is a population growth forecast of 5.5% per decade, and a reducing household size from 2.4 to 2.1 people, combined with current problems of over-heating, congestion, housing affordability and shortages of key workers. Dealing with such problems raises interesting issues for the application of a footprint method to policy making, for example:

- Spatial strategy: The location, density and form of buildings.
- Built environment activity in the urban system: The provision of new buildings for housing, commercial and public services, and the balance of stock / turnover / demolition.
- Construction design and materials: The materials and their energy intensity required per unit of floorspace.
- The energy use and other demands of buildings over their life cycle, the length of that life cycle and their eventual fate.
- Each of the above is influenced by property market, finance, legal and professional issues: for instance where landlord / tenant split responsibility is a constraint to energy efficiency.
- Each of the above is also influenced by lifestyles and cultural shifts: for instance the move towards urban living, or away from timber frame housing.

The current regional mineral strategy contains key targets for maintaining landbank resources for the largest materials types of aggregates, sand and gravel. These include increasing the use of secondary aggregates and recycled materials from 5.3 million tones per annum (23%) to at least 7.4 million tpa (33%) by 2016, to reduce the need for primary aggregates extraction, a trend which should be encouraged.

The regional spatial strategy has an influence on density and location, and local planning and building regulations have limited influence up to a point on building form and energy efficiency. To go further than this, particularly for the existing building stock, would require a new raft of regional powers and resources. There may be a need for some level of trade-off between the construction sector, where F-4 levels of reductions are difficult to anticipate, and the building direct energy sector, where large reductions are technically feasible.

Positive measures might include:

- Integrated resource management enterprises, which achieve step changes in material efficiency and material impact, by coordination between designers, contractors, material suppliers, demolition and waste managers, in the re-engineering of the built environment.
- Integrated energy services consortiums which achieve step changes in energy efficiency by coordination with utilities, financiers, developers, designers, contractors, owners and tenants.

Case study: Thames Gateway Eco-homes

A recent study investigated the implications of building 200,000 new homes to different environmental standards in the Thames Gateway, part of the government's Sustainable Communities plan for the South East. By developing these 200,000 new homes to a minimum of the Building Research Establishment (BRE) Eco-Homes 'Very Good' standard, many environmental savings could be made per home/year when compared with homes built to current Building Regulations: A 32 per cent reduction in carbon dioxide (CO_2) emissions from energy use in the home (this saving of 0.993 tonnes of CO_2/home/year equates to 198,840 tonnes of CO_2 for the 200,000 homes each year), and a 39 per cent reduction in water use could be achieved.

The study showed that even greater savings could be made per home per year by developing all homes in the Thames Gateway to what it calls Z2 standards (Zero fossil Energy, Zero Waste): This would achieve a 99 per cent reduction in CO_2 emissions from energy use in the home (this saving of 3.05 tonnes of CO_2/home/year, equates to 610,640 tonnes of CO_2 for the 200,000 homes each year), a 65% reduction in water use and a 76% reduction in waste sent to landfill.

The Z2 standards are based on the experience of the Beddington Zero Energy Development in South London. This is an urban eco-village developed by the BioRegional Development Group in conjunction with Peabody Trust which aims to show how green living is a real, attractive and affordable option. It comprises 82 homes, offices and live-work units, including a mix of social housing, designed for a comfortable and highly resource efficient way of life. The development recognises that the lifestyles of residents has an important bearing on overall environmental impact, and it makes every effort to make it easy to be 'green'.

For more information see report 'One Planet Living in the Thames Gateway' at www.seiy.org

For further details of our findings on construction see the full Project Report at www.takingstock.org.uk

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