

support a direct relationship with the physical environment and may facilitate sleeping, sitting, and resting outdoors and on the ground (Keys, 2000).

There are significant safety and security issues related to outdoor spaces in remote areas that must be considered. Fencing provides additional security for residents and a bounded area in which to perform outdoor activities, as well as protecting from wild animals and unwanted visitors and keeping children safe in backyards (Fien et al., 2008a). Security hardware and gates should be considered in conjunction with any graded surface intended to permit ramp-free access, so as to protect against dangerous vermin (Fien et al., 2008a). Due to wet seasons and seasonal flooding, this would need to be of a material that is able to endure a wide range of conditions while affording shade and protection from insects.

Including the external living space in assessment both facilitates the culturally desirable use of outdoor space and has a number of other advantages for home modifications and healthy living outcomes. An effective outdoor living space can give relief and comfort to all the residents in the home. In instances of overcrowding, a well-designed external space can spread use-load over a wider area, creating feasible options for managing avoidance relationships and addressing some of the problems related to internal crowding. Sealed and covered verandas that are wide enough to be a temporary living space for eating, sleeping and entertaining, should be considered by planners and designers, as it can alleviate the stress on the dwelling caused by visitors and temporary residents (Fien et al., 2008a; Memmott, Long, & Thomson, 2006). If external spaces are modified to allow sufficient 'sleeping out' areas, it is possible that some of the typical infestation pathways for issues such as scabies can also be reduced.

External cooking areas should also be provided, such as a BBQ or patio cooking area, as many Aboriginal people prefer to cook outdoors (Fien et al., 2008a). As cooking is a bonding family activity, it is also important to create safe and constructive ways to allow people with disability and older people to participate. This is especially of concern for people with mobility impairment, as they may not be able to get out of the way of dangerous cooking practices quickly. Adaptable external spaces that provide additional wet areas for showering, toileting and personal care can also be considered (Fien et al., 2008a). This is an asset in situations of overcrowding, and may also reduce distress in situations in which a resident has particular needs around toileting and bathing that require specific or dedicated access. The inclusion of additional wet areas, accessible living spaces and appropriate ablution facilities can address both residents' needs both culturally and in terms of environmental health (Memmott et al., 2006).

It is also important to remember that a person with mobility impairments does not just need to be able to move around their own home; without appropriate support to engage with the community they may become housebound. This can lead to health problems related to inactivity, such as loss of muscle tone, weight gain, and depression. There are also a wide range of communal activities that require mobility between domestic spaces. It may be wise to consider not only the need for changes to the home, but assessing the activities that the person engages in or is excluded from, to see if there

is a way to integrate mobile technologies for in and out of home use that generates a wider sense of inclusion in community.

Family and kin groups

Within Aboriginal people, there are family relationships of skin, kin, and country, and these relationships are governed by a wide variety of cultural practices that can have a dramatic impact on how people interact with their housing (Memmott et al., 2006). Approaches to Aboriginal housing provision have historically represented a 'lack of fit' between housing type and traditional Aboriginal domiciliary arrangements, defined by dwellings designed for the nuclear family model, which fail to meet the housing needs of many Aboriginal groups (Keys, 2000). It is important to be able to facilitate the appropriate adherence to custom within an enabling housing design framework that supports users with impairments to lead functional lives. A persons' position in the kinship system may impact the way they interact with others in the community (Bishop, Colquhoun, & Johnson, 2006). Some people in the community may be unable to interact with one another due to 'avoidance' relationships (Horton, 1994), which may impact the therapeutic relationship and other relationships with professional service providers (Bennett & Zubrzycki, 2003). Aboriginal clients may be required to avoid contact with persons outside their skin/kin system as well as members of the opposite gender. It is essential to understand kin relationship systems in the community in which the assessment is taking place, as they can have influence on the functional needs of clients when avoidance relationships may dictate that a client needs to quickly leave a room or dwelling, regardless of their level of impairment. The integration of traditional practices into a modern adaptive environment that is designed to support wellbeing is essential.

Cultural practices associated with kin relationships also have a significant impact on how residents and their wider families interact with housing (Morphy, 2007). Aboriginal people are under a cultural obligation to accommodate family, including extended family, should they have nowhere else to go (McGlade & Purdy, 1998). It is common within some Aboriginal groups for relations to visit a home in which they can claim kinship ties to the household, staying at the residence for an indefinite period (Morphy, 2007). Kin migration can occur within a wide region, and results in the temporary or semi-permanent residence in a dwelling of people outside the original household that the dwelling was designed for. These relational obligations are called upon often without warning or prior notice (Fien et al., 2008a) and can involve both the use of kin's home, and the use and removal of property within the home, increasing daily wear and tear of facilities (Memmott et al., 2006). Migration behaviour illustrates how critical it is to understand a client's culture of living in order to design effective home environments.

Within certain Aboriginal cultures the concept of property ownership within a household can be somewhat ambiguous. Family and kin can demand their right to enter, use and remove property from the house (Taylor, 2002). Kin are able to use and remove items from the household without consultation, an issue which needs to be considered in advance by home modification professionals when deciding upon assistive technology within the home. Therefore equipment required for specific family members should be

provided in such a way as to prevent removal or misuse if practical. Additional locked storage spaces within the dwelling to secure belongings may be necessary (Fien et al., 2008a) This is not purely for the sake of the client, but also for the safety of other people who may believe the equipment may be of benefit to other users, but these potential users have not been appropriately assessed for assistive equipment. For example, if a hoist is needed for transfers, establish whether a ceiling hoist is suitable for the members of a household and if so, it may be better to install one instead of arranging a mobile hoist. The benefit of this item is that it is permanent, relatively unobtrusive, requires less space and is considered to have better safety outcomes for carers (Jung & Bridge, 2009).

Housing and healthy living practices

As discussed in Section 2, many of the health conditions experienced in high numbers in Aboriginal communities relate to issues of sanitation, crowding, and pest infestation, and home environments that do not facilitate healthy living practices can both cause and exacerbate functional disability. Kin migration and visitation customs mean that a house designed for a household of four occupants may be occupied by many more over some periods of the year, increasing wear and tear on the dwelling and stretching the capacity of everyday amenities such as water and power supply, cooking areas, and bathrooms. Crowded living conditions creates strain on household facilities (Baillie & Wayte, 2006) Some of the disrepair associated with Aboriginal housing results from the additional strain placed on housing infrastructure that is not designed for such heavy use (Neutze, 2000). This can have a negative impact on even well-designed and well-serviced dwellings, however dwellings in regional and remote communities where infrastructure for reliable access to water, sewerage output, electricity or gas are not consistent, reliable, or even present in some cases can become the sites for significant health and safety hazards.

Sanitation

Torzillo et al. (2008) audited over 4000 houses and their domestic infrastructure with regard to basic sanitation and found Aboriginal housing to be dramatically underperforming when compared to non-Aboriginal housing stock. This is a serious health concern particularly for residents of sub-standard housing who are ageing or have a disability. This survey also revealed a number of dwellings were not connected to a water supply, sewerage, or any form of power (Torzillo et al., 2008). Where these facilities do exist, they were noted as having inadequate infrastructure and subject to frequent failure and breakdown. State and local planning authorities need to be consulted when designing home environments in remote Aboriginal communities to ensure that there is adequate sewage, water, and power infrastructure in place to support existing dwellings and future modifications. Due to the overcrowding prevalent in many Aboriginal households, there is a pronounced lack of adequate toileting, showering, and cooking facilities for the number of residents within dwellings (Memmott et al., 2006). An extra toilet or en-suite bathroom can also be important in facilitating

avoidance relationships, so bathrooms can be segregated for male and female exclusive use (Fien et al., 2008a).

There is the additional challenge that current guidelines for design and construction of Aboriginal housing stock in remote areas do not always sufficiently address the needs of people with functional impairment. For example, the *Environmental Health Standards for Remote Communities in the Northern Territory* stipulates that wet areas such as bathrooms and laundries should be constructed with concrete, and recommends construction details such as shower hobs: “Bathrooms and laundries are seen to be very high-risk corrosion areas. Concrete should be used wherever possible for bathroom and laundry flooring, and concrete hobs provided to avoid water contact with steel framing. Laundries are best placed adjacent to the house so as to avoid the need for steel framing” (Northern Territory Government, 2001, p. B10). However, for residents with functional impairment, concrete flooring poses a significant risk of falls, and shower hobs restrict access for less mobile residents. Residents with mobility impairments who use wheelchairs or walking aids are unable to navigate bathroom features such as standard shower enclosures and concrete hobs without impediment. A graded floor that is designed to contain greywater and direct it to a drainage area can be sloped to allow access for less mobile users, and in instances where a resident may require seated bathing or assisted bathing, an open shower room with no screens or concrete partition walls is a much better option than an enclosed shower cubicle with a hob. The Northern Territory represents the greatest concentration of remote Aboriginal housing tenants - and includes the least healthy cohort of Aboriginal Australians according to ABS statistics (ABS, 2012). Given that the document targets remote community Aboriginal housing, and that it is precisely this sector of the Aboriginal population experiencing higher incidence of impairment and illness, it is of concern that the provisions contained in the NT Environmental Health Standards do not accommodate the needs of those with serious impairments.

Another document, the 2005 Guidelines for Design and Construction of Housing issued by the NSW Aboriginal Housing Office, stipulates that bathing and toileting areas should be kept separate for one bedroom homes (2005, p. 3.13). This poses significant inconvenience to those people in need of both toileting and bathing with assistance, or within a special environment. Separating the two in instances where accessibility is an issue poses a greater risk of accident for people who have difficulty navigating the home. Transport between the two rooms requires the client to be undressed, dressed, and undressed again. This is a process that can take a long time, requires adequate space, and may also require special equipment in both locations. It adds to the burden of duties for carers, and does not aid a resident with care needs to feel comfortable in their own home. A second bathroom or toilet area can also be provided for possible other members of the household, which would reduce the hygiene and sanitation issues associated with overcrowding and bathroom use, and is also a feature requested by many Aboriginal public housing residents (Fien et al., 2008a).

Hygiene and cleanliness

As mentioned in Section 2, the high incidence of many diseases such as otitis media and glue ear in Aboriginal communities is associated with overcrowding and poor hygiene. The creation of clean and health-promoting environments with adequate storage, ablution and laundry facilities would reduce the possibility for re-infective cases of conjunctivitis and transmission to other family members, potentially lowering the number of permanently visually impaired people in Aboriginal communities. Studies have suggested that residents in homes with functional sewage/waste removal, functional utilities and tiled floors experienced far less infestation than residents of homes where these factors were not present (Holt et al., 2010).

There are a number of ways in which an effective home environment can facilitate hygiene and cleanliness in a household that includes someone with a functional disability. Antimicrobial materials and surfaces in kitchens and bathrooms should be considered where possible and appropriate, particularly when residents have a health condition or disability associated with faecal incontinence. Faecal hand to mouth transferred diseases can be more widespread if appropriate areas for treatment and cleaning are not provided. The safe containment and disposal of contaminated waste is needed in all circumstances for the health and safety of the client, their family, friends, carers and visiting healthcare workers. Separate areas to manage treatment of equipment such as stoma bags, catheters and other re-usable care items must be provided. This is for the safety and hygiene of all household members as well as for the protection of expensive medical equipment from daily routine use of sinks, laundry and shower areas, etc.

Training programs also need to be provided to residents in how to properly maintain a safe and clean household. These could include understanding of environmental health issues, the care of whitegoods, and the use, maintenance and repair of electrical and plumbing fittings (Fien et al., 2008a) Cleaning and maintenance kits should also be provided to residents, or available somewhere in the community for borrowing.

Pest and parasite management

In an investigation of parasitic diseases in remote Aboriginal communities in Australia, Holt et al. (2010) state that “the overcrowded living conditions and sanitation and hygiene problems currently present in many remote communities” are a major contributor to the spread of parasitic disease. The prevalence of such endemic infestations increases the likelihood for longer term health complications. The risk of infection and infestation of parasites is much higher in dwellings where appropriate ablution, laundry, sewerage and contaminated waste disposal facilities are not present or are in poor repair. Sanitation and hygiene were identified as problematic issues across remote Aboriginal populations in a report on endemic scabies in Aboriginal communities (La Vincente et al., 2009). The materials examined in the literature review suggested that many sanitation and hygiene issues in remote areas of Australia resulted from failure of utility infrastructure and home facilities for utility supply and waste/sewage removal (Daniel et al., 2011; Lea & Pholeros, 2010).

The numbers of helminthes (parasitic worms such as tapeworms, roundworms, and hookworms) are disproportionately high in remote Australia (Engwerda & Meeusen, 2010). Acquisition may be through soil or water supply; however transmission from person to person is often associated with poor hygiene in relation to toileting and inappropriate disposal of blackwater and faecal materials. The common routes of transmission are either self-retransmission by lifecycle, or hand to mouth transmission. If the water table is contaminated this can also lead to outbreaks of helminthes and other gastroenteric illnesses (Häfliger, Hübner, & Lüthy, 2000). These types of infestations are best controlled by the avoidance of overcrowding, and the provision of appropriate laundry, ablution, and waste facilities.

Overcrowding, poor sanitation and hygiene problems are also related to diarrhoeal disease in remote communities, and these diseases particularly affect children (McDonald et al., 2008). *Escheria coli*, *Strongyloides* and *Cryptosporidium* are the most commonly isolated parasites in this cohort, and their presence is “responsible for significant morbidity in the Australian Indigenous population” (Holt et al., 2010, p. 1124). Similar to other infective and infestive organisms, gastrointestinal diseases can be reduced by providing appropriate environments with functional utility infrastructure. Furthermore, Holt et al. (2010) suggest that residents in homes with functional sewage/waste removal, functional utilities and tiled floors experienced far less infestation than residents of homes where these factors were not present. Tiled floors may be a better option than concrete, which is currently a common floor surface in Aboriginal housing construction, as concrete is porous and can act as a surface of transfer and culture for infection and infestation. In addressing pest management, it is important to ensure preventative strategies exist in the form of simple, accessible laundry and ablution facilities, adequate sleeping space, and storage areas for linen and clothes. Separate storage areas for all family members’ personal clothing and linen may assist in reducing cross-infestation. By facilitating a clean environment it is more likely that treatment of pest infestation will be successful. There should be adequate kitchen storage areas in place for both food and kitchen implements, with doors to prevent vermin from getting to food and prevent young children from accessing kitchen equipment without adult assistance (Fien et al., 2008a).

For residents already suffering with more permanent functional impairments, the possibility of infestation and re-infestation should be reduced as much as possible. Pests such as scabies and head lice can cause distress both emotionally and physically, and may be difficult to eradicate once established. Risk of infection as a result of infestation may be higher in groups with cognitive impairments, users of incontinence products, people restricted to bed and vulnerable to ulcers, infants and those with fragile skin. Eradicating infestation may be more complicated in situations where special equipment is used on an ongoing basis, or where people are restricted to bed or a wheelchair.

Housing and the environment

Landscape fit

One of the major contributors to poor housing outcomes in Aboriginal communities is the unsuitability of techniques and materials used for their environment. Inadequate ventilation and climate control within a dwelling subject to high climatic variation can pose a threat to the wellbeing of its occupants. Prevailing local weather conditions need to be taken into consideration before design and construction of housing (Barker, 2008). Extreme temperatures and humidity effect wet areas and food storage as well as the general wellbeing of occupants. Health priorities that concern housing and its fit with the landscape and climate include dust control, controlling the extremes of temperatures in living environments, and reducing the potential for trauma and physical injuries (Pholeros et al., 2000).

Climatic variation in rural and remote Australia also has a deteriorative effect on the built environment, exacerbating problems with stock maintenance. Without adequate climate management, the elements will hasten disrepair and dilapidation: “climatic variations impact on the quality and rate of depreciation of dwelling stock, particularly in the Far-North and North-West of the country” (Hall & Berry, 2005, p. 297).

Eco-efficient design in remote Aboriginal housing needs to involve building styles, siting and orientation that respond to the local climate and use building materials and water, energy and waste management systems that are environmentally appropriate (Fien et al., 2008a). Housing should be designed for sustainability, both in terms of environmental sustainability such as energy, water use, and minimising waste, and life-cycle cost (Barker, 2008). This is particularly important when implementing modifications solutions in the homes of people with functional impairments, as materials and building styles that suit the environment will reduce the costs of maintenance and replacement due to environmental stress and damage. It is also important in order to minimise the negative impacts of crowding: visitors can place extra stress on energy and water supplies, so it is important to consider alternative, sustainable sources (Memmott et al., 2006)

Outdoor living and social activities need to be assessed in conjunction with the condition of the ground surrounding the home, across all seasons. If the grounds are not accessible for residents with a disability or older people due to either soil drainage problems or weather conditions, it may be appropriate to consider landscape solutions. For instance, tropical regions may experience seasonal monsoons, and there can be ongoing issues related to drainage that reduce mobility, especially for those reliant on wheelchairs and other types of mobility aids. It is common for homes to be elevated off the ground for these climactic reasons, but the external living area may be at ground level. Landscape solutions could be used to create raised external spaces with appropriate drainage. For residences in areas that experience monsoonal weather or are otherwise subject to flooding, ground preparation and drainage can ease the use of wheelchairs outside the home. Good siting and installation of landscape solutions such as French drains can provide a cheap and effective solution to keep ground from flooding, which can also cause damage to the property.

An understanding of traditional Aboriginal techniques of building and orientating dwellings and sourcing materials may lead to better design and construction of housing in remote environments to suit local climates. In rural and remote areas access to infrastructure and dependable supplies of water, sewerage and power can be limited (Baillie & Wayte, 2006), so innovative methods should be investigated as much as possible. However, this is an area where there is limited information available and targeted research is needed. The logistics of transporting materials and constructing in remote locations also needs to be adequately considered (Barker, 2008).

Building and construction materials

Modified standards of practice in construction for remote or tropical zone areas such as in the Torres Straits, Far North Queensland, Western Australia and the Northern Territory have been developed to take into account the extremes of heat experienced in that state. The Northern Territory has separate guidelines for building in coastal and inland remote areas to address the different environmental stressors in these regions. These building guidelines consider issues of damp, ventilation, and insulation, as well as detail materials that will withstand extreme environmental impact of events such as bushfires and floods. State-based Aboriginal housing authorities create standards for service provision, construction and maintenance to public housing stock that sometimes deviate from the Building Code of Australia (BCA), and that are geared towards delivering robust housing solutions and homes that survive the environment. However, these deviations may impede the provision of appropriate home modifications. For example, the *Environmental Health Standards for Remote Communities in the Northern Territory* (Northern Territory Government, 2001, p. 3.12), recommends the use of concrete in the construction of housing in remote areas due to its durability, as mentioned in the previous section.

However, the use of concrete as a floor surface can result in a serious injury due to falls, especially to elderly clients. Falls on hard surfaces can lead to a range of debilitating injuries such as broken hips, fractured skulls and concussion. An elderly client may not recover completely from such a fall. In the general population, fall injuries in elderly people represent a typical first step away from independent living into full-time residential care (Kannus, Sievänen, Palvanen, Järvinen, & Parkkari, 2005). Therefore before home modifications interventions a household should be assessed not only on the basis of the age of tenants, but the propensity for the tenants to fall. This can be gauged by assessing for a) a fall in the previous year (self-reported); (b) taking four or more medications per day; (c) a history of stroke or Parkinson's disease; (d) self-reported problems with balance; and (e) inability to get out of chair at knee height, without using arms (Northern Territory Government, 2001) as well as by assessing the environment for risk due to uneven surfaces, especially where mobility apparatus are in use.

Covering concrete flooring with foam underlay and hospital-grade vinyl could present an improvement in safety, as it allows for some insulation and shock absorption to reduce the impact of plain concrete. If a slip resistant surface is needed, this can be achieved with the type of vinyl used, or with agglomerates such as Sliptech, which can

be employed throughout the house. Insulated floor covering reduces the risk posed by a damaged or contaminated substrate by reducing impact. It is also much easier to clean, as brushed concrete collects dirt very easily, and this is highly problematic for homes situated in arid remote areas. Difficult to clean surfaces that allow dust to gather could pose problems for asthmatic residents, and brushed concrete is also a difficult surface for cleaning faecal contaminants, which can be an issue with certain types of impairments. A more easily manageable surface is therefore recommended. For homes where there is a strong risk of faecal contaminants due to incontinence or other ongoing care needs such as stoma management, care should be taken to ensure the product chosen would be easy to clean and preferably have antimicrobial properties. Concrete flooring throughout a home can also cause drainage problems. Severe weather events and lack of appropriate house site planning can lead to internal flooding. For this reason, a graded floor surface with appropriate drainage as per wet areas should be adopted where climactic factors pose a risk of flooding (Whitfield et al., 2005). This is also of distinct benefit where the household composition includes people suffering incontinence, as cleaning regimes may vary from those of the average household, and adequate drainage is a crucial component of maintaining adequate hygiene.

In terms of home modifications hardware and equipment, adequate consideration of the climate and conditions of remote areas in tandem with the accessibility of the home for the client is equally important. Functional aids and home modifications equipment designed to be employed in urban areas are often prescribed for use in rural and remote areas without taking into account the climactic differences in these environments and the effects of increased humidity and salinity. In her review of health hardware in rural and remote Aboriginal communities, Taylor (2002) notes that: "Housing to cater for this population needs to take into account the rigors of these isolated communities. However, in much of indigenous housing, standard building hardware has been used that was more appropriate for urban communities. This has resulted in continuing failure of certain building elements and components. Window systems, plumbing systems and fixtures, electrical fittings and appliances, door hardware and door systems are the components that frequently fail and these failures occur in all communities".

Given the cost of equipment, it is very important when implementing home modifications to ensure that the solution is one that will have a long life-span despite the environmental conditions. Barker (2008) recommends that industry professionals design with a view to future management and maintenance. In remote areas, where servicing of special equipment is more difficult to arrange, choosing simple, functional design is highly important. Consideration of the environment, materials, and whether there is a tendency towards corrosion, mould, or other damaging conditions, is crucial. For example, carpet is considered a good floor surface to reduce echo and to absorb noise however this floor covering is not suitable in areas of high humidity, high foot traffic or for people who use electric wheelchairs. A semi-commercial grade of vinyl with a high quality underlay may be a better and more functionally suitable option. When designing homes or modifications in remote areas, double-check that the

materials chosen are appropriate for the environment they will be used in, and consult with the local industry to get a clearer idea of what types of construction practices and materials are encouraged or discouraged for environmental reasons.

The Checklist

| Area of specificity for Aboriginal communities | Conceptual ideas | Operational design attributes ¹ | Design element ² | Function from an ageing / disability perspective |
|--|---|--|--|--|
| Cultural appropriateness | A “shelter, around which to conduct the business of living” (Fien et al., 2011, p. 346) | Air circulation Adequate shade at all times of the day Accessible Visually pleasing | Passive solar design Takes consideration of prevailing winds and thermal currents Able to access by all members of the family unit (including kinship groups) | Allows all members of the family unit to access and participate in daily life regardless of ability set Supports carers in their role |
| | Orientation toward ‘country’ and relationship with land | Dwelling is situated in a culturally appropriate position Ensure doors and windows provide effective visual and auditory contact with the environment wherever possible | Consult with local elders and /or relevant peak bodies Consider louvered windows with different materials such as opaque safety glass, plexiglass, and anodised aluminium | Maintains the link with ‘country’ for all |

¹ Attribute – property or characteristic of a physical object of any kind, including construction products, work sections, elements and whole facilities (Leslie & Potter, 2004).

² Element (cost planning) – portion of a project that fulfils a particular physical purpose irrespective of construction and/or specification (Leslie & Potter, 2004).

| Area of specificity for Aboriginal communities | Conceptual ideas | Operational design attributes ¹ | Design element ² | Function from an ageing / disability perspective |
|--|-----------------------|--|---|--|
| Cultural appropriateness (cont'd.) | Outdoor living | Enable meal preparation and consumption in culturally appropriate way (cooking fires vs. stoves or oven) | Outdoor cooking space Outdoor sink with running water and waste pipe Storage space for kindling | Access for users with mobility or sensory impairment Allows all members of the family unit to access and participate in daily life regardless of ability set Supports carers in their role |
| | Outdoor living | A place for people to wash that maintains privacy A place to wash laundry with suitable water collection and disposal | External sanitation spaces Sanitation spaces designed for heavy usage Sanitation spaces that are accessible to those with mobility impairment Opportunity for grey water collection and appropriate re-use | Allows all members of the family unit to access and participate in daily life regardless of ability set Supports carers in their role |
| | Semi – outdoor living | Personal safety considerations Privacy and dignity is considered | Screened in veranda built off the ground Louvres of suitable materials e.g. one way vision security mesh | |

| Area of specificity for Aboriginal communities | Conceptual ideas | Operational design attributes ¹ | Design element ² | Function from an ageing / disability perspective |
|--|--|--|--|--|
| Cultural appropriateness (cont'd.) | Additional shelter for people and animals | A detached shade structure | Open, accessible Suitable pathway to the structure for all users | Able to be accessed by those with mobility impairment, those who use mobility aids, carers who push mobility aids and/or prams and strollers |
| | Location of family and kinship groups when designing settlements & townships | Keep family and kinship groups together | Ensure availability of homes or additional rooms for family/kin members, particularly carers | Visitability is possible for elders and family/kin relations regardless of ability set Family and kin can be contactable and close by for support and assistance Family and kin can visit each other's homes without physical barrier to the home (e.g. no stairs) |
| Eco efficiency | Reduce green mileage in construction | Local materials used where suitable | Consider traditional orientation of dwellings and siting Investigate viability of traditional building materials and techniques | |

| Area of specificity for Aboriginal communities | Conceptual ideas | Operational design attributes ¹ | Design element ² | Function from an ageing / disability perspective |
|--|--|--|--|--|
| Eco efficiency (cont'd.) | Follows 'Green' building guidelines where possible | Utilise appropriate 'green' technology to reduce reliance on high cost (and intermittent) electricity resources Bioclimatic design principles | Use of solar hot water heaters where appropriate Use of solar panels where appropriate Passive solar design Built off the ground to enable air currents beneath the house. Position windows / louvers to take advantage of prevailing winds / sun position | Optimal energy resources are made available to those on limited incomes (e.g. Aged Pension, Disability Support Pension) Reduced need for additional appliances such as air conditioners and heaters – costly to purchase and to run |
| | Landscape fit | Consider landscaping options that enhance the function of the dwelling and provide shelter and shade | Use local flora to support the dwellings aesthetic fit with natural environment and | Careful use of trees and shrubs that will not result in roots disrupting path of travel or cause falls and injury |
| | Protection from local fauna | A space that allows outdoor living and reduced risk of being attacked by insects / vermin | Screened in veranda (mosquito, vermin /& snake management) | People with vulnerable immune systems / skin / respiratory problems are protected from injury and illness via insects / vermin |

| Area of specificity for Aboriginal communities | Conceptual ideas | Operational design attributes ¹ | Design element ² | Function from an ageing / disability perspective |
|--|---------------------------------------|--|--|---|
| Eco efficiency (cont'd.) | Meteorological factors are considered | Thermal performance is factored into design Flooding risks are considered | Suitable eaves / overhang / veranda position and roof pitch Height to veranda is congruent with past flood data Ground care is considered – for example use of French drains ³ to manage moisture | Those most vulnerable to thermal stress or moisture related pathogens such as mould and mildew (the elderly, young children and those with mobility impairment) are protected and able to continue their ADLs in an optimal thermal environment |
| | Access to clean water | All dwellings should have the capacity to receive and manage clean, potable water supplies | Linked to town water systems wherever possible Water tanks with appropriate runoff systems in place where rainwater collection is viable | Opportunity for regular personal hygiene activities, washing of linen, clothing and cleaning living spaces to support those most vulnerable to infection, skin breakdown and other health problems in high humidity, or very hot environments |

³ A French drain (also known as a blind drain, rubble drain, rock drain, drain tile, perimeter drain or land drain) is a trench covered with gravel or rock that redirects surface and groundwater away from an area.

| Area of specificity for Aboriginal communities | Conceptual ideas | Operational design attributes ¹ | Design element ² | Function from an ageing / disability perspective |
|--|---|---|--|--|
| Eco efficiency (cont'd.) | Effective management of human effluent | Acceptable distance from sewage treatment / septic tanks / evaporative pools | Ensure any groundwater / seepage is considered when locating a dwelling. Establish routes of prevailing winds and air currents | People with vulnerable immune systems / respiratory problems are protected from waterborne and airborne pathogens |
| | Management of infestations and pest control from domestic animals | Separation of dogs and other livestock from children | Screened in veranda | People with vulnerable immune systems / skin / respiratory problems are protected from contagions |
| | Management of infestations and pest control from mismanaged waste | Adequate waste removal (water and rubbish) | Allocated secure space for rubbish bins Suitable waste water management systems / water recycling systems | All users protected from vermin, contagions and other problems related to poorly managed waste products |
| | Management of dust / sand storms. | Dust control mechanisms in place Identification of dust risks in area (from both landscape and industry) | Installation of air-conditioning systems with adequate filtration Ensure housing envelope is able to withstand dust penetration if required | People with vulnerable immune systems / skin / respiratory problems are protected from dust borne pathogens, dust related respiratory problems such as asthma etc. |

| Area of specificity for Aboriginal communities | Conceptual ideas | Operational design attributes ¹ | Design element ² | Function from an ageing / disability perspective |
|--|--|--|---|---|
| Employment opportunities | Local resources used | Local materials used where appropriate Housing projects are within reasonable commute to centres of employment and training / support | Ensure that gazetted and non-gazetted residential precincts are identified prior to new builds | That, wherever possible, the aged and those with disabilities are not placed in locations where support services and caring relationships are untenable, and maintenance and modification is unmanageable |
| Lifecycle costing | House is easy to maintain – materials are common / durable / available if need to be replaced | Sanitation spaces designed for heavy use | Electrical fittings designed for heavy use and are humidity / temperature appropriate. Plumbing fixtures are designed for heavy use and are humidity / temperature | Resident is not reliant on external contractors for basic maintenance procedures |
| | A reasonable timeframe for dwelling endurance is determined taking into consideration the environmental press of the geography | The <i>design working life</i> (Leslie & Potter, 2004) is congruent with other materials in the construction | Use of materials that are suitable for the climactic variation of the local area | Resident is not expected to relocate unnecessarily or to live in substandard housing as result of poor material choices |

| Area of specificity for Aboriginal communities | Conceptual ideas | Operational design attributes ¹ | Design element ² | Function from an ageing / disability perspective |
|--|---|---|--|---|
| Innovation in procurement, ownership and construction systems | Dwellings are procured by management agencies that will support the residents with tenancy and / or ownership in a culturally relevant way Dwellings are built from easy to assemble materials | Dwelling design considers the limited availability of ongoing technical expertise and the transient/FIFO nature of modification and maintenance personnel | Provide opportunity for local employment and or training for maintenance and servicing | Increased likelihood of timely build, repair and modification Decreased likelihood of resident needing to seek interim (accessible) housing while awaiting repairs |

Conclusion

This paper has explored many of the key issues that need to be considered when designing effective home environments for Aboriginal people with a functional impairment in remote areas. While many of these issues must be considered when implementing any home modifications solutions, undertaking appropriate new build projects and completing therapist scripted home modifications in housing that is managed for Aboriginal people in remote Australia encounters specific and unique structural, cultural, medical, and environmental challenges. To approach Aboriginal Housing in the same way as mainstream housing is to run the risk of over simplifying issues such as overcrowding, the prevalence of certain diseases and disabilities, the importance of cultural beliefs on how people interact with their homes, and the challenges of extreme climates and temperatures in remote Australia, and then failing to adequately address these issues through the built environment. As discussed in this paper, inappropriate, inaccessible, and deprecated housing has dramatic impacts on the wellbeing of functionally impaired people.

As discussed earlier, housing shortages in remote areas, long waiting lists for public housing, and the failure of existing dwellings to cater for the cultural practices and needs of Aboriginal groups are key contributors to overcrowding. One spare bedroom per dwelling is unlikely to be enough in situations where a household experiences groups of extended family visitors staying with them. Standard 3 bedroom dwellings may not be appropriate for diverse household types, yet “public housing ...has been, and is still being, designed for nuclear families. Innovative design should consider Indigenous culture and extended families – for example, positioning homes in relationship to each other with covered walkways and/or breezeways between them” (Fien et al., 2008a, p. 47). Housing design in remote areas of Australia also needs to take into account the siting and orientation of dwellings to take advantage of views, visibility, light, and proximity to family and friends, in order to appreciate the importance of matching the built environment to the natural landscape, and the importance of meeting cultural needs and preferences.

There is a distinct challenge in determining the real costs of providing culturally appropriate housing across jurisdictions and in a sustainable way (McGlade & Purdy, 1998, p. 149). In many instances, inappropriate housing has simply been inherited from previous housing regimes, and deprecated housing can be difficult and costly to repair and maintain. The high cost of transporting materials and labourers to remote areas to construct new housing is a further barrier. However, from a costing perspective, it may well be substantially less expensive to provide accessible, culturally-appropriate housing from the outset than it is to allow conditions to deteriorate, particularly to the point at which people with a disability or who are ageing are no longer able to live at home. Effective home modifications can reduce or even eliminate the need for formal and informal care services at home for some people with disability (Liu & Lapane, 2009; Verbrugge & Sevak, 2002) and ageing in place rather than transitioning to residential aged care is generally found in the literature to be a better outcome for both

personal wellbeing and financial outcomes (Newman et al., 1990). Home modifications also reduce the hazards in the home environment that put people with a functional impairment most at risk, and maintain a sense of independence and dignity that most people who have a disability or are ageing desire (Carnemolla & Bridge, 2011).

This paper brings to the fore some key strategies in designing home environments through home modifications that can benefit Aboriginal people with disabilities or who are ageing. Yet despite these benefits, use of home modifications services is extremely low amongst remote populations in Australia, and even lower amongst remote Aboriginal populations (Jung & Millikan, 2009). Remote home modification service users face challenges in sourcing occupational therapists to assess their needs, and modifications take longer and require more funds due to the availability of builders and materials and costs of transportation, yet are often those who need these services most.

To fully consider and act upon the issues raised in this paper will require innovation from both industry and policy makers in investing in creative strategies for the provision of housing and home modifications to Aboriginal groups and to undertake true community and stakeholder consultation to ensure this provision is executed in a meaningful and successful manner. In particular, policies to identify and manage the specific and unique difficulties faced by Aboriginal Australians with a disability and who are ageing (or both) will be critical to a meaningful and ongoing dialogue with service providers and tenants with the ultimate goal of effective and appropriate housing for Aboriginal people regardless of their location in Australia. The complex relationship between inadequate housing supply, poor housing conditions, overcrowding, and health and disability needs to be explored further in order to design the most effective home environments in remote Aboriginal communities.

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