Universal Design 2016: Learning from the Past, Designing for the Future
H. Petrie et al. (Eds.)

doi:10.3233/978-1-61499-684-2-101

Accessibility in Public Buildings: Efficiency of Checklist Protocols

Jonas E. ANDERSSON[1] and Terry SKEHAN
Swedish Agency for Participation (Myndigheten för delaktighet)

Abstract. In Sweden, governmental agencies and bodies are required to implement a higher level of accessibility in their buildings than that stipulated by the National Building and Planning Act (PBL). The Swedish Agency for Participation (MFD, Myndigheten för delaktighet) develops holistic guidelines in order to conceptualize this higher level of accessibility. In conjunction to these guidelines, various checklist protocols have been produced. The present study focuses on the efficiency of such checklist protocols. The study revolved around the use of a checklist protocol in assessments of two buildings in Stockholm: the new head office for the National Authority for Social Insurances (ASI) and the School of Architecture at the Royal Institute of Technology (KTH). The study included three groups: Group 1 and Group 2 consisted of 50 real estate managers employed by the ASI, while Group 3 consisted of three participants in a course at the KTH. The results were similar in all of the groups. The use of the checklist protocol generated queries, which related mainly to two factors: (1) the accompanying factsheet consisted of textual explanations with no drawings, photographs or illustrations and (2) the order of the questions in the checklist protocol was difficult to correlate with the two buildings' spatial logic of accessing, egressing and making use of the built space.

Keywords. Accessibility levels, checklist protocol, ex-post evaluations, evaluation efficiency, public buildings

1. Introduction

For professionals in architecture and construction exemplary models and evaluation tools play an important role in assessing the perceived overall quality of a particular building. It is often called architectural quality and it refers to the level of successful implementation of guiding principles for the architectural design [1]. As such, the executed building can be seen as a reflection of the decision-makers' clear-sightedness during the life of a building, i.e. design, programming, realization and maintenance phases [2]. The guiding principles may involve aesthetical, financial and sustainable aspects. Architectural quality also refers to the envisioned fit between the architectural design of the building and the anonymous and large group of different users, who will use the building on a regular basis. Aesthetical, constructional and performative aspects also link the perceived level of architectural quality to the bi-millennial Vitruvian Virtues of firmitas (sustainability), utilitas (usefulness) and venustas (beauty) [3].

[1] Corresponding Author, Myndigheten för delaktighet MFD, Sturegatan 3, Box 1210, SE 17224, Sundbyberg; E-mail: info@mfd.se.

In line with Swedish disability policy, the on-going process of equalization of opportunities for all citizens regardless of personal abilities and characteristics propels usability to the center of attention. In regard to accessibility, usability appears to be the most essential concept for buildings in the modern welfare state. At the core of the concept lies the meticulous work of adjusting every detail of the built space to a large and varied group of potential users, with a focus on details of importance in relation to cognitive, physical and sensory abilities. Within the concept of accessibility, the designers' work often focuses on having access to the building and being able to reach features or functions provided inside or in close proximity to the built space [4]. In this study, access refers to studying the individual's possibility to enter or egress the building, or to gain access to different floor levels that are part of the exterior or interior space. In contrast, reach refers to independently making use of built space and spatial configurations that respond to various activities carried out in daily life [4].

1.1. Aims and Purposes

Buildings are the result of design processes that evolve through a series of decisions concerning the conceived space. However, conceived space is not synonymous with perceived and lived space [5]. This means that accessibility can be seen in two modes, either ex-ante assessments or ex-post evaluations. In the ex-ante mode, accessibility is conditioned by the accumulated competence of the group of architects and other designers. In contrast, in the ex-post mode, the level of accessibility depends either directly on the individual experience or by proxy through experts, who evaluate the built environment in relation to accessibility requirements for the built environment.

The present study examines the use of a checklist protocol for use in an existing building in an ex-post situation. The study centers on the efficiency of the checklist protocol as an easy-to-use indicator of the level of accessibility in existing buildings. Of special concern is whether such checklist protocols generate reliable results that can be used for programming an update of existing public buildings to modern requirements.

1.2. Theory

In economic theory, the Nash equilibrium is an accepted concept for describing the perceived balance between an agent's set of actions with the same agent's prediction of possible actions and events that other stakeholders may enforce [6]. In design theory, a similar equilibrium is believed to exist when aesthetical, financial and technical intentions and requirements for the architectural design are balanced in the realized building [7]. A successful building process often results in a mutual feeling among participating agents, i.e. building developers, architects and other building experts, of a fruitful and positive collaboration during the realization process of the building [1]. However, checklist protocols for assessments of built space have come in demand as an instrument for controlling the correlation between envisioned requirements and the finalized realization, also called Building Performance Evaluations (BPE) [8]. The balance between input in building processes and actual output as built space has been seen to suffer from the effect of economic reasoning [8]. For instance, in the realization process of residential care homes, economic factors gradually overtook the decision-makers' interest during the design phase – the progressive work from idea to actual building – and gained focus over artistic and altruistic intentions [9].

The awareness of the particular needs of people with disabilities, which dates back to the mid-1950s, has resulted in building regulations concerning access and reach in the built space, introduced in 1967 in the Swedish planning and building act (PBL, in Swedish Plan- och Bygglagen). In 1975, access and reach merged into the new concept of accessibility. Following Sweden's ratification of the UN Convention on the Rights of People with Disabilities in 2008, accessibility was paired with the user-oriented concept of usability [10]. In consequence, the Swedish disability policy for the new millennium has introduced a continuum of appropriate and more appropriate accessibility that are active in two frameworks:

- the PBL that defines the lowest acceptable level of accessibility, and;
- the MFD guidelines that define an improved level of accessibility (for buildings that are used by Swedish governmental agencies and bodies) [11].

Both frameworks are harmonized with the International Standard, ISO 21254:2011. The goals of the Swedish disability policy are correlated with the higher level, and in line with the United Nations Convention on the Rights of People with Disabilities. This duality of accessibility intends to realize a higher level of accessibility and inspire building developers on the private market to implement the higher level of accessibility. Built environments for use by the public fall under a third set of rules that have been formulated by the NBHPB, the so-called regulations for easily removable obstacles for indoor and outdoor environments that lead to an intermediary level of accessibility, somewhere between the two levels formulated in PBL and RTRH.

The higher level of accessibility for governmental agencies and bodies is presented in the so-called "Guidelines for Accessibility - Tear down Barriers" [12]. These guidelines are issued by the Swedish Agency for Participation (MFD, Myndigheten för delaktighet). They are supposed to be implemented fully in new constructions, and to the highest reasonable extent in existing buildings. Since the 1990s, Swedish civil administration have implemented principles for new public management [13]. In consequence, public buildings are downsizing their localities, most often having no individual office space, and complying with the shared open office space [14]. This new office planning often relies on a "clean-table at the end of the day-principle" for national, regional and municipal agencies. In addition, local branch offices of public agencies such as the ASI and the National Tax Agency (in Swedish Skatteverket) tend to use shared building solutions. Conference, reception and visiting space that are open to the public fall under the requirements for a higher level of accessibility.

The ultimate aim of any checklist is to ensure an overall quality of a building in use, a post-occupancy evaluation [15]. However, other fields of interest also uses checklists, e.g. the American Institute for Aging (AIA) initiated the development of assessment protocols for appropriate care and the design of special units for people with dementia [16]. Most assessments rely on a visual evaluation, complemented by other sensory information, which might affect the spatial experience [17]. In Sweden, two methods are mainly used for evaluating the lowest acceptable level of accessibility; the so-called TIBB, an instrument that mainly focuses on technical aspects, and the so-called Housing Enabler, HE, an instrument that correlates the user experience with the International Classification of Functioning, Disability and Health, ICF [18]. Both instruments are qualitative and require a one- or two-day-training to learn how to use.

The HE instrument has been validated in several European countries, while the accuracy of the TIBB has been tested in several counties and municipalities.

The MFD has complemented the RTRH with simple checklists that generate a swift overview of inconsistencies between building design and requirements for a higher level of accessibility of public buildings, possible to use when planning new buildings or preparing a refurbishment. Similar checklist protocols are used in other Nordic countries. The intentions of the Danish building code is systematically converted into checklists by the Danish Building Research Institute (www.sbi.dk/tilgaengelighed/tjek-lister). In comparison with the Danish approach, Swedish checklists are a combination of minimum requirements and higher requirements, but often in contradiction so that an improved level has to be chosen, in combination with descriptive language. The holistic intention of Swedish checklists aims at influencing the full design phase and to promote the reflection on the meaning of the requirements in order to avoid a simple checking off of requirements to fulfill.

2. Methodology

The study uses case study methodology [19] and was conducted as a triple case study. The research material consisted of e-mail communication before and after the realization of three workshops on accessibility. These also included assessment exercises in two existing buildings using the checklist protocol. Notes and observations made by the two leaders of the workshops serve as secondary sources.

Two cases, Test group 1 (TG-1) and Test group 2 (TG-2) were identically structured, and were part of one-day educational training courses that were organized by the Authority for Social Insurances (ASI, Försäkringskassan). The training included a four-hour workshop that was led by two MFD officials.

The third case, test group 3 (TG-3) was part of a continuing education course on evaluation methods in architecture that was given at the Royal Institute of Technology (KTH). The course included a two-hour workshop that was led by the MFD.

2.1. Respondents

The study is based on results from three test groups. TG-1 and TG-2 were part of the educational program that the ASI offers real estate managers employed at local branch-offices throughout Sweden every second year. In 2015, the training was provided on two separate occasions, in June and in September. The first occasion attracted 20 participants, TG-1, while the second attracted 30 participants, TG-2. About 80 % of the members of TG-1 and TG-2 were males with previous experience from the building sector. TG-2 had the highest concentration of this experience. About 20 % of the members of TG-1 and TG-2 were women, however, with less experience from the building sector. The estimated age of participants in TG-1 and TG-2 was 45-55 years.

TG-3 was a continuing education course that was open, after a qualification procedure, to those with a university or college education. This group was considerably smaller; consisting of two men and one woman. The men were trained as architects, while the woman had a law degree. The estimated age of participants was 50-55 years.

2.2. Checklist Protocol

The three cases used an expanded checklist protocol with a factsheet for guidance. The checklist was especially designed for the needs of the ASI and aligned with the Swedish legal framework. The checklist was loosely based on the checklists that the MFD developed based on the RTRH. The protocol consists of 32 questions that are organized under seven themes as in the RTRH. Each item/question in the protocol has 3-4 options for response, affirmative or negative as well as the option to expand on the affirmative or negative response and to provide information concerning the chosen alternative.

Table 1. Overview of items in checklist protocol with a total of 32 questions.

Item	Question themes
1	General information about the assessment object, 2 questions (name of assessor, name of place, address, date of visit)
2	Physical accessibility requirements, 9 questions, (exterior and interior features: parking space, level, door opener, door width, hygiene)
3	Visual accessibility requirements, 6 questions, (interior features: contrasts, tactile guiding marking).
4	Acoustic accessibility requirements, 4 questions, (interior features: induction loop)
5	Climatic accessibility requirement, 4 questions, (interior features concerning use of perfume and cleaning products).
6	Emergency and evacuation precautions, 5 questions (interior features and fire emergency plans).
7	Optional information for further developing the protocol, 3 questions.

2.3. Information and Realization of Assessments

In all of the three cases, the assessments were preceded by a one to two-hour lecture on different understandings of the concept of accessibility. Firstly, this referred to accessibility as an open-minded attitude towards people with disabilities, and as a key criterion for creating democratic organizations. Secondly, it referred to accessibility in the built environment. This lecture included information on physical aspects of the built environment that in Sweden are considered to be easily removable obstacles, i.e. minor differences in floor levels, high thresholds, lack of door opening devices, heavy doors, lack of tactile and visual markings on ramps and stairways, inadequate illumination and signage. This information was summarized in a factsheet that also could be used as a manual to facilitate responding to the questions of the checklist protocol. Then followed a one-hour assessment exercise of the perceived level of accessibility in areas open to the public in two buildings. In TG-1 and TG-2, the introduction of accessibility as an attitude and a key criterion for work organizations was presented by one MFD official, while the physical accessibility was presented by another official. In TG-3, this second official presented both understandings of the concept of accessibility.

2.4. Settings

In TG-1 and TG-2, the checklist protocol was used to assess three public areas (entrance/lobby area including exterior access conditions, the conference space, and the stairways with elevator) of the head office of the ASI, situated in a suburb of Stockholm. The building is a refurbished building complex that formerly housed the head office of the company LM Ericsson. The former industrial halls have been converted into open shared office spaces. The office was inaugurated in 2014.

In TG-3, the checklist protocol was used to assess three public areas (ground floor comprised of entrance/lobby area including exterior access conditions, stairway, and basement floor with hygiene space) in the new building of the School of Architecture at the KTH, in the following SA-KTH. The building is the product of the winning entry in an architectural competition held in 2007. The competition was won by KTH alumna architects Tham & Videgård architects in Stockholm. Inaugurated in the fall of 2015, the slick new architecture has gained international interest and won a national architectural award. Inside, there is a swirling open space that is shaped by minor restricted spaces for lecture halls, seminar rooms and ateliers which have blob-like shapes.

3. Results

This section is divided into four sections. Three sections are accounts from the three workshops, i.e. TG-1, TG-2 and TG-3. The fourth section presents preliminary conclusions on the use of the checklist protocol in terms of strengths and shortcomings, and puts forth suggestions for improvement.

3.1. Workshop on Accessibility with Assessment, TG-1

The first workshop in accessibility, i.e. TG-1, was held at the ASI on 17 June 2015. The checklist protocol was introduced with a 30-minute presentation of the protocol and the factsheet. The group was divided into three groups that assessed the three locations of the head office. Two of the three groups were accompanied by MFD officials. The assessments took about one hour for each of the groups. A discussion on the use of the checklist protocol followed the assessment exercise.

3.1.1. Use of Checklist Protocol

The groups encountered initial problems in aligning the protocol with some conditions that were present at the head office. A parking space for persons with disability is recommended to be within a distance of 25 meters from the main entrance. Such a parking space did not exist, and instead a public parking space located some 30 meters from the entrance was assumed to fill the need. Contrast and tactile marking of stairways and ramps caused problems since the existing stairways had not been refurbished fully to modern requirements. In addition, the ramp appeared to be steeper than recommended and ended at a door that swung open onto the ramp. The opening device was located next to the door, forcing a user to position himself on the inclined surface and to make a U-turn to avoid the opening door blade. The accessibility of

hygiene spaces and passages required a folding rule which was not indicated in the protocol. Signage for guidance and for emergency plan were difficult to find.

Ultimately, these problems were possible to link to the BPL and the RTRH, but the factsheet was too summarized and difficult to apply. In addition, TG-1 found acoustic, climatic and emergency conditions difficult to assess during a visit to the localities. The TG-1 suggested that this information could be gained from a short interview with a real estate manager or similar professional. In addition, TG-1 found linguistic flaws and some of the alternative options between an affirmative or negative answer difficult to understand.

3.2. Workshop on Accessibility with Assessment, TG-2

The training course for TG-2 was held on 2 September 2015. The checklist protocol had been revised for this second workshop, so that flaws and inconsistencies pointed out by the TG-1 were corrected and clarified. The checklist was introduced with a 30-minute lecture that was followed by a one-hour assessment exercise. Once again, the same three locations at the head office were assessed. Contrary to the first workshop, the two MFD officials did not accompany any of the three groups.

3.2.1. Use of Checklist Protocol

After the assessment exercise, a discussion on the checklist protocol was initiated. In TG-2, there were lesser problems concerning aligning the questions of the checklist protocol with the requirements of the PBL and the RTRH. The main reason was that the majority of the participants already were familiar with the PBL due to previous long experience as both real estate managers and working on construction sites. Consistent with this experience, at least one person per group had a folding rule or a tap line to verify accessibility issues in the protocol. Similar to the TG-1, the participants found that acoustic, climatic and emergency conditions could only partly be evaluated on site, e.g. the system with combined sonic and visual alarms.

The TG-2 raised an interesting question concerning the assessment of accessibility in ASI buildings: the ASI often leases office space, which means that the property owner had to be consulted about the questions in view of changes. Given the participants' knowledge of legal requirements and conflicts with property owners, they vented their experiences from various local ASI offices. Beside technical implications of the questions of the protocol, the participants forwarded other linguistic issues, in particular, concerning alternative answers that clarify affirmative and negative responses. The TG-2 found these alternative of little use. The TG-2 raised questions on how the results gained from assessments carried with the checklist protocol could be used in relation to other activities such as maintenance. Responses to the checklist protocol gave few indications on how to improve the localities, and the TG-2 wanted a rating scale with numeric values.

3.3. Workshop on Accessibility with Assessment, TG-3

The test with TG-3 was realized in March 2016, with one of the MFD officials, who also accompanied the participants in their assessments. The group paid close attention to the introduction, especially, accessibility for different types of built environment according to the PBL and the RTRH. However, when using the checklist protocol,

large problems started to unfold. The problems could be associated with the building being an "infill" project in between existing buildings, which created several ways of entering and egressing the building.

3.3.1. Use of Checklist Protocol

The problem of identifying the main entrance of the building impacted on how to determine the distance to the closest parking space for persons with disabilities from the main entrance, either 75 or 100 meters from what was perceived by a first-time visitor to be the main entrance, however, only some 10 meters, if the SA-KTH was entered through an adjacent building that gave indirect access to the new building. Additional problems arose when the climate sluice of the perceived main entrance lead to two similar entrances where directional cues from the architectural design did not indicate which one of the two entrances to use.

Once inside the new building, the swirling open space created wayfinding problems. A bannister integrated in a sloping floor gave a directional cue to move straight ahead into an interior with walls in pinewood. However, the uniform design of this space caused confusion and turned into a cul-de-sac. The correct way of using the building was the vertical stairways with elevators that gave access to different floor levels. There were only small signage icons at the height of doorways for locating lecture halls, stairways and hygiene spaces. Despite logical problems in the organization of space, individual space proved to be exemplary according to the protocol. TG-3 found acoustic, climatic and emergency conditions difficult to evaluate on site. The TG-3 raised questions on the practical use of the protocol, since the SA-KTH building was a challenge to access and use. The TG-3 identified a need for orientation plans and instructions.

3.4. Preliminary Conclusions

The three cases give some grounds for formulating some preliminary conclusion on the efficiency of checklist protocols.

1. The results gained from using the checklist protocol are related to the assessor's professional background: greater knowledge of building regulations generates more accurate answers;

2. A complex configuration of the architectural space reduces an efficient use of the checklist protocol, since the order of questioning depends on the building's spatial logics;

3. Specific requirements that concern acoustic, climatic and emergency conditions are difficult to assess on site, and require secondary sources such as drawings and technical documentation of the building;

4. Considering all of these aspect as an entity, checklist protocols could benefit from inclusion of a rating system in order to evaluate the assessed level of accessibility in terms of poor, adequate and higher accessibility.

4. Discussion

This study focused on the efficiency of a checklist protocol for a higher level of accessibility in public buildings. The study generated mixed results that indicated that the efficiency in answering a protocol could be attributed to either the assessor, the building or the checklist protocol per se. This outcome demonstrates the complexity in evaluating accessibility requirements in existing building and its close connection to assessing user values at large [8]. In that sense, the only true assessment of accessible conditions in a building must be made by persons who experience various types of disabilities. Consequently, assessments by proxy have to compensate for the potential bias of the assessor through explicit training or an explicative manual. The results from the three test groups suggest that this is still an issue to address, however, the checklist protocol used in the study proved useful when initiating a deeper discussion on user-oriented design solutions. In that sense, the checklist protocol gave educational gains for persons involved in the real estate management of buildings that the ASI leases.

The results of this study suggest that the checklist protocol, which was used in this study, was in need of a revision. Primarily, these revisions can be associated with linguistic problems, since the wording was not sufficiently precise. In addition, the factsheet could be clarified by the inclusion of drawings, illustrations or photographs in order to illustrate the implication of lowest acceptable level of accessibility and the higher level. However, in both cases these changes raise another issue that also could be related to accessibility: such improvements will only suffice for assessors without visual impairments. This circumstance is important to contemplate, since most existing protocols rely heavily on what can be assessed through an inquisitive eye.

The spatial experience is influenced by the human sense that is the most dominant sense that is used in the spatial experience [17]. In that aspect, the study highlights the problem of converting three-dimensional information into a two-dimensional shape. In TG-3, the unique spatial configuration might have been the reason why the participants had problems in aligning the protocol to the building. Given this circumstance, an improvement of the protocol would include some initial questions on how to access and egress the building. This also suggests that the subsequent assessment has to be based on an acquired knowledge on the building's architectural principle of use.

The cases also suggest that ex-post evaluations to some extent anticipate an ex-ante assessment of foreseeable adjustments that could be implemented in order to minimize shortcomings in the level of physical accessibility. Here, the respondents pointed out a need for a rating system with numeric values, which were correlated with alternative ways of answering the different items. In turn, this rating system could then be associated with appropriate and more appropriate levels of accessibility. In this aspect, assessing accessibility in the built environment shows similarities with assessment tools of complex systems like eldercare and living conditions in residential care homes [16]. This also suggests the need of validating the use of a checklist protocol with several groups of users and different buildings.

Whether the ASI should merely revise the existing checklist protocol for assessment of accessibility in their localities remains an open question. It is clear that assessing accessibility proved to be a more complex matter than was apprehended at first. In conclusion, a closer attention to the fit between user needs and buildings must be considered as a fundamental prerequisite for the successful realization of accessible buildings and sustainable city planning in a future-oriented welfare society.

References

[1] K. Arge and S. Bleiklie, Arkitektonisk kvalitet - En studie om samspillet mellom byggherre og arkitekt [Architectural Quality; a Study on the Relationship between Developers and Architects], Norsk Form, Oslo, 2003.
[2] J. Lundequist, Design och produktutveckling - Metoder och begrepp [Design and product development - Methods and notions], Studentlitteratur, Lund, 1995.
[3] Vitruvius, Ten Books on Architecture, Cambridge University Press, Cambridge, 1999.
[4] A. Buttimer, Home, Reach, and the Sense of Place, The Human Experience of Space and Place, A. Buttimer and D. Seamon, Eds., 166-186, Croom Helm Ltd, London, 1980.
[5] H. Lefebvre, La production de l'espace [The Production of Space], 4th Edition, Anthropos, Paris, 1985.
[6] E. Maskin and T. Sjöström, Implementation Theory, Handbook of Social Choice and Welfare, K. J. Arrow, A. K. Sen, and K. Suzumura, Eds., Amsterdam, Boston, London, Paris, New York: Elsevier & North Holland, 2002.
[7] N. Cross, Design Thinking, Understanding How Designers Think and Work, Berg Publishers, New York, 2011.
[8] W. F. E. Preiser and J. C. Vischer, Assessing Building Performance, Elsevier Butterworth Heinemann, Amsterdam, Boston, London, Paris, New York, 2005.
[9] M. A. Knudstrup, H. H. Hovgesen, and K. Moeller, Beslutningsprocesanalysen - proces, arkitektur, trivsel [The Decision Process: Procedure, Architecture and Human Well-being in the Built Space], Servicestyrelsen, Odense, 2007.
[10] SÖ2008:26, Nr 26. Konventionen om rättigheter för personer med funktionsnedsättning och fakultativt protokoll till konventionen om rättigheter för personer med funktionsnedsättning, [UN Convention on the Rights of People with Disabilities]. New York den 13 december 2006, Sveriges Utrikesdepartement, Stockholm, 2008.
[11] SFS2001:526, Förordning om de statliga myndigheternas ansvar för genomförande av funktionshinderspolitiken [Ordonnance 2001:526 on the Authorities' Responsibility for Realizing the National Disability Policy]. Statens Författningssamling, Stockholm, 2001.
[12] Riktlinjer för tillgänglighet - Riv hindren [Guidelines for Accessibility: Tear down the Obstacles]. Myndigheten för Delaktighet, Stockholm, 2015.
[13] R. Premfors, P. Ehn, E. Haldén, and G. Sundström, Den svenska förvaltningsmodellen [The Model for Swedish Civil Administration]. Demokrati & Byråkrati, R. Premfors, P. Ehn, E. Haldén, and G. Sundström, Eds., Studentlitteratur, Lund, 2009.
[14] C. Bodin Danielsson, The Office, an Explorative Study, Architectural Design's Impact on Health, Job Satisfaction and Well-being, School of Architecture, Royal Institute of Technology, KTH, Stockholm, 2010.
[15] W. F. E. Preiser, Post-Occupancy Evaluation. van Nostrand Reinhold, New York,1988.
[16] P. D. Sloane, C. M. Mitchell, G. Weisman, S. Zimmerman, K. M. Long Foley, M. Lynn, et al., The Therapeutic Environment Screening Survey for Nursing Homes (TESS-NH), an Observational Instrument for Assessing the Physical Environment of Institutional Settings for Persons with Dementia. The Journals of Gerontology 57 (2002) 69-78.
[17] A. Berthoz, Le sens du mouvement [The Sense of Moving], Odile Jacob, Paris, 1997.
[18] S. Iwarsson and B. Slaug, The Housing Enabler. An Instrument for Assessing and Analysing Accessibility Problems in Housing, Nävlinge and Staffanstorp, 2001.
[19] R. K. Yin, Case Study Research, Design and Methods, Third Edition Sage Publications, Inc.Thousand Oaks, 2003.