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NETWORK CONSTRUCTION COST COMPARISON OF OKLAHOMA AND SURROUNDING STATES

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Planning and Research Division
The Oklahoma Department of Transportation
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16. ABSTRACT Keeping abreast of the primary component costs of new construction and the rehabilitation of current roads and highways is a never-ending challenge for transportation departments, including the Oklahoma Department of Transportation (ODOT). ODOT needs to continually assess such primary component costs to ascertain that the expenditures for road construction in Oklahoma are kept at a "reasonable cost"; one where quality work is performed at a rate that is both affordable and comparable to prices and quality in the surrounding states and region. This requires constant research and investigation of such costs and a comparison of costs in surrounding states. This study looked at databases from the Oklahoma Department of Transportation and Departments of Transportation in the surrounding states to develop a standardized list of primary components, comparing similar projects in Oklahoma and the surrounding states. Initially, the objectives of the study were to develop a standardized list of primary components of materials, transportation costs, and start-up costs; compare similar projects in Oklahoma and between states based on traffic load, design, rural/urban areas, and length of projects; analyze the effect of other items on costs, quality control/quality assurance specifications, and performance specifications. A research study was conducted among the surrounding DOTs and ODOT for the development of such a database. It was found to be a highly complicated endeavor. Highway construction projects are extremely individualistic, much like an individual's fingerprints. It was a rare occasion where two separate projects contained enough similarities for meaningful comparisons. In the final analysis, the research uncovered the fact that Oklahoma's costs were lower in some areas, higher in others, or comparable. A more detailed, extensive study requiring a much broader time limit recommended.			
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TABLE OF CONTENTS

LIST OF TABLES	iv
ACKNOWLEDGMENTS	v
EXECUTIVE SUMMARY	vi
INTRODUCTION	1
METHODOLOGY	3
RESULTS	8
Eastern Oklahoma	8
Western Oklahoma	10
Northern Oklahoma	11
Categorical Comparisons	14
Dirt	14
Pavement	18
Bridge	23
Mobilization	27
DISCUSSION	30

LIST OF TABLES

Table 1. Overall Comparisons of Projects	13
Table 2. Bridge Comparisons of Projects	13
Table 3A. Dirt	17
Table 3B. Pavement	21
Table 3C. Bridge	25
Table 3D. Mobilization	29
Table 4. Average Project of Mobilization Cost	29

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Should any mistake be found in this document, we are responsible for it. It should not be attributed to our interviewees.

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EXECUTIVE SUMMARY

Constructing highways is a costly endeavor, especially in times of economic downturn. Moreover, the Oklahoma Department of Transportation (ODOT) allocates a major portion of its budget in constructing highways, roads, and bridges. For this reason, its staff needs to scrutinize closely its financial affairs, especially in areas of highway, road, and bridge construction costs.

Consequently, ODOT wanted to compare the costs of constructing highways and bridges in Oklahoma with costs of doing the same in surrounding states (Arkansas, Colorado, Kansas, New Mexico, Missouri, and Texas). But only data from Texas, Arkansas, New Mexico and Colorado were included in the study because of the difficulty of finding two comparing projects with enough similarities for meaningful comparisons.

Initially, the objectives of the study were to develop a standardized list of primary components of materials, transportation costs, and start-up costs; compare similar projects in Oklahoma and between states based on traffic load, design, rural/urban areas, and length of projects; and, analyze the effect of other items on costs, quality control/quality assurance specifications, and performance specifications.

Using the year 2001 as the base for data collection, databases from state departments of transportation were obtained, and bid items from each state were compared to those from the Oklahoma database. This attempt proved to be very difficult, because there were too many variables involving the ways that bid items were classified by state DOTs.

Therefore, a different method was implemented, which involved selecting projects from each of the Oklahoma divisions and then acquiring similar projects from the states adjacent to each specific Oklahoma division. This method also produced too many differences that made it extremely difficult to find meaningful comparisons. Eventually, a search for projects that had adequate similarities was conducted for comparisons.

The data show that there are areas where Oklahoma spent less than other states, areas where Oklahoma spent more, and other areas where there were no significant differences in costs. For instance, Oklahoma spent three times more money per square foot on its bridge than Texas in the eastern Oklahoma area, but spent almost the exact amount as Arkansas. In the western Oklahoma region Oklahoma spent over four times more on dirt items than New Mexico and five times more than Colorado. But in northern Oklahoma, Arkansas spent over four times more money per meter on dirt items than Oklahoma.

One major noteworthy difference is that whereas Oklahoma focuses on building new roads, other states concentrate on rehabilitation and reconstruction of existing roadways

For ODOT to keep abreast of comparative costs with surrounding states, a broader and more in-depth study of individual projects is necessary. This will require far more time. The process of selecting Oklahoma projects that could be compared is in itself very time-consuming. Following this is the selection of other states' projects. A broadened and more detailed study would certainly be a worthy endeavor.

INTRODUCTION

Given that prices and wages in construction vary seasonally, keeping abreast of the costs of primary components in the construction and the rehabilitation of existing roads, highways, and bridges is a never-ending challenge for transportation departments, including the Oklahoma Department of Transportation (ODOT). ODOT needs to continually assess such primary component costs, or the major cost items such as excavation, borrow, steel, asphalt and concrete materials that are used in road and bridge construction and rehabilitation. This is necessary in order to ascertain that the expenditures for road construction in this state are kept at a "reasonable cost", one where quality work is performed at a rate that is comparable to prices and quality in the surrounding states. This analysis requires constant research and investigation of such costs.

The purpose of this research study is to determine the differences in these costs between Oklahoma and the surrounding states. Consequently, ODOT and Langston University entered into a contractual agreement to compare construction costs of roadway and bridge items per linear mile of roadway and square foot of bridge in Oklahoma to that of the surrounding states. Langston would compare items by districts using data from the fiscal year 2001. Also, the study would conduct unit cost comparison of projects in Oklahoma City and Tulsa with similar units in large cities in the surrounding states such as Wichita, Kansas, Lubbock and Amarillo, Texas and Little Rock, Arkansas.

This document is the product of a six-month study of Oklahoma's construction costs and the construction costs of five surrounding states, Kansas, Texas, Arkansas, New Mexico, and Colorado. (The Missouri Department of Transportation did not provide any information.)

Due to the fact that no matching roadway projects could be located that offered meaningful comparisons, bridge and approach projects only were used in this study.

METHODOLOGY

ODOT assigned two staff members to work with Langston University. These two individuals provided Langston with a list of the bid items Oklahoma used in the fiscal year 2001. This list included bid item information on monies spent on each item by division, quarter (January through March, etc.), occurrences (how many times a particular item was used in a certain division during the year), total quantity, and average awarded price. The list did not include information on individual projects.

Langston immediately contacted the surrounding states and requested their 2001 list of bid items. Gathering such information was a challenge. Each state has literally thousands of bid items. For example, Texas has 1800 bid items for asphalt materials alone! Also, many of the other state Departments Of Transportation staff members felt that such a comparison could not be accomplished. They believe that matching bid items between states involves working with too many variables. Several explained that even though bid items have the same names or titles, there are still so many variables within each individual item that may make a comparison with a like item in another state deceptive. For instance, a bid item such as "Excavation" may include several individual steps in one state that are not included in another state. This would make "Excavation" in the state with the extra steps appear to cost more than in the state without the extra steps.

Additionally, although all of the Departments of Transportation (DOTs) use the Transport Program to list their bid items, each state DOT has its own

unique system. For example, identification (ID) numbers for each bid item differ from state to state, making it impossible to match items by their ID numbers. Even the names of the items differ. Whereas Oklahoma has an item listed as "Clearing and Grubbing," Texas has the item listed as "Prep Row." The two terms may be similar, but there may be some steps included in "Prep Row" in Texas that may not be included in "Clearing and Grubbing" in Oklahoma. Also, where Oklahoma lists materials and their costs individually for a section of concrete pavement, Texas has only one price for a concrete slab, which includes all of the materials in the concrete slab. Furthermore, the materials in a section of concrete slab will vary from project to project.

Additionally, each states' list of bid items has a different format. New Mexico sent a list of items that included the item, total quantity and average price, but did not have them separated by quarters, divisions and number of occurrences. Colorado's list included the quarter, the unit quantity and awarded bid on each item. However, the item was listed first; then, each project that used that item was listed under the item with a brief description of the area where the project is located, instead of the division number. Consequently, a map of Colorado had to be used to locate the area where each individual item was used in each individual project. For example, an item would be used in a list of several projects with their respective locations. One of the projects is located at US 285, Springs Rd. and Log Trail. This very brief description was all we had to identify the division where the project is located on a Colorado map. This process was repeated for each specific bid item used in each project in order to locate all the

divisions the item was used in. For the particular bid item, Rem Structure, there were 22 different projects listed, which meant 22 different locations. Colorado's list of bid items in this format was almost 750 pages long.

As stated previously, Texas sent a list of over 1800 different asphalt items that were used in 2001 and offered to send Langston all the detailed information such as quarters, divisions, etc., after Langston sent the list back with an asterisk by each item for which information was needed. Once the list on asphalt materials was finished, Texas would send Langston information on the next bid item and do the same process over and over again until all items were exhausted. New Mexico's list included the item, item number, unit, total quantity, and average price. There was no information on quarters or divisions, nor was there a unit measurement included.

Additionally, all states do not use the same system of measurement. Some projects are in the metric system and others are in English. As a result, if the bid item costs in one state's project was measured by the English system, and the project in the comparing state was measured by metric, all of the measurements in one project had to be converted to the same system the other state had used.

Initially, ODOT staff located one Grade, Drain, and Surface project and one Bridge project for each of the eight Oklahoma divisions, plus the Oklahoma City and Tulsa urban areas to be used in the analysis.

The other State DOT representatives stated that the projects compared would still have many inconsistencies in the different bid items used, and that

they would have difficulty locating Grade, Drain, and Surface projects. This is because they did not work on new road construction often. The majority of their work involved rehabilitation and reconstruction of older roadways.

The projects from the other states were matched with Oklahoma's projects to compare the items. Problems occurred immediately. There were very few comparable bid items from the Grade, Drain and Surface projects and the Bridge projects. And there were too many discrepancies in the different states' projects to make a meaningful comparative match. ODOT's Project Team was informed about the problem. The team examined the projects for some matches and then went to work finding projects from Oklahoma that would possibly make a better match with the other states. Still, too many differences between the Oklahoma projects and the other states were noted.

ODOT's Project Team advised Langston to take all of the projects from Oklahoma and the other states to the Planning & Research Division and examine these discrepancies. After reviewing the projects, the Planning & Research Division representatives advised Langston University to compare not only individual bid items, but also items by the categories dirt, pavement, mobilization, and bridge.

Langston University's preliminary report to the Planning & Research Division representatives indicated that many of the variables in the selected projects did not provide meaningful comparisons. It was agreed that Planning and Langston University would acquire Typical Cross Section Sheets and Title Pages for the projects from the other states. Langston gathered this information

and met again with Planning & Research. But the same results were obtained as before; most of the items could not match up.

When comparing what initially were believed to be “similar projects,” we found that each project is like a fingerprint, unique and individualistic. Many times, even though they were somewhat similar, variables such as base, dirt work, and length of the roadway fluctuated enough to disqualify the project for meaningful comparisons among the projects from the other states.

In the final analysis, only three projects from Oklahoma were found that provided some meaningful comparisons with projects from surrounding states. Even then, there were some major differences. As stated previously, while the surrounding states spent money on rehabilitation and reconstruction of their existing roads, Oklahoma was building new roads.

Consequently, comparisons have been made on Bridge and Approach projects by area only, involving major bid items, which were divided into four separate and distinct categories: dirt, pavement, bridge, and mobilization.

RESULTS

The following information explores the primary construction costs of bid item categories from fiscal year 2001 in selected projects from three geographical areas in Oklahoma, comparing them with similar bid items in similar projects from adjacent areas in the surrounding states. The projects selected were from the Bridge and Approach category. Projects that could be used to compare Oklahoma projects to were from Colorado, Texas, Arkansas and New Mexico.

Eastern Oklahoma:

The first Oklahoma project selected is a Bridge and Approaches project located in eastern Oklahoma. This project was compared with a Bridge Project in western Arkansas, and a Replace Bridge and Approaches Project in northeastern Texas.

This eastern Oklahoma project is located in Adair County on US 62 at Peach Eater Creek approximately 6.16 miles east of the Cherokee County Line, just west of Christie. The total project length is 3529 feet with the total bridge length at 52.97 yards, or 158.91 feet. The awarded bid was \$1,486,887.01, which averaged \$421 per foot (or \$10.74 per square foot) for the entire project.

The total costs for the major bridge items are \$376,287.90, and the total surface area for the bridge is 6236 square feet, which brings the total costs for major bid items for the bridge to \$60.33 per square foot.

The comparable western Arkansas Bridge Project is located in Sebastian County on Highway 252 just west of the Sebastian/Franklin County Line. The total project length is 1200 feet and the bridge length is 152 feet. The awarded bid went to Crawford Construction Company for \$558,408.48. The total cost of the entire project per linear foot is \$465.34 (or \$16.61 per square foot). The total costs for the major bridge items are \$261,132.88, and the total surface area for the bridge is 4259 square feet. This averages the total costs for the bridge at \$61.31 per square foot.

The bridge project in northeastern Texas is located in Panola County at Sixmile Creek. The total length of the project is 2948 feet, of which the total length of the bridge is 300 feet. The awarded bid went to Longview Bridge and Road, Inc. for \$1,324,624.60. The total cost of the entire project per linear foot is \$449.32 with the average cost per square foot for the entire project at \$10.21. The total bridge costs are \$319,291.64 and the total surface area of the bridge is 13,205 square feet. The average cost for the bridge per square foot is \$24.18.

At first glance, Table 1 shows that the overall costs of each of the entire projects compared in the eastern Oklahoma area do not differ much per linear foot. Oklahoma spent \$421.33 per linear foot on the entire project, Arkansas spent 465.34 per linear foot and Texas spent 449.32 per linear foot.

On the other hand, Table 2 shows the cost per square foot for the major bid items for the construction of the bridges is comparable for Oklahoma and Arkansas only. Bridge costs per square foot are less than half in the northeastern Texas project as those in either eastern Oklahoma or western

Arkansas. This huge differential could be attributed to the length of the bridge. The bridge located in northeastern Texas is twice as long as those for eastern Oklahoma and western Arkansas. Materials could have been cheaper because of buying in larger volume. Additionally, the costs per square foot of bridge in the projects were similar for Oklahoma and Arkansas, but the bridge costs per square foot in Arkansas were higher than in Oklahoma or Texas.

Western Oklahoma

The project selected from western Oklahoma is a Bridge & Approaches project. It is located in Harper County, on US-64 over Dry Buffalo Creek, approximately 4.83 kilometers west of Buffalo, Oklahoma. Awarded to Bemis Construction, Inc. for \$2,143,707.89, it is 1540 meters long with a bridge length of 73.8 meters. Calculating the width of the road at 12.0 meters, the entire project covers 18,480 square meters. This averaged out to a cost of \$116.01 per square meter. With the bridge covering 878.16 square meters, and the major bridge items totaling \$550,842.59, cost per square meter for the bridge averages \$627.27.

The project from southeastern Colorado is located in Prowers County on State Highway 89 south of Holly, Colorado. This project is a Bridge and Reconstruction project and was awarded to TLM Constructors for \$2,966,786.20. The total length of the project is 7842 meters, and the average overall cost of the project is \$378.32 per linear meter. With the width of the road being 12.19 meters, the total area of the entire project covers 95593.98 square meters. This

results in an average cost of \$31.03 per square meter. The bridge covers 631.69 square meters and averages \$1501.90 per square meter. This looks deceptively high for a bridge, however there were actually three bridge structures that were replaced in this project. One was a bridge and the other two were concrete boxes. Costs for the concrete boxes totaled \$279,450. This cost is easily accounted for when looking at the list of bid items for the project, however there are other materials in the list that were probably used on both the bridge and the boxes, which were not separated.

Eastern New Mexico's project is a Roadway Reconstruction project that includes two bridges and two concrete boxes. It is located in San Miguel County on New Mexico State Highway 104. The winning bid went to Versatile Construction Company for \$6,502,398.22. The project length is 12,206 meters and the total cost averaged \$532.72 per meter or \$45.50 per square meter. With the total length of the bridge structures being 117.70 meters and the width at 11.71 meters the area covered by these four structures is 1378.27 square meters. Price for the bridge structures is calculated at \$701.06 per square meter.

Northern Oklahoma

The northern Oklahoma project is a Grade, Drain, Surface and Bridge project located in Mayes County just 10.5 miles east of the junction of US-69 and US-412A in Chouteau. It was awarded to Plains Bridge Contracting of Oklahoma for \$738,890. Project length is 629 meters and the width is 12 meters from shoulder to shoulder. Average cost of the project is \$1174.84 per meter or

\$97.90 per square meter. The total costs of materials for the bridge are \$122,438.90, and the bridge covers 194.4 square meters. This averages \$629.82 per square meter.

The comparison project is a Bridge job located in Benton County Arkansas. It was awarded to Apac-Arkansas, Inc., McClinton-Anchor Division for \$997,750.40. The project length is 396.20 meters, with the bridge length at 46.37 meters, and the roadway at 349.86 meters. The average cost of the total project is \$2514.11 per meter or \$229.18 per square meter. The bridge length is 46.37 meters and covers 508.68 square meters. With bridge items totaling \$311,382.32, bridge costs per square meter are \$612.14.

(See Tables 1 and 2 for a more detailed Overall Comparison Costs)

**TABLE 1
OVERALL COMPARISONS OF PROJECTS**

PROJECT STATE	PROJECT \$ TOTAL	PROJECT LENGTH	PROJECT \$/LF OR L M	PROJECT \$/SF OR SM
Eastern Oklahoma	1,486,887.01	3529 Ft	421.33	10.74
Western Arkansas	558,408	1200 Ft	465.34	16.61
Northeastern Texas	1,324,624.60	2948 Ft	449.32	10.21
Western Oklahoma	2,143,707.89	1540m	139.21	116.00
So. Eastern Colorado	2,966,786.20	7842m	378.32	31.03
Eastern New Mexico	6,502,398.22	12206m	532.72	45.50
Northern Oklahoma	738,980	629.00m	1174.84	97.90
Northeast Arkansas	997,750	396.20m	2518.05	229.18

**TABLE 2
BRIDGE COMPARISONS OF PROJECTS**

PROJECT STATE	BRIDGE TOTAL \$	BRIDGE LENGTH (SF OR SM)	BRIDGE \$/SF OR SM
Eastern Oklahoma	376187.90	6236 SF	60.33
Western Arkansas	261132.81	4259 SF	61.31
Northeastern Texas	319291.64	13,205 SF	24.18
Western Oklahoma	550842.59	878.16 SM	627.27
So. Eastern Colorado	948737.00	631.69 SM	1151.47
Eastern New Mexico	*966252.00	1378.27 SM	701.66
Northern Oklahoma	122438.90	194.40 SM	629.82
Northeast Arkansas	311382.32	508.68 SM	612.14

*Includes \$279,450 for the concrete boxes

CATEGORICAL COMPARISONS OF OKLAHOMA BRIDGE & APPROACHES PROJECTS

DIRT

Eastern Oklahoma

When Dirt items for the projects compared to the project located in Eastern Oklahoma were totaled and their costs calculated we found that northeastern Texas and Oklahoma were very close in dirt item expenditures. Oklahoma's cost in dirt items for its project was \$428,978.00, and Texas' cost was \$430,613.60.

On the other hand, when calculating in Oklahoma's project length, which is 3529 feet and Texas' project length, which is 2948 feet, it is evident that Texas paid considerably more per linear foot on dirt items. Excluding the length of the bridges in both projects, Texas' cost per linear foot on dirt items was \$162.62, and Oklahoma's cost per linear foot was \$127.29. Even though the Texas project length was considerably less (2348 feet) than the Oklahoma project length (3370 feet), and the bridge was almost twice as long (Texas, 300 feet; Oklahoma 159 feet), and even though Oklahoma had one extra dirt item (Type-A Salvaged Topsoil at \$63,425), Texas still paid \$35.42 more per linear foot for dirt items.

Western Arkansas' project length was 1200 linear feet, with the length of the bridge being 152 feet. The total dirt costs were \$107,386. When we subtract the length of the bridge and calculate dirt item costs per linear foot, Arkansas paid \$102.46 per square foot, \$24.83 less per linear foot than Oklahoma.

Western Oklahoma

The totals in Dirt Items for western Oklahoma and southeastern Colorado were close, however Colorado had some extra items such as Muck Excavation, Blading, Backhoe, and Dozing. Still, Oklahoma spent \$288,263 on Dirt, while Colorado spent \$304,530. Eastern New Mexico spent \$552,660 on Dirt, however the New Mexico project is much larger.

However, when the length of the bridges are subtracted from the project lengths, we find that Colorado's project length minus the bridge is over 7690 meters, whereas Oklahoma's length minus the bridge is only 1466.82; however, Oklahoma spent \$196.52 per meter on dirt, and southeastern Colorado spent only \$39.60 per meter on dirt items. . Furthermore, eastern New Mexico spent only 45.72 per meter on dirt. Its project length minus the bridge is 12,088 meters. This is a considerable difference with Oklahoma and the two other states, over four times more than eastern New Mexico and over five times more than southeastern Colorado.

Northern Oklahoma

When Dirt items for the projects in northern Oklahoma were totaled and their costs calculated per square meter, we find that Oklahoma spent \$52,266.56 on the major Dirt Items. Arkansas spent \$126,298. Also, the length of the roadway minus the bridge in this Oklahoma project is 612.80 meters, which calculates the major Dirt Items costs at \$80.29 per meter. Arkansas' roadway length minus the bridge is 349.83 meters; thus, Dirt item costs for Arkansas'

project is \$361.03 per meter. So we can see that although Oklahoma's roadway was almost twice as long as the Arkansas roadway, northern Arkansas spent over four times more per meter on Dirt Items than northern Oklahoma in this comparison.

(See Table 3A for a more detailed Dirt Costs)

TABLE 3A – DIRT

ITEMS	UNIT PRICE	QUANTITY	AMOUNT
EASTERN OKLAHOMA			
Clearing & Grubbing	20000.00/LS	1	20000.00
Unclassified Excavation	5.10/m ³	25,527.00	130187.00
Unclassified Borrow	4.19/m ³	51400.00	215366.00
Type-A Salvaged Topsoil	63425.00/LS	1	63425.00
TOTAL			428978.00
WESTERN ARKANSAS			
Clearing	300.00/STA	8.00	2400.00
Grubbing	300.00/STA	8.00	2400.00
Unclassified Excavation	7.85/m ³	4634.24	36366.00
Compacted Embankment	9.15/m ³	7233.11	66220.00
TOTAL			107386.00
NORTHEASTERN TEXAS			
Prep Row	1000.00/STA	29.48	29480.00
Excavation (Roadway)	5.23/m ³	8558.93	44776.00
Embankment	6.73/m ³	37031.50	248971.60
TOTAL			430613.60
WESTERN OKLAHOMA			
Clearing and Grubbing	49000/LS	1.00	49000.00
Unclassified Excavation	2.57/m ³	92783.00	238452.31
Unclassified Borrow	0.24/m ³	3246.00	811.50
TOTAL			288263.81
SOUTHEASTERN COLORADO			
Clearing and Grubbing	25000/LS	1.00	25000.00
Emb Matl	7.13/m ³	35206.77	250950.00
Muck Excavation	26.16/m ³	191.15	5000.00
Blading	90.00/HR	150.00	13500.00
Backhoe	80.00/HR	48.00	3840.00
Dozing	130.00/HR	48.00	6240.00
TOTAL			304530.00
EASTERN NEW MEXICO			
Clearing and Grubbing	100000/LS	1.00	100000.00
Unclassified Excavation	4.07/m ³	54530.00	199580.00
Borrow	4.55/m ³	63270.00	253080.00
TOTAL			552660.00
NORTHERN OKLAHOMA			
Clearing and Grubbing	8000.00/LS	1.00	8000.00
Unclassified Excavation	4.16/m ³	10516.00	43746.56
Unclassified Borrow	10.40/m ³	50.00	520.00
TOTAL			52266.56
NORTHEASTERN ARKANSAS			
Clearing	950/STA	13.00	12350.00
Grubbing	300/STA	13.00	3900.00
Unclassified Excavation	7.32/m ³	6124.45	44856.00
Compacted Embankment	10.46/m ³	6230.72	65192.00
TOTAL			126298.00

PAVEMENT

Eastern Oklahoma

Total costs of pavement items for the three projects in eastern Oklahoma varied considerably. Oklahoma spent \$388,201.16 on major pavement items, Texas spent \$286,704.00, and Arkansas spent \$80,170.88. Pavement costs of the roadway excluding the bridge in Oklahoma are \$115.19 per linear foot, while Texas' cost is \$122.10 per linear foot and Arkansas spent \$76.50 per linear foot. Also, as noted above in the Dirt Items, Oklahoma's roadway length is over 1000 feet more than Texas', yet Texas spent \$6.91 more per linear foot on the Pavement Items than Oklahoma.

Comparison of the Oklahoma/Arkansas projects shows that Arkansas' cost per linear foot is far less than Oklahoma's (\$38.69 less), and the length of Oklahoma's roadway is over 2000 feet more than Arkansas'. There were far more items in Oklahoma's Pavement Items list than Arkansas' and there were two less Pavement Items in the Oklahoma project compared to the Texas project.

Since all three of these projects contained different types of asphalt materials, the pavement items in this comparison may not be as meaningful as the dirt and bridge items. Interestingly though, when we consider the fact that costs in greater volume are usually cheaper, Arkansas still spent far less than Oklahoma per linear foot, even though smaller volumes of materials were needed.

Western Oklahoma

Total costs of pavement items for western Oklahoma and southeastern Colorado projects were also very close in their totals. Oklahoma's total cost for Pavement Items is \$703,560.32, while Colorado's is \$703,875. However, Colorado's pavement work was mostly overlay and covered 7790.18 meters, with an additional 6323.36 meters of Roadway compared to Oklahoma's roadway length which was only 1461.82 meters. The main bid item for pavement in the Colorado project is Hot Bituminous Pavement. Colorado spent \$694,575 on this item alone, whereas Oklahoma's pavement costs included several materials.

Oklahoma's average cost for pavement items was \$479.65 per meter, and Colorado's cost for pavement items was only \$90.36 per meter.

New Mexico's cost for Pavement Items are considerably more than Colorado's, however there is a vast difference between the Pavement Items for Oklahoma and New Mexico in this area. New Mexico spent \$1,890,918 on pavement, more than twice as much as Oklahoma and Colorado. However, New Mexico's roadway length is 12088.30 meters, and the average pavement costs are \$156.43 per meter, over three times less than Oklahoma.

Northern Oklahoma

Examination of the totals of the Pavement Items for the projects selected to compare the northern Oklahoma project reveals an entirely different picture. Oklahoma spent a total of \$359,00.81 on Pavement Items, compared to Arkansas' total expenditures of \$181,298.20. This is almost twice as much,

however when the roadway areas are measured in square meters and costs are calculated, Oklahoma spent \$48.83 per square meter, whereas Arkansas spent \$41.64 per square meter. Remembering that Oklahoma's roadway length is 263 meters longer and one meter wider, the difference in cost per square meter is close.

However, different types of Pavement Items were used in these two projects, which need to be considered as well.

(See Table 3B for a more detailed Pavement Costs)

TABLE 3B – PAVEMENT

ITEMS	UNIT PRICE	QUANTITY	AMOUNT
EASTERN OKLAHOMA			
Aggregate Base (F - 13)	36.08/m ³	2042.00	73675.00
Traffic Bound Surface Course Type E (R-10)(F-7)	17.11/t	565.00	9667.15
Tack Coat (F-25)	0.31/l	5031.00	1559.61
Prime Coat (F-55)	0.51/l	25,217.00	12860.67
(SP) Asphalt Concrete Type A (PG 64-22 OK)	38.04/t	4196	159615.00
(SP) Asphalt Concrete Type B (PG 64-22 OK)	40.41/t	2253.00	91043.73
Class C Concrete	195.00/m ³	204.00	39780.00
TOTAL			388201.16
WESTERN ARKANSAS			
Aggregate Base Course (Class 7)	13.78/t	2858.00	39382.00
Mineral Aggregate in Achm. Surface Course (1/2")	41.47/t	750.00	31106.88
Asphalt Binder (PG 76-22) in Achm. Surf Course	202.76/t	47.75	9682.00
TOTAL			80170.88
NORTHEASTERN TEXAS			
FL BS (Comp In Plac) (TY A GR2 CL 5)	15.55/m ²	10646.00	165542.00
Rerwking BS Matl. (DC) (TY C CL 5) (8")	5.23/m ³	1715.00	8972.00
Lime (TY A Dry)	103.07/t	203.69	20995.00
Lime Treat Subgr (DC) (8")	2.39/m ²	9207.96	22026.00
Asph Matrl (MC-30)	0.53/kg	12052.71	6368.00
Native Sand	32.96/m ³	24.47	800.00
Aggr (TY B, GR3)	111.17/m ³	121.57	13515.00
Asph (CRS-2P)	0.14/l	46344.65	24486.00
Aggr (TY B, GR4 or LT WT GR4)	110.97/m ³	99.58	11050.00
Cem Stabil Bkfl	228.88/m ³	56.58	12950.00
TOTAL			286704.00
WESTERN OKLAHOMA			
Subgrade Modification	1.85/m ²	21733/00	40206.05
Traffic Bound Surface Course Type A	23/t	129.00	2967.00
Tack Coat	0.10/l	13242.00	1324.20
Prime Coat	0.42/l	26040.00	10936.80
(SP) Asphalt Concrete Type A (PG 64-22 OK)	46.41/t	10267.00	476491.47
(SP) Asphalt Concrete Type B (PG 64-22 OK)	54.06/t	906.00	48978.36
(SP) Asphalt Concrete Type B (PG 70-28 OK)	54.06/t	1678.00	90712.68
Cold Milling Pavement	1.67/m ²	19128.00	31943.76
TOTAL			703560.32
SOUTHEASTERN COLORADO			
HBP (Gr S) (75) (PG 64-22)	54.01/t	12859.34	694575.00
Emul Asphalt (SS)	0.53/l	17602.00	9300.00
TOTAL			703875.00
EASTERN NEW MEXICO			
Base Course or Subbase	10.60/t	39290.00	416474.00
70-22 PG Bituminous	192.28/t	2280.00	438398.00
Hydrated Lime	128.50/t	644.00	82754.00
Plant Mix Bituminous Pavement S.	21.57/t	42880.00	760691.00
Open Graded Friction	50.00/t	4220.00	192601.00
TOTAL			1890918.00

TABLE 3B – PAVEMENT

ITEMS	UNIT PRICE	QUANTITY	AMOUNT
NORTHERN OKLAHOMA			
Aggregate Base	32.00/m ³	1234.00	39488.00
200MM Lime Treated Subgrade	2.60/m ²	10066.00	26171.60
Lime	112.00/t	194.00	21728.00
Traffic Bound Surface Course Type E	19.00/t	200.00	3800.00
Tack Coat	0.42/l	5668.00	2380.56
Prime Coat	0.52/l	19972.00	10385.44
(SP) Asphalt Concrete Type A (PG 64-22 OK)	36.88/t	4134.00	152461.92
(SP) Asphalt Concrete Type B (PG 64-22 OK)	38.75/t	1516.00	58745.00
Class "C" Concrete	230.00/m ³	114.00	26220.00
450MM R.C. Pipe Class III	82.00/m	112.16	9197.12
600MM R.C. Pipe Class III	102.00/m	32.91	3356.82
750MM R.C. Pipe Class III	135.00/m	39.01	5266.35
TOTAL			359200.81
NORTHEASTERN ARKANSAS			
Aggregate Base Course (Class 7)	19.75/t	1150.00	22712.50
Tack Coat	0.26/l	3001.80	793.00
Mineral Aggregate In ACHM Base Course (1½")	32.85/t	1761.75	57871.60
Asphalt Binder (PG 64-22) In ACHM Base Course (1½")	195.11/t	80.74	15753.00
Mineral Aggregate In ACHM Binder Course (1")	41.78/t	410.95	17168.70
Asphalt Binder (PG 64-22) In ACHM Binder Course (1")	202.71/t	23.60	4784.00
Mineral Aggregate In ACHM Surface Course (½")	36.40/t	1112.20	44626.40
Asphalt Binder (PG 64-22) In ACHM Surface Course (½")	198.65/t	73.48	14661.00
Cold Milling Asphalt Pavement	14.35/m ²	204.01	2928.00
TOTAL			181298.20

BRIDGE

Eastern Oklahoma

When Bridge items for these three projects are totaled and their costs calculated per square foot, we find, as mentioned earlier, that the total costs per square foot in major bid items for the bridges in Oklahoma and Arkansas are comparable, but differ by over two times as much with Texas. Oklahoma and Arkansas paid \$60.33 and \$61.31 per square foot respectively, while Texas spent only \$24.18 per square foot. As shown in Table 1, the bridge lengths of the Oklahoma and Arkansas bridges are very close (Oklahoma – 159 ft and Arkansas – 152 ft). In this case, then, it appears that bridge length does make a difference in cost. Texas' bridge is almost twice as long (300 ft), yet Texas paid less than half as much for Bridge Items than did Oklahoma and Arkansas per square foot.

Western Oklahoma

Comparison of totals for Bridge Items shows that western Oklahoma spent \$550,842 while southeast Colorado spent \$948,737. The Oklahoma bridge is 73.18 meters long and the Colorado bridge is only 51.82 meters long.

Differences in cost per square meter in Bridge Items were considerable. Oklahoma paid \$627.27 per square meter and Colorado paid \$1151.47 per square meter. As mentioned earlier, the large discrepancy is probably due to the materials for two concrete boxes in the Colorado Project.

Comparison of Bridge Items between the Oklahoma and New Mexico projects shows that Oklahoma spent \$550,842.59 on this category while New Mexico spent \$966,252.00. As stated above the bridge length for the Oklahoma project is 73.8 meters. The length of the two bridges and the two concrete boxes for the New Mexico project totals 117.70 meters. Oklahoma paid an average of \$627.27 per square meter on Bridge Items while New Mexico spent \$701.66 per square meter.

Northern Oklahoma

When Bridge items for these projects were totaled and their costs calculated per square meter and compared, we found that Oklahoma's Bridge Items costs are \$629.82 per square meter, while Arkansas' costs are \$612.14 per square meter. Oklahoma's bridge is 16.2 meters long compared to Arkansas' 46.37 meters. Oklahoma spent \$122,438.90 for total bridge costs; on the other hand, Arkansas spent \$311,382.32.

(See Table 3C for a more detailed Bridge Costs)

TABLE 3C - BRIDGE

ITEMS	UNIT \$	QUANTITY	AMOUNT
EASTERN OKLAHOMA			
Pre-stressed Concrete Beams (Type III)	391.40/m	190.80	74679.12
Approach Slab	82.40/m ²	253.20	20863.68
Sealed Expansion Joint	386.25/m	25.62	9895.73
Concrete Rail (TR3)	86.52/m	137.20	11870.54
Structural Steel	3.54/kg	2460.00	8708.40
Class AA Concrete	351.23/m ³	141.20	49593.68
Class A Concrete	347.11/m ³	182.10	63208.73
Class C Concrete	412.00/m ³	1.5	618.00
Reinforcing Steel	1.05/kg	1,995.00	19944.75
Epoxy Coated Reinforcing Steel	1.17/kg	20135.00	23557.93
Water Repellant	3.42/m ²	666.00	2277.72
Drilled Shafts 450mm Diameter	824.00/m	22.40	18457.60
Type II-A Special Plain Riprap	25.75/T	2480.00	63860.00
Type II-A Filter Blanket	21.63/T	400.00	8652.00
TOTAL			376187.88
WESTERN ARKANSAS			
Class S Concrete (Bridge)	721.90/m ³	78.68	56799.77
Class S (AE) Concrete (Bridge)	550.00/m ³	111.02	61007.23
Class 1 Protective Surface Treatment	7.92/l	46.18	366.00
Reinforcing Steel -- Roadway (Grade 60)	1.10/kg	459.04	506.00
Reinforcing Steel (Bridge)	1.06/kg	21056.00	22281.00
Steel Piling (HP 10X42)	137.81/m	39.01	5376.00
Structural Steel in Beam Spans	1.94/kg	40860.28	79270.40
Elastometric Bearings	0.06/m ³	140010.00	7860.48
Performed Joint Seal	85.29/m	18.90	1612.00
Filter Blanket	21.53/m ²	121.70	2620.00
Dumped Riprap	45.81/m ³	522.58	23940.00
TOTAL			261638.88
NORTHEASTERN TEXAS			
Cl C Conc (ABUT)	664.52/m ³	31.50	20600.00
Reinforced Concrete Slab	96.80/m ²	1282.00	124200.00
Prestressed Concrete Beam (TY C)	190.36/m	546.20	103940.64
Conc Surf Treat	2.39/m ²	1239.93	2966.00
Riprap	392.34/m ³	56.89	22320.00
Structural Steel (Armor Joint)	3.31/kg	1329.00	4395.00
Rail (TY T202)	147.64/m	193.85	28620.00
Approach Slabs	327.00/m ³	37.46	12250.00
TOTAL			319291.64
WESTERN OKLAHOMA			
Prestressed Concrete Beams	484.50/m	286.80.00	138954.00
Approach Slab	91.80/m ²	228.00	20930.40
PL (Sealed Expansion Joints)	459.00/m	14.42	6618.78
Concrete Rail (TR3)	102.00/m	182.30	18594.60
Structural Steel	4.08/kg	3120.00	12729.60
Class AA Concrete	372.30/m ³	215.80	80342.34
Class A Concrete	372.30/m ³	149.80	55770.54
Class C Concrete	255.00/m ³	10.00	2550.00
Reinforcing Steel	1.02/kg	6230.00	6354.60
Epoxy Coated Reinforcing Steel	1.28/kg	44420.00	56857.60
Piles, Furnished (HP 250x62)	53.04/m	46.20	2450.45
Piles, Furnished (HP 310x79)	63.24/m	185.60	11737.34
Piles, Driven (HP 250x62)	45.90/m	46.20	2120.58
Piles, Driven (HP 310x79)	45.90/m	185.60	8519.04
Water Repellant (Visually Inspected)	4.08/m ²	934.00	3810.72
Drilled Shafts 1500mm Diameter	1122.00/m	60.60	67993.20
Type 1-A Plain Riprap	30.60/t	1520.00	46512.00
Type 1-A Filter Blanket	28.56/t	280.00	7996.80
TOTAL			50842.59

TABLE 3C – BRIDGE (CONT.)

SOUTHEASTERN COLORADO			
Pile Tip	60.00/EA	12.00	720.00
Steel Pile	88.58/m	193.85	17172.00
Drilled Caisson (36 In)	492.13m	103.63	51000.00
Riprap ((18 In)	78.47/m ³	132.28	10380.00
Bitum S and D Pave (Asph)	220.47/t	12.70	2800.00
Structural Steel	2.20/kg	54204.28	119500.00
Structural Steel (Galv)	7.72/kg	308.44	2380.00
Bearing Device	600.00/EA	10.00	6000.00
Waterproofing (Membrane)	10.76/m ²	719.06	7740.00
Bridge Expansion Device (0-4 In)	295.35/m	21.94	6480.00
Concrete Class B (Bridge)	523.15/m ³	121.57	63600.00
Concrete Class D (Box)	294.27/m ³	949.63	279450.00
Concrete Class D (Bridge)	575.46/m ³	215.62	124080.00
Reinforced Steel	0.99/kg	147140.80	145975.00
Reinforced Steel (Epoxy)	1.54/kg	33656.55	51940.00
Transition Ty 3G	800.00/EA	4.00	3200.00
End Anchor (SRT)	1500.00/EA	12.00	18000
Bridge Rail Ty 10M	278.77/m	128.06	35700.00
End Post	80.00/EA	10.00	800.00
Corner and Line Bridge Post	130.00/EA	14.00	1820.00
TOTAL			948737.00
EASTERN NEW MEXICO			
Driven Piles	132.00/	196.00	25872.00
Structural Concrete	363.00/m ³	640.00	232320.00
Substructure Concrete	330.00/m ³	48.00	15840.00
Reinforced Concrete	660.00/m ³	11.00	7260.00
Superstructure Concrete	396.00/m ³	352.00	139392.00
Prestressed Concrete Bridge Member (BT1830)	550.00/m	130.00	71500.00
Prestressed Concrete Bridge Member (BT1370)	588.00/m	162.00	95256.00
Concrete Barrier Rail	209.00/m	149.00	31141.00
Permanent Anti-Graff	8.80/m ²	281.00	2473.00
Reinforced Bars Gra	1.10/kg	59956.00	62652.00
Epoxy Coated Reinforced Ba	1.32/kg	35784.00	47235.00
Structural Steel for Concrete	4.95/kg	4332.00	21443.00
Bridge Joint Strip	385.00/m	47.00	18095.00
Riprap Class A	253.00/m ³	421.00	106513.00
Riprap Class B	4.95/m ³	18032.00	89260.00
TOTAL			966252.00
NORTHERN OKLAHOMA			
Structural Excavation Unclassified	12.00/m ³	180.00	2160.00
Class A Concrete	265.00/m ³	332.00	88006.50
Reinforcing Steel	0.98/kg	19140.00	18757.20
Epoxy Coated Reinforcing Steel	1.04/kg	9380.00	9755.20
TOTAL			118678.90
NORTHEASTERN ARKANSAS			
Class S Concrete – Bridge	600.32/m ³	80.97	48608.10
Class S (AE) Concrete – Bridge	627.84/m ³	134.25	84288.00
Class 1 Protective Surface Treatment	11.89/l	51.86	616.50
Reinforcing Steel – Roadway	1.67/kg	459.03	769.12
Reinforcing Steel – Bridge	1.04/kg	23219.39	24059.30
Steel Piling (HP 10x42)	152.56/m	45.72	6975.00
Structural Steel In Beam Spans (M270-GR50W)	2.38/kg	49450.64	117741.60
Elastomeric Bearings	244.17/dc ³	51.91	12675.20
Preformed Joint Seal	78.75/m	23.77	1872.00
Filter Blanket	4.74/m ²	342.64	1622.50
Dumped Riprap	42.51/m ³	285.96	12155.00
TOTAL			311382.32

MOBILIZATION

Eastern Oklahoma

Comparison of Mobilization Costs of these three projects reveals a large difference in their percentage of the total cost. Oklahoma and Arkansas paid only 2.70% and 3.40% respectively; however, Texas paid 10.19% in Mobilization, which is almost four times more than Oklahoma and almost three times more than Arkansas.

Western Oklahoma

The percentage of total costs for Mobilization of the three comparable projects varied greatly. Oklahoma paid \$79,270 for Mobilization, which was only 3.40% of the total cost of the project. New Mexico paid \$550,000 in Mobilization, 8.45% of the project's total cost, and Colorado paid \$160,000, or 5.39% of the total cost.

Northern Oklahoma

Comparison of Mobilization costs of these two projects reveals that the percentage of the total costs spent on Mobilization is extremely close. Oklahoma paid 1.76 percent, or \$12,000, of its project's entire costs on Mobilization, where Arkansas spent 1.75 percent, or \$17,500 on this bid item.

Average mobilization cost for the Oklahoma projects was 2.62 percent of the entire projects, and the average mobilization cost for the Arkansas projects

was 2.575 percent. Since there was only one project from Texas, New Mexico, and Colorado, there was no average calculated.

(See Tables 3D and 4 for a more detailed Mobilization Costs)

TABLE 3D – MOBILIZATION

ITEMS	PROJECT TOTAL \$	UNIT \$	QUANTITY	TOTAL \$ AMOUNT	%
Eastern Oklahoma	1,486,887.01	40300/LS	1.00	40300.00	2.70
Western Arkansas	558,408	19000/LS	1.00	19000.00	3.40
Northeastern Texas	1,324,624.60	135000/LS	1.00	135000.00	10.19
Western Oklahoma	2,325,328.05	79270	1.00	79270	3.40
Southeastern Colorado	2,966,786.20	160000.00	1.00	160000.00	5.39
Eastern New Mexico	6,502,398.22	550000.00	1.00	550000.00	8.45
Northern Oklahoma	681698.29	12000.00/LS	1.00	12000.00	1.76
Northeast Arkansas	997750.74	17500.00/LS	1.00	17500.00	1.75

TABLE 4 – AVERAGE PROJECT PERCENT OF MOBILIZATION COST

OKLAHOMA	ARKANSAS	TEXAS	COLORADO	NEW MEXICO
2.62	2.58	10.19	8.45	5.39

DISCUSSION

In summary, this limited study of Oklahoma's projects and the contrasting projects from the other states revealed that Oklahoma's construction costs are comparable at times; however, Oklahoma pays more on some construction costs than other states and less on other costs.

In conclusion, while conducting the investigative part of this study, we found that cost comparison between Oklahoma and the surrounding states is far more complicated and time-consuming than it appears on the surface. The great discrepancy in the various materials used in each individual project results in many obstacles when seeking matches of like projects.

Additionally, there is a common thread with the majority of the other states, which lessens the likelihood of finding comparable projects between Oklahoma and these other states. Oklahoma had very few Rehabilitation or Reconstruction projects, whereas the other states had many. Yet the other states had fewer Grade, Drain, and Surface projects. Additionally, most of the state and federal bridge projects in Oklahoma had a large amount of roadway. In other words, Oklahoma has focused on building new roads, while the other states are concentrating on rehabilitation and reconstruction of existing roadways. Not to say one method is superior to the other; still, the difference in the methods naturally creates many different variables when trying to match Oklahoma's projects with the other states.

Consequently, in order to do a more precise report, the following things are recommended.

For ODOT to keep abreast of comparative costs with surrounding states, a broader and more in-depth study of individual projects is necessary. This will require far more time and expense than was allotted for this study. When Langston met with the various engineers and staff members at ODOT and discussed projects with individuals in the surrounding states' Departments of Transportation, there were many hours of discussion, questioning, research and investigation involved. There were also volumes of materials and information transferred electronically from all of these entities to Langston. All of this just scratched the surface.

To first locate matching projects with meaningful comparisons will require hours of research alone. There would also have to be an extensive amount of travel to the other state Departments of Transportation to locate comparable projects and discuss them thoroughly with the staff members, such as engineers, who are familiar with the projects.

Each individual project plan would have to be thoroughly examined to determine first, whether it is a worthy comparative project and secondly, all the details involving its myriad individual characteristics. Experience has already taught us that the process of selecting Oklahoma projects that could be compared is in itself very time-consuming. Following this is the selection of other states' projects, locating the meaningful data, which requires calculating the various measurements, locating projects and identifying details in them that would qualify them for projects of meaningful comparison, then entering the data and finally, calculating and comparing the results.

This would be a worthy accomplishment if such an in-depth, broadened and detailed study were conducted. If the Oklahoma Department of Transportation is interested in such an endeavor, Langston University would like to meet with ODOT to pursue these ideas further.