The characteristics of traditional construction

Abstract

Traditional construction implies more than simply the physical attributes of a building method that has ensured satisfactory performance. It also encompasses the social structure that produces that building method. We should also be aware that just as the building method might have evolved to produce the form that we see today, so might the social structure. This paper considers those social characteristics of tradition construction to ask what lessons might be drawn form them. It recognises that official action might have to be taken in some places to encourage rapid changes that elsewhere might have developed slowly.

The characteristics of traditional construction

Introduction

The title of this conference comes from the simple observation that in a number of instances earthquakes have caused greater destruction to buildings using modern forms of construction than they have to traditional buildings in the same place. This commonly means the use of reinforced concrete that has proved inadequate. However, it is clearly impossible that we should return to nothing other than the traditional forms of building. These new forms of construction have been introduced for good reasons and might, if properly built, be perfectly safe. My thesis here is that traditional construction involves more than just its physical form; it also involves processes that might have been lost in the adoption of the new methods. This means that learning from traditional construction involves examining and learning from those processes.

The physical form

What then are the characteristics of traditional construction from which we are trying to learn? Traditional construction is part of the informal sector of the building industry, largely carried out without professional involvement by builders working with a vernacular that they have learned through some form of apprenticeship. While construction methods vary across the world all share some simple characteristics. These are that:

1 They make use of local materials
2 They have evolved to cope with local conditions
3 They are robust.

The building methods will have been developed to use the most economical materials available that will give adequate standards of performance. This performance includes both the satisfactory planning of the building to suit local patterns of use and a sufficient construction to provide adequate thermal performance and resist the imposed loads. For example, in some places light-framed timber houses might only have to resist light winds, or adobe or stone construction might suit regions of large diurnal temperature variations, and so on. But in earthquake zones we expect to see structural arrangements that will resist

lateral loads and some of these have been described by other contributors to the conference.

Modern engineers might concentrate on providing adequate strength to resist the forces on the structure while others see earthquake resistance as a problem of energy absorption. Similarly traditional structures might exhibit different structural characteristics for earthquake resistance. A timber frame might flex and absorb energy rather than relying upon the strength of the structure while other kinds of construction are able to carry large forces without excessive deformation. Of course, while the present-day engineer makes a conscious choice of design approach, the forms adopted by traditional builders have often developed as a matter of trial and error using the given materials.

By using the term 'robust' to describe traditional construction I mean that the construction used will accept some variation in both the properties of the materials used and in the standards of workmanship. Of course to an engineer this means that the materials are lightly stressed.

The social system

Much traditional construction is carried out in the absence of any formal methods of quality control. Even today this might still be the case, possibly because building is in remote areas where it is difficult to police construction. It might be because there are inadequate resources to control building or because the pace of development has outstripped the ability of bureaucratic systems to keep up. In the absence of formal methods of quality control there must be something else that ensures sound construction. This might be little more than the personal reputation of builders so that a Darwinian survival of the most competent (or at least the most trusted) is in operation. Otherwise there might be methods that are internal to the craft system itself. These are:

1 Control of entry to the trade
2 A recognized training system.
3 Sanctions for poor work.

Traditional building is a craft process by which I mean one where the trainee learns from someone who already has the necessary skills. We commonly call this an apprenticeship although it need not involve the formal training agreement that this word implies. The apprentice works under the direction of a master and does this while engaged in building work. While craft skills can also be taught in formal training programmes away from the work itself, the advantage of the traditional method of learning while working on the job is that the skills are imparted over a long period of time. By doing this the apprentice (or trainee) sees the building techniques he is learning used in a variety of situations. He will see how the basic forms are adapted to suit different situations and thus what is learned is also the ability to make judgements about when and how to make those variations. The apprentice will also learn the limits of the methods used. The result of this is an inherently conservative approach and builders trained in this way will be hesitant to make too many variations upon the standard methods.

Entry to a building trade is often controlled by limiting membership to those who have undergone such an approved apprenticeship. Even today entry to professional bodies requires not only the passing of an examination but also a minimum period of practical experience.

Control of standards in craft systems might involve some form of internal control rather than an externally imposed method. For example, in Britain at one time the craft organisations (called 'guilds') were under an obligation to seek out and destroy any materials or work that was defective. This 'quality control' function which protected the public was carried out in exchange for having entry to the craft restricted. However, the system eventually broke down and it then became necessary for the clients to employ their own people to supervise the work on their buildings [1]. These might be other craftsmen employed in this role, and called 'clerks of works', or they might be professionals. In some cases both were employed. The professionals involved were either architects or surveyors but the use of the former was also associated with professional design, which takes us beyond traditional building.

Developments within traditional construction

As the changes referred to above show, traditional building is far from static. New ideas might be introduced or new materials might become available, and the way in which the craft adapts to such changes depends upon the degree and rapidity of the changes involved and the overall social structure within which it occurs. My own work on the development of carpentry in Britain, during the seventeenth and eighteenth centuries has shown a number of changes that took place [2]. These were:

1 Developments in building forms
2 The introduction of new methods of forming roofs and floors.
3 Changes in the materials available.
4 The introduction of building regulations

Various changes were imposed upon the carpentry and joinery trades to which they had to adapt. There were changes in architecture that involved modifications to the layout of houses and increasing spans for both roofs and floors. These were accommodated by new forms of roof construction that enabled carpenters to build longer spans with less timber, and by changes in the arrangements of floor timbers. It was also necessary to use trussed timber partitions for internal walls of upper floors. Moreover, while these changes were being absorbed by the carpentry trade, shortages of the traditional building timber, native oak, meant that carpenters also had to learn to use imported softwoods. There was to be a further change at the end of the eighteenth century when supplies of these shifted from Baltic countries to North America, again affecting the species of timber that were available – although now the effect was greater on the joinery trade rather than upon carpentry [3]. All these changes were compatible with the existing craft skills.

Of course, public safety also requires a degree of control over building, which was, in Britain and many other countries, first a matter of fire protection. Later came concern for issues of public health that required the development of more complex building regulations and means of enforcement. These controls were

applied over what we would still recognise as traditional building, i.e. buildings of recognizably common form erected without the involvement of professional designers. None of this affected either the method of design or the form of the buildings produced.

At present countries with a long tradition of building control have developed relatively sophisticated systems over a period of time. These developments will have been introduced principally in urban societies but today might be breaking down under pressures of rapid urbanization, especially where a proportion of buildings are not only put up by what I have called the informal sector of the industry but which might also be illegal. It would be naive to assume that similar sophisticated systems could be introduced in places that at present have few building controls and a relatively undeveloped system of administration and enforcement. There are then lessons to be drawn from the early methods that were put in place and which eventually developed into the present sophisticated systems.

Consider the position in Britain where any contravention of the early fire regulations would have been immediately obvious so that methods of inspection could be simple. With a developing need to control building in the nineteenth century under public health regulations, the thickness of walls was controlled to give adequate structural strength and stability. Openings in the walls were controlled for ventilation and light. Again inspection of these requirements was simple. However there was no recommendation for the control of the sizes of floor joists because of a concern that the local authorities, who had to enforce the regulations, would not be able to provide sufficient manpower to check this aspect of construction. Thus, even when there is a control structure in place its possible effectiveness might be limited by the resources available. The lesson to be drawn from this is that in developing new forms of construction methods should be considered which offer simple methods of control. Regulations should be within the powers of the authorities to enforce if they are not to be treated with contempt.

Process of adoption.

Since the building trades successfully adapted to the external pressures for change what were the processes by which this adoption occurred? How, for example, did carpenters learn about the new methods. Part of the process involved the intervention of professionals but, confining attention to the craftsmen, we can identify two principal techniques that were important during the eighteenth century and one that became important later. These were:

1 Word of mouth.
2 Text books.
3 Published regulations.

The simplest transmission process is by word of mouth or by simple copying. Those who learn of a new technique, or who invent it, teach it to others that they know. Alternatively their work might be copied by others. Of course this is a slow process and one which is prone to error because there might be mistakes in copying. In Britain there were rural areas that were still using earlier methods

more than 50 years after the new carpentry techniques had been introduced into the country and had become well known in the major centres.

Another method is through their publication in books and the carpentry techniques introduced into Britain during the seventeenth and eighteenth centuries were illustrated in carpenters' manuals. These were needed to teach carpenters new architectural fashions, to instruct them in the setting out of different kinds of work and to give them an understanding of new structural principles and a wide variety of books were published beginning in the mid-eighteenth century. However, the manual skills that the carpenters required to follow the new methods remained substantially the same. With increasing sophistication in traditional construction the use of such manuals became an aspect of training and the trainee needed to be made aware of such sources.

With increasing official control over building standards it became possible for the regulations themselves to become, in effect, the principal building manual. This was (and to some extent still is) the situation in Britain. Where regulations prescribe building methods builders, or even architects, will follow them, For example the diagrams and tables in the regulations are regularly used to proportion staircases or size roof timbers.

The introduction of new construction methods.

Clearly in countries where there has been a shift form traditional construction to reinforced concrete it is because the latter offers advantages over the former. This might be a cost advantage although it might also be that the new method enables a higher productivity, that is it increases the capacity of the building industry to meet a growing demand for building that cannot be met by expansion of the traditional system. There will not have been time for the new method to be adapted to the circumstances of the place so that buildings might be less than satisfactory in respects that will be immediately apparent. For example they might provide inadequate standards of thermal comfort. Thus we might anticipate some immediate modifications. But our concern here is that it is not until the first earthquake that any possible structural inadequacy of the method, as actually used, will become apparent, by which time very large numbers might have been built. This is what happened with disastrous consequences not only in the recent Turkish earthquakes but also in others.

Note here the use of the phrase 'as actually built'. The behaviour of the structural system under earthquake conditions might not be fully understood by those designing structures. This would lead to failures of design. But well designed structures might be poorly constructed because of inadequate training of builders, or by simple dishonesty because it costs less if poor materials are used or reinforcement is simply omitted. The difficulty with reinforced concrete is that ensuring adequate reinforcement is used requires inspection while control of the quality of concrete requires testing. Some other modern methods of construction, such as timber frame are much simpler to police.

The professional's role is to understand the new method and to design correctly with it. An alternative is for professionals to consider how traditional skills and the

traditional methods of construction might be adapted to compete with the new method. However, my concern here is not to consider the physical forms that such alternatives might take. These will depend upon the nature of the traditional construction. It is the social changes that are occurring that are the issue, whether completely new construction is adopted or whether there is an adaptation of the existing system.

Social questions

The first question is simply who builds with any new form of construction and there are two alternatives:

a) Either the existing builders learn and use the new techniques or
b) new people enter the industry who have not built before.

We might suppose it to be preferable for established builders to adopt the new techniques, assuming that this would ensure a better standard of building. However, there can be dangers where this happens because any craftsman can bring to a new method (or a new material) assumptions and techniques that are no longer appropriate. There have been numerous cases where this has happened in several of different crafts. Training develops habits that are not easy to break and practices that, if not understood, are simply meaningless rituals. It might be a question of unlearning old methods as much as learning new ones.

However, we simply do not know what happens in any particular place when a totally new method of construction is introduced. Traditional builders might simply avoid the new methods of construction or they might manage to change. New people might move into the building industry to satisfy a shortfall in supply or because they see this as a means of avoiding the training barrier which had previously excluded them from building. The new method might be regarded as requiring simpler skills and less knowledge. If that is so what then limits entry to building, who trains the builders and who informs them about the methods?

A possible means of dealing with the first of these questions is to require builders to be licensed in order to prevent the untrained from carrying out building work and so representing a public danger. This is a mechanism used in some countries, the United States for example, but not in others, such as Britain. However registration of builders that is not dependent upon some demonstration of competence, might simply be a piece of meaningless bureaucracy. If builders must be licensed then perhaps only a builder who has attended a course and demonstrated his skill should be able to obtain a license. There is, of course, no essential difference between this and the apprentice system that was required by the traditional craft guilds. It is simply a shift from control by the craft itself to control by the state. Such central control, which implies control over the training as well, might be difficult to implement.

The training of the builders might be a task that central government is unwilling to undertake. In Britain the Construction Industry Training Board was wound up several years ago. However it is possible for the supply sector of the building industry to provide training in the products that it produces. Again citing British

experience, both the steel and concrete producing industries have a history of providing training in the use of their products. Of course, this is because they are in competition with each other and see training as a marketing device. Where reinforced concrete is the only system that is on offer, some other incentives might be needed to encourage the supply industry to take up a training role.

The position is similar for the supply of information on the use of new products that might be introduced to the market because even what appear to be simple changes can produce problems. In the 1970s following the introduction of trussed rafter roofs in Britain which replaced roofs built on site by carpenters, there were a large number of failures because of inappropriate use. To overcome this, the manufacturers deccided to issue leaflets with deliveries of these components to show those on site how they should be used. One could not assume that those employed to build with them would know how to. However these instructions were only produced because of a concern that the failures would lead to a loss of confidence in the product. Information was not spontaneously supplied until a problem occurred.[1] This suggests that we cannot rely upon the market to provide product information. As long as a product or material is bought the manufacturers and suppliers are not concerned how it is used. This might be especially so for products like cement or reinforcing steel that are not closely related to the final form in which they are used.

An obvious measure to address both these issues might be to levy a tax on producers that would be used to pay for training. However, if the government does not wish to engage in this process an alternative might be a tax concession for the costs of any training that the industry itself provides. Such techniques could then be linked to the requirement for builders to be licensed. The advantages I see here are that manufacturers are in a better position to adapt the training to developments in their products and their management of this training would relieve central governments of the need to establish programmes.

The processes of diffusion.

Government policies are not something that we can directly influence but if the intention is to promote safer means of construction we, as professionals should consider what kinds of construction are most likely to be adopted. The direction of a number of papers in this conference has been towards the development of either new or modified methods of construction that will ensure greater earthquake safety than those being used at present. Such innovations are useless unless they are adopted by builders. This means that we should be concerned about the process by which new ideas are adopted and/or about whether our ideas might be well received by those that we hope will use them.

[1] A more detailed examination of this episode is provided by David Yeomans (1988) 'The introduction of the trussed roof rafter in Britain' *Structural Safety,* 5, 149 -153.

In the United States during the 1950s a branch of sociology was established by Everett Rogers [5] concerned with understanding the diffusion of innovations. The original concern of this work was to aid dissemination of the results of agricultural research that had developed new and improved strains of corn. It was not sufficient to simply make the seed available; its uptake by farmers had to be actively promoted. A later concern was to assist aid workers in improving public health in the rural communities of developing countries by introducing better practices in cooking and hygiene. The sociological research looked at two principal issues. It identified the characteristics of people involved in the diffusion process, defining such terms as 'early adopters', 'opinion leaders' and 'change agents'. It also considered the extent to which the practices that they were attempting to introduce conformed to the existing belief patterns of those they hoped would adopt them. This is surely the problem that we need to consider.

In developing improved methods of construction that provide greater security against earthquakes we are in much the same position as the aid workers who were attempting to promote methods of improving public health. Their concerns were to encourage such practices as the boiling of water to kill the disease causing bacteria that could not be seen by their target group. Worse still, for some, boiling water put it into a category of food that was only given to children and the sick. One can imagine the resistance to the new ideas that was experienced. We are attempting to promote building practices to ensure structural safety during events that the builders have not experienced and we cannot assume that builders within the informal sector of the building industry, who might well be conservative in their approach, would readily accept the improvements that they are offered. The problem might not be just that the advantages of the proposed changes are not apparent but that they might even be contrary to normally accepted practice.

I suggest that if we wish to encourage the adoption of building techniques that we believe to be safer than those currently being practised, then we need to learn form the experience of these earlier workers in other fields. Rogers's pioneering work on the diffusion of innovation led to an extensive literature in this general field with his ideas being applied in a wide range of situations. However, in spite of the enthusiastic and widespread adoption of his ideas and methods, his review of the literature shows that there has been almost no application of his ideas to the building industry [6]. We are surely in much the position that he was in during the 1950s and now need to consider his work seriously.

Notes

1 For a discussion of work during this period of transition see David Yeomans (1988), 'Managing eighteenth century building', *Construction History,* 4, 3-19.

2 David Yeomans (1992), *The Trussed Roof : its history and development*, Scolar Press: Aldershot.

3 For a more extensive survey of eighteenth century developments in the British building industry see James Ayres (1998), *Building the Georgian City*, Yale: New Haven and London

4 A more detailed examination of this episode is provided by David Yeomans (1988) 'The introduction of the trussed roof rafter in Britain' *Structural Safety,* 5, 149 -153.

5 Everett M. Rogers (1962), *Diffusion of Innovation*, Free Press: New York

6 See for example the bibliography in E.M. Rogers, 4th edition, 1995.