Virginia Military Institute

Engineering Laboratory Expansion and Renovation

Programming & Feasibility Study

Project No. TL-19-57-07

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EXECUTIVE SUMMARY

A feasibility study for VMI's Division of Engineering was undertaken in order to address the current and future need of the Division. With additional growth in enrollment and Science, Technology, Engineering, and Mathematics (S.T.E.M.) programs, additional space and program requirements are needed to address the growing demand of faculty and cadets. VMI's Division of Engineering is also looking to embrace multidisciplinary, project-based learning along with individual scholarship, which is the future of all engineering education, and will require space organization for success.

Virginia Military Institute is the oldest state-supported military college and the first non-private Senior Military College in the United States. VMI only enrolls uniformed members of the Corps of Cadets offering them an education well-rooted in both physicality and academics. VMI exclusively offers baccalaureate degrees for which includes 14 disciplines in engineering, the sciences, and liberal arts combined with required courses in either the Army, Naval, or Air Force ROTC programs.

As the only military college in the United States that is nationally ranked in the same category as federal military academies, VMI offers a unique educational experience. Average cadet to faculty ratio is 11:1, which allows the professors and cadets to form and develop meaningful relationships from the very beginning to beyond graduation. Faculty are heavily involved in developing the curriculum and partnering with cadets for a wide range of research. Cadets are also held to an absolute standard of integrity and trust and abide by the VMI Honor Code. In short, everything that VMI stands for can be summed up in its Latin motto of "In Pace Decus, In Bello Praesidium" which translates to "In Peace a Glorious Asset, In War a Tower of Strength."

An investment in VMI's Division of Engineering's teaching spaces will provide a "Glorious Asset" for VMI that will spur the school into the future. This investment in campus assets will not only become a "Tower of Strength" towards hosting S.T.E.M majors, one of the most in-demand areas of study, but will also provide the infrastructure to continue to grow as one of the nation's leading military and educational institutes. This lines up with VMI's Vision 2039 plan in that it "aims at improving the academic, military, and athletic programs and infrastructure of the Institute to enhance cadet leadership development and the environment in which it takes place." Such an investment will fill a necessity for new and upgraded facilities in order to help VMI remain among the nation's premier undergraduate colleges.

The study is presented as follows:

A.
To construct a state-of-the-art engineering lab building that meets and exceeds standards of peer institutions.

B.
Create flexible and adaptable lab spaces that provide infrastructural foundation and support for the Engineering Department.

C.
Allocate space for individual and team projects that are responsive to the evolving pedagogy while creating open studio makerspaces that encourage innovation and hands-on learning with updated technology and equipment.

D.
Respect VMI's historic architectural language whilst creating a modern, innovative structure that is future proof.

E.
Design new and renovated engineering spaces that can be experienced as a cohesive series of intriguing labs that will appeal to and attract future cadets and faculty by displaying VMI's mission in action.

COST AND SCOPE SUMMARY

The Benchmark Cost Model included with this study provides a breakout of renovation costs for the existing Nichols Hall and Morgan Hall. These renovation costs are further broken down into Light, Moderate, and Heavy Renovation costs by net square footage of proposed program space.

The cost for the proposed addition to Nichols Engineering Building is calculated on a cost per square foot benchmark derived from similar projects typologies recently completed by CannonDesign. There are three benchmark projects ranging from low cost per square foot to high, normalized to costs in Lexington, Virginia.

The cost to raze the Cocke Hall Annex (pool building) and the cost to renovate the east facade of King Hall following the demolition of Cocke Hall Annex are included as separate line items below the renovation + addition subtotal.

See Section IV, page 75 for a breakdown of these costs:

Construction Cost	$ 33,706,385.00 *
Total Project Budget	$ 45,712,000.00 * (w/ project allowances + alternates)
Total Project Budget	$ 48,312,000.00 * (w/ clarifications per VMI)
Alt. Project Budget	$ 51,519,272.00 * (w/ King Hall and Cocke Hall renovations)

* The Benchmark Cost Model includes project alternates and clarification costs provided by VMI. Additionally, the alternate costs to renovate the 2nd and 3rd floors of King Hall for additional engineering program space and the locker rooms in Cocke Hall for the boxing program, have been included below the line for reference.

TASK I & TASK II

The study for the renovation of VMI's Engineering Buildings and additions to accommodate new S.T.E.M. programs was broken into two tasks. Task I primarily investigated projected program space needs of the Division based on VMI's "Right Sizing" of classes, the desired educational programs to be offered, and the established net area per cadet for the programs considered based on industry standards. A comparison of the projected space needs to the existing available square footage in current facilities revealed a shortfall within VMI's current infrastructure.

Task 1 concluded in July 2019 with the submittal of the Capital Budget Request to the Commonwealth of Virginia that was included in the Governor's Budget Proposal of 2020. Subsequently, VMI initiated Task 2 of the study in September 2019. Task 2 of the Programming and Feasibility Study includes a report of requirements, recommendations, conceptual design study, and an updated program. Responding to the architectural language of the Post, the siting and concept design is woven into the existing planning fabric and maintains the historic integrity of VMI.

Task 1 of the Programming and Feasibility Study considered the potential adaptive reuse of Cocke Hall Annex (Indoor Swimming Facility) as an academic building to house the projected Engineering space shortfall. The existing facility proved to be inadequate, both structurally and toward meeting the space need requirements of the Division.

After the Task 1 analysis proved the re-use of Cocke Hall Annex unfeasible, all options going forward have included the razing of Annex to make room for new additions and/or open space behind J.M. Hall , harkening back to the garden that existed before the construction of Cocke Hall Annex. The full set of parameters influencing site selection also include consideration of the VMI Facilities Master Plan and Preservation Master Plan.

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TASK I OBJECTIVES

A.
Evaluate the structural stability of Cocke Hall Annex and the existing pool to determine whether to renovate or demolish.

B.
Evaluate the impact of moving the existing Cadet Boxing program to the Cocke Hall locker room, and the renovation of the top two floors of King Hall, as well as Cocke Hall Annex for additional Engineering program space.

C.
Evaluate the current and projected space requirements needs of the Division of Engineering to alleviate the shortage area to meet current needs including additional lab space, teaching space, support space, and storage.

D.
Evaluate additional space needs for the CIS Division

E.
Develop a preliminary budget estimate based upon the findings

TASK II OBJECTIVES

A.
Analyze site options in addition to the Cocke Hall Annex site documented in Task I of this Study.

B.
Develop planning documents, massing models, and building elevations for the approved site.

C.
Confirm and revise as necessary the Task I programming to address the quantity and quality of space necessary to meet current and projected needs for lab space, teaching space, support space, and storage

D.
Develop an updated concept design cost estimate based upon the approved site and planning.

In Pace Decus, In Bello Praesidium

PROGRAMMING II.

INTRODUCTION

Since the 2006 renovation of Nichols and Morgan Halls, the Corps of Cadets enrollment has grown from 1,350 to 1,750, while enrollment in S.T.E.M majors has grown from 39% to 59%. As a result, additional class, lab and support space is required to meet the growing demand for academic space and to meet engineering program requirements. VMI's Division of Engineering is also looking to embrace multidisciplinary, project-based learning along with individual scholarship, which is the future of all engineering education, and will require space organization for success.

This Planning & Feasibility Study was developed via two Tasks as detailed on the following pages:

Task One included an evaluation of the existing and projected space needs of the Division of Engineering, an evaluation of the existing and available facilities to accommodate these needs, development of a program, and the development of a preliminary benchmark cost estimate.

Task Two included a report on planning requirements and recommendations, conceptual design studies, and an updated program and conceptual design cost estimate. The siting and concept design respond to the architectural language of the Post, is woven into the existing planning fabric, and maintains its historic integrity.

This Programming and Feasibility Study is the summation of CannonDesign and Thompson & Litton's observations developed through user interviews, site visits, and plan analysis of the existing condition of VMI's Division of Engineering. The information provided is sourced from VMI, public record, and the design team's professional expertise. Recommendations provided by the design team are expected to be further developed with input and approval of VMI stakeholders during the future design phases of the project.

This Programming and Feasibility Study for Virginia Military Institute's Division of Engineering was developed over the course of nine months beginning in the spring of 2019. Inclusive of site analysis exercises, program development meetings, and concept design iterations, the design team engaged with representations from VMI Division of Engineering, Dean's Office, Institutional Planning Office, Facilities, and VMI Museum to develop an Engineering Building Concept Design that would serve as an integral part of VMI's pedagogy and future growth. The scope of the study includes the evaluation of Nichols Engineering Building, Morgan Hall, King Hall, Cocke Hall Annex (Indoor Swimming Facility), and surrounding sites.

The Project Team includes

- Virginia Military Institute
- CannonDesign
    - Architecture
- Thompson & Litton
    - Civil Engineering
    - Mechanical Engineering
    - Structural Engineering
    - Electrical Engineering

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DIVISION DESCRIPTION

The following is a summary of CannonDesign and Thompson & Litton's observations developed through user interviews, site visits, and planning analysis of the existing condition of VMI's Division of Engineering. The information provided is sourced from VMI, public record, and the design team's professional expertise. Recommendations provided by the design team were further verified with the approval of the stakeholders.

The current Division of Engineering is home to three different departments:

1) Mechanical

2) Civil and Environmental

3) Electrical and Computer Engineering.

The Division embraces a "learning by doing" attitude that largely includes a project-based curriculum. VMI pushes to build a holistic person, shown through making detailed projects and prototyping ideas, leading cadets to learn by trial and error. Connections between faculty and cadets within the Division are valued and revered. Within the buildings that the Department of Engineering occupies, there is a vibrant, bustling environment of creativity, but there is not enough room for the cadet projects to flourish. The outdated facilities do not encourage the active learning environment that the faculty need to support the desired pedagogy.

The design team conducted user interviews with key stakeholders including heads of Electrical and Computer Engineering, Mechanical Engineering, and Civil and Environmental Engineering. The following is a summary of the user interviews with these key stakeholders.

INDIVIDUAL DIVISION NEEDS

MECHANICAL ENGINEERING

Mechanical Engineering (ME) currently has 170 cadets enrolled to meet the ideal cap with minor fluctuation. Project-Based education is strongly enforced as a learning initiative by the Division. ME highly utilizes the machine and wood shop which can easily become over-capacitated due to limited storage and large enrollment. In the recent readjustment of space, ME vacated the existing Big B.E.A.M and Small B.E.A.M Lab in Nichols Hall to Civil and Environmental Engineering (CE) in exchange for additional laboratory space on the first level of King Hall. Even with the newly renovated labs there's still a high demand for additional classrooms, makerspace, and storage. The enrollment is consistently higher than projections, causing more stress on the already overcrowded conditions.

CIVIL AND ENVIRONMENTAL ENGINEERING

Civil and Environmental Engineering (CE) currently has the largest enrollment with 200 cadets. In the past, it has risen to as high as 260 cadets. CE currently has a large emphasis on hands-on laboratory teaching including the following open labs: Soils, Concrete, Fluids, Big B.E.A.M, and Environmental labs. Fluids Lab hosts five sections of introductory engineering courses whilst being partially occupied by the Autonomous Vehicle project. There's a strong demand for additional classrooms, faculty offices, and improvements on existing laboratory spaces.

ELECTRICAL AND COMPUTER ENGINEERING

Electrical and Computer Engineering (EE) currently enrolls around 90 cadets, which has doubled since 2000. EE currently occupies most of Nichols Hall Level 500, but faculty offices are scattered throughout the building, this has resulted in a loss of department identity. Though EE has ownership of hybrid classrooms for both lecture and laboratory functions, the rooms are poorly shaped which results in a limitation in class capacity. EE's Capstone Room (405) is one of the few examples, aside from the open cadet study area, that is specifically designated for Cadet Project space.

Right Sizing Numbers

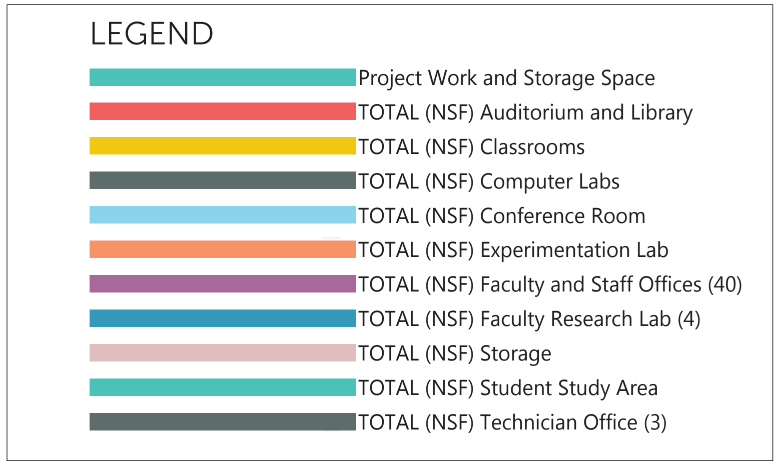
The descriptions above are accounts from interviews with each of the engineering divisions. Per the quest by VMI, the projection for future space need will be based on the "Right Sizing Numbers" of 460 Cadets provided by VMI.

EXISTING PROGRAM SPACE LIST

The following program space list represents the current spaces within Nichols Engineering Building and Morgan Hall that the current Department of Engineering occupies.

VMI				
Existing Space				
Rm. No.	Rm. Name (Existing)	Department (Existing)	Space Type	Total NSF
106	Soil Mechanics 1 & 2	CIVIL ENGINEERING	LAB	1126
108	Concrete Lab	CIVIL ENGINEERING	LAB	904
204	Big BEAM Lab	CIVIL ENGINEERING	LAB	1129
205	Small BEAM Lab	CIVIL ENGINEERING	LAB	248
210	Energy/Dynamic Systems Lab	MECHANICAL ENGINEERING	LAB	1109
211	Engine Testing Room	MECHANICAL ENGINEERING	LAB	150
215	Materials Testing Lab	SHARED	LAB	1664
217	Environmental Eng. Lab	CIVIL ENGINEERING	LAB	1163
218	Chemical Storage	CIVIL ENGINEERING	STORAGE	258
220	Fluid Lab	CIVIL ENGINEERING	LAB	1197
303	Drafting Lab	MECHANICAL ENGINEERING	LAB	979
304	Training/ Post Computer Lab	MECHANICAL ENGINEERING	COMPUTER LAB	461
317	Tool Storage	SHARED	STORAGE	438
318	Metals Shop	SHARED	LAB	1068
321	Woodshop	SHARED	LAB	1399
322	Manufacturing/Machine Design	MECHANICAL ENGINEERING	LAB	779
323	Faculty Office	CIVIL ENGINEERING	OFFICE	137
325	Faculty Office	CIVIL ENGINEERING	OFFICE	140
352	Design Lab	MECHANICAL ENGINEERING	COMPUTER LAB	670
356	Instrumentation Lab/Blandino Lab	MECHANICAL ENGINEERING	LAB	1586
357	9	MECHANICAL ENGINEERING	STORAGE	205
358	Design Lab Equipment	MECHANICAL ENGINEERING	COMPUTER LAB	208
402	Surveying Storage	CIVIL ENGINEERING	STORAGE	227
403	Surveying Lab	ELECTRICAL ENGINEERING	EE LAB	468
404	Digital Design/ Micro Controller	ELECTRICAL ENGINEERING	EE LAB	1036
405	Electornic Repair shop	ELECTRICAL ENGINEERING	EE LAB	465
406	Electronic Maintenance	ELECTRICAL ENGINEERING	OFFICE	464
407	Capstone Project	ELECTRICAL ENGINEERING	STUDENT PROJECT S	686
408	Computational Fluid Dynamic Lab	MECHANICAL ENGINEERING	LAB	293
410	Faculty Research	CIVIL ENGINEERING	OFFICE	218
413	Storage	ELECTRICAL ENGINEERING	STORAGE	160
415	Micro-Electronics	ELECTRICAL ENGINEERING	EE LAB	496
418	Semi-Conductor Lab	ELECTRICAL ENGINEERING	EE LAB	485
419	Classroom	SHARED	CLASSROOM	588
420	Classroom	SHARED	CLASSROOM	586
421	Classroom	SHARED	CLASSROOM	554
426	Electornics/ Circuit Lab	ELECTRICAL ENGINEERING	CLASSROOM	802
427	Comm/ Controls Lab	ELECTRICAL ENGINEERING	CLASSROOM	812
428	Digital Signal Processing Lab	ELECTRICAL ENGINEERING	CLASSROOM	791
429	Geology Lab	CIVIL ENGINEERING	LAB	770
430	Geology Storage	CIVIL ENGINEERING	STORAGE	503
434	Classroom	SHARED	CLASSROOM	531
438	Classroom	SHARED	CLASSROOM	554
439	Classroom	SHARED	CLASSROOM	552
440	EE Student Study Space	ELECTRICAL ENGINEERING	STUDY AREA	473
441	Classroom	SHARED	CLASSROOM	526
445	Equipment	CIVIL ENGINEERING	STORAGE	448
501	Library/ Meeting	SHARED	LIBRARY/AUDITORIU	852
502	Faculty Office	ELECTRICAL ENGINEERING	OFFICE	142
507	Department Chair/ Conference Rm	ELECTRICAL ENGINEERING	OFFICE	273
508	Secretary/ Receoption	ELECTRICAL ENGINEERING	OFFICE SUPPORT	243
509	Faculty Office	ELECTRICAL ENGINEERING	OFFICE	175
510	Conference Room	ELECTRICAL ENGINEERING	CONFERENCE	240
511	Faculty Office	CIVIL ENGINEERING	OFFICE	122
513	Storage	SHARED	STORAGE	110
514	Auditorium	SHARED	LIBRARY/AUDITORIU	1662
518	EE Cadet Research Room	ELECTRICAL ENGINEERING	STUDENT PROJECT S	113
525	Workroom	ELECTRICAL ENGINEERING	OFFICE	102
601	CAD Lab	CIVIL ENGINEERING	COMPUTER LAB	882
602	Faculty Office	CIVIL ENGINEERING	OFFICE	161
603	Faculty Office	CIVIL ENGINEERING	OFFICE	123
605	Faculty Office	ELECTRICAL ENGINEERING	OFFICE	215
608	Conference Room	CIVIL ENGINEERING	OFFICE	273
609	Secretary/ Reception	CIVIL ENGINEERING	OFFICE SUPPORT	243
610	Faculty Office	CIVIL ENGINEERING	OFFICE	102
613	Workroom	CIVIL ENGINEERING	OFFICE	175
616	Cadet Study Area	CIVIL ENGINEERING	STUDY AREA	709
617	Conference Room	CIVIL ENGINEERING	CONFERENCE	261
618	Faculty Office	SHARED	OFFICE	183
619	Faculty Office	CIVIL ENGINEERING	OFFICE	141
620	Faculty Office	ELECTRICAL ENGINEERING	OFFICE	141
621	Faculty Office	CIVIL ENGINEERING	OFFICE	143
622	Faculty Office	CIVIL ENGINEERING	OFFICE	141
623	Faculty Office	CIVIL ENGINEERING	OFFICE	181
701	CAD Lab	MECHANICAL ENGINEERING	COMPUTER LAB	882
702	Faculty Office	MECHANICAL ENGINEERING	OFFICE	161
703	Faculty Office	MECHANICAL ENGINEERING	OFFICE	123
705	Faculty Office	MECHANICAL ENGINEERING	OFFICE	215
708	Conference Room	MECHANICAL ENGINEERING	OFFICE	273
709	Secretary/ Reception	MECHANICAL ENGINEERING	OFFICE SUPPORT	243
710	Faculty Office	MECHANICAL ENGINEERING	OFFICE	102
711	Workroom	MECHANICAL ENGINEERING	OFFICE	175
714	Cadet Study Area	MECHANICAL ENGINEERING	STUDY AREA	709
715	Conference Room	MECHANICAL ENGINEERING	CONFERENCE	261
716	Faculty Office	SHARED	OFFICE	183
717	Faculty Office	MECHANICAL ENGINEERING	OFFICE	141
718	Faculty Office	MECHANICAL ENGINEERING	OFFICE	141
719	Faculty Office	MECHANICAL ENGINEERING	OFFICE	143
720	Faculty Office	ELECTRICAL ENGINEERING	OFFICE	141
721	Faculty Office	MECHANICAL ENGINEERING	OFFICE	181

SPACE BREAKDOWN 2006 VS. 2019



SPACE TYPES

After our site visit and analysis of the current building condition, the design team has designated the different spatial needs in the following categories:

- Auditorium and Library 2514 SF
- Classrooms 5632 SF
- Computer Labs 4910 SF
- Conference Room 3276 SF
- Experimentation Labs 16796 SF
- Faculty and Staff Offices 5778 SF
- Faculty Research Labs 3862 SF
- Storage 1898 SF
- Student Study Area 1891 SF
- Technician Office 887 SF

Note: Faculty teaching and research labs include cadet participation.

The following graph demonstrates the change in space type square footage with VMI's Division of Engineering from 2006 to 2019. The graph demonstrates little to no growth in square footage in contrast to the growth of Cadet Enrollment from the previous page.

GROWTH AND ENROLLMENT DATA

Over the years VMI has witnessed a significant growth in enrollment. The Corps has now risen to 1685 Cadets from the 1377 Cadets 14 years ago. Popularity in S.T.E.M programs has increased from 39% in 2006 to 59% in 2019. Though Nichols Hall was last renovated in 2006, the growth in Cadet enrollment has put a severe strain on the teaching environment and capacity of the building. This establishes a need for additional classrooms, computer labs, class laboratories, cadet study areas, Capstone projects area, and project storage. Furthermore, VMI's teaching style of hands-on learning and cross-disciplinary teaching has resulted in a need for additional space requirement to accommodate undergraduate and faculty research projects, such as the Autonomous Vehicle Project, as well as competitions including Steel Bridge and Concrete Canoe.

The following chart demonstrated the growth in cadet enrollment versus space from 2006 to 2019.

Categories	2006	2019	Percent change from 2006-2019
Enrollment VMI	1,377	1,685	+22.3%
Enrollment Engineering	393	442	+12.4%
Engineering SF	43,078 SF	44,930 SF	+4%

SPACE BREAKDOWN PER FTE

SPACE TYPE	393 FTE 2006 DEPT. NSF	SF/PERSON	442 FTE 2019 DEPT. NSF	SF/PERSON	460 FTE (RIGHT SIZING NUMBER) 2019 DEPT. NSF	SF/PERSON
CLASSROOMS	5,632 SF	14.3	5,632 SF	12.7	8,050 SF	17.5
COMPUTER LABS	6,302 SF	16	4,910 SF	11.1	5,750 SF	12.5
EXPERIMENTATION LABS	15,531 SF	39.5	16,796 SF	38	16,800 SF	36.5
FACULTY TEACHING & RESEARCH LABS (5 Faculty)	0 SF	-	3,862 SF	-	5,000 SF	1000*[1]
FACULTY AND STAFF OFFICES	6,257 SF	-	5,778 SF	-	6,250 SF	125*[2]
CONFERENCE ROOMS	718 SF	-	718 SF	-	1,250 SF	25*[2]
LIBRARY AND AUDITORIUM	2,514 SF	-	2,514 SF	-	4,600 SF	10
TECHNICIAN OFFICE AND STORAGE (3 Technicians)	1,177 SF	-	887 SF	-	2,400 SF	800*[3]
CADET STUDY AREA	1,418 SF	3.6	1,891 SF	4.3	2,875 SF	6.25
GENERAL EQUIPMENT STORAGE	3,529 SF	-	1,898 SF	-	1,840 SF	4
PROJECT AND PROJECT STORAGE	0 SF	-	0 SF	-	3,680SF	8
TOTAL NSF	43,078 NSF	-	44,930 NSF	-	58,495 NSF	-

The following charts demonstrates the square footage of different Space Types over Full Time Equivalent (FTE) and the breakdown of square footage per person for year 2006 and 2019. The 460 FTE is the Right Sizing Number provided by VMI based on the enrollment cap. The square footage per person is based on industry standards and state guidelines.

Note

1. "Faculty Teaching & Research Labs" is calculated based on 5 faculty members with individual labs for undergraduate research and teaching.

2. "Faculty and Staff Offices" and "Conference Room" data are calculated based on 50 faculty and staff members.

3. "Technican Office and Storage" is caculated based on 3 technician staff currently hired by the individual Divisions of Engineering.

SITE SURVEY

The current condition of Nichols Engineering Building, Morgan Hall, and King Hall were analyzed over several site visits and evaluations, The design team found the following concerns that are apparent throughout the Division of Engineering:

Lack of space for studying & projects

The Division of Engineering practices a more traditional approach to teaching that requires faculty to conduct research which often engages cadets. This is culminated in a Capstone project which is a requirement for cadets to graduate. The hands-on approach toward teaching is limited by the shortage of space reserved for individual and team research project space. Additionally, cadets are encouraged not to study in the barracks and are resorting to using empty classrooms after hours to study. Cadets often occupy computer labs while class is in session as it is the only place to study with available computers and the software they require for their studies.

Poorly sized Classrooms and Labs

Current classrooms are not ideal nor on par with industry design standards. Safety and accessibility within the classrooms and laboratory are significant concerns within the small classrooms and labs provided. While individual classrooms may be within the ideal square footage per cadet according to industry standards, classrooms such as Room 426-428 are not equipped for more than 12 -16 cadets. Better-sized classrooms and laboratories can increase classroom capacity thus increasing utilization and efficiency of space. Due to lack of classroom space, classes are often held in the library and auditorium, reducing the availability of these shared resources.

Lack of Faculty Space

There's a general demand for faculty offices and space echoed throughout all of the disciplines in VMI's Division of Engineering. Furthermore, faculty members are sharing offices that are scattered throughout the different levels of Nichols Hall, which diminishes the identity of each discipline. If the Division decides to hire additional faculty members due to the increase in enrollment, it will exacerbate the existing shortage.

General Life Safety Concerns

There is a general health and safety concern with overcrowding in laboratories, classrooms, and shops. Storage under the staircase is a violation of fire safety regulations and can cause other issues as well.

Need for General and Project Storage

There was a common concern for additional storage echoed through the user interviews. The Division has taken different measures to try to counter the lack of storage including but not limited to using faculty offices and partitioning existing laboratories for storage. Currently the Division owns off-site storage for equipment and supplies that requires additional transportation to be moved on Post for teaching. Additional on-site storage will potentially alleviate this issue.

Inadequate Mechanical Systems

An inadequate ventilation and HVAC system has resulted in rust in the equipment of the Metal shop. The foundry is in dire need of adequate ventilation as well and complaints about fumes is prevalent within the Division. Interior environmental conditions are exacerbated by the aging conditions of exterior walls and windows resulting in extreme temperature changes in certain rooms. In Room 429, HVAC noise levels have reached as high as 65 decibels which disrupts teaching and the function of the room. Additional cleaning and disposal systems may be required for specific labs.

Infrastructure

Infrastructure of Nichols and Morgan Hall is dated and over-capacitated. The exterior wall of Nichols has performance issues, including water leakage around the retaining walls and lack of thermal control around doors and windows. The leaks have penetrated into several rooms within the building causing potential mold growth. There is also a diesel fueled engine that is currently exhausted through the exterior wall for which an air entrainment study is suggested to ensure that fumes are not conflicting with any fresh air intake systems surrounding the exhaust system. These problems, if they persist, can cause a number of issues ranging from the health of the building's occupants to the health and structural functionality of Nichols Hall.

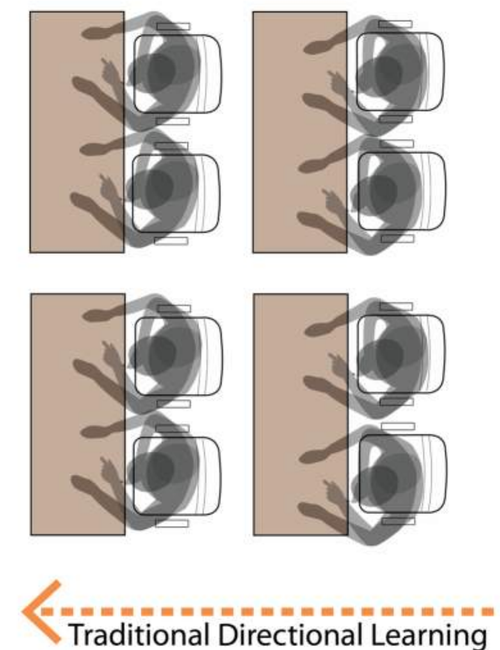
INDUSTRY STANDARDS

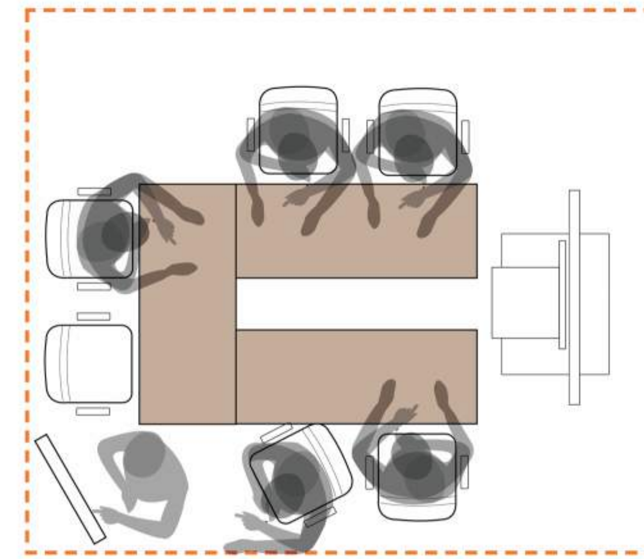
INDUSTRY STANDARDS

Using industry standards and benchmarking from similar projects, the square footage per seat for different space types was used to measure the approximate space need for the number of cadets and faculty in the Division of Engineering. These standards are based of the Virginia Department of General Services: Construction & Professional Services Manual Standard (CPSM), as well as best practices for the industry per the design team's professional expertise. Utilizing the standard guideline of square footage per person, the design team produced a basic estimation of the need of VMI's Division of Engineering given the "Right Sizing" enrollment count.

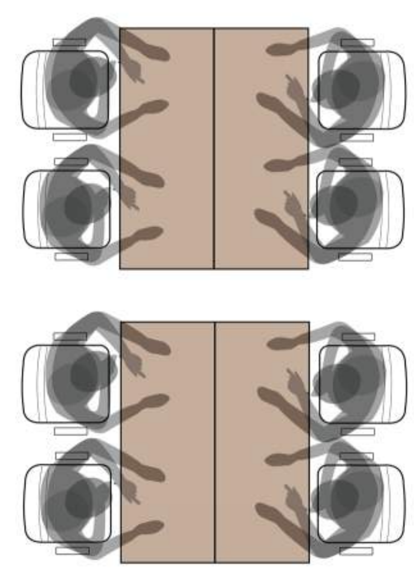
ACTIVE LEARNING

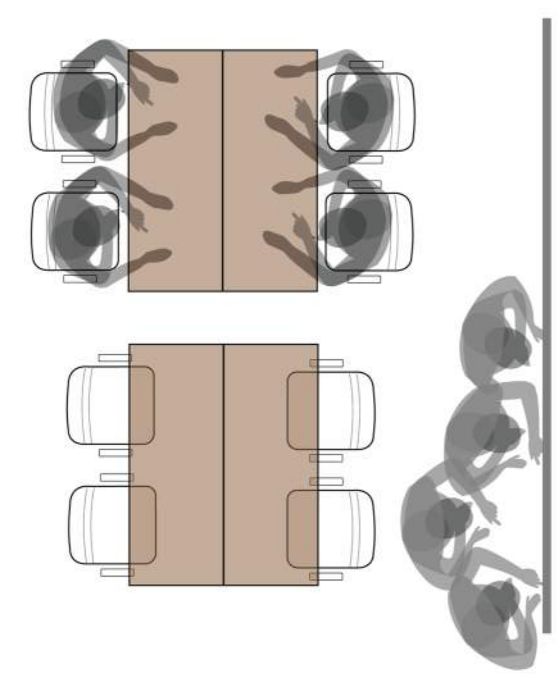
To support the pedagogy that is being encouraged within the VMI classrooms, collaboration and active learning need to be facilitated. This includes traditional directional learning with a professor at the front of the classroom, but also encourages students and teacher to shift and work easily in groups at their desks, with the aid of chalk boards and modern technology. Active learning in S.T.E.M. environment is trending within higher education as student and faculty seek out universities that support and encourage this type of learning. The current square footage per seat within a classroom does not support this type of learning and makes group work and active learning difficult. By increasing the general classroom size, it would allow for more flexibility and adaptability in different styles of learning.





Active Learning Classroom Configuration 1





OTHER CONSIDERATIONS

Aside from the space analysis of the Division of Engineering, additional factors are taken into consideration for the recommendation for this report. They include the following:

VMI Boxing Program

After reviewing the existing drawings of Cocke Hall, site visit and user interview, the design team believes that it is viable to move the existing VMI Boxing program to the 300 Level of Cocke Hall if driven by the need for more classroom area. This move would allow for an additional 5000 Sq. Ft. of space in Level 200 and Level 300 of King Hall for the Division of Engineering. Task 1 proposed the occupation of the upper two floors of King Hall after the VMI's Boxing Program vacates the space. However, through multiple discussions and site analysis, the placement of the Boxing Program is to be determined at a later date, outside of the scope of this study.

Cocke Hall Annex

The Structural Engineers from the design team conducted a site visit to evaluated the current structural condition of the Cocke Hall Annex. See attachment Appendix A for a complete structural report. The design team concludes that the existing facility cannot support a mezzanine without additional structure. Additional structure would entail extensive excavations and other significant site impacts.

One of the goals of Task 1 was to evaluate the feasibility of existing Cocke Hall Annex as a possibility for renovation. As described in the Structural Report, the renovation of Cocke Hall Annex would only yield about 7,000 NSF of additional area because the existing building would not support a new mezzanine without extensive structural upgrades that would seem cost prohibitive. Note that this approach does not account for the structural integrity of the existing roof which is prone to have rusted given the state of other metals within the pool area. This roof structure likely needs to be replaced. Furthermore, this renovation would not alleviate the Division of Engineering's space shortage. Thus, the design team propose to demolish the existing Cocke Hall Annex and construct a new Addition to Morgan Hall to accommodate the growing need of the Division. This new building can be designed to maximize efficiency as it will include the flexibility, adaptability, and infrastructural support expected in a state-of-the-art engineering lab building that can meet and exceed the pedagogical goals of VMI.

Existing Space in Nichols Engineering Building, Morgan and King Hall

To keep pace with peer institutions and maintain its academic rigor, VMI's Division of Engineering needs sufficiently organized and efficiently designed space to embrace the cross-disciplinary, project-based learning along with VMI's focus on individual and holistic scholarship. The Division of Engineering currently occupies 44,930 net square feet of programmed space including classrooms, teaching labs, conference space, research labs, offices and program support space. This space is not always efficiently used because the demand for space exceed the area available, and the conditions, the shape, and sizes of these existing spaces are not ideal for the lab functions taking place within.

Based on an analysis of the quantity and quality of the existing program space in Nichols Hall, Morgan Hall, and the first floor of King Hall, alignment of these spaces with best practices in the industry, as well as the projected academic needs of VMI, the design team projects that Division of Engineering requires an additional 23,000 net square feet of program space.

A new five-story facility adjacent to Morgan Hall, built partially over Nichols Hall West, could yield 21,500 net square feet of additional program space. This new building can be designed to maximize efficiency as it will include the flexibility, adaptability, and infrastructural support expected in a state-of-the-art engineering lab building that can meet and exceed the pedagogical goals of VMI. With efficient and flexible planning, the design will accommodate the Division's needs with the available spaces in King Hall as surge spaces. The following program spreadsheet represents the additional square footage categorized by space type as proposed by the design team.

SQUARE FOOTAGE SUMMARY

In preparation for a site selection presentation to VMI on October 18, 2020, a summary of available and needed square footage for the Division of Engineering was developed. The projected need was derived from an analysis of the findings outlined on the previous pages, including quantity and quality of existing program space in Nichols Hall, Morgan Hall, and King Hall, 'right-sizing' of program space needs based on industry standards and best practices at VMI, and projected STEM enrollment at VMI.

The summary starts with a resulting projected need of 58,500 net square feet (NSF) for the Division of Engineering, plus 2,500 NSF as a flex space, for a total need of 61,000 NSF of program space.

There is 42,400 NSF of existing program space in Nichols Hall and Morgan Hall plus an additional 5,000 NSF on the second and third floors of King Hall. Although the two floors in King Hall were considered for renovation and inclusion in the available existing program square footage, it was decided by VMI that the boxing program would be better served by remaining intact inside King Hall.

Therefore, the total program space need projected for the Division of Engineering is 18,600 NSF (61,000 NSF projected need minus 42,400 NSF existing program space) which, at a 60% efficiency factor for this building typology, equals approximately 31,000 gross square feet (GSF) of new construction.

The design team was further directed to take out of consideration the equivalent 8,000 GSF of new construction that would have compensated for the 5,000 NSF of program space in King Hall. If, in the course of developing the new space plans, the proposed program for the Division of Engineering could not be adequately accommodated in the existing available square footage plus 23,000 GSF of new construction, then VMI would reconsider renovation of the second and third floor of King Hall for use by the Division of Engineering. Additionally, the design team was directed to remove the 2,500 NSF of flex lab space from the program.

Therefore, the resulting projected need of new construction for the Division of Engineering is 20,500 GSF.

PROJECTED NEED:	58,500 NSF	
FLEX SPACE (1 LAB)	+ 2,500 NSF	
TOTAL PROJECTED NEEDS:	**61,000 NSF**	
EXISTING ENGINEERING SPACE: (NICHOLS ENGINEERING BUILDING + MORGAN HALL)	42,400 NSF	
KING HALL RENOVATION: (SECOND AND THIRD FLOOR)	+ 5,000 NSF	
CURRENT SPACE OWNED BY VMI'S DEPARTMENT OF ENGINEERING	47,400 NSF	
TOTAL PROJECTED NEED:	61,000 NSF	
EXISTING ENGINEERING SPACE: (NICHOLS ENGINEERING BUILDING + MORGAN HALL)	- 42,400 NSF	
TOTAL NSF REQUIRED FOR NEW CONSTRUCTION	**18,600 NSF**	
NSF REQUIRED FOR NEW CONSTRUCTION (@ 60% EFFICIENCY)	18,600 NSF	/ .6
TOTAL GSF REQUIRED FOR NEW CONSTRUCTION	**31,000 GSF**	
TOTAL GSF REQUIRED FOR NEW CONSTRUCTION	31,000 GSF	
GSF KING HALL RENOVATION: (SECOND AND THIRD FLOOR)	- 8,000 GSF	
FLEX SPACE (1 LAB)	- 2,500 NSF	
PROJECTED GSF FOR New Addition to Morgan Hall	**20,500 GSF**	

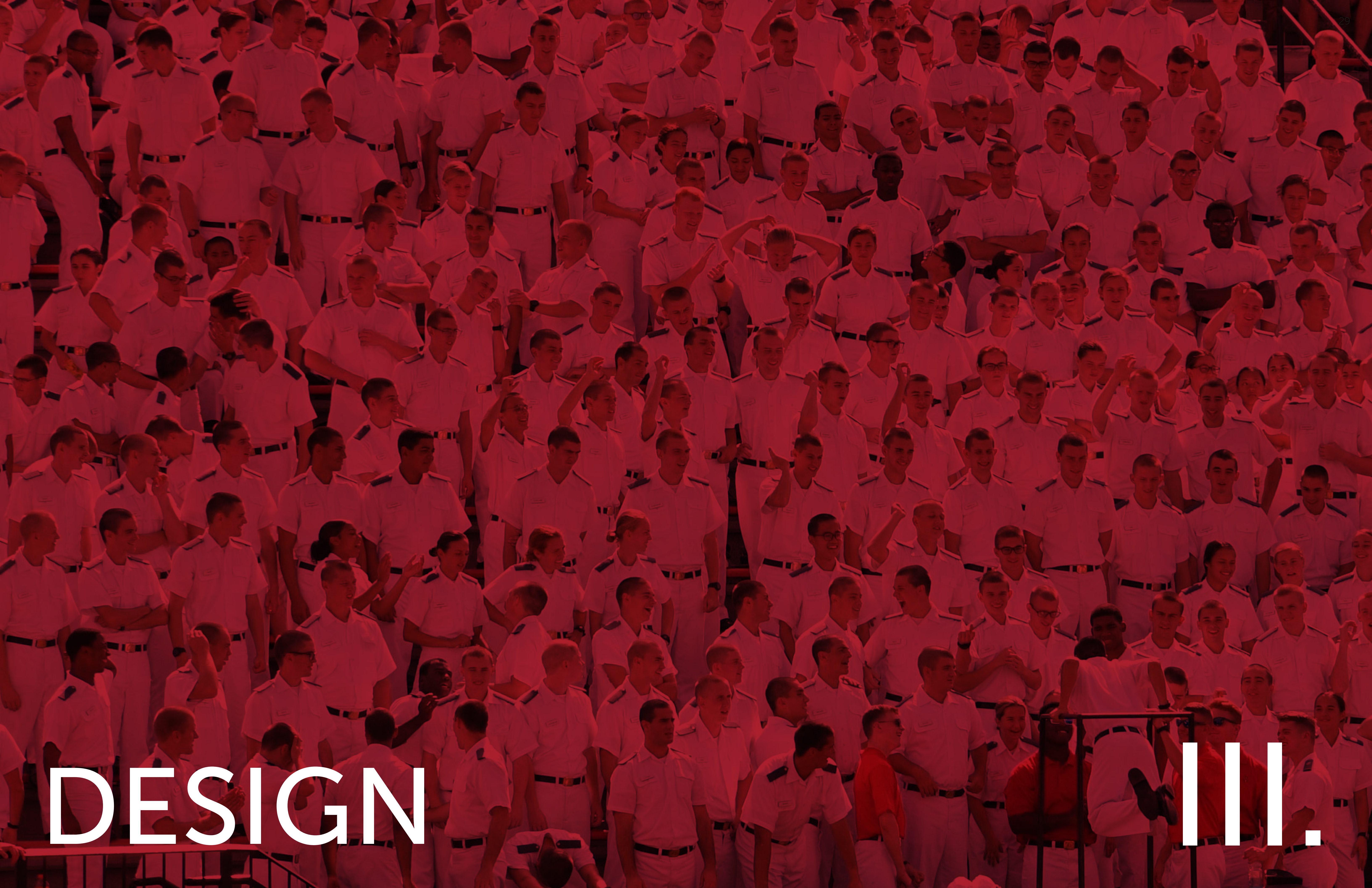
PROPOSED PROGRAM

The following is the proposed program for the New Addition to Morgan Hall separated by Space Type. The Program Summary compares the existing space square footage occupied by VMI's Division of Engineering to what is proposed by the Design Team. The program is further broken down by the ownership of each Divisions of Engineering including Civil and Environmental Engineering, Mechanical Engineering, Electrical and Computer Engineering, and Shared facilities.

VMI Program Summary

Existing Space				Proposed Space			
Rm. No.	Rm. Name	Qt	Total NSF	Rm. No.	Rm. Name	Qt	Total Area
	Total Net Program by Space Type		**42,688**		**Total Net Program by Space Type**		**56,087**
	CLASSROOM	10	6,296		CLASSROOM	17	12,804
	COMPUTER LAB	5	3,103		COMPUTER LAB	6	5,773
	CONFERENCE	3	762		CONFERENCE	3	683
	EE LAB	5	2,950		EE COMPUTER LAB	4	2,454
	Library/Auditorium	2	2,514		Library/Auditorium	1	1,597
	LAB	16	15,564		LAB	17	17,115
	OFFICE	33	5,731		OFFICE	36	5,453
	OFFICE SUPPORT	3	729		OFFICE SUPPORT	6	998
	OTHER	-	-		OTHER	1	706
	STUDENT PROJECT SPACE	2	799		PROJECT SPACE	3	2,535
	PROJECT STORAGE	-	-		PROJECT STORAGE	2	326
	STORAGE	8	2,349		STORAGE	13	3,131
	STUDY AREA	3	1,891		STUDY AREA	6	2,512
	Total Net Program by Division		**42,688**		**Total Net Program by Division**		**56,087**
	CIVIL ENGINEERING		12,125		CIVIL ENGINEERING		17,726
	ELECTRICAL ENGINEERING		8,923		ELECTRICAL ENGINEERING		12,885
	MECHANICAL ENGINEERING		10,190		MECHANICAL ENGINEERING		15,680
	SHARED		11,450		SHARED		9,796

VIRGINIA MILITARY INSTITUTE



DESIGN III.

SITE OVERVIEW AND DESIGN PROCESS

After determining the need for a new Engineering structure, the first decision point to be undertaken in Task 2 of the Programming and Feasibility Study was to select a site from two of the site options presented in Task 1, and another site which emerged in the Task 2 Kickoff meeting, a location previously unavailable to the design team. The site locations are:

Site 1. The existing footprint of Cocke Hall Annex

Site 2. An addition East of Nichols Engineering Building

Site 3. An addition West of Morgan Hall and Nichols Engineering Building

After consulting with key VMI Stakeholders, structural and civil engineers, and cost estimators, the design team determined Site 3 as the most viable option for the location of the new Addition to Morgan Hall. The other two site options proved to be difficult in constructability and costly in execution. The final selected design encompasses an addition to the west of Morgan Hall and to the south and over Nichols Hall Annex on Site 3.

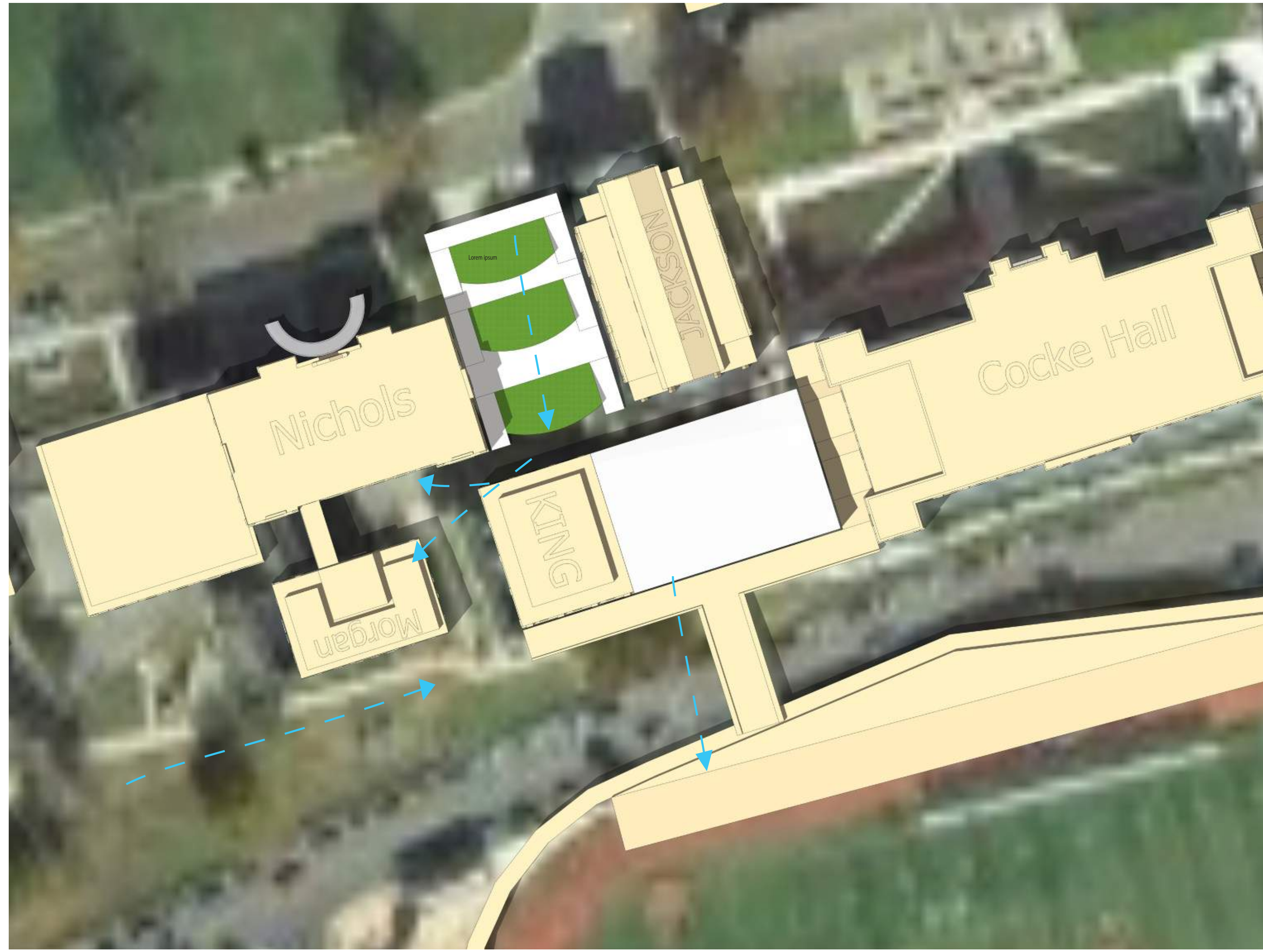
Originally, Nichols Engineering Building was designed to accommodate additional structural load, as shown on existing drawings. The design team took advantage of this opportunity and proposed a simple rectangular plan shape that touches the west facade of Morgan Hall, the south facade of Nichols Engineering Building Annex, and extends on its fifth and sixth floors over the current Nichols Annex roof, presenting a new elevation to the Parade Ground level.

The north facing portion of the proposed new construction over the Annex is lower in height than both Nichols Hall and Preston Hall and will continue the architectural language of the existing Nichols Engineering Building, successfully presenting the addition as a "hyphen" pattern adhering to the current architectural language on the parade ground between the two flanking historic structures while honoring their individual identity. Additionally, with the razing of Cocke Hall Annex, the existing footprint will allow the potential to more clearly re-establish the lost historic visual and physical connection between Central Post and Main Street/ South Post. It will display prominently the South facade of Jackson Memorial Hall from Main Street, while presenting an open view south from the Parade Ground, notwithstanding the partial blockage presented by King Hall.

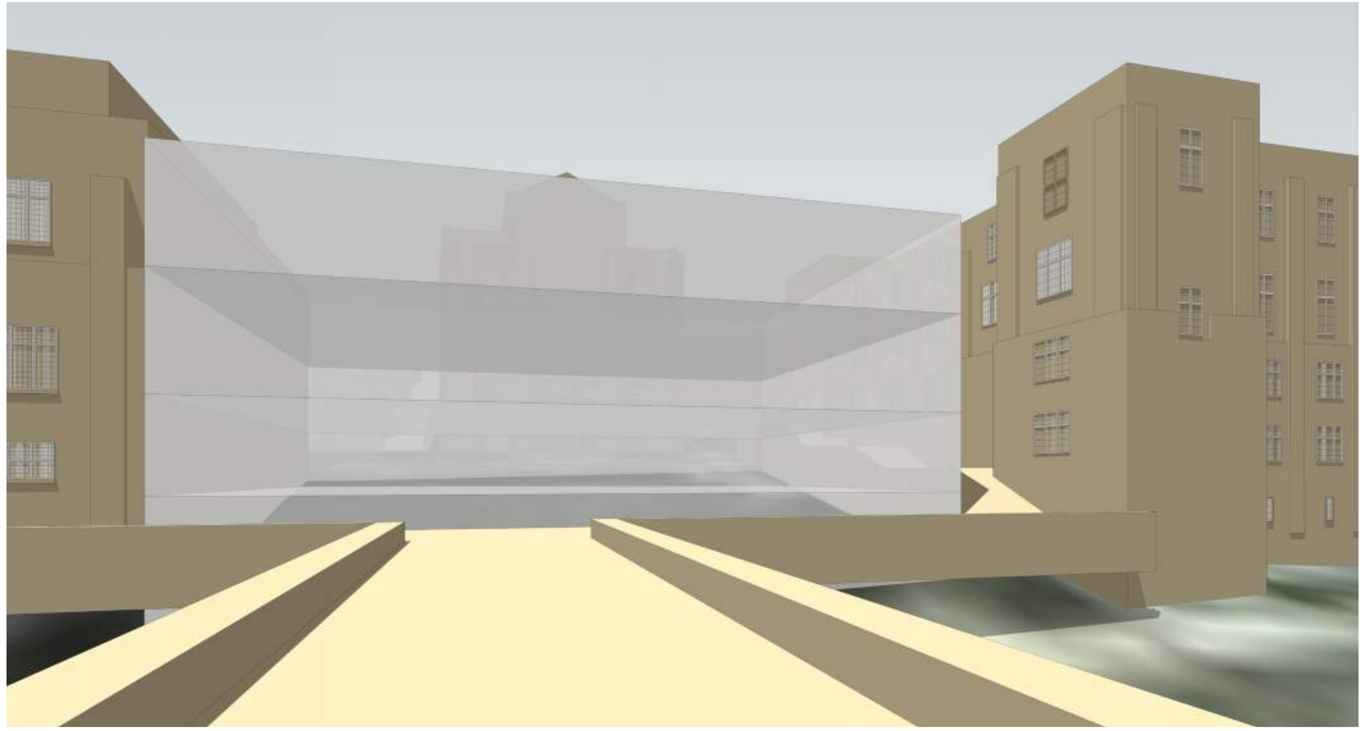
DESIGN ITERATIONS: Option 1

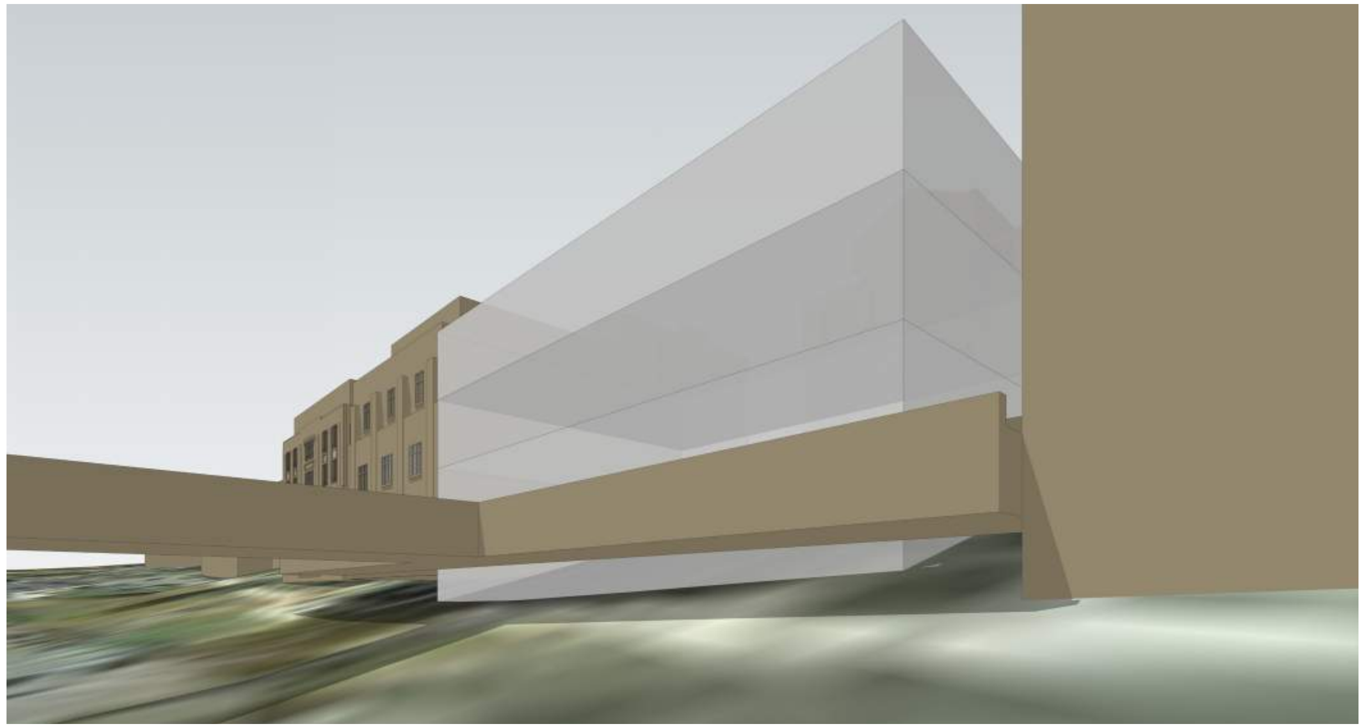
The design team proposed several iterations which was presented to VMI. They are as follow:

The design of Option 1 is to infill the existing footprint of Cocke Hall Annex and connect with the levels of King Hall. The Boxing Program will be moved to Cocke Hall which will free up the upper two levels of King Hall for the Engineering Department. On the first level, an open atrium on the south side of the building will welcome visitors coming from the football field through the pedestrian bridge. On the second level, the northeast side of the building will open up as the second entry to the building from Jackson Memorial Hall. A small loading dock located on the northwest side of the building will serve the need of both structures. A central corridor will connect the existing King Hall to the new Addition to Morgan Hall. Building Support lines the northern side of the building, maximizing available space for laboratories, classrooms, project space and storage.



South Aerial View


South Facade


View from Main Street

DESIGN ITERATIONS: Option 2

Option 2 proposes a large addition to the west side of Nichols and Morgan Hall, partially building on top of the existing Nichols West. This allows for access to the Parade Ground as well as loading access from the south, frees up the space south of Jackson Memorial Hall to be used as a plaza, and lets the whole building function as one facility. The large size of the floor-plate of the addition allows for flexibility in planning.

The main challenges of this option include relocating existing utilities and the need to upgrade the pedestrian walkway south of Morgan and King Hall to create access for service vehicles to Jackson Memorial Hall and the courtyard between Morgan Hall, Nichols Engineering Building, and King Hall. This option disrupts the possibility for vehicles to directly access that courtyard as is currently possible, though access could be provided through the loading dock in the new building.

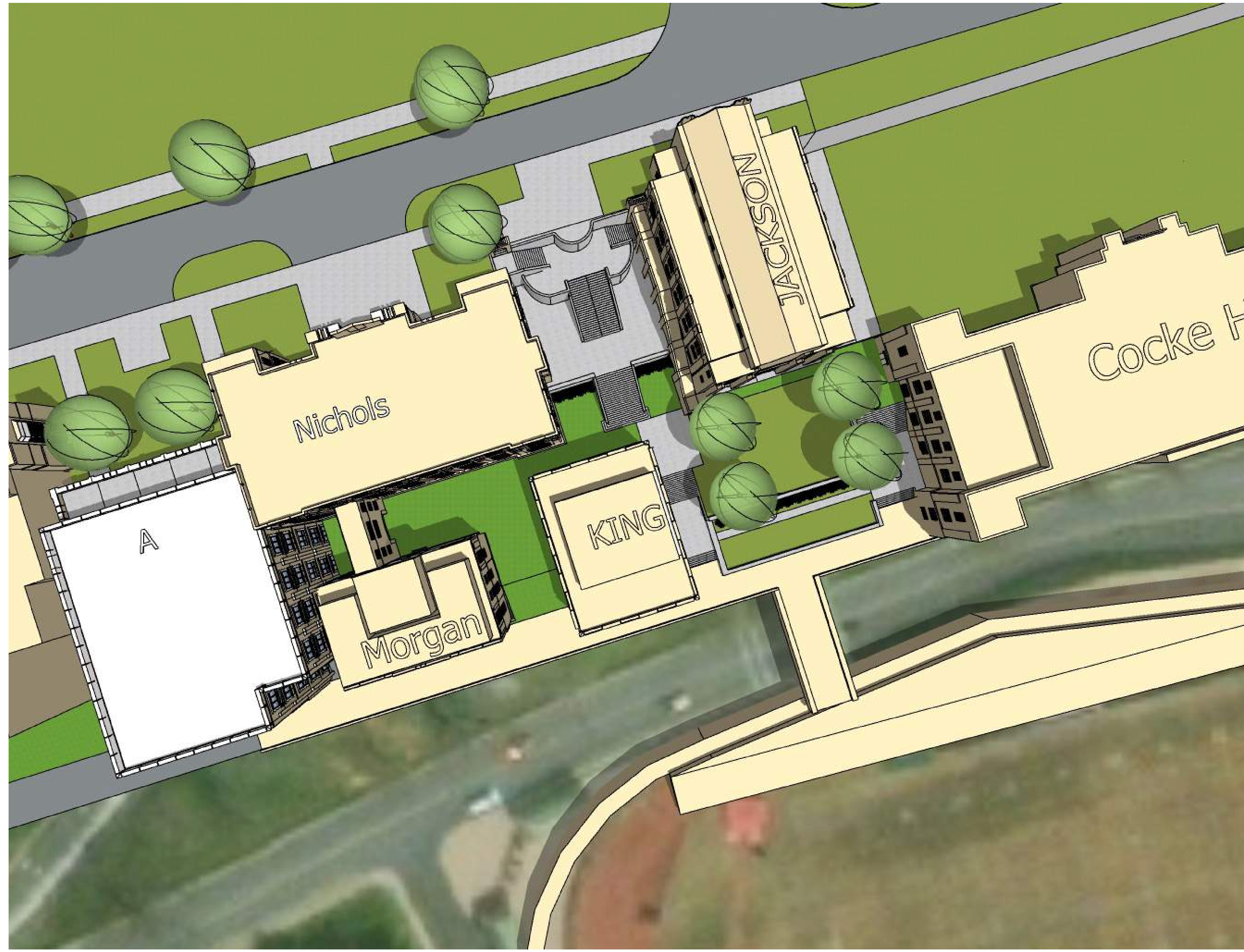
Other challenges include the small first floor footprint creating a limitation on how many program elements can have direct exterior access and some potential disruption to the lower floors of Nichols West during construction.

It can also be considered a challenge that this building would infill the gap between Nichols Engineering Building and Preston Library on the Parade Ground level, creating a continous facade, but this infill condition could be designed to be an attractive addition to the Post.

The opportunities of this option lie in its siting on the Post. Using the site to the west of Nichols and Morgan Hall allows for the new building to connect to both existing buildings and create one integrated engineering facility. This would improve connections between departments and provide one easily accessible main loading entry. This is also by far the easiest option for construction access for the building.

Other potential benefits include opening up a green space with a view to the south of Jackson Memorial Hall, creating access to the new engineering building both from the Parade Ground as well as from the south, and creating improved circulation paths throughout this part of the Post.

Lastly, the possible total square footage for the new building would mean that Boxing would not need to be relocated from King at this time.



North Aerial View

South Facade

South Aerial View

View from Engineering Drive

DESIGN ITERATIONS: Option 3

After further discussion with VMI, additional priorities and preferences for building usage and design were suggested including the impact that an addition to Nichols Hall would have upon the Post's historical context when viewed from the Parade Ground. Views between the buildings are critical to avoid the appearance of a continuous wall that would appear to close off the Parade Ground. Option 3 allows these views from the Parade Ground by narrowing the width of the addition to Nichols. This approach will impact the required program area. Therefore, Option 3 also includes a new infill addition between King and Morgan Hall, a new addition to the east of King Hall, as well as renovations to King Hall to make up the difference in programmatic area requirement. The Existing Engineering Drive would remain as is to access loading and service needs.

Option 3 consists of (A) smaller addition of two new floors above existing West Nichols; (C) Infill addition between Morgan and King Hall; and (B) Addition to the east of King; as well as renovations to King Hall.

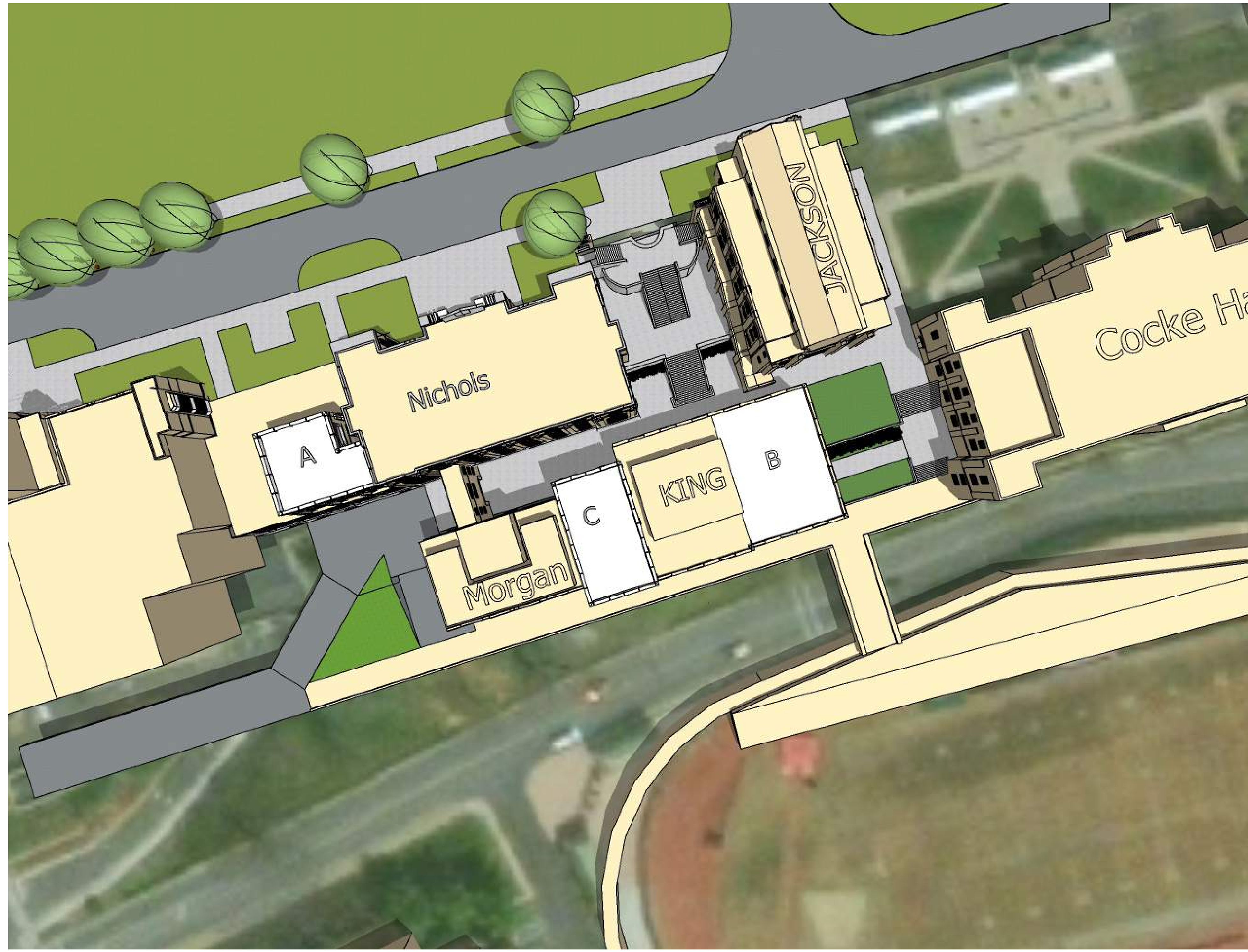
The challenges of this option derive from the nature of it creating multiple small additions to numerous existing buildings.

Aside from construction access being difficult to provide for the infill between Morgan and King Hall and the eastern addition to King Hall, each individual addition would require underpinning and possibly other stabilization of the foundations of adjacent existing buildings, making this a structurally much more costly option.

From a planning point of view, each small addition has a floor-plate that is very difficult to use efficiently, may require multiple cores, and creates numerous challenges in connecting to existing buildings, including matching floor to floor heights, being able to establish an ADA accessible route between Morgan and King, and the necessity of cutting hallways through existing laboratory and classroom spaces to be able to create a coherent circulation path through the combined facility.

Further challenges include highly complex phasing which would potentially impact multiple buildings during the academic year, needing to likely retain existing floor to floor heights that do not work well for modern laboratories, and the need to relocate the Boxing Program from King to Cocke Hall.

Opportunities for this include maintaining the existing Engineering Drive, preserving open space between Preston Library and Nichols by not infilling the gap completely, and opening a green space in the back of Jackson Memorial Hall.



North Aerial View

South Facade

South Aerial View

View from Engineering Drive

CONCEPT DESIGN

The concept design incorporates site opportunities as follows:

SITE OPPORTUNITIES:

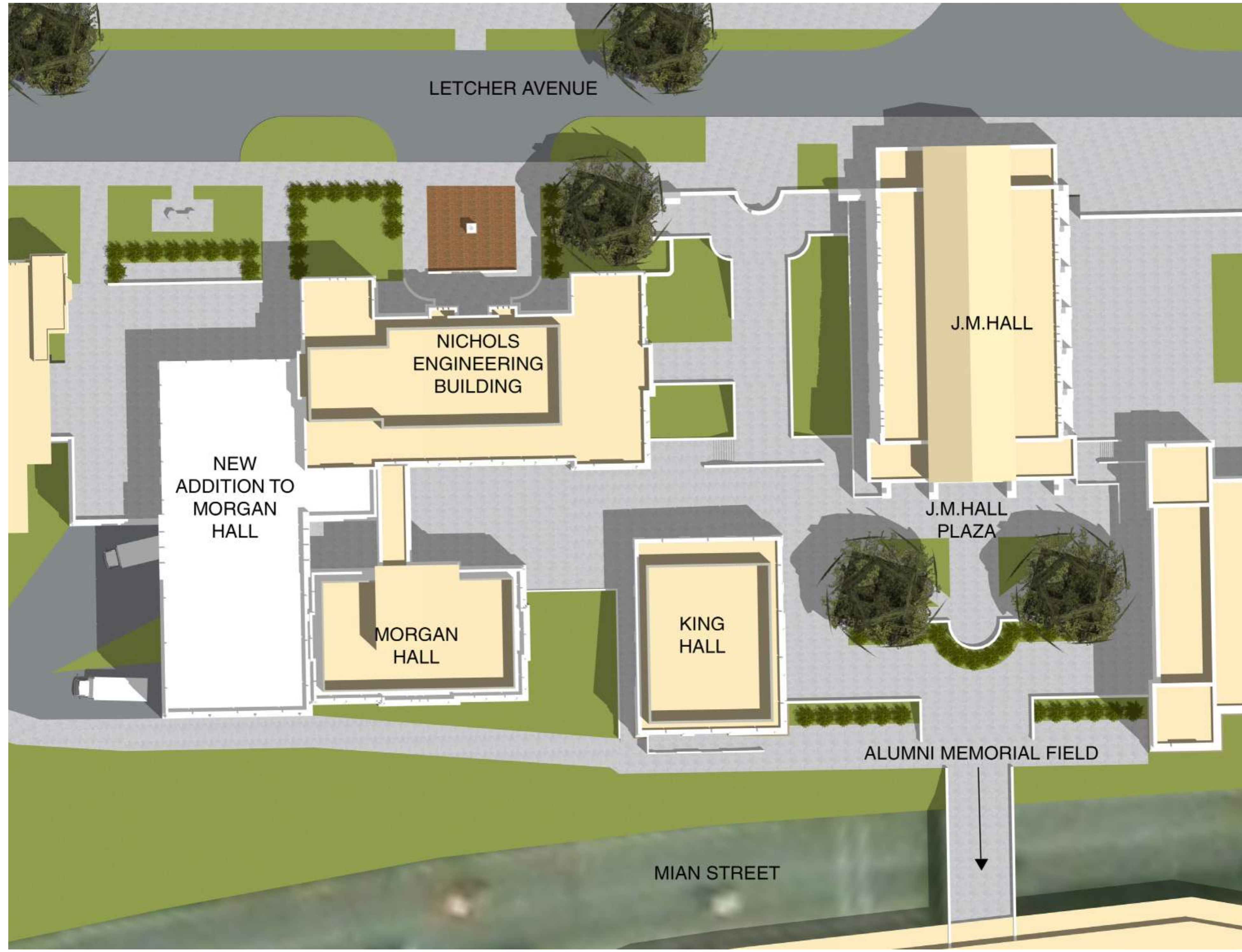
- Maintaining the existing Engineering Drive
- Opening space south of Jackson Memorial Hall
- Creating a connection to all the Engineering buildings
- Simplicity of design on one accessible building site
- Creating a tunnel for Engineering Drive with clearance that is approximately 15' high and 12' wide for vehicle passage

The design considers the need to minimize the presence of The New Addition to Morgan Hall Addition to the west of the existing Nichols Engineering Building from the Parade Ground and to respect the current architectural balance of the façade while maintaining a maximized distance from Preston Hall. This is to maintain the individual building massing and identity. The entrance to the New Addition to Morgan Hall on the Parade Ground will be set back to reduce its overall presence and preserve the feeling of open space between Nichols Engineering Building and Preston Hall. The architectural expression of the new addition will follow the simple, understated language of the existing Nichols Engineering Building to fit seamlessly into its context.

This design option also maintains the use of Engineering Drive to access the back entrances to Nichols Engineering Building, King Hall, Morgan Hall, and Jackson Memorial Hall, as well as providing loading to the New Addition to Morgan Hall, by creating a new tunnel passage. This tunnel will provide a clearance that is approximately 15' high and 12' wide for vehicular access. As the design moves forward, there may be some design challenges to maintain the envelope integrity of this longer vehicular tunnel, including air entrainment exhaust mitigation, and security concerns during off hours. These challenges can be resolved during future design phases.

Other design challenges include accounting for the variances in floor levels between the existing and new building additions. Nichols West Addition can accommodate for these floor level changes by including a stairwell in the zone between Nichols Engineering Building and the New Addition to Morgan Hall, allowing for connections on nearly every floor.

The concept design also provides a unique opportunity to improve the overall fabric of the Post by re-opening a green space in front of Jackson Memorial Hall that had existed in the past. This allows the south façade of Jackson Memorial to be seen from Main Street and allows for the restoration of the west façade of



ARCHITECTURE

Cocke Hall. To complete the composition of this space, a new façade will have to be added to the previously blind east face of King Hall. The design team proposes to follow the composition of its existing south façade. This opportunity creates a new formal quad between Jackson, Cocke, and King Halls and opens the view from the Parade Ground to the football stadium.

BUILDING CHALLENGES

Of the options reviewed, the site selected proved to have the most opportunities and the fewest number of challenges. However, there are several challenges leading to opportunities that can be resolved during the design phases. These include:

The most efficient allocation of both renovated and new spaces need to meet the goals of providing an identity for each of the Engineering Departments.

The smaller floorplate of the new addition limits horizontal adjacencies between programmed spaces.

Site restrictions limit the flexibility of the floor plan layout and potential inefficiencies within the new addition.

The new addition should be dedicated to robust lab space meeting the goals and objectives for state-of-the-art laboratory building that allows cadets to partner with faculty on a wide range of research.

The classrooms need to maintain VMI's unique educational experience of small-class size.

Hands-on-learning labs and Active Learning Classrooms require additional areas for Project Storage, Student Study Areas, and Student Research, which are not sufficiently accommodated in the current conditions.

The larger Nichols Engineering complex needs to reinforce VMI's cultural reputation of providing cadets with environments that encourage hands on learning through close guidance by the professors.

The placement of the building massing limits opportunity for daylight into the spaces.

Vertical expansion incurs some interruptions to programs to the floors below the construction area.

The new addition will require new approaches to Loading Dock Access.

BUILDING OPPORTUNITIES

The design concept provides opportunities to meet each of these challenges.

The redesign of the plan allows for the alignment of each of the different Divisions that were previously scattered throughout the existing infrastructure. Discipline, unity and identity will be recovered because each Engineering Division will have designated levels and rooms.

Although, the floorplate of the new addition is relatively small, it functions as an extension of the existing floorplate because many of the floors of the new addition align with the existing floor levels. Due to this arrangement, the combined larger floor plate allows for the alignment between labs in the new addition and classrooms in the existing building to focus upon one Department per floor. With less travel time between the teaching and the lab spaces, the proximity of each Department's classrooms and labs will enable faculty more time to spend with each cadet.

Labs that require more intensive utilities, tighter environmental criteria such as higher floor-to-ceiling tolerance, and greater square footage per cadet have been relocated to the New Addition to Morgan Hall Addition which maximizes flexibility and expands the capabilities of each program.

The New Addition to Morgan Hall Addition will be dedicated to robust laboratories with highly flexible open labs that will meet a wide range of hands on learning activities and student research. For instance, the plan greatly improves the capacities for the Maker Space, Wood Shop, and Metal Shop functions by creating larger, separated spaces, along with separate spaces allocated to the Foundry and Welding. This would allow a separation of different shop functions and prevent hazardous overcrowding that has been common within the shops. Furthermore, additional spaces allocated for general and project storage will free up existing spaces that have been cluttered and not designed for such functions.

Relocation of certain labs and classrooms to the New Addition to Morgan Hall as well as rearrangement within Nichols Engineering Building and Morgan Hall allow for greater flexibility within the existing infrastructure. The space vacated allows for the increase in the number of classrooms, that have less restrictive environmental criteria. This will maintain VMI's reputation for smaller class sizes. The readjustment of the existing plans within Nichols Engineering Building and Morgan Hall have added an additional 6,000 SF of classroom space. The design team worked closely with faculty leadership to address specific shortages and needs of each of the Engineering Departments. Existing ill-sized classrooms have been redesigned to create a more flexible space and allow greater adaptability for active learning in hybrid-style classrooms.

The additional 21,000 gross square footage in the New Addition to Morgan Hall will address the space shortage of the Engineering Division. Designated areas for Cadet Study, Project Space, and associated Storage Areas are allocated throughout the plan for an additional 3,000 net square feet of space.

To make the most efficient use of the budget, the renovation of Nichols Engineering Building is strategically targeted to focus upon these overall goals so that while some spaces are heavily renovated, others are only moderately or lightly renovated.

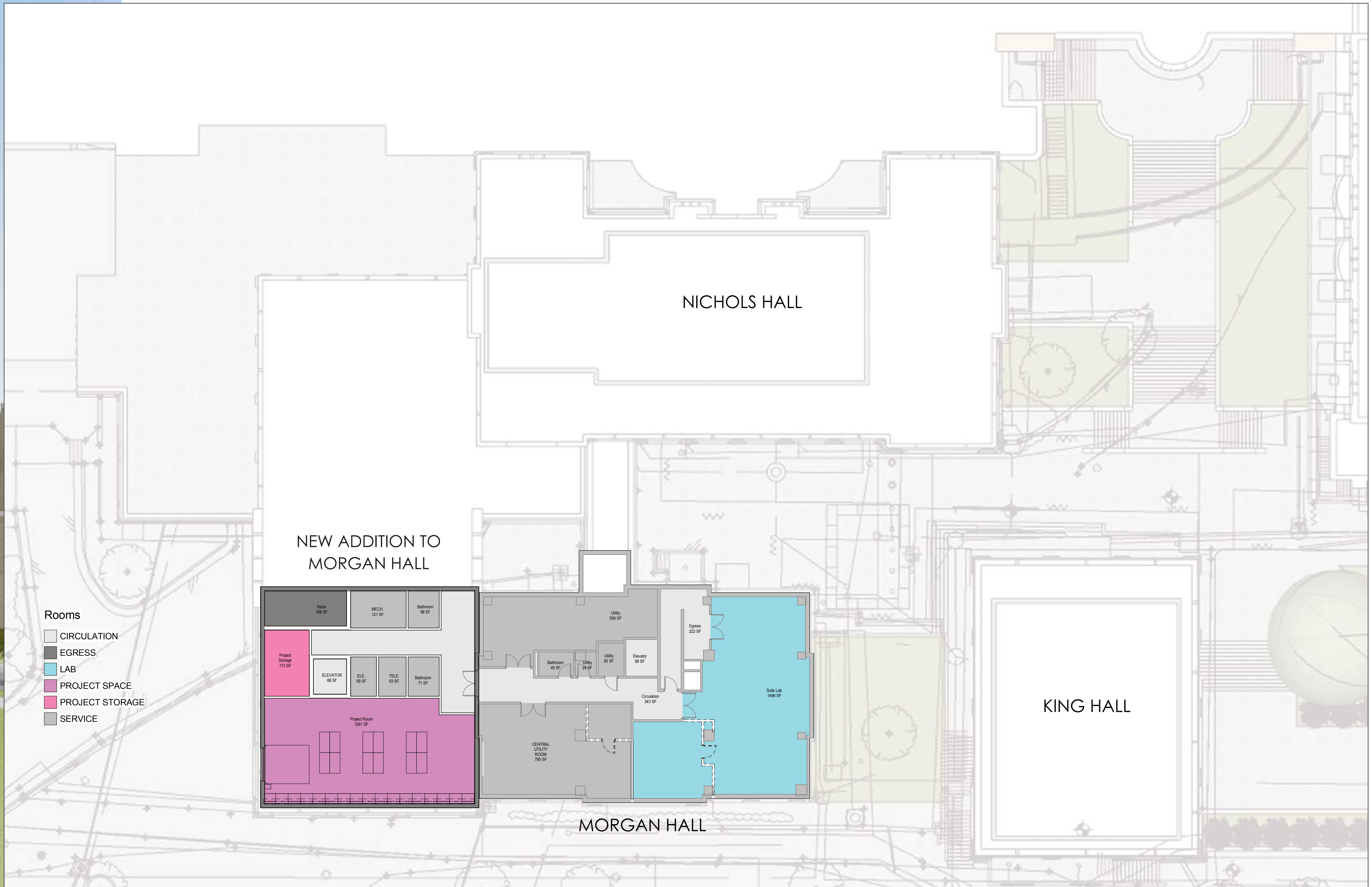
To accommodate lab adjacencies that may be compromised due to the smaller floorplate of the new addition, certain labs are stacked, connected by a stair and a service elevator as is the case for the Maker Space and the Metal Shop.

Despite the density of the larger floorplate created by the new addition aligning with the existing floors, all the new open labs will receive daylight, while daylight within existing classrooms will not be compromised due to maintaining of a courtyard around Engineering Drive. The new internal stair can introduce daylight into the corridor while increasing vertical connections between programs.

Expanding vertically above Nichols West will impact existing programs in the lower levels of this area, but these are generally office functions that can be temporarily relocated during construction.

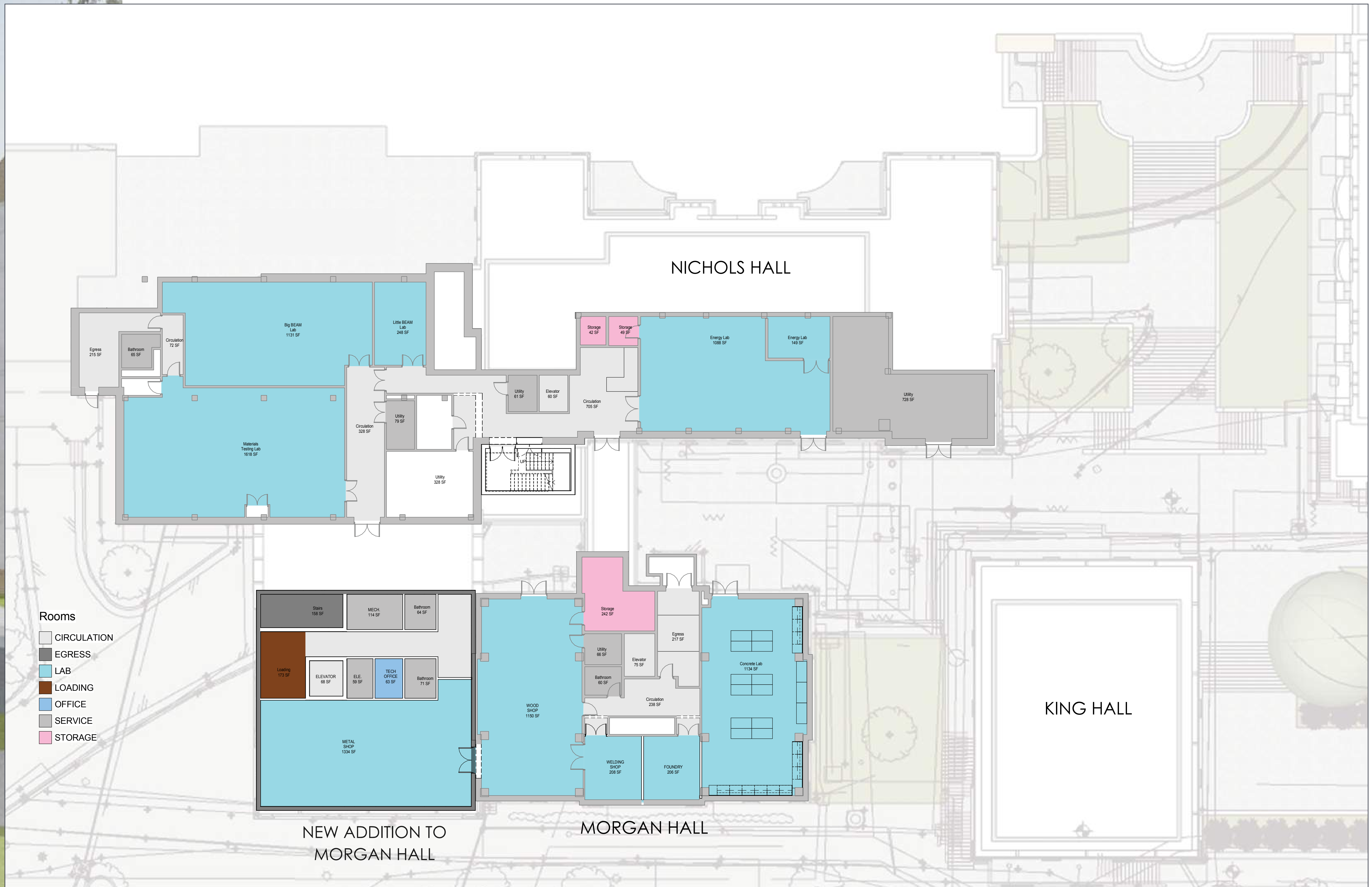
The design concept greatly improves the existing loading and material delivery process, by consolidating all loading functions to the southwest corner and sharing loading area with the existing service area of Preston Hall, and by locating those programmatic functions with greatest needs on the lower levels near this loading zone, adjacent the new service elevator.

North Elevation : View From Parade Ground



Plan: First Floor

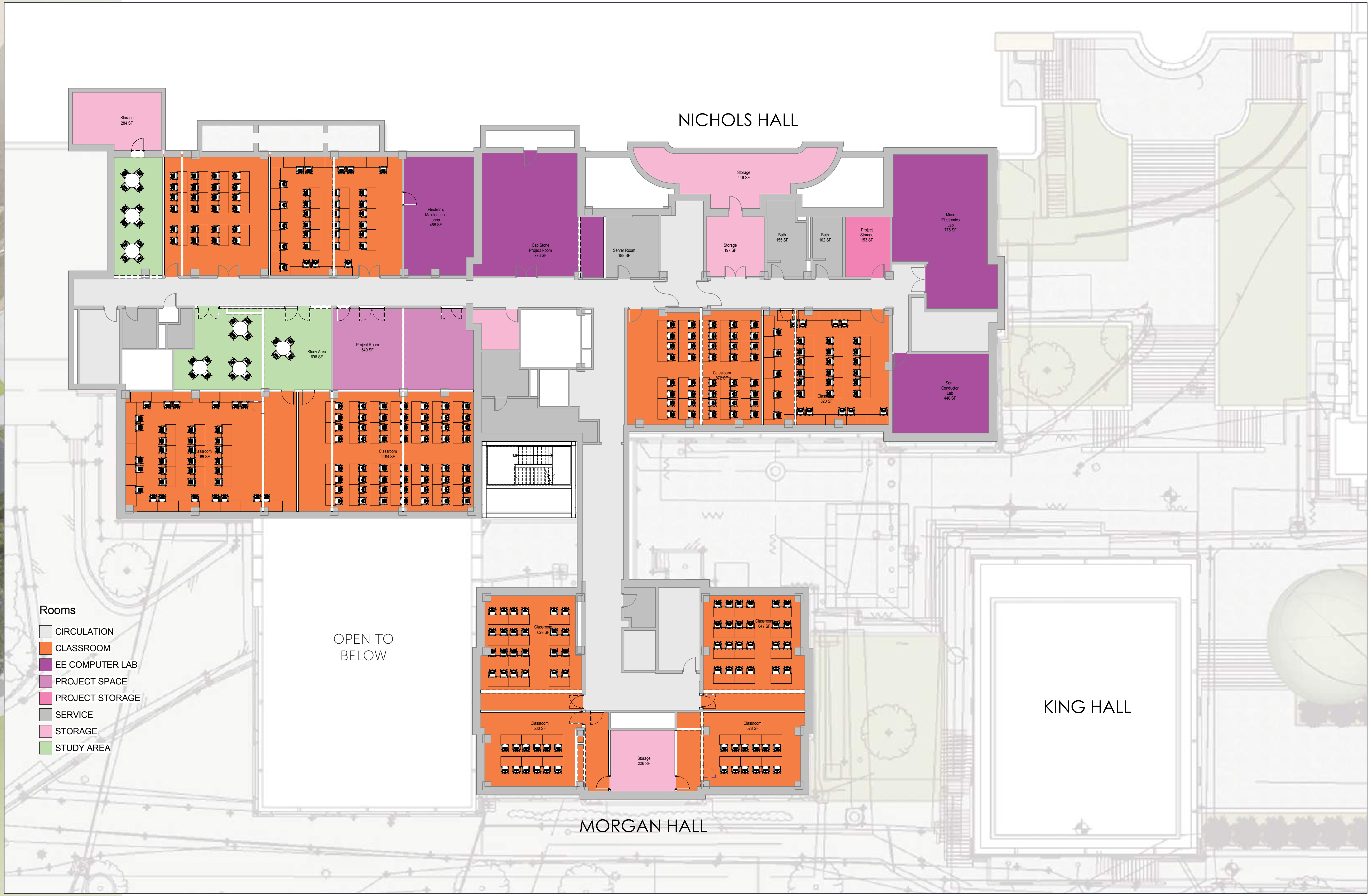
 North & West Elevations : View from front of Preston Library



Plan: Second Floor

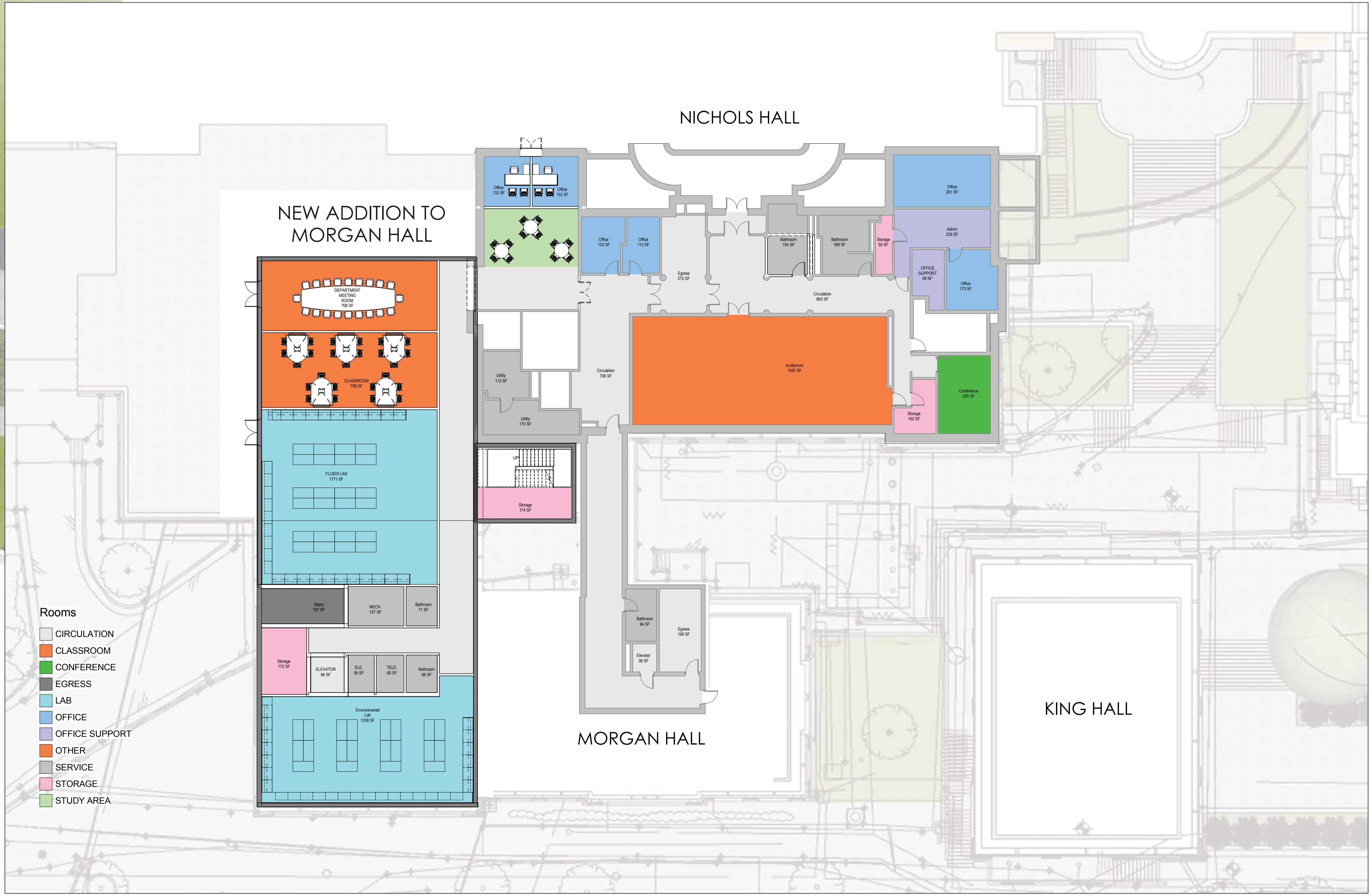
North Elevation : View From Parade Ground

Plan: Third Floor



Plan: Fourth Floor

Aerial : View From Southeast



Plan: Fifth Floor

J.M. Hall Plaza : View From Southeast

Plan: Sixth Floor

 Aerial : View From Southwest

Plan: Seventh Floor

CIVIL

Virginia Military Institute will consist of renovating the grounds surrounding the new addition along with demolition of the existing Swimming Pool building. The area occupied by the Swimming Pool building will be converted to a two-tiered plaza area with landscaping features. Another three-tiered plaza area is proposed to be constructed between Nichols Engineering Building and Jackson Memorial Hall. The proposed site work is located within an area which has been previously developed with existing buildings, concrete sidewalks, asphalt drives, underground utilities, and other appurtenances. The site is located at the end of Engineering Drive.

DEMOLITION

SITE DEMOLITION

Removal and demolition of existing features at, or near, the surface will be needed to prepare for the proposed additions and improvements. Items to be removed include, but is not limited to, surface debris, paving, curbs, slabs, stairways, retaining walls, light poles, drainage structures, trees, shrubs and other ground cover. Underground utilities will need to be removed, or abandoned and plugged, as appropriate. Designated utilities will need to be protected. An existing transformer and generator will need to be relocated. It is not anticipated that a disposal area, temporary or permanent, will be identified near the site. All demolition waste will be hauled to a facility approved for accepting the various materials generated by site demolition.

Limits of demolition will be indicated on the plans and should be field marked. In areas where items such as paving, curbs and slabs are to be partially removed, a neat saw cut at a right angle to surface shall be made through complete section, unless otherwise indicated, at limits of demolition. Prior to removal or demolition of items that abut the face of existing buildings, methods shall be determined to minimize any potential damage.

BUILDING DEMOLITION

The Swimming Pool Building (SPB) between King Hall and Cocke Hall must be demolished and removed to provide space for proposed plaza area. The SPB contains a 25,000 gallon pool with associated filters, pumps and piping. It also contains accessory areas such as spectator seating, lobby, office, bathrooms, etc. Otherwise, the main section of the SPB is one large open area with a roof approximately 30' above pool edge level. Both King Hall and Cocke Hall have pedestrian connections to the SPB.
The demolition shall be accomplished by mechanical means. The use of explosives is not permitted. Foundation walls and footings shall be removed a minimum of two foot below finished grade. Some sections, such as bottom of pool, may need to be removed completely and will be indicated on plans. A hazardous material survey should be done to verify methods needed for disposal. While conducting demolition operations, work should be sprinkled with water to minimize dust. All demolition waste will be hauled to a facility approved for accepting the various materials generated by building demolition.

EARTHWORK

The existing topography consists of moderate to steep slopes that present minor constraints to development. Topographical relief of the site varies from an elevation of approximately 1039 feet from the northeastern portion of the site to an elevation of approximately 982 feet along southern side. Based on the United States Geological Web Soil Survey, on-site soils consist primarily of Need more-Urban land complex with a section of Groseclose-Needmore-Urban land complex at the northern side of the project site. The Hydraulic Soil Group for the project site is C.

Clearing and grubbing operations shall consist of the removal of trees, vegetation, topsoil and objectionable material at or above the original ground elevation. These operations should be minimal as the site has been previously developed. Based on recent construction projects, bedrock is expected to be encountered for excavations of more than shallow depth. Material utilized as fill under the building pad, parking areas, equipment yards, and behind retaining walls shall be compacted to 95% standard proctor. General lawn areas shall be compacted to 90% standard proctor. Proof rolling will be performed to determine if subsoils will adequately support fill material. Surplus or unsuitable material shall be removed and disposed of off-site should no satisfactory areas for disposal exist on-site. Unsuitable material shall be replaced with select fill obtained on-site or from an off-site borrow source.

LANDSCAPING

Landscaping shall include the distribution of topsoil, fine grading, liming, fertilizing, seeding, sodding, planting, and mulching all areas disturbed by construction that are not otherwise hardscaped. Materials include topsoil, agricultural limestone, commercial grade fertilizer, seed mixture, sod, straw, and hay or wood cellulose fiber mulch. The architectural renderings for Option 4 show minimal tree and shrubbery planting in the proposed plaza area between King Hall and Cocke Hall. All plant materials will comply with the American Standard for Nursery Stock – ANSI Z60.1.

UTILITIES

ELECTRICAL DISTRIBUTION:

The electrical service for the new Nichols Hall addition will be provided from the Post medium voltage, 3-phase distribution system. Site development associated with this project will require relocation of the electrical facilities. An existing transformer and emergency generator located near the southwest corner of Morgan Hall are located within the footprint of the building addition. These existing facilities will be relocated approximately 50 feet south to a new equipment area that has a surface elevation close to the elevation an adjacent concrete access way. A retaining wall is proposed to support the equipment area to minimize grading on an existing uniformly graded slope. The exterior of the retaining wall should have a finish complimentary to the exterior of the building addition with screening to block view of equipment. The proposed equipment area will also accommodate an additional transformer and emergency generator. New underground electrical lines will be installed to reconnect the relocated transformer and provide service from the new transformer.

GAS DISTRIBUTION SERVICE

An existing survey indicates that gas service is provided by a gas meter located at the northwest corner of Nichols Engineering building. The site work would not impact this gas service and current plans do not propose items for additional gas service.

WATER SERVICE

An existing water main is located along the south side of North Main Street. An analysis of fire suppression needs may require a connection to this main. A new 8-inch service line could be installed between North Main Street and the building addition. This installation could include a trenchless crossing of a portion of North Main Street and an existing retaining wall. The new service would be constructed in accordance with the City of Lexington's water requirements. It is assumed that there will be adequate water flow and pressure with an 8-inch line. Actual fire flow data will be acquired prior to final design. Valves, hydrants and other appurtenances shall conform to AWWA standards and specifications. Testing and disinfecting of water mains shall be provided in accordance with the Virginia Department of Health (VDH) Waterworks Regulations.

CIVIL (cont.)

SANITARY SEWER SERVICE

Multiple sanitary sewer lines are located below the proposed development area. These sanitary sewer lines flow west to east through the site. Information shown on previous surveys list 6" and 8" sizes made from iron, clay or PVC. One new connection is proposed as a relocation of an existing sanitary sewer line that conflicts with a proposed stormwater detention facility. The connection would be made with a new straddle manhole installed on an existing 8" iron line. The new sanitary service will be a minimum 6" size and have manholes installed at horizontal and vertical deflections with a clean-out just outside building exterior. An "8" clay line along west side of Cocke Hall will need to be reinstalled due to vertical conflicts. Pipe and fittings shall be PVC gravity sewer pipe or HDPE pipe. Manholes shall be precast concrete with O-ring joints, concrete flow channels, and flexible manhole connections. All sanitary sewer utilities shall be provided in accordance with the Virginia Department of Environmental Quality (VDEQ) Sewage Collection and Treatment (SCAT) Regulations.

STORMWATER MANAGEMENT

The area of disturbance for the proposed work is anticipated to exceed 1.0 acre; therefore, the site development will be regulated by the Virginia Stormwater Management Act and subject to Virginia Stormwater Management Regulations and VMI Annual Standards and Specifications for water quality and water quantity. A stormwater management plan shall be provided to control runoff during the life of the proposed Nichols Hall addition and surrounding site. The plan will utilize drop inlets, storm drain pipes, underground stormwater detention facilities to control water quantity, as applicable. All stormwater management structures will be constructed in accordance with the latest editions of the Virginia Department of Transportation's Road and Bridge Standards and Road and Bridge Specifications and the latest edition of the Virginia Stormwater Management Handbook, by the Virginia Department of Quality, as applicable. This project is not within a regulatory floodplain.

Stormwater inlets and pipes shall be designed to pass the runoff volume from the 10-year 24-hour storm event utilizing gravity flow. Underground stormwater detention facilities shall be installed to manage the quantity of stormwater flowing off site. A detention system is proposed to be located near the southwest corner of the building addition. The purpose of this detention system is to meet the water quantity requirements of the Virginia Stormwater Management Regulations, and to ensure that discharge will not exceed the capacity of the existing downstream stormwater management system. Along with an increase in impervious cover, additional drainage area will be directed around the building addition to an existing 6" pipe. The facilities shall be sized to temporarily store the volume of runoff required to reduce peak runoff volumes in order to prevent erosion and flooding of existing downstream stormwater conveyance systems. Internal bypasses shall be installed to prevent damage to the facility during significant storm events that are not regulated by the Virginia Stormwater Management Program. The detention system shall be constructed of Corrugated HDPE Pipe and/or Corrugated HDPE Arches.

The water quality needs for the site is proposed to be satisfied through the purchase of off site nutrient credits. The amount of pollutant reduction is anticipated to be small making the site eligible for credit purchase. On site facilities for water quality would have continuing maintenance needs with clear access that make credit purchase appropriate.

EROSION & SEDIMENT CONTROL

An erosion and sediment control plan shall be provided to control erosion and sediment transport during the construction of the proposed Nichols Hall addition. The plan is expected to utilize silt fence, inlet protection, construction entrances, construction road stabilization, and other temporary measures, as necessary. This is to ensure that sediment transport off-site is minimized. All erosion and sediment control structures will be constructed in accordance with the latest editions of the Virginia Department of Transportation's Road and Bridge Standards and Road and Bridge Specifications, the latest edition of the Virginia Erosion and Sediment Control Handbook, by the Virginia Department of Environmental Quality, and the latest edition of the VMI Annual Standards and Specifications, as applicable. All temporary erosion and sediment control measures shall be removed upon final stabilization of the project site.
Due to site constraints, a contractor lay-down and storage yard may be provided off-site. Gravel may be utilized to stabilize the yard during construction of the proposed Nichols Hall addition. The yard will be removed after the completion of the project and the natural ground cover will be reestablished.

ACCESS AND PARKING

Post construction access should remain essentially the same as existing access. The building addition portion attached to Morgan Hall will require the relocation of the access drive between Morgan Hall and Nichols Annex. There are no anticipated permanent impacts to existing parking spaces. Two new loading points are proposed for the west side of the building addition.
The current proposal does not include any additional consideration beyond existing ADA access. The two plaza areas are planned with steps between tier elevations.

EXTERIOR CONCRETE

Concrete curb and gutter shall be installed adjacent to relocated access drive. Concrete curbs, gutters, walks, pads, and patios shall be constructed of air-entrained 4000 psi concrete, welded wire mesh and grade 60 deformed steel reinforcing bars and shall not be colored or stained. The construction of curb and gutter profiles shall meet VDOT standards of CG-6. The current proposal is for plain concrete pavement for plaza areas.

STRUCTURAL

Design Criteria

The structural system in the addition above the existing facility (Nichols Hall West) will be designed to meet the requirements of the 2015 Virginia Existing Building Code (VEBC) Part II of the Virginia Uniform Statewide Building Code (USBC). The structural system for the new building will be designed to meet the requirements of 2015 Virginia Construction Code (VCC) Part I of the USBC. The following minimum requirements are anticipated:

Risk Category
Risk Category III – Buildings containing educational occupancies for students above the 12th grade with an occupant load greater than 500.

Floor Live Loads
Minimum floor live loads as required by occupancy per ASCE 7-10, Minimum Design Loads for Buildings and Other Structures.

Sample Live Loads

Classrooms	40 psf
Public Rooms, First Floor Corridors, Stairs and Elevator Lobbies	100 psf
Corridors Above First Floor	80 psf
Light Storage	125 psf
Mechanical	150 psf

The structural system will be designed for a minimum floor live load of 100 psf for flexibility during future.

Snow Loads

Ground Snow Load, Pg	30 psf
Snow Importance Factor, IS	1.10
Exposure Factor, Ce	1.0
Thermal Factor, Ct	1.0
Minimum Roof Snow Load, Pfmin	30 psf (per CPSM)

Wind Loads

Ultimate Design Wind Speed, Vult	120 mph
Nominal Design Wind Speed, Vasd	93 mph
Exposure	C

Seismic Loads (Soil Site Classification is Assumed At This Time)

Mapped Short Period Spectral Response Acceleration, SS	0.164
Mapped 1-Sec Period Spectral Response Acceleration, S1	0.068
Design Short Period Spectral Response Acceleration, SDS	0.175
Design 1-Sec Period Spectral Response Acceleration, SD1	0.109
*Soil Site Classification	D
Seismic Design Category	B
Seismic Importance Factor, IE	1.25

*Classification assumed; final classification will be based on geotechnical investigation

Additional Standards

Construction and Professional Services Manual, 2019 Edition
ASCE 7-10, Minimum Design Loads for Building and Other Structures
ACI 318-14 Building Code Requirements for Structural Concrete
TMS 402-13/ACI 530-13 Building Code Requirements and Specifications for Masonry Structures
AISC 360-10 Specifications for Structural Steel Buildings
AISC 341-10 Seismic Provisions for Structural Steel Buildings

Nichols Hall West Addition

Approximately the south two-third of Nichols Hall West was designed, in 1958, to permit the addition of two floors in the future. Two floors will be added on the east side (approximately 51 feet) of Nichols Hall West. The existing roof of Nichols Hall West is a concrete slab which was designed for a 100 psf floor live load which will be the lower new floor and will coincide with Level 5 in Nichols Hall and the new building. The structural framing for Level 6 (new elevated floor) will be structural steel columns above the existing concrete columns. The elevated floor is expected to 4-1/4" of light-weight concrete on a 22-gauge, 2-inch deep composite deck (6-1/4" total slab thickness) supported by steel beams spaced approximately 8-feet on center. The steel beams will range from 16" to 21". The steel girders supporting the steel beam will range from 27" to 30" deep.

Nichols Hall West Addition Roof Framing

The new roof above the addition over Nichols Hall West is expected to be 1-1/2" steel roof deck supported by open-web steel joists supported by steel girders. The steel decking will be utilized in this area to minimize the weight of the structure over the existing framing of Nichols Hall West.

STRUCTURAL (cont.)

Nichols Hall West Addition Exterior Wall Framing

The exterior walls of the addition are expected to be cold-formed steel studs with plywood sheathing. The stud wall framing was chosen for the light weight of the system and since there are no block walls below the exterior walls of the addition.

Nichols Hall West Addition Lateral System

To resist lateral loads imparted on the addition due to wind and seismic loads, concentric X-bracing and/or concentric chevron bracing will be utilized around the perimeter of the addition for the two new levels. Chevron bracing is anticipated to be utilized where windows will conflict with the X-bracing. On the east side of the addition, additional columns will be required to be installed from the new roof down to the lowest level and bear on a new foundation since the existing columns are not aligned and there are no shears walls on the east side of the building. Additional X-bracing may be required at the lower floors to transfer the lateral loads to the new foundations below.

There will be a building isolation joint between the new addition and Nichols Hall where the building is adjacent to Nichols Hall.

New Building Foundation System

Nichols Hall, Nichols Hall West and Morgan Hall are built on shallow foundations. Concrete shallow spread footings and wall footings are expected to be utilized to support columns and load-bearing walls in the new building. The new foundations are expected to be constructed at the same elevation of the existing foundations of Morgan Hall so that the existing foundations are not undermined during construction of the new foundations. The new foundations will be designed for an allowable bearing pressure determined during a geotechnical investigation to be conducted at the proposed site during design of the facility.

The foundation drawings for Morgan Hall indicated that there was a possible presence of rock pinnacles over the site which may have extend above the foundation bearing elevation. Based on this information, there may be a need for approximately 2'-0" of rock removal at some of the new foundations and backfilled with #10 stone to foundation bearing elevation.

The first-floor exterior walls will retain soil due to the slope of finished grade across the site. It is expected that these walls will be a maximum of 18-inch thick, reinforced, normal-weight, concrete walls.

To construct the new building, temporary support of excavation (SOE) will be required to be installed in the drive between the new building and south side of Nichols Hall West. The SOE is required because the bottom of the foundations for the new building is approximately 14 feet below the bottom of the existing foundations of Nichols Hall West. The distance between the two building is approximately 16 feet, thus there is not enough room to lay the excavation back to construct the foundations and lowest level of the new building. It is expected that soldier pile and lagging would be utilized for the temporary SOE. A secant pile wall could be utilized as the SOE for the site. A secant pile wall is permanent SOE and has a higher installation cost than soldier pile and lagging wall. A savings may be possible since the secant wall is permanent and would be utilized as the building concrete retaining walls eliminating the need for the cast-in-place retaining walls.

New Building Superstructure

The New building is proposed to have five (5) floors with the first-floor elevation to match the first-floor elevation of Morgan Hall. The top two (2) floor elevations of the new addition will match the floor elevation of Floor 5 & 6 of Nichols Hall. The new building is expected to be a steel-framed building with steel columns located on a grid spaced approximately 30-feet on center. The first-floor slab in expected to be a 5-inch thick, normal-weight concrete slab-on-grade (SOG) with #3 rebar at 18" oc in each direction. The SOG will have a 6" layer of compacted VDOT #21B aggregate subbase under a 15-mil vapor barrier installed directly under the SOG.

The elevated floors are expected to 4-1/4" of light-weight concrete on a 22-gauge, 2-inch deep composite deck (6-1/4" total slab thickness) supported by steel beams spaced approximately 8-feet on center. The steel beams will range from 16" to 21". The steel girders supporting the steel beam will range from 27" to 30" deep. Columns with new foundations will be required where the building projects over the drive between the new building and Nichols Hall West.

New Building Roof Framing

The roof of the new building will be framed similar to the elevated floor framing in the new building. The concrete roof will reduce the noise level in the classroom from the mechanical units on the roof.

New Building Lateral Framing

To resist lateral loads imparted on the building due to wind and seismic loads, the new building will utilize concrete masonry unit (CMU) shear walls around the perimeter of the building. The CMU shear walls will be outboard of the steel framing and will be continuous for the entire height of the building except where the CMU walls will bear on the concrete retaining walls at the first floor.

There will be a building isolation joint between the new building and Morgan Hall where the building is adjacent to Morgan Hall. There will also be a building isolation joint between the new building and the existing Nichols Hall West and the two new additional floors to be constructed above Nichols Hall West. The elevator shaft in the new building will be CMU walls that will also act as shear walls for the building.

Stair Tower Addition Between Nichols Hall and Nichols Hall West

The stair tower addition is expected to be steel framed with cold-form shaft wall where the walls are adjacent to Nichols Hall and Nichols Hall West. Additional exposed columns will be required adjacent to Morgan Hall to support the corridor at Level 3 connecting to the new building. The columns will be adjacent to Morgan Hall to keep the drive lane below open to traffic. The beams will be exposed between the corridor and the columns at Morgan Hall. The beams and columns will be required to be wrapped to protect the beams and columns from the weather and to make the aesthetically pleasing.

MECHANICAL

SYSTEM DESIGN CRITERIA

OUTDOOR DESIGN TEMPERATURES

Summer	92 F Dry Bulb
	73 F Coincident Wet Bulb
Winter	16 F

INDOOR DESIGN CONDITIONS

Heating and cooling loads will be determined in accordance with the 2015 International Energy Conservation Code and ASHRAE 183. Room temperatures and ventilation criteria listed below will be provided.

D.1.3 MINIMUM ROOM TEMPERATURES

Space	Temperature Range, Deg F
Offices	68 - 75
Laboratories	68 - 75

MINIMUM OUTSIDE AIR VENTILATION REQUIREMENTS

Space	CFM per person	CFM per square foot
Offices	5	0.06
Corridors	-	0.5
Lobbies	5	0.6
Laboratories*		

*(In accordance with the laboratory application. Otherwise same as Offices.)

EXISTING HVAC EQUIPMENT TO BE REPLACED

In our experience for institutional buildings the expected useful life of HVAC systems is much longer than that used for normal Class A offices or other high quality commercial buildings. Although predictions of "expected useful life" are generally available, we believe that for institutional building planning longer lifetime estimates should be used, anywhere from 50% to 100% longer than normal commercial use.

For convenience we have included in the Appendix expected HVAC equipment economic service life data taken from an ASHAE 1977 study (Table 1) and from the Building Owners and Managers Association (BOMA) (Table 2). These should both be considered only rough estimates as ASHRAE in their study has noted that the methods used to collect the data were not statistically correct, and the data may be obsolete for new equipment . However ASHRAE does state, "This is not to say, however, that the available information is not useful." The BOMA data is based on the experience and opinions of the author so it has similar limitations. In any case we would recommend that these be considered very conservative estimates for an institutional application.

Considering the above and assuming that the existing equipment will be at least 20 years old at the time this project is completed, we recommend the following major items of existing HVAC equipment to be replaced in this project:

1. Two 250 ton nominal capacity water cooled water chillers located in the King Hall mechanical room.
2. Two 250 ton nominal capacity cooling towers located on the roof of King Hall

Additionally, because the current dividing wall between King Hall and the Swimming Pool will be exposed the condenser water piping and the steam and condensate piping the insulation on these lines shall be replaced and new aluminum protective jackets installed. Also these lines shall be electrically heat traced.

COOLING SYSTEMS

The new addition will be served by two nominal 35 ton capacity roof mounted packaged air cooled air conditioning units. These units will serve a ducted air supply system utilizing variable air volume units for space temperature control. Each air handling unit will be equipped with variable speed fans for space variable volume control and will have enthalpy controlled fan powered relief type economizer sections.

In addition to the two rooftop air conditioners, a 25 ton capacity dedicated ventilation air unit will be provided to supply makeup air for the engineering laboratory ventilation systems. This system will be provided with an energy recovery wheel for sensible and latent cooling. This energy wheel will be provided with a purge section to acceptably eliminate any cross contamination between the supply and return air path.

In general air supply to the building spaces will consist of ceiling mount diffusers in spaces with ceilings and registers in other spaces. Return air intakes will be provided using ceiling or sidewall grilles. Non- ducted ceiling plenum air returns will be used in spaces with ceilings,

HEATING SYSTEMS

The principle heating systems will be provided using hot water heating coils in the outlet of each VAV box. Additional space heating will be provided in stairwells and other non-cooled areas using cabinet unit heaters. Pre-heat for ventilation and supply air will be provided using hot water coils with integral face-and-bypass dampers in conjunction with coil circulating pumps. The hot water will be generated at approximately 140 F using a shell and tube steam-to-water heat exchanger supplied by 60 psi steam. this steam at approximately 1150 pounds per hour will be extended from the supply in the lower level of the existing building. Duplex hot water pumps will be located in the utility room along with the expansion tank, air/dirt separator and pressure relief valve for the heating hot water system.

Two-way valves with low voltage DDC electric actuators will vary the flow through the heating coils except for the preheat coils, which should utilize three-way valves and circulating pumps.

VENTILATION SYSTEMS

Occupant and general space ventilation will be provided in accordance with the Building Code as indicated above while equipment rooms and electrical rooms with transformers will be ventilated at a minimum rate of 4 air changes per hour. General exhaust ventilation will be provided in laboratories with non concentrated contaminant emissions. Laboratories with specific equipment requiring it will be provided with local exhaust ventilation at approximately the following rates:

- fi fume exhaust, 600 cfm per nozzle
- table saws and other wood working eqipment, 350 cfm per nozzle
- cement bag dumping hoods, 875 cfm per hood
- chemical fume hoods, 600 cfm per hood

Local fans shall be provided near each exhaust point and will convey the air through an appropriate collector or filter then to the make up air unit on the roof. The make up air unit will be provided with a low bypass energy recovery wheel and a purge section to minimize cross contamination with the supply.

ELEVATOR MACHINE ROOM

The elevator machine room will be provided with a ductless split system.

MECHANICAL (cont.)

DUCT DISTRIBUTION SYSTEMS

Supply ductwork construction will be based on SMACNA 4 inch pressure and 2 inch pressure. 4 inch pressure duct construction will be used upstream of VAV boxes, while 2 inch pressure duct construction will be used downstream of VAV boxes. All ductwork seams and joints will be sealed, regardless of pressure rating. Return and general exhaust ductwork construction will be based on SMACNA 2 inch negative pressure.

PIPING DISTRIBUTION SYSTEMS

All piping will be tested at 1.5 times the design system pressure or a minimum of 100 psi, whichever is higher.

Piping Materials:
• Hot Water and Chilled Water: Schedule 40 ASTM a53 steel or Type L copper for mains, Type L copper or schedule 40 ASTM A53 steel for run outs to terminal units.

• Condensate Drains: Type L copper or schedule 40 CPVC where protected from direct sun.
Sizing Criteria:

• Hot Water: Approximately 4.0 ft. wg/100 ft. or 10 fps. 5 fps for copper tube.

• Coil Condensate: Same size as equipment connection.

INSULATION

• Insulation type and thickness will meet or exceed energy code performance requirements.

•Hot water, and condensate drain piping will have fiberglass pipe insulation and an all-service jacket.

• Supply ductwork will be insulated using flexible fiberglass insulation for concealed applications and rigid fiberglass insulation for exposed applications (such as mechanical rooms). Return ductwork within mechanical rooms will also be insulated.

• Outdoor insulation will be protected with adhesive bituminous covering such as Alumagard. Closed cell insulation will be applied.

PUMPS

Pumps will be base-mounted, variable flow, single stage, centrifugal type, complete with inverter duty motor, cast-iron casing, bronze impeller, seals, casing and impeller wearing rings, cast-iron base, stainless steel shaft supported on ball bearings and direct connected through flexible couplings. All pump motor selections will be based on non-overloading through the full range of the pump curve. All pumps will have variable speed drives.
D.11 VARIABLE AIR VOLUME BOXES
Variable volume boxes will be acoustically lined, system pressure independent with maximum and minimum adjustments, low leakage (less than 3 percent with 4 inch S.P.), low-pressure drop, flow sensor, and hot water heating coils.

MOTORS

All motors, except for variable speed motors, will be built per NEMA Standard with high temperature winding insulation. Motors will be premium efficiency type.

ENERGY CONSERVATION MEASURES

The following energy conservation measures will be incorporated into the HVAC design:

• Direct digital control building automation system for optimization of major HVAC equipment operation.

• Supply air temperature reset to minimize air conditioning of outside air and reheat of conditioned air.

• Variable speed drives installed on all variable air volume and constant volume air handling unit supply and return fans to reduce fan horsepower requirements at non-peak conditions.

• Full economizer control on all air handling units to reduce energy consumption.

• Demand controlled ventilation where applicable to limit the quantity of outside air.

• Heat recovery wheel for the exhaust system.

• Variable speed drives installed on hot water pumps to reduce pump horsepower requirements at non-peak conditions.

BUILDING CONTROLS

A new web-based DDC Building Automation System will be used to control the mechanical equipment within the facility. Operating points and alarms will be viewable. Room temperature and humidity set points will be adjustable. Metering will be installed for energy monitoring.

Additionally, when Cocke Hall Annex is razed, an existing pipe chase now concealed by the razed building will be demolished. The east façade of King will be redesigned and constructed architecturally consistent with its other three facades. It is believed from a study of the original construction drawings and field observations that the only piping now in the chase is specific to the swimming pool in Cocke Annex. If however piping serving King Hall is also co-located in this space (i.e., condenser water piping, and/or steam & condensate piping), the insulation on these lines shall be replaced and new aluminum protective jackets installed, and electrically heat traced. Alternatively, the lines in question could be re-routed internal to the King Hall floor plates to coordinate with and facilitate the architectural treatment of the re-designed east wall.

ELECTRICAL

SITE ELECTRICAL UTILITIES

ELECTRICAL SERVICE LOAD ESTIMATE

- Please refer to the Appendix for the Electrical Utility Square Foot Load Summary.

E.1.2 ELECTRICAL SERVICE

- The electrical service for the new Nichols Hall addition will be provided from the Post medium voltage, 3-phase distribution system.

- The secondary for the new Nichols Hall addition will be 1000 amp, 480Y/277 volts, 3-phase, 5-wire provided by a new 750 kVA exterior pad mounted transformer. A new 1000 amp main distribution switchboard, with a 1000 amp, 100% rated service disconnect breaker shall be installed on the ground floor of the new Nichols Hall addition. A new 200kw generator serving only the new Nichols Hall addition will be provided for emergency power supply

- The electrical distribution equipment for the existing portion of Nichols Hall, including Nichols Annex and Morgan hall will remain, however the existing 750kVA transformer along with the existing emergency generator will require relocation outside the new addition footprint.

- The relocated generator and transformer for the existing portion of Nichols hall, along with the new 750kVA transformer and 200kw generator serving the new Nichols Hall addition shall be located approximately 60ft to the South of the existing location. A concrete retaining wall enclosure, similar to the one enclosing the King Hall and Jackson Memorial Hall transformers will be used.

- Four (4) 5 inch conduits encased in concrete will be routed from a new manhole at the Post medium voltage loop. 2 conduits shall carry the primary conductors to the relocated transformer serving the existing Nichols Hall, and 2 conduits shall carry the primary conductors for the new transformer serving the new Nichols Hall addition.

- Due to the location of the Post network distribution and server room in Nichols Hall, special precautions, including the use of a temporary portable generator, shall be taken to minimize the interruption of utility power and generator backup during construction.

ELECTRICAL DEMOLITION AND SERVICE RELOCATION AT COCKE AND KING HALLS

- The existing transformer serving Cocke Hall shall be removed and the existing electrical service which extends from the transformer along the interior chase between Cocke and King Hall shall be demolished. All electrical distribution equipment for Cocke Hall shall be also be demolished.

- The existing Post telecommunications backbone extending the length of Cocke Hall shall be relocated to underground concrete encased ductbank. Special precautions, including temporary backbone routing around the Cocke Hall demolition area, shall be used to minimize the impact on Post telecommunications.

- The existing electrical services for King Hall and Jackson Memorial Hall shall be intercepted underground before entering the chase between Cocke and King Hall, and shall be relocated into new underground concrete encased ductbank running the length of King Hall. The new portion of ductbank shall then tie back in to the existing underground concrete ductbanks extending to the King Hall and Jackson Memorial Hall service entrances.

BUILDING ELECTRICAL SERVICES

SECONDARY DISTRIBUTION

The secondary distribution will be designed to respond to the power needs of this building program with the flexibility to accommodate future space/function changes. The distribution system will be designed to provide the reliability and flexibility required in Post facilities, with special considerations for separation of lighting, receptacle and motor loads.

Secondary distribution voltage will be 480 volts, 3 phase, 4 wire, plus ground. This will provide service to equipment and lighting loads. This will be further transformed down to 208Y/120 volts, 3 phase, 4 wire plus ground as necessitated by the building loads and their location. Generally, this lower voltage will be utilized for receptacles, miscellaneous equipment, etc.

The new secondary distribution system will be separated into the following branches as required by code:

- Normal: This branch provides normal source power to the bulk of the facility load such as general lighting and receptacle loads, miscellaneous equipment loads, mechanical equipment loads, etc., which are not essential to building or user functions; therefore they are not connected to an alternate source of power.

- Emergency (NEC Article 700): This branch provides continuous (normal or alternate source power for the following equipment essential for the safety of human life.

- Interior building means of egress lighting and illuminated exit signs.

- Exterior building means of egress lighting immediately adjacent to exit discharge doorways and select fixtures along the pathway to the parking area.

- Fire detector and fire alarm systems.

- Elevator machine room lighting and receptacles, elevator cab lighting, control, signal, and communications systems.

- Generator set location, task illumination, battery charger, emergency battery powered lighting units, and selected receptacles.

- Optional Standby Branch (NEC Article 702): This branch provides continuous (normal or alternate) source power for systems intended to protect public or private facilities or property where life safety does not depend on the performance of the system. The requirements for equipment and devices to be connected to the standby power system will be reviewed with the Post personnel in subsequent meetings and may include the following:

- Telecommunications room lighting, equipment and data processing systems.

- Electric and mechanical room receptacles (selected).

- Mechanical equipment including: AC split systems for telecommunication rooms and elevator equipment room; condensate return pumps; hot water heating and glycol circulation pumps; heat trace cable for exterior piping and roof drain lines.

- Plumbing equipment including: domestic water booster pumps; sewage ejectors and sump pumps.

ELECTRICAL (cont.)

• Automatically operated doors at handicapped building entrance.
The new secondary switchboards and panelboards will utilize copper on phase and neutral buses with copper ground bus. Panelboards will be provided with 25 percent spare loading and pole capacity; 10 percent spare breakers will be provided in branch circuit panelboards.
All dry type transformers will be CSL-3 115 degrees rise, 220 degrees C insulation class with six 2-1/2 percent taps. Where appropriate neutrals will be oversized within the building distribution system to handle the heating effects of the harmonic loading.

Circuit protection will be:
• Generally, bolt-in type molded case circuit breakers for panelboards.

• Solid state circuit breakers for main distribution equipment to allow device time current coordination.

• 100 percent rated for service entrance main circuit breakers, 80 percent rated otherwise.

• Electronic circuit breakers for primary side of transformers to account for high inrush current in the transformer.
Devices will be fully rated. Series ratings of protective devices will not be acceptable.

Ground fault protective devices will be provided at the main and feeder sections of the main switchboard.
A contactor arrangement will be provided in the main elevator feeder(s) to meet elevator shaft sprinkler code requirements.

EMERGENCY POWER SUPPLY SYSTEM

EPSS Secondary Distribution:

Emergency power for life safety lighting and emergency systems will be derived from a new 200 kW diesel, 480/277 volt, 3-phase, 5-wire stand-by generator. Emergency distribution feeders will emanate from the distribution panel or separately enclosed breakers to automatic transfer switches.
Transfer switch loads will feed code mandated individual distribution branches as outlined in the secondary distribution section of this report. Greater than 3 cycle transfer switches will be considered where fault current level is likely to be very high (65 kA) or when their feeder breakers have short-time delay.

MI (Mineral Insulated) cable will be utilized for emergency system feeders and generator control wiring, which are not installed in spaces fully protected by an automatic sprinkler or suppression system or are not protected within 2-hour fire rated enclosure/spaces.
Emergency system feeder equipment (including transfer switches, transformers, panelboards) will be installed in spaces fully protected by automatic fire sprinkler of suppression systems or be protected within 2-hour rated spaces.
The emergency distribution system will provide for ground fault sensing at the generator set main breaker with a signal of such a condition provided to the remote annunciator. No tripping will be provided for such a ground fault condition as per code requirements.

UNINTERRUPTIBLE POWER SUPPLY SYSTEMS

The existing centralized UPS system serving the Post network distribution and server room shall remain in service. Owner will furnish local UPS equipment for any additional IT server room(s).

LIGHTING SYSTEMS

GENERAL LIGHTING DESIGN CONCEPTS:

To be developed in collaboration with the design team, the lighting design concepts will provide holistic integration of electric and natural lighting systems within the architectural environment. The lighting systems will be designed to enrich the building's environments by meeting the visual needs of the building users while complimenting the architecture and surface finishes. The lighting will be developed in full support of programmatic requirements and will be designed to provide illuminance levels in accordance with IESNA recommendations
The lighting system will support the sustainable design and energy efficiency goals of the project and will be designed to enhance visual quality while minimizing lighting energy use. Efforts will be taken to reduce the lighting load without compromising functionality or quality of the illuminated environment.

LIGHTING EQUIPMENT

Luminaires:
Lighting systems will be specified to provide energy efficient lighting which enhances the quality of the lighted environment.

• Luminaire construction quality, especially with regard to reflectors, shielding, and lenses, is critical to the successful design of low energy, high visual quality spaces. Luminaires will be specified as high quality specification grade equipment by reputable manufacturers and CE/UL/IP listed for the application.
• Luminaire manufacturers will be limited as much as possible to simplify maintenance, reduce replacement part stocking, and increase cost efficiencies for the project.

• Decorative and custom luminaires will be considered and specified only where appropriate for specialized design treatment.

• Luminaires will be specified and located with accessibility and maintenance in mind.

Light Sources:
• Luminaires will generally be specified LED light sources. Linear fluorescent luminaires will be specified only where LED sources are not able to provide the required to achieve the required lighting levels or as requested by the Institute.

• Lamps for interior areas will be specified to have a high quality, color rendering index (CRI) of 80 or greater with color temperature of 3500 or 4100 degrees K. LED lamps will be specified with the highest color rendering options available and appropriate to the luminaire and application.

• Lamps for exterior luminaires will be specified to have a high quality, CRI of 80 or greater with color temperature of 4100 or 5000 degrees K.

• Long life versions of lamps will be specified where available to reduce long term maintenance costs. LED sources will be selected to consider future component replacement and length of the manufacturer's warranty period.
The specification of incandescent or halogen lamp-based luminaires will be considered only where the design calls for their unique qualities and where other alternatives are not feasible. In these instances, LED replacement lamps with integral drivers will be specified in lieu of incandescent or halogen lamps.

• Low mercury versions of linear fluorescent will be specified. The design will endeavor to minimize the variety of lamp types to simplify purchasing, storage, and maintenance.

ELECTRICAL (cont.)

Ballasts and Drivers:

• Fluorescent ballasts will be specified as high efficiency, electronic, program start type with normal ballast factor. High and reduced light output ballasts may be specified as necessary to provide appropriate lighting with minimal load.
Dimming ballasts and drivers will be specified in luminaires where a dimmed environment is required and in locations where daylight responsive controls with ample daylight is anticipated.

• Dimming ballasts and drivers will be specified to dim to 10 percent light output, or less, and will be fully compatible with dimming control equipment. Remote drivers may be required for certain LED luminaires.

LIGHTING DESIGN STRATEGIES

Interior Lighting:
Preliminary illuminance targets for major interior space types for this project have been outlined below. These targets are intended to establish common objectives for the lighting design and are subject to review and acceptance by the design, engineering, and user teams.
• Illuminance targets are based on recommendations by the IESNA and lighting design experience.

Space	Illuminance Target (horiz. foot-candles at work surface)
Classroom	30-40
Laboratory	50-100
Shops	30-50
Office	30-40
Circulation	10-15
Stairs	10
Storage / Mechanical	25-30

The direction and distribution of electric light will be carefully considered for its maximum perceived impact on the interior areas. Emphasis will be placed on vertical illumination to mitigate daylight contrast issues, create a stronger sense of brightness to offer visual cues and orientation, and render architectural materials to their best advantage.

Exterior Lighting:
Lighting treatment of exterior environments will be designed to further enhance the visual experience, and will complement the architecture of the building.

• Exterior façade, landscape, and grounds lighting will subtly highlight identifying elements of the building and its surrounds within the confines of the applicable codes and ordinances.

The safety of building occupants is of primary concern and special consideration will be given to the lighting design where enhanced security is a priority. Pathways and building exits will be illuminated to appropriate levels to meet safety and security guidelines as illustrated in IESNA recommendations.

• Higher illumination levels may be specified where high level security and video surveillance equipment is required.

Emergency, Life Safety and Egress Lighting:

• A complete system of emergency egress and exit lighting will be provided in compliance with applicable codes and standards.
Exit signage will be specified in accordance with the building codes enforced in the locale. Illuminated "Exit" signs will be specified with energy efficient LED light sources.

Strategically arranged corridor lighting luminaires will be specified and controlled to provide code mandated emergency egress lighting.

LIGHTING CONTROLS

Local Control:

• Lighting controls will be provided to minimize electric lighting energy. Multi-level switching, dimming, daylight sensors, occupancy and vacancy sensors, electronic timers and automatic schedule based controls will be applied as appropriate.

• Sensing devices will reduce and/or turn off the associated electric lighting when the space is not occupied and/or when sufficient daylight is present.

• A user override for fixture dimming shall be provided for office, classroom, and laboratory spaces, however, if daylight harvesting sensors are present, this user dimming control shall not allow the brightness in the room to exceed the set target brightness.
Networked Low Voltage Control (NLVC):
A networked low voltage (100-600V) central lighting and plug load control system utilizing relay zoned controls with sensor based, timed, and daylighting control functions will be specified to enhance energy savings.
• Integration: Network gateways will be provided for data links to:

Building Automation System (BAS):
• Lighting control functions will be specified for both interior and exterior applications.

• Plug load control functions will focus on controlling loads left on when not required.

ELECTRIC POWER MANAGEMENT SYSTEM (EPMS)

Web based digital electrical metering systems will be provided to monitor and alarm:
• Electrical loading and protective device positions.

• Service entrance equipment mains and feeders.
Reporting: Device, Assembly, and central operator's PC interfaces will be provided to meet Owner requirements. User friendly custom graphic PC monitoring and controls will be provided to proactively respond to building systems status.

Custom reporting analyses will be provided to:

• Alarm preset conditions.

• Identify trends for proactive operating conditions.

• Identify preventive maintenance measures.

• Allow for LEED points in required Measurement & Verification analyses.

Integration: Network gateways will be provided for data links to:

ELECTRICAL (cont.)

- Networked Low Voltage Control Systems (NLVC).
- Building Automation Systems (BAS).

POWER QUALITY FILTERING SYSTEMS

Surge Protection Devices (SPD):
Transients (surges, lightning, switching events) can introduce harmful voltage or current spikes to electronic equipment used through the facility.
SPD filtering devices will be installed on the main service entrance switchboard. Sensitive equipment may require multiple levels of protection to not only protect equipment from utility disturbances, but also from each other. Additional protection will be analyzed as the design progresses.

LIFE SAFETY SYSTEMS

FIRE ALARM

The existing fire alarm system serving Nichols Hall shall remain in service. Battery, and I/O capacity shall be expanded to handle the addition of devices in the new Nichols Hall addition.
The layout of initiation and notification devices in the existing portion of Nichols Hall shall be modified based on the new use of those spaces.
The system modification and expansion will be divided into the following three major components:

- Detection and signaling system.
- Voice communication system.
- Firefighter's radio communication system.

Detection and Signaling System:
The modified and expanded fire alarm detection and signaling system will have an upgraded battery or UPS power to function for four hours during a major power failure.

These systems will provide complete fire detection and alarm capabilities monitoring manual pull stations and automatic detectors supplied and connected under the electrical section as well as monitoring sprinkler system waterflow and valve position indicators provided by the mechanical section. Signaling devices will be via an audible speaker system and visual flashing indicator lights for the hearing impaired. These systems will be audibly coded utilizing a selection of audio tone and voice signaling over loudspeakers utilized for fire alarm and evacuation signals.

In an alarm condition, the fire alarm system shall also initiate the following:

- Door unlocking and release.
- HVAC smoke damper control initiation if present.
- Control elevator system recall operations.

Voice Communication System:

The same speakers utilized for audible tone will be utilized for emergency paging from the emergency command center to provide for special instructions. Prerecorded messages will be provided as dictated by design. Dual amplification and alternating wiring to speakers from the amplifiers will ensure proper redundancy in this high rise building.
The speaker system design will require voice intelligibility enhancement in all egress paths and places of assembly.

Firefighter's Phone System:
A firefighter's UHF radio communication system will be installed, per local fire Division requirements.

Specific code mandates include:
A predetermined message shall be provided to the alarmed area while normal alert tones are provided to all areas. The voice communication public address system shall provide coverage to elevators, elevator lobbies, corridors, exit stairways, and rooms over 1,000 square feet.
Wiring will be as recommended by the manufacturer. All wiring will be supervised and installed in conduit raceways.

LIGHTNING PROTECTION

A roof perimeter and peaks Franklin rod type copper lightning arrestor system will be installed per NFPA 780 requirements.

ELECTRICAL COMMON WORK RESULTS

WIRE AND CABLE

- Conductor material: Copper.
- Feeders (100 - 600 volts): XHHW, THHN.
- Branch circuits: THWN, THHN.
- Below 100 volts: per UL class and associated system manufacturer requirements.
- AC and MC cable wiring methods will not be used.
- Plenum rated cable will be considered for signal wiring (not including fire alarm) in areas where the ceiling space will be utilized for return air HVAC system cavity. Otherwise, wiring systems in these areas will be installed in conduit.

CONDUIT AND RACEWAYS

The following types of raceways will be specified for the applications listed:

- Underground: RGS, IMC, PVC:
- Electric Service and under roadways: Concrete encased.
- Feeders (100 - 600 volts):
- Generally: RGS, IMC, EMT.
- Wet locations: RGS, IMC.
- Branch Circuits:
- Generally: RGS, IMC, EMT.
- Wet locations: RGS, IMC.
- Below 7 ft. in equipment rooms: RGS, IMC
- In slabs: RGS, IMC, PVC.

ELECTRICAL (cont.)

WIRING METHODS

• A separate green ground conductor will be installed in each feeder and branch circuit redundant to the raceway equipment ground path.

• Dedicated neutrals will be used for all branch circuits. No shared neutrals will be allowed.

• 200 percent neutral conductors will be installed in feeders used for serving harmonic generating loads.

• AC and MC cables will not be used.

• All penetrations through fi re and smoke partitions and floors will be firestopped.

• Fishwires will be installed in all empty raceways.

WIRING DEVICES

• Standard styles with coverplates to match wiring device color will be specified.

• Switches:

• Generally specification grade quiet type.

• Illumination toggle type for emergency and night light switching.

• Receptacles:

• Specification grade.

• Generally NEMA 5-20R.

• Networked low voltage controlled receptacles will include an LED energized indicator light.

• GFCI receptacles will be utilized within 6 feet of a sink.

• Plugstrip will be utilized in work areas.

• Special receptacles or required voltages/ampacities will be provided as dictated by design.

IDENTIFICATION

• Electrical distribution equipment and communication/special systems cabinets will be systematically colored and labeled with screw mounted nameplates.

• Coverplates will be systematically engraved for emergency power receptacles, large switchbanks, and communications/special systems receptacle jacks.

MECHANICAL AND EQUIPMENT CONNECTIONS

• Power wiring shall be provided for all Division 23 equipment including all packaged equipment starters, local disconnect switches, and thermal overload switches.
• Outlets will be provided for controls in each mechanical room.

• Power to all elevators including wiring to controllers.

• Power will be supplied to overhead doors, dock levelers, power mandoors, etc.

• Handicapped and other powered entrance doors to be connected to the motor and controller. Provide push button in mullion.

• All equipment will be provided with the appropriate electrical power connection.

BRANCH POWER RECEPTACLES AND CONNECTIONS

• Receptacles: In general, receptacles shall be provided where needed, including the following:

• Mechanical, electrical, and storage areas, generally one per wall.

• Provide in each lobby, corridor, hallway, etc., a maximum of 50 feet on center.

• Provide three duplex and one quad in each office, meeting area, and conference room.

• Provide GFCI type receptacles at counters in each washroom, within 6 feet of a sink, housekeeping closets, vending machines, elevator pits and elevator machine rooms, and other locations as required per NEC. All exterior receptacles shall be GFCI type with "In Use" weatherproof cover.

• Within 25 feet of mechanical equipment.

• Power connections shall be provided for electric water cooler for drinking fountains and electric valve systems.

• Power connections shall be provided to office equipment (copiers, printers, plotters, computers, etc).

• Overhead busways with modular disconnects shall be provided in all laboratory and shop spaces to serve instructional equipment and machinery. This will ensure flexibility for equipment layout, and type of connected equipment.

•Divided cable raceways with power and low-voltage sections will be provided in all classroom and computer lab spaces to serve computer and other 120V loads. This will ensure flexibility for furniture layout, and type of connected devices.

ELECTRICAL SYSTEMS QUALITY

ROTECTIVE DEVICE COORDINATION STUDY

A short study, arc flash study, rating equipment interrupting evaluation, and a protective device coordination study for the new electrical distribution system will be performed by the successful supplier for their specific equipment. The Contractor will be required to verify the proper equipment and adjustable protective device settings.

SUBMITTALS

The Contractor will be required to assure compliance with the Contract Documents by submitting the following:

• Shop Drawings: showing equipment compliance.

ELECTRICAL (cont.)

• Field Test Reports: showing installation and operating compliance.

• Operating and Maintenance Manuals: Showing operating and maintenance procedures (may include demonstration video tapes).

INSPECTIONS AND TESTING

Field testing of the electrical systems will be specified to assure that the equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.

For life safety systems and main electrical distribution system components, the Contractor will engage the services of a recognized corporately and financially independent testing firm for the purpose of performing the tests.

The Contractor will be responsible to correct any deficiencies found in the testing process as well as any required retesting.

PLUMBING

PLUMBING SYSTEMS

UTILITIES

Sanitary Sewer:
• The existing 4 inch sanitary sewer now serving the Annex will remain to serve the new addition.

Storm Sewer:
• The existing 6 inch storm sewer now serving the Annex will remain to serve the new addition.

Domestic Water:
• The existing 3 inch domestic water service now serving the Annex will remain to serve the new addition.

Natural Gas:
• The existing 1/2" natural gas supply currently extended from Nichols Hall will be re-used and routed to serve the new Laboratories.

DOMESTIC WATER SYSTEMS

• Water shall be routed to the various fixtures and water heaters via piping systems. The existing 3" water service to the Annex will be maintained and provided with a new pressure reducing valve assembly and a reduced pressure zone backflow preventer.

• The expanded facility will utilize the existing supply water pressure to supply all fixtures and equipment. No booster pump system is anticipated to be required at this time.

• The domestic hot water system shall provide 115° F hot water for all locations where fixtures for hand washing occur. It's not expected that higher temperatures will be needed for the Laboratories. A recirculating hot water maintenance system shall be provided to maintain the temperature of the water in the piping system.

• Some of the Laboratories will have eye/face wash fixtures and safety showers. Due to the high volume of tepid water required for these units, especially the safety showers, the existing electric storage hot water heating system will be replaced with a steam converter system.

• Water make-up to the mechanical equipment shall be supplied through local backflow preventers.

PLUMBING (cont.)

• Isolation valves for the domestic water will be provided to isolate individual fixtures within one room or a battery of fixtures within one room.

• Cold-water piping shall be insulated with fiberglass pipe insulation with vapor barrier to prevent sweating. Hot water piping shall be insulated with molded sectional fiberglass pipe insulation to prevent heat loss in accordance with the current edition of the International Energy Conservation Code. (Currently the 2015 Edition).

• Wall hydrants shall be placed on the exterior of the building a maximum of 150 feet on center and at a minimum of at least one hydrant on each accessible building face 50 feet on center.

SANITARY WASTE AND VENT SYSTEM

• The waste system shall connect to each fixture requiring connection and where required will be provided with water seal traps. A vent system shall be provided for fixtures as required to ventilate the waste system and to prevent siphonage of fixture traps.

• The elevator pit shall be provided with an elevator sump pump which discharges to the sanitary drainage system through an open site waste connection. For hydraulic elevators the sump pump shall have an oil monitoring system that prevents the pump from operating when hydraulic oil is present and sends and alarm to the building personnel. The capacity of the elevator sump pump shall be a minimum of 50 gpm.

STORM WATER SYSTEM

• The storm drainage system shall be connected to each roof drain and be routed by gravity to the site storm sewer. Provisions for secondary overflow drainage system will be provided. Secondary system will be sized based on the primary system sizing and will discharge on grade outside the building.

• Storm water piping above ground shall be insulated with fiberglass pipe insulation with vapor barrier to prevent sweating.

• A perimeter foundation drainage system shall be provided around the exposed perimeter of the building.

PLUMBING FIXTURES

Fixtures and Trim:
• Fixture Trim and Accessories will be provided including fixture carriers, faucets, drain outlets, tailpieces, P-traps, stops and supplies.

• Finish: All trim exposed to view shall be polished chrome plated.

• P-Traps: Cast brass adjustable P-trap with cleanout plug, ground joint and 17 gauge minimum weight extension with escutcheon.

• Drain Outlets: Provide a drain outlet of the same manufacturer as the fixture or faucet trim with chrome plated cast brass plug with 17 gauge minimum weight tailpiece. Provide 1-1/4 inch tailpiece on lavatories and 1-1/2 inch on sinks.

• Stops and Supplies: Chrome plated brass with stop and escutcheon flexible riser.

• All faucets, water coolers and drinking fountains shall be constructed of a lead free brass alloy and where applicable, shall be certified to comply with NSF 61 Section 9 Drinking Water Standard.
Public Areas:

• Water Closets: Wall hung, 1.6 gallons per flush siphon jet elongated, vitreous china with automatic type flush valves. Each toilet room shall have a minimum of one fixture mounted for ADA compliance.

• Urinals: Wall hung, 0.125 gallon per flush washout type, vitreous china with automatic flush valves. Each toilet room shall have a minimum of one fixture mounted for ADA compliance.

• Lavatories: Wall mounted or countertop as indicated on the drawings. Faucet shall be a chrome plated unit with integral spout with infrared – hands free operation. Each toilet room shall have a minimum of one fixture mounted for ADA compliance and shall include water supply and trap insulating kits.

• Showers: Single lever, pressure-balanced type mixing valve with deluxe shower head with 2.5 gpm flow rate. Ceramic tile base and wall construction with floor drain. ADA units shall have a floor drain in the vicinity of the shower base.

• Mop Service Basins: 36" x 24" Floor mounted molded stone. Faucet shall be a wall mounted chrome plated combination faucet with vacuum breaker. A separate cold water faucet with vacuum breaker shall be provided for connection to the chemical dispensing unit provided by others.

• Sediment traps. Certain laboratory sinks shall be fitted with sediment traps as required for the lab work. In the Concrete Laboratory a nominal 4ft. x 4ft. size cement and aggregate trap will be constructed in the floor.

• In the environmental lab, the sink drainage will use acid resistant piping.

• Electric Water Coolers: Dual-height with stainless steel trim twin receptors with integral chilled water unit.

Natural Gas Piping:
• Low pressure natural gas piping shall extend from Nichols Hall.
• Piping for above ground system shall be screw fitted Schedule 40 black steel except final runouts of exposed piping may use flexible stainless steel gas tubing. All concealed piping shall be welded.

Water Heater:
• Due to high volume of hot water required for the Laboratory safety showers a steam to hot water converter system will be used for domestic hot water generation. This unit will utilize steam delivered from Nichols Hall. A pumped condensate return system will be used to deliver condensate to the return piping in Nichols Hall.

PLUMBING MATERIALS AND EQUIPMENT

Valves, Flanges, and Unions:
• Water valves 2 inches and smaller shall be all bronze ball type full port Teflon seated ball and 2-piece valve body designed for 600 psi water and shall have threaded ends with sweat adapters.

• Water valves 2-1/2 inches and 4 inches shall be all bronze ball type with full port Teflon seated ball and 2-piece body designed for 400 lbs. non-shock cold water and shall have threaded ends with sweat adapters.

• Water valves 4 inches and larger shall be ferrous alloy, flanged ends, with EPDM liner.

• Check valves shall be horizontal swing free away type.

PLUMBING (cont.)

• Pressure reducing valves and stations shall be spring adjustable bronze type with union connections and integral strainer. Provide pressure gauges and shut-off valves on inlet and outlet of all pressure reducing valves.
Temperature and Pressure Relief Valves:
• Units shall be in compliance with ANSI Z21.22, requirements and AGA certified, ASME rated, automatic reseating to suit installation, 150 psi pressure setting, 210° F setting.

Unions:
• Unions on copper piping shall be bronze minimum working pressure of 200 psi.

• Unions on steel and iron shall be ferrous ground joint brass to iron, rated for the working pressure of the system.

• Copper Tube Connections: All copper tubing will be connected with press type fit couplings. No soldering will be permitted.

Water Distribution:
• All Aboveground Potable Water Systems:

• Tubing to be Type L hard temper with wrought copper fittings conforming to ASTM B88-and ASME B16.22. All joints shall be fitted as noted above. Welded joint polypropylene tubing may be substituted in suitable locations.

• For final runouts to the individual plumbing fixture stops, polypropylene piping may be used.

Drainage and Vent Piping:
• Aboveground Soil, Waste, Vent and Rainwater Piping:
• Hubless Cast Iron Soil Pipe: No-hub pipe with 4-band clamp Sealing gasket shall be neoprene in accordance with ASTM C564, CISPI 301-75.

• PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste and vent patterns. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). Use adhesive primer that has a VOC content of 550 g/L of less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

Below Ground Soil, Waste, Vent and Rainwater Piping:
• Asphaltum coated, service weight, cast iron pipe and fittings with resilient neoprene push-on joints, ASTM A72, ASTM C564-70.

• PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste and vent patterns. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). Use adhesive primer that has a VOC content of 550 g/L of less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

Waste and Vent Systems 2 Inches and Smaller:
• Tubing to be Type L hard temper with wrought copper fittings conforming to ASTM B88-and ASME B16.22. All joints shall be press fitted as noted above.

• PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste and vent patterns. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). Use adhesive primer that has a VOC content of 550 g/L of less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

• Acid Resistant Laboratory Sink Piping: As required for drainage delivery to an acid neutralizer piping shall be CPVC piping except in return air plenums where PVDF piping shall be used. All fittings shall be manufactured for the type of piping used.
Plumbing Specialties:

Hose Bibbs and Wall Hydrants:
• Hose Bibb for Toilet Rooms: Chrome plated brass, 3/4 inch with vacuum breaker and loose tee handle.

• Hose Bibb in Mechanical Areas: Inlet and threaded outlet, rough brass, loose tee handle.

• Wall Hydrants in Recessed Box: Anti-siphon, lockable, all bronze interior, 3/4 inch solder inlet, stainless steel box and cover with identification.

Backflow Preventers:
• Reduced Pressure Backflow Preventers:

• 2 Inches and Smaller: Bronze body, stainless steel check seats, unions, strainer and shutoff valves.

• 2-1/2 Inches and Larger: Stainless steel body and stainless steel trim, flanged, strainer and shutoff valves.

• Provide an air gap fitting and full size indirect waste to floor drain.

Vacuum Breaker:
• For Hot or Cold Water: Bronze, atmospheric vent, clean plated in exposed, finished areas.

Plumbing Specialties:
• Cleanouts shall be furnished and installed at all locations required by applicable Codes, in accessible locations, at bottoms of soil and waste stacks, and other locations shown on the drawings and at each change of direction. All cleanouts shall be brought up to finished floor. Outlets shall be caulked or no hub type.

Floor Drains (FD):
• Toilet Rooms, Shower Rooms and Plenums Dura-coated cast iron body with bottom outlet, combination invertible membrane clamp and adjustable collar and nickel bronze strainer with flashing clamp device.

• Mechanical Rooms: Dura-coated cast iron body with bottom outlet, seepage pan and combination membrane flushing clamp and frame for anti-tilt heavy duty slotted grate with suspended sediment bucket.

Roof Drains (RD):
• Dura-coated cast iron body with combination membrane flashing clamp/ gravel guard and low silhouette aluminum dome, supplied with underdeck clamp and vandalproof secured top.

FIRE SUPPRESSION

A wet pipe sprinkler system will provide fire suppression throughout the new addition. The system will consist of a new 6" supply extended from the existing 6" supply main located in Nichols Hall. A new 6" alarm riser will be added to the existing main and will serve a new manual wet type Class I standpipe located in the proposed new stairwell. This new standpipe will act as a combined standpipe-sprinkler supply and shall serve floor control valves for the sprinkler supply on each level. The standpipe shall also provide 2-1/2" fire Department hose connections on each level.

DESIGN CRITERIA

Sprinklers shall be provided throughout the building to protect all areas, including electric rooms and elevators. Sprinklers for the elevator will be a preaction system in accordance with the requirements of the current edition of the "Virginia Construction and Professional Services Manual" (currently the 2019 Rev 0 Edition). All sprinkler work will comply with the applicable edition of NFPA 13, "Standard for the Installation of Sprinkler Systems" (currently the 2013 Edition).
The standpipe will comply with the applicable edition of NFPA 13, "Standard for the Installation of Standpipe and Hose Systems" (currently the 2013 Edition).

Sprinklers in mechanical rooms, storage rooms and laboratories shall be designed to meet Ordinary Hazard Group 1. Other areas shall be designed to meet a Light Hazard classification except elevators shall be designed to meet Ordinary Hazard Group 2.

Application:
Light Hazard:

- Classrooms.
- Offices.
- Corridors.
- Toilet Rooms.
- Pool area

Ordinary Hazard:

- Mechanical Rooms.
- Storage Rooms.
- Electric Rooms.
- Laboratories.
- Elevator as noted.

PIPE AND FITTINGS

- Sprinkler piping sized 2 inches and smaller and all standpipe piping shall be Schedule 40 black steel with threaded or groove coupled joints and fittings.

- Sprinkler piping sized 2-1/2 inches and larger shall be Schedule 10 black steel with roll groove type connections and fittings. Pressure rating shall be 175 psig minimum.

- Fittings for Grooved End Steel Pipe shall be cast of ductile iron conforming to ASTM A-536 or malleable iron conforming to ASTM A-47, or forged steel conforming to ASTM A-234 (A-106, Gr. B), with grooved or shouldered ends for direct connection into grooved piping systems with steel pipe and shall be UL listed and FM approved, rated for a minimum 300 psi maximum working pressure (MWP).

- All pipe, fittings, valves, devices and associated appurtenances shall be rated for pressures that may be developed.

SPRINKLERS

All sprinklers shall be listed by U.L. and approved by FM.

Standard Type – all areas without ceilings:

- Type: Standard, quick response, upright, sidewall or pendent type.
- Finish: Brass.
- Fusible Link: Fusible solder link type or glass bulb type temperature rated for specific area hazard.

All areas with ceilings:

- Type: Standard, quick response, with recessed escutcheons.
- Finish: Chrome plated.
- Escutcheon Finish: Chrome.
- Fusible Link: Fusible solder link type or glass bulb type temperature rated for specific area hazard.

VALVES

All valves shall be UL listed and FM Global approved. All valves that are installed as a part of this specification shall be provided with pressure ratings suitable for their intended service.

Shut-off and/or control valves shall be:

- Outside screw and yoke valve. Cast iron body, bronze mounted, flanged ends, solid wedge, 2-1/2 inches in size and up. All bronze, solid wedge, threaded ends, 2 inches and under in size both to be electrically supervised.
- Bronze supervised slow close butterfly valve, threaded ends, stainless steel disc and stem, built-in supervisory switch, slow-close operator, up to 2-1/2 inches in size, or
- Butterfly type indicating valves, ductile iron body, bronze disc, rubber seat, gear operator, with built-in supervisory switch. Wafer body style is not acceptable.

Check valves shall be Iron body, bronze mounted swing check with flanged ends, 2-1/2 inches in size up to 8 inch size or Iron body, spring actuated, wafer check, sizes 4 inches through 8 inches or Grooved end, iron body, spring activated, sizes 2-1/2 inches through 6 inches.

All check valves up to 2 inches in size shall be all bronze with screwed ends.

Trim Valves: (for use on inspectors test set ups, alarm check valves, dry pipe valves, etc.)

- Gate Valves - all bronze, solid wedge, outside screw and yoke, rising stem, screwed ends.
- Ball Valves - all bronze, 400 lb. WWP, screwed ends.
- Globe Valves - all bronze, 200 lb. WWP, screwed ends.
- Check Valves - all bronze swing check, rubber disc, 200 lb. WWP, screwed ends.

FIRE DEPARTMENT HOSE VALVES AND RELATED EQUIPMENT

Hose valves 2-1/2 inch, exposed type chrome plated brass. Complete with cap and chain.

TECHNOLOGY

TECHNOLOGY SYSTEMS

GENERAL CRITERIA

The technology systems to be provided for the Nichols Hall renovation and new Nichols Hall addition consist of four (4) categories for which systems will be identified, including telecommunications, facilities, security (Life Safety), and audio-visual systems. Each category is further defined for individual systems which will be installed based on the requirements set forth in the project criteria. The following systems will be provided for this facility:
Telecommunications Systems:
- Pathways and Spaces:

Main Equipment Rooms.

- Universal Structured Cabling System (Owner Provided):

Inter-building, Outdoor/Exterior: Wide Area Network (WAN)/Service Provider Connectivity.

Intra-building, Indoor: Local Area Network (LAN).

- Backbone Cabling.
- Horizontal Cabling.

Wireless – Indoor WLAN wireless access points.

- Telecommunications Grounding System.
- WAN/LAN Network Electronics:

Network Electronics (Owner provided).

Wireless Network System; wireless access points (Owner provided).

- Telephone System (Owner Provided):

Expansion of existing telephone system.

Facilities Systems:
- Master Clock Systems.
- Public Address Systems.
- Video Distribution System:

Analog Video Distribution System.

Digital Broadband Video Distribution System.

- Emergency Telephones (Blue Phones).
- Lobby/Reception Paging Systems.
- Area of Rescue Assistance (ADA) Intercom Systems.
- Lightning Protection.

Electronic Safety and Security Systems:
- Intrusion Detection.
- Access Control System.
- Video Surveillance.

Audio-Visual Systems:
- Presentation Systems.
- Professional Sound Systems.
- ADA Assistive Listening Systems.
- Digital Signage Systems.

SUBMITTALS

The Contractor will be required to assure compliance with the Contract Documents by submitting the following:
- Shop Drawings: Showing equipment compliance.
- Field Test Reports: Showing installation and operating compliance.
- Operating and Maintenance Manuals: Showing operating and maintenance procedures (may include demonstration DVDs).

RENOVATION WORK

New systems will be expanded from Nichols Hall to cover the new Nichols Hall addition.

All material and equipment which will be required by the Owner to be salvaged and which is not scheduled for reuse will be delivered to the Owner and/or stored where directed on the site. If the equipment is to be reused, it will be thoroughly cleaned prior to reuse.

STANDARDS

- ANSI/EIA/TIA 568-C.1 – Commercial Building Telecommunications Standard.
- ANSI/EIA/TIA 569-C – Commercial Building Telecommunications Standard for Buildings and Spaces.
- ANSI/EIA/TIA 606-C – Administrative Standards for Telecommunications Infrastructure.
- ANSI/EIA/TIA 607-C – Commercial Building Grounding, Earthing and Bonding Requirements for Telecommunications.
- ANSI/EIA/TIA 758-B – Customer-Owned Outside Plant Telecommunications Standard.
- ANSI/EIA/TIA 862A – Building Automation Systems Cabling Standard for Commercial Buildings.
- ANSI/EIA/TIA 942 – Telecommunications Infrastructure Standard for Data Centers.
- BICSI - Telecommunications Distribution Methods Manuals, 12th Edition.
- NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings.
- ANSI/INFOCOMM 1M: 2009 Audio Coverage Uniformity in Enclosed Listener Areas.

TECHNOLOGY (cont.)

- INFOCOMM 10-201X AV Systems Performance Verification.
- BICSI 005-2013 - Electronic Safety & Security Design.
- BICSI 004-2012 - Healthcare Facilities Design.

TELECOMMUNICATIONS SYSTEMS

PATHWAYS AND SYSTEMS

Telecommunications Rooms:
Telecommunications Rooms (TR) will be located throughout the new Nichols Hall addition based on the layout and any additional design requirements set forth by the Owner. The TR serves as the recognized connection point between the backbone extending from the existing infrastructure in Nichols Hall, and horizontal pathways, cabling, etc. BICSI requires a minimum of 1 TR per floor and each TR to serve a maximum of 10,000 square feet. These limitations will be observed with discretion based on the high costs associated with these requirements. Typically, the 90 meter maximum horizontal distance allowed by EIA/TIA standards will be limited to 80-85 meters and TR coverage will be determined based on those maximum parameters.

• TRs will be provided with corridor access. Doors will open outward to allow additional space within the room for equipment.

• TRs will be located away from areas susceptible to flooding. Toilet rooms, washrooms, etc. will not be permitted above telecom rooms. Water lines and other systems not required within the TR will not be permitted.

• A Telecommunication room's primary function is to house the intrabuilding fiber optic backbone and horizontal cross-connect serving that floor area. It will also include the following design elements:

• Size: Minimum 10' x 10' with an 8.5' ceiling height. These dimensions may vary based on the anticipated structured cabling requirements installed.

• Lighting: Minimum 50 footcandles. Emergency lighting will be provided in the space.

• Continuous, Dedicated Environmental Control: TR will generally contain active components and require one air change per hour with positive pressure (to minimize dust). The temperature will be maintained between 64 - 75 degrees F and a relative humidity of 30 - 55 percent.

• Pathways: Ladder tray will be provided to support cabling entering from above the data racks with proper dropout devices and conduit sleeves. Slots, etc. will be provided to maximize access to ceiling space, between stacked TRs or other areas as required. All pathways will be properly fi re-stopped per ASTM 814 upon completion of work.

• Grounding: A Telecommunications Grounding Busbar (TGB) will be provided in each TR to enable signal equipment grounding. Each TGB will be connected to the Telecommunications Main Grounding Busbar (TMGB) in the existing Nichols Hall Main TR with a Telecommunications Grounding Backbone (TBB) sized per IEEE and EIA standards.

• Telecommunications rooms will also house other system equipment such as Security, Building Automation System (BAS), Fire Alarm, and Video distribution equipment.

• Emergency generator power circuits and an owner supplied Uninterruptible Power Supply (UPS) will provide emergency power to electronic equipment to allow proper shutdown without corrupting data. Coordinate with Power Distribution Systems Section.

• Data Racks will be Panduit 8' x 19" standard, open-frame, free-standing heavy-duty racks with EIA/TIA universal mounting holes. All data racks will be equipped with horizontal and vertical cable management solutions to optimize efficiency and allow proper bend radius for cabling. There will generally be two data racks installed at each TR. Space will be provided for Owner provided data network electronics, etc.

Pathways:

• Telecommunications/systems cabling will be allowed to be installed open above accessible ceilings utilizing an appropriate means of support. Cable bundles will generally be installed above corridor ceilings in a new wire mesh basket tray. The tray will be routed in major corridors that link Departments, offices, and support spaces. Individual runs will exit the cable tray and be supported by a conduit stub or J-hooks above the accessible ceiling prior to termination. The following systems will be permitted to be installed in the available cable tray. The size of the cable tray will be dependent on the quantity of cables, expected growth, utilization of 50 percent of tray and HVAC equipment/ductwork routing.

• Telecommunications cabling; data, voice, video UTP cabling.

• System cabling; public address (STP), video cabling (coaxial).

• Security cabling; access control, intrusion detection, CCTV cabling.

All rooms will be provided with conduit sleeves within the ceiling cavity for each system installed in the building. Sleeves will be sized for maximum growth potential of the individual system installed. An additional sleeve will be provided for future use. All conduit sleeves will be properly fire-stopped per ASTM 814.
Each work area outlet will be provided with a double gang backbox with single-gang or double-gangmud-rings for termination of telecommunications devices. Each backbox will be served with a minimum 1 inch emt conduit stubbed up to accessible ceiling space. It is not necessary to extend conduit to corridor or directly to cable tray. All unused outlet boxes will be covered with blank coverplates.

In renovation areas, the Contractor will be allowed to install telecommunications cable open in accessible wall cavities if available. In areas where conduit and outlet box systems cannot be accommodated, in existing walls, surface raceway with appropriations for power receptacles will be utilized for installation.

STRUCTURED CABLING SYSTEM

Requirements:

Backbone cabling will consist of inter-building backbone systems exterior, OSP distribution systems and intrabuilding backbone systems interior, telecommunications room connectivity. Horizontal cabling systems will consist of the cabling between the telecommunications room and the work area outlet.
A Wireless Local Area Network System will be provided throughout the Nichols Hall renovation and the new Nichols Hall addition. It will consist of cabling and access points throughout the post. The quantity of Wireless Access Points (WAPs) will be determined as the design progresses and the Owner coverage requirements are provided. It is anticipated that Power

TECHNOLOGY (cont.)

over Ethernet (PoE) devices will be utilized and power will be provided for the WAPs at the Telecommunications Rooms only.

Cabling Requirements:

• All Telecommunications Rooms within the building will be connected via intrabuilding backbone systems cabling. Backbone cabling in the new Nichols Hall expansion will be routed in a star topology via available pathways extending from the existing network infrastructure in Nichols Hall. The backbone cabling will provide service for voice, data and digital video systems. The following media will be installed:

• Multimode Fiber Optic Cabling: 24-strand, plenum rated. Installed in an interlocking armored sheath.

• Cabling will be installed in EMT conduit systems/accessible cable tray/ plenum-rated innerduct.

• Fiber optic cabling will terminate in rack mounted fiber optic patch panel enclosures utilizing dual LC type connectors.

• Fiber optic patch cords, 2-strand, zip-type in standard 2-meter lengths will be provided.

• Multimode fiber optic cabling will be laser optimized and certified for 10 Gigabit Ethernet up to 300 meters.

• Multi-pair, UTP copper cabling; 100-pair, Category 3, plenum-rated.

• Cabling will generally be installed in cable tray or open above accessible ceiling space.

• All backbone fiber optic cabling will be tested with an Optical Time Domain Reflectometer (OTDR) and power meter for signal loss. All backbone copper cabling will be tested for continuity. All documentation will be certified for warranty purposes.

Horizontal Cabling:
• The horizontal cabling solution will consist of an end-to-end copper solution installed by a vendor certified by that manufacturer for installation and warranty. Warranty will be based on a standard replacement requirement for non-performing cable/components that meet the requirements of a Category 6 solution.

• Horizontal cabling will be Category 6, 4-pair, 23-24 AWG, UTP, 350 MHz copper cabling system terminating on 19-inch rack-mount, 48-port, RJ-45 patch panels in standard, open frame data distribution racks at the TR.

• Wireless access points will utilize (2) Category 6A cables.

• Horizontal cabling will extend from the Telecommunications Room to the work area outlet in all task locations. Multiple outlet jacks will be terminated in each common modular outlet faceplates at most locations.

• All cabling will be terminated utilizing an 8-pin, RJ-45, jack with a standard TV568A wiring pattern.

• Outlet faceplates will match the Owner's requirements. Jacks will match the modular faceplate. Faceplate color will be coordinated with the associated clean power receptacles.

Device Quantities:
• Data Outlets will be provided based on the program requirements of the space.

• The typical data outlet will consist of two (2) data jacks under a single gang outlet faceplate for office and program space.

• Miscellaneous: Equipment, storage, MEP, etc. shall consist of one (1) data drop.

Testing:
• Each installed permanent link/channel will be tested to Category 6 standards with a level III analyzer. Testing will be documented by the installer showing graphical comparisons to all standard testing criteria including length, wire-map, attenuation, NEXT, PS-NEXT, ELFEXT, PS-ELFEXT, ACR, PS-ACR and return loss.

• The installer will be required to certify the available headroom of the cabling system as advertised by the manufacturer.

Warranty:
All horizontal cabling will be certified by the manufacturer and include at minimum a 15-year application assurance warranty.

Labeling:
• All modular outlets and patch panels will be labeled with a machine printed vinyl label in a font size and color approved by the Owner. The labeling scheme will meet EIA/TIA 606C Standards and the Owner's requirements.

SIGNAL GROUNDING SYSTEM

• A Telecommunications Bonding Backbone (TBB) will be routed and terminated in each TR on the TGB. The TBB and TGBs will be used to ground all telecommunications cabling, shields, racks, equipment, sleeves, and raceways that have the potential to act as a current carrying conductor. All wires used for telecommunications grounding will be identified with green insulation and labeled per EIA/TIA standards.
All racks, sleeves, and equipment will be bonded to the TGB.
G.2.4 NETWORK ELECTRONICS (OWNER PROVIDED)

• Space will be provided in equipment racks for Owner provided network electronics.

• Expansion of Existing Integrated VoIP Communication System (Owner Provided).

POST SYSTEMS

VIDEO DISTRIBUTION SYSTEMS

Analog Video Distribution System:
An analog video distribution system will be provided to allow the distribution of the local cable TV signal and other modulated signals such as satellite, DVD,

BluRay, TV-Studio signals via coaxial cable to each program location.
Video Outlets:
• Provide outlets at locations as determined by the program.

Cabling:
The video distribution within the building will utilize a star topology extending from the existing head-end location in Nichols Hall, through each TR, to the work area outlet. Backbone cable will consist of one RG11 broadband coax cable extending from the head end to each TR. Horizontal cable will consist of RG6 coax tapping off the distribution amplifier in each TR and homerun to each video

TECHNOLOGY (cont.)

outlet at each program location. All coaxial cabling will be 75 ohm, plenum-rated cabling terminated with F-connectors.

EMERGENCY TELEPHONES (BLUE PHONES)

- Emergency telephones will be located as determined by the program.
- Units will be stand-alone structures with incorporated emergency push button speaker-phone to direct dial security. Analog operation will be used.
- Unit may be integrated with informational dial pad.
- Units will have a blue siren/strobe.
- Integrated speaker for mass notification.
- Integrated camera (User or surveillance).

AREA OF RESCUE ASSISTANCE INTERCOM SYSTEM (ADA)

ADA area of rescue intercom system is specified for selected areas, to allow communications between the fire alarm annunciator location and each area of rescue location and elevator lobbies. The existing Nichols Hall area of rescue intercom system shall be expanded to include required areas in the new Nichols Hall addition.

SECURITY SYSTEMS

Security for the new Nichols Hall addition will include the expansion of three (3) existing systems serving Nichols Hall. These systems include an intrusion alarm system, access control system, and video surveillance system.
The security system expansion will incorporate multiple wiring techniques, field processing units, and peripheral devices, and interface with Post intrusion alarm system that detects entry utilizing door contacts at all perimeter doors and through motion detection devices as directed by the Owner. The system provides a local alarm and remote alarm to an off site monitoring station.
Provide alarm and status indicators for the following:

- Alarm monitoring of specific items such as water detection, defibrillator monitoring, emergency generator status, etc.
Security system will include the expansion of existing Nichols Hall access control systems to limit entry into the building.
- Card readers will be located based on program requirements.
Security system will include the expansion of existing Nichols Hall video surveillance utilizing IP fixed, Pan/Tilt/Zoom (PTZ) cameras providing coverage of major gathering areas, stairwells, entrances, and corridors.
Security system raceways will consist of conduit stubs from outlet boxes to accessible corridor ceiling spaces where exposed wiring will be routed in the cable tray or 'J' hooks. Wiring will be as recommended by the manufacturer.

AUDIO / VISUAL SYSTEMS

The audio/visual systems will consist of the expansion of existing Nichols hall system, and will provide control and distribution of several forms and sources of media. It is anticipated that AV systems will be provided in conference rooms, classrooms, and other areas as determined by the Owner.

Video Display:
Typical rooms will consist of a Large format LCD display on the teaching wall. Where room size demands a large screen, a projector will be provided with a powered flat matte white flush-mounted screen will be provided. The LCD projection unit will be a minimum 5000 ANSI lumen unit with connectors for the proper input from the controller/switcher/output.

Audio:
An audio amplifier will be provided to allow adjustable volume control. Speakers will be provided. The speakers will be determined by performance and the aesthetics of the room.

Controller:
A fixed controller will be provided to provide simple one-touch operation of the media sources and presentation equipment. The controller will be a unit that allows a user with little or no experience to operate the equipment efficiently.
Source Equipment:
Equipment will be provided such as BluRay player, document camera and inputs from Owner provided equipment such as tablets or laptops, wireless video interface.

Public Address system:
A Post wide public address system will be provided for communication of emergency announcements throughout the building. PA system will include required speakers, amplifiers, cablings and inputs. Interface to the telephone system will be provided to allow announcements from any telephone handset with Authorized access.
Interface will be provided to auxiliary sound systems to allow emergency take over of systems.

Digital Signage:
Expansion of existing Institutes digital signage system manufactured to accommodate new locations as identified by the owner.

WIRE AND CABLE

- Below 100 Volts: Per UL class and associated system manufacturer requirements.
- Plenum-rated cable will be considered for telecommunications and signal wiring (not including fire alarm) in areas where the ceiling space will be utilized for return air HVAC system cavity. Otherwise, wiring systems in these areas will be installed in conduit.

CONDUIT AND RACEWAYS

The following types of conduit will be specified for the applications listed:

WIRING DEVICES

Standard styles with vandal resistant nylon coverplates (to match wiring device color) will be specified.

IDENTIFICATION

Electrical distribution equipment and communication/special systems cabinets will be systematically colored and labeled with screw mounted colored Lamocoid nameplates.

Cover plates will be systematically labeled with vinyl, type-written labels for telecommunications/ special systems receptacle jacks.

NOT ANTICIPATED FOR INCLUSION IN PROJECT (OWNER PROVIDED)

- Computers.
- Network Electronics.
- Wireless Access Points.
- VoIP System Expansion.

COST ESTIMATE

The Benchmark Cost Model included with this study provides a breakout of renovation costs for the existing Nichols Engineering Building and Morgan Hall. These renovation costs are further broken down into Light, Medium, and Heavy Renovation costs by square feet.

The cost for the proposed addition to Nichols Hall is calculated on a cost per square foot benchmark cost derived from similar projects recently completed by CannonDesign. There are three benchmark projects ranging from low cost per square foot to high.

The cost to raze the Cocke Hall Annex (pool building), the cost to renovate the east facade of King Hall following the APPENDIX demolition of Cocke Hall Annex, the cost to renovate the 2nd and 3rd floors of King Hall, and various site improvement costs are all included as a separate line items below the Renovation + Addition subtotal.

Additionally, the soft costs contributing the Total Project Cost have been provided by VMI and are included below the Total Construction Cost subtotal.

* The Benchmark Cost Model inlucdes project alternates and clarification costs provided by VMI. A final review of the total costs (construction and project) will be completed following review of this draft submission, prior to final submission of the study.

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VMI Engineering Building Study
Benchmark Cost Model-Option #4
March 25, 2020

   

	VMI Light Renovation 23,272 GSF		VMI Medium Renovation 12,472 GSF		VMI Heavy Renovation 17,041 GSF		VMI New Addition 21,563 GSF		Rutgers University Life Sciences Center Grand Total / Element Quantity	Webster University Interdisciplinary Science Building Grand Total / Element Quantity	Buffalo State College Science Building 15 Phase 4 Grand Total / Element Quantity	Towson University New Science Facility Grand Total / Element Quantity
GT Grand Total	**$ 182.66 /gsf**	**$ 4,250,962**	**$ 245.69 /gsf**	**$ 3,064,196**	**$ 302.57 /gsf**	**$ 5,156,143**	**$ 463.28 /gsf**	**$ 9,989,796**	**$ 390.81 /gsf**	**$ 395.62 /gsf**	**$ 436.60 /gsf**	**$ 464.26 /gsf**
A10 Foundations							$ 21.18 /gsf	$ 456,614	$ 12.95 /gsf	$ 23.04 /gsf	$ 32.33 /gsf	$ 16.38 /gsf
B10 Superstructure							$ 57.66 /gsf	$ 1,243,350	$ 38.40 /gsf	$ 31.10 /gsf	$ 53.74 /gsf	$ 47.40 /gsf
B20 Exterior Enclosure							$ 44.96 /gsf	$ 969,383	$ 39.61 /gsf	$ 43.44 /gsf	$ 53.11 /gsf	$ 24.66 /gsf
B30 Roofing							$ 9.06 /gsf	$ 195,356	$ 3.06 /gsf	$ 5.79 /gsf	$ 8.23 /gsf	$ 11.16 /gsf
C10 Interior Construction	$ 15.58 /gsf	$ 362,520	$ 24.92 /gsf	$ 310,852	$ 31.16 /gsf	$ 530,913	$ 31.16 /gsf	$ 671,796	$ 25.08 /gsf	$ 33.78 /gsf	$ 20.49 /gsf	$ 45.27 /gsf
C20 Stairs							$ 7.21 /gsf	$ 155,502	$ 2.54 /gsf	$ 3.71 /gsf	$ 8.41 /gsf	$ 2.19 /gsf
C30 Interior Finishes	$ 22.73 /gsf	$ 529,018	$ 22.73 /gsf	$ 283,513	$ 22.73 /gsf	$ 387,375	$ 22.73 /gsf	$ 490,169	$ 12.94 /gsf	$ 28.89 /gsf	$ 36.99 /gsf	$ 12.12 /gsf
D10 Conveying							$ 4.38 /gsf	$ 94,406	$ 6.34 /gsf	$ 4.02 /gsf		$ 2.78 /gsf
D20 Plumbing	$ 9.66 /gsf	$ 224,781	$ 15.45 /gsf	$ 192,745	$ 18.93 /gsf	$ 322,609	$ 19.32 /gsf	$ 416,548	$ 17.62 /gsf	$ 20.54 /gsf	$ 17.34 /gsf	$ 21.77 /gsf
D30 HVAC	$ 39.04 /gsf	$ 908,488	$ 62.46 /gsf	$ 779,008	$ 76.51 /gsf	$ 1,303,878	$ 78.08 /gsf	$ 1,683,546	$ 102.12 /gsf	$ 58.33 /gsf	$ 52.36 /gsf	$ 99.49 /gsf
D40 Fire Protection	$ 2.68 /gsf	$ 62,276	$ 4.28 /gsf	$ 53,400	$ 5.24 /gsf	$ 89,379	$ 5.35 /gsf	$ 115,405	$ 5.06 /gsf	$ 5.21 /gsf	$ 5.64 /gsf	$ 5.50 /gsf
D50 Electrical	$ 24.39 /gsf	$ 567,504	$ 39.02 /gsf	$ 486,621	$ 47.80 /gsf	$ 814,491	$ 48.77 /gsf	$ 1,051,657	$ 52.90 /gsf	$ 45.60 /gsf	$ 39.78 /gsf	$ 56.81 /gsf
E10 Equipment	$ 19.66 /gsf	$ 457,614	$ 19.66 /gsf	$ 245,246	$ 19.66 /gsf	$ 335,089	$ 19.66 /gsf	$ 424,008	$ 6.21 /gsf	$ 22.72 /gsf	$ 26.03 /gsf	$ 23.70 /gsf
E20 Furnishings	$ 4.34 /gsf	$ 100,971	$ 4.34 /gsf	$ 54,113	$ 4.34 /gsf	$ 73,936	$ 4.34 /gsf	$ 93,556	$ 1.47 /gsf	$ 4.02 /gsf	$ 7.24 /gsf	$ 4.62 /gsf
F10 Special Construction	$ 5.77 /gsf	$ 134,237	$ 5.77 /gsf	$ 71,941	$ 5.77 /gsf	$ 98,296	$ 5.77 /gsf	$ 124,379	$ 5.63 /gsf			$ 5.91 /gsf
F20 Selective Building Demolition	$ 15.00 /gsf	$ 349,080	$ 15.00 /gsf	$ 187,080	$ 20.00 /gsf	$ 340,820			$ 2.09 /gsf	$ 0.80 /gsf	$ 0.61 /gsf	
G10 Site Preparation							$ 13.99 /gsf	$ 301,645	$ 9.36 /gsf	$ 9.55 /gsf	$ 9.44 /gsf	$ 15.60 /gsf
G20 Site Improvements									$ 2.24 /gsf	$ 11.92 /gsf	$ 15.18 /gsf	$ 10.55 /gsf
G30 Site Mechanical Utilities							$ 5.25 /gsf	$ 113,206	$ 4.63 /gsf	$ 4.25 /gsf	$ 3.47 /gsf	$ 4.31 /gsf
G40 Site Electrical Utilities							$ 4.00 /gsf	$ 86,252	$ 0.33 /gsf	$ 1.78 /gsf	$ 4.45 /gsf	$ 10.81 /gsf
Z10 General Conditions & Requirements	$ 23.83 /gsf	$ 554,473	$ 32.05 /gsf	$ 399,678	$ 50.43 /gsf	$ 859,357	$ 60.43 /gsf	$ 1,303,017	$ 40.22 /gsf	$ 37.12 /gsf	$ 41.78 /gsf	$ 43.24 /gsf

Renovation + Addition Subtotal	74,348 GSF	$ 302.11 /gsf	$ 22,461,098
Raze Existing Cocke Hall Annex Building	10,035 GSF	$ 30.00 /gsf	$ 301,050
Façade Repair Allowance	3,400 WSF	$ 175.00 /gsf	$ 595,000
Existing Foundation Repair Allowance			$ 250,000
Underpinning Allowance	5,000 SF	$ 50.00 /gsf	$ 250,000
Renovation Phasing Premium		15%	$ 1,870,695
Site Improvements Allowance-Per Thompson & Litton			$ 2,250,000
Letcher Plaza Improvements-Allowance			$ 150,000
Reroute Data/Telcom-250LF			$ 50,000
Add Site Lighting-Allowance			$ 75,000
Escalation to Mid-Point January 2024		4% / Year	$ 5,453,542
Total Construction Cost	**74,348 GSF**	**$ 453.36 /gsf**	**$ 33,706,385**

Clarifications:

The above is a benchmark average of comparable project bid values adjusted to Lexington, VA in December 2019 Construction Dollars.

The above costs are actual and final construction dollars. Therefore all contingencies, including but not limited to, Design, Estimating, Construction and Owner are excluded.

The above costs exclude temporary relocation, move management and soft costs, including but not limited to, A/E & consultant fees, financing and FF&E.

The above costs exclude sales tax.

The above costs exclude structural modifications/upgrades and hazardous material abatement.

The above costs exclude all sustainability premiums.

The above costs exclude replacement/upgrade to any head-end infrastructure.

The Following **Soft Costs** are based upon historical VMI CBR Records:

			% of Total Construction Cost	
Design and Related Services			12.0%	$ 4,045,000
Inspection & Testing			3.0%	$ 1,011,000
Project Management and Other Costs			10.5%	$ 3,539,000
Construction Contingency			3.0%	$ 1,011,000
Furnishings & Moveable Equipment		$ 32.50 / BGSF	7.1%	$ 2,400,000
Total Project Cost	**74,348 GSF**	**$ 614.84 /gsf**	**35.6%**	**$ 45,712,000**

Additional Costs - Per Owner Request			
Temporary Relocation Allowance			$ 400,000
Sales Tax			$ 1,600,000
Structural Modifications			$ 250,000
Hazmat Allowance			$ 150,000
Sustainability (LEED) Allowance			$ 200,000
Total Project Cost	**74,348 GSF**	**$ 649.81 /gsf**	**$ 48,312,000**

Renovate King Hall	5,000 GSF	$ 302.57 /gsf	$ 1,512,864
Renovate Cocke Hall	5,600 GSF	$ 302.57 /gsf	$ 1,694,408

CONCLUSION

Virginia Military Institute is the oldest state-supported military college and the first non-private Senior Military College in the United States. VMI only enrolls uniformed members of the Corps of Cadets offering them an education well-rooted in both physicality and academics. VMI exclusively offers baccalaureate degrees for which includes 14 disciplines in engineering, the sciences, and liberal arts combined with required courses in either the Army, Naval, or Air Force ROTC programs.

As the only military college in the United States that is nationally ranked in the same category as federal military academies, VMI offers a unique educational experience. Average class enrollment is 11 cadets, which allows the professors and cadets to form and develop meaningful relationships from the very beginning to beyond graduation. Faculty are very heavily involved in developing the curriculum and partnering with cadets for a wide range of research. Cadets are also held to an absolute standard of integrity and trust and abide by the VMI Honor Code. In short, everything that VMI stands for can be summed up in its Latin motto of "In Pace Decus, In Bello Praesidium" which translates to "In Peace a Glorious Asset, In War a Tower of Strength."

The design team is confident that the proposed design will address the need of VMI's Department of Engineering. The renovation and addition address the imperative need for storage and additional classroom and lab space. The redesign of the existing plan within Nichols Engineering Hall and Morgan Hall creates right-sized instruction spaces that is comparable to industry standards and VMI peer institutions. A well-organized makerspace partitioned for designated shop functions will create a shared, communal space within the department and the entire post. An investment in VMI's Division of Engineering's teaching spaces can become a "Glorious Asset" for VMI that can spur the school into the future.
This investment in campus assets would not only become a "Tower of Strength" towards hosting S.T.E.M. majors, one of the most in-demand areas of study, but would also provide the infrastructure to continue to grow as one of the nation's leading military and educational institutes. This lines up with VMI's Vision 2039 plan in that it "aims at improving the academic, military, and athletic programs and infrastructure of the Institute to enhance cadet leadership development and the environment in which it takes place." Such an investment can fill a necessity for new and upgraded facilities in order to help VMI remain among the nation's premier undergraduate colleges.

APPENDIX IV.

APPENDIX

1. VMI Engineering Feasibility Study – Task I, dated 07.16.2019

2. Structural Analysis of Cocke Hall Annex – as included with the Task I study

3. VMI Engineering Feasibility Study – Executive Summary ("Walking Doc"), dated 12.19.2019

4. Table 1 ASHRAE

5. Table 2 BOMA

6. Detailed Program List

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