

COCKROACHES IN THE UK: DESIGNING BUILDINGS TO REDUCE THE RISK OF INFESTATION

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Abstract—Cockroaches require relatively warm conditions and in the UK are mainly confined to buildings. These insects are capable of carrying food-poisoning bacteria and causing allergies. To avoid these adverse health effects the risk of cockroach infestations in buildings needs to be minimised.

This paper reports on a survey of the findings of environmental health officers in England and Wales when assessing the scale of cockroach infestation and subsequently considers the effects of building design on minimising spread. Over 80% of local authorities who responded reported cockroaches; infestation was more common in metropolitan and urban areas than in rural authorities. Infestations were reported to be most serious in multi-occupancy dwellings such as tower blocks and low rise flats. More than a third of the authorities associated cockroach infestations in these buildings with ducted services and rubbish chutes and considered both contributed towards difficulties in achieving control.

In a subsequent study, detailed examination of flats in an infested block found discarded food and evidence of cockroaches in "service cupboards" which provided access to electricity cables and water pipes. These "service cupboards" ran vertically the full height of the building and gaps around pipes passing through each floor were sufficiently large to allow cockroaches to move vertically between floors. In these flats, cockroaches could also spread horizontally using the space between the floor and ceiling. Droppings within these voids confirmed their use by cockroaches.

Complete exclusion of cockroaches, from dwellings is rarely practical. However this paper suggests measures which can significantly reduce risks of spread, such as sealing or reducing voids which provide harbourage and distribution channels within and between dwellings. It recommends all ducts should be sealed where services pass through walls, ceilings and floors; essential voids should have access hatches and high standards of hygiene should be maintained within ducts. These measures are best achieved and most likely to succeed if implemented during the initial construction phase.

INTRODUCTION

Cockroaches have long been acknowledged as pests in England and Wales, with records dating from at least 1624 (Rhen, 1945). Their requirement for relatively warm conditions means that in the UK they are mainly confined to buildings, though they are very occasionally found outside in rubbish tips (Beatson and Dripps, 1972). Three species are found in buildings in the UK, the oriental cockroach (*Blatta orientalis*), the German cockroach (*Blattella germanica*), and the American cockroach (*Periplaneta americana*). Although varying in their habits and significance, all three species have the potential for rapid reproduction which can result in a population of many hundreds within a single building. The scale of the problem in the UK can be judged by recent reports of the Institution of Environmental Health Officers. In 1988/89 just over 26,000 buildings were disinfested (Anon, 1991) but the number of premises treated for cockroaches increased to nearly 43,000 in 1990/1991 (Anon, 1992) and remained at this level during 1992/1993 when over 41,000 properties were treated (Anon, 1994).

Cockroaches are highly mobile insects and can feed on almost any organic matter; in buildings they act as scavengers principally on exposed food and food waste. The presence of cockroaches in dwellings is of significance to the occupants in a number of ways. They may carry disease for many pathogenic species of bacteria and other organisms are naturally carried by cockroaches which can thus act as mobile reservoirs of pathogenic bacteria (Peck, 1988; Fotedar *et al.*, 1991). Allergy to cockroaches is among the most common allergies in asthmatics (Brenner, 1991; Brenner *et al.*, 1991). To avoid adverse health effects there is clearly a need to minimise as far as possible the risk of cockroach infestations in buildings.

The work reported here was undertaken under contract for Department of the Environment (Building Regulations) to identify factors in building construction which contribute to increased risks of infestation by cockroaches. The long term aim is to provide advice to architects and builders on designing and constructing 'healthier' buildings which have low risk of infestation by cockroaches.

STUDY METHODS

Initial survey

Questionnaires were sent to a sample of 90 of the 400 local authorities in England and Wales representing a range of metropolitan, urban and rural environments. Almost half the questionnaires were completed and returned, 23 from metropolitan, 11 from urban and 10 from rural authorities.

Environmental health officers (EHOs) were asked if their Authority had a cockroach problem and if so which types of building were most affected. They were also asked to indicate subjectively the seriousness of the problem on a scale of 1 to 4 (4 being 'very serious'), and also to identify factors they thought contributed to infestation.

Identification of transmission routes between flats

The initial questionnaire survey identified multiple occupancy buildings as those most frequently and more seriously infested with cockroaches. Construction details such as ducts and voids were considered as important features in contributing to increasing risks of infestation. The second phase of the study aimed to locate specific areas used by cockroaches and to identify features and factors in the ducts and voids which permitted establishment and transmission of the infestation within the building. This study entailed the detailed examination of a 19-storey block of flats which was being refurbished following major persistent problems of cockroach infestation. The block had been evacuated and the flats were being partially dismantled prior to reconstruction. This refurbishment enabled detailed investigation of the original design and construction details which would not have been possible in inhabited dwellings. The block in general and two of the flats in particular were carefully examined for indications of cockroaches (such as spotting, oothecae, nymphs and adults).

RESULTS AND DISCUSSION

Questionnaire survey

Effect of the external environment and dwelling type

Cockroach infestations were found to be more common in metropolitan (100% incidence) and in urban authorities (82%) than in rural authorities where only 40% reported infestations. The problem was perceived as most severe by metropolitan authorities (30% reported "very serious" problems in one or more dwelling types) whereas only one urban authority (9% of total) reported the same level and none of the rural authorities considered the infestations to be "very serious" (Table 1). Of the housing types examined tower blocks, low-rise flats and terrace houses were most frequently infested (Table 2) but only in tower blocks and low rise flats were the infestations perceived as being "very serious".

The higher incidence and severity of infestations in multi-occupancy dwellings undoubtedly reflects the ease with which cockroaches are able to move from dwelling to dwelling without the risk of being exposed to adverse outside climate conditions. When moving between buildings in urban and metropolitan areas, where individual buildings tend to be close together, cockroaches are less exposed to these risks than in rural areas. Also, it is possible that there is a greater turnover of

Table 1: Incidence of cockroach infestations in relation to type of local authority.

Type of local authority	Number responding	% age reporting infestation	% age reporting "very serious" infestations
Metropolitan	23	100	30
Urban	11	82	9
Rural	10	40	0

Table 2 Incidence of cockroach infestations in relation to dwelling type

Type of dwelling	Number reporting infestations*	% age of authorities reporting infestation	% age of authorities reporting "very serious" infestations
Tower block	22	50	14
Flats, low rise	27	61	9
Terrace	24	55	0
Semi-detached	12	27	0
Detached	11	25	0

*Total number of local authorities responding = 44

occupants in metropolitan areas, and particularly in flats, and this would increase the risk of transmission of cockroaches, for instance when carried in on furniture and personal items

Building features influencing cockroach infestation

Local authorities generally associated the presence of cockroach infestations with design features such as ducted services (81%) which were also considered as contributing towards difficulties in achieving effective control of existing infestations by 64% of authorities (Figure 1) Cockroaches within such voids are able to avoid and survive the effects of insecticidal sprays applied to internal surfaces of dwellings

EHOs also associated district heating (69% of authorities) with cockroach infestation This was hardly surprising as the extensive ducting associated with district heating systems has been identified previously as providing an extensive, heated habitat for such insects (Building Research Establishment, 1992) Rubbish chutes were another building feature considered by EHOs (in 36% of authorities) as contributing to the risk of infestation Other reported factors included multiple occupancy (36%) and degree of cleanliness (69%) both of which were also high on the list of factors considered to inhibit effective control measures (by 58% of authorities)

Study of transmission routes between dwelling units

The detailed study of the dismantled flats found evidence of cockroaches in voids within floors, and in "service cupboards" It was also apparent that items of food discarded in these areas (possibly by

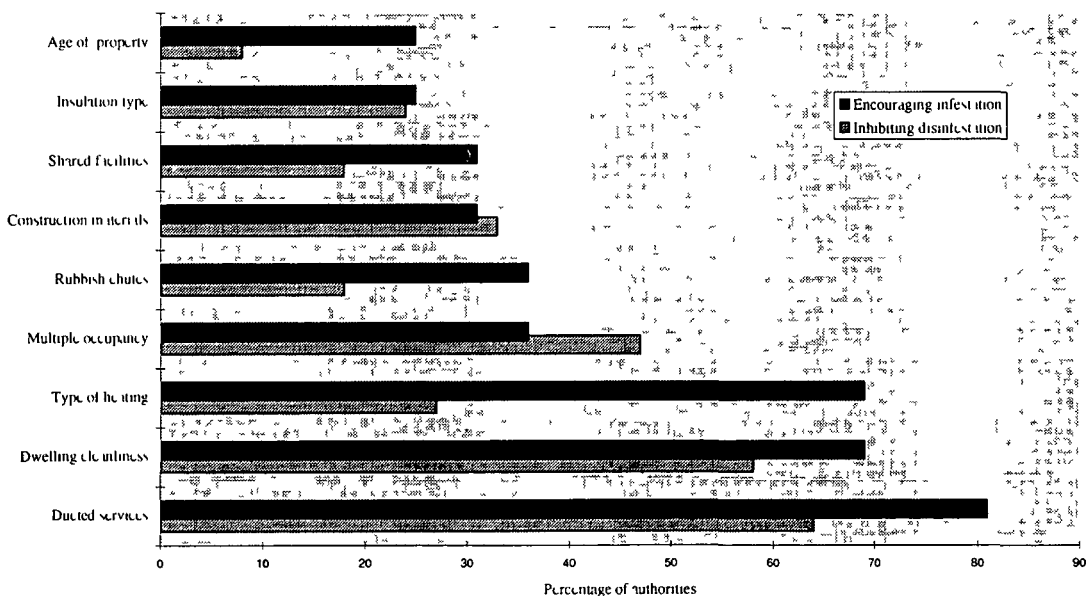


Figure 1 Factors identified by authorities as encouraging cockroach infestations and inhibiting disinfection procedures

service personnel) had provided a food source. Building defects were also found which would allow cockroaches to move between these voids. Hot water pipes from the central boiler house were sleeved where they entered the "service cupboards" but the gaps between most pipes and their sleeves were found to be sufficiently large to allow the passage of cockroaches and on occasion were loosely filled with paper. Gaps were also present between electrical cables and the electrical conduit passing between floors, and where soil pipes passed through the floors (Figure 2). Furthermore, because these pipes ran from ground level up a vertical stack for the whole height of the building the insects were able to move easily between floors. Also running the full height of the block and connecting all 19 flats was a ventilation stack for supplying and removing air from the bathrooms. Since insect-proof grilles were not provided to the outlets, this stack also allowed cockroaches to move easily from dwelling to dwelling.

The floors of the dwellings were laid on 50 x 50 mm battens over a concrete slab which formed the ceiling of the flat below. Heating pipes and other services ran from the "service cupboards" into this sub-floor void without any form of sealing. The supporting joists were deeply notched to receive the cables etc, allowing cockroaches to move easily within the void and gain access to all parts of the dwelling using the gaps around the cables and pipes passing out of the sub-floor void. In this way cockroaches were able to enter the kitchen, bathroom and airing cupboards. Since the voids also carried the electrical wiring for the lights on the ceiling of the dwelling beneath and the wiring was not sealed in the access hole (Figure 3), they also provided a downward route for transmission between floors. Common floors/ceilings and walls therefore frequently provided voids through which cockroaches could spread. More recent work by BRE has found that in blocks of flats, between 79 and 95% of infestations were in groups of flats linked by such voids. A very low number of infestations were recorded in isolated single flats.

In this particular building the communal rubbish chute with access hatches at each floor did not have evidence of cockroach infestation, possibly because exposure to outdoor temperatures and the routine general disinfestation undertaken discouraged infestation. Thus it may be that rubbish chutes are not a major source of cockroach infestation where proper remedial measures are taken.



Figure 2. Service cupboard showing gaps between pipes and concrete and conduit taking cable.



Figure 3. Lighting circuit cable descending through unsealed hole in concrete ceiling to flat below.

IMPLICATIONS FOR NEW BUILDING CONSTRUCTION

Complete exclusion of insects, including cockroaches, from domestic dwellings is not a practical possibility because their size enables them to enter through minute cracks (Building Research Establishment, 1992). They may also be transported into buildings inside infested packaging.

Since ducting and voids have been shown to provide harbourage and potential routes for the spread of cockroaches it can be assumed that measures to reduce them will significantly reduce the risk of cockroach infestations. Where such voids cannot be avoided, the presence of cockroaches can be expected to be reduced if the voids can be easily treated. Consideration should therefore be given to measures which increase the efficiency or ease of application of insecticide treatments (for example installation of inspection/treatment hatches). Such measures are particularly important in multi-occupancy dwellings in view of their high risk of cockroach infestation, and should be specified and implemented as essential preventative precautions during initial construction.

From the study we undertook, the following general recommendations can be made for design and construction detailing:

- Seal around all services where they pass through walls, ceilings and floors, particularly those between dwellings. Polyurethane foam applied from aerosol cans and flexible silicone or acrylic sealants can be expected to be effective. However no specific evidence is available on the long-term resistance to cockroaches of these sealant types (laboratory tests are in hand to determine the effectiveness and longevity of such sealants).
- Provide access hatches for inspection and application of insecticidal treatments where voids are unavoidable.
- Seal tightly around ventilation ducting and provide openings with insect-proof mesh; mesh with holes 1 mm² should be effective.
- Consider providing separate ventilation ducting for each dwelling unit.
- Maintain high standards of hygiene in service areas.
- Do not allow food residues to accumulate during construction.

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