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Investing in the Future:The Reinvigoration of Educational Facilities Proposal for a Performing Arts Magnet School in Knoxville, Tennessee

Luke A. Sims

University of Tennessee - Knoxville

To the Graduate Council:

I am submitting herewith a thesis written by Luke A. Sims entitled "Investing in the Future:The Reinvigoration of Educational Facilities Proposal for a Performing Arts Magnet School in Knoxville, Tennessee." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Architecture, with a major in Architecture.

L. David Fox, Major Professor

We have read this thesis and recommend its acceptance:

Dean John McRae, Mark Schimmenti

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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Investing in the Future: The Reinvigoration of Educational Facilities
Proposal for a Performing Arts Magnet School in Knoxville, Tennessee

A Thesis Presented for the
Master of Architecture Degree
The University of Tennessee, Knoxville

Luke A. Sims
Aug. 2008

Abstract:

A student's environment directly affects his ability to learn. School design must take into consideration the growing needs of the educator, the students, and their community. This research establishes design principles for new K-12 educational facilities. These principles will be based upon successes of past educational facilities, new educational demands, new technologies, stricter security guidelines, sustainable design, and the desire to create a connection to the school's local community.

Source: Kees Rutten

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Over 45,000 educational facility projects broke ground between 2000 and the end of 2005, totaling over $165 billion in construction cost alone. According to McGraw-Hill Construction Analytics' *Special Sector Study: Education*, released in January of 2007, an additional 260,000 students will enroll each year into an already overcrowded educational system. The "baby boom echo" is ready for school. The children of World War Two's baby boomers, numbering in the millions crowd into schools across the nation.

If the average class size in the United States will remain to be 25, the construction of K-12 classrooms will need to total more than 10,000 units each year, just to keep up with the enrollment growth. (Linn, 12) A large demand for replacement facilities affects the industry, in addition to the enrollment growth. The United States Department of Education states that the average lifespan of a school building is 42 years. In response to the population increase of the baby boomer generation many schools were constructed during the 1950s and early 1960s and therefore currently need to be renovated or replaced completely. Figure 1 illustrates the break down of types of project in American school construction.

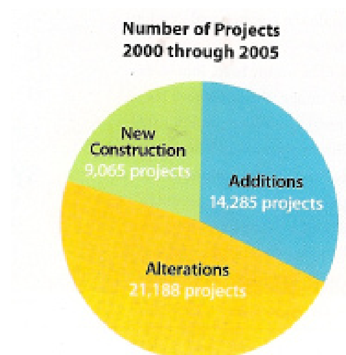

Figure 1: New School Construction
Source: McGraw-Hill Construction Analytics 2007

This demand for educational facilities is unprecedented in American history. Demographic evidence of the coming demand has been mounting for some time. From 1977 to 1990,the number of children born to baby boomers increased by 25 percent, reaching a peak of 4.1 million births in 1990.In the following decade, public high school enrollment increased 19 percent and elementary school enrollment increased 12 percent. By the year 2000,public and private school enrollment, kindergarten through grade 12,had reached a record 53.2 million students. After stabilizing somewhat between 2000 and 2010,enrollment increases are expected to resume. Between 2010 and 2020,the number of children aged five to seventeen will increase by 6 percent. By 2030,total school enrollment is projected to be 60 million (U.S. Department of Education, Office of Public Affairs 2000).

With such a thriving field of design and construction comes an opportunity to re-evaluate the principles of school design. Architects, school officials, and builders have an opportunity to incorporate lessons learned from past educational facilities, along with new technologies, stricter security guidelines, sustainable design, and connections to the community. The goal of this research is to establish new design principles for the educational facility typology of the twenty-first century.

The second half of the research is a design for a school that fully incorporates the principles established. The project is a performing arts magnet high school placed in the dense urban context of downtown Knoxville, Tennessee. While the urban location and program of a magnet school may not conform to traditional ideas of secondary education in the southern United States, it further illustrates that the majority of these principles can be applied to a large variety of situations.

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typological discussion

Although rarely balanced properly, designs of K-12 schools have always reflected both changing educational concepts and current architectural ideas. It is known for the highest level of education to occur the student must be provided a space that is separate from constant distraction. New design principles need to be established for the current age of educational facility. It is the desire of educators, communities, and pupils that designers create a space that is most suitable for the specific needs of the task being performed, a space that can adapt to the ever changing needs of the occupant, and a space that will serve multiple programs throughout the entire day, in addition to a distraction-free environment.(Wakefield, 22)

Educational facilities have had a variety of formal layout typologies throughout history. Schools' progression from the once-common one room schoolhouse to the current massive institutions has explored both a variety of spatial arrangements and student interaction.

An understanding of which definition of typology I am using required before providing an analysis of past educational building typologies. Rafael Moneo's writing On Ty-

pology, ask the simple question, "*What then is type?*" Then continues on to describe a type in the simplest terms, a concept which describes a group of objects characterized by the same formal structure. It is fundamentally based on the possibility of grouping spaces by certain inherent structural similarities. (Moneo, 24) In other terms it can be defined as thinking about architecture in groups. In terms of this research the typology of focus is the educational facility.

There is a question of what kind of educational facility? The term educational facility is not specific. An educational facility topology groups all educational levels of school buildings. Primary education, also known as elementary level and often middle school level, secondary education, the final stage of compulsory education known as high school, and higher education, such as colleges and universities, are completely different programs and in return require different facilities.

One concept of typology describes the *Gestalt* approach of the term. A meaning of forms or shapes, an organized whole that is perceived as more than the sum of its parts. (Moneo, 25) An educational facility typology is simply a building where learning occurs.

A second concept of typology describes the relationship of elements, forms, or spaces, which defined the whole. The focus on the individual forms differentiates this concept from the previous. The spatial relationships of the constant program create different solutions and therefore provide variations to the typology. In this concept one discusses specific types within a general typology. An Open Floor Plan Primary Educational Facility is obviously a much more specific description than simply an Educational Facility. This begins to discuss a formal layout of the elements of the building.

Quatremère de Quincy was the first to give a coherent and explicit formulation of an idea of type in architectural theory. Quatremère de Quincy wrote in length of

how type enabled architecture to create links to the past. By using an established typology during design the architect creates a metaphorical connection with the moment when the man first developed the typology. During Quatremère de Quincy's lifetime the idea of type-form architecture grew immensely. Throughout the nineteenth century manuals and handbooks offered models and examples of how building types should be executed. This idea is in complete contradiction to the, then new, idea of program. The type-form based architecture denied variation required by changing programs within a typology. This denial of variation of program caused a shift from a type-form theory to a new focus on composition. (Moneo, 28) Moneo description composition is found in his writing, *On Typology*.

"Composition is the tool by which the architect deals with the variety of programs offered by the new society; a theory of composition is needed to proved an instrument capable of coping with a diversity that, with difficulty, can be reduced to known types."
– Moneo

By this definition of composition we can group the following precedence as changes in educational facility compositions rather than typologies. Composition resolves the connection between form and program. (Moneo, 28) With the growth of specific educational program in recent years there have been numerous new compositions in school buildings.

Moneo claims that one of the frequent arguments opposing a typological view of architecture is, when designing by typology, the framework of that type hinders the design and in turn becomes a "frozen mechanism" that denies change when reproduced. Once the definition of a typology becomes so specific it appears that strict guidelines are established and thus prevent variation. However if used properly the architect will identify the type in which he is designing and work within the boundaries of the typology. Working in a specific typology does not necessarily imply

mechanical reproduction of past buildings. Rather than being a frozen mechanism a type can act as the framework in which change and adaptation can occur.

In the following section I will provide an analysis of past educational facility typologies' formal layout, compositions. Principles for creating formal relationships in schools will be formed from this analysis.

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Experimental building types have occurred since the number of pupils grew beyond the one-room schoolhouse. Over the past fifty years the relevance of the current educational building types have been questioned. Several new formal compositions have been proposed. A chronological investigation of these compositions will illustrate the designs' progression and response to educational needs.

Figure 2 shows the plan of a state secondary school for girls in Munich. This 1940 school is laid out in a traditional double-loaded, single-corridor style with classrooms lining both sides. In general this layout preceded all other compositions discussed. This traditional layout is a strict,

Figure 2: Secondary School, Munich, 1940
Source: Author

rational layout that provided an efficient solution to the increasing size of pupils. The spaces however did not offer flexibility or rooms that responded to specific program. While this solution was suitable for the educational programs and style prior to the middle of the twentieth century, it quickly became outdated as educational styles advanced. New requirements of subject specific rooms caused a shift from uniform room styles to ones that adapt and provide amenities for the subjects being taught.

The efficiency of the linear layout can be an example of a strong organizational tool in planning. The linear double-loaded layout reduces area required for circulation, while still providing a location for interaction to occur, much like a street setting in an urban downtown.

In response to the population increase of baby boom generation the largest increase in school construction took place during the nineteen-fifties and early nineteen-sixties. The traditional classroom was opening up.

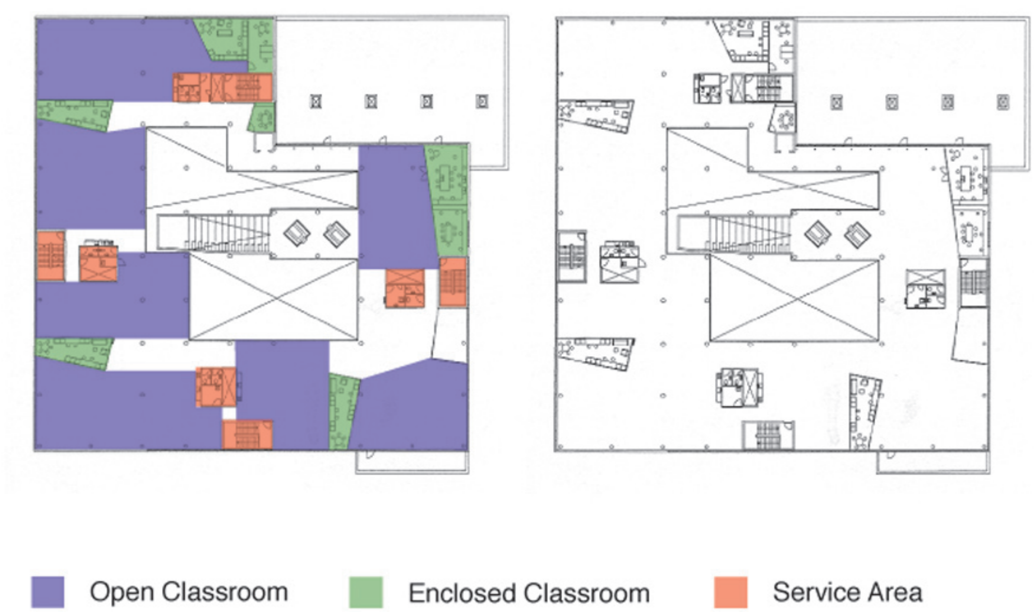


Figure 3: Hellerup Compreshensive School, Copangan, Denmark
Source: Author

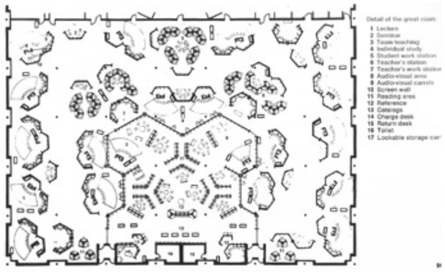
The self-contained square space dominated by the teacher has become a part of a larger series of spaces. (Wakefield, 22) The shift away from the traditional rectilinear double-loaded corridor led to a composition known as an open-plan. Open-plan schools were designed with little or no partitions between classrooms. Figure 3 is an example of an open-plan school in Copenhagen, Denmark. The blue tone illustrates how open each of the classrooms were. The theory is transparency and openness encourages interaction and communication amongst students studying similar subjects. Many post-war schools implemented this plan. It should be noted that the implementation of these open-plan schools mirrored

By many of today's standards, the open plan school was not a successful spatial layout, especially for K-12 educational facilities. While the flexibility of the plan was positive, many problems were created. The inability to create a distraction-free space for concentrated lessons proved to be the major downfall of the plan. The attention span for a student is already tested in an environment of peers. The educator had more difficulty retaining the students' attention when the open plan did not deny either visual or audio distractions.

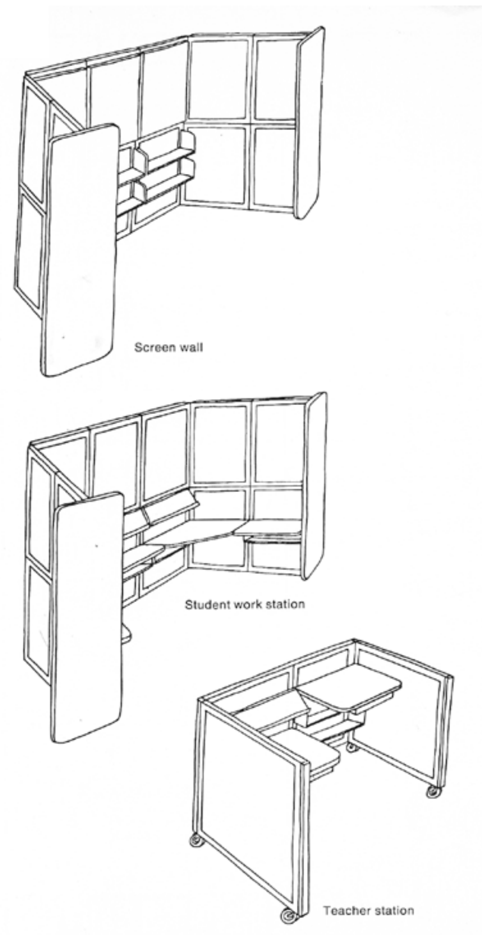
Although the example above is in Denmark open-plan schools were located worldwide. Figure 4 shows an addition to North Kingstown High School in North Kingstown, Rhode Island. However this addition was completed in 1970, almost a full decade after the majority of the open-plan schools were built. The Enclosure Diagram in figure 4 illustrates the only partition walls in this massive room. The furniture included in Figure 4 is require to separate the eight classes that meet simultaneously in this room.

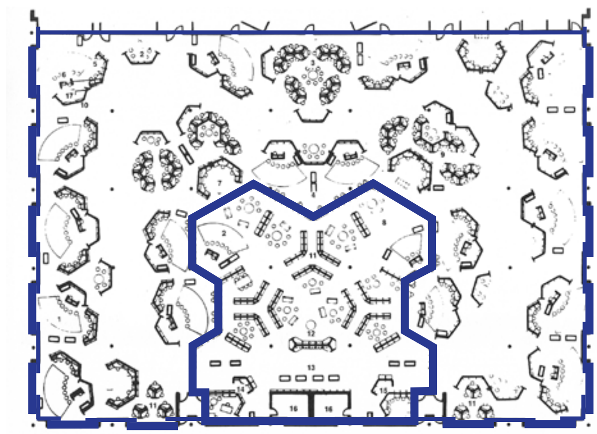
North Kingstown High School

North Kingstown, Rhode Island
Open Plan

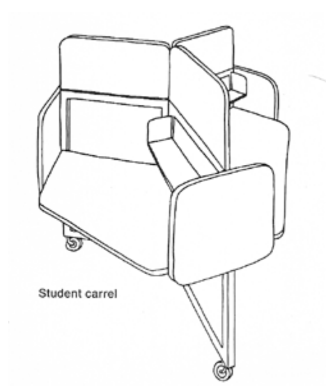


Floor Plan - Open Composition
Great Room Addition - 1970





Enclosure Diagram



Furniture For Creating Enclosure/Separation

Figure 4: North Kingstown High School Addition - 1970
Source: Diagram - Author
Photo - nksd.net

As mentioned in the introduction, the average lifespan of a school building in the United States is approximately 42 years, and many of the schools designed in this an open plan manner had to adapt their schools to a more traditional enclosed classroom type once the open plan failed them. (U.S. Department of Education) A 2003 study as documented by Paul and Reusser, distraction-free spaces for concentrated lessons can substantially boost school performance. This study confirmed what several educators had known for many years, even before they were placed in these open plan schools. Teachers need an environment that does not compete with their lessons, rather one that allows for concentration and learning to take place. (Wakefield, 22-28)

In response to the open plan designed school planners worked to adapt the existing open plan buildings to the new demands. This often resulted in what was being known in the early seventies as 'Cluster' or 'Pod' schools. The idea behind these schools was to group the subjects being taught into specific areas of a building. If students and teachers had to listen to the other classes taking place adjacent to their classroom then they should be similar subjects, regardless of school level.

When adapting an open plan school to this new cluster plan classroom location was changed, and partitions, rarely reaching the ceiling, were added. The distractions were still present but not as severe. This design was a response to the designed forced on the educators a decade or two before. However there were some schools that missed the demand for new school during the baby boom era. These groups needed a new school building in the early to mid-nineteen-seventies. This was their opportunity to start with a new slate, a new evaluation of the needs and demands. However many schools took the new idea of cluster schools as the basis for their design, rather than a response to errors of the past. In other words, several

new school constructions designed their buildings with the cluster plan despite its known flaws.

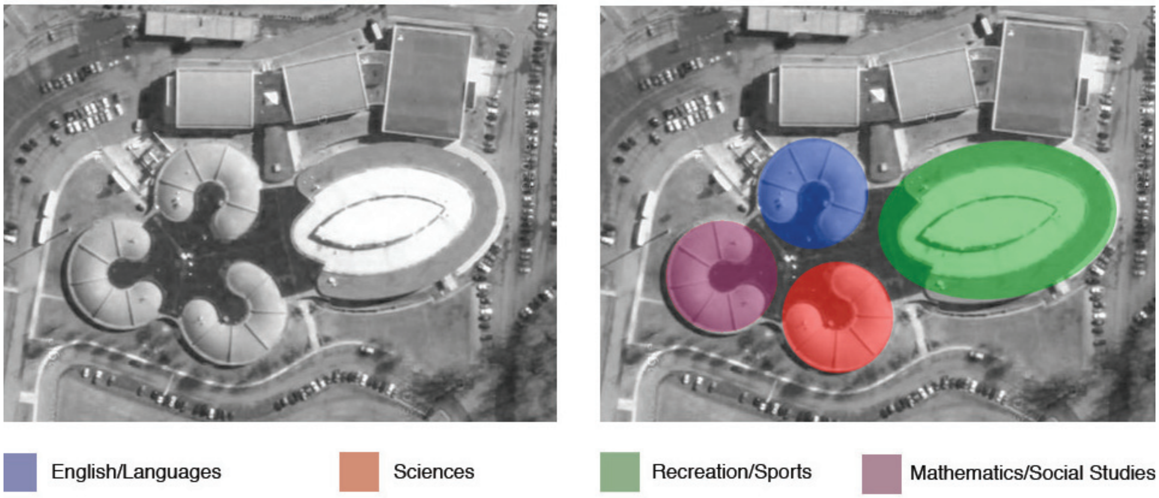


Figure 5: Clarksville High School, Clarksville, Tennessee, 1972
Source: Diagram - Author

A great example of this is the current building for Clarksville High School located in Clarksville, Tennessee, first opened in 1972. Figure 5 shows the three identical wings or clusters of the school. The interior spatial arrangement is clearly defined in the exterior plan. The cluster plan is so strictly adhered to that the same circular form is repeated throughout the entire school. Each cluster, English/ Languages, Mathematics/Social Studies, and Sciences includes confusing circulation and oddly shaped classrooms in order to retain the geometrical aspect of the cluster.

It was also during the nineteen-seventies that schools begun sealing up all connection to exterior spaces. Windows were minimized, exterior spaces were eliminated, and classes rarely traveled beyond the school building's shell. This movement is a result to the new standards or views on creating a so-called sanitary environment and the energy-efficient-design ideas brought on by the oil crisis of the 1970s. While significantly cutting energy consumption, this fad also had the unfortunate side effect of practically eliminating natural day light from schools.The high school in discussion was no different. Each wing of the school provided absolutely no exterior windows. Along with adapting to the

new sanitary aspect to the design, the lack of windows kept the focus on the interior spatial arrangement. (Sims)

The same issue that caused the open-plan schools to fail continued to prove the downfall of cluster schools. While distractions may be lower in the partially partitioned cluster arrangement the fact is that this arrangement is still inferior to a typical enclosed classroom. However, this was one of the first shifts to grouping similar educational topics into similar locations of the building, or separate building all together. This idea's precedent is higher educational facilities and how they are arranged on university campuses.

The cluster plan can serve as a precedent in which future schools should design areas of schools rather than simply a line of divided classrooms. One can include spaces for specialized educational amenities by designing an entire areas of a school. For instance, a Math and Science area would include laboratories that would serve multiple class levels. This achieves the interaction aspect of the cluster plan, while reducing the space required for areas, such as laboratories or presentation rooms, which are not used on a daily basis.

The floor plans of William Monroe Trotter School in Lower Falls, Massachusetts, seen in Figure 6 demonstrates how several of the cluster-plan school compositions worked. The classroom cluster diagram shows the openness between different classes, while the discipline cluster diagram illustrates how specific educational disciplines were grouped together. More importantly the red area represents the group areas that are used by different classes or students throughout the day. This is the first example analyzed that offers multiple spaces for a single classroom. Spaces should be provided for different scales of educational instruction, in addition to classes requiring specific facilities for certain subjects. The following section provides examples of new educational demands and the projects that have responded to them.

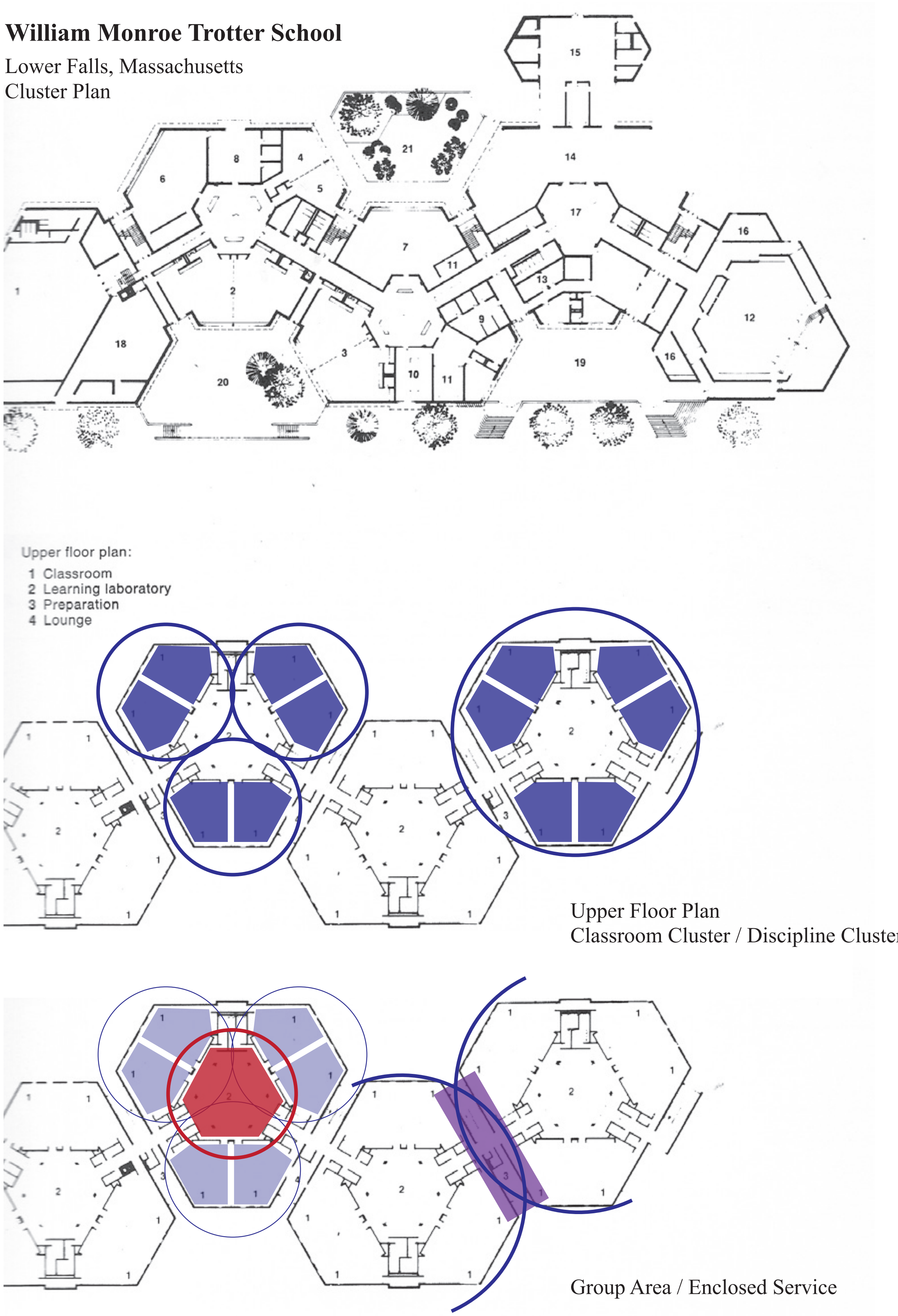


Figure 6: William Monroe Trotter School, Lower Falls, Massachusetts, 1969
Source: Diagram - Author

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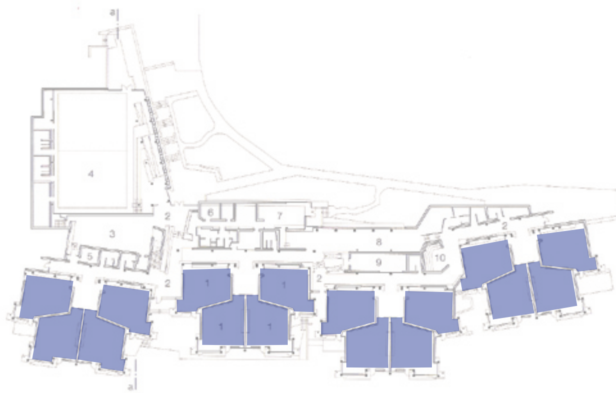
“Secondary schools have not changed for a hundred years or more. At least that was the conclusion reached by the National Association of Secondary School Principals (NASSP) in its report in 1995. Of course, some of the details of curriculum, teaching, and architecture for education have changed, but the fundamentals facts of high schools have remained unaltered. The high school of 1900 was based on classrooms and laboratories along with specialized facilities such as an auditorium, a library, a gymnasium…”
- Brubaker, 191

Despite the NASSP stance on school buildings, the educational process is changing. For several subjects the single teacher as the focal point of a class of twenty-five students seems to be an idea of the past. Students are learning from each other, learning from example/doing, learning from their environment, learning from self-direction. (Brubaker, 191) The school building and classroom architecture must respond to these changes. At a macro-level school should provide opportunities for students to explore different methods of learning. These opportunities derive from openness to a new approach to education by the teachers themselves. An idea that is difficult to initiate if the facility itself not allow for adaptation.

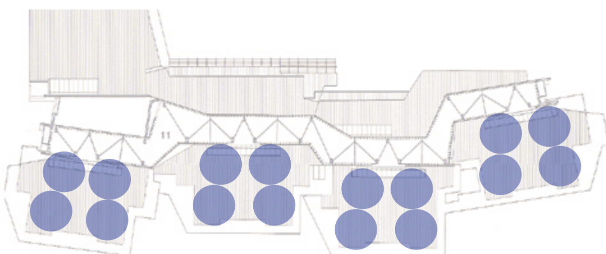
One of the simplest ways to respond to changes in education is to providing several spaces at different scales. Designing by this principle allows for single instruction, small or large group instruction or the entire class. Patkau Architects designed the primary school, Strawberry Vale, located in Victoria, British Columbia with this principle in mind. Figure 7 diagrams the way in which issues of scale were incorporated. The issue of scale can be applied to all educational levels although this is a primary level facility. By providing 'nooks' in the classroom a student use the space as a refuge for a more personal level of education. Patkau Architects also designed opportunities for visual connections to adjacent classrooms, while still providing enclosure for a distraction-free environment. Within this same school the hallways are designed to be occupied by students both during classes and intermissions between classes.

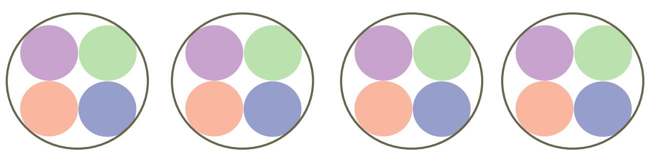
Strawberry Vale School

Victoria, British Columbia
Rural Primary School

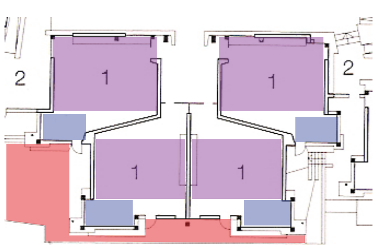


Level 1 Floor Plan
Classroom Organization





Organizational Method
Multiple Educational-Level Classrooms Organized Together



Issues of Scale
Multiple Scales For Different Program

Figure 7: Strawberry Vale School, Patkau Architects, 1995
Source: Diagram - Author
Photo - patkau.ca

Diezinger and Kramer Architects worked with the same diversity-in-scale principle as Patkau Architects in their design for the primary school in Eichstätt, Germany. However their design approached the principle with a more strict formal composition. Figure 8 diagrams the architects' take on providing different scales. A group room between each of the classrooms allows for a smaller scale environment for students, while the exterior courtyards provide a meeting area for large groups. (Schittich, 183)

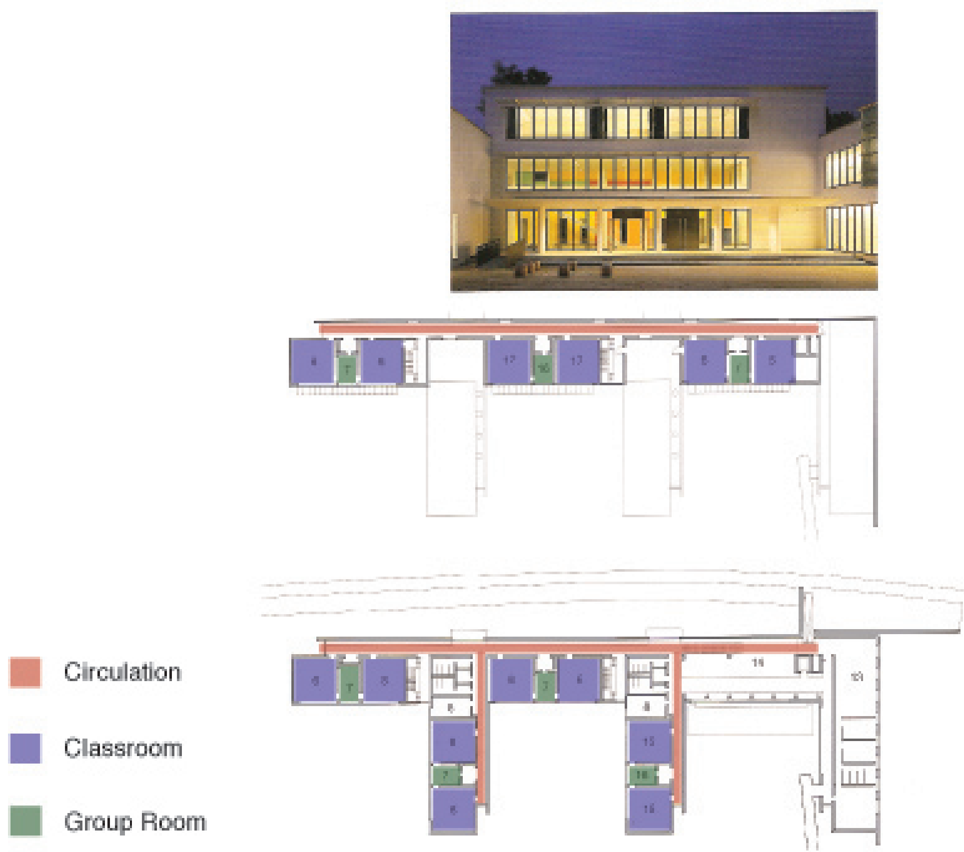


Figure 8: Diezinger and Kramer Architects, Special Pedagogic Center, Eichstatt, Germany, 2001
Source: Diagram - Author
Photo - Detail Magazine

In addition to providing multiple scales in space the three protruding wings that organize the building in an easy to understand pattern. The wings organize the school, while creating partially enclosed courtyards. (Schittich, 183) The cluster plan mentioned earlier is another example of creating educational wings within a building. However, this approach's formal organization and enclosed spaces is far superior to cluster plan.

Providing spaces for group interaction has been the focus of this section, however there remains an approach to education that has not be discussed, a space that requires its own unique space. The individual-self-directed educational process is being incorporated into several levels of education. Students are briefly instructed in a group setting and then released to work on their own. Designers should respond to this process by providing a space that work at a more personal scale. The use of technology in the classroom enhances this approach. Students are now able to work individually while connecting to a massive amount of information through the computer.

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“Few doubted that the… technology revolution would have an impact on K-12 education, but when third graders started turning in their homework using personal digital assistants, we know we’ve made a quantum leap from the era of chalk and blackboard.”
– Russell Fortmeyer, NYC Electrical Engineer

Several educators are adapting their instructional style to a technologically-assisted plan. With the advancements and availability of technology, specifically computers, schools are focusing on providing the student with the skills to advance in a technology-based society. The days of scarce numbers of school computers are gone. Now several schools assign their student their own computer, assign them homework online, and teach them to do ‘show-and-tell’ using Microsoft PowerPoint. (Fortmeyer, 41)

The one of the most recent school districts to equip their students with laptop computers is in Kansas City, Kansas. The school board’s distributed 5,000 Apple MacBooks to high school students to use at both school and at home serves as an example of the growing trend to incorporate technology in the classroom. The project aims to better prepare students for college and a profession in a techno-

logically based global market. Schools cannot require the purchasing of personal computers, due to a variety of financial status of the students. The Kansas City School District paid the bill of approximately $6.4 million for the lease of the 5,000 computers. Parents are responsible for the $25 insurance fee, and those unable to pay the insurance fee are allowed to perform community service as a substitute payment. (Bormann)

According to Doug Dillingham, Supervisor of New Educational Facilities and Construction for Knox County, Tennessee, measures to advance the incorporation of technology begin at the designing stages. However Programming Standards for High Schools established locally in 1999 only require a minimum of two computer workstation outlets per general classroom, and no requirements on the actual equipment. This may be a result of the completion date of the Programming Standards. The major push for technology in the classroom occurred at the turn of the 21st century, after these specific standards were established. Several school districts are beginning to implement similar programs to Kansas City to fully incorporate technology into the daily curriculum.

A few American schools remain years behind the national technology standard, with just a limited number of non-networked computers and dial-up modems for Internet access. While others are advanced well beyond their specific needs. Most schools, of course, lie somewhere in the middle of this spectrum. Obviously a large factor in these conditions is budget. However, wealth does not always equal technological sophistication. A recent technology survey of Connecticut's public schools revealed that you cannot always judge how well or sensibly a district or individual school is making technology-related decisions by how wealthy the school district is. The deciding factor in how well the school incorporates technology determined by the enthusiasm and commitment of the faculty and staff. (Merritt,

151)

The proper technology is also needed in addition to faculty enthusiasm. All too often schools purchase and install technology that does not take into consideration the specific need of the curriculum. One size does not necessarily fit all. Charles H. Stallard's 2001 book, *The Promise of Technology in Schools: The New 20 Years investigates* the role of technology in today's schools, and how they can keep up with the demand of ever-changing technology. Stallard's recommendations for incorporating technology are compiled in the following list. (Stallard, 65)

- Informational technology should be viewed not as an add-on than can be cut when budgets are tight, but rather as an integral space of every educational-related task.
- Every teacher should accept the imperative of using technology to improve learning.
- It is necessary that colleges and university departments of education provide their students – soon to join the ranks of America's public school teachers – with meaningful training in the use of technology in the classroom.
- On the state and district levels, it is critical to streamline procedures for the procurement and installation of technology.
- On the regional and district levels, school systems desperately need to find workable ways of sharing the staffing and budgetary burdens imposed by schools' increasing use of informational technologies.

As designers we are limited to the amount of influence we have on the incorporation of technology. However, specific measures can be taken in order to provide the educators with appropriate technologies. Figuring group technologies such as projection rooms, audio/video areas, me-

dia centers, computer labs, and equipment storage into the design encourages technological integration. While providing computer workstation outlets may be a preliminary step, it is by no means the only steps designers can influence the incorporation of technology into today's schools.

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On December 1, 1997, in Paducah, Kentucky, Michael Carneal wrapped two shotguns, two rifles, and one pistol in a blanket and took them to Heath High School. When he arrived to school he pulled out the pistol and fired 8-rounds in quick succession at a youth prayer group, killing three students and wounding five. Views of school safety and security were forever changed. In the ten years since the Heath High School shooting took place twenty-one shootings in America have been documented, twelve of which were high schools. (cnn.com)

Numerous reports and books address the issue from an educator or administrator's point of view, however little has been written on how the actual design can prevent these violent events from happening. When asked "How can schools provide security without sealing off all connection to the exterior?" Doug Dillingham responded, "By sealing off all connection to the exterior." Although Dillingham responded in a witty fashion, the truth or current view is in his response. Current design principles require a complete separation from interior and exterior for safety and security reason. Unfortunately lack of natural ventilation, day lighting, and

enclosed windowless boxes are often a result of this view. Dillingham stated that he, as a supervisor of new educational facilities has completed CPTED training and school designers are also encouraged to be come familiar with CPTED. CPTED refers to the organization Crime Prevention Through Environmental Design. While CPTED does not have specific guidelines for school building, their strategies can be applied to schools to provide security while still allowing for connection between the interior and exterior. The following four strategies for crime prevention are listed on the CPTED website:

1. Natural Surveillance - A design concept directed primarily at keeping intruders easily observable. Promoted by features that maximize visibility of people, parking areas and building entrances.

2. Territorial Reinforcement - Physical design can create or extend a sphere of influence. Users then develop a sense of territorial control while potential offenders, perceiving this control, are discouraged. Distinguish private spaces from public spaces.

3. Natural Access Control - A design concept directed primarily at decreasing crime opportunity by denying access to crime targets and creating in offenders a perception of risk. Gained by designing building entrances to clearly indicate public routes and discouraging access to private areas with structural elements.

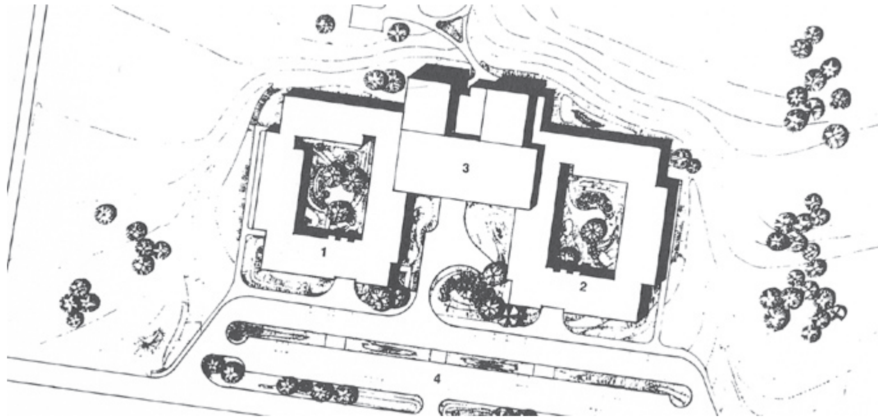
4. Target Hardening - Accomplished by features that prohibit entry or access: window locks, dead bolts for doors, interior door hinges.

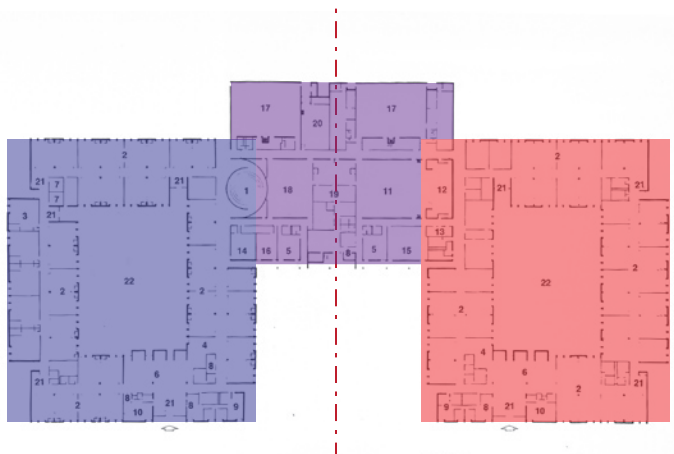
Figure 9 illustrates an example of this CPTED design approach. This school, which is actually two schools with shared facilities, incorporates enclosed courtyards that serve to protect the student. The courtyard arrangement provides an enclosed space that can be occupied by students both during and in between classes. This simply design feature incorporates at least three of the four design strategies listed above. Classrooms that have windows that open to or view out onto the courtyard encourage natural surveillance. Recessing the entrance further back in the shared facilities area also encourages territorial reinforcement. The threshold established by the two wings divides the realm of private and public and further protects the school from intruders entering.

In comparison the school in secondary school in Vienna (Figure 10) documents a courtyard composition that does not meet CPTED strategies or school building codes. While this school does offer visual connections to the courtyard it does not enclose the space. Both students and non-students are able to travel among the school grounds without being monitored or controlled. This variation on the use of the courtyard is due to a difference in international culture. Students in this secondary school in Vienna are free to leave the school grounds. In America assumed that students would be in class constantly from approximately 8 am till 3 pm, whereas several international educational practices only require the student to be present per class and often leave several hours between classes. For this reason one should be cautious to offer design principles for international schools.

Northside Primary / Hamilton Road Intermediate Schools

Fairport, New York
Courtyard Plan With Two Schools





First Floor Plan
Dual Schools With Shared Facilities

Courtyard Composition

Floor plan:

1 Large-group instruction
2 Classroom wings
3 Kindergartens
4 Study area
5 Faculty
6 Library
7 Reading
8 Office
9 Conference
10 Health
11 Auditorium-gym station
12 Stage
13 Practice rooms
14 Primary music
15 Intermediate music
16 Art
17 Gymnasium
18 Cafeteria-gym station
19 Kitchen
20 Boiler
21 Lobby
22 Court

Figure 9: Northside Primary / Hamilton Road Intermdiate Schools
Source: Diagrams - Author

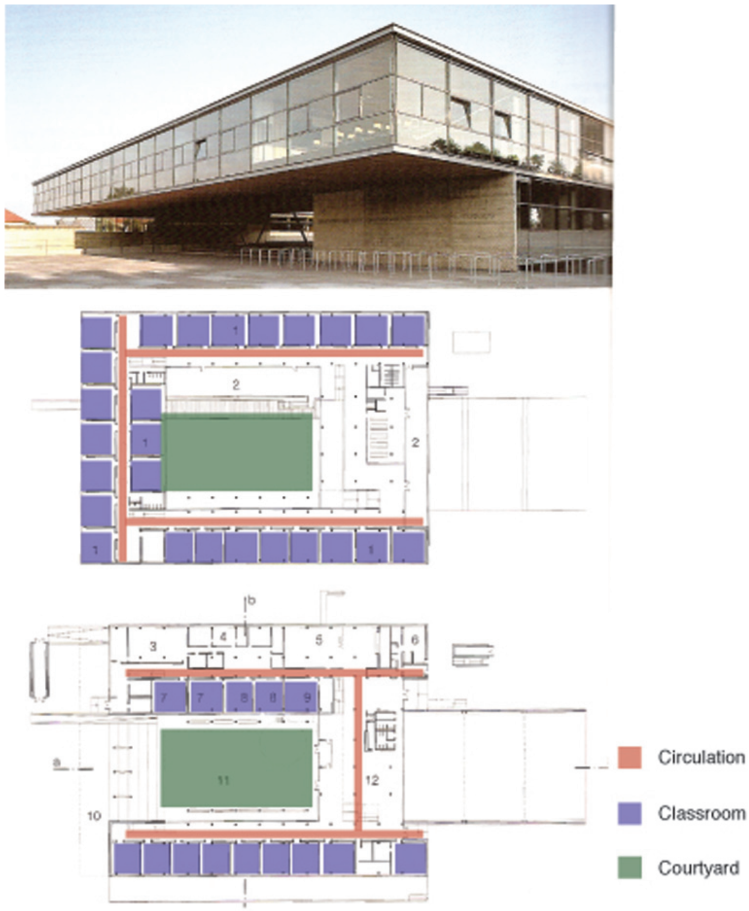


Figure 10: Secondary School, Vienna, Austria
Source: Diagrams - Author
Photo - Spiluttini, Detail Magazine

Designers should consider precedents like these and work to develop new ways to provide protection without destroying the level of design. School design will not move beyond the sealed off boxes of the 1970s if existing guidelines are strictly followed without any interpretation. While new security and surveillance technologies, cameras, metal detectors, and magnetic-lock doors, provide a higher level of protection than ever before, it is important to remember that the architect's design has the largest impact on surveillance and security and should provide a safe, secure environment that is still at a high level of design.

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sustainable design

Sustainable design is arguably the leading focus in current day architectural discussion. Sustainable design, also known as green design, refers to buildings designed with environmental goals in mind. The essential aim of sustainable design is to produce places in a way that reduces use of non-renewable resources, minimizes environmental impact, and relates people to the natural environment. The statistics cited in the beginning of the document, 45,000 educational projects breaking ground between the beginning of 2000 and the end of 2005, totally over $165 billion in construction cost for these projects places the educational facility industry in a position to be a forerunner in green design. (Linn, 12) It is this rate of growth that allows designers to reevaluate the current design criteria and place a focus on sustainable issues along with the needs of the educators and students.

Dena Evans, Fellow of the American Institute of Architects, describes high-performance schools, or green/sustainable design as:

"…healthy, productive, and comfortable environment for students and teachers, that provide high levels of acoustics, thermal and visual comfort… These buildings also use highly-efficient heating, cooling, and lighting systems fueled by renewable sources where possible. Their site planning is environmentally responsive, controlling such things as glare from parking lot lights, and storm water runoff."
(Evans, 23)

The United States Green Building Council's Leadership in Energy and Environmental Design (LEED) will be releasing a new rating system specifically for school buildings during the spring of 2007. With all of this push for sustainable design it is important to remember the occupants, and the effects of the green design on them. Does a high-performance school really make a difference? Yes. The Sustainable Buildings Industry Council and Collaborative for High Performance Schools list the following benefits for these green designed schools: better student performance; reduced operating cost; increased average daily attendance; better teacher satisfaction and retention, and reduced liability exposure.

Joel K. Sims' 2001 article for School Planning and Management titled "Green Schools: A Design Fad or a Trend Worth Embracing?" discusses the movement of designing environmentally sensitive school as a fad. Throughout the years several educational design fad pass out of popularity. For example, the open classroom fad, discussed in an earlier section, has literally taken decades to undo or the sealed off cluster plan of the 1970s. However, green school designs seem different from these fads. The green school philosophy incorporate good, sensible approaches to the environment that educational architects, and the school administrators who employ them, should take into consideration. (Sims, 16)

Financial Benefits of Green Schools
Schools ($ per square foot)

Energy	$9
Emissions	$1
Water and Wastewater	$1
Increased Earnings	$49
Asthma Reduction	$3
Cold and Flu Reduction	$5
Teacher Retention	$4
Employment Impact	$2
TOTAL	$74
COST OF GREENING	($3)
NET FINANCIAL BENEFITS	$71

Greening America's Schools, Capital E, 2006

Figure 11: Cost of Greening
Source: Capital E, 2006

Questions of increased cost rise when discussing implementing new technologies, building materials, and design techniques. However a study performed by Greg

Kats, the managing principal of Capital E, a green building energy technology consultancy, claims that the total cost of designing with a green criteria cost less than 2 percent more than designing in a traditional method, see Figure 11. In response, the United States' Department of Energy estimates that "New high-performance schools – designed to save energy and reduce environmental impact – can cost 50 percent less to operate than traditionally design schools."

As architects move into the next generation of school designs it is critical that sustainable issues be addressed. Green design shall not be limited to photovoltaic panels or high tech expensive solution. Rather, ideas of passive HVAC systems and lighting systems should be implemented wherever possible.

In addition to passive systems the building's layout affects its impact on the environment. Single level schools that spread acres in all directions use substantial amount of

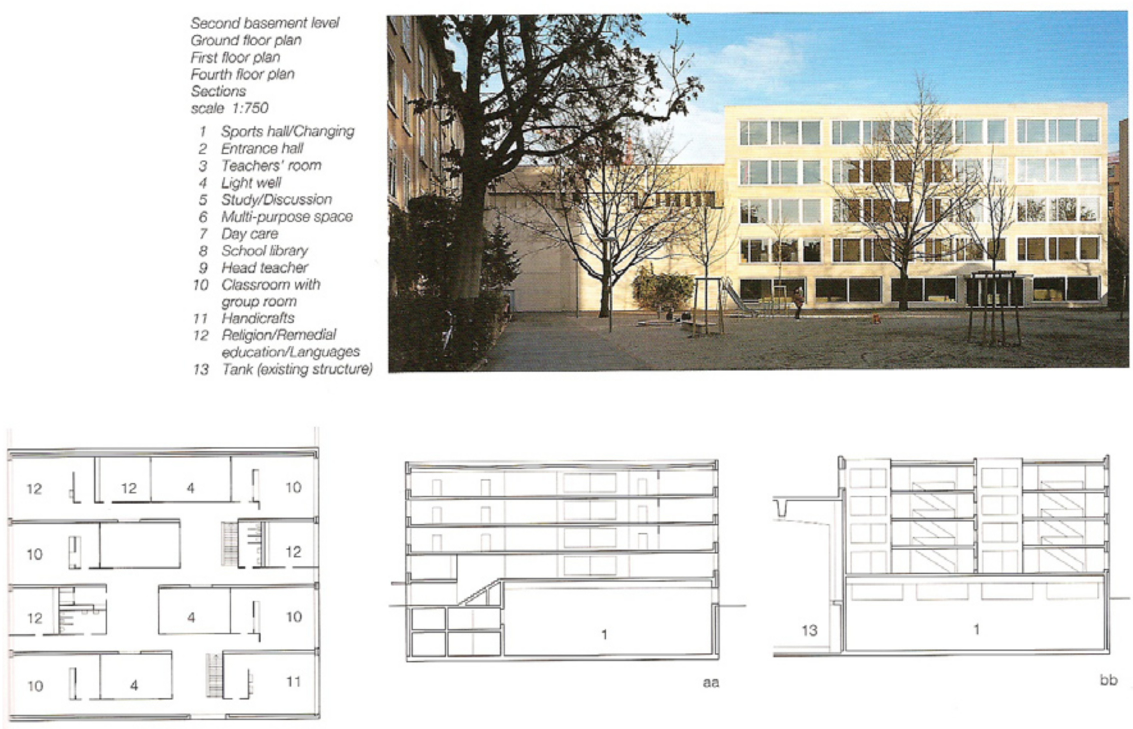

Figure 12: Volta School, Basle, Switzerland
Source: Ruedi Walti, Detail Magazine

materials in relation to a multilevel structure. By condensing the program into a multi-level form the designer reduces the footprint of the building so that surrounding land can be used for other purposes.

Architects, Miller and Maranta, designed this multi-level school in Basle, Switzerland. Located in a traditional workers' area, the school occupies the site of an old heavy-oil tank for a municipal power station. The two sections in Figure 10 illustrate how the designers were able to condense the program while still allowing offering classroom suitable, well-lit areas. Section bb in Figure 10 illustrates the two light wells that illuminate the inner areas of the building.

Although this example does not do so, light wells can act in the same way as courtyards when dealing with passive cooling system. Light wells can be used in cross ventilation or stack ventilation systems. By doing so the designer is able to design much deeper buildings and still implement sustainable design.

In short, green schools can have lasting effects on school districts and the communities they serve, whether the green design aspect is achieved by incorporating cutting edge technologies, designing with passive systems, through daylighting and cross-ventilation, or simply condensing the building to use less materials.What better way to train students to conserve the Earth's natural resources than by giving them a school that demonstrates how it can be done?

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An additional approach to sustainable design is to create a building or environment that suits multiple programs or functions throughout the day. Offering activities beyond the typical eight to three school day benefits to both the school and the community in which it sits. The sustainable aspects of this design is when organizations take advantage of existing buildings for multiple programs, thus reducing the amount of new construction required for a community and lower the impact on the environment.

A school can act as a community hub, like a new version of the old town square. The school's amenities should be designed to be more open than in past years. Use of the school's auditoriums, sports facilities, food service facilities, libraries, media centers, and computers labs add to the quality of the community while providing a connection to the school. (Bingler, 16) Community use of schools is not a new concept, however in recent years schools are sealing off of their doors to the public. This could be a result of the security measures discussed in a previous section. With

thoughtful planning the private realm of the students and the public realm of the community can coexist. By opening its doors, the school creates an identity for the school within its local community.

Providing the connection encourages the community to become involvement in various school activities and programs, and in turn benefits both the school and the community. While the benefits to the community are obvious, the school may profit more. Joe Agron, editor of American School and University magazine, questions where the pressure of this movement toward increasing community use of educational facilities actually comes from? Some say it is the community itself. Community participation is greater when the time comes for fundraising or school decisions to be made. School districts are also finding that it is much easier to get funding for a facility when the taxpayers see additional benefits of the building – namely community benefits. (Taylor, 6)

Any opposition to community use of the facilities often comes from the school faculty. The “not in my classroom” mentality often makes the integration of community difficult. Fanning/Howey Associates publication titled *Community Use of Schools, Facility Design Perspectives* suggests that the facilities themselves, if properly and thoughtfully designed, can greatly diminish many of the difficulties of community use. (22) This places an emphasis on the architect from the very beginning. The primary issue of security and separation should be address by the architect along with the school administration. Planning, in both a physical and scheduling manner, literal spatial separation, and general security features will allow safe opportunities for the school to reach out to the community, and over time the school may truly become the heart of its community.

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It is apparent through the numerous schools and ideas analyzed that the educational facility typology is shifting. A shift that is determined not by a single event or invention but one that takes into consideration all of the topics discussed. These topics cannot be integrated into new schools without first understanding the compositional aspect of school design. Through the analysis provided in the beginning of this document a designer will be able to understand what spatial arrangements are successful and which need to be avoided. Once the an understanding of the compositional portion of design is established the designer should use issues of educational demands, technology integration, security, sustainability, and community outreach to further shape the new school.

Quatremère de Quincy theory of composition claims that composition is needed to provide diversity within a typology. These new design principles will continue to add diversity and complexity within the educational facility typology. However these principles should be used as guidelines and are intended to be

flexible to some extent. If the compositions are exactly repeated in future projects then the criteria established becomes the frozen mechanism that several critics argued against when designing by typology. The principles established must act as like a typology and perform as a framework in which change and adaptation can occur.

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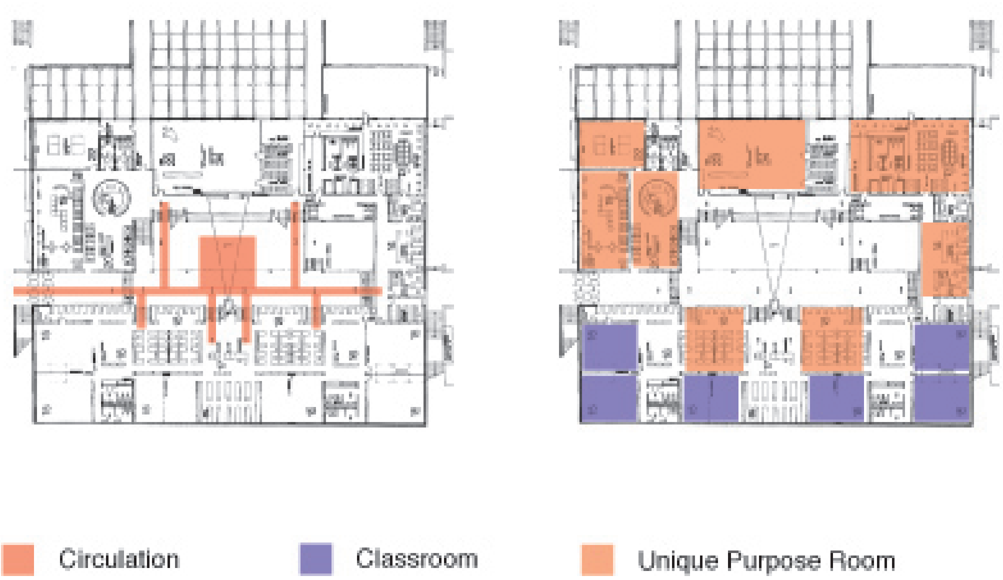


Figure 13: Combined Circulation
Source: Author

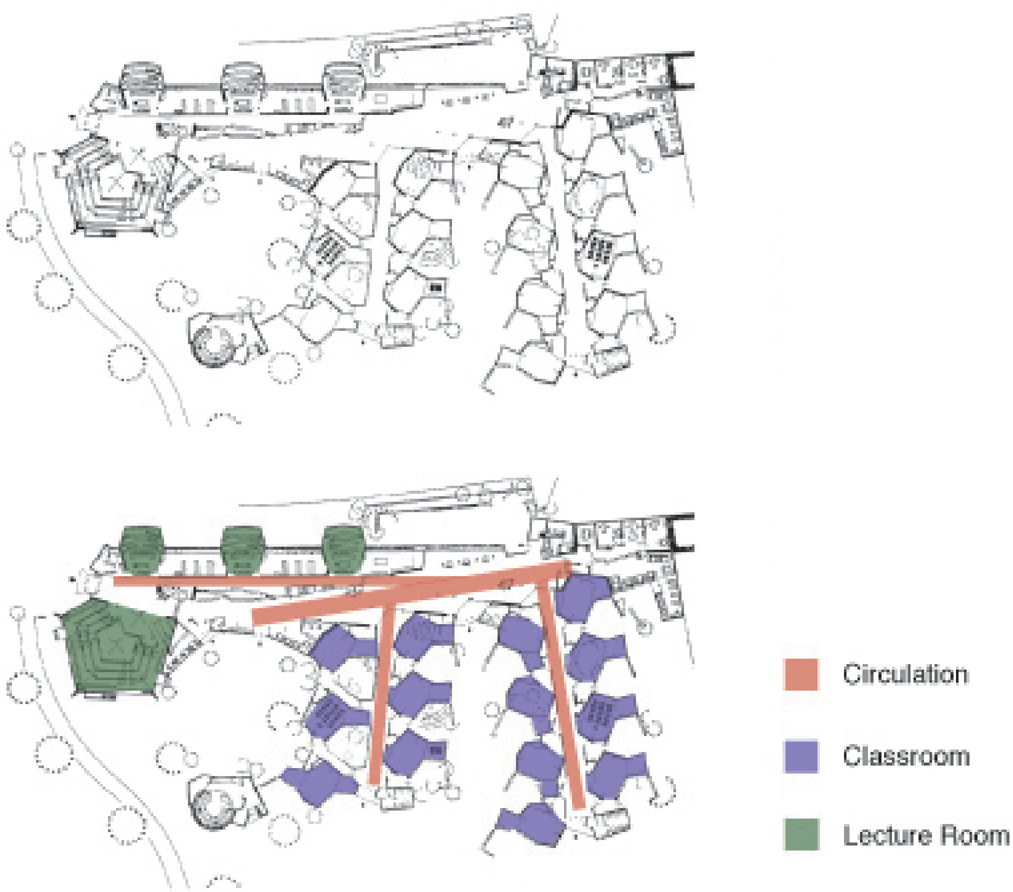
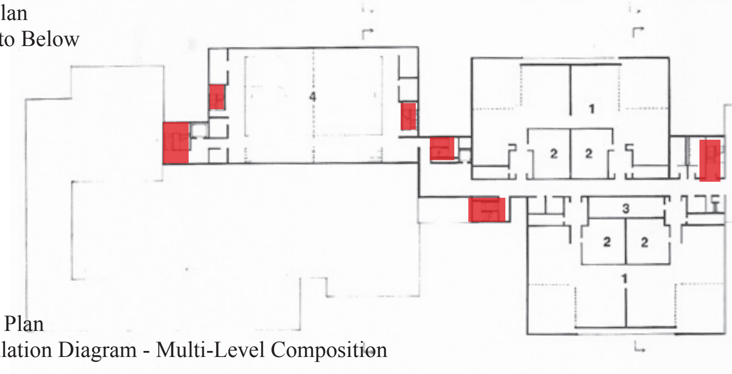


Figure 14: Geschwister-Scholl School
Source: Author

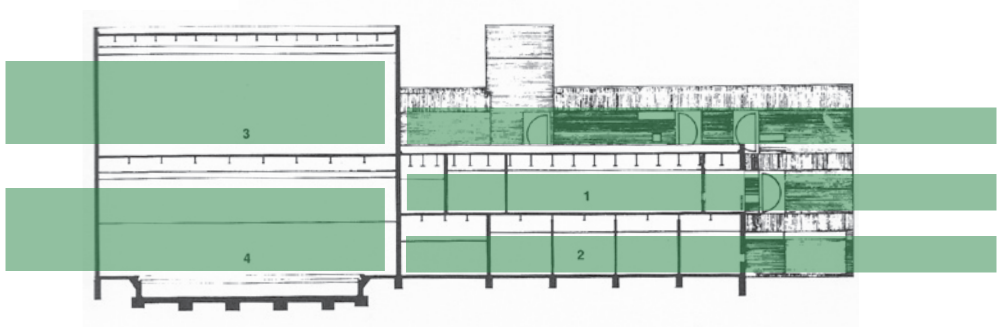
Minot-Hemenway School

Boston, Massachusetts
Multi-Level Urban Primary School

Third Level Plan
Spaces Open to Below



Second Level Plan
Vertical Circulation Diagram - Multi-Level Composition

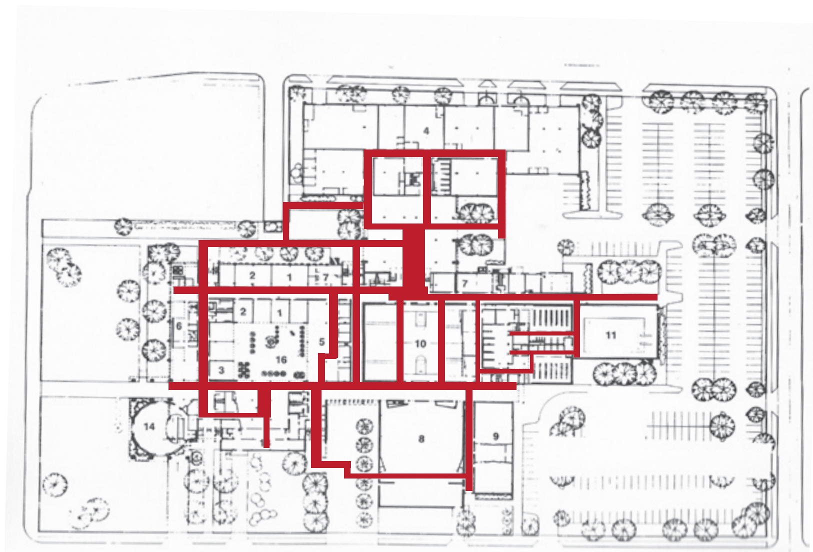


Building Section
Multi-Level Composition

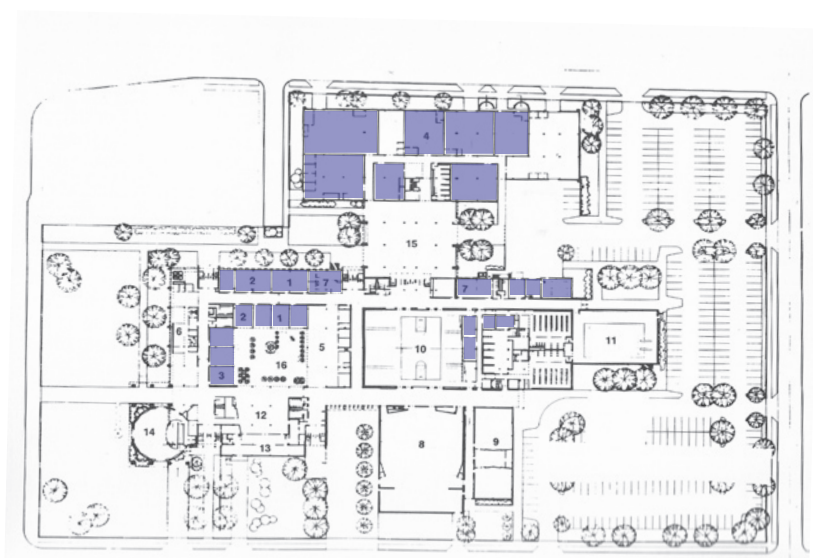
Figure 15: Minot Hemenway School
Source: Author

East Technical High School

Cleveland, Ohio
Complex Plan



First Floor Plan - Site Plan
Circulation Diagram - Complex Connections



Classroom Diagram - Program Grouping

Figure 16: East Technical High School
Source: Author

Figure 17: School for Individual Learning
Source: Author

site analysis

The program of the performing art magnet school will be placed on the 300 and 400 block of Gay Street in Knoxville, Tennessee. This urban site allows direct connections with the local downtown Knoxville community, while providing unique opportunities for the newly established design principles to be incorporated. Figures 18 – 21 represent proposed locations and orientations on the 300 and 400 block. Incorporating a program of approximately 160,000 square feet within this dense urban setting, while meshing with the existing fabric will prove to be challenging, but a strong example that the design principles established could be incorporated in various situations.

Figure 18 : Proposed Site A - Approximately 55,000 sq ft. Footprint

Figure 19 : Proposed Site B - Approximately 42,000 sq ft. Footprint

Figure 20: Proposed Site C - Approximately 40,000 sq ft. Footprint

Figure 21: Proposed Site D - Approximately 55,000 sq ft. Footprint

Figure 22, a figure/ground illustration of the site illustrates the density the urban context. Gay Street, the main downtown street in Knoxville, has very few vacant lots. The proposed site, always represented by the red overlay, takes advantage of two surface parking lots on the East side of Gay Street and a floor of the vacant building that separates them. The barrier created by State Street to the East is an important design concern of the site. This undeveloped barrier is illustrated along with Henley Street to the West, the other street that frames downtown, in Figure 23. As the individual programs of the school are placed within the site it is important to note that existing condition and usage, or lack there of State Street.

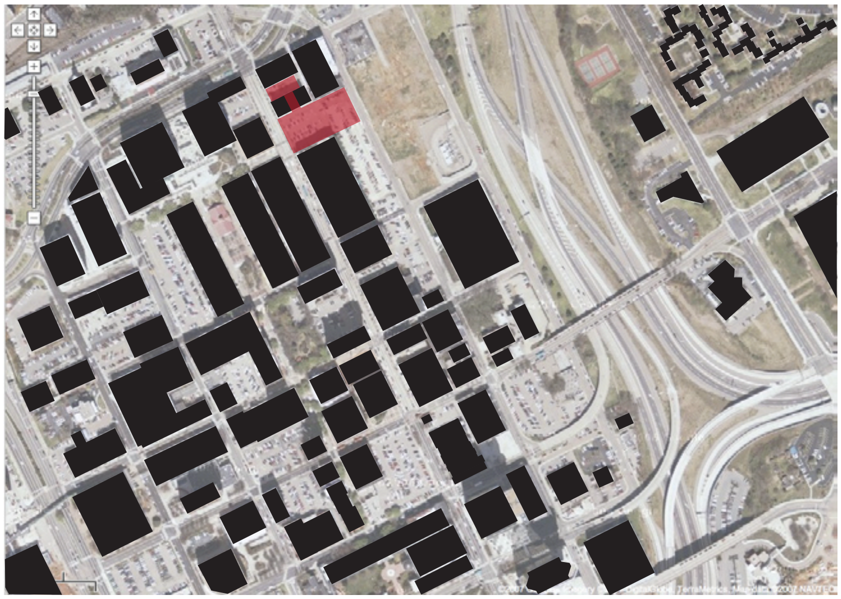


Figure 22 : Figure/Ground

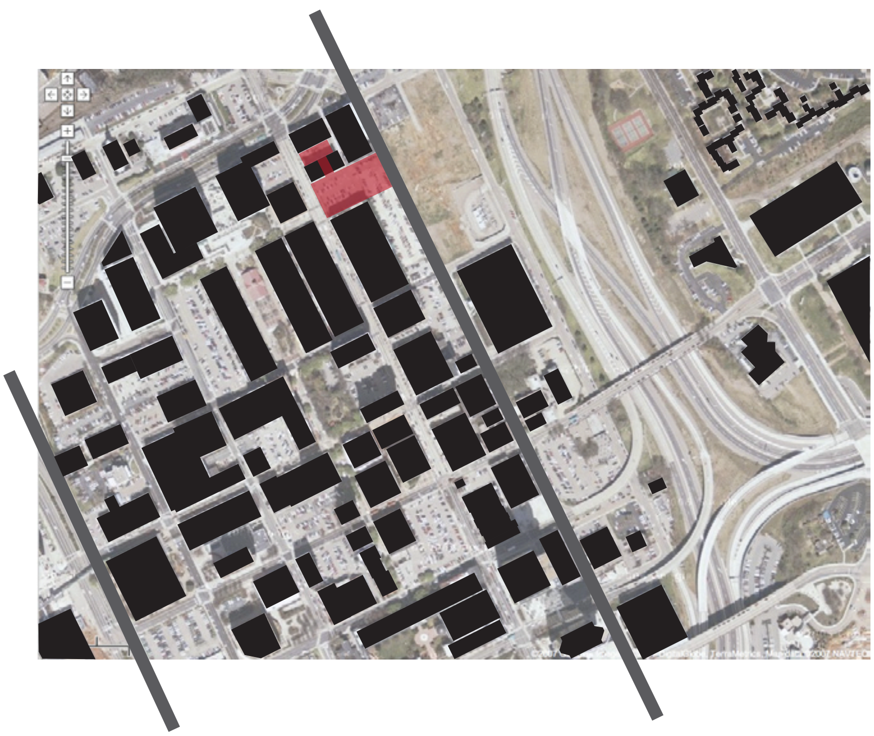


Figure 23 : Street Barriers

Downtown Knoxville meets several pedestrian friendly design criteria, based on Raymond Unwin's 1909 writing on town planning. Unwin writes that program should be condensed into a quarter-mile radius of its town center. The quarter-mile radius is determined by five minute walking distance. This ideal situation orchestrated within the Knoxville downtown. If Market Square represents the center of the density then the majority of the downtown is encompassed within the desired distance. Figure 24 uses cyan to illustrate the pedestrian intensity of Gay Street and its surrounded environment. Higher concentrations of pedestrian traffic are present as the color thickens. The most activity occurs around Market Square, represented by the large rectangular form on Figure 24 and the two cultural centers on Gay Street. The attractions adjacent to the site include a variety of restaurants, museums, and theaters that provoke a mix of pedestrian activity throughout the day and night. While the focus is placed on the immediate context of downtown, it is important to address other local opportunities for pedestrian activity. Figure 25 represents addition pedestrian-friendly locations. The two largest rectangles are located over the site used for the 1982 World's Fair, a prime location of green space used for concerts, festivals, recreation, and other pedestrian activity. Figure 25 re-emphasizes the local of public occupied areas in comparison to green areas. With the exception of Market Square, which houses vegetation, yet no grass, the emphasized areas are public parks used throughout the day for various activities.

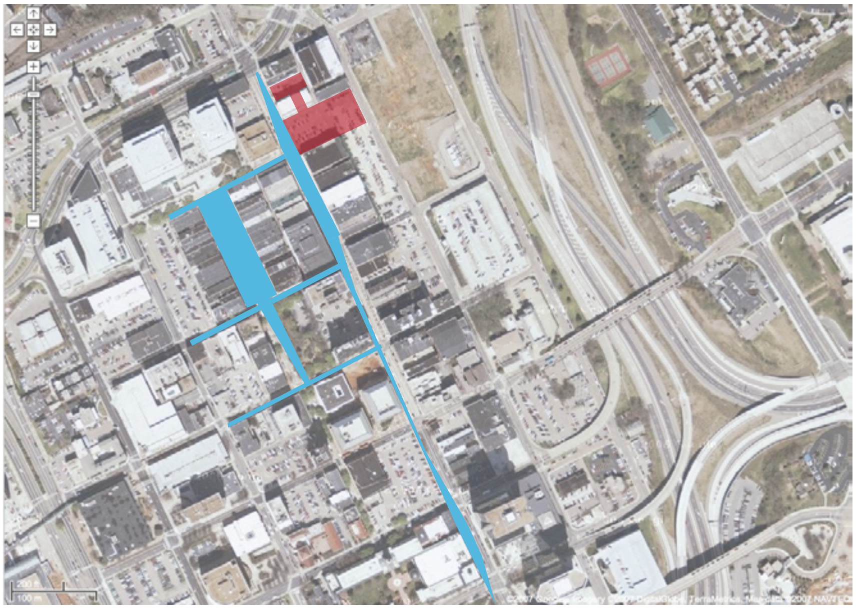


Figure 24: Pedestrian Intensity

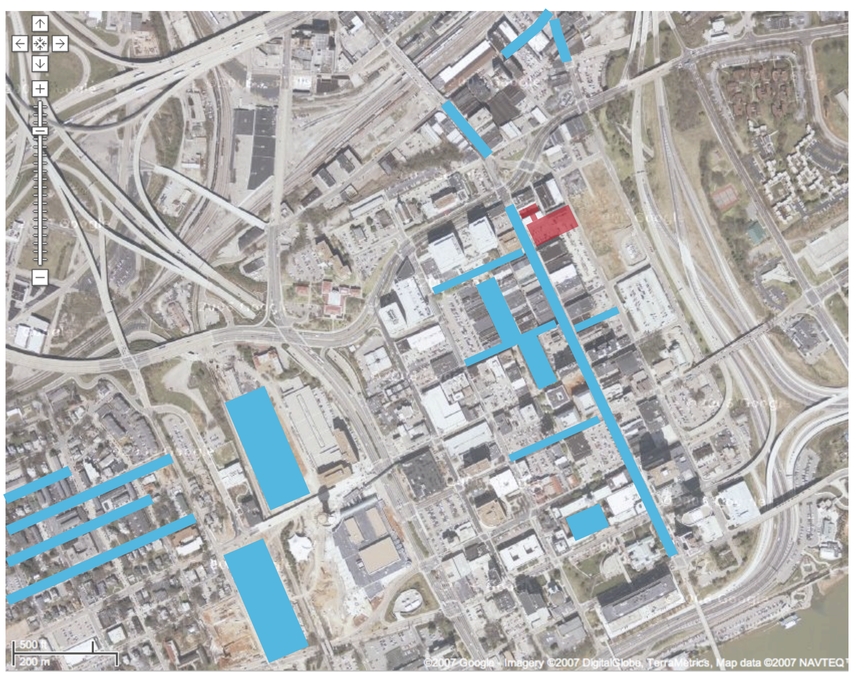


Figure 25 : Pedestrian-Friendly Areas/Streets

Figure 26 begins a series of diagrams expressing the existing cultural fabric of downtown Knoxville. Added to the existing artistic community is one of the driving forces in placing a performing arts magnet school in this urban setting. Diagrams 26 through 29 point out existing galleries and theaters of the proposed site's surroundings. The program for the school has allocated large portions to galleries and auditoriums that are intended to incorporate public use at certain times of the day or during special events.

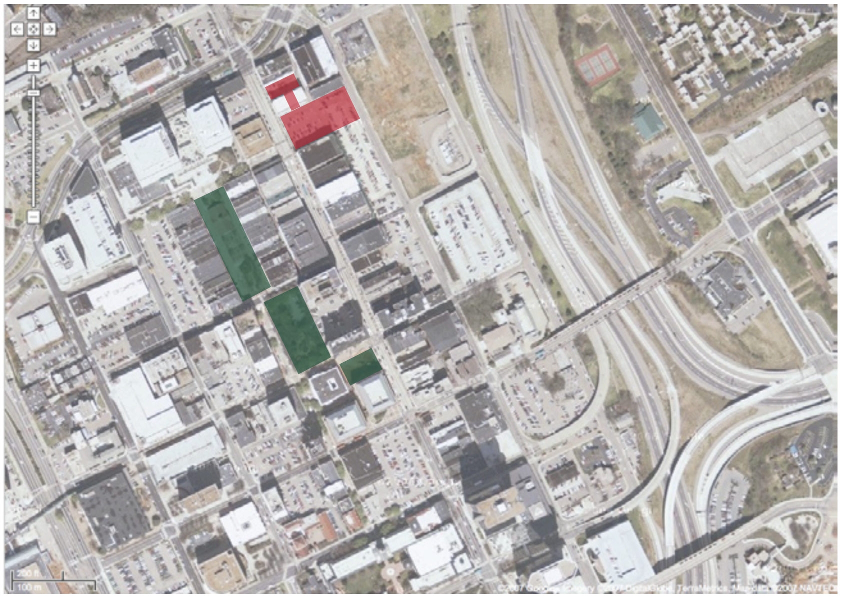


Figure 26 : Public Occupied Areas

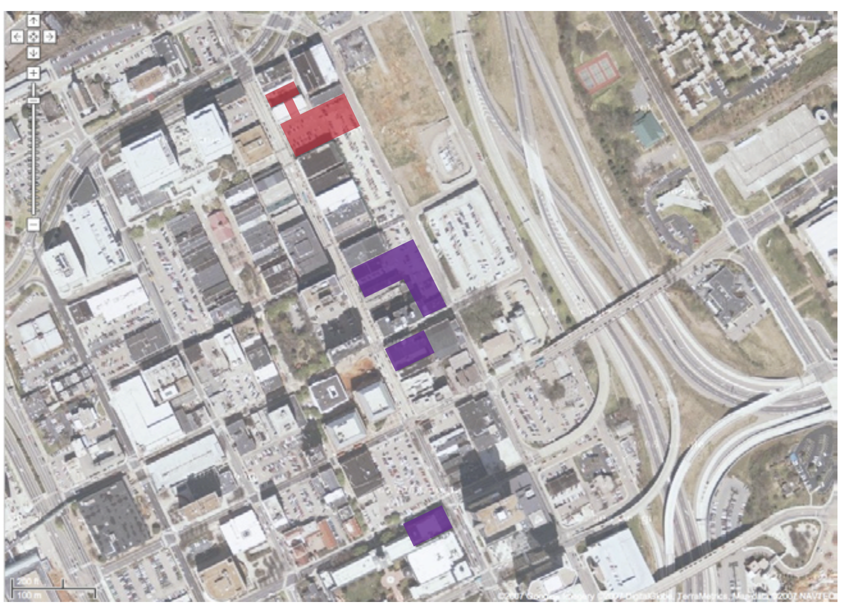


Figure 27 : Existing Downtown Theatres

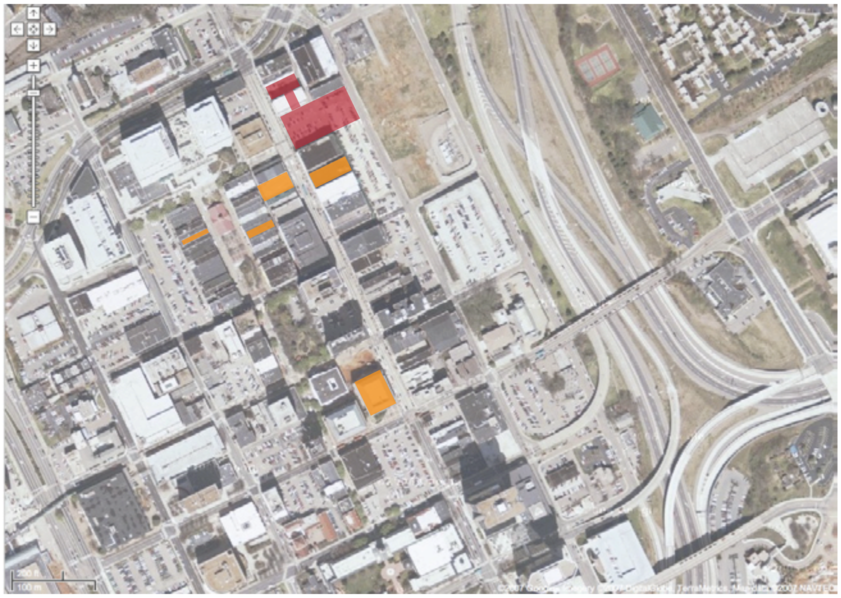


Figure 28 : Existing Local Galleries

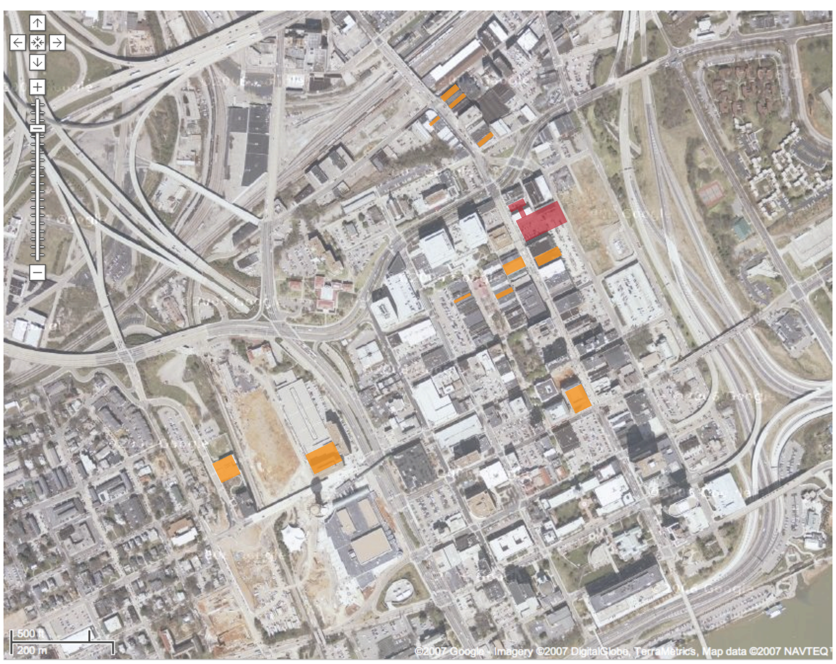


Figure 29 : Existing Local Galleries

With the advantages of adding to the cultural fabric and downtown renovation of this urban site come disadvantages of size, circulation, security, and parking. The three streets that run north and south, adjacent to, and through the site will directly affect the site. While Figure 30 locates the streets in discuss, Figure 31 begins to illustrate the characteristics of the streets. The thickest line on Figure 31 represents the traffic density of Gay Street. As mentioned earlier, Gay Street is the main downtown street and provides the majority of the circulation through downtown. This street begins with a bridge over the Tennessee River to the south and the 900th block and extends nine blocks before disbursing to smaller streets. Gay Street was the primary commercial street of the late nineteenth, early twentieth century and has several buildings placed on the historical registry. While Gay Street is the most populated, State Street to the east provides a similar scale street that is less traveled; however, State Street is currently one way to the north. The final street located on the diagram is simply an alley that has been named Fire Street. This street is merely twenty feet wide. Treated by the businesses on the 400 and 500 blocks of Gay Street as a service entrance. This street may provide access for school bus or service access for the school in the design.

Figure 30 : Adjacent Streets

Figure 31 : Street Traffic Density

Figure 32 illustrates the traffic direction of the adjacent streets. Due to the single direction of traffic on State Street traffic often proceeds at a rapid pace, too dangerous for students or pedestrian traffic. Through a master plan of the site I plan to redevelop the usage of State Street for future expansion.

Figure 32 : Traffic Direction

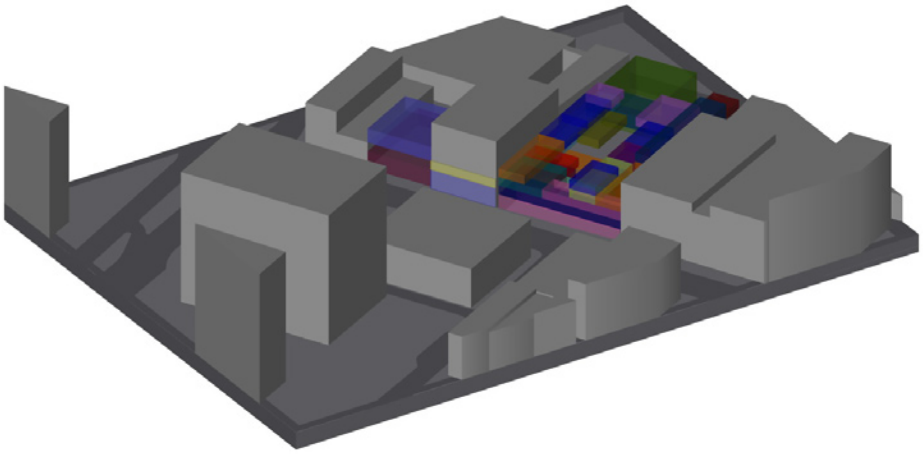
Figure 33 : Street Orientation

According to a calculation provided by Knox County Program Standards a school of 400 students requires approximately 250 parking spaces. Providing this much parking in a dense urban setting becomes highly controversial. An adequate number of parking will be figured into the design, although public and school transportation will be provided for students and visitors of the school. The yellow-orange tone on Figure 34 documents where existing parking is located. The long parking the runs parallel to State Street is a three-story garage that will be shortened for the school design.

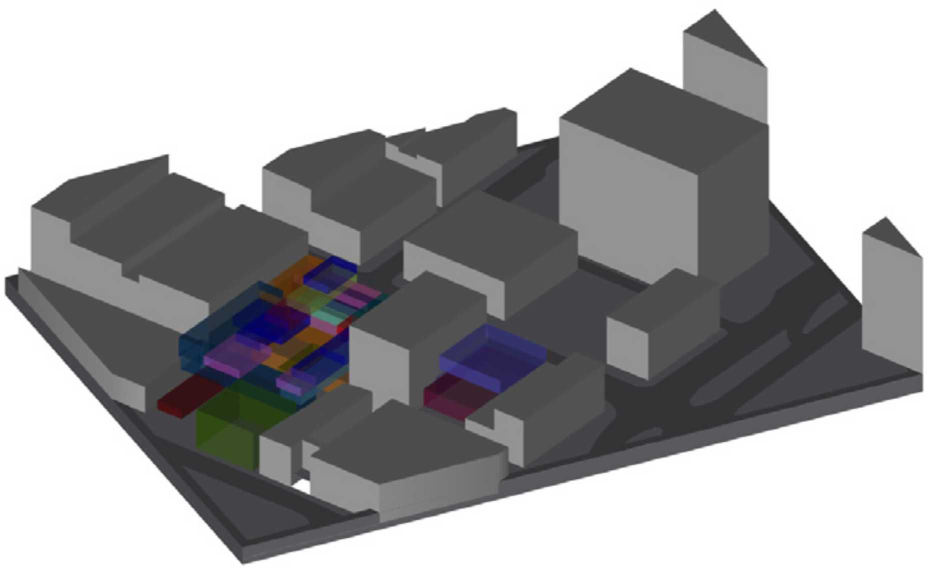
Once the program is arranged on the site several diagrams like Figure 35 demonstration potential entrances to the site. While the diagram does not differentiate between the entrances it is likely that different occupants, e.i. students, teachers, staff, visitors, will use different entrance.

Figure 34 : Existing Parking

Figure 35 : Potential Entrances To Site



Entire Program Combined
Axon From West



Entire Program Combined
Axon From East

Figure 36: Volumetric Study
Source: Author

qualitative program

The qualitative program of the performing arts magnet school will prove to be the feature that sets apart this urban school from existing school buildings. When placing a school in an urban context it is important to establish boundaries of public and private sectors. My design will incorporate public areas at street level and below beyond standard school hours. As a performing arts school it is important to incorporate the community and display the works and talents of the students. For this reason a gallery, auditorium, and practice areas will all be placed on the street level, adding to the existing cultural fabric of downtown Knoxville.

In order to provided protection and security the privacy level will increase as the occupant ascends to higher levels. Due to the necessity for security students will remain above street level for the majority of the day; this includes an upper-level passage through the existing vacant building at 318 South Gay Street. A two-story enclosed courtyard will be included, to provide security without completely sealing off connection to the exterior. Cross-ventilation and natural day lighting is possible by working with a courtyard building. These features will enhance the students' experience,

while decreasing the need for fossil fuels to environmentally control the rooms.

In addition to providing a community connection through public galleries, theaters, and resource center, it is important to incorporate the program into the exiting conditions and fabric of the historic downtown. The project must incorporate the approximately 160,000 square-foot program in a way that does not engulf an entire city block. This will be achieved by placing program within an existing vacant building in an adaptive reuse manner and adjusting the scale to fit the surrounding buildings. Breaking down the Gay Street façade into various scales or proportions maybe necessary to prevent

Above all this design must incorporate the design principles established in the central proposition.

quantitative program

High School: 400 Student Enrollment
Building Program Summary

		Square Footage
Administration		4,335
Guidance Suite		2,150
Clinic		480
Special Education		2,330
General Classroom		1,200
English		3,150
Mathematics		4,825
Social Studies		2,175
Foreign Language		2,250
Journalism		1,425
Business Education		1,825
Theater		5,000
Speech		1,050
Health Safety & Wellness		1,250
Driver's Education		1,210
Science		8,660
Art		4,015
Music: Choral/General		3,500
Music: Band		5,650
Physical Education		15,400
Media Center		7,230
Cafeteria Complex		8,070
Auditorium		13,425
Building Maintenance		2,629
Miscellaneous		4,400
Mini-Auditorium		6,400
Dance Studio		4,930
	Total NSF	118,964
	Grossing Factor	(x) 1.35
	Building Program Total:	**160,601**

Program	Units		NSF/Units	NSF Subtotal
Administration				
Reception	1		800	800
Principal's Office	1		200	200
Asst. Principal's Office	2		150	300
Disc. Stud. Waiting	1		75	75
Mailroom	1		50	50
Faculty Lounge	1		250	250
Workroom	1		400	400
Staff Toilets	2		80	160
Conference Room	1		320	320
General Storage	2		100	200
Record's Storage	1		100	100
Bookkeeper's Office	1		120	120
Attendance office	1		120	120
In-school Suspension	1		800	800
I.S.S. Unisex Toilet	1		80	80
Itinerant Office	3		120	360
		Total NSF		4,335
Guidance Suite				
Waiting Area/Clerical	1		300	300
Career Center	1		450	450
Guidance Classroom	1		600	600
Counselor's Office	1		150	150
Conference Room	1		150	150
Workroom	1		300	300
Records Vault	1		100	100
General Storage	1		100	100
		Total NSF		2,150
Clinic				
Cot Area	2		200	400
Toilets - Unisex	1		80	80
		Total NSF		480

Special Education			
Resource Classroom	1	900	900
Teacher Planning Area	1	50	50
CDC Classroom	1	1000	1,000
Teacher Planning Area	1	50	50
OT/PT Office	1	120	120
General Storage	1	50	50
Staff Toilets	2	80	160
	Total NSF		2,330
General Classroom			
Seminar Room		1	1,200
	Total NSF		1,200
English			
(9-12th Grade) classroom	3	900	2,700
Teacher Work Area	1	275	275
Textbook Storage	1	175	175
	Total NSF		3,150
Mathematics			
(9-12th Grade) Classroom	4	900	3,600
Teacher Work Area	1	275	275
Computer Lab	1	800	800
Textbook Storage	1	150	150
	Total NSF		4,825
Social Studies			
(9-12th grades) Classroom	2	900	1,800
Teacher Work Area	1	225	225
Textbook Storage	1	150	150
	Total NSF		2,175
Foreign Language			
Teacher Work Area	2	900	1,800
Foreign Language Lab	1	200	200
Teacher Work Area	1	150	150
Textbook Storage	1	100	100
	Total NSF		2,250

Journalism

Annual Classroom	1		500	500
Newspaper Classroom	1		500	500
Teacher Planning Area	1		150	150
Textbook Storage	1		50	50
Teacher Work Area	1		225	225
		Total NSF		1,425

Business Education

Classroom	1		700	700
Teacher Work Area	1		150	150
Computer Lab	1		700	700
Server Room	1		75	75
Textbook Storage	1		200	200
		Total NSF		1,825

Theater

Drama Classroom	2		900	1,800
"Black Box" Theater Lab	1		2700	2,700
Control Booth	1		100	100
General Storage	1		200	200
Teacher Planning Area	1		100	100
Textbook Storage	1		100	100
		Total NSF		5,000

Speech

Classroom	1		900	900
Teacher Planning Area	1		150	150
		Total NSF		1,050

Health Safety

Classroom	1		900	900
Teacher Work Area	1		150	150
Teacher Planning Area	1		50	50
Textbook Storage	1		150	150
		Total NSF		1,250

Driver's Education

Classroom	1		900	900
Teacher Planning Area	1		120	120
Exterior Storage	1		150	150
Textbook Storage	1		40	40
		Total NSF		1,210

Science				
(9-12th Grades) Classroom	1		900	900
(9-12th Grades) Classroom/Lab	2		1860	3,720
(9-12th Grades) Laboratory	1		1400	1,400
Teacher Work Area	1		300	300
Chemical Storage	2		200	400
Prep Room	3		380	1,140
Textbook Storage	2		400	800
		Total NSF		8,660
Art				
Classroom	1		1540	1,540
Teacher Planning Area	1		100	100
Kiln/Clay	1		75	75
Photography Laboratory	1		400	400
Gallery	2		750	1,500
Storage	1		400	400
		Total NSF		4,015
Mini-Auditorium				
Mini-Auditorium	1		3000	3,000
Platform	1		1500	1,500
Control Booth	1		1600	1,600
General Storage	1		300	300
		Total NSF		6,400
Dance Studio				
Dance Studio	1		3200	3,200
Teacher Plan Area/ Tlt./Shower	1		200	200
Entrance	1		200	200
Girl's Dressing Room/Tlt./Shower	1		700	700
Boy's Dressing Rm/Tlt./Shower	1		500	500
Costume/Equipment Storage	1		130	130
		Total NSF		4,930

Music: Choral/Genl.				
Teacher Planning Area	1		150	150
Teacher Work Area	1		250	250
Vocal Rehearsal Room	1		1500	1,500
Ensemble Room	1		350	350
Practice Room	2		75	150
Classroom/Music Laboratory	1		500	500
Music Library/Storage	1		300	300
Robe & Storage Room	1		300	300
		Total NSF		3,500
Music: Band				
Instrumental Rehearsal "A"	1		2000	2,000
Instrumental Rehearsal "B"	1		1000	1,000
Teacher Planning Area	1		100	100
Teacher Work Area	1		200	200
Ensemble Room	1		600	600
Practice Room	2		75	150
Music Library/Storage	1		200	200
Music/Equipment Storage	1		300	300
Instrument Storage	1		700	700
Uniform/Costume Storage	1		250	250
General Storage	1		150	150
		Total NSF		5,650
Physical Education				
Concession Stand	1		250	250
Gymnasium: Seat 1000	1		7750	7,750
Teacher Planning Area	2		150	300
Laundry	1		150	150
Equipment Storage	1		400	400
Dressing Room	2		750	1,500
Shower/Toilet	2		300	600
Athletic Dressing/Locker Room	1		1000	1,000
Athletic Dressing/Locker Room	1		1000	1,000
Weight Room	1		1000	1,000
Athletic Equipment/Uniform storag	1		450	450
Training Room/Film	1		750	750
Teacher Work Area	1		250	250
		Total NSF		15,400

Media Center

Conference Room	1		250	250
A.V. Equipment Storage	1		300	300
Main Resource Center	1		4500	4,500
Librarian Office	1		150	150
Print/Media Library	1		250	250
Production Area	1		300	300
Workroom	2		200	400
Professional Library	1		200	200
Staff Toilet	1		80	80
General storage	1		100	100
Classroom	1		700	700
		Total NSF		7,230

Cafeteria Complex

Dining	1		2500	2,500
Food Prep	1		1500	1,500
Table/Chair Storage	1		75	75
Serving Area	1		1000	1,000
Dish Room	1		500	500
Freezer/Cooler	1		500	500
Non-food Storage	1		180	180
Manager Office	1		100	100
Toilet/Lockers	1		140	140
Receiving/Transport Cart Room	1		275	275
Dry Storage	1		600	600
Exterior Receiving	1		400	400
Transporting Cart Storage	1		300	300
		Total NSF		8,070

Auditorium

Ticket Booth	1		75	75
House	1		6400	6,400
Stage	1		2000	2,000
Student Dressing Room/Tlt/Shwr.	2		600	1,200
Faculty Dressing Rm/Tlt./Shwr.	2		100	200
Control Booth	1		200	200
Piano Storage	1		150	150
Prop Storage	1		1000	1,000
Scene Shop/Prop Const.	1		1000	1,000
Storage/Workroom	2		600	1,200
		Total NSF		13,425

Building Maintenance			
Mechanical Room	1	1200	1,200
Electrical Distribution	1	769	769
Electrical Closet	4	40	160
Custodial Closet	4	50	200
Housekeeping Storage	1	300	300
	Total NSF		2,629
Miscellaneous			
Student Toilets	10	400	4,000
Main Technology Dist. Center	1	400	400
	Total NSF		4,400
	Total NSF		**118,964**
	Grossing Factor		(x) 1.35
	Total Square Footage		**160,601**

occupancy/building type

Occupancy Type

Assembly Group A – A-1: Assembly uses, usually with fixed seating, in tended for the production and viewing of the performing arts or motion pictures including, but not limited to:

Motion Picture Theaters
Symphony and Concert Halls
Television and Radio Studios Admitting an Audience
Theaters

Educational Group E: Educational Group E occupancy includes, among others, the use of a building or structure, or a portion thereof, by six or more persons at any time for educational purposes through the 12th grade. Religious educational rooms and religious auditoriums, which are accessory to places of religious worship in accordance with Section 508.3.1 and have occupant loads of less than 100, shall be classified as A-3 occupancies.

Construction Type

Type I-A – 3-Hour Noncombustible Construction
3-Hour Noncombustible construction requires a fire-resistance rating of 2 hours per floor construction and 3 hours for columns and bearing walls

Structural Steel columns, beams, joists, and decking must be protected to these values with applied fireproofing materials or an appropriately fire-resistive ceiling of plaster, gypsum board, or fibrous panels

Reinforced Concrete columns must be at least 12 in. in dimension, and loadbearing walls must be at least 5 in. thick. Floor slabs must be at least 5 in. thick. Concrete one-way and two-way joist systems (ribbed slabs and waffle slabs) with slabs thinner than 5 in. between joists require protection with applied fireproofing materials or an appropriately fire-resistive ceiling of plaster, gypsum board, or fibrous panels

Posttensioned Concrete floor slabs must be at least 5 in. thick

Precast Concrete columns must be at least 10 in. in dimension, and beams at least 7 in. wide. Loadbearing wall panels must be at least 6 thick. Solid slabs may not be less than 5 in. Hollow core slabs must be at least 8 in. deep and may be used without a topping. Double and single tees require applied fireproofing materials or an appropriately fire-resistive ceiling of plaster, gypsum board, of fibrous panels, unless a concrete topping 3.25 is poured.

Brick Masonry loadbearing walls must be at least 6 in thick. Vaults and domes must be at least 8 in. deep with a rise not less than one-twelfth the span.

Concrete Masonry loadbearing wall must be 8 in. thick. Depending on the composition and design of the masonry unit, applied plaster or stucco facing may also be required.

Type II-A – 2-Hour Noncombustible Construction

2-Hour Noncombustible construction requires a fire-resistance rating of 2 hours for columns and bearing walls

Structural Steel columns, beams, joists, and decking must be protected to these values with applied fireproofing materials or an appropriately fire-resistive ceiling of plaster, gypsum board, or fibrous panels

Reinforced Concrete columns must be at least 10 in. in dimension, and loadbearing walls must be at least 5 in. thick. Floor slabs must be at least 5 in. thick. Concrete one-way and two-way joist systems (ribbed slabs and waffle slabs) with slabs thinner than 5 in. between joists require protection with applied fireproofing materials or an appropriately fire-resistive ceiling of plaster, gypsum board, or fibrous panels

Posttensioned Concrete floor slabs must be at least 5 in. thick

Precast Concrete columns must be at least 8 in. in dimension, and beams at least 7 in. wide. Loadbearing wall panels must be at least 6 thick. Solid slabs may not be less than 5 in. Hollow core slabs must be at least 8 in. deep and may be used without a topping. Double and single tees require applied fireproofing materials or an appropriately fire-resistive ceiling of plaster, gypsum board, of fibrous panels, unless a concrete topping 3.25 is poured.

Brick Masonry loadbearing walls must be at least 6 in thick. Vaults and domes must be at least 8 in. deep with a rise not less than one-twelfth the span.

Concrete Masonry loadbearing wall must be 6 in. thick. Depending on the composition and design of the masonry unit, applied plaster or stucco facing may also be required.

zoning/building codes

Zoning for 350 Gay St. Knoxville, Tennessee

The entire proposed site falls under Neighborhood Commercial with the Central Business District and Commercial districts framing the site.

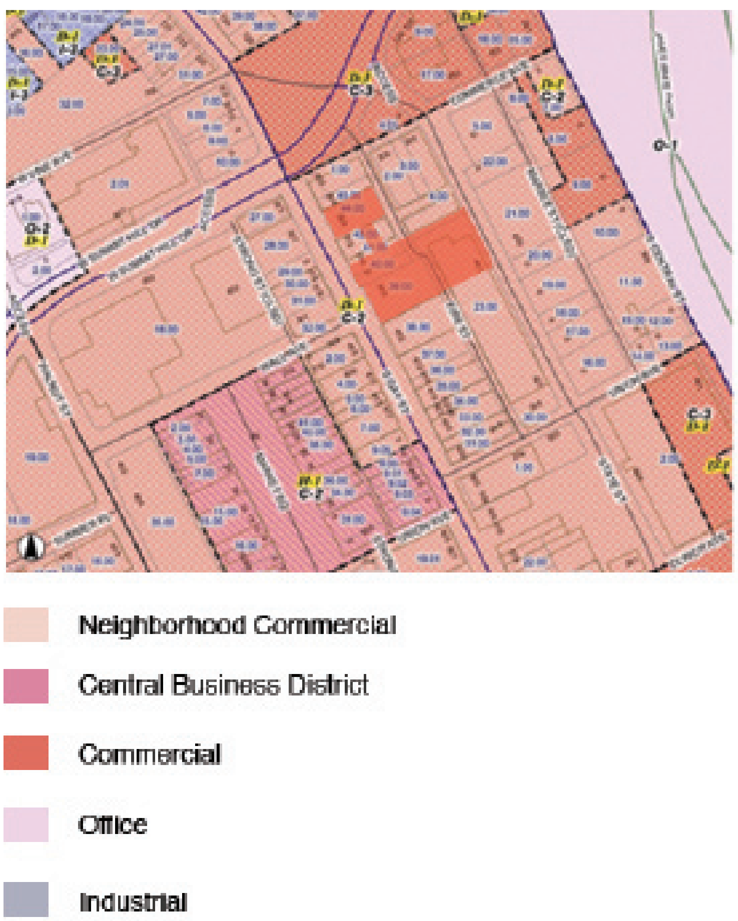


Figure 37: Zoning For Site
Source: KGIS.org

Egress Requirements

E: Educational

Maximum Travel Distance from Most Remote Point to Nearest Exit Enclosure

Unsprinklered – 200 ft
Sprinklered – 250 ft

Maximum Travel Distance to Two Independent Egress Paths

Unsprinklered / Sprinklered – 75 ft

Largest Room That May Have Only One Door

50 occupants

Maximum Length of Dead-End Corridor

20 ft

Minimum Clear Corridor Width

72" for 100 or more occupants
44" for 50 - 100 occupants
36" for 50 or fewer occupants

Minimum Net Clear Egress Door Width

32"

Minimum Stair Width

44" for more than 50 occupants
36" for 50 or fewer occupants

Widths of Egress Components

Educational Occupancies, Classroom Areas — 20 ft^2 net

Widths per Occupant

Doors, Corridors, and Ramps	- Unsprinklered –	.2"/occupant
	Sprinklered –	.15"/occupant
Stairs	- Unsprinklered –	.3"/occupant
	Sprinklered –	.2"/occupant

Educational Occupancy, Shops and Vocational Areas — 50 ft^2 net

Widths per Occupant

Doors, Corridors, and Ramps	- Unsprinklered –	.2"/occupant
	Sprinklered –	.15"/occupant
Stairs	- Unsprinklered –	.3"/occupant
	Sprinklered –	.2"/occupant

Exercise Areas — 50 ft^2 gross

Widths per Occupant

Doors, Corridors, and Ramps	- Unsprinklered –	.2"/occupant
	Sprinklered –	.15"/occupant
Stairs	- Unsprinklered –	.3"/occupant
	Sprinklered –	.2"/occupant

General Building Heights and Areas

General Height and Area Limitations

503.1 General. The height and area for buildings of different construction types shall be governed by the intended use of the building and shall not exceed the limits in Table 503 (Figure __) except as modified hereafter. Each park of a building included within the exterior walls or the exterior walls and fire walls where provided shall be permitted to be a separate building.

503.1.2 Buildings On Same Lot. Two or more buildings on the same lot shall be regulated as separate buildings or shall be considered as portions of one building if the height of each building and the aggregate area of buildings are within the limitations of Table 503 as modified by Sections 504 and 506. The provisions of this code applicable to the aggregate building shall be applicable to each building.

503.1.3 Type I Construction. Buildings of Type I construction permitted to be of unlimited tabular heights and areas are not subject to the special requirements that allow unlimited area buildings in Section 507 or unlimited height in Sections 503.1.1. and 504.3 or increased height and areas for other types of construction.

Sprinklers

An approved sprinkler systems is required for Group E occupancies when located on a floor below the level of exit discharge, or with floor area exceeding 20,000 sq. ft, except where each classroom has at least one exterior exit door at ground level. A sprinkler system is also required for any Group E occupancy with:

A floor having an occupant load of 30 or more located more than 55 ft above grade

Any story or basement greater than 1500 sq. ft. in area without openings to the exterior

Most underground portions of the building where occupancy occurs more than 30 feet below the lowest level of exit discharge

Unlimited Area

Occupancy E buildings of Non-combustible construction of any rating, or of Ordinary 1-hour or Mill construction, may be of unlimited area when Sprinklered throughout, surrounded on all sides by public ways or yards not less than 60 ft in with, and where each classroom has at least two means of egress, one of which discharges directly to the exterior.

Egress Requirements For Assembly Seating

Seating
For a row with egress at both ends:
Maximum row length: 100 seats
Minimum clear row spacing: 12”
plus 0.3” for every seat above 14

For a row with egress one end only:
Maximum length: 20’
Minimum clear row spacing: 12”
plus 0.6” for every seat above 7

In all cases, clear row spacing need never exceed 22”

Aisles
Aisle width:
Minimum: 30” for aisle serving not more then 14 seats; 36” for aisle serving seating on one side, or not more than 50 seats on two sides; 2” for aisles serving more than 50 seats on two sides

For occupant load; Not less than 0.2” per person for aisles sloped not more than 1:12 or 0.22” per person for aisles with greater slopes

Aisles proving egress at only one end may vary in width; aisles with egress at both ends must be uniform in width.

Longest dead end aisle; 20’, unless seats served by a dead-end aisle are with no more than 24 seats of another aisle and minimum clear row spacing is as required for rows with egress on one end only

Cross-aisle width: Same as for aisles, sized for combined capacity of converging aisles

Maximum slope of aisle: 1:8

With special smoke control provisions, the International Building Code permits reductions in seating row width, aisle width, and travel distance requirements, particularly for spaces with larger occupant loads.

Aisle Stairs And Handrails
Minimum tread depth: 11”
Maximum riser height: 8”; up to 9” permitted where necessitated by slope of adjacent seating
Minimum riser height: 4”

Stair width:
Minimum: 36” for stairs serving seating on one side or not more than 50 seats on two sides, or 48” for stairs serving more than 50 seats on two sides.

For occupant load: Not less 0.3” per person for stairs with risers not greater than 7” ; add an additional 0.005” per person for each additional 0.1” of riser height; where egress requires stair descent and no handrail is within 30” to either side, and an additional 0.005” per person

Handrails:
Required: All stairs’ ramped aisles serving seats on not more than one side and sloped more than 1:15 (ramped aisles not sloped more than 1:8 serving seats on two sides do not require handrails)

Handrails subdividing stairs or aisles serving seats on both sides may be discontinuous to allow aisle access; the minimum space between the handrail and adjacent seating is 23”

Travel Distance Limits
Maximum travel distance to an exit:
Unsprinklered: 200’
Sprinklered: 250’
In open-air seating: 400’ to the exterior, or unlimited in Type 1 or II construction

Wheelchair Requirements for Assembly Seating

International Building Code	Total Capacity	Wheelchair Places
	4-25	1
	26 – 50	2
	51 – 100	3
	101 – 300	5
	301 – 500	6
	500 – 5000	6, plus 1 additional

for each 150 seats or portion there of.

Minimum Number of Separate Wheelchair Locations

	Up to 150	1
	151 to 500	2
	500 to 1000	3

Design Project Analysis

The following is an overall analysis of the second portion of the thesis research, the design portion. The six topics which new design principles were drawn from were implemented throughout the entire design process. Some principles such as community outreach and new security measures guided the design from the very beginning, while decisions on how to incorporated technology or respond to education at various scales, as defined in the new educational demands section of the writing, were decided on further along into the project.

While all principles were considered and implemented into the design, it is evident that certain principles took precedent over others. It will always be too difficult to equally divide the focus given to each principle, even with the lack of constraints of a fictional project. The focus may not be equally divided, however the designer should be able to find a balance between these principles, based on the needs of the students and faculty, needs of the community and existing site conditions. In my design more of a focus was placed on community outreach, incorporating technology and responding to education at various scales

than sustainable design. Although, components such as the light/noise screen on the Gay Street façade, natural lighting and ventilation were all influenced by sustainable design.

As mentioned before, after completing the design for the East Tennessee Performing Arts High School I made compromises between the different principles established and how they were included in the design. Furthermore, it should noted that much like the architects of the post World War Two era, there was difficulty balancing the needs of the students and faculty with the personal design desires of the architect. Ultimately the student is the client and a strong knowledge of their needs should be established and referred to during all stages of school design.

Investing in the Future: The Revigoration of Educational Facilities

Proposal for a Performing Arts Magnet School in Knoxville, Tennessee

A student's environment directly affects his ability to learn. School design must take into consideration the growing needs of the educator, the students, and their community. This research establishes design principles for new K-12 educational facilities. These principles will be based upon successes of past educational facilities, new educational demands, new technologies, stricter security guidelines, sustainable design, and the desire to create a connection to the school's local community.

Over 45,000 educational facility projects broke ground between 2000 and the end of 2005, totaling over $165 billion in construction cost alone. According to McGraw-Hill Construction Analytics' Special Sector Study: Education, released in January of 2007, an additional 260,000 students will enroll each year into an already overcrowded educational system. The "baby boom echo" is ready for school. The children of World War Two's baby boomers, numbering in the millions crowd into schools across the nation.

If the average class size in the United States will remain to be 25, the construction of K-12 classrooms will need to total more than 10,000 units each year, just to keep up with the enrollment growth. (Linn, 12) A large demand for replacement facilities affects the industry, in addition to the enrollment growth. The United States Department of Education states that the average lifespan of a school building is 42 years. In response to the population increase of the baby boomer generation many schools were constructed during the 1950s and early 1960s and therefore currently need to be renovated or replaced completely. Figure 1 illustrates the break down of types of project in American school construction.

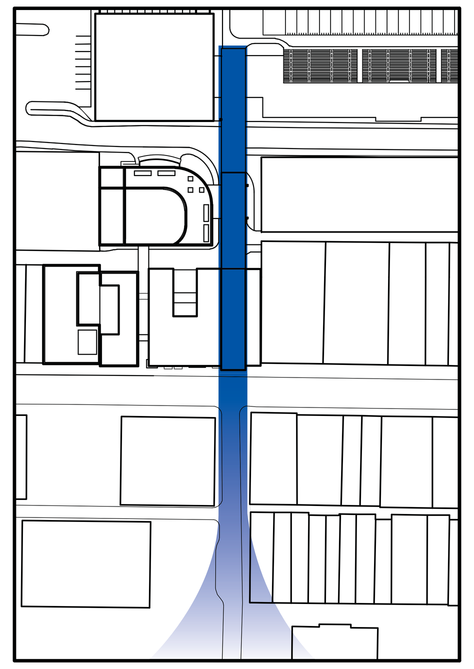
This demand for educational facilities is unprecedented in American history. Demographic evidence of the coming demand has been mounting for some time. From 1977 to 1990,the number of children born to baby boomers increased by 25 percent, reaching a peak of 4.1 million births in 1990.In the following decade, public high school enrollment increased 19 percent and elementary school enrollment increased 12 percent. By the year 2000,public and private school enrollment, kindergarten through grade 12,had reached a record 53.2 million students. After stabilizing somewhat between 2000 and 2010,enrollment increases are expected to resume. Between 2010 and 2020,the number of children aged five to seventeen will increase by 6 percent. By 2030,total school enrollment is projected to be 60 million (U.S. Department of Education, Office of Public Affairs 2000).

With such a thriving field of design and construction comes an opportunity to re-evaluate the principles of school design. Architects, school officials, and builders have an opportunity to incorporate lessons learned from past educational facilities, along with new technologies, stricter security guidelines, sustainable design, and connections to the community. The goal of this research is to establish new design principles for the educational facility typology of the twenty-first century.

The second half of the research is a design for a school that fully incorporates the principles established. The project is a performing arts magnet high school placed in the dense urban context of downtown Knoxville, Tennessee. While the urban location and program of a magnet school may not conform to traditional ideas of secondary education in the southern United States, it further illustrates that the majority of these principles can be applied to a large variety of situations.

GAY STREET ELEVATION

0' 8' 16' 32' 64'

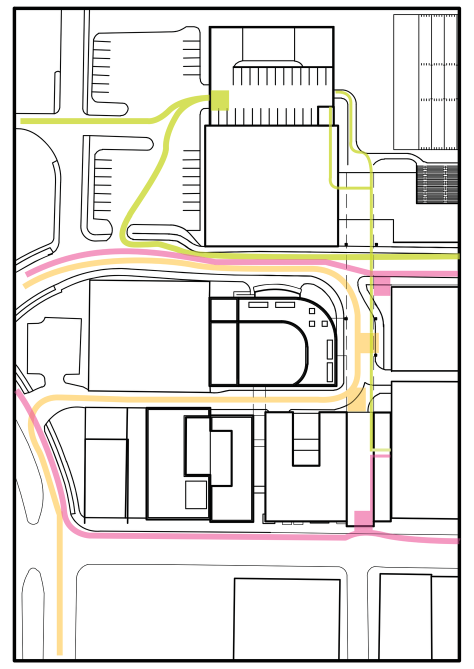


VISUAL MOMENTUM

CONTINUE THE PATHWAY OF WALL STREET THROUGH BUILDING AS CIRCULATION SPINE AND CONNECT TO STATE STREET

CONNECTION

LINKING TOGETHER TWO DOMINATE PUBLIC SPACES OF DOWNTOWN KNOXVILLE



BUS ROUTE
STUDENT DROP OFF
SELF DRIVEN

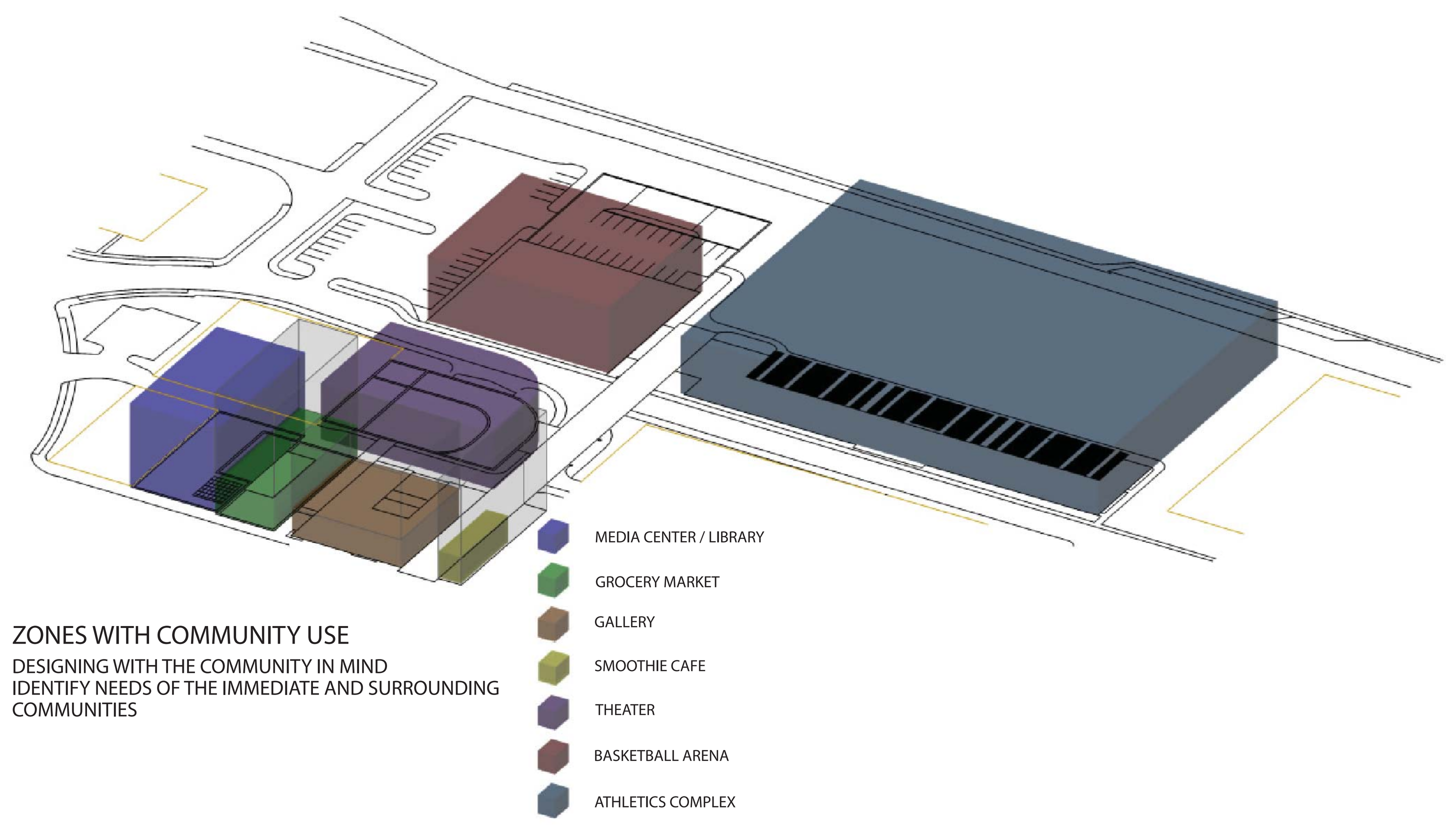
VEHICULAR CIRCULATION

SITE PLAN

PROJECT PLACED ON GAY ST. OF KNOXVILLE, TENNESSEE

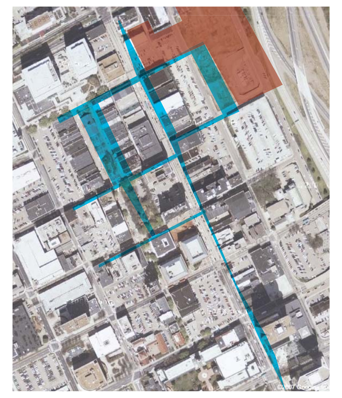
0' 32' 64' 128' 256'

COMMUNITY OUTREACH



ZONES WITH COMMUNITY USE

DESIGNING WITH THE COMMUNITY IN MIND
IDENTIFY NEEDS OF THE IMMEDIATE AND SURROUNDING COMMUNITIES



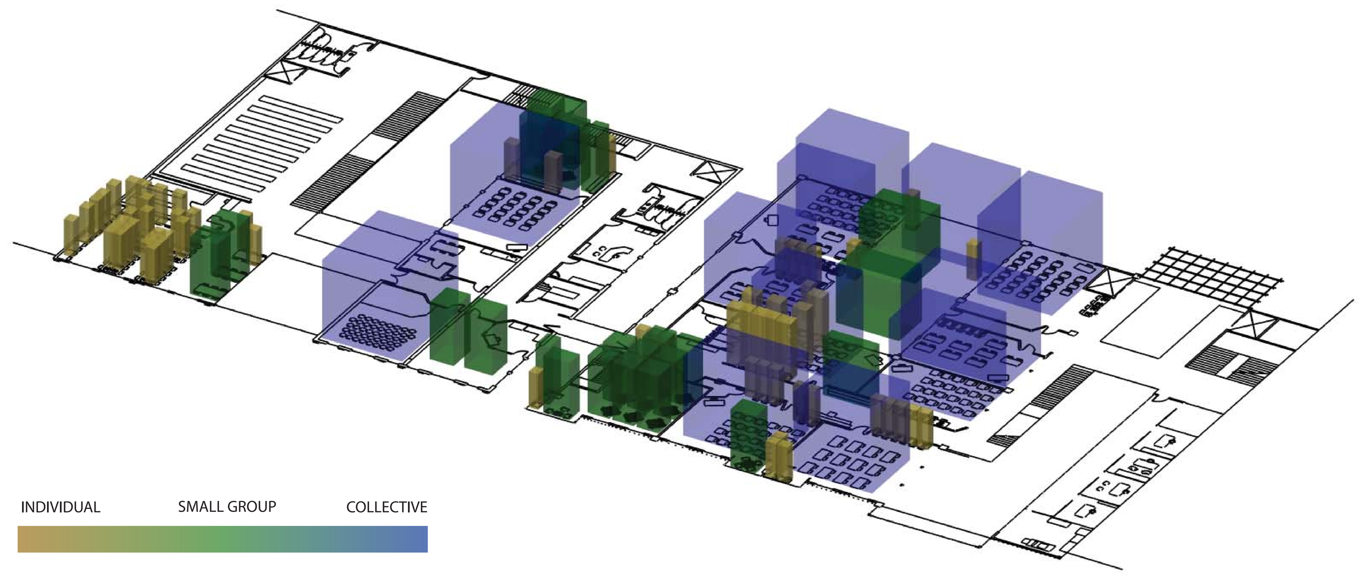
PEDESTRIAN INTENSITY

SITE PLACEMENT TAKING ADVANTAGE OF THE EXISTING PEDESTRIAN CONCENTRATION

EXISTING THEATERS

ADDING TO THE EXISTING CULTURAL FABRIC OF DOWNTOWN

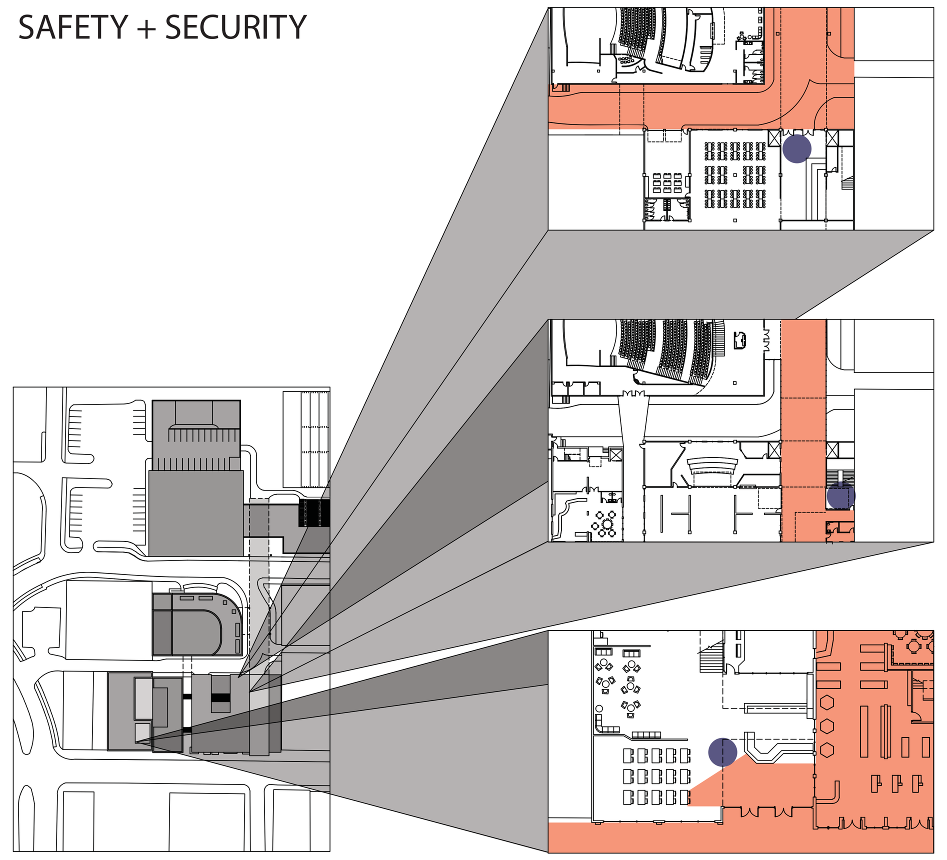
EDUCATION AT VARIOUS SCALES



RESPONDING TO EDUCATIONAL NEEDS

DESIGNING SPACES FOR THE INDIVIDUAL TO THE COLLECTIVE EDUCATIONAL PROCESS

SAFETY + SECURITY

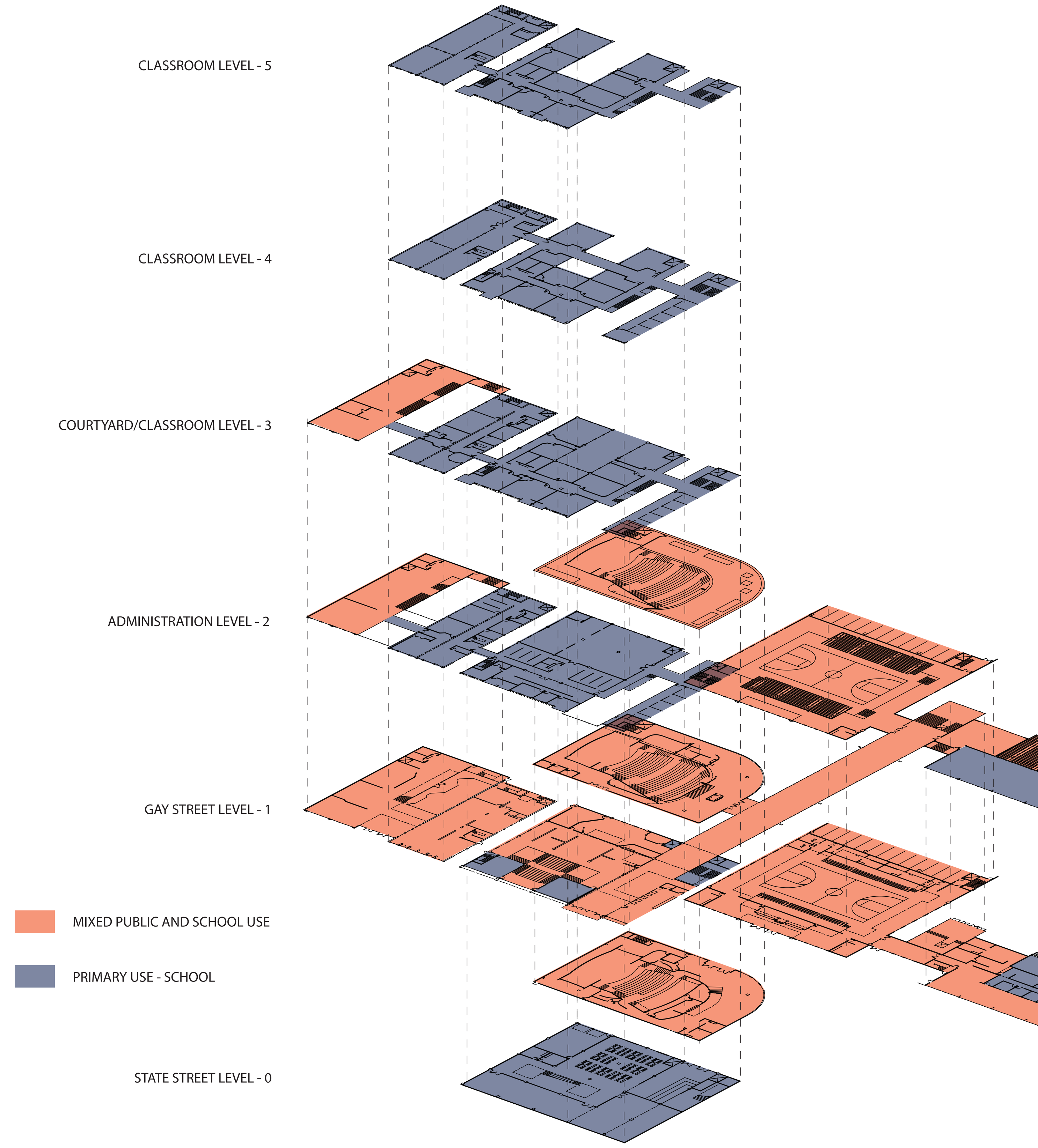


SECURITY CHECKPOINTS

LIMITED NUMBER OF ACCESS POINTS PROVIDES SECURE ENVIRONMENT WITHOUT FULL SEPARATION OF ENVIRONMENT

DESIGN AS THE HIGHEST LEVEL OF SECURITY

SCHOOL DESIGN WILL NOT MOVE BEYOND THE SEALED OFF BOXES OF THE 1970's IF EXISTING GUIDELINES ARE STRICTLY FOLLOWED WITHOUT ANY INTERPRETATION. WHILE NEW SECURITY AND SURVEILLANCE TECHNOLOGIES, CAMERAS, METAL DETECTORS, AND MAGNETIC-LOCKED DOORS, PROVIDE A HIGHER LEVEL OF PROTECTION THAN EVER BEFORE, IT IS IMPORTANT TO REMEMBER THAT THE ARCHITECT'S DESIGN HAS TEH LARGEST IMPACT ON SAFETY AND SECURITY AND SHOULD PROVIDE A SAFE, SECURE ENVIONMENT STILL AT A HIGH LEVEL OF DESIGN.

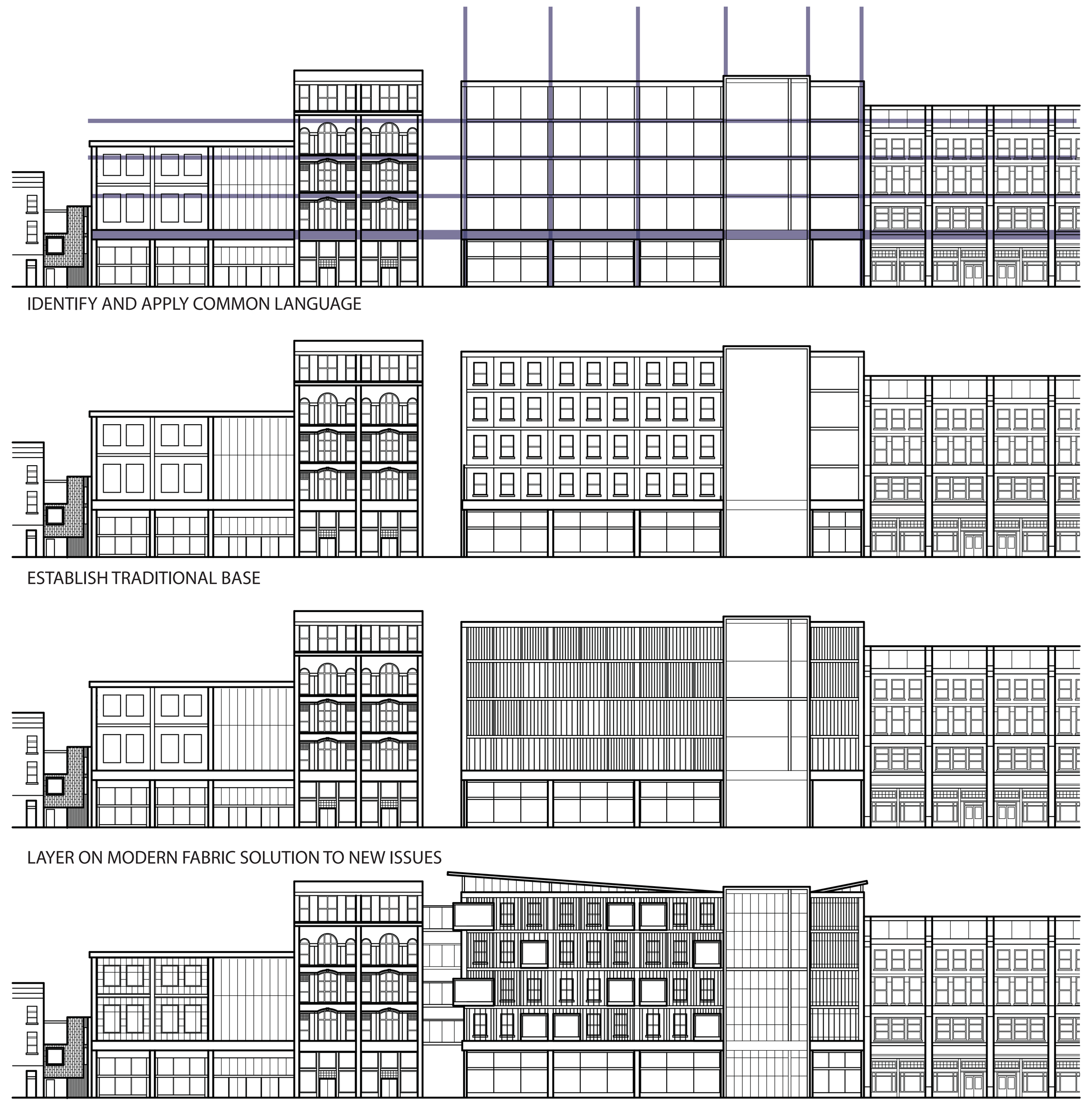


DIVISION OF SPACES

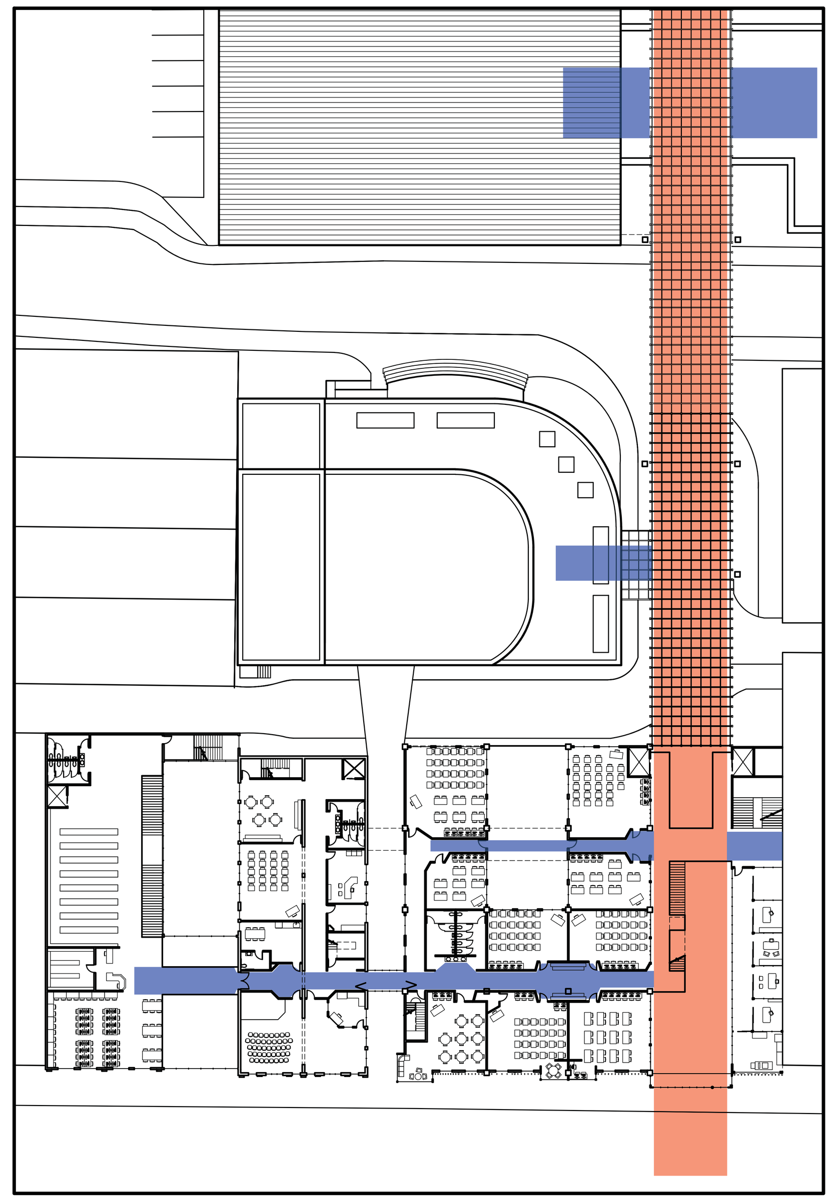
THE SCHOOL IS ZONED TO ALLOW THE PUBLIC TO VISUALLY INTERACT WITH THE STUDENTS, WHILE STILL PROVIDING PHYSICAL DISCONNECT FOR THE SAFETY AND SECURITY OF THE STUDENTS.

THEATER ELEVATION WITH REAR OF CLASSROOM BUILDING

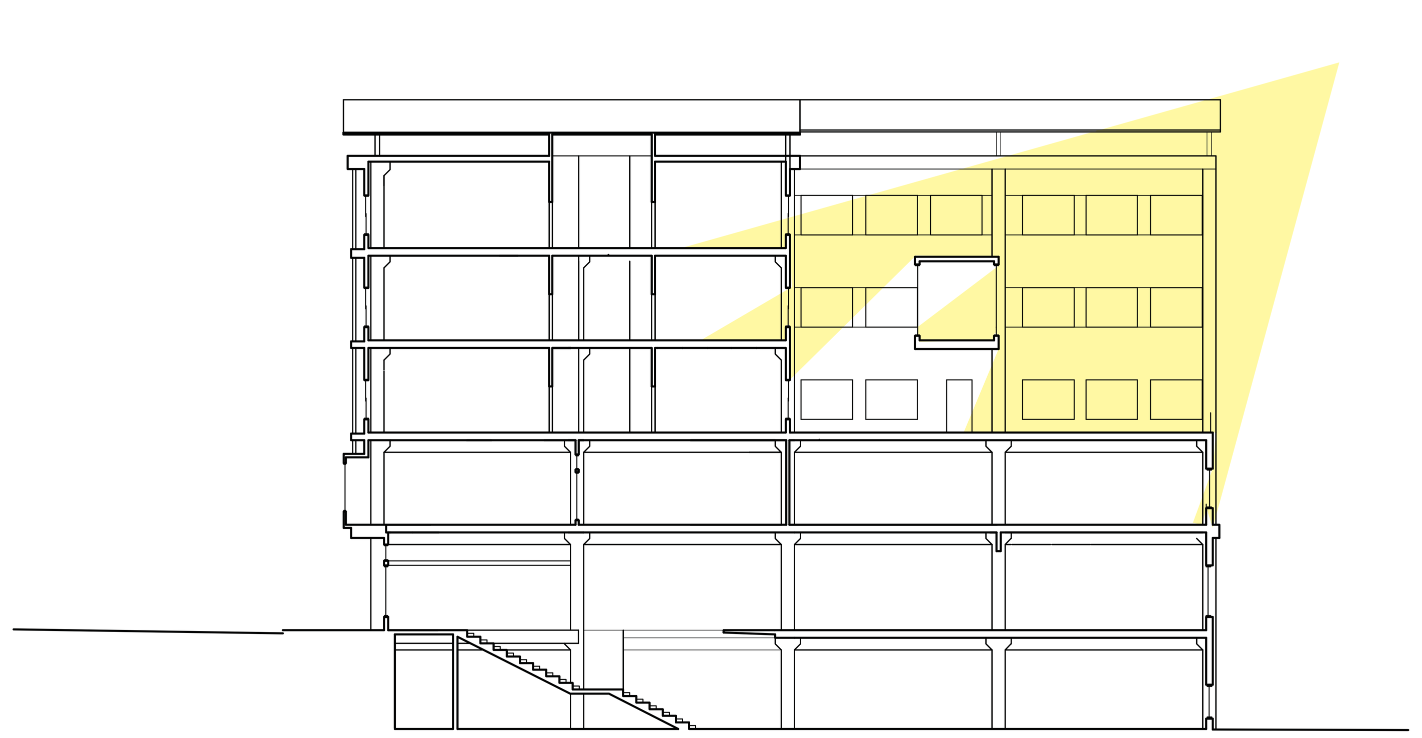
ENTRANCE LOCATED AT STATE STREET LEVEL AND THROUGH ATRIUM WALKWAY



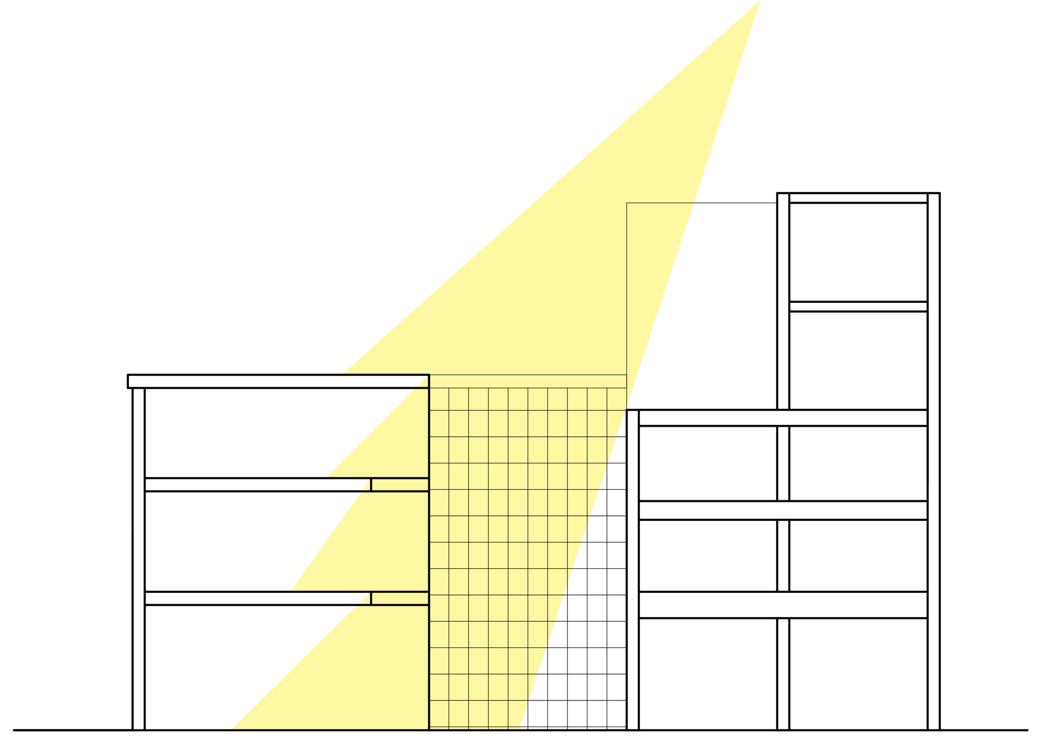
HISTORIC FACADE STUDY
SITE ADJACENT TO BUILDINGS BUILT EARLY 1900s



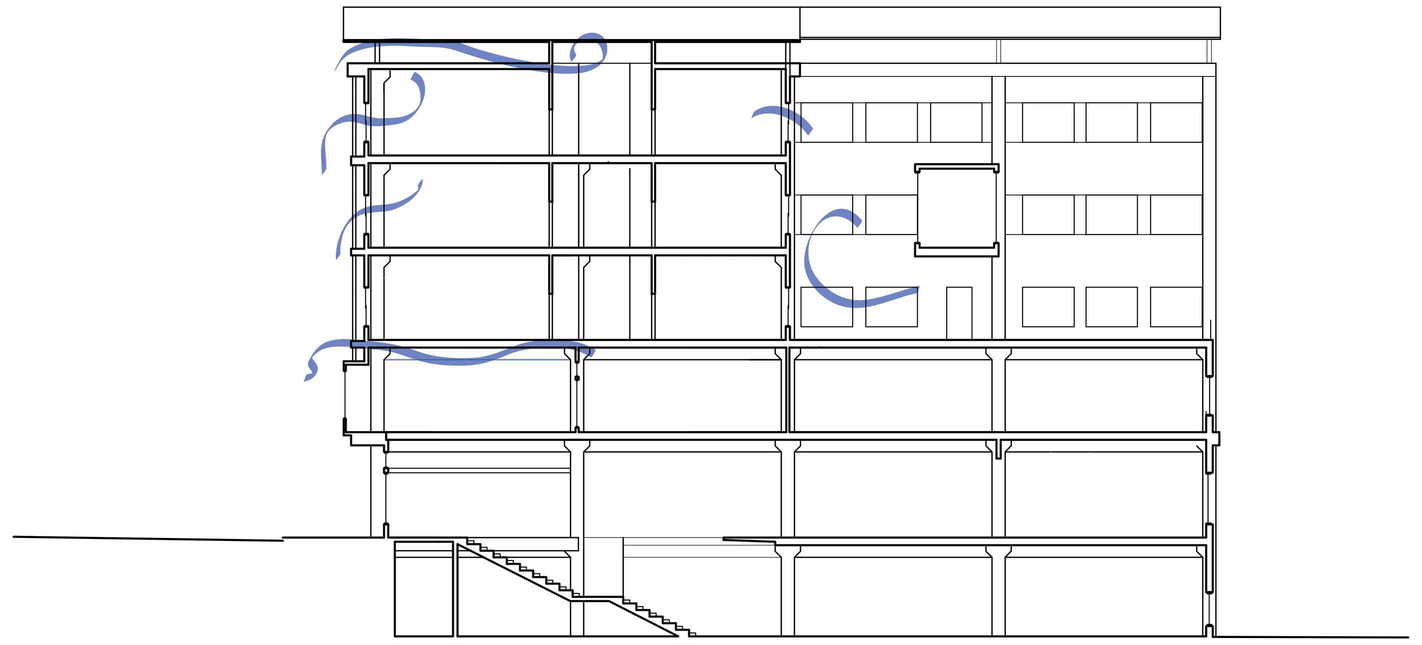
CIRCULATION SPINE
ATRIUM PROVIDES MAIN CIRCULATION WHILE SECONDARY BRANCHES OFF



COURTYARD CONFIGURATION
COURTYARD PROVIDES NATURAL LIGHT INTO DEEP BUILDING



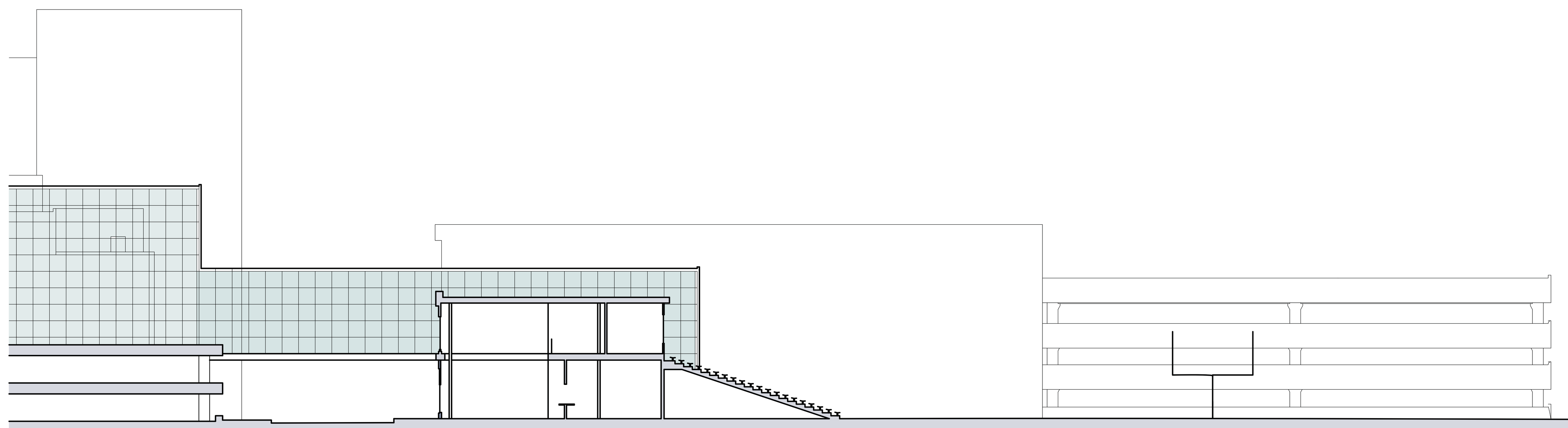
SETBACK LIGHT CANNON
ALLOW LIGHT INTO ADJACENT BUILDING
THROUGH NEW SETBACK COURTYARD



NATURAL VENTILATION
PULL FILTERED EXTERIOR AIR THROUGH A HOLLOW CORE SLAB

ATHLETICS COMPLEX ELEVATION
LOCATED ON THE EAST SIDE OF STATE STREET

0' 8' 16' 32' 64'



SECTION CC
SECTION THROUGH THE ATHLETICS COMPLEX
DISPLAYING BUIL T IN SEATING

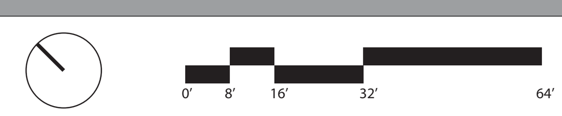
0' 8' 16' 32' 64'

SECTION BB
SECTION THROUGH THE THEATER
DISPLAYING REAR OF CLASSROOM BUILDING

SECTION AA
SECTION THROUGH THE ENTIRE CAMPUS

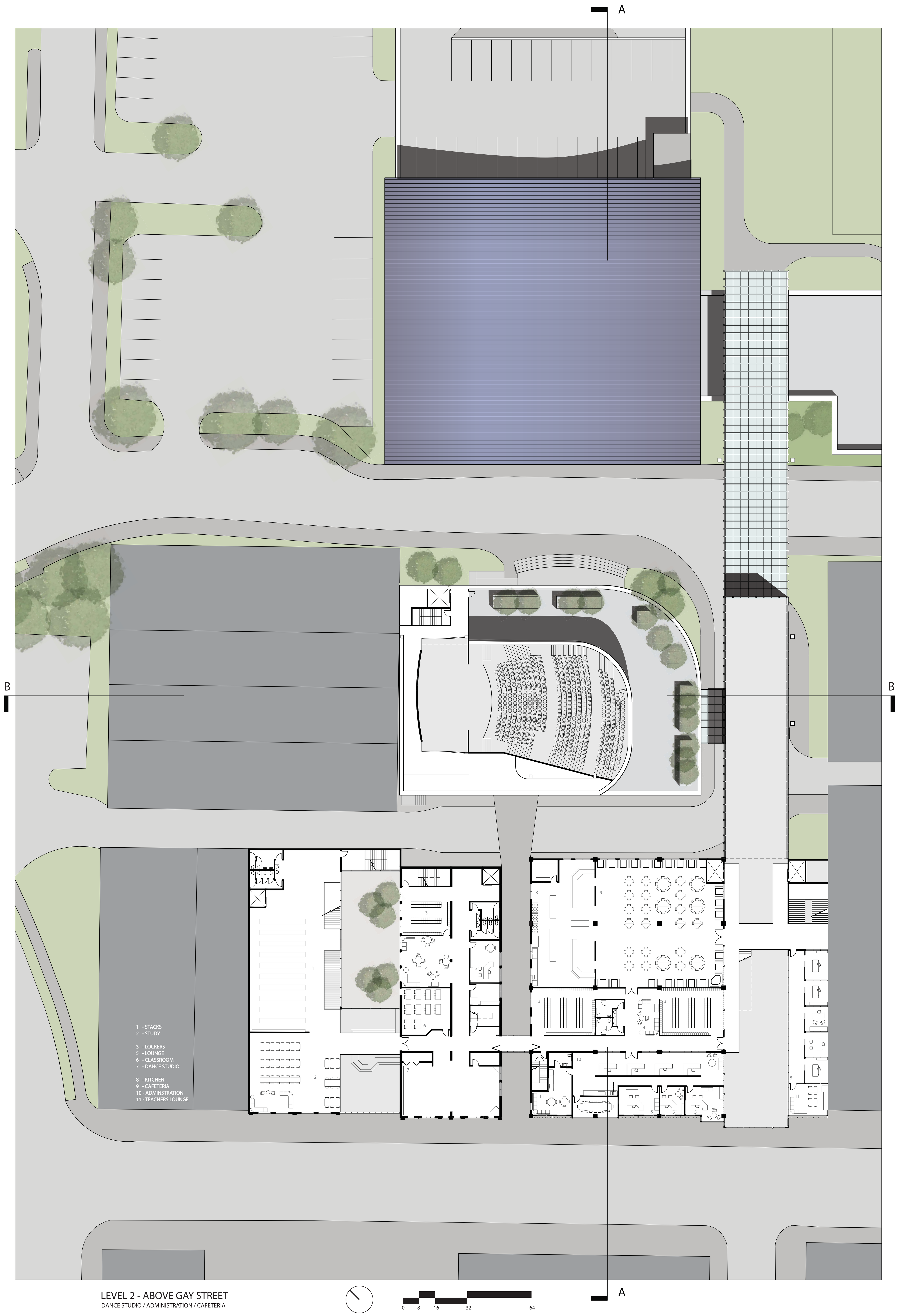
STATE STREET LEVEL

ONE LEVEL BELOW GAY STREET - THEATER / GYMNASIUM / ATHLETICS COMPLEX



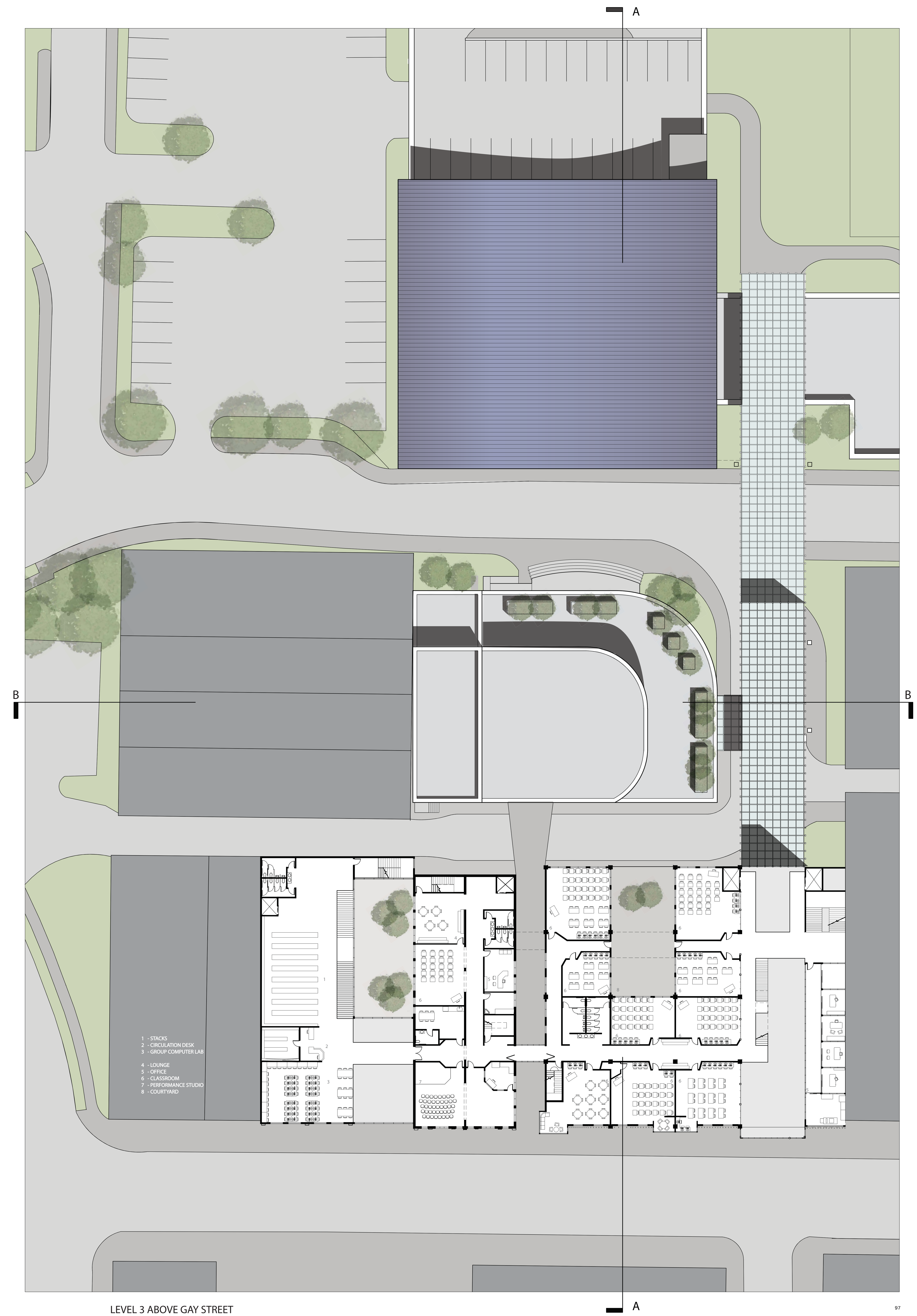
GAY STREET LEVEL

MAIN PUBLIC ACCESS TO SITE - MEDIA CENTER / GROCERY / GALLERY



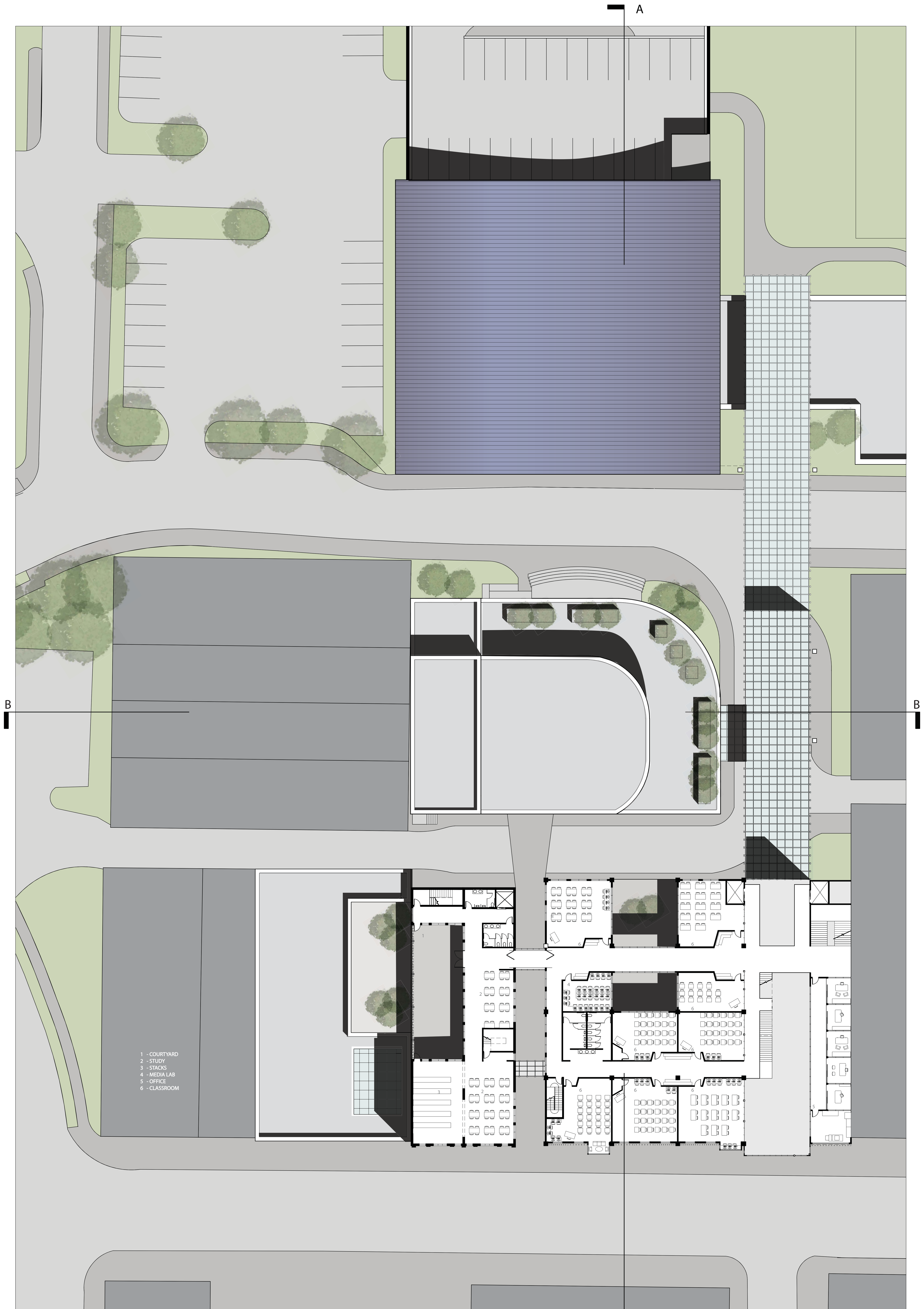
LEVEL 2 - ABOVE GAY STREET

DANCE STUDIO / ADMINISTRATION / CAFETERIA

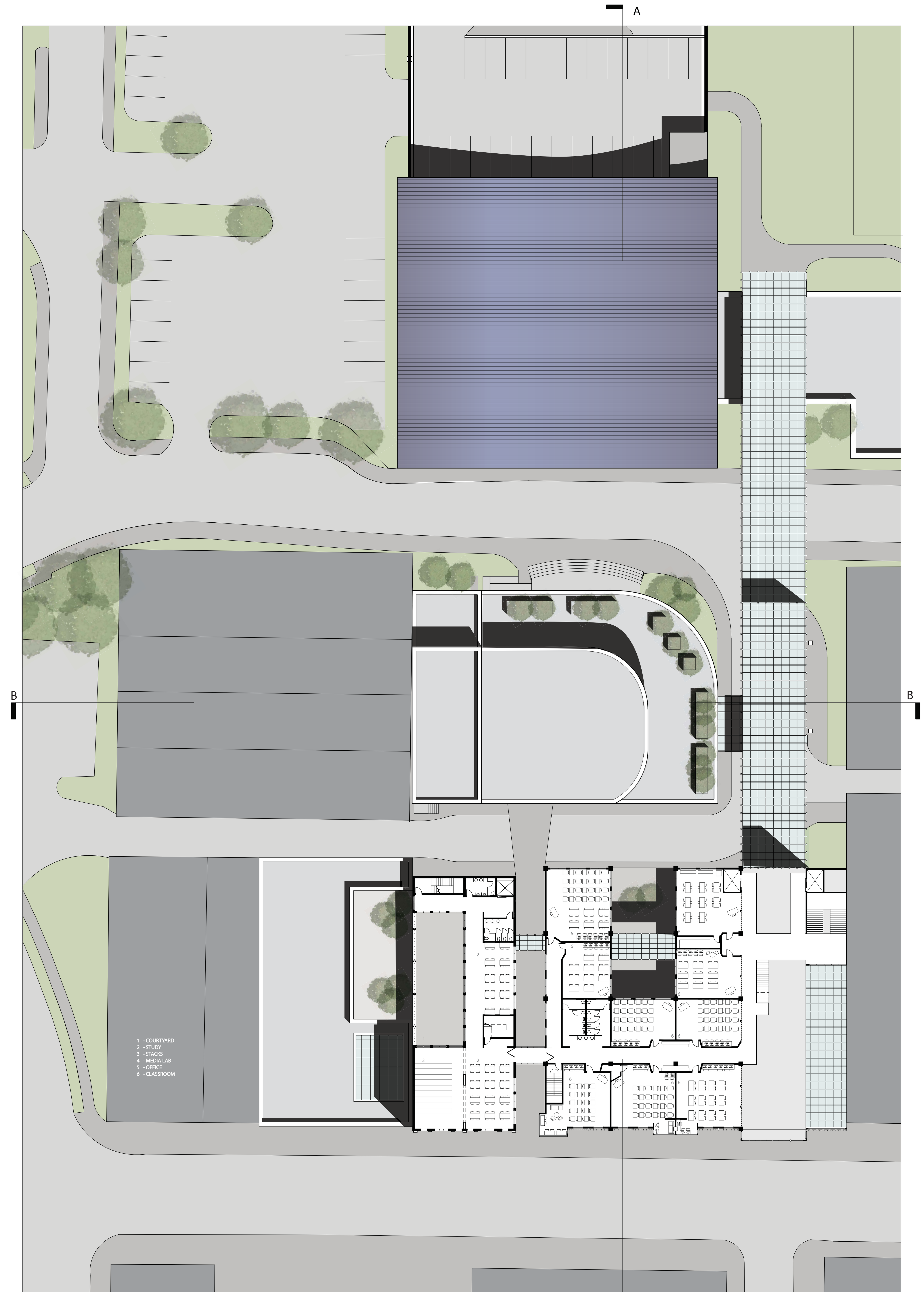


LEVEL 3 ABOVE GAY STREET

STACKS / CLASSROOMS / COURTYARD



LEVEL 4 - ABOVE GAY STREET
STUDY / CLASSROOM / BRIDGE



LEVEL 5 ABOVE GAY STREET
STACKS / CLASSROOMS

vita

Luke A. Sims was born February 7, 1983, and was raised in Beaver Dam, Kentucky for the majority of his life, until he moved at age 18 to pursue a Bachelor of Science degree in Engineering Graphics and Design from Murray State University in Murray, Kentucky. Upon graduating Cum Laude from Murray State in May of 2005, Sims immediately moved to Knoxville, Tennessee to complete his education at the University of Tennessee. While pursing both degrees Sims maintained several jobs including J. Patrick Kerr Architects and Design Innovation Architects. Sims graduated Magna Cum Laude in May of 2008 with a Master of Architecture degree. After graduation Sims moved to Greenville, South Carolina, and began his professional career with Neal-Prince Architects.