

# ARCHITECTURAL DESIGN ASPECTS OF HOME-BASED TELEWORK FOR PEOPLE WITH PHYSICAL DISABILITIES - A CASE STUDY

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## Introduction

A critical element in the feasibility of establishing viable and satisfactory home teleworking units is the layout and design of the home environment. Previous research had shown that the incorporation of electronic work into the living space of teleworkers raised a range of social, psychological and spatial issues which require careful consideration as they bear critically on the health and wellbeing of teleworkers and their families and ultimately on the viability of home teleworking [Moran 1986, Ahrentzen, 1987].

To date there is little research which architects and homeowners can use to guide the design of new housing or the adaptation of existing housing for home telework. An architectural psychological exploration was undertaken which aimed to raise awareness of the issues involved and suggest much needed guidelines for the layout, design and management of home teleworking units.

## Theoretical Background

Contemporary Western culture regards the home as haven, 'primary territory', 'symbol of the self' and imbues it with deep psychological and socio-cultural significance [Cooper, 1976; Rapoport, 1977]. Home teleworking affects the balance between public and private, inside and outside, personal and social, working and living etc. The architectural and behavioural issues resulting need to be planned for. Combining working and living spaces under one roof can result in insufficient or unsuitable space for both living and work purposes, conflict and competition for the use of space and frequent distractions and disturbances.

The decision to engage in paid work in the home involves a change of lifestyle for the teleworker. Roles also change. In addition to the role of spouse, parent, daughter etc. which the teleworker may have played in the home prior to the uptake of telework, [s]he now also has goals and roles related to performing paid work in the home, which may be more or less compatible with former roles of own and household members. The new combination of roles resulting from telework will vary depending on the telework situation and will effect not only the role and function of the home but the way teleworkers use the environment outside the dwelling i.e. their territorial functioning.

The socio-spatial issues involved in home teleworking were explored with four people with physical disabilities who were working at home. This case study was part of a larger study which explored the feasibility of home and centre based telework for people with physical disabilities [Cullen et al 1989].

## **Participants and Methods**

**Participants :** Four home based teleworkers participated in the case study. Three of the teleworkers were wheelchair bound and one a person of restricted growth. One of the wheelchair respondents had restricted movement in the upper body, being a quadriplegic, the other two had good upper body movement. Three were female, one male. Three were in their mid twenties, one in the mid forties. One was a graduate, the remaining three had different levels of formal education but all had some keyboard skill and/or computer training.

**Methods :** A multimethod approach to data collection was adopted. The following five main procedures were used -

### **1. Archectural Inventory of the Home and Primary Workroom**

o Floorplans of each homebased teleworker interviewed was sketched and rooms defined

o Layout of the room in which the computer was located was drawn and dimensions recorded. Rooms with visual and physical access to the workroom were noted.

o The positioning of the following in the work room was sketched -

Doors and Windows

Source and Type of Artificial Lighting

Eletrical Connections

Telephone Outlet[s]

Furniture Arrangement

Computer and Peripherals

North Orientation

**2. Equipment Inventory :** An inventory of equipment located in the each teleworker's home was compiled

**3. Questionairre :** Each teleworker interviewed completed a questionairre. Information was collected on activities carried out in the home and workroom; type, frequency and source of disturbances; use of the environment outside the dwelling; proximate neighbourhood facilities and amenities desired; and desired features and decor of an ideal homeworking environment.

**4. Interview :** A detailed semi-structured interview was conducted with each participant covering a broad range of issues which bear on the psycho-spatial experience of the home e.g. background characteristics; household composition; previous and present work experience; social and living experiences; impact of telework on own and others use of and feelings about the home; number and frequency of work-related callers; overlap of activities; adaptations to structure or changes in use of the home to compensate for disabilities and/or home based telework etc.

**5. Design Game :** A design game was completed by each participant called the Location Test [Peled 1976; see Box 1]. The game emphasises the physical attributes of places but the data analytic techniques applied help elucidate the meaning and significance of places. It is a powerful technique which goes

beyond present experiences with an existing building, to the exploration of future places in both conceptual and physical terms. The results of the analyses can thus inform the renovation of existing homes or the design of new homes which would accommodate joint living and working spaces.

**Box 1 Description of the Design Game Used in the Architectural Psychological Exploration of Joint Working/Living Environments.**

The Location Test developed by Peled [1976] was modified for use in the present study. The game consists of a board on which a circle in 111cms radius is drawn, surrounded by an outside zone. Trainees are asked to imagine that the circle stands for their Ideal Teleworking Home and the outside zone the site on which the home is situated. The upper half of the circle stands for the Back of the ideal building and the lower half of the circle the Front .

The activities which the ideal building were to accommodate were presented to the players on stickers (3 x 2cms) [see Elicitation of Activities below]. Each player was instructed to place the stickers on the board, putting those activities which they considered related close together on the board and those not related further apart, as they would like them to be in an ideal environment.

When the players had placed all the stickers on the board they were invited to make changes if they wished. The final configuration was then stuck to the board. Next the players used a marker to encircle activities they thought "went together" and those they thought were "separate". These procedures helped to define the places which the users wanted in the ideal building and the relationship between these places.

Players were encouraged to verbalise their thought processes as they performed the task. When the game was completed players were asked to explain why they had placed the stickers as they did.

**Elicitation of Activities used in the Location Game.**

The activities used in exploring teleworkers' ideal home environment were elicited on the basis of a study carried out with six trainees with physical disabilities who were considering establishing themselves as home teleworkers [and who also completed the Location Game]. Trainees were asked to list the activities they perform in their homes at present along with desired and likely future activities not currently accommodated. Trainees were encouraged to put forward infrequently occurring activities as well as those which occurred on a day to day basis. Discussion took place while the elicitation phase was in progress. The elicitation of activities was carried out in a group context and activities mentioned were listed on an overhead projector, a final listing agreed and a number assigned to each activity [see Figure 1, in text]. These activities were presented to the four surveyed teleworkers and they were asked to add or omit activities as they wished.

**Analysis of the Location Game**

The ALSICAL Procedure from the SAS programme suite was used to analyse the data generated by the Location Game [Joyner, 1983]. The coordinate data was converted to a square symmetric dissimilarity matrix. Kruskal's [1964] least squares monotonic transformation was applied. Young's S-Stress - an iterative algorithm that minimises an index of fit, was used.

## **Socio-spatial Contextualisation of Home-Based Teleworkers Interviewed.**

**Background Characteristics, Housing and Household Situation :** All four respondents were unmarried and lived with their families in the family home. None of the group were combining the telework role with that of parent or chief housekeeper. All four lived in houses which were large and/or had spare capacity, affording the teleworkers the possibility of having a separate room for use as a work room. Thus many of the problems associated with teleworking in shared, often cramped space where teleworkers are playing multiple roles, were not experienced by the present group and this should be borne in mind in interpretation of the research findings. [For example, all four reported experiencing little to no disturbances while they worked].

Three of these teleworkers lived in two storey houses, one in a bungalow. One had carried out structural alterations to the house following the onset of the disability - an additional wing had been constructed with a bedroom, bathroom and personal living room. With the uptake of telework, the living room doubled as a work room and location for a range of equipment. This was considered to be an unsatisfactory situation by the teleworker concerned. Two of the teleworkers studied had not altered the house structurally, but used a very infrequently used sitting room as a work room and consequently did not displace frequently occurring activities in the home. The third teleworker had converted her downstairs bedroom to a workroom.

### **Socio-Spatial Issues Emerging from Questionnaire and Interview Data.**

Interviews carried out with the teleworkers revealed that they confined telework to the work room and did not use other locations within the house to carry out work. Nevertheless, some reported that other family members' use of the home had altered since the uptake of telework [but this did not have negative consequences on interpersonal relationships with household members].

The teleworkers who were working on-line for long spells during the day found themselves in a situation where they were monopolising the only telephone line in the house. This of course caused problems for other family members who could not make or receive calls. The presence of only one line caused problems for the teleworkers themselves also as they could not carry out work-related voice communication with the office nor use the telephone for social calls. The latter is particularly significant in the context of a disabled group whose mobility and consequently social contact can be further restricted in such circumstances. On-line teleworkers planned to increase the number of telephone lines to the house.

The other main circumstance where telework impacted on the use of the home by other family members related to having work related callers passing through the domestic space. Having work related callers pass through the hall and living room [i.e. semi-private areas of the home], to the work room resulted in these areas being kept particularly tidy, free from personal affects etc. and sometimes disturbed use of the living room for family activities. The teleworker in question planned to overcome these problems by building a workroom to the front of the house, with a separate entrance and meeting space.

The teleworkers interviewed reported that their feelings about the home had not changed since they began teleworking. Similarly their use of the macro environment had not changed. It should be noted that the teleworkers interviewed had been engaged in homework for less than a year and it is likely that their experiences may change over time [Moran, 1986].

### **Socio-Spatial Issues Emerging from Analysis of the Location Game**

The emergent two dimensional Alscal solution for all four teleworkers is shown in Figure 1. [Individual solution spaces were plotted for each teleworker also but are not presented here]. Not surprisingly the three wheelchair bound teleworkers placed all activities in the 'downstairs' section of the boardgame, indicating that their preferred housing type was a bungalow since stairs were impossible or extremely difficult for them to negotiate. All four teleworkers favoured a completed separation of work space from the living areas of the home.

The desire for separating the work space physically and psychologically from other areas of the home is reflected in the combined results shown in Figure 1, where work related activities are grouped together and positioned to the left hand side of the space at a distance from 'living' activities. The teleworkers interviewed wanted to 'be able to switch off' and 'close the door on work at the end of the day'. They felt strongly that they did not wish work to intrude on their own or others living space. They each favoured a work space which was fully enclosed architecturally [i.e. a separate work room. It is possible that the degree of psychological separation favoured by the teleworkers interviewed here would be somewhat less if the teleworkers were combining the role of teleworker with that of parent etc.].

In the absence of a separate work entrance the teleworkers interviewed felt that the work room should be as close as possible to the front door in order to minimise work-related callers' auditory, visual or physical access to the private areas of the house. In addition teleworkers did not wish to be 'on view' to callers to the house.

Figure 1 also shows the importance for disabled teleworkers of having a toilet proximate to the workspace. The non-work activities show a gradation from social to personal/private. To the right of the space are the more public and social activities - cooking, eating, using the phone for personal/social calls. Beside these are positioned living-room type activities such as watching TV, being with the family and seeing friends. The activities read, relax and be alone are positioned closer than expected to social activities in the home by the present group, indicating little psychological separation. Quite frequently, in research with other groups, these solitary type activities, are positioned closer to the more private spaces in the home e.g. own bedroom. The present findings may indicate a desire amongst disabled teleworkers to optimise their social contact. This was stated explicitly by one of the teleworkers interviewed who grouped the 'be alone' sticker with family and social activities. A related finding was the desire expressed by those interviewed that the workroom be placed to the front of the house, which would afford them visual access to the public street and to day to day activities in the neighbourhood. Having the workroom facing onto the public arena would also afford a sense of being in tune with the activity patterns of others and a sense of the rhythm of the day. Care should be taken, however, to avoid the teleworker being 'on view' to callers or passers-by.

Figure 1

Two Dimensional ALSCAL Solution Space for an Ideal Home with Combined Working and Living Spaces (n=4)

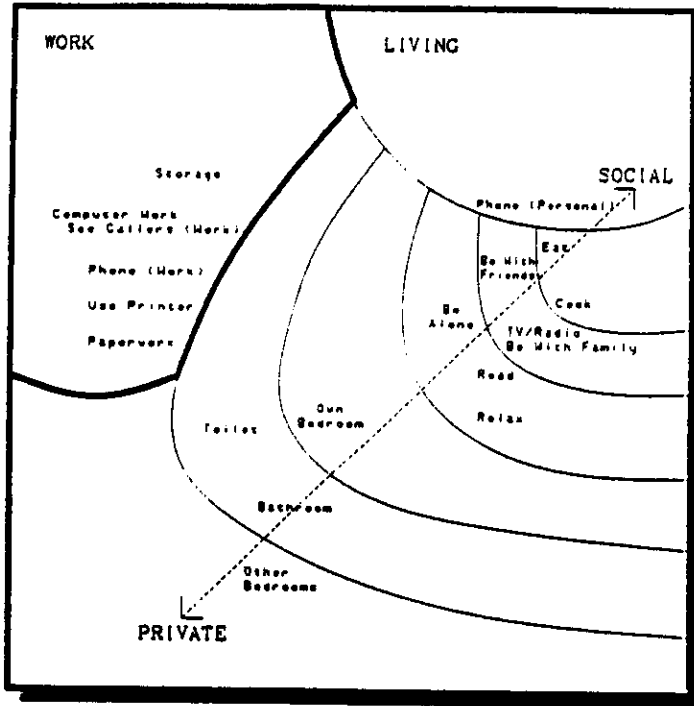
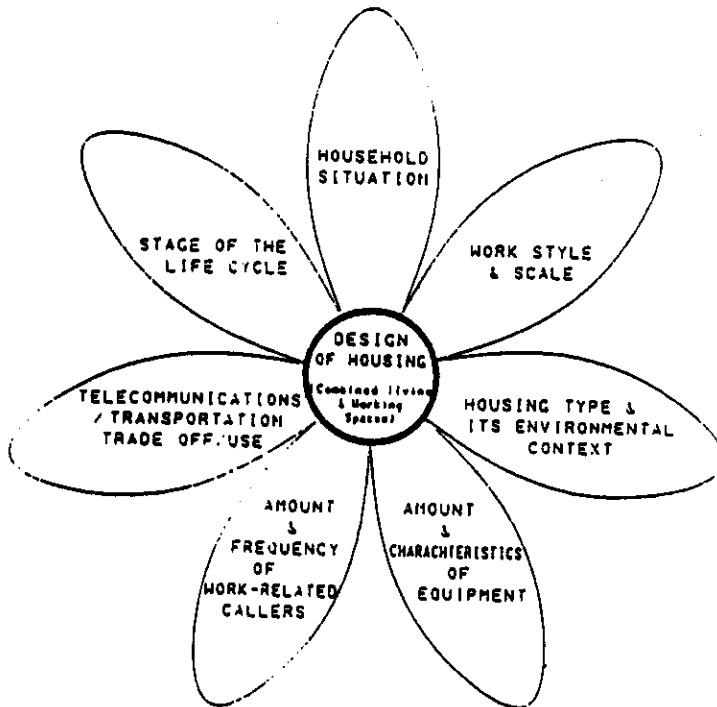


Figure 2

Key Dimensions for Consideration in Designing Housing with Combined Living & Working Spaces



On the basis of the explorations outlined above, preliminary design guidelines for joint living/working environments are outlined below. Figure 2 outlines some critical dimensions in the consideration of architectural solutions for combined working and living environments. The implications of these dimensions for each telework situation need to be considered and the guidelines put forward should be interpreted in the context of these considerations.

### **Preliminary Design Guidelines for the Design of Housing with Joint Working-Living Environments**

The following summary design guidelines emerged from the exploration of the socio-spatial situation of the home based teleworkers interviewed. It is assumed that the general guidelines for the design of accommodation for the disabled will be adhered to [see for example - NRB, 1988; Kelly & Snell, 1988] and these are not repeated here. It is important to note, however, that while general design guidelines are useful in setting minimum standards, satisfactory design solutions need to be tailored to the specific needs of the disabled user.

The guidelines below aim to raise awareness of the special considerations which arise in the design and adaptation of housing to accommodate joint living and working environments - particularly for disabled teleworkers. The most appropriate design solution for any particular teleworker will depend on their particular work, familial, housing situation etc.

#### **Relationship to the External Environment**

0 When the scale of the teleworking arrangement is large and when clients call to the teleworker's home on a frequent basis -

- provide a separate entrance to the workspace clearly identifiable from the domestic entrance while maintaining the morphology of dwelling;
- provide a balance in form and image between workplace and dwelling which is sensitive to its environmental context.

0 When a separate entrance is architecturally difficult to establish or considered to be unnecessary, position the workspace in order to minimise visual, auditory and physical access to the private areas of the residence [e.g. a location near the front door will minimise callers crossing or viewing into the residence and will facilitate the reception of deliveries].

0 Afford the teleworker visual access to day-to-day activities by positioning the workspace [-most likely to the front of the dwelling] so that it relates to the public environment outside the dwelling. Avoid design features which afford callers or people passing-by visual access to the teleworker.

0 Provide discreet but visible signage.

0 Provide a covered entrance area to facilitate transfer to/from wheelchair from/to car. [Wheelchair users interviewed noted that this transfer could take up to five minutes and was particularly difficult in inclement weather in the absence of an appropriately sheltered entrance].

### **Layout and Adjacencies within the Dwelling**

0 Provide an architecturally enclosed workspace - preferably a separate workroom which is used solely for work; obtain the desired level of visual, auditory and physical separation from living spaces. In situations where a separate room is not available the teleworker will need to consider establishing privacy through other means e.g. erecting physical barriers, establishing social rules regarding the use of space, time scheduling etc.

0 Provide a reception-display, waiting area which is part of the workarea [and is not part of the private circulation within the residence].

0 Design or adapt space and choose furniture and fittings to communicate the image desired e.g. hi-tech business, office environment etc.

0 Provide a toilet proximate to the workarea for use by the disabled teleworker.

### **Workstation Ergonomics, Luminous and Thermal Environment**

0 Create an ergonomically satisfactory workstation design; refer to established guidelines [e.g. Cullen and Ryan, 1982] and consider special needs.

0 Choice of equipment and peripherals should be informed by any special needs the teleworker may have; adaptations if required should be put in place at the onset of telework.

0 Choose and position printer[s] to minimise noise; provide acoustic hoods if necessary.

0 Allow free wheelchair access to worksurfaces, equipment and peripherals.

0 Avoid deep worksurfaces, particularly when upperbody movement/forward reach is restricted.

0 Provide for control of lighting, heating, ventilation and air conditioning etc. by teleworker.

0 Position and choose controls, plugs, sockets, window and door handles etc. for easy reach and operation.

### **Telecommunications**

0 The number and type of telecommunications lines required will depend on the type and scale of telework undertaken. Research in the area consistently highlights work-related, social and familial problems associated with inadequate provision of lines. On-line teleworkers may require a number of dedicated data lines [e.g. data transmission, fax etc.]. In addition, where such lines are in constant use throughout the workday, at least one telephone line for work-related voice communication is essential.



0 A separate telephone for receiving and making social calls [which can be shared with other household members] is considered desirable by most teleworkers. Consideration should be given to the location of this telephone. Many teleworkers prefer the non-work, social telephone to be located in domestic space, outside auditory reach of the workspace.

0 For disabled teleworkers who may have difficulty reaching the telephone before it rings off, consideration should be given to installing a number of outlets in convenient locations or to providing cordless and/or hand free sets.

0 Provision of an answering machine confers a number of advantages to the teleworker. It confers privacy by controlling access. It can minimise intrusion of work-related calls into living time and can confer freedom to leave the house without fear of missing important business calls. The decision to invest in an answering machine or service will depend on the scale and type of telework engaged in, the individual teleworkers' use of the home, their workpatterns and those of their clients.

### **Storage and Security**

0 Provide adequate storage for work-related materials.

0 Provide fire proof and lock up storage for sensitive documents, when appropriate.

0 Position screens etc. to avoid affording callers visual access to sensitive material.

### **Conclusions**

This case study highlighted a number of socio-spatial issues which arise in the design of houses for home based teleworkers generally and some special considerations which apply when people with physical disabilities engaged in paid work in the home. As a result of these preliminary investigations guidelines for planning, design, management and use of joint working and living environments in the home were put forward.

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