

Audit

Report



OFFICE OF THE INSPECTOR GENERAL

**CONSTRUCTION PROJECT FOR THE CONSOLIDATED
EDUCATION AND TRAINING FACILITY AT THE
U.S. AIR FORCE ACADEMY**

Report Number 93-003

October 2, 1992

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Department of Defense

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The following acronyms are used in this report.

CCHE.....Colorado Commission on Higher Education
CETF.....Consolidated Education and Training Facility
CPEC.....California Postsecondary Education Council
FTE.....Full-time equivalent
NCHEMS....National Center for Higher Education Management Systems
OMB.....Office of Management and Budget
WICHE.....Western Interstate Commission on Higher Education



INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
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October 2, 1992

MEMORANDUM FOR ASSISTANT SECRETARY OF THE AIR FORCE (FINANCIAL
MANAGEMENT AND COMPTROLLER)

SUBJECT: Audit Report on the Construction Project for the
Consolidated Education and Training Facility at
the U.S. Air Force Academy (Report No. 93-003)

This final report is provided for your review and comments. It addresses the justification and need for the construction of the Consolidated Education and Training Facility (CETF) at the U.S. Air Force Academy (the Academy). It is emphasized that the scope of this audit only addresses the need for additional space at the Academy, as represented by the \$36 million CETF project to expand the main academic building. It does not address the proposed four-phase project for the Fairchild Hall Modernization Program, valued at approximately \$54 million. The audit was performed as part of the overall Audit of Construction Projects for Training Facilities, Project No. 1RB-0029.

The Department of the Air Force provided comments on June 19, 1992, in response to a draft of this report dated May 13, 1992. The Air Force nonconcurred with the finding, potential monetary benefits, and the recommendation. The Air Force stated that the Academy has less space than other comparable institutions, that a laboratory-classroom teaching module was not considered in our analysis, and that space guidelines we used were some of the most austere and did not take into account the unique aspects of the Academy. The Air Force questioned our primary use of the 1990 "Academic Space Needs Analysis," the most recent study prepared on academic space needs. Additionally, the Air Force indicated that technological advancements and environmental and safety restrictions have caused a need for more academic space. The comments provided by the Air Force included new information and detailed comparisons that were not available for analysis during the audit. Additional field verification of this new information was performed to determine its impact on our overall audit evaluation, and is presented in the Audit Response section of the report beginning on page 15.

Our analysis and verification of the comments provided by the Air Force, including the new information, confirmed our basic premise that the need for additional space at the Academy is not supported by reliable documentation, space guidelines established by the academic community, or the practices at comparable institutions of higher education. Our additional audit work

disclosed that the Academy has more academic space than the other institutions cited by the Air Force for comparison purposes; that the Academy definition of a laboratory-teaching module was not consistent with that used by other academic space planners; and that our application of space guidelines and use of the "Academic Space Needs Analysis" were appropriate. For these reasons, supported by details in the Audit Response section in Part II of the report, we believe that our recommendation is still warranted and should be implemented.

DoD Directive 7650.3 requires that all audit recommendations be resolved promptly. Recommendations and potential monetary benefits are subject to resolution in accordance with DoD Directive 7650.3 in the event of nonconcurrence or failure to comment. The "Status of Recommendation" section at the end of the finding identifies the unresolved issues and the specific requirements for your comments. Your comments should be provided within 60 days of the date of this report.

The courtesies extended to the audit staff are appreciated. If you have any questions on this audit, please contact Ms. Mary Lu Ugone at (703) 692-3320 (DSN 222-3320) or Mr. Timothy Tonkovic at (804) 766-3319. The planned distribution of this report is listed in Appendix E.



Robert J. Lieberman
Assistant Inspector General
for Auditing

cc:
Secretary of the Air Force
Superintendent, U.S. Air Force Academy

Office of the Inspector General, DoD

AUDIT REPORT NO. 93-003
(PROJECT NO. 1RB-0029.03)

October 2, 1992

CONSTRUCTION PROJECT FOR
THE CONSOLIDATED EDUCATION AND TRAINING FACILITY
AT THE U.S. AIR FORCE ACADEMY

EXECUTIVE SUMMARY

Introduction. During our ongoing Audit of Construction Projects for Training Facilities (Project No. 1RB-0029), we reviewed a major project at the Air Force Academy to expand the main academic building by constructing a Consolidated Education and Training Facility. Congress authorized \$39 million for this project, \$18 million in fiscal year 1991 and \$21 million in fiscal year 1992. Appropriations totaling \$36 million have been provided, \$15 million in fiscal year 1991 and \$21 million in fiscal year 1992.

Objective. The objective of the audit was to evaluate the data on which the Air Force Academy based its construction requirements for expanding the main academic building and to determine if alternatives to new construction were fully considered. We also evaluated the adequacy of internal controls as they related to the construction of training facilities.

Audit Results. Space requirements that supported the expansion of the Air Force Academy's main academic building were inflated in some cases and were not accurately computed in others. Total space requirements were overstated by at least 223,000 square feet, and planned reductions in future cadet enrollment had not been considered.

Internal Controls. Procedural weaknesses in the construction and approval process within DoD will be addressed in the audit report on the overall Audit of Construction Projects for Training Facilities.

Potential Benefits of Audit. About \$36 million, less design breakage, (see Appendix C) can be put to better use if the Air Force Academy cancels the construction project and uses existing facilities to satisfy its space needs.

Summary of Recommendations. We recommended that the proposed construction project for the Consolidated Education and Training Facility at the Air Force Academy be canceled.

Management Comments. The Air Force nonconcurred with the finding, potential monetary benefits, and recommendation. Details on management comments are provided in Part II of this report, and the complete text of management's comments is in Part IV. The Air Force should provide comments on the unresolved issues within 60 days of the date of this report.

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This report was prepared by the Readiness and Operational Support Directorate, Office of the Assistant Inspector General for Auditing, DoD. Copies of the report can be obtained from the Secondary Reports Distribution Unit, Audit Planning and Technical Support Directorate (703) 614-6303 (DSN 224-6303).

PART I - INTRODUCTION

Background

Training facilities are the third most frequent type of facility built by the DoD and account for about 14.5 percent of the dollar value of the military construction program, not including family housing. From FYs 1988 through 1992, about \$2.8 billion was appropriated for construction of DoD training facilities. Construction projects for training facilities included firing ranges, armories, Reserve centers, training support centers, and classroom buildings.

The Military Departments either renovate or construct training facilities to meet essential training requirements and are required to expeditiously complete the facilities so that the training missions and readiness capabilities are not impaired. Training facility requirements must be sufficiently defined, validated, and periodically revalidated before construction begins.

During the Audit of Construction Projects for Training Facilities, Project No. 1RB-0029, we reviewed the construction project at the Air Force Academy to build a 139,000-square-foot expansion of the existing main academic building. Congress authorized \$18 million in FY 1991 and an additional \$21 million in FY 1992 for this construction project. About \$36 million has been appropriated for the project; \$15 million in FY 1991 funds and \$21 million in FY 1992 funds.

The Academy was constructed in Colorado Springs, Colorado, in the late 1950's. Until 1968, about 2,500 cadets attended the Academy annually. In 1968, Congress expanded the enrollment at the Academy to about 4,500 cadets. Since that time, the Academy has been commissioning about 950 officers a year. In FY 1992, Congress passed a bill reducing enrollment at the Academy to 4,000 cadets by 1995.

Air Force Manual 86-2, "Civil Engineering Programming Standard Facility Requirements," dated March 1, 1973, describes policies, responsibilities, and procedures to help achieve accuracy, completeness, and uniformity in planning, programming, and budgeting for the operation, maintenance, and construction of needed facilities.

Objectives

The objective of the audit was to evaluate the data on which the Air Force Academy based its construction requirements for expanding the main academic building and to determine if

alternatives to new construction were fully considered. We also evaluated the adequacy of internal controls as they related to the construction of training facilities.

Scope

The audit focused on the proposed construction of the Consolidated Education and Training Facility, expanding the Air Force Academy's main academic building. At a programmed cost of \$39 million, the approved construction project would add 139,000 square feet of academic space. The academic space consists primarily of classroom, laboratory, and office space. We visited the Air Force Academy and other Air Force and DoD organizations responsible for the construction approval and execution process. We also met with the architectural firm and its subcontractor, which performed studies of space needs for the Air Force Academy. Additionally, we visited the Colorado Commission on Higher Education to obtain an independent technical assessment of the criteria and methodology used in forming our audit conclusions.

At those locations, we reviewed procedures for developing facility requirements and obtained available project documentation dated from 1980 to 1991 on project initiation, validation, and approval. Site visits were made from April through October 1991. The activities we visited or contacted are in Appendix D.

This economy and efficiency audit was made in accordance with auditing standards issued by the Comptroller General of the United States as implemented by the Inspector General, DoD, and accordingly included such tests of internal controls as were considered necessary.

Internal Controls

Procedural weaknesses in the construction and approval process within DoD will be addressed in our report on the overall Audit of Construction Projects for Training Facilities.

Prior Audits and Other Reviews

In the past 5 years, no audits have specifically addressed construction of training facilities comparable to the Consolidated Education and Training Facility at the Air Force Academy.

PART II - FINDING AND RECOMMENDATION

AIR FORCE ACADEMY EXPANSION

Documentation supporting the expansion of the main academic building at the Air Force Academy (the Academy) showed that total space requirements were overstated by at least 223,000 square feet. The overstatement was primarily caused by inconsistencies in applying the space guidelines endorsed by the Colorado Commission on Higher Education when computing the space requirements. In addition, for some special laboratory courses, enrollment was counted as if students used classrooms and special laboratories simultaneously, which duplicated space requirements. After adjusting for those discrepancies, we estimated that the existing facilities provided about 84,000 square feet more than needed, rather than a shortage of 139,000 square feet as claimed by the Academy. Furthermore, planned reductions in future cadet enrollment were not considered in the requirements determination. The \$36 million appropriated for the project should be put to better use.

DISCUSSION OF DETAILS

Background

In the late 1970's, the Academy identified a need to expand academic facilities and determined that three additional buildings were needed: a science center, a consolidated leadership center, and a consolidated medical and dental clinic. The architectural firm that participated in the original design of the Academy was hired to validate space requirements and to develop a plan for future growth. In 1985, the firm published its results in the "Cadet Area Master Plan" (the Master Plan). The Master Plan showed a requirement for an additional 166,000 square feet of academic space and proposed expanding the existing academic building (Fairchild Hall) rather than constructing three new buildings. After the Master Plan was published, the Academy redefined its space needs from 166,000 square feet to about 143,000 square feet. In October 1989, design work for the Consolidated Education and Training Facility (CETF) began and resulted in a proposal to construct a 139,000-square-foot facility, costing an estimated \$39 million. As of September 1991, the Academy has spent about \$2.2 million for the design and engineering of the CETF. Appendix A provides a chronology of events.

In the fall of 1989, a Colorado-based architectural consulting firm, specializing in analyzing space requirements for colleges and universities, was hired to revalidate the space needs. Guidelines on calculating the Academy's space needs were not available in DoD. Therefore, the Academy relied on the firm to determine the criteria to use in calculating space requirements. In determining the Academy's space needs, the firm generally applied space guidelines from the Colorado Commission on Higher

Education (CCHE). In April 1990, the firm published its results in the "Academic Space Needs Analysis" (the Analysis). The Analysis identified a need for 123,000 square feet of additional academic space. Also, the Academy planned for an additional 8,500 square feet for a dental clinic and 7,500 square feet for which requirements were not documented. The Analysis did not include the 16,000 square feet identified by the Academy.

DoD's military construction approval process provides internal controls for ensuring that projects with valid requirements are approved, funded, and constructed. Air Force Regulation 89-1 "Facilities Construction - Design and Construction Management," November 1, 1988, requires Air Force major commands, including the Academy, to provide planning, design, and construction project management before submitting a proposed new construction project for approval. Normally, proposed projects are reviewed and approved successively by the Air Force, the Office of the Secretary of Defense (OSD), and the Office of Management and Budget before the projects are included in budget requests to the Congress. In this case, the proposed project was rejected by OSD and was not included in the President's budget. Nevertheless, as of January 1992, Congress had appropriated \$36 million and authorized \$39 million for the project.

Proposed Consolidated Education and Training Facility

Space requirements. We reviewed the consulting firm Analysis, which proposed a requirement for 123,000 additional square feet, and the requirement for 16,000 square feet of space identified by the Academy. Although the firm generally used CCHE space guidelines in determining academic space needs, in some instances other guidelines that provided more space were used. Moreover, space requirements were inflated for courses that were conducted in both classrooms and special laboratories because enrollment was counted twice. We employed the same methodology used in the Analysis and applied the fall 1989 course enrollment to the CCHE guidelines in determining space requirements. We determined that the requirements were overstated by at least 223,000 square feet. Also, project documentation showed that space requirements may have been overstated by another 30,000 square feet because the Analysis used 30,000 fewer square feet of existing space than was identified in the Master Plan. Specific overstatements in square footage requirements are described in the following sections and are summarized in Appendix B.

Classrooms. In the Analysis, classrooms were divided into four categories: classroom, lectinar, mini-lectinar, and seminar rooms. Space for those four categories was overstated by a total of 47,382 square feet. The Analysis showed a need for 10,380 square feet of additional classroom space. Our computations determined that existing facilities exceeded requirements for classroom space by 37,002 square feet. Space requirements were overstated primarily because enrollment for courses was inflated. The Analysis showed that courses using both a laboratory and classroom for instruction needed classrooms full-time, even though the classrooms and laboratories were used part-time. Additionally, enrollment for courses held for only part of a semester was counted as full semester enrollment. Specifics on the overstatement of 47,382 square feet are discussed below.

Enrollment. Classroom enrollment for special laboratory classes was inflated, which resulted in overstated space needs of 25,124 square feet. Special laboratory classes were defined by the Academy as classes using both a classroom and a laboratory for instruction. The Analysis showed that each special laboratory session needed a classroom 100 percent of the time and a laboratory 100 percent of the time, even though classrooms and laboratories are not normally used simultaneously for the same course. In computing special laboratory space needs for some courses, the Academy reduced enrollment by a factor of 50-percent. However, in the Analysis, the factor was not applied in determining classroom space needs. Therefore, we applied the same 50-percent factor to all special laboratory courses in determining classroom space needs.

The Analysis contained an additional overstatement of 17,955 square feet related to course enrollment. There were two primary reasons for the overstatement. First, full semester enrollment was improperly included for courses that met only for part of a semester. Some Academy courses were divided into three sessions, each meeting for a third of a semester. For each session, the Analysis included enrollment for the entire semester, resulting in three times the space required. Second, according to Academy officials, additional classroom space was needed so that students attending several sections of a course could meet in one area. However, enrollments for those types of courses were counted twice: enrollment for the course sections taught jointly and total enrollment for the course. If more space is needed for jointly held course sections, the Academy could use existing lecture halls, which the Analysis showed as underused space.

Station sizes. Actual average station sizes were not used, causing classroom space requirements to be overstated by 3,354 square feet. The Analysis stated that average existing station sizes were used in determining classroom space requirements. The Analysis showed the actual average station

sizes at the Academy were 26 square feet for classrooms and 28 square feet for seminar rooms. However, the Analysis used 27 square feet for classrooms and seminar rooms.

Undocumented space requirements. The Analysis contained 949 square feet of space for a lecture area that was not supported by documentation.

Laboratories. In the Analysis, laboratories were divided into three categories: special, teaching, and non-classroom. Special laboratory classes used both a laboratory and a classroom for instruction. Teaching laboratory courses used only a laboratory for instruction. Space for non-classroom laboratory courses was used for independent research by the faculty, cadets, or the tenant research organization. In total, laboratory space requirements were overstated by 69,236 square feet as shown in the following table.

Laboratory Square Footage Requirements

	<u>Academy Requirements</u>	<u>Recomputed Requirements</u>	<u>Overstated Requirements</u>
Special	142,062	90,025	52,037
Teaching	34,786	30,720	4,066
Non-classroom	<u>26,822</u>	<u>13,689</u>	<u>13,133</u>
Total	<u>203,670</u>	<u>134,434</u>	<u>69,236</u>

Special laboratory. The Academy currently has 105,544 square feet of space designated for courses defined as special laboratory classes. Using course offerings and enrollment data, we computed a requirement for 90,025 square feet. Therefore, instead of needing an additional 36,518 square feet, as shown in the Analysis, the Academy has a surplus of 15,519 square feet of special laboratory space. The net overstatement for special laboratory space requirements was primarily attributed to overstating the time cadets spent in a laboratory. Also, the Analysis did not include space requirements for a special laboratory class that was misclassified as a teaching laboratory course. The following table provides our computations of required square footage for special laboratories.

**Special Laboratory
Square Footage Requirements**

	<u>Square Feet</u>
Academy Requirements Identified by the Analysis	142,062
Less: Time Accounted for Twice in Special Laboratory Courses	(56,892)
Add: Course Misclassification and Miscellaneous Errors	<u>4,855</u>
Special Laboratory Space Requirements	<u>90,025</u>

Double scheduling. The Analysis showed laboratories would be occupied even when instruction occurred in a classroom. For example, in Chemistry 131, which meets for two sessions daily, the Academy showed a need for laboratory and classroom space for the same time periods daily. According to the chemistry department chairman, laboratories are used only once a week for that course. By definition, special laboratory classes use laboratories part-time. For Chemistry 131 and other similar courses defined as special laboratory, the Analysis should have used a factor accounting for time not spent in a laboratory. The Analysis showed that laboratory space requirements were reduced by 50 percent for 37 of the 81 special laboratory classes. There was no documented rationale for not applying the 50-percent factor to all 81 special laboratory classes. Therefore, we used the 50-percent factor in determining space requirements for the remaining 44 special laboratory classes. A CCHE representative stated that a 50-percent factor would be reasonable absent any other factor, general or course-specific.

Special laboratory misclassification. An incorrect course classification and some other minor enrollment misstatements caused the Academy to understate its space requirements for special laboratories by 4,855 square feet. Specifically, the Analysis classified Biology 215 as a teaching laboratory course instead of a special laboratory class. The misclassification caused a 4,349-square-foot understatement in the special laboratory category and an overstatement in the teaching laboratory category. Space requirements were understated by another 506 square feet because of minor enrollment and square footage errors in the Analysis.

Teaching laboratory. The space required for teaching laboratory courses was overstated by 4,066 square feet. The overstatement primarily occurred because of the Biology 215 misclassification discussed in the special laboratory category,

causing an overstatement of 4,408 square feet. The overstatement of 4,408 square feet was reduced by minor understatements of enrollment for other teaching laboratory courses.

Non-classroom laboratory. Requirements for non-classroom laboratory space were divided into two categories: space for independent research by Academy faculty and cadets and space for the Frank J. Seiler Research Laboratory, an Air Force Systems Command tenant research organization. Non-classroom laboratory space needs were overstated by 13,133 square feet. Of that amount, 4,193 square feet was related to the tenant organization.

CCHE guidelines were not used to determine non-classroom laboratory space. Instead, the Western Interstate Commission on Higher Education (WICHE) guidelines, which provided more space, were used. According to Academy officials, the WICHE guidelines were used because CCHE guidelines did not provide enough space for research and development. However, the Academy did not document how research and development space needs differed from the other two types of laboratory space for which CCHE guidelines were applied. For consistency, we used CCHE guidelines. Our computations are shown below.

**Non-Classroom Laboratory
Square Footage Requirements**

	<u>Analysis</u>	<u>CCHE</u>	<u>Overstatement</u>
Required Space	26,822	13,689	13,133
Existing Space	<u>(13,518)</u>	<u>(13,518)</u>	<u>0</u>
Total	<u>13,304</u>	<u>171</u>	<u>13,133</u>

WICHE guidelines provided larger station sizes per researcher. For example, the WICHE guidelines provided 450 square feet per aeronautical researcher and 300 square feet per psychology researcher; whereas, the CCHE guidelines provided 133 square feet per aeronautical researcher and 142 square feet per psychology researcher. We used the same methodology as used in the Analysis, but applied the CCHE standards. Using the CCHE guidelines, the Academy has a need for only 171 additional square feet.

Office functions. The Analysis divided office space requirements into three categories: offices, office service, and conference rooms. CCHE guidelines were primarily used in the Analysis to determine classroom and laboratory space needs, but were not used to determine office space needs. Instead, Academy-developed standards were applied. Academy representatives stated more office space was required because of the proposed office

design and because the Academy faculty had a heavier work load than other academic institutions. The deviation from CCHE guidelines inflated space needs in each of the three categories as shown in the following table.

Office Space Square Footage Requirements

	<u>Academy Guidelines</u>	<u>CCHE Guidelines</u>	<u>Overstated Requirements</u>
Offices	140,845	108,610	32,235
Office Service	20,717	10,405	10,312
Conference Rooms	<u>30,630</u>	<u>7,678</u>	<u>22,952</u>
Total	<u>192,192</u>	<u>126,693</u>	<u>65,499</u>

Suite circulation. The Analysis should not have included 28,823 square feet of suite circulation space for offices (23,475 square feet), office service (3,453 square feet), and conference rooms (1,895 square feet). Air Force Manual 86-2, "Civil Engineering Programming Standard Facility Requirements," dated March 1, 1973, states that circulation, wall thickness, stairways, and other miscellaneous space are included in gross square-footage requirements and should not be included in net square-footage requirements. However, the Academy included in its net square-footage requirements separate line items for suite circulation space for offices, office service, and conference rooms. The Analysis computed circulation space by multiplying by 20 percent the total space required in the three categories of office space. Academy officials stated that additional suite circulation space was needed because offices were arranged in suites instead of the traditional hallway setting. However, project documentation did not support the additional space requirements for suite circulation. Additionally, discussions with an engineer from the U.S. Army Corps of Engineers indicated that a 20-percent factor for additional suite circulation was not reasonable.

Offices. Individual offices were overstated by a total of 32,235 square feet. As discussed above, 23,475 square feet is attributed to suite circulation. The remaining 8,760-square-foot overstatement occurred because the Analysis used Academy-developed space guidelines rather than those suggested by other educational commissions, such as the CCHE. Again, for the sake of consistency, we applied the CCHE space guidelines in our computations.

The Analysis showed that the Academy needed additional office space because of "extensive administrative duties" and because the Academy wanted to attract outstanding visiting professors. In our opinion, additional administrative duties do not translate into a need for more space. In determining office space requirements, CCHE guidelines use the number of personnel assigned. Also, the guidelines advocate that educational institutions stay within the overall guidelines for office space, but that space could be allocated between academic disciplines based on their individual needs. A comparison of office sizes recommended by CCHE to Academy-developed standards is shown below.

Comparison of Office Sizes

	Square Feet	
	Academy	CCHE
Dean	600	200
Vice Dean	300	150
Department Heads	200	150
Senior Tenure Professor	175	120
Visiting Professor	175	120
Tenure Professor	150	120
Instructors	120	120
Enlisted	80	80
Civilian	80	80

Office service. Office service space needs were overstated by 10,312 square feet. As previously discussed, 3,453 square feet is attributed to suite circulation. The remaining overstatement of 6,859 square feet occurred because CCHE guidelines were not used. The office service space included departmental work areas, reception areas, and departmental file and supply service areas. The Analysis computed office service space by multiplying 10 percent of the total office space required instead of using space guidelines suggested by other educational commissions. CCHE guidelines based office service space on the number of personnel within each academic department and already included circulation and reception space. Application of the CCHE guidelines resulted in a requirement of 10,405 square feet instead of 20,717 square feet.

Conference rooms. Conference room space needs were overstated by 22,952 square feet. Of that amount, 21,057 square feet was attributed to the use of Academy-developed space criteria rather than CCHE guidelines. The Analysis also inappropriately included 1,895 square feet of suite circulation space. Academy-developed criteria provided 20 square feet for every .9 faculty member (a premise that concludes that more than 110 percent of the staff would meet at one time) and additional

space for small meeting rooms. The CCHE guidelines recommended 20 square feet of conference room space for every three professional staff members.

The Analysis stated that conference room space was needed:

because of such unique programs as common graded review, where the instructors teaching a particular course will be involved in developing common examinations and grading them.

Additionally, the Analysis stated that small meeting areas could be used as multi-use offices. However, we believe vacant classrooms, existing conference rooms, and underutilized lecture halls could be used for common graded reviews and faculty meetings. We applied the CCHE guidelines, which resulted in space requirements of 7,678 square feet instead of 30,630 square feet.

Common space. The Academy overstated common space needs by 6,657 square feet because the Analysis did not compare those requirements to the 6,689 square feet of existing space. The Analysis stated that common space provides for lockers and study space, student-targeted merchandising, and other general-use space and that the Academy did not have common space. However, we believe the Academy base exchange and the ticketing office, which had a total of 6,689 square feet, should have been considered common space. The Academy should have compared its existing space to its common space requirement.

Library. The Academy did not need 8,539 square feet of additional space for the library as shown in the Analysis. The Master Plan stated that the capacity of the cadet library surpassed suggested space guidelines. Additionally, the Analysis stated that the CCHE guidelines suggested a college with an enrollment similar to the Academy's should have about 242,000 volumes in the library. The Analysis stated that the library had about 600,000 volumes. To account for growth, the Analysis applied a 2.5-percent growth rate to the Academy's collection and projected it would have about 900,000 volumes in 20 years. Thus, the Analysis applied 900,000 volumes to the CCHE guidelines. The growth rate should not have been applied because the CCHE guidelines already provided for growth. According to a CCHE official, the guidelines provide a 20-percent buffer for growth. We recomputed the Academy's library space needs, applying 600,000 volumes to the CCHE guidelines and found additional space was not needed. Therefore, we reduced library space requirements by 8,539 square feet, the additional space proposed by the Analysis.

Medical clinic. The Academy's planned expansion of the medical clinic by 9,463 square feet was based on the clinic providing:

- o services that are being provided at the main Academy hospital about 2 miles away;

- o 78,000 clinic visits, although available documentation showed that about 60,000 visits occurred in FY 1990 and about 62,000 in FY 1991;

- o 1,700 square feet of space for the Bioenvironmental Health function to relocate to the main academic building, although available documentation showed that the existing space was sufficient; and

- o facilities for 10 doctors and nurse practitioners, although the June 1991 staffing document showed only 7 were authorized and assigned.

The Analysis showed that the clinic would provide such services as pathology, radiology, and physical therapy. A clinic official stated that convenience to the cadets was the primary reason the clinic provided those services, even though they are available at the Academy hospital. Based on the number of actual clinic visits in FYs 1990 and 1991, the number of clinic visits was overstated by about 30 percent. Additionally, the number of visits should decline as a result of the 10-percent reduction in cadet enrollment.

Other space requirements. The Academy planned an additional 8,500 square feet for a dental clinic. Plans to move the dental clinic to the main academic building were not justified by available documentation. Although the Analysis did not include the dental clinic, the Academy planned to move the clinic from a dormitory to make more rooms available for cadets and to eliminate the need to house three freshmen in a single room. The clinic is located in a dormitory and will be moved to the main academic building (Fairchild Hall). However, the planned reduction in cadet enrollment will result in available dormitory rooms. The Academy has 2,118 dormitory rooms and will have a surplus of 236 beds, or 118 rooms, as a result of the reduction in enrollment to 4,000 cadets by FY 1995. The Analysis did not state any space requirements for the dental clinic, but Academy representatives stated that the dental clinic will be included in the building. Further, the Academy planned an additional 7,500 square feet of space for which documentation did not exist.

Existing academic space. The Analysis showed 30,000 fewer square feet of existing academic space than the Master Plan. The Master Plan, prepared in 1985 by the original architects of the Academy, showed the Academy had about 727,000 net square feet of academic space. However, the Analysis showed the Academy had 697,000 net square feet or about 30,000 fewer square feet than

the Master Plan. According to Academy officials, the difference occurred because the Master Plan included wall thickness in the total net area and the Analysis did not. However, the Master Plan did not specify it included wall thickness in the total net area. The Master Plan stated:

The total of "all" building space is equal to Total Gross Area. The total of "all useable" building space is equivalent of Total Net Area. Circulation, mechanical, electrical, telephone, janitorial, building storage and shops, loading docks, shafts, and toilet spaces, unless otherwise specified, are not included in Total Net Area calculations.

Understating existing space by 30,000 square feet increases surplus space by the same amount.

Future cadet enrollment. The Academy did not consider the reduction in cadet enrollment when computing space requirements for the CETF. As part of the Defense Authorization Act (the Act) for FYs 1991 and 1992, Congress mandated that the Service academies decrease entering class sizes from 1,500 students to 1,000 by 1995. However, in November 1991, Congress revised the Act and limited Service academies to an overall enrollment of 4,000 cadets by 1995, or about a 10-percent reduction in enrollment at the Academy.

The Academy did not revalidate space requirements to consider enrollment reduction. Air Force Manual 86-2, "Civil Engineering Programming Standard Facility Requirements," March 1, 1973, requires major commands to acquire and maintain justifications for building new facilities. Academy officials stated they did not believe the proposed 10-percent reduction in enrollment would affect their project; therefore, they did not recompute space needs. However, according to the Master Plan, the need for the expansion of academic facilities (the CETF) is directly related to the size of the cadet enrollment and support staff. Accordingly, the Academy should have recomputed space requirements to consider the 10-percent enrollment reduction.

Conclusion. The Academy overstated project requirements and did not validate or update requirements as significant changes occurred. CCHE space guidelines were cited as the primary basis for determining space needs. However, in some instances, other space guidelines were used in the computations of space requirements. By applying the CCHE guidelines consistently and using documented enrollment data, we determined that the Academy had a surplus of about 84,000 square feet of academic space instead of a need for an additional 139,000 square feet. If the CETF is built, the Academy will have about 223,000 square feet of space that is not needed.

RECOMMENDATION, MANAGEMENT COMMENTS, AND AUDIT RESPONSE

We recommend that the Superintendent of the U.S. Air Force Academy cancel the proposed construction of the Consolidated Education and Training Facility (Project No. XQPZ900011).

Management comments. The Air Force nonconcurred with the finding and recommendation to cancel construction of the CETF.

The Air Force response, summarized by the Academy Superintendent, included a compilation of position papers and letters from instructors and contractors. Because of the length of the response, we have highlighted the key points raised by the Air Force concerning the draft report. The complete text of the Air Force comments is in Part IV of the report.

The Air Force provided a comparison of the assigned space per full-time student at the Academy to assigned space per full-time student at other institutions of higher education. The data provided by the Air Force depict the Academy as having less space per student than the other institutions.

The Air Force stated that our analysis did not consider the Academy requirement for a laboratory-classroom teaching module. The Air Force indicated that the laboratory-classroom teaching module (referred to as integrated teaching laboratories by the Academy) is accepted as far superior to either a separate lecture hall or separate laboratory class throughout the basic science and engineering academic community. The Air Force noted that the University of Colorado at Boulder, San Jose State University, and other universities were among those promoting and using the integrated teaching laboratory concept.

Additionally, the Air Force stated that the CCHE space guidelines used by the auditors were in the lowest quartile of academic space guidelines used in 17 states and did not take into account unique aspects of the Academy. The Air Force questioned our primary use of the "Academic Space Needs Analysis" for the audit and emphasized that data from extensive academic department interviews should be used to determine space requirements.

Further, the Air Force indicated that, although the Academy expanded its academic facilities in the late 1960's to accommodate the growth of enrollment from 2,500 to 4,417 cadets, changes that have occurred since that time require more academic space. Those changes include a requirement for more complex laboratories; increased use of space-intensive equipment, such as computers and lasers; increasingly stringent environmental and safety constraints; and expansion of curriculum.

Audit response. To provide a complete and accurate assessment of the Academy's comments, we visited facility planners at six universities, four of which were cited in the Air Force response. We also met with six nationally recognized facility planning experts responsible for establishing space guidelines for institutions of higher education.

To discuss determinations of space and the integrated teaching laboratories concept, we visited the University of Colorado at Boulder, Georgia Institute of Technology, Michigan Technological University, and San Jose State University (universities mentioned in the Air Force response) and two nationally recognized institutions (College of William and Mary and Stanford University). Also, we visited the Colorado Commission of Higher Education; the California Postsecondary Education Commission; the Council on Higher Education, Virginia; and the National Center for Higher Education Management Systems to discuss the application of space guidelines. A complete list of activities visited is shown in Appendix D.

After a review of the Air Force comments, an analysis of data obtained from facility planners, and discussions held with those facility planners, we concluded that the basic condition remains. There is no need for a 20-percent increase in academic space at the Academy, especially when cadet enrollment will be reduced by 10 percent. Details on which we base our conclusion are provided below.

Comparisons with other institutions. The Air Force comments indicated that the academic facility planning community uses space per full-time equivalent (FTE) student in evaluating space requirements. The total FTE students are normally determined by dividing the total number of student credit hours by 15 credit hours (the average work load). Academic space (assignable square feet) is then divided by total FTE students to derive the actual assigned square feet per FTE student. A graph comparing the existing assigned square feet per FTE student at the Academy with the planned space at other colleges and universities was included in the Air Force response, page 51.

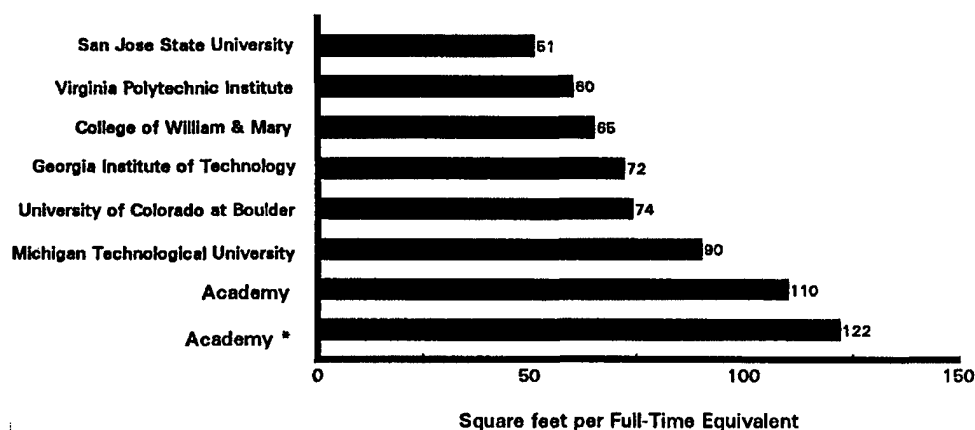
We showed the graph to academic facility planners at Georgia Institute of Technology, Michigan Technological University, and the University of Colorado at Boulder. Those institutions were depicted as having more space per FTE student than the Academy. The facility planners objected to the use of planned space and the inclusion of research space in depicting their academic space. The planned space shown did not reflect actual space or future construction plans. A facility planner at the Georgia Institute of Technology stated that the Air Force response included contractor-generated data, which were not representative of the institution's academic space needs. Also, Michigan Technological University officials stated the Academy used a contractor-developed proposal of the university's academic space needs that had not been accepted by the university.

Additionally, the facility planners stated that research space should not have been included in the space comparison. Research space primarily involves graduate and doctoral students. The Academy is a baccalaureate degree institution and does not offer graduate level or doctoral instruction to cadets. Finally, the graph does not accurately present our audit data on the Academy's space requirements.

To accurately compare academic space at the four universities to the academic space at the Academy, we obtained actual assigned space per FTE student from facility planners at those universities. We compared only existing academic space at the schools and excluded research space. Also, we included in our comparison the College of William and Mary and the Virginia Polytechnic Institute and State University. Data on the Virginia Polytechnic Institute and State University were obtained from the Council on Higher Education, Virginia. The comparison of existing space is shown in the graph below.

Comparison of Existing Space

(Excluding Research Space)

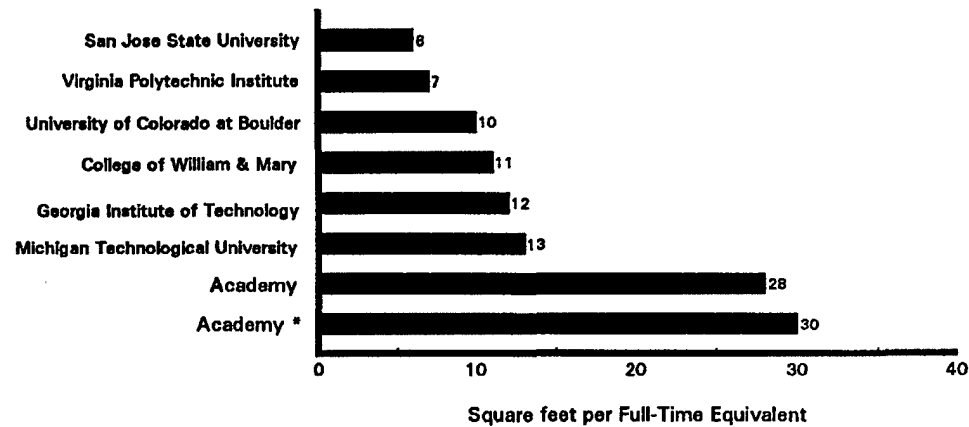


* Based on cadet enrollment of 4,000 in 1995.

As shown above, the Academy has more academic space than other larger institutions. Once cadet enrollment is reduced to 4,000, the assigned square feet per FTE student will be even greater.

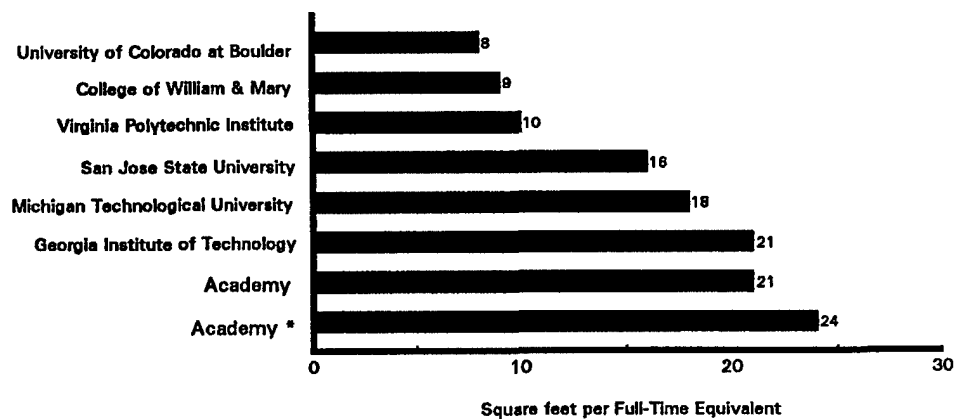
We also compared the assigned square feet per FTE student for classrooms and laboratories. The following graphs show the existing instructional space per FTE student at the Academy as compared to other institutions.

Comparison of Existing Classroom Space



* Based on cadet enrollment of 4,000 in 1995.

Comparison of Existing Laboratory Space



* Based on cadet enrollment of 4,000 in 1995.

As shown, the Academy has more than twice the classroom space per FTE student than some of the other institutions depicted. The Academy's existing laboratory space is equivalent to that of the Georgia Institute of Technology, a leading research institution. Moreover, when the Academy's enrollment decreases to 4,000 cadets, it will have more laboratory space per FTE student than the Georgia Institute of Technology. Facility planners emphasized the efficient use of existing facilities rather than construction of additional space.

Integrated laboratories. Air Force comments indicated that the "integrated teaching laboratory" concept is the concurrent scheduling of a classroom and laboratory for the same class. Space planners in California, Colorado, and Virginia described the concept as conducting a class only in a laboratory, not scheduling both a classroom and a laboratory. The facility planners did not advocate the scheduling of both a laboratory and classroom for the entire class meeting because it was inefficient use of space. Further, we met with officials from San Jose State University and the University of Colorado at Boulder, referenced by the Air Force as proponents of the "integrated laboratory teaching" concept. Those two universities did not have such a concept implemented nor did they advocate scheduling both a classroom and laboratory for an entire class meeting.

CCHE guidelines. We met with a facility planner at the California Postsecondary Education Commission (CPEC) to discuss its nationwide study, "A Capacity For Learning," referenced in the Air Force comments. A CPEC official agreed that if strictly applied, CCHE guidelines were some of the more austere guidelines. However, applying CCHE guidelines to adjusted variables, such as station sizes and projected station use, could result in more space. Our computations allowed significantly more space than a strict application of CCHE guidelines would have provided for both classrooms and laboratories because we applied CCHE guidelines to adjusted variables. In changing the station size and projected station use hours, we more than doubled the classroom space provided for by the most generous guidelines as discussed in the CPEC study.

"Academic Space Needs Analysis." The Air Force took exception with the use of the 1990 "Academic Space Needs Analysis" on which we based the audit. We used the Analysis because it was the most recent and detailed study of the Academy's academic space needs. Further, as stated in an internal Academy document ("Comparison of Results of Academic Facilities Space Needs Studies"), the Analysis ". . . validated the space programmed for the CETF . . ." Our review of the Analysis was based on the CCHE space planning guidelines, because the Academy used those guidelines to determine over 50 percent of its total academic space requirement. According to the Analysis:

Three space need guideline systems developed for application at colleges and universities were studied before the guideline system of the Colorado Commission on Higher Education was selected as being most appropriate in most areas for application at the Air Force Academy.

Although we based our audit on the CCHE guidelines, we also considered the uniqueness of the Academy. Details on our analysis of academic space are provided below.

Class sizes. We obtained data on the average size of classes at the Academy, both core and noncore curriculum classes, and on overall usage data on classrooms. The data show that the average class sizes at the Academy are well within documented goals and that there are enough classrooms to accommodate the students. We reviewed the "Fall 1991 Class Section Size Report" from the Academy Registrar's Office and found the average size of core and noncore curriculum courses satisfied the Academy's goals as stated in the 1984 Master Plan. A chart showing the average class sizes compared to the Academy's goals is shown below.

**Comparision of the Academy's Average
Class Sizes to Academy's Stated Goals**

	<u>Number of Cadets</u>	
	<u>Goal</u>	<u>Average</u>
Core courses	18-22	18.9
Major courses	12-16	13.8
Design/Seminar courses	8-12	*

* Design/seminar courses are included in major courses.

None of the higher education institutions we visited, including Stanford University, Georgia Institute of Technology, and the University of Colorado at Boulder had such a small number of students per class as at the Academy. Considering that standard classrooms at the Academy hold about 22 cadets, with some holding up to 30, the Academy's classrooms are large enough to accommodate an average class size. Further, a utilization report from the Academy Registrar's Office shows about 30 classrooms are vacant at any given time. In comparison, officials at Stanford University and the University of Colorado at Boulder stated they have no vacant classrooms during the middle of the day. Based on the above data, there is no support for additional classroom space at the Academy.

Non-class laboratory space. The Academy did not adequately justify using the more generous WICHE guidelines for space for independent research. According to officials at the CCHE and the Commission on Higher Education, Virginia, before independent research space would be allowed, a detailed space justification, by academic discipline, would be required. According to the CCHE senior planner, a blanket statement covering all disciplines would not be acceptable. Moreover, the President of the National Center for Higher Education Management Systems (co-author of the WICHE guidelines), said the WICHE research guidelines were developed before miniaturization technology was fully used in many of the engineering and science fields. He further stated that based on current technology, the WICHE guidelines may provide more space than is needed for certain disciplines. We believe applying the CCHE guidelines for independent research was proper and that the Academy did not fully justify using the more generous WICHE guidelines.

Office space. Discussions with facility planners confirmed our conclusions that the Academy has more than enough office space. According to the Air Force, the CCHE space guidelines we applied were too austere. To ensure that our overall conclusion on office space was sound, we calculated the Academy's space needs using the CPEC guidelines for research universities. According to the nationwide CPEC study, research universities require more office space per faculty member than other types of universities, such as state universities that do not offer master and doctoral degrees. The results of our calculation are shown below.

**Office Space Needs Analysis Using CCHE and
California Research University Guidelines
(in square feet)**

	<u>Space Needs</u>	Existing Academy <u>Space</u>	<u>Surplus</u>
California	117,000	171,041	54,041
CCHE	126,693	171,041	44,348

As shown above, if the CPEC or the CCHE guidelines are applied, the results are similar: the Academy has sufficient academic office space to perform its work load. According to the CPEC study, the CPEC guidelines were within 11 percent of the national mean for office space. Had we applied the guidelines for state universities in California, which the Academy more closely parallels, the calculation would have shown a need for even less

space than provided by CCHE guidelines. The following paragraphs discuss each of the specific issues affecting overall office space needs.

Suite circulation. The President of the National Center for Higher Education Management Systems ("NCHEMS") told us that suite circulation space is already included in space guidelines. Also, the Chief Planner at the CCHE stated architectural preferences should not influence space needs. If additional suite circulation space is desired, it should be taken from overall office space and should not be included as a separate space requirement.

Conference rooms and office service space. Our previous comparison of the Academy's office space to the guidelines used for California research universities included office, office service, clerical support and conference room space. As shown in the comparison, the Academy has more office space than would be provided to California research universities. We see nothing wrong with providing conference room space for every three faculty members, as recommended by CCHE. The U.S. Naval Academy does not provide dedicated conference room space for 100 percent of its faculty. One academic division at the Naval Academy does not provide its various academic departments with conference rooms because full faculty meetings were held in vacant classrooms and lecture halls. The Air Force has not clarified why vacant classrooms and lecture halls cannot be used for full faculty meetings. The 23,000 square feet of underused lecture hall space at the Academy could be used for visiting lecturers and faculty meetings.

Individual offices. Additional faculty work load at the Academy does not translate into a need for more space, as claimed by the Air Force. The Academy has a student to instructor ratio of about 7 to 1. Therefore, the work load for the faculty at the Academy may be lower than at other leading institutions across the country.

Library space. We held discussions on efficient use of library space with planning experts at three state commissions on higher education. The Deputy Director of the Commission on Higher Education, Virginia, stated he would discourage building additional library space because the use of technology decreases the need for more space. Also, the senior planner at the CCHE stated that the CCHE requires institutions to show the extent to which compact storage devices are used before approval of additional space requirements. Further, to make more efficient use of space, the State of California advocates that its schools use automatic retrieval systems for publications not receiving much circulation. The Analysis used in our audit did not address the use of such technology as an alternative to building more space.

Also, the library at Georgia Institute of Technology has much less space per volume than the library at the Academy (see chart below). Further, the library at Georgia Institute of Technology serves about 13,000 FTE students, twice as many FTE students as the library at the Academy.

**Comparison of Existing Library Space per Volume
(in square feet)**

	<u>Georgia Institute of Technology</u>	<u>Academy</u>
Volumes	1,431,377	600,000
Existing Space	140,000	116,000
Square Feet Per Volume	.0978	.1933

Medical and dental clinics. The existing cadet medical clinic occupies about 9,100 square feet in the main academic building. The CETF design includes about 18,500 net square feet for a new medical clinic and about 8,500 square feet for a new dental clinic. The proposed medical and dental clinics will occupy about 20 percent of the CETF.

Medical clinic. In FY 1985, there were about 68,000 visits to the clinic at the Academy. The 78,000 clinic visits in FY 1986 were used by the Air Force to support its claim that the clinic was undersized, inefficiently designed, and occupied space needed for expansion of academic needs.

In its response, Air Force management stated:

DoD-standard square footage requirements for health facilities are determined by the number of providers, and not by the number of visits, although one would expect a correlation. With the 10% (cadet) reduction, the required specialists, such as orthopedic surgeon for sports medicine needs, will not be reduced. With the same number of providers, the square footage requirements will not be affected.

However, DoD Instruction 6015.17, "Planning and Acquisition of Military Health Facilities," March 17, 1983, states that outpatient facilities and dental facilities shall be based on the population served.

DoD Instruction 6015.17 also states that at a minimum, an economic analysis shall be prepared, submitted to, and approved by the Office of the Assistant Secretary of Defense (Health Affairs), when a project involves a new or replacement health facility. The economic analysis, which is used to select the most effective alternative meeting the forecasted demand for health care, was not submitted as required. Even though the analysis was not submitted, the Academy Hospital Commander stated that the medical facility at the Academy was woefully inadequate, drastically undersized, and inefficiently designed to deliver state-of-the-art health care.

The chart below shows our comparison of the Academy's clinic to those at other universities cited in the Air Force's response.

<u>School</u>	<u>Clinic Square Feet</u>	<u>FTE Students</u>	<u>Clinic Square Feet per FTE Student</u>
Georgia Institute of Technology	15,363	13,360	1.15
Michigan Technological University	2,222	6,482	.34
Air Force Academy	9,072	6,200	1.46
Air Force Academy (Proposed)	18,535	5,600*	3.31

* 5,600 reflects a student body of 4,000 cadets.

The existing Academy clinic has about 1.46 square feet per FTE student. With the reduction in cadet enrollment, the square footage per FTE student will increase to 1.62. If the medical clinic is doubled in size, it would contain about 3.3 square feet per FTE student.

Dental clinic. The Academy originally stated that the primary reason for building a new dental clinic was to obtain additional dormitory space. Now, the Academy has responded that the dental clinic needs to be upgraded. As previously mentioned, no analysis was made to support the addition for the dental clinic.

Undocumented space. Comparing the Analysis used in our audit to the CETF design shows that 7,500 square feet of space is undocumented. The chart below shows how we arrived at the 7,500 square feet of undocumented space.

Undocumented Space

	<u>Square Feet</u>
Space Needs Analysis	122,966 nsf*
Add:	
Dental Clinic	<u>8,500 nsf</u>
Currently Documented Need	131,466 nsf
Less:	
CETF Design	<u>(139,000 nsf)</u>
Total Undocumented Space	<u>7,534 nsf</u>

* Net square feet

Reduction in enrollment. Our analysis showed that the 10-percent enrollment reduction will lower the class sizes well below the Academy's goals, and will have a significant effect on its academic space needs. The Academy's desired core class size is 18 to 22 cadets, according to the 1984 Master Plan, not 16 as stated in the Air Force reply. According to the "Fall 1991 Class Section Size Report" issued by the Registrar's Office, 18.9 cadets, not 23, was the average class size for core curriculum. A 10-percent drop in enrollment would reduce the classes to about 17 cadets which is well within the Academy's goals. Moreover, even with 23 cadets, a 10-percent reduction would reduce the core class sizes to 20.7 cadets which is within the Academy's goals.

Conclusion. When the need for more academic space was originally identified in the late 1970's, DoD was on the verge of the largest peacetime expansion since World War II. However, changing world events have caused the DoD to restructure forces, reduce budgets, and eliminate military installations. Therefore, new construction projects, like the CETF, should be supported by a current project analysis and rationale to justify expansion efforts. The rationale provided by the Air Force did not support new construction. The new information developed in the audit demonstrates the construction of the CETF expands the Academy facilities beyond that supported by validated requirements for space, at a time when cadet enrollment is declining, the Air Force is downsizing, and budget reductions are occurring. The Air Force and the Congress should reconsider their support for the project.

STATUS OF RECOMMENDATION

Response to Final Report
Should Include

<u>Addressee</u>	<u>Reconsideration of Position</u>	<u>Proposed Action</u>	<u>Completion Date</u>	<u>Related Issues*</u>
Superintendent, Air Force Academy	X	X	X	M

M= Monetary Benefits

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PART III - ADDITIONAL INFORMATION

Appendix A - Chronology of Events

Appendix B - Calculations of Space Requirements

Appendix C - Summary of Potential Benefits Resulting
from Audit

Appendix D - Activities Visited or Contacted

Appendix E - Report Distribution

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APPENDIX A: CHRONOLOGY OF EVENTS

<u>Date</u>	<u>Event</u>
Late 1950's	Original facilities at the Academy were constructed. Cadet population was 2,500.
Late 1960's	Enrollment increased to 4,500 cadets. Fairchild Hall was expanded by 30 percent to accommodate the increase in enrollment.
Late 1970's	The Academy identified a need for three additional buildings; a Science Center, a Consolidated Leadership Center, and a Consolidated Medical and Dental Clinic.
June 1985	The "Cadet Area Master Plan," prepared by the original architects of the Academy, documented a need for the CETF. Instead of constructing three additional buildings, the CETF would expand the existing main academic building by about 166,000 square feet.
May 1988	Another architectural firm began design of the CETF.
June 1988	The CETF project was 35-percent designed.
May 1989	Preliminary Design Analysis (60-percent review) was completed.
September 1989	The Academy hired an additional architectural firm to perform an "Academic Facilities Utilization and Upgrade Study" (the Study).

APPENDIX A: CHRONOLOGY OF EVENTS (cont'd)

<u>Date</u>	<u>Event</u>
September 1989	As part of the Study, a subcontractor was hired to revalidate the academic space needs at the Academy.
October 1989	Program Budget Decision 301 deletes \$36 million for the CETF project. Prior to this date, the CETF project had been deleted two times through the Program Budget Decision process.
October 1989	Final Design Analysis (90 percent) showed the CETF would provide an additional 139,000 square feet.
April 1990	The "Academic Space Needs Analysis," prepared by the subcontractor, showed a need for 123,000 square feet of additional academic space.
October 1990	The DoD Authorization Act for FY 1991 and and FY 1992 required the Service academies to reduce their entering class sizes from 1,500 to 1,000 by the fall of 1995.
April 1991	The firm performing the "Academic Facilities Utilization and Upgrade Study" issued a report charting a course for modernization of the academic facilities at the Academy through the end of the century.

APPENDIX A: CHRONOLOGY OF EVENTS (cont'd)

<u>Date</u>	<u>Event</u>
June 1991	The Academy submitted a request for an additional \$54 million to renovate the existing main academic building.
October 1991	The DoD Authorization Act for FY 1992 and FY 1993 modified the FY 1991 and FY 1992 Authorization Act and required the Service academies to reduce total enrollment from their current level of 4,500 cadets to 4,000 cadets by the fall of 1995.

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APPENDIX B: CALCULATIONS OF SPACE REQUIREMENTS

Space Needs Calculations (in Square Feet)

Function	Existing (a)	Academy		IG, DoD		Overstated Requirements (f)
		Space Needs (b)	^{1/} (Shortage) or Surplus (c)	Space Needs (d)	^{2/} (Shortage) or Surplus (e)	
			(a-b)		(a-d)	(b-d)
Classrooms	147,808	158,188	(10,380)	110,806	37,002	47,382
Lecture Halls	22,867	22,867	0	22,867	0	0
Teaching Labs	27,187	34,786	(7,599)	30,720	(3,533)	4,066
Special Classroom Labs	105,544	142,062	(36,518)	90,025	15,519	52,037
Non-classroom Labs	13,518	26,822	(13,304)	13,689	(171)	13,133
Offices	133,165	140,845	(7,680)	108,610	24,555	32,235
Office Service	12,777	20,717	(7,940)	10,405	2,372	10,312
Conference Rooms	25,099	30,630	(5,531)	7,678	17,421	22,952
Common Space	0	6,657	(6,657)	0	0	6,657
Library	116,604	125,143	(8,539)	116,604	0	8,539
Other Study Facilities	2,110	2,110	0	2,110	0	0
Special Use Facilities	30,603 ^{3/}	29,962	641	29,962	641	0
Shop	4,718	4,718	0	4,718	0	0
Storage	26,739	36,735	(9,996)	36,735	(9,996)	0
Support Units (Includes Medical Clinic)	<u>28,349</u>	<u>37,812</u>	<u>(9,463)</u>	<u>28,349</u>	<u>0</u>	<u>9,463</u>
Totals	<u>697,088</u>	<u>820,054</u>	<u>(122,966)</u>	<u>613,278</u>	<u>83,810</u>	<u>206,776</u> ^{4/}

^{1/} Space needs published in the 1990 "Academic Space Needs Analysis."

^{2/} Recomputed by the auditors using CCHS guidelines.

^{3/} Includes 6,689 square feet of space for base exchange and the ticketing office.

^{4/} Does not include 8,500 square feet planned for a dental clinic and an additional 7,500 square feet planned for undocumented requirements, resulting in a total of about 223,000 square feet of excess academic space.

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APPENDIX C: SUMMARY OF POTENTIAL BENEFITS RESULTING FROM AUDIT

<u>Description of Benefit by Implementing Recommendation</u>	<u>Amount and/or Type of benefit</u>
Economy and Efficiency. Cancellation of the construction project will result in funds put to better use.	\$36 million in FYS 1991 and 1992 Military Construction, Air Force funds put to better use, less design breakage.

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APPENDIX D: ACTIVITIES VISITED OR CONTACTED

Office of the Secretary of Defense

Comptroller of the Department of Defense, Washington, DC
Assistant Secretary of Defense (Production and Logistics),
Washington, DC
Assistant Secretary of Defense (Health Affairs), Washington, DC

Department of the Army

Headquarters, Army Corps of Engineers, Washington, DC

Department of the Navy

Naval Facilities Engineering Command, Chesapeake Division,
Washington, DC
U.S. Naval Academy, Annapolis, MD

Department of the Air Force

Deputy Chief of Staff (Logistics and Engineering), Washington, DC
Deputy Chief of Staff (Personnel), Academy Activities Group,
Washington, DC
U.S. Air Force Academy, Colorado Springs, CO
Office of Legislative Liaison, Washington, DC

Non-DoD Federal Organizations

Office of Management and Budget, Washington, DC

Non-Government Activities

Colorado Commission on Higher Education, Denver, CO
Council on Education Facilities Planners, International,
Columbus, OH
Association of Physical Plant Administrators of Universities and
Colleges, Alexandria, VA
Office of Facilities Planning, Ohio State University,
Columbus, OH
Paulien and Associates, Denver, Colorado
North Central Association of Colleges and Schools, Commission on
Higher Education, Chicago, IL
California Postsecondary Education Commission, Sacramento, CA
University of California, Oakland, CA
California State University, Long Beach, CA
Council on Higher Education, Virginia, Richmond, VA
National Center for Higher Education Management Systems,
Boulder, CO

APPENDIX D: ACTIVITIES VISITED OR CONTACTED (Cont'd)

Non-Government Activities (Cont'd)

University of Colorado at Boulder, Boulder, CO
Georgia Institute of Technology, Atlanta, GA
Michigan Technological University, Houghton, MI
San Jose State University, San Jose, CA
College of William and Mary, Williamsburg, VA
Stanford University, Stanford, CA

APPENDIX E: REPORT DISTRIBUTION

Office of the Secretary of Defense

Assistant Secretary of Defense (Force Management and Personnel)
Assistant Secretary of Defense (Production and Logistics)
Assistant Secretary of Defense (Public Affairs)
Assistant Secretary of Defense (Reserve Affairs)
Comptroller of the Department of Defense
Deputy Assistant Secretary of Defense (Installations), Assistant
Secretary of Defense (Production and Logistics)
Director, Joint Staff

Department of the Army

Secretary of the Army
Inspector General, Department of the Army
Auditor General, U.S. Army Audit Agency

Department of the Navy

Secretary of the Navy
Assistant Secretary of the Navy (Financial Management)
Auditor General, Naval Audit Service

Department of the Air Force

Assistant Secretary of the Air Force (Financial Management
and Comptroller)
Auditor General, Air Force Audit Agency

Other Defense Activities

Defense Base Closure Commission
Defense Logistics Studies Information Exchange
Inspector General, Defense Intelligence Agency
Inspector General, National Security Agency

Non-DoD Federal Organizations

Office of Management and Budget
U.S. General Accounting Office, NSIAD Technical Information
Center

Chairman and Ranking Minority Member of the Following Congressional Committees and Subcommittees:

Senate Committee on Appropriations
Senate Subcommittee on Defense, Committee on Appropriations
Senate Subcommittee on Military Construction, Committee on
Appropriations
Senate Committee on Armed Services
Senate Subcommittee on Manpower and Personnel, Committee on Armed
Services

APPENDIX E: REPORT DISTRIBUTION (Cont'd)

**Chairman and Ranking Minority Member of the Following
Congressional Committees and Subcommittees: (Cont'd)**

Senate Subcommittee on Readiness, Sustainability, and Support,
Committee on Armed Services
Senate Committee on Budget
Senate Committee on Governmental Affairs
Senate Subcommittee on Oversight of Government Management,
Committee on Governmental Affairs
House Committee on Appropriations
House Subcommittee on Defense, Committee on Appropriations
House Subcommittee on Military Construction, Committee on
Appropriations
House Committee on Armed Services
House Subcommittee on Military Installations and Facilities,
Committee on Armed Services
House Subcommittee on Military Personnel and Compensation,
Committee on Armed Services
House Subcommittee on Readiness, Committee on Armed Services
House Committee on Government Operations
House Subcommittee on Legislation and National Security,
Committee on Government Operations

PART IV - MANAGEMENT COMMENTS

Department of the Air Force

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DEPARTMENT OF THE AIR FORCE COMMENTS



DEPARTMENT OF THE AIR FORCE
OFFICE OF THE CHIEF OF STAFF
UNITED STATES AIR FORCE
WASHINGTON DC 20330

19 JUN 1997

**MEMORANDUM FOR ASSISTANT INSPECTOR GENERAL FOR AUDITING
OFFICE OF THE INSPECTOR GENERAL DEPARTMENT
OF DEFENSE**

**SUBJECT: Draft Audit Report on the Construction Project for the Consolidated
Education and Training Facility at The U.S. Air Force Academy
(IRB-0029.03) - INFORMATION MEMORANDUM**

This is in reply to your memorandum for the Draft Audit on the Construction Project for the Consolidated Education and Training Facility at the U.S. Air Force Academy requesting comments on the findings and recommendation made in subject draft report.

We nonconcur with the findings and recommendation in the draft report. Management comments are provided at the attachment.


MICHAEL P. C. CARNS, General, USAF
Vice Chief of Staff

1 Atch
Management Comments

DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)



DEPARTMENT OF THE AIR FORCE

HEADQUARTERS UNITED STATES AIR FORCE ACADEMY
USAF ACADEMY COLORADO 80840-5000

REPLY TO
ATTN OF: SUPT

11 JUN 1992

SUBJECT: Response to Draft Audit Report on the Construction Project for the Consolidated Education and Training Facility (CETF) at the U S Air Force Academy (Project No 1RB-0029.03)

TO AF/CE

We strongly nonconcur with the DOD/IG draft audit report. The auditors used a broad application of the austere guidelines developed by the Colorado Commission on Higher Education (CCHE). In a nationwide study directed by the California Postsecondary Education Commission, CCHE guidelines were shown to permit less space, on the average, than well over 75% of the 17 states with sufficiently well-established guidelines to be included in the study. Also, the auditors charged that the Academy was not consistent in the application of those guidelines. Even for schools in Colorado under the jurisdiction of the CCHE, it is seldom, if ever, the case that deviations from those guidelines are not approved. For example, CCHE has approved facilities which provide Colorado University with 96 sq ft per student, while the DOD/IG is recommending only 62 sq ft per student at the Academy. We believe it appropriate that the two professional firms which analyzed our requirements used data from their intensive departmental interviews rather than the CCHE guidelines exclusively, given the many unique requirements of the Academy relative to civilian schools, and since the Academy is not under the jurisdiction of the CCHE.

The auditors also failed to recognize the Academy requirement for the laboratory-classroom teaching module, a concept present in the original design of Academy academic space. Throughout the basic science and engineering academic communities, this arrangement is accepted as far superior to either a separate lecture or a separate laboratory class.

Some background to the construction proposal is helpful in understanding issues raised by the audit. Academic space at the Air Force Academy was originally designed for 2,500 cadets. In 1964 Congress increased the cadet wing by about 76% to an end-strength of 4417. (Recently, Congress reduced the end-strength to 4000.) To accommodate the 1964 expansion, the academic facilities were expanded, but only by 30%. At the time, the Air Force accepted this more austere academic space allowance. However, since the late 1960s the shortage of space has increasingly taken toll of our academic program as other factors have changed.

- Disciplines that at one time did not require laboratories now do and the disciplines that required laboratories now require more complex and exacting laboratories. The original facility was designed for laboratories in six departments; today, 12 departments require laboratories, with the additional laboratory space jury-rigged in areas largely unsuitable for laboratory use
- The increased use of space-intensive equipment, such as computers, lasers, and spectrometers, is now commonplace in the undergraduate laboratory environment at all major universities and colleges. Our programs are no exception.
- Increasingly stringent environmental and safety constraints acutely affect our curriculum and our accreditation. To ensure compliance in a building designed in the mid-50's, we are forced to omit pertinent lessons and experiments to avoid violations, compromising



DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

pedagogically sound principles. The list of omissions and alterations to lesson plans and courses continues to grow.

- Finally, the original building was designed for a single, core curriculum, with no electives. Today, the curriculum has expanded and we have 25 major courses of study.

With these new factors exacerbating the situation, the space squeeze we accepted in the late 1960s became untenable. Two independent professional studies by firms experienced in academic planning, plus three in-house reviews, yielded two independent analyses of our current space requirements that agreed to within approximately 0.2%. These are expressed in the CETF design which has been authorized and funded by the Congress and challenged by the DOD auditor.

In terms of space per equivalent student -- a parameter familiar to the academic planning community -- the history becomes this:

Original design	approximately 102 sq ft
After 1964 expansion and construction	approximately 75 sq ft
After CETF construction	approximately 91 sq ft
DOD/IG recommendation	approximately 62 sq ft

For perspective, current academic planning around the United States ranges, for example, from Arapahoe Community College at 38 sq ft per equivalent student to institutions such as Michigan Tech College of Engineering with 109 sq ft per equivalent student, and Georgia Tech with 213 sq ft per equivalent student. West Point currently has 84 sq ft per student and Annapolis stands at 102, which is about where the Air Force Academy started in the early 1960s.

The legislative history may be pertinent. Air Force's bid for FY90 funding was unsuccessful, but in FY91 Congress appropriated \$15M to start construction. In FY92, OSD requested the accompanying \$15M authorization. Congress responded with support for the complete facility in a \$36M authorization and an additional \$21M appropriation. It was in this same legislation that Congress reduced the authorized cadet wing strength.

We reiterate; we strongly nonconcur with the draft audit report. In our response, we have tried to be as explicit and objective as possible. We have clearly delineated our perspective on each of the findings and recommendations, a perspective which in most cases is quite different from that of the auditors. We encourage a careful reading of the "Discussion of Details" at attachment 2 to explain our position of strong nonconcurrence. If further clarification of our concerns is needed, please don't hesitate to contact the Dean of the Faculty at the Academy.



BRADLEY C. HOSMER
Lieutenant General, USAF
Superintendent

3 Atch

1. Management Comments, undated
2. Discussion of Details, undated, w/1 Atch
3. Supporting Letters and Papers, undated

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REPORT OF AUDIT (Project No. 1RB-0029.03)
DRAFT AUDIT REPORT ON
THE CONSTRUCTION PROJECT FOR THE
CONSOLIDATED EDUCATION AND TRAINING FACILITY
AT THE U.S. AIR FORCE ACADEMY
DATED 13 MAY 1992

RECOMMENDATION: Documentation supporting the expansion of the main academic building at the Air Force Academy (the Academy) showed that total space requirements were overstated by at least 223,000 square feet. The overstatement was primarily caused by inconsistencies in applying the space guidelines (endorsed by the Colorado Commission on Higher Education) for facilities of higher education in the computation of space requirements. In addition, for some special laboratory courses, enrollment was counted as if students used classrooms and laboratories simultaneously, thereby duplicating space requirements. After adjusting for these discrepancies, we estimated that the existing facilities provide about 84,000 square feet more than required rather than a shortage of 139,000 square feet. Furthermore, planned reductions in future cadet enrollment were not factored into the requirements determination. In view of the downsizing initiatives that are in progress, as well as concerns within the Department to adhere to near term fiscal constraints and budget reductions, it is our opinion that the proposed construction project at the Academy falls in a "nice-to-have" category and should be cancelled. The \$36 million appropriated for the project should be put to better use.

MANAGEMENT COMMENTS. NONCONCUR. The recommendation implies that documentation supporting the expansion of the academic building overstated our requirements. This is not the case. Two independent professional studies by firms experienced in academic planning, plus three in-house reviews, yielded two independent analyses of our current space requirements that agreed to within approximately 0.2%. The results of these studies are expressed in the CETF design which has been authorized and funded by the Congress.

These studies were based on intensive weekly interviews and visits conducted over six months by each of two separate professional firms, one in 1985 and the other in 1989. Care was taken to ensure the two studies were completely independent. Based on those interviews and visits, we applied the very austere CCHE guidelines to the extent that our unique requirements permitted. CCHE standards have been shown in nationwide

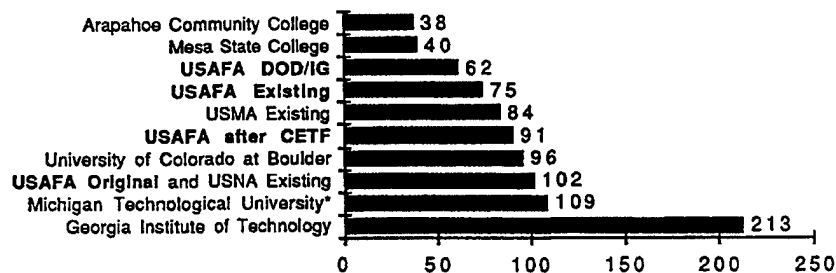
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studies to lie well within the lowest quartile of academic space guidelines across the country. To apply those guidelines across the board would be, in effect, reducing the Academy's standards to that of a "below average" school, even in Colorado. As explained in the chart below, using the measure of academic space as square feet per 15 semester hour student, or sq ft/FTE, planned academic space for the University of Colorado at Boulder will provide 96 sq ft/FTE. Our stated requirement will provide less than that, specifically, 91 sq ft/FTE. The audit alleges that we require only 62 sq ft/FTE. Currently, we stand at 75 sq ft/FTE. As two other points of reference, existing facilities at the Naval Academy provide 102 sq ft/FTE and existing facilities at West Point provide 84 sq ft/FTE.

Space Comparison

(Non-service academy data taken from previous studies by Paulien.)



Planned Space per Full Time Equivalent
Sq ft/FTE

* College of Engineering Only

Note: Basic Academic space includes classrooms, teaching labs, academic offices, research labs, and other departmental space

With regard to space requirements, no duplication occurred. At issue is the design of a "laboratory-classroom module" used in certain science classrooms. The auditors did not accept using this design. The design is used in the original architectural drawings of the Academy and is documented in the Academy archives. It includes a laboratory portion and a lecture portion, and allows for a high degree of pedagogical flexibility. Recently more schools have begun to show an interest in this design, and it has been referred to as "integrated teaching laboratories." Among the schools now using the concept is the French and Italian Air Force Academies, the University of Idaho College of Engineering, San Jose State

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University in California, the University of Michigan, the University of Arizona, and the University of Indiana. A strong proponent of the concept is located right here in Colorado, specifically, the Physics Department at the University of Colorado-Boulder. This design, with its recent growth in interest, strongly attests to the foresight of the original designers of the academic facilities at the Academy. The experience gained by Academy basic and engineering science faculty over the years has borne out the wisdom in this original design concept. By not including space to allow for this pedagogical approach, the auditors clearly dictate teaching methods that will be used at the Academy.

Relative to the recent 10% reduction in the size of the cadet wing, it is not clear that a recomputation and accompanying redesign would be cost-effective. In many cases the reduction will simply result in a return closer to the original Academy design standard. For example, the classrooms now in use at the Academy were designed, according to the archives, for 16 cadets in the normal classroom. Core courses make up two-thirds of the courses a cadet takes, and the average class size in those courses is 23 cadets. After the reduction, with the same number of sections, our average core class would have 20.7 cadets. So the reduction offers little relief, from the current section sizes which are 144 per cent of our design standard, to 129 per cent.

Many of the costs associated with operating an institution such as the Academy are fixed costs, even in terms of space, as opposed to variable costs which are more directly related to the number of users. Requirements such as the library, the number of courses offered, and the number of sections taught, especially when our core course section size is now 144% of the Academy design standard as discussed above, represent fixed operating costs and fixed space requirements.

The program for construction of academic facilities at the Academy is not a "nice-to-have" addition. We have a documented lack of adequate laboratory facilities which is degrading the curriculum, causing environmental and safety concerns, and increasing concerns over accreditation. We also have a documented shortage of space in a building designed nearly forty years ago for a single, core curriculum. The academic space requirement and the design of the CETF to meet that requirement is based on sound, professional judgment to satisfy urgent space requirements necessary to support the Academy curriculum now and in the decades ahead.

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DISCUSSION OF DETAILS

PART I -- INTRODUCTION (pg 1)

- 1 1. Background (pg 1). Concur in principle.

Phrase on last line of page 1 and first line of page 2, "... to build a 139,000 square foot expansion of the existing main academic building." [Quote 1]

The implication is that the entire 139,000¹ square feet is for academic space². In fact, only 111,453 square feet have been designed for academic space. Of the remaining, 18,535 square feet are for the medical clinic and 8,975 square feet are for the cadet dental clinic.

- 1 Phrase on line 10 of page 2, "... commissioning about 950 officers a year." [Quote 2]

In 1988, 1074 officers received their baccalaureate degree and commission. So far in 1992, 1067 have received their baccalaureate degree and commission. The average for the last ten years has been 1003.

- 1 Sentence on lines 10-12 of page 2, "In FY 1992, Congress passed a bill reducing enrollment at the Academy to 4,000 cadets by 1995." [Quote 3]

On 5 Dec 91, Public Law 102-190, in Sections 511 and 2301 respectively, authorized the reduction in the cadet wing and simultaneously funded the project to provide for our academic space requirements.

2. Objectives (pg 2). Noted.

3. Scope (pg 3). Concur in part

- 2 Sentence on lines 9-11 of this section, "We also met with the architectural firm and its subcontractor who performed studies of space needs for the Air Force Academy." [Quote 4]

The architectural firm of Skidmore, Owings, and Merrill(SOM), the original architects of the Academy, did the space needs analysis for the "Cadet Area Master Plan" upon which the CETF programming was based. This fact was briefed to the auditors during their single visit on 20 Aug 91, as well as during their inbrief and outbrief sessions at the Academy. According to appendix D of the draft report, the firm of Skidmore, Owings, and Merrill has not been contacted by the auditors.

- 4 Internal Controls (pg 4). Noted.

5. Prior Audits and Other Reviews (pg 4). Noted.

1 All square footages are in net assignable square feet

2 Throughout this response, academic space includes both academic and leadership space

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Part II -- FINDING AND RECOMMENDATION (pg 5). Nonconcur.

The recommendations forwarded in this report are unusual in that there is only one alternative mentioned, that of complete cancellation. This is especially unusual in light of the fact that the project in question has been recommended by five reviews of the requirements, two by professional architectural firms, including the firm which originally designed the Academy, and funding has been approved by two houses of Congress.

1. AIR FORCE ACADEMY EXPANSION (pg 5). Nonconcur.

Sentence contained in lines 4-7, "The overstatement was primarily caused by inconsistencies in applying the space guidelines (endorsed by the Colorado Commission on Higher Education) for facilities of higher education in the computation of space requirements." [Quote 5]

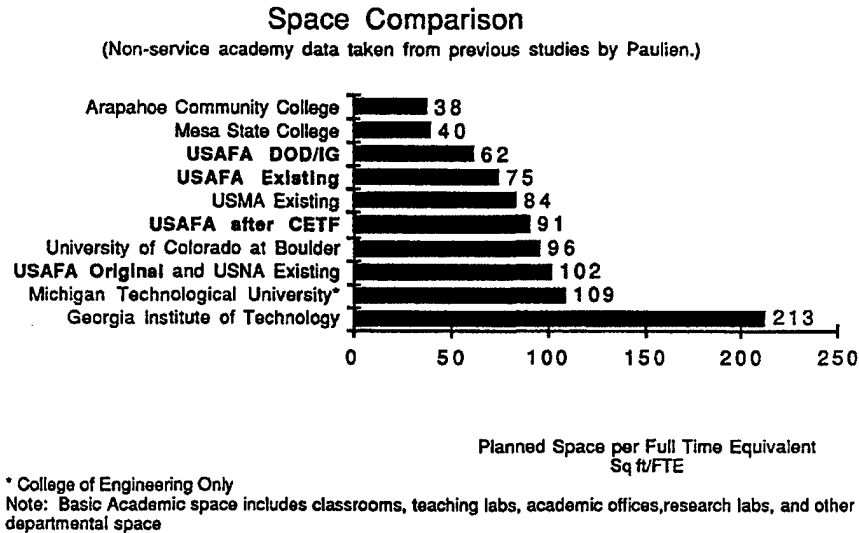
3

The application of guidelines to determine our academic requirement was based on intensive weekly interviews and visits conducted over six months by two separate professional firms, one in 1985 and the other in 1989. Care was taken to ensure the two studies were completely independent. Based on those interviews and visits, we applied the very austere CCHE guidelines to the extent that our unique requirements permitted. CCHE standards have been shown in nationwide studies to lie well within the lowest quartile of academic space guidelines across the country. To apply those guidelines across the board would be, in effect, reducing the Academy's standards to that of a "below average" school, even in Colorado. As shown in the chart below, using the measure of academic space as square feet per 15 semester hour student, or sq ft/FTE, planned academic space for the University of Colorado at Boulder will provide 96 sq ft/FTE. Our stated requirement will provide less than that, specifically, 91 sq ft/FTE. The audit alleges that we require only 62 sq ft/FTE. Currently, we stand at 75 sq ft/FTE. As two other points of reference, existing facilities at the Naval Academy provide 102 sq ft/FTE and existing facilities at West Point provide 84 sq ft/FTE.

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3

Sentence contained in lines 7-10, "In addition, for some special laboratory courses, enrollment was counted as if students used classrooms and laboratories simultaneously, thereby duplicating space requirements." [Quote 6]

We did not duplicate space requirements. At issue is the design of a "laboratory-classroom module" used in certain science classrooms. The auditors dispute using this design. The design is used in the original architectural drawings of the Academy and is documented in the Academy archives. It includes a laboratory portion and a lecture portion, and allows for a high degree of pedagogical flexibility. Recently more schools have begun to show an interest in this design, and it has been referred to as "integrated teaching laboratories" in some locations. Among the schools now using the concept is the French and Italian Air Force Academies, the University of Idaho College of Engineering, San Jose State University in California, the University of Michigan, the University of Arizona, and the University of Indiana. A strong proponent has been here in Colorado in the Physics Department at the University of Colorado-Boulder. This design, with its recent growth in interest, strongly attests to the foresight of the original designers of the academic facilities at the Academy. The experience gained by Academy basic and engineering science faculty over the years has borne out the wisdom in this original design concept. By not including space to allow for this pedagogical approach, the auditors clearly dictate teaching methods that will be used here at the Academy.

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Sentence contained in lines 13-15, "Furthermore, planned reductions in future cadet enrollment were not factored into the requirements determination." [Quote 7]

3

Relative to the effect of a reduction from 4500 to 4000 cadets by 1995, our perception is that this will result in a return closer to the Academy design standard. The classrooms now in use at the Academy were designed, according to the archives, for 16 cadets in the normal classroom. Core courses make up two-thirds of the courses a cadet takes, and the average class size in those courses is 23 cadets. After the reduction, with the same number of sections, our average core class would have 20.7 cadets. So the reduction offers relief from the current section sizes which are 144 per cent of our design standard, to 129 per cent.

Sentences contained in lines 18-21, "...it is our opinion that the proposed construction falls in a "nice-to-have" category and should be cancelled. The \$36 million appropriated for the project should be put to better use." [Quote 8]

3

The fourth reporting standard for government audits, as taken from page 7-12 of Government Auditing Standards, 1988 Revision, is:

The report should be complete, accurate, objective, and convincing, and be as clear and concise as the subject matter permits.

The sentences in the report referenced above, by the writer's admission, are opinion, and clearly do not fall within the objectivity intended for government audit reports as outlined in auditing standards.

2. DISCUSSION OF DETAILS (pg 6). Concur in part.

a. Background (pg 6). Concur in principle.

3

Phrase on line 6 of page 6, "... was hired to validate..." [Quote 9]

The firm was hired to determine space requirements, at this point there was nothing to "validate." If indeed they were hired to "validate" previous work it seems that reference to that previous work would be in their report.

Phrase on lines 14-15 of page 6, "In October 1989, design work for the Consolidated Education and Training Facility (CETF) began ..." [Quote 10]

3

The architectural firm of Henningson, Durham, and Richardson(HDR) was placed on contract by the Corps of Engineers in May, 1988. This is important in that it makes it clear that the study by Paulien and Associates(referred to in the draft report as "the Analysis", herein referred to as the Paulien study, the Paulien report, or Paulien), on which the auditors focused nearly exclusively, was not the basis for the architectural design, let alone the programming of CETF. And as mentioned in the comments in paragraph 3b, Part I, above (quote 4), the auditors had been thoroughly briefed on this matter on three separate occasions prior to

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publication of the draft report. They were briefed on 14 May 91, 20 Aug 91, and 3 Mar 92. After publication of the Paulien study results, it became apparent that the study's value to the CETF program was to provide a second, independent professional result, confirming the academic space requirements for the Academy. While special care was taken to ensure the Skidmore, Owings, and Merrill study published in 1985 and the Paulien study that began in 1989 were completely independent, the two professional studies came to the same conclusion regarding our space needs. Unfortunately, the intensive research and comprehensive studies accomplished by these two professional firms have not been reviewed with care by the auditors. For example, again referencing the documented sources in appendix D, the Skidmore, Owings, and Merrill organization was not even contacted.

3 Phrase on line 16 of page 6, "...and resulted in a proposal to construct..." [Quote 11]

The program was originally submitted in the FY 87-91 USAF POM, and then modified in the FY 88-92 POM.

3 Phrase on line 18 of page 6, "... the Academy had spent... " [Quote 12]

The funds expended were Air Force design funds.

3 Phrase on the first line of page 7, "... was hired to revalidate.." [Quote 13]

As mentioned previously in this response(see quotes 4 and 10), the error in this opinion adhered to by the auditors was briefed to them on three separate occasions, and shown to them in the 1990 publication of the Paulien study which the auditors reviewed extensively. Again, if indeed the firm was hired to "revalidate" previous work it seems that reference to that previous work would be in their report. On the contrary, on page 1-1 of their report, in the section entitled "Overview of Project Scope," it is made clear that the charter for the Paulien study was to determine utilization requirements within Fairchild Hall proper, and that the CETF facility was specifically excluded from the charter of the Paulien study. In addition to the fact that the CETF program was submitted before the Paulien study started, a quick review of the Statement of Work for their contract is conclusive.

4 Sentence on lines 9-10 of page 7, "The Analysis identified a need for 123,000 square feet of additional academic space." [Quote 14]

The 123,000 square feet is not all for academic space. Paulien's report showed a need for 122,966 additional square feet of space. Of this requirement, 9463 square feet were for the medical clinic. The remainder, 113,503 square feet, was the additional requirement for academic space.

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4

Sentence on lines 10-13 of page 7, "Although not part of the Analysis, an additional 8,500 square feet for a dental clinic and 7,500 square feet of undocumented requirements were planned by the Academy." [Quote 15]

Pure and simple, this assertion results from faulty analysis. We assume these figures result from subtracting approximations to numbers taken from the Paulien study from numbers in the finished design for CETF, which are based on the SOM report. In a very real sense, this is subtracting apples from oranges. Even if the 7,500 square foot undocumented allegation were correct, it would be in fact surprising, and indeed confirmative to the requirements, that the difference would be as little as 7,500 square feet. But in fact the difference is indeed smaller.

If we are careful in our calculations, and then make the comparison, we find that this difference is only 2,757 square feet rather than the 7,500 square feet incorrectly forwarded by the auditors. And when the auditors say that the figure is undocumented, we can only surmise that what they mean is that a number taken from one report is not documented in the other. But then no one would expect that to be the case.

To arrive at the accurate figure of 2,757 square feet we proceed as follows. Currently in the SOM-based design there are 138,963 square feet. To find the square footage of academic space, we subtract the design square footage for the medical and dental clinics. This leaves 111,453 square feet. Locating the medical clinic in the CETF frees up 9,072 square feet of academic space in the existing building, leaving a total of 120,525 square feet. The SOM Master Plan calls for removal of building 2413, which houses the 50th ATS, and inclusion of those functions in the academic building. Building 2413 contains 4,265 square feet of space. The net square footage of academic space that becomes available then, with the construction of CETF, is 116,260 square feet.

If we wish to compare the CETF program and design with the academic requirement shown in the Paulien study, we must take the 122,966 square feet from that report, and subtract the 9,463 square feet allowed for the medical clinic expansion. This leaves a net square footage from the Paulien report for academic space of 113,503 square feet. Subtracting the 113,503 square feet from the 116,260 square feet leaves the true difference between the two studies as 2,757 square feet.

Phrase on the first line of page 8, "...rejected by OSD..." [Quote 16]

4

To avoid misunderstandings here, let's be a bit more complete in our description of the projects funding history.

In FY90 and FY91, even though the Air Force was unsuccessful in their bid to include the program in the President's Budget, Congress appropriated \$15M to start construction of the new facility in FY91. Subsequently, in FY92, OSD requested the accompanying \$15M authorization. Congress responded to OSD's FY92 request with full support for the complete facility in a \$36M authorization and an additional \$21M appropriation. In this same piece of

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legislation, signed as Public Law 102-190 on 5 Dec 91, Congress simultaneously supported the complete new facility in Section 511, and in Section 2301, reduced the congressionally authorized cadet wing strength.

b. Proposed Consolidated Education and Training Facility (pg 8). Nonconcur.

(1) Space requirements (pg 8). Nonconcur.

Phrase on lines 5 and 6 of this paragraph, "...in some instances other guidelines that provided more space were used." [Quote 17]

The implication is made here that a search was done to find liberal guidelines whenever possible. Perhaps review of a nationwide study on guidelines might be helpful.

During the period from 1987 to 1990, the California Postsecondary Education Commission (CPEC) engaged a consulting firm to analyze space guidelines as they exist in all 50 states. The firm found guidelines in 17 states that were sufficiently well-established to withstand an in-depth analysis.

As shown by tables from the CPEC study entitled A Capacity for Learning, published in January, 1990, and summarized below, Colorado ranked toward the bottom in each of the major categories of facility types.

Facility Type	Number of States Surveyed	Colorado Ranking*
Classroom	16	13
Teaching Lab	15	14
Research	11	10
Office Space	17	14

**This means in teaching labs, for example, that Colorado provides next to the least square footage for teaching labs among the 15 states with established guidelines for teaching labs.*

The Academy is a national institution. The professional consultants who determined the academic space requirements for the Academy were trying to maintain a nationally competitive academic institution while applying conservative space guidelines to the extent possible. Had the consultants even used a national average, the space requirements would have been significantly greater.

Sentence on lines 7-9 of this paragraph, "Moreover, space requirements were inflated for courses that were conducted in both classrooms and special laboratories because enrollment was counted twice." [Quote 18]

Please refer to the same allegation made previously in this report and previously responded to in section II, paragraph 1 above.(see quote 6)

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4

Phrase on lines 9 and 10 of this paragraph, "We employed the same methodology used in the Analysis ..." [Quote 19]

The auditors could not have used the same methodology as used in the Analysis. The auditors spent a matter of a few hours in group discussion with a small group of faculty representatives. Then they applied austere guidelines across the board to arrive at a set of numbers with no concern for their pedagogical implications.

The consulting firm of Paulien and Associates, whose work the auditors focused on, employed an extensive process detailed on page 1-1 of their report. This process included detailed questionnaires, intensive individual meetings that averaged 90 minutes with each department and staff agency discussing responses on the questionnaires, and tours of the facilities assigned to each department noting academically unique requirements where they existed. They studied the transcripts of these interviews and compiled them into a 500-page document. After completing this research, they applied experienced, studied, professional judgments to arrive at the recommended space requirements in their report.

After careful scrutiny of the draft report and the Paulien report, it seems that most of the time spent by the auditors was not in determining the academic space requirements of the Academy, but rather in identifying allegations against the work done by the consultants which would justify their convenient application of austere guidelines across the board.

Last sentence on page 8, "Also, project documentation showed that space requirements may have been overstated by another 30,000 square feet because the Analysis used 30,000 fewer square feet of existing space than was identified in the Master Plan." [Quote 20]

4

The draft audit report does not get to the facts. A small sample of the room-by-room measurements by the two architectural firms reveals an approximate 5% difference in their methods of measurement. For example, refer to the following chart taken from the two professional studies.

Room type(no.)	Paulien(sq ft)	SOM(sq ft)	% Difference
classroom(4F6)	600	630	5.0
laboratory(2D4)	1027	1139	10.9
lectinar(3K10)	1314	1372	4.4

The rooms chosen were very typical rooms in Fairchild Hall. If we assume this to be representative of the different measuring techniques used by the two professional firms, the difference in their measurement of existing space could easily be 5%. The existing space shown by Paulien was 697,000 square feet and 5% amounts to 34,850 square feet. This difference was exhibited throughout the two studies and amounts to a difference in measurement techniques. The technique used to develop the numbers in the Paulien report

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included computer-based measurement verification software, where the cumulative measurements were checked against the building dimensions. The SOM work did not include the use of such software.

(a) Classrooms (pg 9). Nonconcur.

5

Sentence on lines 3 and 4 of this paragraph, "Space for those four categories was overstated by a total of 47,382 square feet." [Quote 21]

In essence, there are two reasons the auditors make this allegation. First, they did not accept the teaching technique which uses the laboratory-classroom modules discussed previously in this response under paragraph 1 of Part II (see quote 6). Alleged unnecessary classroom space for this reason is 25,124 square feet.

Secondly, the auditors did not allow space to give the Superintendent flexibility to schedule an entire class for a part semester course. For example, in the fall of 1989, Professional Military Science 110 was scheduled at the direction of the Superintendent for all incoming cadets in the first half of the semester. The urgency in this case was to give the new cadets follow-on instruction in honor, ethics, and professionalism that begins during summer Basic Cadet Training. The draft report directs that this course be offered in two half semester courses. The auditors allege that not having the flexibility for courses like this will save nearly 17,955 square feet.

According to the auditors, the remainder of the 17,955 square feet could be saved by not having classrooms available to occasionally put several sections together for group discussions, group experiments, etc. This happens frequently, that on an unscheduled basis it is pedagogically advantageous for several sections to assemble together, sometimes for only part of a period. Also, as a note of interest outside normal academic requirements, many Academy-approved conferences and meetings are held in those rooms by organizations from across the nation. This is of no direct benefit to the academic program, but it is an opportunity for visibility of the Academy and our academic program.

5

Sentence on lines 7-9 of this paragraph, "Space requirements were overstated primarily because enrollment for courses were inflated." [Quote 22]

No evidence is given to support the assertion for inflated enrollment data. The auditors and Paulien used the same data. Rather, at issue is the point discussed above in paragraph 1, Part II (see quote 6). Specifically, the auditor's refusal to accept the Academy's preferred teaching methodology in a laboratory-classroom environment.

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(i) Enrollment (pg 9). Nonconcur.

Sentence on lines 1-3 of this paragraph, "Classroom enrollment for special laboratory classes was inflated, which resulted in overstated space needs of 25,124 square feet." [Quote 23]

5

Specifically here, as discussed previously under paragraph 1 of Part II and under paragraph 2b(1)(a) above (see quotes 6 and 22), the auditors are alleging this space is unnecessary for the classroom part of the laboratory-classroom modules.

Phrase on line 2 of page 10, "...not normally used..." [Quote 24]

5

Classrooms and laboratories are "not normally used" simultaneously because the space-constrained environment currently existing does not provide the required space.

Sentence on lines 9 and 10 of page 10, "The Analysis contained an additional overstatement of 17,955 square feet related to course enrollment." [Quote 25]

5

(Please refer to previous comments under paragraph 2b(1)(a) above in the response to quote 21.) The auditors are alleging this space is unnecessary because they do not accept half semester scheduling for entire classes of cadets.

Sentences on lines 10-16 of page 10, "There were two primary reasons for the overstatement. First, full semester enrollment was improperly included for courses that met only for part of a semester. Some courses were divided into three sessions,...resulting in three times the space required." [Quote 26]

5

We have not found any factual basis to this allegation by the auditors. The only possibility for a misunderstanding that we can presume, is that Aviation Science has a course that meets in three 10-lesson blocks. But enrollment was not counted three times.

Sentences on lines 17-20 of page 10, "Second, according to Academy officials, additional classroom space was needed so that students attending several sections of a course could meet in one area. However, enrollments for those types of courses were counted twice..." [Quote 27]

5

(Please refer to previous comments under paragraph 2b(1)(a) above in the response to quote 21.) The term "counted twice" may be misleading here. It is true that cadets enrolled in a given set of courses may need these rooms at various times throughout the semester during the same class period in which their class is scheduled in their normal classroom. However, the purpose of these "joint" classrooms is to provide a slightly larger room, designed to facilitate group discussions, demonstrations, etc., which are not scheduled for other classes so that they are available to all courses.

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5

Phrase on lines 22-24 of page 10, "...the Academy could use existing lecture halls, which the Analysis showed as underused space." [Quote 28]

(Please refer to previous comments under paragraph 2b(1)(a) above in the response to quote 21.) Many times the reason for joint class sessions is to facilitate group discussion. Lecture halls do not satisfy this need, their arrangement, their size, etc. are all wrong. There is little, if any, common ground between the purpose of lecture halls and the purpose of joint class sessions.

(ii) Station sizes (pg 11). Nonconcur.

5

Sentence on lines 1-3 of this paragraph, "Actual average station sizes were not used, causing space requirements to be overstated by 3,354 square feet." [Quote 29]

The station size is the space per cadet in a classroom. The issue here is using precise, individual measurements as opposed to an average. The original design concept for the Academy was 37.5 square feet to allow space for individual cadet tables and cadet access to blackboards in the classroom rather than the armchairs in the typical university classroom. From precise measurements, Paulien found the station sizes to range from 26 to 28 square feet. The reason the numbers are smaller than in the original design is the shortage of space that has resulted from the inequitable expansion of the academic space with the increase in size of the cadet wing in 1968, as well as increasing pressure over the past decades for laboratory space. In their analysis, Paulien used an average of 27 square feet for station size. The auditors propose using 26 square feet for classrooms and 28 square feet for seminar rooms to realize a net savings of 3,354 square feet. Relative to the original design concept for the Academy of 37.5 square feet per station, the Paulien study understated our requirement by 50,076 square feet.

(iii) Undocumented space requirements (pg 11). Nonconcur.

6

Sentence comprising this paragraph, "The Analysis contained 949 square feet of space for a lecture section that was not supported by documentation." [Quote 30]

This space is not undocumented. It was briefed to the auditors as well as documented on page 2-8 of the Paulien report which they studied intensely for a year. The space alleviates scheduled overflow classes into conference rooms, laboratories which are unrelated to the class, etc. This allegation by the auditors has no factual basis.

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(b) Laboratories (pg 11). Nonconcur.

Sentence on last two lines of page 11, "In total, laboratory space requirements were overstated by 69,236 square feet as shown in the following table." [Quote 31]

6

Predominantly at issue in this allegation is the "laboratory-classroom module" discussed previously under paragraph 1 of Part II (see quote 6). This issue accounts for 52,037 square feet of the space in question in this section alone.

Another 4,066 square feet claimed by the auditors to be a "misclassification" that they found, was in reality, a reclassification of a course by the Academy after the Paulien report was published. The fact that it was a reclassification was briefed to the auditors. Regardless, the 4,066 makes little difference since it was appropriately added to the special laboratory requirement by the auditors and subtracted from the teaching laboratory requirement.

The remaining 13,133 square feet resulted from the auditors' choice of different space guidelines than used by Paulien.

(i) Special laboratory (pg 12). Nonconcur.

Sentence on lines 5-7 of this paragraph, "Therefore, instead of needing an additional 36,518 square feet, as shown in the Analysis, the Academy has a surplus of 15,519 square feet of special laboratory space." [Quote 32]

6

As discussed previously under paragraph 1 of Part II and mentioned in paragraph 2b(1)(b) above (see quotes 6 and 31), the auditors' refusal to accept the laboratory-classroom teaching technique dictates that in all classes with laboratories, the laboratory and lecture sections must meet independently. In addition, with the arithmetic the auditors used, 50% of the class time must be spent in laboratory and 50% in lecture. This issue rests with pedagogical judgment which the auditors dispute.

Sentence on lines 7-10 of this paragraph, "The net overstatement for special laboratory space requirements was primarily attributed to overstating the time cadets spent in a laboratory." [Quote 33]

6

Earlier in their report, on lines 7-9 of page 8 in the paragraph entitled "Space requirements," the auditors claimed a different reason.

4

Moreover, space requirements were inflated for courses that were conducted in both classrooms and special laboratories because enrollment was counted twice.

Regardless of the reason the auditors wish to claim, the issue remains the same. The issue is whether to allow space for the laboratory-classroom modules.

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6

Sentence on lines 10-12 of this paragraph, "Also, the Analysis did not include space requirements for a special laboratory course that was misclassified as a teaching laboratory course." [Quote 34]

As mentioned in the opening of paragraph 2b(1)(b) above (see quote 31), this was not a misclassification. It was a reclassification. When Paulien did their analysis, Biology 215 was classified as a teaching laboratory course. Later, after they published their report, the Academy reclassified the course as a special laboratory. This reclassification was briefed to the auditors.

(ii) Double scheduling (pg 13). Nonconcur.

7

Sentence on lines 5-7 of this paragraph, "According to the chemistry department chairman, laboratories are used only once a week for that course(Chemistry 131)." [Quote 35]

To finish the thought and not leave implication of a laboratory being used only "once a week," we need to realize that the information the auditors were given included the fact that Chemistry 131 is a core course. So every cadet must enroll in the course during their fourth class year, and consequently, over 20 sections need use of the laboratory for one lesson each week. This amounts to 40 hours of laboratory use each week in just Chemistry 131.

7

Sentence on lines 7-8 of this paragraph, "By definition, special laboratory courses use laboratories part of the time." [Quote 36]

This is not the definition of special laboratories, neither does the definition imply this. As reviewed several times earlier, special laboratories are the same as the laboratory-classroom modules. Their purpose and value is that lecture and laboratory portions of the course can be more thoroughly integrated, giving a richness to the pedagogy in these courses that is only recently being recognized by other schools, but has been part of the Academy design since its beginning. (see quote 6)

7

Sentences on lines 8-13 of this paragraph, "For Chemistry 131 and other similar courses defined as special laboratory, the Analysis should have used a factor accounting for time not spent in a laboratory. The Analysis showed that laboratory space requirements were reduced by 50% for 37 of the 81 special laboratory courses." [Quote 37]

This concept does pay greater pedagogical dividends in certain courses than others. Based on their in-depth interviews with each department, Paulien determined that this requirement could be relaxed in 37 of the 81 special laboratory courses. The auditors dispute the teaching concept even though they were given strong testimonies of its pedagogical value from department heads who happened to be available when the auditors were here. As a result they disallowed the required space in all 81 of those courses. (see quote 6)

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Sentence on lines 13-15 of this paragraph, "There was no documented rationale for not applying the 50% factor to all 81 special laboratory courses." [Quote 38]

7

The only documented rationale was the thorough documentation in the Paulien report and the saturating briefings on the subject given to the auditors by faculty representatives. Again, the rationale for the laboratory-classroom modules is the rich pedagogical benefit, and the rationale against the modules is that it saves space. There are many ways to save space at the expense of pedagogy. (see quote 6)

Sentence on lines 17-19 of this paragraph, "A CCHE representative stated that a 50% factor would be reasonable absent any other factor, general or course-specific." [Quote 39]

7

The credibility of this source is not established, and the statement is so well-guarded that it is practically meaningless. Other factors the CCHE representative might have been interested in include the pedagogical benefit experienced by the Academy faculty who have used the design in their classrooms and the particular value of this learning environment in light of the many demands made on cadets' time.

(iii) Special laboratory misclassification (pg 14). Nonconcur.

Sentence on lines 1-4 of this paragraph, "An incorrect course classification and some other minor enrollment misstatements caused the Academy to understate its space requirements for special laboratories by 4,855 square feet." [Quote 40]

7

This is the auditors' reference to the reclassification of Biology 215 from a teaching laboratory course to a special laboratory course after the Paulien report was published. (see quote 31) In addition, the auditors allege minor enrollment and square footage errors. The auditors were given more data to work from than was given to Paulien. Some of this data, since it was provided after the end of the school year may have been slightly different than that given to Paulien. In any case, few people would refer to those minor differences as "errors."

Sentence on lines 6-9 of this paragraph, "The misclassification caused a 4,349 square foot understatement in the special laboratory category and an overstatement in the teaching laboratory category." [Quote 41]

7

The issue repeated here is still the reclassification briefed to the auditors rather than the misclassification claimed by the auditors. (see quote 31) The reclassification of Biology 215 from a teaching laboratory course to a special laboratory course does add 4,349 square feet to the requirement for special laboratory courses and reduce the requirement for teaching laboratory courses by 4,066 square feet.

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7

Sentence on lines 9-11 of this paragraph, "Space requirements were also understated by another 506 square feet because of minor enrollment and square footage errors in the Analysis." [Quote 42]

This is due to possible differences in the data provided to Paulien when compared to the additional end of year data provided to the auditors. (see quote 40)

(iv) Teaching laboratory (pg 14). Nonconcur.

7

Sentences on lines 1-5 of this paragraph, "The space for teaching laboratory courses was overstated by 4,066 square feet. The overstatement primarily occurred because of the Biology 215 misclassification discussed in the special laboratory category causing an overstatement of 4408 square feet." [Quote 43]

This is the auditors' specific reference to subtracting the requirement for Biology 215 due to its reclassification from a teaching laboratory course to a special laboratory course. (see quote 31)

8

Sentence on lines 5-8 of this paragraph, "The overstatement of 4,408 square feet was reduced by minor understatements of enrollment for other teaching laboratory courses." [Quote 44]

Again, this is due to possible differences in the data provided to Paulien when compared to the additional end of year data provided to the auditors. (see quote 40)

(v) Non-classroom laboratory (pg 15). Nonconcur.

8

Sentences on lines 5-7 of page 15, "Non-classroom laboratory space needs were overstated by 13,133 square feet. Of that amount, 4,193 square feet were related to the tenant organization." [Quote 45]

The auditors straightforwardly applied the CCHE guidelines, whereas Paulien adapted the Western Interstate Commission for Higher Education (WICHE) guidelines.

Referencing the chart given in paragraph 2b(1) of Part II above (quote 17), of 11 states with established guidelines, CCHE guidelines for research space rank next to the bottom.

Paulien adapted the WICHE guidelines for research space. WICHE researchers did not wish to set national "standards," and, therefore, showed a range of space. At a major research university the upper end of the guideline range would normally be used. For an undergraduate institution such as the Academy the lower end seems appropriate. The WICHE guidelines assume a research team consisting of a faculty member and up to four students. Since normally a research team at the

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Academy consists of two cadets and one faculty member, Paulien used half of the lowest number in the WICHE range as the guideline number for faculty and cadet research.

In the Frank J. Seiler Research Laboratory, the appropriate full WICHE guideline was used for full-time professional researchers.

8

Sentence on lines 13-16 of page 15, "However, the Academy did not document how research and development space needs differed from the other two types of laboratory space for which CCHE guidelines were applied." [Quote 46]

Academy researchers work on many projects of general aeronautic and astronautic interest, in addition to other projects with broad application in the Air Force. Many of these projects are space intensive. In addition, a portion of the research effort at the Academy is accomplished by full-time professional researchers in the Frank J. Seiler Research Laboratory.

Phrase on lines 4 and 5 of page 16, "We used the same methodology as used in the Analysis, ..." [Quote 47]

8

Vast differences exist in the methodology applied by the auditors as opposed to that used in the Paulien and SOM reports. These differences include relative experience as academic planners and the amount of research performed to understand our academic needs, many of which are unique to the Academy. In addition, the auditors seized upon every opportunity to save space, regardless of the pedagogical costs and the expense incurred to cadet time and scheduling, whereas this lack of regard for pedagogy, cadet time and scheduling was not present in the studies performed by Paulien and SOM.

(c) Office functions (pg 16). Nonconcur.

Phrase on line 17 of page 16, "The deviation from CCHE guidelines inflated space needs..." [Quote 48]

9

Again, referring to the chart given in paragraph 2b(1) of Part II above (quote 17), CCHE guidelines, which were developed for civilian schools in Colorado, ranked fourth from the bottom of 17 states with established guidelines for office space. Typically, in civilian schools, faculty members spend little time in their offices. The faculty members at the Academy, all-military except for several visiting professors, spend most of the day in their offices taking care to accomplish tasks for their students relegated to undergraduate assistants at many civilian schools such as extra instruction or grading homework. The assertion that CCHE is correct is unsupported here -- as elsewhere.

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9

(i) Suite circulation (pg 17). Nonconcur.

Sentence on lines 1-4 of page 17, "The Analysis should not have included 28,823 square feet of suite circulation space for offices (23,475 square feet), office service (3,453 square feet), and conference rooms (1,895 square feet)." [Quote 49]

The suite circulation provided in the Paulien study was 20% of the net assignable space. The corresponding figure used in the SOM study was 25%. The auditors allowed no space for suite circulation. (see quote 52)

9

Sentence on lines 4-9 of page 17, "Air Force Manual 86-2, 'Civil Engineering Programming Standard Facility Requirements,' dated March 1, 1973 states that circulation, wall thickness, stairways, and other miscellaneous space are included in gross square footage requirements and should not be included in net square footage requirements." [Quote 50]

Let's take the exact quote given in chapter 13, paragraph 13-2c of the referenced manual.

c. Net Floor Area. The total gross floor area in the building, less space taken up by outside walls, interior partitions, stair towers, elevator shafts, toilets, basements unsuited for office use, permanent hallways and corridors, machinery or equipment used for heating or ventilating the building, machinery or equipment used for furnishing light and power for building, water supply equipment, and elevator machinery.

The auditors misread this manual. Referred to here is permanent hallways for circulation between office areas. This reference makes no allowance for circulation within a given office area, which is referred to in the Paulien report as suite circulation. Suite circulation is determined by moveable walls that accompany modular furniture.

9

Sentence on lines 14-18 of page 17, "Academy officials stated that additional suite circulation space was needed because offices were arranged in suites instead of the traditional hallway setting. However, project documentation did not support the additional space requirements for suite circulation." [Quote 51]

It doesn't seem efficient to have major hallways with one-deep offices to the side. The CETF design, as well as the current building, has department offices arranged in suites as opposed to one-deep offices off a major hallway.

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Sentence on lines 18-21 of page 17, "Additionally, discussions with an engineer from the U.S. Army Corps of Engineers indicated that a 20% factor for additional suite circulation was not reasonable." [Quote 52]

9

The credibility of this source is not established.

The implication from the draft audit report is that the Corps of Engineers disapproves of 20% suite circulation space. This can not be the case since the drawings for the project, which now are at the 100% review level, have been approved by the Corps at every level of design review.

In the attachment to this response is a signed letter from Mr. Daniel L. Sommer, P.E., with the U.S. Army Corps of Engineers in Omaha, Nebraska. Mr Sommer is Chief of the Omaha District Military Branch, responsible for overseeing the design of this project. Mr. Sommer states that "...20% for suite circulation space is approximately correct. Our experience is that the circulation space is often considerably more than originally anticipated."

(ii) Offices (pg 17). Nonconcur.

Sentences in the first seven lines of this paragraph, "Individual offices were overstated by a total of 32,235 square feet. As discussed above, 23,475 square feet are attributed to suite circulation. The remaining 8,760 square foot overstatement occurred because the Analysis used Academy-developed space guidelines rather than those suggested by other educational commissions, such as the CCHE guidelines." [Quote 53]

9

There are about 600 military faculty members at the Academy. The 8,760 square feet allegation of overstatement was made on the basis of CCHE standards for office space, which rank fourth from the bottom among the 17 states with established guidelines for office space. (see quote 17) Roughly then, dividing 8,760 by 600, we are allowing about 15 square feet more per military faculty member than the fourth lowest in the nation allows for civilian faculty members who typically spend little time in their office. Again, there is no rationale nor justification offered by the auditors for using CCHE as opposed to other guidelines available.

^{to}
Sentence on lines 8 and 9 of page 18, "In our opinion, additional administrative duties do not translate into a need for more space." [Quote 54]

10

The all-military faculty members at the Academy use their offices for more hours each day and for more functions than a faculty member at a typical civilian school. Included in those functions are a significantly greater number of hours spent in their office helping cadets with their assignments, counseling cadets, exercising supervisory relationships among the faculty, and working with other faculty members to achieve a high degree of course standardization.

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10

(iii) Office service (pg 19). Nonconcur.

Sentences on lines 1-5 of page 19, "Office service space needs were overstated by 10,312 square feet. As previously discussed, 3,453 square feet is attributed to suite circulation. The remaining 6,859 square feet overstatement occurred because CCHE guidelines were not used." [Quote 55]

Again, this allegation results from applying the fourth lowest standards for office space established in the nation. (see quote 17) The standard applied by Paulien would allow one service space for every ten offices.

10

(iv) Conference rooms (pg 19). Nonconcur.

Sentences on lines 1-4 of this paragraph, "Conference room space needs were overstated by 22,952 square feet. Of that amount, 21,057 square feet occurred because Academy-developed space criteria rather than CCHE guidelines were used." [Quote 56]

Conference rooms are used extensively in each department at the Academy. Larger departments have always had two conference rooms because of how much they are used. They are probably the most-used space on the faculty except for individual work stations. The purpose of conference rooms at the Academy has no parallel at civilian institutions.

Examples of activities for which conference rooms are used include daily lesson meetings in core courses and group grading of exams. These activities are essential to standardization of course offerings, especially since roughly one-fourth of the faculty is new to the Academy each year. Other activities include frequent departmental meetings which serve as departmental commander's call, faculty and cadet receptions, promotion and award ceremonies, colloquia, seminars, noon-time brown-bag research presentations, and Class Committee meetings twice each semester to review the progress and make recommendations for cadets with poor performance records. Even spontaneous meetings are called within a department when the occasion demands. Whereas conference rooms in civilian schools are seldom used, departmental conference rooms at the Academy are at the center of the professional development and teaching quality assurance within each department.

10

Sentence on lines 4-6 of this paragraph, "The Analysis also inappropriately included 1,895 square feet of suite circulation space." [Quote 57]

The conference rooms will be located within departmental suites, central to the offices in the department. This assertion by the auditors is unsupported.

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Parenthetical on lines 7 and 8 of this paragraph, "...a premise that concludes that more than 110% of the staff would meet at one time)..." [Quote 58]

10

To have more people attending an activity in a department conference room is not at all unusual. For example, cadets and members from other departments commonly attend functions in conference rooms.

Sentence on lines 2-5 after the indented quote on page 20, "However, we believe vacant classrooms, existing conference rooms, and underutilized lecture halls could be used for common graded reviews and faculty meetings." [Quote 59]

11

The need for conference rooms in each department is extremely well-established. Some of the uses of conference rooms have just been reviewed earlier in this subparagraph.

(d) Common space (pg 20). Nonconcur.

It is not clear whether the auditors distinguished between "common" space and "commons" space. Space available for student use between classes at many civilian universities is referred to as "the commons." This is the purpose of the space referred to as "commons" in the Paulien study.

11

Sentence on first three lines of this paragraph, "The Academy overstated common space needs by 6,657 square feet because the Analysis did not compare those requirements to the 6,689 square feet of existing space." [Quote 60]

There is no existing "commons" space in the academic building.

Sentence on lines 7-9 of this paragraph, "However, we believe the Academy base exchange and the ticketing office, which had a total of 6,689 square feet, should have been considered common space." [Quote 61]

11

The base exchange shoppette and the SATO ticket office may be "common" space, but they certainly are not "commons" space. During peak scheduling periods empty classrooms are very rare, and typically the halls are lined with cadets seated on the floor studying because, outside of walking quite a distance to the library, this is their only place to study. The "commons" space is intended to remedy this situation. The CCHE guideline was used here in the Paulien study, however, in this instance, the auditors chose not to use the CCHE standard.

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11

(e) Library (pg 21). Nonconcur.

Sentence on lines 1-4 of page 21, "The Academy did not need 8,539 square feet of additional space for the library as shown in the Analysis. The Master Plan stated that the capacity of the cadet library surpassed suggested space guidelines." [Quote 62]

The Paulien study did not suggest that the cadet library needed more space at this time, but in academic master planning it is normal to project a 20 year collection growth. That projection, utilizing a 2.5% growth rate, is at the low end of what most institutions use.

11

Sentence on lines 12 and 13 of page 21, "The growth rate should not have been applied because the CCHE guidelines already provided for growth." [Quote 63]

This is not the case. CCHE guidelines now apply a justifiable growth rate. It is certainly appropriate for the Academy to use the CCHE-adopted approach of applying a growth rate. This is especially true since the Academy is a repository for a large number of federal documents. It would be justifiable to use a greater growth rate than the low-end 2.5% used in the Paulien study.

11

Sentence on lines 13-15 of page 21, "According to a CCHE official, the guidelines provide a 20% buffer for growth." [Quote 64]

This 20% buffer is not to allow for growth. When shelves in a library are, on the average, 80% full, the library is considered to be at capacity. The 20% buffer is provided to minimize extensive personnel costs in frequent reshelving of books to keep them in sequence as books are added to the collection or returned from borrowers.

12

(f) Medical clinic (pg 21). Nonconcur.

Phrase on the last two lines of page 21, "services that are currently being provided at the main Academy hospital about 2 miles away;" [Quote 65]

These services are being offered at the main Academy hospital. However, the main hospital is not only 2 miles away, but it is currently 88,000 square feet short of space required to deliver the scope of healthcare for which they are responsible, without an added responsibility that would include cadets and active duty members from the cadet area. The auditors also overlooked the reduction in quality and efficiency of healthcare provided to the cadets and the inherent costs of the logistical tail, both in terms of the required daily roundtrip transportation for about 300 individuals and the loss of cadet man-hours available for their duties.

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Phrase on lines 1-3 of page 22, "78,000 clinic visits, although available documentation showed that about 60,000 visits occurred in FY1990 and about 62,000 in FY1991;" [Quote 66]

12

The requirement for the medical clinic was reported in the Paulien study, but it was established by the Air Force Health Facilities Office located in Dallas, using DOD standards. This study was reported on 28 September 1987. The 78,000 visits to the cadet medical clinic occurred in FY84. However, the medical resources unit at the Academy affirmed that DOD-standard square footage requirements for health facilities are determined by the number of providers, and not by the number of visits, although one would expect a correlation.

Phrase on lines 4-7 of page 22, "1,700 square feet of space for the Bioenvironmental Health function to relocate to the main academic building, although available documentation showed that the existing space was sufficient;" [Quote 67]

12

Relocation into the cadet clinic is necessary to provide an adequate functioning facility for the Bioenvironmental Engineering Department (SGPB). It is currently located approximately 8 miles from the cadet clinic. This department is an integral part of the aeromedical services program and, as such, the Bioenvironmental Engineer is a key advisor and reports directly to the Chief, Cadet Clinic/Aeromedical Services. SGPB is responsible for industrial health, and they work closely with virtually every aspect of the cadet wing and faculty. Of particular note, they work very closely with the Chemistry, Biology, and the Frank J. Seiler laboratories to maintain compliance with hazardous materials directives.

Phrase on lines 8-10 of page 22, "facilities for 10 doctors and nurse practitioners, although the June 1991 staffing document showed only 7 were authorized and assigned." [Quote 68]

12

Currently there are 6 flight surgeons, 1 orthopedic surgeon, 2 optometrists, 1 physical therapist, 1 general duty nurse, and 2 nurse practitioners, for a total of 13 healthcare providers assigned full-time to the cadet clinic. Additional healthcare providers such as dermatologists regularly hold office hours in the clinic on a part-time basis.

Sentences on lines 15-19 of page 22, "Based on the number of actual clinic visits in FYs 1990 and 1991, the number of clinic visits was overstated by about 30%. Additionally, the number of visits should decline as a result of the 10% reduction in cadet enrollment." [Quote 69]

12

There is no reason to use FY90 or FY91 as opposed to FY84, especially since we should be prepared for at least slight surge requirements in event of limited outbreaks requiring medical care. Right now, the main Academy hospital, as well as the cadet clinic, is significantly short of the DOD standard.

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Besides, as mentioned, the DOD-standard for square footage requirements is not based on actual clinic visits, but on the number of providers. With the 10% reduction, the required specialists, such as an orthopedic surgeon for sports medicine needs, will not be reduced. With the same number of providers, the square footage requirements will not be affected.

(2) Other space requirements (pg 22). Nonconcur.

12

Sentence on last two lines of page 22 and first line of page 23, "Plans to move the dental clinic to the main academic building were not justified by available documentation." [Quote 70]

There has never been a facility built for the cadet dental clinic since the original construction of the Academy. Prior to 1969, it was collocated with the medical clinic as in the current design for the CETF. In 1969, the cadet wing expansion forced the cadet clinic to absorb the space occupied by the dental clinic. The dental clinic was temporarily relocated into the dormitory built to accommodate the wing expansion. Today, it remains in its temporary location. It includes 18 cadet dormitory rooms furnished with dental equipment, while the DOD standard for its scope of responsibility is 21 dental treatment rooms. The cadet dental clinic is consistently downgraded on inspections by the Health Facilities Management Team for inefficiently designed facilities. Inclusion in CETF will correct this longstanding deficiency.

12

Sentence on lines 13 and 14 of page 23, "Further, the Academy planned an additional 7,500 square feet of space for which documentation did not exist." [Quote 71]

A detailed explanation of this allegation by the auditors is given in the comments contained in paragraph 2a, Part II (quote 15). The auditors perceived lack of documentation results from a logical error in their arithmetic. They subtract Paulien numbers from SOM based numbers and the results, quite predictably, do not add up. To avoid repeating the length of the discussion previously given, please refer back to the response to quote 15.

(3) Existing academic space (pg 23). Nonconcur.

13

Sentence on first two lines of page 24 after the indented quote, "Understating existing space by 30,000 square feet increases surplus space by the same amount." [Quote 72]

The difference in the existing space calculations between the SOM work and the Paulien work was explained in paragraph 2b(1), Part II (quote 20). In that paragraph, data is compared from the two reports to demonstrate the source of the 30,000 square foot difference in existing space calculations. The SOM work for the academic requirements was part of a master plan for the entire cadet area. The work done by Paulien focused on the academic requirements exclusively. The data reported by Paulien was prepared using IBM's Architectural Engineering Series software not available during the more broadly based study by SOM.

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(4) Future cadet enrollment (pg 24). Nonconcur.

Sentence on lines 1-3 of this section, "The reduction in cadet enrollment was not considered when computing space requirements for the CETF." [Quote 73]

13

From the auditors' own words on lines 6-9 in this section of their work, this legislation was signed into law in 1991. That is about seven months ago. How we could have known this in advance and incorporated the reduction into the design plans is not clear.

13

Many of the costs associated with operating an institution such as the Academy are fixed costs, even in terms of space, as opposed to variable costs which are more directly related to the number of users. Requirements such as the library, the number of courses offered, and the number of sections taught, especially when our core course section size is now 144% of the Academy design standard, represent fixed operating costs and fixed space requirements. It is doubtful whatever reduction in space that might be appropriate, would do little more than pay for the redesign costs.

The shortages the Academy has endured since the 1968 expansion have become increasingly costly to our academic programs, particularly in those departments equipped with laboratories. The number of departments with laboratories has increased from six in the early years of the Academy to where currently twelve of our nineteen departments are equipped with laboratories. The availability and, unavoidably, the subsequent requirement for sophisticated equipment have produced requirements for many of the early laboratories to increase in size. Examples include computers in both the classroom and laboratory, lasers, and a whole host of sophisticated measurement and analytical equipment in both the basic sciences and engineering.

Sentence on lines 6-9 of this section, "However, in November 1991, Congress revised the Act and limited Service academies to an overall enrollment of 4,000 cadets by 1995, or about a 10% reduction in enrollment." [Quote 74]

13

The effect of this reduction is discussed in the previous paragraph and elsewhere in this response. (quotes 3, 7, 69, 73, 77) A perspective not restated in detail in the previous paragraph is that right now the average section size in the core courses is 23 cadets per section. Core courses constitute two-thirds of a cadet's curriculum. With the same number of sections, the 10% reduction would reduce the core section size to an average of 20.7. The original design concept for the Academy was a maximum of 16 cadets per section. The reduction in size will bring these core classes from 44% over capacity to merely 29% over capacity.

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

Final Report
Reference

13

Sentence on lines 10-11 of this section, "The Academy did not revalidate space requirements to consider enrollment reduction." [Quote 75]

This issue was thoroughly discussed in the previous two comments. (Also, see quote 76)

13

Phrase on lines 16-17 of page 24, "Academy officials stated they did not believe the proposed 10% reduction in enrollment would affect their project; therefore, they did not recompute space needs." [Quote 76]

The implication here is illogical. The implication is that in the last seven months, since the project was funded and the reduction imposed by Congress, that we should have revised all the work that went into establishing our requirements and then entered into a revision cycle with the architectural firm who has the drawings at the 100% design level ready for contract bidding. In fact the most recent request for information from the auditors was during their 3 Mar 92 informal outbrief. Thus we would have had to accomplish those years of work within four months.

The reduction occurred midway through the audit, yet the auditors own calculations did not reflect any assumed effect of the reduction.

13

Phrase on the last line of page 24 and the first two lines of page 25, "...the need for expansion of academic facilities (the CETF) is directly related to the size of the cadet enrollment and support staff." [Quote 77]

To be directly related to means that as one increases or decreases so does the other. No one disputes that fact. The question is the degree to which space requirements decrease with a 10% reduction in the size of the cadet wing. It is our view that the space requirements will not be reduced significantly relative to the necessary redesign costs.

13

Sentence on lines 2-4 of page 25, "Accordingly, the Academy should have recomputed its space requirements to consider the 10% reduction in enrollment." [Quote 78]

Bluntly, again, it is painfully obvious that this has not been physically possible. Nor is it clear that such a recomputation and accompanying redesign would be cost-effective.

(5) Conclusion (pg 25). Nonconcur.

13

Sentence on lines 5-7 of page 25, "The Academy overstated project requirements and did not validate or update requirements as significant changes occurred." [Quote 79]

Every allegation of overstatement throughout the draft report has been corrected. There has been no overstatement of space requirements or double counting of enrollment, nor has there been a need established to update our requirements.

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

Final Report
Reference

Sentence on lines 7-10 of page 25, "CCHE space guidelines were cited as the primary basis for determining space needs; however, in some instances, other space guidelines were used in the computations of space requirements." [Quote 80]

13

The only reason the Academy asked Paulien to base their study on CCHE guidelines was to conserve space and reduce costs. As austere as the CCHE guidelines are when compared to other states' guidelines, they were used as much as possible. When they were modified or replaced by other guidelines the accompanying rationale, based on intensive departmental interviews, was fully discussed in the Paulien report.

Sentence on lines 10-13 of page 25, "By applying the CCHE guidelines consistently and using documented enrollment data, we determined that the Academy had a surplus of about 84,000 square feet of academic space instead of a need for an additional 139,000 square feet." [Quote 81]

13

Consistent application of CCHE guidelines serves the purpose of saving space and short-term dollars, and it obviates the need to do the research necessary for determining the true requirements of the academic program at the Academy.

Sentence on lines 13-15 of page 25, "If the CETF is built, the Academy will have at least 223,000 square feet more than required." [Quote 82]

13

This allegation stands in the face of a decade of conscientious work by scores of professional educators and university planners.

3. RECOMMENDATION FOR CORRECTIVE ACTION (pg 25). Nonconcur.

Sentence on lines 1-3 of this section, "We recommend that the Superintendent of the U.S. Air Force Academy cancel the proposed construction of the Consolidated Education and Training Facility (Project No. XQPZ900011)." [Quote 83]

14

The program for construction of academic facilities at the Academy is based on sound, professional judgment to satisfy urgent space requirements necessary to support the Academy curriculum now and in the decades ahead.

1 APPENDIX
Audit Comments, undated

DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

AUDIT COMMENTS

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Memorandum from Paulien and Associates, dated 3 Jun 92

It was the report by Paulien and Associates, entitled "United States Air Force Academy, Academic Space Needs Analysis," that the auditors reviewed. The last seven pages of this section is the first chapter from that report.

page 2

Letter from Skidmore, Owings, and Merrill (SOM), dated 5 Jun 92

It was SOM, the original architects of the Academy, that performed the study resulting in the Cadet Area Master Plan upon which programming for CETF was based.

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Letter from OZ Architecture, dated 4 Jun 92

OZ Architecture was contracted to study and design modernization of the existing building, to facilitate the Fairchild Modernization programming efforts. As part of their work, OZ subcontracted Paulien and Associates to study the Academy's academic requirements to assist in design of the modernized Fairchild Hall.

page 29

Letter from the State of Colorado, Department of Higher Education, Colorado Commission on Higher Education(CCHE)

This letter discusses the jurisdiction of the CCHE and the intentions of the commission's guidelines for use as an academic planning tool.

page 39

Memorandum from the U.S. Army Corps of Engineers, dated 4 Jun 92

This memo discusses the 20% suite circulation allowance in the CETF design. It is referenced on page 17 in the "Discussion of Details."

page 40

Letter from the USAF Academy Hospital Commander, dated 27 May 92

This is a letter of support for expanding the Cadet Clinic. The audit report takes issue with the space needs of the Clinic.

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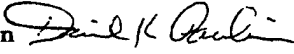
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MEMORANDUM

TO: Col. Dave Nolting
Associate Dean for Resources
United States Air Force Academy

FROM: Daniel K. Paulien 

DATE: June 3, 1992

SUBJECT: Response To Inspector General Report on the Consolidated Education
and Training Facility (CETF) at the United States Air Force Academy

In providing you my response to this report, I am going to first give you some background on my experience, discuss major assumptions which I believe the Inspector General continues to misrepresent, and then comment on specifics in the report.

Brief Outline of Consultant's Experience

Since this will be read by individuals not familiar with Paulien & Associates, I wanted to provide a brief background statement. I served as Coordinator of Facilities Planning and Research for the Colorado Commission on Higher Education (CCHE) in the early 1970's. I was co-author of the 1973 version of the CCHE Guidelines. I then went to the Auraria Higher Education Center where I prepared all of the pre-architectural facilities program plans for that 30,000 plus student urban renewal campus in Denver. I served as Director of Planning and Student Auxiliary Services there. In 1979 Paulien & Associates was founded as my full-time planning practice. Our higher education clients include the Georgia Institute of Technology, University

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of Arizona, University of Colorado, Colorado School of Mines, University of Idaho, Michigan Technological University, University of Missouri, University of Northern Colorado, University of Northern Iowa, Colorado State Colleges, and the Colorado Community Colleges. Almost all of our work involves determining space needs. I am an elected member of the board of the Society for College and University Planning and wrote the space guidelines portion of the Handbook of Facilities Planning, Vol. 1, Laboratory Facilities Published by Van Nostrand Reinhold in 1990.

Major Misinterpretations in Inspector General Report

The analysts from the Inspector General's office came to the first briefing I attended (August 1991) with a number of strongly held misconceptions about the purposes of the report we did for the Air Force Academy. Despite two lengthy meetings with them and despite unanimous input from all representatives from the Air Force Academy, OZ Architecture and myself pointing out these misconceptions, they have continued to move forward with them. They are the following:

1. They continue to state that this study was an attempt to revalidate the CETF needs. CETF was already far along in design as their own timetable indicates and this study was clearly to look at the upgrade of Fairchild Hall.
2. They continue to state that our purpose was to apply the Colorado Commission on Higher Education Guidelines. This was never the task I was given. I was to use my professional judgment in applying appropriate space needs tools to analyze the facilities requirements of the academic departments at the Air Force Academy.

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3. They continue to assert that the substitution of non-CCHE guidelines is inappropriate. In fact, in recent work on master plans for Fort Lewis College, Mesa State College, and Western State College, we made a number of substitutions including substituting a guideline from WICHE that in one case was 250% greater than the comparable CCHE guideline, substituting other guidelines from the Council of Educational Facilities Planners/International (CEFPI) which also were significantly greater and substituting University of Illinois guidelines that were more generous in another instance. CCHE analysts have proven themselves over the years to be open to cases made about specific needs.

4. They seem to believe that CCHE has authority over the Air Force Academy. During the May 29 meeting the Inspector General's program director asked whether I had requested CCHE permission to make the substitutions. CCHE had no involvement in my study. The Air Force Academy is a national institution. The Colorado Commission on Higher Education has no jurisdiction over the Air Force Academy. The first chapter of my study is devoted exclusively to pointing out the special needs of the academic programs at the Air Force Academy.

Continued Confidence in 1990 Study

I appreciate the opportunity you gave me to participate in the briefings held last August, this March, and this May, and to read the report of the Inspector General. I believe on all major points that my 1990 study was, and remains, an appropriate reflection of the needs of the academic departments at the Air Force Academy. The rest of this memo will give background on the major points already outlined and deal specifically with the individual comments made in the Inspector General report.

DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

Purpose of Space Needs Analysis

The space needs analysis was contracted as part of the Fairchild Hall utilization and upgrade study. As the Inspector General's timeline points out, the design of CETF had started about a year and a half before our study was authorized and at the time we began work the preliminary design analysis for CETF (60% review) had already been completed. Our study was never intended to justify the CETF project. In fact we had discussions with Col. William E. Ayen, your predecessor, and Byron Bloomfield, the project manager assigned by Base Civil Engineering, that seriously discussed whether we should just ignore the departments that were to be housed in CETF. The conclusion was that we should provide a complete analysis of all the academic departments. The planning work that went into CETF was never shared with me during the course of my study. The Academy deliberately did not want me to be influenced by the earlier findings regarding CETF.

Applicability of CCHE Guidelines

The Inspector General report makes the assumption that the right course of action for me to have taken was to have applied the Colorado Commission on Higher Education Guidelines without any deviation or taking into account unique aspects about the Air Force Academy program. The first chapter of my report is entitled *Determining Space Needs for The Unique Air Force Academy Academic Program* (included as an Appendix to this letter). I pointed out a whole series of areas where the Academy operates differently from state colleges and universities. When I started my study no particular guideline or course of action was proposed. The Academy representatives asked me to bring them examples of several guidelines

DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

and help them think through the best approach. Because the Academy is physically located in Colorado, the guidelines of the Colorado Commission on Higher Education were one of three that were analyzed. Because they are more detailed in some areas than the other two and because the purpose of this study was not to maximize the space justification but rather to provide a fairly detailed look at the relative space needs of each of the academic departments, the joint conclusion was that the Colorado guidelines were to be the primary ones utilized. However, it was always understood that I was to exercise my professional judgment in those areas where I felt the CCHE guidelines were inappropriate, where they needed to be modified or where another set of guidelines seemed more appropriate to the Academy situation in a particular category.

Detailed Analysis of Academy Needs

Part of the scope of work for this study was that I was to meet for an hour and one-half, and more time if needed, with each of the academic departments and that detailed transcripts of those meetings would be produced by my office to provide appropriate background and guidance to the planning process. A bound set of transcripts of 424 pages was presented to the Academy documenting the detailed discussions held with each department. This detailed information influenced some of the applications made in the space needs study. The Inspector General staff has not had such input and based on a March 3, 1992, all-day meeting, tended to brush aside any comments that were brought up by those USAFA departments which were represented at the briefing and spoke up about unique elements in their academic program.

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

Relative Ranking of Colorado Guidelines

Concurrent with the study I was doing and published after the completion of my study, the state of California conducted an analysis of existing space guidelines across the 50 states. Many states do not have detailed guidelines in place. Of those who do, it was found that the Colorado guidelines tended to generate either the lowest or close to the lowest findings for each of the categories which California studied. The Colorado guidelines were developed in the 1960's and have had very little updating since they were published in comprehensive form in 1973. In consulting work done for Colorado state colleges, we have pointed out major problems with guidelines specifically in physical education and music. The CCHE staff has agreed to alternate guidelines which provide significantly more space than the CCHE guidelines which are dramatically too low in those fields.

We have provided you with results from studies we have conducted for the Georgia Institute of Technology, Michigan Technological University and the University of Colorado at Boulder, all institutions with large engineering programs. All three of them generated space needs greater than those generated by us for the Air Force Academy on a per full-time equivalent student basis.

The findings of the Inspector General are that the Academy only needs approximately 80% of its existing space in the academic categories. This would put USAFA 50% or more below the square feet per FTE student findings for these other institutions with large engineering programs.

The Inspector General report notes that Fairchild Hall was constructed for 2,500 cadets and in 1968 when Congress expanded the enrollment to 4,500 cadets, Fairchild Hall was only expanded by 30%. A 30% increase to 2,500 cadets would be 3,250 cadets,

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indicating the likelihood that a space need exists at the 4,500 cadet capacity and even at the 4,000 cadet limit enacted by Congress after our study was completed.

The Inspector General report comments on the fact that our study did not deal with reduced cadet numbers. As noted, the Congressional action did not come until after our report was completed and USAFA did not ask us to analyze the impacts of this change.

USAFA As A National Institution

As an educational facilities planner, I reject that Inspector General report's concept that the Colorado Commission on Higher Education guideline should be applied in rote form to the Air Force Academy. The Academy is a national institution which happens to be located in Colorado. It has a different instruction methods and faculty work requirements from that of state colleges and universities. This results in greater needs for classrooms, laboratories, and faculty conference rooms. I believe that the findings of our study were very conservative and were not meant to, and did not, inflate the needs of the Academy.

Understatement of Existing Space

The Inspector General makes much of the fact that our study showed 30,000 less square feet than analysis done by others in the mid-1980's. OZ Architecture measured and put on computer assisted drafting equipment all the space requirements relevant to our study. I believe that the actual space shown was accurate within a reasonable margin of error. The level of detailed effort involved in calculating the existing space and the sophistication of the computer tools they utilized, both speak

DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

to the accuracy of their results. The earlier analysis may not have calculated assignable square feet in the same way OZ did. OZ used the Office of Education Higher Education Facilities Inventory and Classification Manual, 1973, the current classification standard for higher education space. A new draft manual has not changed these calculation standards.

Classroom Analysis

The Inspector General report disagrees with the USAFA policy that classrooms and special class laboratories are shown as being utilized at the same time for certain courses. The practice is for the Registrar to schedule the classroom for the entire class meeting time. The special class laboratory is dedicated to use in a particular department and its use is tracked by the department. The Inspector General report considers this double counting and deletes half of the classroom and special class laboratory hours produced by those classes. The United States Air Force Academy has scheduled its classes this way for many years so that instructors have flexibility to take their classes between the classroom and the special laboratories during a designated class period. It allows flexibility for part of the period to be utilized in lecture and the rest of it involved in hands-on experience by the students. This desire is not unique to the Air Force Academy. While the Inspector General report indicates they talked to the CCHE analyst who objected to this approach, it is a fact that in many technical and laboratory intensive programs, departments attempt to do this whenever possible.

The Academy has tended to include laboratory work within the framework of lecture courses to a greater extent than is true at state colleges where there are often

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lecture sections fully separated from a laboratory section held in a different facility on a different day.

After talking with all of the academic departments at the Academy, there is a general view of those involved with these laboratories that this flexibility is a distinct advantage to them in maximizing the educational advantages to their students. We saw nothing to suggest that this was inappropriate or wasteful. It indeed was a unique response to the outstanding undergraduate education that the Academy provides to its students.

We believe we also properly counted space need in larger lectinars for those multiple sections meeting together for specific meetings. The Inspector General report objects to this, and considers it double counting. We believe that within the context utilized, this finding was appropriate.

The Inspector General chooses to recommend that actual average station sizes be utilized, while we used an average across all of the types of classrooms. The station sizes range from 26 to 28 square feet. We felt using an average of 27 square feet was an appropriate response to simplify complex analysis and explanations. We continue to see nothing sinister in our attempt to propose an average size since we were substituting it for a pure guideline number (15 square feet in CCHE) which would have been wildly incorrect because the individual cadet tables utilized in all the small classrooms at the Academy are more space intensive than the tablet armchairs used at many other institutions.

The Inspector General indicates there was an undocumented 949 square feet in the classroom area. In fact, that finding is documented in the report and this was pointed out directly to the Inspector General's people when they inquired during the

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course of their analysis. Page 2-8 explains that this is for lecture sections that were taught in laboratories and conference rooms, but which would have been taught in classrooms had they been available. Therefore, under the concept we utilized, it was appropriate to calculate guideline space for them in the classroom category and this was the 949 square feet. I cannot help pointing out that I resent the continued use of "undocumented" when this was pointed out directly to the Inspector General analysts and it is documented for anyone to see in the report they were reviewing.

Special Laboratory Analysis

The Inspector General report objects to what they consider double scheduling which I have already addressed in the "Classroom Analysis" section. The Academy and their consultants both believe that this is appropriate academic flexibility and not an issue of double scheduling. The special laboratories do not have other uses than for the subject matter for which they were built. They are needed at their existing sizes (except in those instances where the use is heavy and multiple laboratories may be needed). An example of a special laboratory is the rocket laboratories for Aeronautical Engineering which are utilized by students to study the workings of the engines. Under the Inspector General approach, the end of a rocket might have to be chopped off because not enough space would be justified for it (based on numbers of student hours times a laboratory factor). Clearly if these are an integral part of the academic program, enough space needs to be provided to house them regardless of how many student contact hours are generated for those laboratories. We found that enough student contact hours were generated with the academic scheduling discussed above that we did not go into a secondary analysis which would determine

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the minimum amount of space needed for each laboratory regardless of student enrollment. We do this on projects reviewed by CCHE and they usually approve such upward adjustments for "dedicated labs." The Inspector General report has not done this and I believe has produced a space surplus result that is not appropriate in this area because it would not allow the minimum space needed for some of these special laboratories.

The Inspector General points to a misclassification regarding Biology 215. The Biology department and we both believe that this was correctly categorized since it was scheduled by the Registrar during the Fall 1989 term which was the basis for our study.

The Inspector General also points to "minor enrollment and square footage errors." Following the completion of our study, continuing analysis of the academic statistics was done by Col. Ayen and continuing analysis on the space amounts was done by OZ Architecture. We believe that our analysis was substantially correct based on the course and facilities information made available to us by the Academy and by OZ Architecture. The Inspector General was given later versions of course information and square footage information. While these may more correctly reflect the end of semester enrollments and current square footages, they are not the versions that were available to us during the course of the study. I do not believe that substantial errors or misclassifications exist.

Non-Classroom Laboratory Space

The Inspector General report objects to the fact that we did not use CCHE guidelines but used another guideline system for this category. We very carefully

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discussed the needs for this type of space with the Frank J. Seiler Research Laboratory people and with academic departments which desire and/or require that faculty members conduct non-classroom laboratory research and strongly encourage upper level students to do the same. We believe the approaches we utilized (we adapted the WICHE guidelines downward to reflect USAFA use patterns as explained in the report) are appropriate and reflect the need for the Academy to have a modest amount of additional space in this category. The California comparative study we referenced earlier showed the Colorado research guidelines to be the 10th lowest out of 11 state guidelines compared. CCHE is considering increasing its guidelines in this category.

Office Functions

In this area I believe the Inspector General report may be furthest off the mark. The Academy has very different expectations on its faculty from those at most state colleges and universities. All faculty are required to put in a full duty day. This means they are utilizing the offices much more intensively than would be the case at most colleges and universities. Additionally, the Academy requires more than half of a student's four-year load to be in core courses taken by all cadets regardless of their major. This means, for many courses, as many as 30 sections are taught during a semester. The departments make sure that each instructor is teaching the students the same material. Common tests are administered, they are commonly graded, and there is a great deal of interaction required among the instructors teaching in these sections. This means there is a greater need for office space, and a greater need for conference room space. In addition, instructors are required to provide additional instruction to any cadets who desire it. This is usually done in the offices. The

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Inspector General report findings suggesting that the Academy only needs about 74% of the existing office and conference room space do not seem credible to me.

The Inspector General report argues with suite circulation and says that this is part of non-assignable space. This is true if these are public hallways. We did not include public hallways. However, when the departmental offices are in a suite configuration, the space utilized to get from one office to another is classified as office service space under traditional higher education space classifications contained in a Department of Education Higher Education Facilities Inventory and Classification Manual it published in 1973 (then it was the Office of Education). This holds true in a current version of the space classification manual that is now in draft form. The Inspector General report is just wrong on this subject. We believe, based on our experience, that a 20% circulation factor is a reasonable one. In some instances less can be enough, but we have seen situations where as much as 35% is needed. We respectfully disagree with the unnamed engineer from the U.S. Army Corp of Engineers who found a 20% factor not reasonable. Our experience with many higher education institutions is that this is a reasonable, even conservative, factor.

The Academy has in place and desires to keep larger offices for its departmental leadership than are normally provided by the higher education space guidelines. These individuals are required to hold a great many meetings and it seems appropriate to continue the planning decision made in the 1950's to provide relatively large offices for these key individuals.

I believe that the use of a 10% office service factor was an appropriate one, and it simplified the analytical process. Ohio State University uses this factor in its office planning. The CCHE factors (which the Inspector General states in this application

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would have generated only half as much space) are in our experience not as responsive to unique factors, such as the size and space issues at USAFA, than is a percentage based guideline.

I have already commented on the need for conference rooms. The Inspector General has chosen to approach this on the basis of a regular college or university. I believe the additional conference room space which our study recommended and which was unanimously endorsed as being necessary at the Academy is appropriate. It again reflects an approach that has been in place since the 1950's. The Academy faculty need to meet regularly to coordinate their teaching of the many core courses required to be taken by all cadets.

Commons Space

The Inspector General wishes to place the existing space used by the base exchange and the ticketing office in this category. This is not the type of space that we proposed. During our extensive time on-site, we noticed cadet duffle bags often being placed in stairwells. We learned of cadets needing to go to the library to get a copy of a paper that they had to turn in for a class because no copying equipment was available to them in the classroom area. There was no study lounge available to cadets in the academic zone of the campus if they had one hour between classes and wished to remain in the academic zone studying. Because of these factors, it seems to us that a CCHE guideline of 1.5 square feet per full-time equivalent student for student services functions in academic buildings seemed appropriate. It is a broad application and would need further analysis during design of Fairchild Hall to

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determine if all that space was needed. This space was intended to be academically related space as was noted in our executive summary:

This could be utilized for such items as departmental study areas, lockers for cadets, additional self-help rooms for copying reports for classes, and preparing other visual aids for class presentation. (Page ES-4).

This category was not intended to include the cafeteria which is primarily used by faculty and staff and the other base exchange space in Fairchild as suggested in the Inspector General report. Our study carried those functions forward separately as support unit space.

Library

The Inspector General has missed the fact that the CCHE analysts have now adopted an approach which allows the current collections amount to be used as the base figure with a justifiable growth rate for the collection projected forward for 20 years. This is the approach we utilized. The Paulien & Associates study did not suggest that the cadet library needed more space at this time, but in academic master planning it is normal to project a 20-year collection growth. That projection, utilizing a 2.5% growth rate which is at the low end of what most institutions attempt to do, suggested that there would be some need for additional space before the year 2010. Paulien & Associates still believes that is a correct analysis. Our study pointed out that the Air Force Academy is a repository for a large number of federal documents including all military publications and that this produces a collection size much greater than might normally be the case if only the Academy's student body size and undergraduate nature are considered.

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The Inspector General report is wrong in saying that the CCHE factors include a growth rate. I have correspondence from CCHE regarding two state college master plans we have done, suggesting that the library findings be based on the existing collection plus growth rate. The 20% buffer discussed in the Inspector General report is the normal library planning practice that suggests that when shelves are 80% full on the average, the library should be considered at capacity. This is to minimize the extensive personnel cost in frequently reshelving books to keep them in sequence as books are added to the collection or returned to the collection after being borrowed by users.

Other CETF Space

The Paulien & Associates report showed the CETF proposed space for the Medical Clinic since its move will free-up Fairchild Hall space. The Dental Clinic is not now in Fairchild Hall and so was not included in our report. Since our work did not involve the CETF program, we do not know anything about the 7,500 square feet the Inspector General claims was included in that program without documentation.

Existing Academic Space

This issue was addressed earlier. We continue to believe the numbers in our report are more accurate than those from older USAFA reports.

Future Cadet Enrollment

During the time of the study there was no requirement on the Academy to look at reduced enrollments. This came later as shown in the chronology provided by the

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Inspector General. It is therefore not reasonable to expect the Paulien & Associates report to have addressed that issue.

Comment On Appendix B

On March 3, 1992 the Inspector General's staff shared with us approximately 11 pages of detailed calculations which went into their summary findings. The May, 1992 report does not include those calculations as an appendix, therefore, we were not able with certainty to understand the changes between the draft and the final report which resulted in somewhat larger DOD-IG findings for classrooms, teaching labs, and special classrooms.

I am pleased that the Inspector General report did accept our arguments that the law department library should not be considered part of the library space on the campus, but rather as academic department study space. However, they did not agree with the need to increase that space which I believe is clearly documented in our report.

Conclusion

The analysts again state their view that the CCHE guidelines should have been used consistently. This was not the charge the Academy gave Paulien & Associates which was to provide academic space needs analysis using our professional judgment.

Based on my work with approximately 40 higher education campuses around the country, I do not find that the Inspector General report result that the Academy has a surplus of about 84,000 square feet to be credible. They did not speak with the academic departments to understand special and specific needs, they did not take into

DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

account minimum space requirements for special class labs, and they did not take into account the unique office space requirements resulting from the duty day concept and the heavy reliance on core classes with common grading.

cc: Jeff Wright, OZ Architecture

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CHAPTER ONE DETERMINING SPACE NEEDS FOR THE UNIQUE AIR FORCE ACADEMY ACADEMIC PROGRAM

The United States Air Force Academy contracted with OZ Architecture, P.C. to prepare an Academic Facilities Utilization and Upgrade Study. OZ Architecture engaged the services of Paulien & Associates/Planning & Development Services to conduct the space needs analysis portion of the study.

OVERVIEW OF PROJECT SCOPE

Paulien & Associates was asked to apply relevant facilities space needs guidelines to the academic departments and staff agencies housed in Fairchild Hall and adjoining buildings, including the Aeronautics Laboratory, the 50th ATS Building, and the Observatory.

The study scope includes all units reporting to the Dean of Faculty (DF), and in addition, units reporting to the Commandant of Cadets (CW), which are now housed in Fairchild Hall or which may be housed in Fairchild Hall if the Consolidated Education and Training Facility (CETF) is constructed and the Frank J. Seiler Research Laboratory (FJSRL), part of the U.S. Air Force Systems Command.

Colonel William E. Ayen, Associate Dean for Resources, served as the Project Director, with Byron Bloomfield, of Base Civil Engineering, serving as the day-to-day contact with the architect and consultants.

The Air Force Academy provided the consultants with a room-by-room facilities inventory developed in the early 1980's. It was updated by each unit responding to a questionnaire from Colonel Ayen. A copy of this questionnaire is enclosed as Appendix A. As part of the current study, OZ Architecture is automating floor plans for all the facilities, utilizing a new computer-aided design and drafting system developed by IBM with Skidmore Owings & Merrill Architects. A detailed facilities inventory has been conducted, which included field identification of more than a dozen attributes for each room, and the photographing and measuring of each room. The photographs have been extremely helpful in verifying the classification of rooms where there is a question about the most appropriate room use code to assign.

The process included the distribution of a second questionnaire developed by the consultants and the project coordinators at the Academy, which asked each department to comment on problems they were having with specific types of space; describe in more detail unique aspects of their instructional program; analyze projected changes in educational approaches; comment on whether additional courses were expected within current enrollment levels; and describe their need for physical relationships with other departments. A sample questionnaire is also enclosed as Appendix B.

The consulting team met with each academic department and each staff agency for an intensive meeting which averaged 90 minutes per department. These meetings discussed the issues raised in the questionnaire and included a tour of unique facilities assigned to each department. Paulien & Associates has prepared a complete transcript of all these interviews, which is a separate document that has been presented to the Dean of Faculty,

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

both in computer diskette form and in printed form. Chapter 3 of this study, which organizes information by department, will contain highlights from the departmental interview process.

UNIQUE ASPECTS OF USAFA ACADEMIC PROGRAM

The application of guidelines to the Air Force Academy proved to be a unique challenge because there are a number of items about the Academy's academic program that differ dramatically from those at most other state or private colleges. Among these unique items the following merit some discussion:

M-DAY, T-DAY SCHEDULE

The Air Force Academy does not utilize Monday, Wednesday, Friday and Tuesday, Thursday scheduling as takes place at most institutions of higher learning. Instead, the Academy uses an M-Day, T-Day schedule in which each course meets on alternating days, i.e., during the first week of the semester M-Day classes meet on Monday, Wednesday, and Friday, and T-Day classes meet on Tuesday and Thursday. On the second week of the semester, T-Day classes meet on Monday, Wednesday, and Friday, and M-Day classes meet on Tuesday and Thursday. If there is a holiday and M-Day classes met the day before the holiday, T-Day classes will meet the day after the holiday. This means that the cadet always has one school day between class meetings for each class. Each M-Day class meets for 42 periods during the semester, and each T-Day class meets for 42 periods during the semester. The guidelines utilized for this study are based on weekly use expectations. Therefore, all M-Day classes and all T-Day classes were considered as meeting 2.5 periods per week, describing the average over a two-week period.

On many campuses, because of the popularity of three-hour classes, Tuesday and Thursday classes meet for 75-minute periods while Monday, Wednesday, Friday classes meet for 50-minute periods. At the Air Force Academy, all classes meet for 50 minutes. As will be discussed below for some courses which include laboratory work, the class is scheduled for two consecutive 50-minute periods and only one course out of the entire curriculum meets for a three-period block of time.

SHORTER ACADEMIC WEEK

Residential campuses traditionally have an academic day schedule roughly from 8:00 a.m. until 5:00 p.m. At some campuses, no classes are scheduled over the noon hour, but the majority of public institutions now schedule courses through the noon hour. In the past, often Friday afternoons were lightly utilized. More and more, a full five-day schedule is being developed.

At urban institutions heavy course scheduling takes place from 8:00 a.m. until 9:00 p.m. or later.

Almost all the facilities guidelines which have been developed by states or universities are based on an academic day of 8:00 a.m. to 5:00 p.m. Some of them have translated this as a 40-hour week. Most of the guideline systems assume that courses will be scheduled during the noon hour and therefore utilize a 45-hour academic week. At the Air Force Academy, there are four academic periods before the lunch break, starting at 8:00 a.m., and three academic periods after the lunch break. After this, cadets are

DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

scheduled for intramural sports, intercollegiate athletics and other activities. Some intercollegiate sports also utilize the seventh academic period each afternoon. The first period after lunch every M-Day is devoted to professional military training. All academic facilities are blocked out for that purpose and no classes are scheduled. Professional military training will utilize many of the facilities in Fairchild Hall on certain days. On other days the cadets may be involved in activities outside of the academic facilities.

Other military training courses such as Aviation 105 are scheduled during the academic day. Physical education courses are also scheduled during the regular academic day. Physical Education courses were excluded from this study since they are not held in Fairchild Hall.

There are a total of 13 periods in which academic classes scheduled by the Registrar take place over a single M-Day, T-Day lesson cycle. Multiplying the 13 periods by 2.5, the average times per week each M-Day or T-Day class would meet, produces a total of 32.5 hours per week, compared to the guideline academic week of 45 hours.

In Chapter Two, the consultants describe the process that was utilized to modify the classroom and laboratory guidelines so that a comparable weekly utilization expectation was achieved taking into account the significantly lower number of hours available per week.

The Dean of Faculty has studied whether a change to a more traditional Monday, Wednesday, Friday and Tuesday, Thursday schedule might have advantages to the Academy. Additional study has been given to whether the academic day could be lengthened by moving professional military training to more intensive blocks of time between academic trimesters. No decision to change from the current system has yet been made.

SMALL GROUP INSTRUCTION

The United States Air Force Academy is committed to small group instruction for almost all aspects of the academic program. Virtually all classes have class sizes of 24 or less. The average class size in the fall of 1989 was 19. Because the program at the United States Air Force Academy contains 30 required core courses which are taken by all cadets, a large number of sections for those courses must be offered each term to allow all cadets to complete these requirements. Up to 30 sections will be offered of a particular core course in a given semester.

This instructional methodology results in the need for a large number of rooms for scheduled classes relative to the student body size. As currently classified by the consultants, there are 213 rooms used for non-laboratory instruction (classrooms, mini-lectinars, lectinars, seminar rooms), at the Air Force Academy. This is after certain rooms that may be considered classrooms at the Academy were reclassified because they were not being used on a scheduled basis for class activity. The Auraria Higher Education Center in Denver, which serves over four times as many full-time equivalent students but does so with a much longer academic week, which includes extensive evening use, only has approximately 140 classrooms.

It should be noted that the Academy's use of classrooms is at a comparable level to the percentage of use normally expected by facilities guidelines. The consultants note that because of the large number of sections taught at the Air Force Academy, the number of classrooms does not seem excessive for this specific program and the academic schedule.

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REQUIRED CORE COURSES

The United States Air Force Academy curriculum has an extensive number of required core courses. All cadets must take 30 different core courses with between 46 and 49 courses required for graduation. Every academic department offers at least one core course, meaning that all cadets have an extensive common academic background regardless of the major they have chosen. At a public university, there might be as few as a half-dozen courses required of all students. In most cases, students are given options of taking one or more courses within a subject area cluster. At the Academy, specific courses are required. For most core courses, the expectation is that the course is taken during a particular academic year for each cadet. Core courses are taken during all four years of a cadet's attendance at the United States Air Force Academy.

CLASSROOM/LABORATORY SCHEDULING

At the United States Air Force Academy, all courses which have laboratories meet either for one period, two consecutive periods, and in the case of one chemistry course, for three consecutive periods. The classroom and laboratory activity are both conducted within that time block. In some cases, both the classroom activity and the laboratory activity take place in the same room. In those cases, the consultants have classified those rooms as laboratories so that more generous laboratory guidelines can be applied to correctly reflect the fact that special furnishings are required in almost every instance. In other cases, the classes move to a laboratory facility at some point during a meeting period. This may not happen during every lesson, but happens on a pre-arranged schedule.

The scheduling concept used at the Academy is that the classroom is scheduled for the entire block of time for those classes which include laboratories, and if the laboratory is in another location, this is not noted on the scheduling information in the Registrar's office. This contrasts with usual practice at state universities, which will list a specific time and place for the classroom portions of a course, and a separate time and usually a separate place for the laboratory portion. For a three-credit hour course with laboratory at a state university, there would normally be two weekly hours of classroom use plus a three-hour laboratory. At the Academy, there will be either 2.5 weekly hours of use including both the lecture and lab, or more normally, two periods per lesson for a total of five hours per week with both lecture and lab included. It is not unusual at an average state university for laboratory courses to be four-credit courses with three hours per week of lecture plus a two-hour or three-hour lab. In some cases, the variation would be one large lecture section and one or two smaller discussion sections plus the laboratory. At the United States Air Force Academy, all academic courses are considered three-credit courses in terms of student requirement toward graduation except for a Principles of Chemistry course which meets for a three-hour block per lesson. It is considered a five credit-hour course and is the only laboratory course which meets for more than a two-hour block. This means that the scheduling possibilities for sections of Principles of Chemistry are limited to one meeting in the morning and one meeting in the afternoon on T-Days, and a morning meeting on M-Days, because there are only two periods available in the afternoon on M-Days. The two-hour laboratory block courses have two scheduling possibilities in the mornings and one in the afternoons on both M-Days and T-Days.

For core courses, it is not at all unusual for them to be offered in all available time configurations. The Air Force Academy semester of 42 M-Days and 42 T-Days (or 17 weeks) is one to two weeks longer than the semesters at many other colleges and universities.

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CADET ACADEMIC LOAD

The academic load of a cadet is quite ambitious. For most cadets, it consists of six academic courses during a semester, one professional military studies course each year, plus the required professional military training period and required physical education course work during each semester. Cadets averages 21 credit hours over the eight semesters which is 1.4 full-time-equivalent students per cadet using the 15 student credit hour definition of a full-time equivalent student used in the Colorado state system of higher education. This means that the 4,436 cadets would generate over 6,200 FTE if they were in the state system.

Because of this heavy load, instructors are limited to requiring two hours of outside work for the average cadet for each hour of class meeting. For those courses which meet for two periods, the second period is included in that requirement, meaning that only one hour of outside work can be assigned. For the Principles of Chemistry, two hours can be required in addition to the three hours of class time.

COMMON COURSE CURRICULUM

For each course at the United States Air Force Academy there is a course director, and detailed information is kept in bound form of the information distributed to students and the course outline. For courses with multiple sections, all instructors are expected to teach the same material at the same lesson within the semester. Common tests are given to cadets several times during the semester for each core course. This means that all cadets meet at the same time to take those courses. This activity takes place at 7:00 a.m., and utilizes as many rooms within Fairchild Hall as are necessary for those courses. Departments have to coordinate with the Registrar to assure that sufficient rooms are available for the common graded review testing.

ACADEMIC DUTY DAY

Another significant difference between the United States Air Force Academy and the average state university is that faculty are expected to be onsite for a duty day extending from 7:30 a.m. until 4:30 p.m. This is the time period when all academic facilities are open. Some departmental laboratory facilities remain open for extended hours. General use facilities (classrooms, library, computer labs) are open until 11:00 p.m. on week nights.

Instructors are expected to give extra instruction (E.I.) to any cadets who request it. This usually takes place with one or two cadets meeting with an instructor in the instructor's office. This has posed a particular problem with the current open office system for instructors. As one department indicated, an instructor giving extra instruction is not only giving it to the cadet, but at least three other faculty members in adjoining offices. This situation will be addressed in the next chapter dealing with office space requirements.

FACULTY COMPOSITION

The military officer faculty members, who make up almost the entire faculty at the Air Force Academy, consist of two types: those professors with tenure, which is a limited number whose career track will keep them at the United States Air Force Academy, and a much larger number of officers who are serving a four-year term at the Air Force Academy and will then be transferred to other locations within the United States Air Force. Many departments have one distinguished visiting professor who, in many cases, is a civilian

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on a one or two-year leave from a university, and in some cases, can be an individual from other aspects of government service. The Academy hopes to establish endowed chairs for each department, which, in most cases, would be an additional civilian long-term position.

THE ROLE OF RESEARCH

The United States Air Force Academy only provides a baccalaureate-level degree. Faculty members are not expected to make research a major part of their activity as would be the case at a doctoral-level university. However, the leadership of the United States Air Force Academy early on recognized the importance of exposing cadets in the sciences and engineering in particular to research. This resulted in the establishment of the Frank J. Seiler Research Lab, which is part of the United States Air Force Systems Command managed from Andrews Air Force Base in Maryland. The Frank J. Seiler Lab conducts research in chemistry, laser physics, and aerospace-mechanics. In addition, it provides research opportunities for faculty members at the Air Force Academy and for cadets. It also has an allocation of funds that can be made available to faculty in any subject field area at USAFA. The grants usually are for travel expenses involved in research or other similar costs of conducting research. No salary monies are provided from that pool of funds.

The United States Air Force Academy expects faculty members to spend approximately 10 percent of their effort on research. The science and engineering departments have laboratory research going on involving faculty and cadets apart from the research of the Frank J. Seiler Lab. Both of these types of research are discussed in Chapter Two.

ORGANIZATION OF THE ACADEMIC PROGRAM

The 19 academic departments at USAFA are divided into four divisions. These are Basic Sciences, Engineering, Humanities, and Social Sciences. The list below shows how the departments fit into each of these units and also lists interdisciplinary degree programs with the departments that teach them. The list which follows shows the departments within their divisions and also lists the majors and minors that are offered within each unit. This information is taken from the 1989-1990 Curriculum Handbook.¹

¹United States Air Force Academy, 1989-1990 Curriculum Handbook, page 89.

DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

**TABLE 1-1
LIST OF DEPARTMENTS AND MAJORS**

<u>SPONSORING DIVISION OR DEPARTMENT</u>	<u>MAJOR/MINOR</u>	<u>REQUIRED COURSE UNITS</u>
Basic Sciences Division	Basic Sciences (Divisional Major)	46
Biology	Biology	47
Chemistry	Chemistry	47
Computer Science	Computer Science	49
Mathematical Sciences	Mathematical Sciences	47
Physics	Physics	49
Engineering Division	General Engineering (Divisional Major)	46
Aeronautics	Aeronautical Engineering	49
Astronautics	Astronautical Engineering	49
Civil Engineering	Civil Engineering	48
Electrical Engineering	Electrical Engineering	49
Engineering Mechanics	Engineering Science	49
Humanities Division	Humanities (Divisional Major)	46
English	English	48
History	History	47
Foreign Language	Foreign Language Minor ²	N/A
Philosophy and Fine Arts	Coordinate Divisional Major Only	46
Social Sciences Division	Social Sciences (Divisional Major)	46
Economics and Geography	Economics	47
	Geography	47
Law	Legal Studies	47
Management	Management	47
Political Science	Political Science and International Affairs	47
Behavioral Sciences and Leadership	Behavioral Sciences	47
INTERDISCIPLINARY		
Astronautics	Space Operations	47
Mathematical Sciences, Management, Computer Science, and Economics and Geography	Operations Research	47

²A foreign language concentration is available only as a minor, not a major.

DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

SOM

5 June 92

Colonel David Nolting
HQ
USAF/DF
Fairchild Hall
6th Floor
United States Air Force Academy, CO 80840-5701

Re: USAFA
1984 Master Plan Program

Dear Colonel Nolting:

As requested, we have reviewed the Program Data for the United States Air Force Academy which SOM prepared and submitted in December 1984. This data was contained in three reports:

- **Space Inventory Report** cataloguing existing spaces in the Cadet Area and their use. Information was compiled in a computer data base which calculated the areas based on the module line grids established for the Project; this produced a level of accuracy consistent with the master planning process;
- **Curriculum Program Report** detailing the existing and proposed programs for the Cadet Area.
- **Facility Analysis Report** which analyzed the curriculum programs, the existing spaces, and the need for any new facilities to meet Program objectives. The space standards used to determine the need for new facilities were derived through a review of applicable portions of 6 sources including WICHE, (a public agency through which the 13 western states work together and a primary source); Colorado Commission on Higher Education; U.S. Military and Naval Academies; Department of Defense; University of California System; and University of California Research Area Criteria

The Program Data was prepared in cooperation with a team of professional educators, including the administrative staff, the faculty staff and the civil engineering staff of the Academy, who worked closely with SOM to develop the data and select the criteria that reflected the unique character of the Air Force Academy. This Master Plan program is the product of the best collective professional judgement applied to known data using highly respected methodology. Given the data and assumptions of 1984, we do not believe that this group of professionals would reach a different conclusion today.

The result of the Program efforts was consistent with the level of detail required for a Master Plan. This data was subsequently reflected in the Cadet Area Master Plan prepared in June 1985.

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220 East 42nd Street New York, New York 10017
212 309-9500, Fax 212 309-9750

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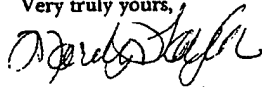
DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

Skidmore, Owings & Merrill

Mr. Duane Boyle
5 June 92
Page two

We would be pleased to discuss this matter further or to participate in any reevaluation of the Program if the original criteria (i.e., size of cadet body or type of cadet programs) which led to the conclusions reached, have been modified.

Very truly yours,



Marilyn Jordan Taylor

MJT:dlr

cc: D. Boyle
J. Wright
M. Keselica
File: 55044-100
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ARCHITECTURE

June 4, 1992

Col. Nolting
Associate Dean for Resources
HQ U.S.A.F.A./D.F.T.
U.S.A.F. Academy, CO 80840-5701

Dear Sir,

We have asked for the opportunity to comment on the Department of Defense Inspector General Draft Audit because it is fundamentally and irretrievably flawed.

Their errors and omissions are so numerous that a scholarly item-by-item response cannot be undertaken without first addressing their underlying assumptions and lack of methodology. The Draft Audit illustrates that their mistaken assumptions and misapplied equations result in poor conclusions.

The basic premises which lead the DoD-IG to indefensible results fall into three categories: Assumptions, Methodology and Pedagogy. This letter will address each of these in turn.

ASSUMPTIONS

The DoD-IG report assumes that the facilities of an average state school in Colorado are sufficient for Academy's mission. This assumption is clearly indicated by their unquestioning adoption of the Colorado Commission on Higher Education (CCHE) guidelines as their most (although, as we will later show, not their exclusively) used criteria. The assumption is wrong on three accounts. First the audit team apparently never explicitly considered the mission of the United States Air Force Academy or its Faculty. Its mission is not to be average. Its mission should be stated here for the record because it was the starting point of the Academic Space Needs Analysis (the Analysis) of April 1991.

The Academy's mission is to provide instruction and experience to all cadets so that they graduate with the knowledge and character essential to leadership and the motivation to become career officers in the United States Air Force.

Second, it is untenable to compare the Academy to a state school. The Academy must be a national school to attract and educate students of the character and ability required to become career officers.

The mission statement of the Faculty is far longer and more involved than the Academy's. The audit team should have taken the time to read, understand and apply it to their analysis. It states in part:

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(The) Faculty mission (is)...

To provide specialized in-depth education that allows cadets with the ability and motivation to complete a major field of study and enhance their potential for service to the Air Force and the nation.

To provide the flexibility that allows cadets to proceed in a quality academic program as far and as fast as their talents permit, and to reach a level of excellence that matches their potential. To instill in graduates the dedication and motivation to maintain a high state of readiness during peacetime... and to win if war is forced upon us.

With its emphasis on excellence, specialization and leadership skills in war and peace, the Academy can hardly be compared to an average state school. The original Analysis established the minimum space needs to support the mission of the Academy and its Faculty. The DoD-IG Draft Audit attempts to make a case that the Academy, despite its increasingly technical curriculum, actually needs substantially less space.

Third, the choice of the CCHE guidelines on the part of the audit team, was apparently made without benefit of comparison to other available guidelines for appropriateness. Current research, which the audit team admitted at the formal brief they had not seen, shows that the CCHE guidelines are arguably among the two or three lowest state guidelines in the entire nation.

The reason given by the audit team for adopting this guideline as its measuring stick, is that the original Analysis "...generally applied space guidelines from the Colorado Commission on Higher Education..." . In fact, as the team admitted during the formal brief, the Analysis used them in only four out of fourteen space categories. The audit team indicated that their report was consistent, yet their same documentation showed they used CCHE in only seven of the fourteen categories.

In the case of the original Analysis (and in the independent Master Plan by the original architects) selections of which criteria to use were made on the basis of expert judgement by recognized authorities applying principles of academic planning to the unique curriculum and student body. The audit team appears to be second guessing the experts who have brought considerably more knowledge, experience and time to their respective corroborating analyses. With the benefit of neither such expertise on their staff nor consistency in their own approach, they built their case on an extremely slippery slope.

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METHODOLOGY

The American Heritage Dictionary makes the following distinction: "*Method* emphasizes procedures according to a detailed, logically ordered plan... *Routine* stresses procedure from the standpoint of detail and rather rigid sequence; it involves only the mechanical skills necessary for unvarying practice". Clearly the DoD-IG team has approached their audit as a routine, which alone is insufficient for the discipline of academic planning.

The methodology used in the original study involved physical surveys (to determine the exact extent and condition of the existing space), Faculty interviews (each department was interviewed for about two hours to ascertain their curricula and existing limitations, if any), determination of the enrollment data, observation of instruction, conferences and other faculty/student interaction.

Baselines were established for curriculum program plans, existing space use, use patterns and enrollment. Concurrently space guidelines were evaluated from a palette of those that might be appropriate to the unique mission and constraints of military academic life. Demands on cadets are nearly around the clock including military and flight training, athletics, formal dining, extra instruction and study, all in addition to academics. Similarly, Faculty has many specialized duties above and beyond their civilian counterparts.

Guidelines were selected based exclusively on their appropriateness to the general requirements of the missions served and the specifics of the unique requirements of the curriculum, Faculty and Cadets of the Academy. These were applied to the enrollment figures supplied by the Registrar. There is little dispute about these basic numbers of Cadets in each class. (The Draft Audit claims there is "double counting", but this will later be shown to be a pedagogical, not numerical, dispute that the audit team has with the Faculty.)

The result of this professional analysis is that for the Academy to remain in the first tier of engineering schools nationwide it requires about an additional 123,000 square feet of academic space.

The fact that the qualitative data, the subjective impressions of the consultants and the quantitative analyses all agree gives complete confidence in the results. Further confirmation is given by agreement with the independent study by the original architects of the Academy. Finally, the comparisons to the other service academies and comparable schools of national reputation, graphically presented in the body of this response, confirm beyond a shadow of a doubt the accuracy of this work for the Academy. The Draft Audit stands alone against the evidence, facts and results of methodical academic planning.

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PEDAGOGY

Pedagogy is defined as "the art or profession of teaching". The roots of the word are from the Greek words for teacher and leader. It is our belief that the selection of teaching methodology should be made by these leaders. The Department of Defense also promulgates the philosophy of having decisions made at the lowest appropriate level of personnel. The audit team would, to the contrary, impose their own interpretation of what is best by cutting 87,000 square feet of academic space from the current size.

The DoD-IG report makes much of "enrollment discrepancies", "inflated enrollment" and "double scheduling". Enrollment discrepancies between the two reports actually comprise an insignificant differential.

The fact of the matter is that what the audit team calls "double scheduling" etc. is the traditional and time-proven method of teaching used in laboratory courses since the inception of the Academy. Furthermore it is a concept that is not unique and is gaining popularity at other universities. The curriculum is regularly reviewed intensively and extensively by Faculty. Despite many other updates of method and technology the concept of a "lab module" comprising a coupled classroom and laboratory for a class to learn both abstract and practical concepts during a single period has remained a building block of their pedagogy.

The Faculty is convinced, and has demonstrated to the consultants, that there is a great pedagogical benefit to the Cadets from their teaching methodology. Whereas the Draft Audit stated that "a CCHE representative stated that a 50-percent factor would be reasonable absent any other factor, general or course specific", he has also stated that "the heart of the whole programming process is the curriculum program analysis". Furthermore he stated that although the burden of proof would be on the institution, if a sound pedagogical reason could be demonstrated, additional space would be approved by his organization. In fact, he noted he had just approved a request by a state school for about three times the guideline amount for a school of music based on demonstrated pedagogical reasons. (Telephone conversation with Dick Ross on 20 May 1992.)

An example that might elucidate the irrationality of the audit team's misapplication of guidelines would be a hypothetical application of a guideline to a dining hall at an average state school and at the Academy. The guideline would assume that, say, one-third of the students dine at a single time. Applying that guideline to Mitchell Hall would indicate a space about one-third of its existing size. The audit team would then dutifully report that fact. The proper academic planning approach is to delve into the guideline, the mission and

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the workings of the institution to determine how the philosophy of Cadet life at the Academy differs from that at Average U. We believe from discussions with Mr. Dick Ross at the CCHE that he would approve the full existing size of Mitchell Hall if the Faculty could prove sound pedagogical reasons for having all the Cadets dine at one time. Judging from the Draft Audit, the auditors would not be similarly convinced. They repeatedly make this miscalculation. We further believe that anyone who would disapprove of the required space for allowing the Cadets to dine all at once would be telling the Academy and its Faculty how to conduct their mission.

SPECIFICS OF THE DRAFT AUDIT

Having set the record straight on the poor choice of assumptions and routine by the DoD-IG it is now possible to address their specific errors in analysis. By and large they are sufficiently covered in the main body of the Academy response but this letter will continue to point out the foundational errors which lead to their conclusions.

Classrooms

Enrollment figures cited by the auditors are not actually in dispute. The same numbers were used in both analyses. The audit team has dismissed the traditional pedagogy of the Academy and this is the basis on which they postulate "double enrollment".

The actual technique used by the Faculty involves extensive blackboard work or lecture during the same class period as laboratory work. Often the classroom and lab are physically adjacent and only accessible by passing through one to get to the other. The original design of the 1950's was made to accommodate this pedagogy. That pedagogy is even more valid today.

Station sizes

The use of an average station size of 27 square feet in lieu of 26 for classroom and 28 for seminar is a perfectly reasonable approach.

"Undocumented Space"

This space is for classes held in inappropriate areas, such as conference rooms, due to the fact that all classroom space was already scheduled in the time block.

Special Labs

"Double scheduling" is the same pedagogical (not numerical) issue discussed above. The course misclassification merely swaps space from this category to the Teaching Labs and

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does not affect the overall numbers. The miscellaneous errors appear to comprise about 450 s.f. and are statistically insignificant to the findings.

Teaching labs
See Special Labs above.

Non-classroom Labs

The use of the CCHE guideline here is indefensible without including square footage for each lab assistant. It is not meant to be used as a figure for the researcher alone. The CCHE guideline does not include necessary space for assistants. They must be calculated separately and added in. The Draft Audit does not do so.

The WHICHE guideline used in the original Analysis is a better choice for three reasons. First it is a regional (as opposed to a state) guideline, second the WHICHE guidelines are more appropriate for engineering schools and third its guide includes space for assistants.

One last caveat is critical to recommendations of space near or below bare minimum guidelines. That is, certain programs have minimum thresholds below which it is impossible to teach the course. It is the responsibility of the audit team to ascertain that these will indeed be met; they apparently did not do so. The Aero Lab is a case in point. A wind tunnel takes a certain number of square feet regardless of whether one or 4000 students will use it. The Draft Audit, by ignoring this, suggests either cutting off an end of the wind tunnel or discontinuing a course of study deemed by the Faculty to be critical to the educational needs of future officers of the Air Force. The fact that they could adopt the lowest guidelines for the marquee subject at the flagplane organization for the entire military is further evidence that the audit team did not factor in the mission of the Academy.

Office

The determination to use an Academy standard here in lieu of CCHE derives from the mission and duties of the Faculty which are radically different from their counterparts at an average state school. To quote again from the mission statement of the Faculty:

To provide - by daily example - models of professional career Air Force officers who embody the concepts of service to country, duty and integrity.

The draft audit dismisses the additional duties of the faculty. In contrast to their civilian fellow instructors, the USAFA instructor is required to be on the premises for the entire

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duty week regardless of whether he is teaching at the time. Furthermore, instructors are required to give individual instruction to whomever requests it. Other equally important duties include personal counselling, academic counseling, common grading and curriculum development, and orientation of frequent replacement personnel. All of this is in addition to their military duties. The DoD-IG, having never considered the mission of the Academy, now equates the Faculty mission and duties to those of an average state school.

Office Service

The issue of office service is directly related to that of office space. With the additional academic, administrative and military duties of the Faculty, additional office service can be reasonably expected.

Circulation

The audit team claims "discussions with an engineer at the U.S. Army Corps of Engineers indicated that a 20-percent figure (for suite circulation) was not reasonable". We were not able to determine with whom the audit team had this discussion, but it was decidedly not Dennis Williams, who is the most familiar with Fairchild Hall and the CETF of anyone on their staff. In his words the 20-percent factor was "on the tight side if anything". We have asked Mr. Williams to write a letter and ask that you include it in the appendix so reviewers can know the facts of the matter.

There are other architectural reasons for additional space in this category which relate to the historical nature of the building. The whole Cadet Area is eligible for inclusion on the National Historic Register. The President's Advisory Committee on Historic Preservation has placed the USAFA on the cover of its report to the President. The entire Cadet Area is subject to design guidelines, whose effect was completely ignored by the Draft Audit, which constrain the design in many ways. Most cogent to this discussion, they mandate conformance to monumental scale and a seven foot module structural grid. This results in a certain level of inefficiency where rooms must be made fourteen feet wide instead of, say, eleven feet. The inefficiency is especially magnified when designing and accessing small spaces such as offices.

As the architects for the Project Description for phase one of the Fairchild Hall Academic Facilities Modernization we can vouch for the fact that the 20-percent factor is barely adequate. This subject was briefed to the audit team when they visited. It was shown to them in plan form and they were invited to visit the *in situ* prototype offices on the sixth floor.

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

June 4, 1992

Col. Nolting

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Conference Rooms

The amount of conference space use witnessed by the consultants at the Academy is unparalleled in our experience. It is an order of magnitude greater than that of any other institution with which we have experience. Conference rooms are used for frequent Divisional, Departmental and course specific meetings. They are used continually for course development, evaluation and common grading. They are used for full department staff reviews of each and every Cadet. They are also used for additional instruction of larger groups of Cadets.

The CCHE guideline is directed at a faculty far different from the Academy. They are inappropriate to apply to this Faculty, their mission and the amount that they work.

Common Space

The two facilities to which the auditors refer, SATO and the Faculty BX, are not really student targeted-merchandising. In addition that space is accounted for in the Support Space category elsewhere in the original Analysis. The types of facilities intended by the guideline include copy centers, study lounges, locker space and the like. This is the intention of the original Analysis, which is subverted by the misinterpretation by the audit team.

Library

The CCHE guideline may not even be appropriate here, as it would indicate a collection of about 240,000 volumes. The USAFA currently has some 600,000 volumes. The fact that the collection is a Library of Congress Regional Depository is not something anticipated by CCHE guidelines.

Discussions with Mr. Dick Ross at the CCHE indicated that application of a growth factor was reasonable if that were supported by plans of the library. Our figure of 2.5-percent per year came from our discussions with the Academy librarian and reflect his projected net growth. Mr. Ross felt he had been misinterpreted on the subject of the 20-percent factor which the audit claims is for growth. Rather, according to Mr. Ross, the 20-percent is a factor at the stacks only for filing space and is neither a growth factor nor a multiplier for the other functions such as administration, study, or reading.

Medical Clinic

The Medical clinic was outside of the scope of our study. However, we understand what the audit team does not: that the Cadets have very limited time to devote to anything but academics, academic life, athletics and military training. We understand the decisions that have been made by the administration and Faculty to make every effort to optimize each

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

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minute of the Cadets' time. Furthermore, we understand that if the required facilities are not provided at the Cadet Area they must be provided elsewhere at similar cost and additional inconvenience.

Dental Clinic

The advantages of collocating the Medical and Dental Clinic are evident from a Cadet's time use point-of-view.

Existing Academic Space

The fact that an audit team would not establish a baseline for existing square footage from which to start is hard to comprehend. It is equally hard to believe that the audit team would use their dereliction to cast doubt on the Analysis. Additionally their attempt to discredit the Academy's explanation for the difference is a *non sequitur*. The passage they quote from the previous SOM study does not address the issue of wall space which they are attempting to disprove.

We talked to SOM to determine how their methodology might have differed from ours. They noted a difference of 5-percent between a master plan study (SOM's) and a detailed facilities plan is not the least bit unusual. The actual difference is only 4-percent.

We have asked SOM to submit a letter to indicate their methodology, level of accuracy and the fact that they stand behind their results as a reasonable approximation of existing and projected space. More significant than any small differences between their Master Plan and our Academic Space Needs Analysis, is the general agreement on the scope of required academic space. Although SOM used primarily the WHICHE guidelines (which are very appropriate with their emphasis on engineering) their figures indicate a requirement of 166,000 s.f.

Most importantly, the existing square footages used in the Academic Space Needs Analysis are accurate to levels previously unavailable due to emergent computer technology. In the course of our study we physically entered, photographed and surveyed each room. Each room was then CAD drawn in real units within the framework of the existing building envelope and 28 foot structural grid. The computer was then programmed to calculate the square footage of each room and automatically insert it into a computerized database. The base square footage numbers used in the Analysis are, in short, the best that modern technology has to offer.

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

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Future Cadet Enrollment

The Analysis was completed before the directive to downsize the Cadet class size and could not have anticipated that decision. The audit inexplicably does not quantify what they believe the impact of such a downsizing might be. As noted above in the discussion under Non-classroom Labs, the burden falls on the audit team to now consider minimum sizes for programs based on actual pedagogical requirements.

Rather than be specific, the audit leaves the reader to assume that the resulting space reduction should be proportional. Perhaps they are not specific because they realize the pitfalls of this argument. As briefed to them by the Registrar a small reduction of students tends to reduce the section size not the number of sections offered. Our discussions with Mr. Ross of CCHE confirmed this noting that reductions, if any, would be more dependent on "enrollment configuration than simple enrollment reduction".

CONCLUSIONS

In this response letter we have exposed the flaws in the assumptions, methodology and results of the audit.

We stand behind our report in general and specifics as an appropriate and correct application of the disciplines of academic planning and architecture.

Sincerely,



Jeffrey S. Wright AIA, Principal
OZ Architecture

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

STATE OF COLORADO

Department of Higher Education
COLORADO COMMISSION ON HIGHER EDUCATION



Brian H. Hall, Chairman
Robert L. Hawkins, Vice-Chair
Marshall A. Crawford
Peter R. Decker
Harold L. Enarson
Steven W. Farber
Christine Johnson
James P. Johnson
Deedee Gale Mayer

Roy Romer
Governor
David A. Longanecker
Executive Director

June 11, 1992

Colonel David Nolting
Associate Dean for Resources
HQ USAFA/DFT
USAF Academy, CO 80840-5701

Dear Colonel Nolting:

It has come to my attention that the Colorado Commission on Higher Education's facilities planning guidelines have been used to assess the future facilities needs of the United States Air Force Academy. While the Academy, as a federal facility, does not fall under the jurisdiction of the state of Colorado, I thought it might be appropriate to share the Commission's perspective on the most appropriate uses of our space planning guidelines.

The Commission uses its facilities guidelines to assist in assessing the present and future facilities needs, consistent with each Colorado public higher education institution's facilities master plan. An institution prepares a facilities master plan only after it has completed a comprehensive academic master plan, which defines the institution's academic vision. Educational programming, therefore, drives facilities planning.

While CCHE's facilities guidelines have proven to be a very useful planning tool, they are only guidelines, not hard and fast standards. Colorado's public higher education institutions often seek and receive variances from the guidelines, based on defensible justification for using alternative planning assumptions. When variances are requested to accommodate unique educational programs or activities, the Commission seeks to find alternative proxy measures for facility requirements, such as facilities requirements for comparable programs around the country. Given the U.S. Air Force Academy's unique educational role and mission, I would expect justification for some, perhaps substantial, exception to CCHE guidelines to accommodate the future pedagogical activities of the Academy.

I hope that these comments prove helpful as you assess the needs of the Air Force Academy to continue to provide in the future the cutting edge educational program for which it is so highly respected today.

Sincerely,

David A. Longanecker

AMEND Page 39

1300 BROADWAY, SECOND FLOOR, DENVER, COLORADO 80203 • (303) 866-2723 • FAX #: (303) 860-9750

DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)



DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
215 NORTH 17TH STREET
OMAHA, NEBRASKA 68102-4978



REPLY TO
ATTENTION OF

CEMRO-ED-MF (415-10f)

4 June 1992

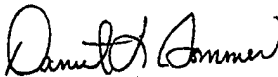
MEMORANDUM FOR U.S. Air Force Academy, ATTN: COL Nolting, Bldg 8120,
Colorado Springs, CO 80840-5346

SUBJECT: Suite Circulation Space, Consolidated Education Training
Facility, U.S. Air Force Academy

1. This office has reviewed the suite circulation paragraph, room size and requirements for instructor's offices and some suite layouts and feel the additional 20% for suite circulation is approximately correct. Our experience is that the circulation space is often considerably more than originally anticipated.

2. Questions and concerns may be addressed to Dennis Williams at (402)221-4523.

FOR THE COMMANDER:


DANIEL L. SOMMER, P.E.
Chief, Military Branch
Engineering Division

CF:
OZ Architecture, ATTN: Jeff Wright, 1580 Lincoln St., Suite 200, Denver,
CO 80203

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)



DEPARTMENT OF THE AIR FORCE

USAF ACADEMY HOSPITAL
UNITED STATES AIR FORCE ACADEMY
USAF ACADEMY, COLORADO 80940-5300

REPLY TO
ATTN OF: SG (S101)

27 May 1992

SUBJECT: DOD Audit Response

TO: DFT/Colonel Nolting

1. I wholeheartedly agree that completing the Consolidated Education and Training Facility (CETF) is essential. Contrary to DOD's position, we must have this facility if we are to continue educating high calibre Air Force officers. Completing CETF is also imperative from a health care delivery perspective because the current facility is woefully inadequate.
2. The Cadet Clinic is drastically undersized and inefficiently designed to deliver state-of-the-art health care. We assign highly qualified health care professionals to the Cadet Clinic and then provide them an inadequate environment in which to practice their art. Without a new clinic, I fear, we will be unable to continue providing the type of comprehensive health care our patients deserve.
3. Again, I support your efforts in defending the USAF Academy position that the CETF is absolutely required if we are going to continue producing outstanding Air Force leaders of the twenty-first century.


CHARLES K. MAFFET, Colonel, USAF, MC
Command Surgeon/Hospital Commander



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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

SUPPORTING LETTERS AND PAPERS

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Letter from the Department of Chemistry, dated 26 May 92

This letter summarizes for the Department of Chemistry, the same issues discussed in attachment 1 for the Department of Biology.

page 6

Letter from the Department of Civil Engineering, dated 5 Jun 92

This letter summarizes for the Department of Civil Engineering, the same issues discussed in attachment 1 for the Department of Biology.

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Letter from the Department of Chemistry, dated 2 Jun 92

This letter discusses environmental concerns within the present facility that will be corrected by the CETF.

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Paper, prepared by the Department of Civil Engineering

This paper discusses the lack of facility support for the new environmental engineering track and Academy concerns about laboratory safety within the present facility.

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Paper, prepared by Academy Staff

This paper discusses comments relative to CETF that were made during recent reviews by various accrediting bodies.

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)



DEPARTMENT OF THE AIR FORCE

THE DEPARTMENT OF BIOLOGY
UNITED STATES AIR FORCE ACADEMY
USAF ACADEMY COLORADO 80840-5701

REF: TO
ATTN: DFB

3 June 1992

SUBJECT: CETF and the Department of Biology

TO DFT (Colonel Nolting)

1. This letter summarizes the facilities limitations that result in undesirable teaching and learning within the Department of Biology and highlights the value of CETF as the best solution to these problems.

2. Background: The Department of Biology is located primarily in the A and B blocks on the second floor of Fairchild Hall. We are now the second largest of 20 departments in number of majors taught in spite of the fact that we are the second smallest department in number of faculty members. Our facilities presently cover 12,675 sq ft. This would expand to 27,700 sq ft in CETF. The standard used in this comparison comes from the Colorado Commission for Higher Education (CCHHE). Specific constraints will be addressed by sub-discipline/activity.

3. Core Biology: This required course is taught annually to 1,000 cadets. We have only four laboratory rooms for the entire course, and each lab room seats only 16 students. Therefore, in order to support the nine essential laboratory experiences each semester, we have to cycle from 30-33 sections through these lab rooms. Because of limited classroom space, these lab rooms also double as lectures rooms. This also forces the combining of sections for non-lab periods. And, since the lab rooms are separated only by a folding partition, a less than ideal teaching situation exists. Moreover, it results in a significant compromise of the desired small lecture environment. The fix is CETF which will provide five special lab rooms for 24 students each with full access to models, multiple sinks, and spontaneous lab demonstrations during any lesson.

4. Botany: This course is taught nearly two city blocks from the laboratory preparation area and the remainder of the department. Limited natural light restricts the availability of live specimens for study. There are no facilities for planting and repotting of plants, yet these activities are required for student projects and labs. Bulky growth chambers are housed in the classroom because there is no room for them elsewhere. CETF will provide a state-of-the-art greenhouse with multiple environments for most specimens needed. This greenhouse would be adjacent to a 24-seat classroom, well-appointed with model storage. Even in the CETF design, our botany labs (35.8 sq ft/student) are below the CCHHE space standards (43.4 sq ft/student) by 18%.

5. Human Anatomy and Physiology: Both of these courses are presently taught in non-lab classrooms (one sink, no lab benches), but 30% of the lessons involve two-hour lab sessions or demonstrations. Because of constrained space, bulky lab equipment must be stored in the already small classrooms. The present design offers 31.4 sq ft/student, less than 50% of the 74.4 sq



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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

ft/student specified by the CCHE standard. The current lab room contains no air treatment or evacuation hoods, air handling is totally inadequate. Students are exposed to toxic fumes from cadavers and other specimens during dissections. Electrical outlets are frequently overburdened. Maximum enrollment in these two heavily-subscribed courses is 112/year (100% utilization). Enrollments in these courses have been restricted in the last two years. Indeed, 24 students have been denied course entry into Anatomy since Fall 1990. Projected enrollments for the 1993 academic year will exceed this number.

6. Zoology: This two-hour lecture/laboratory course is taught in a 16-seat "special lab" room which is overcrowded and environmentally substandard. Dissections of preserved specimens occur in a poorly ventilated classroom. Students are at risk of excessive exposure to toxic fumes. The CCHE space standard of 55.8 sq ft/student far exceeds the present 31.8 sq ft/student. Because of space limitations, practical lab exams must be conducted in shifts and on alternate days to written exams. The impact is reduced time for lectures, and excessive exam time.

7. Senior Biology Seminar: The course is presently taught in the Biology Conference Room. The desired enrollment in this discussion-oriented course is 10-12 students/section. The scheduled enrollment for 1993 is 120 students per year. This means that the Conference Room will be unavailable for department use greater than 60% of the time, resulting in severe limitations on faculty access for professional reading, grading, and conferences.

8. Cadaver Dissection in Human Anatomy: 80% of our majors (many medical school-bound) take Human Anatomy. For security reasons and to isolate toxic fumes, dissection is now conducted in two very small isolated rooms. Eight cadets must crowd into a 135 sq ft room already cramped with support equipment. Available space per student (14 sq ft) is far below the 74.4 sq ft CCHE standard. Ventilation in the dissection rooms is marginal, even though it was recently upgraded significantly. The impact is that students are denied quality dissection time. Each student performs dissection for less than 25% of the two-hour lab period. Dissection teams are shuffled through the cramped rooms in short shifts.

9. Special Lab: The Department has only one lab room for Genetics, Microbiology, Cell Biology, Developmental Biology, and Zoology laboratory examinations. Sixteen days each semester this room is monopolized for Zoology Lab practicals. No other labs can be scheduled during these days which creates a severe planning limitation. This results in pedagogically faulty separations between pertinent lectures and applicable labs. Also high course traffic through this lab increases the risk of student contamination from microbial specimens. Lab technicians and researchers must use portions of the lab for course preparations and sterile procedures which is very disruptive to the continuity of lab instruction. In addition, sterile air filtration hoods produce high background noise in a very small room. There are only 14 work stations available and 31 sq ft/student versus the CCHE standard of 55.8 sq ft/student. The impact is inefficient use of lab time and a high risk of lab accidents because of severe congestion.

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

10. Lab Animal Care/Housing: AFR 169-2 requires all DOD lab animal facilities to seek accreditation by the American Association for Accreditation of Lab Animal Care (AAALAC). The 276 sq ft now available is far below the AAALAC standard of 1575 sq ft for our multi-species colony. We cannot presently meet the AAALAC standards because: we are unable to isolate separate species from sharing the same air; facilities engineers have been unable to provide sufficient air changes; no isolated room is available for cage washing and decontamination; no shower facility exists for gowning and then showering after animal exposure; surgery and sterile animal prep areas now serve double duty for aquaria (frogs) and cadaver storage. Consequently, valuable research specimens and data are lost from poor maintenance of temperature and humidity.

11. Dedicated research space: The limited space now reserved for research is an embarrassing constraint to quality faculty and faculty-led student projects. Ten cadet-researchers and ten faculty-mentors now attempt research in 560 sq ft. Most of this space is allocated to excellent quality research equipment. Each research team has access to less than three linear feet of bench space! This room contains no fume hoods for toxic chemical or hazardous organism handling. Our UV transilluminator cannot be effectively isolated to prevent inadvertent exposure of passers-by. Many research equipment items are not immediately accessible because of limited usable space. Electric circuits are constantly overloaded, risking loss of computer data and equipment damage. The low temperature freezer creates a very high noise level and outputs temperatures above 75°F. Also housed in this room is an overflow faculty desk.

12. Faculty and Staff Offices: The Department offices are spread out across 500 yards of hallways (the full length of Fairchild Hall)! Excess faculty time is spent in transit from office to office. The Department fails to experience the cohesive continuity possible in clustered offices. Students have great difficulty in locating some faculty members. Eighty-five percent of the department members are located more than 200 yards from the nearest copier resulting in a significant time sink. The Department Head is totally isolated from 80% of his scattered faculty. In 1994, the Department will be authorized 22 faculty and five civilian staff, but currently has office space for only 21, total. Some of the current offices are only 70% the size authorized by CCHE guidelines. Private counseling is impossible as is concentrated lesson planning.

13. Laboratory Storage and Lab Preparation: The Department is functioning at less than 30% of the CETF design for lab prep space. Many bulky equipment items are stored in classrooms and relocated daily. A crowded two-story lab storage area containing two small offices is located 250 feet from the lab prep area requiring multiple daily trips. This is a very inefficient arrangement. Moreover, supply and equipment security is marginal due to the fractionated nature of storage. Technicians must disrupt lab classes to gain access to sterile safety hoods. There is no chemical fume hood available for hazardous chemical preparations. Chemicals must be prepared in remote chemistry labs and carried through 100 yards of open hallway.

14. Extra-Instruction (EI) and Computer-Aided Instruction (CAI) Rooms: We have no space available for EI or CAI! Specialty computers now sit unused because of lack of space. No quiet area is available for student-faculty EI.

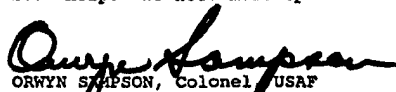
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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

Faculty members wear ear plugs to lesson plan while EI occurs in the next "cubby-hole" office.

15. Herbarium and Museum Collections: These are presently housed in archaic storage cabinets fully 1/4-mile from 90% of our classrooms. These valuable collections are not accessible to faculty members for classroom use. Lack of space for storage, fumigation, and maintenance is leading to collection deterioration. Exquisite specimens are frequently available but we lack space to accept these acquisitions.

16. Help! We need more space!


ORWYN SIMPSON, Colonel USAF
Professor and Head

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

DEPARTMENT OF THE AIR FORCE
DEPARTMENT OF CHEMISTRY
USAF ACADEMY, COLORADO

FROM: HQ USAFA/DFC
2354 Fairchild Drive, Suite 2A21
USAF Academy CO 80840-6230

26 May 1992

SUBJ: Consolidated Education and Training Facility (CETF)

TO: DFT (Col Nolting)

1 The proposed CETF will alleviate a number of problems the Department of Chemistry encounters on a daily basis as we provide cadets quality education in chemistry. The problems center around space limitations, adequate electrical power, and safety.

2 a. Space limitations in both the classroom and the laboratories will be positively addressed in the CETF. Classrooms in the chemistry department are unique compared to other classrooms because of the necessity for ventilation, a sink with running water, as well as outlets for gas and air. These special facilities are used almost daily during lectures to illustrate chemical principles. The chemistry classrooms were originally designed for 16 students, allowing the instructor to have access to each student's desk in order to oversee each student's work while practicing a variety of problem solving exercises. Currently, we are forced to place from 20 to 22 students in the space which was designed for 16. This makes it virtually impossible for the instructor to oversee the individual work of his/her students. CETF will provide classrooms which seat up to 28 students and allow ample room for the instructor to move among the students.

b (1) Laboratory space is limited in a number of areas. First, each of the core labs is designed to accommodate 16 students. As mentioned above, the typical core chemistry class has 20 to 22 students, requiring students to share benches or the department to schedule more than one lab for each section of students. Each core chemistry laboratory in CETF will allow 24 students to independently perform experiments, thereby alleviating the core lab space constraints.

(2) The norm in academe is for all organic chemistry experiments to be performed in a fume hood because of the use of volatile chemicals. The department is equipped with a total of 7 fume hoods, 4 of which are in the organic lab. Each hood is capable of supporting a maximum of two students at a time. Since there are typically 16 students scheduled for each organic lab and it is virtually impossible to schedule the labs so that all 7 hoods are available for the organic lab classes, it is necessary to modify experiments and to cycle students through the hoods during critical parts of the experiments. This causes a significant loss of time in the lab and further limits the range of experiments which the cadets can complete. The CETF will be equipped with ample hood space, with 12 being located in the organic lab.

(3) The physical chemistry laboratory handles up to 17 students during each three hour lab period and as many as 50 students--55 scheduled for Fall 1992--use this lab during the fall semester. Because of equipment requirements, each student or student team works on a different experiment. Physical chemistry experiments

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

require as many as four lessons to complete and the current crowded conditions require a great deal of time for the students to set up and tear down their experiments so that the space is available for other students during a subsequent lab period. The CETF will more than double the space for physical chemistry lab and provide a more efficient arrangement which will limit the wasted time and increase the time available for student instruction and experimentation.

(4) Independent research with a faculty member is an important part of the chemistry curriculum. A total of 21 students did research during the 1991-1992 academic year, 9 in the fall semester and 12 during the spring semester. Over half of the research projects involved organic chemistry experiments, further exacerbating the hood space problem discussed above. The dedicated research space can adequately handle 6 students, thus requiring the cadets to spend a good portion of their time setting up and tearing down experiments so that the lab space can be used by other cadets. The CETF will provide 5 faculty research labs which will accommodate a minimum of 15 research students and their faculty advisors. The increased space will allow cadets to set up their experimental apparatus and leave it until it is no longer needed.

3 a We are in the process of integrating computers into our labs to give cadets exposure to the latest methods of data acquisition and analysis. The use of computers also allows the cadets to do more complex experiments and process their data in real time. This enables the students to modify their experiments, run them again, and assess the effects of their modifications. The computers also enhance safety by virtually eliminating the need for routine laboratory hazards such as mercury thermometers and manometers, previously required for measuring temperature and pressure. There are currently 9 labs which can support core chemistry. Current power availability in the labs allows only 6 computers to be installed in each lab, meaning that one section of core chemistry requires two lab rooms for each class section. This requires that lab be offered at least four out of the five academic days during the week. Upgrading power in the current facilities will require running new wire and conduit at a substantial cost. While this can be done, it does not allow the lecture and lab to be integrated in such a way that it maximizes student learning. The CETF will be equipped with adequate power to allow more computers in the lab and better tie the lab experience to the lecture sequence.

b Power considerations also have a significant affect on the wide variety of sophisticated instrumentation in the department. Unstable power, both power interruptions and power surges, have caused expensive repairs for highly sophisticated instrumentation which operates 24 hours per day. The power inadequacies in Fairchild Hall also severely limit the use of our instruments. For example, our gas chromatograph/mass spectrometer, an instrument which is routinely used at temperatures in excess of 400 °C, can not be heated above 290 °C without tripping a circuit breaker. As old instrumentation is replaced with new and more sophisticated models, increased power needs further complicate the power problems already described. The chemistry area of the CETF has been specifically designed to provide adequate power and circuit protection, and to look to the future and be capable of handling increased power requirements.

4 a Laboratory safety is a constant concern for the Department of Chemistry and we make every effort to comply with all EPA and OSHA standards. The existing fume hoods were added after the initial construction of Fairchild Hall. Their addition reduced the aisle space between the hoods and the adjacent benches to less than two feet. The National Fire Protection Association Standards for aisle widths in chemistry laboratories is three feet. Again, this hazard limits the range and scope of

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

experiments the students can perform and the hazard becomes more critical as the laboratories become more crowded, making lab evacuation more difficult. The CETF has been designed to alleviate these kinds of problems since the fume hoods and general aisle requirements are an integral part of the building design.

b The current hood space and ventilation system severely constrain the range of experiments our students can perform. In 1983, the firm of McFall, Konkel and Kimball Consulting Engineers, Inc found that the existing laboratory hoods had marginal airflow rates, were not in compliance with the hazard rating of the chemicals used, and that inadequate make-up air was being provided to the chemistry laboratories for exhaust purposes. The engineering firm further noted that a portion of the bench hood exhaust ductwork had reached the end of its life expectancy--and that was nine years ago with no improvements since that time. The engineering firm went on to report that the cement-asbestos panels are detaching from the support framing and were creating a maintenance and potential health hazard. The Academy's civil engineers reported that the existing ductwork will require replacement with new ducting of larger diameter but that the existing utility chases do not have the room to support such a replacement. Upgrading the current ventilation system, then, will require a massive construction project which will affect all 6 floors of Fairchild Hall. The CETF has been carefully designed to comply with EPA and OSHA standards and to allow for increased requirements.

5 Space, power, and safety problems will continue to hamper the ability of the Department of Chemistry to maintain a nationally recognized program in chemical education. The CETF will address these problems and ensure that our cadets are given the best possible education under the safest possible conditions.


HANS J. MUEHL, Col, USAF
Professor and Head

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)



DEPARTMENT OF THE AIR FORCE

THE DEPARTMENT OF CIVIL ENGINEERING
UNITED STATES AIR FORCE ACADEMY
COLORADO SPRINGS, COLORADO 80840-8701

5 June 1992

REF: TO
ATTN OF: DFCE

SUBJECT: CETF and the Department of Civil Engineering

TO: DFT

1. This letter summarizes the facilities limitations that result in undesirable teaching and learning within the Department of Civil Engineering. It highlights the value of CETF as the best solution to these problems.

2. Background: The Department of Civil Engineering is located on sixth floor of Fairchild Hall with two small labs on the second floor, a teaching lab on the fourth floor and six special use labs on the fifth floor. The 5600 square feet of laboratory space currently under DFCE custody is totally inadequate. Approximately a third of the total space is physically separated from the main lab area which seriously degrades our ability to provide quality technical support and safety controls when several labs are in progress simultaneously. That same area does not satisfy either Environmental Protection Agency (EPA) or Office of Safety and Health Administration (OSHA) air and water quality standards. Our storage space is seriously deficient with less than 400 square feet currently available versus a requirement for 1000 square feet of dedicated storage space. As a result, valuable laboratory floor space and the concrete moist cure room are currently used for storage. A dedicated Civil Engineering Laboratory of not less than 13,500 square feet is required to support laboratory exercise and demonstrations in several specialty areas: environmental sciences, soils and asphalt properties, hydraulics and fluid mechanics, structural engineering and engineering materials. The uniqueness of experiments conducted in each of these areas results in the requirement for separate functional areas. This also permits concurrent use of each of the functional areas as will frequently be necessary. This concept is consistent with current practices at other major universities.

3. Civil Engineering Core Course, Air Base and Design and Performance (Civ Engr 310): The department of Civil Engineering uses 6 special labs in teaching Civ Engr 310 (student enrollment-approximately 550 per semester). In the Fall 1987 semester a trial offering of Civ Engr 310 was taught

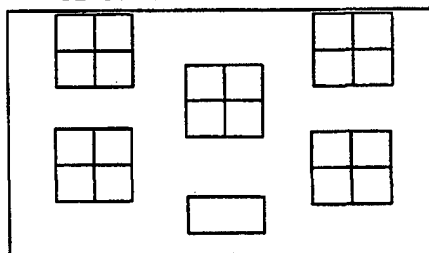
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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

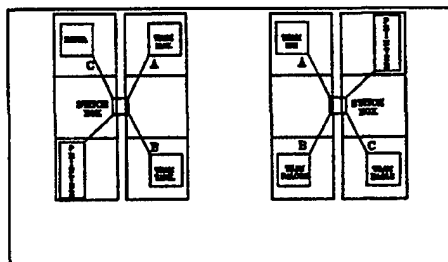
to three sections of cadets as Civ Engr 495, Special Topics. The purpose was to determine how to most effectively teach the course material while integrating a preliminary version of the CRISIS software into the course. Section size was limited to 16 cadets with 4 groups of 4 cadets per section. Lectures and computer instruction were accomplished in a single classroom which contained 4 computers with digitizing tablets and two printers. This trial offering of the course material clearly demonstrated that a separate room was required for lectures and another to teach the computer applications. Attempting to lecture around the computers while using appropriate visual aids was difficult at best. In addition, the cadets had a difficult time taking notes around the computers, digitizing tablets and printers. Our current Civ Engr 310 course has a maximum section size of 20 cadets with 5 groups of 4 cadets. A typical classroom layout has an instructors desk and twenty student desks (see Figure below.) The classroom is used for lectures, quizzes and exams.

CE 310 CLASSROOM LAYOUT



The computer rooms which support this course have 6 computers with digitizing tablets (1 is an instructor computer), computer screen projection equipment, two printers and a plotter.

CE 310 COMPUTER LAB LAYOUT



DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

Cadets switch back and forth throughout the semester between the two rooms. Instruction can not be accomplished with 50% of the space for the classroom or 50% of the space for the lab. Space allocation studies should dedicate 100% for each room. The Audit Report reduced disciplinary requirements for classroom space in all courses by an arbitrary 50%. For example, this core course (a double period course which meets 10 of the 13 available class periods over a two-day period and uses approximately 90% of the entire 110-minute class period) uses both a standard classroom configured for five four-person groups and a computer applications laboratory configured with five computer workstations and common use printers. Cutting this space requirement per section in half would dictate that this course either not be taught or be totally restructured without the use of computers. It is because of computers that innovations have been incorporated into this course, and led to the single largest Air Force funded research effort at the Academy. Clearly, the DOD IG Audit Report's arbitrary 50% reduction in classroom space for Civ Engr 310 constitutes dictating how the subject material should be taught. Similar arguments could be made for each of the other courses. That's outside the DOD IG charter--dictating how undergraduate education should be taught.

4. **Environmental Engineering:** The current Environmental Engineering Laboratory supports our Bachelor of Science Degree in Civil Engineering which is accredited by the Accreditation Board of Engineering and Technology (ABET). Starting in Jan 1993, this laboratory will also be used to support a separate Environmental Engineering Option under the Civil Engineering Major. This Environmental Engineering Option will double the environmental courses and associated laboratory work from four to eight courses. We intend to obtain accreditation for this new option, however, with the current inadequate environmental engineering laboratory accreditation will not be possible (see section 8 below). The existing Environmental Engineering Laboratory does not meet the current OSHA standard: Occupational Exposures to Hazardous Chemicals in Laboratories, 29 CFR SECTION 1910.1450, published 31 Jan 1990. Only by severely limiting class sizes and implementing labor intensive operating procedures are we able to provide minimal instruction and research in the laboratory. A larger laboratory with the facilities required by the current OSHA Standard is required to continue to meet the educational requirements of the USAF Academy and do so safely. A major laboratory inadequacy which violates 29 CFR SECTION 1910.1450 and which will be corrected by the CETF is:

- NO LABORATORY HOODS ARE AVAILABLE for chemical mixing or for performing experiments with hazardous materials. All routine hazardous chemical mixing must be done in a laboratory hood located in the Department of Chemistry Laboratory at the opposite end of Fairchild Hall (approximately 600 feet away) and chemicals transported to the environmental laboratory with a high potential for spills. Cadets and faculty can not

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

perform experiments using hazardous materials which results in reduced hands-on learning and research opportunities. Current procedures for two routine wastewater analyses involve boiling concentrated sulfuric acid for several hours and should be conducted under a laboratory hood which is not available in the existing laboratory. Other routine operations which can not be accomplished in the existing laboratory are:

- (1) Mixing hazardous chemicals
- (2) Analysis of wastewater for fats, oils and greases
- (3) Conducting adsorption experiments with porous media
- (4) Experiments on products of combustion

OSHA Standard 29 CFR SECTION 1910.1450 contains specific recommendations for laboratory facilities and operations which are not mandatory, but make sense from a health, safety and operational perspective, and there is a possibility that they will become mandatory in the future. Our current laboratory falls significantly short of these recommended standards:

a. **WORK CONDUCTED MUST BE APPROPRIATE TO THE PHYSICAL FACILITIES AVAILABLE.** Our current laboratory is very small with laboratory work stations, classroom space and chemical storage all in the same room. Chemical storage blocks some of the blackboards and the desks are pushed into half of the lab making it hard for all the cadets to see the blackboards. During laboratory exercises cadet work stations are very close together which makes conducting experiments more difficult and hazardous. As a result, class sizes are limited and some cadets are denied enrollment in environmental engineering courses.

b. **LABORATORY SHOULD HAVE SINKS.** Current work stations do not have sinks which is a potential safety hazard and also requires limited class sizes. In addition, work stations do not have compressed air, vacuum or gas which severely limits laboratory operations.

c. **ADEQUATE, WELL-VENTILATED STOCKROOMS.** The current acid storage area has no ventilation which could be a severe problem if a spill occurred.

d. **MINIMIZE ALL CHEMICAL EXPOSURES.** With no laboratory hoods, sinks or adequate ventilation it is not possible to minimize chemical exposures.

USAF Academy graduates must be able to meet the changing needs of the Air Force and today's Air Force has a dramatically increasing demand for people who can solve tough environmental problems. An example of the demand is that this year the Air Force will spend more on environmental compliance and restoration than on military construction. A viable Environmental Engineering Program, which is not possible without a functional environmental laboratory, will help the

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

Air Force meet the demand. We must ensure we have the right people with the right training to do the job.

5. Civil Engineering Practices: The loss of CETF will have a serious detrimental effect on Civ Engr 350, "Civil Engineering Practices". This is a hands-on, experimental course which exposes cadets to surveying and theory of measurements, and to civil engineering material properties. The main impact to the surveying part of the course is equipment storage. Currently the surveying equipment (levels, theodolites, transits, and electronic transits plus their associated tripods, rods, etc.) share a small storage room with drafting equipment and computer hardware and software. The room is so overfilled that it is virtually impossible to organize, and must be partially emptied to gain access to the next lesson's set of equipment. Scheduled update to this course includes the acquisition and use of GPS (Global Positioning Satellite) equipment, which will further exacerbate the storage dilemma. The loss of CETF will most affect the materials portion of Civ Engr 350, which includes laboratory exercises which test properties of metals, timber, concrete and asphalt. The metals, timber and concrete labs all use universal testing machines which are currently shared with the Department of Engineering Mechanics. This awkward situation requires careful, and oftentimes less than desirable, coordination to avoid conflicting uses between different classes. Furthermore, the fact that each machine is different, with varying capabilities, prevents us from allowing each lab group to perform their "own" experiment (we are often forced to "demo" a test), greatly reducing the value of the "hands-on experience." Individual shortcomings of the universal testing machines include inadequate deformation measurements (the equipment must be removed from the test specimens prior to ultimate failure to avoid equipment damage - thus a significant portion of the stress-strain curve is lost), lack of capacity (we cannot test standard 6" diameter concrete cylinders), and lack of space (a class cannot easily be assembled to effectively view a demo). The concrete laboratory includes mix design and casting concrete specimens. Due to inadequate space, the class must be split in half to mix the concrete, and even then the teams interfere with one another. Inadequate ventilation hoods mandate the use of dust masks while handling concrete aggregates and cement. To test our concrete samples they must be sulfur-capped. The poor ventilation results in eye and nose irritation, and considerable complaints from neighboring activities (DFSIV, Biology, Engineering Mechanics) due to the objectionable sulfur fumes. The asphalt lab includes preparation of an asphalt sample for strength testing. The lack of asphalt ventilation hoods forces us to limit ourselves to emulsion asphalts which require no heating. Also we need to use Engineering Mechanics equipment to clean our asphalt equipment.

6. Geotechnical Engineering: The Geotechnical Track will be severely impacted if CETF does not become a reality. Specific course impacts are as follows:

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

a. **Civ Engr 390 - Soil Mechanics:** This course will be affected the most should we lose CETF. First, section sizes will necessarily remain at a maximum of 16 and work group sizes will typically remain at 4 cadets due to limited space in current laboratory facilities. Expanded laboratory facilities (i.e., CETF) will allow us to increase the section size while reducing the work group size, concurrently reducing the number of sections which must be offered and increasing the amount of "hands on" time per cadet. Second, only one experiment at a time can be set up in current laboratory facilities due to lack of work space. Hence, make-up labs are not easily accomplished and must wait until ongoing experiments are completed. Third, current laboratory facilities dictate the use of non-standard samples due to inadequate space for sample preparation and the absence of a soils curing room. Fourth, new triaxial equipment recently acquired to update the course is barely accessible due to items stored on the adjacent floor and counters. Finally, since other courses share the same laboratory space careful scheduling is absolutely essential as we can barely fit one section in the lab, much less two.

b. **Civ Engr 488 - Pavement Design and Transportation Engineering:** Enhancement of this course will also be curbed should CETF not come to fruition. Specifically, DFCE has no laboratory facilities for testing asphalt paving materials. At present, all instruction regarding asphalt testing is presented via lecture and slides - no "hands on" laboratory work or demonstrations. This will remain if CETF does not provide additional laboratory space for asphalt testing.

c. **Civ Engr 491- Earth Retaining Structures and Slope Stability:** Problems associated with lack of storage space and laboratory space in current facilities also afflict this course. For example, laboratory sessions must be scheduled to avoid conflict with Civ Engr 350 since both cannot operate in the lab simultaneously. Moreover, last semester's retaining wall competition was done in the materials storage room since adequate floor space was not available in the main lab. Again, access and work space around the triaxial equipment will impact this course.

d. **Geotechnical Research:** Research is difficult to do due to lack of laboratory facilities - both equipment and space for ongoing setups. Two obvious drawbacks are the limited ability for faculty development through research and the absence of opportunities for cadets to learn by working on the research projects.

7. **Structural Engineering:** The major drawback with structural engineering courses is the lack of space. There are numerous activities we would like to incorporate in to the classes if we had the lab space. Some of these items are as follows:

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

a. Use hard floor (reaction floor, shock isolated from building) for dynamic loading of structural members. Also, examine a steel beam which has been strain gaged to verify where the bending formula is valid and where it is not valid. A laptop computer could be used to do the analysis on the spot. This experiment would introduce the students to strain gages as well as compliment the theory given in other courses.

b. Let students build scaled down frames using steel or aluminum sections showing all the connection types. Difficulties in actually constructing joints the students designed or were told to design would be a good learning experience.

c. Let the students actually build a concrete beam from a given set of plans. The student could place the rebars then pour the concrete. After it cures, a real beam could be tested to destruction on the hard floor.

d. Allow the students to build the bridges they design in the course as well as to build previously used bridges. Actual testing of the bridges on the hard floor would help verify (or negate) analytical models and techniques. This learning experience would help them evaluate alternate designs.

8. **National Accreditation:** The future national accreditation of the Academy's Civil Engineering Program by the Accreditation Board for Engineering and Technology (ABET) is dependent upon CETF. The last ABET report (28 Aug 91) stated on page 6 that

"Laboratory equipment is adequate, but more laboratory space is needed. Completion of the Consolidated Education and Training Facility should provide the program with sufficient laboratory facilities."

Further, the North Central Association of Colleges and Schools Report on the Academy (28 Jun 89), page 15, stated

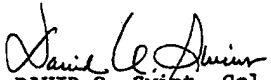
"The major physical facilities problem is the critical need for additional academic space. When the size of the Academy was increased to its present authorized limit, the physical facilities were not correspondingly enlarged. Consequently, space for laboratories, classrooms, and offices is extremely limited and is a concern for the future."

9. **Conclusion:** Numerous exhaustive studies, accomplished over the past nine years--in-house DF Interdepartmental Working Group for Academic Facilities (1983-84); Skidmore, Owens, and Merrill (SOM) Academy Master Plan (1984-85); and the five Paulien and Associates Reports (1989-91), were accomplished by nationally-recognized professionals with extensive credentials in academic curricular matters. If the findings of this audit report stand, the net effect is a dictatorial statement of how academic disciplines should be taught. The undergraduate civil

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

engineering education at the Academy is nationally accredited now, but must be capable of meeting the changing needs of the Air Force. As such, the program must be sufficiently flexible in this evolving process to respond to new technologies. Recent examples include...the creation of the Mechanical Engineering option within the Engineering Science Major and the creation of the Environmental Engineering option within the Civil Engineering Major. CETF will permit academic education to adjust to this evolution into the 21st Century.



DAVID O. Swint, Col, USAF
Professor and Head
Department of Civil Engineering

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

DEPARTMENT OF THE AIR FORCE
DEPARTMENT OF CHEMISTRY
USAF ACADEMY, COLORADO

FROM: HQ USAFA/DFC
2354 Fairchild Drive, Suite 2A21
USAF Academy CO 80840-6230

2 June 1992

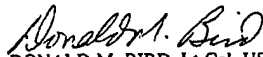
SUBJ: CETF Impact on Environmental Issues

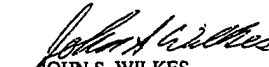
TO: DFT (Col Nolting)

1 Environmental considerations in both the Department of Chemistry and the Frank J Seiler Research Laboratory center around two issues, hazardous waste storage and the safe use of chemicals. These issues are addressed in the design of the CETF and will enhance our ability to provide a safe environment for both cadets and staff.

2 Many of the chemicals used in both laboratories have maximum exposure limits which are established and monitored by the EPA. The Department of Chemistry has documented its need for more and better hood systems to ensure that the EPA limits are observed. Limits have been met in the past by modifying experiments and cycling the students through the existing hood space. As the EPA continues to reduce exposure limits, it becomes more difficult to meet the requirements with the existing facilities. In 1983, the firm of McFall, Konkel and Kimball Consulting Engineers, Inc found that the existing laboratory hoods had marginal airflow rates and were not in compliance with the hazard rating of the chemicals being used. They further reported that the ductwork had reached the end of its life expectancy and was posing a potential health hazard due to the detachment of the cement-asbestos panels which support the ductwork. The engineering firm also reported that the make-up air for laboratory exhaust was insufficient. This means that the volatile chemicals that are exhausted through the fume hoods may still be at a concentration in excess of EPA limits when vented into the atmosphere. This, then, poses a potential risk to the cadets and staff who inhabit the cadet area on a daily basis. The CETF hood systems have been designed with technology that is 30 years ahead of the existing facilities. The new system will provide sufficient airflow to ensure compliance with EPA standards well into the future and allow the Department of Chemistry and Frank J Seiler Research Laboratory to continue to provide the best in education and high quality research without jeopardizing safety.

3 EPA standards for hazardous waste storage and disposal are becoming increasingly more stringent. Currently, both the Department of Chemistry and the Frank J Seiler Research Laboratory store their hazardous wastes in the same areas used for fresh chemicals and solvents. This necessity greatly increases the difficulty of not only tracking the amounts and kinds of hazardous waste but also makes it difficult to limit unnecessary exposure to such wastes. Dedicating space for hazardous waste accumulation in the existing facilities will further limit our ability to conduct up-to-date laboratory experiments for the cadets and to accomplish research. Further, there is no space in Fairchild Hall which can provide adequate ventilation for the storage of hazardous wastes until they are removed for disposal.


DONALD M. BIRD, Lt Col, USAF
Deputy Head
Department of Chemistry


JOHN S. WILKES
Technical Director
Frank J Seiler Research Laboratory

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

ENVIRONMENTAL ENGINEERING LABORATORY (ROOM 2H34)

1. The existing Environmental Engineering Laboratory does not meet the current OSHA standard: Occupational Exposures to Hazardous Chemicals in Laboratories, 29 CFR SECTION 1910.1450, published 31 Jan 1990. Only by severely limiting class sizes and implementing labor intensive operating procedures are we able to provide minimal instruction and research in the laboratory. A larger laboratory with the facilities required by the current OSHA Standard is required to continue to meet the educational requirements of the USAF Academy and do so safely.

2. The current Environmental Engineering Laboratory supports our Bachelor of Science Degree in Civil Engineering which is accredited by the Accreditation Board of Engineering and Technology (ABET). Starting in Jan 1993, this laboratory will also be used to support a separate Environmental Engineering Option under the Civil Engineering Major. This Environmental Engineering Option will double the environmental courses and associated laboratory work from four to eight courses. We intend to obtain accreditation for this new option, however, with the current inadequate environmental engineering laboratory accreditation will not be possible.

3. A major laboratory inadequacy which violates 29 CFR SECTION 1910.1450 and which will be corrected by the CETF is:

- NO LABORATORY HOODS ARE AVAILABLE for chemical mixing or for performing experiments with hazardous materials. All routine hazardous chemical mixing must be done in a laboratory hood located in the Department of Chemistry Laboratory at the opposite end of Fairchild Hall (approximately 600 feet away) and chemicals transported to the environmental laboratory with a high potential for spills. Cadets and faculty can not perform experiments using hazardous materials which results in reduced hands on learning and research opportunities. Current procedures for two routine wastewater analyses involve boiling concentrated sulfuric acid for several hours and should be conducted under a laboratory hood which is not available in the existing laboratory. Other routine operations which can not be accomplished in the existing laboratory are:

- (1.) Mixing hazardous chemicals
- (2.) Analysis of wastewater for fats, oils and greases
- (3.) Conducting adsorption experiments with porous media
- (4.) Experiments on products of combustion

4. OSHA Standard 29 CFR SECTION 1910.1450 contains specific recommendations for laboratory facilities and operations which are not mandatory, but make sense from a health, safety and operational perspective, and there is a possibility that they will become mandatory in the future. Our current laboratory falls significantly short of these recommended standards:

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

a. WORK CONDUCTED MUST BE APPROPRIATE TO THE PHYSICAL FACILITIES AVAILABLE. Our current laboratory is very small with laboratory work stations, classroom space and chemical storage all in the same room. Chemical storage blocks some of the blackboards and the desks are pushed into half of the lab making it hard for all the cadets to see the blackboards. During laboratory exercises cadet work stations are very close together which makes conducting experiments more difficult and hazardous. As a result, class sizes are limited and some cadets are denied enrollment in environmental engineering courses.

b. LABORATORY SHOULD HAVE SINKS. Current work stations do not have sinks which is a potential safety hazard and also requires limited class sizes. In addition, work stations do not have compressed air, vacuum or gas which severely limits laboratory operations.

c. ADEQUATE, WELL-VENTILATED STOCKROOMS. The current acid storage area has no ventilation which could be a severe problem if a spill occurred.

d. MINIMIZE ALL CHEMICAL EXPOSURES. With no laboratory hoods, sinks or adequate ventilation it is not possible to minimize chemical exposures.

5. In summary, USAF Academy graduates must be able to meet the changing needs of the Air Force and today's Air Force has a dramatically increasing demand for people who can solve tough environmental problems. An example of the demand is that this year the Air Force will spend more on environmental compliance and restoration than on military construction. A viable Environmental Engineering Program, which is not possible without a functional environmental laboratory, will help the Air Force meet the demand. We must ensure we have the right people with the right training to do the job.

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

Point Paper on
Accreditation Board Comments Relative to CETF

- North Central Association of college and Schools Report on 28 Jun 90.

-- On page 15 the evaluators stated:

"The major physical facilities problem is the critical need for additional academic space. When the size of the Academy was increased to its present authorized limit, the physical facilities were not correspondingly enlarged. Consequently, space for laboratories, classrooms, and offices is extremely limited and is a concern for the future."

-- On page 27, the evaluators stated:

"Space availability is a problem that should be solved by the addition of the consolidated education and training facility."

-- On page 38, the evaluators stated:

"The office, teaching laboratory, and classroom areas available to support the academic programs of the Academy are stretched to the limit. Space and equipment needed for new thrusts and for expansion of existing programs to maintain their excellence are not available. We commend the administration for recognizing this need and for planning expansion of facilities through construction of the proposed consolidated education and training facility. We support the need for this addition and recommend that its funding be made a high priority."

- Computing Services Accreditation Board Report 3 Aug 89.

-- On page 7 the evaluators stated:

"Many faculty office are small, i.e. cubicles with partitions, and would be considered barely adequate by most standards. They only marginally meet the intent of the Computing Sciences Accreditation Board criteria."

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DEPARTMENT OF THE AIR FORCE COMMENTS (Cont'd)

- Accreditation Board for Engineering and Technology 28 Aug 91.

-- On page 2 the evaluators stated:

"Facilities are generally adequate to excellent. It is noted that the new space scheduled for the near future will help alleviate some problems with laboratory space and provide needed improvement in the facilities."

-- On page 6 the evaluators stated:

"Laboratory equipment is adequate, but more laboratory space is needed. Completion of the Consolidated Education Training Facility should provide the program with sufficient laboratory facilities." The civil engineering laboratory currently in Fairchild hall is approximately 3,900 SF and is one of two engineering laboratories to move into CETF with 12,500 SF.

-- On page 11 the evaluator stated:

"The laboratory quarters are small for the number of students that must be accommodated. This problem is expected to be alleviated when a planned new building opens." The mechanical engineering laboratory will remain in Fairchild Hall after CETF is constructed.

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AUDIT TEAM MEMBERS

William F. Thomas, Director, Readiness and Operational Support
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Scott Grady, Team Leader

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Donald Pierro, Auditor

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