ArchNet IJAR
International Journal of Architectural Research

ARCHITECTURE FOR AUTISM: Autism ASPECTSS™ in School Design

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Abstract
Architecture, as a science, deals with the manipulation of the physical environment to facilitate certain functions and elicit intended behavior. This environment is comprised primarily of sensory elements- textures, colors, patterns, acoustics etc. In accordance to the sensory definition of autism, these elements play an important role in autistic behavior and their cognition and integration are at the core of the disorder. This definition is the basis of the Autism ASPECTSS™ Design Index as discussed here. The objective of this paper is to illustrate the use of this index and its seven principles- Acoustics, Spatial sequencing, Escape, Compartmentalization, Transition spaces, Sensory zoning and Safety- as a design development tool. The paper summarizes the impact of these principles on the development of spatial design criteria for the Advance Center for Special Needs in Qattameya, Cairo, designed by Progressive Architects, and presents a possible prototype for schools for autism which would follow the ASPECTSS™ principles.

Keywords: Autism; educational environments; school design; special needs.

INTRODUCTION

Architecture is the science of environment creation, the manipulation of spatial organizations to fit the needs of its users. Architects commonly use the sensory environment - i.e. the auditory, visual, tactile and air quality characteristics of space- to convey meaning and messages to users hence facilitating functions and activities within a space, particularly in the case of special needs users (Malik, 2005).

Despite the apparent possibilities of designing favorable architectural environments for autistic users, autism has generally been excluded from architectural design codes and guidelines. In a personal communication, and in response to this exclusion, a representative of the International Code Council stated, "I know of no building or accessibility code that incorporates requirements specifically to address children with autism" (Brown, L., 2003, CBO Codes & Standards Development). The United Nations has issued a mandate on this matter (UN Global Program on Disability, 1993). Although not legally binding, it presents governments with a moral commitment to provide equal opportunities for persons with disabilities, including access to built environments. No specific references are made in the mandate regarding individuals with developmental disorders or even autism. It has since been pointed out that individuals with developmental and psychosocial disorders, of which autism is one, have been overlooked (Al-Thani, 2004). Various building codes of practice have also excluded specific requirements for designing for autism, although mentioning autism in a very limited sense with generic reference to acoustics for special needs (Architects & Building Branch, 1992, 1999, 2001, Building Bulletins 77, 91, 94). These documents do, however, provide comprehensive guidelines for dealing with other special needs and learning difficulties.

This general exclusion may be a result of the non-standardized nature of challenges and, respectively, needs along the autistic spectrum. It is the contention of this paper however, that a design strategy to deal with these varying challenges may be put in place allowing a form of customization for groups of users. This strategy will also facilitate the generation of broad design guidelines and policies. Research in the area of architectural design for autistic users, though limited, is available. In an architectural review of an existing education/treatment facility Myler et al discuss this lack of specialized literature and outline some guidelines for designing for autism dealing with issues such as limiting stimulation, acoustics, air quality, safety and lighting (Myler et al, 2003). Other similar reviews discuss the design itself and process involved in creating a facility for autistic users (Forcier, A., 1999). The National Autistic Society in the UK also provides a series of guidelines for architects and builders, but these seem to be anecdotal given that no empirical research is cited as an evidence base for these design guidelines (National Autistic Society, 2012). None of these, however, present an evidence based design model that can be used to generate design guidelines for the autistic user.

According to more recent literature, the key to designing for autism seems to revolve around the issue of the sensory environment and its relationship to autistic behavior. This role of the sensory environment in autistic behavior has been an issue of debate since Leo Kanner first defined the disorder in 1943 (Kanner, 1943). From the early works of Rimland and his discussion of sensory stimulation and its relationship to autistic behavior (Rimland, 1964) to Delacato and his discussion of "sensoryisms" in (Delacato, 1974), the sensory environment has been part of the autism dialogue. Simply stated this dialogue hypothesizes that autistic behavior- which is characterized by repetitive behavior, limited communication skills, challenges in social interaction and introversion- may be a result of a malfunction in sensory perception. This malfunction may take the form of hyper-sensitivity or hypo-sensitivity, in its various degrees and across the scope of all the senses, leaving individuals with autism with an altered sensitivity to touch, sound, smell, light, color, texture etc. In other words, this leaves them with an altered sense of the world around them.

Recent literature, however, has begun debating the weight and pivotal role first attributed to the sensory environment in the dynamic relationship of the autistic user with his or her environment. Although possibly an effect of increased skill development amongst previously untreated autistic individuals, generalization of skills as opposed to dealing with the sensory stimulation per se, has received increasing attention in the literature. In all cases, the role of the "sensory phenomena" is still undergoing much discussion (Firth, 2003. p. 10 as cited in Henry, 2011). Kern et.al have shown that sensory stimulation and its consequent processing- or in other words the crux of the user-built environment relationship- is characteristic of all individuals with autism (Kern, et.al, 2007 as cited in Henry, 2011), while Dawson and Watling estimate this prevalence as predominant, but not global (Dawson & Watling, 2000 as cited in Henry, 2011). In all cases it seems to be agreed upon amongst most researchers that the sensory environment, with its colors, textures, patterns, lights, shapes and spatial qualities, while requiring further investigation, plays some role in the disorder (O'Neil & Jones, 1997).

This debate in the autism research community has brought upon a parallel debate in the architectural research community that serves it. Two seemingly polar opposite positions are emerging among the approaches to designing for autism and are discussed in a series of articles by ArchDaily's Christopher Henry (Henry, 2011, Henry, 2012). The first position is what has been called the "Nuero-Typical" approach, and proposes the immersion of the autistic user in as typical and stimulating an environment as possible, in order to encourage adaptation to the over-stimulation so typical of the disorder and to replicate the level of stimulation found in the real world. The conceptual basis behind this design approach is that it would best prepare the autistic user for the generalization of his or her skills, particularly those acquired in a learning environment, to the outside world. Proponents of this approach contend that it addresses the more pressing issue of generalization, rather than sensory sensitivities. It seems however that this approach presupposes first that generalization is the bigger challenge. Additionally it assumes that the user has received a certain quality of care and a consequent minimum level of baseline skill, whereby the autistic user is able to adapt to a degree that allows them to even use such environments. This, however is not always the case, particularly in the more severe instances of the disorder, in the early stages of intervention and in cases where intervention has been delayed or not been made available to the autistic individual, as is the case in most of the developing world. A further limitation of this approach is that it has not been empirically investigated and is based on a hypothesis rather than evidence based research (Marion, 2006).

The second, to which this paper subscribes and upon which it is based, is the Sensory Design Theory, which stipulates that favorably altering the sensory environment can be conducive to positive and constructive autistic behavior, particularly in learning environments. Based on clinical research first published in 2008, Sensory Design Theory presents a flexible and adaptable tool which acts as a catalyst for architectural design criteria development for architectural environments based on their sensory qualities, and in response to autistic sensory needs (Mostafa, 2003, Mostafa, 2008). Although seemingly prescriptive, it allows for different levels of application and advocates the creation of a variety of stimulus zones to respond both to different activities and different skill levels of its users. Similar to the neuro-typical approach, it addresses the issue of generalization of skill by avoiding the "greenhouse" effect using graduated sensory spaces, from the highly adapted to the typical, to allow for gradual skill development (Mostafa, 2008, p. 204).

Sensory Design Theory has been empirically tested and preliminary evidence seems to indicate that autistic users, particularly those on the extreme side of the spectrum and those at the beginning of their interventional treatment, show increased attention span, faster response time and improved behavioral temperament through application of the Sensory Design Theory (ibid, pp. 197-205). Although more research is required to investigate the scope and long-term effects of this approach, it is however one of the few evidence based research theories addressing architecture for autism (Henry, 2012) and is the basis of the presentation of the case study design project in this paper- the new Advance Education Center, Qattameya-Cairo, Egypt, which is the first building to be designed according to Sensory Design Theory.

AUTISM, ARCHITECTURE AND BEHAVIOUR

Sensory Design Theory is based on the concept of the sensory environment as a major role-player in the process of perception and behavior development. Much like the concept of the "sensory diet" (Willbarger & Willbarger, 1991 and Anderson, 1998), this environment is considered something that can be manipulated to the benefit of the autistic user. If we look at typical perception as the understanding of, and relevant responding to, the sensory input from the surrounding environment (i.e. the architectural design), we can better understand the role of architecture in autistic behavior. Most interventions for autistic individuals deal with the sensory malfunction itself and the development of strategies and skills for the autistic individual to use when coping with these malfunctions. It is the contention of this research that autistic behavior can be influenced favorably by altering the sensory environment, i.e. the stimulatory input resulting from the physical architectural surroundings of color, texture, ventilation, sense of closure, orientation, acoustics etc., before, rather than after the sensory malfunction occurs (Mostafa, 2003, Mostafa, 2008). Perhaps by altering this sensory input in a manner designed to accommodate specific autistic needs, behavior may be improved, or at least a more conducive environment created, for more efficient skill development. Previous research has shown this to be a successful approach, particularly in the area of acoustical design (Mostafa, 2006, Mostafa 2008).

THE SENSORY DESIGN MODEL

This brings us to the development of the model used to generate the design criteria applied in the case study, "the sensory design model". This model is comprised of a matrix based on two axes (Figure 1). The horizontal axis represents the various sensory areas involved in perceiving the physical environment, or the sensory profile, while the vertical represents the architectural attributes that may be manipulated to accommodate various sensory needs for autism. These architectural attributes are partially based on Ching's definition of architecture (Ching, 1996). In view of the sensory definition of autism as well as an understanding of architecture, design criteria, indicated by numbers, can be generated by the critical analysis of the intersection of each of these axes.

			SENSORY ISSUE														
			Auditory			Visual			Tactile			Olfactory			Proprioceptive		
			Hyper	Hypo	Interference	Hyper	Hypo	Interference	Hyper	Hypo	Interference	Hyper	Hypo	Interference	Hyper	Hypo	Interference
ARCHITECTURAL ATTRIBUTE	Structure	Closure	1	2		1	2	1	2	1		1	2		2	1	1
		Proportion	3	4	3	3	4								4	3	
		Scale	5	6	5	5	6	5	6	5					6	5	5
		Orientation					7									7	7
		Focus	8			8										8	8
	Balance	Symmetry	9	10		9	10	9							9	10	9
		Rhythm					11									11	11
		Harmony				12	13	13	12							13	13
		Balance				14	15	14							14		14
	Quality	Colour				17	16			18							
		Lighting	19			19	20										
		Acoustics	21	21	21												
		Texture		22					22	23							
		Ventilation										24	25	24			
	Dynamic	Sequence				26	26	26		26						26	26
		Proximity				27		27								27	27
		Routine	28			28		28								28	28

Figure 1: Sensory Design Matrix (Source: Author).

Since autism is a spectrum with each individual exhibiting a different sensory profile with variant response to stimuli (Anderson, 1998), this matrix will generate different, and sometimes conflicting, design guidelines for each sensory profile examined. Optimally, this matrix could be used to customize designs, for example in a home environment where only one autistic user is involved. This however, is not applicable in buildings where groups of autistic individuals use the same spaces, such as schools and respite centers. A general sensory profile, however, may be developed comprised of the most common sensory challenges faced by autistic users when dealing with a built environment. These commonalities were assessed through an online international survey of one hundred families in 2002 while developing the index. The objective of this survey was to ascertain the importance and impact of the architectural environment on families with autism by ranking the most prevalent sensory environment issues- acoustics, visual environment, tactile environment etc., and served as a basis for the later development of the Autism ASPECTSS™ Index. (Mostafa, 2008).

THE AUTISM ASPECTSS™ DESIGN INDEX

By looking at these common sensory environment problems, such as acoustics, texture, lighting etc. a group of design principles were generated through the matrix. Some of these suggested guidelines were empirically evaluated in a school environment and indicated promising results (Mostafa, 2003, Mostafa, 2006 and Mostafa, 2008). These principles are summarized in the following proposed Autism ASPECTSS™ Index, and were used as a basis for the development of the design of the Advance School for Autism in Egypt:

1. ***A**coustics:*
   As mentioned previously, a preliminary exploratory survey of 100 parents and primary caregivers of children with Autism Spectrum Disorder (ASD) ranked acoustics as the most influential feature of the sensory environment upon autistic behavior. Further empirical research has shown that by reducing noise levels and echo in educational spaces for children with autism, their attention spans, response times and behavioral temperament, as measured by instances of self-stimulatory behavior, are all improved. This improvement reached in some instances a tripling of attention span, a 60% decrease in response time and a 60% decrease in instances of self-stimulatory behavior (Mostafa, 2008). This criterion proposes that the acoustical environment be controlled to minimize background noise, echo and reverberation within spaces used by individuals with ASD. The level of such acoustical control should vary according to the level of focus required in the activity at hand within the space, as well as the skill level and consequently severity of the autism of its users. For example, activities of higher focus, or according to Sensory Design Theory, those taking place in "low stimulus zones", should be allowed a higher level of acoustical control to keep background noise, echo and reverberation to a minimum. Also provisions should be made for different levels of acoustical control in various rooms, so students can "graduate" from one level of acoustical control to the next, slowly moving towards a typical environment in order to avoid the "greenhouse" effect (Mostafa, 2008).

2. ***SP**atial Sequencing*
   This criterion is based on the concept of capitalizing on the affinity of individuals with autism to routine and predictability. Coupled with the criterion of Sensory Zoning, which will be discussed shortly, Spatial Sequencing requires that areas be organized in a logical order, based on the typical scheduled use of such spaces. Spaces should flow as seamlessly as possible from one activity to the next through one-way circulation whenever possible, with minimal disruption and distraction, using Transition Zones which are discussed below.

3. ***E**scape Space*
   The objective of such spaces is to provide respite for the autistic user from the over-stimulation found in their environment. Empirical research has shown the positive effect of such spaces, particularly in learning environments (Mostafa, 2008). Such spaces may include a small partitioned area or crawl space in a quiet section of a room, or throughout a building in the form of quiet corners. These spaces should provide a neutral sensory environment with minimal stimulation that can be customized by the user to provide the necessary sensory input.

4. ***C**ompartmentalization*
   The philosophy behind this criterion is to define and limit the sensory environment of each activity, organizing a classroom or even an entire building into compartments. Each compartment should include a single and clearly defined function and consequent sensory quality. The separation between these compartments need not be harsh, but can be through furniture arrangement, difference in floor covering, difference in level or even through variances in lighting. The sensory qualities of each space should be used to define its function and separate it from its neighboring compartment. This will help provide sensory cues as to what is expected of the user in each space, with minimal ambiguity.

5. ***T**ransition Zones*
   Working to facilitate both Spatial Sequencing and Sensory Zoning, the presence of transition zones helps the user recalibrate their senses as they move from one level of stimulus to the next. Such zones can take on a variety of forms and may be anything from

a distinct node that indicates a shift in circulation to a full sensory room that allows the user to re-calibrate their sensory stimulation level before transitioning from an area of high-stimulus to one of low-stimulus.

6. ***S**ensory Zoning*
   This criterion proposes that when designing for autism, spaces should be organized in accordance to their sensory quality, rather than the typical architectural approach of functional zoning. Grouping spaces according to their allowable stimulus level, spaces are organized into zones of “high-stimulus” and “low stimulus”. The former could include areas requiring high alertness and physical activity such as physical therapy and gross motor skill building spaces. The latter could include spaces for speech therapy, computer skills and libraries. Transition zones are used to shift from one zone to the next.

7. ***S**afety*
   A point never to be overlooked when designing learning environments, safety is even more of a concern for children with autism who may have an altered sense of their environment. Fittings to protect from hot water and an avoidance of sharp edges and corners are examples of some of these considerations.

APPLICATION OF SENSORY DESIGN THEORY AND AUTISM ASPECTSS™: A CASE STUDY OF THE ADVANCE SCHOOL, EGYPT

The Advance School Project- Objectives, Outline and Student Body Profile

The Advance Centre for Special needs is the full-time educational service provided by the Egyptian Society for the Developing Skills of Special Needs Children in Egypt. The objective of the center is twofold. Primarily it deals with skill development of children with developmental delays with a focus on autism, which comprises 70% of its student body. Its ultimate goal is maximum independence of its students, and hence integration into society. In addition, it aspires to raise the awareness of the community with regards to special needs in general, and autism specifically. The age groups addressed in the services of this center range from children of 2 years to adults of 21 years and above. Children of the center will not “graduate” in the traditional sense of the term, but will be provided with support in the form of continued education and therapy as well as employment opportunities at the center and assistance towards inclusion in the community.

The center is located in a newly developed suburb of greater Cairo, Egypt, as part of New Cairo in the Qattameya district. The total plot is approximately 4200 m2 with a permissible footprint of 30% or 1200 m2. The maximum allowable height is 13 m or 3 stories, creating a maximum built-up area 3600 m2 above ground. For cost-efficiency purposes these areas have been maximized to accommodate as many students as possible. When completed the center should provide full-time educational services to 70 students, as well as part-time support and supervision to at least 50 others.

Architectural Program

The architectural program developed by the researcher in conjunction with the administrative, educational and clinical team of the school is summarized briefly as follows:

1. Administration			
	1.a Central Administration		
		Reception Area, Accounts, Board of Directors	
	1.b Faculty Administration		
		Faculty offices and services	
			School director, Clinical director, Registrar offices, Teacher training/ Faculty conference room, Faculty lounge with workstations, Main resource library
	1.c Assessment and Diagnostic Centre		
			Waiting area for parents and applicants, Diagnostic room equipped with a/v, Observation room, Conference room, Diagnostic center director's office/ visiting specialist
2. Educational and Therapy Centre			
	2.a Core Educational Spaces		
			Class bases (10), Observation rooms, One to one instructional spaces, Shared resource rooms and teacher prep areas, Storage
	2.b Therapy Spaces		
			Speech and language therapy (6) with adjacent observation rooms, Psychomotor Therapy (2), Occupational Therapy (1), Physiotherapy room (1), Storage spaces, Shared office space for therapist preparation (1), Hydrotherapy, Enclosed swimming pool &services
	2.c Vocational Studies Workshop (2)		
	2.d Artistic Therapy and Skills		
		Arts and Crafts Studio	
		Drama, Movement & Music Therapy Studio	
	2.e Outdoor Learning		
			Classroom related learning patios, Age appropriate cluster courts, Psychomotor learning through play centers, Sensory gardens, Formal playfields and PE spaces, formal Vocational Gardening area
3. Community Related Facilities			
	3.a Commercial Outlets		
			Arts and Crafts outlet, Plants and produce outlet, Business and Computer center, Bakery outlet
	3.b Community Participation Spaces		
			Multi-purpose Assembly hall
4. Ancillary Services			
		Bathrooms	
		Kitchens (including life skills kitchen in model home)	
		Electromechanical Services	
5. Assisted Living Centre			
		Private single and double student bedrooms with en suite bathrooms (9 housing 9-16 students), Supervisor bedrooms with en suite bathrooms (3), Group living room and workspace (1 per floor= 3), Kitchenette (1 per floor= 3), Medical coordinator's office (1), Residence manager's office (1), Family room and group lounge adjacent to garden, Group kitchen, guest toilet.	

APPLICATION OF SENSORY DESIGN THEORY AND THE AUTISM ASPECTSS™ DESIGN INDEX

The objective of this paper is to illustrate the application of the ASPECTSS™ principles to the design development of the Advance Education Center. To this end the 7 principles were the driving force behind the programming and development of design criteria at all levels: detailed program development; contextual consideration related to site location, surrounding activities and community participation with the center; whole-school issues related to zoning, spatial organization, proxemics etc.; classroom configurations; furniture layouts and finishing specifications. Using a simple matrix, each of the 7 ASPECTSS principles were mapped against each of the stages of the design process- from programming to material specifications- and used as a catalyst to generate design solutions. The following overview describes the results of this mapping and consequent catalytic discussion with regards to whole-school design decisions as well as the different functional components of the building- learning spaces, support spaces and living spaces.

Whole School Issues

Successful architecture deals with a building as a whole, rather than the simple sum of its parts. Hence, to design for an issue with sensitivities as particular as autism, one must first look at the elements dealing with the building as a whole. As a result of the application of the ASPECTSS principles, the following design guidelines were developed with respect to context and community, zoning, circulation and fire safety.

1. Context and Community

One of the more important problems of special needs children that have recently come to the forefront of research and literature is the issue of inclusion and respect in society. Through design it may be possible to assist such inclusion. The provision of community-linked services is essential to this end. Facilities such as the commercial outlets proposed create an opportunity for student interaction with society. This helps develop social and vocational skills in the students as well as promote a positive productive image of autism to the community at large. As with all student areas throughout the center, these outlets are kept visually simple to reduce student's over-stimulation. Storage areas, display areas, workspaces and customer areas are kept visually and spatially separate and organized. Natural lighting is used as much as possible, as well as natural ventilation. Noise exposure is kept to a minimum in "high focus" areas such as computer stations in the business center or accounting stations in the other outlets.

The functions that are provided in the assembly hall can also be utilized to encourage inclusion. These functions may include, but are not necessarily exclusive to: awareness campaigns, parent home program training sessions, parent support groups, teacher training seminars, school organized shows and school assemblies.

2. Zoning

When designing for a group of students with the sensory challenges found predominantly in those with autism, the organization of functions with respect to one another is of great importance. This functional organization, or zoning, has great impact on the comfort of the user, the conducive quality of the healing and learning environment, as well as the independence enjoyed by these students as they navigate the center. It is the contention of the Sensory Design model and Autism ASPECTSS™ design index that the autistic user identifies with the architectural environment around him or her in accordance to sensory zoning rather than conventional functional zoning (Figures 2 and 3).

Fig. 2- View of the overall organization of building (Source: Author).

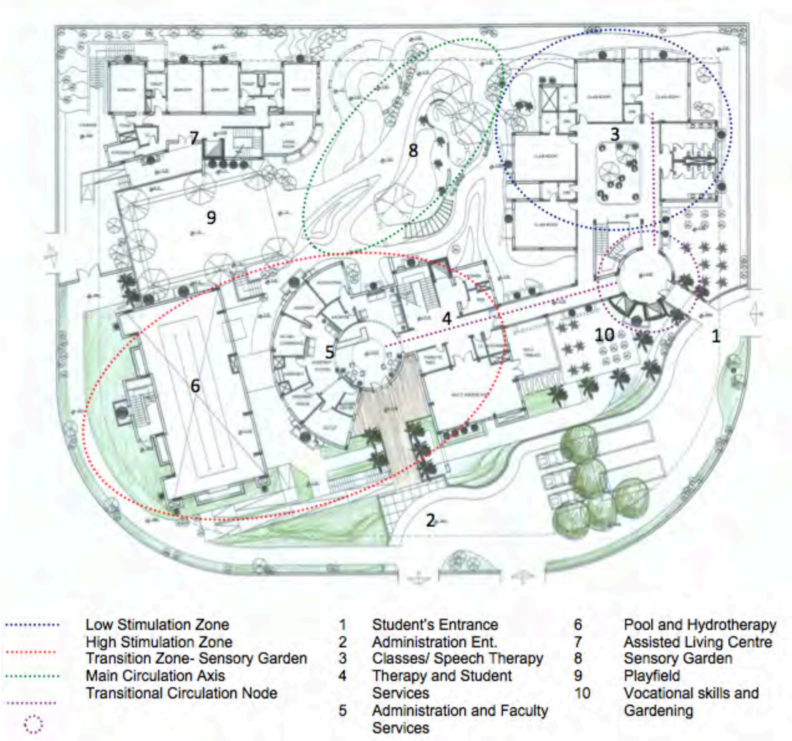

Figure 3: Entry-level plan and Sensory Zoning (Source: Author).

With this in mind, when designing for autism, buildings may be designed with a new outlook. Spatial groupings should follow “autistic” logic and involve sensorial compatible functions. These groupings should be accessed through a one-way circulation system, emphasizing, as well as capitalizing on, “routine”. For example high-stimulus functions like music, art, crafts and psychomotor therapy, requiring a high level of alertness can be grouped together, while low-stimulus functions or “high focus” areas like speech therapy, one to one instruction and general classrooms, requiring a high level of concentration, can be grouped together. Services, which are usually high-stimulus, including bathrooms, kitchens, staff-rooms and administration, should be separated from the student areas. Buffer areas such as gardens, free-play, sensory curriculum rooms and some other open spaces may act as transitional areas between the low-stimulus “focus” zones and the high-stimulus “alertness” zones. As will be discussed shortly, transition zones also play a role in easing such shifts.

3. Way-finding, Navigation, Circulation and Spatial Sequencing

The importance of this issue cannot be over-emphasized. When coupled with sensory zoning, the issue of conducive way finding and navigation may greatly aid the special needs user in gaining various skills and independence while freeing staff and faculty. Without such an approach to design, faculty and staff become responsible for guiding children throughout their day as they move from one activity to another. This is not only time-consuming but robs the child of skill-development opportunities. Using circulation schemes related to the visual daily schedules and picture exchange communication (PEC) systems used in the center’s educational programs also enhances active learning of communication skills as it provides the child with an opportunity to apply his or her skill to a real-life situation.

A “one-way” circulation scheme that builds on the special needs user’s affinity to routine is employed throughout this building. This circulation corresponds to the general daily schedule of the student’s activity as he/she moves through the school. Due to the diversity of the children’s educational needs and school operation issues like scheduling this may be very difficult to generalize and standardize. However an attempt to group functions for each age group in zones through which the children move progressively throughout the day is employed. Transition zones such as gardens and sensory curriculum rooms may assist when this one-way circulation is not possible.

The use of a circular node or junction, in the form of a cylindrical tower, between the two main circulation axes, should create such a transition zone between the two sensory zones. It is suggested, as well, that this space, being visually and spatially distinguishable from the remainder of the forms used in the project, will aid the student in independent navigation by creating a visual cue to the change in sensory zone, hopefully preparing him for the shift in the sensory environment and quality of activity about to take place.

Visual aids such as color and pattern are employed in circulation areas to assist way finding. This is done discreetly to avoid visual over-stimulation. Signage is another important part of way finding and navigation. Conventionally dependent primarily upon the written word, signage is a challenge for communication-disordered individuals like those with autism. It has been found that individuals with autism, although sometimes unable to communicate with conventional language of the spoken and written word, can communicate well using pictures (Grandin, 1996). This concept can be applied to signage schemes where pictorial language can be displayed in parallel with written language. In addition to assisting navigation, this will help develop skills as well as raise self-esteem and encourage inclusion. When continuously viewing and understanding a pictorial sign with written words next to each symbol, eventually some written words may begin to be understood by association. Using these types of signs will also allow all children to be included in the group of those who can read. Various colors and themed symbols are used to indicate different functions in the school. In a manner similar to pictorial signage, textural signage is proposed as a communicative tool capitalizing on the tactile, in addition to the visual, cognitive capabilities of the students. Various textured materials are also used to indicate circulation areas, changes in levels and for the creation of interesting sensory experiences, particularly in outdoor learning environments.

The lighting used in all circulation spaces is natural with placement that avoids glare and silhouetting. This issue is important not only for those with visual issues but also for those with auditory processing problems and challenges. Such individuals commonly depend on visual cues such as body language and facial expression to assess situations and silhouetting impairs this. The use of contrasting materials in various elements-floor, wall, ceiling, doors- helps visually define and differentiate, helping to clarify the visual qualities of circulation areas. Over-stimulation, however, is avoided.

4. Fire safety and evacuation

Traditionally the issue of fire safety and evacuation has focused on wheelchair users and non-ambulant individuals. The same concepts, however, can be applied to autistic users. The evacuation strategy proposed involves insuring the safe and effective movement of the challenged individual from any point in the building under various fire location scenarios (progressive horizontal evacuation), to a safe spot or refuge. This refuge should be secure and located away from the evacuation flow. An appointed faculty or staff member will meet the individual at this assigned refuge and proceed to evacuate him/her.

Learning Spaces:

1. General Classroom Design

A clustered organization is used in designing the classrooms. This introverted organization creates an internal, contained, open-air space that can fulfill various functions. The first is the creation of a space of an intimate scale allowing students with delayed social interaction skills the chance to interact with smaller groups of children in a familiar environment. The second is the environmental benefits of courtyard design such as temperature regulation (Reynolds, J., 2002).

Finally, these courtyards provide opportunities for outdoor learning- in themes such as nature, weather, motor skills etc., which has been shown to be very advantageous and beneficial (Millet, 2004).

As a zone the classrooms are located in the low-stimulus area of the school. Each classroom or "class-base" has an average of 7 students with at least 3 teachers and assistants. The classrooms themselves are designed acoustically to reduce external noise permeation as well as internal echoes. With a concept similar to that of sensory zoning, the classroom is designed in a compartmentalized fashion. Each function or activity is allocated to a "station" which can be physically and visually separated from the remainder of the classroom by low partitions, levels or different flooring materials and colors. These stations are organized throughout the classroom according to their sensory requirements with high focus functions like fine motor skills, matching, sorting and academics located in well-lit areas allowing alertness without distraction. Natural lighting is introduced with above eye-level sills to allow indirect sunlight in without visual distractions. Optimally these windows are north facing to avoid glare and direct light. For each activity an optimum and distinct furniture and equipment layout is used consistently. It has been found that some activities are best performed with certain layouts (Mostafa, 2003). Over time this consistency will act as a visual cue for the student and will assist him/her in predicting the task at hand, hopefully reducing the time needed to get on task.

Open areas for floor play are also included as well as provisions for group work. Resources are to be organized so that they are readily available without being highly visually accessible to avoid distraction to the child. Closed storage cupboards or open shelving with neutral boxes are ideal. These resource nodes can be placed centrally between two or more classes in a small teacher preparation area to be more efficient.

An additional, but essential station is included, namely an "escape space". This is located in the lowest stimulus area of the classroom. Essentially it is a small partitioned area where a child may seek refuge whenever over-stimulated or overwhelmed. This space is intimate and partially enclosed to limit the sensory environment the child needs to deal with. It is designed as a sensory neutral space with various items close at hand, much like a small Snoezelen sensory curriculum room (Hulsegge, & Verhal, 1987), so that the child can have the space customized according to his or her sensory needs. These items may include cushions of various textures, brushes, sand paper, small tents, blankets, fiber optic lights, music headphones and perhaps aromatherapy oils. Anecdotal evidence shows that the mere presence, and not necessarily regular use, of this space in a classroom is sufficient to reduce the tantrums and outbursts of over-sensitive children, increasing their productivity in class (Mostafa, 2003). This area can also be used at the beginning and end of classes to help children calm down and prepare to be more receptive to the upcoming tasks.

Being a comprehensive center, the role of the classroom, though primarily instructional, also includes elements of training for both parents and other teachers or specialists. For this purpose, joint observation rooms are made available directly adjacent to the classrooms. These are small rooms with one-way mirrored windows looking directly into the classes, with a/v equipment for taping sessions. These can be used as part of teacher training courses as well as parent awareness and home program training.

2. Specialized Therapy Spaces

The center provides various specialized spaces for speech, occupational, psychomotor therapy etc., as outlined in the program. All these spaces, with the exception of speech therapy, are considered the high stimulus functions and should be grouped accordingly in that sensory zone. Each function, however is kept acoustically separated from the others using high quality wall systems. Lighting, whenever possible, is natural and indirect, from a source above eye-level to avoid visual distraction. Fluorescent lighting, which emits a low hum and flickers, is avoided. Shared resource and preparation areas, as well as observation rooms are also provided.

As an activity, each of these therapies has different characteristics and hence requires a different quality of space. For example the psychomotor therapy room is designed in a more linear proportion allowing directional movement along its length. A preparation/storage space is located at one end and is accessible via a large rolling horizontal panel that opens onto a shelved area directly behind where the students begin their activity. The therapist can prepare and organize the necessary equipment on these shelves from the adjacent resource and equipment storage area, allowing independent and structured access to the students without over-stimulation and distraction. These resource areas are located between, and accessible from, two adjacent therapy rooms. This will economize on space and expensive equipment that can be shared. The occupational and physical therapy rooms are organized in a similar fashion.

The art therapy area incorporates various activities including painting, printing, sculpture and pottery, which is located on an outdoor terrace. As in the classrooms these different activities are organized in stations kept partially visually and spatially separate. Natural lighting is achieved through a skylight, creating an enjoyable and creative environment. Located above the pre-vocational workshop, artwork can be integrated to help students create beautiful and functional objects such as simple furniture, leather goods and home accessories. A large storage and preparation area are made available.

The pre-vocational workshops are located on the ground floor with direct access to an outdoor area for large-scale activities such as carpentry and metal work, as well as formal gardening. The activities in the workshops are divided into two groups including but not limited to woodwork, bamboo, candle making, tapestry and computers. The workshops are furnished with adjustable stools and tables with durable surfaces throughout. Both the workshops and art studio are located close to the outlets to allow easy transportation of products and goods with minimal distraction to the rest of the center.

The enclosed swimming pool and hydrotherapy are located at the farthest possible location from the classrooms and the low-stimulus zone. Being a high-stimulus function, this essential activity needs to be housed in an enclosure that minimizes acoustical disturbances such as echoes, whilst being safe and hygienic. The hydrotherapy is comprised of a sensory pool that activates various jets at different parts of the body to provide tactile stimulation. External access for extra-curricular use is provided.

The speech therapy rooms, being high-focus activities requiring a low-stimulatory environment, should be located as part of the low-stimulus zone. Research has shown the preliminary success and long-term sustainability of performance of speech and communication in soundproofed speech therapy rooms (Mostafa, 2006). It is important however not to provide only soundproofed rooms, to avoid a “greenhouse” effect, where the child is only able to communicate in an acoustically controlled room and is unable to generalize these skills outside the classroom. In this design a group of rooms with various levels of soundproofing are made available. In this way the child can graduate from one level of acoustical control to the other as he or she acquires the necessary skills with the ultimate objective of generalizing communication skills in a non-controlled environment.

3. Outdoor Learning Spaces

As mentioned previously, outdoor spaces can play an essential role in learning (Millet, 2004). Research has also shown that in children with autism, outdoor spaces may actually be preferable (Hebert, B. 2002). With autism it is essential to capitalize on every learning opportunity and outdoor areas can be instrumental in this. As mentioned previously, the small outdoor classroom courtyards may help create the opportunity for small-group social interactions between students. In a similar manner the larger playground area may allow for larger scale interactions.

Hebert mentions various benefits of the outdoor space or “healing garden”, such as sensory integration and play therapy. In addition to these, this study presents the architectural role of the outdoor learning space as a transitional zone. This zone is essential to the success of the sensory zoning concept in that it allows the sensory recalibration of the student. When moving, for example, from a high stimulus function such as music and movement therapy in the high stimulus zone, to a low-stimulus high focus activity such as communication therapy the student can pass through the outdoor area and be allowed a few minutes to perform a sensory readjustment to prepare for the upcoming task.

This sensory readjustment may be conducted in a variety of spaces made available. A sensory garden comprised of textured pathways, water-play, ball pools, sand pits and an aromatherapy herbal garden is the core of this space. In addition to using the formal gardening area provided, part of the students' vocational training may be the maintenance of the sensory garden. This will not only improve their sense of achievement and provide them with viable skill training, but gardening has also been shown to have many benefits in autism (Schleien et al, 1991). Water features may also be used to mask background noise. A free-standing expression wall painted with blackboard paint allows the students to articulate themselves artistically, promoting free self-expression as well as allowing those with poor fine motor skills to use their more developed gross motor skills in producing large scale artwork.

Various shaded seating alcoves are provided to protect student's overheating which may be a precursor to seizures in predisposed students (Tsai & Leung, 2006). These also allow individuals and groupings of different sizes to sit. Accessibility and usability are further issues. All pathways are ramped at level changes and sensory elements, such as textured tables, water play and sand pits, are raised to be available to wheelchair users. Playground equipment is to be designed for non-ambulant users as well (ODPM, 2003).

Other essential outdoor learning spaces include the formal vocational garden where students can learn various skills. In addition to gardening, small projects can be carried out including herbal packaging, floral arrangements, organic produce and others. By marketing these services and products to the community through the available commercial outlets in addition to income to the center, the students will gain important skills and hopefully improve the image of special needs as a burden on society. A formal playfield for organized sports is also provided.

Support Spaces: Diagnostic Centre

Comprised of rooms for parents, assessment and diagnosis, specialists, intake and conferencing as well as training, this area provides a welcoming atmosphere and is easily accessible from the visitor's parking area and entrance. It is also accessible from the chairman's office and relevant center faculty. Some resources such as brochures and reading material can be made available from the resource library. The diagnostic room is arranged much like a small class, with various stations, and is visually accessible from an observation room. The diagnosing specialist, observing parents, as well as parent and teacher training activities, can use this observation room. The diagnostic center is used for intake of new students, provision of outside assessment services and extra-curricular support for special needs individuals affiliated and enrolled elsewhere. The general atmosphere of this area of the center is respectful, private and welcoming, to reassure both the parents and children.

Living Spaces: Assisted Living Centre

The objective of this assisted living service is to provide supervised on site accommodation for students. Such accommodation may act as a transition towards supervised living off-campus or independent living with the ultimate objective of integration into the community (Marquette & Miller, 2002). All efforts are made to create a dignified environment conducive of skill development and independence, departing completely from the former approaches of life-long institutionalization of individuals with autism (Taylor, 1987).

With this in mind the building is designed as 3 apartments, as close as possible in format as would be found in a typical Egyptian home. Each of these apartments has 3-4 bedrooms with private bathrooms for each, a small kitchenette and workspace. Students may share a room with another student, a supervisor or live independently, depending on their skills and level of independence. A large kitchen and a lounge area are located on the garden level for group activities and entertaining visitors as well as various vocational tasks. A medical supervisor and building manager are available around the clock in addition to the various supervisors or buddies.

The location of the building, although on the same site, does not allow for direct access to the school grounds, despite the obvious convenience. The reason for this is to create the feeling that the two buildings and their users are neighbors, rather than give the live-in students a sense of institutionalization. Each student will have to walk around the site to reach the main entrance of the school, navigating traffic and the neighboring community along the way.

CONCLUSION: LOOKING TO THE FUTURE OF ARCHITECTURE FOR AUTISM

Although just a beginning, the Advance School is the first project designed according to the Sensory Design Theory and applying the Autism ASPECTSS™ Design Index. The process of this application using the seven principles as catalysts for guideline development, proved to generate various criteria not typically used in educational environments and learning spaces. This paper provides a detailed discussion of the impact of autism-aware design on all levels of school planning- from whole school issues to details of class configuration and layout. The Advance Center may be considered a working prototype towards more autism-friendly design. Post-occupancy evaluation could further determine the success of this process.

It is proposed that this Autism ASPECTSS™ Design Index may further be used to develop designs for other building typologies such as assisted living communities and respite centers. It may also be used as a framework to facilitate inclusion in mainstream facilities and public services. Finally, it may also have applications, in a weighted format, to act as an audit index, to help rate the appropriateness of an environment for autistic users. In this manner this index may help encourage inclusion and integration into society and community by facilitating autistic skill development and creating a healthier, more conducive environment for all.

It is hoped that the thoughts presented in this paper will begin a move towards listening with all of our senses to the needs of these bravely challenged individuals, and motivate us to develop the knowledge and technology to design more appropriate architecture.

Acknowledgements

Mrs. Maha El Helali and all of the ADVANCE school administration and staff provided the generous cooperation required to develop the program of the educational center discussed in this paper. The underlying theory of the work presented here would not have been developed without the consent and support of all the parents of the children involved in earlier studies. Their participation and support is greatly appreciated. More information about their society can be found at http://www.advance-society.org .

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