Loughborough University Institutional Repository

Methods of drying flooded domestic properties: the perceptions of UK building surveyors

This item was submitted to Loughborough University's Institutional Repository by the/an author.

Citation: SOETANTO, R. and PROVERBS, D.G., 2003. Methods of drying flooded domestic properties: the perceptions of UK building surveyors. IN: COBRA 2003 Conference, RICS Research Foundation, University of Wolverhampton, 1-2 September 2003, pp. 149 - 162.

Additional Information:

- This is a conference paper.

Metadata Record: https://dspace.lboro.ac.uk/2134/16571

Version: Accepted for publication

Publisher: © RICS

Rights: This work is made available according to the conditions of the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International (CC BY-NC-ND 4.0) licence. Full details of this licence are available at: https://creativecommons.org/licenses/by-nc-nd/4.0/

Please cite the published version.

Methods of drying flooded domestic properties: the perceptions of UK building surveyors

Robby Soetanto[1] and David G. Proverbs[2]

[1] *Department of Civil and Building Engineering, Loughborough University, Leicestershire, LE11 3TU, UK*

[2] *School of Engineering and the Built Environment, University of Wolverhampton, Wulfruna Street, West Midlands WV1 1SB, UK*

Abstract

The prediction of more frequent flooding events in the UK necessitates the development of reinstatement standards for flood-damaged domestic properties. This is because current reinstatement methods exhibit significant variance which ultimately influence cost and time needed for repair works as well as their overall performance. Prior to the commencement of repair works, it is important that appropriate drying methods be used so that subsequent repair works are not damaged by latent defects such as fungal attack. This paper presents the perceptions of 289 building surveyors regarding methods used to dry flooded domestic properties. Findings suggest that surveyors consider various methods to assist drying rather than focusing on a single dominant method. Furthermore, the drying method is not a scientific process but rather one based on experience and subjectivity. These facts highlight the lack of definitive guidance on drying out flooded buildings. Further research is recommended towards developing standardised drying out procedures and techniques.

Keywords: flooding, domestic properties, repair work, flood damage assessment, building surveyor

Introduction

Among natural disasters, floods seem to be the most destructive in terms of magnitude and human impact (Chapman, 2002; Purnell, 2002). Throughout Britain, the risk of flooding is significant. There are five million people along with nearly two million homes; 185,000 business properties worth over £215 billion and agricultural lands worth over £7 billion at risk from flooding in England and Wales (Halcrow *et al*., 2001; Harman *et al*., 2002). The worst recorded coastal flooding in 1953 claimed 480 lives and an estimated £5 billion (at current prices) of damages (Crichton, 2003). Crichton

(2003) argued that a similar flood today could lead to more deaths and insured losses of over £20 billion. The situation is further magnified when considering climate changes that are occurring on a world-wide scale. Research has identified that the frequency of flooding is set to increase due to changes in climate conditions (Scottish Office Environment Department, 1995; Bates *et al.*, 1996; Minnery and Smith, 1996; Hulme and Jenkins, 1998).

Although floods are an inevitable phenomenon, their impacts could be minimised by appropriate actions prior to and post-flood events. Knowledge of how to assess and subsequently repair flood-damaged domestic properties is highly important and would help insurance companies, loss adjusters, building surveyors, repair specialist contractors and home-owners to mitigate damage and return the property to its pre-flood condition as early as possible. A thorough review of the literature in the flood damage domain indicated little consensus of opinion and ignorance of many factors regarding damage assessment procedures or 'optimal' repair methods (Proverbs *et al.*, 2000; Nicholas and Proverbs, 2002). This suggests that the damage caused by floods is considered by many to be a simple problem to resolve, whereas in reality, it is a complex phenomenon. This complexity is even more apparent when considering the need to appropriately dry flood-damaged properties (i.e. to reduce the water content of the building material to an acceptable level) prior to the commencement of repair works, so that subsequent repair works are not damaged by latent defects such as fungal attack, necessitating the need of rework.

This paper presents the perceptions of building surveyors regarding methods and equipment in the process of drying out flooded domestic properties, as part of a research programme aimed to standardise the assessment of flood-damaged domestic properties in the UK. Data were collected from a UK-wide questionnaire survey of building surveyors and loss adjusters. The analysis was based on 289 completed questionnaires representing a considerable sample of experts involved in the repair of flood-damaged properties. A brief background information of drying out flooded building now follows.

Drying out flooded building: a brief background information

Gummerson *et al*. (1980) detailed the capillary transportation of water in masonry structures. It was found that there is a linear relationship between the cumulative absorption of fluid verses the square root of time. It was also found that those materials with large pores have significantly lower sorptivities, defined as the absorption of a liquid into a material, containing empty or partially empty pores, via capillary attraction (Illston, 1994, p.171), than those materials with fine pores; this is regardless of the initial porosity of the materials. Following the identification of various materials' sorptivity characteristics, wetting and drying curves were then detailed (Gummerson *et al*., p.22). Wetting and drying curves are a graphical method of illustrating the pressure that is required to remove water from a porous material's pore matrix (see for example Figure 1). Wetting and drying curves in the majority of construction materials differ in shape, due to the pore voids not being uniform in diameter throughout the material. Hence, time duration of floodwater in contact with the building structure and the sorptivity characteristics of the building's materials must be considered in prediction of drying out times.

Figure 1 about here

Hall *et al*. (1984) specifically concentrated their research on water evaporation and the drying process in brick and block materials. The process of drying is defined as "unsaturated flow liquid within the porous solid; vapour flow within the porous solid; the liquid-vapour phase change; and convective-diffusive transfer of vapour from the surface of the solid to the surroundings." Because of these sub-processes of unsaturated flow theory, it was hypothesised that drying of porous materials would depend markedly on external factors as well as on the material's properties. Hall *et al*. (1984) admit that in developing their theory of drying of building materials they have aimed to avoid needless complexity whilst retaining physical validity.

To observe the drying behaviour of clay bricks, Hall *et al*. (1984) saturated specimens with water under vacuum conditions and then allowed the brick to be dried under constant conditions of air flow, air temperature and air humidity. The bricks were then weighed and the amount of water evaporated after certain predetermined time periods noted. From observations made during the above process, two distinct stages of drying were observed. The first stage, known as *stage I*, is called the constant drying rate period; whilst the second stage (*stage II*) is known as the falling drying rate period. By considering both stages in isolation, Hall *et al*. (p.14) concluded that "because the first stage of drying appears to be essentially uninfluenced by material properties, it is generally accepted that free evaporation of liquid is occurring at the solid surface. Thus, the rate of drying is controlled by the vapour properties of the evaporating substance- its saturated vapour pressure p_o and its binary diffusion coefficient in air D_v." They suggested that increasing the air speed is probably the most cost effective method of increasing the *stage I* drying time, which might be achieved by using fans or even by good natural ventilation within a building.

Hall *et al*. further provided a simple guide to evaporation rates as presented in Table 1.

Table 1 about here

Having discussed drying of a single composite material (brick or block material), it is worth considering water movement in two 'joined' porous building materials. There are numerous examples of composite layers in building construction e.g. plaster onto brick or blockwork, render onto brick or blockwork, skim plaster onto plasterboard etc. Because of the large number of construction techniques which have two (or more) composite porous materials joined together, knowledge of water movement in such composites is relevant to this particular research.

Wilson *et al*. (1995a and 1995b) conducted research into the absorption of water into a composite bar consisting of two dissimilar materials which were 'joined' by hydraulic contact. It was concluded that the absorption rate through a material of higher sorptivity into one of lower sorptivity decreases immediately after the wet front passes the junction of the two materials. After the wet front has passed the junction between the materials, the first material becomes saturated and the rate of water absorption becomes dependant upon the rate of absorption into the second material. Hence, the second material controls the absorption of fluid into the composite. Similarly, for absorption through a material of lower sorptivity into a material with higher sorptivity, the rate of water absorption depends upon the sorptivity characteristics of the second material. Again the second material controls the absorption rate. This means that the duration of flooding is critical to the amount of water that can be absorbed by a composite material. For instance, if the flooding period is very short and the first layer of the composite does not become saturated then water absorption by the second layer is unlikely. It is also evident that the sorptivity characteristics of the materials exposed to flooding are significant in influencing the quantity of water absorbed.

Prior to commencement of reinstatement work, it is crucial that the material's level of 'dryness' is determined so that the likelihood for rework is reduced. In this regard, Dill (2000) provided technical guidance on a range of techniques available for determining moisture presence in building elements and which method(s) are the most appropriate to assess a particular situation. Although useful, this guidance does not provide measures of the effectiveness of these various techniques as used in practice.

When considering practical issues associated with drying out buildings, the BRE (1974) suggested three principal methods that could be used, i.e. the use of natural ventilation by keeping windows open, the use of heaters and opening of windows, and the use of dehumidifiers and closing of windows. This demonstrates the uncertainty that exists in regard to effective drying methodologies, a point exacerbated when one considers the plethora of 'drying equipment' (dehumidifiers, fans, heaters) and 'drying experts' available in the marketplace.

In sum, the literature describes the occurrence of water absorption in building elements and practical methods to dry them. Presently, there is lack of knowledge of the effectiveness of various drying methods, including how to determine if a building is sufficiently dry for repair works to commence. This research attempts to address these issues and presents the views of a large sample of experts in this field. The following section describes the methodology adopted for this research.

Methodology

A questionnaire was designed to capture building surveyors' perceptions regarding drying out flooded domestic properties. Respondents were initially invited to indicate details of their employer, working area, job title and experience in assessing flood-damaged properties. Then, they were asked to indicate and rate the effectiveness of the equipment and procedures *presently* and *ideally* used to dry a flood-damaged building whose temperature ranges from 0^oC to 10^oC. This was to reveal any possible constraints or external factors (e.g. the need to minimise cost) that may influence what equipment is currently used in practice. A list of options for drying out flooded buildings was provided and respondents were allowed to choose one or more of those considered appropriate. They were then asked to indicate the effectiveness of their preferred method on a five-point scale, where 1 indicates 'very poor', 2 'poor', 3 'average', 4 'effective' and 5 'very effective'. These levels of effectiveness allowed comparison between methods. To ensure validity and reliability, methods compared had to accumulate a minimum of 10 responses. Additionally, respondents were also asked to indicate the number of dehumidifiers to be installed.

The second part investigated whether the respondents sealed off sections of the property to assist drying and what methods were used to determine the number of sections. Here, respondents were also asked to indicate the types of heaters (if used) by selecting from a range of options provided.

The final part concerned the methods and/or equipment *presently* and *ideally* employed to determine if a building is sufficiently dry. As before, options were provided and perceived effectiveness was measured on a five-point scale.

One thousand and eight hundred members of RICS' Residential Faculty were initially targeted. Additionally, members of the Chartered Institute of Loss Adjusters were targeted via an invitation to participate in the survey published in the January 2002 edition of the Loss Adjuster magazine. This strategy yielded a response of 289 completed questionnaires and were subsequently used as the basis of analysis.

Analyses were conducted using *Microsoft Excel* and *SPSS*. Levels of experience in terms of the length of time involved in the assessment of flood-damaged properties were best collected in the form of ranges because this form allows easier recall (Fellows and Liu, 1997). Each range was then assigned a numerical value representing ordinal data. Levels of effectiveness which could be regarded as ordinal type variables, were converted into a Likert scale from 1 indicating 'very poor' to 5 indicating 'very effective'. Although there is an argument that treating Likert scale-based data at this level of measurement as an interval scale is a violation of parametric test assumptions, there is an equally strong argument for doing so due to the advantages gained, as exemplified by Labovitz (1967). The description of the respondents now follows.

Characteristics of the respondents

Figure 2 presents the nature of respondents' organisations. Most of the respondents (59.7%) were working for loss adjuster firms. This is not really surprising given that loss adjusters are the persons very much involved in the assessment of properties after the events of disaster including flooding. Almost one-quarter of the respondents (23.3%) were working for surveying consultancy practices. Eight percent classified their organisations as consulting engineers. Six percent were working for damage repair specialists. The remaining 8.6% classified their organisations as estate agents/housing associations (3.1%), environmental services (1.7%), Local Authorities (1.7%), insurance companies (1.4%), and architectural practices (0.7%). The total percentage was slightly more than 100 percent since respondents were allowed to categorise their organisations into more than one category where appropriate. Although the majority were loss adjusters, as a whole, the views of the respondents could be deemed to represent various organisations involved in the assessment of flood-damaged properties.

Figure 2 about here

Figure 3 exhibits the operating regions of the respondents' organisations. Almost half of the respondents (48.9%) were working in the South-East region of the UK. About one-fifth (18.0%) were working in the South-West. As a whole, the sample was dominated by respondents working throughout England and Wales, while few were operating in Scotland.

Figure 3 about here

Figure 4 shows the respondents' levels of experience in terms of the number of years in assessing flood-damaged properties. Most respondents (74.0%) had been assessing flood-damaged properties for more than 5 years. The mean was 3.12 and the median was 3.00 (i.e. ranging from 10 to 15 years). These indicate that respondents have extensive experience in the assessment of flood-damaged properties and their views can be deemed as those of experts in this domain.

Figure 4 about here

Methods and/or equipment employed to dry flood-damaged buildings

Present drying methods (i.e. equipment and/or procedures currently being used) and their perceived effectiveness are presented in Table 2. A majority of respondents (74.7%) turned the existing heating system on to assist drying; a method considered to be practical and timely. More than a-half (50.9%) just allowed the dwelling to dry with natural ventilation. However, almost two-thirds (63.5%) would use fans to increase ventilation. The use of dehumidifiers was quite significant (51.3 and 69.0%). Although the least popular option, quite a considerable number of respondents (43.3%) would install temporary heating to help dry the flooded building. These findings suggest that surveyors consider various methods to assist drying rather than focusing on a single dominant method.

Table 2 about here

Although the most popular, the use of existing heating systems was perceived to be the second least effective method (3.11) after natural ventilation (2.55). The most effective methods were the use of dehumidifiers (refrigerant, 3.80 and desiccant, 3.84). The use of fans (3.39) was perceived to be the third most effective method. The use of temporary heating (3.16) was considered more effective than the use of existing heating systems (3.11), although the difference was quite marginal. Generally, with the exception of natural ventilation, all other methods were perceived to be somewhat effective. Natural ventilation was considered below average as a drying method.

Ideal drying methods and their effectiveness are presented in Table 2. About forty percent (41.2%) of the respondents indicated their ideal drying methods would be different from existing drying methods. In other words, more than one-half would not use different methods from their present methods even if they were allowed to do so (i.e. if there were no constraints). The most popular ideal drying method was to install temporary heating as indicated by 16% of respondents. Interestingly, natural ventilation was second although only ten percent indicated such an ideal preference (9.7%).

Assisting drying with use of the existing heating systems was the least popular method (4.0%).

Generally, the perceived effectiveness of the ideal drying methods (with the exception of refrigerant dehumidifier) was higher than present drying methods (refer to Table 2). Notably, natural ventilation improved from 2.55 to 3.85 as the ideal method. The perceived efficacy of this method may be linked to the relatively lower costs involved. Further, while this method may be considered the most effective, the time taken to dry buildings this way, may make it prohibitive. Considerable improvement was also observed in the use of temporary heating systems. Overall, the use of desiccant dehumidifiers was considered the most effective method to dry flooded buildings.

Various methods to determine the number of dehumidifiers to be installed in a flood-damaged property, were identified by more than three-quarter of the respondents (77.3%) and presented in Figure 5. Property size (in terms of volume, area, number of rooms) was the most important determinant as identified by almost half of the respondents (46.3%). About one-third considered this task to be outside their expertise and would seek advice from specialists/contractors (32.2%). The capacity of available dehumidifiers (14.5%) was also an important consideration to be matched with the property size. It is interesting to note that some respondents would rely on experience-based trial and error (8.9%) and generalisation (e.g.) of one dehumidifier per room or two per standard semidetached house (10.3%). This indicates that for some, the drying process is not a scientific process but rather one based on experience and subjectivity. The reliability of such decisions must be doubted.

Figure 5 about here

Sealing off sections of the building to assist drying

About two-thirds of the respondents (63.5%) sealed off sections of the property to assist the drying procedure. Methods to determine the number of sections are presented in Figure 6. Most (63.6% of those who sealed off sections of the property) indicated that the number of sections were dependent on each individual project. This suggests a high level of subjectivity on behalf of the flood damage assessors. Some respondents indicated ‘more scientific’ methods including the capacity of dehumidifiers (24.2%)

and the volume of each room (23.0%). Some indicated more 'practical' methods including the sealing of each room individually (15.2%), and separation of the upper and lower floors (1.8%). Very few considered the comfort of the property owner and health considerations (0.6%).

Figure 6 about here

Respondents who sealed off sections of the property and installed heaters to assist drying, were also asked to indicate the types of heaters presently used as shown in Figure 7. Three-quarters (75.0%) used electric warm air heaters, while some used gas fire heaters (18.1%) and electric radiant type heaters (14.6%). Very few utilised electric bar type heaters (2.8%) and a combination of dehumidifiers and central heating systems (2.8%). The use of air movers/fans (1.4%) was even more seldom. One respondent indicated an aversion to the use of heaters as these were said to cause cracks in materials due to too rapid drying.

Figure 7 about here

Methods and/or equipment employed to determine if a building is sufficiently dry for repair works to commence

Table 3 shows present methods to determine whether a building is sufficiently dry for repair works to commence and their perceived effectiveness. Visual observation is the most popular method as used by 79 percent of the respondents. Rather surprisingly, this method was perceived the least effective (2.63). The second most popular method was electrical resistance metres as identified by more than 40 percent (40.8%). These metres are somewhat unreliable due to the presence of salts in masonry (Dill, 2000, p.26). That is, high moisture levels may be detected, when in fact there is only a high salt content present. This suggests a lack of knowledge in regard to appropriate methods to determine dampness levels.

Table 3 about here

Humidity sensors (36.3%), electrical capacitance metres (32.1%) and calcium carbide moisture metres (27.1%) were also utilised. Other respondents just allowed a predetermined number of days to pass after the flood before repair works were commenced (31.7%). Several methods including microwave moisture gauges (7.3%), electrical earth leakage techniques (4.2%), radars (2.3%), nuclear magnetic resonances (1.9%), and thermographic inspections (1.9%) were less utilised.

Apart from the subjective methods (i.e. based on visual observation and allowing a number of days after the flood), the differences in the effectiveness between the methods were marginal. The most effective method perceived was calcium carbide moisture metres (3.68). The subjective methods (2.63) were perceived to be the least effective but ironically used quite extensively.

Ideal methods to determine if a building is sufficiently dry for repair works to commence and their perceived effectiveness are presented in Table 3. Forty-four percent (44.7%) of the respondents indicated that their ideal methods were different from present methods. Humidity sensors were the most popular ideal method as identified by more than one-fifth (22.5%). Thermographic inspection was the second most popular ideal method (18.3%), however this is rarely used at present. Subjective methods including visual observation (0.4%) and allowing a number of days after the flood (1.5%), were not considered ideal by most. These suggest that practitioners are aware of the ineffectiveness and inaccuracy of such subjective methods, and would prefer to use alternatives.

Generally, perceived effectiveness of all methods improved in the ideal scenario (refer to Table 3). In fact, calcium carbide moisture metres and thermographic inspections were considered more than ‘effective’. Differences in the effectiveness between other methods were marginal.

Conclusion

Prior to the reinstatement of flood-damaged domestic properties, it is crucial that appropriate methods and/or equipment be used to dry buildings so that subsequent repair works are not damaged by latent defects such as fungal attack. Based on the perceptions of 289 experts, various findings regarding aspects of drying out flooded buildings have been presented. These included methods and/or equipment to dry flood-damaged buildings, and methods and/or equipment used to determine if a building is sufficiently dry for repair works to commence.

Findings suggest that surveyors consider various methods to assist drying rather than focusing on a single dominant method. The most popular method involved making use of any existing heating systems, a method considered to be practical and timely. The most popular ideal drying method was to install temporary heating, followed by natural ventilation. Property size (in terms of volume, area, number of rooms) was the most important factor to determine the number of dehumidifiers to be installed in a flood-damaged property. Some damage assessors would rely on experienced-based trial and error and generalisation of one dehumidifier per room or two per standard semidetached house. This indicates that for some, drying is not a scientific process but rather one based on experience and subjectivity.

Two-thirds of the respondents sealed off sections of the property to assist the drying procedure. A high degree of subjectivity was again found in determining the number of sections to be sealed off. Furthermore, findings suggest a lack of knowledge in regard to appropriate methods to determine dampness levels, and hence reliance on subjective methods (i.e. based on visual observation and allowing a number of days after the flood). These methods were perceived to be the least effective but ironically used quite extensively. The most effective method perceived was calcium carbide moisture metres. These facts highlight the lack of definitive guidance on various aspects of drying out flooded building. Further research is recommended towards developing standardised drying out procedures and techniques, to ensure higher quality and reduced reinstatement costs.

Acknowledgement
The authors gratefully acknowledge the financial support provided by the sponsor of this research, Lloyds TSB Insurance; and also the support in kind provided by Rameses Associates and the RICS Foundation. The authors also wish to thank building surveyors and loss adjusters who participated in the questionnaire survey.

References

Bates, B. C., Jakeman, A. J., Charles, S. P., Sumner, N. R. and Fleming, P. M. (1996) Impact of climate change on Australia's surface water resources. In Bosma, W. J., Pearman, G. I. and Manning. M. R. (eds.), *Greenhouse*. Coping with climate change, CISRO, Australia, pp.248-262.

Building Research Establishment (1974) *Drying out buildings*. ISBN 0 5125 126 9. Reprinted 1990.

Chapman, J. (2002) Flood defence management in England and Wales: the role of planning. *RICS Faculties and Forums Seminar, 'Flooding – your business, your client and you'*, 20 March.

Crichton, D. (2003) *Flood risk and insurance in England & Wales: are there lessons to be learned from Scotland?* Benfield Greig Hazard Research Centre, Department of Earth Sciences, University College London, London.

Dill, M.J. (2000) A review of testing for moisture in building elements. CIRIA Publication C538, London.

Fellows, R. and Liu, A. (1997) *Research methods for construction*. Blackwell Science Ltd., Oxford.

Gummerson, R. J., Hall, C. and Hoff, W. D. (1980) Capillary water transport in masonry structures: building construction applications of Darcy's law. *Construction Papers* 1, pt. 1, 17-27.

Halcrow Group Ltd., H.R. Wallington and John Chatterton Associates (2001) *National appraisal of assets at risk from flooding and coastal erosion, including the potential impact of climate change*. A final report for Department for Environment, Food and Rural Affairs.

Hall, C., Hoff, W. D. and Nixon, M. R. (1984) Water movement in porous building materials-VI: evaporation and drying in brick and block materials. *Building and Environment*, **19**(1), 13-20.

Harman, J., Bramley, M.E. and Funnell, M. (2002) Sustainable flood defence in England and Wales. *Civil Engineering, 'Floods – A new Approach'*, **150**(Special Issue 1), 3-9.

Hulme, M. and Jenkins, G.F. (1998) Climate change scenarios for the United Kingdom. *UK Climate Impacts Programme Technical Report No.1*, Climate Research Unit, Norwich, UK.

Illston, J. M. (1994) *Construction materials: their nature and behaviour*, 2nd edition. Spon Press, London. ISBN 0 419 15470 1.

Labovitz, S. (1967) Some observations on measurement and statistics. *Social Forces*, **46**(2), 151-160.

Minnery, J.R. and Smith, D.I. (1996) Climate change, flooding and urban infrastructure. In Bosma, W.J., Pearman, G.I. and Manning, M.R. (eds.), *Greenhouse*. Coping with Climate Change, CISRO, Australia, 235-247.

Nicholas, J. and Proverbs, D.G. (2002) Assessing flood damage to domestic dwellings: the present and future state of knowledge. *Construction Information Quarterly*, **4**(1), 1-3.

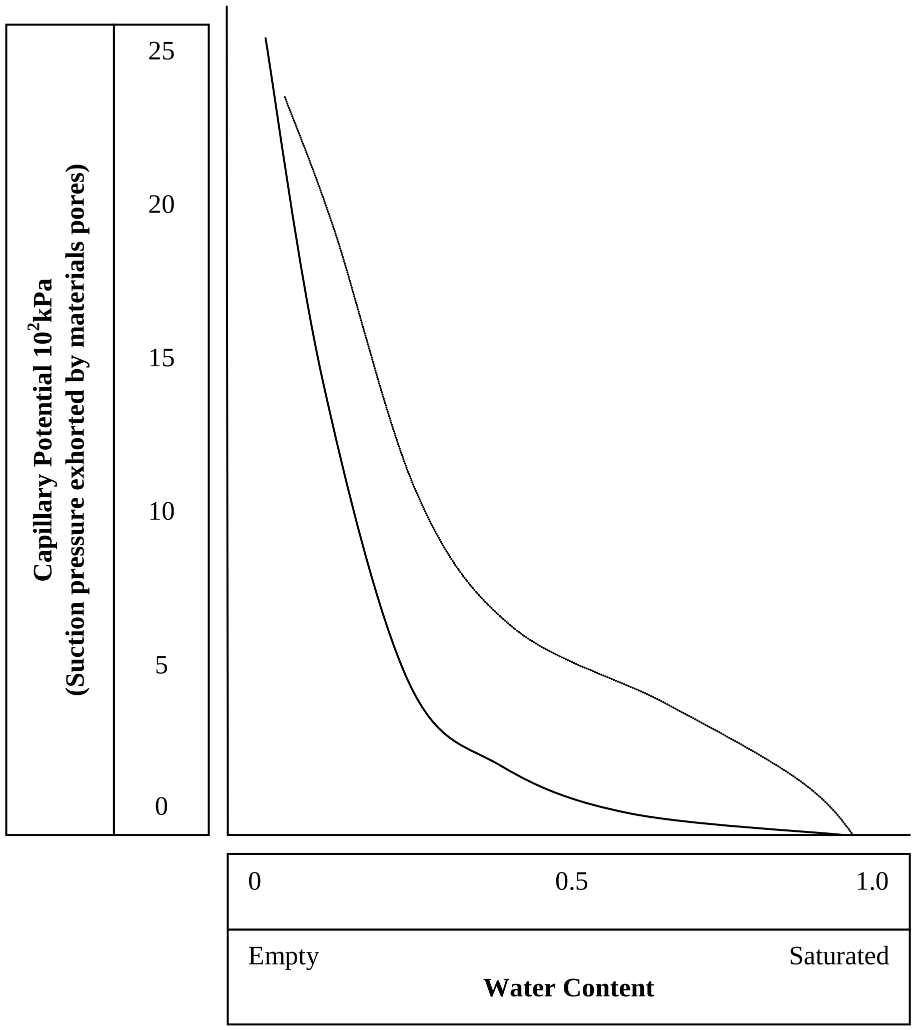
Proverbs, D.G., Nicholas, J. and Holt, G.D. (2000) Surveying flood damage to domestic dwellings: the present stage of knowledge. *The Royal Institution of Chartered Surveyors Research Foundation Paper Series*, **5**(8).

Purnell, R. (2002) Flood risk – a government perspective. *Civil Engineering, 'Floods – A new Approach'*, **150**(Special Issue 1), 10-14.

Scottish Office Environment Department (1995) *National planning policy guideline (NPPG7): planning and flooding*. HMSO. ISBN 1350-6153 & 0 7480 2961 3.

Wilson, M. A., Hoff, W. D. and Hall. C. (1995a) Water movement in porous building materials–XIII: absorption into a two layer composite. *Building and Environment*, **30**(2), 209 –219.

Wilson, M. A., Hoff, W. D. and Hall. C. (1995b) Water movement in porous building materials–XIV: absorption into a two-layer composite (S_A<S_B). *Building and Environment*, **30**(2), 209 –219.



denotes typical 'wetting' curve

denotes typical 'drying' curve

Figure 1 Absorption characteristics of a common clay brick

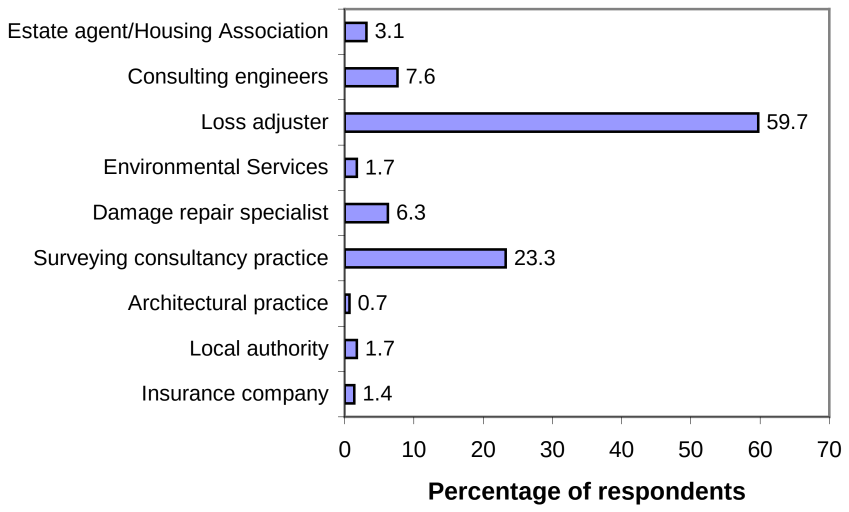


Figure 2 Respondent organisations

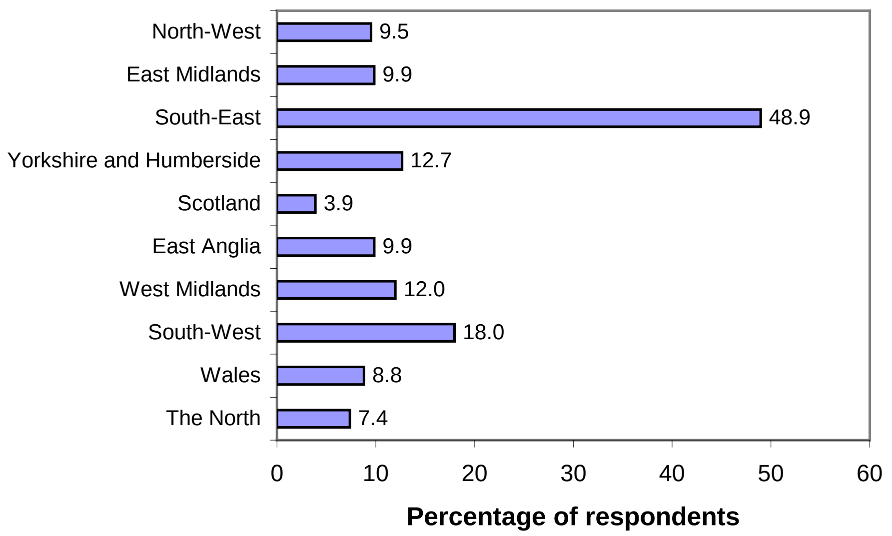


Figure 3 Operating regions of the respondents' organisations

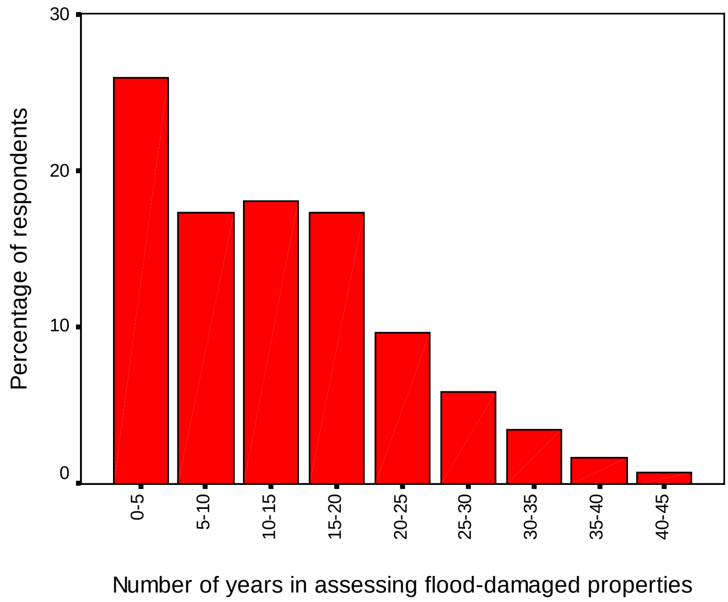


Figure 4 Respondents' levels of experience in terms of number of years in assessing flood-damaged properties

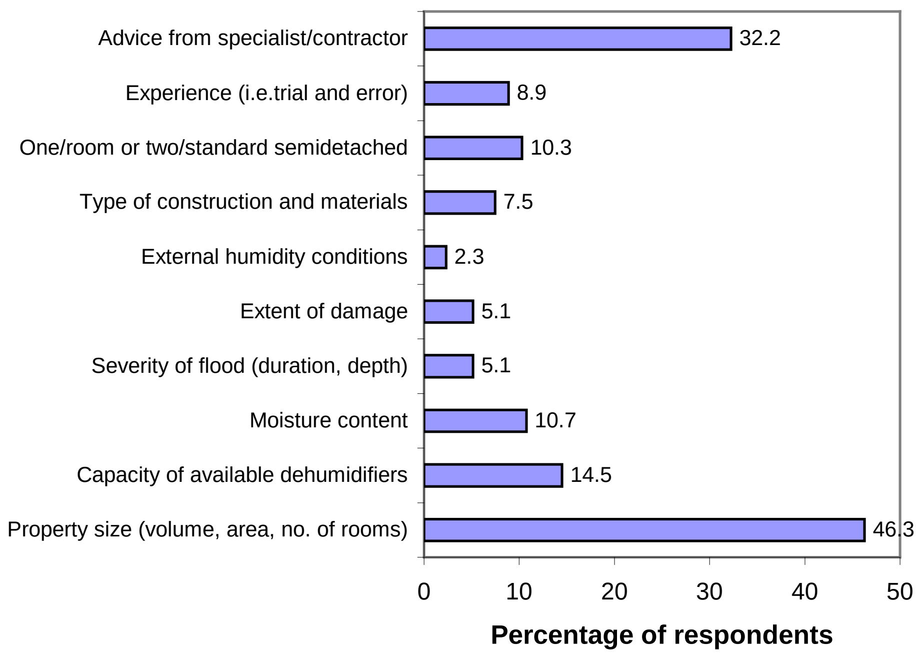


Figure 5 Methods to determine the number of dehumidifiers to be installed in a flood-damaged property

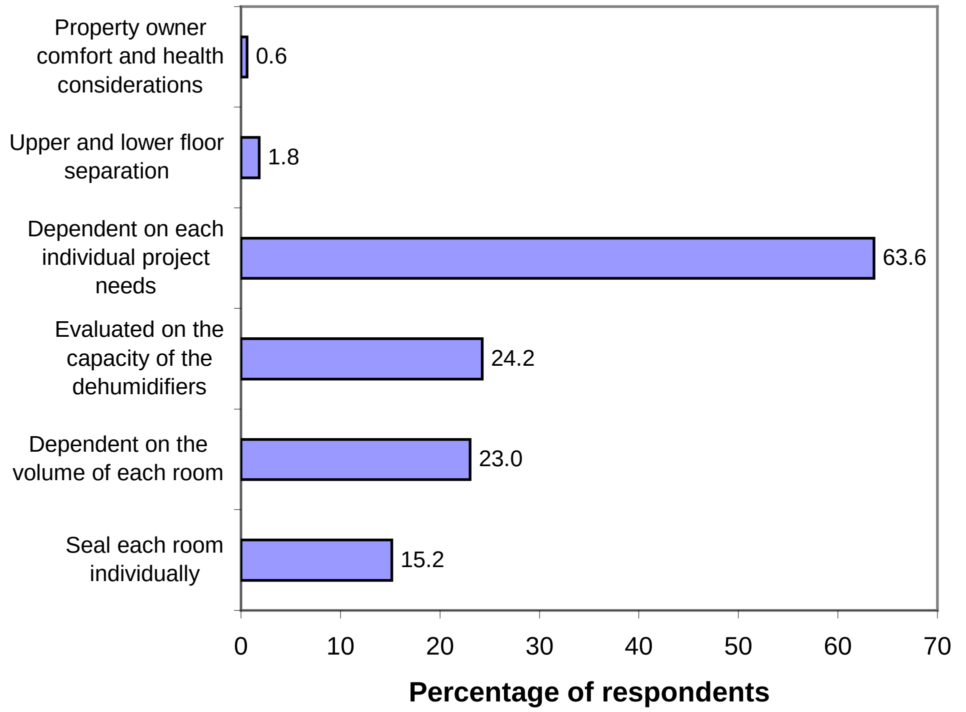


Figure 6 Methods to determine number of sections

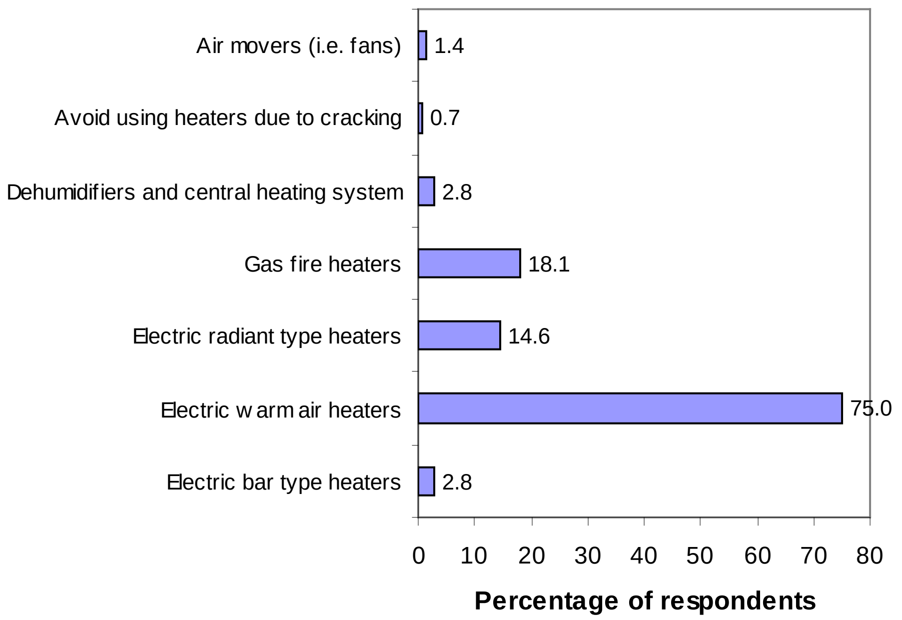


Figure 7 Types of heaters to assist drying

Table 1 Drying rates of brick walls under certain weather conditions

Weather condition	Evaporation rate (average) [g m^{-2} h^{-1}]
For a few hours after driving rain	68
Over a four day period after driving rain	20
Other average rates	1 - 7

Table 2 Present and ideal drying methods and their perceived effectiveness

Drying methods	Presently used		Ideally used	
	Percentage	Effectiveness scale (1-5)	Percentage	Effectiveness scale (1-5)
Install temporary heating	43.3	3.16	16.2	3.76
Install refrigerant dehumidifier	51.3	3.80	5.4	3.47
Install desiccant dehumidifier	69.0	3.84	8.7	4.04
Increase ventilation with fans	63.5	3.39	8.3	3.43
Building's heating system	74.7	3.11	4.0	3.45
Natural ventilation	50.9	2.55	9.7	3.85

Table 3 Present and ideal methods to determine whether a building is sufficiently dry and their perceived effectiveness

Methods to determine dryness	Presently used		Ideally used	
	Percentage	Effectiveness scale (1-5)	Percentage	Effectiveness scale (1-5)
Thermographic inspection	1.9	*	18.3	4.00
Radar	2.3	*	4.6	3.50
Nuclear magnetic resonance	1.9	*	4.6	3.64
Microwave moisture gauge	7.3	3.35	13.4	3.76
Humidity sensors	36.3	3.62	22.5	3.81
Electrical resistance metre	40.8	3.54	6.1	3.53
Electrical earth leakage technique	4.2	3.20	3.4	*
Electrical capacitance metre	32.1	3.40	4.6	3.58
Calcium carbide moisture metre	27.1	3.68	11.1	4.04
Allow a number of days to pass after flood	31.7	2.63	1.5	*
Visual observation	79.0	2.63	0.4	*

Note: * = The number of respondents who chose this method was considered too small (i.e. less than 10), and therefore was not used for comparison.