New Eurocode 5: a boost for timber bridge construction?

The campaign for timber use, wood.forgood., welcomes Eurocode 5. In this article it suggests that Part 2 of the new code will encourage engineers and designers to work more with wood in the construction of bridges for a wide variety of applications

The Norwegian building and construction industry attracts international attention for outstanding and innovative design. In particular, its expertise in building large timber structures is unrivalled and 3 years ago saw the completion of the world's longest timber road bridge, the Flisa Bridge, built across the river Glomma about 100 miles north of Oslo. It has a central clear span of 70m, an overall length of 196m and carries two lanes of traffic and a pedestrian walkway. The main trusses and parapets are built from glued-laminated timber (glulam) and the bridge deck is a stress-laminated plate made from sawn planks supported on steel cross-beams.

A timber bridge on this scale may be unusual, but it is only the scale that is unusual. In recent years there has been a significant increase in the number of wooden bridges being built. With the larger projects this is principally as a result of further refinements in the development of glulam, which has outstanding qualities and is very much the high-tech timber product of today. However, there are many other varieties of timber available and this choice of performance and aesthetics, combined with other factors such as environmental and sustainability issues, together with developments in the new Eurocode system, all point to a further increase in the use of wood for bridge building.

UK code for timber bridge design

Wood.forgood says: 'Last year saw the publication of Eurocode 5 (*Design of timber structures*) and it included the first ever design code in the UK (Part 2) to deal specifically with timber bridges. The UK National Annexes relating to this have been circulated for comment and are soon to be published, following which they will be approved for use in the Building Regulations and by 2010–2012 all structural timber design should be to Eurocode 5'. IStructE points out: 'It is not just the UK National Annexes that are likely to be approved for use under the Building Regulations but also the Eurocodes themselves. The Building Regulations are not relevant to many bridge designs. Other relevant authorities such as the Highways Agency will also need to approve the use of Eurocodes for bridge design.'

Leonardo Bridge project, Norway

Arnold Page, Senior Engineer at TRADA, feels that the new Eurocode 5 has some definite advantages for engineers: 'The same basis for design as other materials should result in a number of benefits. Safety factors will be known and greater economies in both design and materials ought to be achieved. Also, the formula base is ideal for spreadsheets and software, with 300 formulae and only 22 tables altogether, compared with BS 5268 which has only 44 formulae, but involves 114 tables'.

IStructE is producing a new series of manuals relating to all the structural Eurocodes. TRADA has joined with them to produce one specifically on Eurocode 5, to provide comprehensive information on the detail needed to design all the most common timber structures and components – including bridges. It is anticipated that this will be published in autumn 2006.

The overriding principle behind the whole Eurocode system is that there should be common rules for calculation and design throughout the European Union and it should serve as a basis for reference in contracts, both within and outside the EU. As Charles Trevor, Managing Director of wood. for good. points out: 'The fact that structures made of timber will be designed in the same way as those made from other materials, having exactly the same design basis and safety format – barring a few criteria peculiar to timber itself – should certainly encourage designers unaccustomed to working with wood, to experiment and facilitate comparative designs using different materials. Eurocode 5 will result in less confusion and fewer errors and make it easier for students to learn structural design.'

Enormous potential

The potential opportunities for using wood in bridge building are certainly not limited to large scale construction. There are a host of opportunities in settings such as parks, environmental centres, access bridges over roads, railways and waterways, garden and leisure centres and urban shopping precincts.

East London represents a real and immediate opportunity with all the Olympics regeneration work planned. Many of the currently neglected open spaces in the area will take on a new lease of life. Greens, commons and pathways will be developed for walkers and cyclists, naturalisation of the riverbanks through ecological corridors and habitat creation are planned – and over 100 bridges are to be built throughout the lower Lea Valley. Surely timber would seem the natural solution in every sense.

It may seem paradoxical, but the more wood we use for construction purposes, the more beneficial it is in the fight against global warming – and Eurocode 5 could well represent a further significant step forward in the increased use of wood. Only a small percentage of the material used for building purposes is recyclable, but wood is unique as the only renewable resource.

The European forest industry, from which over 90% of the wood used in the UK is sourced, recognises that its future is inextricably linked to the protection and expansion of its forests and professional management of these resources, coupled with strong and effective legislation means that by planting more trees than are harvested every year, well managed forests increase by an area about the size of Cyprus. As a result more carbon dioxide is sucked out of the atmosphere and more oxygen is released, with forests acting as carbon sinks, keeping large amounts of carbon dioxide locked up and out of the atmosphere.

Leonardo Bridge project, Norway

In 1502 Leonardo da Vinci created a simple drawing of a graceful bridge with a single span of approximately 240m as part of a civil engineering project over the Golden Horn, an inlet at the mouth of the Bosphorus River in what is now Turkey. Although the bridge was never built, Leonardo had surmised correctly that the classic keystone arch could be stretched

narrow and substantially widened without losing integrity by using a flared foothold, or pier and the terrain to anchor each end of the span. All this being proposed some 300 years prior to such engineering principals being generally accepted.

Norwegian painter and public art creator, Vebjørn Sand, saw the original drawing and a model of the bridge in an exhibition of Leonardo's architectural and engineering designs in 1996 and was determined that the structure should be completed in Norway.

A number of sites were considered and eventually the chosen location was across the main highway linking Oslo and Stockholm. The bridge, which consists of three elegant glulam bowed arches, designed to support each other and carry the footpath which spans the highway, also saw the development of a new technique developed to preserve the bright colour of the Norwegian pine used in the project. The entire structure was prefabricated and assembled on site in a matter of days, causing minimal traffic disruption.

Hamsterley Forest kit bridges County Durham, UK

Located in Hamsterley Forest and managed by Forestry Commission England, the Hamsterley Mountain Bike Area is already popular with both mountain bikers and leisure cyclists and hopes to bring in significant revenue for the rural economy.

Hamsterley Forest kit bridges County Durham, six have been built so far

A key element in the development of the forest leisure facilities is the use of 'timber kit bridges', six having been constructed so far. The bridges, which meet relevant British Standards, are made from Forest Stewardship Council (FSC) certificated European Redwood and were constructed by enthusiastic local volunteers.

The largest is a curved bridge 10m long and 1.5m wide and all the units feature 1.4m high ranch style balustrades. Over the next 2 years, there are plans to create more routes up to the international mountain bike standard and in the long term build a trail up to 40km long. The new mountain bike centre will complement the region's cycling strategies and support the multi-million UK cycle tourism market.

Tullibardine Bridge, Perth, Australia

The Tullibardine distillery nestles at the foot of the Ochil Hills in Perthshire and draws from the same source of crystal pure spring water that fed the first public brewery in Scotland from which King James IV purchased his celebratory coronation beer in 1488.

Having been 'mothballed' in 1994 the distillery lay dormant until June 2003, when it was purchased by a consortium and developed, to the tune of £10M, into a visitor centre – aptly named Tullibardine 1488. The distillery remains at the heart of the development but a 21m timber bridge spans the Danny Burn and links visitors to the new 50 000ft^2 Tullibardine retail and tourist centre. The bridge comprises three sections each 1.8m wide, the centre section being 15m in length and two side elements are each 3m long. The structure, which was prefabricated in Lincolnshire and transported to site, is made from European Redwood and fitted with anti-slip deck boards for additional safety. The bridge leads directly onto a pathway and provides easy access for wheelchair users.

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