January 2002

LAO
60 YEARS OF SERVICE

Building Standards in Higher Education

ELIZABETH G. HILL • LEGISLATIVE ANALYST

In this report we examine how the California Community Colleges, California State University, and the University of California use three key types of building standards—construction cost guidelines, space standards, and utilization standards. We find that they are not being used uniformly by the segments, resulting in construction costs that are higher than necessary and possible over-statement of facilities needs. As a result, we make various recommendations for improvements to make them more useful to the Legislature. ■

Acknowledgments

This report was prepared by Paul Guyer and reviewed by Mac Taylor. The Legislative Analyst's Office (LAO) is a nonpartisan office which provides fiscal and policy information and advice to the Legislature.

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INTRODUCTION

Guidelines and standards can help in making decisions about capital outlay funding for the California Community Colleges (CCC), California State University (CSU), and the University of California (UC). The three most important of these are construction cost guidelines, space standards, and utilization standards.

- *Construction cost guidelines* provide a yardstick against which to compare the cost of facilities at the three segments with those at comparable institutions.
- *Space standards* help in understanding the amount of space needed for different purposes at campuses.
- *Utilization standards* help in assessing how well campuses are making use of facilities they already have.

In this report we look at existing guidelines and standards, analyze how they are being used by the three segments, and make recommendations for improvements that may make them more useful to the Legislature.

COST GUIDELINES

CURRENT COST GUIDELINES

State capital outlay projects are typically funded in three main phases—preliminary plans, working drawings, and construction. Cost of the preliminary plans and working drawings phases are substantively less than the cost of the construction phase and generally in proportion to it. In this discussion of construction cost guidelines, we are referring only to the *cost of construction contracts*. There are other costs in the construction phase of projects, but they are associated with administrative and regulatory requirements, and not directly related to the cost of construction.

The CCC and CSU have used construction cost guidelines for a number of years. The UC used construction cost guidelines at one time, but has not done so in recent years. The CCC and CSU construction cost guidelines cover a number of building types, but in this report we look at those that are most important. These are—

- Classrooms.
- Teaching laboratories.
- Research laboratories.
- Faculty offices.

Classrooms, teaching laboratories, and faculty offices are common to all three segments. Research laboratory guidelines apply only to UC. While there are two categories of teaching laboratories—engineering and science—we focus in this report on science labs. This is because they are more costly and there are substantially more of them currently being constructed in higher education.

Construction cost guidelines were initially developed by each segment based on a review of actual construction costs over a period of years. Once established, the guidelines have been increased annually to reflect inflation in

construction costs using a "California Construction Cost Index" (CCCI) calculated each year by the Department of Finance (DOF). The CCCI is derived from the *Engineering News-Record* magazine's Building Cost Index (BCI), a widely regarded measure of construction costs. The DOF calculates the CCCI by modifying the BCI to reflect construction costs in California only.

Construction cost guidelines are discussed here in terms of assignable square feet (asf). Assignable square feet is the space in a building that is usable for programmatic purposes. It is determined by subtracting from a building's gross square feet areas such as lobbies, corridors, restrooms and building equipment rooms.

Community Colleges

Community college construction cost guidelines for 2001-02 are shown in Figure 1. The DOF projects no increase in the CCCI for 2002-03, so these should presumably remain unchanged for 2002-03.

California State University

Figure 2 shows CSU's construction cost guidelines used for 2001-02. As previously discussed, these would presumably apply to fiscal year 2002-03 capital outlay proposals because the DOF projects no increase in the CCCI for 2002-03. In June 2001, however, CSU increased its construction cost guidelines above those which would apply using the CCCI-based method of adjusting for construction cost inflation. Figure 2 shows these proposed new guidelines and the percentage increase over its existing ones.

The CSU has indicated the higher costs proposed for 2002-03 are needed (1) because of building code changes enacted over the years and (2) in order to incorporate more expensive materials and systems into buildings that purportedly are more cost-effective on a life-cycle basis. We discuss below our concerns with this proposed increase.

University of California

The UC does not use construction cost guidelines. A review of recent projects, however, provides insight into UC's costs. Figure 3 shows the construction cost for new UC buildings—consisting primarily of classroom, teaching

Figure 1

CCC Construction Cost Guidelines For 2001-02

(Dollars Per Assignable Square Foot)

Building Type	Guideline
Classrooms	$256
Teaching laboratories	398
Faculty offices	270

Figure 2

CSU Construction Cost Guidelines For 2001-02 and Proposed for 2002-03

(Dollars Per Assignable Square Foot)

Building Type	2001-02 Guidelines	Proposed 2002-03 Guidelines	Increase
Classrooms	$254	$299	18%
Teaching laboratories	397	466	17
Faculty offices	264	309	17

laboratory, research laboratory, and/or faculty office space—that were funded by the state in the 2001-02 budget.

These buildings will provide over 650,000 asf of new space on UC campuses, 56 percent of which is for research, 16 percent offices, 12 percent teaching laboratories, 10 percent classrooms, and 6 percent other space. The construction cost of these buildings cannot be directly compared with the construction cost guidelines used by the community colleges and CSU because they contain such a high percentage of research space. We discuss below how the cost of UC research facilities compares to the cost of comparable research buildings at other public and private institutions.

Analysis of Construction Cost Guidelines

Comparative Costs

Construction costs at the three segments can be compared to those of comparable buildings constructed elsewhere by public and private owners. We maintain our own data base by accumulating construction cost records for comparable public and private buildings from a variety of industry sources. Construction costs in our data base are adjusted for inflation and geographical differences in construction costs. Figure 4 (see next page) summarizes cost information from our data base. It indicates that, at the 50th percentile (or median cost), the classrooms figure ($272) is slightly above the guidelines used by CCC and CSU, and the teaching labs and offices figures are considerably below their CCC and CSU counterparts.

As can be seen, the numbers from our data base are generally in the same ballpark as the

Figure 3

UC Buildings Funded by the State in 2001-02[a]

(Dollars Per Assignable Square Foot)

Campus	Building	Primary Uses[b]	Construction Cost
Merced	Classroom and office	Classrooms and offices	$296
San Francisco	Parnassus services building—seismic replacement	Research	942
Davis	Veterinary Medicine 3A	Research and teaching laboratories	674
Riverside	Physical Sciences 1	Research	565
Riverside	Engineering Building Unit 2	Research, teaching laboratories, and offices	411
Riverside	Biological Sciences Building	Research	556
San Diego	Engineering Building Unit 3B	Research	376
San Diego	Pharmaceutical Sciences Building	Research	525
Santa Barbara	Life Sciences Building	Research and offices	492
San Francisco	Fresno Medical Center	Offices and teaching laboratories	352
Davis	M.I.N.D. Institute	Research	533
Merced	Science and Engineering Building	Research and teaching laboratories	515
Average			**$520**

a Buildings for which one or more phases were funded in 2001-02.

b 75 percent or more of the space in the building is designated for the uses indicated.

Figure 4

LAO Construction Cost Data Base

(Dollars Per Assignable Square Foot)

Building Type	Number of Buildings in Data Base	75th Percentile[a]	50th Percentile	25th Percentile
Classrooms	74	$328	$272	$210
Teaching laboratories[b]	173	404	325	270
Research laboratories	391	481	386	306
Offices	55	251	199	145

a "75th percentile" means 75 percent of the buildings in the LAO data base cost less than the amounts shown.

b Over 95 percent of the teaching laboratory buildings in the LAO data base are science laboratories.

existing construction cost guidelines used for CSU and CCC. As such, we believe they help confirm the appropriateness of the current cost guidelines.

Research Space. With regard to research space, however, our data base shows that the cost of most UC research facilities is considerably higher than those being built throughout the country. As Figure 3 indicates, most recently funded UC research buildings have a construction cost in excess of $500/asf. This compares to our data base, which shows that three-fourths of research laboratories cost less than $481/asf. In our *Analysis of the 2000-01 Budget Bill* (pages G-68 through 71), we discuss this issue in greater detail and recommend that the Legislature fund UC research facilities at the 75th percentile cost of the comparison group in our data base.

The CSU Proposal to Increase Cost Guidelines

The CSU and CCC have both used construction cost guidelines for a number of years. They were originally developed based on historical construction cost records for the segments. In subsequent years these guidelines have been increased annually using the CCCI. As discussed above, in June 2001 CSU increased its guidelines 17 percent to 18 percent above what would be indicated if the increase were limited to the change in the CCCI. The CSU indicates this is necessary because building code changes over the years have increased the cost of buildings. While this is true, the CCCI takes these code changes into account because it is a measure of *actual building costs in California*—and it has proven reliable over a number of years. The only documentation CSU has provided in support of this increase is a consultant's report that is based on assumed costs for a hypothetical building that has been neither designed nor constructed.

The CSU also indicates these guideline increases are needed in order to incorporate more expensive materials and equipment into buildings that purportedly will be cost-effective on a life-cycle basis. The CSU has not, however, submitted any data to substantiate that any specific material or equipment is more cost-effective than other alternatives on a life-cycle basis and that the material or equipment cannot be incorporated into the project within the existing construction cost guidelines. To increase construction cost guidelines for all buildings in the CSU system just because they *might* be

justified for a specific project and material or equipment is not appropriate.

It is always appropriate to review historical guidelines. Should CSU—or any segment—provide specific data that justifies adjustments to the current guidelines, changes would be in order. At this time, however, we recommend the Legislature not approve funding for CSU capital outlay projects using the segment's proposed 2002-03 construction cost guidelines. We recommend the Legislature approve funding only based on construction cost guidelines that have been increased by the amount of increase in the CCCI projected by the DOF.

Construction Cost Guidelines Recommendations

Based on our review, we make the following recommendations with regard to construction cost guidelines.

Instructional Space. We have previously recommended the Legislature apply construction cost guidelines when funding capital outlay projects for the three segments of higher education. After comparing the cost guidelines used by the community colleges and CSU and the actual costs of UC buildings with the data base we maintain and the commercial estimating guidelines discussed above, we conclude that the cost guidelines used by CCC and CSU are reasonable. There are small differences in the guidelines of these two segments, so we recommend the higher of the two amounts be used by the Legislature to make funding decisions. Our recommended guidelines are shown in Figure 5 for classrooms, teaching laboratories, and faculty offices. We recommend these same guidelines be used to evaluate UC capital outlay proposals as well.

Research Space. For the one type of UC building which has no counterpart at the community colleges or CSU—research facilities—we recommend the Legislature use the 75th percentile cost from our data base of comparable buildings. This means 75 percent of the buildings in the data base cost *less* than this amount. This guideline is also shown in Figure 5.

Other Funding Sources Available to Segments. Our recommendations do not prevent the segments from constructing more expensive buildings if they so desire. All three systems have other sources of funds for capital outlay that can be used to supplement state funding if necessary. Community colleges have the ability to provide funds from local bond issues. The UC has demonstrated for many years its ability to raise construction funds from private donors. Similarly, CSU has been significantly increasing the amount of capital outlay funding it generates in gifts from private donors. If the Legislature uses construction cost guidelines in making funding decisions, it will allow limited state resources to be invested as broadly as possible, without preventing the segments from constructing more expensive buildings if they choose to do so.

Figure 5

LAO Recommended Construction Cost Guidelines For CCC, CSU, and UC

(Dollars Per Assignable Square Foot)

Building Type	Construction Cost Guideline
Classrooms	$256
Teaching laboratories	398
Research laboratories	481
Faculty offices	270

SPACE STANDARDS

Space standards are used to determine the amount of space needed in buildings to suit programmatic needs. They are the amount of space measured in asf allocated on a per student or per faculty member basis in buildings (although they may be allocated on some other basis in special cases, such as "per book equivalent" in libraries).

In its 1990 *Capacity for Learning* report CPEC proposed revised standards to the Legislature. In May 1990 the LAO prepared an analysis of these proposed standards. Our report concluded that adoption of several of the CPEC recommendations would increase the need for space at a substantial cost. The CPEC proposal was presented to the Legislature but was not

CURRENT SPACE STANDARDS

There are different standards for the many instructional, research, and administrative activities that take place at a campus. Space standards for California's public higher education facilities generally date back to 1955, with some subsequently having been revised. The complete current standards are documented in *A Capacity for Learning* issued by the California Postsecondary Education Commission (CPEC) in 1990. Figure 6 shows a few of the more important ones for instructional spaces. Figure 7 shows examples of standards for UC research space.

Figure 6

Examples of Current Space Standards For Instructional Space

(Assignable Square Feet per Station[a])

Space	CCC	CSU	UC
Classrooms	15	15	15
Teaching laboratory (biological sciences, lower division)	55	55	55
Teaching laboratory (biological sciences, upper division)	—	60	60
Teaching laboratory (computer sciences, lower division)	40	49	45
Teaching laboratory (computer sciences, upper division)	—	49	55
Faculty office	85	118.5	138.7

a Such as a desk in a classroom, a space for a student at a laboratory bench, or a faculty member's office.

Figure 7

Examples of Existing Space Standards For UC Research Space

(Assignable Square Feet)

Space	Per FTE[a] Faculty Member	Per Graduate Student	Percent Additional for Service Space[b]
Biological Sciences	250	145	10%
Computer Sciences	180	100	10
Engineering Sciences	300	185	15
Physical Sciences	250	145	10
Social Welfare	40	20	5

a Full-time equivalent.

b Service space is used for such things as storage of materials and equipment used in laboratory exercises, or instructional equipment like projectors and physical models.

approved. Subsequently, the segments generally have continued to use the space standards in use before the CPEC report, with the exception that UC uses the more generous standards proposed in the CPEC report for research laboratories. For example, the existing standards allow 250 asf of research laboratory space for each full-time equivalent (FTE) faculty member in the biological sciences (see Figure 7) whereas the CPEC-proposed standards would allow 25 percent to 80 percent more space, depending on specific research needs. The CPEC-proposed standards would also allocate 175 asf to 250 asf for each post-doctoral fellow, whereas the existing standards do not provide additional space for these individuals. This is discussed further below.

ANALYSIS OF SPACE STANDARDS

Instructional Space

Our review of the instructional space standards currently used by the segments indicates that they are still appropriate for the Legislature to use in determining facilities needs. The standards provide adequate space for the segments needs and are consistent with guidelines used in other states.

Thus, at this time we would not suggest any changes to the existing space standards for classrooms and teaching laboratories at the three segments. We do, however, take issue with UC's space standards for research laboratories, as discussed below.

Research Laboratories at UC

The calculation of research space needs is complex, using either the existing standards or those proposed by CPEC in its *Capacity for Learning* report because they differ depending on the academic discipline. It is also difficult to directly compare the existing and CPEC-proposed standards because the CPEC grouping of academic disciplines is different than that in the existing standards. In its *Capacity for Learning* report CPEC recommended new research space standards. CPEC has informed us that it established these standards *by asking UC what standards it recommended*. While CPEC relied on UC's recommendations, they were reviewed by an advisory group and compared with information obtained from other states by a consultant. Figure 8 shows the difference between the CPEC-proposed research space standards and

Figure 8

UC Research Laboratory Space
Existing Versus CPEC[a] Proposed Space Standards

(Assignable Square Feet [asf] per Full-Time Equivalent [FTE] Student, Faculty Member, or Post-Doctoral Fellow)

		Existing		CPEC-Proposed		Percent Increase
	FTE[b]	asf/FTE[c]	asf	asf/FTE	asf	
Faculty	9,205	155.6	1,432,298	213.2	1,962,506	37%
Graduate students[d]	21,808	89.2	1,945,274	118.9	2,592,971	33
Post-doctoral fellows	2,723	—	—	217.8	593,069	—
Totals			**3,377,572**		**5,148,546**	**52%**

a California Postsecondary Education Commission.

b Faculty and student populations projected for 2002 by UC in its *Instruction and Research Space Summary, 2001-2006 Capital Improvement Program* report.

c Weighted average calculated by CPEC in its *Capacity for Learning* report (Displays 79 and 81, pages 108 and 111) based on the distribution of UC research space among academic disciplines in 1987-88.

d Space need is calculated under both the existing and CPEC-proposed standards based on 75 percent of graduate student enrollment.

the existing space standards. It shows that application of the CPEC-proposed standards could increase the need for research space by over 50 percent.

The UC currently has 6.1 million asf of research space, ranging from about 1.5 million asf at Berkeley to about 300,000 asf at Santa Cruz. Total research space is about 75 percent more than the amount justified using the existing space standards and about 18 percent more than justified under the CPEC-proposed space standards. Although there may be shortages at some campuses and in some disciplines, the university has more research space systemwide than warranted under either set of standards.

The UC also has received state funding for over 400,000 asf additional research space in 2001-02. Figure 9 shows that over half of the space funded in the current year is for research laboratories.

We are concerned about UC's use of the CPEC-proposed standards for research space for two reasons. First, CPEC has indicated the space standards it has proposed are essentially the same as space standards UC proposed, without substantive independent validation. Second, the CPEC-proposed standards provide additional space for post-doctoral fellows which in our view has not been justified. Post-doctoral fellows assist with research activities in research laboratories and it is not clear why they need additional space. We estimate new construction to accommodate this additional space would cost over $280 million.

Space Standards Recommendations

With regard to space standards, we recommend the following.

Classrooms, Teaching Laboratories, Offices. We recommend the Legislature evaluate the need for new classroom, teaching laboratory, and office space at the three segments using existing space standards

Research Space at UC. We recommend the Legislature continue to evaluate the need for research space at UC using existing space standards. The more generous space standards proposed by CPEC and currently used by UC increase the estimated need for research space by about 50 percent without ample justification or validation. In evaluating capital outlay proposals for research space at UC, we also recommend the Legislature recognize the large amount of existing research space at UC, which significantly exceeds the amount suggested under either the existing or CPEC-proposed standards.

Figure 9

UC Allocation of Space in New Buildings Funded by the State in 2001-02[a]

(Assignable Square Feet [asf])

Type of Space	Space (asf)	Percent of Total
Research laboratories	438,224	55.8%
Teaching laboratories	120,193	15.3
Offices	115,540	14.7
Other	69,197	8.8
Classrooms	42,239	5.4
Totals	**785,393**	**100.0%**

[a] Twelve new buildings that were wholly or partially funded by the state in the *2001-02 Budget Act*.

UTILIZATION STANDARDS

Utilization standards refer to the amount of time rooms and "stations" (such as a desk, laboratory bench, or computer terminal) *should be* used. "Utilization" is the amount of time rooms and stations are *actually* used. Utilization standards used by the segments address utilization on an "hours-per-week" basis.

CURRENT UTILIZATION STANDARDS

Utilization standards apply to instructional space such as classrooms and teaching laboratories, but not research laboratories. Standards used by the segments are summarized in Figure 10. The utilization standard—"Weekly Hours Station Use"—is derived by multiplying the time a room is available for use during the week by the average percentage occupancy during that time.

All three segments assume classrooms are available 53 hours a week and that they will be occupied—on average—two-thirds of the time. (That occupancy percentage might actually be achieved, for example, by having full classrooms two-thirds of the time and empty classrooms the remaining time.) Thus, as Figure 10 shows, the classroom utilization standard for all three segments is the same—35 weekly hours station use. The utilization standards for laboratories are considerably less than the levels of classroom standards.

ANALYSIS OF UTILIZATION STANDARDS

Instructional Space

The community colleges and CSU do not report the actual utilization of their classrooms and teaching laboratories. Without information about how intensively these segments are using their existing facilities it is difficult for the Legislature to evaluate proposals to construct new instructional facilities.

The UC reports biennially on the utilization of its instructional space. The latest available report reflects campus enrollment and facilities in the fall term of 1999. This information for UC's eight existing general campuses is summarized in Figure 11 (see next page). The figure shows that UC campuses are using classrooms at between 64 percent and 84 percent of the standard. It also indicates that they

Figure 10

Utilization Standards—CCC, CSU, and UC

Category	Weekly Room Hours	Station Occupancy Percentage	Weekly Hours Station Use
CCC			
Classrooms	53.0[a]	66.0%	35.0
Teaching laboratories	27.5	85.0	23.4
CSU			
Classrooms	53.0	66.0	35.0
Teaching laboratories			
• Lower division	27.5	85.0	23.4
• Upper division and graduate	22.0	80.0	17.6
UC			
Classrooms	52.5	66.7	35.0
Teaching laboratories			
• Lower division	27.5	85.0	23.4
• Upper division	22.0	80.0	17.6

[a] Standard is 48 hours for campuses with less than 14,000 weekly student contact hours.

are closer to their utilization standard for teaching laboratories—with two campuses actually exceeding the standard.

If UC utilized its facilities at 100 percent of the utilization standards (each station used 35 hours per week and each teaching laboratory station used 20 hours per week), it could serve over 40,000 additional FTE students with its current facilities. Figure 12 shows how each campus could have accommodated more students in 1999 simply by meeting the existing utilization standards.

Figure 11

UC Utilization of Instructional Space, Fall 1999

Campus	Standard Weekly Hours Station Use	Utilization as a Percent of Standard
Classrooms Standard—35 Weekly Hours Station Use[a]		
Berkeley	24.6	70%
Davis	29.4	84
Irvine	27.0	77
Los Angeles	22.5	64
Riverside	29.3	84
San Diego	28.6	82
Santa Barbara	24.6	70
Santa Cruz	27.1	77
Teaching Laboratories Standard—20 Weekly Hours Station Use[b]		
Berkeley	17.0	85%
Davis	17.0	85
Irvine	18.0	90
Los Angeles	16.5	82
Riverside	21.6	108
San Diego	21.3	106
Santa Barbara	14.7	73
Santa Cruz	16.4	82

a The UC standard is for classrooms to be available 52.5 hours per week.

b The UC indicates it does not distinguish between lower and upper division teaching laboratories in the way the existing utilization standards do (see Figure 10), and instead uses a single standard of 20 weekly hours of station use.

Year-Round Operation

In addition to increasing instructional capacity by using facilities more hours per week, as discussed above, it can also be increased by operating more weeks each year. The Legislature has recognized this and expressed its intent that CSU and UC operate facilities year round in order to minimize the need to construct new instructional facilities *(Supplemental Report of the 2001-02 Budget Act,* pages 84 and 94). Operating year round can increase the number of students accommodated with existing facilities by up to one-third.

If the segments were both to operate year round and utilize their space at existing standards, they could increase the capacity of existing facilities dramatically. For example, UC could potentially enroll over 75 percent more students by utilizing facilities at the utilization standards and operating year round. We would expect similar enrollment increases for CSU.

Utilization Standards Recommendations

With regard to utilization standards, we make the following recommendations.

The CCC and CSU Should Report Utilization. We recommend the Legislature direct the community colleges and CSU to report their space utilization in the same manner as is currently being done by UC. Utilization should

Figure 12

Additional UC Students That Could Have Been Accommodated in 1999 Using Space at the Standards

(Full-Time Equivalent Students)[a]

Campus	Students Accommodated	Additional Students That Could Be Accommodated
Classrooms		
Berkeley	23,109	9,810
Davis	16,355	3,092
Irvine	13,837	4,110
Los Angeles	22,587	12,595
Riverside	8,585	1,167
San Diego	13,420	2,986
Santa Barbara	11,646	4,897
Santa Cruz	8,622	2,503
Teaching Laboratories		
Berkeley	3,239	581
Davis	2,812	504
Irvine	892	100
Los Angeles	1,487	316
Riverside	1,404	-106
San Diego	1,656	-104
Santa Barbara	1,539	555
Santa Cruz	1,096	241

[a] The UC reports utilization in "weekly student contact hours" (WSCH). Fifteen WSCH equals one full-time equivalent student.

be reported at least biennially and should show actual hours per week of room use.

Segments Should Utilize Facilities at Least Up to Standards. We recommend the Legislature direct the segments to operate their instructional facilities at least as intensively as called for by the existing utilization standards. We recommend the Legislature consider the extent to which campuses are utilizing their existing instructional facilities when considering capital outlay proposals for new instructional facilities.

Year-Round Operation. We recommend the Legislature continue to emphasize to the segments that it is the intent of the Legislature that the segments operate their facilities year round with nearly equal enrollments in all terms.

CONCLUSIONS

Guidelines and standards are important decision-making tools for the Legislature in making capital outlay budgeting decisions for higher education. As described above, we believe the Legislature should continue to use existing guidelines and standards for all three segments. As academic disciplines evolve and instructional methods change, modifications to these criteria may be needed. We recommend the Legislature review any proposals for modifications; verify them independently; and approve, modify, or reject changes as part of the budget process. This will provide the segments with information that will be helpful in assuring that future capital outlay proposals are consistent with the Legislature's intentions. We believe this will help the Legislature ensure the provision of quality facilities to California students, while marshalling limited state resources in a cost-effective manner.