Department for Communities and Local Government

Analysis of fires in buildings of timber framed construction, England, 2009-10 to 2011-12

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Department for Communities and Local Government

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Key Points

Numbers of incidents

- From April 2009 to March 2012, Fire and Rescue Services in England attended 2,485 fires in timber framed buildings.

- Of the 2,485 fires, 176 were in dwellings, 340 were in non-residential buildings and the remaining fifteen were in other residential buildings (on caravan sites or holiday accommodation).

Damage in timber framed dwelling fire

- Timber framed dwellings suffered more damaged from fire than dwellings of no special construction. Of the 176 fires in timber framed dwellings, 10% of these resulted in damage of an area of over 200 square meters compared to only 4% (of 4,135 fires) for non-timber framed dwellings.

Damage in under constructed timber framed dwelling fire

- Among under constructed buildings, the ratio of fires in timber framed buildings to non-timber framed building is 1:9 compared to the ratio of 1:57 (timber framed vs. non-timber framed) for fully constructed buildings.

- Fires in under constructed timber framed dwelling caused a greater damage compared to non-timber framed dwellings. Out of total fires in under constructed timber framed dwellings, 18% of these resulted in damage of an area of more than 200 square meters compared to only 1% for dwellings of no-special construction.

Casualty rates in timber frame dwellings

- Fatality and non-fatal casualty rates are very similar in timber framed and non-timber framed dwellings.

1. Introduction

This analysis focuses on the amounts of heat and flame damage in building fires identified as being timber-framed compared with fires in buildings recorded as being not of special construction[1].

The first section considers buildings that were not under construction, while the second examines buildings under construction. The analysis was carried out for dwellings and non-residential buildings separately.

Analysis of fires in buildings of timber frame construction was included in the '*Fire statistics monitor, April 2009 to March 2010'* which was published in August 2010. This analysis repeats the previous work but uses three years of data combined in order to increase the power of the statistical test used in drawing conclusion.

2. Fires in timber frame buildings not under construction

From April 2009 to March 2012, there were 2,485 fires attended by Fire and Rescue Services in England in buildings of timber frame construction. Examination of the distribution of the extent of heat and flame damage shows that fires in buildings recorded as being timber-framed had proportionally considerably fewer fires of damage of 5m^2 or less. This result does not stand up to scrutiny however, since the structure of a building is unlikely to have any bearing on numbers of small fires. What is likely however is that the type of construction of a building, particularly of a dwelling, will often not be evident following extinction of a small fire. This is because timber frame dwellings are built to look like a building of standard construction.

It is reasonable however to assume that fires with heat and flame damage of greater than 20m^2 will result in timber frame buildings being identified and reported accurately[2].

Of the 2,485 fires in timber frame buildings, 531 had heat and flame damage of more than 20m^2. Of these, 176 were in dwellings (chart 1 and summary table 1) and 340 were in non-residential buildings (chart 2 and summary table 2).The remaining fifteen – far too few from which to draw conclusions – were in other residential buildings, of which five were fires on caravan sites and four were in other holiday accommodation.
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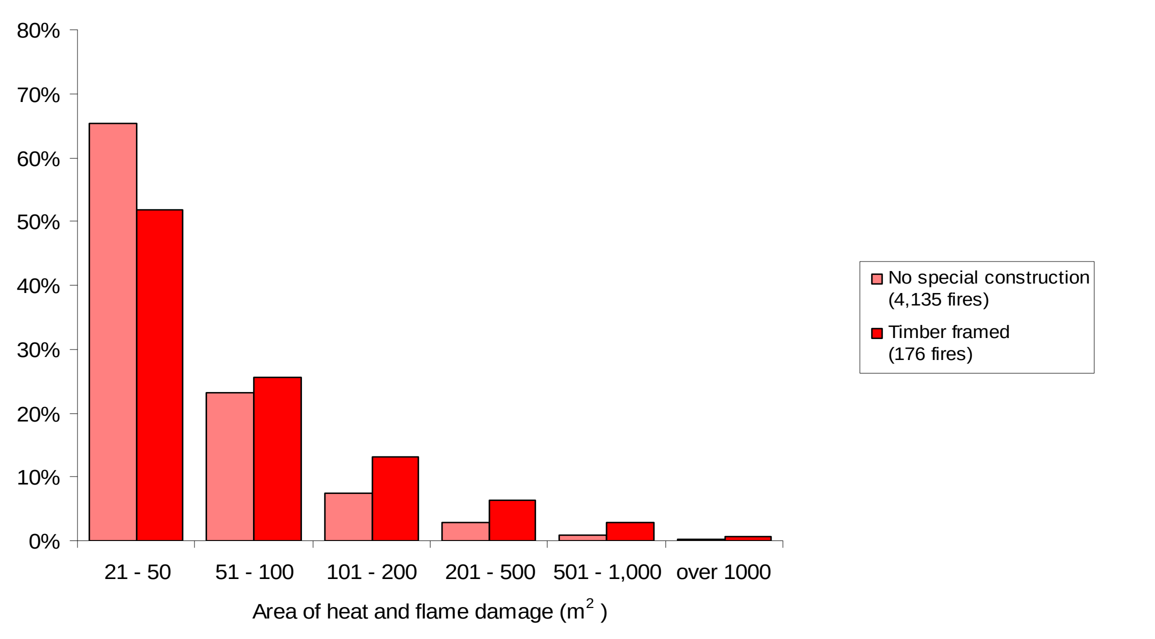
2.1 Fires in timber frame dwellings not under construction

Fires in timber frame dwellings not under construction were proportionally fewer in the lowest category included in the analysis (21-50m^2) than for dwellings of no

[1] The Incident Recording System asks for all building fires "Was there any special method of building construction involved?" with responses being categorised according to the following list: None, Timber framed, Cladding, Sandwich panels, Atria, Thatch, Large single storey retail premises, Other, Not known.
[2] In dwellings, damage of over 20m^2 is almost without exception beyond the room of origin of the fire.

special construction. The opposite is true for all categories of greater area of damage (see chart 1 and summary table 1)).

Chart 1: Distribution of heat and flame damage over 20m^2 in fires in dwellings, England, April 2009-March 2012



Summary table 1: Distribution of area of heat and flame damage in fires in dwellings, England, April 2009-March 2012

Area of heat and flame damage (m^2)	No special construction		Timber framed	
None	26,713	-	178	-
Up to 5	59,027	-	476	-
6 - 10	7,245	-	104	-
11 - 20	4,450	-	96	-
21 - 50	2,706	65%	91	52%
51 - 100	961	23%	45	26%
101 - 200	304	7%	23	13%
201 - 500	116	3%	11	6%
501 - 1,000	34	1%	5	3%
over 1000	14	0%	1	1%
Total (21m^2 and greater)	4,135	100%	176	100%
Total (all sizes including none)	101,570	-	1,030	-

The appropriate statistical test (Pearson's chi-squared test) was used to examine whether there is any significant difference between timber-framed dwellings and dwellings of no special construction in terms of area of damage. The result is highly significant[3] indicating that fires in timber-framed dwellings do tend to have a

[3] Chi-squared = 25.6 with 3 degrees of freedom (groupings used to avoid cells with fewer than 10 cases: 21-50, 51-100, 101-200, 201+ m^2)

greater area of heat and flame damage on average compared to fires in dwellings of no special construction; i.e. that the differences in proportions observed are extremely unlikely to be the result of chance variation[4].

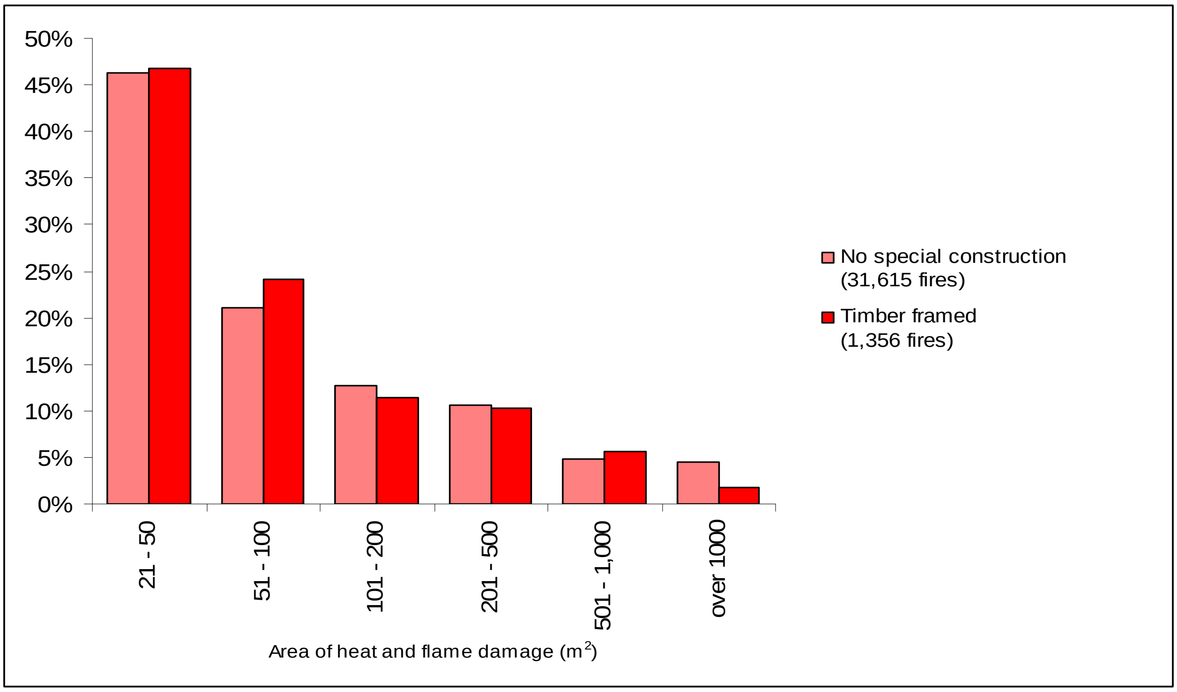
Turning to casualties, rates are very similar in dwellings of timber frame construction and in dwellings of no special construction, and from which it is not possible to conclude any difference:

- Fatality rate of 0.0078 per fire in timber-framed dwellings and 0.0068 fatalities per fire across all dwellings of no special construction. NB These rates are based on eight fatalities and 782 fatalities respectively. Thus, the size of the total number of fatalities in timber frame buildings (eight) means that this comparison is not robust.

- The rate of non-fatal casualties is 0.19 per fire in timber framed dwelling (based on 202 non-fatal casualties) compared to the rate of 0.20 per fire in dwellings of no special constructions (based on 20,371 non-fatal casualties).

2.2 Fires in timber frame non-residential buildings

Chart 2: Distribution of heat and flame damage over 20m^2 in fires in non-residential buildings, England, April 2009-March 2012



The distribution of size of damage in fires in non-residential buildings of i) timber frame construction, and ii) no special construction, appears fairly similar (see chart

[4] The chi-squared test shows the observed difference between the distributions of extent of heat and flame damage between i) timber frame and ii) no special construction to be highly significant. It is worth noting that all but the smallest included category (21-50) are higher for timber-framed.

2). The chi-square test supports this. It finds no evidence at all of difference in the distribution of size of fires between the two types of building[5].

Summary table 2: Distribution of area of heat and flame damage in fires in non-residential buildings, England, April 2009-March 2012

Area of heat and flame damage (m^2)	No special construction		Timber framed	
None	7,006	-	71	-
Up to 5	17,490	-	452	-
6 – 10	2,674	-	298	-
11 – 20	1,743	-	195	-
21 – 50	1,250	46%	159	47%
51 - 100	569	21%	82	24%
101 - 200	342	13%	39	11%
201 - 500	288	11%	35	10%
501 – 1,000	132	5%	19	6%
over 1000	121	4%	6	2%
Total (21m^2 and greater)	2,702	100%	340	100%
Total (all sizes including none)	31,615		1,356	

Out of 1,356 fires in non-residential buildings of timber frame, there was no fatal incident. Fifteen fatalities were recorded in all such buildings of no special construction. Just as for dwellings, these numbers are far too small to enable to draw any conclusion of difference based on statistical test.

Rates of non-fatal casualty per fire were slightly different between the two types of non-residential buildings. In all timber frame non-residential buildings the rate is 0.032 per fire (44 non-fatal casualties) compared to 0.051 per fire (1,600 non-fatal casualties) in all non-residential buildings of no special construction. While the casualty rate is lower overall for timber-framed buildings, this category of non-residential buildings covers a wide range of building types, and so the differing casualty rate may well be due to other differences in design or usage, as opposed to being due to the different method of construction itself.

3. Fires in timber frame buildings under construction

For buildings under construction, it is unlikely that there would be an issue with identifying whether a building is timber-framed or not. Therefore, when analysing the size of damage in fires in buildings under construction it is reasonable to include all fires, including the smallest.

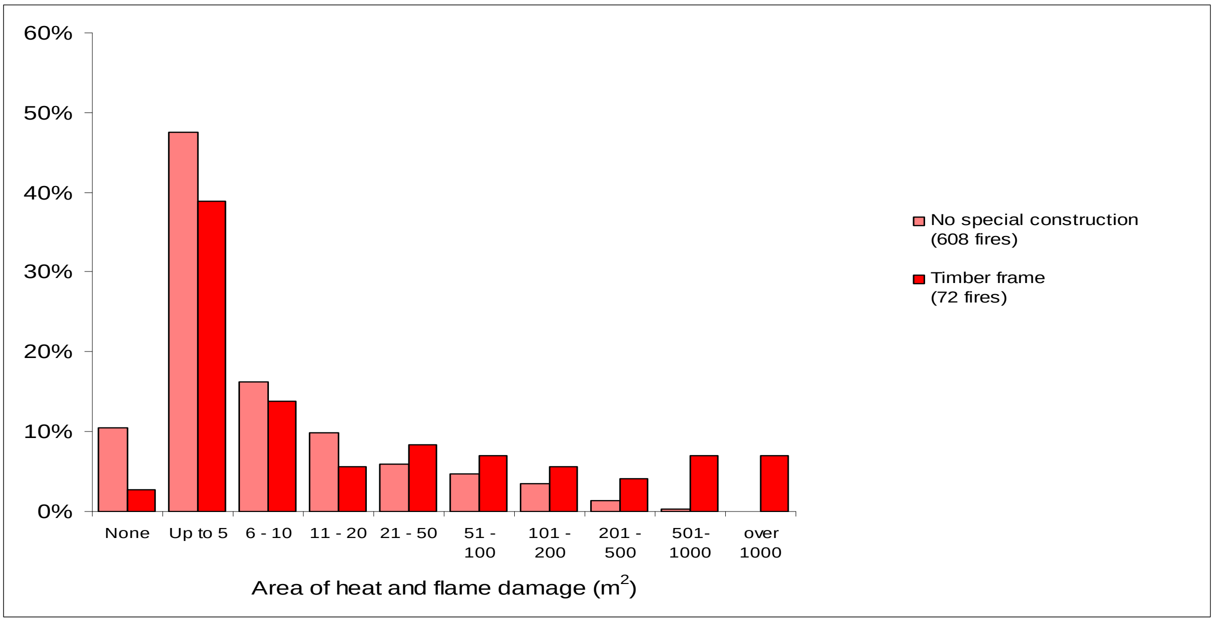
From April 2009 to March 2012, there were 118 fires in timber frame buildings under construction compared to exactly 1,103 fires in buildings under construction whose structure was of no special construction. Among buildings under construction, the ratio of fires in timber frame buildings to fires in buildings of no

[5] Chi-squared = 3.4 with 4 degrees of freedom. This is much less than the critical value for 5% with 4 degrees of freedom of 9.49. The following groupings were used to avoid cells with fewer than 10 cases: 21-50, 51-100, 101-200, 201-500 and 500+ m^2).

special construction is much higher at 1:9 (118 compared to 1,103) compared to the same ratio for buildings not under construction (1:57, 2,485 compared to 141,075 fires).

The distribution of the area of damage for buildings under construction of i) timber frame, and ii) no special construction, are shown in chart 3 for dwellings and chart 4 for non-residential buildings. Both give the impression of differing patterns between buildings of i) timber frame and ii) of no special construction.

Chart 3: Distribution of area of heat and flame damage in dwellings under construction, England, April 2009-March 2012

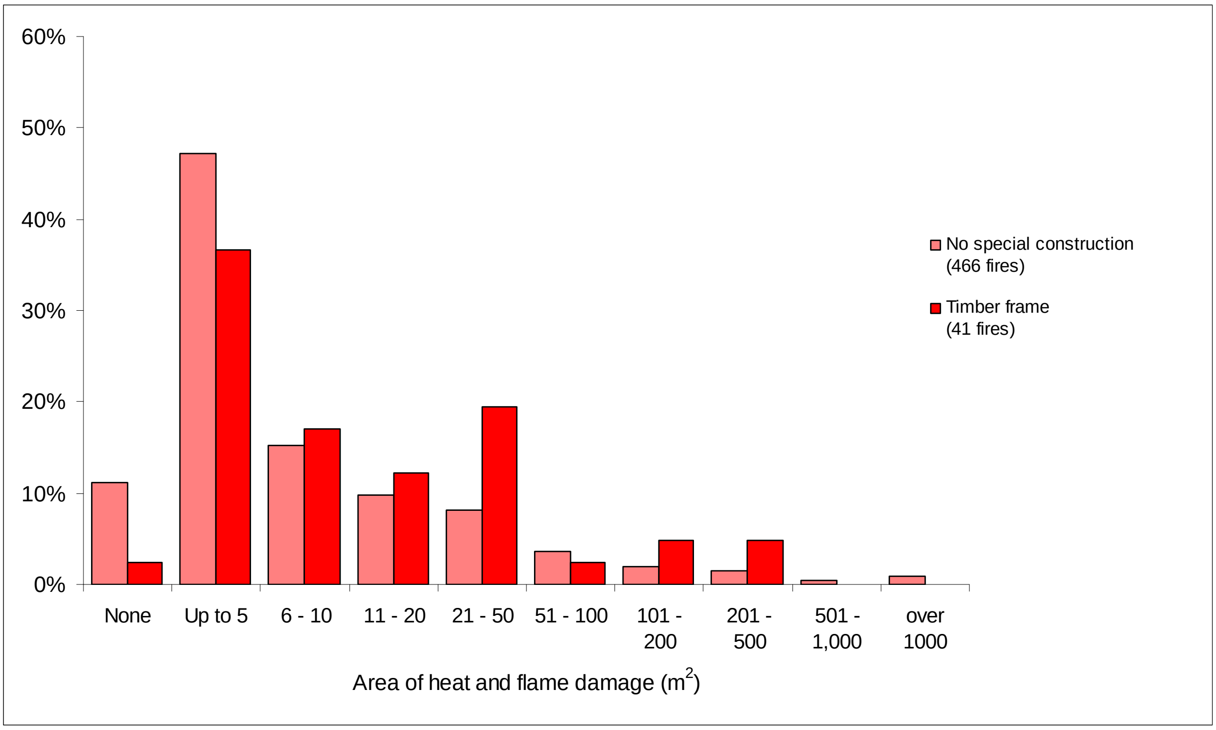


Summary table 3: Distribution of area of heat and flame damage fire in dwellings under construction, England, April 2009-March 2012

Area of heat and flame damage (m^2)	Non special construction		Timber frame	
None	64	11%	2	3%
Up to 5	289	48%	28	39%
6 - 10	99	16%	10	14%
11 - 20	60	10%	4	6%
21 - 50	36	6%	6	8%
51 - 100	29	5%	5	7%
101 - 200	21	3%	4	6%
201 - 500	8	1%	3	4%
501-1000	1	0%	5	7%
over 1,000	1	0%	5	7%
Total	608	100%	72	100%

Chart 3 shows a clear pattern suggesting a difference in area of damage in fires between the two types of dwellings under construction, ie higher proportions of fires under 5m² for buildings of no special construction and higher proportions for timber-framed buildings for fires with larger areas of fire damage. The chi-square test is highly significant, confirming this statistically[6].

Chart 4**:** Distribution of area of heat and flame damage in non-residential buildings under construction, England, April 2009-March 2012



Summary table 4: distribution of fires in non-residential buildings under construction, England, April 2009-March 2012

Area of heat and flame damage (m²)	No special construction		Timber frame	
None	52	11%	1	2%
Up to 5	220	47%	15	37%
6 - 10	71	15%	7	17%
11 - 20	46	10%	5	12%
21 - 50	38	8%	8	20%
51 - 100	17	4%	1	2%
101 - 200	9	2%	2	5%
201 - 500	7	2%	2	5%
501 - 1,000	2	0%	0	0%
over 1000	4	1%	0	0%
Total	466	100%	41	100%

6 Chi-squared=26.3 with 3 degrees of freedom (the following groupings were used to avoid cells with fewer than 10 cases: 0-5, 6-19, 11-50 and 50+ m²)

Although chart 4 has more fluctuation than chart 3 for proportions by size of fire damage for fires in buildings with timber frame (eg for the 21-50m^2 and 51-100m^2 categories), chart 3 and chart 4 appear to have broadly similar underlying patterns. The chi-square test (using the data from table 4/chart 4) is significant[7] providing evidence that the difference between the distributions of the amount of damage in non-residential buildings is statistically significant between non-residential buildings of i) timber frame and ii) no special construction.

Turning to casualties in buildings under construction:

- there were no fatalities over the period (April 2009 to March 2012)
- among buildings under construction, there were eleven non-fatal casualties from fires in timber-framed properties, and thirty four in fires in buildings of no special construction. These numbers are too small to allow robust conclusions to be drawn over rates of casualty in buildings under construction.

[7] Cell sizes dictate grouping 0-5, 6-20 and 20+ metres square, so that the number of incidents in each category are not too small to allow a valid statistical test. The resulting chi-square equals 7.6 (2 degrees of freedom), which is greater than the critical value for significance at 5% level.