SEMINAR AT THE ISTANBUL UNIVERSITY OF TECHNOLOGY
3 SEPTEMBER 2003
Bryan Walford

The Turkish Timber Association, who facilitated a meeting of ISO Technical Committee 165, "Timber Structures", asked several of the delegates to give reports on the state of timber construction in their countries. This was for the benefit of architecture and engineering students. The presentations were:

Zeynep Ahunbay (Turkey) Istanbul Technical University, Faculty of Architecture - *Traditional Timber Buildings in Turkey*
Erol Karacabeyli (Canada) FORINTEK - *Performance of Timber Structures in Earthquakes*
Rob Grantham (UK) BRE - *Findings from the BRE TF2000 Project*
Frederic Rouger (France) CTBA - *CE Marking and Eurocode5*
Murat Talu (Turkey) Turkish Timber Association - Turkish Experience with New Timber Structures
Kevin Cheung (USA) WWPA - *North American Experience of Timber Structures*
Bryan Walford (New Zealand) Forest Research - *New Zealand-Australian Experience of Timber Structures*
Powerpoint files are available on all except the first above, which was a slide show.

Traditional timber buildings in Turkey.

Turkey has been without significant timber resources for so long that very little exists or remains of traditional timber buildings. Traditional construction was post-and beam, with thatch or tile roofing. In style and construction they were practically identical to old rural buildings still to be seen across much of Europe and UK.

Performance of timber structures in earthquakes

This showed some dramatic movie clips of one, two and tree-story light timber frame buildings under test on a shaking table. These tests were done at the University of California, UBC and Kogakuin University in Japan. Lateral loads up to 0.6g were applied, which is well above the level to which light timber framing is normally designed. The 3-storey design with an open bottom storey as shown in the figure above gave the results in Table 1.

Figure 1: *Test building on shaking table*

Table1: *Observed damage versus acceleration*

Max. acceleration	Framing +exterior sheathing only	+ stucco, internal linings and steel frame retrofit to lower storey	Steel retrofit frame removed
0.36g	Little damage	No visible damage	-
0.5g	Near collapse	Minor interior damage	-
0.6g	-	No further damage	Some cracking of the stucco and linings in lower storey

By comparison, masonry houses give similar performance up to about 0.3g but at 0.5g they are a total loss. The comparative performance is represented in Figure 2.

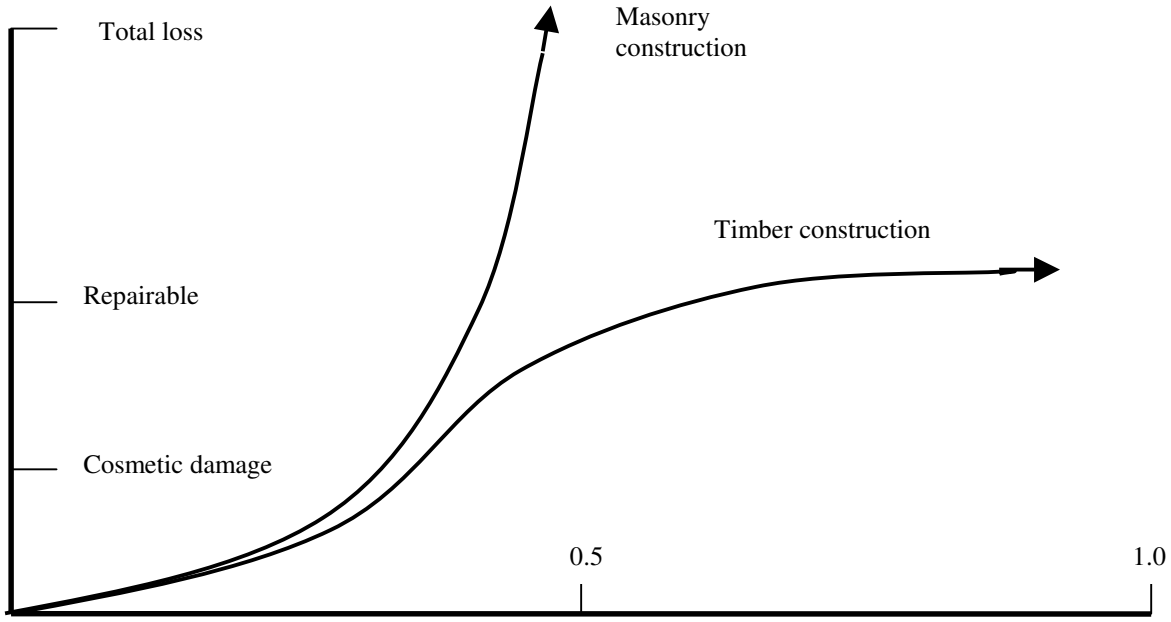

Figure 2: *Comparative performance of masonry and timber in earthquake test*

Findings from the BRE TF2000 project

This gave a history of the progress of wood frame construction in the UK:

1920s Platform frame introduced from Sweden
1970s Boom in timber frame construction – reached 25% of starts
1984 World in Action programme – starts dropped to below 5%
1991 Building Regulations changed – to deal with perceived problems
1994 Medium-rise feasibility study
1995 Timber Frame 2000 Project (TF2000)
1997 World's first 6-storey platform timber frame
2001 Experimental programme completed
2003 Design Guidance published (BR454 from www.brebookshop.com)

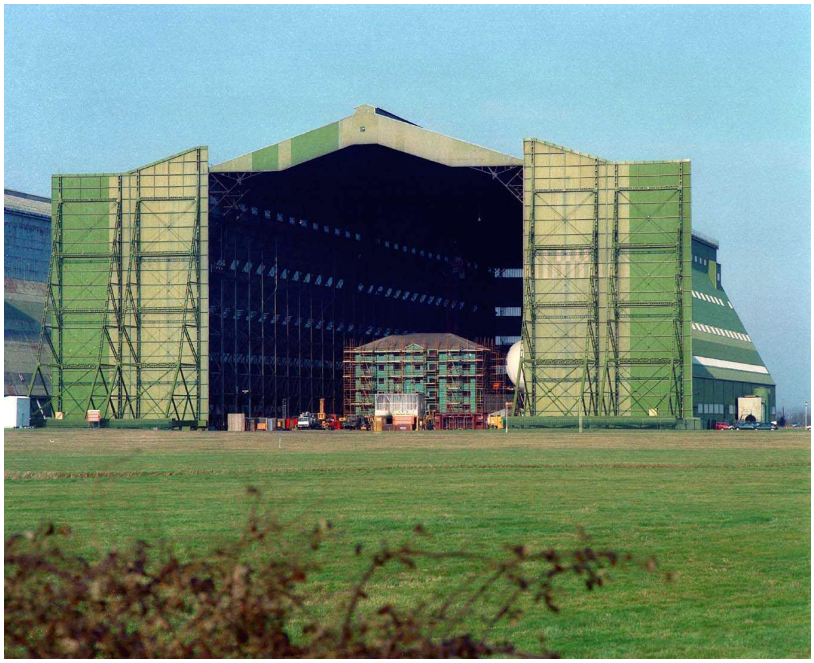

Figure 3: *TF2000 building in hanger*

The TF2000 project was impressive, although the six-storey building is dwarfed by the airship hangar at Cardington, as shown in Figure 2. Besides proving the building's fire, acoustic and structural performance, they studied the relating change in height between the brick cladding (which swelled) and the timber frame (which shrunk). The total differential movement ranged from 30 to 70 mm depending on the choice of materials.

CE Marking and Eurocode5

The system of CE marking in Europe was described as applying to products, components and kits, but not to systems, parts of works, or to entire works. It is a complex system, involving testing laboratories, approving authorities, those who approve the approver's etc. Quite a serious burden to be borne by producers but it must be worth it. A likely export from NZ would be glulam, but that has to meet one of the glulam strength classes which have the design properties given in the following table:

Table 2: *European glulam stress grades*

Class	GL24h	GL28h	GL32h	GL36h		GL24c	GL28c	GL32c	GL36c
Bending, MPa	24	28	32	36		24	28	32	36
Tension //, MPa	16.5	19.5	22.5	26		14	16.5	19.5	22.5
Tension T, MPa	0.4	0.45	0.5	0.6		0.35	0.4	0.45	0.5
Compr //, MPa	24	26.5	29	31		21	24	26.5	29
Compr T, MPa	2.7	3	3.3	3.6		2.4	2.7	3	3.3
Shear, MPa	2.7	3.2	3.8	4.3		2.2	2.7	3.2	3.8
E modulus // mean, GPa	11.6	12.6	13.7	14.7		11.6	12.6	13.7	14.7
E modulus // 5%, GPa	9.4	10.2	11.1	11.9		9.4	10.2	11.1	11.9
E Modulus T, GPa	0.39	0.42	0.46	0.49		0.32	0.39	0.42	0.46
Shear modulus, GPa	0.72	0.78	0.85	0.91		0.59	0.72	0.78	0.85
Density 5%, kg/m3	380	410	430	450		350	380	410	430

The subscript c refers to combined grades of laminations while subscript h refers to homogeneous layups. The GL24 grade is possible in radiata but the higher grades are almost out of sight without re-sorting very careful selection methods.

Figure 4: *Turkish style light timber frame building*

Turkish experience with new timber structures

"New" timber construction in Turkey started in the 80s with the relaxation of import regulations to allow kitset houses, mainly log houses. In 1983 the North Americans gave seminars on light timber frame construction and since then there has been a steady growth. The housing market is growing at 5 to 10%/year (now approx. 22,000/yr) and 5% of these are timber frame. The 1999 earthquake stimulated interest in timber building although the 2001 economic crisis was a setback. The styles are very similar to those seen in New Zealand with a Turkish flavour in that they often incorporate a tower, as shown in Figure 4. Other examples are shown in Figure5.

Figure 5: *Examples of timber frame construction in Turkey*

Figure 6: *Apartment building in Portland, Oregon*

Figure 7: *Marriot Spring Suites Hotel*

North American experience of timber structures
This presentation covered a wide range of timber structures, concentrating on multi-storey timber frame residential buildings, such as these apartments in Portland, Oregon.

New Zealand-Australian experience of timber structures
A very similar presentation to that on North America.