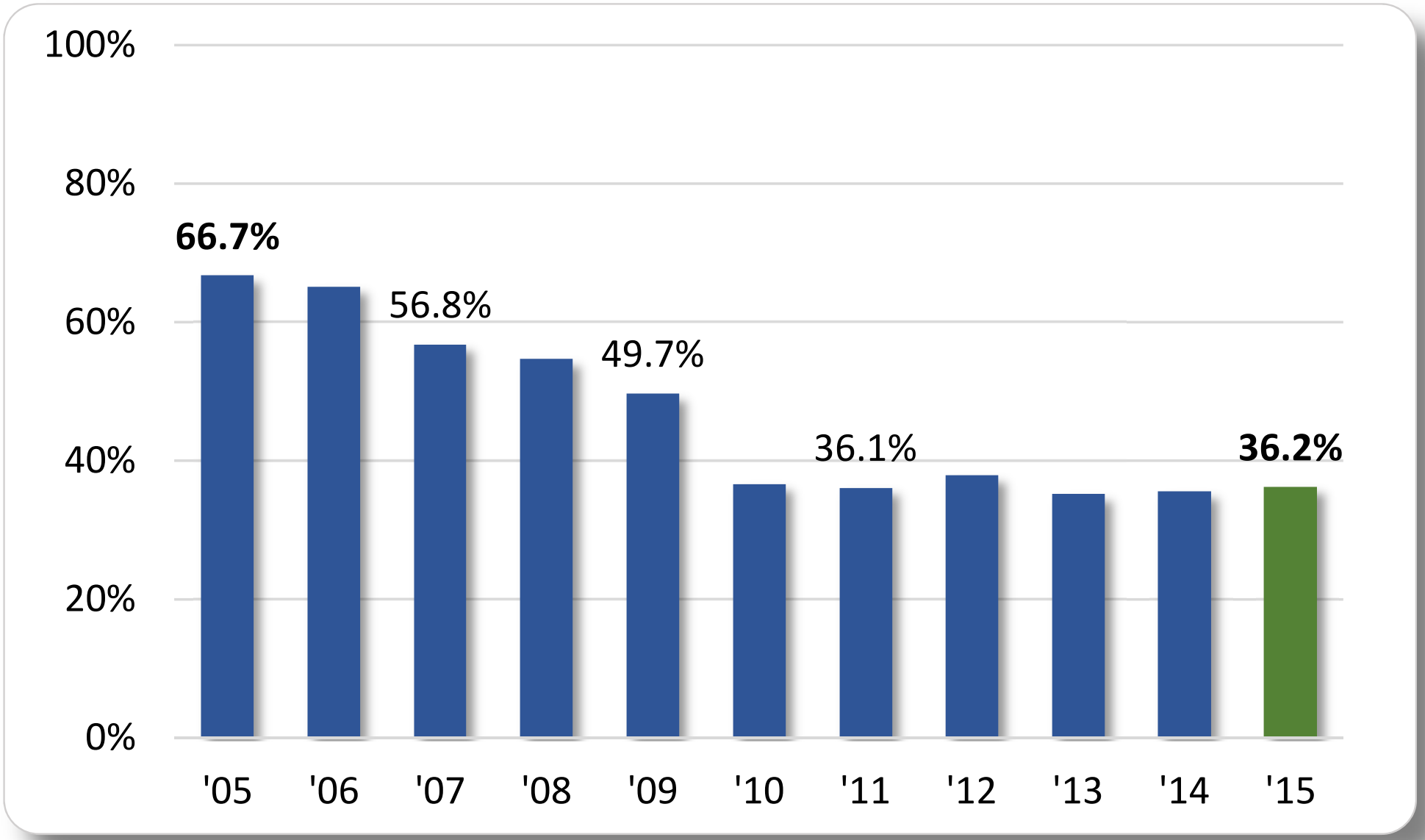
State Gross Square Footage, Portables, and Prototypical Schools

PSCOOTF

October 20, 2015

Presenter:
Bob Gorrell, Director, PSFA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Relevance of Discussion - Affordability

- The two largest capital assets in New Mexico are its roads and its schools with each valued at around $20B.
- Capital assets have three strategic variables to sustainability into the future:
  - Funding - Available to replace assets and do sufficient maintenance to ensure the expected life of the assets.
  - Affordability - Total size of assets that available funding can support.
  - Maintenance Effectiveness – Capabilities to accomplish sufficient and adequate maintenance within available funding.

2015 Estimated Costs to Own and Operate K-12 Public Schools in New Mexico

Infastructure

Facility Replacement and Capital Maintenance (Building Systems Replacement)

Square Feet	Replacement Cost Per Square Foot	Total Replacement Cost	Expected Years of Life	Annualized Amoritzation
61,000,000	$320	$19,520,000,000	45	$433,777,778

	Cost Per Square Foot	Average Square Foot Per Student	Annual Cost Per Student
Expected, Based on Adequacy:	$7	120	**$853.33**
Actual Costs with 340,365 students:			**$1,274.45**

Operational

Heat, Cool, Clean, Routine Maintenance and Grounds

Square Feet	Annual Cost Per Square Foot	Annual Operating Costs
61,000,000	$7.50	$457,500,000

	Cost Per Square Foot	Average Square Foot Per Student	Expected Annual Cost Per Student
Expected, Based on Adequacy:	$7.50	120	**$900**
Actual Costs with 340,365 students:			**$1,344.15**

Gross Square Feet and Cost to Own

- If New Mexico's schools were **"Sized-Right" annual cost per student** should be approximately $850 amortized facility cost, and $900 in operational (heating, cooling, cleaning, routine maintenance) or - **$1,750** per student per year.
- PSFA estimate that for our actual GSF per student in New Mexico, the **annual cost per student for current GSF** should be $1,270 amortized facility cost, and $1,300 in operational cost or - **$2,570 per student per year**.
- Based on 340,000 students, the potential avoided costs if schools were sized-right, would be approximately $280M per year. This estimate assumes appropriate and sufficient operational dollars, including maintenance, are being expended. [340,000 x $820 (delta $s operational for sized-right versus actual) = $278,800,000]

Do Portable Classrooms Impact Teaching and Learning?

Chan, Tak Cheung

Journal of Educational Administration, v47 n3 p290-304 2009

Purpose: The purpose of this paper is to examine the possible impact portable classrooms have on the teaching and learning process by exploring current related literature. Design/methodology/approach: This paper takes a synthesis approach, analyzing current studies to assess the impact of portable classrooms on teaching and learning. Findings: No significant impact of portable classrooms on teacher perception, teacher morale, teacher job satisfaction, student achievement, and behavior is detected. Negative student attitude is found in one of the studies reviewed. Technical testing shows negative relationships between portable classrooms and health and safety conditions, but the permanent structures are sometimes worse. Research limitations/implications: An experimental study on the impact of portable classrooms on teaching and learning is needed. Analysis of current studies indicate that the impact of portable classrooms on teaching and learning is not as negative as assumed. Still, the negative effects of deterioration or lack of maintenance cannot be underestimated; making implementation strategies, maintenance schedules, relocation plans, and plans for ultimate replacement vital. Originality/value: This paper represents the first of its kind to synthesize the findings of current studies on portable classrooms. Results are of great value to educational decision makers. (Contains 3 tables.)

Descriptors: Student Attitudes, Maintenance, Job Satisfaction, Mobile Classrooms, Teacher Morale, Teaching Methods, Correlation, Educational Environment, Educational Facilities, Educational Policy, Teaching Conditions, Meta Analysis, Research Reports

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NATIONAL CENTER FOR EDUCATION STATISTICS
Institute of Education Sciences

FRSS
Fast Response Survey System

Public School Principals Report on Their School Facilities: Fall 2005

Statistical Analysis Report

U.S. Department of Education
NCES 2007-007

U.S. Department of Education
Margaret Spellings
Secretary

Institute of Education Sciences
Grover J. Whitehurst
Director

National Center for Education Statistics
Mark Schneider
Commissioner

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Executive Summary

The extent to which school buildings support education has been an important topic for policymakers. One issue is the physical condition of the buildings, particularly as school buildings age. Another is the ability of the buildings to accommodate shifts in the nation's population: some communities have experienced decreases in school-age population due to outmigration or shifts in the age distribution, leading to below-capacity enrollment in their schools, while others have experienced large increases in population and have needed to build new schools, expand existing ones, or put more students in buildings than the buildings are designed to serve. This report is based on a survey of school principals conducted by the National Center for Education Statistics (NCES) in the Institute of Education Sciences, U.S. Department of Education. It presents current information on the extent of the match between the enrollment and the capacity of the school buildings, environmental factors that can affect the use of classrooms and school buildings, the extent and ways in which schools use portable buildings and the reasons for using them, the availability of dedicated rooms for particular subject areas (such as science labs or music rooms), and the cleanliness and maintenance of student restrooms. The data were collected from mid-September 2005 through late January 2006 from public elementary and secondary schools in the 50 states and the District of Columbia. *T*-tests were used to test for statistical significance.

The Capacity of School Buildings

Principals often reported a mismatch between the capacity of school buildings and the number of students in those buildings. More than half of the principals reported that their school had fewer students than the school's design capacity: 21 percent said their school was underenrolled by more than 25 percent, and 38 percent said their school was underenrolled by between 6 and 25 percent (figure 1; table 1). The remaining schools included those that had enrollments within 5 percent of their capacity (22 percent) and those that were overenrolled (10 percent were overenrolled by between 6 to 25 percent above their capacity, and 8 percent by more than 25 percent of their design capacity). The percentage of schools that were underenrolled by 6 to 25 percent increased from 33 percent in 1999 to 38 percent in 2005, and the percentage that were overenrolled by 6 to 25 percent decreased from 14 percent to 10 percent.

- Those schools that principals described as overcrowded used a variety of approaches to deal with the overcrowding: using portable classrooms (78 percent), converting non-classroom space into classrooms (53 percent), increasing class sizes (44 percent),

building new permanent buildings or additions to existing buildings (35 percent), using off-site instructional facilities (5 percent), or other approaches (12 percent) (table 2).

- While one of the primary ways of dealing with overcrowding was to use portable (temporary) buildings, portable buildings were also used by schools that were not overenrolled. From a list of nine possible reasons for using portable buildings, three were given by one-third or more of the principals: an increase in enrollment (69 percent), initiatives to reduce class size (34 percent), and a need to add or expand an academic support program (33 percent) (table 4).

- Schools used portable buildings in a variety of ways: for general classrooms (73 percent of schools with portables), academic support areas (58 percent), storage (27 percent), music rooms (26 percent), before- and after-school care for school-age children (13 percent), early childhood programs (11 percent), art rooms (10 percent), computer labs (9 percent), language labs (9 percent), office/administrative space (9 percent), library media centers (6 percent), teacher work rooms (6 percent), day care centers for preschool-age children (4 percent), and other uses (14 percent) (table 5).

- Of those principals that considered their schools to be overcrowded, 40 percent anticipated that the overcrowding would be substantially reduced or eliminated within the next 3 years (table 6). The reasons that they gave included the completion of new permanent buildings or additions to existing buildings (68 percent), the completion of new schools nearby (43 percent), school boundary changes with existing schools (37 percent), and projected declines in the local school-age population (17 percent).

Availability of Dedicated Space in Selected Areas

Schools often had dedicated rooms or facilities to support particular subject areas: 83 percent had a gymnasium to support physical education, 81 percent had one or more music rooms, 70 percent had one or more art rooms, and 48 percent had one or more science labs (table 7).

Environmental Factors and School Buildings

The survey asked principals about the quality of the space in their buildings. Nine specific environmental factors were examined: artificial lighting, indoor air quality, size or configuration of rooms, acoustics or noise control, physical condition, ventilation, heating, natural lighting, and air conditioning.

- Overall, for eight of the nine environmental factors, 80 percent or more said that each factor was either satisfactory or very satisfactory in their permanent buildings (figure 3; table 9). The only exception was air conditioning: 17 percent of the schools did not have air conditioning in their permanent buildings, and thus did not rate it as either satisfactory or unsatisfactory. Satisfaction with the nine environmental factors in portable buildings ranged from 72 percent to 91 percent (figure 4; table 12).

- Giving separate responses for permanent and portable buildings, 56 and 55 percent of principals said that these environmental factors taken together did not interfere at all with the delivery of instruction, while the remainder reported at least some interference: 33 and 30 percent reported there was interference to a minor extent, 9 and 13 percent to a moderate extent, and 1 and 2 percent to a major extent (table 17).

- Forty-two percent of the principals were very satisfied and 50 percent were satisfied with the cleanliness and maintenance of student restrooms at the school (table 18).

Summary

Background

The extent to which school buildings support education has been an important topic for policymakers. One issue is the physical condition of the buildings, particularly as school buildings age: a 1995 U.S. General Accounting Office report estimated the cost of bringing existing schools into good condition at $112 billion. The report noted that about one-third of schools, with 14 million students, reported the need for extensive repair or replacement of one or more buildings, and that almost 60 percent of schools reported at least one major building feature was in disrepair. In addition, schools faced federal mandates to make schools accessible to all students and to remove or correct hazardous substances such as asbestos, lead paint, and radon, costing $11 billion of the $112 billion total. A later follow-up report indicated that the need for repairs, though widespread, was distributed unequally throughout the nation: the greatest needs were in central cities, the West, large schools, secondary schools, schools where more than half of the students belong to racial/ethnic minorities, and schools where 70 percent or more of the students were poor (U.S. General Accounting Office 1996). Later reports also documented a continuing and possibly growing need. A 2000 report by the National Education Association estimated the cost of repairs/renovation at $322 billion. One fundamental reason for the need for repairs was the safety of the students and teachers, but the quality of the school buildings affects other factors as well. It forms part of the context for learning, so that factors such as lighting, noise reduction, and air quality can influence student behavior and academic achievement (Lackney 1999; Schneider 2002). It also is related to teacher satisfaction: 48 percent of teachers who transferred to another school and 39 percent of teachers who left teaching cited the need for significant repair of school facilities as a source of dissatisfaction (U.S. Department of Education 2005; see also Buckley, Schneider, and Shang 2005).

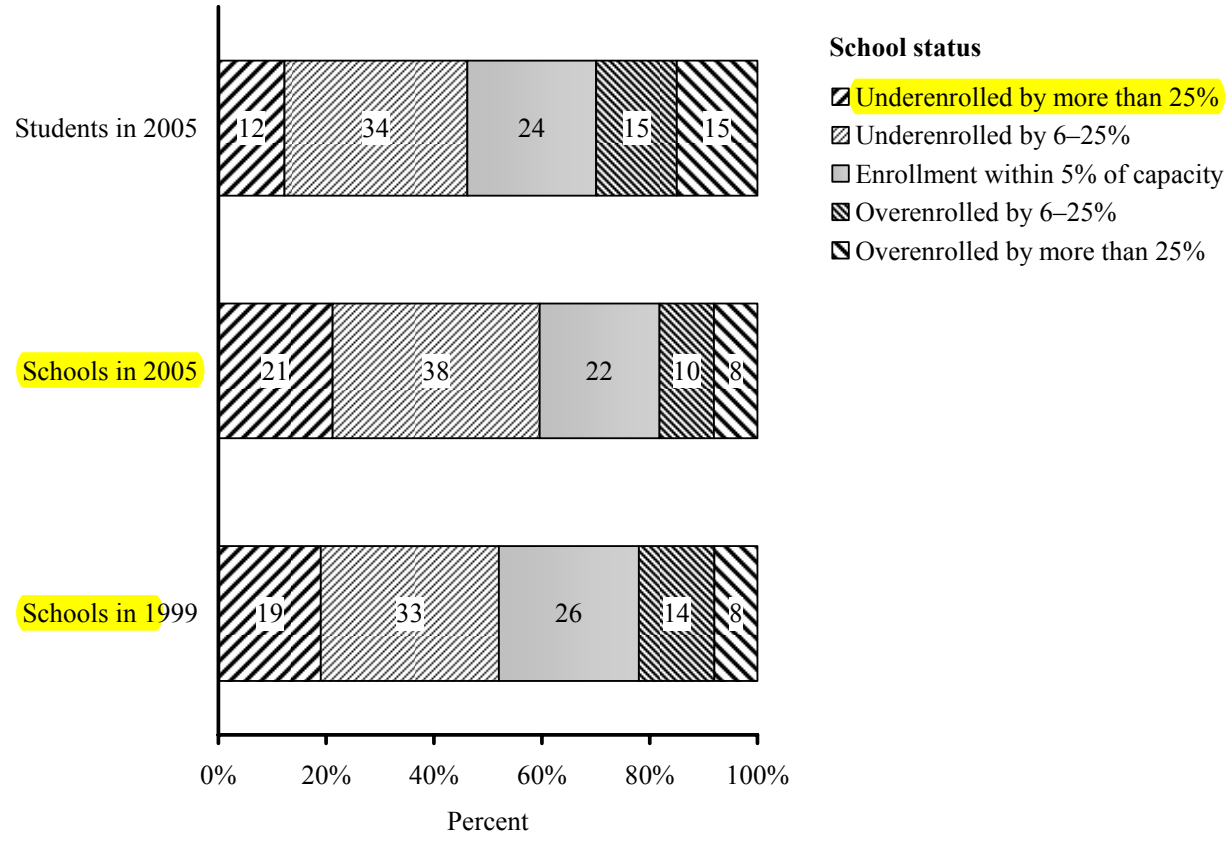
Another issue is whether schools have sufficient capacity to fulfill their purposes. One difficulty is that the buildings may become less suitable when there are shifts in the nation's population: some communities have experienced decreases in the school-age population due to outmigration or shifts in the age distribution, leading to below-capacity enrollment in their schools, while others have experienced large increases in population and have needed either to build new schools, expand existing ones, or put more students in buildings than the buildings are designed to serve. A 1999 Fast Response Survey System (FRSS) survey asked school district personnel to provide the number of students a school was designed to serve (here labeled the design capacity) and the enrollment size for that school; it found that 52 percent of schools had enrollments that were below the design capacity by more than 5 percent,

(Colmenar et al. 2005). For this 2005 survey, design capacity was chosen because it is a commonly used metric for examining school needs, and because it allows measures of change over time (by comparing the current estimates with those of the earlier FRSS study in 1999). FRSS studies are designed to be short and to impose relatively little burden on the survey respondents, and it therefore was not feasible to develop a complete picture of school space issues.

There was often a mismatch between the capacity of school buildings and the number of students in those buildings. More than half of the principals reported that their school had fewer students than the school's design capacity: 21 percent said their school was underenrolled by more than 25 percent, and 38 percent said their school was underenrolled by between 6 to 25 percent (figure 1; table 1). The remaining schools included those that had enrollments within 5 percent of their capacity (22 percent), and those that were overenrolled (10 percent were overenrolled by between 6 to 25 percent above their capacity, and 8 percent by more than 25 percent of their design capacity). For both categories of overenrollment, the percentage of students in those schools was greater than the percentage of schools (15 percent versus 10 percent, and 15 percent versus 8 percent); also, the percentage of students in schools that were underenrolled by more than 25 percent was lower than the percentage of schools (12 percent versus 21 percent). By comparing these results with a similar study conducted in 1999, one can also measure change in the capacity of school buildings relative to their enrollments. The percentage of schools that were underenrolled by 6 to 25 percent increased from 33 percent to 38 percent, and the percentage that were overenrolled by 6 to 25 percent decreased from 14 percent to 10 percent.

The percentage of principals who said that they considered their school to be overcrowded (15 percent; table 2) was not significantly different from the percentage who indicated that their school was more than 5 percent over their design capacity (10 percent at 6 to 25 percent over capacity, plus 8 percent at more than 25 percent over capacity). Despite these similarities, principals' perceptions did sometimes disagree with the statistics that are based purely on design capacity: 52 percent of those principals whose enrollment exceeded the design capacity by 5 percent or less considered their schools to be overcrowded, and 26 percent of those whose enrollment exceeded the design capacity by more than 5 percent did not consider their schools to be overcrowded (not shown in tables).

Figure 1. Percentage of public schools reporting that they were underenrolled, at capacity, or overenrolled in 1999 and 2005, and percentage of students at such schools in 2005



NOTE: Detail may not sum to totals because of rounding.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Fast Response Survey System (FRSS), "Public School Principals' Perceptions of Their School Facilities: Fall 2005," FRSS 88, 2005.

Underenrollment by more than 25 percent was more common at small schools (41 percent) than at medium or large schools (14 percent and 6 percent, respectively), in the Central region (27 percent versus 16 and 19 percent in the Southeast and West), and at small town or rural schools than at schools in other locales (31 percent versus 12 and 16 percent) (table 1). By contrast, overenrollment by more than 25 percent was more common in large schools (19 percent) than in small and medium schools (2 percent and 6 percent, respectively), in the Southeast and West (11 percent and 15 percent versus 2 percent in the Central and Northeast regions), in city schools than in small towns and rural areas (14 percent versus 4 percent), and in schools with 50 percent or more minority enrollment (16 percent versus 0 to 8 percent).

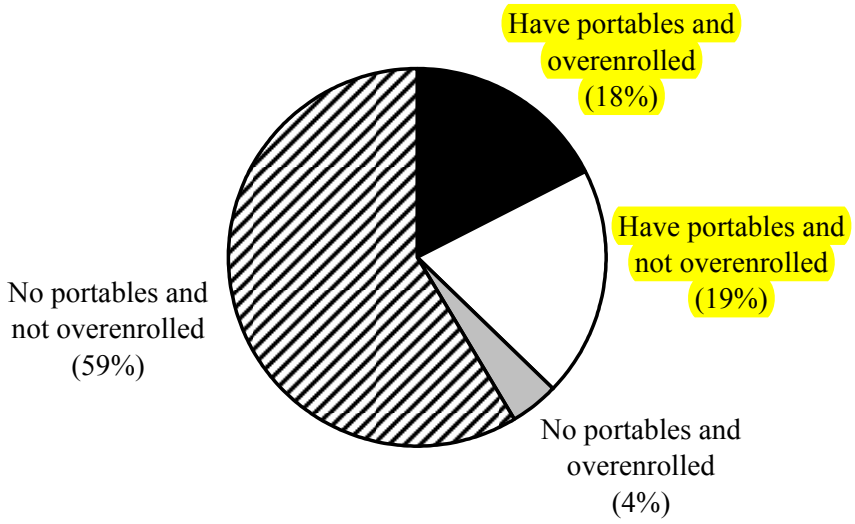
Approaches to Overcrowding

Those 15 percent of schools that principals described as overcrowded used a variety of approaches to deal with the overcrowding: using portable classrooms (78 percent), converting non-classroom space into classrooms (53 percent), increasing class sizes (44 percent), building new permanent buildings or additions to existing buildings (35 percent), using off-site instructional facilities (5 percent), or other approaches (12 percent) (table 2). Schools often used a variety of these approaches in combination: 79 percent used two or more of these approaches, and 36 percent used three or more (not shown in tables).

Use of Portable Buildings

As noted, one of the primary approaches to overcrowding is to use portable (temporary) buildings. However, the usage of portable buildings is much greater than might be anticipated based on tables 1 and 2 alone: 37 percent of all public schools had portable buildings (table 3), compared with 18 percent that were overenrolled. In fact, the percentage of schools with portables that were at or below capacity was not significantly different from the percentage with portables that were overenrolled (19 percent versus 18 percent; figure 2), while 4 percent of schools were overenrolled but not using portables. This finding indicates that overenrollment is not the only reason for using portables.

Figure 2. Percentage of public schools with and without portables, by overenrollment status: Fall 2005



NOTE: Detail may not sum to totals because of rounding.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Fast Response Survey System (FRSS), "Public School Principals' Perceptions of Their School Facilities: Fall 2005," FRSS 88, 2005.

The schools with the greatest use of portable buildings were as follows:

- Large schools (52 percent had portables, compared with 27 and 36 percent of other schools);
- City schools (49 percent versus 28 and 39 percent in the other two locales);
- Schools in the West or Southeast (62 percent and 41 percent, respectively, compared with 17 and 20 percent in the other two regions); and
- Schools with high minority enrollment (53 percent among schools where 50 percent or more were minorities, compared with 19 to 42 percent in other schools) (table 3).

Reasons for use. From a list of nine possible reasons for using portable buildings, three were given by one-third or more of the principals: an increase in enrollment (69 percent), initiatives to reduce class size (34 percent), and a need to add or expand an academic support program (33 percent) (table 4). Other reasons, cited by 14 percent or fewer of the principals, were changes in the academic programs or curriculum such as the introduction of a foreign language (14 percent); the need for space for new or expanded technology (12 percent); the introduction of prekindergarten, Head Start, or another early childhood program (11 percent); temporary relocation of staff or students due to renovation or replacement of existing buildings (11 percent); the introduction of all-day kindergarten (9 percent); the need for additional office or administrative space (7 percent); and other reasons (13 percent). Many of these reasons involved the configuration of the schools: whether or not the schools were overcrowded, they used the space provided by portable buildings to accomplish policy objectives such as reducing class size or supporting academic programs.

Some categories of schools gave different responses than others. Principals in medium or large schools were much more likely to give an increase in enrollment as a reason (75 and 85 percent compared with 37 percent among small schools), and principals in the Northeast were more likely than those in the Southeast to give the introduction of all-day kindergarten as a reason (22 percent versus 1 percent). Principals at schools with minority enrollments of 50 percent or more were more likely than those at schools with minority enrollments of less than 6 percent to give initiatives to reduce class size as a reason (44 percent versus 24 percent).

Types of use. The portable buildings were used in a variety of ways: for general classrooms (73 percent of schools with portables), academic support areas (58 percent), storage (27 percent), music rooms (26 percent), before- and after-school care for school-age children (13 percent), early childhood programs (11 percent), art rooms (10 percent), computer labs (9 percent), language labs

(9 percent), office/administrative space (9 percent), library media centers (6 percent), teacher work rooms (6 percent), day care centers for preschool-age children (4 percent), and other uses (14 percent) (table 5).

There were some differences between schools based on school characteristics (table 5). Using the portables as general classrooms was more common in large schools (88 percent) than in small schools (55 percent), in schools with a minority enrollment of 50 percent or more (82 percent) than in schools with minority enrollments lower than 6 percent (63 percent), and in the Southeast and West than in the Central region (71 and 80 percent, respectively, versus 47 percent; the 23 percentage point difference between the Northeast and Central regions was not statistically significant due to large standard errors).

Anticipated Reductions in Overcrowding

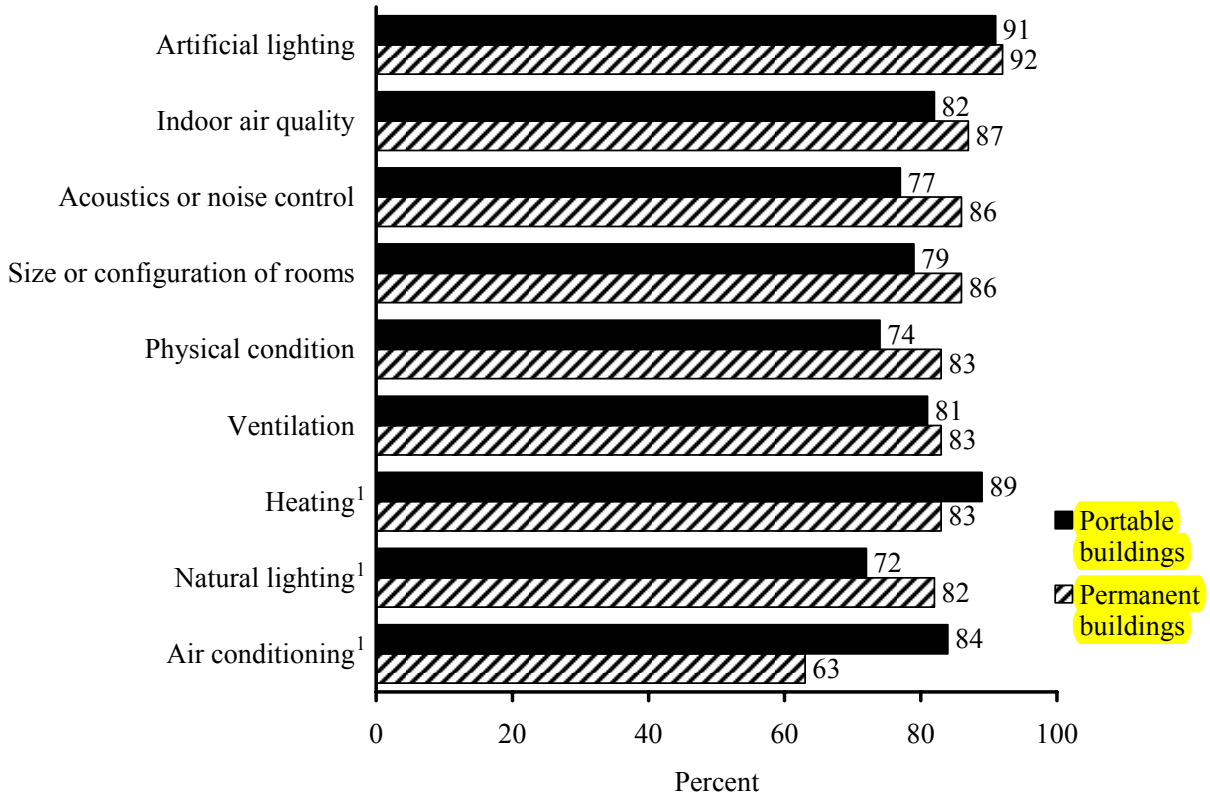
Of those principals who considered their schools to be overcrowded, 40 percent anticipated that the overcrowding would be substantially reduced or eliminated within the next 3 years (table 6). The reasons that they gave included the completion of new permanent buildings or additions to existing buildings (68 percent), the completion of new schools nearby (43 percent), school boundary changes with existing schools (37 percent), and projected declines in the school-age population in the school's service area (17 percent).[1]

Availability of Dedicated Space in Selected Areas

Schools often had dedicated rooms or facilities to support particular subject areas: 83 percent had a gymnasium to support physical education, 81 percent had one or more music rooms, 70 percent had one or more art rooms, and 48 percent had one or more science labs (table 7). For each of these kinds of space, between 69 and 78 percent of principals at schools with such facilities said that the room/facility supported their school's ability to deliver instruction to a major extent. Additionally, between 13 and 20 percent said that the room/facility supported instruction to a moderate extent, while 5 to 8 percent said they supported instruction to a minor extent, and 3 to 5 percent said that the room/facility did not support delivering instruction at all.

[1] Because only 15 percent of the principals considered their schools to be overcrowded, the standard errors for all of these statistics tend to be high, and comparisons among different subgroups of schools generally are not significant.

Figure 4. Percent of public schools indicating that various factors were satisfactory or very satisfactory, by type of building: Fall 2005



[1]For some respondents, this environmental factor was not applicable. For permanent buildings, 17 percent had no air conditioning, 3 percent had no natural lighting, and 1 percent had no heating. For portable buildings, 4 percent had no natural lighting, 3 percent had no air conditioning, and 1 percent had no heating. Such responses could indicate either the lack of a need or an unfulfilled need. The statistics here are based on all responses, not just those expressing an opinion.
NOTE: Statistics are from tables 10 and 12, and may differ from those in tables 9 and 11 due to rounding.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Fast Response Survey System (FRSS), "Public School Principals' Perceptions of Their School Facilities: Fall 2005," FRSS 88, 2005.

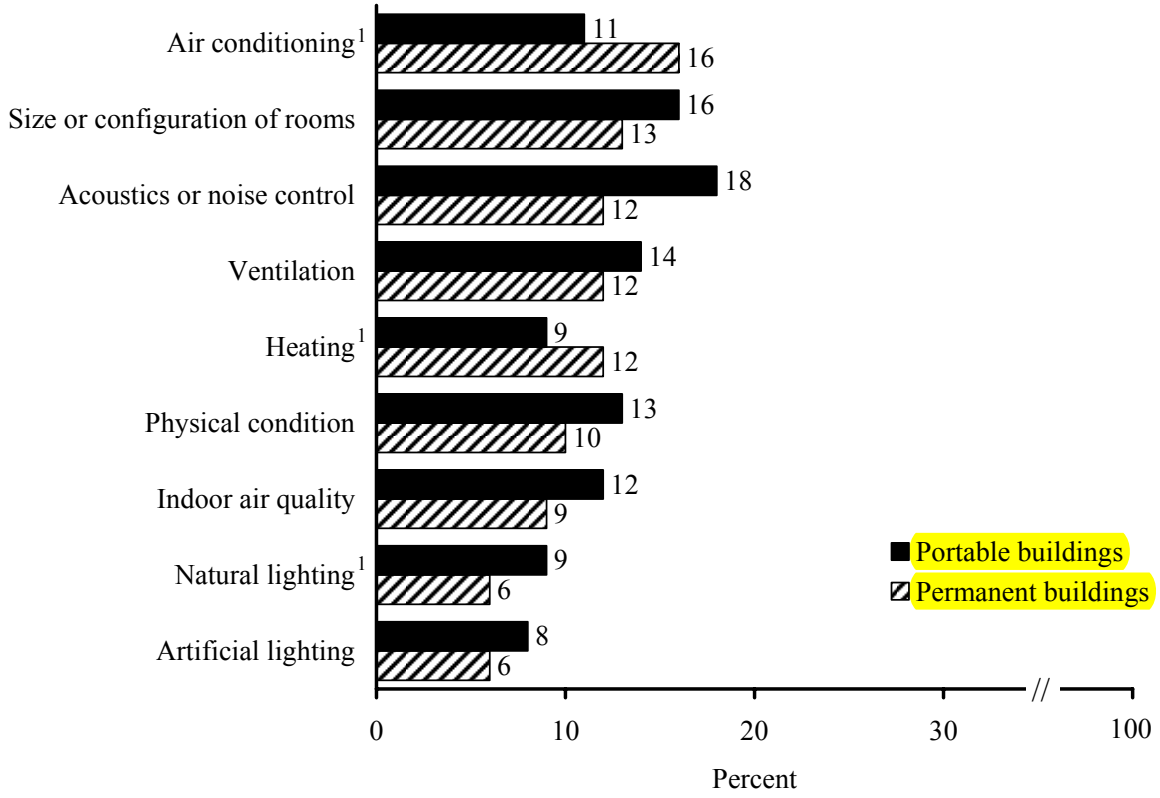
Impact on Instruction

In addition to asking about satisfaction with the nine environmental factors, the questionnaire also asked about the extent to which the factors interfered with the ability of the school to deliver instruction. Principals were given four categories for their responses: not at all, to a minor extent, to a moderate extent, and to a major extent; for the three categories of heating, air conditioning, and natural lighting, they could also reply that the environmental factor was not applicable (this primarily was a consideration with regard to air conditioning in permanent buildings). As with the immediately preceding discussion of satisfaction, the absence of a factor such as air conditioning could interfere with

the ability of the school to provide instruction. This discussion therefore includes all schools when presenting percentages rather than providing percentages only for those schools that provided an opinion.

Even when combining together the two categories "to a moderate extent" and "to a major extent," relatively few schools indicated that the factors interfered with instruction: the percentages indicating there were problems ranged from 6 to 16 percent with regard to permanent buildings, and from 8 to 18 percent with regard to portable buildings (figure 5; tables 13, 14, 15, and 16). Acoustics or noise control was more likely to interfere with instruction in portable buildings (18 percent) than in permanent buildings (12 percent).

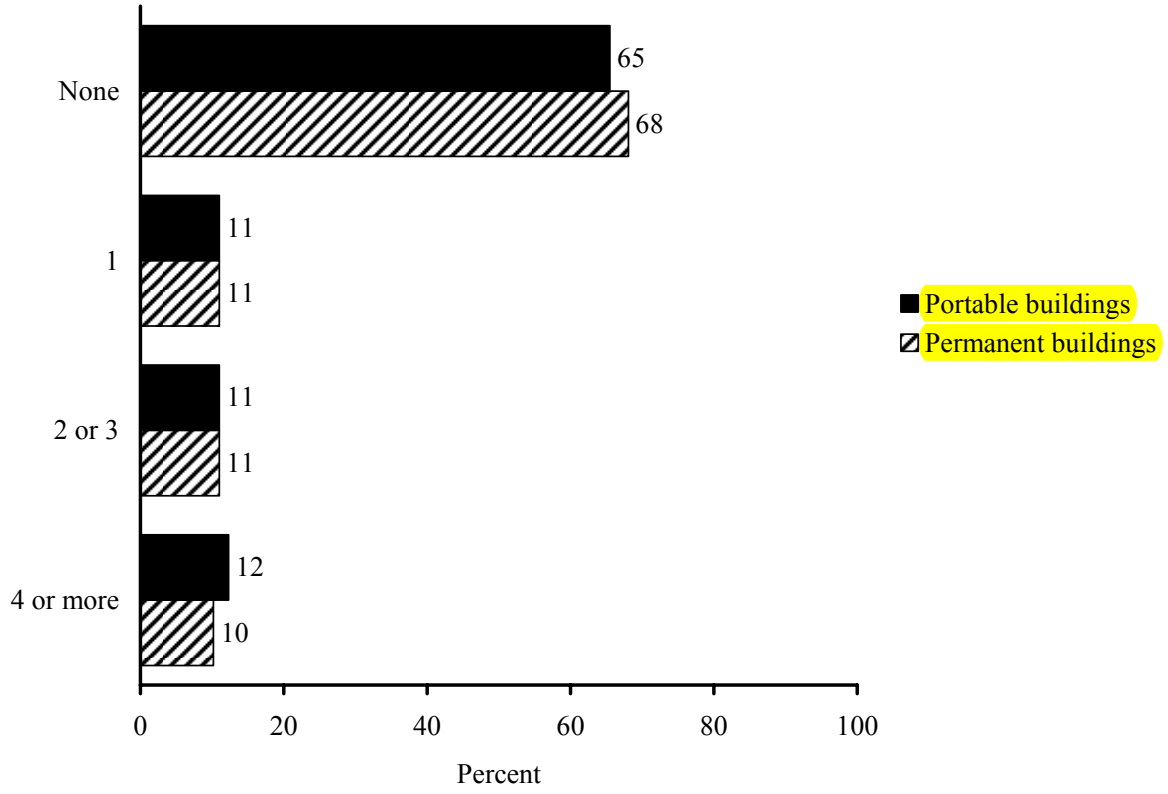
Figure 5. Percent of public schools indicating that various environmental factors interfered with their ability to deliver instruction, by type of building: Fall 2005



[1]Respondents could indicate this environmental factor was not applicable. In permanent buildings, 17 percent had no air conditioning, 3 percent had no natural lighting, and 1 percent had no heating. In portable buildings, 4 percent had no natural lighting, 3 percent had no air conditioning, and 1 percent had no heating. Such responses could indicate either the lack of a need or an unfulfilled need. The statistics here are based on all responses, not just those expressing an opinion.
NOTE: Statistics are from tables 14 and 16, and may differ from those in tables 13 and 15 due to rounding.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Fast Response Survey System (FRSS), "Public School Principals' Perceptions of Their School Facilities: Fall 2005," FRSS 88, 2005.

Looking at all nine factors together, roughly one-third of schools indicated that there was at least one factor that interfered with their ability to deliver instruction to at least a moderate extent (32 percent with regard to permanent buildings, and 35 percent with regard to portable buildings; figure 6).

Figure 6. Percent of public schools indicating various numbers of environmental factors interfered with the ability of the school to deliver instruction to a moderate or major extent, by type of building: Fall 2005



NOTE: Statistics for portable buildings are based on the 33 percent of public schools with classrooms in portable buildings. Details may not sum to 100 due to rounding.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Fast Response Survey System (FRSS), "Public School Principals' Perceptions of Their School Facilities: Fall 2005," FRSS 88, 2005.

Principals also were asked to describe the overall extent to which environmental factors interfered with the delivery of instruction, taking all of these factors together. The results were similar for permanent and portable buildings (table 17). About half (55 and 56 percent) of principals said that these environmental factors did not interfere at all with the delivery of instruction, while the remainder reported at least some interference: 30 and 33 percent reported there was interference to a minor extent, 9 to 13 percent to a moderate extent, and 1 and 2 percent to a major extent.

Portables are effective learning spaces

- Can maximize districts and statewide utilization by avoiding overbuilding and therefor minimize the cost of facilities ownership.
- Portables can be relocated where needed versus bricks-and-mortar that cannot.
- Portables, when used and maintained properly, are just as effective for learning as bricks-and-mortar.
- Portables cannot totally replace bricks-and-mortar, but can be used strategically for long-term maximization of available funding.

Prototypical Schools

- Have been used successfully in New Mexico in areas with high growth, but only for elementary schools.
- Have been tried repeatedly throughout the country and with no current ongoing success.
- Prototypical spaces, including portables, can be used strategically to speed delivery of educational space and limit risk of poorly functioning space.
- Every community have different emphasis on learning programs, weather differences, and differing site conditions – the best school facilities designs are contextual.

CEFPI
The School Building Association

Prototype School Designs:

Can Prototypes Be Used Successfully?

A CEFPI Research Publication

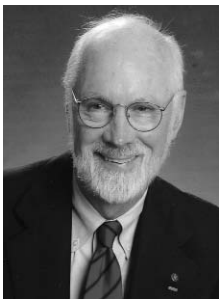
The Authors:

Laura A. Wernick, AIA, REFP
John F. Miller, FAIA
Erica Metzger
Heather Hansman
HMFH Architects, Inc.

Table of Contents

Biographies

Laura A. Wernick, AIA, REFP, is a Principal of HMFH Architects, Inc. She is extremely active in the national dialogue on architecture and education, and has organized and spoken at CEFPI conferences, both regionally and nationally, as well as the AIA's Committee on Architecture for Education. Her projects include the nationally recognized Thompson Middle School in Newport, RI, an urban facility that goes beyond classroom education and links students and families to a variety of social services. In addition, she has been responsible for the design of public and private elementary, middle and high school facilities, as well as unusual, technically complex renovations, such as the Electro-Acoustic Music Studio at Harvard University's Paine Hall. Ms. Wernick is a member of the Boston Society of Architects Ethics Committee, CEFPI, the UMASS Lowell Graduate School of Education Advisory Board, and President of the Child Care Resource Center. She holds a B. Arch. from Cornell University.



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Introduction

Across the country school districts are faced with unprecedented growth. As student populations increase, existing schools are overcrowded and falling in to disrepair. Communities and school districts are searching for an efficient, cost effective way to build new schools that are tailored to their students' needs, and can provide adequate resources as their student population continues to expand. Many communities have looked to prototype, or stock designs, as a way to fulfill their needs.

The purpose of this report is to determine under what circumstances the use of prototype school designs are appropriate, what measurable benefits are realized, and if any disadvantages result from their use.

Methodology

A search of reports, studies, papers and articles related to the use of prototype school designs was conducted. The search resulted in numerous studies prepared by Departments of Education including Arkansas, California, Georgia, North Carolina, Virginia and Washington and position papers prepared by the American Institute of Architects (AIA) and state components. They spanned a period from 1964 to 2005 and included AIA components from California, Illinois, New Jersey, North Carolina, Pennsylvania, Texas and Utah.

We reviewed articles written by Architects, Educational Planners and Educators. We also reviewed newsletters and articles. We identified school districts that are currently using prototype school designs and communicated with them by email and telephone.

An email inquiry was sent to American Institute of Architects' State Government Network members to identify architects who have or are designing prototype schools and to identify school districts that have used prototype school designs. A preliminary questionnaire was developed based on issues identified by research and outreach efforts. While we received some useful data, the response to that effort was disappointing

What is a Prototype?

In the literature we reviewed prototypes are often referred to as: Stock Plans, Standard Plans, Clone Plans, Duplicate Plans, Plan Reuse and Model School Design Plans. For the purpose of this report we will use the following definition:

Prototype School Plans are construction documents that have been used to construct more than one school with minor modifications required for the second and subsequent schools.

Current Trends in School Design

Current trends in school design theory support a planning process that is often at odds with the development of prototype school designs. In the Report from the National Summit on School Design, convened by the American Architectural Foundation and Knowledge Works Foundation, in Washington on October 6-8, 2005 the following eight (8) recommendations for School Design Excellence were stated:

1. Design Schools to Support a Variety of Learning Styles
2. Enhance Learning by Integrating Technology
3. Foster a "Small School" Culture
4. Support Neighborhood Schools
5. Create Schools as Centers of Community
6. Engage the Public in the Planning Process
7. Make Healthy, Comfortable, and Flexible Learning Spaces
8. Consider Non-Traditional Options for School Facilities and Classrooms

Ronald Bogle, President and CEO of the American Architectural Foundation said in the Report on the National Summit on School Design, that "we have moved beyond the one-size fits all approach to school design to an age of greater innovation and flexibility tailored to meet the needs of individual students, schools and communities." He further stated, "The successful schools of the future need to apply the research on how students learn and how the quality of our educational facilities affects student performance, health, safety, self esteem and well being" (2006).

Prior Studies by State Departments of Education

We reviewed and have summarized the findings of the following studies prepared by State Departments of Education:

1. "Stock Plans Program, Experience of Two School Districts," Washington, 1960
   The use of stock plans may have contributed to the higher costs in school construction. The school building program can best be served by the continued encouragement of original design and use of new and varied materials.

2. "Stock Plans for Schools: Chimera or Panacea," California, 1970
   History indicates that achieving modern school facilities at less cost through the use of stock plans is an unrealized dream….the idea of stock plans has been extensively explored and the preponderance of available facts and opinions has prompted us to reject stock plan proposals as neither sound nor economical.

3. "Standard Architectural Drawings for School Buildings," California, 1972
   Use of prototype school designs...was impractical due to variations in soil conditions, weather conditions, site access, orientation, accessibility of utilities, educational program policies and class size.

4. "Recommendations Regarding the Development and *Use of Stock Plans," Georgia, 1991*
   The feasibility of using this approach as a means of reducing costs or shortening the time required for design and construction of new schools does not appear to be practical nor economical.

5. "School Design," Oregon, 2000
   Prototype designs make sense within a local system when building multiple buildings of the same type in a short time frame.

6. "School Design," Virginia, 2002
   The economy of multiple uses of architectural plans is doubtful at best, and the most would be a fraction of the total cost of a school building. The perceived savings with model school design plans are actually nothing more than shifting costs from the local school division to the Commonwealth.

7. "Prototypical Building Designs: Recommendations," Arkansas, 2004
   The feasibility of using this approach does not appear economical and/or practical to meet the educational facilities needs of the State of Arkansas.

Other Case Studies:
The American Institute of Architects' Position Regarding Prototype School Design

The American Institute of Architects opposes state implemented prototypical school designs because they believe that they compromise both the children's learning experience, and the architectural integrity of the designs.

"The AIA believes school facilities should be designed and built to fit the environment, the location and the specific needs of children and teachers using those schools." And that "Standardized, or stock, plans fail to incorporate individual communities' specific educational needs."(AIA, 2005).

Although using prototype designs may result in some initial savings, the cost of revising the plans and adapting them to specific sites usually negates them. The AIA found that of the 25 states that have used standard designs all 25 have stopped using them, because they were not beneficial.

Systems Approach

In the 1960s, California, Toronto and Boston utilized a systems approach to school construction. Standard criteria were established for mechanical and electrical systems. Modular ceiling and partitions components were developed, designed to be efficient, and to provide the same facilities and resources across the district. These components could be assembled into modules that were adaptable to different sites. Although they proved easy to build, they were not as flexible

as originally envisioned, and public bid laws provided obstacles to cost effective purchasing. Eventually all three programs were discontinued.

Clearinghouse of Prototype School Designs

California, North Carolina, Florida and Pennsylvania have created web sites that feature prototype school designs. The underlying goal of a library of school designs is to make designs available to school districts to reduce the time it takes to design a school from scratch and to reduce the fees paid to architects and engineers. There are, however, corollary benefits. Clearinghouse web sites provide easy access to successful designs that can educate architects, educators and the public on current trends in school architecture, best practices in school design and examples of sustainable design.

New York City Prototype Schools

In the mid-90s, the New York City school system was faced with both the disrepair of their existing schools, and a constantly increasing population. To address the need for more space, and better quality schools the city developed a Prototype School Program. The City hired four architects to create a series of modular designs that could be adapted to different site conditions. These schools provided solid facilities and could be built quickly and relatively inexpensively. These designs were considered a success at the time because they alleviated the desperate need for space, and provided a quality-learning environment. The projects were criticized for limiting community involvement and their lack of individuality. Approximately 20 schools were constructed before the program was discontinued.

Philadelphia School District "Little School House" Program

Like New York, Philadelphia was faced with a rapidly increasing student population, and a lack of space. In 1997 the city, along with the architecture firm VITETTA developed the "Little School House" design, a common core of administrative and recreational spaces that could be combined with classroom wings. They were designed to be both flexible, and predictable. In 1999, the "Little School House" facilities were awarded the Facility of the Month Award by School Construction Magazine. (Richard Sherman, personal communication, December 12, 2003)

Clark County School District, Nevada

Clark County has one of the fastest growing enrollment rates in the country. Because of this they also have one of the largest construction programs. The district has been using prototypes since the 1960's and they have constantly seen major savings. They have constructed 68 schools since 1998 and had 10 additional schools under construction at the time of this study. The use of prototypes has resulted in a 2-3 % savings on design and a 3-8% savings on construction. Change orders are less than ½ of a percent. Up to a year is saved in the overall process. The district uses the architect who designs a given prototype each time that given prototype is constructed to avoid legal issues and to make the process more predictable. They are also constantly making minor changes and refinements to the prototypes. Clark County considers their prototype program a success, partially due to their long range planning which identifies community needs and appropriate sites well in advance, and the experienced staff that oversees each project.

Loudoun County Public Schools, Virginia, and Orange County, Florida

Both Loudon County and Orange County have a high growth rate, and are building lots of schools quickly. In Orange County, in 5 years they have built 27 elementary schools and they will build an additional 24 within the next 4 years. Both counties have found prototypes to be cost effective and time efficient. The use of prototypical plans has reduced construction costs and design fees, as well as change orders. Internal staff is constantly reviewing and updating the plans. The reported disadvantage of the programs is that the schools lack individual character and do not always reflect specific community needs.

Brockton, Massachusetts

Because Massachusetts tends to have smaller school districts, with more community involvement, and constant change to building codes, prototypes are illogical, even in districts with rapid growth. The Brockton, Mass school district built 5 new schools in 7 years, but found that using prototypes was neither time, nor cost efficient. Due to funding delays and program changes the initial designs had to be revised and redesigned, which extended the time frame, and increased costs

Haverhill, Massachusetts

Haverhill, Mass is one of the few smaller school districts that considers the use of prototypes a success. The city built four nearly identical elementary schools over a period of 5 years. Community involvement in the design process impacted the design but all schools incorporated the same basic facilities. Haverhill considers the prototype program a great success in part because the concept of a prototype was instrumental in gaining public support for the funding of the project. Due to site specific adaptations required, the anticipated cost savings were not achieved, but the schools were awarded the 1994 William W. Caudill Citation by *American School & University.* That this important award was given to a prototype school disproves the notion that prototype designs cannot be worthy of architectural recognition.

Findings

State Controlled Prototype School Design Programs

Our research concluded that a state-run program to provide prototype school designs for its school districts was not practical and would not result in cost savings. Not one of the states we looked at recommended using prototypes. According to the American Institute of Architects' 2006 stock plans issues brief, twenty-five (25) states have used prototype school designs and all twenty-five (25) have abandoned the use when the school districts realized they were losing money and receiving an inferior product.

Large, Rapidly Growing School Districts

These school districts have shown the advantages of using prototype designs. When building many of the same type of school it can be cost effective and quicker to use the same plan repeatedly. The communities that have shown the most success with this have continually revised their plans, and have a full time staff dedicated to the upkeep of prototypes.

Smaller School Districts

Smaller school districts confronted with a short-term enrollment bulge often opt for a prototype school design plan. The benefits enjoyed by larger school districts are rarely realized by smaller school districts that are building two (2) or three (3) schools at one time. The anticipated cost savings may not be realized if the selected prototype needs to be adapted to neighborhood requirements or specific site constraints.

Kit of Parts

In several rapidly-growing school districts the Kit of Parts, or Module system of building schools, has been an answer to the need for quality learning spaces to be built quickly. This approach allows flexibility to adapt to differing sites and school sizes. Although they lack in individuality they are often less rigid than a set prototype design. However, even a kit of parts approach requires continual updating.

Clearinghouse of Prototype Designs

Statewide websites or clearinghouses have shown benefit, not only as a library of plans, but also as a resource for architects, and school districts on new technology, and previous successes. Although plans may not necessarily be reused, they are a valuable learning tool.

Systems Approach to School Buildings

In the 1960s, California, Toronto and Boston developed and used a system approach to school design and construction. The expectation of savings from standardizing building systems and materials while providing interior flexibility were not realized and all three programs were ultimately abandoned.

Conclusion

Research has shown that there is a strong correlation between the design of a school and the performance of its students. When we looked at Prototype School Designs as an answer to the need for high quality quickly built schools we found the following:

- State-run Prototype School Design Programs are not practical and will not result in cost savings.
- Prototype School Design Programs in large school districts where there are ample resources can ultimately result in significant savings in time and cost when a large number of school buildings are being built within a short time frame.
- There is a lack of documentation on actual cost savings achieved when a school district reuses a prototype design that requires modification for site adaptation, educational program changes, or code changes.
- Web-based clearinghouses of prototype school designs are a valuable resource. However, there is a lack of research that documents cost savings from the reuse of these plans as well.
- A Kit of Parts approach to prototype school design has been used successfully when a large number of school buildings are being built within a short time frame. This variation of a prototype design addresses a number of the disadvantages of the one-size-fits-all approach.

Educators believe that schools should be designed to meet the needs of the individual student. Architects and educational planners advocate for schools to be designed that take advantage of, and respond to site-specific and community specific characteristics. Under the right conditions, the decision to use a prototype design can save time and money. The decision of whether to build a prototype versus a site-specific design is usually a trade off and should only be made after a careful analysis of the benefits and disadvantages.

- Conduct a thorough analysis of any anticipated cost and/or time savings
- Study the design to determine that it will support the educational program and will allow for future changes
- Establish goals for sustainable design (green, high performance) similar to California's Collaborative for High Performance Schools (CHPS) and measure the prototype school design against them
- Provide for a community process in the selection of a prototype school design;
- Use the architect that designed the original prototype school for reuse to avoid the liability issues and conflicts with architectural registration laws, which may arise if a second architect is retained;
- Provide a Lifecycle Cost Analysis to determine the long-term costs of repairs and maintenance;
- Perform a quality control review of the design documents; and
- Perform a value engineering review of the design documents.

If a school district decides to develop one or more prototype school designs to use over a period of time, the recommendations listed above would be relevant. In addition, the school district should:

- Use the eight (8) recommendations included in the Report from the National Summit on School design;
- Allow time to develop each prototype—a good prototype takes additional effort to develop;
- Design the prototype to facilitate educational changes;
- Use a quality-based selection process for architect selection. Hiring an Architect based on fee bidding may not result in design excellence; and
- Consider using a modular or Kit of Parts approach.

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Based upon our review of literature related to prototype school design and school districts that have used prototype school designs, the evidence leads to the following conclusions:

- State-run Prototype School Design Programs are not practical and will not result in cost savings.
- Prototype School Design Programs in large school districts can result in significant savings in time and cost when a large number of school buildings are being built within a short time frame.
- There is a lack of research that documents cost savings when a school district used a prototype design that required modification for site adaptation, educational program changes or code changes.
- Web-based clearinghouses of prototype school designs are a valuable resource. However, there is a lack of research that documents cost savings from the reuse of these plans as well.
- A Kit of Parts approach to prototype school design has been used successfully when a large number of school buildings are being built within a short time frame. This variation of a prototype design addresses a number of the disadvantages of a the one-size-fits-all approach.

Educators advocate that schools should be designed to meet the needs of the individual student. Architects and educational planners advocate that schools should be designed to take advantage of and respond to site-specific characteristics. The report from the National Summit on School Design and the Council for Educational Facility Planners International's Guide for Educational Planning strongly recommend a public planning process. A site-specific design process is the best way to respond to these goals and recommendations. The decision to use a prototype design is usually a trade off and should only be made after a careful analysis of the benefits and disadvantages.

Our research found a lack of data that compares the cost of designing and constructing a prototype school with the cost of designing and constructing a non-prototype school. Most studies are based on surveys, opinions and anecdotal reports. While this is all useful information from which to make a decision, it would be helpful to have more analytical data. This would help to inform the ongoing debate on the use of prototype schools.

Appendix

List of Benefits and Disadvantages When Prototype Schools Are Used

The studies, reports and papers that have been written about prototype school design list many of the same benefits and disadvantages of using prototypes.

Benefits

- Reduced time for design and construction.
- Reduction of costs.
- Provides design consistency and equity of facilities.
- Prototype designs can be improved from lessons learned.
- Review and approval processes are faster.
- Savings are realized through bulk purchasing.

Disadvantages

- Expectations are unrealistically high.
- Anticipated cost savings are not realized.
- Prototype School Designs are not effective when used as a "quick-fix" without proper research and planning.
- Modifications are required due to site, educational needs, product and code changes, potentially negating cost savings.
- Community control and involvement is reduced or eliminated, reducing neighborhood pride and ownership.

- Lack of design diversity.
- Costs of developing a pool of designs may exceed potential savings.
- Prototype school plans have a limited shelf life due to changing educational needs, code changes, availability of new materials and systems.
- Problems are created regarding architectural registration laws, copyright laws and liability insurance coverage.
- Prototypes cannot accommodate unique educational programs, teacher input, differing sites, number of students and grade configurations in as effective a manner as site-specific design.
- Prototype design programs operated by a state or a large school district require a large staff for administration and quality control.
- Prototype school designs cannot offer the benefits of a site-specific design.
- Poor designs can be perpetuated and errors can be repeated.
- Prototypes can result in higher costs due to a lack of competitive bidding if proprietary specifications are used.

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Prototypical Schools and the Design Cost Debate

- Every community have different emphasis on learning programs, different weather, and differing site conditions – best school facilities designs are contextual.
- Savings from design avoidance are not a good ROI.
  - For most facilities including schools, their only purpose is to support the function. Facilities must be specifically designed to optimize performance including product quality and through put, minimized operational costs, and maximized expected life.
  - Total cost of constructing a facility is estimated to be 2% of the total whole life costs associated with a facility.
  - Design for schools is typically only 00.12% [12/1000th] of the total whole life cost. Architectural fees are about 6% of the construction costs [0.02 x 0.06 = 0.0012].

Life-Cycle Cost Analysis (LCCA)

by Sieglinde Fuller
National Institute of Standards and Technology (NIST)(http://www.nist.gov/index.html)
Last updated: 06-28-2010

INTRODUCTION

Life-cycle cost analysis (LCCA) is a method for assessing the total cost of facility ownership. It takes into account all costs of acquiring, owning, and disposing of a building or building system. LCCA is especially useful when project alternatives that fulfill the same performance requirements, but differ with respect to initial costs and operating costs, have to be compared in order to select the one that maximizes net savings. For example, LCCA will help determine whether the incorporation of a high-performance HVAC(/resources/hvac.php?r=lcca) or glazing system(/resources/windows.php?r=lcca), which may increase initial cost but result in dramatically reduced operating and maintenance costs, is cost-effective or not. LCCA is not useful for budget allocation.

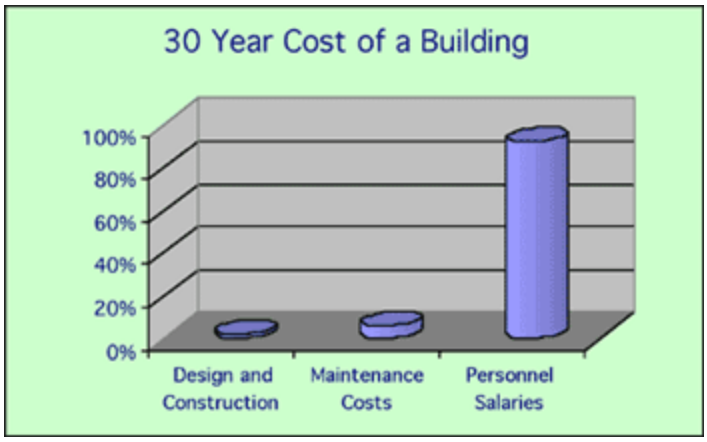
Lowest life-cycle cost (LCC) is the most straightforward and easy-to-interpret measure of economic evaluation. Some other commonly used measures are Net Savings (or Net Benefits), Savings-to-Investment Ratio (or Savings Benefit-to-Cost Ratio), Internal Rate of Return, and Payback Period. They are consistent with the Lowest LCC measure of evaluation if they use the same parameters and length of study period. Building economists, certified value specialists, cost engineers, architects, quantity surveyors, operations researchers, and others might use any or several of these techniques to evaluate a project. The approach to making cost-effective choices for building-related projects can be quite similar whether it is called cost estimating (/design/utilize_management.php), value engineering(/design/use_analysis.php), or economic analysis (/design/use_analysis.php).

DESCRIPTION

A. Life-Cycle Cost Analysis (LCCA) Method

The purpose of an LCCA is to estimate the overall costs of project alternatives and to select the design that ensures the facility will provide the lowest overall cost of ownership consistent with its quality and function (/design/func_oper.php). The LCCA should be performed early in the design process while there is still a chance to refine the design to ensure a reduction in life-cycle costs (LCC).

The first and most challenging task of an LCCA, or any economic evaluation method, is to determine the economic effects of alternative designs of buildings and building systems and to quantify these effects and express them in dollar amounts.



Viewed over a 30 year period, initial building costs account for approximately just 2% of the total, while operations and maintenance costs equal 6%, and personnel costs equal 92%. Graphic: Sieglinde Fuller
Source: Sustainable Building Technical Manual / Joseph J. Romm, Lean and Clean Management, 1994.

B. Costs

There are numerous costs associated with acquiring, operating, maintaining, and disposing of a building or building system. Building-related costs usually fall into the following categories:

- Initial Costs—Purchase, Acquisition, Construction Costs
- Fuel Costs
- Operation, Maintenance, and Repair Costs
- Replacement Costs
- Residual Values—Resale or Salvage Values or Disposal Costs
- Finance Charges—Loan Interest Payments
- Non-Monetary Benefits or Costs

Only those costs within each category that are relevant to the decision and significant in amount are needed to make a valid investment decision. Costs are relevant when they are different for one alternative compared with another; costs are significant when they are large enough to make a credible difference in the LCC of a project alternative. All costs are entered as base-year amounts in today's dollars; the LCCA method escalates all amounts to their future year of occurrence and discounts them back to the base date to convert them to present values.

Initial costs

Initial costs may include capital investment costs for land acquisition, construction, or renovation and for the equipment needed to operate a facility.

Land acquisition costs need to be included in the initial cost estimate if they differ among design alternatives. This would be the case, for example, when comparing the cost of renovating an existing facility with new construction on purchased land.

Construction costs: Detailed estimates of construction costs are not necessary for preliminary economic analyses of alternative building designs or systems. Such estimates are usually not available until the design is quite advanced and the opportunity for cost-reducing design changes has been missed. LCCA can be repeated throughout the design process if more detailed cost information becomes available. Initially, construction costs are

Questions or Comments?

For more information, visit:
www.nmpsfa.org.

or phone: 505-843-6272

THANK YOU!