COST AND AREA COMPARISON PER STUDENT OF THE PUBLIC ELEMENTARY SCHOOLS IN TEXAS BASED ON THE PROJECT DELIVERY SYSTEMS

A Thesis

by

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ABSTRACT

It has been shown that there exists a correlation between the cost of construction of elementary schools and the project delivery systems. Previous research showed that Competitive Sealed proposal contract method of construction is $4000 cheaper than the Construction Manager at Risk method of construction per student for elementary school construction in Texas.

This research investigates the elements causing construction cost variation in elementary schools of Texas by comparing and contrasting the two forms of contract documents, CSP and CMR. Two schools were selected for the study, although the schools are technically in different regions of Texas, the geological record suggests that there is not much difference in the techniques used for foundation construction and hence a reasonable comparison is possible.

A comparison was completed of the contract documents for two elementary schools. School A was built using CSP and School B using CMR. The two schools were built for about $13000 per student in line with A. N. Reinisch's findings for CSP contracts in Texas, but not CMR average costs. The two ISD's who supplied the documents were clearly concerned at cost control and appear to have managed this process. The earlier findings of a cost difference between CSP and CMR are not overturned by this study. Future studies involving a greater number of schools and the development of a central database are recommended.

DEDICATION

I dedicate my research to my family, to my mom Latha Rani who instilled in me confidence that helped me be what I am today, to my dad Rakesh Kumar for paying all my fees, and my brother Kishan for all those fights and talks. I would like to thank Dr. Nichols, my chair for guiding and helping me throughout this research, without whom this research would not have been accomplished. I specially want to thank my friend Bhavya for persuading me to get my master's and my roommate Deepika for being there for me, motivating me and for making all those delicious food. Special thanks to my friends Vishnu and Shabeeb for helping me with my research. Also to Jenni Marshall, for helping me edit and proof read my research. At last I want to dedicate my thesis to all my friends for being there for me in every possible way.

ACKNOWLEDGEMENTS

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Thanks also go to my friends and colleagues and the department faculty and staff for making my time at Texas A&M University a great experience. I also want to extend my gratitude to the Texas Elementary School Superintendents for participating and providing me with data for my research.

Finally thanks to my family and friends in India and USA for being there for me when I needed them the most.

NOMENCLATURE

CSP	Competitive Sealed Proposal
CMR	Construction Manager at Risk
TEA	Texas Education Agency
PDS	Project Delivery System
ISDs	Independent School Districts
FAST	Financial Allocation Study for Texas
ESC	Education Service Center
SBOE	State Board of Education
DBIA	Design Build Institute of America
GMP	Guaranteed Maximum Price

DEFINITIONS

- Texas Education Agency (TEA): An entity "responsible for guiding and monitoring certain activities related to public education in Texas"
- Education Service Centers (ESC): The state of Texas has grouped school districts within twenty educational service centers
- Elementary Schools: school facility built for education, which houses kindergarten – 5^{th} grade, elementary school sometimes include kindergarten, grade 6^{th} to grade 8^{th}.
- Independent School Districts (ISD): Signifies that the school districts is an independent political entity, with a board of trustees controlled by state government legislation
- Project Delivery Systems (PDS) : A contractual method of delivering a building to the client
- Construction Cost: The final amount paid by the ISD as specified by the superintendents. All amounts will be in millions of US dollars
- Construction cost per student: For the purpose of this study, cost per student was determined by dividing the actual cost to build the elementary school by the enrollment numbers.
- Construction cost per student per square feet: for the purpose of this study, cost per student per square feet was obtained by dividing the construction cost per student by the area of the school

- Design Build Institute of America (DBIA): The Design-Build Institute of America is the organization that defines, teaches and promotes best practices in design-build (Design Build Institute of America, 2013)
- Competitive Sealed Proposal (CSP): Is a traditional contract method, which is also known as Hard Bid. In this method the cost of construction is fixed even before construction is started.
- Construction Manager at Risk (CMR) : Is a method of contract in which the contractor give a guaranteed maximum price for the project and any additional cost will be borne by the contractor
- State Board of Education: this body is the head of the school districts in Texas, is situated in Austin and is responsible for the operations of all the public schools in Texas
- Financial Allocation Study for Texas (FAST): This agency examines both academic progress and spending at Texas' school districts and individual school campuses

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CHAPTER I

INTRODUCTION

BACKGROUND

The construction of the educational facilities has ranked highest in total value of the non-residential construction for the past several years and maintains this rank in 2011 (McGraw-Hill Construction, 2011). Reinisch (2011) clearly showed the difference in average costs between elementary schools built using Construction Manager at Risk (CMR) and Competitive Sealed Proposal (CSP). The CMR is four thousand dollars per student more than the CSP contracts. The objective of this research is to compare and contrast actual documents for the two types of contracts to determine if a difference in form or element exists between the contract types.

As with all such work into contract and bid forms this work is controversial and subject to diverse opinion. The need to develop and fund our public school facilities in order to positively impact student learning has been established in a significant body of research (Luke, 2007).

This chapter summarizes the research objective, the study hypothesis and the limitations of the study. Chapter II summarizes the literature review, Chapter III presents the study method, Chapter IV provides the results of the study analysis and Chapter V provides conclusions for the work.

RESEARCH OBJECTIVE

The research objective is to compare and contrast the construction standards and documents between typical contracts using the two delivery systems Competitive Sealed Proposal and Construction Management at Risk for public elementary schools in Texas to determine if differences in the contract documents account for the cost differential identified by others.

HYPOTHESIS

The hypothesis for the study is:

No difference in construction standards can be observed between contract documents used for the two delivery systems, Competitive Sealed Proposal and Construction Management at Risk for public elementary schools in Texas.

STUDY LIMITATIONS

The study limitations are

- The study is restricted only to the elementary school projects completed after the year 2000 in Independent School Districts (ISD) within the state of Texas
- Analysis is limited to the Project Delivery Systems that have enough data to perform a sound review
- The schools selected reflect normal construction in Texas schools

SIGNIFICANCE OF THE STUDY

The results from this study can be used to make decisions regarding the equity of funding of public elementary facilities in terms of contract methods.

CHAPTER II

LITERATURE REVIEW

INTRODUCTION

Alternate delivery methods are used for the construction of the public elementary schools in Texas as permitted under state law. This study is an extension of previous research projects at TAMU on Texas Elementary school construction that focused on the cost of construction of elementary schools per student (Singh, 2008). This chapter outlines the literature review for the study, with sections on:

- A history of the Texas Education Code
- Texas School Funds
- Delivery Systems
- Existing Studies
- Public School construction
- US Financial crisis of 2008
- Texas Economy during the Financial crisis of 2008
- The effect of the Financial crisis on construction industry
- Legislation affecting Texas Public School Construction
- US construction expenditure 2004 to 2012
- Summary

A HISTORY OF THE TEXAS EDUCATION CODE

The Texas education system dates back to 1840 when the first Anglo-American Public School Law was enacted (Texas Education Agency, 2013). The act of 1840 set aside 17,172 acres of land for school development. The subsequent Act of 1845 retained focus on the funding for schools, which directed one-tenth of the annual state tax revenue towards the school development. This act also created the Texas Permanent School Funds for the benefit of the public schools. In 1884 the school law was rewritten and the Office of State Superintendent was re-created; the Permanent School Fund was to be invested in county and other bonds to increase income. The income from the Permanent School Funds is approximately $765 million a year(Texas Education Agency, 2010). A series of additional laws granted cities more freedom resulting in the creation of independent school districts.

The Texas Education Senate Bill No 1, passed in 1995, changed the procurement form for the construction of schools in Texas. According to the Senate Bill the procurement process for the school with contract value above $25,000 has to be on the basis of “best value” and not on the basis of the traditional design-bid-build method (Design Build Institute of America, 2013). All the Texas school districts were granted permission to choose a suitable delivery system. Later Bill 583, passed in 1997, gave a detailed procedure for the schools following alternative delivery methods. The other amendments in the bill aimed to help the education system.

The 2002 Federal Education Plan states that no child should be left behind -- the Texas accountability system holds schools and districts accountable for student performance on assessment tests and dropout rates ("The Elementary and Secondary Education Act (The No Child Left Behind Act of 2001)," 2002).

THE TEXAS EDUCATION AGENCY

The Texas Education Agency (TEA), located in Austin, comprises the Commissioner of Education and agency staff along with the State Board of Education (SBOE) and facilitates the operations of 20 Education Service Centers, which in turn help operate the 1,024 (Wunneburger, 2011) school districts present in the Texas Public Education System (Texas Education Agency, 1993). The Texas Education Agency controls the operations of the public schools, administers the distribution of funds and data collection system.(Combs, 2012). The State Board of Education helps establish policies and sets standards to develop the education programs for the schools. The operations of the Texas Education system are funded by both state and federal government. Figure 1 shows the 20 different education service centers in Texas.

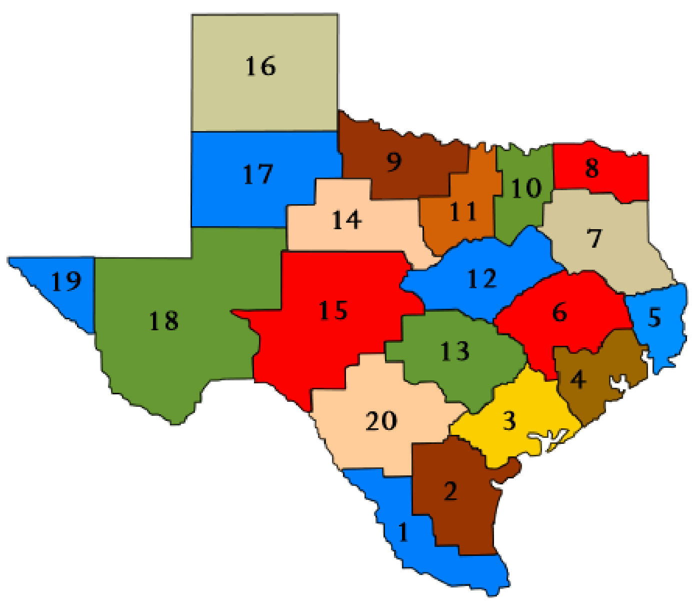


Figure 1 Texas Education Service Centers and Locations

The list of the twenty school centers is shown in Table 1.

Table 1 A List of Twenty Education Service Centers in Texas

No	Education Service Center
1	Edinburg
2	Corpus Christi
3	Victoria
4	Houston
5	Beaumont
6	Huntsville
7	Kilgore
8	Mount Pleasant
9	Wichita falls
10	Richardson
11	Fort worth
12	Waco
13	Austin
14	Abilene
15	San Angelo
16	Amarillo
17	Lubbock
18	Midland
19	El Paso
20	San Antonio

There are 1,024 school districts in Texas which are operated by 20 education services. Figure 2 shows the map of the school districts in Texas.

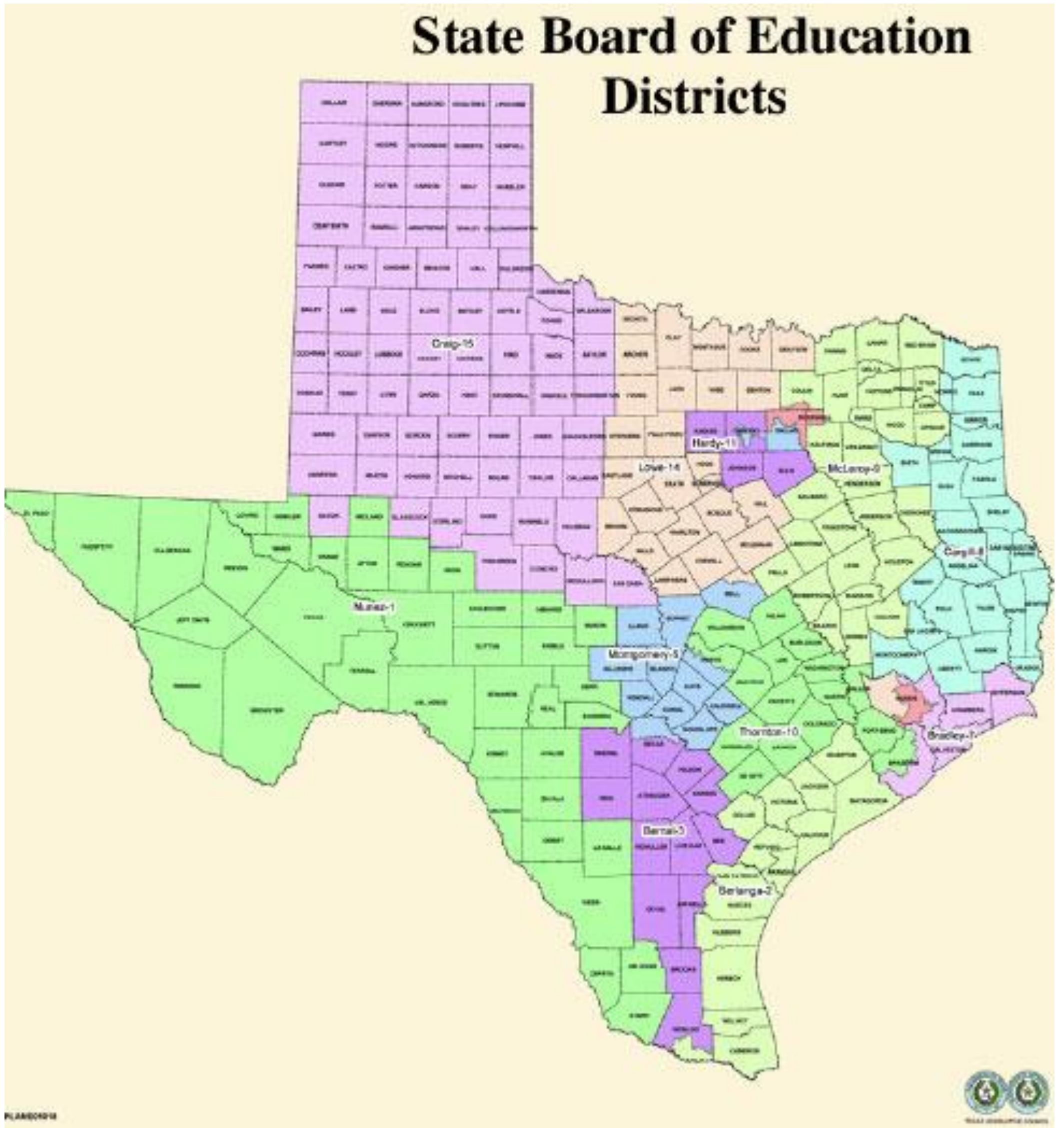


Figure 2 Texas Independent School Districts

TEXAS SCHOOL FUNDS

The Division of State Funding, Texas Education Agency (TEA), administers school facilities funding and standards, including the Commissioner of Education's rules regarding school facilities. The main funds for schools come from local property tax, federal funds and state funds. Public and Higher Education together constitute the largest category of state spending by far, accounting for 41.4% of all appropriations and 60.7% of general revenue spending in the 2010-11 biennium.

Tier 1 ensures a base or "foundation" funding level for all students at a local tax rate of $0.86 per $100 of property value. All districts are entitled to $2,537 per student in Average Daily Attendance (ADA). In the period 2001 and 2009 all the school districts together have spent $41.3 billion on new school construction.

There are three funding agencies for monitoring the funds for the schools, namely the Instructional Facilities Allotment (IFA), the Existing Debt Allotment (EDA), and the New Instructional Facilities Allotment (NIFA). The IFA was formed in 1997 to help repay debt for classrooms, libraries, and other instructional facilities. In 1999, the Texas Legislature created the Existing Debt Allotment (EDA) to provide assistance for debt; allotment is distributed automatically to every school district with eligible outstanding bonded debt. The equalized distribution formula is based on tax effort, property values, and number of students. The New Instructional Facilities Allotment (NIFA) provides reimbursement of up to $250 per student in average daily attendance in the first year of operation of a new campus, plus up to $250 for each additional student in the second year of operation (Combs, 2012).

Texas allocates the funds to the district mainly through the Foundation School Program. The funds in the program contain the proceeds from revenue from land sales, lease on offshore oil lands and other mineral holdings. According to the Texas Tax Payer Research Association (2012) about $7.5 billion in state education funds came from the available school funds from the proceeds of lottery, recaptured property taxes, natural gases, franchises, tobacco and sale of used cars. Thus Texas funding diverts all the above mentioned revenues to the construction and towards the instructional needs of the Texas school students.

The funds distributed among the school districts are based on the state and local revenue which includes property taxes. Property taxes are different for every region resulting in disparities in spending on the education system between school districts, even districts that abut each other. Some districts have high commercial property taxes gathering more funds for school spending, whereas the other districts have low taxes rates due to the less expensive commercial property taxes, gathering fewer funds for school spending. This imbalance results in rich and the poor school districts. Over the years, the poor school districts struggled to keep up with the minimal requirements for the education program, whereas the rich school districts built more facilities with attractive classrooms and hired better qualified teachers.

In order to minimize the disparities prevailing in the Education Funding System the State of Texas enacted the Legislation Act of 1993 which was nicknamed the Robin Hood Plan or Texas Education Code: Chapter 41 Wealth Equalization(Texas Education Agency, 1993) This act is similar to the Legend of Robin Hood who "Robbed from the rich and gave it to the poor", this law recaptured the property taxes revenue from the property-wealthy school districts and distributed those in the property poor districts in an effort to equalize the financing for all the schools district throughout the state of Texas. Figure 3 shows the School District Expenditure per pupil in the State of Texas

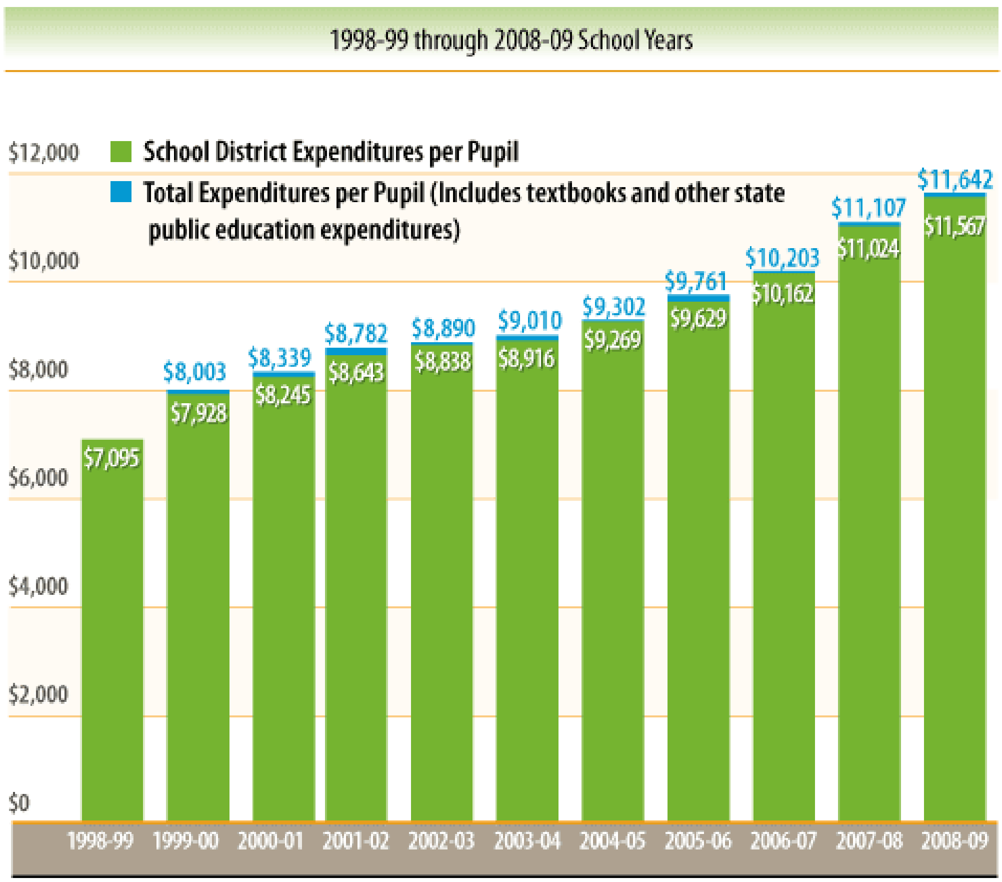


Figure 3 School District Expenditure per Pupil (Combs, 2012)

The cost of education per student to meet the state standard according to the Supreme Court (1993) is $3,500 per student. The adjusted current value estimated per student after adding the inflation is $6,576, and according to the FAST Report 2011, the current district revenue per student is $5,060. Only 223 districts out of 1,024 can meet the current district revenue cost requirements.

DELIVERY SYSTEMS

Introduction

The Design Bid Build delivery system was the only system used for the construction of public schools until 1995, when the Texas Legislature passed the Senate Bill allowing the use of alternate delivery project systems for the construction of public schools and higher education institutions. The bill did not do away with the design- bid-build method; rather, it listed the method under the 6 different alternative delivery systems available as competitive bidding. The alternative delivery methods available are:

1. Design Bid Build
2. Design Build
3. Bridging
4. Construction Manager at Risk
5. Construction Manager- Agent
6. Competitive Sealed Proposal

Design Bid Build

This is the oldest and still used delivery system in public construction. The system allows for the contract to be awarded without any political pressure. This system has three phases: design, bid, and build. The school district hires a designer to create detailed drawings and specifications as per state and local requirements. Then the buyer selects a builder through RFP based on the design documents prepared by the designer. This is a system where 100% of the design documents for the project are completed before the construction and eliminates all the risks associated with the design phase except for the mistakes in the documents, unknown factors on site, climate changes and weather. Figure 3 shows this contract system (Matheny, 2005)

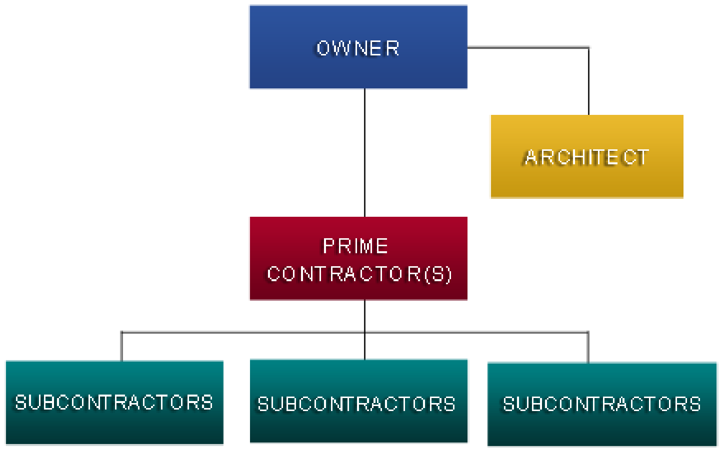


Figure 4 Design Bid Build or Traditional Hard Bid System (A. N. Reinisch, 2011)

The main issue with this delivery system is the long schedules and the economic limit to criteria as noted by Feigenbaum (2011). Sometimes owners try to overcome this problem by pre-qualifying the bidders. This technique assures the owners that the selected bidder has the ability to perform the work as per requirements.

School design and construction is a specialized business requiring a high skill level and a need to meet tight deadlines and fixed budgets. There are two significant issues observed in this type of construction.

Issue one is School Districts relying heavily on one group or small set of related groups to undertake work. It is the syndrome of "Better the dog I know". A way around the problem is prequalification of bidders. If bidders are qualified to undertake the work, then the only remaining issue is price. A fair competition of price between five firms provides a reasonable competition and ensures that prices are likely to be fair.

Issue two is scope creep. The school work expands to fit the available budget. So taking together these two issues identify the very real problem of meeting the objectives of Texas Constitution to provide, a public education to all (State of Texas, 2011). The results observed from this research point to current form of Texas system. There are arguments on both sides of the system that are beyond the scope of this work.

Design Build System

Design-build is an integrated approach that delivers design and construction services under one contract with a single point of responsibility. According to a study, more than 40% of the non-residential construction utilizes this system and 30% of the school projects are built by this delivery system (Design Build Institute of America, 2013). Figure 5 shows the various construction industries utilizing the design build delivery method.

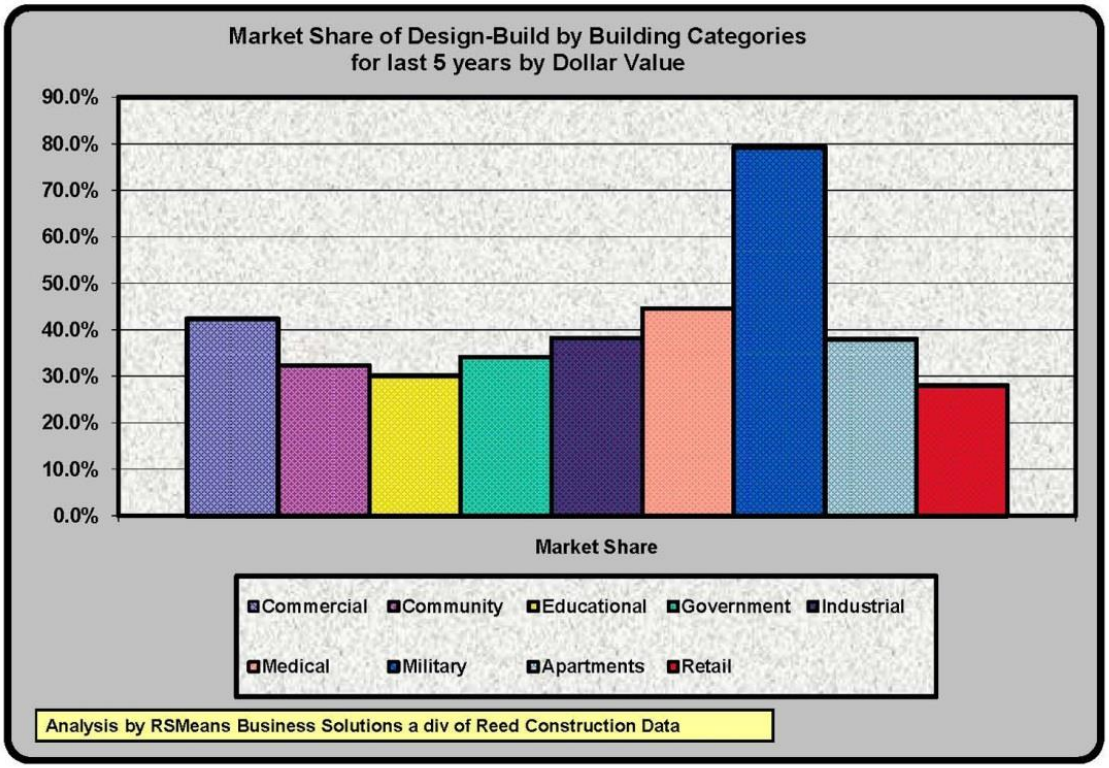


Figure 5 Market Share of Design Build Projects in Past 5 Years (Design Build *Institute of America, 2013*)

The design build system typically overlaps the design and construction phase and, more importantly, has a single contract system where the owner gets into contract with a design builder. The design builder can either: have an in house designer, work with a company, or subcontract the design depending on the requirement. This makes it very easy for the owner to handle a single contract project and avoid all the hassles of managing multi-party contracts. The selection method for this delivery system is based on qualification and cost. The designer and builder are both involved in the design phase of the project to make it more economical. The contract type is either a guaranteed maximum price (GMP) with contingencies or a lump sum. The GMP is a contract with the owner that states the cost of the project will not be higher than the specified price (A. Reinisch, & Caguioa, C, 2010). Figure 6 shows the stages in the design build system.

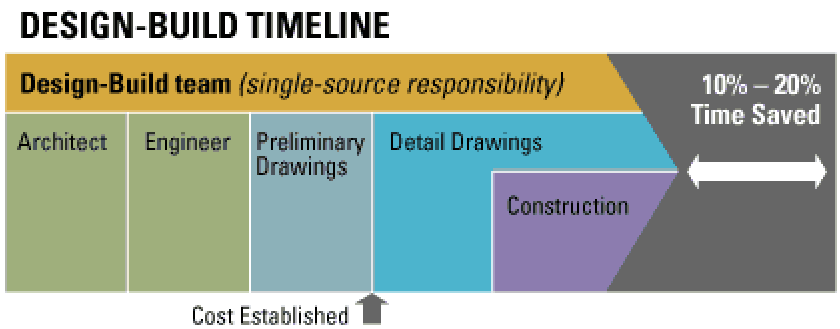


Figure 6 Design Build Timeline (A. N. Reinisch, 2011)

The issue with Design Build is the pressure on the contractor for profit. This profit squeeze can affect the quality of the work. There is limited resource to solve this problem once the contract is amended. This contract form required an element of trust in the builder that is not necessary in the hard bid contracts.

Bridging Method

This type of delivery system is a combination of design build and design-bid-build with an additional step where the owner hires a bridging designer to do the programming for the project. The programming is used as a document for the selection of the design builder. It is a 6 step process which includes: schematic drawings, design and RFP documents, a bid negotiation phase, construction documents, a second step award and a construction phase. The major difference between these systems compared to other Project Delivery Systems (PDS's) is how and when the cost is established (A. N. Reinisch, 2011). Figure 7 shows the Bridging Method.

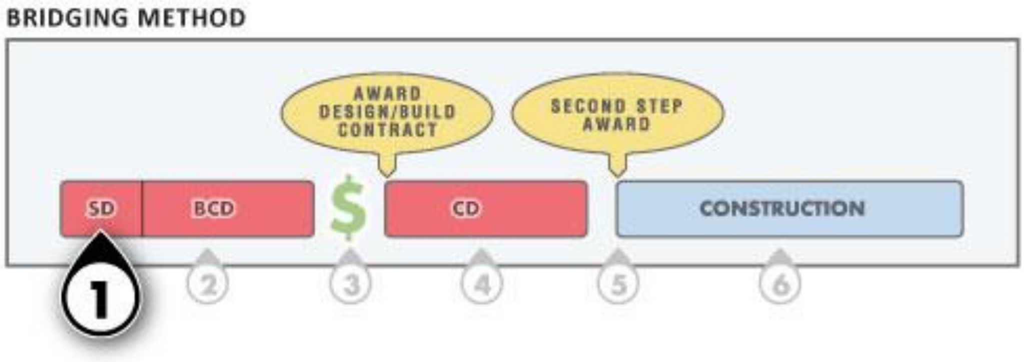


Figure 7 Bridging Method (A. N. Reinisch, 2011)

In the first phase the owner hires a design consultant to put together the schematic drawings. The second phase consists of creating bridging documents and a lump sum price for the project by the designer. In the third phase the owner fixes a lump sum cost. This is the only system where the owner is able to decide the cost at an early stage which is not possible in any other delivery methods. If the owner agrees to the cost offered by the design builder the project moves to the fourth stage where the team prepares the final contractual documents. In the fifth phase, the construction phase, the owner can choose to work with the selected team or hire a new subcontractor to complete the project as similar to CMR (Matheny, 2005)

Construction Management Agency

This system is not a delivery method; rather, it is a Construction Management agency used by the owner, who does not have knowledge of construction, and is also used to manage multiple projects. This system consists of an owner hiring an agency to act as a consultant for the pre-construction phase and as a construction manager for the construction phase (Grasmick, 2009). This process has been successfully used by Lend

Lease to manage shopping centres' development in Australia, but within a tight vertically integrated management structure (A. N. Reinisch, 2011). One view is that the CMR is a technical variant of the CMA.

Construction Manager at Risk

This system is most commonly used in the construction industry today as it offers the owner flexibility and open book records of the contractor. In this system, the contractor works with the designer in the design phase to plan the project within the given budget. Once the design documents are ready, the owner can choose to continue with the contractor based on design and budget or terminate the contract and hire another subcontractor to complete the project. If the owner decides to continue with the CM, the reimbursement type chosen is GMP. In this contract type the contractor is at risk, as he has to finish the work on a guaranteed price and the open book record keeps the contractors from being unethical (Reinisch & Caguioa, 2010). Figure 8 below shows the CM at risk timeline and the system.

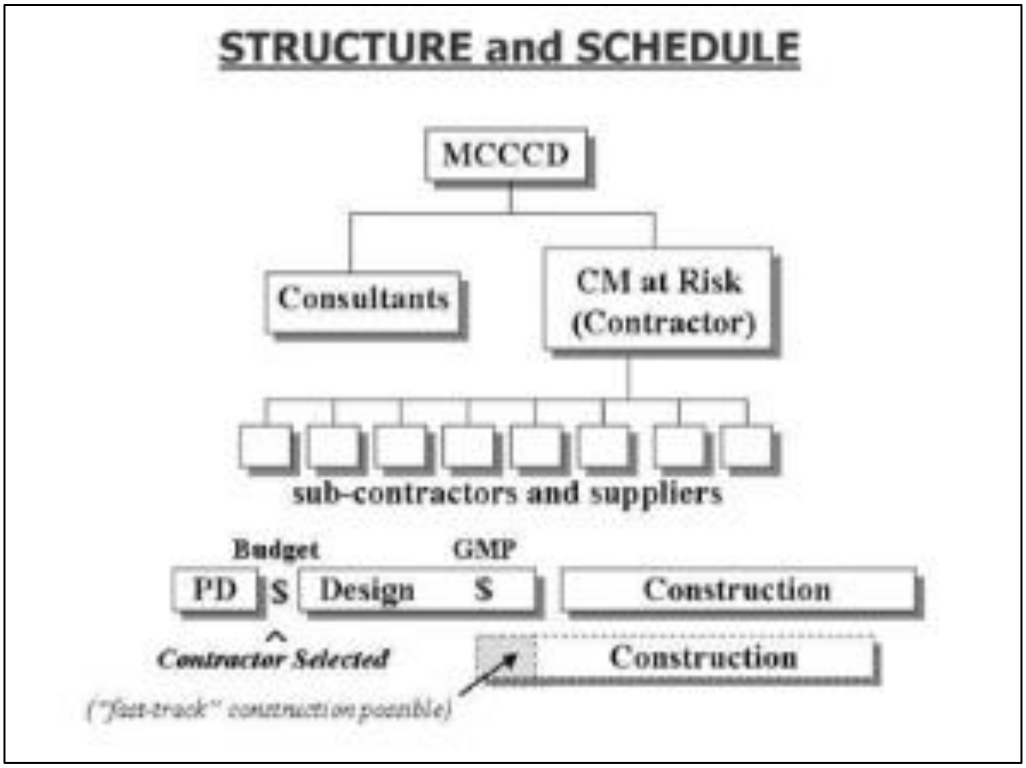


Figure 8 Construction Manager at Risk (A. N. Reinisch, 2011)

This system is interesting as it has the benefits of a single team, which should all things being equal yield a good result. However, Reinisch (2011) shows that this system yields higher costs per student than hard bid contracts. There are two issues here

- Scope creep – the school districts are spending available funds and so the ISD spends the available funds or puts in objects into the contract,
- Limited competition: Using here a form of sub-contractor selection that has a low participation rate.

One measure of competition is the Herfindahl Index. This index measures the relative weights and interests of the competition in a market. An independent set of four to five companies provides an accepted level of competition. It is difficult to see how this is achieved in CMR contracts.

Competitive Sealed Proposal

This delivery method is similar to the design-bid- build system except that the selection of the contractor is done on the basis of qualification and his past experience. The selection criteria are: qualification, price and project duration. The selection is done on the basis of the score made by the bidders. The owner using this system has to be very careful because when the bidder bids over the budget then the owner runs the risk of re-bidding the project with the same scope (Grasmick, 2009). The owner should also have a complete set of drawings and specifications for the project in order to get a fixed cost. Mowery's work (1983) clearly shows that for some projects the level of control provided by intra-firm management is preferable to contractual management.

Texas has a population in excess of 20 million and it is a mature market with a saved construction industry. Clearly the imperative need is to obtain value for money in the construction of school buildings. If Reinisch (2011) is correct then building works are not as cost effective as could be achieved.

It is beyond the scope of work of this research to consider this matter fully, but it is suggested that

- Consideration to be given to establishing a state registration for school construction firms.
- Establish a database of all school contractual and cost documents for use in research of construction costs.

EXISTING STUDIES

There have been studies attempting to understand the funding pattern for the public elementary schools and the delivery systems used for the construction of the educational facilities. All of this research essentially points at the need of optimising the use of available funds either due to the shortage of funds, economic crisis or diversion of funds to instructional use to accommodate the shortage of teachers.

The research about the elementary schools by (Luke, 2007)at the University of North Texas has aimed to study the inequities in funding the construction of educational facilities using the statistical tests such as: the McLoone Index, the Verstegen Index, the coefficient of variation, and the Federal Range Ratio. A part of that study states that there are differences in the facilities of the rich and the poor school districts of Texas.

The results of this study show that the inequities are due to various reasons like the diversion of funds towards the instructional use due to budget cuts and crisis. The research proposes the following to the Texas State Legislature:

"The prudent course of action for the state of Texas is to determine an equitable facilities funding approach, implement appropriate funding mechanisms, and engage in long-range facility needs assessment and planning for the future" (Luke, 2007).

In order to provide an effective public school system for the state's children, the development of equitable facilities funding mechanisms is critical.

The statistical data obtained from McGraw- Hill (2011) and the US Census Bureau (2011b) related to construction and the economic downturn that occurred in the last decade helps in analyzing the construction cost of the educational facilities in the state of Texas.

The study was first initiated by Konchar and others who wanted to compare the three main delivery systems, the Design-Bid- Build, Design-Build and the Construction Manager at Risk, used in construction and develop performance criteria (Konchar & Sanvido, 1998). These criteria focused only on commercial projects. There were several other studies which focused on the decision making criteria for selecting the best delivery method. Some of these studies are by Mahdi who utilized the Analytical Hierarchy Process (AHP) used to define a set of factors and assist in decision making for the project delivery method (Mahdi, Riley, Fereig, & Alex, 2002) . Oyetunji and Anderson (2006) created a weighted matrix with 20 criteria for selecting the best project delivery method using cost and time as the main factors. Reinisch and Caguioa (2010) also noted that there are several methods for choosing what authorities consider as the most appropriate delivery method.

The Texas education system acts as a wall between the distinct independent school districts, which makes it difficult to understand the problems and the real costs involved in different delivery methods. Hence, there is a need for researching more about the construction cost of schools in Texas based on the delivery systems. Chan and Kumaraswamy utilized the Mean Score method of analysis to their study, “An Evaluation of Construction Time Performance in the Building Industry”. They interviewed various contractors in an attempt to find the factors causing the delay in the construction of a building. The studies conducted by (Singh, 2008) and Sethi (2009) formulated the research question about the construction cost of schools and the delivery methods used. Their research focused on the impacts of the delivery system in relation to the time and schedule for the project.

Debella and Ries (2006) conducted a study, which focused on comparing the delivery performance within the school districts; however, their studies were restricted to Ohio, Pennsylvania, New Jersey, Massachusetts and Virginia. The study consisted of both qualitative and quantitative analyses. Quantitative analysis included cost related variables such as schedule and litigation, and the qualitative analysis included variables such as the punch list, start up, callbacks, administrative burden, team communication, etc. The results from their study were "…projects are the building blocks that help organization achieve goals and objectives that support their mission and vision…" the observation made by Debella and Ries (2006), they also concluded that the three most important elements or factors governing the completion of a project are: schedule, cost and technical performance.

Reinisch (2011) studied the various delivery methods and the cost impact on the construction cost due to the delivery methods. The study used survey to determine the delivery method used for the construction of the facility in the independent school districts of Texas. The results were analyzed using comparative means tests to determine the more optimum delivery method of the two, and the result from the study proved that the Competitive Sealed Proposal (CSP) delivery method of construction is $4000 dollars cheaper than the CM at Risk method of delivery system.

Wunneburger aims to study the school funding inequalities in order to find the impact of this inequality on the construction of the education facilities. According to this studies “An efficient public schools system cannot be funded unequally”(Wunneburger, 2011). Students do not under perform because of a lack of skills, but rather they frequently have been short-changed by the hiring of less qualified teachers. This happens most often in low socioeconomic areas within minority populations (Peske & Haycok, 2006 and Aviles- Reyes, 2007). Thus the study aims to prove the effects of in equal funding system on the quality of education provided. Some of the impacts are: the districts defer the maintenance due to lack of funds, even close schools or sometimes employee less experienced teachers which lowers the standard of education system in the district.

This research builds on the previous research by Reinisch (2011) and aims to find the cost variation per square foot in the construction of education facilities amongst the rich and the poor district of Texas using the compare and contrast method.

PUBLIC SCHOOL CONSTRUCTION IN TEXAS

The non-residential construction spending in the US in 2011 totalled $533 billion dollars of which public sector constitutes $283 billion dollars (Haughey, 2011). The school districts spent about $16.4 billion on construction projects during the year 2009 which included: $12 billion of new school construction (72.9%), $2.1 billion for extension of existing buildings (12.9%) and $2.3 billion (14.2%) on retrofitting and modernization of the existing buildings. From 1979 to 2001, for a period of 23 years, the school districts have spent almost $226 billion dollars on projects, spending less than half on new school construction. The studies show that over a period of 15 years the school construction spending averaged over $18 billion annually with $10.2 billion in new schools, $4.2 billion for expansion and $3.6 billion for retrofitting.

The school districts in the US are divided into 12 regions. Texas, Oklahoma and Arkansas are included in Region 9. According to the report, Region 9 was responsible for 14 per cent of the nation's construction spending accounting for the second highest spending region in the nation. From 2002-2009 the public school construction in Texas was about $41 billion and accounted for 40% of the completed educational facilities in 2009 (Abramson, 2010). Most ISDs have increased the need for construction: caused either by the expanding student population, need for technology, question of safety and accessibility or for the need to upgrade schools. The school boards are often faced with multiple demands for construction dollar (Abramson, 2010). An attempt to lower the class size by the policy makers in order to increase the quality of education has resulted in the increase of school construction in Texas, and has also increased the cost of construction per student by almost 85%.

The Figure 9 below shows the average spending per student in different states from 1995 to 2010. Figure 10 shows the state by state expenditure.

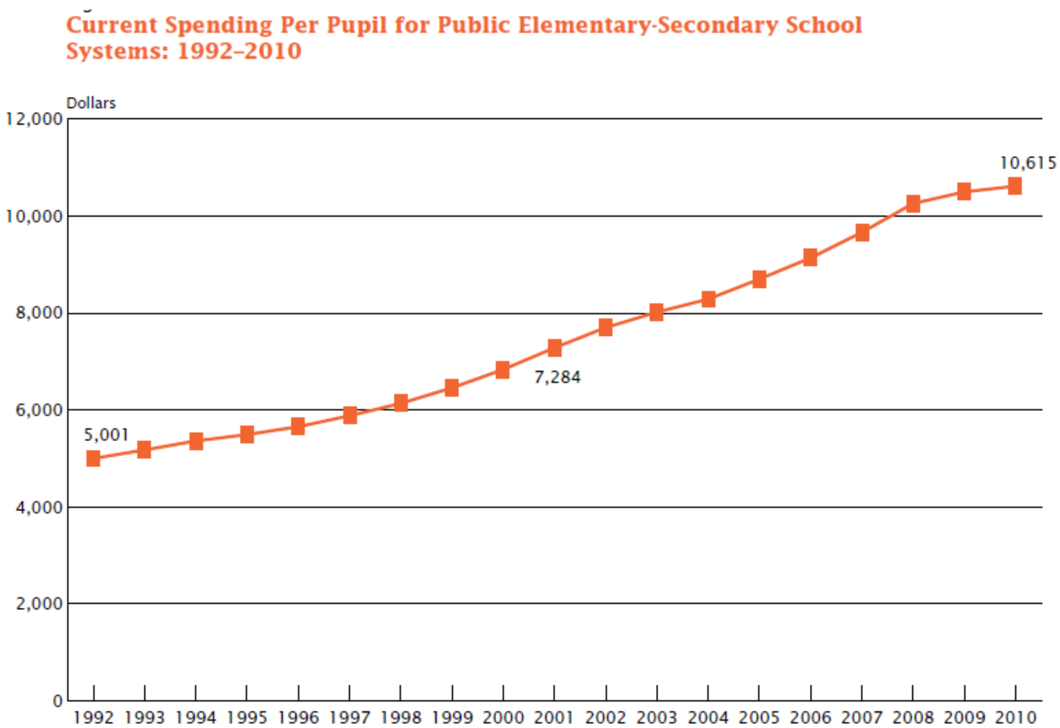


Figure 9 The Current Spending on Public Elementary School per Pupil 1992-2010

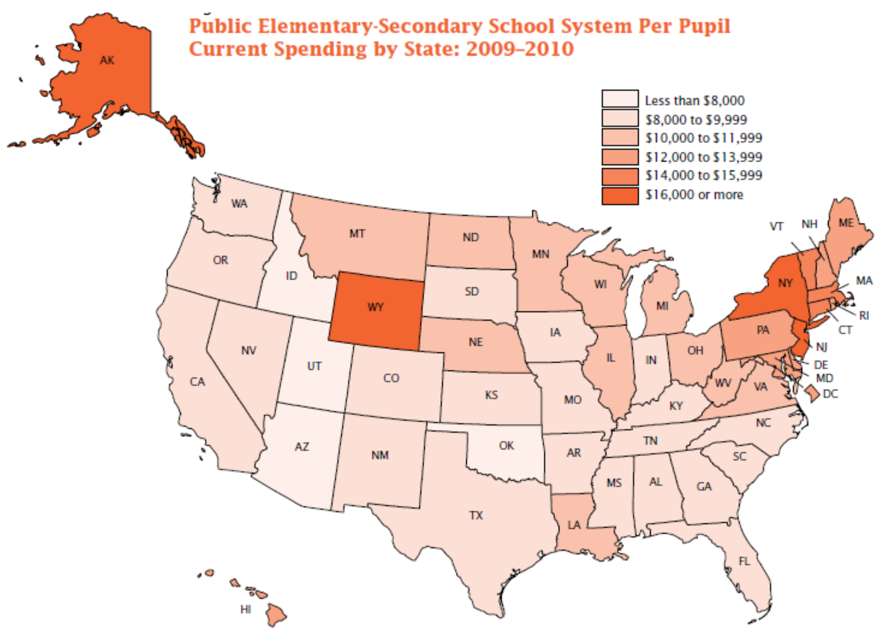


Figure 10 Current Spending per Pupil by State 2009-2010

The population of Texas accounts for 8% of the nation's population and the most school construction dollars spent are in the Texas, Oklahoma, Louisiana and Arkansas region. The national average over the past decade for the construction of public elementary schools rose by 81% from $102 to $185 dollars (Abramson, 2010) . A group of superintendents from the state of Maryland came to a conclusion that "project financing, project procurement and project delivery are interwoven into one another" (Grasmick, 2009). The cost of construction and the whole construction process is affected by the delivery system chosen, hence selecting the design, schedule, and calculating the cost according to the owner's satisfaction is very important to achieve the desired goal (Grasmick, 2009). As previously mentioned there are various delivery methods available for the construction of the public schools. Texas is one of the largest school regions in the country with 7,885 schools that educate more than 4.75 million students (Texas Education Agency, 2010). Hence, it becomes more than important to choose the most optimum delivery method for construction in order to get the best return on investment for the state.

THE US FINANCIAL CRISIS OF 2008

The global financial crisis, which started in 2006, was officially declared a recession by the end of 2007. It was caused by: to sub-prime mortgages, collateralized debt obligations, frozen credit markets and credit default swaps. This financial crisis is easily considered the worst the world has seen since the Great Depression of 1930s.

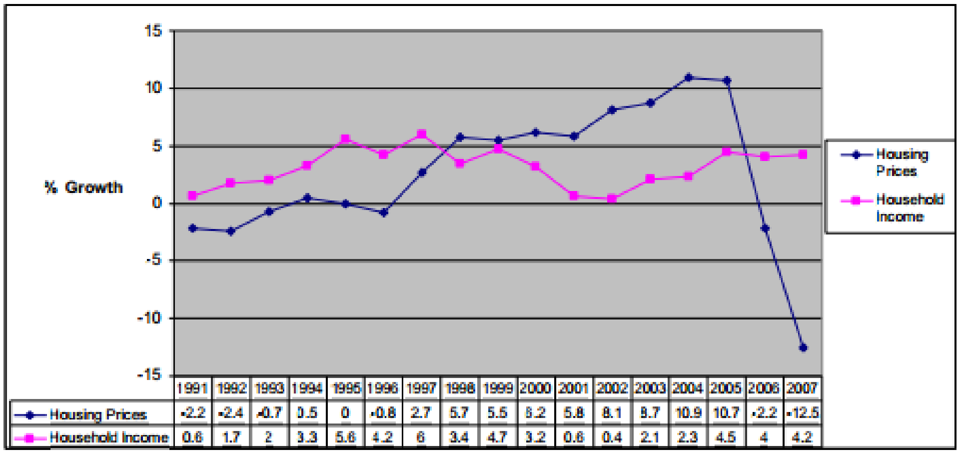
The first sign of serious trouble on Wall Street came in June 2007, when the investment bank Bear Stearns shuttered two of its hedge funds that had lost severely in the mortgage market, damaging the financial institutions across the globe. The root cause of the economic and financial crisis was the United States mortgage market selling sub-prime mortgages to large numbers of consumers with inadequate incomes. These mortgages were in turn bundled into securitized paper investments, and sold by Wall Street to major financial institutions across the globe.

In the United States, the housing market reached its peak in 2006 when there was a serious drift seen in spending in the housing sector over the past decade. During 1997 to 2006, American house prices rose by 124 (The Economist, 2007), and to add to this the interest rate was dropped to low levels by Alan Greenspan the Federal Reserve chairman. Too much foreign money was flowing into the US from the Asian countries, especially China, and the Wall Street institution could borrow cheap money. The low interest rates made it easy for the homeowners to buy big houses which they could hardly afford. The bankers bundled up these loans and sold them as Collateralized Debt Obligations (CDOs) to investors with a high percentage of returns on the unrated CDOs.

During the peak of the market boom the banks were offering construction loans for over 110% of construction costs at times. Consumers cashed in the equity in their homes, taking out a total of $2 trillion via loans, refinancing, and sales. This excessive availability of capital made new construction very attractive for developers while also causing a run up on bids for existing products causing the values to skyrocket (A. N. Reinisch, 2011). The ratio that measures household debt to GDP doubled from 50% in the 1980s to 100% of GDP by the mid-2000s. The last time the level of debt was 100%

of GDP was in 1929, the beginning of the Great Depression. Figure 11 shows the groth of US Housing Prices.

Growth of U.S. Housing Prices versus Household Income, 1991–2007



Source: S&P/Case-Shiller National Home Price Indices; U.S. Census Bureau.

Figure 11 Growth of US Housing Prices Versus Household Income

After the crash, the majority of US homes were worth less than the mortgage people held for them (News 2009).

In 2007, serious rates of foreclosures began and the homeowners defaulted on the mortgage leaving the bank with too many houses on sale creating more supply than demand. This reduced the value of the houses. The homeowners still paying the mortgage realized that they were paying more than the actual value of the house and decided to stop paying the mortgage leaving the bank in huge debts. There was a record twenty percent decrease in the home values for the first time in twelve years since the Great Depression. The biggest shock came to Wall Street in September 2011 when Lehman Brothers investment bank “felled by the weight of about $60 million in toxic bad debts” collapsed signifying the beginning of a global meltdown (Duncan, 2008).

The US Government pumped in $700 billion into the US economy but was not sufficient enough to nullify the effect of the recession in progress. All the financial institutes were in huge debt due to the homeowners defaulting on their mortgages and the banks lacked trust to lend any more money, freezing the credit market throughout the globe. The failure of Lehman brothers started a chain reaction and the London based Hedge funds, dependent on Lehman for day to day financing, found they were unable to do business. This was because UK's Lehman subsidiary accounts were frozen, (A. N. Reinisch, 2011) thus triggering a chain reaction globally. The aftermath of the crisis has almost halted the economy, and even to this day, it is suffering and still recovering from the financial crisis.

TEXAS ECONOMY DURING THE FINANCIAL CRISIS OF 2008

The population of Texas is twelve percent of the entire United States of America in 2009 and 13.8% of US educational spending, being second in the country after Nevada, California and Arizona (U.S. Census Bureau, 2011b). The financial crisis in 2008 was a big shock to the entire America, but the Texas economy was not badly affected and the other regions. The factors attributing to a strong stable economy are numerous.

Texas with Austin as capital has the second largest economy in the nation and the 15^{th} largest in the world based on its GDP. It houses the top 6 of the top 50 fortune 500 list company including Exxon Mobil, ConocoPhillips, AT&T, Valero Energy, Marathon oil and Dell. It also holds the title of largest exporter in the United States accounting for $192.2 billion of exports in 2008 (U.S. Census Bureau, 2011a).

In 2008 during recession when the national average for foreclosure was ten percent Texas had only six percent foreclosure. This gave the economy more liquid cash in hand, which could be used for investment in business generating more revenue and creating jobs, although the issue at this moment is one of the banks sitting on cash (Lahart, 2010).

THE EFFECT OF THE FINANCIAL CRISIS ON THE CONSTRUCTION INDUSTRY

The construction industry remained stable from 2000- 2003 with average spending. In 2004 the dollar spending skyrocketed from 891,000,000 to high a spend level of 1,167,554,000 in 2006 but the spending rapidly decreased in 2009 by 136,000,000 compared to the previous year with a drop of 12.7% (A. N. Reinisch, 2011).

The problem in the construction industry started with the domestic housing market in 2007-2008. Between 2006 and 2008 780,000 jobs disappeared due to the economic crisis (International Labour Organization, 2013), and reports stated that the crisis will result in a reduction of long term US GDP by 2.4 percent , anticipating a reduction in both employment and increased cost of capital resulting from the crisis lasting long in the future.

The economy entered into recession in December 2007 with the increasing oil prices and the tightening of the credit market but was not yet announced until the crisis became very acute. Mid-September 2008 clearly exacerbated the pre-existing economic Slow down turning a mild downturn into a deep recession. The recession was a deep shock to the American confidence in the economy and the ability of the government to deal with the crisis. All the families and the business stopped spending, the firms stopped hiring, freezing the investment projects which resulted in the economic plunge with GDP falling by 5.4 percent and 6.4 percent in the last quarter of 2008. The first quarter of 2009 was the worst six months for economic growth since 1958.Figure 12 below shows the employment rate due to the financial crisis.

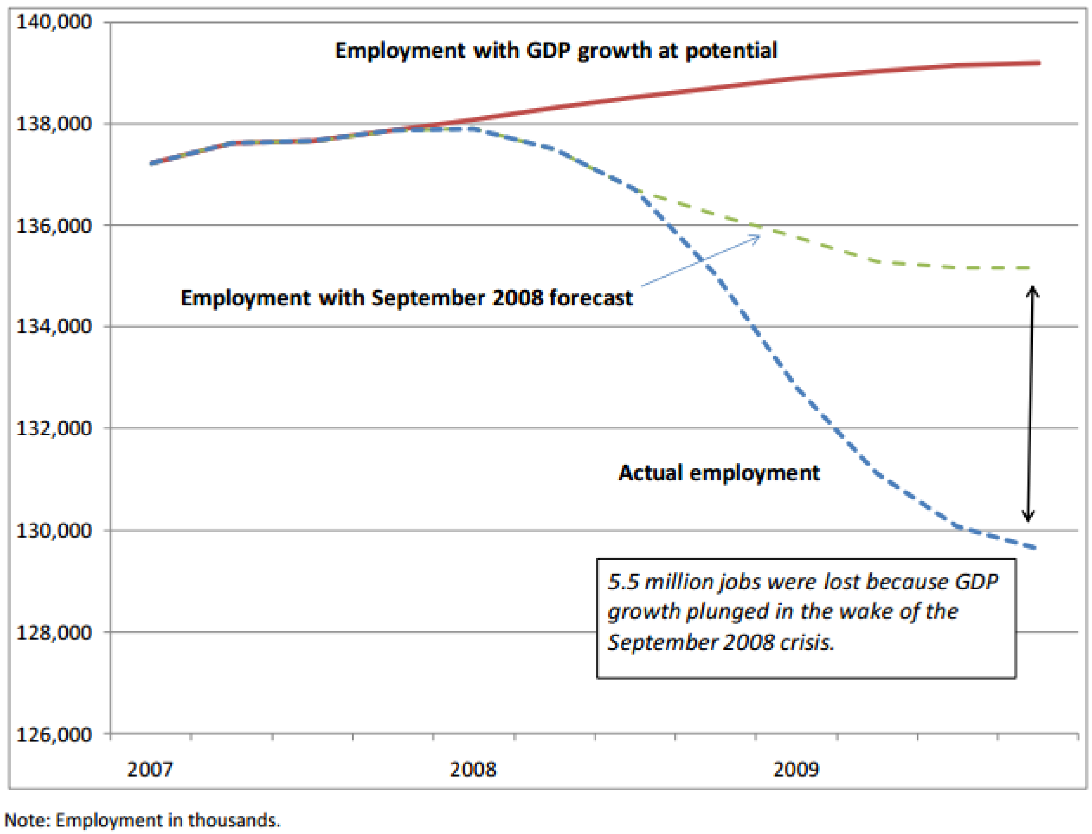


Figure 12 The Employment Rate due to the 2008 Financial Crisis

Economic recovery is now proceeding slowly in to United States. Interest rates are at very low levels, it is possible to refinance homes at four percent interest levels. The negative effect of these low rates is that the effective rate of return on invested capital is very low.

LEGISLATION AFFECTING TEXAS PUBLIC SCHOOL CONSTRUCTION

In 1995, the Texas Legislature passed Bill No 1 which allowed the Independent School Districts (ISDs) to use alternative delivery methods other than DBB which was the only Delivery system allowed by the government for the construction of schools. This allowed the ISDs to choose from different delivery systems available to get the best results. In 1997 the legislature passed bill No 583 which provided definitions and procedures for these new delivery tools (Steck, 2013) it was a dramatic change in the construction method. CMR and CSP are the preferred delivery methods

The Legislature created a new Department of Construction Services (DCS) responsible for school grant applications. The act makes DCS responsible for most of the process while maintaining the education commissioner's responsibility of evaluating the projects for compliance with certain educational requirements and assign priority categories. The act also required reducing reimbursement rates for building a new or replacement school from 10% to 70% of the eligible cost from 20% to 80%, unless a district can justify that the cost of new construction is lesser than renovating or remodelling an existing school. It also requires the DCS Commissioner to set a maximum cost per-square-foot for school construction by county and allows him or her to reject any application for a project that exceeds it.

The legislature established a five-member school building Projects Advisory Council to meet at least quarterly to discuss :school building project matters, develop model blueprints for new projects, conduct studies, research, analyses, and recommend improvements to the school building projects process to the governor and the Appropriations, Education, and Finance committees (**PA 11-51**, effective July 1, 2011).

US CONSTRUCTION EXPENDITURE FROM 2004 TO 2012

Figure 13 below shows the construction expenditure in the US for the period of 8 years from 2004 up to 2012

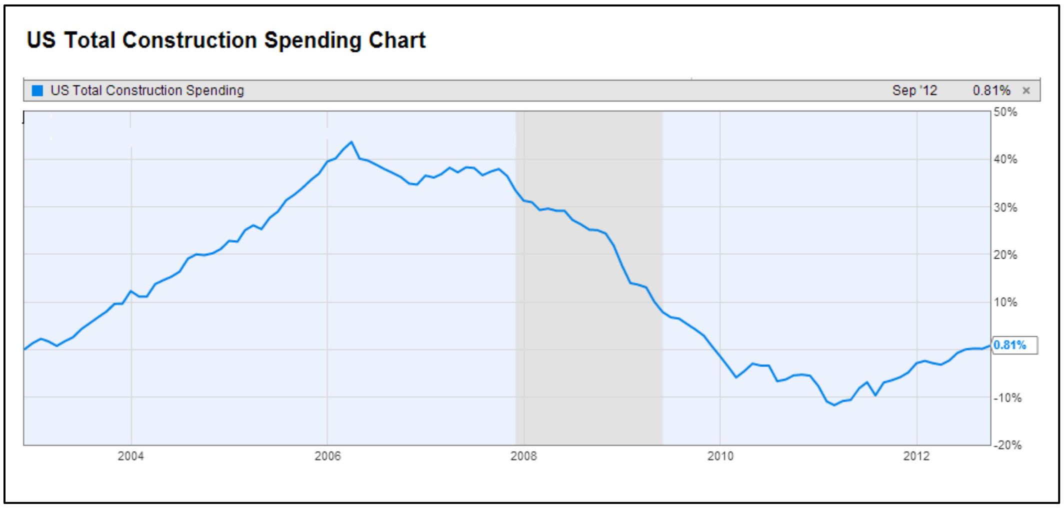


Figure 13 The Construction Expenditure from 2004 to 2012

The construction industry is slowly recovering from the recession in 2008, but for the industry to outgrow the recession it will take time. Previous research claims that it would take several more years for the construction industry to climb out of recession in construction spending and absorb the excess capacity generated in the period 2003 to 2012.

All forecasts point to continued recovery in 2013, as we begin to return to long-term trend levels that are needed to house a growing number of U.S. households.

The Federal Reserve in September said it would spend $40 billion a month to buy mortgage-backed securities to give a boost to home sales in hopes that it will support faster economic growth and stronger gains in the job market (Steck, 2013).

SUMMARY

There have been major changes in the US economy since the 1980's. The steady growth period during the 1990's up until 2006 saw a healthy investment in schools and new construction in Texas. As with all economic market, change is sought by some to increase returns, either by cutting costs or controlling costs. Unfortunately change comes with side effects, often unforeseen and quite significant. Construction Management at Risk appears to have side effects that need to be addressed.

Texas Legislation opened a door to alternative contract forms in the late 1990's. As with all human interactions contracts depend on interpersonal relationships, which can come to dominate the acquaintance process. The metaphor becomes ISD XYZ only uses firm ABC to deliver projects. This is not economically healthy. It discourages competition change. Reinisch clearly showed that alternative delivery systems do not often lower costs, yet serious forces remain that went to continue with CMR contracts probably for some of the following reasons:

- it increases contractor returns, it is noted that no one will suggest a system that lowers returns (Hartford, 2005)
- it allows the ISD to more closely control the contractors and sub-contractors, but that comes at a cost, it can lead to scope creep

Some can control costs.

CHAPTER III

STUDY METHODOLOGY

INTRODUCTION

This study continues on from a number of previous studies into the cost of different delivery systems for Texas Elementary Schools. Texas Elementary Schools were selected by the study team because:

- they form simple common element to construction
- they do not often include elements such as gyms, swimming pools, science room and the like
- they are more numerous than the high schools

Reinisch (2011) showed that the project delivery systems impacted costs per square feet of construction. The question raised then is the cost difference reflected in the construction documents. A review of a significant number of construction documents in Texas for Elementary Schools is difficult because of:

- time involved in record collection
- difficulty in identifying and obtaining the documents
- different construction conditions

The objective of this study is to determine if a comparison could be made between documents and then to compare two sets of documents. The study hypothesis

“No difference in construction standards can be observed between contract documents used for the two delivery systems, Competitive Sealed Proposal and Construction Management at Risk for public elementary schools in Texas”.

The study method was:

- survey ISD in Texas to determine if recent contract documents for Elementary Schools were available for CSP and CMR contract type
- request access to documents if they are available
- travel to each ISD to inspect and record the documents
- compare and contrast the documents to determine the common elements of the documents and the differences
- compare the costs of the two types of contracts

SELECTION OF ELEMENTARY SCHOOLS

The selection of Elementary Schools was limited by:

- the ability to travel to the school sites in a reasonable time
- need to focus on growth area that had a better chance of recent construction
- time available to the ISD to comply with this request, which is time intensive

A letter was sent to 334 ISD superintendents outlining the study objectives, asking for assistance in identifying standard school projects and requesting access to documents. The study sites are maintained as confidential.

DATA COLLECTION

A site visit was made to each of the ISD that agreed to assist in the study, each site visit included:

- meeting with the ISD representatives to discuss the contracts
- a discussion on the contract form and the ISD's preference
- data collection by taking photographs of the school drawings

STUDY ANALYSIS

It is never an easy or straight forward process to compare construction costs for major projects, even for different bids on the same projects. The study analysis will compare the different schools in terms of:

- compare and contrast the local geological conditions to ensure that difference in cost due to geology can be allowed for and understood
- compare and contrast the basic statistics of size, student number and rate per square from the documents and from RS Means (2013)
- compare and contrast the building typology and the structures
- compare and contrast the finish levels and elements provided in each school
- determine if there are real differences between the contract forms

A summary of the findings will be made in the report.

CHAPTER IV

STUDY RESULTS

INTRODUCTION

This chapter summarizes the study results. The stages were:

- school identification
- site visits
- compare each element of the contract document for
    - similar elements
    - dissimilar elements
- complete a statistical analysis of the school data
- review and test the hypothesis

School Identification

As with all site data collection studies there is a limit to the available resources. The first stage in the school identification process was to identify the regions of Texas with high growth rates, which means an area with a likely candidate for recent school construction. 334 out of 1024 ISD superintendent were shortlisted. An email was sent to the targeted ISD, as shown in Appendix A to Appendix B. The data collected was in accordance with the IRB approval obtained or the research. IRB approval document as presented in Appendix C. Four School Districts responded to the request for access to documents on recent school construction. Two school districts agreed to provide access to the contract documents. Table 2 summarizes the details for the two schools include in the study. No identifying information was provided as required by IRB approval.

Table 2 Data Summary for Two Schools

School	Contract type	Location
A	Competitive Sealed Proposal	Southwest part of State
B	Construction Manager at Risk	Northeast part of State

Each of the contract form is available for the study. The critical issue is that a valid statistical comparison is difficult with only two results. Interestingly, each of the study team was passionate about their preferred contract type. The key elements to the discussions on the form of contracts were:

- cost
- control level

Table 3 summarizes the bids of cost details for School A. The range of bids is 0.65 million in a bid average of 11.45 million or 5.6%, which is an acceptable range of bids.

Table 3 School A-Cost Data

Component	Bid $Million
Bid 1	11.85
Bid 2	11.34
Bid 3	11.20
Average Bid	11.45

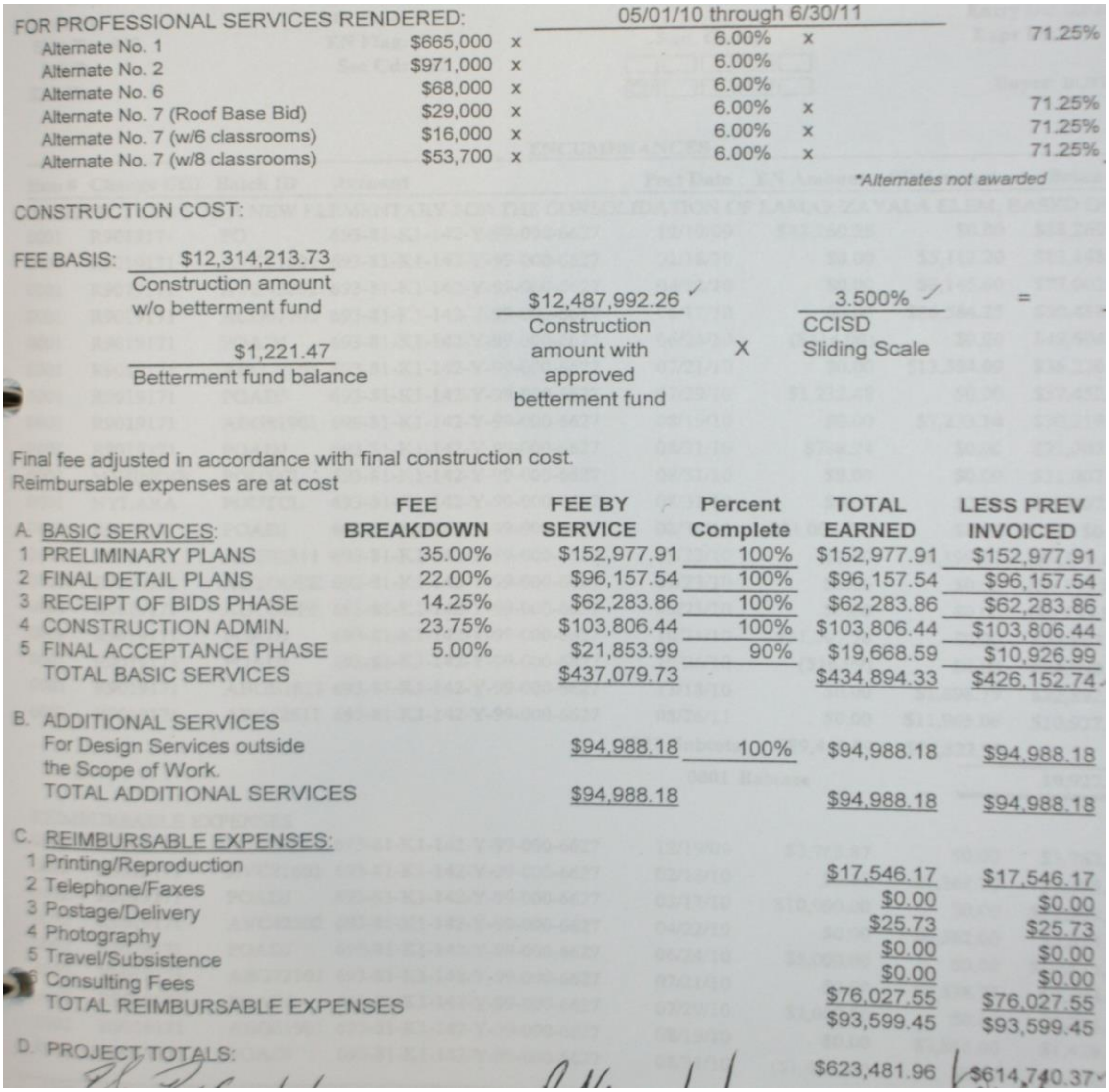
Table 4 lists the ancillary costs and student data for School A.

Table 4 School A Data

Component	Number
Architects Fee	3.5%
Architects Fee	$388.675
Professional Services	$623482
Student Population	$900
Cost per student for School	$12,444
Cost per student for professional services	$ 692

Reinisch (2011) found that the average cost per student for CSP in period up to 2011 was $ 14,500. School A has that cost 86% of the average for CSP school construction in Texas year 2000 to 2011, allowing for the professional fees to rise to 90%. The recent drop in construction activity for Texas due to the 2008 recession had clearly impacted the construction costs. School A clearly lies with the set identified by Reinisch (2011) for CSP.

Figure 14 shows a summary of the professional fee for School A



FOR PROFESSIONAL SERVICES RENDERED: 05/01/10 through 6/30/11

Alternate No. 1	$665,000	x	6.00%	x		71.25%
Alternate No. 2	$971,000	x	6.00%			
Alternate No. 6	$68,000	x	6.00%			
Alternate No. 7 (Roof Base Bid)	$29,000	x	6.00%	x		71.25%
Alternate No. 7 (w/6 classrooms)	$16,000	x	6.00%	x		71.25%
Alternate No. 7 (w/8 classrooms)	$53,700	x	6.00%	x		71.25%

*Alternates not awarded

CONSTRUCTION COST:

FEE BASIS: $12,314,213.73 Construction amount w/o betterment fund

$1,221.47 Betterment fund balance

$12,487,992.26 ✓ Construction amount with approved betterment fund X 3.500% ✓ CCISD Sliding Scale =

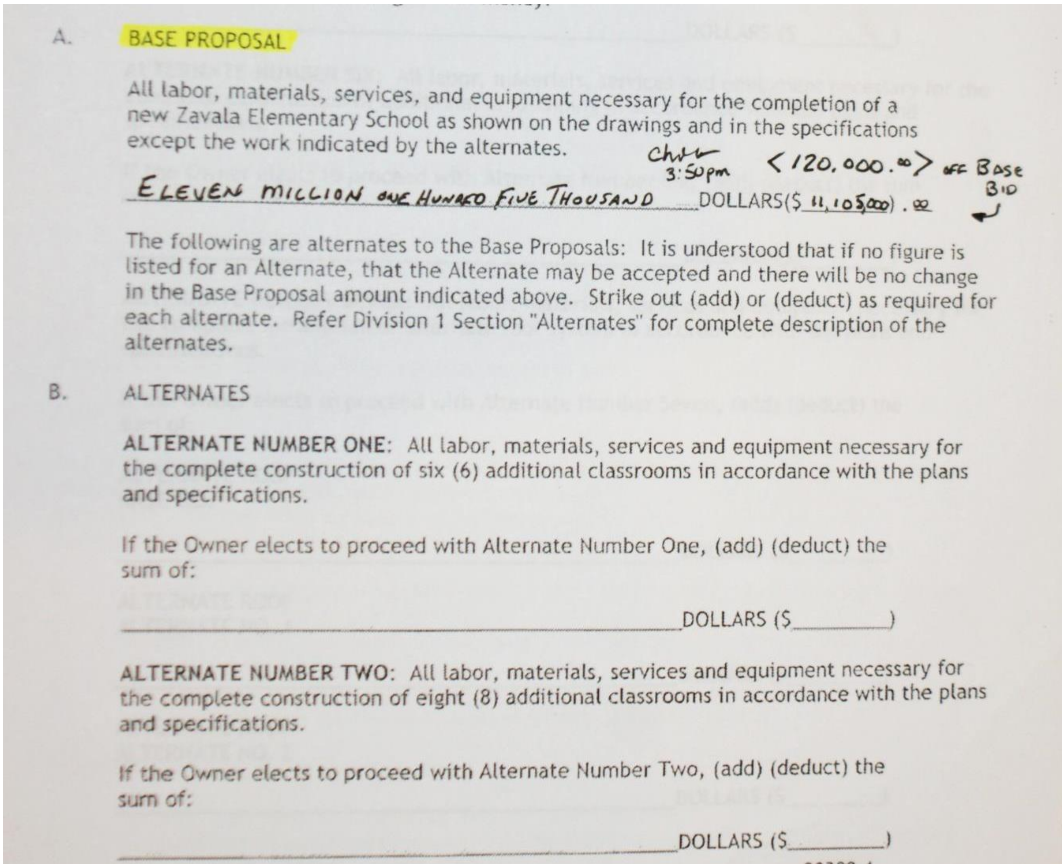
Final fee adjusted in accordance with final construction cost.
Reimbursable expenses are at cost

	FEE BREAKDOWN	FEE BY SERVICE	Percent Complete	TOTAL EARNED	LESS PREV INVOICED
A. BASIC SERVICES:					
1 PRELIMINARY PLANS	35.00%	$152,977.91	100%	$152,977.91	$152,977.91
2 FINAL DETAIL PLANS	22.00%	$96,157.54	100%	$96,157.54	$96,157.54
3 RECEIPT OF BIDS PHASE	14.25%	$62,283.86	100%	$62,283.86	$62,283.86
4 CONSTRUCTION ADMIN.	23.75%	$103,806.44	100%	$103,806.44	$103,806.44
5 FINAL ACCEPTANCE PHASE	5.00%	$21,853.99	90%	$19,668.59	$10,926.99
TOTAL BASIC SERVICES		$437,079.73		$434,894.33	$426,152.74
B. ADDITIONAL SERVICES					
For Design Services outside the Scope of Work.		$94,988.18	100%	$94,988.18	$94,988.18
TOTAL ADDITIONAL SERVICES		$94,988.18		$94,988.18	$94,988.18
C. REIMBURSABLE EXPENSES:					
1 Printing/Reproduction				$17,546.17	$17,546.17
2 Telephone/Faxes				$0.00	$0.00
3 Postage/Delivery				$25.73	$25.73
4 Photography				$0.00	$0.00
5 Travel/Subsistence				$0.00	$0.00
6 Consulting Fees				$76,027.55	$76,027.55
TOTAL REIMBURSABLE EXPENSES				$93,599.45	$93,599.45
D. PROJECT TOTALS:				$623,481.96	$614,740.37

Figure 14 Project Professional Budget

The professional project budget at 5.56% of the school's construction cost is in line with normal professional fee expectations. It is evident that the school construction was economic.

Figure 15 shows the bid obtained from the lowest bidder.



A. BASE PROPOSAL

All labor, materials, services, and equipment necessary for the completion of a new Zavala Elementary School as shown on the drawings and in the specifications except the work indicated by the alternates.

ELEVEN MILLION ONE HUNDRED FIVE THOUSAND DOLLARS($ 11,105,000).00

<120,000.00> off Base Bid

The following are alternates to the Base Proposals: It is understood that if no figure is listed for an Alternate, that the Alternate may be accepted and there will be no change in the Base Proposal amount indicated above. Strike out (add) or (deduct) as required for each alternate. Refer Division 1 Section "Alternates" for complete description of the alternates.

B. ALTERNATES

ALTERNATE NUMBER ONE: All labor, materials, services and equipment necessary for the complete construction of six (6) additional classrooms in accordance with the plans and specifications.

If the Owner elects to proceed with Alternate Number One, (add) (deduct) the sum of:

__________ DOLLARS ($__________)

ALTERNATE NUMBER TWO: All labor, materials, services and equipment necessary for the complete construction of eight (8) additional classrooms in accordance with the plans and specifications.

If the Owner elects to proceed with Alternate Number Two, (add) (deduct) the sum of:

__________ DOLLARS ($__________)

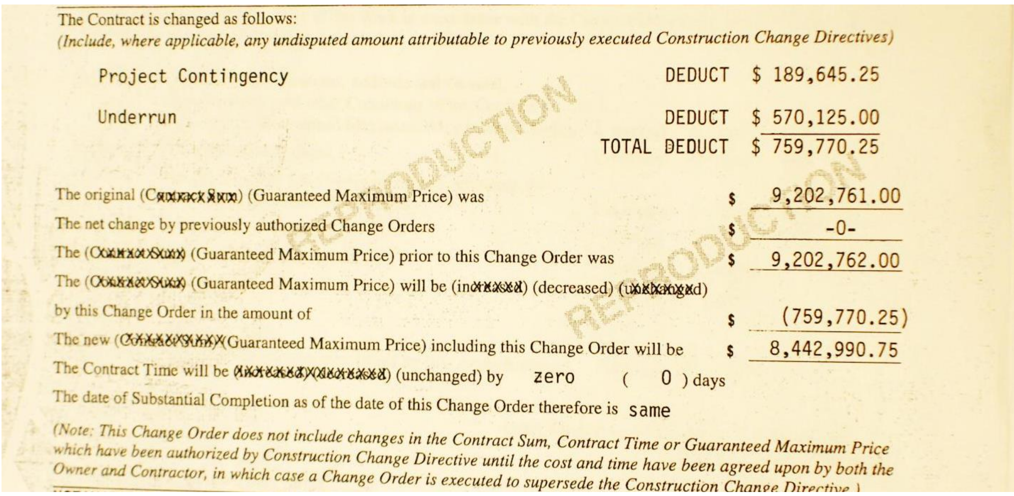
Figure 15 School A- Lowest Bid

Table 5 summarizes the school cost data for School B. School B constitutes of two buildings termed B1, which consists of Pre-K to grade 2 and B2, which consists of Grade 3 to 5. Building B1 houses 400 students and B2 houses 250 students.

Table 5 School Cost Data for School B

Component	Number
Bid cost	$9.2 million
Number of student	700
Cost per student	$13,142

As required by the state law the school was designed by an Architect. Figure 16 sets out the guaranteed maximum price for the school at $9.2 million dollar for $13,142 per student including fees.


The Contract is changed as follows:
(Include, where applicable, any undisputed amount attributable to previously executed Construction Change Directives)

Project Contingency	DEDUCT	$ 189,645.25
Underrun	DEDUCT	$ 570,125.00
	TOTAL DEDUCT	$ 759,770.25

The original (Cxxxxxxxxx) (Guaranteed Maximum Price) was	$	9,202,761.00
The net change by previously authorized Change Orders	$	-0-
The (Cxxxxxxxxxx) (Guaranteed Maximum Price) prior to this Change Order was	$	9,202,762.00
The (Cxxxxxxxxxx) (Guaranteed Maximum Price) will be (inxxxxxx) (decreased) (uxxxxxxxd) by this Change Order in the amount of	$	(759,770.25)
The new (Cxxxxxxxxxx)(Guaranteed Maximum Price) including this Change Order will be	$	8,442,990.75

The Contract Time will be (xxxxxxxxxxxxxxxxx) (unchanged) by zero (0) days
The date of Substantial Completion as of the date of this Change Order therefore is same

(Note: This Change Order does not include changes in the Contract Sum, Contract Time or Guaranteed Maximum Price which have been authorized by Construction Change Directive until the cost and time have been agreed upon by both the Owner and Contractor, in which case a Change Order is executed to supersede the Construction Change Directive.)

Figure 16 Bid Data for School B

Figure 16 also shows the deductibles from the cost to reduce the project contingency amount and the under run yielding $759,770, which reduces the project cost to $8.44 million or $12,601 per student.

Reinisch (2011) found that the average cost per school for CMR was $18,500 per school student. School B cost per student is 65% of this amount. Clearly School B was built as economically as School A, all other things being equal. The next steps are to check for equality of construction.

Risk is the key element in the Construction Manager at Risk contract form. Reinisch (2011) showed that the average difference between a CSP contract for the state of Texas at a CMR $4000 per student on 27.5% of the cost of construction of SCP average schools. This is an expensive method to shift risk.

The contract for School B had a bid amount of $13,142 per student which is consistent with the winning bid for school B allowing for professional fees. The saving achieved according to Fig 16 was $759,000 on the contract sum. Allowing for the recession of 2007 to 2011, it would appear that School B was built requiring a small risk. The two ISD teams have clearly kept a tight control on costs for both school and construction contracts.

COMPARE AND CONTRAST CONSTRUCTION OF THE TWO SCHOOLS

Background

The difference between the two schools may be reflected in difference in construction standards or site conditions. This section of the study compares and contrasts construction for the two schools. The key differences to be examined are:

- Geological conditions
- Classroom standards
- Site works
- School Demolition
- Foundation plans

Geological Background

A difference in geology of the school site can lead to a difference in foundation and hence construction unit costs. Figure 17 shows the geological map for Texas. Figure 18 shows the tables that accompany the explaining the symbols used in the Figure 17.

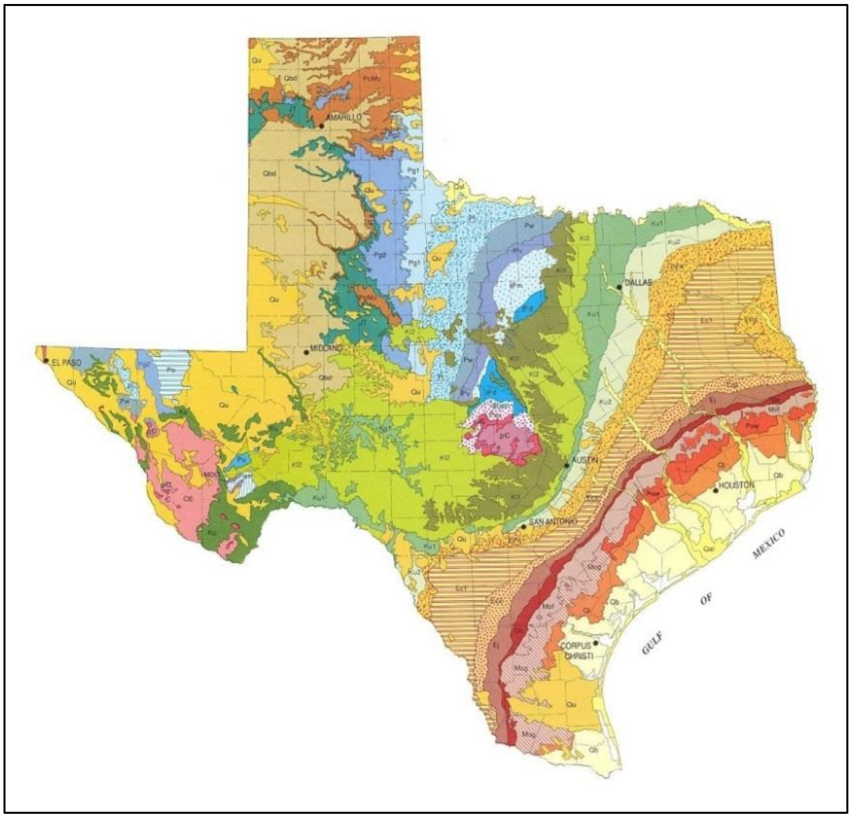


Figure 17 The Geological Map of Texas

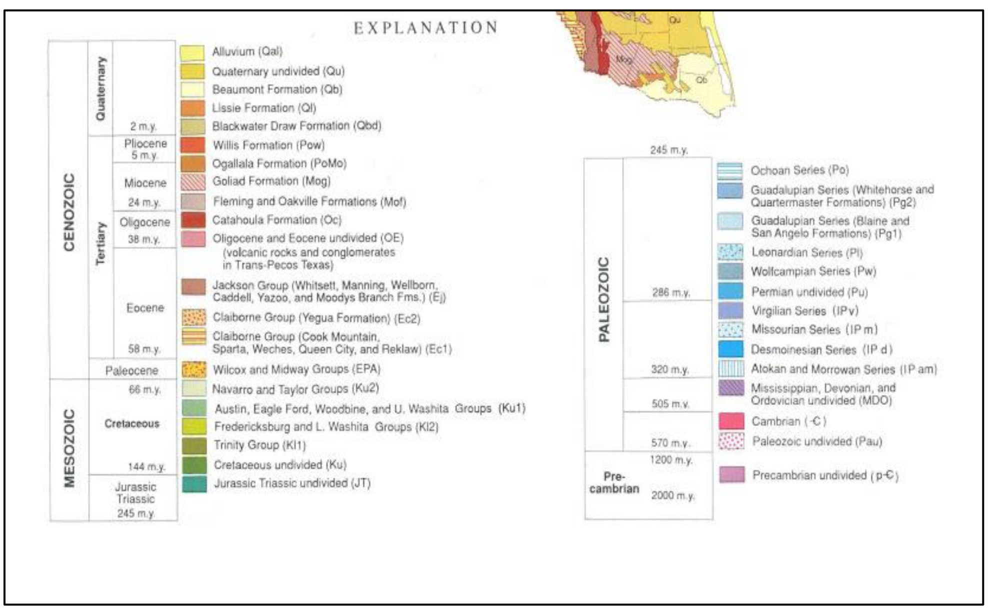


Figure 18 Explanation Sheet for the Geology of Texas

School A Geology

School A comes under the Qb region on Figure 17, which is the Beaumont formation region. This region mainly consists of clay, silt and sand. It also includes stream channel, point bar, natural levee and back-swamp deposit(Bureau of Economic Geography, 2013). These features are:

- the stream channel is a stream of river consisting of bed and stream banks. They exist in different geometries and are controlled by water and sediment movements
- point bar is an area of deposition formed on the inside of a stream bend and is crescent shaped
- natural levee is an elongated embankment composed of sand and silt deposited along the banks of the river during the time of flood
- back-swamp deposit is the floodplain section that lies between the natural levee and the edge of the floodplain region and has silts and clay deposits after a flood. Concretions of calcium carbonate iron oxide, and iron manganese oxides are found in the zone of weathering
- the thickness of the soil in this region is usually around 70 feet

School B Geology

School B comes under the Ec1 region on Figure 18, which is the Weches formation region. This region includes Glauconitic, Glauconitic marl, Quartz sand and clay (Bureau of Economic Geography, 2013). The features of these soils are:

- glauconite belongs to the mica group, green in color, occurs as rounded aggregates and is usually found in greensand used as a fertilizer
- glauconitic marl- is a calcium carbonate or lime-rich mud which contains variable amounts of clays and silt
- quartz sand and clay, grayish green in color weathers to yellowish brown and reddish brown
- limonitic, bands- which is iron oxide widely occurs in yellowish- brown to black color
- clay-ironstone, marine mega- fossils are also found in abundance
- the thickness of the soil is usually 50-90 feet

Comparison of Geology of Two Schools Regions

The two regions namely Beaumont and Weches formation are mainly composed of sand and clay. The primary soil is sand and the secondary soil is clay, which forms a 70 feet thick soil layer, exhibiting similar properties. Since there is no difference in the soil conditions of the two regions, it is evident that there is not much difference in the foundations of the two schools. It is concluded that geology should not play a significant determinant in the cost differences between schools. If the geology does play a significant cost difference, this difference will be evident in the footing design.

Room Size and Standards for Elementary Schools in Texas by TEA

The Texas Education Agency has established minimum standard dimensions for the classroom size and number of students per class. The number of students in a kindergarten to grade 4 classrooms is limited to 22. Pre-kindergarten–grade 1 classrooms are required to provide 36 square feet per pupil or a classroom of at least 800 square feet. Elementary level grades 2-5 are required to provide 30 square feet per pupil or a classroom of size 700 square feet.

Middle and high school grades 6-12 are required to provide 28 square feet per pupil or a classroom of 700 square feet. Table 1 presents the recommended minimum standards for the square feet needed in a standard science classroom.

Table 6 Classroom Standards by Texas Education Agency

TEA Classroom Standards		
Grade levels	Minimum square feet per room	Square feet per student
Prek–1	800	36
2–5	700	30.
6–12	700.	28.

School A Characteristics comparison with TEA standards

Figure 19 shows the floor plan for School A.

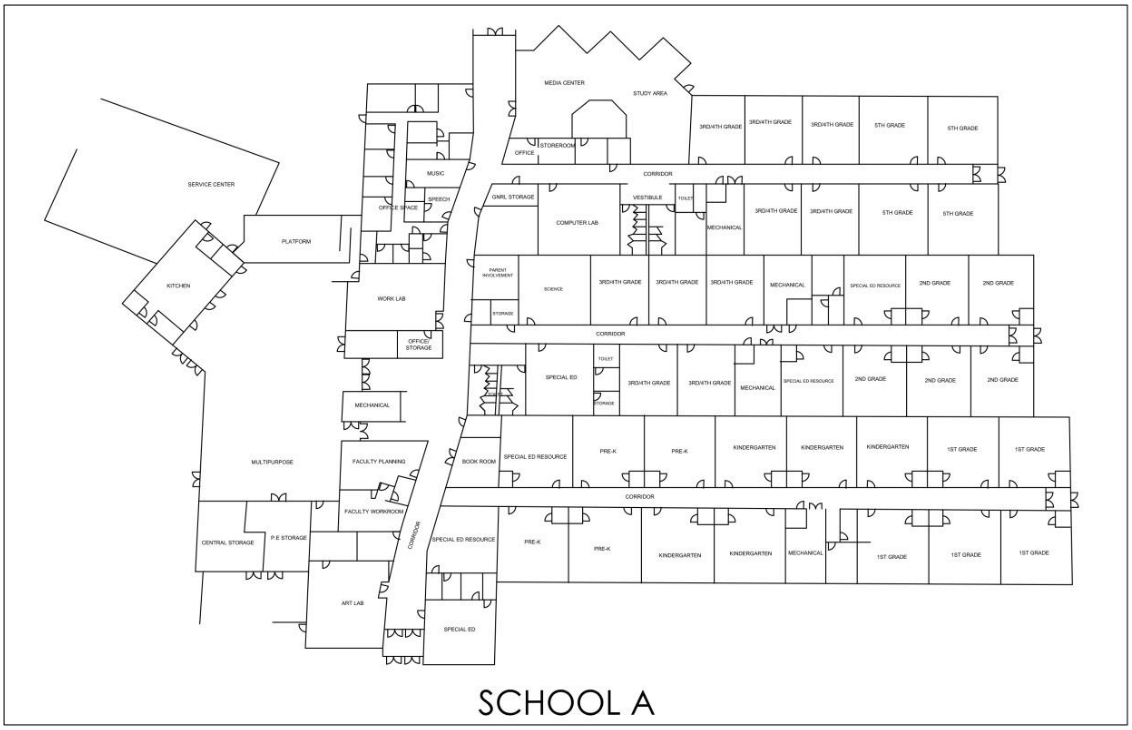


Figure 19 Floor Plan of School A

The size of the classrooms in school A is as follows, the width of the classroom is 26.5 feet and length is 31.4 feet and has an area of 832.1 sq. ft. According to the Texas Education Agency standards given in the table the standard size of a classroom for an elementary school is 800 sq. ft. per class and hence school A meets the standard requirements as per Texas Education Agency standards. Table 7 summarizes the characteristics of School in terms of TEA standards

Table 7 Characteristics of School A

Description	Count
Classroom	38
Computer Lab	1
Music lab	1
Multipurpose room	1
Conference Hall	1
Aministrative Hall	1
Storage Room	1
Staff Room	1
Stage area	1
Playground	1
Bicycle rack	1
Parking lot	2
Speech	1
Testing	1
Nurse room	1

The total area for School A is 85080 sq. ft.

The size of the classroom in school B is as follows, the width of the classroom is 25 feet and the length is 27 feet and has an area of 700 sq. ft. According to the Texas Education Agency standard given in the table the minimum required area of a classroom in an elementary school is 700 sq. ft. per class and school B meet the standard requirements.

School B Characteristics compared to TEA Standards

Figure 20 shows the floor plan of School B

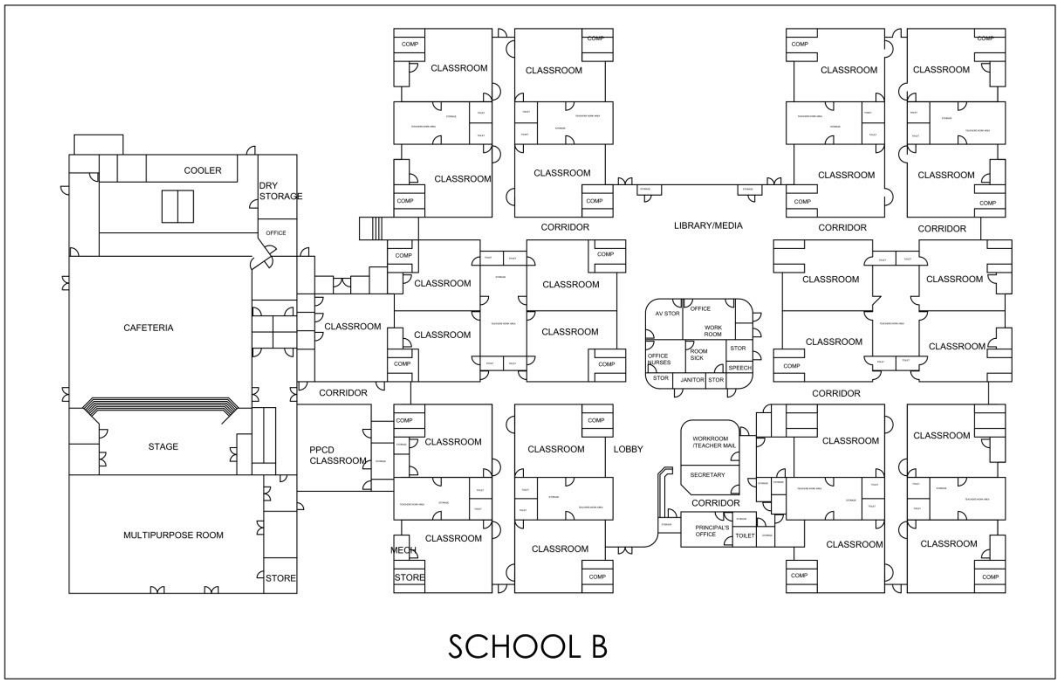


Figure 20 Floor Plan of School B

The characteristics of Building B1 and B2 are shown in table 8.

Table 8 Characteristics of School B

Description	Number
Classroom	25
Library Media	1
Teachers work area/ storage area	8
Cafeteria	1
Multipurpose room	1
Stage	1
Teachers storage/Dinning area	5
Administrative suite	1
Parking lot	2
Kitchen	1
P.E Gym	1

Site Work – School A

Figure 21 shows the site work plan for School A

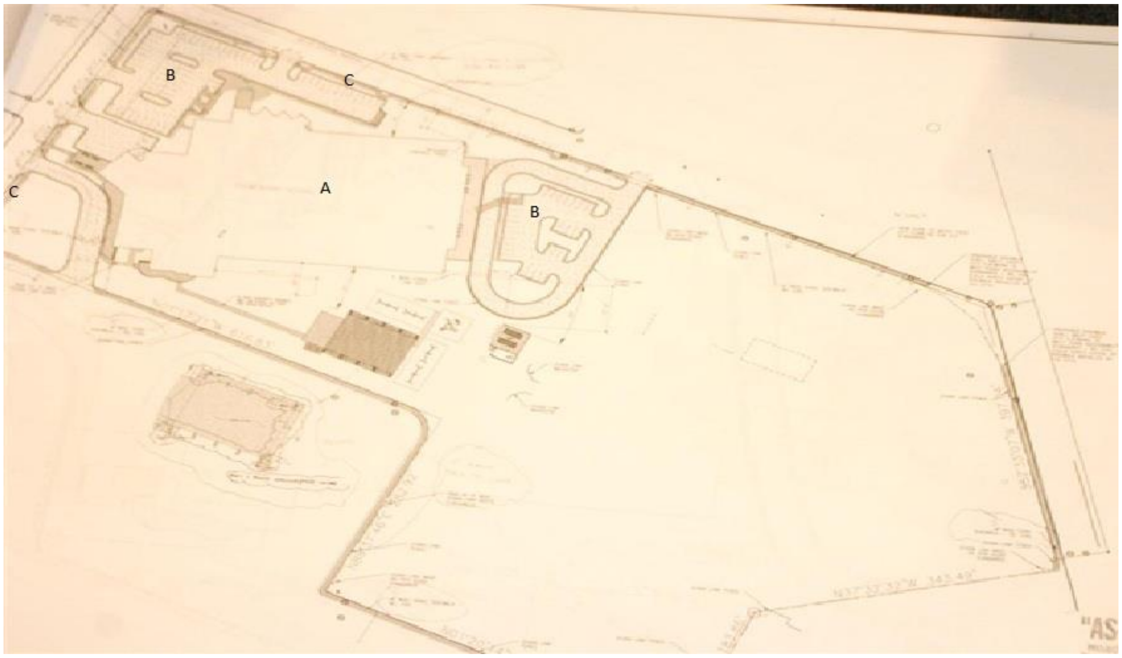


Figure 21 Site Layout Plan of School A

Table 9 summarizes the key elements of the site work

Table 9 Key Elements of Site Work of School A

Component	Symbol	Description	Area sq. ft.
Elementary School	A	900 students	85,080
Parking lot	B	70 spaces	35,232
Concrete Sidewalk	C	Length= 1,389 feet Width=4 feet	8,950

RS Means (2013) provides a tool to determine approximate costs for items B and C in the table 8. The cost for the parking lot is $7 per sq. ft.

The concrete side walk is also constructed at $7 per sq. ft. The total estimated cost for these elements is $309,274 dollars, which is 2.7% of the total contract value.

Site Work –School B

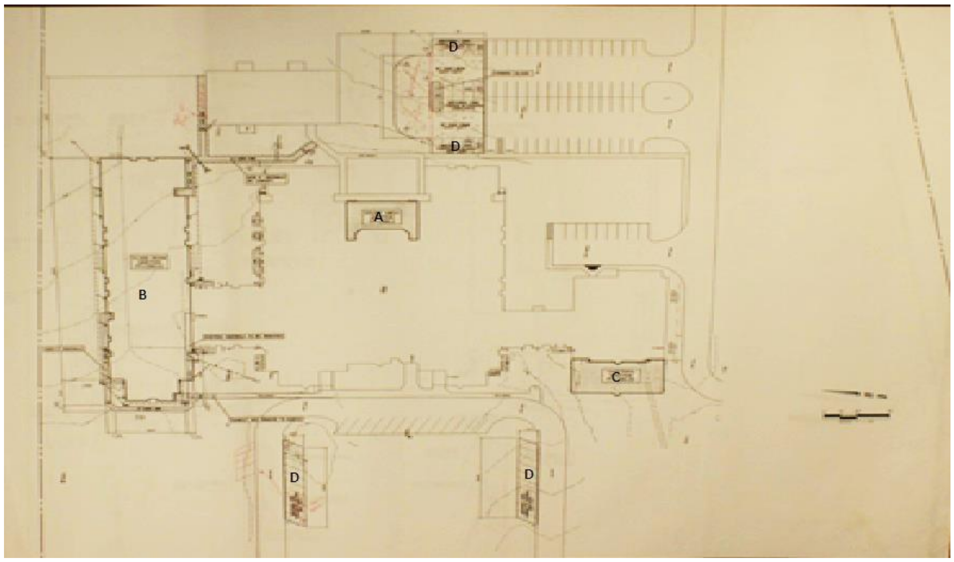


Figure 22 Site Layout Plan of School B1

The school is not a new construction and hence has new additions to the existing plan. Table 10 summarizes the key elements of site work

Table 10 Key Elements of Site Work for School B1

Component	Symbol	Area sq.ft
New study area addition	A	2,310
New classroom addition	B	21,263
New cafeteria addition	C	3,330
Additional concrete parking spaces	D	6,757

Figure 23 shows the site layout plan of building B2

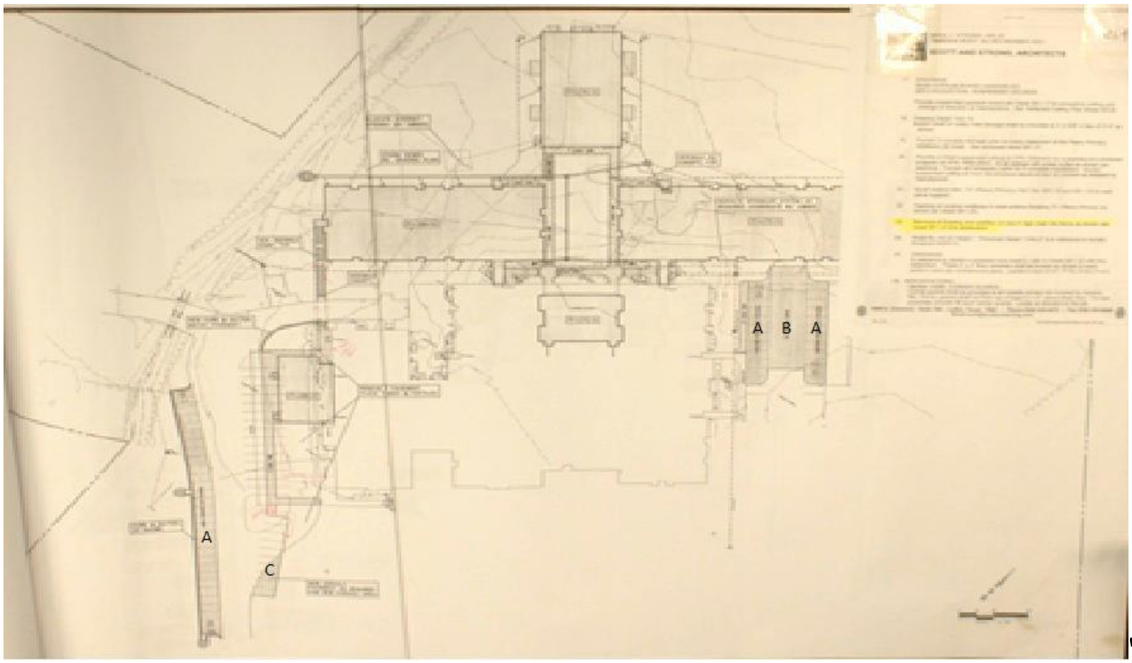


Figure 23 Site Layout Plan of Building B2

Table 11 summarizes the elements of Building B2

Table 11 Key Elements of Building B2

Component	Symbol	Area sq.ft
Additional parking spaces	A	8,716
Asphalt drive	B	3,141
New asphalt pavement	C	586

The estimated cost for these road components of Building B1 and B2 is $ 134,400 dollars, which is 1.46% of the total contract value.

Demolition for School

Figure 24 shows the demolition plan for School B.

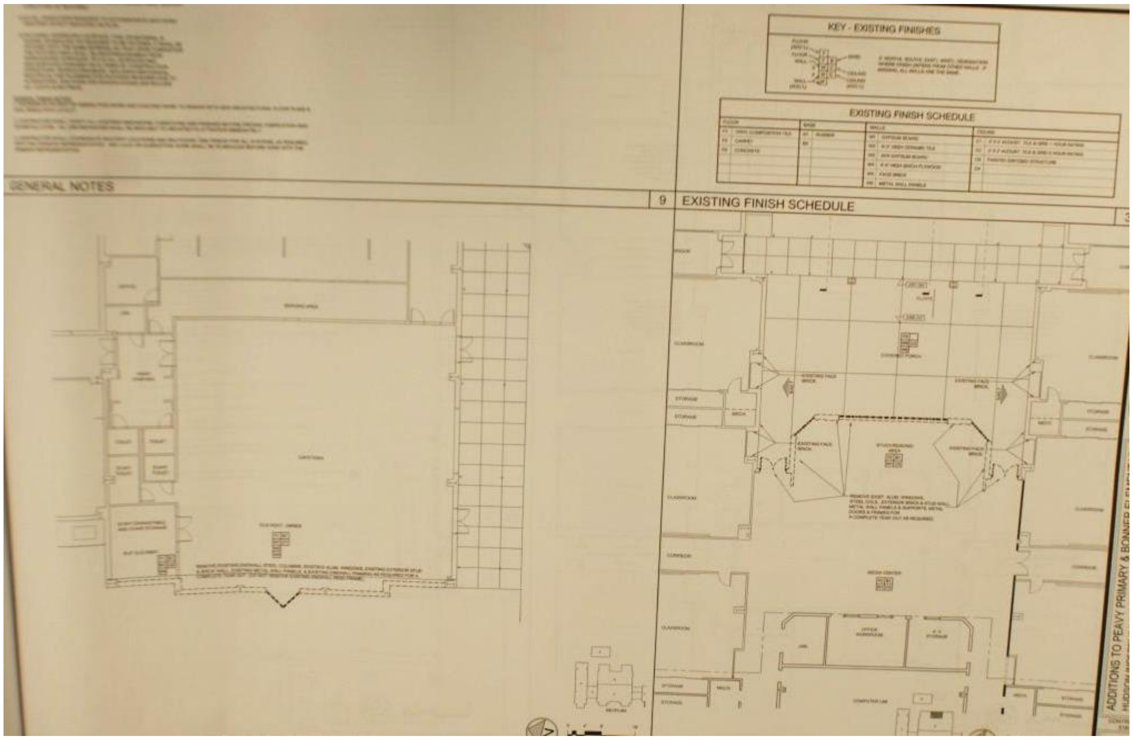


Figure 24 Demolition Plan of School B

School B is an existing structure which has classroom additions and hence includes demolition of some of the existing structures. It involves demolition of existing floors, walls, ceilings, windows, doors and face bricks. The figure above shows the demolition plan.

School A is a total new construction and hence it does not involve any demolition. The demolition cost and repair cost are assumed to balance the cost of new construction

Foundations

Figure 25 shows the foundation plan for School A

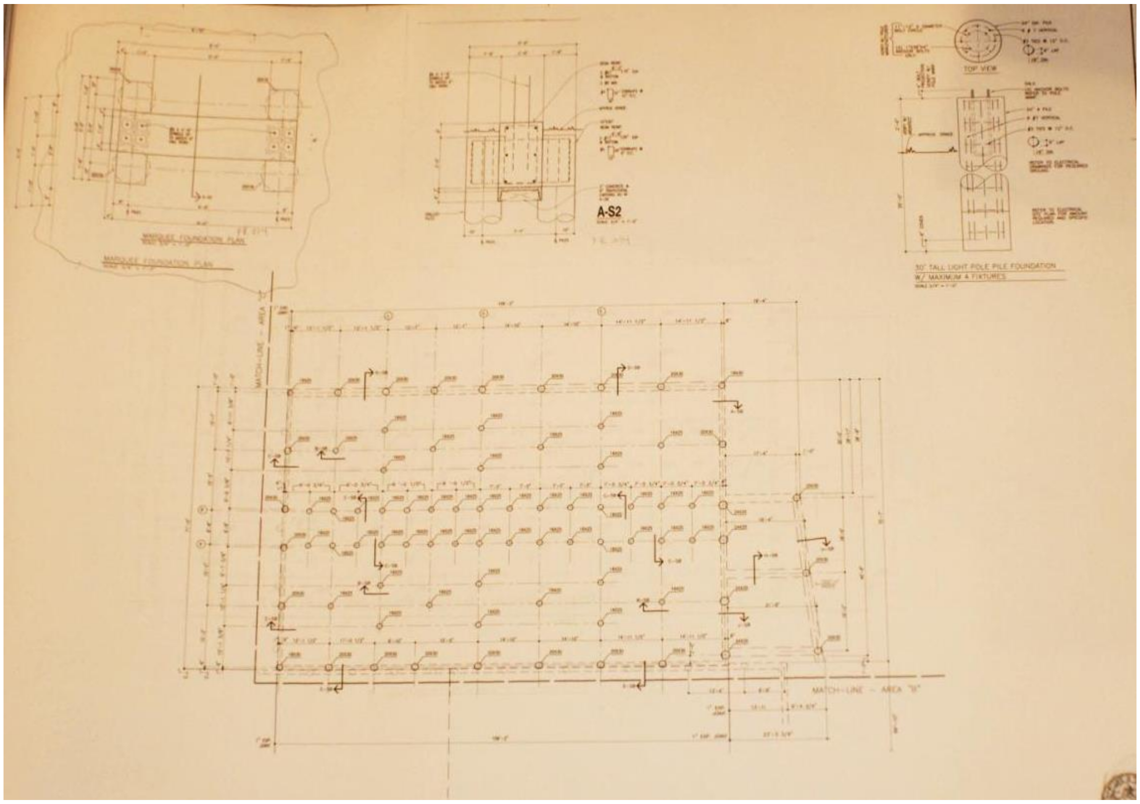


Figure 25 Foundation Plan of School A

The picture shows the foundation plan for School A. The type of foundation is pier foundation. The foundation design is in accordance with the building code and is based on a geotechnical report. The bearing capacity of the soil is 2000 psi. The diameter of the pier foundation is 24 inches. Concrete used for foundation shall have minimum compression strength of 3000 psi. This is a fairly standard design for an elementary school founded on a sandy soil. Piers are provided to reach a firm foundation.

Figure 26 shows the foundation plan for school B.

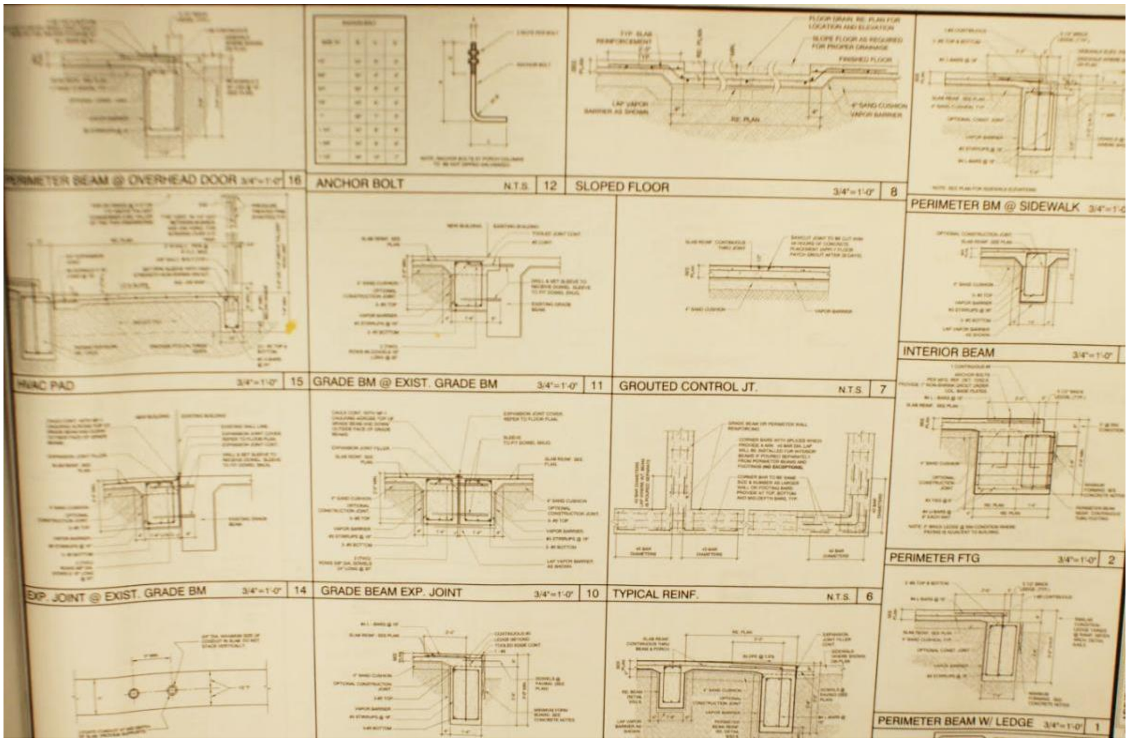


Figure 26 Foundation Plan for School B

The type of foundation used is pier foundation. The foundation design is in accordance with the building code and is based on geotechnical report. The diameter of the pier foundation is 20 inches. There is no significant difference in the foundation. It is concluded that these minor differences do not impact the cost.

Doors and Windows

Figure 27 shows the door plan for School A

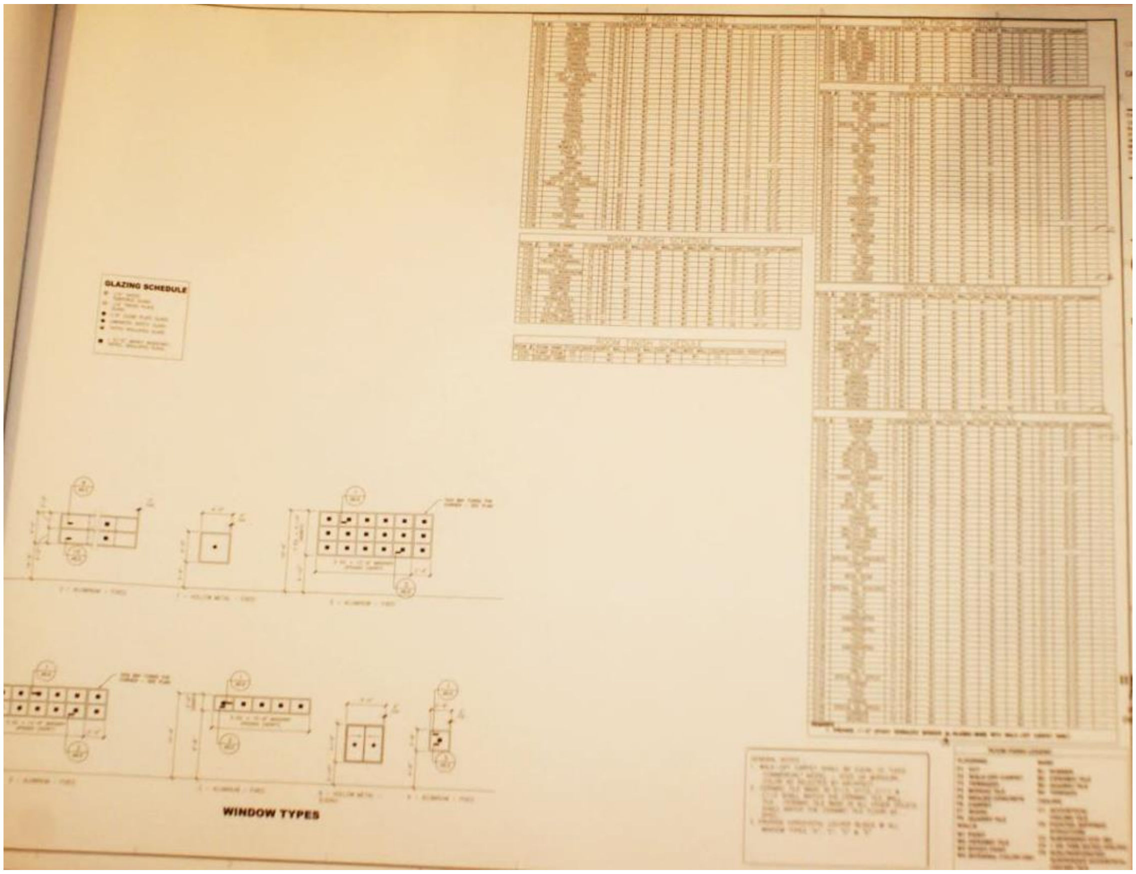


Figure 27 Door Plan for School A

Plastic laminate doors and aluminum sliding doors are the two types of doors used in the project.

Figure 28 shows the door plan for School B.

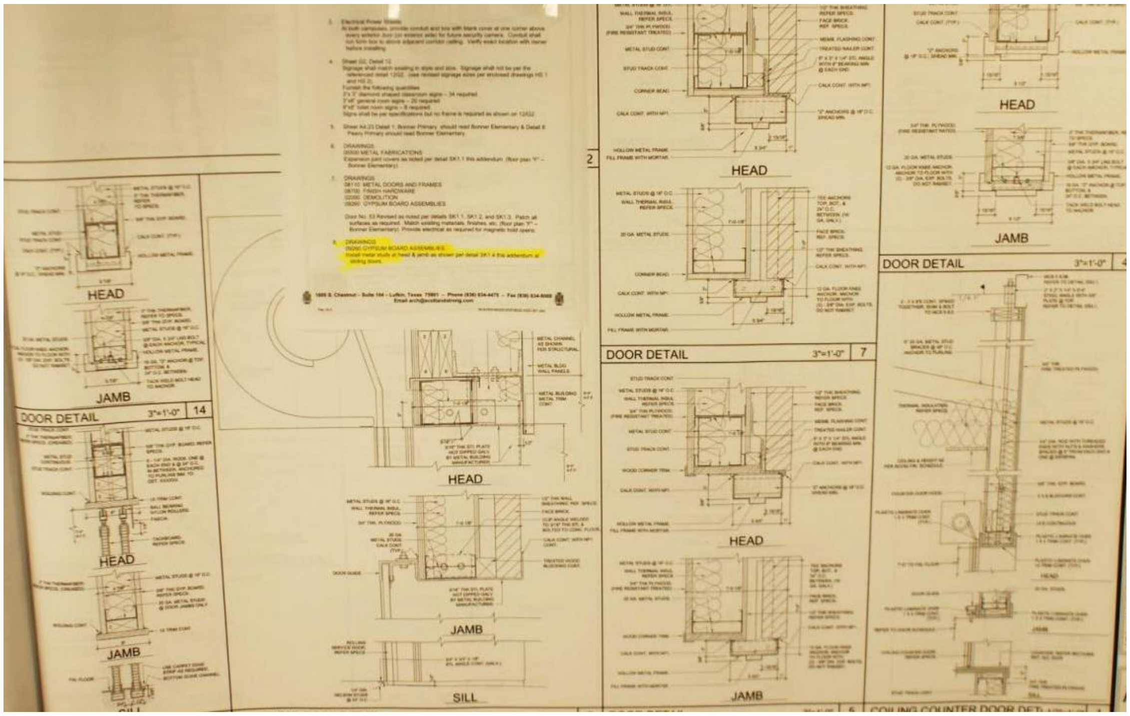


Figure 28 Door Plan for School B

The door types used in the project are overhead doors, Aluminum sliding doors, wooden flush doors and coiling counter doors. A comparison of the costs for the different doors based on RS Means(2013) suggest that door cost are less than 1% of the total construction cost. These differences are not significant.

Figure 29 shows the window plan for School A

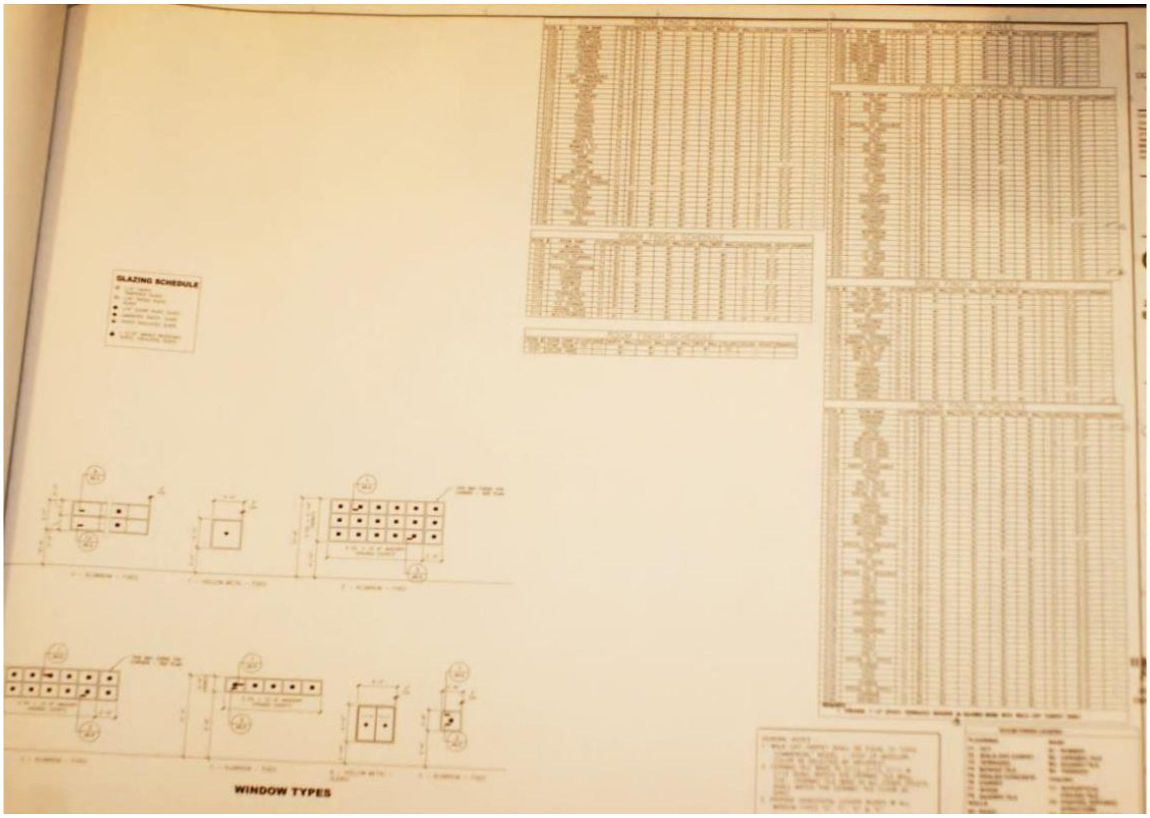


Figure 29 Window Plan for School A

The window type used for this project is Aluminum fixed window and hollow metal sliding windows.

Figure 30 shows the window plan for School B.

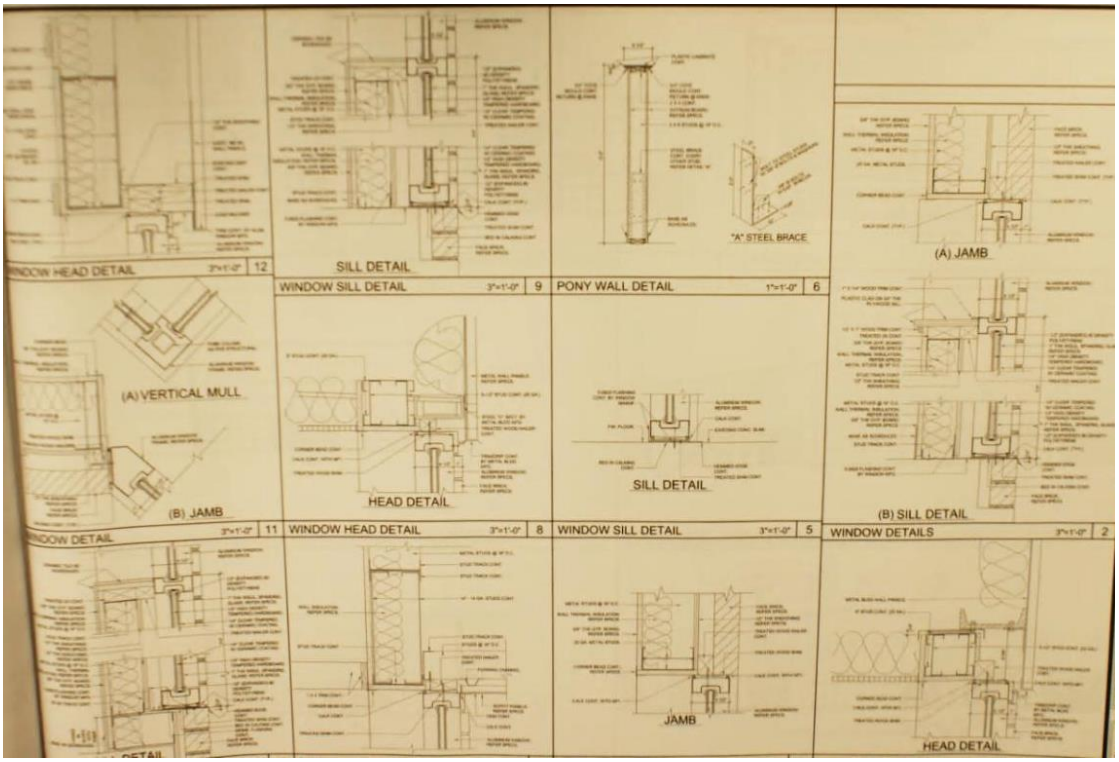


Figure 30 Window Plan for School B

The plan shows various details for the windows such as the window sill details, window head details and window details. Aluminum windows are used in the project.

Finishes

Figure 31 shows the exterior finishes plan for School A.

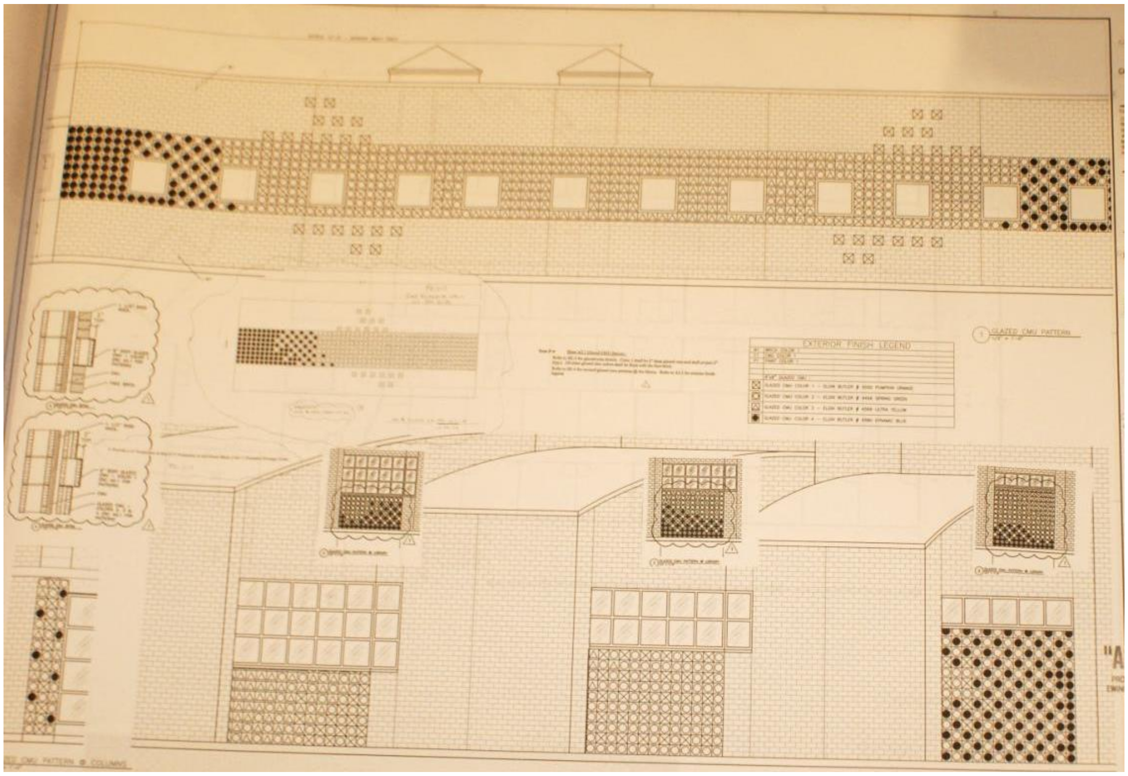


Figure 31 Exterior Finishes Plan for School A

The picture above shows the exterior details for school A. The facade is mainly covered with bricks, concrete masonry unit and paint.

Figure 32 shows the exterior finishes plan for School B.

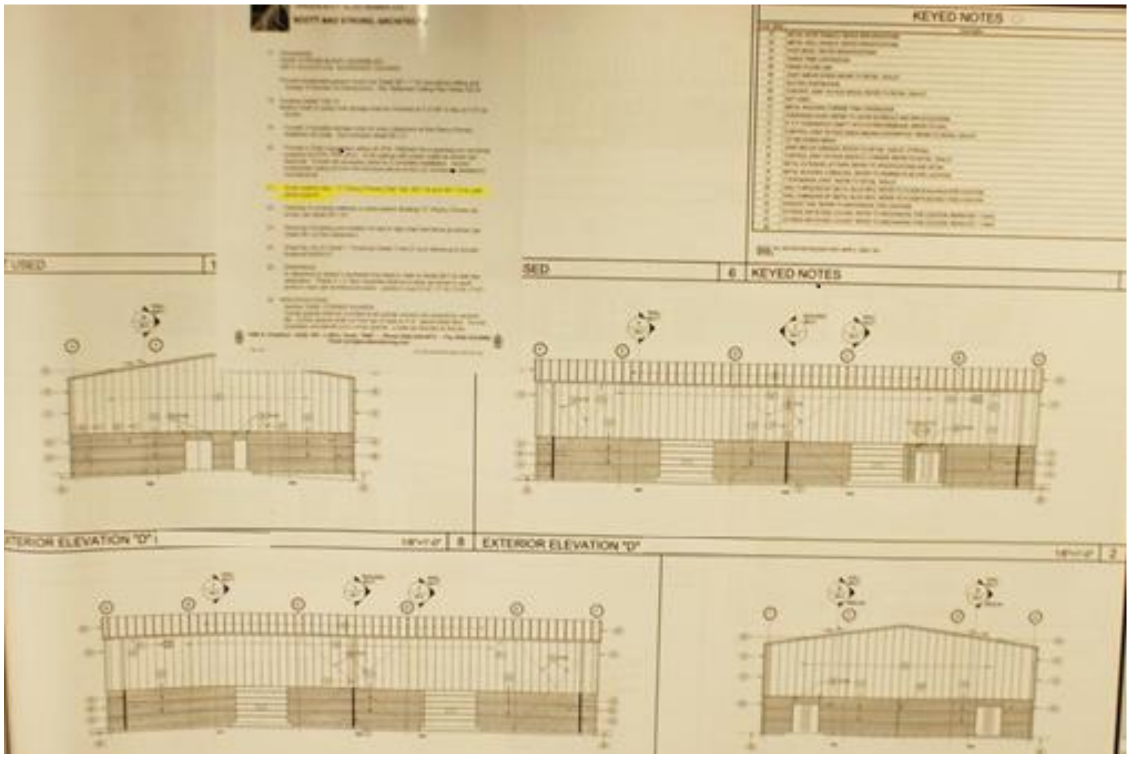


Figure 32 Exterior Finishes Plan for School B

The façade of the school is brick and steel sheeting with a steel sheeted roof. The cost of construction for external walls for School B is likely to be less than for School A, although a more detailed analysis could be required to confirm the point.

Mechanical

Figure 33 shows the HVAC plan for School A.

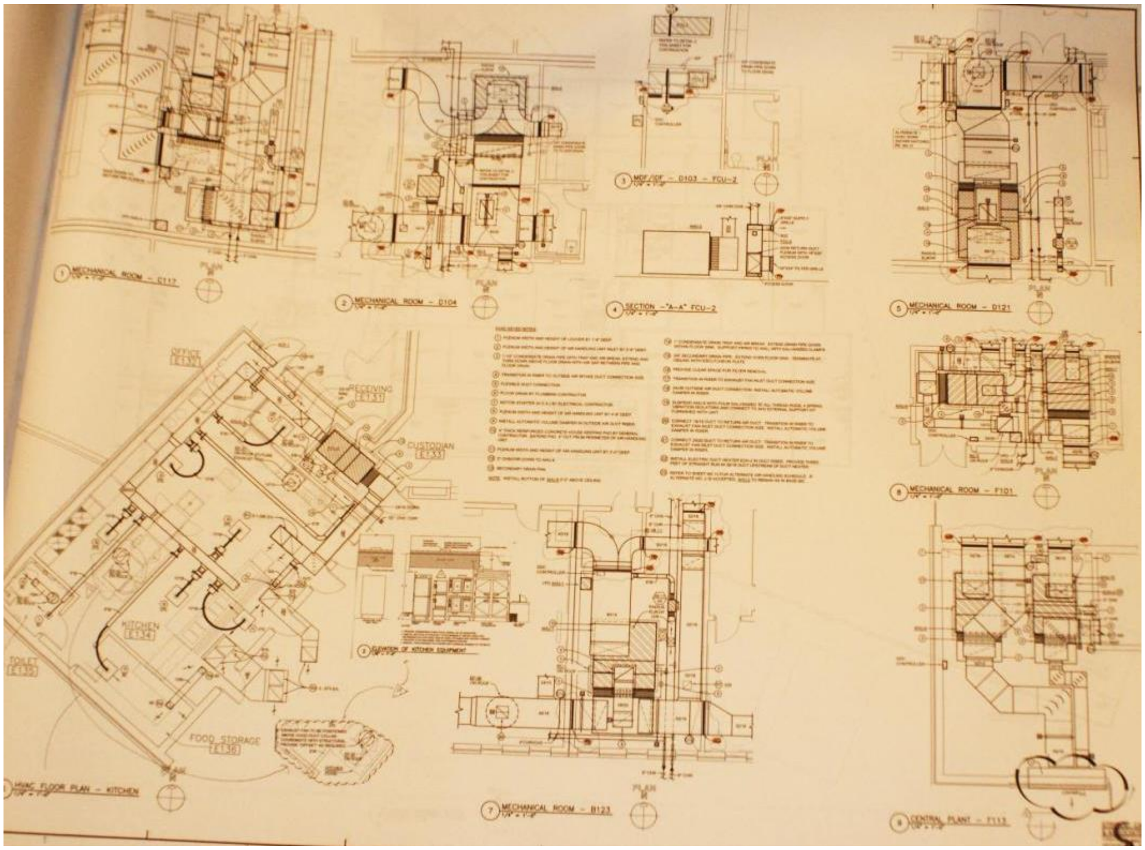


Figure 33 HVAC Plan for School A

The plan shows mechanical room plan details and kitchen HVAC details.

Figure 34 shows the HVAC plan for School A.

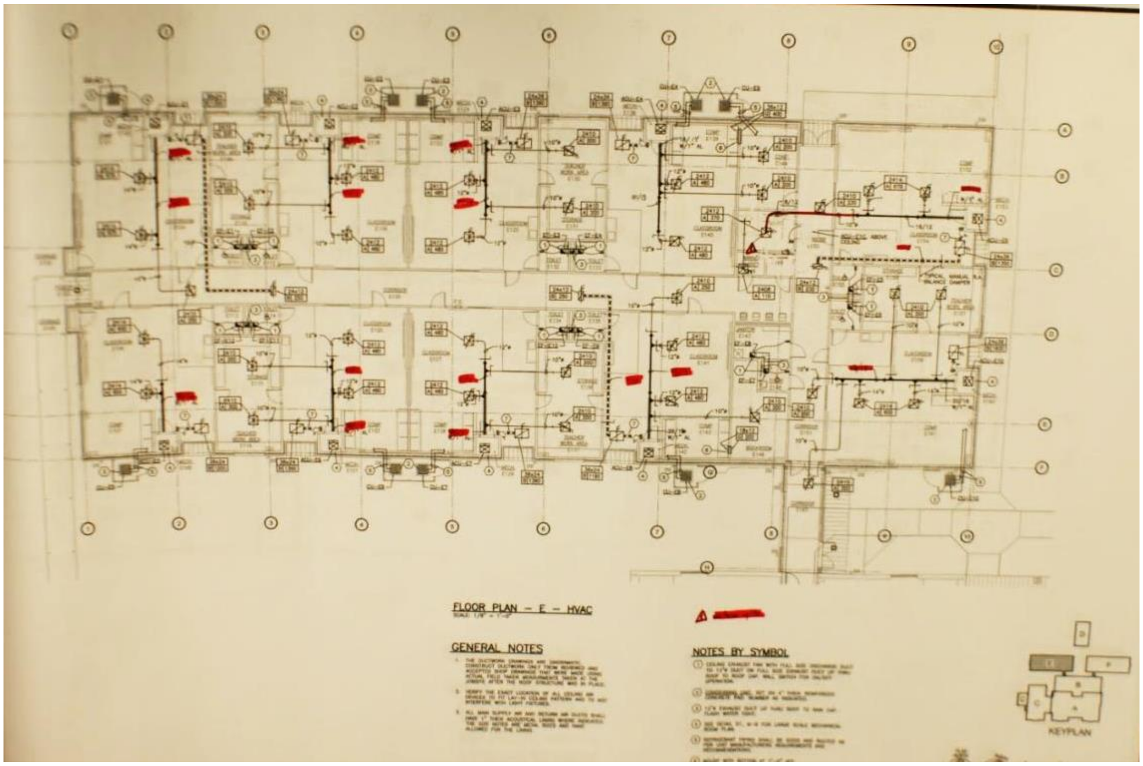


Figure 34 HVAC Plan for School B

The details of the HVAC system are mentioned in the general notes section. All the main supply air and return air ducts have 1 inch thick acoustical lining wherever necessary.

A Comparison of the School Construction

Although the two schools are from two different regions, they have certain properties in common as follows:

- foundation: The foundation for both schools is similar to each other, based on the geological report. The average depth of soil in both the region is around 70 feet and hence the foundation depth for both the schools is assumed to be same. Both the schools use pier foundation and have similar properties. It is concluded that there is not much difference in cost of foundation for both the project
- doors and windows: The two schools majorly use wooden flush doors and aluminum sliding doors. Although school B uses overhead doors and coiling doors at several places, it is only few in numbers. Aluminum windows are used in both schools and have almost similar specification, school A uses one extra type of window which is hollow metal sliding window type
- exterior finishes: it is expected that the cost for exterior walls for School B are slightly less than School A

Some of the differences between the two schools are as follows

- demolition: One of the major differences between the two schools is demolition, it is typical only to School B since it is not a new construction, and involves addition of new classrooms, parking space, cafeteria and study areas. School A is a complete new construction and therefore does not involve demolition or replacing existing structure

- Area of the classrooms:
    - the area of classrooms in School A is around 832 sq. ft and is more than the required standard which is 800 sq, ft for a school consisting of classroom Pre-K through fifth grade. It is slightly more than the required standards and has more area per classroom than school B
    - the area of classrooms in school B is around 700 sq. ft. and is as per the required standard which is 700 sq. ft. for elementary schools consisting of classrooms from second grade to fifth grade. Although the area of classrooms in school B is as per requirement, it has slightly lesser area in comparison with school A as shown in figure

The Figure 35 shows the area per classroom of School A and School B

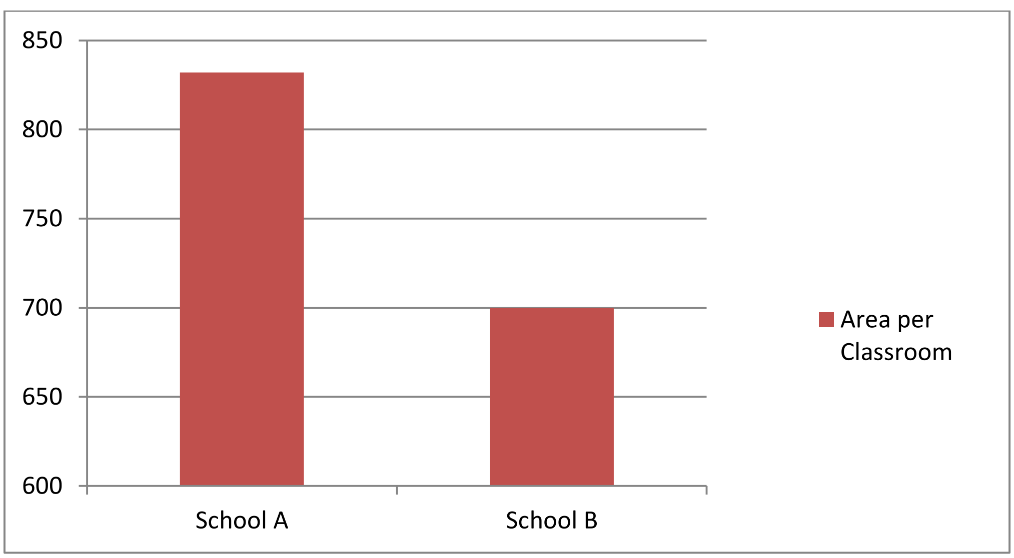


Figure 35 Area per Classroom for Schools A and B

- Number of students :
    - School A accommodates 900 students
    - School B accommodates 700 students and Figure 36shows the number of students in school A and school B

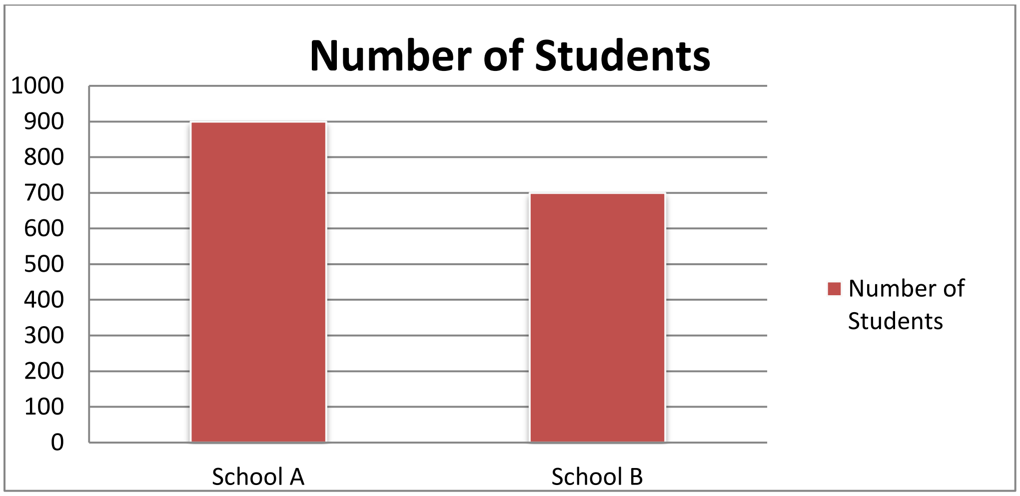


Figure 36 Number of Students in School A and B

SUMMARY

There are a number of interesting differences between the two schools in terms of

- contract type
- building exterior
- space per student

Yet the two schools allowing for all of the differences have a cost per student that is entirely consistent with the average value for CSP contracts established by Reinisch (2011). School A is in an ISD that uses CSP contract forms. This form has been shown to deliver the lowest cost consistently. School B is an ISD that uses CMR.

However, it is clear from the discussions with the ISD contract personnel that cost is a key criterion for both districts. The final contract costs for the CMR suggest that the risk to the contractor is limited and that to some extent the contractor acted effectively as an agent for the ISD. There is nothing wrong with this arrangement, but it could be clearer to contract in this form. One could opine that the tight financial control by the district does not warrant a risk shift to the contractor. Nothing in this study overturns the finding by Reinisch (2011). Clearly tight control is possible with both contract types as was shown in these two contracts.

CHAPTER V

CONCLUSIONS

School Districts in the state of Texas manage large budgets, which is a significant proportion of the state accounts. The budget includes construction of new schools and facilities. A study of elementary school construction delivery methods has continued at TAMU for a number of years. Reinisch (2011) showed that of the two most common delivery methods were Competitive Sealed Proposal and Construction Manager at Risk. The average cost per student for Competitive Sealed Proposal was $14,500 and for Construction Manager at Risk is $18,500. The clear question is why does the difference exist? This study has reviewed the cost for two contract types for two elementary schools in Texas. The Elementary School built using Competitive Sealed Proposal was in the southern part of the state and the Elementary School built using Construction Manager at Risk was in the northern part of the state. The two schools cost per student was in line with the findings by Reinisch (2011) for Competitive Sealed Proposal contracts. The Competitive Sealed Proposal School's construction was compared to the Construction Manager at Risk school construction. Allowing for the geographic distance between the schools, the construction cost was very similar, with both at about $13,000 per student.

The real issue, however, is the risk borne by the contractor. There is no risk without return. School B, Construction Manager at Risk, included significant cost savings, which ensured that the risk borne by the contractor was low. There are no significant difference is the end product of the two contracts.

This research does not negate the earlier findings (A. N. Reinisch, 2011). Clearly the cost for Construction Manager at Risk is higher on average in Texas. A 27.5 % increase to cover the risk of cost overrun could appear to be a high return to the contractor if it exists as such.

The results from this study clearly show that Competitive Sealed Proposal and Construction Manager at Risk can give similar results. The question is really how do you control this at a state level to ensure equitable cost to the school districts at acceptable returns to the construction community. A four thousand dollar differential is not really equitable for the school districts in terms of the risk transfer.

In terms of future research, a study is suggested that looks to develop a state based monitoring system to collect data on construction contracts with a long term goal of ensuring funding equity.

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APPENDIX A

EMAIL SENT TO THE INDEPENDENT SCHOOL DISTRICTS

Figure 37 shows the invitation letter sent to the ISDs superintendent requesting participation in the study

College of Architecture

TEXAS A&M UNIVERSITY

DEPARTMENT of Construction Science

John Nichols
Associate Professor

March 29, 2013

Dear Superintendent:

Cost of School Construction Study

Masters Students from the Construction Science Department at TAMU have completed a number of studies into the cost of elementary school construction in the State of Texas. The results from these studies seem to indicate that the delivery method used for the contract impacts on the cost of construction. Delivery methods relate to the form of the contract agreement, for example, whether it is a Hard Bid Contract or Construction Manager at Risk Contract type. Texas law permits alternative delivery systems for school related projects. One of our students, Sheetal Goyal Rakesh, is continuing this study. Her research plan is to look at the contract documents for recent elementary school construction in Texas to attempt to determine the reasons for the differences.

I would ask for your assistance in this project if:

1. your School District has recently, since 2004, constructed an elementary school or schools
2. our research personal can have access to the contract documents and the payment documents for any new elementary school construction

We would come to your school and copy the necessary documents. We expect that the copying process would take a few hours. In accordance with our Institutional Research Boards (IRB) requirements, the all coded responses are confidential. If you participate, your responses and the data is coded for the storage of final publication. We would merely refer to Site A, B etc. All data is stored on a TrueCrypt encrypted volume as required for the necessary IRB approval, with only the two research personnel having the password.

Participants are free to terminate the participation at any time without any prejudice. The research presents no more than minimal risk of harm to anyone at your offices, as we will travel to your offices to collect the data. This research is reviewed by the human subject's protection program and/or Institutional Review Board at Texas A&M University, for research related questions regarding your rights as a research participant, you can contact thesis office at (979)458-4067 or irb@tamu.edu.

Upon completion of the study, the student wishes to give a copy of all findings of this research to each of the participants as a token of appreciation for their valuable input. For more information, please contact

Langford Architectural Complex
3137TAMU
College Station, TX 77843-3137

Tel. 979.845.6541 Cell. 979.492.4136

IRB NUMBER: IRB2013-0149
IRB APPROVAL DATE: 04/10/2013
IRB EXPIRATION DATE: 03/31/2016

Figure 37 Invitation Letter - Page 1

Sheetal Goyal Rakesh
Construction Management Major, Construction Science Department, Texas A&M University
College Station, TX- 88743
Mobile number: (979)422-7022
Email address: sheetalgoel@tamu.edu

Research advisor's contact details
Dr. John Nichols
Department of Construction Science College of Architecture, Texas A&M University
College Station, TX- 88743

If you have any questions on this matter, please contact me at Texas A&M University on 979 845 6541, 979 492 4136 or at jm-nichols@tamu.edu.

Yours sincerely

John Nichols
Associate Professor

IRB NUMBER: IRB2013-0149
IRB APPROVAL DATE: 04/10/2013
IRB EXPIRATION DATE: 03/31/2016

Figure 38 Invitation Letter - Page 2

APPENDIX B

INFORMED CONSENT LETTER

Figure 39 shows the informed consent letter.

Informed Consent Form

The following information is provided so that you can decide whether or not you wish to participate in this study. You should be aware of the fact that even if you agree to participate initially, you have the freedom to withdraw at any point in time throughout this study. Refusal to participate will not result in any penalty. Participation in this study indicates that you are at least 18 years of age and have a consent form signed by you or your legal parent/guardian.

The purpose of this research is to investigate the actual costs for at least two recently constructed schools, one low cost and one high cost. The goal is to determine if the cost differences exists in the finished product as meeting the minimum state standards, or whether additional materials or other elements make up the cost differential.

The results of this research may not benefit you directly but it can be used to better direct the state spending and education to be fair to all in accordance with the constitutional requirements for the government.

The research presents no more than minimal risk of harm to the human subjects and involves no procedures for which written consent is normally required outside of the written context. Again be assured that the information you provide will be kept confidential and only Sheetal and Dr. Nichols will have access to it. If you have any questions please feel free to contact the researchers listed below. Thank you so much for your participation and co-operation.

Sincerely,
Sheetal Goyal Rakesh, Student researcher at Department of Construction Science, Texas A&M University, College Station, TX-77845. (979)422-7022, sheetalgoel@tamu.edu

Dr. John M. Nichols, Associate Professor, Department of Construction Science, Texas A&M University, College Station, TX-77843. (979)-845-6541, Jm-nichols@tamu.edu

Continuation of this study affirms that the participant is either at least 18 years old or has signed consent form and has received a copy of this consent form, also has understood the above information and agrees to voluntarily participate in this research.

X ______________________________________ **DATE:** ____________

IRB NUMBER: IRB2013-0149
IRB APPROVAL DATE: 04/10/2013
IRB EXPIRATION DATE: 03/31/2016

Figure 39 Informed Consent Letter

APPENDIX C

INSTITUTIONAL REVIEW BOARD APPROVAL LETTER

Figure 40 shows the approval letter from the IRB.

DIVISION OF RESEARCH

Office of Research Compliance and Biosafety

TEXAS A&M UNIVERSITY

APPROVAL DATE:	04/10/2013
MEMORANDUM	
TO:	Sheetal Goyal Rakesh TAMU - College Of Architecture - Construction Science
FROM:	Dr. James Fluckey Chair Institutional Review Board
SUBJECT:	Initial Review Submission Form Approval

Protocol Number:	IRB2013-0149
Title:	Cost and Area Comparison per student of the public elementary schools in Texas based on the Project Delivery Methods
Review Type:	Exempt
Approved:	**04/10/2013**
Continuing Review Due:	02/28/2016
Expiration Date:	03/31/2016
Review Categories and Regulatory Determinations:	45 CFR 46.101(b)(4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.
Document of Consent:	Written consent in accordance with 45 CF 46.116/ 21 CFR 50.27

This research project has been approved. As principal investigator, you assume the following responsibilities

1. **Continuing Review:** The protocol must be renewed by the expiration date in order to continue with the research project. A Continuing Review application along with required documents must be submitted by the continuing review deadline. Failure to do so may result in processing delays, study termination, and/or loss of funding.
2. **Completion Report:** Upon completion of the research project (including data analysis and final written papers), a Completion Report must be submitted to the IRB.
3. **Unanticipated Problems and Adverse Events:** Unanticipated problems and adverse events must be reported to the IRB immediately.
4. **Reports of Potential Non-compliance:** Potential non-compliance, including deviations from protocol and violations, must be reported to the IRB office immediately.
5. **Amendments:** Changes to the protocol must be requested by submitting an Amendment to the IRB for review. The Amendment must be approved by the IRB before being implemented.
6. **Consent Forms:** When using a consent form or information sheet, you must use the IRB stamped approved version. Please log into iRIS to download your stamped approved version of the consenting instruments. If you are unable to locate the stamped version in iRIS, please contact the office.
7. **Audit:** Your protocol may be subject to audit by the Human Subjects Post Approval Monitor. During the

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Figure 40 Approval Letter