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Dear sir/madam,

Just in case the enclosed article in "ByggentreprenÖrerna" may bring an enquiry to you, I have enclosed copies of the paper. Some minor corrections have been incorporated and it is in an easier form for copying.

I hope you find it convenient to use this version should there be any need for it- the original was published in the proceedings of Healthy Buildings '88, but I think this one is better for distributing.

Thank you for your cooperation.

Yours sincerely,

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CRITERIA FOR SELECTING A HEALTHIER HOUSE IN SYDNEY, AUSTRALIA

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Abstract

This paper describes the choice and application of six factors to indicate which of four existing houses in Sydney, Australia, provided the healthiest home environment. One factor, magnetic field levels in rooms and gardens, was directly measured. Five other factors were estimated by architect's inspection and owner interview. These were outdoor air quality, indoor pollution from an oil-fired space heater, household management including recalled pesticide use, damp problems and design aspects likely to influence indoor air quality. The relative importance of these factors for the region and for the prospective occupants is discussed.

Introduction

Before estimating the relative "healthiness" of existing buildings, all relevant criteria need to be identified, assessed and weighted according to likely significance to the health of building users. In the home environment, time and cost restrictions may limit investigation of all factors. Yet it is here that healthy buildings may interest many people, particularly those with chronic ill health. Private housing may be selected according to its apparent healthiness despite incomplete or inadequate information. This paper describes the process of finding and evaluating healthiness criteria for four detached houses in the suburbs of Sydney, Australia. A family of four, three of whom had suffered hypersensitivity reactions for many years, wished to choose from houses 1, 2 and 3 a healthier home environment than house 4. A prompt decision was required in case any house was sold meanwhile. The family emphasised avoidance of traffic fumes and power lines. With architectural inspection of all houses during one afternoon in July 1985, a broader basis for decisions was sought. This exercise was essentially a comparative one using observed and recalled data where other appraisal techniques were not available. Despite its preliminary nature, this comparison illustrates problems likely to be encountered in more sophisticated healthy building assessments.

Selection and Assessment of Criteria

Lists of important health criteria have been compiled for indoor environments (8), and for home environments in countries such as Sweden (4). As similar studies have not been made for Australian housing, criteria selection for this project was based on local knowledge of building practice and on-site observations. Many criteria relevant to other countries and building types were considered irrelevant to a healthiness comparison of the four Sydney houses. Other criteria were omitted from the comparison as no assessment method of any kind was available. Six criteria were selected.

Eliminated criteria. If radon emission from ground or building materials were present, the fixed venting of subfloors and rooms of the houses was expected to prevent significant accumulation. Formaldehyde pollution was discounted for similar reasons, but also because all parts of all houses were at least seven years old. There was little use of particleboard and no urea formaldehyde foam insulation in any of the houses, which were predominantly of brick veneer construction with plaster internal linings. Furnishings were not considered as these were readily changed if unsuitable. Tobacco smoke was not noticeable in any house. Combustion products of gas were not of concern, as all houses had electric stoves and no gas connected. Asbestos was present in cement sheets behind tiling and in some linings, but there was no evidence that significant loose fibres would be present in the air.

Omitted criteria. Intermittent pollution sources near each house, such as neighbour's combustion devices, could not be estimated on a single, warm afternoon. Similarly, indoor levels of residues from any pentachlorophenol-containing wood preservers or paints could not be assessed. Such products have been readily available for use by builders and householders, but their use is not visible, nor easily recalled, nor was chemical sampling possible. Two possibly relevant criteria for the home environment were thus omitted from consideration.

Magnetic field (MF) levels. Magnetic fields originating from manmade sources may be many times greater than naturally occurring fields, particularly at frequencies of 50-60 hertz (Hz) at which domestic electricity supplies operate. According to a World Health Organisation (WHO) report, recent epidemiological data associating increased incidence of cancer with exposure to very weak fields of 1 to 10 milligauss (mG) can neither be accepted nor dismissed, but require further study (10). With one of the four houses opposite a power line reserve, MF was considered a valid criterion for comparisons. MF at 50 Hz plus harmonics up to 300 Hz was measured in most rooms and some gardens of all houses. All readings were taken during a time of non-peak power use, on a weekday between 12pm and 4pm. Peak values were assumed to be less important than those which represented typical occupant exposures of longer duration such as in bedrooms. Representative values were sought by measuring fields toward the middle of rooms, away from appliances, and at waist height close to the zone most often occupied by adults standing, sitting or lying down. With the exception of house 2 few appliances were operating. In houses 1, 3 and 4, readings were also taken with power off to check the influence of the external power distribution network on magnetic field levels.

Outdoor air quality. Sydney is the largest Australian city having over three million inhabitants, extensive suburbs of detached houses and reliance on motor transport. Backyard incineration of household refuse was a widespread practice in 1985, and wood fires had gained in popularity. Therefore it was not reasonable to discount outdoor air quality as a factor in the comparisons. All houses were in outer suburbs. Near bushland reserves in St. Ives, outdoor air quality was likely to be better than in built up areas of St. Ives or Castle Hill.

Indoor pollution from an oilfired space heater. Combustion products from fossil fuel burning have been identified as a health hazard in the indoor environment (4). With incomplete combustion carbon monoxide may have been a particular problem in the existing residence. Pollution was estimated by the presence or absence of an oil heater, by its age and by occupants' reports of odours indoors.

Household management. Cleaning products and pesticides have been identified as important sources of indoor pollution, particularly persistent chemicals such as chlordane which can be difficult to remove after contamination (8). The Australian Standard of 1978 for existing buildings recommended application of water emulsions of aldrin, chlordane, dieldrin or heptachlor for termite control (3). Studies of pesticide residues in mothers' milk show that levels are raised in the bodies of house occupants following external treatments of the building (7). These pesticides have been listed as carcinogens (9), and can persist and accumulate in human tissue (1). One of the few aspects of household management which the owners of the houses could recall was having had annual contracts for termite and spider control. Although none had records of chemicals used, the possibility of a build up of organochlorines in regularly treated home environments (6) could not be ignored in a healthiness comparison of housing. Potential for effect on future occupants was considered greater where the last treatment was said to be recent, and where the largest number of annual termite treatments was recalled.

Dampness. High indoor humidity may lead to increased levels of moulds, their spores or metabolites, which may produce symptoms of irritation in sensitive persons (4). The four houses were inspected during dry weather and damp problems noted where rooms smelt musty, where water stains were visible, and where excessive settlement of floors had occurred and adjacent ground surface was visibly damp. Problems were estimated as worse where dampness was extensive or longterm, thus likely to keep indoor humidity at elevated levels.

Design factors likely to influence indoor air quality. Potential for indoor air pollution was considered greater where spaces containing pollutant sources such as vehicles or mould growth opened directly into habitable rooms. Wide opening windows which made airing easier and screened porches which allowed for less use of insecticides were considered assets to air quality. An important design aspect was solar orientation. At Sydney's latitude, solar gains from the northeast to the northwest in winter can greatly reduce the need for supplementary house heating, thus shortening the heating season. With less burning of fossil fuel required, there is less potential for combustion fumes to affect indoor air quality.

Results

The range of MF readings for all houses is shown in Figure 6, and estimates of the five other criteria are summarised in Figure 7.

House 1. MF readings were generally 3mG and less, except near the refrigerator (9mG) and at the seat of the electric organ (13 mG) when it was switched on, as shown in Figure 1. Neither the major grid high voltage line seventy metres distant nor the local 3-phase supply on the footpath twenty metres from the house was significantly affecting indoor MF levels, as is shown in Figure 2. The house was located in a built up area of St Ives. The oil heater was seven years old and did not smell when unlit. The house was said to have been pesticide treated annually until about 1982. Dampness was not evident, although some indoor moisture sources were not vented and the house was overshadowed by a tall building on its west. Ventilation could have been restricted, as windows were top-hung, opening to a maximum of 150 mm at the base of the sill. The living room was oriented for morning sun, and garage and store were separated from the house.

House 2. MF readings were under 2 mG, as shown in Figure 3, when most appliances were operating. Heating was electric, with no oil heater. Location was similar to house 1. Annual treatments for termites and spiders were recalled for most of the seventeen years since construction up to 1985. Water damage was evident in eaves linings and cornices, but the house was not generally damp. The garage was attached, but did not open into the house.

House 3. MF readings were 1 mG or less with power on, as shown in Figure 4. The house was in St. Ives, adjacent to the last house at the end of a normal domestic supply line. Extensive bushland reserves were opposite. There was no oil heater. Householders stated that there had been no pest treatments for spiders or termites in seventeen years, and possibly none in the twenty years since construction. The house was sited on a high dry ridge, with no evidence of damp even in subfloor spaces. The garage opened into the lower part of the house, but the connecting stair was remote from bedroom and living areas.

House 4. The existing residence at Castle Hill was found to have the highest MF readings as shown in Figs. 5 & 6, mainly due to house wiring. The oil heater was twelve years old. It smelt even when off and not used for many months. Occupants reported downdrafts in the flue and the smell of both raw and burnt oil while it was operating. It was located in the living room, where persistent damp problems had occurred under the low timber floor and in adjacent garden. Both combustion fumes and subfloor wetness could increase indoor humidity. This room was open to the central stairwell, and pollution of fumes and moulds could readily rise to bedrooms above. The garage which had been used for storage of chemicals as well as cars, was connected to the central stairwell. The house was said to have had annual external pesticide treatments for most of nine years since construction to 1982.

Discussion

Of the six criteria likely to be relevant to the house comparison, only one, MF, could be quantified. Indoor MF levels did not provide a basis for choice using WHO guidelines for human exposure, which are several orders of magnitude greater (10). Four factors could be assessed to some extent by inspection, and results suggested that houses 1, 2 and 3 were all likely to provide a healthier home environment than house 4. The most difficult factor to estimate was previous household management, particularly the repeated use of persistent organochlorines in the home environment. Yet to have ignored this factor because of inadequate assessment methods would have been unwise. The family, including teenagers, had already experienced up to nine annual external pesticide treatments of the home, and may have accumulated residues in their body tissues. In this case, further exposure may have been the major environmental health risk. Accepting owners' recall as accurate, house 3 appeared the healthiest choice.

With long term health risks being associated with commonly used termiticides, further research on exposure patterns resulting from their domestic use is needed for Australian housing. In America, it was found that dieldrin could still be present in soil more than twenty years after soil treatment. Dieldrin is not readily decomposed in soil and residues tend to circulate from one medium to another by slow volatilisation in air (1). Migration patterns of such organochlorines in houses and house sites may be a major consideration in assessing the healthiness of Australian housing for many years to come.

As shown in this small sample of Sydney houses, exposures to various indoor pollutants may occur in the same place at the same time. In house 4, car exhausts, mould and oil heater fumes could be present simultaneously in the central circulation space. Migration of subfloor pesticides, particularly in the constantly damp areas, was possible but unknown. In this house, one hypersensitive resident occupied a bedroom with an MF reading of 6.0 mG, and other rooms she often used during the daytime had readings of 7.0 mG and 9.0 mG. Combined effects of fields of this magnitude and other factors on human health are being investigated. Long term exposure is considered by some to exhaust the adaptive capacity of the body, thus lowering resistance to disease (5). A mechanism for cancer promotion by weak levels of MF interfering with defense systems of cells in the presence of carcinogens, has been proposed (2). If simultaneous presence of several factors, such as carcinogens and elevated MF levels, were found to be a greater risk than either factor alone, multiple exposure patterns such as in house 4 could be particularly significant to occupant health.

This preliminary exercise demonstrates difficulties which may be encountered in any multifactorial assessment of the healthiness of existing housing. Effects of multiple exposures may be hard to assess from present guidelines. Actual occupant exposures may not be indicated by measurements made during limited time periods. Factors such as household management may be extremely variable, and impossible to investigate economically with acceptable scientific means. The most important criteria may be overlooked, particularly if only quantifiable data are accepted for comparisons. The development of a full set of assessment criteria relevant to the building type, the region and the needs of the prospective occupants was found to be the essential basis for a healthiness comparison of housing. Where practical solutions must be found on the basis of incomplete information, an assessment framework which recognises such limitations is required.

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Acknowledgement

Magnetic field readings were provided by Bruce Ayling, of the Commonwealth Scientific and Industrial Research Organisation, Division of Coal Technology, North Ryde 2113, Australia.

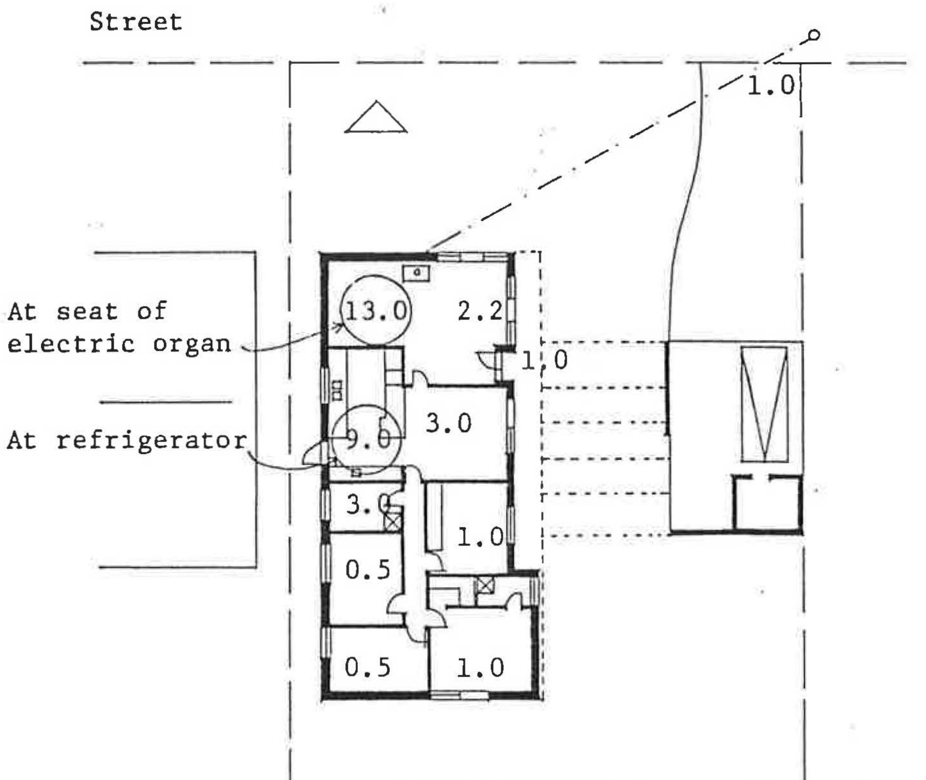

Fig. 1. Plan of house 1 near high voltage lines. MF readings in rooms with power on are shown in mG. Localised readings are shown encircled.

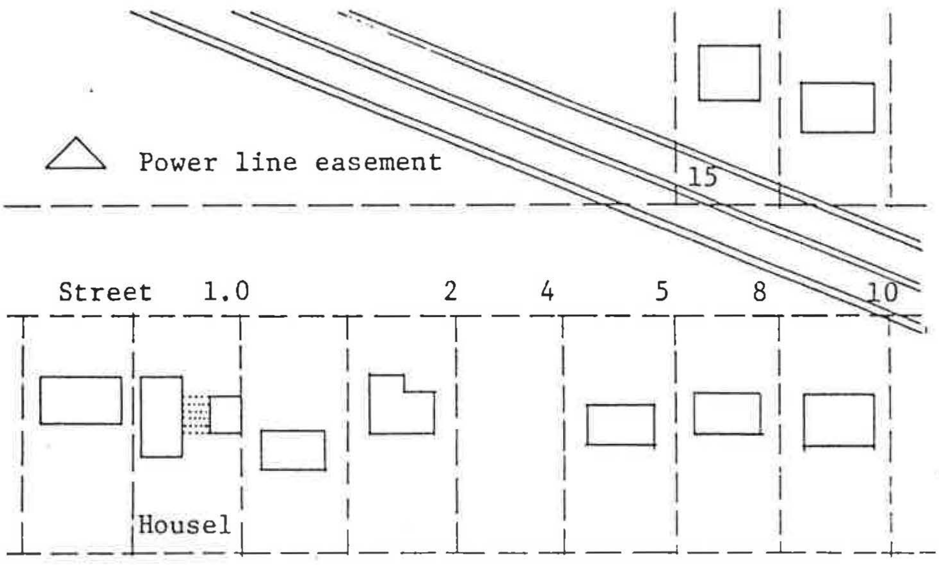

Fig.2. MF readings on street outside house 1 are shown in mG.

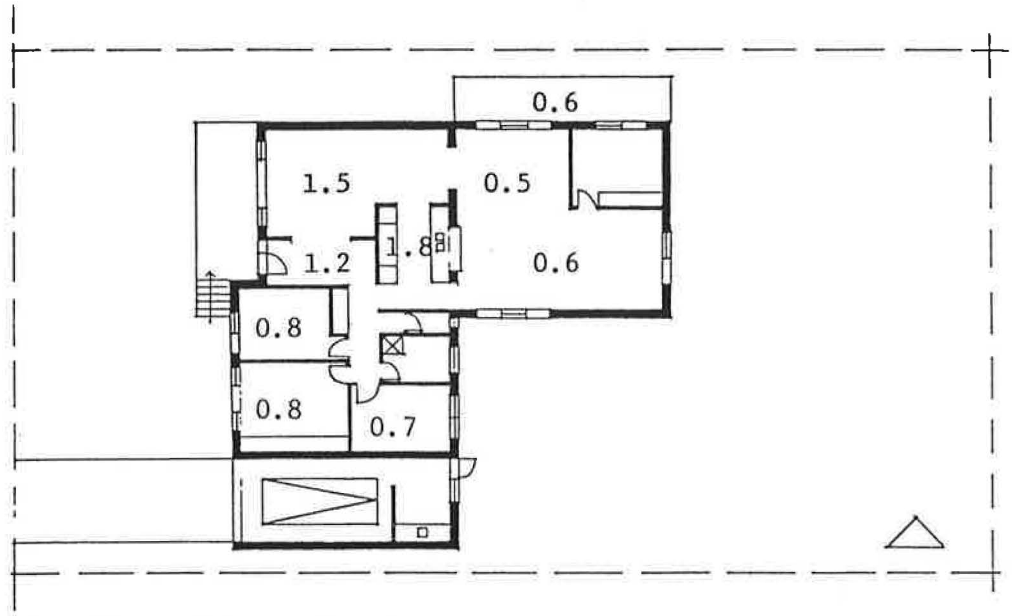

Fig. 3. Plan of house 2. MF readings with power on are shown in mG.

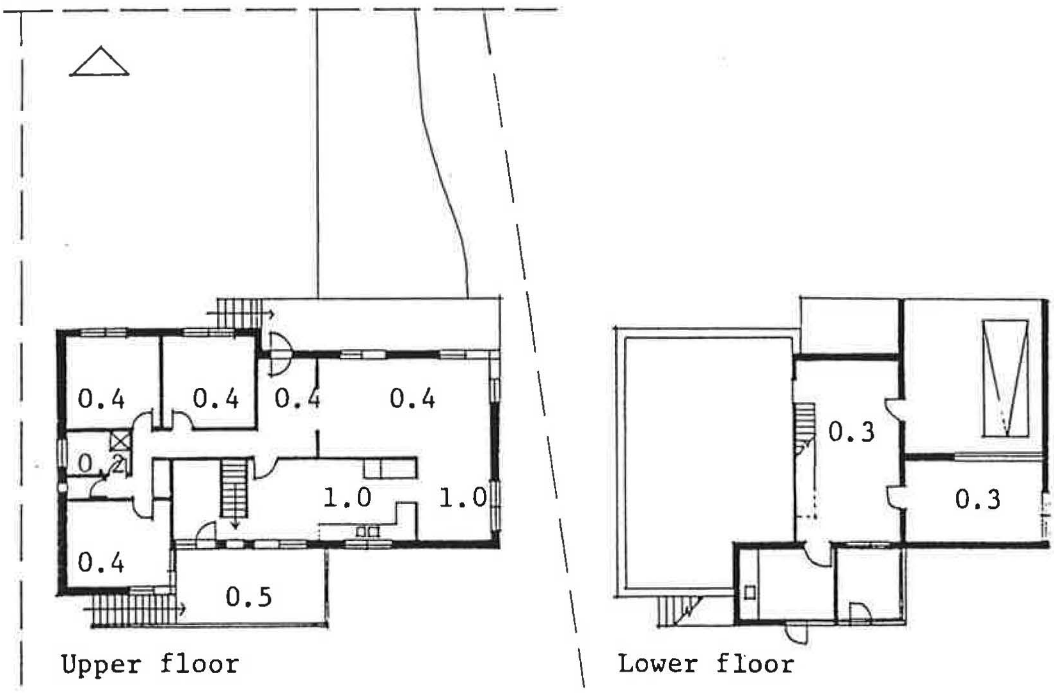

Fig. 4. Plan of house 3. MF readings with power on are shown in mG.

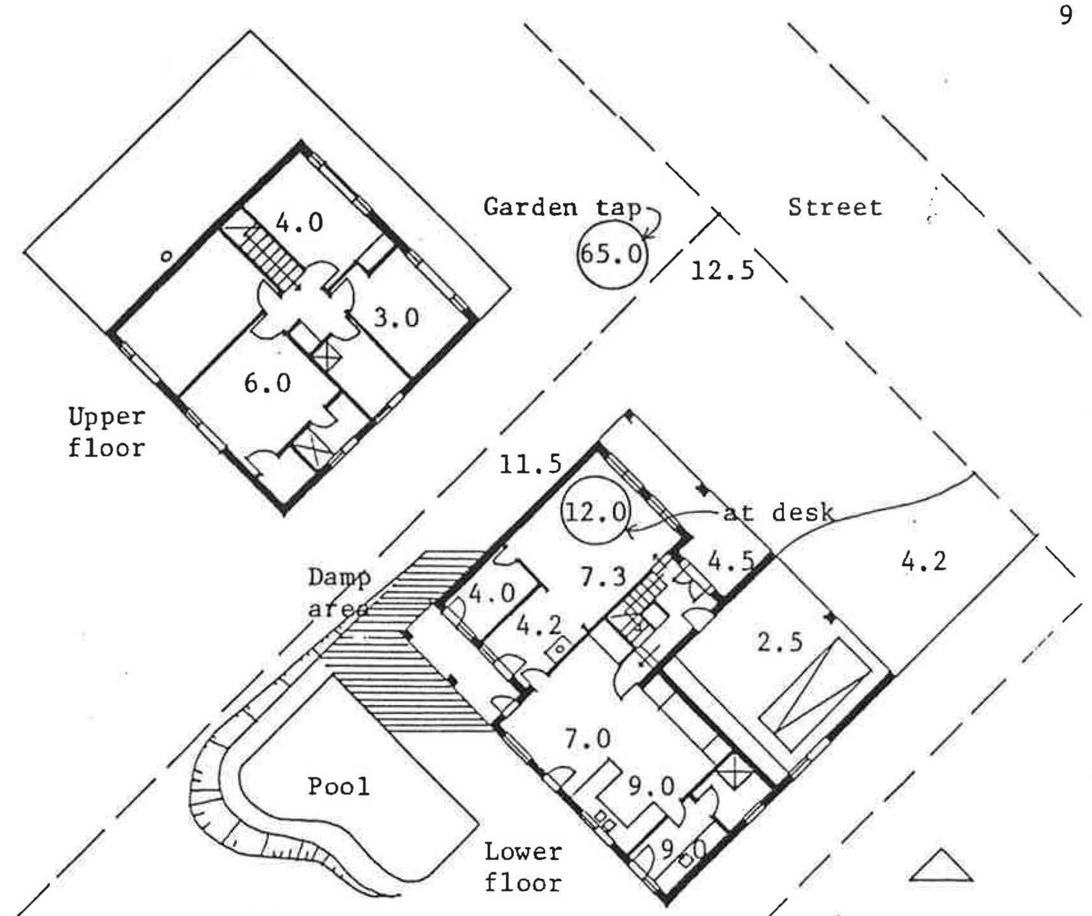

Fig. 5. Plan of house 4. MF readings in rooms with power on. Units are mG, and localised readings are shown encircled.

	House 1	House 2	House 3	House 4
Power on				
- all rooms	0.5 to 3.0	0.5 to 1.8	0.3 to 1.0	3.0 to 9.0
- bedrooms	0.5 to 1.0	0.7 to 0.8	0.3 to 0.4	3.0 to 6.0
Power off				
- all rooms	0.5 to 1.0	not measured	0.1 to 0.3	0.8 to 2.8
- external	1.0 at gate	not measured	not measured	3.2 to 12.5

Fig.6. Range of MF readings in milligauss for all houses.

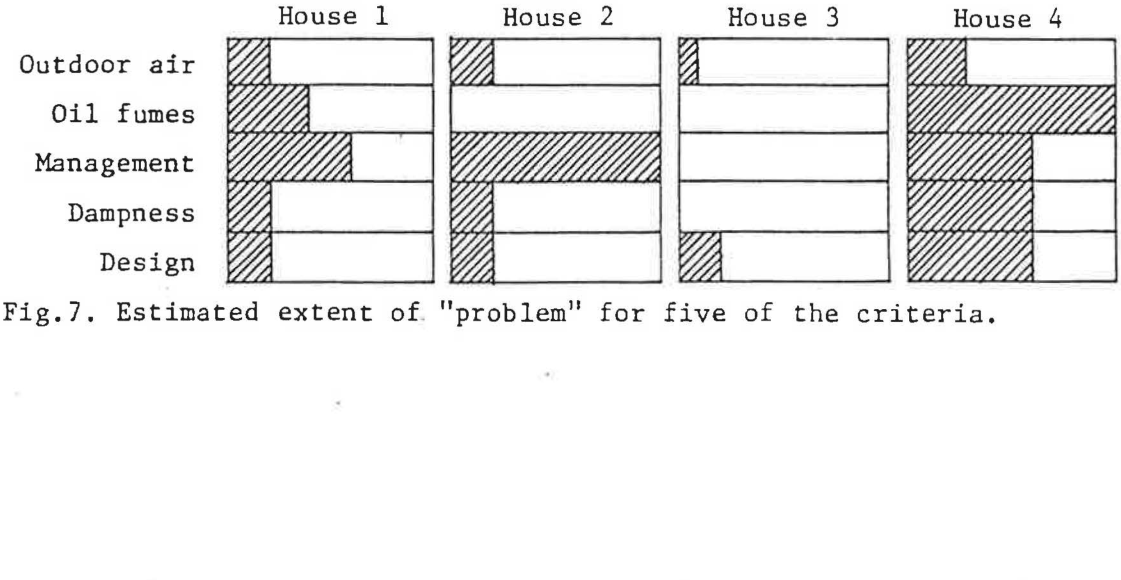

Fig.7. Estimated extent of "problem" for five of the criteria.

CRITERIA FOR SELECTING A HEALTHY HOUSE

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Abstract

If present research on indoor air quality is to be of wide benefit in housing, a framework for assessing the overall healthiness of a dwelling is needed. The identification of all criteria and their relative importance along with a prediction of future effects on human health, are basic to a healthy building assessment. This process is illustrated with an exploratory study of the relative healthiness of four detached suburban houses in Sydney, Australia. Of sixteen possible criteria, those used in the comparison were magnetic field levels, outdoor air quality, damp problems, indoor combustion fumes, previous household management and design factors likely to influence occupant exposure to pollutants. Results indicate the need to develop qualitative guidelines for healthy building, based on a comprehensive set of criteria relevant to the region, building type and needs of future occupants.

Background

The concept of healthy housing is an attractive one. However, at the practical level of defining any dwelling as "healthy", assessment methods and standards are required for all relevant environmental factors. That such an evaluation system is not yet fully developed is unlikely to deter would-be occupiers of healthy dwellings; practical decisions on building, renovating or moving house will be made according to whatever information is available. If only one relevant factor is left out of the decision making process, such a change could lead to a less healthy home environment.

The exercise described here deals with the search for a set of criteria upon which the selection of a healthy house could be based. Its practical aim was to identify a house that was healthier in all important respects than the existing residence of an Australian family, where the mother and both children had experienced symptoms of hypersensitivity for many years. Many of the factors which have been linked with unhealthy dwellings in cold climates are not common in Australia. Typical houses are detached, on relatively large allotments, and do not have basements or mechanical ventilation. Air-tightening of dwellings for energy conservation was estimated by Biggs and Bennie (1987) to be uneconomic in most cases. Radon levels such as have focussed attention on the indoor air quality of housing in other countries have not been found. Nonetheless it can not be assumed that all Australian houses are healthy. Special factors such as the high level of home ownership, and the cultural attitude that all houses should be as different as possible from each other may be working against problem identification. For this exploratory study, healthiness criteria were based on characteristics of four typical suburban houses in Sydney, and assessment was comparative. For most factors, qualitative investigation only was possible. Where measurement was available, exposure standards were not definite. However the task of identifying all criteria and estimating their relative importance is basic to any healthy building assessment, no matter how sophisticated the investigative procedures or how clear the exposure guidelines for each criterion may become in future.

Criteria Selection and Assessment

The range and extent of health-related problems have been estimated for indoor environments generally in the United States by Repace (1982), and for housing in Sweden by Lindvall (1987). Similar reviews have not been made for Australian buildings, although a study by Ferrari et al. (1988) indicated that unvented gas appliances could be a source of air pollution in Sydney houses.

The four houses being compared were in most parts brick veneer with plaster internal linings and fixed wall vents. None had gas connected. All houses including additions were more than seven years old, and did not have ureaformaldehyde foam insulation or extensive areas of particleboard. Problems from gas and formaldehyde were therefore unlikely. Radon problems were also unlikely, as levels in standard above-ground houses of this type were found to be low in a survey by Baggs and Wong (1985). Asbestos in cement sheet linings was present in all houses, but there was no evidence that significant fibres were likely to become airborne. No house was in a noisy location, and lack of daylight is rarely a problem for detached housing at this latitude. Pollution of indoor air from furnishings or tobacco smoke could be controlled by future household management. These eight factors were not considered relevant to the comparison. Two more were possible relevant, but were omitted as no assessment method of any kind was available. These were contamination of the indoor environment with persistent chemicals, such as pentachlorophenol and its contaminants in paints and wood preservers, and intermittent pollution from nearby combustion sources such as neighbour's incinerators. Six further criteria appeared relevant, and were able to be assessed to some extent. This was done by a combination of measurement, owner interview and building inspection during a warm winter day following a period of dry weather. Comparison was made by ranking the houses in order of apparent merit for each criterion from one to four. Results for the existing residence house D, and alternative houses A, B and C are shown in table 1.

Magnetic field (MF) levels were a major concern of the future occupants, as house A was opposite a high voltage power line. MF from manmade sources may be many times higher than naturally occurring fields, particularly at frequencies of 50-60 hertz (Hz) at which domestic electricity supplies operate. MF at 50 Hz with harmonics up to 300 Hz was compared in all houses, toward the middle of rooms and away from appliances. Readings at house A were 0.5 to 3.0 milligauss (mG) indoors, and 1.0 to 2.0 mG outdoors. Comparable readings in the existing residence were higher, being 2.5 to 9.0 mG indoors and 4.2 to 65.0 mG outdoors. Each house was ranked according to its highest bedroom reading. These were 1.0, 0.8, 0.4 and 6.0 mG.

Outdoor air quality was also an important consideration to the future occupants. Sydney is Australia's largest city, with over three million inhabitants, extensive suburbs of detached housing and reliance on motor transport. Houses A, B and C were chosen because all were to the northern fringe of the suburbs near an extensive bushland reserve. However, backyard incineration of domestic refuse was a widespread practice at the time, and woodburning heaters were becoming popular in outer suburban housing. Therefore the houses were ranked by density of neighbouring settlement as an indicator of likely future outdoor air quality. House C was opposite a large reserve, house A near the smaller open space of the powerline easement, and house B was fully surrounded by detached houses.

Dampness can cause high indoor humidity which, through increased exposure to moulds, their spores or metabolites may produce symptoms of irritation in sensitive persons as noted by Lindvall (ibid). The existing residence had long standing damp problems, indicated by mustiness, visible mould and floor subsidence in the living room, with wetness of adjacent ground. None of the alternative houses had damp problems to such an extent, although unvented moisture sources in house A might lead to elevated humidity at times. Water damaged eaves linings in house B did not necessarily mean indoor humidity problems, while in house C which was sited on a high rocky ridge, there was no evidence of dampness even in unsealed subfloor spaces.

Combustion fumes in indoor air have also been linked with health problems. Oil fired space heaters and vehicles garaged under houses were potential sources of indoor pollution. The existing residence had both, and occupants reported the smell of both raw and burnt oil when the heater was operating, suggestive of incomplete combustion and carbon monoxide pollution. House A had a newer oil heater, and house C had a garage underneath. House B was all electric, with garage attached but not opening in to the house.

Previous household management including the use of certain cleaning agents and pesticides may influence indoor pollution levels, with substances such as chlordane difficult to remove after contamination according to Repace (op. cit.). The only available indicator for this criterion was the householder's recall of having had annual contracts for pest control. The owner of house B recalled treatments for termites and spiders for most of the previous seventeen years. Nine treatments were recalled for the existing residence, with external treatments washing under the front door on several occasions. Three treatments within seven years were recalled for house A. Occupants of house C stated there had been no such treatments for seventeen years. No householder could recall the names of the compounds used, but the Australian Standard of 1978 recommended application of chlordane, heptachlor, dieldrin or aldrin for termite control for existing buildings. Thus the possibility of contamination with persistent organochlorines could not be ruled out. Dieldrin, for example, is described by Ackerman (1980) as not decomposing readily but tending to migrate from one medium to another by slow volatilisation in air, and able to accumulate in human tissue. Soil residues could still be present up to twenty years after treatment. The four houses were ranked according to opportunity for contamination, with the chance of misapplication or accumulation in the home environment considered greater the larger the number of treatments recalled.

Design factors in housing may affect the well-being of occupants in many ways, some of them dependant on personal responses and not readily predicted. However certain design factors in these houses could influence the exposure of inhabitants to indoor pollutants. In the existing residence, a central stairwell enabled pollutants from mould and oil heater to rise directly from the open-planned livingroom to bedrooms above by natural updrafts. With most of its large windows facing southwest, the house required an unusually long heating season of ten months. These two design factors indicated prolongued occupant exposure to combustion fumes. All other houses were oriented for winter sun to a greater extent. They were ranked by balancing other positive and negative design characteristics. In house A, the window type and location could inhibit cross ventilation, encouraging high indoor humidity. In house C, garage and stores opened into habitable space downstairs, but the connecting stairwell was remote from bedrooms. A large screened porch which allowed for outdoor living without use of insecticides and repellants was a positive "healthy design" characteristic for this region. House B had the best orientation, with potential for solar gains in winter and cross ventilation in summer.

What Makes a Healthy House?

Any of the sixteen criteria outlined in table 1 may be of major relevance to the healthiness of various building types in different situations, and the list is by no means comprehensive. For instance, the presence of specific allergens may sometimes be of overriding importance, as may the siting of a building over ground pollutants. Of the six criteria used for this comparison, some were obviously more relevant than others.

The least important criterion appeared to be magnetic fields. According to the World Health Organization guidelines for human exposure, MF readings at all houses were well below the level for concern. However, in 1987 WHO recommended further research into health effects of MF levels below 100 mG. If such fields can act as cancer promoters, as suggested by Marino and Morris (1985) and Adey (1988), MF levels could be important to the healthiness of Australian dwellings, but not as a single issue. This exercise suggests that simultaneous exposure to other pollutants would need consideration as well as field sources such as house wiring.

Two criteria of special relevance to Sydney were outdoor air quality and dampness. In smaller, less humid cities such as Adelaide, these factors may be less important to the choice of a healthy house. On the other hand, fumes from vehicles, heaters and cookers are possible pollutants in most Australian dwellings. With no nuclear power, the use of coal, gas, oil or wood as fuel is widespread. For detached houses, design can be used to some extent as a predictor of likely occupant exposures. With most of the population living in coastal cities between twenty five and forty degrees latitude, solar orientation of dwellings could greatly reduce the duration of supplementary heating and hence exposure to combustion fumes. In Australia, lack of attention to energy conservation may be contributing to indoor air problems, rather than the opposite as has been found for buildings in colder climates.

The mild climate also means that most Australian dwellings are in termite regions, and structural timbers may be damaged. In recent decades control by physical barriers has largely been superceded by soil treatment with persistent chemicals. The number of householders who opt for annual precautionary treatments as reported in this study is unknown. Termiticides commonly used in Australia have been listed as carcinogens by the United States Environmental Protection Agency (1986). In Western Australia, Stacey and Tatum (1985) found increases in pesticide content of human milk relating to treatments of house exteriors. Without further research on the prevalence of such applications and routes of human exposure, this aspect of previous household management cannot be discounted as one of the most important criteria for selection of a healthy house in Australia. If in the Sydney house comparison, further exposure to pesticides was the major environmental health risk for the family moving house, then house C appeared the healthiest of the four dwellings, and house B may well have been the least healthy of all, despite its other positive characteristics. To make a choice on one criterion alone may have been reasonable in this case, and may also be in others, where agricultural practices have allowed for human exposure to the same pesticides through the food chain as well as the built environment.

Summary

This comparative investigation was of practical value, despite the limited information available. It became evident that one house had multiple problems which could contribute to occupant ill-health. In another culture, it may even have been considered a "sick building". The task of assessing the healthiness of existing housing stock is not a simple one. Investigative methods of the workplace may be inadequate for the more complex domestic environment, with its diversity of occupant behaviour and management methods; qualitative guidelines may be of greater use. This exercise demonstrated some practical requirements for defining buildings as healthy. A recipe for healthiness cannot be imported ready made from other countries, nor even borrowed from other regions of the same country. Finding all environmental criteria significant to the region, building type and needs of future occupants is the first step towards healthier buildings.

Table 1: Healthiness criteria for dwellings: four houses in Sydney, Australia, are ranked in order of apparent merit for six of the criteria .

CRITERIA	SIGNIFICANCE :	HOUSES A	B	C	D.
Unvented gas appliances	–				.
Formaldehyde	–				.
Radon	–				.
Asbestos	–				.
Noise	–				.
Daylighting	–				.
Furnishings	–				.
Tobacco smoke	–				.
Paints, wood preservers	?				.
Nearby combustion sources	?				.
Magnetic fields	+	3	2	1	4.
Outdoor air quality	+ +	2	3	1	4.
Dampness	+ –	3	2	1	4.
Indoor combustion fumes	+ –	3	1	2	4.
Previous household management	+ + + –	2	4	1	3
Design characteristics	+ +	3	1	2	4

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