ASSESSING THE INCLUSIVENESS OF BUILT FACILITIES: A CASE STUDY OF HIGHER EDUCATION FACILITIES

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Abstract

Purpose – The purpose of this paper is to develop a quantitative appraisal model for assessing the inclusiveness of built facilities in higher education institutions. The Building Inclusiveness Assessment Score, or the BIAS, developed is used to assess the inclusiveness of the built facilities in the Hong Kong University.

Design/methodology/approach – In this study, a comprehensive review of relevant guides and manuals in Canada, Hong Kong, Singapore, the US and the UK is conducted. Two Multiple-criteria Decision Analysis (MCDA) techniques, the Analytic Hierarchy Process (AHP) and the Non-structural Fuzzy Decision Support System (NSFDSS), are studied and compared and the latter is applied to analyse the weightings of inclusion attributes. On-site appraisals of 28 buildings in the Main Campus of the Hong Kong University are carried out and shortcomings resulting in exclusion are identified.

Findings – Using the BIAS, the common areas of the built facilities in the Hong Kong University are appraised. As suggested by the preliminary result, the built facilities are not fully inclusive and there are ample rooms to improve their inclusiveness. Areas that require immediate attention are those related to the access and the safety of persons with disabilities (PWDs).

Originality/value – Access audit and access appraisal are the methods adopted to appraise the inclusiveness of built facilities nowadays. This research seeks to obviate their shortcomings by minimising the subjective judgements of the assessors in the BIAS proposed. Compare with earlier studies in the subject, more quantitative elements are incorporated into the BIAS and its assessment procedures are detailed.

Keywords Barrier-free Access, Building Performance Assessment, Disability Inclusion, Facilities Management, Universal Design

Paper type Research paper

Introduction

Inclusion is one of the essential values that represent a civil society. It is not only a big but also a vague term. A society is an inclusive one if it is unaffected by differences in race, gender, class, generation and geography when equal opportunities are insured, and civil authority is superior to military and economic power (Atkinson, 2010). Though inclusion in architecture may be simply regarded as 'building for all', it is commonly related to disability inclusion.

As time goes by, disability theory and models are developed and evolve. Religious and then medical model of disability were developed, and disability is seen as the outcome of interaction between persons with disabilities (PWDs) and a non-inclusive society in the social model (Goldsmith, 1997; Holmes-Siedle, 1996; United Nations, 2006). In respect of the advancement of the rights of PWDs in society and development, the United Nations have taken giant leaps; for example, the Standard Rules on Equalisation of Opportunities for Persons with Disabilities was introduced in 1994 and the Convention on the Rights of Persons with Disabilities was adopted in 2006. As stated in the latter convention, countries and regions who have signed the convention are obligated to identify and eliminate obstacles and barriers to accessibility in buildings and other physical environment. No matter whether a country or a region has signed this convention or not, access for PWDs to buildings has increasingly become a legal right.

To build a disability inclusive society, an answer is to design built facilities based on universal design principles. Such an idea in gist is to design products, environments, programmes and services to be usable by all people to the greatest extent possible, such that neither adaption nor specialised design is necessary, and assistive devices for particular groups of PWDs should be included where necessary (Mace, Hardie and Plaice, 1991; United Nations, 2006). What is more, the idea is characterised by 7 principles namely 1. equitable design 2. flexibility in use 3. simple and intuitive 4. perceptible information 5. tolerance for error 6. low physical effort and 7. size and space for approach and use (The Center for Universal Design, 2006). As far as sustainability is concerned, disability inclusion is actually a relevant issue. On top of environmental sustainability, sustainability buildings should be socially and economically sustainable as well, for sustainability has not only environmental but also social and economic dimensions. As socially sustainable buildings, equity and accessibility should be presented for everyone should have equal rights and freedoms. With regard to economic sustainability, non-inclusive buildings are economically unsustainable for they fail to capture the enormous opportunity brought by PWDs, which are estimated to be 10-12% of the world population (The World Bank, 2009).

Though there are more works in disability inclusion and it is more pushed in buildings in recent years, our built environment is still far from inclusive. Among the barriers to a fully inclusive built environment, one is the assessment of accessibility of built facilities. The assessment at the moment is conducted by way of access audit and access appraisal (Sawyer and Bright, 2004). The methods are, however, not flawless. On the one hand, they involve complicated assessment processes against a long checklist. On the other hand, there are many subjective elements that rely on the experience of assessors to make judgment (Wu, Lee, Tah and Aouad, 2007). A research gap for a quantitative and more objective mechanism to appraise the inclusiveness of built facilities is therefore identified.

The primary purpose of this research is to develop an appraisal model that makes quantitative assessment of the inclusiveness of built facilities possible. Comprehensive review of barrier-free design guidelines and manuals is conducted to construct the assessment hierarchy. The constructed appraisal model, the Building Inclusiveness Assessment Score (BIAS), is applied to investigate the case of a higher education institution, the Hong Kong University. On-site appraisals of inclusive features of 28 buildings which are built between the 1910s and the 2000s are undertaken, and shortcomings resulting in exclusion are identified. Because the second stage of this research is still ongoing, only preliminary findings from the first stage are reported.

Research Methodology

Serving the purpose to develop a quantitative appraisal model for assessing the inclusiveness of built facilities in higher education institutions, this research begins with a review of literature, guides and standards that are relevant to disability inclusion of built facilities. It is crucial to the development of the inclusion assessment framework later. Given the development of the assessment framework is one of the cruxes in this research, another crux is to determine the weighting of individual inclusion attributes in the framework according to their importance towards disability inclusion. Following this the developed assessment framework is used to study the case of the Hong Kong University. In the following, the assessment framework, the weighting methods, the case of the Hong Kong University and data collection will be discussed separately.

The Assessment Framework

Disability inclusion of built facilities is actually begun with designing for persons with disabilities which was advocated after the World War II. In 1959, the US' first national standard for accessibility, the American Standard A117.1 American Standard Specifications for Making Buildings and Facilities Accessible to, and Usable by, the Handicapped, was published. This standard was later set as the model for corresponding standards and legislations against exclusion of PWDs in buildings in the UK (Goldsmith, 1997). As a response to the standards and the legislations, there have been keen interests to assess whether the accessibility of buildings has compiled with the legal requirements or not. In some cases, there are also interests to appraise the inclusiveness of built facilities. At present, the appraisal is done qualitatively and subjectively by access audit or access appraisal. For example, in local context, access audit was used to study the access provisions in public housing estates (Chan, Lee and Chan, 2009). The problems of access audit and access appraisal have, however, been well-documented in literature and elsewhere in this paper. To obviate the subjective elements in these methods, Wu *et* al. (2007) sought to develop a quantitative building accessibility model using the Analytic Hierarchy Process (AHP), notwithstanding the rating scales for individual accessibility criteria are not explained in their work.

As can be seen above, an appraisal model which is objective, quantitative and easy to use is required to fill the research gap. To develop the assessment framework, a comprehensive review of guidelines and standards in Canada, Hong Kong, Singapore, the US and the UK is conducted (BCA, 2007a; 2007b; Buildings Department, 2008; British Standard Institute, 2009; International Code Council, 2009; NRC-IRC, 2010; Peloquin, 1994; Sawyer and Bright, 2007). When the assessment framework is developed, due reference is made to

Design Manual: Barrier Free Access 2008 in Hong Kong and BS8300: Design of Buildings and Their Approaches to Meet the Needs of Disable People in the UK. Since the problem is disability inclusion of built facilities in higher education institutions, it is broken down into elements of different levels from general to specific and attributes or factors identified from guidelines and manuals are grouped under corresponding criteria. In Figure 1, the hierarchy developed for the time being is shown. A dilemma is, however, posed when this hierarchy is developed. In Tam and Tummala (2001), they are of a view that many criteria at multiple levels will make subsequent pair-wise comparison difficult. On the contrary, items on the lengthy checklist used in accessibility assessments should be incorporated into the hierarchy so that they are compared and their relative importance is established. This attempt will make the appraisal model developed more objective and it fills the research gap remained from Wu *et* al. (2007). Moreover, disability inclusion is a big word. It concerns with physical, visual, and speech disabilities, and hearing impairments. For the aforestated reasons, the authors would recommend an amendment to the current hierarchy. The current hierarchy should be decomposed into separate hierarchies that represent different disabilities before they are integrated again to appraise the overall inclusiveness. In Figure 2, an improved hierarchy for persons with visual disabilities is shown.

A four-level hierarchy is developed for the time being. The top level, which is the goal of the hierarchy, is to give a score that shows the overall inclusiveness of built facilities in higher education institutions. The subordinate level is split into design and management. They are the hardware and the software that make built facilities inclusive. Design in general is the physical features of built facilities that are outlined in the inclusive design guidelines and manuals. Under design, inclusion attributes of the physical features are organised under their respective areas and facilities. For management, it means the actions taken to plan, monitor and maintain an inclusive environment. In Table 1, the details of items in level II to level IV of the hierarchy is shown.

The rating scale sets the rule to govern the rating of quantitative attributes in the assessment scheme. A continuous scale from 0 to 2 is used, where 0 is given to design or practice that are disability exclusive and 2 is assigned to fully inclusive design or practice. This practice is different from earlier studies (e.g. Ho *et* al., 2004; Then, 1996) where the rating begins with the legal minimum, i.e. the worst practice is the legal minimum. Here the rating assigned to design or practice that has fulfilled the legal minimum is 1. To determine whether an attribute is qualified as fully inclusive design or practice, references are made to relevant guides and standards. As the actual condition often lies between the prescribed ratings, the method of linear interpolation is used to calculate the rating. Where an attribute is qualitative, dichotomous or multinomial classification is applied to give a rating (Ho, 2000).

The Building Inclusiveness Assessment Score (BIAS)

It is more desirable and convenient to present complex information of the inclusiveness of built facilities in form of a simple score. Such a score is called the Building Inclusiveness Assessment Score (BIAS) which is an aggregated figure of the ratings (F) and weightings (w) of all attributes that affect the inclusiveness of built facilities in higher education institutions (Ho *et* al., 2004):

$$\text{BIAS} = g(w_1, w_2, \dots, w_n; F_1, F_2, \dots, F_n) \quad (1)$$

where BIAS is the Building Inclusiveness Assessment Score;
w_1 (i = 1, 2, … , n) denotes the non-negative weighting of the *i*th inclusive attribute and all w_i's sum to unity;
F_i denotes the (standardised) rating of the *i*th inclusion attribute;
n is the total number of inclusion attributes; and
$g(.)$ is a continuous or discrete function that combines all w_i's and F_i's through the weighted arithmetic mean:

$$\text{BIAS} = \sum_{i=1}^{n} w_i F_i \quad (2)$$

From (2), it can be seen that the BIAS is positively related to each F_i, provided that the weightings w_is are all positive. To put it differently, the higher the F_i, the higher the BIAS, if other F_js (where $j \neq i$) remain unchanged. As the computation method of rating for quantitative attributes, F_i, has been previously discussed, the approach to weight the inclusion attributes, w_i, will be explained next.

The Weighting Method: AHP v.s. NSFDSS

The weighting of the inclusion attribute, w_i, is measured using the Multiple-Criteria Decision Analysis (MCDA) technique. As a rule of thumb, the established relative importance of individual attribute towards disability inclusion should be objective, and the solution delivered should be consistent and least biased. Two MCDA techniques namely the Non-structural Fuzzy Decision Support System (NSFDSS) and the Analytical Hierarchy Process (AHP) are studied and compared, and the latter is chosen to prioritise the attributes. The two techniques are in general similar to each other. Both of them are comprised of decomposition, comparative judgement and synthesis of priorities (Tam *et* al., 2002). Recall that the problem here is disability inclusion in higher education built facilities, it is decomposed into elements of different levels from the general to the more specific at the lower levels and a decision criteria is constructed (Tam, Tong, Chiu and Fong, 2002). This is followed by pair-wise comparison between factors and then the consistency level and relative weighting of each criterion are calculated (Chen, 1998; Ho *et* al., 2004; Saaty, 1980; Wu *et* al., 2007). Compare with other MCDA techniques including NSFDSS, AHP is a popular MCDA tool and its operation is simple (Ho *et* al., 2004). Contrary to the benefits, NSFDSS is applied for a simplified scale of importance of NSFDSS enables automatic consistency correction. Furthermore, NSFDSS can assign more precise priority to the decision criteria than AHP for NSFDSS uses more semantic operators to measure difference in the magnitude of the first ordered decision and others (Tam, Tong and Chiu, 2006; Yau and Chan, 2008). On that account, NSFDSS is more desirable and it is chosen to analyse the weightings of inclusion attributes.

The Case of the Hong Kong University

The Hong Kong University (HKU) is the oldest tertiary institution in Hong Kong and one of the oldest universities in Asia. The coming year will be the universities' centenary since her foundation in 1912. In 2009/2010, there are 22,139 students and 6,010 academic staffs in ten faculties. Of the ten faculties, most of them are located in the Main Campos of the university.

In HKU, inclusion is seen as an important cornerstone of a good employer and a good university and so the university is committed to promote equal opportunities. An example of that initiative is the formation of the Universities' Equal Opportunity Committee (EOC) and the Disability Action Sub-committee. They are units that are dedicated to promote equal opportunities for all and foster disability inclusion in the university. An item on the agenda is to make the HKU campus a truly accessible campus. It has planned to improve the accessibility of buildings by building more lifts and wheelchair ramps, and the upgrading works are undergoing bit by bit. Further to the endeavours to ameliorate the inclusiveness of built facilities, supportive services to students with disabilities are offered by the Centre of Development and Resources for Students (CEDARS). The supportive services include but not limit to assistance related to basic necessities, commuting and study, and the CEDARS also coordinates buddies and volunteers to help the students. Irrespective of the Universities' commitment to advocate equal opportunities, the exceptionally hilly terrain of the Main Campus is seen as a great challenge to a disability inclusive campus (The University of Hong Kong, 2011).

Data Collection

The use of the BIAS to appraise the inclusiveness of built facilities is explained here, and the appraisal conducted in the Main Campus of the University of Hong Kong is used as an example. To put it simply, part of the on-site appraisal focuses on the common areas while the rest looks at particular facilities such as lecture theatres and toilets in a building. As the BIAS is developed with an aim to minimise the subjective elements, the assessors need not to be experienced or professional in disability inclusion. They are briefed about the assessment procedures of the BIAS and are trained on-site before they conduct actual appraisal. In the course of on-site appraisal, it is conducted by at least two assessors and they must follow the procedures laid down in the BIAS. The data to be collected are either in numerical form or yes/no items. At the same time, photos are taken for future reference. So the appraisal involves the use of simple equipment only, including but not limit to measuring tape, metal ruler, spring scale and digital camera. The on-site appraisal of the common areas has been completed by March 2011, while the assessment of particular facilities and the surveys to solicit the weightings of inclusion attributes are still ongoing. Preliminary findings from the first stage of assessment will be presented next.

Preliminary Findings

Of the 28 buildings surveyed in the Main Campus of the Hong Kong University, their built form and design are varied for their year of construction spanned from the 1910s to the 2000s. Using the BIAS, findings from the on-site appraisal of the common areas of those 28 buildings are presented below.

Wheelchair users or persons with ambulant disabilities are excluded from a multi-storey building where lift is not provided. In addition, some buildings are non-inclusive to wheelchair users due to the presence of a step(s) at entrances, and this observation is not uncommon.

A network of tactile guide path that connects buildings with external access routes and other buildings is established. It is, nonetheless, often terminated by the entrance and not connected to the lift zones. Another observation is that the tactile guide path is chopped and disconnected when it overlaps with channel covers and gratings. Moreover, tactile warning strips are sometimes not provided at landings of some stairs and ramps.

For ease of navigation, room numbers are assigned inconsistently in some buildings. Though the layout of these buildings is simple, it is difficult to navigate around the building and identify the way for different numbering methods are used in the same building.

Handrails are in general fixed at height within the recommended range. In some short stairs, however, no handrail is installed. On handrails the requirements for Braille and tactile and horizontal extension are seldom filled.

Accessible toilets to cater the needs of PWDs are not provided in some buildings. Where they are provided, some of them are small without sufficient space for wheelchair users to manoeuvre, and some are not equipped with emergency call bell or alarm, or both.

Accessible car parking spaces are provided in most if not all of the surveyed buildings. Nevertheless, only a few of them have complied with the requirements in dimensions and marking in law. Commonly the car parking spaces are narrower and the markings showing the international symbol of accessibility are smaller.

No provision of accessible lift for PWDs is founded in some buildings. A major problem is related to indication and notification of lifts. Only a few of lifts have audible signal to indicate their arrival, their direction of travel and closing of the doors. Besides, the visual indication to show acknowledgement message in case of emergency in some lifts are unclear. Wheelchair users may experience difficulties when they move in and out of lift cars. It is because lift cars of some lifts are small and the interior finishes of lift cars are not reflective at appropriate height.

Conclusion

Inclusion is one of the fundamental values that constitute a civil society. As far as inclusion in built environment is concerned, it is synonymous to disability inclusion and relates to sustainability. Non-inclusive buildings are unsustainable buildings for they are socially and economically unsustainable. As a barrier to achieve disability inclusion in our built environment, currently available methods to assess the accessibility of buildings are qualitative in nature and they largely rely on the assessor’s experience to make subjective judgements. Though there have been attempts to ameliorate the assessment process, there remains a research gap for a handy assessment tool that is quantitative and more objective. The BIAS proposed here are developed with inclusion attributes that are grouped under respective areas and facilities, and the attributes are weighted. It gives not only an overall inclusiveness score but the perceived weights of the inclusion criteria are also determined. Two Multiple-criteria Decision Analysis techniques, the AHP and the NSFDSS, were studied and compared, and the NSFDSS was applied to analyse the priority of the inclusion attributes in the hierarchy. This technique was chosen for it is less time consuming yet gives more precise result than the AHP.

The BIAS developed is then applied to study the inclusiveness of built facilities in the Main Campus of the Hong Kong University. As suggested by the preliminary results of on-site appraisals, the built facilities are not fully inclusive and there are ample rooms for improvement. Areas that require immediate attention are related to the access and the safety of PWDs, such as the provision of lifts and emergency call bell and alarm in accessible toilets. Last but not least, it is important to reiterate the philosophy of disability inclusion in built facilities is building for all, rather than for PWDs only. Contrary to that misbelief, an inclusive built environment benefits everyone. No matter whether a society is a young or an aged one, disability inclusion of built facilities should be advocated.

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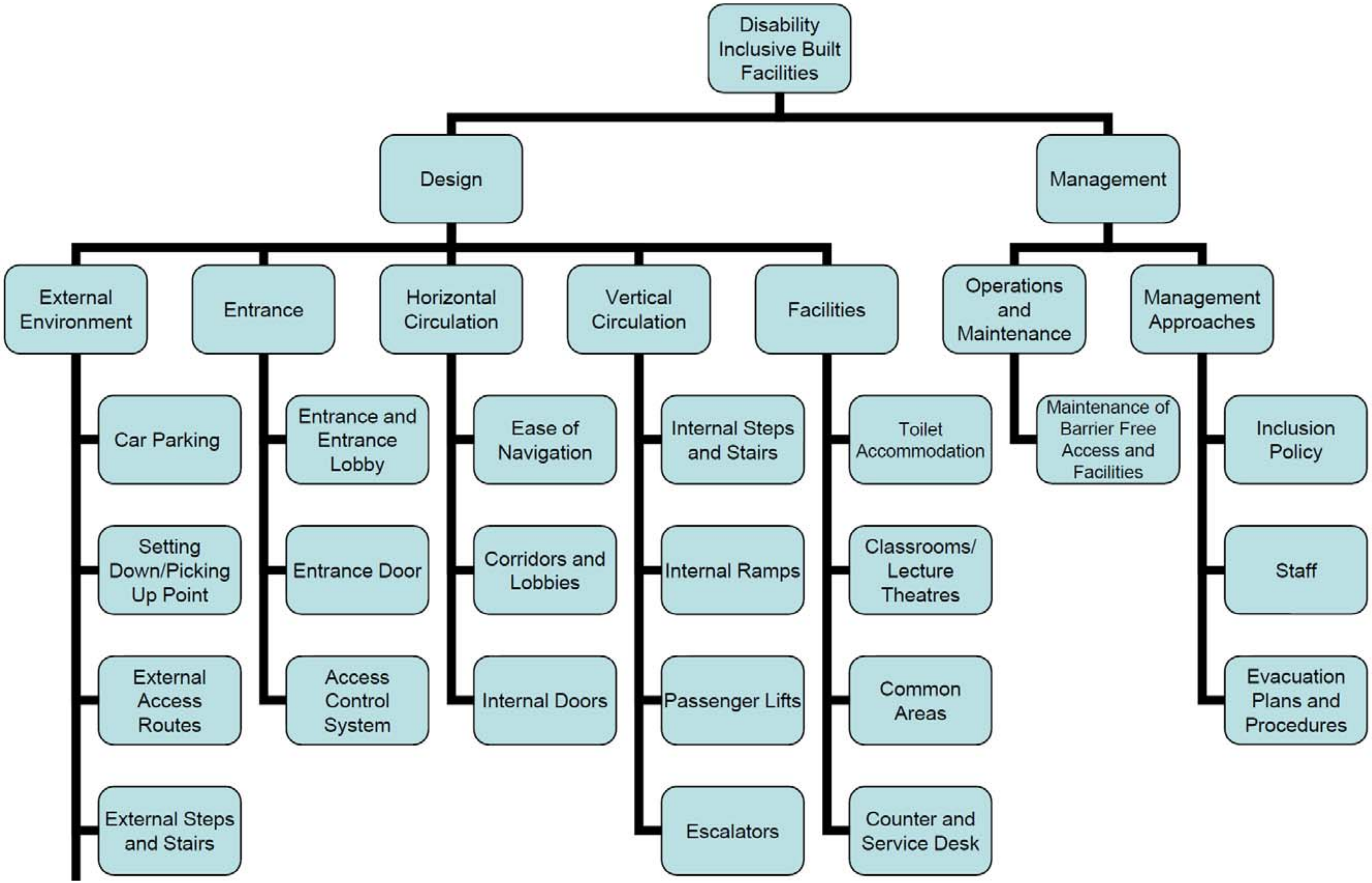

Figure 1: Hierarchy of attributes in relation to the inclusion of PWDs in higher education facilities

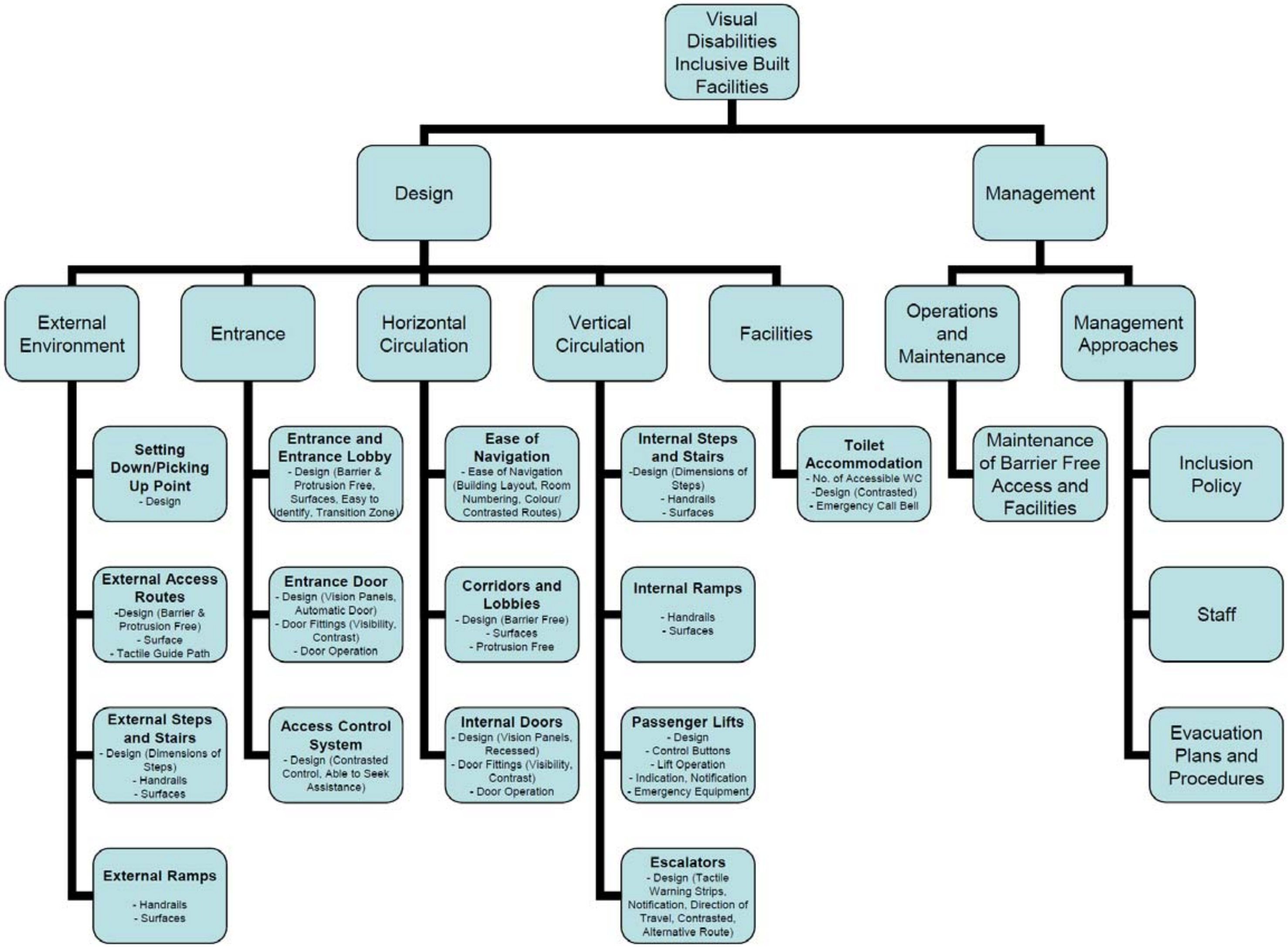

Figure 2: Improved hierarchy of attributes when the goal is inclusion of persons with visual disabilities in higher education facilities

Level II	Level III	Level IV
External Environment	Car Parking	• No. of Accessible Parking Space • Design of Accessible Parking Space
	Setting Down/ Picking Up Point	• Design of Setting Down/ Picking Up Point
	External Access Routes	• Design of External Access Routes • Surface of External Access Routes • Provision of Tactile Guide Path
	External Steps and Stairs	• Design of External Steps and Stairs • Handrails of External Steps and Stairs • Surfaces of External Steps and Stairs
	External Ramps	• Design of External Ramps • Handrails of External Ramps • Surfaces of External Ramps
Entrance	Entrance and Entrance Lobby	• Design of Entrance and Entrance Lobby
	Entrance Door	• Design of Entrance Door • Door Fittings • Door Operations
	Access Control System	• Design of Access Control System
Horizontal Circulation	Ease of Navigation	• Ease of Navigation
	Corridors and Lobbies	• Design of Corridors and Lobbies • Surfaces of Corridors and Lobbies • Protrusion Hazard
	Internal Doors	• Design of Internal Doors • Door Fittings • Door Operations
Vertical Circulation	Internal Steps and Stairs	• Design of Internal Steps and Stairs • Handrails of Internal Steps and Stairs • Surfaces of Internal Steps and Stairs
	Internal Ramps	• Design of Internal Ramps • Handrails of Internal Ramps • Surfaces of Internal Ramps
	Passenger Lifts	• No. of Accessible Passenger Lifts • Design of Passenger Lifts • Control Buttons of Passenger Lifts • Lift Operation • Indications and Notifications • Emergency Equipment
	Escalators	• Design of Escalators
Facilities	Toilet Accommodation	• No. of Accessible WC Cubicles/Accessible Unisex Toilet • Design of Accessible WC Cubicles/Accessible Unisex Toilet • Emergency Call Bell in Accessible WC Cubicles/Accessible Unisex Toilet
	Classrooms/ Lecture Theatres	• Design of Classrooms/ Lecture Theatres • Building Services and Relevant Facilities • Assistive Technology
	(Student) Common Areas	• Design of Common Areas and Fittings • Building Services
	Counter and Service Desk	• Design of Counter and Service Desk
N.B. 1. Design in general is concerned with dimensions and layout of individual areas and facilities. 2. Surfaces are referred to the firmness, the slip resistance, the pattern and the luminous contrast of finishes. Provision of tactile warning strips is also under surfaces. 3. Handrails have to meet requirements in dimensions and shape, fixing position and luminous contrast. It is also necessary to provide Braille and tactile information on handrails. 4. Door: door design is about the dimensions of doors; door fittings are about the furnishings or fixtures on door leaves; door operation is about the opening and the closing of doors.		

Table 1: Level II to Level IV inclusion attributes in the assessment hierarchy

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