

Multicultural and Inter-disciplinary Aspects of Design and Technology: an Overview of Japanese Carpentry

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Japanese carpentry treats both tools and wood with a reverence that may seem a world away from the workbench in British schools, as Graham Howells reports

Visiting a trainee English teacher on teaching practice recently, I found her encouraging the pupils to write haiku, a Japanese form of poetry with a very simple structure. Having recently returned from a two-year contract in Japan, I was able to lend the student a book of haiku poetry with the Japanese and English versions printed side by side. The pupils were able to copy the characters and to have a brief introduction to a completely different mode of writing from that which they were used to. This episode represents a very small contribution to intercultural awareness, and we are accustomed to these contributions coming mainly through the arts and humanities areas of the curriculum. This article will try to show how teachers of design and technology might also be able to give a broader perspective to both the practical and the intellectual sides of the subject.

■ Religious background

We are used to the idea of a close connection between the medieval craftsman and the spiritual life of his time. The great cathedrals represent some of the most advanced technology of the period. We may imagine the consultations between the bishop, with access to the accumulated scientific knowledge of the ancient world preserved in texts, and the chief mason, relying on knowledge accumulated from a lifetime's experience. As far as we can tell, however, there was a separation between the lives of these men: one existed in a full-time religious life, the other in a secular one. In Japanese tradition the carpenter, although not a priest, has traditionally been much more closely associated with the spiritual values ascribed to materials, and to religious ceremony than his European counterpart.

If we are studying the relationships involved in Japanese carpentry therefore, we are immediately taken into the interdisciplinary area of comparative religion and there is an opportunity here to link with RE teaching. Coaldrake illustrates the strong connection between the Japanese carpenter and religious observance:

The deep religious meaning of the Way of the Carpenter is reflected in the many solemn ceremonies and rituals that have been performed since ancient times as an integral part of the building process. Most of these ceremonies follow the rites of the native Shinto religion, but there are wide

variations in observances depending on local or family customs.... The cyclical rebuilding of the Grand Shrines of Ise every twenty years is the supreme example of architecture transformed into ritual.

Even in contemporary Japan, ground-breaking, ridge-raising and completion ceremonies are still observed in many building projects. The ground-breaking ceremony (*jichinsai*) begins the on-site construction process with rituals designed to appease the tutelary gods of the building site and to pray for the safety of all concerned in the building operation.

In traditional practice, the chief master carpenter himself frequently officiated at the ceremonies, donning the robes of a Shinto priest and intoning invocations and blessings ancient in origin.

Coaldrake, *The Way of the Carpenter*, 1990:5

On examining the belief system of the Shinto carpenter, we find a great intensity of feeling towards his materials which comes from the allocation of spiritual value to all living beings. The selection of wood for building involves an understanding of the personality of the mountain on which the trees have grown, and something of that personality is carried into the buildings that are constructed from those trees. Thus trees that grew on the south side of a mountain should form the south side of a building, those from the north should face the north. One of the last remaining temple master carpenters, Tsunekazu Nishioka, stated: 'To grasp the personality of a tree, you must converse with that tree. Whenever I fell a tree, before I raise the saw I pray, 'I pledge, as a temple carpenter, that I will do nothing that will extinguish the life of this tree'.'

Within the philosophy of Christianity, with its emphasis on the transcendental, the material presence of the cathedral or church is simply an expression of human striving to escape the earthly shackles of original sin; in Shinto the temple expresses the essence of the natural forces that shaped both the materials and the faith of the people. This difference is accentuated by the development of European architecture into stonework, whereas the Japanese temples remained wooden. The mason dominated the stone, carving it to his will, whereas the Japanese temple carpenter observed the twists and stresses built into his

PUPILS AS MAKERS

The Crafts in Secondary Schools

NATIONAL CONFERENCE ON FRIDAY 3RD NOVEMBER 1995

10.00-4.30 at the Forum Hotel, Cromwell Road, Kensington, London SW7

Fee: £50 with 10% discount (£45) for school based delegates (to include lunch, tea and coffee and an advance copy of the National Survey report *Pupils as Makers — The Crafts in Secondary Schools*)

As part of current research into the role and importance of *learning through making*, the Crafts Council, in partnership with Roehampton Institute London, commissioned a survey of current provision for, attitudes to and practice of craft at Key Stages 3 and 4. Questionnaires were circulated, via the head teacher, to all Design and Technology and Art and Design Departments in secondary schools in England and Wales. The excellent response — over 2,400 departments completed and returned their questionnaires — indicates the strength of interest in the current debate and about the importance of practical learning in general education. *51% of the returned questionnaires were completed by Design and Technology departments.*

The conference will explore the implications of the findings of the survey and the action required at national and local level to secure resources for practical learning through intelligent making. Speakers will include Tony Ford, Director of the Crafts Council; Dr. Rachel Mason, Survey Director; HMI Peter Jones and HMI Michael Ive.

The conference is being run by the Crafts Council in partnership with the National Society for Education in Art and Design, as part of the NSEAD's annual course and conference.

For further details about PUPILS AS MAKERS: The Crafts in Secondary Schools and conference booking forms please contact:

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***LEARNING THROUGH MAKING:** the Crafts Council's research project, please contact: Susan O'Reilly, Education Officer (Schools and Young People), Crafts Council, 44a Pentonville Road, London N1 9BY. Tel: 0171-278-7700.

trees during growth periods of up to 1,000 years, and selected his wood so that the strengths and weaknesses of related timbers cancelled each other out. This 'organic' method of construction, together with the innate flexibility of wood and the subtlety of jointing systems is, of course, imposed by the geological factors that impose earthquakes on Japan with tragic frequency. The stone-built European cathedral simply would not survive in Japan without massive strengthening that would destroy the aesthetic effect of stone tracery that we are familiar with. When the 1923 earthquake hit Tokyo, causing immense devastation, the five-storey wooden pagoda of the Kaneiji temple, 32 metres high, survived intact. Post-war research into earthquake-resistant structures showed the value of transferring into modern materials the elasticity inherent in the nature and design of the wooden buildings.

In the temple complex of Horyuji in the ancient city of Nara, the carpenters have summarised their relationship between themselves, their work and their material:

To form a pagoda is to form wood
To form wood is to form a tree
To form the tree is to form a man
To form a man is to form the mind
To form the mind is to understand the craftsman
The master craftsman who errs is unworthy of his trade

If we needed any confirmation of the value of this philosophy, we can find it in the fact that in Horyuji are some of the oldest wooden buildings in the world, up to 1,200 years old. It is worth noting in passing that in the modern industrialised world of Japan, a diluted form of the carpenter's philosophy is still found. The craftsman who errs on the Toyota production line, the shopgirl who does not wrap goods properly, the computer assembler who misplaces a dab of solder, are all made to feel that they have done more than just a sloppy job — they have let down themselves as well as the team they work with.

Materials and Ecological Consequences

We have seen how the traditional Japanese carpenter identifies with his material. In the European tradition we find also the use of particular woods for specific purposes, and the use of either natural or artificially formed curved trunks and branches in the construction, for example, of knees in roof-beams and wooden shipbuilding. The Japanese carpenter took this further, with a family growing its own trees from which an individual would cut the wood from which he fashioned his tools. In this way the craftsman felt that the tool was an intermediary between him and the larger, older and therefore more venerable trunk that was to be shaped and given a new life as a structural member of a temple. As Prof. Teijiro Muramatsu of Hosei University puts it.

The Japanese love the beautiful grain of unpainted wood, a love which led to the development of delicate carpentry tools and the skills to handle them. For instance, there are many kinds of planes, from rough to fine, and each of them [is] individually suited to a particular hardness of wood.

The wood used for the most important load-bearing sections of the temple was (and is, in restorations) hinoki, Japanese Cypress or *Chamaecyparis obtusa*. It is an evergreen conifer native to Japan that grows to a height of 40 to 50 metres, with a straight grain that makes it easy to split. As has been noted above, hinoki trees may be cut when they have already been growing for 1,000 years, and some of the components in the Nara buildings have been standing for the same length of time. Hinoki has some interesting qualities:

One of the most remarkable features of hinoki is its longevity. Scientific tests have found that it is 30 percent stronger two hundred years after it is first cut. Thereafter it gradually weakens until a thousand years later, when it has returned to its original strength. The secret of its strength lies in its fine grain (only about one millimetre between growth rings) which aids oil retention.

Coaldrake, 1990:20

This quality adds another dimension to the Japanese carpenter's relationship with his craft — time. The tree he cuts has been living for an almost unimaginable time before he was born,

and will survive for at least as long after he is dead, so the individual human intervention serves simply to change the purpose of the wood within the living world. The European builder who puts beams in a cathedral roof is creating stability and beauty for the greater glory of God, but the material is a subordinate part of that relationship.

There is, however, a price to pay in ecological terms for the Japanese devotion to wood. Hinoki is now rare in Japan, so it is imported from Taiwan. We read that Japanese timber merchants are responsible for 'logging out' South-east Asia and, along with Britain and Germany, are the biggest importers of South American hardwoods. While visiting a Japanese pottery village I heard a potter complain that it was difficult to get the red pine he needed for his traditional wood-fired kiln. When I pointed out that we were surrounded by pine-covered hills, I was told that the Japanese preferred to import their red pine from Malaysia, thus preserving the aesthetic qualities of their own hills. Clearly the Japanese have to do some serious thinking about their relationship with a valuable tradition, and the limited resources of the modern world. There seems to be a sublime ignorance in Japan of the outside world's concerns about the country's predatory attitudes: the Japanese pavilion at the Seville Expo was a proudly all-wood construction.

■ Tools

We have seen how the wooden shafts of the tools could come from private plantations grown by a family of carpenters. The metal sections of cutting implements would be made by specialist smiths using, in the case of knives and chisels, the techniques used in the fabrication of samurai swords. The metal is heated, folded over on itself and beaten, then folded again and so on. In the Carpentry Tools Museum in Kobe one could see video films of this technique, and of the resultant tools being used. (At the time of writing, I do not know if this excellent historical museum has survived the recent earthquake that devastated much of Kobe.)

There is an interesting difference between the Japanese wood chisel and its western counterpart: paradoxically, it has to be able to take and hold a sharper edge than the western chisel precisely because most of the woods used are softwoods. The head of the chisel is of

a brittle, hard steel which is forged onto a softer steel for reasons of resistance and economy. The underside of the chisel is concave to allow an easier separation of the chisel in deep cuts and, as with the western tool, it has a hardwood handle. Sharpening these tools is part of the morning ritual of the carpenter; he will use two or three stones of varying smoothness and my pottery teacher, who had been a carpenter, told me that he spent an hour each morning sharpening, to 'concentrate my mind on the day's work'. It is indicative of the relationship of the Japanese craftsman with his materials that one heard of specially smooth volcanic stones for sharpening kitchen knives being sold for up to £1,000.

An interesting tool with no equivalent in the west is the *yariganna*, or spear plane, which I saw being used on video in the Takenaka museum. The tool is literally a spear, which is held in two hands and passed along a beam. Perhaps the nearest equivalent is our two-handed drawing knife. Both are unsupported by a guiding frame and rely on the strength, control and eye of the user for good results. Although it had gone out of use by the end of the nineteenth century, Tsunekazu Nishioka recreated one of these tools in the restoration of the main pavilion of the Horyuji and made the following comment:

Hinoki wood cut with a *yariganna* is immaculately smooth to the touch and rain-drops bounce off cleanly upon contact. I feel this to be one of the reasons that ancient wooden structures survive longer than those erected in modern times. The electric planes available today make work go faster, but the surfaces they produce are rough and uneven, and since rain-water is not cleanly repelled the decaying process is accelerated.

It would seem that Mr Nishioka's recreation has caught on, because I noticed two *yariganna* in a display case in a hardware shop in the town of Miki, a tool-making centre near to Kobe.

Another interesting aspect of Japanese cutting tools is that the saw and the plane are both used with a pulling motion. The saws seem to be very flimsy but an American friend recommended them as 'the sharpest saws you will ever own'. An interesting variation is the double-edged saw with cross-cutting teeth on one edge and ripping teeth on the other. The

Fig. 1: The janawa-tsugi joint

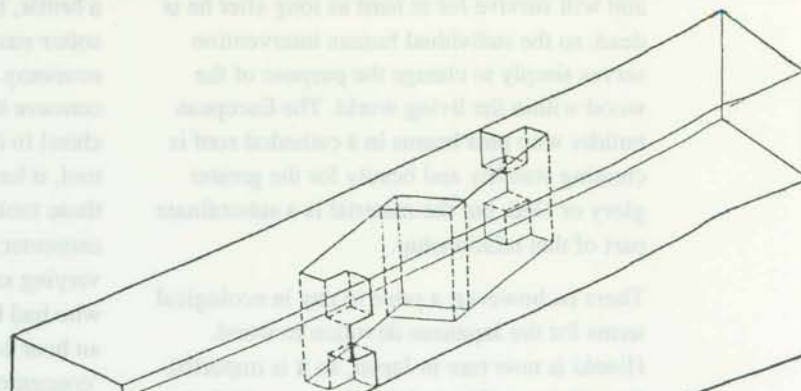


Fig. 2: The kama-tsugi joint

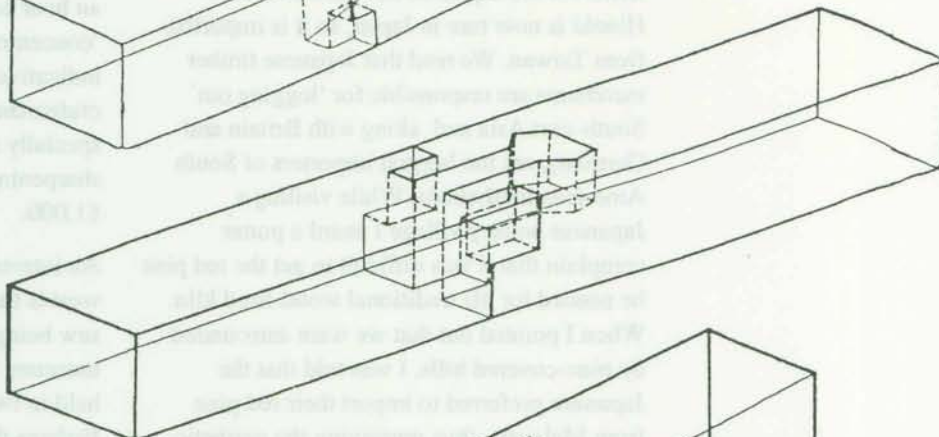
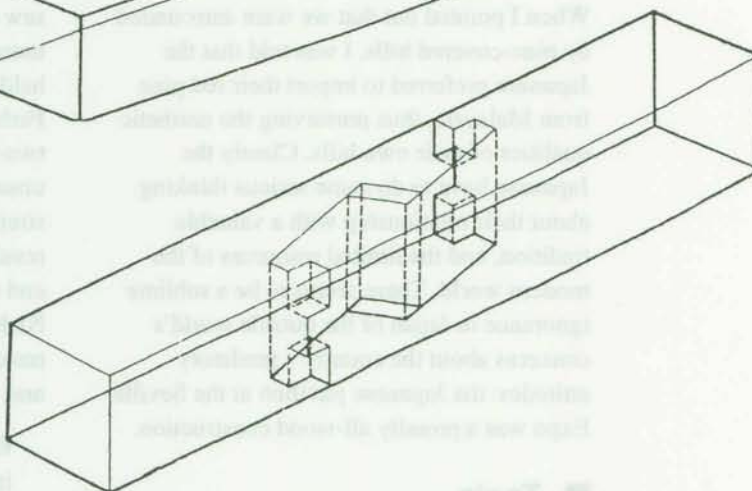


Fig. 3: The sao-tsugi joint



traditional plane is similar to the western type, with a metal pin passing through the wooden body and the blade being held by a capping piece tapped into place with a hammer. As with the chisels, the plane blade has a hard steel cutting edge forged onto a mild steel body. The Takenaka museum videos show carpenters planing long streamers of shavings from beams, and Coaldrake's reference to this echoes Nishioka's view on the water-shedding quality of well-smoothed wood:

The blade is carbon steel tipped and normally used in conjunction with a capping iron ('chip breaker'). This increases the overall efficiency of the planing blade by directing wood shavings away from the cutting edge of the blade. The combination of superlative cutting steel, skilful technique and careful setting of the blade results in

long, continuous ribbons of shavings, which may be less than 0.03 millimetres in thickness, and a polished wood surface on which water pools as if on stone. Sandpaper should not be necessary to perfect the surface. In fact sandpaper is still regarded as anathema by strict Japanese carpenters who believe using it violates the fibre of the wood.

Coaldrake, 1990:66

The carpenter will also incorporate a series of two or three concave areas on the base of the plane to reduce resistance as the plane passes over the wood.

Another interesting aspect of traditional Japanese carpentry is the use of the *sumitsubo*, the equivalent of the western chalk line. The *sumitsubo* is usually a beautifully crafted



hardwood reservoir of ink incorporating a wheel over which passes a cord. As the cord is pulled out, it is soaked in ink and then laid along the wood to be marked.

■ Joints and Techniques

The aspect of Japanese carpentry that is most obviously relevant to design and technology teaching in Britain is the application of types of joints that are not common in European carpentry, if used at all. According to the translator's note in Seike (1977:10) 'Only three of the joints in this book (the cross lap, common dovetail, and bevelled shoulder mortise and tenon) have legitimate equivalents in English'. Having studied the joints illustrated in Dr Seike's book, I would argue with that statement, but the 48 joints illustrated in this work contain some that are not used in Britain, and it is claimed that Japanese joinery has a vocabulary of up to 400 different joining methods. This does not mean that there is no overlap between the two traditions, but the simple Japanese scarf joint illustrated in Seike, for example, has a much more acute angle than the European one, with its customary proportion of 6:1.

Illustrated opposite is the *janawa-tsugi*, translated as the mortised rabbeted oblique scarf joint, which is designed to withstand stresses of tension and bending. When a bolt and strap are added, it is claimed that the joint is almost as strong as a sound beam of the same dimensions (Seike, 1977:108).

The *kama-tsugi*, or gooseneck mortise and tenon, takes its name from the Japanese word for the reared head of a snake, and was invented to resist tension forces. Over time the head of the male joint developed from a square shape to that shown here.

Sometimes building conditions do not allow space for the gooseneck mortise and tenon joint to be inserted from above or below, and in these circumstances the following joint, the *sao-tsugi*, or lapped rod mortise and tenon, is used.

■ Conclusion

What application does this very brief introduction to Japanese carpentry techniques have to our learners? As I suggested at the beginning of this article, there are multiple opportunities for linking with other areas of the curriculum that deal with questions of religion (the shinto and Buddhist temples), biology (the different types of woods, the ecological consequences of the Japanese attitude towards wood), geography (the physical nature of the Japanese archipelago and its exposure to earthquakes) and, of course, design and technology. I have not been able to illustrate more than three of the joints used in Japan, but these technically challenging and anyone interested in obtaining the Seike book, will find another 45 joints to experiment with. This need not be merely an academic exercise: anything that expands the learner's vocabulary of techniques is useful. I understand that in the USA woodworkers are importing Japanese tools and some readers may be interested in doing the same. The planes and chisels, although expensive, are works of art in themselves. I cannot give the names of any British importers of these tools and it may be easier to try to find someone returning from Japan to bring them. The town of Miki, at the back of the hills behind Kobe, is a centre where tools are made and by making a trip to one of the two branches of a large hardware supplier there, one can find every type of implement for carpentry, masonry, horticulture and the kitchen.

■ References

- Coaldrake, W.H., *The Way of the Carpenter*, New York, Weatherhill, 1990
- Hibi, S., *Japanese Detail*, London, Thames & Hudson, 1989
- Kanada, M.M. 1989, *Color Woodblock Printmaking*, Tokyo, Shufunotomo
- Seike, K., *The Art of Japanese Joinery*, New York, Weatherhill, 1977
- Takenaka, Takenaka Carpentry Tools Museum (brochure), Kobe, Takenaka Komuten Co Ltd