Concrete Proposals

From cost effective basements to whole super insulated houses, ready mixed concrete has a lot more to offer the self-builder than just poured foundations, says Mark Brinkley, in the first of six special features on using the grey matter.

Of all the major elements that go into building a house, concrete gets the least attention. People argue until the cows come home over the pros and cons of using timber frame as against bricks and blocks, they bust the bank to get a particular roof tile and they'll fight over which heating system is best. But when it comes to concrete, they just chuck it in the ground and forget it.

Yet concrete occupies a unique niche in the world of construction. For a start, it usually arrives on site as a sloppy liquid and it has to be shaped there and then. But once this is done – and providing it's done correctly – it provides a rock like platform. There is really nothing else quite like it and it's a measure of its success that it is taken for granted the way it is. But in taking it for granted, we risk closing our minds to many of the unusual uses for concrete. These we will cover later in the series. But we'll start by looking at what concrete is, how it varies, how to buy it and how best to handle it on site.

What is it?: Concrete has existed in various forms since classical times. There is an archaeological site in Israel dating back to 7000BC which has uncovered an early form of concrete, still in remarkably good condition. The Romans were big users of concrete – in fact the very word concrete is derived from the Latin concretus, meaning grown together or compounded. Most of the surviving Roman structures, from the Colosseum to Hadrian's Wall, were constructed using concrete.

Techniques for making concrete have moved on from these early beginnings but the principle is still broadly the same – pieces of an inert hard material such as gravel or crushed rock are mixed together with a paste of cement and water and this is left to harden over time. Early versions of concrete used lime as a binding agent – you sometimes hear this referred to as lime concrete – but this has now been superseded by Portland cements which were first developed in England in the 1800s.

Despite the standardisation of its constituent parts, concrete exists in many different formats. By changing the type of aggregate, concrete can be made so light it can float or so heavy that it is almost twice its usual density. It can be made waterproof or porous. The surface can be as smooth as glass or rough textured or patterned. And it doesn't have to be dull grey – a variety of pigments are available which can transform the look and feel of concrete.

How to make concrete: Making small amounts of concrete is an easy DIY task – if you have a concrete mixer. General purpose concrete is made with a mix of sand and 20mm stone, often referred to as all in ballast or just 'all in'. You can make a reasonably strong concrete with this by mixing in the proportion of six shovels of all in ballast with one shovel of Portland Cement. DIY stores sell dry concrete mix in 25kg bags but if you want to mix more than a couple of barrow loads, you would do better to get the cement and the aggregate separately.

Even so, mixing concrete is slow going. One person working with an electric or diesel mixer will mix about a cubic metre of wet concrete in around an hour. Making concrete on site in a mixer will cost between £40/m^3 and £60/m^3, largely dependent on how cheaply the aggregates (i.e. the sand and gravel) are bought, which itself depends on the quantity bought. In largish (10 tonne plus) loads, aggregates should be obtainable at under £10/tonne; however, aggregates are much more expensive in small loads. Another factor to consider is availability of mixers (usually hired at £10/day).

Mixing on site is often referred to as hand batching and whilst hand batching is fine for small tasks like concreting a small patio area, once the volume of concrete gets above two cubic metres it is usually much more convenient and just as cheap to get the whole lot delivered to site in a readymix concrete lorry.

Readymix loads are always going to be preferable where consistent concrete strength is important because the mixing of the ingredients can be carried out much more accurately. Crucially this includes the amount of water going into the batch, something which has an important effect on the long term performance of the concrete. In contrast, ▶

▲ It's a measure of its success that concrete is taken for granted the way it is but in doing so we risk closing our minds to many of the unusual uses beyond poured foundations and oversite slabs. Ready mixed concrete can also be used to create basements, drives, paths and highly energy efficient houses using insulated formwork.

A standard readymix lorry holds 6m³ of concrete – equivalent to around 70 barrow loads – and if you require several loads, the supplier will send a new truck out every 40 minutes or so to give you time to unload. Be warned that there is a time penalty if you delay a readymix truck.

when hand batching, it is difficult to control the amount of water in the mix.

How to buy Readymix: There are a few crucial points to understand before you even start looking for a readymix supplier. Don't just phone up and say you want some concrete. There are various types of concrete available for different applications and you need to be able to explain how the concrete is to be used. There is a lot of building jargon regularly bandied about here and if you don't know your strip footings from your trenchfill or whether your slab is reinforced or not, then you must seek the help of a professional to give you the necessary guidance. The concrete you need is dependent on a number of factors – typically what the concrete is being used for, how it's being delivered, whether the concrete is being reinforced with steel and whether there are any chemically aggressive ground conditions – here you need a specially formulated mix usually referred to as being sulfate resisting.

The readymix suppliers themselves are well versed in helping you select the best mix for your particular application but they depend on you giving them accurate information which means that you need a basic understanding of the issues involved. If you have unusual ground conditions, your architect or building inspector should be advising you closely as to what exactly is required. You may need to specify a required workability – your chosen supplier should be able to advise on this issue – and you must ensure that water is not added to the concrete on site.

In order to simplify matters, readymix is now usually supplied in a range of designated mixes (see table on p103). Not only are these designed to be correct for each application but they are also independently quality assured – indeed these designated mixes can only be delivered by quality assured suppliers. There are – confusingly – two quality assurance schemes in operation in the readymix industry, one operated by BSI and the other by QSRMC, and their logos should be prominently displayed on Yellow Pages adverts and invoices.

Another crucial bit of information needed is

> **"The price of readymix is very sensitive to the distance it has to travel, so in order to get a competitive price, buy locally."**

the volume of concrete required. You can estimate this pretty accurately by site measurements – the volume, in cubic meters, is derived from multiplying the length by the breadth by the height, all of course worked in metres. So, for instance, a concrete floor slab measuring 10m x 6m x 0.1m deep would require 6m³ of readymix. If you can't accurately measure the volume you need – for instance you might be filling a formless hole – you must be able to give some indication of what you think the volume might be. You pay for readymix by volume and your supplier needs to know, within reason, how many truckloads he is going to supply.

Readymixed concrete is usually sourced direct from the suppliers. They have their own section in Yellow Pages – look under Concrete – Ready Mixed. Some of these suppliers have links with builder's merchants which can be useful for self-builders as it means you may be able to buy your readymix on account rather than having to pay a cheque in advance. The price of readymix is very sensitive to the distance it has to travel so, in order to get a competitive price, look for suppliers who are local.

Most applications are best poured in one session so you need to book a delivery well in advance and have the manpower available to make sure it's all placed correctly. Normally concrete remains workable for a few hours – though in very hot weather it can start setting much sooner. A standard readymix lorry holds 6m³ of concrete – equivalent to around 70 barrow loads – and if you require several loads the supplier will send a new truck out every 40 minutes or so to give you time to unload. Be warned that there is a time penalty if you delay a readymix truck. Also be aware that it is conventional to charge something for the empty space if you only take a part load. Therefore, if you were to order, say, 9m³ of readymix this would require two 6m³ lorries on site but the second one would only be half full and you will pay something for the 3m³ capacity that you haven't used.

Typically, whilst readymix costs between £45 and £60/m³, the part load charge is usually levied at around 30% of this price to cover the fixed costs of the driver and truck. The empty space charge is often waived on larger orders – typically more than two full truckloads. Generally, the more readymix you can pour in each session, the cheaper the unit cost of it will be. On smaller pours, it may be more economical to use one of the many Mini Mix suppliers who run fleets of small readymix trucks. It's a good idea to check to see if they have a quality control system in place.

Health & Safety: One important point to understand is that wet concrete burns the skin. Not immediately – it's not hot to touch. Rather it's a slow acting chemical burn. Getting wet concrete splashed on your skin is not a problem, provided you don't leave it there for hours. You must wash it off thoroughly. Note that if you get a splash in your eye you should wash it out immediately. If you are having to wade through wet concrete in order to level it (as you probably would if you are pouring a floor), make sure that you are wearing a decent pair of waterproof boots – wellingtons are ideal – so that your feet don't come into contact with the concrete. No matter how hot it is, don't strip off to pour concrete – keep covered.

Other issues to watch out for are back injuries and trench collapse.

Barrowing concrete is heavy, exacting work and you need to be fit to do it – each cubic metre of concrete weighs around 2.5 tonnes. If you are not up to it, consider hiring a concrete pump which will deliver the concrete to the spot you actually want it. Trench collapse can be very dangerous, especially if you are working with deeper than normal foundation trenches – deep trenches are usually filled with concrete which will, of course, prevent any collapse but the action of filling the trenches, either from wheelbarrows or dumper trucks, can cause the trench walls to give way. If you feel that there is a danger of trench collapse, the use of a concrete pump is strongly advised.

Concrete pumps can be hired for around £150–£200/day. They pump a full load (6m³) in 20 minutes, about three times quicker than three men barrowing. They are extremely useful when there are large amounts of concrete to be shifted (say more than 30m³) or where access is difficult or safety a concern. If using a pump be sure to let the readymix supplier know, because the concrete is more fluid and the through put of lorries is much faster than on a normal job.

Green issues: Some environmental campaigners have attacked the use of concrete in construction. However, a close analysis of its impact shows that it is, arguably, one of the more benign materials used and many of the better informed environmentalists know this and some will even happily advocate its use.

Whilst cement production is a potentially polluting process, it is now very well controlled. And whilst cement also uses a lot of energy to manufacture, it is only a minor constituent of concrete, typically around 15% by volume. In recent years there has been a tendency to blend Portland cement with other products that are processed wastes of other industries. These cements are used in many prestigious civil engineering projects like bridge building so there is no doubting their effectiveness. Concrete technology never stands still and there is constant innovation going on in producing mixes which either perform better or recycle more waste materials.

The largest constituent part of readymix is of course aggregate – chiefly sands and gravels and crushed rock, the products of quarrying. Whilst the creation of new quarries is undoubtedly a thorny political topic, the actual long term environmental impact of quarrying is negligible. Holes in the ground are needed for landfill and recreation. The UK is now dotted with dozens of nature reserves formed out of abandoned quarries.

Concrete production also tends to be a very local affair. Because it's heavy and bulky, transport costs make up a huge part of the delivered cost of readymix and the country as a whole is well supplied with readymix plants – there are over 1,200. Therefore, unlike with other building materials, you will rarely see readymix lorries clogging up the motorways – the average distance travelled from readymix plant to site is less than 15 miles. In an increasingly congested Britain there is a good argument to stay local if you want to build green and, on this front, readymix is an ideal choice of material.

Finally, it's not generally realised that concrete itself is readily recyclable. Although correctly specified it will last for centuries, it can also be readily broken up and reused, usually as hardcore in foundations but increasingly in place of aggregates in new concrete mixes. ■

TYPICAL APPLICATIONS FOR DESIGNATED MIXES

TYPICAL APPLICATION	MIX DESIGNATION	RECOMMENDED WORKABILITY (nominal slump, mm)
FOUNDATIONS		
Blinding and mass concrete fill	GEN1	75
Strip Footings (non aggressive soils)	GEN1	75
Mass concrete foundations (non aggressive soils – i.e. Class 1 sulfate conditions)	GEN1	75
Trench fill foundations (non aggressive soils)	GEN1	125
Reinforced foundations in Class 1 sulfate conditions	RC35	75
Foundations in Class 2 sulfate conditions	FND2	75
Foundations in Class 3 sulfate conditions	FND3	75
Foundations in Class 4A sulfate conditions	FND4A	75
Foundations in Class 4B sulfate conditions	FND4B	75
GENERAL APPLICATIONS		
Kerb bedding and backing	GEN0	very low (nominal 10)
Drainage works to give immediate support in non aggressive soils	GEN1	very low (nominal 10)
Other drainage works in non aggressive soils	GEN1	50
Oversite below suspended slabs (non aggressive soils)	GEN1	75
Fill to wall cavities	GEN1	125
Solid filling under steps	GEN1	75
FLOORS		
House floors with no embedded metal		
■ Permanent finish to be added e.g. screed or floating floor	GEN1	75
■ No permanent finish to be added e.g. carpeted	GEN2	75
House floors containing embedded metal	RC30	50
Garage floors with no embedded metal	GEN3	75
PAVING		
House drives, domestic parking and external paving	PAV1	75
Heavy duty external paving	PAV2	50

NOTES

1) Concrete containing any embedded metal should be specified as reinforced

2) A higher grade of concrete than that tabulated for floors may be necessary to obtain a satisfactory power float finish