Lonsdale
PATENT GLAZING & ROOFLIGHTS

RESEARCH INTO THE PERFORMANCE OF PATENT GLAZING.

Technical Digest Number One

THE PERFORMANCE OF PATENT GLAZING ROOFS SUBJECTED TO SMOKE TEMPERATURES

By J. Colvin,
Pilkington Glass Consultants

Sponsored by the Patent Glazing Contractors Association,
191 Cirencester Road, Charlton Kings, Cheltenham, Glos GL53 8DF
Tel: 01242 578278, Fax 01242 578283

CONTENTS

ILLUSTRATIONS AND DIAGRAMS

1. INTRODUCTION

The use of large areas of glazing in roofs of atria has led to fire officers to question the integrity of the roof glazing when it is subjected to hot smoke from fires. Atria are often part of the escape routes and also access routes for firemen, so the collapse of glass panes, or larger areas of roof glazing, is a hazard to be avoided.

When subjected to smoke temperatures, the materials in a glazed roof will attain temperatures roughly half way between the smoke temperature and the external ambient temperature. On this basis, up to smoke temperatures around 300°C, it can be predicted that aluminium and steel glazing bars will remain intact and also that wired glass, laminated glass and toughened glass would remain in position without collapse. This prediction is supported by tests conducted in Norway (1), where all three types of glass, glazed in aluminium frames, remained intact for 30 minutes when subjected to furnace temperature of 300°C.

However, smoke temperatures can rise as high as 600°C, and at temperatures this high it is no longer easy to predict the performance of glazing bars or glass, since the material properties of aluminium, laminated glass and toughened glass start to become critical at around 300°C. An increasing volume of enquiries about the performance of glazed roofs at smoke temperatures above 300°C, together with the publication of BS 7346:Part3: 1991, which suggests that smoke curtains should be tested at a smoke temperature of 600°C, led the Patent Glazing Contractors Association (PGCA) to have an ad hoc test performed at Warrington Fire Research Centre (2).

2. SMOKE TEMPERATURE TEST

In order to obtain the maximum possible amount of information from the test, it was decided to attempt the following temperature regime:

300°C furnace temperature for 30 minutes
400°C furnace temperature for 15 minutes
500°C furnace temperature for 15 minutes
600°C furnace temperature for 30 minutes

The patent glazing was designed as a monopitch roof of area 4045mm long x 3400mm down the slope, the roof pitch being 15°. The patent glazing bars spanned 3300mm between supports and the single glazed glass panes were fully supported only on two opposite longitudinal edges by the patent glazing bars. The large roof area allowed six generic types of patent glazing bar and four types of glass to be installed. Figure 1 shows the general arrangement of the patent glazing roof.

The patent glazing bars, enumerated in figure 1, were:

1. Inverted, thermally-broken aluminium bar with aluminium cap.
2. Traditional lead-sheathed steel bar.
3. Traditional plastic-sheathed steel bar.
4. Inverted aluminium bar with aluminium cap.
5. Traditional aluminium bar with aluminium wings.
6. Traditional aluminium bar with aluminium cap.
7. Inverted aluminium bar with aluminium cap.

and the glass panes, enumerated in figure 1, were:

8. 7mm thick Georgian Wired Cast glass.
9. 7mm thick Georgian Wired Cast glass.
10. 6mm thick Georgian Polished Wired glass.
11. 6mm thick Clear Toughened glass.
12. 7mm thick Georgian Wired Cast glass.
13. 6.4mm thick Clear Laminated glass.

3. RESULTS

During the first ten minutes of the test, all the wired glass panes and the laminated glass pane cracked, but all the panes remained in position.

By the end of the first period of the test, the interlayer material (PVB – polyvinylbutyral) in the laminated glass had started to degrade. During the second period of the test (furnace temperature 400°C) the interlayer began to turn brown, but the laminated glass remained intact. Apart from further cracks in the wired glass panes, none of the patent glazing bars or the other glass panes was showing any signs of distress.

When the furnace temperature was increased to 500°C, small pieces of glass quickly became detached from the laminated glass and the interlayer material began to

glow in places and degrade very quickly. Five minutes after the furnace temperature was raised to 600°C, the laminated glass pane collapsed, necessitating the termination of the test.

At this stage in the test, all the patent glazing bars were intact and showing no signs of distress, although some of the gasket materials, plastic sheathing and lead sheathing had melted. All the wired glass panes were still in position, although cracked, and the toughened glass pane was unaffected. Subsequently, a destructive test on the toughened glass pane indicated that it was still fully toughened.

4. DISCUSSION

The results of the test have shown that sloping patent glazing, conforming to BS 5516, glazed with panes of wired glass, toughened glass or laminated glass, at least 6mm thick, will remain integral up to smoke temperatures of 400°C. If smoke temperatures above 400°C over escape or access routes are predicted from fire analysis studies, then it would be advisable to not use laminated glass.

Although the duration of testing at a furnace temperature of 600°C was short, the behaviour of all six types of patent glazing bar, the four wired glass panes and the toughened glass pane indicated that these were not in any distress. None of the bars was showing any significant distortion or bow, which might indicate imminent collapse. The wired glass had cracked in the early stages of the test, but was stable. The toughened glass looked undamaged and the subsequent ad hoc breakage test indicated that it was still fully toughened. It is very likely that sustained exposure for 30 minutes at this temperature would have caused no further deterioration of the integrity of the system.

Two other inferences may be drawn from the results of this test:

(a) Patent glazing bars are lightweight supporting members and, in this test, were spanning a longer distance than they would normally be expected to. Heavier supporting members of aluminium or steel should perform equally well.

(b) It is likely that, glazed in a vertical position in a lightweight frame, toughened glass would conform to the test requirements for smoke curtains in
BS 7346: Part 3.

5. CONCLUSIONS

1. Both aluminium and steel patent glazing bars should perform adequately at smoke temperatures up to 600°C.

2. Sloping patent glazing, conforming to BS 5516, incorporating panes of wired glass or toughened glass, at least 6mm thick, should remain integral at smoke temperatures up to 600°C.

3. At smoke temperatures below 400°C, sloping patent glazing, conforming to BS 5516, incorporating panes of wired glass, toughened glass or laminated glass, at least 6mm thick, should remain integral.
4. Aluminium or steel supporting members of a heavier section than patent glazing bars should also withstand similar smoke temperatures.

5. Toughened glass, at least 6mm thick, in lightweight frames should be suitable for smoke curtains conforming to BS 7346: Part 3.

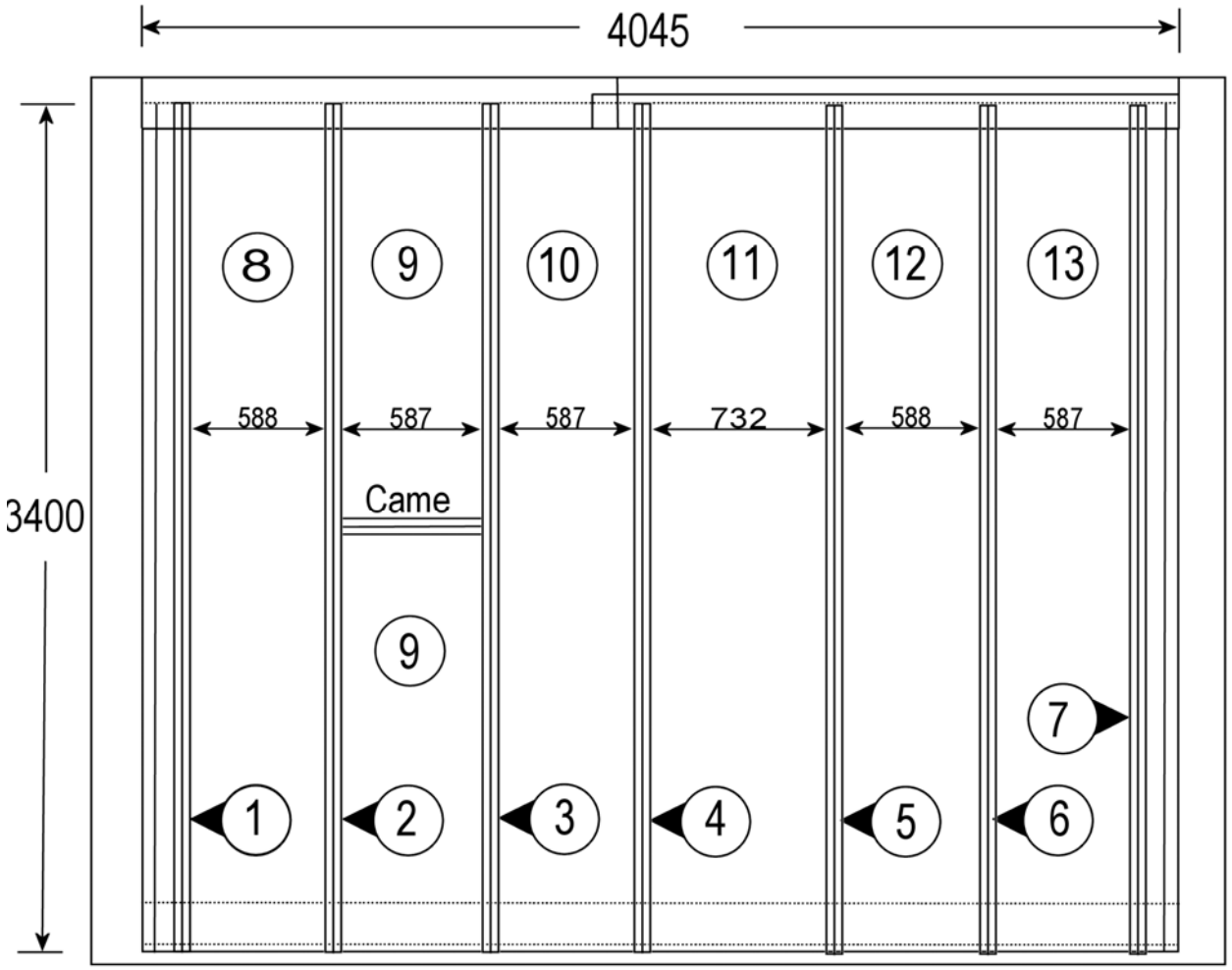

FIGURE 1. General arrangement showing the specimen over the furnace.

6. REFERENCES

1. *Per Peterson: "Overhead Glazing Recommendations in Norway Based on Fire Tests", Glass Digest,* August 15, 1988, pp 87-88

2. *WARRES No. 51333:"Ad-hoc Fire Test on a Patent Glazing Roof Structure", copies available form the Patent Glazing Contractors Associates, 13, Upper High Street, Epsom, Surrey. KT17 4QY*

John Colvin is Technical Services Manager with Pilkington Glass Consultants and is a member of the Technical Committee of the PGCA.