Conducive learning environments for children with ASD

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EXPLANATORY DOCUMENT

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Abstract

Autism Spectrum Disorder (ASD) impacts an individual’s cognitive, sensory and social processing abilities. At present, there is no effective cure. However, in many cases the difficulties faced can be mitigated through early intervention.

In 2018, there were approximately 75,000 New Zealanders on the spectrum, with diagnosis rates projected to increase. Children diagnosed with mild to high forms of autism lack the funding and resources required for special education schooling and therefore, are expected to cope within the mainstream framework among neurotypical peers with minimal support. Currently, children with ASD are subjected to poorly designed facilities (satellite units), often unused classrooms in mainstream schools that are not purpose-built and therefore not conducive for learning. Traditionally satellite units serve children who qualify for funding, however, this project proposes a transitory facility within a mainstream school for children who otherwise would receive minimal support at a time when mitigation has the greatest impact.

This research project proposes a new architecture of education that prioritises not only learning for children with ASD but fosters a sense of agency through learning for children on the spectrum. To achieve this, the resulting architecture is established on a hybrid intervention method based on principles of flexibility and choice, correlating with sensory design and a student-centred pedagogy. In addition, this learning environment attempts to create a more supportive community for people with autism, by helping mitigate difficulties faced and raising awareness.

The design proposal combines educational and architectural theories based around learning and perception of space through analysis of existing practice. To achieve this, the research project develops a design methodology based on three avenues of spatial research: autism, education and sensory perception as the common factor bridging the existing gap. The design proposal is a combination of Magda Mostafa’s ASPECTS guidelines for ASD with the physical manifestation of David Thornburg’s primordial metaphors for learning and a variety of sensory design principles related to spatial perception.

Sensory design employs first-person experience that directly correlates to our understanding of the environment. Disparities amongst the neurotypical and neurodiverse sensory processing capabilities pose a multifaceted challenge for designing an inclusive learning environment catered to the individualistic learner of the 21st century.

The result of this project is an architecture of education that enables people with autism to learn and participate in a conducive environment. The architecture is integrated into the existing mainstream school (Three Kings School) and demonstrates a shift in current practice relating to inclusivity. By combining two schools of thought relating to architectural intervention for autism, the project creates opportunities for children with ASD to become independent and active learners.
Acknowledgements

First and foremost, I would like to thank my tutors Jeanette Budgett, Hamish Foote and all others for their guidance over the course of this project, I am indebted to you.

To my extende homeslices and all other friends who I have had the pleasure of meeting during my time at architecture school, thank you for the laughs, conversations and support.

To my brother, who unknowingly sent me down the path of architectural studies six long years ago. Thank you, your timely support made all the difference.

Most importantly, to my parents, thank you for all the sacrifices you have made to ensure I had the opportunity to pursue this degree, your endless support has been paramount.

For my Paati and Ammama,
Love Always.
1. **ASD (Autistic Spectrum Disorder)**
ASD is a developmental disability caused by differences in the brain that affects social interaction, communication, interests and behaviour.

2. **Home Base**
Home base education refers to education at the student’s home. The purpose of this is to provide a comfortable environment for someone whose learning might be affected by unfamiliar environments, such as in the case of an autistic person.

3. **Inclusion**
Inclusion in education refers to integrating students with different (neurological) capabilities. It is based on the viewpoint that a mixed experience can improve social interaction, among special needs, specifically, autistic students.

4. **ILE (Innovative Learning Environment)**
An ILE or Innovative Learning Environment is one that can evolve and adapt as educational practices evolve and change – thus remaining future-focused. This may include acoustics, open and closed spaces or a combination of the two, use of colour, etc.

5. **Neurodiverse**
Neurodiverse is a concept that recognizes that all variations of human neurological function need to be respected as just another way of being. In other words, it identifies that everybody is different and that these differences are normal, rather than deficits.

6. **Neurotypical**
Neurotypical (or NT) is an abbreviation of ‘Neurologically Typical’ which is widely used within the autism community and refers to people who are not on the autism spectrum, otherwise considered to be ‘normal’.

7. **Pedagogy**
Pedagogy is the method, and practice of teaching. It encompasses teaching styles, teaching theory, and feedback and assessment.

8. **Satellite Unit**
A satellite unit is a section within mainstream school that specifically caters to special needs students.

9. **Savant Syndrome**
Savant Syndrome is a rare, but extraordinary condition in which persons with serious mental disabilities (such as ASD) have some ‘island of genius’ which stands in marked, incongruous contrast to overall handicap.
Introduction
1.1 - Background

Education today, grows, adjusts and contours to changes in society and is personalised to the individual learner. While most children are catered for under the unifying mold of mass education within mainstream schooling, there are those who fall through the cracks of the ‘regular’ education system. Children with mental, physical and psychological disabilities account for 11% of all disabled people in New Zealand. 52% of those disabled children have difficulties learning.

Under the large umbrella of special education, Autism Spectrum Disorder (ASD) holds a unique place. Recent statistics indicate one in 68 children are diagnosed with ASD and it is four times more prevalent in boys than girls.1

While little is known about the cause of the disorder, it is not an illness, rather a neurological difference.2 Autism Spectrum Disorder is the name for a group of lifelong developmental conditions that affects communication, cognition and social interaction. As the disorder is a spectrum, its impact is uniquely varied and its effects dependent on one’s emotional and environment. People with ASD are sensitive to their environment primarily due to sensory processing deficits. Varied impact can be seen in an individual’s IQ. Some can be gifted or have severe mental disabilities while, mild forms of ASD can be and sometimes is indistinguishable from the neurotypical population.

While the cause of autism is unknown, its prevalence seems to be increasing globally. The increase from approximately three per 1000 children being diagnosed with ASD in the 1990’s to now (1/68), can be attributed to an expansion of the diagnostic criteria, higher awareness better diagnostic detection, or genuine prevalence of the disorder. The vast spectrum affects children with varying severity, which means while some children require support their whole lives, there are those who can find independence through early intervention in schooling.

The spectrum hosts children of varied abilities. ASD is often misassociated to have a large population of savants, a common misconception caused primarily by media through television and films (eg. Rain Man (1988)). While 10% of people with ASD are estimated to have enhanced or savant abilities, compared to 1% in the non-autistic population, the popular myth overshadows people with ASD who have less than or average levels of intellectual ability and capacity who make up the majority (90%).

Children diagnosed with severe autism in New Zealand are well cared for by the government in terms of educational funding from Early Childhood Education (ECE) till the completion of Secondary Schooling. Children who are diagnosed anything other than very high or high needs are offered little support and are often lost within a classroom of neurotypical children in mainstream schooling.

A school is considered to be the place where one of the most important human activities takes place; the education and development of children. Childhood is a distinct physical and mental phase experienced by everyone. It is a period when the mind is most malleable and developmental traits are formed and set for life. The necessity of developing a strong foundation in basic motor, social and behavioural skills is vital for the world of today.

Schools are educational institutions which have reflected wider society views. The 21st century has been a time of inclusion with acceptance and celebration of diversity across all fields, especially education. Currently the educational practice employed in New Zealand and globally pledges to inclusive learning. However, it poses multiple pedagogical, social, political and architectural issues.

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1.2 - Project Outline

The current approach toward inclusive learning is providing classrooms or a block unit within a mainstream school for children with cognitive disabilities, specifically ASD, to attend and participate in school-wide activities. These spaces are called satellite classes or units. Most satellite units in New Zealand use pre-existing prefabricated classrooms to house children requiring assisted learning. This calls for an urgent need for specifically purpose-built units.

Satellite units currently cater only for children enrolled in special education schools with very high or high needs. They must also qualify for a funding scheme provided by the government known as Ongoing Resource Scheme (ORS). Children who do not meet the needs for funding are thrust into mainstream schooling with little or no support.

The design outcome of this project proposes an intermediary facility (within the Satellite unit) for children transitioning from early childhood education (ECE) into primary schooling, catering for those children who are neither high needs nor neuro-typical, while continually servicing students from special schools within the unit.

Three Kings Primary School located at the intersection of Mt Albert Rd and Mt Eden Road, the beginning of an arterial road into the heart of Auckland City is an appropriate test site for a purpose-built Satellite Unit. The existing school stands above remarkable history, shares land with the Carlson Cerebral Palsy School and has a strong historic connection with the Ranfurly Veterans Home opposite. The site has potential to become a learning precinct for children of all capabilities.

The project is a three-part analysis:

1) Sensory Design/Autism/Education Literature Analysis
2) Site and Context Analysis
3) Satellite Unit Design

Three Kings Primary School, the chosen site currently does not cater for children with cognitive and complex learning disabilities. Therefore, this project is for a new design rather than remodelling existing buildings on the site. Furthermore, the site provides opportunities for a relationship to grow between the elderly in the retirement home and the children who will occupy the unit.
How can architecture create a conducive learning environment for children with autism through sensory design?
1.4 - Aims and Objectives

This project aims to develop a new way of thinking about inclusive school architecture by first identifying the shortcomings of existing models(s), then understanding the individualistic approach of 21st century learning and finally creating a conducive environment for children with ASD to learn basic life skills and find agency.

The project attempts to achieve its aims by:

- Identifying and analysing previous and existing educational models within mainstream and special education and their architectural implications
- Using sensory design as a driver to produce an outcome that is not only grounded in theory, but also functional in helping children with ASD in therapy and learning.
- Using architecture to raise awareness of the evolving educational model and highlighting the downfalls of mass education in respect to the design of school architecture due to the notion of inclusivity.

The Satellite Unit Design will be the focus of this project, specifically the learning areas such as the classrooms, play space and therapy rooms. The primary intent is to enhance the experience of schooling for children with ASD, through sensory design and break out from the existing monotonous school architecture which does not meet functional requirements of 21st century learning.

1.5 - Scope and Limitations

The scope of this topic could be set from a minute detail such as furniture design within a classroom to an entire school campus dedicated to assisting students with ASD in learning. Therefore, setting scopes and limitations will help direct the project narrative.

There is no cure for Autism. This project does not aim to find a cure, but rather use existing techniques to mitigate issues through early intervention with the help of architecture. The project focuses on spatial relationships, sensory design and a purpose-built product that can benefit children with ASD in learning.

While sensory design relates to the human experience through the commonly known five senses, it also extends to two more crucial aspects. Proprioception and vestibular sense accounts for a major part of one’s cognition, especially during the developmental stages of childhood. This project focuses more on visual, auditory, vestibular and proprioceptive senses.

Currently the Ministries of Education and Health (New Zealand) both heavily influence the diagnosis, support and building processes related with ASD. Together they have formed a guideline from diagnosis, support of people affected by ASD, education of children and adults with ASD to management and professional development. This resource is primarily based on content within the curriculum. This project does not try to implement a new curriculum or model of teaching, instead it focuses on how the existing curriculum can be implemented within the fabric of a responsive architecture.

Existing literature does not provide a definitive approach towards designing for autism due to its unique occurrence in individuals. Studies pertaining to forms of mitigation through architecture are based on empirical and anecdotal evidence, lacking ASD specific studies due to methodological issues. This project uses a mixture of the neurotypical and sensory sensitive approach in designing spaces for all children on the spectrum, with a focus on moderately affected children who are currently overlooked. The project hopes to raise awareness of children with cognitive difficulties and simplify the overwhelming transition from early childhood to primary schooling and, to provide a place to equip children with basic skills and techniques for a life of independence.

Architecture regarding educational spaces for autism generates a dichotomy within interventional methodologies. Polarities occur between existing practices in the design realm to determine the best approach toward mitigation, as well as the educational realm, regarding the concept of inclusivity.

Magda Mostafa, Simon Humphreys and Christopher Beaver are proponents of the sensory sensitive approach toward design for autism, which advocates for modified environments to help an autistic individual function comfortably psychologically and physiologically. Christopher Henry opposes by suggesting a neurological approach in which the autistic individual, with support, learns to function in a normal environment. The disparities between the two schools of thought translate into a design theory conundrum due to the lack of autism specific evidence conclusively proving or disproving either approach. Sensory sensitive supporters challenge conventional design knowledge gathered by studies based on neurotypical subjects. While the (currently implemented) neurotypical approach believes in extrapolation of tested theories amongst the general populous, applies for people with ASD, until proven otherwise. The neurotypical approach toward design for autism, educational legislation and policies are still within a mainstream environment. While informal guidelines exist currently for designing for autism, educational spaces away from instigating change. In the meantime, this project aims to provide a physical outcome based on sound principles proven to enrich the educational experience of people with ASD.

Peder Haug and Kjell Grøtt Games attempt the unrest the gaps between ideals and realities and pertains to the notion of inclusivity. Most countries have a divide between mainstream and special education within the concept of inclusion. The debate for inclusivity according to Haug exists on two levels, first, between the narrow and broad definitions of inclusion and second, between inclusion per se as a matter of place or providing learning opportunities. The quality and condition of the physical learning environment influences and informs its occupants’ behaviour. Learning environments today, appear as a cluster of varied spaces equipped to offer support for unique learning styles. The radical pedagogical shift to a student-centric model introduced by John Dewey during the educational reform (1900’s) is finally producing tangible architectural outcomes resembling educational theory. Kim Dewey and Karen Fisher’s Designing for Education: The school as socio-spatial assemblage highlights historical as well as existing teaching and learning typologies used worldwide and their spatial correlations. Furthermore, they argue for the need of an assemblage of learning spaces to co-exist for a 21st century learning environment to be successful. Comparatively, David Thornburg’s primordial metaphors for learning proposes a four-part method for designing for autism, existing interventions and gaps where change can be affected. Determining the similarities and differences between the neurological and neurotypical perceptions of space, architecture and sensory stimuli and how this may result in a hybrid approach toward designing an inclusive space for the individualistic learner.

The research project involved an intricate web of back and forth between Literature/Analysis/Design to formulate the design outcome(s).

1.6 - State of Knowledge

1.7 - Methodology

The research project involved an intricate web of back and forth between Literature/Analysis/Design to formulate the design outcome(s).

Linking sensory, autism and educational theories to create a design toolkit to utilize while making design decisions. Extract architectural implications of design parameters and sensory perception literature (as summarised below each section).

Design

Applying elements carried into toolkit from literature and analysis through hierarchy based on reason and intent to design the Three Kings School Satellite Unit.
Literature 2-3
2.1 - What is Autism Spectrum Disorder (ASD)?

ASD is defined as a neurological disorder characterized by difficulties in communication, socialisation and concentration. People with ASD tend to exhibit a narrow field of repetitive behaviour. The disorder is a spectrum condition uniquely affecting people in varied ways, with people functioning on higher or lower ends of a continuum based on individual situations.6

2.2 - Origin

Coined in 1911 the term "autism" was used by psychiatrist Eugen Bleuler to describe a schizophrenic symptom of a patient that was withdrawn from the world. The term itself originates from the Greek word 'autos' meaning self. In 1943, child psychiatrist Leo Kanner studied 11 children who exhibited difficulty with social interaction and the vast contrast in Kanner's (disproven) claim of origin of autism ('or maternal deprivation).8

Hans Asperger was working separately in Vienna with children who resembled Kanner's descriptions.9 They did not have linguistic problems but were clumsy and lacked fine motor skills. Unfortunately, Asperger's work [later known as Asperger's Syndrome (AS)] would not be realised in the English-speaking world for decades after it was published (1991). A key difference in diagnosis of Asperger's patients was overachievement in specific cognitive domains, now known as high-functioning autism. The high-functioning cognitive and linguistic skills coupled with qualitative differences in social interaction and the vast contrast in Kanner's (disproven) claim of origin of autism (being 'or maternal deprivation) led to the origin of autism (being 'high-gigantor-mothers' or maternal deprivation) helping distinguish Asperger's Syndrome (AS) and autism as separate entities. Although the disabilities were subtly different Lorna Wing, a UK expert in ASD alluded to Kanner's autism being a spectrum which included Asperger's Syndrome (AS).10 After much debate over diagnosis processes, similarities between AS and High Functioning Autism (HFA) and research for mitigation, the American Psychiatric Association (APA) merged AS into a unitary category of ASD in their latest edition of Diagnostic and Statistical Manual of Disorders (DSM-5) in 2013. (For the official diagnostic + method of diagnosis in NA see appendix 1)

2.3 - Overview of Education for ASD in New Zealand

Education was declared a human right in 1948 under the Universal Declaration of Human Rights. The declaration demands compliance of accessible, affordable (free) and compulsory education in the fundamental stages of human life. The article goes onto outline the quality of "education to be directed to the full development of the human personality and to the strengthening of respect for human rights and fundamental freedoms."11 Fundamental freedoms such as speech, thought, belief and expression are formulated in the earlier stages of human life. For children with ASD these freedoms are more difficult to attain. In New Zealand Special Education became recognised within the Education Act 1989. Unfortunately for many that time, disabled children were institutionalised under eugenic based ideologies advocating no future for children with mental or physical disabilities.12 Many children today with low to mild autism would have been sent to psychiatrists institutions to live out their lives. The Education Act states "people who have special education needs (whether because of disability or otherwise) have the same rights to enrol and receive education at state schools as people who do not." (reference act directly). The Act marked the first step toward "inclusive education", which stipulates all students are welcome and can participate in all aspects of school life, therefore shifting the focus of disability support from a medical standpoint into the realm of education (learning support). Progressive curricular advancements made through legislation and policies have come fruition in the form of tangible implementation, however are they are yet to be translated into the architectural realms.


Regarding architecture and autism, a gap remains in successful and accessible built environments for children with varied severity of ASD. Inclusivity within the curriculum means learning together in the same environment. Unfortunately, this notion has stalled architectural growth of the (inclusive) school typology. Existing solutions for inclusivity emerge from accommodating a few special needs children into a mainstream class and therefore designing classrooms and other spaces to the standards of children with higher needs is infeasible. However, Satellite Units provide an opportunity to reimagine school typology. A niche consisting of children from special needs schools learning in mainstream schools to enjoy selected inclusive activities. No doubt the Ministry of Education’s (MEd) goal is to have a completely universal system where children of all abilities can coexist in one classroom, however the reality of being different, celebrating those differences while being given equal opportunities supersedes the utopian vision.

Education in New Zealand is supported by the government (Ministry of Education) in various ways from Early Childhood Education (ECE) through Secondary School Education. New Zealand is a leader in learning support in Satellite Units must have ORS to qualify, which means children attending mainstream schooling while being enrolled in a special school belong to the 1% and have very high or high needs requiring support. Meanwhile the remaining children with ASD are thrust into mainstream school unless their parents have the means to educate them privately. ORS for a child with ASD funds resource specialists, speech and occupational therapists, and most importantly teacher aides. Teacher aides provide one-on-one assistance for children and are arguably one of the most instrumental elements for children formulating techniques to cope with their environment. It is evident there is no cure for ASD, however through intensive intervention and continued support, children can form habits to help mitigate effects of the sensory environment in daily tasks and help them navigate independent lives by the agency of communication and social interaction. Simply put, the most effective way to manage ASD would be to provide full-time one-on-one assistance to children, especially in their initial years of schooling. However, this is not possible due to a lack of resources and feasibility wherein lies the difficulty for children with ASD and teachers in mainstream schooling without external support.

Children with ASD outside the supported 1% with learning difficulties and external support, children can form habits to help mitigate effects of the sensory environment in daily tasks and help them navigate independent lives by the agency of communication and social interaction. Simply put, the most effective way to manage ASD would be to provide full-time one-on-one assistance to children, especially in their initial years of schooling. However, this is not possible due to a lack of resources and feasibility wherein lies the difficulty for children with ASD and teachers in mainstream schooling without external support.

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2.4 - How Autism Affects an Individual

A primary characteristic of ASD includes a heightened sensitivity to the environment. The role of the sensory environment in autistic behaviour has been debated since the disorder was first defined by Leo Kanner in 1943. Magda Mostafa’s ‘ARCHITECTURE FOR AUTISM: Autism ASPECTSS in School Design’ highlights the relevance of sensory stimulation, using historic advocates such as Bernard Rimland and Carl Delacato who hypothesized autistic behaviour to be a result of sensory perception malfunction.17 Temple Grandin described autism as “seeing the world through a kaleidoscope and trying to listen to a radio station that is jammed with static at the same time.” Add to that a broken volume control, which causes the volume to jump erratically from a loud boom to inaudible.18 People with ASD sometimes have abnormal responses to incoming sensory stimuli from the surrounding environment. While neurotypical people can integrate their senses cohesively to navigate their surroundings, People with ASD are unable to participate ‘normally’ in mainstream environments. 

Hyper or hypo-sensitivity is present for all senses including auditory, visual, olfactory, gustatory, and tactile. Such overreacting to sensory stimuli alike. 

A primary characteristic of ASD includes a heightened sensitivity to the senses and their perception of the world. Hyper or hypo-sensitivity can be seen in the unusual reactions toward sensory input. The four patterns are: seekers, avoiders, bystanders, and controllers. While everyone has a unique sensory processing consideration, Winnie Dunn’s model for sensory processing highlights four basic patterns of how people with ASD react to sensory stimuli in their surroundings. The sensory stimi in the environment correlate to the five senses mentioned earlier (sight, hearing, touch, proprioceptive and vestibular) and controlling their input through modification of factors are discussed below, such as: light, colour, acoustics, texture, proxemics, spatial considerations etc.21

2.5 - Hyper / Hypo Sensitivity

An autistic person’s perception of space, or lack thereof, can be attributed to their hyper or hypo sensitivity to external stimuli. The inability to shift between various forms of stimuli causes an overload, giving individuals with autism an altered sensitivity to the senses and their perception of the world around them. Hyper or hypo-sensitivity is present for all senses including vestibular movement, proprioception and proxemics. The result of needing (hypo) or not needing (hyper) sensory stimuli can be seen in the unusual reactions exhibited by autistic people. These responses, while seeming odd to the neurotypical observer, is in fact an attempt to recalibrate control over one’s environment through generating or rejecting sensory stimuli alike.21

Architecture has the capacity to positively influence behaviour of individuals with ASD who are clearly affected by the sensory stimuli in their surroundings. The sensory stimuli in the environment correlate to the five senses mentioned earlier (sight, hearing, touch, proprioceptive and vestibular) and controlling their input through modification of factors are discussed below, such as: light, colour, acoustics, texture, proxemics, spatial considerations etc.21

21 Winnie Dunn’s model for sensory processing highlights four basic patterns of how people with ASD react to sensory input and suggests specific intervention strategies. While everyone has a unique sensory processing system, everyone can be categorised into a pattern based on their habitual reactions toward sensory input. The four patterns are: seekers, avoiders, bystanders, and controllers.21


A seeker requires a dense sensory experience which when unavailable results in self-stimulating actions such as the need to touch surroundings, hum, tap and frantically shake their legs. An avoider is the opposite of a seeker. An individual who is often overwhelmed by the flooding of sensory input, needing physical refuge from crowds, visually cluttered spaces and various scented spaces. Sensors are extremely particular about their sensory input. Their behavioural characteristics include attention to detail and discriminating abilities relating to all the senses. Sensors can differentiate between brands of the same product, specific textures and temperature etc. Often, sensors are portrayed as having OCD (Obsessive-Compulsive Disorder) or being pedantic.

Lastly, bystanders are the opposites of sensors. A bystander would be oblivious to sensory input noticed easily by others. Bystanders are not fazed by minor details, they can concentrate in busy places which would be challenging for others.

Dunn’s conceptual model provides designers with spatial considerations for a variety of users based on their habitual responses. These include options such as: spaces of refuge for avoiders, visual, audio and tactile prompts for bystanders, communal areas for seekers and self-regulating activities mimicking daily life for sensors.

Studies conducted by Mostafa and others suggest people with ASD are more likely to find sensory input through touch and sound most challenging amongst others. However, it would be impossible to design communal spaces such as schools and classrooms to cater for every individual’s sensory processing system. Dunn summarises two basic strategies under which most forms of intervention takes place.

Reducing or enhancing the sensory stimuli of the situation and/or

Providing the child with cognitive strategies to regulate their responses to the situation

The former technique presents more scope for architectural intervention as the latter depends on behavioural and curricular adjustments. The table below further illustrates some of the potential reactions to hyper and hypo-sensitivities faced by an individual with ASD.

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### Sensory Overload

<table>
<thead>
<tr>
<th>Sense</th>
<th>Hypo-sensitive</th>
<th>Hyper-sensitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auditory</td>
<td>Does not respond when name is called; Enjoy strange noises; Enjoying making loud, excessive noises.</td>
<td>Overly sensitive to loud noises; Appears to hear noises before others; Cannot function well with background noise.</td>
</tr>
<tr>
<td>Tactile</td>
<td>Touches people and objects unnecessarily; Has abnormally high pain threshold (does not appear to hurt after a hard fall); Does not appear to feel extreme temperatures</td>
<td>Avoids wearing certain fabrics; Becomes distressed during grooming; Does not like being wet or going barefoot; Reacts negatively to being touched.</td>
</tr>
<tr>
<td>Visual</td>
<td>Disregards people or objects in environment; Can see only outlines of certain objects; Likes bright colours and bright sunlight</td>
<td>Bothered by bright lights (covers eyes or squints); Easily distracted by movement; Stares at certain people or objects.</td>
</tr>
<tr>
<td>Vestibular</td>
<td>Moves around unnecessarily; Enjoys spinning in circles; Becomes excited about any task involving movement</td>
<td>Seems unbalanced; Becomes distressed when upside-down or when feet leave the ground.</td>
</tr>
<tr>
<td>Smell/Taste</td>
<td>Some reports of Pica or eating non-food substances; &quot;Feels&quot; objects with mouth’; Seeks out strong smells; Oblivious to some scents</td>
<td>Picky-eater; Won’t eat foods with particular smells, or at certain temperature.</td>
</tr>
<tr>
<td>Proprioception</td>
<td>Unaware of body position in space and body sensations like hunger; Often lean against people or objects</td>
<td>Odd bodily posture; Uncomfortable in most positions; Difficulty manipulating small objects.</td>
</tr>
</tbody>
</table>

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26 Dunn et al., "Many Perspectives," 27.
29 Dunn et al., “Many Perspectives,” 30.
2.6 - Fixations and Interests

Aside from hyper and hypo-sensitivities, people with ASD are famously known to have narrow interests, sometimes genius level mastery of specific subjects. Famous autistic people include Albert Einstein, Mozart, Nikola Tesla, Bill Gates and Steve Jobs. 18

Kristi Gaines and others in "Designing for Autism Spectrum Disorders", group having narrow interests as repetitive behaviours and suggest a possible explanation for exhibiting such tendencies occur due to a lapse or lack of executive functions. Executive functions contain cognitive processes such as concentration, planning and attention, all which people with ASD have little to no control over. Consequently, this leads to poor impulse control, inflexibility and unusual behaviour. 19 Contrary to the general population’s understanding of ASD, not every autistic person will make the history books for their contributions towards their specific field of interest. However, as all children do, children with ASD too, develop particular interests which often become obsessions; relating back to the need and insistence for rigid, repetitive behaviours towards routine and physical environments. Individuals with ASD have strong preferences for predictability which can aid or disturb their interaction with the environment. 20 While obsessions can appear disruptive, Temple Grandin believes they can create opportunities for learning and provide a segue into mainstream career paths. Grandin enforces the importance of fostering an autistic child’s fixations by providing her own life experiences as an example. As a child Grandin’s interest was drawing; specifically, drawing horses. Her mother noticed her interests early and pushed her toward drawing a variety of things. In high school, Grandin’s science teacher provided a segue (in the form of an optical illusion drawing) for her interest of art to manifest into the monumental work she produced later in cattle farming. 21 The importance of utilizing an autistic child’s fixation to generate interest into other subjects is crucial not only to influence behaviour at a certain time, but to help equip them with the tools to navigate a life of independence and fulfillment.

As the effects of ASD regarding sensory processing deficits and the positive influence of sensory design as a form of mitigation is gathered primarily through empirical and anecdotal research, recent literature questions the weight and role of the sensory environment and its dynamic relation to autistic behaviour.

2.7 - Understanding Perception - Neurotypical vs Autistic

Sensory design relates to how the human mind perceives, understands and reacts to spatial constructs. Complete understanding of spatial constructs is dependent on two factors, perception and mediating intelligence. Perception can be simply defined as the process of recognising, interpreting and responding to sensory stimuli available in an environment. The sensory information is gathered through our sense organs’ receptors, organised and evaluated with memory and responded to through how we interact with the environment. Problems arise for people with ASD when the sensory stimuli in a given environment under-stimulates or overstimulates them. The differences between neurotypical and autistic perception is compared and discussed below.

2.7.1 - Response & Experience

An experience is dependent on how we perceive, respond to and interact with the world around us. Comprehension of objects in space relies on sensory data filtering through memory, however, sensation (raw data) is merely not enough, perception (processing and interpretation) too factors into the experience one has. Joy Malnar and Frank Vodvarka’s ‘Sensory Design’ suggests humans experience three kinds of sensory responses: “first, an immediate physical response to stimulus, often involuntary; second a conditioned response based on prior knowledge of its source; and finally, a response to stimulus as it has been identified in an individual’s memory associated to a specific time and place”.

The first response, is a qualitative evaluation of the building or space (‘intimate’, ‘monumental’, ‘cramped’ etc.) based on the reaction of the sense organs to the stimuli. The initial response establishes a ‘mood’ which does not necessarily, and often is not aligned with the building’s function or meaning. The second response produces multiple reactions based on the character of the stimuli and our understanding of the source, often an inquiry (is this familiar?). The third and final response is remembered sensation(s), which if strong enough can reconstruct places. However, irrespective of the power of a mental image, memory remains a nuanced and selective ‘version’ of an experience information is gathered through our sense organs’ receptors, organised and generalised for a variety of individuals. Remembered sensations or memories are dynamic experiences which flash into consciousness, frequently being refined and reinforced through new experiences. While these mental images are a repository of information gathered through the sensorium, Frances Downing states “such images present to the mind much more than just an initial remembered percept; it contains multiple versions of involvement that reach into the emotional and intellectual realms.”

For example, a memory of one’s childhood backyard can evoke not only sensory experiences such as the shade offered by trees or the smell of freshly cut grass but also the emotional facets of belonging, safety and identity. James Gibson suggests, “we do not see all that is available to be seen, or even all that is reflected on the retinas of our eyes. We see what we have learned to see… we attribute qualities or referents to external objects or events, which based on experience, are relevant to our condition.” If reality itself is in fact subjective, how then can one invoke a sensation or ‘feeling’ perceived by all users experiencing a given space?

Thomas Thiis-Evensen’s theory of ‘Archetypes in Architecture’ provides a theory for achieving shared experiences, which has the potential to enhance learning and the accompanying environment for autistic individuals. He claims architectural forms and their communicative aspects are dependent on the recognition of varying experiential levels: private, social and universal. Private experiences refer to the personal experiences we as individuals possess, social experiences relate to common cultural associations and universal experience is defined as ‘spontaneous and unconscious reactions to architecture... independent of symbolic associations’. Shared experiences are based on recognition with reference to our bodily experiences and therefore common to all people as they are gained through confrontations with the world around us. The interactions one has with nature forms a complex web of references which make up the basis for our reactions when we move in relationship to objects in space. Forces of nature such as gravity, day and night, rain and sunshine are common for us as a species, and therefore shared experiences of bodily experience is further emphasised by Geoffrey Scott, who concurs “we unconsciously identify with weight, pressure and resistance in the forms we see... and the quality of light may induce a similar sense of unease for the experiencer). The notion of weight and substance therefore a space designed to not allow penetration implies a notion of architectural elements equate to the floor, wall and roof working in unison to accomplish fundamentally a balance of forces between inside and outside, a “battle [which] is an existential prerequisite for mankind.” Furthermore, these elements contain within them an expression of weight and substance which inform and induce common qualitative experiences. (For example, night time is considered eerie, invoking a sense of unease or fear, therefore a space designed to not allow penetration... achieves shared experiences, which has the potential to enhance learning and the accompanying environment for autistic individuals.

On prior knowledge of its use based on function through past experiences, however the physical experience of passing the threshold is based on the existence of doors. In that, a narrow and short opening of a thick wall infers a tight fit possibly into a smaller space beyond, and a wide and tall opening consequently infers the opposite. This-Elven concludes, “what the surroundings do and what we can do in them are not related to experiences coming differently from individual to individual, rather they exist as different possibilities within the same offer”. Therefore, while multi-sensory spaces offer various possibilities for children with ASD catering to individual needs, existential expression which fundamentally effects our architectural experience can be planned and designed in a way to induce a shared experience.

Thomas Thiis-Evensen’s universal architectural language which can be formed through analysing the interaction between users and their environment. The ‘shared experience’ felt through natural forces translates into architecture as a result of universal elements. Thiis-Evensen’s notion of architectural elements equate to the floor, wall and roof working in unison to accomplish fundamentally a balance of forces between inside and outside, a “battle which is an existential prerequisite for mankind.” Furthermore, these elements contain within them an expression of motion, weight and substance which inform and induce common qualitative impressions.

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This notion secures the intangible aspects of education and ASD design theory into reality by characterising 'feelings' with physical interpretations. Thorburn’s cave space for introspection could be translated into a heavily walled, sunken floor, narrow doored and downward angled roof to mimic a common image of a naturally formed cave which will simulate similar psychological and physical experience of being outdoors in a cave. Similarly, a different combination of the elements (floor, wall and roof) would provide a different formal outcome but could induce the same atmosphere. The fundamental aspect of design then shifts to the forms of the elements selected reflecting the designer’s intended expression.25

Thiis-Evensen’s architectural elements and their expressions can be coupled with J.J Gibson’s sensory systems (illustrated in next section) to investigate how various architectural features can be interpreted. While Thiis-Evensen simplifies architectural expression to the only elements (floor, wall, roof), the idea of expressing motion, weight and substance can be translated to other features within architecture, as they basically are in another form one other features within architecture, as they basically are in another form one fundamental aspect of design then shifts to the forms of the elements.

The psychological passing through of a space prior to physically experiencing it, (mentioned above) relates closely to the Prospect-Refuge theory.26 The Prospect-Refuge theory developed by Jay Appleton (conceptualised by Konrad Lorenz) proposes that the need to see without being seen27 is an intrinsic human trait, instilled for survival. Appleton claims humans by Konrad Lorenz) proposes that the need to see without being seen27 is an intrinsic human trait, instilled for survival. Appleton claims humans

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communications function of architecture has held weight across all doctrines within architecture. Formalist architect Ludwig Mies van der Rohe states “it is explicitly related to facts, but in the realm of significance... architecture depends on its time.” Simply put, if architecture was to be defined with a primary purpose, it would be provision of shelter for the physical activities of mankind. Meanwhile, the communicative function of architecture would not be considered important.


delaying affecting children with ASD. Due to the nature of people with ASD being hyper and hypo-sensitive to sensory stimuli, Hall’s model of proxemics relates especially to children with ASD learning in the same environment. Children may have greater or lesser tolerances regarding their territorial boundaries. Hypo-sensitivity to proprioception will result in larger personal space requirements as individuals will rely on interacting with objects around them to help orient themselves. On the contrary, a tactilely hypersensitive individual would consequently have smaller tolerances for all zones of interpersonal distances.12 Hall’s model of proxemics further reinforces the importance of providing children with ASD opportunities for controlling their level of engagement and participation in an environment as diverse as classrooms can be. 2.7.2 - Meaning Symbolism, significance and meaning plays an integral role within our understanding of spatial constructs and architecture. Symbolism and meaning are often misunderstood as a lack of empathy among people with autism. Lack of understanding social cues, the situation’s behavioural expectations and other people’s emotions, has been misunderstood as a lack of empathy among people with autism. Lack of understanding of spatial constructs and architecture. Symbolism, significance and meaning plays an integral role within our lives. The forms of architecture too hold a strong referential importance. Understanding forms acting as signs and symbols for other objects or situations. Perceptual and conceptual meaning relates to the common understanding of forms acting as signs and symbols for other objects or categories. Presentational meaning contains both presentational and referential meanings within it. Presentational meaning encompasses forms not acting as signs due to no previous experience to draw from, instead they are observed forms themselves. On the contrary, a tactilely hypersensitive individual would consequently have smaller tolerances for all zones of interpersonal distances.12

12 Hershberger, Architecture and Meaning, 39.


14 Robert Hershberger in ‘Architecture and Meaning’ summarises various types and levels of meaning which may be used when designing buildings. Existing thoughts range from diverse strands of thinking including mentalistic, behavioural, dispositional, mediational and linguistic theories. Hershberger categorises two types of architectural meanings within an internal stimulus-response situation; representational and responsive (with several sub-categories). Representational meaning contains both presentational and referential meanings within it. Presentational meaning encompasses forms not acting as signs due to no previous experience to draw from, instead they are observed forms themselves. On the contrary, a tactilely hypersensitive individual would consequently have smaller tolerances for all zones of interpersonal distances.12

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The Gestalt principles are a set of laws describing how humans typically see objects by grouping similar elements, recognising patterns and simplifying complex images as well as interacting with their environment. The core of the theory is "the whole is other than the sum of the parts." The primary ability to organise perceptions into a coherent whole as opposed to individual pieces, is a cognitive processing disability for people with ASD. Bogdashina states the neurological mind has the capacity to "fill in the gaps" and predict the final picture, as opposed to an individual with ASD who is unable to break down the whole image or situation due to the inability of processing large amounts of stimuli simultaneously. On the contrary, people with ASD have an acute ability to focus on the parts of the whole.60

Alongside the inability to understand whole situations, interactions and experiences, people with ASD are known to lack the ability to generalise skills learnt in one setting and apply it to another (discussed later). This further reinforces the presentational understanding patterns of people with ASD, being stuck in an infinite loop of an inability to categorise objects and interactions, unable to create a web of experiences to draw from. Temple Grandin suggests people with ASD learn about social interactions and emotions by experiencing them.61

"The primary ability to organise perceptions into a coherent whole as opposed to individual pieces, is a cognitive processing disability for people with ASD."60

"The whole is other than the sum of the parts."60


61 "The need to engage - dispositional不开放空间 suggests one should walk into the large open space. Relating back to the description of forms directing a certain action. Relating back to the architectural model of the door (as mentioned earlier) determines the user's perception and experience: his memories, purposes and values. Our dependence on internal or external representations is dependent to a large extent on a person's mind, predominantly applying presentational and prescriptive meanings to the object itself, but is referring to something else. The Gestalt principles are a set of laws describing how humans typically see objects by grouping similar elements, recognising patterns and simplifying complex images as well as interacting with their environment. The core of the theory is "the whole is other than the sum of the parts." The primary ability to organise perceptions into a coherent whole as opposed to individual pieces, is a cognitive processing disability for people with ASD. Bogdashina states the neurological mind has the capacity to "fill in the gaps" and predict the final picture, as opposed to an individual with ASD who is unable to break down the whole image or situation due to the inability of processing large amounts of stimuli simultaneously. On the contrary, people with ASD have an acute ability to focus on the parts of the whole.60

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"The whole is other than the sum of the parts."60

Contrary to the Classical senses, modern psychologists have introduced various other senses (temperature, pain, internal senses, vestibular, proprioceptive and principal senses) which are not based on any specific sensory organs. Autism is widely known to involve seven senses, the traditional five and vestibular and proprioceptive senses. J.J Gibson proposed humans utilise their senses as a highly integrated, inclusive, information-seeking mechanism made up of five interlinked systems: Visual system, Auditory system, Smell-Taste system, Basic-Orienting system and Haptic system.

The last two systems mentioned are crucial for understanding three-dimensionality and therefore experience of space and architecture. The basic orientation system refers loosely to Thiis-Evensen and Haptic system incorporates the sense of touch extended to include pressure, pain, temperature and kinaesthesia. Pallasmaa goes one step further and states “all the senses can be regarded as extensions of the sense of touch – as specialisations of the skin.” This shift in understanding of perception assists proprioceptive tendencies among people with autism. Learning motor-skills in the developmental years relies heavily on one’s proprioceptive and vestibular senses, therefore, the kinesthetic aesthetic of a learning environment should be equally, if not more important than the visual experience. More research needs to be done in the realm of proprioception in autism spectrum conditions.

All senses utilise receptors or neuropsychological pathways to interpret stimuli. The understanding of biological semantics regarding the perceptual senses are not the focus of this study, however, it is important to note various perceptual senses exist, that are not reliant on any specific sensory organ, but very much exist in one’s psyche. These perceptual senses include time, agency and familiarity. They appear to be intangible and subjective which predominantly are, however, they can be manifested into the built environment through symbolism and shared experience.

The understanding of biological semantics regarding the perceptual senses exist in multi-dimensionality including head and whole body. These perceptual senses include time, agency and familiarity. They appear to be intangible and subjective which predominantly are, however, they can be manifested into the built environment through symbolism and shared experience.

Sense of agency refers to the feeling of control over actions and their consequences. Dissimilar to other aspects of conscious experience, the sense of agency is not an accurate reproduction of objective reality and is hard to measure due to methodological issues. While various theories (Comparator Model and Theory of Apparent Mental Causation) exist in the conceptual understanding of the sense of agency, it is the contention of this project that architecture alone cannot allow users to feel a sense of agency, instead it can provide opportunities for users to act (experience their surroundings) in certain ways, therefore inducing the sense of agency.

Agency within the educational realm translates directly into the idea of learning and the transfer of learning. The ultimate goal of learning is to have access to information for a wide set of purposes. The idea of school learning transferring into everyday home life is a fundamental change which opposed ‘formal discipline’ theory, which primarily involved rule learning through general skills building or mental muscle performance. All senses utilise receptors or neuropsychological pathways to interpret stimuli. The understanding of biological semantics regarding the perceptual senses are not the focus of this study, however, it is important to note various perceptual senses exist, that are not reliant on any specific sensory organ, but very much exist in one’s psyche. These perceptual senses include time, agency and familiarity. They appear to be intangible and subjective which predominantly are, however, they can be manifested into the built environment through symbolism and shared experience.

Ironically, the lack of skill transfer and generalisation affects people with ASD due to developmental delay, making learning basic skills at an early age difficult compared to a neurotypical person. While the curriculum for ASD education remains outside the scope of this project, agency can be attributed through spatial navigation (wayfinding) and understanding sensory cues. Orientation and sense of place allows one to identify with or locate spaces, which can be regarded as the most primitive form of agency - to know where one is. Research states spatial navigation utilises visually as a means of navigation to manipulate through space and promote sense of agency.
the same neural network as episodic memory, which is categorised under impairments among other cognitive processes for people with ASD. A study proving significantly diminished performances of tasks relating to episodic memory suggests individuals with ASD have impaired navigation skills due to difficulties in generating cognitive maps of one’s surroundings. This creates a design opportunity in the means of navigation to induce a sense of agency.

As discussed in the section above, there are large disparities between the neurotypical and autistic brain regarding perceptions and experiences of space and architecture. It is obvious that current neurotypical environments do not correlate with the needs of an autistic user. Nonetheless, children with ASD currently learn in mainstream classes, where the classrooms are designed for neurotypical learners. The successes and downfalls of the current typology for learning environments are discussed later, however the two forms of architectural intervention available and employed to mitigate the effects of ASD are discussed below.


2.8 - Architectural Approaches for Mitigating Autism

A debate exists between two schools of thought in relation to autism and how it might be mitigated through architectural intervention. Developmental psychologists are yet to identify the defining causes of ASD however, “a question mark hangs over the ‘sensory phenomena’, which are often reported but not currently required for diagnosis.” The two approaches are:

Neurotypical Approach

The neurotypical approach advocates for participation of the autistic user into a typically simulating environment in order to encourage functioning in the ‘real world’. This in turn aims to foster skills of adaptation to counter any over-stimulation an autistic individual may encounter.

Proponents: Christopher Henry,

Sensory Sensitive Approach

The sensory sensitive approach pertains to modifying an environment in the favour of its users to positively influence their behaviour.

Proponents: Magda Mostafa, Simon Humphreys, Christopher Beaver

There is a wide belief that people with ASD lack generalisation skills. This appears to be a more universal difficulty when compared to sensory processing abnormalities. Generalisation allows us to transfer skills learnt in one scenario and translate them into various situations intuitively. Individuals with ASD find it difficult to integrate information and generalise previously learnt concepts to new situations. Laura Klinger and Geraldine Dawson’s ‘Prototype formation in autism’ hypothesises an inability among autistic children to abstract a summary representation during category learning, which suggests children with ASD categorise instead by memorising a set of rules that are not transferable when learning a new category, thus imprisoning them to the specific environment where they learnt the skill. This view makes a strong argument against the provision of sensory sensitive spaces which may be beneficial during early intervention, but hinder transition into neurotypical environments where children will be unable to apply skills learnt prior in a controlled setting.


80-85 inability to generalise a skill learnt in one environment and transfer to another by virtue of an environment of people with ASD.

Scenario 1

Scenario 2

Scenario 3

World

FIG 50: Neural network (visualisation) of episodic memory and spatial navigation

FIG 51: Achieving sense of agency through providing choices

FIG 52: Inability to generalise a skill learnt in one environment and transfer to another (Primary shortcoming of people with ASD)
Proponents of the sensory sensitive approach counter the generalisation debate by arguing the need for a child with ASD to learn a skill prior to being able to generalise it. If a skill is unattainable or only attainable with difficulty in a neurotypical simulated setting, then the act of generalisation becomes impossible, and taking the neurotypical approach toward educating children with ASD becomes impossible. Another argument for sensory sensitive spaces maintains that a societal responsibility is necessary for individuals with learning and cognitive difficulties to not need to conform to mainstream standards of learning. Why should individuals with learning disabilities have to subscribe to the ‘typical’ standard for access and acceptance of society? This neurotypical approach also assumes that current neurotypical learning environments represent the best spaces to learn in. It is often forgotten mainstream school typologies and design did not always prioritise assistance in learning as much as solve a simple mathematical conundrum of accommodating as many students per classroom as physically possible. Thus, raising questions regarding the functionality of current mainstream learning environments, the effectiveness of ILEs (Innovative Learning Environments) and the notion of inclusivity realistically being attainable, rather than a mere utopian buzzword (discussed in a later section).

Having no theoretical ASD specific evidence for either argument, this project utilises a hybrid (neurotypical + sensory sensitive) approach toward designing for ASD, drawing from studies and theories based on neurotypical subjects as well as anecdotal data gathered for ASD theories. There also exists a secondary agenda of providing spaces to encourage eventual generalisation abilities, to foster independence and successfully transition children into mainstream schooling.

Design parameters discussed below stem from the two opposing mitigation approaches of architectural intervention illustrated above. Each element of design discussed will be included as part of a ‘design toolkit’ to provide guidelines for the design outcome.

2.9 - Design Parameters for Autism

An increased world interest in mental health awareness has led to an opportunity to revise principles for design of public spaces (such as schools) where neurodiverse people may interact with the neurotypical population. The requirement for a change in design parameters stem from the (aforementioned?) debate regarding current typical environments not being the ‘best’ possible spaces to thrive in. Perhaps, by overcompensating design outcomes to aid the cognitively challenged, neurotypical users could also benefit from a richer experience of architecture. However, this school of thought opposes the existing mode of practice (neurotypical approach) where people with special needs are assimilated into the neurotypical environment and expected to succeed. The argument to employ a sensory sensitive approach to cater for the minority (neurodiverse users with cognitive and behavioural deficits) in all forms of design is riddled with economic questions.

Yet, within the context of school design architecture, there exists a significant overlap in functional requirements for all children (neurodiverse and neurotypical), varying only in the degree of application.

The primary architectural design parameters outlined by various professionals include: Lighting, Exterior Views, Spatial Considerations, Auditory Performance and Colour.

The primary architectural design parameters outlined by various professionals include: Lighting, Exterior Views, Spatial Considerations, Auditory Performance and Colour. These parameters have within them sub-categories, as well as disputes regarding their validity of effectiveness for people with ASD.


88 Dunn et al., “Many Perspectives.”
2.9.1 - Lighting: Lighting design for people with autism consists of two subcategories, daylighting and artificial (fluorescent) lighting. Sensory sensitive approach advocates, both architects and researchers are against (direct) fluorescent lighting. There exists a belief that people with autism are vulnerable to the supravisional flicker of fluorescent lighting which leads to headaches, nausea and even vomiting, coupled with the life-saving hum often created in standard fixtures. Numerous cases report children with ASD often distracts in a reasonably calm environment, suddenly displaying stressful behaviour (head-banging, fidgety fingers, stomach, confusional, tonic-clonic seizure) or disengage with artificial lighting of spaces. Christopher Beaver, a pioneer ASD related architect claims artificial lighting is the “single most difficult element to get right in an autism-friendly environment.” Henry argues illuminating perimeter lighting where the light source is not visible to cause distraction and in turn provides an even light coverage. Shabha and Gaines support Beaver’s claim by determining visual triggers such as the source, intensity and luminance of daylighting and artificial lighting. Sensory sensitive approach to architectural intervention. Christopher Henry’s ‘Designing for Autism: Lighting’ summarises various architect’s design practices for autism related architecture. Like most of the existing research regarding design for autism related architecture, daylighting too, lacks conclusive proven evidence for or against the use of daylight, Henry cumulatively interviewing various architectural firms involved in designing for cognitive challenges, there exists a divide in adhering of theory. Some designers oppose conventional knowledge regarding design for most of the population base on data collected through anecdotal evidence of individuals with ASD. Bogdashina and others claim, “many autistic people confirm bright lights and sunshine disturb and often cause distortions.” This suggests employing architectural elements that allow direct sunlight penetrations such as skylights, clerestories and windows may be counterproductive for learning environments due to shadows and glare. Daylighting comparatively, raises two schools of thought rooted deeply within the opposing positions of the sensory sensitive and neurotypical approach to architectural intervention. Christopher Henry’s ‘Designing for Autism: Lighting’ summarises various architect’s design practices for autism related architecture. Like most of the existing research regarding design for cognitive challenges, there exists a divide in adhering of theory. Some designers oppose conventional knowledge regarding design for most of the population base on data collected through anecdotal evidence of individuals with ASD. Bogdashina and others claim, “many autistic people confirm bright lights and sunshine disturb and often cause distortions.” This suggests employing architectural elements that allow direct sunlight penetrations such as skylights, clerestories and windows may be counterproductive for learning environments due to shadows and glare. On the contrary, vast research exists which indicates positive effects of daylighting for neurological people on cognitive abilities, productivity and overall health. Advocates both architects and researchers are against (direct) fluorescent lighting is the “single most difficult element to get right in an autism-friendly environment.” Henry argues illuminating perimeter lighting where the light source is not visible to cause distraction and in turn provides an even light coverage. Shabha and Gaines support Beaver’s claim by determining visual triggers such as the source, intensity and luminance of daylighting and artificial lighting. Sensory sensitive approach to architectural intervention. Christopher Henry’s ‘Designing for Autism: Lighting’ summarises various architect’s design practices for autism related architecture. Like most of the existing research regarding design for cognitive challenges, there exists a divide in adhering of theory. Some designers oppose conventional knowledge regarding design for most of the population base on data collected through anecdotal evidence of individuals with ASD. Bogdashina and others claim, “many autistic people confirm bright lights and sunshine disturb and often cause distortions.” This suggests employing architectural elements that allow direct sunlight penetrations such as skylights, clerestories and windows may be counterproductive for learning environments due to shadows and glare.

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95 Dunn et al., “Many Perspectives,” 51.
96 Ghasson Shabha and Kristi Gaines, “A comparative analysis of transatlantic design interventions for therapeutically enhanced learning environments – Texas vs West Midlands,”
100 Dunn et al., “Many Perspectives,” 51.
102 Henry raises an intriguing argument for utilising daylighting in designing for autism regardless of the unknown. The world of special education is plagued by high attrition rates, especially in the form of ever-changing staff. Therefore, a conscious attempt to design for lower attrition rates of staff through utilising daylight may result in greater tangible overall health resulting in lower attrition rates. The world of special education is plagued by high attrition rates, especially in the form of ever-changing staff. Therefore, a conscious attempt to design for lower attrition rates of staff through utilising daylight may result in greater tangible overall health resulting in lower attrition rates.
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A comparative study of a variety of existing design outcomes for ASD sensory implementations will be illustrated in the yellow section for each design parameter, which will then be summarised with architectural implications (after Precedents section) for a design toolkit.

107 Dunn et al., “Many Perspectives,” 51.
Exterior views are related closely to daylighting as the former is often created due to the latter. Therefore, it is crucial for both elements to work in concert to ensure controlled functioning outcomes for users. Similar arguments made by researchers and designers for and against daylighting are presented at the meeting of the Research Autism Conference, July 8, 2015.

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2.9.3 - Spatial Considerations:

"One of the most profound mysteries of autism has been the remarkable ability of most autistic people to excel at visual and spatial skills.” – Temple Grandin

Spatial considerations encompass the other parameters (Light, Views, Acoustics and Colour). As mentioned earlier, all parameters outlined are interlinked and dependent on each other for all design outcomes. Spatial considerations account for five out of seven ASPECTS guidelines interlinked and dependent on each other for all design outcomes (Spatial Sequencing, Escape Space, Compartmentalisation, Transition Zones and Sensory Zoning).

There exists a vast account of teachers, parents, researchers and designers reinforcing the importance of escape spaces, break-out rooms and pausing areas. These spaces are proving to be beneficial not only within autism specific environments but mainstream schooling too.119 Joan Scott Love in ‘How autism-friendly architecture can change autistic children’s lives’ suggests providing alcoves or recesses within schools as an opportunity for children to withdraw, process information and recalibrate, especially when transitioning between significantly different environments.120

Compartmentalisation is a tool used in all learning environments to ensure a controlled outcome within the space, such as a reading corner located facing the wall to remove distractions (See Montessori classroom layout). Spatial Sequencing too coincides with good design practice for mainstream school design and supports long standing claims of children with autism needing structured routine, order and predictability. Christopher Beaver reinforces the importance of providing a simple geography with generous circulation spaces.121 Mostafa adds, “one-way circulation and seamless flow between spaces helps minimise disruption.”122 Additionally, Teresa Whitehurst suggests abolishing the institutional approach toward circulation spaces by transforming the corridor “into a usable space in its own right”123, especially for play. The use of utilising dead corridor spaces not only applies to autism specific environments, but is a popular principle among various building typologies, including mainstream schools. Kim Dowey and Kern Fisher refer to this as “streetspace”, which contributes to one of their six-part typologies of learning spaces within a school.124

Iain Scott reinforces the need for withdrawal areas to be woven into the social fabric of the classroom that can be doubled as an individualised teaching space and not appear to be experienced as a punishment.108 This raises an interesting issue regarding spatial configuration, as isolation is desired but without a well-planned classroom, withdrawal spaces can evoke negative connotations such as abandonment.

117 Joan Scott Love in ‘How autism-friendly architecture can change autistic children’s lives’
An important element present across many existing designs for autism is the use of curvilinear walls. Teresa Whitehurst notes curvilinear walls facilitate movement within the building’s layout and is especially useful for children who struggle with visual and spatial processing. The curved wall invites an individual to use it tactically as “staff noticed that children often placed their hands on the walls, following the contours round the corridor.”

Simon Humphreys too, advocates for the use of curvilinear design and employs it in all his works including residential projects for people with autism.

Joan Scott Love introduces the idea of taster spaces which allows children to engage with part of an activity prior to entering the space and exploring. Spatial ramifications of these precursor areas could include an interactive percussion wall prior to entering the music room or an engagement with water through shallow channels on the floor before entering the pool. The idea of providing precursor spaces also introduces elements of choice and control, relating once again to the Prospect-Refuge theory (discussed earlier). The Hope Network – Centre for Autism in the United States utilises the precursor method by allowing children into a multi-sensory room for ten minutes prior to class. Teachers report children have longer attention spans and less loss of focus, making lessons more productive and a richer learning experience.

The various sizes of spatial volumes used in autism specific spaces are also a point of controversy. Different projects with similar functional requirements (autistic learning environments) produce vastly opposing outcomes spatially. Some believe small spatial volumes with low ceiling heights that result in intimate proportions are necessary and successful in teacher-student interaction areas. Others believe large volumes with airy spaces and high ceilings, coupled with more space per child reaps greater rewards. Anecdotal evidence and opposing arguments exist for both scenarios, with smaller spaces causing anxiety and larger spaces causing unfamiliarity.

Simon Humphries believes the proxemics of people with autism is far greater than neurotypical people. Henry defers everyone maintains a bubble of space which they look to protect to individual. As we mentioned earlier, the bubble and its territorial distinctions vary from individual to individual on the spectrum due to the variety of sensitivity experienced. Thus, a learning environment should have a mixture of spatial volumes, providing flexibility for a variety of users.

Spatial considerations heavily relate to Thin-Emma’s motion, weight and substance, spatial delimitations, in which the roof, wall and floor in a variety of arrangements make architecture. As seen above, the angle and height of the roof (+ floor level changes) produces a variety of spaces with different sensations below. Daylighting and exterior views are interrelated, spatial considerations control which spaces will be illuminated and which spaces will contain perforations or openings.
2.9.4 - Acoustic Performance:

“A poor acoustical environment is an architectural barrier to students as much as a set of stairs might be a barrier for a child in a wheelchair” - K. P. Roy

Speech is a vital component of teaching and learning in most classrooms. 80% of all activities taking place within a classroom require listening and speaking. A study conducted by Oticon Foundation on teachers in New Zealand revealed 71% found noise within the classroom to be a significant problem. One third of the teachers surveyed indicated regular speaking within the classroom required strained levels of volume. Louis Sutherland and David Lubman suggest “learning is dependent on the ability to communicate with spoken language and that perception of spoken language is the foundation for the ability to read and write.” Hence, good acoustic conditions are important not only to neurotypical children and teachers, but especially important for children with speech and language difficulties, ergo children with ASD.

While Christopher Henry comments on empirical evidence gathered by Mostafa to be flawed methodologically due to sample size etc., the study showed a 300% improvement in attention span (in some cases) and a 60% decrease in response time and instances of self-stimulatory behaviour.

Acoustic performance is perhaps the only design parameter theoretically consistent across both neurotypical and autistic children. Like mainstream classrooms, an autism specific environment too should aim to reduce background noise, reverberation and echo. Using sensory zoning, compartmentalisation and a suitable material palette, various spaces within a learning environment could contain differing acoustic control depending on the activity taking place within the space. This reinstates the importance of all sensory design parameters for autism working in unison to produce a well-integrated outcome.

Magda Mostafa conducted a preliminary exploratory survey prior to formulating her ASPECTSS guidelines in the form of a basic survey. The aim was to deduce the most influential feature of the sensory environment. Acoustics ranked first. While Christopher Henry comments on empirical evidence gathered by Mostafa to be flawed methodologically due to sample size etc., the study showed a 300% improvement in attention span (in some cases) and a 60% decrease in response time and instances of self-stimulatory behaviour.

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136 National Disability Authority, “Increasing the Accessibility of School Buildings.”
2.9.5 - Colour: The use of colour holds more importance than mere aesthetic appeal. Colour has proven to influence blood pressure, eye strain, brain development, energy levels, mental clarity and mood changes. It is considered to be one of the most influential aspects of an environment, inducing both psychological and physiological reactions. The effects of colour extend to various other aspects such as perception of light and temperature as coloured lighting can highlight similar coloured objects, therefore influencing one's perception of space.

The importance of colour is superior for autistic children as they rely more on non-verbal cues than neurotypical children. A test of children with autism revealed 85% saw colours with greater intensity than neurotypical children. Christopher Beaver and GA Architects formulated a low arousal colour palette by first receiving 85 colours approved by the Design Research Centre, then narrowing them down through opinions from designers, teachers and children with ASD. The colour palette can be seen below. 

While the palette may be considered subjective, the basic principles of how to use colour can be translated. Using colours in tonal blocks aids in spatial understanding as children can discern the varying elements of the room (wall, floor, ceiling). Martin Peat, contractor for various projects of the National Autistic Society (UK) advocates for the use of pastel colours with a contrasting bolder colour to highlight a feature wall or element. Subtle changes in colour aids children with understanding the layout of the building which means they are easier to navigate, which can be reassuring and cause comfort. Colour coding is often utilized within the learning process and therefore it is important to ensure the environment does not clash with the basic primary colours used.

140 Kathie Engelbrecht, “The impact of color on learning” (NeoCon and HDR, Chicago, 2003).
145 Emily Flint, Correspondence through Email, Auckland, New Zealand March 25, 2019.
2.10 - Autism in Media

Currently the world stands at an interesting moment in the history of autism where the number for the diagnostic rate of people with autism has progressively increased through understanding the condition and having raised awareness, the envelope for ASD has expanded in every direction, not only for people with autism and their families but also the greater general population. 146

ASD’s diagnostic criteria has evolved since its discovery and is described “as a continuum of traits”147 which includes a vast number of adjacent conditions within the spectrum. For example, Asperger’s syndrome, a similar disorder containing developmental abnormalities in social interaction but not speech and language delay, was added to the ASD diagnosis as of 2013 according to the DSM-5. 148

Similarly, the perception and image of autism in the media has also drastically evolved over time. From institutionalisation being the only prognosis to modern solutions and aid available for people with ASD to live their lives as within the spectrum. For example, Asperger’s syndrome, a similar disorder containing developmental abnormalities in social interaction but not speech and language delay, was added to the ASD diagnosis as of 2013 according to the DSM-5. 148

A common misconception of autism which was and still is projected heavily toward further research as well as awareness by the masses. Research films such as The Accountant, Adam (2009) and My Name is Khan (2010) to name a few, star protagonists with Asperger's Syndrome (AS). While AS is a form of autism, falling under the diagnostic range, the films do not accurately illustrate a person's life who is on the spectrum. Unlike, two recent television dramas Good Doctor (2017) and The Good Doctor (2017) which have lead characters who have High Functioning Autism's (HFA). While the characters exhibit above average to genius level intellect, like their preceding shows and films, the two television dramas go further in providing authentic and accurate insights into the worlds of people living with autism and their carers in a contemporary setting. Subsequently, television shows and films in the 21st century have further reinforced the idea of vast intellectual abilities among all autistic people (which is not accurate). Films such as The Accountant (2016), Adam (2009) and My Name is Khan (2010) to name a few, star protagonists with Asperger’s Syndrome (AS). While AS is a form of autism, falling under the diagnostic range, the films do not accurately illustrate a person’s life who is on the spectrum. Unlike, two recent television dramas Good Doctor (2017) and The Good Doctor (2017) which have lead characters who are High Functioning Autism's (HFA). While the characters exhibit above average to genius level intellect, like their preceding shows and films, the two television dramas go further in providing authentic and accurate insights into the worlds of people living with autism and their carers in a contemporary setting. Subsequently, television shows and films in the 21st century have further reinforced the idea of vast intellectual abilities among all autistic people (which is not accurate). Films such as The Accountant (2016), Adam (2009) and My Name is Khan (2010) to name a few, star protagonists with Asperger’s Syndrome (AS). While AS is a form of autism, falling under the diagnostic range, the films do not accurately illustrate a person’s life who is on the spectrum. Unlike, two recent television dramas Good Doctor (2017) and The Good Doctor (2017) which have lead characters who are High Functioning Autism's (HFA). While the characters exhibit above average to genius level intellect, like their preceding shows and films, the two television dramas go further in providing authentic and accurate insights into the worlds of people living with autism and their carers in a contemporary setting. Subsequently, television shows and films in the 21st century have further reinforced the idea of vast intellectual abilities among all autistic people (which is not accurate). Films such as The Accountant (2016), Adam (2009) and My Name is Khan (2010) to name a few, star protagonists with Asperger’s Syndrome (AS). While AS is a form of autism, falling under the diagnostic range, the films do not accurately illustrate a person’s life who is on the spectrum. Unlike, two recent television dramas Good Doctor (2017) and The Good Doctor (2017) which have lead characters who are High Functioning Autism's (HFA). While the characters exhibit above average to genius level intellect, like their preceding shows and films, the two television dramas go further in providing authentic and accurate insights into the worlds of people living with autism and their carers in a contemporary setting.


150. American Psychiatric Association, “Diagnostic and Statistical Manual of Mental Disorders”

Finally gained some recognition which contributed to an increased interest in autism among the earliest portrayals of a character with developmental disabilities being the protagonist of a film. While the technical differences of the technical requirements of the respective medical conditions were not made clear, autism as a disorder is by no means a laughing matter, however society has deemed it permissible to see some of the difficulties and challenges faced (primarily social awkwardness) to have comedic value in a way that is not offensive, rather informative.

3.1 - Pedagogies Influencing Evolution of Classroom Design

Refer to appendix 4 for Origins of School Architecture

The design of learning environments has transformed and continues to transform with new typologies of learning spaces being formed. These new typologies use pre-existing learning spaces and their complex spatial interrelationships to form modern learning environments seen today. Changes in the built environment occur based on changes in pedagogical theories and practice. Pedagogies influence and reflect the style of teaching taking place within the classroom. It is evident not only within the curriculum but can be recognised spatially too. The transformation in school design follows the pedagogic changes influenced by society throughout history, consequently resulting in architectural variations.

3.1.1 - Circa. 1800 - 1890

The nineteenth-century school design was based on a monitorial model, rooted deeply in a teacher-centric pedagogy of authority and discipline. Proportional width to height ratio of classrooms which determined sufficient ventilation and lighting was considered paramount and it was to be used wisely so it did not obstruct proceedings in the way of direct sunlight or reflected glare, “30 square inches of glass every square foot of floor space.”

School buildings had their forms determined by two main criteria: layout of classrooms and number of students. Lessons were conducted in large halls with children sitting in rows side by side.


Southwark Central School (1816) for example, constructed prior to the Robson era housed 288 children who sat side by side in 18 rows with 16 pupils in each row. The class had windows beginning 6 feet off the ground to restrict views outside with drapes at intervals to soften and break up the large volume.

The classroom was a product of the Industrial Age in its uniform environment designed to prepare children for their future as factory fodder and aid the economy by being productive members of the workforce.

3.1.2 - Circa. 1890-1960

Nearing the end of the nineteenth century, the large open halls became segmented into an early version of the traditional classroom seen today. A key change in design was in the size of the classroom, both spatially and in terms of population occupancy. Robson determined housing more than 60 pupils in a space for learning was inflexible and too difficult to be managed by one teacher, therefore his model for the classroom contained five rows of double desk seating from front to back based on an unscientific theory of acoustic reception of information in relation to distance. Nonetheless the new arrangement allowed for circulation space around desks for the teacher to monitor each student and furthermore allowed children to leave their desk during class. As the state-school movement flourished around populated urban areas of the world, early schools were often a single block of 2-4 floors as a result of their site exigencies causing problematic external areas which were overshadowed play spaces reminiscent of prison yards.

The mid-twentieth-century school design marked a significant pedagogical shift, transforming from the teacher-centric model to the student-centric model of learning. John Dewey, an icon of the movement for educational reform introduced ideas of social context, student interaction and play.


3.1.3 - John Dewey

John Dewey (1859-1952) was an American psychologist, philosopher and originator of progressive education during a time when the mass education system was a machine constructed by industrialism. Alvin Toffler in 'Future Shock' (1970), summarizes how children were pre-adapted to the new world of repetitive indoor toil and collective discipline where time was regulated by the factory whistle rather than the cycle of the sun and moon. He uses a perfect metaphor of assembling the students (raw material) to be processed by teachers (workers) in a centrally located school (factory) to imitate the workings of a factory. Reglementation, lack of individualisation, rigid systems of seating, grading and the authoritarian role of the teacher; all critiques of modern-day education are the same aspects which made mass public education at the time of its origin an effective instrument for social control.

Dewey established an experimental school to test and explore his radical ideas about experiential education and new methods of teaching. Through his various publications critiquing psychology, education and aesthetics he formulated an unprecedented set of democratic principles and a hands-on approach that revolutionised educational practice worldwide. The primary focus of his ideology was to link education to the child's experience by integrating (for the first time) the use of senses within the educative process. Subsequently, he "believed that school must represent present life - life as real and vital to the child as that which he carries on in the home, in the neighbourhood, or on the playground".

By providing a coherent experience which could be engaged in various environments, Dewey believed the child would be able to relate to the content being taught and learn through repetitive, relevant and purposeful application. Experiences can be passive and unstimulating, traditional education too induced experiences; however, Dewey theorised an educative experience is one where a connection between an action and its consequence is understood and the value lies in the perception of relationships or continuity among events. Learning by doing was a concept developed to steer future generations of children to become active and creative citizens of the world, he argued "only in education, never in the life of a farmer or physician does knowledge mean primarily a store of information aloof from doing".

The shift from teacher-centred to child-centred pedagogies made tangible differences in the architectural outcomes of schools and their classrooms. Dewey equated the dated educational methods of the nineteenth century to a similar spirit in architecture; having stylistic as opposed to social concerns. Dewey's new (at the time) philosophies toward education and schooling are reflected in Frank Lloyd Wright's early work, Hillside Home School and Hillside Home School II (plans unavailable). Dewey's open approach, aiming to replicate the diversity of the real world, helped eradicate the duality between home and school life. The experimental school expanded the classroom into studios, laboratories and workshops to better serve students' broader skills. School locations changed from being constrained to urban sites to more rural settings, seen today as suburban neighbourhoods.

Work conducted by Hans Scharoun, Aldo van Eyck, Herman Hertzberger and others resonated Dewey's principles of a variety of learning spaces for a variety of subjects. New educational ideals developed a trend toward 'open-air' schools to promote well-being of students. The new ideals were prominently utilised for early childhood learning, where another influential educational reformist (Maria Montessori) impacted the spatial relationship between student, teacher and learning environment.

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Another influential icon of the educational reform which took place at the turn of the 20th century was Maria Montessori. An advocate of the child-centred teaching model, she revolutionized the process of educating children. Formulating her theory for a new pedagogy based on observation and discovery, the Montessori method of teaching was the first to approach education through the field of medicine not encumbered by existing educational assumptions, creating a ‘scientific’ pedagogy where the classroom was treated as a laboratory.

Developing an interest in children’s diseases during medical school, Montessori offered care for ‘feeble-minded’ children housed in asylums around Rome. Upon seeing the rough conditions children were expected to survive in (such as being housed with adult patients, minimal caregiving and sustenance), she decided to research the education of feeble-minded children. An early observation that was underrated at the time of discovery but could be accredited as one of the most significant and influential findings is the concept of perceiving mental deficiencies as pedagogical problems rather than medical issues. The assumption for many years was that neurodivergent people should be institutionalised, therefore ostracising them. Montessori’s method to educate children with special needs was influenced by French doctor Jean-Marc-Gaspard Itard (1775-1838), who worked with deaf children throughout his career as well a famous student ‘Victor the Wild Boy of Aveyron’.

Montessori’s findings too implied architectural changes, within the parameters of the classroom. The classroom is re-designed to accommodate choice. Classrooms contain defined spaces with shelves or display tables breaking up areas by subject. Children are encouraged to interact with materials as they please, therefore keeping true to the underlying philosophy of choice. Classrooms also include reflective spaces such as a corner or table with well-chosen items to invoke meditative thought. All classes are uniquely suited with underlying Montessori principles present. Pre-school rooms feature non-standardised sizing for chairs, tables, sinks, tables, reachable shelves and child-sized kitchen tools to develop motor skills and allow independence.

Montessori’s child-centred model theorised that a child has an innate need for knowledge and is capable of initiating learning in a prepared environment. The teaching method recognised individuality and uniqueness of learning style of each child and introduced individual learning plans (known today as ILP or individual education plan [IEP]).
3.1.5 - Circa. 1960 - Present

Prior to the turn of the millennium contemporary school designs consisted of a series of rooms intended to serve specific functional requirements, within the rigid framework of the educational model assigning periods of time dedicated to individual subjects. Schools, just as homes adhered to the modernist concept of consistent spatial plans, that is "a precise organization of objects in time and space".165 As rooms in homes are given functions such as cooking, eating, lounging, entertaining and sanitation, they inherently impose an agenda for life and configure our behaviour with the set environment. Envisioning school design in such mono-functional terms as the home can hinder the personal development of a child. Herman Hertzberger summarises "... a thing exclusively made for one purpose, suppresses the individual because it tells him exactly how it is to be used. If the object provokes a person to determine in what way he wants to use it, it will strengthen his self-identity. Merely the act of discovery elicits greater awareness. Therefore, a form must be interpretable - in the sense that it must be conditioned to play a changing role".166 This insight by Hertzberger illustrates the dichotomy of school design and the transition of educational models during the twentieth century. Traditional teaching methods of discipline and control within heavy, robust and inflexible spaces were contrasted by progressive methods of teaching, inducing individual creativity, in lightweight modernist buildings opening up to their environments. The fundamental change of educational strategy to employ "social interaction rather than autonomous isolation" fuelled radical changes in both the architectural responses toward school design.167

“social interaction rather than autonomous isolation”168 fuelled radical changes in the architectural responses toward school design. Radical student-centric pedagogies demanded pioneering architectural responses. The 1970’s introduced the ‘open-space’ (or ‘open-plan’) school concept. Its premise physically was to remove adjoining walls between classrooms to promote movement by teachers across multiple classes. Theoretically, the open-plan school was derived from the 1960’s schoolhouse typology (discussed earlier) with a change in the pedagogical thinking.169 Like modern thinking regarding modern learning environments and innovative learning environments (ILEs), educationalists believed in exercising the varying skills of children in a large dynamic space with more teachers, as opposed to confining a group of children with one teacher in a static classroom. However, experimental schools had to install permanent walls between the open spaces, “segmenting into traditional classroom cells.”170 This was due to the inadaptability of teachers being able to function in the new ways demanded by the space. Instead, teachers employed traditional teaching methods, causing disparities between pedagogic intent and user usage.171

In the new millennium, a substantial re-emergence of student-centric pedagogies are occurring due to unprecedented technological advancements as well as the recognition of a large variety of learning styles. Concepts such as individualised learning, skill transfer and coherent application of learning theories decades ago are finally coming to fruition. The primary shift from the open-plan era to modern-day learning environments lies in the “assemblages of different spaces grouped in clusters.”

Kim Dovey and Kenn Fisher believe the use of a variety of learning spaces (such as learning commons, meeting areas, outdoor learning spaces and traditional classrooms) together in a multitude of new arrangements, best enable student-centric pedagogies to translate into their architectural counterparts.

3.2 - ILEs / Modern Learning Environments

The Ministry of Education New Zealand defines an innovative learning environment (ILE) as "one that is capable of evolving and adapting as educational practices evolve and change - thus remaining future focused."

Dovey and Fisher conducted an international review of school designs to formulate typologies of learning spaces and teaching approaches in learning environments.

The need for a summary of innovative learning environments (ILEs) was required due to the vast array of designs that exist in schools today. The five learning typologies range from traditional learning spaces to open-plan learning spaces, differing spatially in terms of ‘openness’. Similarly, typologies of teaching-approaches vary from a teacher-centric approach to individual learning (as shown).

A technical report published in 2017, utilising Dovey and Fisher’s international survey illustrated, 58% of learning spaces in Australasian schools were traditional cells (A) and 36% of schools surveyed still employed the traditional teaching approach (1).

Interestingly, the second most popular form of learning space was the open-plan (E) and teaching typologies included teacher facilitating group instruction (2) and collaborative learning (4) with the teacher being peripheral. This suggests learning environments are progressing slowly from one end of the spectrum to the other. These findings align with this project’s goal of a need to find a middle ground. A middle ground not only spatially or for teaching methodologies but for the individualistic user (with autism).

Studies mentioned prior were based on research of mainstream schools, environments and children. However, the findings can be translated into viable concepts for children with autism. The irony of the situation currently faced by designers, teachers and children with ASD, is the dichotomy between spatial requirements of the autistic user based on sensory sensitivities and the spatial outcomes resulting from ILEs. An ideal learning environment for an autistic user would be (C) or (D) within one classroom and a range of teaching approaches occurring in different areas of the room as required.

For children with ASD, the adaptive and flexible spaces illustrated need to occur within one classroom, unlike the premise of ILEs, which looks to merge two or three classrooms together. Another irony between the history of mainstream schooling and the spatial/sensory requirements of the autistic child is the rigidity of routine, order and predictability involved in the traditional classroom, which translates seamlessly to the psychological and physiological needs of an autistic user (as discussed in Autism section). Unfortunately, the solution is not as simple as making ASD-friendly learning environments today, replicas of the nineteenth-century mainstream classroom, and therein lies the rub.

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3.3 - Variety of Learning Spaces / Assemblies

The world of today, which learners enter after leaving school is dramatically different to the learner experience of traditional education. There is a dire need to close the gap between advancements of the world and the education system’s inability to meet the challenges they pose. The requirement for a variety of learning spaces is not only existent for children with autism but has become interwoven into the mainstream schooling agenda. The Ministry of Education (NZ) released a publication analysing the importance of providing a variety of learning spaces within schools to cater for a variety of learning styles. The report summarised positive links between flexible spaces in the physical environment and student outcomes.179 The report concludes by demanding all educational projects align their “visioning and design process to consider the potential links in association with a variety of learning spaces and other variables that may influence student outcomes.”180 Modern educational reforms such as Dovie and Fisher who propose assemblages (see above) for their flexibility of equipping schools to meet a variety of children’s needs, are not alone.

3.3.1 - David Thornburg

David Thornburg, a futurist and educationalist, published “Campfires in Cyberspace: Primordial Metaphors for Learning in the 21st Century,” near the turn of the millennium. The book demonstrates the important role of education from a technological viewpoint, the variety of learner theories can be extrapolated spatially. “The existence of learning communities predates civilization.”181 Thornburg proposes the need for four crucial learning forms being available to students, for them to have a truly wholesome experience of learning through choice.

3.3.2 - Campfire

Campfire learning is a metaphor for the use of storytelling as a mechanism for teaching. Storytelling is a powerful tool dating back to pre-historic times as the only form intergenerational information sharing, which exists even today in remote parts of the world amongst indigenous people. The use of storytelling brings with it the ability of interpretation, fostering imagination, allowing people to absorb elements of the same story appropriate for the individual.178

While the idea of storytelling speaks to the teaching approach, it spatially translates into a communal area. A communal area within a learning environment allows for students to interact and provides a platform for the teacher to disseminate instructional information. A mode of teaching resonating with traditional educational methods. Communal spaces are especially important for the autistic learner as verbal cues, the primary form of communication within most classrooms, are difficult to understand for people with ASD. Therefore, dedicating a space for children to come to in order to receive communal information reinforces equality within the classroom.

3.3.3 - Watering Hole

The watering hole metaphor is derived from its historical existence of a variety of species needing to gather at a central source of water.180 The idea translated into modern workplaces is ‘watercooler talk’. While watercooler talk insinuates gossip, the initial metaphor relates to the communal time spent travelling to gather water when people shared information with each other. The watering hole symbolises a place to learn from peers in a more informal way, where each member is both teacher and learner simultaneously. Spatially watering hole spaces would simulate small clusters of deals with provision to interact between groups but also be able to productively carry out tasks with sufficient acoustic separation.

For children with ASD the concept of peer learning is difficult due to their inability to interact socially with others. An adaptation of Thornburg’s model could be the watering hole becoming a more intimate version of the campfire with a teacher aide becoming a facilitator of the conversation as required.

3.3.4 - Cave

Continuing the metaphor of primordial learning environments, the campfire evokes interactions with experts (teacher), watering hole with peers and finally the cave, with asocials.182 The importance of solitude when learning cannot be overstated. It stems from the need to internalise knowledge in order to understand it. Self-learning is the process of the passing of knowledge from an externally accepted to an internally held belief.183 Spatially, the metaphor can be taken literally in the sense that a retreat space be provided in an otherwise, very communal environment. A cave space brings with it a multitude of sensory issues, primarily acoustics. As mentioned in sections before, the importance of escape spaces or breakout rooms are paramount for children with ASD. Time allowed to recalibrate, recoup from an overwhelming experience opens a window learning opportunity. In regard to self-learning, autistic children at a young age may not have the capacity to formulate their own ideas, therefore, the cave space could be a series of one-to-one learning spaces in a different atmosphere to the remainder of the classroom.

179 Gabriele Metz, “The Impact of Physical Design on Student Outcomes.”
178 Gabrielle Wall, “Impact of Physical Design on Student Outcomes.”
180 David D. Thornburg, Campfires in Cyberspace: Primordial Metaphors for Learning in the 21st Century, near the turn of the millennium. The book demonstrates the important role of education from a technological viewpoint, the variety of learner theories can be extrapolated spatially. “The existence of learning communities predates civilization.”
181 David D. Thornburg, Campfires in Cyberspace (Starsong, 1999), 1.
182 David D. Thornburg, Campfires in Cyberspace (Starsong, 1999), 1.
183 David D. Thornburg, Campfires in Cyberspace (Starsong, 1999), 1.
3.3 - Life
Life refers to the application of insights gathered through the other three learning styles. The importance of knowledge application resonates within the past century of educational reform. Linking back to Dewey’s critique of education where knowledge meant a store of information aloof from doing. The spatial connotations regarding life application can only be documented based on information received from parents. As discussed earlier, children with ASD have difficulty generalising skills. This means learning undertaken within a classroom may not translate at home or other aspects of life. The neurotypical approach offers a possible solution by utilising neurotypical environments within learning facilities. An example of this can be seen in the Hazelwood School for the Blind (precedent study), where the school consists of a variety of toilets with differing fixtures to simulate public environments for children to acclimatise to.

3.4 - Inclusion
Mainstream schooling comes with a pedestal demanding attainment. The ‘one size fits all’ mould of mass education automatically assumes the goal for children with special needs is to integrate. This project too aims to eventually transition children into mainstream schooling. However, there exists a school of thought (among special educationists) that perhaps inclusion cannot be attained in the conventional format, as the Ministry of Education currently plans to.

Inclusion has been and is a controversial concept within the realm of education. Its definition fluctuates by country as well as international organisations such as UNICEF, UNESCO and the UN.\textsuperscript{185} The common elements among the various definitions link to ideologies based around participation, democratisation, equity and justice. Simply put, inclusion strives to secure equal educational rights for all people with varied learning needs in a general classroom.\textsuperscript{186} Peder Haug critically discusses inclusive ideals and practices, highlighting its multifaceted forms and applications. The polarising approaches defining inclusion as placement for all and inclusion as the best place for learning, raises pedagogical, legislative and socio-economic complexities outside the scope of architecture.\textsuperscript{187}

\begin{itemize}
  \item \textsuperscript{185} James Le Marquand, Personal Interview, Auckland, New Zealand May 8, 2018.
  \item \textsuperscript{187} Haug, "Inclusive Education: Ideals and Reality," 297.
\end{itemize}

It is clear there exists a gap between ideals and realities in the implementation of inclusion, however, many countries including New Zealand administer different types of intermediary provisions such as satellite units. Intermediary provisions such as transitional facilities and approaches (TEACCH) may not be the answer to solve implementation difficulties and differences of inclusive practices, but they provide scope for an architectural variation in the pursuit to determine where children (neurotypical and neurodiverse) learn best.

Gaines and others surmise the existence of a variety of results from studies regarding inclusion. Reviews of literature suggest academic and behavioural performance of children with disabilities improve in an inclusive setting.\textsuperscript{188} Conversely, studies also show children with disabilities prefer and perform better in special education classrooms. There are benefits of inclusion outside the scope of teaching and learning too. Both neurological and neurodiverse children displayed “growth in social outcomes and improved self-concept.”\textsuperscript{189} Varied studies indicate inclusion may be beneficial for some students but not all, however, further studies are required for conclusive proof for either argument.

\begin{itemize}
  \item \textsuperscript{188} Kristi Gaines et al., “Learning Environments,” in Designing for Autism Spectrum Disorders (London: Routledge, 2016), 184.
  \item \textsuperscript{189} Haug, “Inclusive Education: Ideals and Reality,” 298-303.
\end{itemize}

(See appendix 6 for a summary table outlining findings regarding inclusion, formulated by Kristi Gaines and others + MOE document excerpt highlighting satellite unit in cooperation.)
Architectural implications of all design parameters discussed in the literature section have two common factors; Flexibility and Choice. The nature of designing communal spaces such as schools and offices, brings with it a notion of flexibility due to the increased usage by a variety of people, as opposed to a residential environment such as a home. This, coupled with a spectrum of sensitivities faced by autistic people demands for all design elements to be used as much or as little as the occupant chooses. The elements from the autism and education section are merged below, which will later be refined with case study and precedent study findings.

Architectural implications of Lighting include:
- Purposeful perforations to control intensity
- Upward facing fixtures
- Perimeter lighting with hidden source
- Overhangs to mitigate stark light/shadow change
- Skylight and clerestorey with louvered provision
- Mindful of surrounding shadows
- Materiality

Architectural implications of Views include:
- High sill heights
- Upward angled window openings
- Controlled glazing
- Flexibility of exposure inside/outside
- Translucent elements to control visibility
- Monitoring exterior conditions
- Materiality

Architectural implications of Acoustics include:
- Spatial arrangement of varied learning areas
- Materials to absorb excess sound
- Diffusers on walls + ceilings
- Acoustic zoning based on function

Architectural implications of Colour include:
- Highlighting elements wall/roof/matt
- Perception of space
- Navigation

Spatial considerations encompass all the other parameters as they inform every aspect of the building. Spatial volumes are influenced by the function or activity conducted within the space which is then informed by the combination of the other parameters mentioned. Spatial considerations are especially important within learning environments and therefore are at the top of the hierarchy.

Summary (Flexibility)
To formulate a design brief, various existing facilities around Auckland were examined to highlight effective and ineffective spaces currently used for educating children with disabilities. Outside the scope of viewing existing spaces, conversations with teachers, principals, representatives from the Ministries of Health and Education and paediatricians proved most valuable. Views and opinions of various stakeholders at different stages of a child’s educational journey with special needs were examined; from diagnosis to early childhood and eventually primary schooling. Special education schools are the home bases of their respective satellite units. Children learning in satellite classes within mainstream schools are enrolled to a local special school but attend the mainstream school if they qualify for support and are able to learn in a semi-mainstream environment.

Children with high to very high needs will probably never see a mainstream class due to lack of resources and impractical inclusion expectations. However, children with mild to high needs would be utilizing resources they do not need and therefore satellite units bridge the gap between mainstream and special schooling. Oaklynn and Arohanui special schools were both visited first to see how different special schooling is to mainstream spatially and otherwise. Their satellite units were Arahoe and Glenavan Primary Schools (Oaklynn) and Edmonton Primary (Arohanui). Additionally, Mt Roskill Primary School was also visited, a stand-alone unit with no affiliation to a special school.
4.1 - Oaklynn Special School

20 Mayville Avenue, New Lynn
Waitakere 0600
New Zealand

The school has 5 satellite units in the area. Each class has approximately 6 students with similar needs and are supported appropriately with a specialist teacher and aides. The school also provides a reverse buddy system for mainstream students to come interact with students of the special school. Recently downsized, the school removed a large block and replaced it with an outdoor uncovered paved play space. The site consists of 3 primary blocks of function, staff block, teacher training block and children’s block. The school provides in-house training and professional development for staff who work in the satellite units.

Classrooms are setup with barriers determining different spaces for use and a breakout room is provided in between every 2 classrooms. Spaces within are temporarily altered due to unforeseen planning regarding sensory design. North facing doors and windows in many rooms are covered to reduce visual stimuli and distracting shadows. Classrooms are barren of displays due to their distractive qualities being amplified among children with sensory sensitivities.


![FIG 129: SPATIAL ALLOCATION OF FUNCTIONS](image1)
![FIG 130: ESCAPE SPACE SHARED BY TWO CLASSROOMS](image2)
![FIG 131: MAKESHIFT WINDOW COVERS + SPATIAL SEGREGATION THROUGH CHANGE IN FLOOR MATERIAL + HIGH CONTRAST WINDOW VIEWS](image3)
![FIG 132: ZONES CREATED THROUGH MOBILE BARRIERS AND FURNITURE (COMpartALISATION)](image4)
Arahoe Primary opened its new purpose-built satellite unit in 2011. Located on the northern end of school, the unit sits on the fringe of the school field and paved play area. Flanked by classrooms to the west and a courtyard playground to the south. Unlike Te Ara Hou, access to the unit is through the school and unsheltered. The unit consists of 2 classrooms, a communal shared space, a breakout room, 1 toilet and 2 additional rooms intended for staff. The new building has acoustic tiles on the ceiling for noise absorption and skylights for even lighting without shadow. Again, staff space is compromised and has become additional storage space. The sensory room is a regular room, possibly designed as an office now used as a break out space with a few bean bags. According to staff the biggest issue with the unit is the toilets or lack thereof, as there is only one toilet in the facility which is currently use by students and teachers. While the location of the unit appears to be inclusive, acoustically the surroundings are too loud for children to focus. The barrier between abandonment and isolation should be a key consideration during planning.

Ideally, the sensory room should include proprioceptive and vestibular elements such as a soft gym and other low arousal interactive opportunities to stimulate sensory breaks. Spaces could be categorised as learning and recharging spaces to distinguish the function of the space. Play spaces are often barren and seem as an afterthought, often unsheltered and therefore unusable at all times. Classroom layout is similar to the special schools and other satellite units, following a rectangular boundary with spaces segregated by furniture, dividers and flooring material along with added shading via shower curtains. Site topography across the unit due existing basketball courts allows for heightened windows which overlook the school field that minimally reduce visual distractions.
FIG 138: CLASSROOM COMPARTMENTALISATION - TEMPORARY SHADE, ART WORK, FURNITURE

FIG 139: KITCHEN ALCOVE

FIG 140: NATURAL LIGHT SOURCES - SKYLIGHT + WINDOWS OVERLOOKING THE FIELD

FIG 141: STAFFROOM DOUBLED AS STORAGE SPACE

FIG 142: SECONDARY STAFF AREA TRANSFORMED INTO RESOURCE ROOM
Glenavon Primary has the first purpose-built satellite unit in Auckland, named Te Ara Hou (new pathway). Glenavon Primary shares similar site specifications as Three Kings School (the site chosen for this project), it too, has an adjoining pre-school on site. The satellite unit is located on the eastern end of the school and has its own entry (shared with preschool). The unit consists of 3 class rooms, which were originally 2 but have extended due to demand. While the facility holds its title as the 'first purpose-built' facility for ASD, it simply seems to be a new build for hosting students from Oaklynn, as opposed to many other units which end up being an unused block of classrooms at a mainstream school. The area assigned is vast, however, sensory considerations do not seem accounted for in the design process.

Large roof overhangs allow for vast covered areas for play and negate the sun penetrating large windows, however, usage of concrete as the primary building material causes reverberation making the spaces in between the two classrooms unusable for sheltered play. The large windows often cause visual distraction making it difficult for teachers to keep students engaged. Like Oaklynn, the satellite unit too follows a function per block model where 3 blocks are used for teaching and 1 block is for staff and toilets. The staffroom is extremely over populated and located in between the two classrooms with no real separation. While this works well for supervision purposes, the staff never truly get a space for themselves. Classroom layout follows the home base with spaces segregated through temporary barriers such as furniture, dividers and floor material in a rectangular classroom. Storage space and breakout spaces were not considered and therefore do not exist at this facility.
FIG 146: SPATIAL ALLOCATION - COVERED PLAY

FIG 147: STAFF AREA

FIG 148: CONCRETE FLOORS AND WALLS CAUSING ECHO

FIG 149: COMPARTMENTALISATION + DAYLIGHTING FACING NORTH

FIG 150: PREFAB ROOM - COMPARTMENTALISATION + ARTIFICIAL LIGHTING
4.4 - Arohanui Special School

Arohanui is a special education school with 12 satellite classes in various mainstream schools around Auckland. In addition, the school also provides specialist teachers via their outreach programme who are all trained in-house. Unlike mainstream schools, the spatial hierarchy in terms of allotted area of spaces for children compared to staff is almost equal. The outreach service is responsible for the specialist teacher training required within their own satellite affiliates as well as providing substitute teachers for other classes. Aside from funding provided by the Ministry of Education (MoE), specialist school principals are proponents of Public Private Partnerships (PPP) which yield higher quality designs.

A contemporary example is the Flanshaw Road School satellite unit which was conceived through a rigorous collaboration between the school staff and design team. Currently under construction, the basic sketch illustrates how the L-shaped design allows for supervision of two classrooms simultaneously due to the location of the staff space.

Like Te Ara Hou satellite unit, roofs surrounding the paved play space have exaggerated overhangs which act as added inhabitable spaces during bad weather. While the overhangs were designed to be wider to comfortably house two wheelchairs, wide top-covered corridors and transitional spaces provide great opportunities to allow classrooms to ‘spill’ out and produce moments of social interaction. Classrooms follow an adapted Montessori-style layout with semi-enclosed ‘rooms’ made of temporary barriers within a rectangular skeleton. The importance of breakout spaces is expressed specifically within special schools due to the vast range of disabilities among children utilising the same space. Nevertheless, these spaces are often unconducive spaces or leftover storage spaces of classrooms which are often stark and dingy. The image to the far right illustrates adaptive renovation of a previously adjoining storage space being turned into a much-needed alcove for the existing classroom through an opening in the wall.
4.5 - Edmonton Primary School

The satellite unit at Edmonton Primary is extremely well located as it does not sit abandoned from the remainder of the school, nor is it in too close a vicinity of other auditory disturbances. Flanked by the communal paved space of play to the west, the staff block to the south and buffered by a green space to the north, the unit sits tucked on the eastern fringe of the site. The design shares resemblance of the units from Arahoe and Te Ara Hou in terms of spatial functions and their formal representations. It follows a simple three block stack with a double-heighted classroom (yellow) being hugged by single story blocks on either side. The western block (red) comprises of a kitchen and staff space with a glazed viewport for monitory purposes. Ancillary functions are located within the eastern block (purple) with showers and toilets.

Due to a lack of storage space, the unit received a much-needed extension in the form of a patio on the northern face to house wheelchairs and other large physical therapy equipment. The classroom is well lit with high south facing windows flooding in even light. Formally, the class room is square in shape with the bottom corners mitred. On the north west corner of the classroom stands a black gazebo which acts as a sensory break out space (pictured right). Edmonton satellite unit upon its entrance has an airlocked security door for the ‘runners’, an unprecedented feature among other units.
Mt Roskill Primary is unique in that, it functions as both a special and mainstream school. The Endeavour Centre currently caters for 42 students with a range of learning difficulties. Students supported within the centre must still qualify for ORS government funding. The purpose-built centre has 4 class rooms, on-site therapy space and specialised physical equipment for mobility. Thoughtfully located at its conception, the centre now stands adjacent to a large covered area utilised by the entire school. While this space is beneficial for its secured play qualities, the acoustic reverberations caused throughout learning periods can affect concentration levels of children. Make-shift visual barriers reduce distractions, however due the close vicinity of the spaces, children eventually are distracted. Classrooms follow the similar layout of all other case studies with a few key differences.

All classrooms are divided by adjustable walls to extend areas if necessary. However, placement of equipment and furniture suggests the function is rarely used. Classrooms also have a soft gym corner which acts as a breakout space. Each classroom has an assigned outdoor play space (covered) separated through temporary barriers and fencing. Spatially, all classrooms are double-height upon entry with the ceiling sloping downward. Large windows are placed above room entries to funnel light from the exaggerated central clerestory walkway.
Summary

Upon meeting with staff from all facilities, a common list of issues began to form. Special school home bases (Oaklynn and Arohanui) were larger in size due to accommodation of children with various disabilities. However, they faced the same issues as their satellite units within mainstream schools (Arahoe, Glenavon and Edmonton).

While most of the units visited were supposed to be purpose-built, there were a multitude of disparities between architectural intent and usage of the spaces. The primary issue was related to spatial considerations, both within the classroom and extended throughout the unit in relation to the remainder of the school.

The common issues included (based on staff hierarchy):

- Location relative to remainder of school (based on Spatial connection and Acoustics)
- Lack of flexible spaces (link back to previous summary)
- Lack of design for purpose
- Access to outdoor play
- Storage
- Staff Space
- Shared indoor communal space
- Acoustic barriers

The issues raised above link directly to the design toolkit which began in the literature section with the added considerations of locating the unit on a mainstream school site. A visual summary is illustrated on the next page.
Precedents
Hazelwood School is a purpose-built state facility with 52 children aged 4-18 who have severe visual, mobility, cognitive and sensory impairments. Many of the school's pupils are dual sensorially disabled, representing the most extreme cases of disabled children of the city's educational roll. All students are autistic and requiring lifetime support. The project demanded a range of complex clinical needs unlike any other architectural design. Pre-design approach was a collaborative experience involving extensive workshops and discussions with the school community to better understand and cater for the specific needs of the facility. The project involved combining two existing schools together on one campus while simultaneously eliminating all institutional and conventional thinking of school design. Conceptually the design aimed to provide a space to foster independence and secure learning.

Due to the mobility concerns of the programme, navigation and wayfinding predominantly steered the design outcome. The winding plan created due to existing beech trees on site allows for strong internal circulation, while the concave bends allow for cradled outdoor openings. Indoor-outdoor realms seamlessly transition due a practical need of immediacy between the spaces to ensure safety of students.

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Even the smallest feature of architecture can be conceived as a learning aid.

– Alan Dunlop
The double-loaded curving corridor also doubles as a navigational trail rail and storage space to reduce clutter within adjoining classrooms, which had been declared by staff as the root cause of visual distractions leading to loss of concentration in some students. Storage boxes stand below the clerestory glazing and are fronted by a series of zig-zagging wooden walls (trail rail) cladded in cork at hip height, embedded with tactile signifiers allowing visually impaired children to orient themselves within the school. Other tactile signifiers aside from the common use of light and colour include floor textures and purposefully placed HVAC grills which aid in independent movement along the corridor.

Classrooms are located along the northern edge of the site overlooking green play spaces and gardens, creating intimate outdoor teaching environments. High northern clerestory walls form the façade allowing maximum daylight to penetrate deep into the building with even distribution. Various forms of therapy spaces are provided in the western end of the school including a hydrotherapy pool, soft play room, gymnasium and musical therapy areas. Ancillary spaces include a dining hall, a variety of toilet facilities with different types of fittings to educate and prepare children for other social circumstances and dormitories for older children to experience a degree of independence in a secure environment.

Material choices were paramount as they determined how the school would be ‘felt’ by its occupants. A palette of highly textured materials which could stimulate touch and smell were selected for their sensory qualities. The beam structure is an exposed timber frame naturally weathering. Weatherboards used, contain strong grains which offer a gentle rippled navigational cue through tactility. Reclaimed roofing slate and zinc tiles hang vertically as cladding to signify external spaces. On the southern elevation the tiled walls become a strong heat source due to the sun, providing a secondary cue of location for students.

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Sale Specialist School was created through the consolidation of multiple existing campuses into a single purpose-built educational facility on a greenfield site. Originally opened in 1984 to accommodate 15 students, the roll increased to 70 in 2014 with the school having spread across 3 campuses utilising portable buildings as classrooms. A dire need for space was approved by the government to provide the only dedicated specialist education facility within the area. The new school is projected to cater for 144 students between the ages of 5 and 18 with the provision of adding a further 40 students with additional buildings.

The plan comprises of 5 building blocks situated around a central plaza. The homesteads are located to the north, northwest and west of the plaza, with the administration block to the east and a multipurpose block to the south. Facilities are planned to incorporate separate learning buildings for different ages to provide the traditional schooling transition feel of mainstream schooling. However, there are no specific ages assigned to the facilities and they can be used as required to allow flexibility.

Student safety was given utmost importance in concept of the design and therefore implemented throughout various design decisions. Due to the site being adjacent to a highway, pick and drop off zones required security as well as a bus-loop drop off at the central plaza.

5.2 - Sale Specialist School
ClarenHopkinsCleare Architects (CHC)
(Victoria, AUSTRALIA) 2017

The plan comprises of 5 building blocks situated around a central plaza. The homesteads are located to the north, northwest and west of the plaza, with the administration block to the east and a multipurpose block to the south. Facilities are planned to incorporate separate learning buildings for different ages to provide the traditional schooling transition feel of mainstream schooling. However, there are no specific ages assigned to the facilities and they can be used as required to allow flexibility.

Student safety was given utmost importance in concept of the design and therefore implemented throughout various design decisions. Due to the site being adjacent to a highway, pick and drop off zones required security as well as a bus-loop drop off at the central plaza.
The design responds to a contemporary pedagogy in which spaces provided are engaging and supportive for diverse learning needs of every student. Each homestead roughly equates to what a satellite unit should potentially provide. The learning homestead contains 6 classrooms with a variety of spaces to allow students access to the type of space that gives them most personal comfort and choice in their learning. Learning spaces are flexible as they have the provision of being opened for large group activities as well as quiet rooms and secure external courtyards for inclusive learning. Courtyards are strategically placed behind or beside homesteads to "reduce the need for fencing and creating a less institutional environment."[215]

The corridor provides spaces for learning with social gathering areas and seating nooks promoting interaction. Classrooms share a kitchen area, quiet room and a disabled toilet with drawer. Visual connections between spaces allow students to experience various forms of learning prior to engaging and applying themselves, further reinforcing the idea of the contemporary learning model straying from the traditional ‘one size fits all’ thinking. Staff area is situated centrally with glazed walls for passive supervision as well as designated offices and rooms for therapy.[216]

A signature element used among other educational works by Clarke Hopkins Clarke includes the use of spinning poles in the corridor space for its proprioceptive and play potential. This is coupled with the learning environment ‘spilling’ into the communal corridor, activating it for usable space, changing the notion of corridors as simply transitional realms. Emily Flint, an architect involved on this project comments on how the theory of the space within a mainstream school and special school should remain the same. Education no longer looks like rows of students learning from one source. Learning spaces now respond to each student’s individual learning needs and these various needs must be met by providing a variety of spaces to give students the opportunity to engage with their learning.[217]
Western Autistic School (WAS), is an educational organisation with two campuses providing programmes for primary and secondary students diagnosed with ASD. WAS offers a short-term intensive program for early primary years as well as limited spaces in specialist programmes for upper primary and secondary pupils. The school utilises research-based knowledge and expertise to construct programmes and services to assist the educational processes of children with ASD. The educational model employed at WAS incorporates best practice in the education of students with ASD, fostering integration into mainstream or special schools with provision of support. Established in 1979 in a church hall with six pupils, the purpose-built school in Laverton recorded 200+ students in 2014. The campus at Laverton consists of learning spaces, specialist teacher support and a short-term adolescent intervention programme (Wattle Education). The main feature of the school is the three pods consisting of eight learning areas around a central communal space. Each learning space also houses a kitchen, breakout space and storage areas combined with controlled outdoor play. The pods are assigned to different age groups and act as smaller sub-school environments. The use of pods provides a refreshing plan layout for learning spaces, compared to the standard double-loaded corridor with classrooms. Close vicinity of learning spaces causes a lack of sufficient acoustic barriers; however, most classrooms are separated with storage, kitchen and escape spaces.

5.3 - Western Autistic School

Hede Architects

[WESTERN AUSTRALIA] 2010

The campus at Laverton consists of learning spaces, specialist teacher support and a short-term adolescent intervention programme (Wattle Education). The main feature of the school is the three pods consisting of eight learning areas around a central communal space. Each learning space also houses a kitchen, breakout space and storage areas combined with controlled outdoor play. The pods are assigned to different age groups and act as smaller sub-school environments. The use of pods provides a refreshing plan layout for learning spaces, compared to the standard double-loaded corridor with classrooms. Close vicinity of learning spaces causes a lack of sufficient acoustic barriers; however, most classrooms are separated with storage, kitchen and escape spaces.
The wattle acts as the school’s own satellite unit. The stand-alone building consists of a large central communal space, flanked by two learning areas (classrooms). The classrooms each have a silent room and a relax area (which are not present within the pods). The wattle also houses its own staff space, kitchen and laundry area.

The campus at Laverton also has an Autism Teaching Institute (ATI) which was established in 2005. The ATI provides specialist teacher training at diploma and graduate diploma levels in teaching students with ASD and implementing change, (similar to the base schools Arohanui and Oaklynn analysed in case studies section). An increase in spaces for teaching teachers within special education schools has occurred in response to a perceived need for specifically trained professionals.  

Additional spatial requirements to accommodate various age groups of children, teachers and staff creates a central communal and administrative building. These individual buildings create a central light court (courtyard) which is fenced by the surrounding buildings, as opposed to standard rail fencing which is often used to segregate children.

Additional Spatial Requirements to Accommodate Various Age Groups of Children, Teachers and Staff. Creating a Central Communal and Administrative Building. These Individual Buildings Create a Central Light Court (Courtyard). This is Fenced by the Surrounding Buildings, as Opposed to Standard Rail Fencing Which is Often Used to Segregate Children.
Summary

The main issue faced with precedent examples was the predominant reliance of spatial analysis in plan. As opposed to the case study analysis which was experienced as staff and children would on a regular basis. However, all the examples above were purpose-built buildings with an emphasis of architectural intent on circulation spaces (corridor play, way finding, navigation tools). A secondary consideration, not explored in literature was the importance of materiality. Textured, non-reflecting (light/sound), durable materials are ever important within a sensory sensitive facility. The key findings in terms of architectural implications and hierarchy of importance are listed below.

The toolkit grows with the addition of precedent analysis elements, merged with the case study and literature priorities.
Design 6
6.2 - Site Selection

FIG 192: LOCATING THE SITE - NEW ZEALAND (NTS)

FIG 193: LOCATING THE SITE - AUCKLAND (NTS)

FIG 194: LOCATING THE SITE - AUCKLAND SUBURBS - THREE KINGS (NTS)

FIG 195: LOCATING THE SITE - THREE KINGS - SURROUNDINGS (NTS)
Site selection was a straightforward task due to the program of the project. The selection process was driven by the premise that it would be located within an existing mainstream school. This determined any school chosen would naturally already be a suitable space for children. The key determinant for site selection then fell to the surrounding buildings within the school premises and their spatial relationships as discussed throughout this text. A secondary agenda was to choose a mainstream school with no existing satellite unit to avoid any preconceived notions of spatial arrangements and current use. Therefore, none of the case study sites could be used.

Auckland being a diverse city in every sense of the word, provided an umpteen number of possible sites. As the selection criteria was quite broad, the mainstream school selected, could have been located within any suburb. Three Kings School was selected due to the capability of the site’s surroundings and history reflecting the needs of children with ASD as well as its features being able to be seamlessly interwoven into the design process.

The real challenges regarding site allocation only arise after determining the mainstream school due to the spatial considerations (see design toolkit) regarding inclusivity. Location, Access, Navigation, Wayfinding and Acoustics determined where within the mainstream school the satellite unit was placed. The hierarchy placed on location of unit influences all other decisions that followed, such as classroom and therapy spaces design.
6.3 - Locating the Site
Access is an essential part of architecture, especially for communal buildings such as schools. Furthermore, accessibility plays a larger role within inclusivity as entry and exits points should not be segregated for use.

Keeping this in mind, drop off/pickup zones, foot traffic heavy zones and possible satellite unit access points will be analysed below.

Primary points of entry/exit to the school(s) are located across the eastern and western flanks of the property. Parents and caregivers momentarily park on the already busy Mt Eden Rd at peak times for drop offs and pickups.

Teacher carparks are available for all three [current] facilities, with the mainstream school carpark located off Mt Eden Rd, CAIS kindergarten carparks along and off St Andrews Rd.

Walking accessibility points are scattered all along the east and west ends of site, with the main entry on the south-west corner. However, this main entry, now opens almost directly onto the main intersection, which raises safety concerns.

Conversely, the entry points from the east are far less car traffic heavy (St Andrews Rd).

Queensway a no exit street meets the school field on the northern boundary, flanked by residential housing, providing another subdued walking entry/exit for children.

Three Kings School is one of the few schools remaining in Auckland without fencing. While fencing may be installed soon, it will interfere with the current public access used by many to reach the bus stop.
Literature, case and precedent studies revealed the importance of acoustic performance within an educational setting. Prior to locating the unit on site, some basic acoustic analysis was considered.

The large precinct sits beside an extremely busy intersection located on the south west corner of the school. In addition, Mt Eden Road leads into the CBD with frequent buses passing both ways throughout the day. The proposed area to locate the unit would have to occupy the field in some way due to the majority of the mainstream school being located on the southern border. CASS sits to the east and the kindergarten almost dead centre of the property. The intent of the this proposal, and subsequently a satellite unit, is to intrude as little as possible with the existing building layout.

The ideal acoustic location for the unit would be the paved courts on the north eastern corner of the precinct. This is simply due to the distance between the noisest parts of the site (mainstream school + intersection) being at the polar opposite ends. As mentioned earlier, St Andrews Road is far more discrete in comparison. However, locating the site at the existing courts would mean children would have to walk the entire campus to reach mainstream classes, interfering with inclusive practices. Furthermore, as learnt from case studies, there lies a fine line between isolation and abandonment.

Conversely, locating the unit as a extension of a current building too would be problematic as seen in Arahoe case study.

The choice to locate the unit on the eastern end of the field combined existing access routes as well as acoustic isolation.

Keeping the notion of inclusivity in mind, the project proposes utilizing the existing points of access as all students occupying the schools currently do, with the introduction of a new entry from Queensway for disabled access. This is due to the site being home to historic, heritage stone walls and stairs which were not designed to accommodate wheelchairs. Additionally, the unit is located within close proximity to the school hall and swimming pool in order for children from the unit to be able to take part in communal events with peers.

Three Kings reserve can be accessed with supervision and act as an extension of the school field.
6.4 - Site Views

FIG 210: DRONE SHOT MARKING CORRESPONDING IMAGES

FIG 211: ROCKWALL

FIG 212: PATHWAY FROM ST ANDREWS RD CONNECTING MT EDEN RD

FIG 213: EXISTING STONE STAIRS LEADING TO FIELD/PAVED COURTS

FIG 214: ST ANDREWS RD ENTRY
6.5 - Program

It is imperative to understand how many children can and will be accommodated within the satellite unit. The nature of satellite units, as their function suggests, is to be a smaller version of a special education school. Size is also influenced by funding. As discussed in the ORS section, only students who qualify for support are eligible to attend satellite units.

There exist mutual benefits for host schools and base schools agreeing to build a satellite unit. The Ministry of Education funds the project, new build or upgrade of existing space and determines the allotted funding through an area entitlement calculation. As seen above, the space per child depending on their needs is 3 - 11m² within teaching areas.

This project technically would not qualify for funding as it aims to serve children with ASD with mild to high needs who would not qualify ORS funding as well. Therefore, this project only adopts the concept of satellite units and does not aim to assign space based on MoE calculations.

Opposing the MoE's strict, albeit scarce allotment of space are Simon Humphreys and John Jenkins, two UK-based architects who while proposing the Thomas Bewick School (Autism Centre in Newcastle) felt 27,000sqf (2500sqm) for 90-100 pupils was far too less space per child. Humphreys suggests "about 460sqf per child" should be allotted when designing for autism. This provides a stark contrast to the MoE's area entitlement with a difference of over four to ten (approximately 42 sqm) times more space.

As many elements related to autism, there does not exist one correct answer. The MoE’s calculation would have been formulated for two classrooms and ancillary areas, whereas Thomas Bewick School would be an entire campus. Based on case studies, a standard mainstream sized classroom accommodated 8-15 students per class. As this project aims to integrate the vast spectrum of mild to very needs children, each classroom will be designed accommodate 15-20 students. Staff to student ratio is based on the needs of each individual and therefore the number of occupants per class will always be in flux.

As discussed throughout this text, opportunities offered to children with ASD is one-way architecture can help induce a sense of agency. Intervention strategies to help mitigate autism rely on identifying stress inducing behaviours and subsequently providing techniques to help deal with the hyper or hypo sensitivity in a safe and appropriate manner.

As seen in case studies and precedent studies, many schools offer in-house specialist teacher training for staff to work in corresponding satellite units. While a staff training space would be beneficial, the nature of the site chosen is diverse in student needs (CASS). Therefore, the additional programme proposed is to be a diagnostic and therapy space. Unlike a full scale therapy centre, the space is envisaged to service the children within the unit primarily but is available to be used by the entire precinct as well as be open to the public, functioning both on weekdays and weekends (similar to Mt Roskill Primary School Unit). The therapy space, unlike a teacher training space also addresses the issue of school buildings often not being able to be used productively during holidays and weekends. A swimming pool for hydrotherapy as well as converting one of the courts into an indoor gym is proposed. Access to the therapy centre will be from Queenway (indicated before).

The spaces listed illustrate the use of the unit:

**6.5.1 - Additional Program**

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The spaces listed illustrate the use of the unit:

**Administrative:**

- Reception
- Staff offices
- Assessment/Diagnostic area
- **Educational:**
  - Classrooms (Communal/Group/Individual)
  - Therapy rooms
  - Communal corridor
  - Outdoor learning
  - Gymnasium
- **Ancillary:**
  - Toilets + Showers
  - Kitchens/Wet areas
  - Storage

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6.6 - Initial Design Investigation

The initial design investigation proposed hugging the satellite unit against the curving rock wall (south-east corner of the field) for security and safety purposes, as it provided a natural boundary to one side of the unit while simultaneously being as far away as possible from the unfenced Mt Eden Road edge (western boundary of site). Formally, the concept aimed to utilise the three-access axes (mainstream school link/St Andrews Rd link and Queensway link) as a circulatory artery, with classrooms branching off to the west, an outdoor area to the east and the therapy centre to the north-east.

Keeping inclusivity and shared use of amenities in mind, the design concept proposes the walking path from St Andrews Rd which bends along the top of the rock wall and leads into the mainstream school be sheltered and act as the unit’s main form of entry. The sheltered roof will also extend to the school hall, promoting frequent usage and engagement for communal activities. The main entry is also adjacent to the Central Auckland Specialist School (CASS), which can share pick up/drop off zones.

While the form of the classroom fluctuated throughout the design process, the overall program spatial sequence was set. This was due to the therapy centre needing its own entry for use without causing distractions to students. A sweeping curve for the circulation space remained constant as an element for ease of navigation and wayfinding.

The initial idea was to incorporate the gradient by having each classroom cascade below the other, creating a dynamic northern facade with immense opportunity for daylighting design. Within the classroom, the basic concept was to extrude compartmentalising elements which exist in most classrooms and break the rectangular form. The compartments were envisaged to correspond with David Thornburg’s primordial metaphors for learning. Each space within the classroom would also cascade, promoting spatial sequencing on a public to private gradient (campfire/watering hole/cave).

A variety of classroom spatial arrangement iterations to incorporate a mixture of curvilinear and rectilinear elements were investigated.
In the first design iteration, the circulation artery attempted to use a central ramp flanked by stairs dropping 750mm per class. Halfway down, a sheltered communal use podium overlooked the outdoor learning and play space, facing the rock wall (which acted as a natural boundary). The artery would then merge with ground plane (Field) and converge with the main entry from the east and follow onto the therapy space which was initially proposed as a two-storey space.

The classroom form originated from case studies highlighting the importance of requiring a variation of spaces (gathering mat space, small group space, individual learning space, staff area and amenities (kitchen + toilets + storage)). These spaces were then placed into a hierarchal system which utilised spatial sequencing and acoustics to determine their locations in relationship to each other.

It was quickly learnt why mass educational buildings are predominantly modest in form. The foundation of classroom design relies on repetition of shapes and corresponding measurements to ensure tessellation is achieved. This meant shared walls between two classrooms had to have the same properties regardless of their functions being opposite in nature. This can be seen in the linking image above where 3 different types of wall coverages (slanted/curved vertical and horizontal) were experimented with. However, in some instances the slanted wall could work (see fig). As one class’s cave space has an inward angled wall to promote seclusion, while the other side of the wall slants outward in a communal space to make it appear larger and double as reclined seating.

The key downfall of this iteration turned out to be within its central premise of level change. The realities of achieving noteworthy changes in height to get a sense of ‘travelling further down to reach the cave’, meant each classroom would need abundant ramp space in conjunction with the varied learning environments to maintain an all-inclusive practice.
6.6.2 - Iteration 2

The second iteration proposed an irregular classroom form which consisted of a different arrangement of spaces (see bubble diagram), unable to be linked seamlessly, thus creating awkward leftover spaces. A key development was in assigning the different learning environments spatial qualities. The communal space adopted a curvilinear form, the workroom (watering hole) remained rectilinear and the escape space (cave), a mixture of both. These changes in architectural expression through visual cues, provided a different experience to that of the first iteration. The curving communal space wall intrigues the user to leave the convex circulatory artery and enter the inviting concave wall of the classroom.

Inability to tessellate in an interlinked manner opens opportunities for new spatial relationships as classrooms can be either shut off from each other (same shape repeated) or look into each other (floorplan flipped horizontally). Keeping the same orientation created a more private outdoor space, while facing each other posed challenges regarding views. The intermediary spaces between classrooms also act as an outlet from the corridor area, leading onto the school field.

6.6.3 - Iteration 3 + 4

The third and fourth iteration stem from similar principles, with key differences in entry into classroom from corridor, escape space becoming the central element of the classroom and the use of concave and convex walls for smoother curves to promote movement within theiriusscopic environments. The concept model above illustrates the spatial variety as imagined.

The use of a curved wall results in a concave and convex surface within the adjacent spaces of the divide. The convex wall gives an impression of an expanding movement toward the experiencer or an enfolding movement protecting the space within. In its essence a convex surface resists approach toward its interior space. However, its double effect lies in its guiding capacity leading the experiencer around a corner with its bend. Thus, a convex wall can be characterised not only its outward expansion but also by an inward facing concentration. This is demonstrated within the new cave space which has been re-established as a central element of the classroom.
On the contrary, when facing a concave wall, the interior space appears to succumb to the user’s forward movement as well as being an embracing form evoking a sense of being received. A representation of the concave form inducing safety and security by its nature can be witnessed in a person receiving another for embrace with open arms. Like the convex surface, the concave surface too has an inward and outward force characterising its existence. A literal cave exemplifies both, the outward force of the surroundings yielding, as well as the inward force of being enclosed.

A key development within these iterations was in adjusting spaces by learning typology. The escape space in previous iterations were envisaged as an alcove but was designated as cave space intended for individual learning. Iteration 3 and 4 propose a more uniform approach of spatial proportions giving equal importance to all three learning areas. This premise allows the cave space to be utilised to house a form of learning as opposed to being respite space for recalibration.

Furthermore, an emphasis was placed on elongating the entry space in the form of a lobby area to sit, store bags and engage with the corridor space. A basic model and sketch illustrate the intended structural elements concentrating around the nucleus of the classroom – Cave space.

6.7 - Developed Concept

This development retains several key components of the previous classroom iterations. Abandoning the notion of incremental level changes within the unit and classrooms for navigational and disabled access purposes, the unit sits on a raised platform half way up the rock wall. The one-level unit allows children to navigate the space on a consistent ground plane, descending only into green spaces (field/outdoor learning space/therapy garden). However, the increased height creates an issue of disconnection with the existing pedestrian network of the main entrance of the school. This is solved by providing stairs to the east and west, and a long ramp leading from the mainstream school path directly into the unit. The altered access point allows access from St Andrews Flat entry for all students to remain intact.

Classrooms were combined based on sharable functions. Elements such as the large group learning (campfire) area, breakout space and the cave (individual learning) area could be shared by the adjacent classroom which allowed for a compact outcome. Having two classrooms in closest vicinity raised possible acoustic issues, which were alleviated by ensuring low level noise spaces bridged the gap between the primary work spaces. Maintaining the cave space as the nucleus of the classroom allows for a radial sequencing of adjacent areas.

The need to control daylight was resolved with 3 separate roof systems (classrooms, corridor and therapy space). This allowed each space to have clerestories, unlike previous iterations where roofing was differentiated for each space within. The cave space within the classroom penetrates the roof to allow flooding of light within the space. Similarly, the campfire space receives an even flow of light from the south facing clerestory. Stark contrast between light and shadow are also accounted for on the northern face of the unit with a large overhang angling downward, cutting the high sun from creating unwanted shadows in the work room space.

The circular nature of the design stems from the ideas discussed in the properties of concave and convex walls inducing movement when faced toward each other. This aids in wayfinding and ease of navigation as an undulating form subconsciously induces movement. Furthermore, a variety of entrances lead by the main circularity artery utilise continuous walls. Flexibility of spatial arrangements which were critiqued in existing facilities, when utilised properly can have negative repercussions of unintended cluttering, resulting in disruptive spaces. However, by integrating the temporary barriers within the fabric of the architecture ensures firstly, a designated home for the component, and secondly, creates an interactive environment, which can be changed based upon need. This can be seen in the cave and communal space of the developed proposal, where barriers fan out to create individual areas, as well as collapsible/sliding doors to increase or reduce floor space as needed.

These considerations can be seen below.
FIG 243: DEVELOPED FLOOR PLAN

FIG 244: VIEW OF CORRIDOR AND ONTO MAIN ENTRY

FIG 245: ENTRY FROM MAINSTREAM SCHOOL (ROCKWALL PENETRATED)

FIG 246: LOOKING IN FROM MAIN ENTRY / PARENT WAITING AREA

FIG 247: VIEW OF ACCESS TO TOILETS

FIG 248: ENTRY TO OFFICES / MAIN ENTRANCE

FIG 249: ACCESS TO HEATED POOL

FIG 250: ACCESS TO CLASSE RROOMS

FIG 251: ACCESS TO ROUTE TO SCHOOL HALL/POOL

FIG 252: ACCESS TO GARDEN

FIG 253: ACCESS TO SHELTERED PLAY

FIG 254: ACCESS TO OUTDOOR PLAY

FIG 255: ACCESS TO THERAPY CENTRE OFFICES

FIG 256: ACCESS TO RECEPTION (THERAPY)
FIG 247: FLOOR PLAN SPATIAL DESIGNATION

FIG 248: SECTION AA - SHOWING LIGHTING FORMS (GRADIENT = INDIRECT)

FIG 249: OPENABLE CAVE SPACE

FIG 250: COMMUNAL SPACE - UPON ENTRY
FIG. 251: SPATIAL FLEXIBILITY / SIGHT LINES / ACOUSTICS

FIG. 252: LOOKING NORTH EAST
This project intended to address the question: "How can architecture create a conducive learning environment for children with autism through sensory design?" The intent of this project was to design an architectural environment that fosters agency and provides a versatile learning environment to aid mitigation through early intervention.

The project set out to discuss the problems regarding modern learning environments not being conducive for the autistic learner. The growing disparities between mainstream education and the notion of inclusivity could be associated with a dichotomy between spatial requirements and the perceptions of neurotypical and neurodiverse individuals. The project hypothesised a way of overcoming this divide through a combination of the sensory sensitive and neurotypical approach of architectural intervention for autism. This would help create a diverse range of opportunities for children to gain a sense of agency in order to become active learners within the learning environment. As theories related to sensory design prioritise the first-person experience of space, they were thoroughly investigated to formulate a toolkit for the design and analysis of this project.

The nature of the project’s program demanded a location within a pre-existing school, where the unit could be seamlessly integrated. The move to situate the unit within Three Kings School in central Auckland, was predominantly driven by the existing amalgamation of an educational precinct already being formed; in the way of three schools occupying the site as well as the Ranfurly Veteran’s home, which is envisaged to connect with unit as a plethora of resources.

Sensory design as a methodology can be argued is present in all buildings, however the question of how much sensory design techniques help in creating conducive learning environments for children with ASD remains largely undefined. This is due to two reasons. First, it is near impossible to formulate a quantitative test of determining the success of the design being conducive, simply based on the spectral nature of autism. Second, it would be just as impossible also, to formulate empirical evidence of an unbuilt design due to the difficulty of engaging with the space, thus being unable to perceive it. At best, small scale adaptations of spaces proposed could be implemented in a test site to monitor attention span, response times and frequency of self-stimulating behaviors to conclude if an opportunity for learning can be created (like Magda Mostafa’s research for design matrix formulation). On the contrary, a neurotypical individual could extract the qualitative atmospheric conditions and foreshadow a theoretical building’s environment to determine its success or failure.

This project also sought to understand how space is comprehended by people with autism, particularly abstract ideas such as interpretation, using neurotypical perception as the control group. The subjective nature of perception makes this enquiry an ongoing exploration, needing more data or an alternative methodology, perhaps outside the scope of architecture.

Through the research into existing and previous models of education, the main conclusion that has been drawn is that current modern learning environments such as ILEs, while revolutionary for neurotypical children, is not conducive for those with ASD due to completely opposing ideologies. The notion of inclusivity needs a thorough examination of its spatial implications as well as establishing its purpose within policy and legislation.

This investigation highlighted the integral need for solid pedagogical theories to underpin the design outcome. The primordial metaphors for learning (campfire, watering hole and cave) shaped the form of the resulting satellite unit through their corresponding architectural expressions using the elements of roof, floor and wall. These influenced the spatial qualities of each environment based on a learning style they were trying to achieve. Design parameters (light, exterior views, spatial considerations, acoustics and colour) formulated from literature and case study analysis manifested in the form of an inside-out approach where the classroom design and its spatial interrelationships took importance over other aspects. This often posed a conundrum between incrementally differentiated importance placed on design drivers. Key decisions influencing the notion of inclusion were access and navigation, as seen in the effort of retaining existing pedestrian networks and shared usage of entry/exit points.

By no means does this project demonstrate a perfect educational environment for children with ASD. The best environment to harness the largest window of opportunity for teaching and learning would be through an individual’s fixation or interest, preferably in a familiar space such as one’s home. Mental health being amidst the international conversation of identity, significant changes are and already have been implemented regarding societal responsibilities of acknowledging and accommodating those with physical and cognitive difficulties. The goal is to light an eternal flame in the minds of designers to consider all users when creating.
Final Design
List of Figures
null
Appendix 1
Medical Diagnostic
Medically, the diagnostic criteria for ASD split into 5 parts, however the 3 relevant parts are listed below:

A) Persistent deficits in social communication and social interaction across multiple contexts.

B) Restricted, repetitive patterns of behaviour, interests or activities as manifested by at least two of the following:

- Stereotyped or repetitive motor movements, use of objects, speech or systems
- Insistence on sameness, inflexible adherence to routines, ritualized patterns of behaviour
- Highly restricted, fixated interests that are abnormal in intensity or focus.

C) Symptoms must be present in the early developmental period (but may not fully manifest until social demands exceed limited capacities).

Appendix 2

Magda Mostafa ASPECTS Findings Summary

Magda Mostafa is one of the first designers to consider architecture for autism by devising a framework of design guidelines for ASD called “ASPECTS” in 2018. The primary objective of her study was to remedy existing poor health care for ASD patients by defining design criteria to customise spaces for autistic individuals or a group of people with similar sensory profiles. The matrix developed plots architectural attributes against common sensory issues and provides a grid with environmental design suggestions for various combinations of sensory malfunction. An avid advocate of the sensitive sensory approach, her research aimed to show that poor sensory design challenges and sensory abnormalities negatively impact the lifestyle of an autistic individual, ranging from poorly integrated verbal and non-verbal communication, abnormalities in eye contact and body language or deficits in understanding and use of gestures to total lack of facial expressions and nonverbal communication.

Method of Diagnosis in NZ
ASD diagnosis is done through sensory profiling predominantly at a young age for children with autism. For those children with autism, it is possible to identify whether they can cope with changes in their environment or not. This can be done by observing the child during various social contexts.


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Her discoveries are summarised below:

- Based on response to surveys, acoustics was deemed the most influential factor affecting children with ASD. Therefore, a graduated series of modified rooms for speech therapy and spaces requiring acoustic properties are suggested to be designed within facilities. The emphasis on gradual spaces is made to avoid habituating children to optimum environments making them dependent and unable to generalise skills for real world scenarios.

- The importance of providing ‘escape spaces’ within learning environments to allow for children to withdraw themselves from over stimulating situations in order to re-calibrate, acknowledge sensory overload and allow growth through self-learning, eventually transforming into independence.

- Arrangement and compartmentalisation of spaces provide a sense of routine which leads to increased focus and concentration, as the sensory environment is purposefully limited to ensure the users assimilate educational content easily.

- Sensory zoned spaces as opposed to functional zoned spaces coupled with a one-way circulation emphasising routine and structure provide a new dimension of thinking for designers to consider spatial use in a logical and meaningful way. Applications of sensory zoning provides diversion in thinking and physically helps children to transition from one part of the building to another.

- Psychological research indicates visual cues for autistic users provide strong associative and communicative avenues of engagement. Translated into the architectural realm, this idea could provide distinctive landmarks indicative of spatial and functional character promoting a sense of orientation and individual navigation leading to independence.
Appendix 3

Atypical & The Good Doctor summary

Atypical follows the central character Sam, an 18-year-old high school student on the autism spectrum who yearns for a romantic relationship with a female; a semi-comedic quest which drives the show’s plot while also containing heavier themes illustrated through the relationships shared with family members and friends. For maximum authenticity Sam's character demonstrates intensified obvious autistic behaviours listed under the umbrella of ASD in DSM-5. He struggles to understand social cues, fails to recognise sarcasm often perceiving everything literally, is fixated on penguins with a deep-seated interest in Antarctica and the Arctic environment and speaks with a monotonous voice indicating lack of verbal development. Most interestingly the show includes neurotypical characters who are the carers for Sam and in many ways symbolise respective roles played by supporting family members and caregivers of people with autism (in reality). The father is portrayed as a conservative man living in denial of his son's atypical behaviour, the mother, a classic overprotective, over-involved 'know-it-all' type character and the younger neurotypical sibling who is often annoyed by the various hurdles needing to be jumped to co-exist within the household, forever trying to gain approval from her parents as achievements seem diminished when compared to her atypical brother completing menial tasks, all the while being protective of her brother's shortcomings in the social realm of high school. While the show does not represent every household with a member being on the spectrum, similarities in daily routines of a neurotypical household can be seen to make the show relatable. As for the differences, viewers are exposed to the tremendous amount of compromises made by both family members and the autistic individual.6


“The Good Doctor” follows an autistic savant, Dr. Shaun Murphy a talented surgeon who displays autistic characteristics such as social awkwardness, lack of eye contact, fiddling with fingers in stressful situations and appearing to lack emotion. The show illuminates interesting work place relationships and most importantly debunks the idea of lack of empathy among people with ASD. The show also displays the political issue of hiring people with disabilities who are often unemployed. Like ‘Atypical’, daily tasks of an independent, working autistic individual is portrayed for audiences to gain perspective of the difficulties faced in carrying out simple day-to-day tasks as the average neurotypical individual.7


Appendix 4

Origins of School Architecture

The roots of an architectural typology for schools can be traced back centuries to monastic and cathedral schools, comprising of children surrounding a master (teacher). This authoritarian teacher-centric model along with institutional workhouses and prisons shaped private and public schooling worldwide.8 Spatial allocation by functional layout within homes and other buildings is a relatively recent concept. Until the 18th century, people occupied spaces within dwellings freely with no conscious spatial determinations, spaces were not specialized or sacred. Beds were set up at the time of their need and put away during the day. ‘Schools’ or educational spaces for development of young children had no fixed room(s) or building(s), the world inhabited served as their form of education. Western societies slowly began adopting the idea of assigning functions to rooms within the household and the concept of the corridor as an internal street formed connections between various rooms with varying social hierarchies. Early board schools during the height of the Industrial Revolution inadvertently took form of the 18th century house with individual (class) rooms, direct circulation routes and large communal halls in the centre. Radical educators of the time developed progressive theories concerning the education of poverty-stricken children within cities and over populated cities where children were forced to work in factories from a young age due to a direct result of industrialisation. Spaces were configured orderly, and classes adhered to the Prussian system (factory model) of segregating children by age group. Societal conditions mirrored the educational model in its oppressive, rigid and routine framework.9

To combat the plight of poor living conditions and mistreatment of young children, countries during the mid-19th century implemented legislation allocating grants for school building and compulsory education for children between the ages of 6-11. Although forms of schooling were available prior, they were mostly commercial institutions or church related. Education Acts across Europe especially the UK brought to light for the first time, the need for coherence in teacher, student and environmental needs of education spaces. Teaching philosophies employed prior to the rise of public schooling considered the educational system and its spaces merely vessels for disseminating instruction, concentrating on discipline, moral teaching, rote memorisation and recall within a rigid hierarchical system as opposed to acquiring basic skills and knowledge. The movement brought about publications and treatises for school design. While much of the work focused purely on the architectural style of exterior facades, Henry Barnard's 'School Architecture' (1841) was one of the first design manuals to draw attention to the health requirements of schools.

"Go where he would, in city or country, he encountered the district schoolhouse, standing in disgraceful contrast with every other structure designed for public or domestic use. Its location, construction, furniture and arrangements seemed intended to hinder, and not promote, to defeat and not perfect, the work which was to be carried on within and without its walls". Barnard critiqued the deficiencies of school-houses around USA. His publication highlighted the physical (architectural) shortcomings, of several plans recommended by educators and catalogued various schools and their plans across USA. The idea was to add new information with each successive edition and create a database for school designers. Barnard's critique of physical attributes such as location, size, light, ventilation, temperature, seating, teacher arrangements, apparatus, external arrangements (yard) and construction illustrated the predicament of state schooling but failed to offer design solutions.

Meanwhile, the London School Board appointed E.R Robson to direct a massive expansion of school construction to accommodate mass schooling in urban areas. Utilising his experiences from travelling to the USA, Germany and Switzerland he published 'School Architecture: Practical Remarks on the Planning, Designing, Building and Furnishing of School Houses'. A cohesive documentation of educational needs and their respective architectural design responses set a framework for school design that is apparent even today.

Schools during the mid-19th century were treated in a simple utilitarian manner. However, during the early years of the 20th century when large scale school construction boomed, improvement in design standards for lighting, ventilation and fire safety were implemented. Practical considerations along with rational, efficient, and systematic plans to design schools at the lowest cost resulted in a highly regulated school design. Factors relating to health and safety override design decisions even today, defining school architecture to the mould created almost a century ago with little scope for creative solutions.
Appendix 5

Maria Montessori

Initial teaching concepts included designing materials to monitor engagement. Didactic materials were designed to be attractive, self-correcting and sequential with an abundance of basic concepts isolated for ease of understanding and taught through sensory input. Montessori’s success with educating children with special needs turned her toward the mass education of neuro-typical children. Here, with the help of an experimental classroom she devised methods and made discoveries used prominently in early childhood and special education today.12

- Independence through self-regulation, routine and lack of assistance toward tasks achievable by the child provide opportunities to engage and learn from the task at hand or their environment.
- Montessori divided childhood into 3 separate stages. 0-3 years, 3-6 years and 6-12 years. Each stage demanded different forms of learning and the diverse age difference within classes (as opposed to Prussian system), encouraged communal based learning and utilised a family-type structure where older students of the class become mentors for the younger students, who feel supported and reassured about challenges ahead.
- A prepared environment designed and monitored by the teacher has an indirect influence on the child’s absorbent mind. By observing children under the age of 3, Montessori deduced the mind is attentive even when formal teaching and learning is absent. Therefore, a participatory environment is paramount for “effective and permanent results of any kind, physical, intellectual or spiritual”.13 Children pick up their mother tongue language without having need to be taught, but by simply experiencing their environment.


Appendix 6

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>ISSUES AND FINDINGS</th>
<th>RELATED ARTICLES</th>
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<tr>
<td></td>
<td>2. Improvement in self-concept</td>
<td>Peck, Carlson … Helmstetter, 1992</td>
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<td></td>
<td>3. Cost effective</td>
<td>Banerji … Dailey, 1995</td>
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<td></td>
<td>4. Improved academic performance</td>
<td>Affleck et al., 1988</td>
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<td>5. Improved motivation</td>
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<td></td>
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<td>Banerji … Dailey, 1995</td>
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<td></td>
<td></td>
<td>Rea et al., 2002</td>
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<td></td>
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<td>Waldron … McLaskey, 1998</td>
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<td></td>
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<td>Banerji … Dailey, 1995</td>
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<td></td>
<td></td>
<td>Rea et al., 2002</td>
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<td>Disadvantages</td>
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<td>Holloway, 2001</td>
</tr>
<tr>
<td></td>
<td>2. No benefit/difference</td>
<td>McDonnell et al., 2003</td>
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<tr>
<td></td>
<td>3. Effective for/not all</td>
<td>Affleck et al., 1988</td>
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<td></td>
<td></td>
<td>Fore et al., 2008</td>
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<td></td>
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<td>Manset … Semmel, 1997</td>
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Site Information

The isthmus of Auckland is one of the most distinctive volcanic regions on earth. It owes its special character to a large number of extinct volcanic cones with more or less clearly preserved craters. Auckland city is formed over an active field of volcanoes (50), known as a ‘hotspot’, which have all erupted in last 250,000 years. Three Kings, formerly known as ‘The Kings’ is a cluster of five significant scoria cones (of which only 1 remains today) and mounds sitting inside a large explosion crater spanning approximately 1000m, making it the most complex and largest explosion crater in Auckland. Te Tatua-a-Riukiuta is the Maori name for Three Kings, which translates as the girdle (or belt) of Riukiuta. The volcano got its name by being the location of judicious marriages, binding 3 diverse genealogical lines of Tainui, Arawa and Ngati Aw. Various iwi share connections with Te Tatua-a-Riukiuta, a rich tapestry of Mana Whenua’s layers of intertwined history built over time forming “a significant cultural heritage place”. A place valued by descendants with different versions of stories adding layers to the diverse history that encapsulates individual identities and interconnections between the people, making the place significant to many Mana Whenua.

In addition to location and opportunities for integration in the wider partner school, it is important to recognize the valuable City that students attending the satellite provision will gain that will inform them about their value relative to partner school students. Similar to sharing the same entrance, layout of classrooms, and other spaces in the satellite provision should be of the same design and build quality as those in the partner school. It is also important to consider access from public transport routes and contact data spaces that are safe for students at both the satellite provision and its partner school (For children, Schools, and Families, 2006). Particular attention should be paid to ensuring multiple outdoor spaces, such as playgrounds, give students access to opportunities for social interaction with peers, in addition to a separate courtyard specifically for satellite provision students.

Satellite provision is reintroduced to an existing school site, there are logistical and structural restrictions that would not be present if satellite provision were being constructed at the same time as the school. Students in satellite provision remain in the classroom for a much longer period of time than students in the partner school, meaning the satellite provision has to be located to give those students access to both the junior and senior facilities of a partner primary school. In a construction situation, there are more opportunities for designing satellite provision so that students are located in the same areas of the school as peers of a similar age. For example, there could be a satellite classroom in the junior section of the school, and an art classroom to the senior section of the school.

Appendix 8

Satellite provision integrated with a partner school

For students to feel that they belong and are valued in the same way as partner school students, access to satellite provision classes should be mainstream through the entrance to the school for all partner school students. Satellite provision classes should be mainstream through the entrance to the school for all partner school students (Greivell, 2020), while keeping in mind the mobility and space needs of these students in a way that is both a crowded and fast-paced part of the school (Department for Children, Schools and Families, 2008). Considering travel distances, the satellite provision would be located in a reasonable proximity to the school’s main entrance (Plummer, 2011, 2012). However, if students find the size and function of the main entrance overwhelming, incorporating satellite provision should also have an alternative entrance located in a central part of the school (McAllister & Hudson, 2015).

This must be biddable with the likelihood that satellite students may be physically isolated from accessing the school site through different methods of transport, and consideration of the space needs for students given to ensuring that students among via fax and other forms of wheelchair access are adequately provided for, while making the drop and picking up students with mobility issues does not cause traffic congestion issues for other users using the school entrance.

It is important to have regard to travel distances and routes when designing satellite provision that is dispersed throughout the partner school (Clark, 2015). Likewise, it is important to think about the structure of shared spaces or opportunities for interaction, so that interaction can be beneficial for students rather than cause students from the satellite provision to feel uncomfortable or vulnerable (McAllister & Hudson, 2015).

In addition to location and opportunities for integration in the wider partner school, it is important to recognize the value that students attending the satellite provision will gain that will inform them about their value relative to partner school students. Similar to sharing the same entrance, layout of classrooms, and other spaces in the satellite provision should be of the same design and build quality as those in the partner school. It is also important to consider access from public transport routes and contact data spaces that are safe for students at both the satellite provision and its partner school (For children, Schools, and Families, 2006). Particular attention should be paid to ensuring multiple outdoor spaces, such as playgrounds, give students access to opportunities for social interaction with peers, in addition to a separate courtyard specifically for satellite provision students. Co-location and satellite provision may give the school site access to certain facilities and arrangements, where students from the special education school can use the school site for learning areas for the mainstream or partner school that may not be able to be used by the surrounding school (Patchett-Campbell & Kingston, 2000). There are also possibilities for “reverse inclusion”, where students from the mainstream or partner school access resources within the special education school or satellite provision (Greivell, 2009; Planning & Building, vol. 11). Dual placement options can be a lot more manageable for students with special education needs if a satellite provision is shared, with a main school, thus making it easier to make connections with the site, where the environment is familiar, and to have clients from the special education education to school or satellite classes if they feel uncomfortable or vulnerable.

Three Kings’ (and Auckland’s) strong connection to basalt and scoria does not end with its landscape attributes. It is deeply embedded within both Maori and European history. Prior to the arrival of the early settlers, parapet-like volcanic stone walls were already erected as forts on one of the cones of Te-Tatua-a-Riukiuta. George Graham (1874-1952), an Auckland born accountant by profession was also a native agent helping Maori families with legal, health and housing problems. Being an active member of the Polynesian Society, he translated and recorded ancestral stories via various tribe leaders and descendants in the early years of the 20th century. Some explain the stone walls were built by Te Tatua’s 3 sons.

Quarry

The early European pioneers of Auckland used the mounds and cones as signal stations, often finding scoria and basalt rock a hindrance to farming activities. However, they soon found scoria was easily extractable and cheap to transport being lightweight, unlike basaltic denser rocks which had to be blasted and broken down before use. Subsequent to the Land Wars of the 1860’s, there was an increase in demand for stone for buildings, retaining walls, harbour reclamation, road cuttings and base infill. Commercial quarrying at Three Kings began approximately in the 1870’s and today two of the three peaks have been decimated. A view made in the 1920’s of Mt Eden, where previously the Southern King stood, illustrates the intensity with which the site was quarried. 

Winstone Ltd (now Winstone Aggregates) had the greatest impact of all quarries in the area. The company not only provided raw materials but also manufactured building materials during the building boom after the Second World War. 112 different masonry blocks of shape and colour were produced on site. Winstone Aggregates, now an aggregate of a larger company has consent to quarry until 2030. It is estimated the quarry can be operable for another 25-30 years, though 80% of the site has already been quarried, after which plans of converting the space into a lake, arena, business park or housing is proposed. While the development of the quarry site was a politically controversial issue, an agreement in the form of a compromise was reached between the developer and resident groups following over 5 years of opposition to the $1.2 billion housing development project that aims to have the first homes completed in 2019. Residents groups appealed to the Environment and High Courts raising concerns regarding excavation depth, lack of connection with the proposed town square and the lack of recognition of the Big King and other volcanic features of the area giving the suburb its identity. All appeals were withdrawn when Fletcher Living agreed to infill the quarry by 4 metres to raise ground level and "transform the eyesore quarry which is the second largest brown site in Auckland into a modern, integrated, inner-city community with high quality public spaces and playing fields;" while being "respectful" of surrounding landmarks and features. The area’s very own locally harvested material is reflected within the current aesthetics of the suburb, with a strong connection to its past and identity. However, there is uncertainty of the link being present in the proposed plans.

Ranfurly Home
Located south of Three Kings School on Mt Albert Rd at the intersection, Ranfurly Veterans’ Home was opened on 10th December 1903. Currently on its original site, which had previously been occupied to house the first few teachers of the school, the Governor of New Zealand at the time Earl Ranfurly proposed a home and hospital to be built for veterans returning from the South African War who fought for the British Empire. The building(s) would also stand as a national memorial to the war. The home has been extended multiple times over the years, with the most drastic redevelopment occurring in 2011. An agreement by the Ranfurly Trust and a private retirement village (Retirement Assets Ltd.) sought a redevelopment of the site housing a 60 bed hospital and Home as well as 170 apartments for the retirement home. The design follows an integrated retirement village and aged care facility with the retirement homes surrounding the refurbished Ranfurly House which houses a support centre on the second floor and a village community centre on the ground floor. Construction of the buildings were completed in 2016.

Carlson School for Cerebral Palsy (CASS)
Carlson School for Cerebral Palsy is a base special school opened in 1972, located adjacent to Three Kings School within the same parcel of land, except it is officially accessed from 261 St Andrews Road. The school has two satellite classes at local schools, Oranga School and Waikowhai Intermediate. Schooling is coupled with Early Childhood Education (ECE) to support transition into various forms of schooling such as special school, mainstream school and satellite classes. Carlson provides education and therapy programmes for students from ages 5 to 21 (with ECE beginning at age 3). The school curriculum is based on specialized learning programmes which prioritise key competencies stated in the New Zealand Curriculum (NZC). Programmes at Carlson include sensory arts, music therapy and intensive interaction. As all special schools, Carlson offers an Individual Education Plan (IEP) for each student to accommodate varied learning styles and capacities. Classrooms at the base school are functionally sound with ample outdoor activity spaces. Architecturally the form of the buildings differ from buildings of Three Kings School mainly in colour and roofing style. Contextually the special school is cordoned off by large (heritage) trees to separate the two schools co-existing on one site and controlling accessibility. Carlson School for Cerebral Palsy merged with Sunnydene Special School located close by, further down (West) Mt Albert Road at 48 Smallfield Ave, Mt Roskill. The two schools merged to form Central Auckland Specialist School (CASS) for children with intellectual and physical disabilities with complex needs. The recently (2013) redeveloped site of formerly known Sunnydene Special School received a 1.6-million-dollar revamp (almost double the projected figure) funded by the MoE; making it a logical decision for the merged school base its headquarters there. A contemporary two-storey block which is more a support centre than a school with an administration area, staff room, resource room, auditorium and seminar room for community use and professional development with plans for construction of school grounds and classrooms upcoming.
Other Surroundings

Directly across the road (Mt Eden Road), west of the Three Kings School site stands the historic Mt Roskill Borough Council Building which once housed council chambers, a mayoral office and administrative offices. Opened in 1957 with an extension built in 1990, it is a Three Kings heritage building which due to leaks and black mould was mothballed and closed in 2012. Prior to 1957, the site was earmarked to be Auckland Council recognised the heritage nature of the building and decided to eliminate the extensions and reinstate the original building in a 3.4-million-dollar project.37

North of the council building is the Three Kings Reserve, a vast open public park occupied primarily during non-business hours on weekdays and weekends for sport, leisure and recreation by the local community and neighbouring suburbs. Further west down Mt Albert Road is the Mt Roskill Public Library, beneath which is a community centre with various rooms for hire.

Site History (Proposed Site)

In 1875 the community petitioned the Board of Education to declare Mt Roskill an Educational District. The tender for building one classroom 30 by 20 feet (9x6m) with an entrance porch was issued in December 1878, and Mt Roskill School was officially opened on May 6th 1879 with 44 children enrolled and a sole teacher. Funds raised by public subscription was used to plant shelter trees in the playground, start a library and an additional school room in 1885 measuring 18 by 20 feet (11.5x6m). A major concern of the time was the lack of sunlight due to long shadows of the peaks resulting in dampness within the building. Due to enrolment increases over the years additional classrooms were added to the original school house. 4 rooms were added in 1891, 2 more in 1912 and the nucleus of the block fronting Mt Albert Road consisting of 2 classrooms, classrooms and a school hall was built in 1927. The original school rooms were replaced in 1936 with blocks of buildings and despite many alterations Three Kings School, which had its name changed in 1943 and became a Primary-only school due to a better representation of its actual location and the opening of the Mt Roskill tri-campus, is the oldest school in Auckland to remain on its original site. The school roll peaked in 1950 with 642 students, which resulted in other schools being opened in the area to even out capacity. An important feature of the school today, rich in heritage and historic value are the stonewalls and terraces located around the school and on its grounds. Part of a beautifying scheme during the Great Depression of 1930’s, the school saw a significant transition from a rural district to a highly populated urban area. Few skilled masons and approximately 100 unemployed men with primitive tools such as hammers and picks spent years dislodging and breaking up masses of lava rock, levelling the ground for a field and constructing the terraces. A single reminder of the state of the grounds was left in the form of one outcrop, above which a sundial was placed and exists even today.38 39

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39  Pishief, “Three Kings Heritage Study,” 87-93.