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# Development of Stress-Laminated Arched Structures

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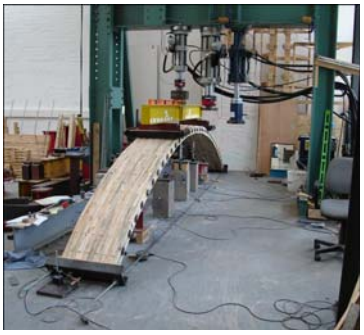
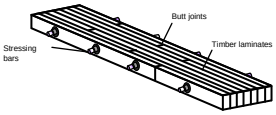


**What is Stress-Lamination of Timber?**

Stress-lamination of timber is a method of construction where a group of rectangular sawn timbers are compressed together by high tensile steel or threaded bars.

The bars are passed through pre-drilled holes in the wide face of the timber sections and are tightened against external bearing plates.

The resulting pressure sets up friction forces between the laminates which make the whole into a solid load-bearing timber plate or deck with the ability to distribute load laterally and longitudinally.




**Objectives**

•To formulate design rules for stress-laminated timber (SLT) arch structures
•Statically load test and analyse different arch profiles
•Dynamically load test slender structures
•Evaluate critical construction parameters
•Compare test results with computational, analytical and experimental results
•Evaluate different construction techniques to enable safe building in the field

**History**

Vertical nailed lamination of timber was developed by Philibert Delorme in 1561.
Early vertical lamination was used to make beams to build domes.
Modern flat deck stress-lamination was developed in USA during the 1980's.
The first stress-laminated timber arch was tested at Napier University in 2002.

2.1m span test arch

6m span test arch

15m span bridge

**Testing**

A total of twenty scaled arch bridges of different rise and spans (2.1m, 6.0m and 8m) were subjected to a series of static and dynamic loadings in the laboratory to examine their strength and stiffness characteristics. The effect of several factors influencing their performance were studied. This was followed by analytical and experimental examination of a 15m full-scale bridge in the laboratory and a 20m arch in the field.
Currently, over 40 permanent stress-laminated bridges have been built commercially throughout the UK.

20m Test Span Glentress July 2004

Construction of SLT arch bridge

**Advantages**

- SLT structures disperse loads laterally
- Utilise timber of size and quality that is easily available
- Avoid the need for troublesome weak timber joints
- Effectively make large structures from small and low quality timbers

**Future Developments**

- Timber road bridges
- Retaining walls
- Industrial/large span floors
- Dome roofs