

SECTION THREE – FIRES IN ROOF VOIDS INVOLVING TIMBER TRUSSES

INTRODUCTION

WHAT IS A TRUSS?

A truss can be defined as structural members (such as boards, timbers, beams, or steel bars) joined together in a rigid framework. They are most often in the shape of a triangle or series of triangles; some trusses are rectangular. Trusses can be built of wood, steel, wood and steel, or aluminium. Concrete trusses are not common but do exist, usually in very large structures. The truss framework is usually arranged in a single plane so that loads applied at points of intersecting members will cause only direct stress (compression or tension). Three-dimensional trusses (space frames) are very light in weight. The design of a truss, which separates compressive and tensile stresses, allows for a minimum of materials to be used, resulting in economic benefit.

The top and bottom members of a truss are called chords. The top chord of a truss is in compression, and the bottom chord is in tension. The inner members are called webs and give stability to the truss system. The unique characteristic of a truss is the inherent stability of the triangle. Web and chord members arranged in a triangle are much more stable than the same members arranged in a square. The square configuration requires diagonal bracing, which then produces multiple triangles

MATERIALS USED IN CONSTRUCTION.

The most common materials used in the construction of roof trusses are:

- Heavy timber roof and floor systems
- Lightweight pre-fabricated timber trusses
- Steel trusses.



Figure 1. - Typical lightweight truss construction.
(photo courtesy of Vincent Dunn)

USE OF PRE FABRICATED TIMBER TRUSSES

There is nothing new in the use of pre-fabricated timber trusses; they have been common in the construction industry for many years; most modern domestic dwellings feature them. Their use in commercial premises is more recent but is rapidly growing. The performance of pre-fabricated timber trusses in fire is not comparable with more traditional methods of roof construction and firefighters must be aware of the problems which may occur if they are involved in fire.

Pre-fabricated timber trusses are constructed of softwood and are connected together using galvanised plates. In fire conditions these plates weaken rapidly and may fail this leads to a loss of integrity of the truss which because it is under tension may 'spring'

This spring effect may lead to a rapid collapse of the roof structure.

A further factor is that there is a trend to use trusses which are lighter construction than previously used; these lighter trusses have little "sacrificial strength" and thus collapse quicker in fire conditions.

There have been two incidents in Shropshire recently (2005/06) which have involved fires which have spread to the roof space and resulted in unusually rapid collapse of the roof. In each case the building was of similar construction:

- Single storey, brick built load bearing walls, with clay tile covered pitched roof supported on pre-fabricated timber roof trusses spanning between the external walls.
- A ceiling of Class "O" construction separated the roof space.
- Both of the fires involved buildings which were part a purpose built 'parade' of shops; these building were in use as Spar mini-supermarkets"

In one of the cases investigation has revealed an accurate picture of the sequence of events. The fire was discovered and reported at 17:20hrs by staff. The fire started by deliberate ignition of waste cardboard which was stored in a receptacle outside at the rear of the store. The fire spread via a vent into the roof space and rapidly gained a hold. First attendance was at 17:26hrs two pumps. By 17:40hrs the entire roof of the store had collapsed.

The Structural Engineer (PJ Barnett Associates) involved in the clearing and reconstruction of the site stated in a letter that **"It was no doubt the nature and design of the construction which resulted in this rapid collapse. It is proposed that the replacement roof structure will be structural steel frames supported off the external masonry wall"**

OPERATIONAL CONSIDERATIONS

As always, the Incident Commander's actions will depend on their Dynamic Risk Assessment. Part of the Assessment will involve identifying that timber trusses form part of the construction of the building, and this being the case, establishing to what extent the truss system is involved in the fire; in order to do this it may be necessary open up parts of the ceiling to investigate (as detailed below).

Reference	Author	Status	Date	Page
OPS11PT2S3	J Labouchardiere	New	10/06	2 of 3

A Safety Officer or Officers must be appointed as a priority and given the specific brief of monitoring for signs of collapse.

At least three scenarios can occur in which firefighters may suffer fatalities and injuries while operating at fires involving truss roof and floor systems

1. While firefighters are **operating above a burning roof or floor truss**, they may fall into a fire as the sheathing or the truss system collapses below them. For this reason no firefighters should be positioned on or above a burning roof. Aerial Appliances must be used to provide a safe working platform.

2. While firefighters are **operating below the roof or floor inside a building** with burning truss floor or roof structures, the trusses may collapse onto them.

Extreme caution must be exercised when operating under a trussed roof system involved in fire; unless persons are trapped, the fire must be fought defensively. Interior conditions must be constantly monitored for signs of collapse if crews are committed. Crews should avoid working under areas of the roof which may be bearing machinery or heavy objects.

Efforts should be made to open the ceiling to reveal the extent of the fire; a charged hose line must be provided to cover this work to guard against possible backdraught. Thermal imaging cameras may be useful in locating the seat of the fire.

Exit routes must be kept clear and where possible alternative exit routes identified.

3. While firefighters are **operating outside a building with burning trusses**, the floor or roof trusses may collapse and cause a secondary wall collapse. Safety Officers must be appointed to ensure that no personnel enter the hazard area; the hazard area may be estimated as one and a half times the height of the wall.

REFERENCES

Shropshire Fire and Rescue Service SIP - Fires Involving Trussed Roofs.

Manual of Firemanship Book 8 -Building Construction: Elements of Structure; Behaviour of Roofs & Roofing Materials in Fire.