Building Adaptable Housing - From Theory to Practice

Current Developments in the Netherlands

Theo J.M. van der Voordt
OSPA, Research Institute of Urban Planning and Architecture
Delft University of Technology
Department of Architecture
Berlageweg 1
2628 CR, Delft
The Netherlands

Summary

Mass housing is usually not designed with the needs of physically handicapped people in mind. When a person living in a 'normal' house becomes handicapped, he and his partners are forced to choose between often drastic and expensive adaptations of their house or a move into a better adapted home. In order to evade this, a plea to design 'adaptable buildings' has been made by several authors. The idea is to design houses in such a way that they are accessible and habitable for normal and handicapped people alike, only needing minor adaptations in the case that one of the tenants is handicapped. In this paper the dissemination of this idea in Dutch building practice is reviewed. Further, the required floor space and costs of adaptable homes are compared with those of 'normal', i.e. not easily adaptable houses. It appears that the differences are rather limited. However, when an adaptable home in its adapted state must comply with the guidelines outlined by the Dutch Council of the Disabled, a strong increase of floor space is required. Reconsidering of this claim is recommended in order to reconcile ideals and practice.

Résumé

La construction des habitations de masse n'a guère tenu compte des besoins spécifiques des personnes handicapées physiques. Ces habitations n'ont pas été conçues pour les cas où un locataire deviendrait handicapé. Les nécessités d'adaptation sont très coûteuses, trop coûteuses le plus souvent, pour que le locataire handicapé puisse les supporter; il est donc obligé de déménager. Aussi de partout s'élèvent des voix plaidant pour 'l'habitation adaptable'. Dans cette perspective, on prévoit d'emblée l'éventuelle occupation du logement par une personne physiquement handicapée; des adaptations ultérieures de l'aménagement seront requises, mais celles-ci peuvent être réalisées sans nécessiter de travaux trop importants ou trop coûteux. Cet article montre comment, aux Pays-Bas, on a réagi concrètement à l'introduction de cette nouvelle idée. L'article compare également la surface requise pour 'l'habitation adaptable' et les frais de construction y relatives avec ceux d'un logement 'normal', c'est-à-dire d'un logement qui n'est pas facilement adaptable. Il s'avère toutefois qu'un logement ayant été adapté devrait, pour correspondre aux normes établies par le Conseil néerlandais pour les personnes handicapées physiques, avoir une surface considérablement plus étendue. Il semble donc nécessaire d'ajuster les normes requise par le Conseil, ceci afin de faire coïncider idéal et réalité.

1. Adaptable Housing for Everyone

In the present-day construction of mass housing, there is very little provision made for potential occupancy by a person with a physical handicap. As a consequence of this housing policy, often complex and expensive adaptations have to be made in order to cope with the requirements of a disabled occupant. At the present time, in the Netherlands, almost 20'000 homes are adapted per year, *after* construction (Nationale Woningraad, 1988). This costs, in total, approximately 107 million guilders, that is about 85 million Swiss francs[1]. Half of these cases involve minor adjustments costing less than 2000 guilders, such as the installation of handles or a raised toilet bowl. In well over 3000 homes, however, major adjustments are necessary, in which case costs vary from 10'000 guilders to more than 45'000 guilders. This last amount causes great problems, because it is the maximum amount, as stated in the Regulation on Financial Support for Housing the Disabled (BGSHG), for which one may be eligible for government subsidy (Ministerie van VROM, 1978). Those persons who become handicapped as a result of illness or an accident are often forced to move. It is estimated that there are 7000 such cases per year! In order to avoid the disadvantages of the above 'individual approach' to adapted housing, a more 'categorical approach' has been developed by the Dutch government. This means that a limited number of homes is already adapted during construction, in order to meet the assumed needs of a specific category of disabled people (in practice, usually people in wheelchairs), without the future occupant being known. Local authorities often aim for a percentage of 0.5 to 1.5 percent of newly built houses to be specially adapted. Although this categorical approach leads to less expensive individual adaptations, after construction, there are disadvantages too. For handicapped people in wheelchairs, the range of choices on the housing market is severely limited. For corporations, there is the added problem of management. The building of adapted housing in stockpile leads to some vacancy and necessitates (temporary) rental to non-handicapped persons. Construction of adapted housing to meet a concrete demand, on the other hand, leads to long waiting lists and complicated procedures. This is reason enough to challenge designers, corporations and municipal authorities to realize adaptable accommodation, that is to say:

> "Accommodation which is not specifically adapted or intended for disabled occupants, but which is designed in such a way that it can be adapted easily, and relatively cheaply, should the occupant become disabled, and which is already approachable, accessible and can be visited by a disabled person from the time it is built or renovated" (Nolte, 1988).

Given this definition of the building of adaptable housing, about 40 corporations in the Netherlands have begun experimenting with realizing this concept in practice. The experiment consists of approximately 27 different projects, comprising a total of some 1200 homes. The first project, a housing complex for the elderly, was completed on September 23, 1987. At the end of 1989, ten projects had been completed, including single-family homes, flats in medium- and high-rise developments, housing of the single-family type for elderly people, with all the residential facilities on the ground floor, and 'lean-to' apartments attached to an old people's home. The initiator of the experiment is the National Housing Council (Nationale Woningraad, or NWR). The NWR is an umbrella organization comprising 700 housing corporations and local authorities which, together, administer 1.3 million of the 5.7 million homes in the

1 1 Hfl = about 0.79 Sfr.,; 1 Hfl = about 3 FF.

Dutch housing stock. The go-ahead to begin the NWR experiment was given during a symposium on "Adaptable Building and Adapted Living" in Arnhem, June 1984. The experiment will be officially concluded at the end of 1990. It is supported by the "Steering Committee for Experiments in Public Housing" (SEV), as part of a programme of experiments in housing for the elderly. Further subsidy is received by the Department of Action for Disabled People of the European Communities.

With adaptable building, the initiators hope to achieve various goals. Homes which can be more easily visited, and a greater freedom of choice on the housing market, are expected to have a positive effect on the continuing social integration of the handicapped. Moreover, adaptable housing can prevent handicapped persons from having to move against their will. Yet another aim concerns the curtailment of procedures, and savings on the costs of adaptation *after* construction, should one of the occupants become handicapped. A final aim is to increase the practical value of the housing for everyone, thus creating better rentability. After all, even non-handicapped people can benefit from adaptable housing. Consider, for example, the advantages of wider doorways for removal, for people who are temporarily disabled, for households in which one of the elderly members has become disabled, and for people who would like to be able to invite a handicapped friend into their home. Because the target group for adaptable housing includes *everyone*, the experiment is focused expressly on ordinary housing, and not just on specific housing for the handicapped. Adaptable housing is ordinary housing for ordinary people!

2. Preconceptions

There are few who would fail to endorse the aims described above. This being the case, why has it taken so long for adaptable housing to become widely accepted? It is particularly striking that, even within movements such as "flexible housing" or "open plan building", the possibility that one of the occupants may become disabled is hardly considered. In the well-known book by Professor Habraken (1961!), and in more recent publications by the Architectural Research Foundation (SAR) and other involved in open plan building (Kapteÿns *et al.*, 1989), attention is paid only to the possibility of increasing or decreasing the size of the housing, or changing the layout, in accordance with changes in user requirements. Preconceptions and insufficient knowledge would appear to be the most significant explanatory factors here. Firstly, there has been, until recently, a lack of reliable data concerning the requirements with which an adaptable home must comply. With regard to this point, on the basis of a comprehensive research of the existent literature and of interviews with (organizations for) handicapped people, highly detailed requirements for adaptable homes have been formulated in the theoretical phase of the NWR experiment, "Building Adaptable Housing". These requirements are specified in the NWR publication "Requirements for Building Adaptable Housing" (Drenth & Nolte, 1987). Figure 1 shows an example of the "dining unit", in which is indicated how much space is needed to place a number of elements next to each other. Secondly, it has been (and still is) widely assumed that adaptable housing requires considerably larger homes, and that it is, technically speaking, extremely complicated, and too expensive. An interim assessment connected with the NWR experiment (EGM Architecten, 1988), and a study conducted by the Delft University of Technology (Van der Most van Spijk & Van der Voordt, 1989) have made it possible to examine these views more closely.

DINING

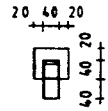
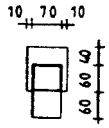
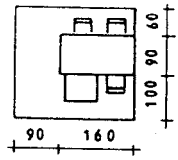
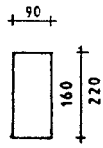
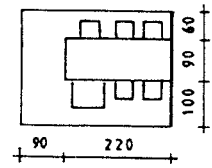
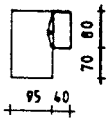
elements	user codes	requirements
measurements in cm		positioning of elements according to number of occupants
1 chair 	A	
2 adaptable seating unit 	R,L,Ls	2 or 4 occupants 
3 table 	A,R,L,B,Sz Ls	6 occupants 
4 cupboard 	R	
5 view from the dining area	A,R,L,U,Mg, Ls	**towards the street, if no view towards the street is possible from the sitting area**
		balustrade max. 900 mm high

Fig. 1 Measurement data taken from NWR Requirements for Building Adaptable Housing: the dining unit.

User codes: A = all users, B = blind persons, L = persons with a limited use of their legs who do not use any aids, Ls = persons on crutches and users of walking frames, Mg = motorically disabled persons, R = wheelchair users, Sz = partially sighted, U = persons with limited stamina.

Fig. 1 Mesures fournies par les normes du Conseil national de l'habitat, concernant la construction d'habitations adaptables: la salle à manger.

Codes: A = tout utilisateur, B = aveugles, L = personnes ayant un handicap aux jambes, Ls = personnes utilisant des béquilles ou une aide pour marcher, Mg = personnes handicapées sur le plan moteur, R = utilisateurs en chaise roulante, Sz = partiellement aveugle, U = personnes à endurance limitée.

3. Adaptable Building and the Required Size of Housing

3.1. Method

In order to be able to assess the difference in floor area between adaptable and non-adaptable housing, one must first gain a precise insight into the spatial needs of both handicapped and non-handicapped people. Reference points, however, are lacking. Varying systems of standards are in circulation for the minimum measurements of attributes, "functional areas" and complete living quarters. Much of the data on measurements is attuned chiefly to theoretical averages. In order to determine housing size, the standard of a "modal" family, consisting of husband, wife and two children, is often used. With regard to the installation of fittings in the home, the focus is generally on the healthy adult, of "normal" height, who has full use of all bodily functions. This applies, for instance, to the "Model Building Ordinance" formulated by the Association of Dutch Municipalities (Vereniging van Nederlandse Gemeenten, 1987). The ordinance includes all the minimum requirements with which every home in the Netherlands must comply. These regulations are frequently adjusted. At the present time, the 22nd supplement (MBV22) is in effect. Other systems of standards have been specifically developed with the handicapped in mind. A well-known example in the Netherlands is the handbook "Call for Admittance" ("Geboden toegang"), published by the Dutch Council for the Disabled (Stichting Nederlandse Gehandicaptenraad, 1986). Premises, upon which further work can be based, must be clearly specified. Both the NWR and the TU Delft are trying, each in their own way, to resolve this problem.

The approach used in the interim assessment of the NWR experiment was very practice-oriented. On the basis of three projects already realized a comparison was made between the original, non-adaptable design, an adaptable design according to the NWR Requirements for Adaptable Building, and an adapted design according to the guidelines described in "Call for Admittance". The adaptable designs were actually built. The initially non-adaptable designs and the adapted designs have only been developed on paper. They have been used, in particular, for comparison of the required floor space and building costs. All three designs are similar in type of construction, number of rooms and pattern of spatial relations between main activities. Differences are restricted to the measures of spaces, according to the minimum space requirements of the standards or guidelines in question. The first study was done of ten adaptable homes for the elderly in low-rise buildings belonging to the Oosterhout Housing Foundation. The study resulted in improved dimensions in a follow-up project consisting of 24 homes, 24 adaptable flats for elderly people (high-rise) in Winterswijk, and 20 divisible one-family homes in Zierikzee. Fig. 2 shows the floor plans for the project in Oosterhout.

The method employed by the TU Delft is more theoretical in nature. Originally, the study was based on existing homes. The available floor area of these homes was compared with the floor area necessary for an adaptable variant. The spatial layout of both home and variant was the same; the measurements of the variant, however, were such that it could be fairly easily adapted later on. Because there were no univocal adaptability requirements available at the start of the study, the essential measurements were determined by the TU's own provisional standards, which were based on practical experience and limited experimental research. In this study, researchers also explored whether or not an adaptable design might be possible, given a different layout of the floor plan, within the available floor area.

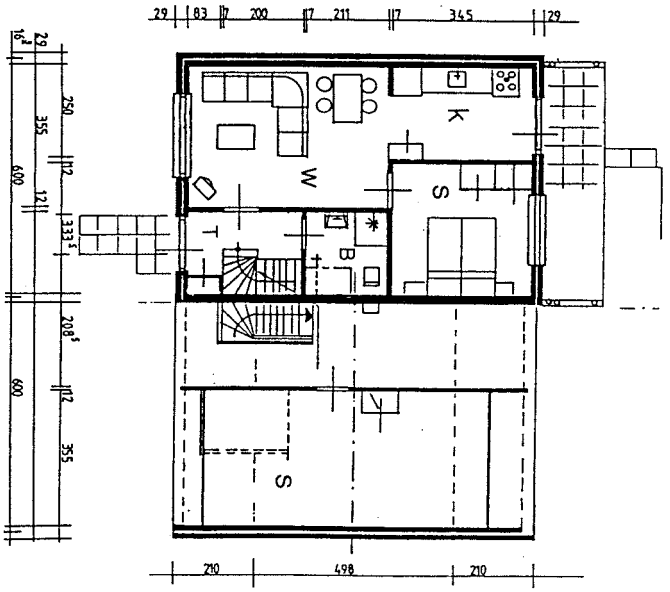


Fig. 2a: Floor plans of one-family homes in Oosterhout - original design (non-adaptable) Legend: T = entrance hallway, W = living room, S = bedroom, K = kitchen, B = bathroom/toilet, Be = storage.

Fig. 2a: Plan du rez-de-chaussée d'une maison familiale à Oosterhout - plan original (non adaptable) Légende: T = hall d'entrée, W = salle de séjour, S = chambre à coucher, K = cuisine, B = salle de bains/ toilettes, Be = réduit.

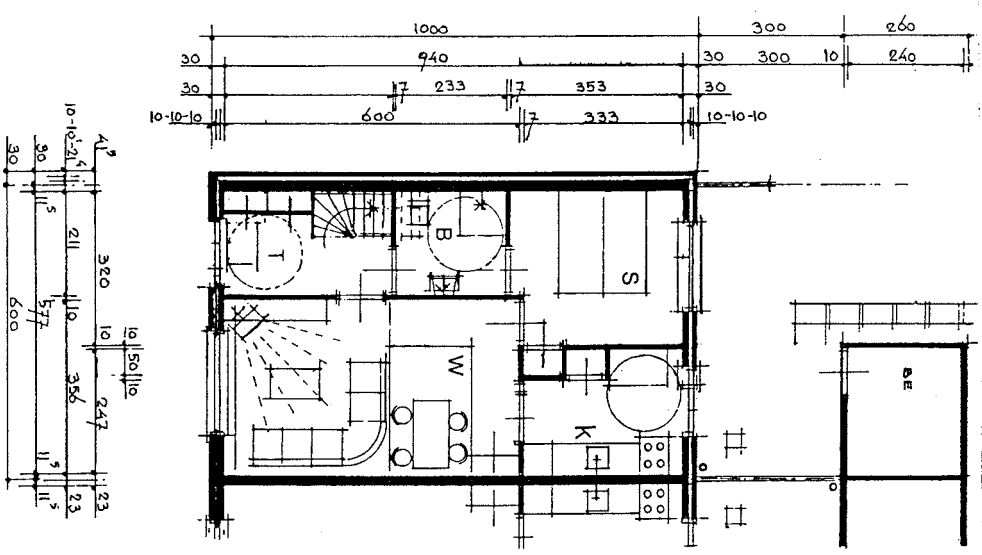


Fig. 2b: Floor plans of one-family homes in Oosterhout - adaptable design, first series of 10 homes. Legend: T = entrance hallway, W = living room, S = bedroom, K = kitchen, B = bathroom/toilet, Be = storage.

Fig. 2b: Plan du rez-de-chaussée d'une maison familiale à Oosterhout - plan adaptable, première série de 10 bâtiments. Légende: T = hall d'entrée, W = salle de séjour, S = chambre à coucher, K = cuisine, B = salle de bains/toilettes, Be = réduit.

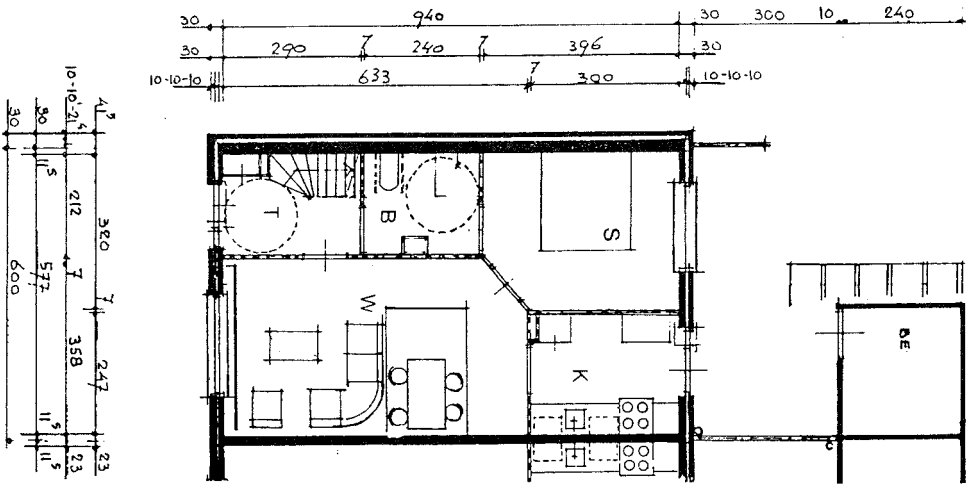


Fig. 2c: Floor plans of one-family homes in Oosterhout - adaptable design, second series of 24 homes. Legend: T = entrance hallway, W = living room, S = bedroom, K = kitchen, B = bathroom/toilet, Be = storage.

Fig. 2c: Plan du rez-de-chaussée d'une maison familiale à Oosterhout - plan adaptable, seconde série de 24 bâtiments. Légende: T = hall d'entrée, W = salle de séjour, S = chambre à coucher, K = cuisine, B = salle de bains/toilettes, Be = réduit.

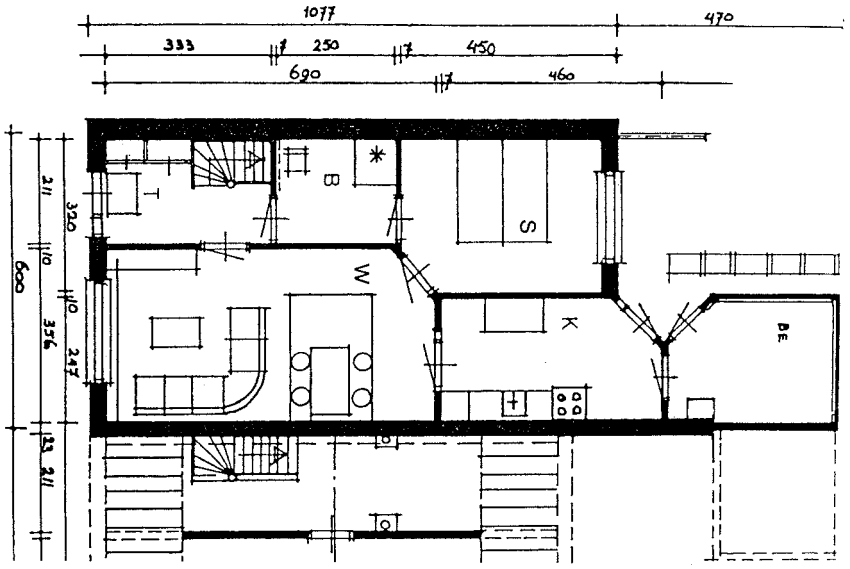
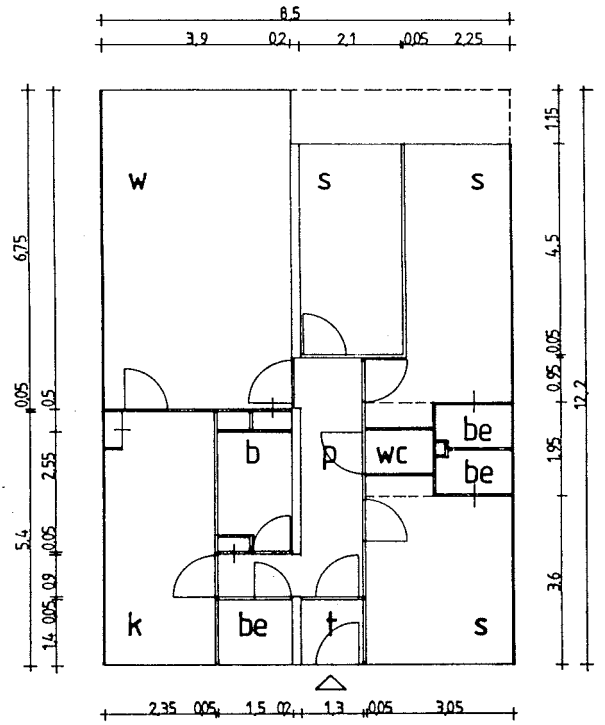


Fig. 2d: Floor plans of one-family homes in Oosterhout - the same design in adapted state, intended for use by disabled person confined to wheelchair, yet having normal arm and hand functions and capable of performing own domestic duties. Legend: T = entrance hallway, W = living room, S = bedroom, K = kitchen, B = bathroom/toilet, Be = storage.

Fig. 2d: Plan du rez-de-chaussée d'une maison familiale à Oosterhout - adaptation à l'intention d'un handicapé en chaise roulante, capable d'utiliser ses bras et ses mains et de prendre soin de son ménage. Légende: T = hall d'entrée, W = salle de séjour, S = chambre à coucher, K = cuisine, B = salle de bains/toilettes, Be = réduit.



		4 rooms							
		gallery							
bko m²	t/p	w	s	s	s	k	b/wc	be	
91,9	10,0	26,3	11,7	11,7	8,5	12,3	5,3	6,8	

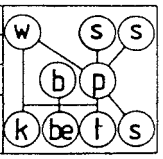
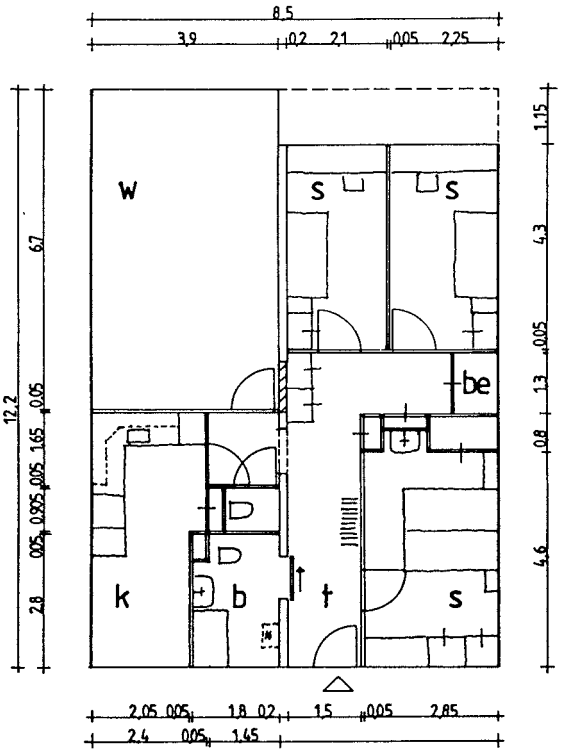
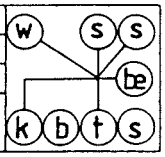


Fig. 3a Realized design (a) and adaptable variant (b) within the same supporting structure, designed by architect J.J. Kroon (Bouwplan Wesselerbrink, Enschede).

Fig. 3a Plan réalisé (a) et variante adaptable (b) pour la même structure de support. Architecte: J.J. Kroon (Bouwplan Wesselerbrink, Enschede).



		4 rooms						
		gallery						
bko	t	w	s	s	s	k	b	be
92,8	14	26,1	12,4	9,2	8,5	12,1	6,0	5,8



(b)

Legend:	T = entrance hallway K = kitchen	W = living room B = bathroom/toilet	S = bedroom Be = storage
Légende:	T = hall d'entrée K = cuisine	W = salle de séjour B = salle de bains/toilettes	S = chambre à coucher Be = réduit

Figure 3 shows an example of one of the homes examined during the initial phase of the study, as well as an adaptable variant. The results of the comparison between surface areas within such an approach are strongly dependent on the homes which are the subject of the comparison. A spacious ERA-flat (a common type of home in the Netherlands, which goes by the name of the building company concerned) will yield different results than a home which has been purposely kept small to conserve energy. Therefore, in the second instance, an alternate approach was chosen. Functional floor plans, or "standard models", were developed for six typical layout variants (Table 1). These are rectangular floor plans which were designed according to the minimum space requirements of particular standards, given the spatial relationship between the most important functions, and which aim at a minimum total floor area. The measurements were determined according to the minimum measurements as stated in:

a. The 22nd supplement of the Model Building Ordinance (MBV22). As mentioned earlier, every home in the Netherlands must comply with the minimum requirements of this ordinance.
b. The guidelines laid down by the Public Housing Department of The Hague (VH/DH) (Dienst Volkshuisvesting Den Haag, 1987). Most Dutch municipalities have higher quality requirements than those outlined in the Model Building Ordinance. The VH/DH guidelines are fairly representative of the requirements which are usually demanded by (large) municipalities in the case of social housing projects.
c. The NWR's "Requirements for Adaptable Buildings". For the time being, these are the only reasonably detailed guidelines for adaptable housing available.
d. "Call for Admittance" (GT). According to the NWR, an adaptable home in its adapted state must comply with the guidelines outlined in "Call for Admittance". For this reason, these guidelines are also included in the surface area comparison.

In this way, 6 (layout variants) x 4 (systems of standards) = 24 standard models, or reference models, were created on paper. Figure 4 shows the floor plans for layout type 4.

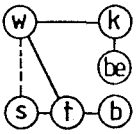
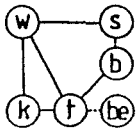
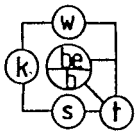
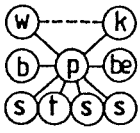
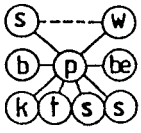
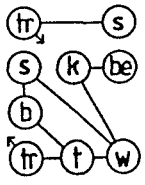
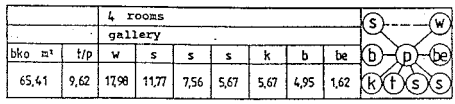
	Spatial relations		Way of access	Number of rooms
1.		sleeping area on gallery side, kitchen and living room on opposite side.	gallery	2
2.		kitchen on gallery side, living room and sleeping area on opposite side.	gallery	2
3.		sleeping area on gallery side, living room on opposite side, kitchen in between.	gallery	2
4.		sleeping areas on gallery side, kitchen and living room on opposite side.	gallery	4
5.		sleeping areas and kitchen on gallery side, living room and master bedroom on opposite side.	gallery	4
6.		living room on entrance side, kitchen and sleeping areas on opposite side, sleeping area upstairs.	single-family house	4

Table 1 The layout variants studied in Delft

Table 1 Les différents plans étudiés à Delft

		4 rooms						
		gallery						
bko m²	f/p	w	s	s	s	k	b	be
65,41	9,62	17,98	11,77	7,56	5,67	5,67	4,95	1,62



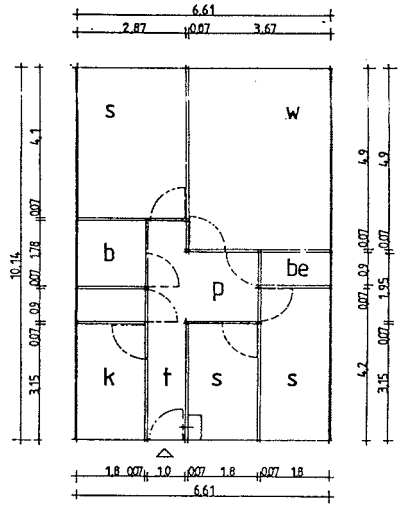
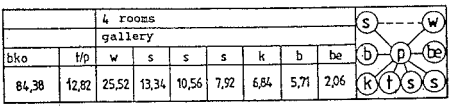


Fig. 4a Layout variant type 5 ('Era-flat'), according to minimum measurements of four systems of standards: Model Building Ordinance, 22nd supplement (MBV22).

Fig. 4a Variation du plan du type 5 ('appartement Era'), selon les mesures minimum de quatre systèmes de standards: Model Building Ordinance, 22ème supplément (MBV22).

		4 rooms						
		gallery						
bko	f/p	w	s	s	s	k	b	be
84,38	12,82	25,52	13,34	10,56	7,92	6,84	5,71	2,06



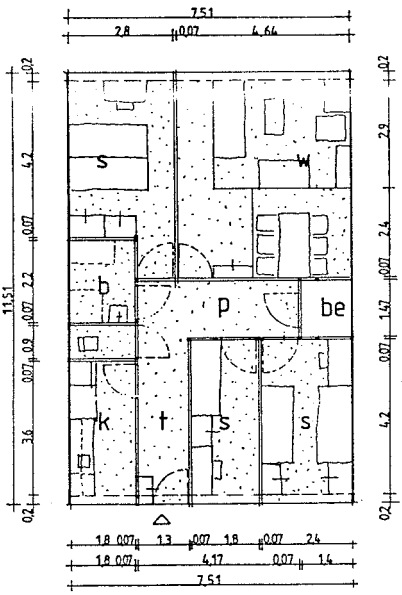
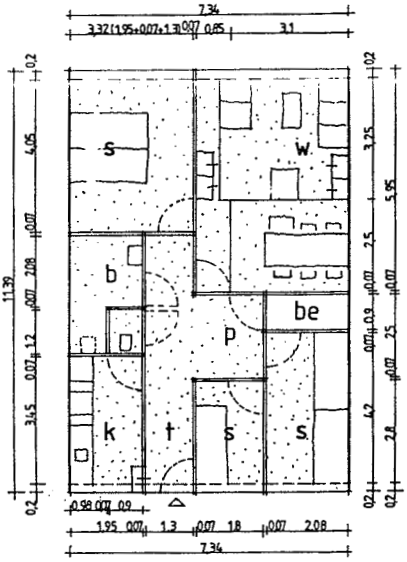


Fig. 4b Layout variant type 5 ('Era-flat'), according to minimum measurements of four systems of standards: Guidelines of the Public Housing Dept., The Hague (VH/DH).

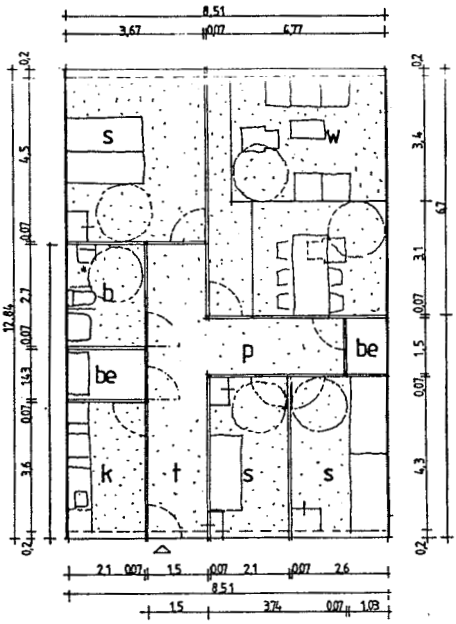
Fig. 4b Variation du plan du type 5 ('appartement Era'), selon les mesures minimum de quatre systèmes de standards: Normes établies par le Département de l'habitat, La Haye (VH/DH).



		4 rooms gallery							
bko	t/p	w	s	s	s	k	b	be	
81,73	13,87	29,50	13,45	8,74	5,04	7,12	6,53	1,87	

Fig. 4c Layout variant type 5 ('Era-flat'), according to minimum measurements of four systems of standards: Requirements for Building Adaptable Housing (NWR).

Fig. 4c Variation du plan du type 5 ('appartement Era'), selon les mesures minimum de quatre systèmes de standards: Normes établies par le NWR pour la construction d'habitations adaptables.



		4 rooms gallery							
bko	t	w	s	s	s	k	b	be	
104,77	17,72	31,96	17,25	11,7	9,45	7,98	5,67	4,5	

Fig. 4d Layout variant type 5 ('Era-flat'), according to minimum measurements of four systems of standards: "Call for Admittance" (GT).

Fig. 4d Variation du plan du type 5 ('appartement Era'), selon les mesures minimum de quatre systèmes de standards: Normes établies par le "Call for Admittance" (GT).

3.2. Results

The results of the *NWR experiment's interim evaluation* may be summarized as follows. In the projects in Winterswijk (width = 7.2m; depth = 10.2.m) and Zierikzee (width = 5.4m; depth = 9.0m), both the adaptable variant and the adapted variant (= subsequently adapted according to the spatial needs of a handicapped resident) appeared to fit within the supporting structure of the original design. In Oosterhout, on the other hand, the original design proved too cramped to allow the realization of an adaptable home design within the available floor area. Strictly speaking, an expansion of the (gross) depth from 9.18m to 9.37m would have been sufficient to comply with the NWR adaptability requirements. Instead, an extension to 10.0m was chosen, in connection with possible future adaptations. This size, however, in its adapted state, would have been insufficient to meet with the demands in "Call for Admittance". An additional extension would be required, involving the moving of the rear facade, at least in the first project of 10 homes. The gross depth would then be 10.77m. In a later project of 24 homes, this extension was rendered unnecessary by several clever alternations in the basic design (including a smaller entrance hallway and a more spacious bedroom). All in all, the results of the NWR experiment seem to indicate that, in many cases, adaptable building does not require extra floor area, provided the designer is creative enough! A closer look at the floor plans, however, makes it necessary to add several comments. In the Oosterhout project, the space available to the user near the doors is extremely cramped, particularly for persons in wheelchairs. The doors between hallway and living room open out into the sitting area, and those between living room and kitchen open out into the eating area. Therefore, they do not, strictly speaking, fulfill the NWR requirements for adaptable building. In the project in Winterswijk, a bedroom measuring 2.96 x 3.90m was realized. According to NWR requirements, however, a minimum of 3.00 x 4.05m (excluding radiator strip) is required. The fact that the present occupant regards the cramped space as merely a slight inconvenience (she cannot reach the area between bed and rear facade) is, in itself, fortunate. Yet, because of this fact, the comparison between the surface areas of non-adaptable and adaptable designs is no longer solidly based.

The results of the *Delft Study* are summarized in Figure 5. Indicated is the minimum required floor area, according to four systems of standards, for the six layout variants studied. The "interior net surface area" (BKO) has been chosen as the standard unit of measure. This is the gross floor area of the home, less the construction surface area (walls, columns, and such like), closed balconies and loggias, communal areas and storage areas larger than 1.5m^2. The study in Delft led to the following conclusions:

1) Adaptable building requires larger homes than the minimal size prescribed by current governmental regulations, such as the Model Building Ordinance. The two-room homes studied are, on average, 37% larger. For the four-room homes studies, this percentage is approximately 28%. With regard to current building practice, however, the differences between non-adaptable and adaptable homes are considerably smaller. Taking as reference point the guidelines formulated by the Public Housing Department in The Hague, adaptable two-room homes, according to the NWR guidelines, are roughly 12% larger than prescribed. For the four-room homes, the difference is a mere 3%.

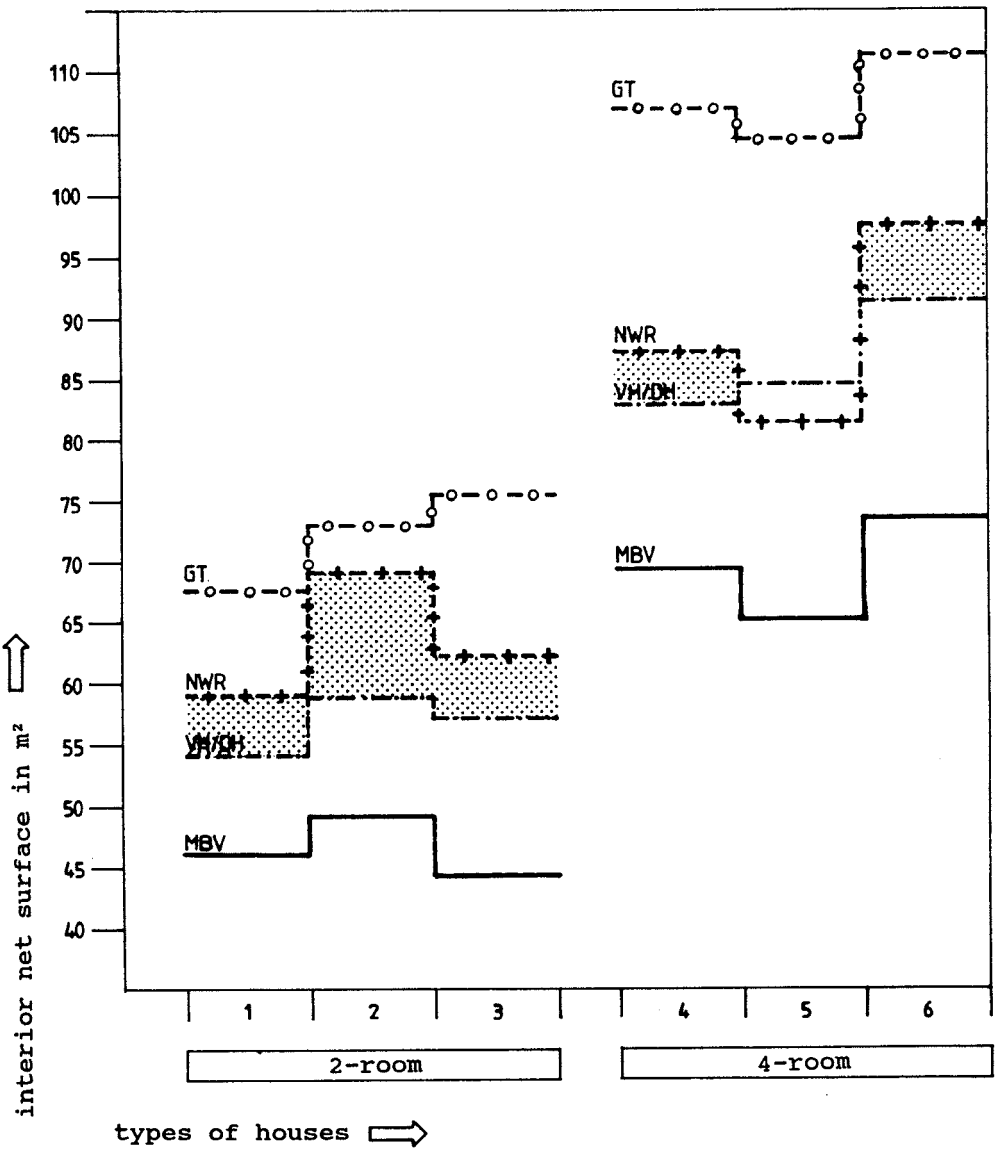


Fig. 5 The difference in required floor area, according to four systems of standards, calculated for 6 layout variants. For details of these layout variants, see Table 1. Abbreviations: MBV22 = Model Building Ordinance, 22nd supplement, VH/DH = Guidelines of the Public Housing Dept., The Hague, NWR = Requirements for Building Adaptable Housing, GT = "Call for Admittance".

Fig. 5 Les différences dans la surface de sol requise, selon quatre systèmes de standards, calculés pour 6 variations de plan. La Table 1 fournit les détails de ces variations.

2) When compared with the minimal required width for homes, according to the guidelines formulated by the Public Housing Department in The Hague, adaptable homes are hardly any larger. For the two-room homes, the difference is 4%; for the four-room homes, the difference is an average 0%.
3) The difference in floor area between adaptable and non-adaptable homes varies from one type of layout to the next. In the case of reference model 5 (ERA-flat type), the minimal floor area required, according to NWR criteria, averages 3% less than the minimum floor area according to the measures specified in the VH/DH guidelines.
4) In 5 of the 6 layout variants studied, the minimal number of m^2 BKO required, according to NWR adaptability requirements, falls within the number of m^2 which, according to The Hague guidelines, is considered subsidizable.
5) The minimal number of m^2 BKO required, according to "Call for Admittance" is considerably higher (about 26%) than that required by currently accepted quality standards such as the space standards of The Hague. The requirement that "an adaptable home, in its adapted state, must comply with 'Call for Admittance' " seems, in many cases, to be an unrealistic one, unless the extra floor area can be created by (later) expansion of the home.

This final point appears to be refuted by the discoveries made in the NWR experiment. Both in Zierikzee and in Winterswijk, the original design proved spacious enough to allow the realization of an adapted design within the available floor area. As stated earlier, however, there was some deviation here from the minimum requirements in "Call for Admittance". Moreover, in the homes in Zierikzee, a bedroom would have had to be sacrificed in order to allow the homes, in their adapted state, to comply with these requirements. Only through practical experience will we learn to what extent this situation will meet with protest from the occupants.

Despite the comments above, one may justifiably conclude that the difference in floor area between adaptable and "traditional" designs is not a vast one, especially when we consider that, until recently, there has been so little experience acquired in adaptable building! Bearing this in mind, the difference between the first and second experiments in Oosterhout can certainly be called promising. It is also quite plausible that further experience with the NWR experiment could lead to more detailed adjustment of the "Requirements for Adaptable Building".

4. The Myth of High Expenses

During the Arnhem symposium, a ticklish matter was debated, i.e., the following question: To what extent will adaptable building lead to additional costs? According to one of the architects present, approximately 1'600 extra guilders per home would be necessary, while another architect estimated that there would be practically no additional costs whatsoever. Reason enough for a hefty conflict! The evaluation of the three projects done by the NWR experiment shows that a conclusive answer is not possible yet. Table 2 gives an overview of the differences in cost between the original, non-adaptable designs, the adaptable variants, and the homes in their adapted state. The home chosen as reference model for a home in adapted state is one that complies

		Additional Costs per Home	Adaptation Costs General facilities	Construction costs	Total
1.	**Oosterhout:**				
a.	Original design	n.t.v.	11'330.-	44'550.-	55'850.-
b.	Adaptable, 1st series (10 homes)	Hfl. 4'610.-	11'330.-	34'570.-	45'900.-
c.	Adaptable 2nd series (24 homes)	Hfl. 3'380.-	11'330.-	12'970.-	24'300.-
2.	**Winterswijk:**				
a.	Original design	n.t.v.	11'330.-	23'970.-	35'000.-
b.	Adaptable	- Hfl. 120.-	11'330.-	2'370.-	13'700.-
3.	**Zierikzee:**				
a.	Original design	n.t.v.	11'330.-	44'150.-	55'480.-
b.	Adaptable	+ Hfl. 878.-	11'330.-	32'020.-	42'350.-

* The adaptation costs required to alter a home into a home in adapted state (according to the guidelines in "Call for Admittance") are comprised of two portions: general facilities (e.g. installation of handles, replacement of a toilet bowl with a higher bowl) and a construction portion. The general adaptations are equivalent for all projects.

Table 2 Comparison of building and adaptation costs of three projects from the NWR experiment "Adaptable Building".

Table 2 Comparaison des coûts de construction et d'adaptation pour les trois projets de l'expérience "Construction adaptable".

with the spatial needs of a wheelchair user with normal arm and hand function, who is able to perform his own domestic activities. Based on the data in Table 2, the conclusion seems justified that, if the design has been well formulated, adaptable building need not be much more costly than non-adaptable building. In the Winterswijk project, the adaptable variant is even 120 guilders less expensive than the original, non-adaptable variant. The lower costs result from a balance between the extra cost of inner door frames, inner doors, floor tiles and electrical fittings (intercom, telephone in bedroom), and the cost savings obtained from a smaller interior wall surface (and a subsequent saving on wall tiles), and the omission of thresholds. Only in the first project completed - the first of two series of adaptable homes in Oosterhout - was the adaptable design considerably more expensive than the original, non-adaptable variant. In the first series, the difference amounted to no less than 4'610 guilders. With a bit of clever designing, the difference was reduced to 3'380 guilders in the second series. The additional costs of this project are mainly the result of a difference in floor area be-

tween the original design and the adaptable variant. In any case, one must be particularly aware, with regard to the cost comparison, of what the reference points are. In the evaluation report, a choice was made for a practical comparison. With this method, the (theoretical) building costs of an original, non-adaptable design are compared with the costs of that same design, after the requirements for adaptable building have been incorporated into it. Obviously, this method can only be employed when plans are concerned which are not adapted, on the basis of adaptability requirements, until a later stage. In other cases, it may be necessary to draw a comparison with a theoretical reference home. Although the building costs of adaptable homes are, on the average, higher, the general expectation is that the differences in cost will diminish in the future. On the one hand, increased experience in this area will result in better basic floor plans, which will limit the need for later adjustments (cf. the experiences in Oosterhout). And on the other hand, because the application, on a broader scale, of what are now regarded as "special provisions", such as extra high and broad doors, will lead, in the long run, to standardization and a saving in expenses. The final column in Table 2 shows that the adaptation of an adaptable home is considerably less expensive than the adaptation of a home in which little or no account has been taken of (future) occupation by a person with a handicap. These figures become even more interesting when compared with data on homes which are adapted under the terms of the Regulation on Financial Support for Housing the Disabled. As stated earlier, nearly 20'000 homes per year are involved, and a total of approximately 107 million guilders spent. In some 1'480 cases, major adjustments are required, costing an average of 30'000 guilders. If we assume that these are primarily architectural adaptations, and that, according to Table 2, savings of 30-60% are feasible, then this could mean savings, for approximately 1'500 homes, of 13.5-27 million guilders per year. This opens up new perspectives for the future! Building adaptable homes can also lead to other social savings. Disabled persons often remain longer than is medically necessary in rehabilitation centres or hospitals because adaptation of their own accommodation is difficult, or even impossible, and alternative accommodations must be sought. The possibility of less time-consuming adaptation, which is offered by adaptable housing, limits this unnecessary expenditure in the health-care field. Although the "zero option" (= no extra costs) is probably not achievable for every home, it certainly seems to be a matter of budgetary neutrality, macro-economically speaking. In the long run, however, a transfer of funds will be required, from the present subsidy budget to municipal funds perhaps, or in the form of premiums for corporations which build adaptable homes.

5. Discussion

A philosopher once said, "Yesterday's illusion is today's ideal and tomorrow's reality". With the principle of adaptable building, we seem already to be approaching a new dawn. The results of the study in Delft, and the practical experiences yielded by the NWR experiment, indicate that, in many cases, it is quite possible to realize adaptable building, and that it will not necessarily lead to large, complicated floor plans. The extra floor area which *is* required is minimal, especially for 4-room homes. Additional research is needed in order to reach more definitive conclusions. Among other things, standard models will have to be developed for such dwellings as 3-room flats and walk-up buildings.

Some extra floor area, for that matter, ties in well with the current tendency towards larger living quarters, and will certainly be beneficial to rentability throughout

the life cycle of a home. Various of the corporations involved in the NWR experiment have already gone further with their first experiment, and are even planning to build all new homes in an adaptable way. This is not to say that all the problems are now resolved. The NWR's conclusion that "adaptable building is an approach which can be applied to every home" is a very optimistic one. There will undoubtedly be many more cramped homes built, for socio-economically weaker groups in particular, which will barely lend themselves to adaptable building. The required floor area for a home in adapted state remains an important topic of discussion. According to the NWR requirements for Adaptable Building, an adaptable home in adapted state must comply with the guidelines formulated in "Call for Admittance". Compared with the guidelines of the Public Housing Department in The Hague, the required floor area for the reference models studied is, on the average, 26% greater. Obviously, this has important consequences for the expense. Problems may be avoided if more consideration is given, in the designing stage, to expansion possibilities. This is scarcely feasible, however, with gallery flats, unless the expansion can be achieved in a sideward direction. In the Netherlands, there are various examples of gallery flats, in which a portion of the wall dividing the flats has been executed in brickwork, to make possible the joining of the two flats in the future. But, "simple and relatively inexpensive", it is not. One question which still stands out, in this regard, is that of whether or not persons who are confined to a wheelchair at an early age are truly benefited by a "normal" home, even if it is adaptable in certain areas. For this category, a "special" home with somewhat roomier dimensions, and with all the residential facilities on the ground floor, would probably be more practical in the long run. In this context, it is interesting to establish that the total net floor space of entrance hall, living rooms, bedrooms, kitchen and bathroom according to German guidelines (Höffs & Hoeschke, 1981) is about the same as the floor space required according to the standards of "No Admittance", whereas the total net floor space according to the guideline for special wheelchair housing of Worisek (1973) and Goldsmith (1975) are even 5% more. With regard to wheelchair users, one might consider adopting a two-track policy: on the one hand, by continuing to build homes specially adapted to meet the needs of this category, and on the other hand, by building adaptable homes for this category, even though some concessions may have to me made to user-comfort.

The "suitability for visiting" of walk-up flats is also problematic. International developments in the area of small and inexpensive lifts in (existing) living complexes certainly give cause for hope, but it is highly doubtful that such a solution would be applied if the occupants themselves do not consider it a problem, and if it is "merely" the odd visitor who cannot climb the stairs. One final point which should be mentioned here is the ratio of new construction to renovation. Compared to the total housing stock, the sector of new construction is fairly limited. This is another reason why possibilities must be sought to apply the principle of adaptable building to the renovation of the existing housing stock. The reference models developed during the Delft study are a useful aid to making a first, global analysis: which homes, out of the existing stock, are suitable, as far as available floor area and the proportion of width to depth, for adaptation to the needs of a physically handicapped occupant? Unfortunately, the first cautious attempts in this direction have not been very optimistic, especially when the NWR requirements for adaptable building, in their entirety, have been taken as a basic premise. For this reason, the Delft University of Technology, together with the NWR, has begun a follow-up study in order to introduce a certain hierarchy into the requirements for adaptable building. It is, for example, quite con-

ceivable that adaptable renovation of existing homes for disabled persons in wheelchairs could involve too much expense, but that it would pose hardly any problems, either technical or financial, for ambulant disabled persons. The intention is to further develop these ideas, theoretically, before embarking on a practical experiment on Adaptable Renovation.

Despite these remarks, the studies and practical experiments described here have made it obvious that much is possible in the field of adaptable building, even within the cramped margins of the present budget. Hopefully, the formulators of design guidelines and government standards will take to heart the lessons learned from the theory and practice of adaptable building. Now, more than ever, it is essential to realize the development of a flexible housing stock to anticipate the varied need for living space, and the possibility to react, on a long-term basis, to changes in this need. Particularly as a result of current demographic and social developments (e.g. a strong increase in the number of elderly persons, and a policy which encourages more help at home, in order to limit placement in institutions), both the usability of new homes and careful management of the existing housing stock require special attention.

Annex: List of Definitions

A home is *approachable* if any disabled person can reach the front door from the public highway without assistance.

A home is *accessible* if any disabled person can enter through the front door without assistance, and be able, at least, to reach the living room.

A home is *suitable for visiting* by a disabled person if he or she can enter through the front door without difficulty and be able, at least, to reach the living room and kitchen and, possibly with assistance, be able to use the toilet.

A home is *usable* by a disabled person if he or she can live in it without difficulty; that is, if all customary activities can be performed there, independently and without restrictions.

Building adaptable housing is the creation or renovation of accommodation which is not specifically adapted or intended for disabled occupants, but which is designed in such a way that it can be adapted easily and relatively cheaply, should the occupant become disabled, and which, from the time it is built or renovated, is approachable, accessible, and suitable for visiting by a disabled person.

Adapted housing is housing which, when it is built, or at a later stage, is adapted to the individual requirements of a disabled occupant.

Adapted housing in stockpile is housing which is already adapted, when built, to meet the assumed needs of a specific category of disabled persons, without the future occupant being known.

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