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Interactive Architecture: Creating Opportunities for our Future

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interactive architecture

creating opportunities for our future

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INTERACTIVE ARCHITECTURE

creating opportunities for out future

Technological developments and the emergence of the information age have accelerated the pace of change that affects our needs. The increased pace has shortened the cycle of obsolescence for technology and programs. The needs of society are changing at such a rapid pace that once a building is finished being constructed the needs considered during the design phase are sometimes no longer applicable. Therefore, a building must be able to actively respond to ever changing conditions and needs in order to maintain its effectiveness and value.

It is the contention of this thesis that developing more interactive relationships will create new opportunities for a building to respond and adapt to the rapid pace of change. Through means of flexibility and efficiency, this expanded dynamic process can generate direct engagement between a building and the users and the natural environment that interact with it.

The proposal is a middle school for the community of DUMBO, Brooklyn, in which the building will respond to the individual, community and city's changing programmatic needs and site conditions. The purposed school lends itself to the investigation of this expanded dynamic process which is always influx. This investigation will look at these new interactive relationships as a design tool in order to respond to educational requirements, motivate learning and make new teaching practices more productive.

ROLE OF A BUILDING

A building currently acts as the facilitator of an interactive relationship between people and our natural environment. This interactive relationship is a dynamic process that occurs over time and results in responsive systems that react to environmental conditions and people's needs. These experiences are often limited by the physical constraints of a building in which they occur. Currently as these conditions and needs evolve beyond those defined in the original design of a building, the only options available are 1) moving to a new facility to meet the expanding needs; 2) modifying the existing facility to accommodate the newly defined needs; or 3) operate in a constrained space limiting the effectiveness of the building (Brand).

In order to meet these evolving conditions and needs, a building must become an active component instead of a facilitator. Once a component, two new interactive relationships are created and the dynamic process is expanded. These new relationships, one between the people and the building and one between the building and the natural environment, will create more opportunities to respond to dynamically changing conditions and accommodate for new criteria. Together, these three interactive relationships will foster flexibility and efficiency and create direct engagement between people, the building and the natural environment.

ROLE OF A SCHOOL

A school, which is a vehicle for learning and a place to become educated, is not susceptible to the increased pace of change. If anything, a school needs to anticipate changing conditions and needs in order to prepare its students for the future. As a result, a school's curriculum and facilities are constantly adapting to accommodate these changes. Often times due to political and economic reasons, schools are retroactive to shifting needs versus proactive. While today, there is still a debate of how to prepare students for the 21st century, there is an overwhelming consensus that current teaching practices that date back to the Industrial Revolution, are not effective ways of learning. These practices of "sitting in rows, listening to teachers lecture, scribbling note by hand and reading from textbooks that are out dated by the time they are printed" are not just inefficient teaching practices but do not motivate children to learn (Wallis). Children, more than ever, need to be prepared to know more about the world, think outside the box, understand the importance of new sources of information and develop good people skills (Wallis). There is a current growing demand for preparing children for this globalized age of information. While new teaching practices and even newer technologies are trying to combat these new demands, they are often constrained to the buildings that contain them. Even more so, as unforeseen demands and new teaching practices and technologies arise, even a building that is built for this age of globalization could restrict future learning requirements. With an expanded dynamic process that includes a building; more opportunities are created in order to combat these shifting conditions to prepare students for the unknown future.

A middle school teaches students that range in age from 10-14 years old. During this early adolescent period, students are not just engaged in cognitive and physical development but in social development as well. A middle school becomes a place where students individually develop personalities and preferences at different paces. Therefore curriculum, "must take many forms, in both student-centered and teacher-centered arenas, and must nurture growth and promise success for students at different stage of growth" (Messiak).

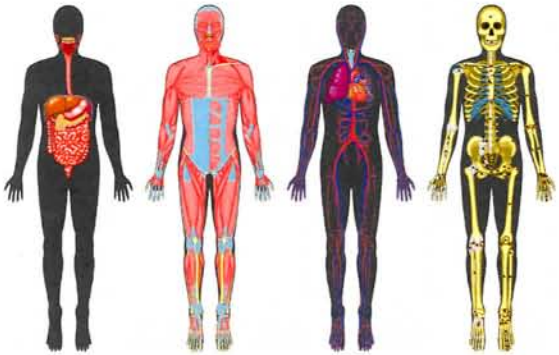
In the urban context, a school makes a positive contribution towards urban redevelopment. The vitality of a city depends on desirable housing, recreational space, and schools. This vehicle must become a learning environment that is more inclusive and integrated with the community as a whole (Johnson). This will not only benefit the neighborhoods cohesiveness but allow a school to actively engage with surrounding conditions and needs of the community.

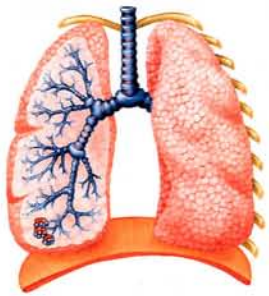
INTERACTIVE RELATIONSHIP

Looking at the current interactive relationship between users and the natural environment will help in understanding what an interactive relationship; a responsive system, is, and what it mean to respond? This will help explain the results of the expanded dynamic process that includes a building.

To respond means to answer or correspond to something or to react to an influence or stimulus. A responsive system is a collection of these influences. Responsive systems exist all around us: they can be seen in nature, in buildings and especially in ourselves. Looking at existing responsive systems will help to define and categorize the interactive relationship between the building and both users and natural environment in order to enhance the effectiveness value of a building. These systems will show the meanings behind the function, what triggers a response and its subsequent impact. While the trigger and the response make up the interactive relationship, the meaning behind the function, illustrates the purpose and role of that interaction.

To understand this relationship, it is essential to look at the two elements that make it up – the user and the natural environment. The user is the occupant inhabiting an environment. The user is made up of two components - the human body and human nature. The natural environment is a surrounding condition or influence. The natural environment is also made up of two components - climate and other living organisms.





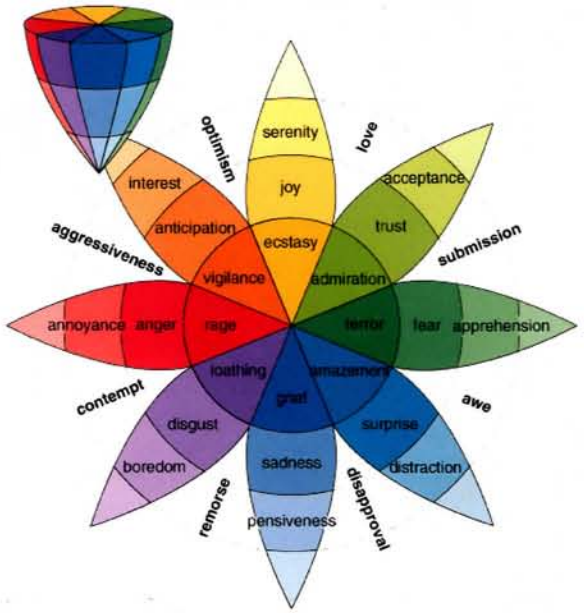
The human body is a physical unit which is categorized into different organ systems. These systems which include the digestive, muscular, cardiovascular and skeletal, perform functions based on changes in the environment. These systems, composed of organs and senses, are engaged in an interactive relationship with the surrounding environment. Over time, as environmental conditions changes, our human body learns to adapt to these varying influences as purely a means of survival.

An organ performs a specific function in response to these influences. The heart, whose purpose is to circulate blood through blood vessels, constantly fluctuates its pumping rate as a means of response. The lungs which work directly with the heart and transports oxygen from the atmosphere into the bloodstream, also changes its function (respiration rate) as a responds to the changing environment. The skin, the outer covering of living tissue, regulates against temperature changes. Its interaction with its surrounding influences can result in sweating and goose bumps. Other organs like the kidneys and liver also interact through homeostatic and metabolism, respectively, in order maintain stability of the human body.

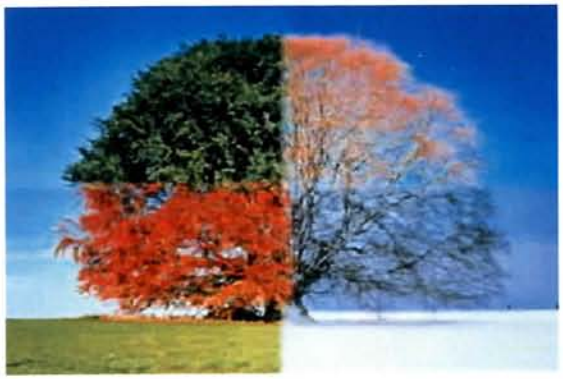
Senses are signals of perception that respond to the environment. Commonly known as our five senses - sight, hearing, taste, smell and touch - these processes help the human body comprehend these external conditions. These signals of perception are the mechanism that interpret environmental stimuli and transmits them to our organs, which then can then perform their specific function. When senses are not properly working, like in the case with blindness and deafness, the user's interactive relationship with its environment is severely hindered.

Human nature is the collection of internal individual characteristics of behavior. This behavior is measured on psychological and sociological terms. Psychology, which is the study of emotions and perception, tries to understand feeling states – subjective experiences.

These states have adapted in individuals as a means for survival. Robert Plutchik documented these adaptive feeling states into eight primary emotion dimensions, characterized by four pairs of opposites. He describes how there is a stimulus or influence, followed by a recognition of that stimulus. This recognition is transformed into a feeling state which is then transform into a behavior and finally into an effect. This series of events shows how human nature is a responsive system. This interaction, which Plutchik says is our adaptive struggle for survival, is not only our way to communicate with our environment but with each other as well. This behavior is how we perceive our surroundings via senses (sight, hearing, taste, smell and touch); this behavior is how we develop social relations via visual communication (facial expressions) and audio communication (language, crying); and, this behavior is how we learn via developing motor skills (gross and fine motor skills).



STIMULUS EVENT	COGNITION	FEELING STATE	OVERT BEHAVIOR	EFFECT
threat	"danger"	fear	escape	safety
obstacle	"enemy"	anger	attack	destroy/ obstacle
gain of valued object	"possess"	joy	retain or repeat	gain resources
loss of valued object	"abandonment"	sadness	cry	reattach to lost object
member of one's group	"friend"	trust	groom	mutual support
unpalatable	"poison"	disgust	vomit	eject poison
new territory	"examine"	anticipation	map	knowledge of territory
unexpected event	"what is it?"	surprise	stop	gain time to orient



The natural environment in the broadest sense refers to ecological units that originate without massive human involvement. These units are categorized into eco-systems - aquatic, desert, rainforest, tundra. An ecosystem is an area where climate (temperature, precipitation, wind) and living organisms (plants and animals) are in an interactive relationship. Over time, as climate changes, living things have learned to adapt to varying influencing as purely a means of survival. These adaptations are the interaction, in which the user (plants and animals) is responding to their environment (climate).

Climate is the average of weather conditions. Weather conditions include factors such as temperature, precipitation and wind. Temperature is a result of the motion of particles which make up a substance. It can vary from day to night as a result from the rotation of the Earth, and throughout the year, as a result of the axis of the Earth. Precipitation is the result of the concentration of water vapor saturating the atmosphere. This concentration – clouds – produces rain, sleet and snow. Wind is circulation of the atmosphere which is a result of a thermal difference. These factors are constantly changing and impacts the way be act and how buildings function and look. These factors are the major source of responsive systems.

For animals, this adaptation for survival can be seen in behaviors such as migration, camouflage, hibernation and regeneration. Migration is a response to seasonal and periodic changes in environmental conditions, such as temperature and food availability. This behavior of moving to find more desirable conditions can be seen in salmon, humpback whales, Canadian geese, monarch butterflies and caribou. Hibernation, also a response to seasonal changes in environment conditions, is an adaptation for when movement is not the most effective way towards survival. This metabolic depression to conserve energy can be seen in bats, groundhogs, ladybugs and squirrels. Camouflage is the act of concealing by altering appearance, usually to blend in with the surrounding environment. This survival behavior, seen in frogs and chameleons, is for protection from predators. Regeneration is a response to replace a lost or damage body part. An act that starfish and salamanders perform, regeneration allows for these users to stay alive when conditions have not been favorable. While animal behavior can be carried out in different ways, these adaptations are always triggered by the changing surrounding environment, in which survival is the reason behind the response.






Adaptation as means of survival is also present in plants. A plant survival depends on the capability to perform a chemical reaction called photosynthesis. This reaction takes light energy (sunlight) and converts it into chemical energy. Through the subunit called chloroplast, carbon dioxide and water is converted into oxygen and carbohydrates. Consequently, a plant response to the natural environment revolves around the ability to maximize photosynthesis. This has resulted in plants taking form in many different shapes and sizes. As a response to cold and dry changing seasonal conditions, deciduous trees perform a process called abscission. Performed by oak, elm, birch and maple trees, this process involves losing leaves, flowers or fruit. In order to build new leaves and to perform photosynthesis again, a deciduous tree must wait for nutrients in the soil to be replenished, or for environmental conditions to become more desirable. Evergreen trees have learned to adapt to these seasonal changes of nutrient levels in a different way. Instead of losing its leaves, it performs photosynthesis in needles. These needles make it easier for trees like pines, redwoods, spruces and cypresses to survive during cold and drought. The lotus flower response to a lack of sunlight by closes its pedals at night. In extreme circumstances it will sink underwater, as a way to survival unfavorable conditions. The sanguaro cactus is also a good example of how a plant has learned to adapt to its environment. It is located in the Sonora desert in Arizona, where rain is infrequent and occurs mostly in the summer. As a result, this cactus uses its swallow root system and pleats to make the most of the rain when it does come. A sanguaro cactus can expand its shape to store up to five tons of water, which could last it several months. This adaptive behavior has allowed the sanguaro cactus to thrive in an environment that receives less than ten inches of rain a year.

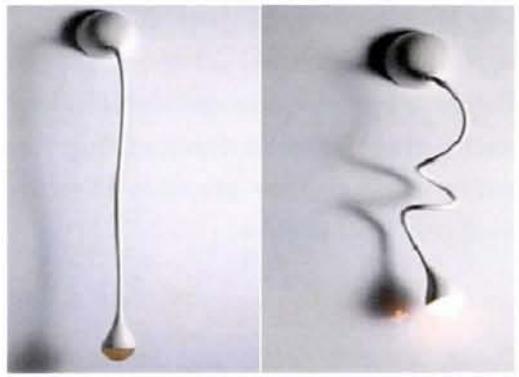
THE BUILDING

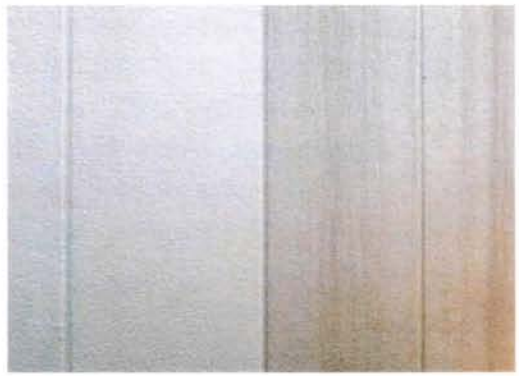
It becomes evident that this existing interaction relationship is one that involves direct and constantly engagement. A responsive system is the result of adapting to existing conditions.

The building refers to man-made object. This relatively enclosed form is typically confined by means of conventional floors, walls and a roof. The building acts as the facilitator for the interactive relationship between the user and the natural environment. Over time, as climate changes, humans have learn to adapt, via the building, to these varying influences as a primarily means of survival. A building is simply at the mercy of climatic influences and human adaptive behavior. Therefore, while a building is not static and can be considered a responsive system, the ability to respond is limited to ways defined in the original design.

A building exhibits movements as a result of people responding to changing climatic conditions. These movements include but are not limited to loads, apertures, luminosity and temperature. Loads, which are forces exerted on an object come in two forms – dead and live. Dead loads, which are permanent and include structure, walls and floors, react to live loads, which constantly vary and include wind, snow and people. Together these loads put pressure on the built object, whereas the object will compression or sway. Apertures are openings in a surface and allow the passage of light, air and sound. In the form of windows and doors, these elements can be opened or closed depending on environmental conditions. While apertures are the catalyst for interaction, the interaction is the process of controlling the enclosing membrane. The same goes with the luminosity and temperature. The user is in control of these elements with blinds, dimmers and HVAC systems, but they are really a reaction to the natural environment. As with a squirrel that hibernates, the building, in a squirrel's case a burrow, is not the interaction but the result of interaction between the squirrel and the natural environment.

The materiality can also determine the movements that a building exhibits over time. Brick, concrete, metal and glass all change depending on environmental conditions. As the temperature fluctuates, brick and concrete expands and compresses; metal and glass collect moisture. These building materials are merely retroactive and generally cannot actively respond to the needs of people, but with the development of new and innovative materials primarily known as smart materials, possibilities for this respond become available. Piezoelectric materials produce a voltage when stress is applied. They could bend, expand or contract when energy is applied. These materials are being used in dances floors as a way to take people's movements and turn them into lighting effects. Shape memory alloys are bendable metals. When heat is applied, these alloys can bounce back into their original shapes. Nitinol, a composite of nickel and titanium, which can be seen in glasses frames, is a shape memory alloy. Another smart material is nano-materials. These microscopic morphological have a high surface are to volume ratio, which makes it easy to change the properties of the particles. An example of this is self-cleaning concrete which as used in the Jubilee Church in Rome.





RESPONSIVE ARCHITECTURE

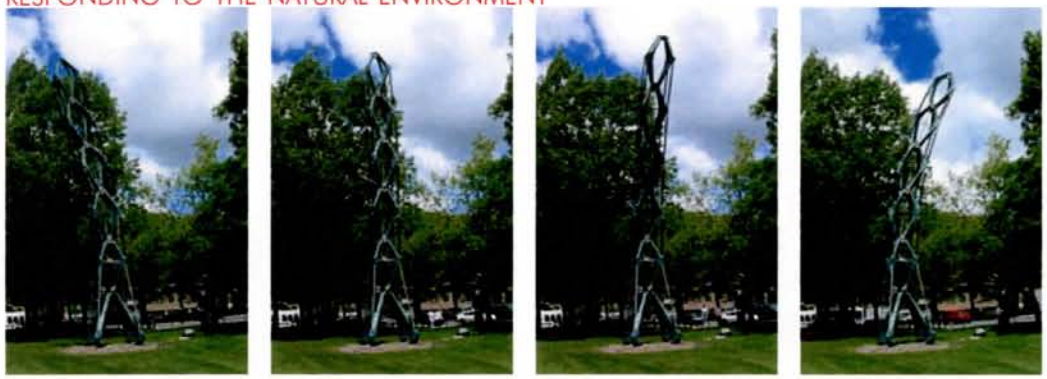
The idea of creating an interactive building is not new. There have been recent examples where architectural design has had the ability to actively respond to either changing programmatic or external environmental conditions in a way that can directly benefit the needs of the user. In some cases, this result is purely a means of innovation and in others it is to create an awareness of these natural environmental conditions. These projects create the necessary engagement between the components of the dynamic process, but in many cases only perform one task. While they create desired result, it is a predetermined result, whose purpose is still unclear. The actions taken in response to conditions are generally spontaneous behavior and that create physical, experiential and social interaction. These examples do, however, confirm the role of interactive features in building design and can form the basis for expanded use of these features in a more flexible and valuable way. A few examples of this new trend are discussed.

RESPONDING TO THE NATURAL ENVIRONMENT

These projects focus on developing an interactive relationship between the building and the natural environment. They are able to actively respond to wind and temperature.

RESPONDING TO THE USER

These projects focus on developing an interactive relationship between the building and the user. They are able to actively respond to sounds and movements.



WhoWhatWhenAir's "Muscles" project in 2006, made up of pneumatic muscles which control an articulated jointed spine, could actively respond to wind direction and velocity.

In 2006, LAB [au], choreographed the 4200 windows of the Dexia Tower to create a visual and luminous facade that changed color based on exterior temperature.

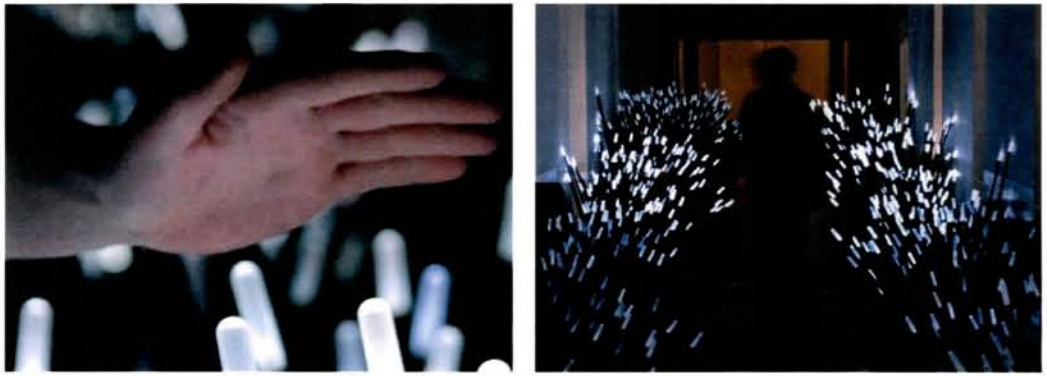
Theo Jansen's Strandbeest project, are "walking" kinetic structures made of piping, wood and sails, that respond to the wind. These wind driven automatons not only generate a visualization of the wind, but at times can change the effect of that wind.

In 2007, Daniel Rozin used motors, mechanical mirrors and a video camera to create Weave Mirror. This installation used 768 C-rings that rotated to reflect the movements of people standing directly in front of it.

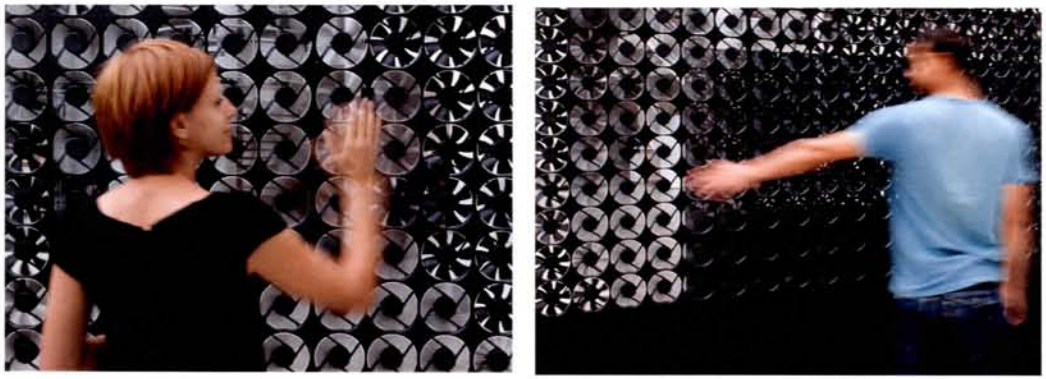
Reciprocal Space by Ruairi Glynn, created a moving physical space by have walls have a reciprocal affect to a person's movements.

Decoi's "Hyposurface" project, attempts to build a surface that can respond to both sound and movement of people. The wall, is able to act like liquid to create waves, patterns and text, based on the participation of the people within it.

Usman Haque's "Evoke" installation in 2007, responded to voices - words and music - to create colorful light patterns on the façade of York Minster.



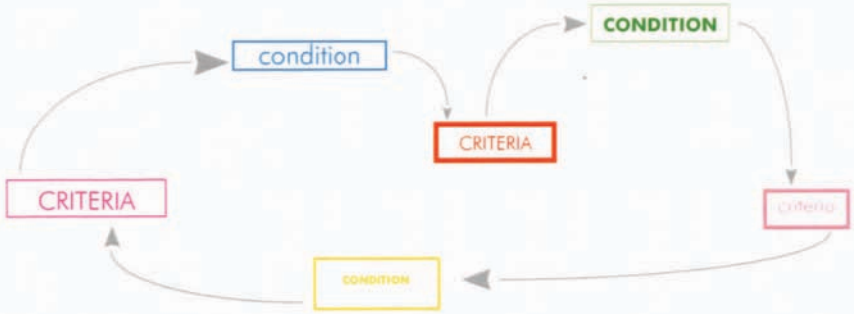
In the 2006 project called Dune 4.0, Studio Roosegaarde used fiber optic cables that changed intensity in brightness according to the sounds and motions of people.

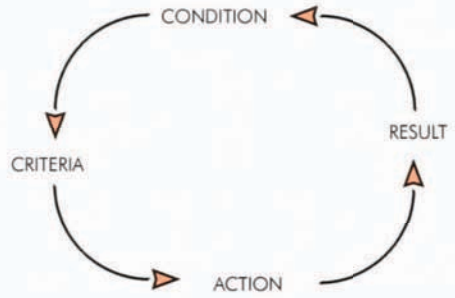


A year later, Studio Roosegaarde took hundreds of ventilators that could react to sound and motion. In an installation called Flow 5.0, it created illusive landscape of transparencies and artificial wind.

DYNAMIC PROCESS

The dynamic process is an interactive relationship where a condition is measured against defined criteria, causing an action to be taken to achieve a certain result. This process is one that occurs over time with a clear purpose and is integral to the user's experience. It is a cyclical process, composed of reciprocal actions - the conditions affect the criteria and the criteria affect the conditions.

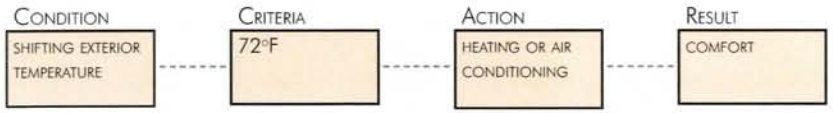




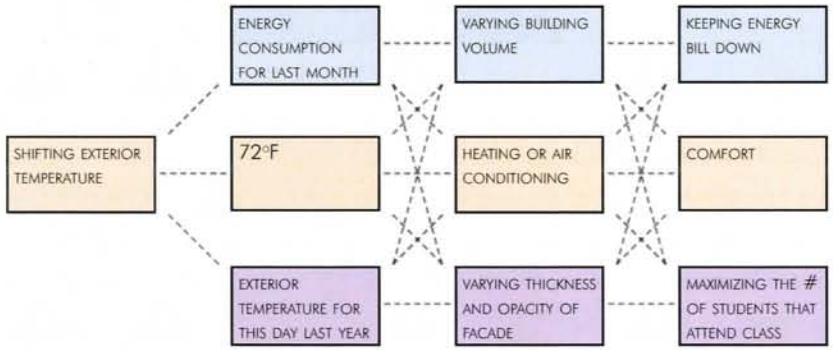
A condition is an existing state. It is a prerequisite to a necessary result and is the initiator of the dynamic process. The condition creates a framework in which the criteria can be applied. This framework can be generalized as a rhythm - a measured movement which varies in length and accentuation. These variations are based off events. Rhythm is measured on two factors: time and use. The rhythm of time is daily, weekly, seasonal and yearly. The rhythm of use is site and program. While a condition is an existing state, understanding the anticipated state and the forecasted condition, will illustrate how the existing state might change over time. Only when looked at collectively, is the framework understood. Only after understanding the framework can the type of criteria be identified.

Criterion is a standard by which something can be judged or determined and a basic on which action is taken. Action are taken to achieve a desired a result.

EXISTING DYNAMIC PROCESS



EXPANDED DYNAMIC PROCESS



In the current dynamic process, a building is a facilitator between the people and the natural environment. A thermostat currently acts as a medium in which people use to interactive with natural environment. As the exterior temperature varies, a thermostat is used meet criteria, such as 72 degrees. By moving a dial, an action – heat or air conditioning – is implemented to create the desired result. In this current example, there is a limited amount of criteria and therefore a limited about of actions that could be taken in order to meet the desired result of comfort.

In the expanding dynamic process, a building becomes an active component which creates two new interactive relationships. These new relationships generate additional criteria and additional actions, which allow a building to participate in a more responsive way to achieve the same desired results. A thermostat in this expanded process would be able to understand more criteria then just on and off or heating and cooling. Taking the same conditions, criteria could be 'energy consumption for last month' or 'exterior temperature for this day last year.' This new thermostat could then measures the new criteria and evolve new ways to act, in order to produce the most appropriate outcome such as: 'keeping energy bills down' or 'maximizing the number of students that attend class' (Haque). This creates direct engagement, with both the user and the natural environment that can evolve over time and can increase the amount of opportunities a building has to achieve that more specific results.

PURPOSE

Purpose is a desired result. The value of the desired result in the existing interactive relationship is one evolving around survival. With the creation of the two new interactive relationships, this evolution becomes more flexible and efficient. This flexibility and efficiency allow for more opportunities to get the desired result. Therefore the purpose of the expanded dynamic process is to function in the best possible manner with the smallest amount of waste of energy and space in order to achieve a goal. These functions create new opportunities and generate engagement for a building to become an environmental device, learning tool and space saver.

INTERACTION AS AN ENVIRONMENTAL DEVICE

Architectural strategies today look at taking existing environmental conditions as way to save energy. Most of these strategies are passive systems which require little user interaction. Their designs are intended to reduce the overall impact of a building. This impact is composed of both a climatic impact (weather – temperature, precipitation and wind) and a human impact (energy use, water use and waste). Using green materials, photo-voltaic solar panels and fixed louvers to maximize southern sun exposure helps achieve this goal, but do not engage the occupants. Without this engagement, an awareness of these impacts is not understood. Without understanding, human behavior does not change and the building independently become more efficient. Interaction as an environmental device must use the current technologies in buildings that make them efficient in collaboration with the occupant's movements and needs. With a school, these needs range from lots of natural light to complete darkness and is aimed to create an environment that encourages students to learn. This collaboration creates necessary flexibility that can evolve over time opposed to becoming a fixed architectural element that accommodates selective needs.

INTERACTION CAN BE A LEARNING TOOL

Motor skills are voluntary movements in order to complete a task. This movement is categorized in two groups - gross motor skills and fine motor skills. Gross motor skills are large muscles movement functions such as walking and maintaining balance. Fine motor skills are small muscles movement functions such as hand eye coordination and dexterity. The development of these skills is considered essential in the education community. Without the proper development of these skills, children are not able to efficiency complete assignments, which have an adverse affects their education. To prevent these affects, schools try to engage children with their surroundings. If a child's surrounding is critical for this engagement to occur, then the building must becomes the vehicle for development. Interaction as a learning tool must become the place for engagement that can motivate learning and make teaching more productive.

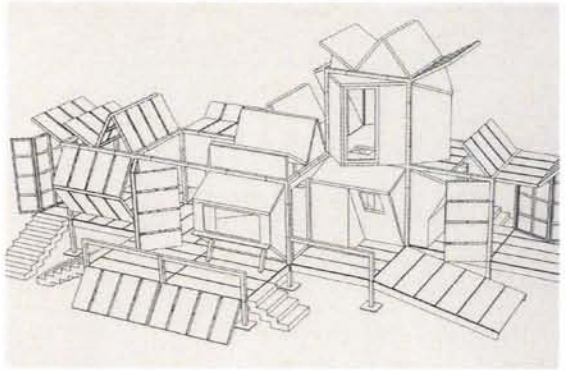
INTERACTION AS A SPACE SAVER

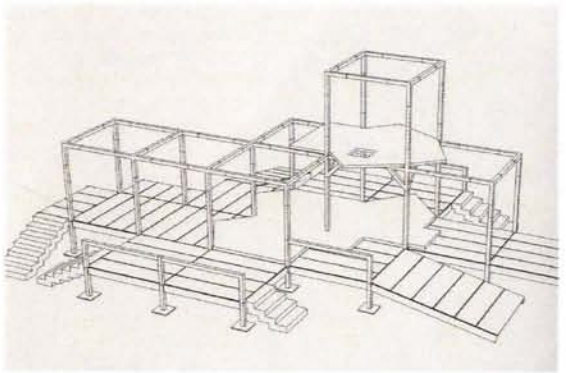
Either for economic or environmental reasons, compact spaces are becoming increasing advantageous. It is considered a viable solution for increasing programmatic efficiency. Limited footprints and overwhelming demand have created a need to critically look at how program changes over time. In the urban context, compact program becomes one of necessity. The density of a city creates a need for programs to become condensed or spaces to have multiple functions. This has resulted in vertical growth; as with skyscraper, and transforming architecture elements; as with moveable partitions. Kisho Kurokawa's, Nakagin Capsule Tower, in 1972, utilized these techniques to address the density in Tokyo. It shrunk the size of an apartment to about 95 square feet. This apartment building, composed of prefabricated pods, looked at where programs overlap occurred and made that overlap more efficient (Kurokawa). Inside the pods elements folded up and programs were stacked to make the building not just spatially efficient but to meet specific programmatic needs. Bonbon's, Convertible Doc Sofa/Bed, shows how furniture can act as a space saver. Unlike stackable chairs, this sofa that transfers forms into bunk beds shows how one piece of furniture could have multiple purposes.

These functions create new opportunities that generate engagement because the built environment can actively respond to the user's needs and the natural environment conditions. This engagement can be categorized into two groups: physical and experiential.

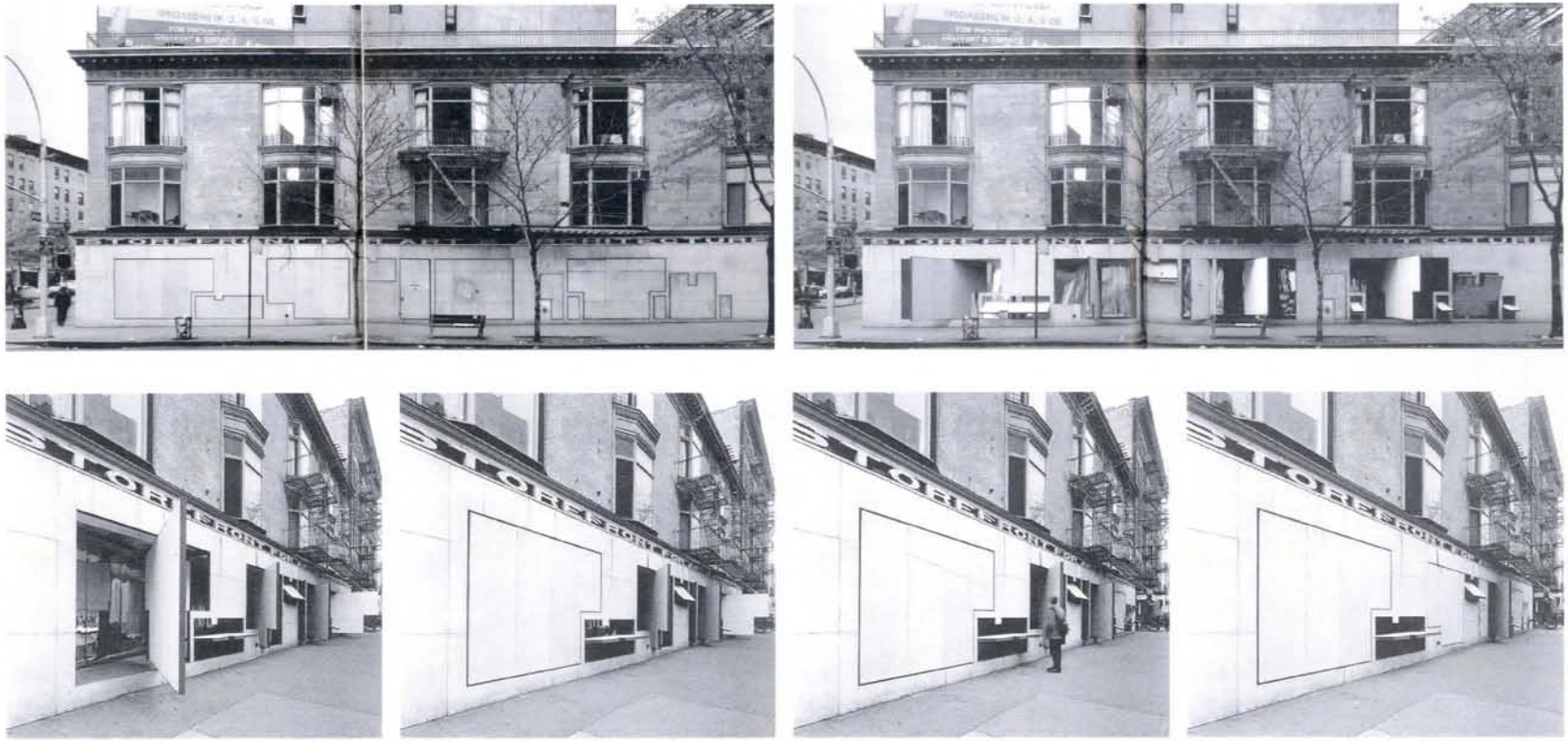
PHYSICAL ENGAGEMENT





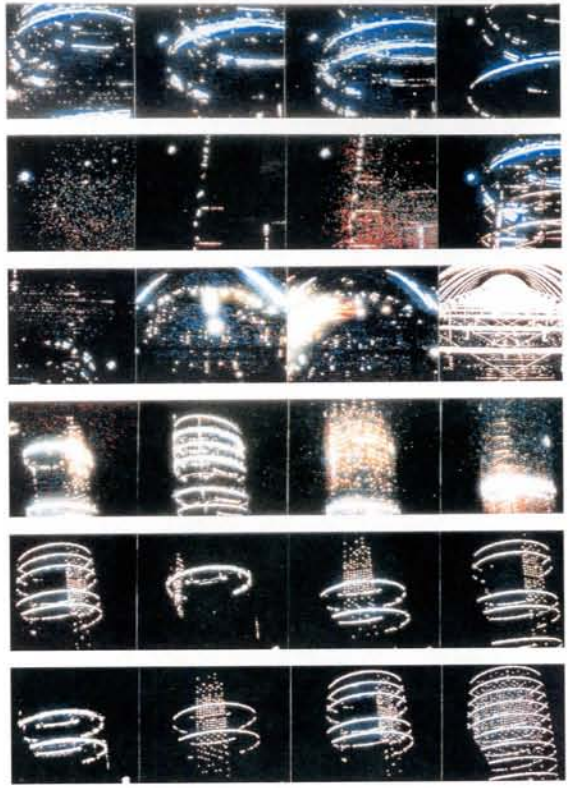



The engagement generated by the new opportunities created by the expanded dynamic process can be grouped into two categories. The first is physical engagement. This kind of engagement is an objective reality. It is how things really are. It is able to be counted and is external to the mind. Michael Jantzen's M-house, is a good example of how architecture uses physical engagement. Built in Gorman, California, it uses an open space steel frame grid to allow a variation of manipulative components to accommodate a wide range of changing needs. Composed of hinged interchangeable panels which can fold in and out, the house becomes an actively component of the dynamic process (Jantzen). The interchangeable panels create flexibility which allows the building to efficiently respond to the natural environment conditions (sun, rain, wind) and user's needs (places to sit, sleep, work and eat).

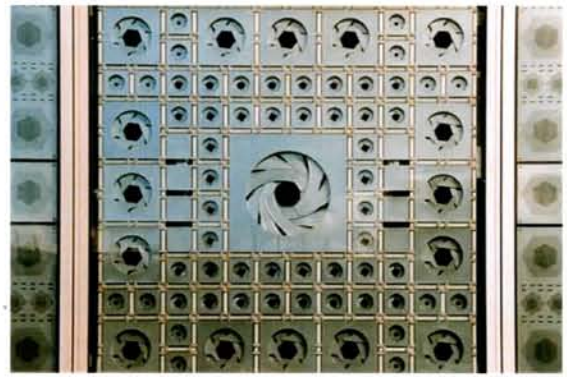
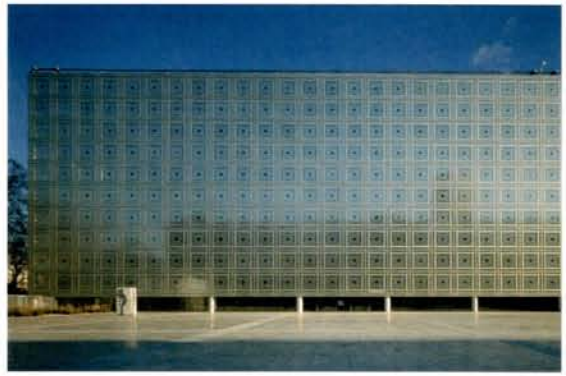
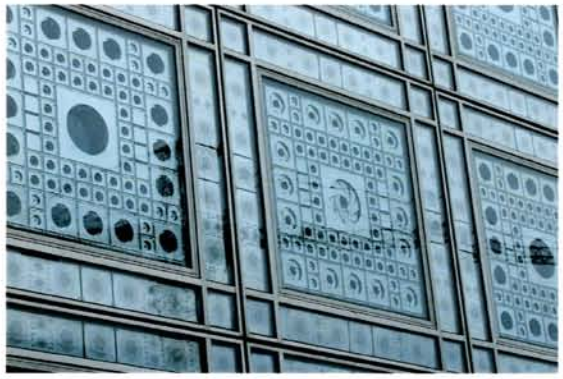


Steven Holl's, Storefront for Art and Architecture, built in 1993 in Manhattan, also uses hinged panels to respond to the small footprint of the gallery by overlapping the program of the street and gallery spaces. It engages people by requiring muscle power to move the panels, which creates an intensified sensory experience. The design also allows for more freedom and flexibility for the artists to display their work (Ritter).

EXPERIENTIAL ENGAGEMENT



The second category is experiential engagement. This is a subjective perception. It is an opinion, assumption or belief that exists within the mind. This mental act is a characteristic of an individual. Toyo Ito's Tower of Winds, built in 1986, is a good example of how experiential engagement. In the center of a roundabout in Yokohama, Japan and surrounded by apartment and office buildings, the project sought to act as urban maintenance to redress an obsolete tower that acted as a ventilation shaft for an underground shopping complex. It uses 1280 mini-lamps, 12 white ring shaped neon lamps and 30 floodlights, which change intensity depending on the direction and velocity of the wind and the frequency of the surrounding noise. The changing light patterns enable the building to actively respond environmental conditions (wind and sound) and engage the user by stimulating their senses and increasing their perception of space they're occupying (Roulet).


In 1987, Jean Nouvel, used the Arab World Institute's south façade as a way to interact with the natural environment. He created an electronically operated diaphragm wall that controls the passage of sunlight into the building. This façade's 240 motor controlled apertures open and close every hour in response to the amount sunlight present at that time (Loriers). This creates an effect of changing patterns of light and shade.

An interactive relationship is a cyclical dynamic process, whose aim is to meet criteria to achieve a desired result. The development of two new interactive relationships creates new opportunities and new methods through means of flexibility and efficiency. As the criteria change in response to shifting conditions, these means increase the possibilities that a building can accommodate the desired result. Consequently, it is essential to look at all the existing and anticipated conditions in order to understand the present and potential criteria that need to be meet.

PROGRAMMATIC CONDITIONS

STUDENTS

The expanded dynamic process will be applied to a middle school in Brooklyn, New York. The school must be able to evolve as the needs of the community change over time. This will help retain the school's prominent role to serve as a place to educate young adolescences.

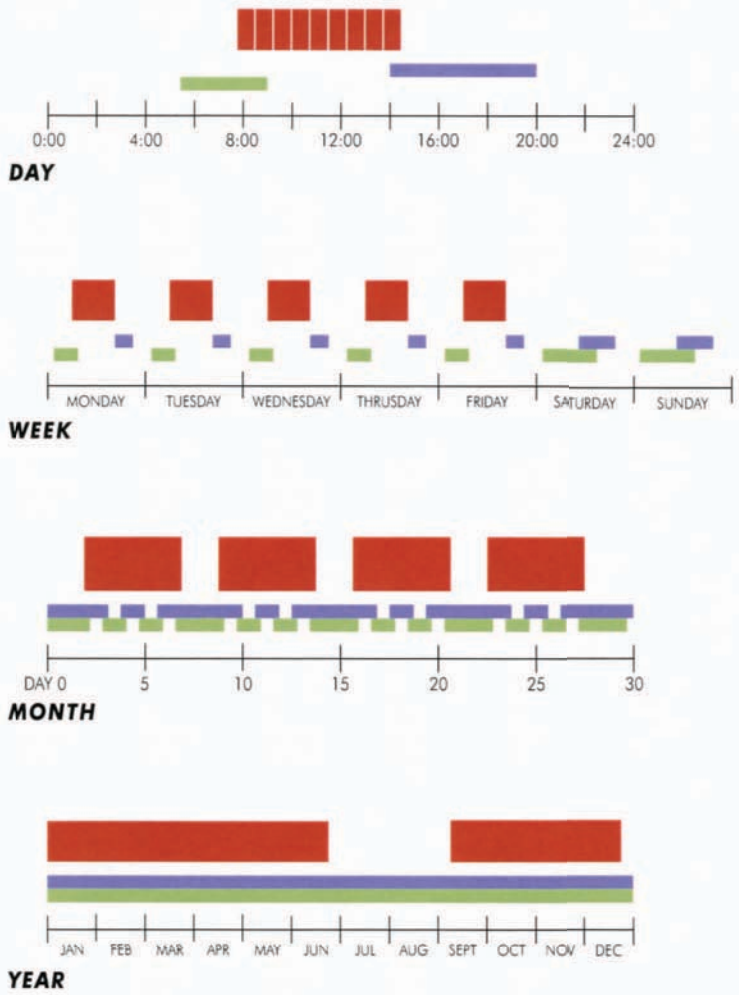
Middle school for the student is considered a transitional period for cognitive, physical and social development. For these early adolescent (10-14 years old) cognitive growth, it is a time where students begin to have the ability to think about indirect relationships and abstractions; they are able to reasons with concepts and interact with the hypothetical (Messick). Before this period, students are only able to understand concrete thought or observable properties in order to solve logical problems. The early adolescent years also marks a time of distinct physical changes. Shifts in hormone production can result in a gain of eight to ten pounds in weight and two inches in height. Changing physical features cause inflated levels of self-consciousness, which can affect behaviors and attitudes. Social interaction among peers rapidly increases in relation to this cognitive and physical development. This interaction creates strong desires for independence, at the same time, a large need for adult support. Since these developments occur in early adolescence at different times and at different rates, middle school's curriculum needs to handle a variation in needs and desires. Howard Gardner's Theory of Multiple Intelligences, recognizes these variations of talents and shows how to effectively teach the board range of interests. This has implications on what types of spaces are required to accommodate these interests which range from small intimate spaces to large group area. Therefore a balance of guidance and independence, create opportunities in developing individual personalities and preferences. As a result, teaching practices that accommodate individual behaviors are more appealing to middle school students (Messick).

CHARACTERISTICS OF GARDNER'S MULTIPLE INTELLIGENCES

Intelligence	Like To -	Is Good At -	Learns Best By -
Linguistic	Read Write Tell stories	Memorizing names, places, dates, trivia	Saying, hearing and seeing words
Logical (math)	Do experiments Figure things out Work with numbers Ask questions	Math Reasoning Logic Problem solving	Categorizing Classifying Working with abstract patterns
Spatial	Draw, build design Daydream Look at pictures Play with machines	Imagining things Sensing changes Mazes/puzzles Reading charts	Visualizing Dreaming Working with colors and pictures
Musical	Sing, hum tunes Listen to music Play an instrument Respond to music	Remembering melodies Noticing pitches/rhythms Keeping time	Rhythm Melody Music
Bodily (kinesthetic)	Move around Touch and talk Use body language	Physical activities (sports, dance, acting)	Touching Moving Interacting with space Processing knowledge through bodily sensations
Interpersonal	Have lots of friends Talk to people Join groups	Understanding people Leading others Organizing Communicated Mediating conflicts	Sharing Comparing Relating Cooperating
Intrapersonal	Work alone Pursue own interests	Understanding self Focusing inward Following instincts Pursuing interests	Working alone Doing individualized projects Having own space

TEACHING

A middle school's program is one that is always influx. The framework is constantly changing because the conditions that make up the framework are changing. Even within the normal operating hours, the period of most concentration, there are numerous activities that are occurring within a school. These activities require classrooms, administration and teacher's offices, gymnasiums, auditoriums, cafeterias, libraries, outdoor play areas, bathrooms and storage. Throughout operating hours, the schedule of a middle school usually entails eight 40-50 minutes classes, which are separated by 5 minute breaks that allow for movement from room to room to occur. When not in session, during early mornings, evenings and weekends, a school's activities can be extended to interact with community. These activities which include meetings, concerts and plays, expands the program in order to make the building useful for more than just six hours a day (Department of Education). This rhythm of activities can be broadened from just the day and week. Throughout the year, the influx of activity changes as well. These conditions include summer and winter breaks, which currently last nine and two weeks, respectively. From year to year, the number of students and principle curriculum can also shift.



Varied rhythmic conditions:
- school
- extra-school activities
- community

These current rhythmic conditions change the type of criteria that the building needs to meet throughout over time. Schools where space is readily available, have huge footprints in order to accommodate all the criteria, resulting in spaces that are used for only a fraction of a day as seen with wood shops, cafeterias, and television studios. Schools where space is limited, as seen in urban areas, cannot met all the criteria, resulting in spaces which multiple programs not designed for them, try to use; such as a gymnasium being used as an assembly hall.

To respond to these varied rhythmic conditions, classroom layout and content has become flexible to maximize control. Considered the heart of a school, the control within a classroom can maximize student learning and productivity. This control hopes to foster better interaction among students (Johnson). As a result, building systems become generic to support a room's reconstruction throughout time. Furniture is able to be moved and stacked to accommodate varying educational activities and the surface of walls is able to be modified to accommodate varying course materials. Even with this limited flexibility, for the most part the typical classroom still has a grid of desks and chairs facing a teacher's desk, and teaching is still done via the acquisition wall. This wall holds the blackboard and is where new material and concepts students are currently studying is located. This is the primary portal from which teaching is dispensed from. Maintenance walls on the sides hold supporting material that has already been covered (Johnson). This current mode of teaching was designed for the masses and primarily role is to prepare children to become workers. School experiences are devoid of opportunities to create an original thought, when "filling in blanks on worksheets, regurgitating facts from textbooks, writing formulaic five-paragraph essays and taking multiple choice tests" are standards in teaching practices, unofficially known as passive teaching (Wolk).

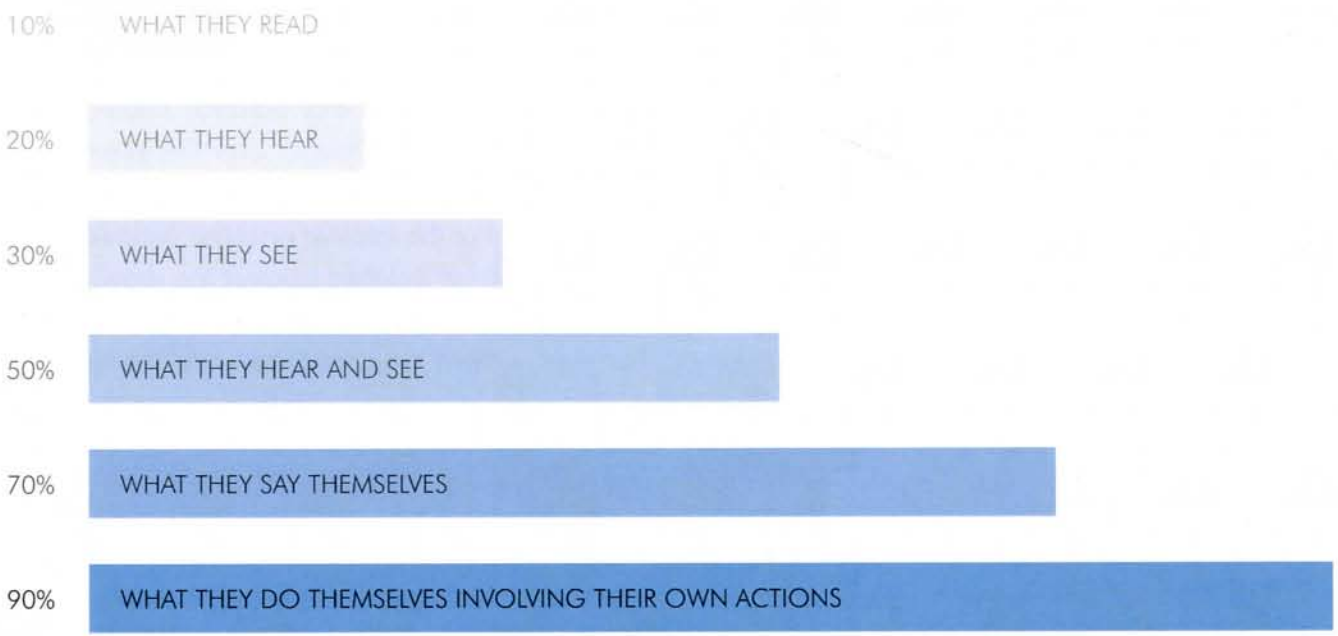
Movable furniture allows for limited flexibility in classrooms today

TRENDS

This traditional method of using the blackboard as a primary means of teaching has been seen as one that does not actively involve the student. This lack of involvement has been found to discourage motivation and attendance, which results in inadequate student performances. This has resulted in trends that create dynamic factors in teaching. These factors are essential in order to develop skills and muscular experiences which are essential to gaining clear definite ideas of the world. Reports find that a "seat fastened to the floor is ill-suited to a child's needs" and that "an idea is not completed until it is realized in action" (O'Shea). Activity between the senses and the muscles create both mental and motor development. Studies have shown during learning, students best retain information that they have obtained themselves (Neufart). The benefits of actively hand's on learning can be seen in the graph on the following page. These numbers have impacted curriculums to incorporate a wide range of teaching styles from, teacher-centered to student-centered. Teacher-centered is the tradition straight lecturing, while student-centered is more guided discovery and problem solving (Pangrazi).

The Montessori Method's philosophy, developed by Maria Montessori by 1912, sees the importance of student-centered teaching. It is a hands on approach to learning, encourages children to develop their skills by doing many activities such as: kinetic movement and motor skill coordination. In Montessori schools, the classroom provides an atmosphere that allows children to learn at their own pace and interact with others. It has an emphasis on adapting a children's learning environment to benefit their development. It sees the environment as a way to learn abstract concepts and practical skills. While predominantly focusing on children below the age of twelve, these methods have shown to be beneficial in fostering both "positive social relationships and academic skills in children as they continue to grow up". It has also shown a "higher level of interest and motivation while doing school work." This interaction is a product of the three-year age range of students, which allows for a more flexible learning pace and for older students to become teachers by presenting what they have already learned. As a result, Montessori schools layout revolves around a center room which serves as a place of interaction. It is where students present their discoveries and learn from each other. This space creates a common idea to promote social interaction while minimizing disruption to student classrooms (Montessori).

RANGE OF TEACHING STYLES

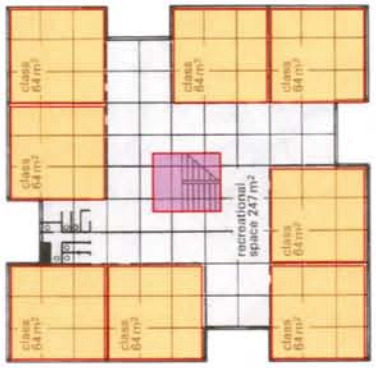


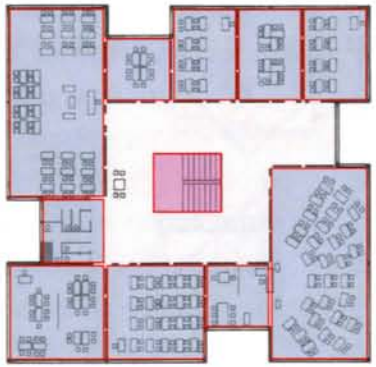
PERCENTAGE OF INFORMATION THAT IS RETAINED PER LEARNING ACTIVITY

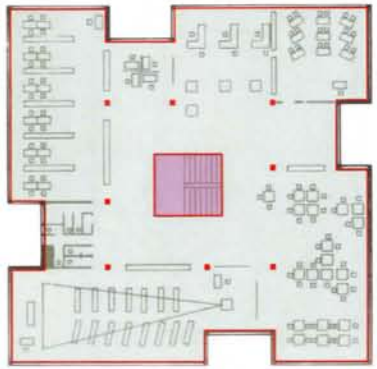
TECHNOLOGY

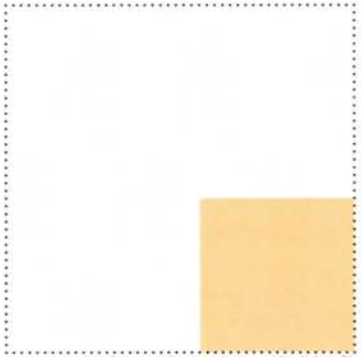
New technologies have also played a part in incorporate dynamic factors into the classroom. They have created the possibility in increasing access to electronic information and more complex student tasks. These possibilities have created new forms of learning like collaborative learning in which students work as a collective versus on a purely individual level. This has resulted in project based work and peer coaching versus lecturing via the blackboard. Collaborative learning creates more active involvement in which students are able to think about information, manage information, make choices and execute skills (Department of Education). Its desire stems from the awareness that group dynamics are becoming the context for adult's achievement in the real world. Consequently, collaborative learning stresses actual accomplishments, fosters cooperation and competition and teaches teamwork. Larry Rosenstock, the principle of High Tech High in San Diego, a charter science high school opened to the public, says that "experiment may be the one way to prepare the next generation for the global economy." It is more about getting hands on experience versus preparing for bubble answer tests. Experience is what creates engagement. A school must recognize these trends in hands on engagement through new technologies to develop skills and motivate learning (Rosenstock). This engagement is the purpose that will create the necessary interaction between the user (students) and the building.

These technologies have also created new mediums for teaching. Hybrid courses, ones that balance traditional face to face classroom instruction with on-line components; and, on-line courses which are completely taught over the internet, are the latest trends in higher education as a means of economy. They use the benefits of the internet – emailing and blogging – to provide instant gratification, immediate feedback and constant access of class materials. The use of the internet provides flexibility as students can work at their own pace and more productive use of time. These benefits have to be weighed against the drawbacks of losing of faculty and student interaction. As a result, preliminary studies have reported that the perception of quality of hybrid courses and full on-line courses is no better than traditional methods (Jackson). But even without substantial benefits, this type of teaching is expected to grow in popularity as a result of economics.

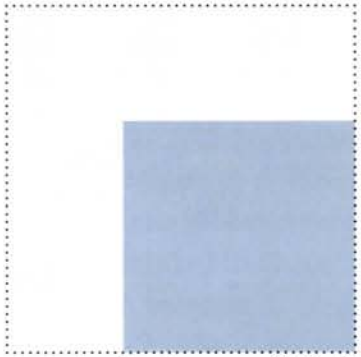








traditional teaching (2.00m²)



teaching in groups (3.00m²)

open plan teaching (4.50m²)

Spatial implications for differing teaching methods. Space required per student -

Either with the Monessori Method, collaborative learning or on-line courses, the teacher's role has changed. No longer are teachers the center of attention as the dispenser of information, but facilitators. They instead set project goals and provide guidelines and resources. Therefore, the teacher becomes a guide to help draw in different aspects for the child to look into and research, rather than having to be the source of all the information. This major shift in teaching practices is in respond towards preparing students for a globalized age of information, that require thinking outside the box and developing good people skills, versus sitting in cubical farms all day (Wallis). In the age of shaped by new technologies, these changing teaching practices are often limited by a building which was designed for passive teaching.

This is current problem facing the New York City Department of Education which is responsible for varying aspects of all the schools in New York City. These responsibilities range from the construction authority to standards in curriculum. Challenged by inadequate funds and limited spaces, the construction authority has to factor in many considerations before constructing a new school or renovating an existing one. These range from site location, indoor air quality, energy efficiency, material selection, waste management, power supple, food, recycling programs, transportation, and green spaces (Department of Education). The NYC Department of Education standards in curriculum seek to integrate these new teaching practices and technologies, with traditional teaching strategies. Technologies range from smart-boards (touch sensitive blackboards) and computers, seek to make more information readily available to students. While these technologies have changed the curriculum and have helped increase learning, the space of the classroom has remains the same.. Even with the flexibility of movable and stackable furniture, the typical classroom never anticipated these new technologies. As a result, computers are often placed against a back wall or in some cases take over an entire room. Consequently, the building can at times can hinder the full potential these new learning practices have. In addition, the extra space required for these technologies and learning practices cannot always be met.

With the addition of technology, classrooms become more cramp and maintenance walls are lost.

SITE CONDITIONS

The site is in a Brooklyn neighborhood called DUMBO (Down Under the Manhattan Bridge Overpass), located New York City. Economic, social and political trends are contributing to a growing city, borough and neighborhood. New York City is the most densely populated city in the United States. One of five boroughs, Brooklyn (Kings County) is the most populated with 2.5 million residents. The size and concentration of Brooklyn is important because it requires a large infrastructural network of highways, bridges and subways to transport residents within the borough and to the rest of the city. This network is a major component to the framework. This network's rhythm is, in turn, a major component to the existing conditions. The neighborhood of DUMBO is vital part to this network.

The official boundaries of DUMBO are the East River to the North, Bridge Street to the west, Prospect Street to the South and Old Fulton Street to the East. It is roughly 78 acres (.12 square miles).

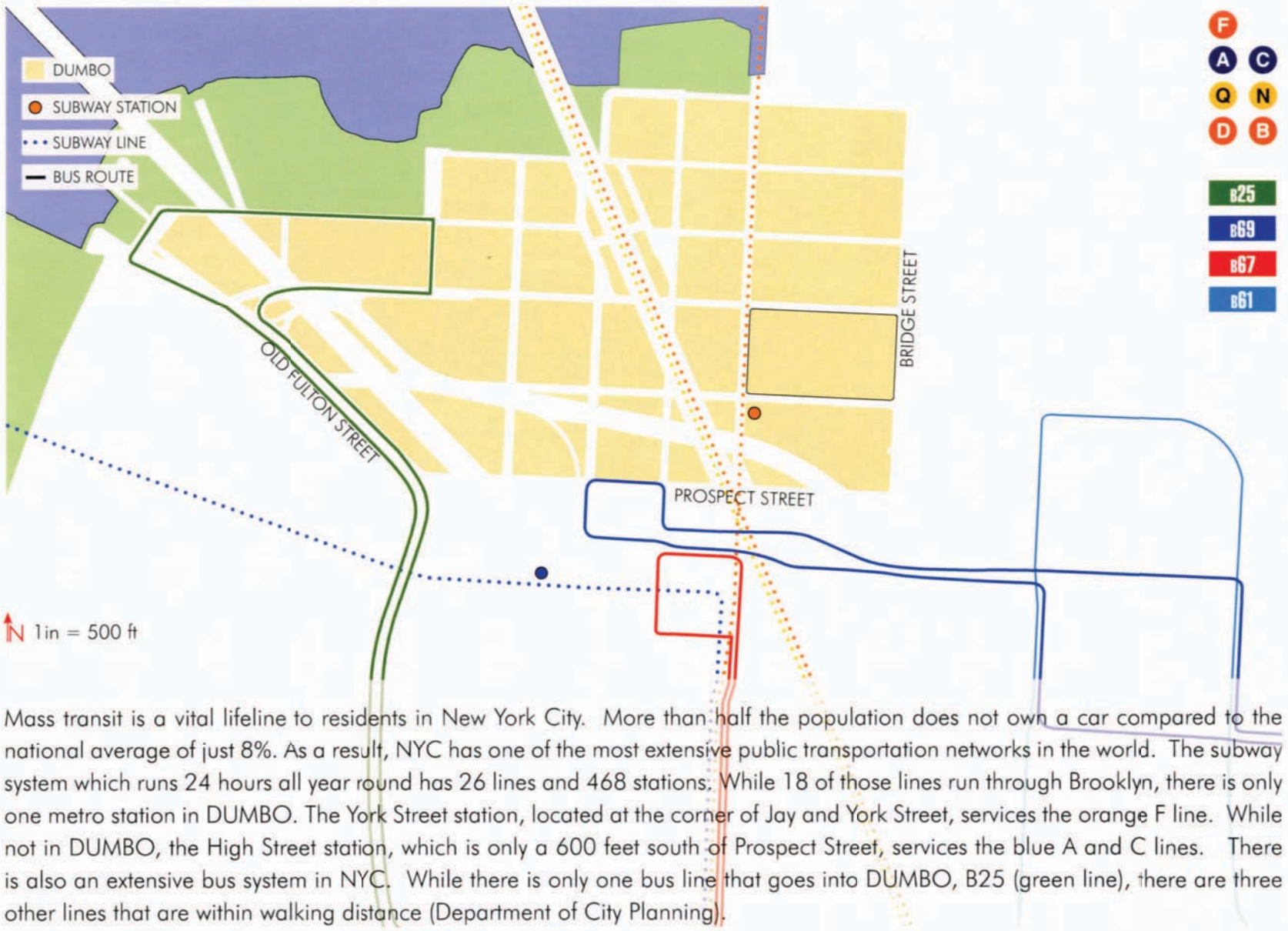

N
1 in = 20,000 ft

VISUAL BOUNDARIES

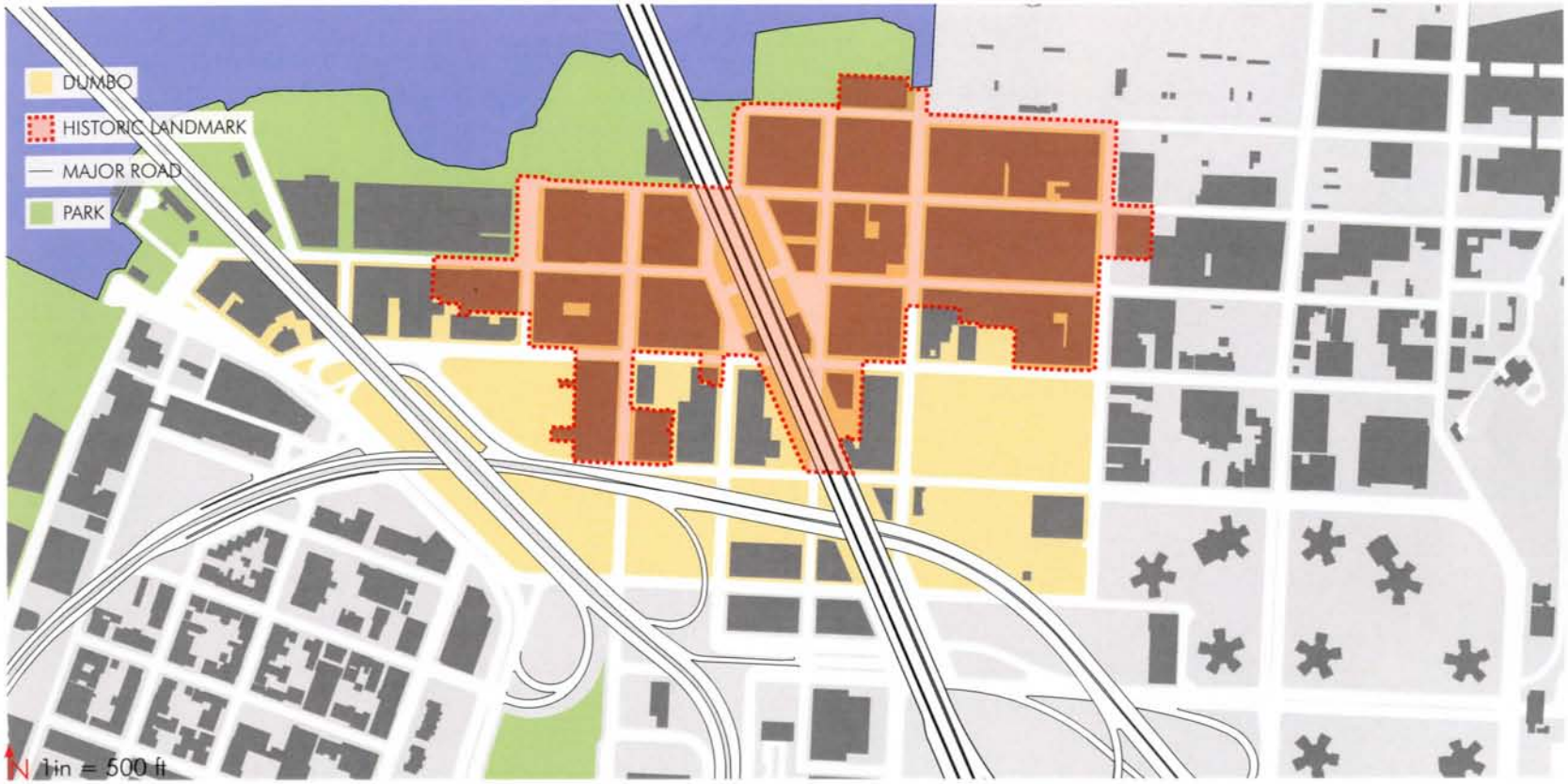
There are also visual network boundaries which make up the existing condition. These boundaries have alienated DUMBO from the rest of Brooklyn and have physical confined it. They are East River, Brooklyn Bridge, Manhattan Bridge and Brooklyn Queens Expressway (BQE). The East River, limits DUMBO from growing north. Brooklyn Bridge Park acts as a buffer to the water and the neighborhood. This 1.3 mile park also acts as a destination for the residents of Brooklyn. Completed in 1883, the Brooklyn Bridge acts as the western visual boundary to DUMBO. It now is a major artery that enables the transport of pedestrians, bicyclists and cars to and from Manhattan and Brooklyn. Each day on average, 145,000 cars, 1,200 bikes and 3,000 pedestrians cross over the bridge (Department of City Planning).

Completed in 1909, the Manhattan Bridge acts as a visual boundary that cuts DUMBO in half. It is also a major artery that enables the transport of pedestrians, bicyclists and cars as well as subways to and from Manhattan and Brooklyn. Each day on average 80,000 cars, 320,000 mass transit riders and 3,000 pedestrians and bicyclist cross over the bridge. The Manhattan Bridge is currently being renovated as part of a massive thirty year reconstruction program which is not schedule to be complete for another six years. This can sometimes change the daily rhythm of traffic on it. Completed in 1964, the Brooklyn Queens Expressway acts as the southern visual boundary to DUMBO. This elevated highway serves a daily traffic volume of 122,000 cars. This artery feeds both the Brooklyn and Manhattan bridges. Currently almost 93 percent of Brooklyn residents that travel to Manhattan travel using the subway (Department of City Planning).

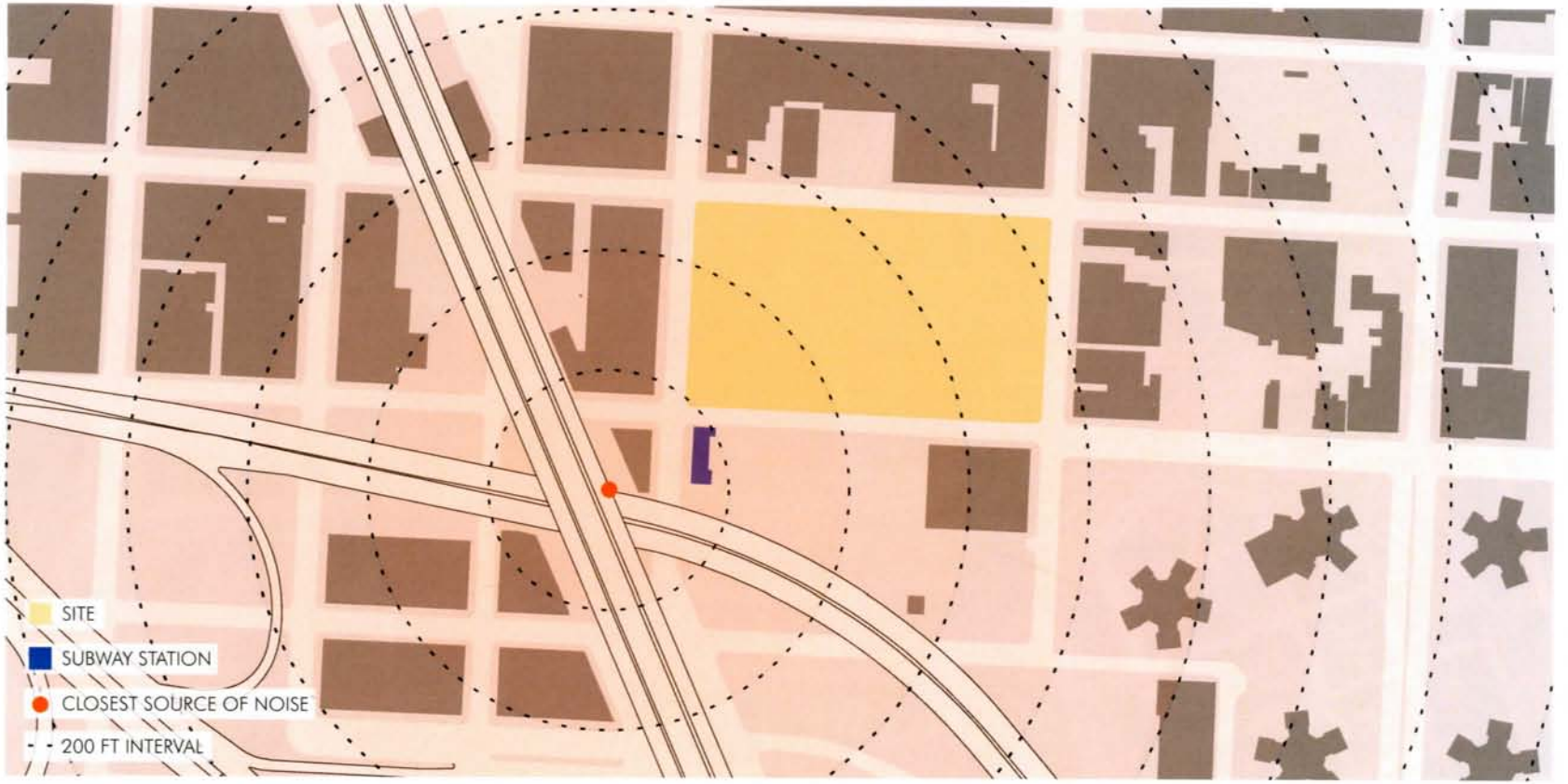

N
1 in = 20,000 ft



Mass transit is a vital lifeline to residents in New York City. More than half the population does not own a car compared to the national average of just 8%. As a result, NYC has one of the most extensive public transportation networks in the world. The subway system which runs 24 hours all year round has 26 lines and 468 stations. While 18 of those lines run through Brooklyn, there is only one metro station in DUMBO. The York Street station, located at the corner of Jay and York Street, services the orange F line. While not in DUMBO, the High Street station, which is only a 600 feet south of Prospect Street, services the blue A and C lines. There is also an extensive bus system in NYC. While there is only one bus line that goes into DUMBO, B25 (green line), there are three other lines that are within walking distance (Department of City Planning).



Before this infrastructure was built, DUMBO was a manufacturing center filled with factories. Due to many reasons these factories were abandoned and by the 1980s were being occupied by artists who converted them into lofts, which soon made DUMBO the SoHo of Brooklyn. In 1998, the area was rezoned from manufacture to residential. As a result the area has quickly been transforming from a warehouse district to a mixed neighborhood including a growing residential base. In the last decade hundreds of residential units have been constructed and the population has rapidly grown. In 2008, the population has tripled from about 2,000 residents to 6,000 residents. On December 18, 2007, the New York City Landmarks Preservation Commission voted unanimously to make an overwhelming majority of DUMBO a historic district. It is evident that the needs of the DUMBO are certain continue to change and evolve in the future (Landmarks Preservation Commission).



This network has environmental implications. Due to all the major arteries surrounding DUMBO, at times the neighborhood becomes a very noisy place to be. While a normal conversation is about 30dB and a noisy office can be 60dB, a subway is 80dB and heavy traffic is 90dB. For every 10dB the noise is 100 times louder. The building will need to actively respond to sound in order to accomodate more productive learning.

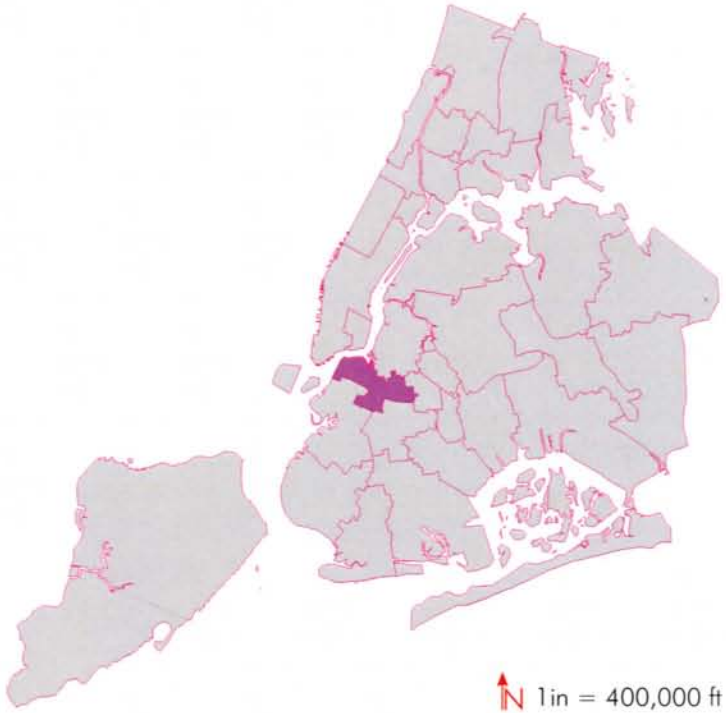
DISTANCE FROM SOURCE (FT)	SOUND LEVEL (dB)
200	44
400	38
600	34.5
800	32
1000	30
1200	28.5
1400	27
1600	26
1800	25

During the early morning and late afternoon hours, the Manhattan Bridge and surrounding buildings cast shadows on the site. To the left of the image is a 33 stories apartment. Finished in 2007, this building dramatically blocks the sun during late afternoon winter months. The proposed school need to understand that other tall buildings might also be constructed which will continue to change sunlight patterns on the site. The wind on the site can at times become discomforting. The prevailing winter winds come from the northwest and in combination with the sea-land breeze, the wind could become potentially strong. How the tall buildings can channel to alter these winds, is also important in knowing immediate site conditions.

DISTRICT 13

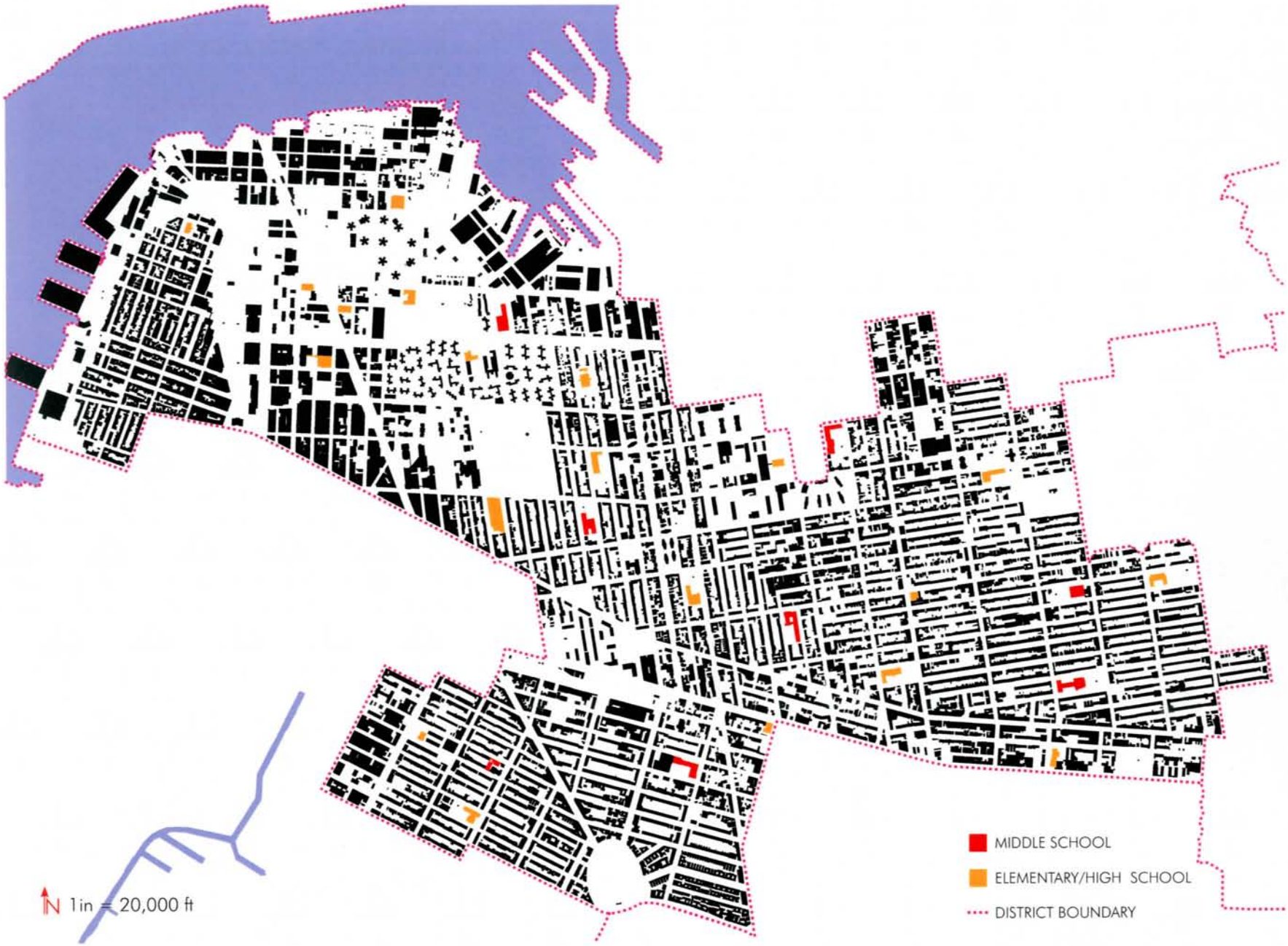
New York City is divided into 31 school districts. DUMBO is located in district 13. In district 13, there are 18 elementary, 9 middle schools and 11 high schools. For the most part children who live in district 13 go to a school in district 13. This allows for an easy commute, via walking or subway, to and from school.

The planned housing development will create an overwhelming demand for schools in neighboring areas. In district 13, an expected 9,000 housing units will be built in the next five years. This growth is documented in the "Growing Pains," a report released by NYC Comptroller Office in May 2008. It stated that DUMBO was a striking example of "serious flaws" within the Department of Education's current capital plan (Department of Education). This capital plan which goes to 2009 has not projected the "serious pockets" of overcrowding in this neighborhood. This is the main reason behind the Department of Education decision to incorporate a new school in DUMBO for its just released five-year capital plan proposal for 2010-2014. The proposal, which was release in November 2008, states that "the analysis indicates that five districts in Brooklyn will see growth over the next years. District 13, contains a substantial surplus of space given current enrollment levels, but is projected to need a school building in the DUMBO area. This is primarily due to the projected housing growth." It forecasts a need for a middle school that has a capacity for roughly 400 students. With current spacing standard about 45,000-50,000 square is needed to adequately accommodate this capacity (Department of Education).



DISTRICT 13 MIDDLE SCHOOLS

Address	Number	Name	Enrollment
300 adelphi st	K113	MS 113 Ronald Edmonds	878
300 willoughby ave	K117	JHS 117 Francis Scott Key	430
141 macon st	K258	JHS 258 David Ruggles	497
101 park ave	K265	JHS 265 Susan McKinney	648
62 park place	K266	MS 266 Park Place	216
80 underhill ave	K571	MS 571	279
344 monroe st	K301	Satellite E Middle School	220
170 gates ave	K103	Satellite III	291


MIDDLE SCHOOL
ELEMENTARY/HIGH SCHOOL
DISTRICT BOUNDARY
N 1in = 20,000 ft

TRENDS

Led by Major Michael Bloomberg, an initiative on a city wide scale named plaNYC, has been proposed to create a vision of New York City over the next 25 years. This vision looks at population and demographic growth and sets priorities for refurbishing the city's infrastructure in a sustainable manner. PlaNYC consists of three components – opeNYC, maintaiNYC, and greeNYC. OpeNYC is preparing for the explosion of New York City's population which is expected to increase by one million over the next two decades. MaintaiNYC is repairing aging infrastructure which includes city bridges, power plants and mass transit. GreeNYC aims to conserve resources with a goal of reducing the city's carbon emission by 30% (Department of City Planning). This plan is critical for understand the city's expected conditions in terms growth over time. It also sets a standard for borough initiatives to work off of.

The borough of Brooklyn has also anticipated conditions through studies and developmental initiatives. Downtown Brooklyn pedestrian study looked at five zones in Brooklyn and developed strategies that promote walking in hopes to unify different parts of Brooklyn. One of these zones is the Manhattan Bridge underpass. The study states that "a unified streetscape along Jay Street would enhance its importance as the main street in the focus area, and visually connect the downtown core to the Manhattan Bridge and the waterfront in DUMBO. It continues to state that "through sidewalk treatment, lighting and landscaping, the critical zone – the underpass – at Sand Street will help link DUMBO with the rest of Brooklyn" (Department of City Planning).

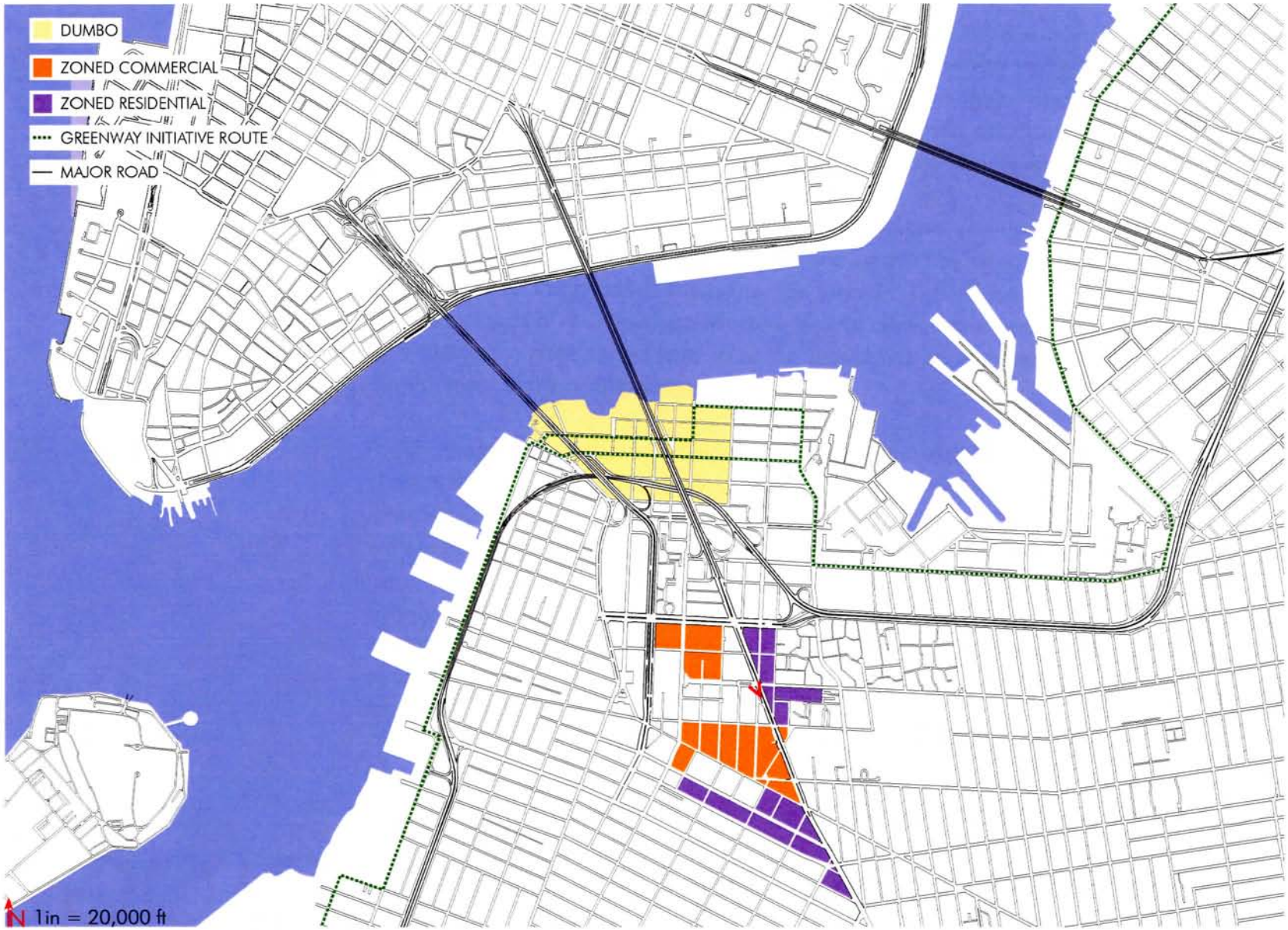

BROOKLYN BRIDGE
MANHATTAN BRIDGE
BQE
SITE
UNDERPASS
STREETSCAPE IDENTIFY
PARK
N 1in = 500 ft

This study is in coordination with another initiative called the Brooklyn Greenway Initiative. This initiative is part of an overall planning effort along 14 miles of the Brooklyn waterfront. It called to "provide a human scale connection between numerous waterfront communities now divided by highways and transit infrastructure." It will be a path roughly about thirty feet wide to accommodate two seven foot bike lanes, a ten foot pedestrian path and six feet of landscaping. Both of these programs emphasize walking and unity (Department of City Planning).

These two initiatives are working in parallel to the main undertaking that will shape Brooklyn and its future conditions. Known as Brooklyn Downtown 2012, this initiative is a master plan that will transform Brooklyn's skyline and streetscape with more than 60 projects. It will primarily convert Flatbush Avenue, the artery that feeds the Manhattan Bridge, by adding 1.2 million square feet of office space, 1.6 million square feet of retail facilities, 14,000 residential units, 2,400 hotel rooms, and a professional sports arena. This development, which sees itself as Brooklyn's midtown Manhattan, will have a drastic impact on all surrounding neighborhoods including DUMBO (Department of City Planning).

These borough initiatives are complimented with SEED which stands for Smart Environmental Efforts in DUMBO. This program is meant to demonstrate the ease of environmental action on the most local level. It promotes it DUMBO Green Guide which talks about street recycling programs, alternative modes of transportation, reduced plastic consumption and a decrease in energy use.

These initiatives and programs shows that the anticipated state of DUMBO and surrounding neighborhood will focus on environmental awareness and creating a visual identity based of pedestrian travel. These trends also illustrate continuation of the current growth of the region (DUMBO Improvement District).


DUMBO
ZONED COMMERCIAL
ZONED RESIDENTIAL
GREENWAY INITIATIVE ROUTE
MAJOR ROAD
N
1in = 20,000 ft

METHODOLOGY

The development of the expanded dynamic process will enable a building evolve in order to meet the needs of the people within. It will create flexibility and efficiency, as a means to more accurately respond to changing site and programmatic conditions. This is critical in an educational environment where curriculum, teaching practices and technologies are constantly shifting in order to best prepare students for the real world.

The design process will not only focus on how a build can change over time, but the impact it has. Elements will be designed to create engagement by stimulating the senses and give responsibility to the people that occupy the school. The utilization of smart materials and current methods of responsive architecture, will be applied this urban middle school, in order to maintain the effectiveness and value the school has on promoting education and on the development of the neighborhood.

A design approach that understands the existing framework and anticipated trends that will change the framework over time, will be critical in maintaining this value. While we could forecast this change over time, it cannot be precisely determined. Therefore, the design methods will create spaces that cannot just adapt but are sustainable to unpredictable conditions.

Drawing techniques that explain the building's process over time will show the physical and experiential effects from the development of the two new interactive relationships. The rhythm of time and use will be the mechanism that will measure these processes in order to interpret the effects of the interaction.

Interaction is not a single system but multiple systems co-evolving in close independence (Weinstock). The complete system emerges from adaptive behavior and responsive forms that participates in a dynamic exchange of conditions and criteria. The purpose of to create opportunities, will address the rapid pace of change and give our students a better chance to prepare for the future.

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