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PORTLAND CEMENT CONCRETE PAVEMENT REVIEW OF QC/QA DATA 2000 THROUGH 2003

Eric Chavez, CDOT Pavement Design Unit

January 2005

COLORADO DEPARTMENT OF TRANSPORTATION
RESEARCH BRANCH

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16. Abstract

This report analyzes the Quality Control/Quality Assurance (QC/QA) data for Portland Cement Concrete Pavement (PCCP) awarded in the years 2000 through 2003. Analysis of the overall performance of the projects is accomplished by reviewing the Calculated Pay Factor Composite (CPFC) and Incentive/Disincentive Payments (I/DP). Analysis of each of the test elements: thickness, compressive strength, sand equivalent, and flexural strength is also completed. The results of the evaluation are presented in tables, figures, and reports.

The overall quality of PCCP evaluated is very high. The quality levels in each of the elements are approaching the maximum of 100%. The pay factors for the individual elements are also close to their maximums. The material being produced is well above the minimum standards set by the specifications.

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Portland Cement Concrete Pavement
Review of QC/QA Data
2000 Through 2003

by

Eric Chavez

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Prepared by
Colorado Department of Transportation
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Colorado Department of Transportation
Research Branch
4201 E. Arkansas Ave.
Denver, CO 80222
(303) 757-9266

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1.0 INTRODUCTION AND COMMENTS

The Colorado Department of Transportation (CDOT) began Quality Control/Quality Assurance (QC/QA) construction of portland cement concrete pavement (PCCP) in 1997 with the release of Revision to Sections 105, & 106 Quality of Portland Cement Concrete Pavement as a pilot specification. In 1998 additional projects were awarded under revised pilot specifications. The specification became a Standard Special Provision in 2000 with the release of "Revision to Sections 105, 106, & 412 Quality of Portland Cement" and "Revision to Sections 105, 106, & 412 Quality of Portland Cement Concrete Pavement (Alternative Strength Criteria)."

This report analyzes the PCCP data for the years 2000 through 2003. Projects are evaluated by analyzing the Calculated Pay Factor Composite (CPFC) and Incentive/Disincentive Payment (I/DP). Each of the test elements: thickness, compressive strength, sand equivalent, & flexural strength is also evaluated. The data is evaluated by year and yearly reports are presented in this report. Recap reports comparing the yearly data are also presented. Charts comparing the quality level and pay factor information for the years 2000 through 2003 are displayed for each of the test elements. Also, detailed reports containing project data are presented for each of the years 2000 through 2003.

2.0 SPECIFICATIONS

Specifications – "Revision of Sections 105, 106, and 412 Quality of Portland Cement Concrete Pavement" and "Revision of Sections 105, 106, and 412 Quality of Portland Cement Concrete Pavement (Alternate Strength Criteria)." These specifications govern all of the QC/QA calculations used for Portland Cement Concrete Pavements. An Incentive/Disincentive Payment (I/DP) is calculated for each process. I/DPs on processes that contain one and two tests are calculated using the small quantity equation. Quality levels (Percent within limits) are calculated on all processes that contain more than two tests. The calculations for quality level follow Colorado Procedure 71, see the procedure for details. Processes group like material or

construction techniques together. As long as the material being evaluated remains unchanged it will be added to the current process. New processes will be created if the material changes or if the construction technique is changed. See the Revision to Sections 105, 106, and 412 for details on processes.

When compressive strength criteria is used the calculations for I/DP will be based on the results of three elements: thickness, compressive strength, and sand equivalent. When flexural strength criteria is used the calculations for I/DP will be based on two elements: thickness and flexural strength. The maximum incentive payment for the PCCP is 5% under either of the testing criteria. The maximum pay factor for each of the test elements is listed in Table 1.

Table 1. Maximum Pay Factor for Various Elements

Element	Maximum Pay Factor
Thickness	2%
Compressive Strength	2%
Sand Equivalent	1%
Flexural Strength	3%

Pay factors will be calculated for each process using the following equations:

A. For compressive strength and pavement thickness:

When $3 \leq Pn \leq 5$
If $QL \geq 85$, then $PF = 1.00 + (QL - 85)0.001333$
If $QL < 85$, then $PF = 1.00 + (QL - 85)0.005208$

When $6 \leq Pn \leq 9$
If $QL \geq 90$, then $PF = 1.00 + (QL - 90)0.002000$
If $QL < 90$, then $PF = 1.00 + (QL - 90)0.005682$

When $10 \leq Pn \leq 25$
If $QL \geq 93$, then $PF = 1.00 + (QL - 93)0.002857$
If $QL < 93$, then $PF = 1.00 + (QL - 93)0.006098$

When Pn ≥ 26
If QL ≥ 95, then PF = 1.00 + (QL - 95)0.004000
If QL < 95, then PF = 1.00 + (QL - 95)0.006757

B. For flexural strength:

When 3 ≤ Pn ≤ 5
If QL ≥ 85, then PF = 1.00 + (QL - 85)0.002000
If QL < 85, then PF = 1.00 + (QL - 85)0.005208

When 6 ≤ Pn ≤ 9
If QL ≥ 90, then PF = 1.00 + (QL - 90)0.003000
If QL < 90, then PF = 1.00 + (QL - 90)0.005682

When 10 ≤ Pn ≤ 25
If QL ≥ 93, then PF = 1.00 + (QL - 93)0.004286
If QL < 93, then PF = 1.00 + (QL - 93)0.006098

When Pn ≥ 26
If QL ≥ 95, then PF = 1.00 + (QL - 95)0.006000
If QL < 95, then PF = 1.00 + (QL - 95)0.006757

C. For sand equivalent:

When 3 ≤ Pn ≤ 5
If QL ≥ 85, then PF = 1.00 + (QL - 85)0.000667
If QL < 85, then PF = 1.00 + (QL - 85)0.005208

When 6 ≤ Pn ≤ 9
If QL ≥ 90, then PF = 1.00 + (QL - 90)0.001000
If QL < 90, then PF = 1.00 + (QL - 90)0.005682

When 10 ≤ Pn ≤ 25
If QL ≥93, then PF = 1.00 + (QL - 93)0.001429
If QL < 93, then PF = 1.00 + (QL - 93)0.006098

When Pn ≥ 26
If QL ≥ 95, then PF = 1.00 + (QL - 95)0.002000
If QL < 95, then PF = 1.00 + (QL - 95)0.006757

The I/DP for the process is calculated using the following equation:

I/DP = (PF-1)(QR)(UP)

where: QR = Quantity Represented by the process.
UP = Unit Price bid for the Item.

The total I/DP for an element shall be computed by accumulating the individual I/DP for each process of that element.

The I/DP for the project will be the summation of all calculated I/DPs.

The calculations for pay factor and Incentive/Disincentive Payment have remained unchanged since the release of the Standard Special Provisions in 2000. The calculation for quality levels has remained unchanged since the beginning. Use of CDOT's QC/QA computer program is a requirement of the specification. The computer program is based on this specification.

3.0 CALCULATIONS AND DEFINITIONS

Process Quantities – Process quantities are used for all calculations in this report except for the calculation of the Calculated Pay Factor Composite. In general, processes group like material or construction techniques together. As long as the material being evaluated remains unchanged it will be added to the current process. If a change to the material or the construction technique occurs then a new process will be created. Please see the Revision to Sections 105, 106, and 412 Quality of Portland Cement Concrete Pavement for details on processes.

Calculated Pay Factor Composite – The Calculated Pay Factor Composite (CPFC) is a way to evaluate the overall performance of the project. The CPFC represents the percentage increase or decrease to the unit price for PCCP paid on the project. Projects with a CPFC greater than 1.0 will have received an incentive payment. Projects with a CPFC less than 1.0 will have received a disincentive payment. The CPFC is back calculated from the project's Final Incentive/Disincentive Payment (I/DP). This calculation is used rather than an overall quality level calculation since a project can contain processes in which no quality level is calculated, processes with less than three tests. The calculation used also addresses the problem which occurred in some of the reported projects in which the final element quantities were not equal. This

calculation is used in order to avoid the problems associated with averaging of the data. The calculation is as follows:

$$CPFC = (I/DP / ((UP_P) * (QR_P))) + 1$$

Where: CPFC = Calculated Pay Factor Composite.

I/DP = Incentive/Disincentive Payment for the project.

UP_P = Calculated Unit Price for the project.

QR_P = Quantity Represented Project, average of the reported element quantities.

$$UP_P = (\sum (UP_n * Q_n)) / \sum Q_n$$

Where: UP_n = Unit Price for the process.

Q_n = Quantity represented by the process, thickness element only.

I/DP (Incentive/Disincentive Payment) - The amount of increase or decrease paid for a quantity of material within a test element. The I/DP for a project is the summation of all calculated element I/DPs.

LSL (Lower Specification Limit) – The lower limit of the specification range. All of the test elements used in testing PCCP only have a LSL. The LSL used in the thickness element is plan thickness minus 4 tenths of an inch or 10 mm.

Mean to TV - The difference between the mean for the process and the target value for the test element. Negative numbers indicate that the mean for the process is below the target value for the element. Positive numbers indicate that the mean for the process is above the target value. A mean above the target value, positive values, indicated that the mean is moving farther away form the lower specification limit on lower specification limit only tests. All of the PCCP test elements have only a lower specification test limit. Positive values, and the higher that value is, increase the likelihood that more of the test results will be in specification. The mean for the process in relationship to the specification limits is one of the two factors that effect the calculation for quality level. The other factor is the standard deviation for the process.

Pay Factor - The amount of increase or decrease, displayed as a percentage, applied to the unit price for the quantity of material represented by the process for a test element.

PT (Plan Thickness) – The planned thickness of the pavement. The lower tolerance limit (TL) used in the thickness element is PT minus 0.4 inches (10 mm). TL is used in the calculations for quality level and Incentive/Disincentive Payment.

Quality Level – Quality levels (Percent within limits) are calculated in accordance with Colorado Procedure 71. Quality level analysis is a statistical procedure for estimating the percent compliance to specification limits and is affected by shifts in the arithmetic mean and by the sample standard deviation. Analysis of both factors is essential whenever evaluating quality level results.

Std. Dev. (Standard Deviation) equation: $s = \sqrt{\frac{\sum(X - \bar{X})^2}{n - 1}}$

Std. Dev. – V (Standard Deviation minus the V Factor) - A comparison of the standard deviation for the process to the historical standard deviation for the element, the V Factor. Negative values indicate that the process has a smaller standard deviation than historically reported. The lower the calculated value the better. The standard deviation for the process is one of the two factors that affect the calculation for quality level. The other factor is the mean for the process in relationship to the specification limits.

TV (Target Value) - A calculated value for the mean of a process which would result in 85% of the material being within specification limits if it was produced at the same standard deviation as historical data, the V factor. The target value for the compressive strength, sand equivalent, and flexural strength elements is the lower specification limit plus V times 1.65. For the thickness element the target value is plan thickness plus V times 0.65. The lower specification limit in the thickness element is plan thickness minus 0.4 of an inch or 10 mm.

V (V Factor) - One standard deviation for the test element based on historical data.

Weighted Average – The weighted average calculation used in this report is calculated based on the amount of material represented.

4.0 DESCRIPTION OF REPORTS

In general, the amount of detail contained in the reports increases as you proceed through this report, summary or recap reports appear first. Detailed reports that contain all of the data appear in the appendices.

Report Criteria – At the beginning of each report the selection criteria are listed for the data contained in the report. The primary grouping of projects is by their bid date. Quality levels are not calculated on processes that contain less than three test results. Therefore, these processes are excluded from the reports that contain quality level calculations. Other justifications as to why a project or process is excluded from the report are detailed in the report criteria.

Sample Size – Not too many conclusions should be drawn when the number of observations, sample size, is small. Generally speaking, an evaluation of five or less samples is not considered very reliable. Always check the number of samples included in the evaluation when doing comparisons of the data. Most of the reports presented here will indicate the number of samples included in the various data groupings. Figures in this report will have associated tables that will give the number of samples included.

Project Listing, report 1. This report contains project information for the projects included in the evaluation from 1/1/2000 through 12/31/2003. The report is grouped by year and the projects are sorted by bid date. The subaccount, bid date, test criteria, region, project code, location, total plan quantity, testing units, and supplier ID are listed

for each project. Totals are calculated for each of the testing criteria and for the test unit.

Calculated Pay Factor Composite and I/DP, report 2. This report evaluates two key calculations for each project, the Calculated Pay Factor Composite (CPFC) and the project Incentive/Disincentive Payment (I/DP). The Calculated Pay Factor Composite gives an index of the overall quality of the project; see Calculations and Definitions for details on the calculation of the CPFC. The I/DP is the incentive or disincentive amount the project received for the PCCP. The report groups the projects by year. The maximum and minimum values are displayed for CPFC and I/DP for each year. A weighted average is calculated for CPFC. A non-weighted average is calculated for I/DP for each year. At the end of the report the maximum, minimum, and weighted averages are given for the bid date range contained in the report.

Note - There is not a direct correlation between Calculated Pay Factor Composite and Incentive/Disincentive Payment. The calculations for pay factors are dependent on the number of tests and the quantity of material associated with each process. Differences in the process quantity can result in a different calculation for pay factor even if the quality levels are the same. Please refer to the Revision to Sections 105 and 106 for details on the calculations.

Recap by Year Reports: Thickness, Compressive Strength, Sand Equivalent, & Flexural Strength reports 3, 4, 5, & 6. These are recap only reports that evaluate the test element by year. The information contained in these reports is grouped by year and testing unit, USA or SI. The testing unit does not change the test procedure in the sand equivalent test so both units are combined in that report. For each year, the best, worst, and weighted average are given for quality level, pay factor, I/DP, mean minus target value, standard deviation, and standard deviation minus the V factor. The mean to target value and standard deviation minus V factor calculations are important whenever evaluating the quality level for the process, see calculations.

Note - The best or worst results displayed do not necessarily come from the same process. The calculations for quality level and pay factor are dependent on the number of test results included in the process and vary slightly as the number of tests are changed. Also, the calculation for quality level is dependent on both the standard deviation of the process and the mean for the process as it relates to the specification limits. A low standard deviation does not necessarily mean a high quality level. Likewise, a larger standard deviation does not necessarily mean a lower quality level.

Project Data, report 7. The Project Data report displays all of the QC/QA data reported for each project. The projects are sorted by subaccount for each year. Each project's data is detailed by test element and then process. For each process the item, price, quantity, number of tests, quality level, pay factor, I/DP, mean, target value, mean minus target value, standard deviation, V factor, and standard deviation minus the V factor are given. Project totals are given for each project. For each element the number of tests, quantity, and I/DP are calculated. The calculation for CPFC is detailed for each project. This report contains all of the project's data and is the best report to review when concerned about an individual project. All of a project's data may not be contained in other reports if that data does not meet that report's individual criteria.

Process Information by Year, Thickness, Compressive Strength, Sand Equivalent, & Flexural Strength reports 8, 9, 10, & 11. These reports detail each of the test elements by year and testing unit. The test unit does not affect the calculations in the sand equivalent element so all of the processes are grouped together in that report. The criteria for each report are listed in the report header. Processes with less than three tests are excluded from these reports since no quality levels are calculated on these processes. For each year, the best, worst, and weighted average are given for quality level, pay factor, I/DP, mean minus target value, standard deviation, and standard deviation minus the V factor. The mean to target value and standard deviation minus V factor calculations are important whenever evaluating the quality level for the process, see calculations.

5.0 DISCUSSION OF THE DATA

5.1 Projects Evaluated

Table 2 displays the number of projects and amount of material awarded and evaluated by year. Some of the projects included in this evaluation were constructed using SI units. In some instances in this report the plan quantity is shown as a combination of units. This was done to quickly present the quantity without having to do a conversion or display two separate values. No conversion of the units or test results was done in this report. In the sand equivalent element the testing unit does not make a difference in the testing. Both units are combined in the reports for this element. In all of the other elements the reports the data is presented and grouped by the original testing unit. A relatively small number of projects are included in some of the data groupings. In three of the yearly evaluations only one project was included in the evaluation. Not too many conclusions should be made when the number of projects is small. Even though there is a somewhat limited amount of data a good evaluation of the specifications can be conducted. Additional project data will be added to the database as they are received by the Pavement Design Unit.

Table 2. Projects Evaluated

			Evaluated, Criteria			
	Awarded		Compressive Str.		Flexural Str.	
Year	Projects	SY/m2	Projects	SY/m2	Projects	SY/m2
2000	16	2,526,647	8	1,320,472	4	940,012
2001	11	1,907,658	6	347,976	1	233,277
2002	6	672,846	4	175,674	2	234,921
2003	10	809,888	1	102,013	1	39,431

5.2 Calculated Pay Factor Composite

The Calculated Pay Factor Composite (CPFC) information for the years 2000 through 2003 is displayed in Table 3. The CPFC is an index of the overall quality of the

pavement based on the test results in the test elements. A CPFC above 1.0 indicates that an incentive payment was paid for the PCCP. A CPFC below 1.0 shows that a disincentive was applied to the pavement. The average CPFC for each year 2000 through 2003 is displayed in Figure 1. The average incentive payment is above 3.5% in each year and for the four-year period. All projects evaluated received some amount of incentive payment, CPFC greater than 1.0, for the PCCP. The lowest reported CPFC was 1.00618. Two projects received the maximum amount of 5% and eleven other projects were above the 4% mark, see report 2, appendix A. Just slightly less than half of the projects evaluated received incentive payments of greater than 4%.

Table 3. Calculated Pay Factor Composite

			Calculated Pay Factor Composite		
Year	Projects	SY/m2	Weighted Average	Minimum	Maximum
2000	12	2,188,871	1.03938	1.00953	1.04995
2001	7	573,359	1.04191	1.00618	1.05000
2002	6	427,269	1.03654	1.01008	1.04529
2003	2	145,670	1.03897	1.01668	1.04929
2000 to 2003	27	3,335,169	1.03943	1.00618	1.05000

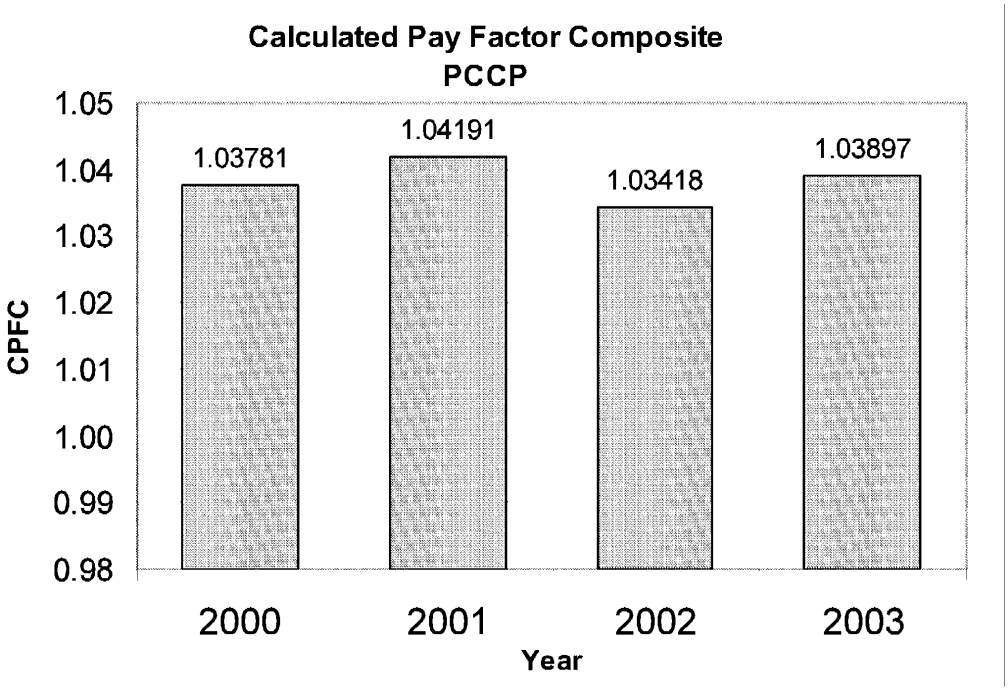

Figure 1. Calculated Pay Factor Composite by Year

5.3 Incentive/Disincentive Payments

A recap of the Incentive/Disincentive Payments for the years 2000 through 2003 is presented in Table 4. Every project evaluated received some amount of incentive payment. The average incentive has been just slightly under 4% in each of the years. In 2000 that worked out to be an average of greater than $182,000.00 per project. The projects constructed since 2000 have been smaller in size and the average dollar amount per project has decreased.

Table 4. Incentive/Disincentive Payments – Recap by Year

			Incentive/Disincentive Payment		
Year	**Projects**	**SY/m2**	**Average**	**Minimum**	**Maximum**
2000	12	2,188,871	$182,782.01	$41,430.93	$441,429.80
2001	7	573,359	$96,663.17	$20,318.88	$305,316.23
2002	6	427,269	$83,592.92	$3,772.66	$213,295.38
2003	2	145,670	$44,622.24	$18,814.20	$70,430.27
2000 to 2003	27	3,335,169	$128,178.83	$3,772.66	$441,429.80

5.4 Recap of Data 2000 through 2003 - Thickness, Compressive Strength, Sand Equivalent, & Flexural Strength

The recap results for each of the test elements for the years 2000 through 2003 are listed in Table 5. The quality level, pay factor, and standard deviation are shown for each element. The mean to target value and standard deviation minus V factor are also calculated. The mean to target value calculation shows the relationship between the mean for the test results in comparison to the target value for the element. Negative numbers indicate that the mean is below the target value. Positive values show that the mean is above the target value. The higher the number the better as it shows that the mean is moving farther away from the lower specification limit increasing the likelihood that more of the material will be within specification limits. The standard deviation minus V factor shows the comparison of the standard deviation for the test results to the

historical standard deviation, the V factor. A negative number indicates that the standard deviation for the process is smaller than the historical values. Positive values show that the sample standard deviations have exceeded the historical values.

A very high percentage of the material being produced is within specification limits. For the data groupings used, year and test unit, only four of the element quality levels reported are below 98% within specification limits. Three of those are reported in the thickness element. The remaining one was reported in the flexural strength element in 2003. The lowest calculated quality level was just slightly under 93% within specification limits. All of the pay factors except one are above the 1.0 mark signifying that incentives have been paid on those elements. Many of the element pay factors are approaching the maximum allowable values: thickness 2%, compressive strength 2%, sand equivalent 1%, & flexural strength 3%. The mean to TV column shows that the material being produced is above the target value for the elements, positive values. All of the test elements used for testing PCCP only have a lower specification limit so none of the material can be out on the upper end. Being above the target value increases the likelihood that more of the material will be within specification limits. This property is shown in the performance of both the compressive strength and flexural strength elements. The material being produced is well above the target value allowing almost 100% to be within the specification limits. The weighted average mean over the four-year period for the compressive strength element USA units is 5,745 psi. The lower specification limit for this element is 4,200 psi. When analyzing the standard deviations for the test elements we find that the material currently being produced is below the variation of the historical data, shown as negative values in the St. Dev. minus V column. Most of these calculated values are negative or close to zero. The exception to this is in the compressive strength element which has mostly positive values. The variation in this element is slightly above the historical values. However, this element has the best results in the mean to target value calculation which allows a high percentage of the material to be within specification limits even with a slightly greater variance. Figures 2 through 9 display the quality levels and pay factors for each of the elements.

Table 5. Recap of Yearly Data by Test Element

Thickness

Year	Proj.	SY/m2	Tests	Quality Level	Pay Factor	Mean to TV	St. Dev.	V	St. Dev. - V
2000 USA	7	1,355,922	388	98.913	1.01608	0.148	0.330	0.400	-0.070
2001 USA	5	462,489	152	99.713	1.01909	0.364	0.326	0.400	-0.074
2002 USA	5	311,092	141	96.524	1.00911	0.154	0.416	0.400	0.016
2003 USA	2	145,670	55	99.438	1.01839	0.357	0.316	0.400	-0.084
2000 SI	5	775,262	329	96.735	1.00654	3.231	9.477	10.000	-0.523
2001 SI	2	103,776	106	92.957	0.99448	2.673	11.912	10.000	1.912
2002 SI	1	109,507	65	99.562	1.01859	6.433	9.057	10.000	-0.943

Compressive Strength

Year	Proj.	SY/m2	Tests	Quality Level	Pay Factor	Mean to TV	St. Dev.	V	St. Dev. - V
2000 USA	4	835,946	139	99.893	1.01979	838	410.7	400.0	10.7
2001 USA	4	229,578	103	99.949	1.01985	1,190	544.3	400.0	144.3
2002 USA	3	94,573	67	99.834	1.01958	1,150	450.5	400.0	50.5
2003 USA	1	99,575	26	99.990	1.01997	323	305.7	400.0	-94.3
2000 SI	4	460,645	165	98.987	1.01751	6.023	2.917	2.760	0.157
2001 SI	2	106,566	112	99.524	1.01884	7.870	3.835	2.760	1.075
2002 SI	1	100,047	61	99.735	1.01947	8.159	2.488	2.760	-0.272

Sand Equivalent

Year	Proj.	SY/m2	Tests	Quality Level	Pay Factor	Mean to TV	St. Dev.	V	St. Dev. - V
2000	8	1,284,132	311	99.349	1.00845	4.63	2.018	4.000	-1.982
2001	6	336,144	203	98.807	1.00676	5.72	2.458	4.000	-1.542
2002	3	134,080	118	100.000	1.01000	4.74	1.282	4.000	-2.718
2003	1	99,575	27	99.354	1.00932	1.98	3.522	4.000	-0.478

Flexural Strength

Year	Proj.	SY/m2	Tests	Quality Level	Pay Factor	Mean to TV	St. Dev.	V	St. Dev. - V
2000 USA	3	711,869	152	99.318	1.02696	27.3	34.593	50.000	-15.407
2001 USA	1	232,911	27	100.000	1.03000	100.1	47.807	50.000	-2.193
2002 USA	2	215,555	62	99.147	1.02497	6.9	39.426	50.000	-10.574
2003 USA	1	46,095	41	95.203	1.00111	31.4	67.922	50.000	17.922
2000 SI	1	154,219	33	99.884	1.02950	202.6	287.67	345.00	-57.33

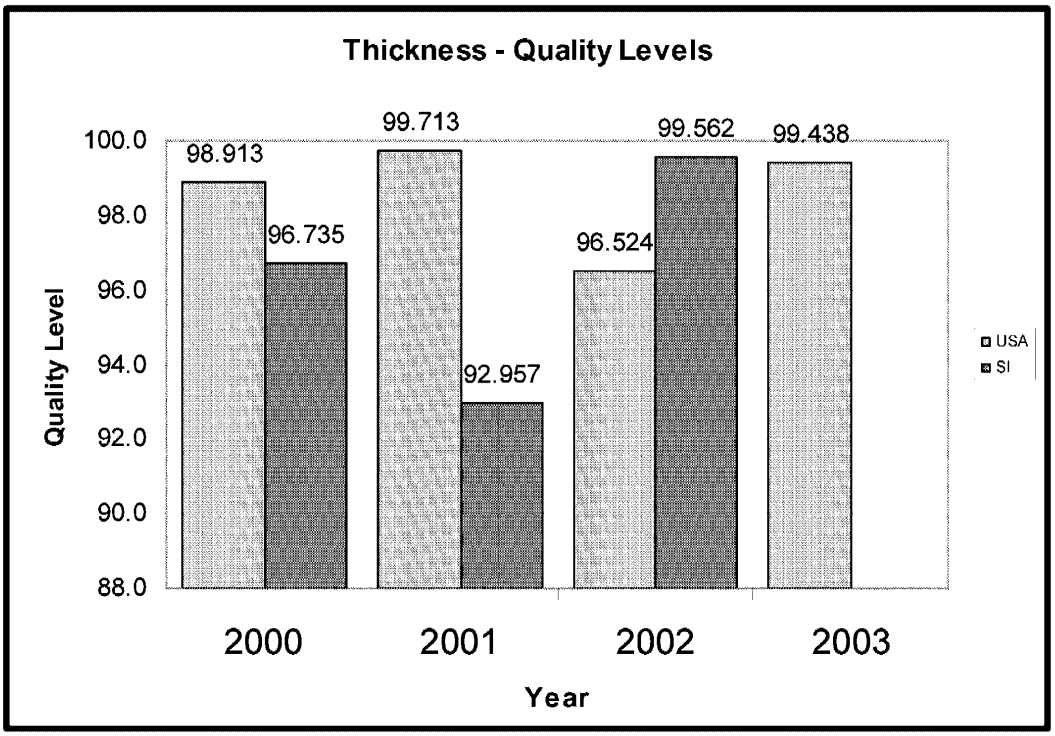

Figure 2. Thickness Quality Levels

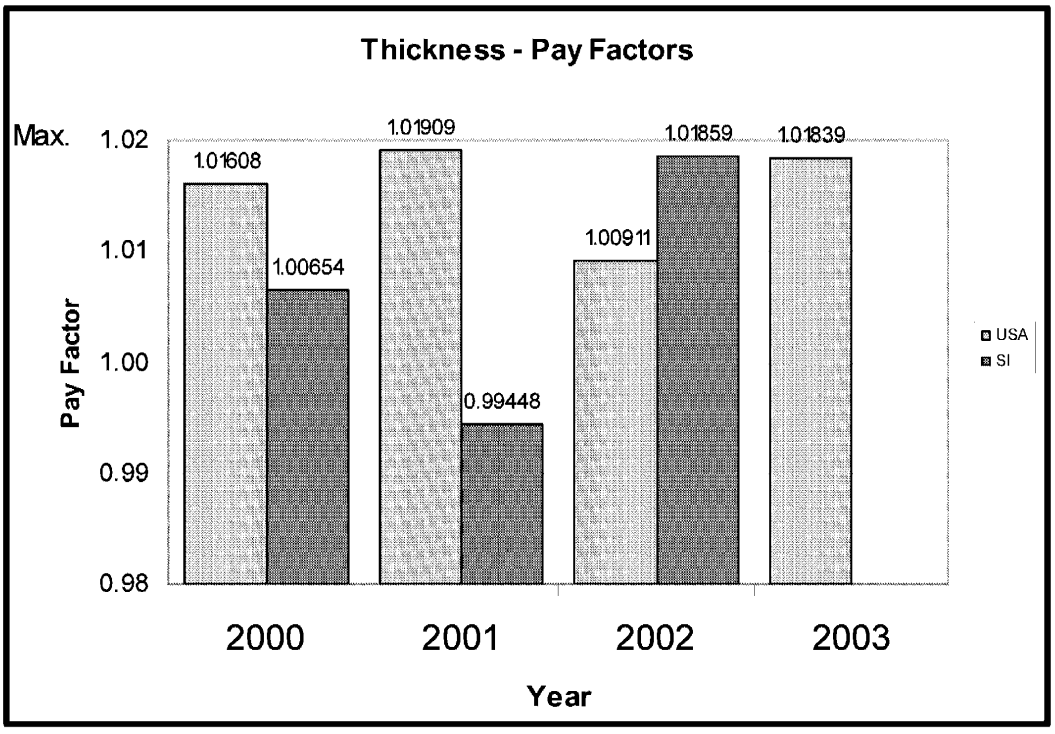

Figure 3. Thickness Pay Factors

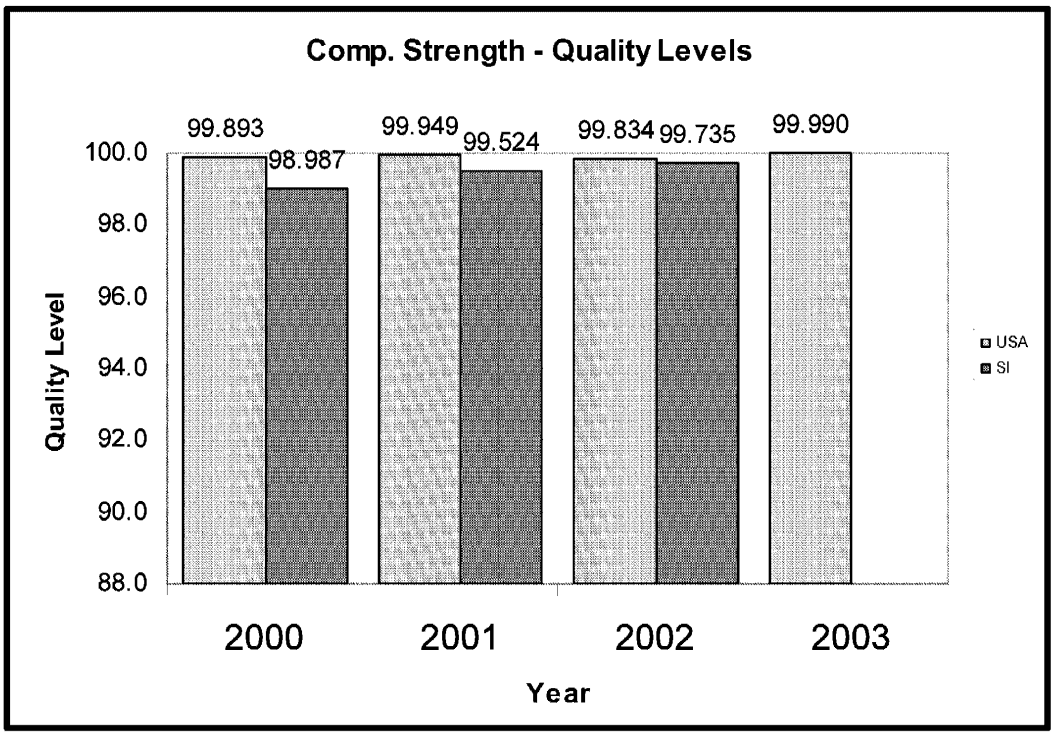

Figure 4. Compressive Strength Quality Levels

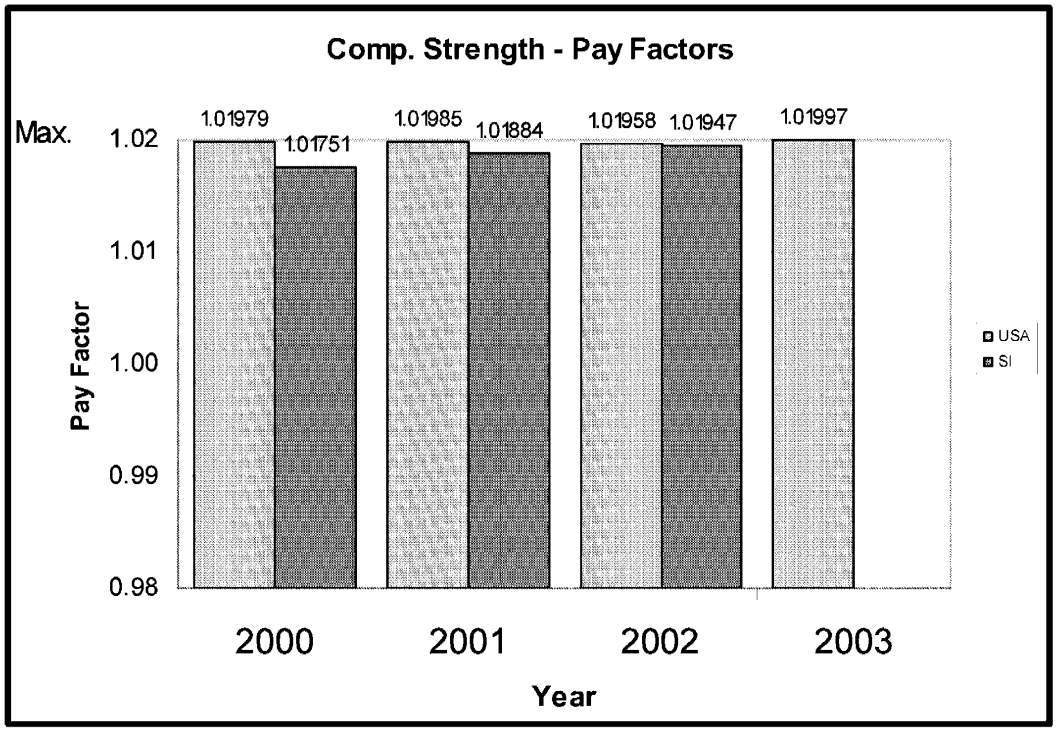

Figure 5. Compressive Strength Pay Factors

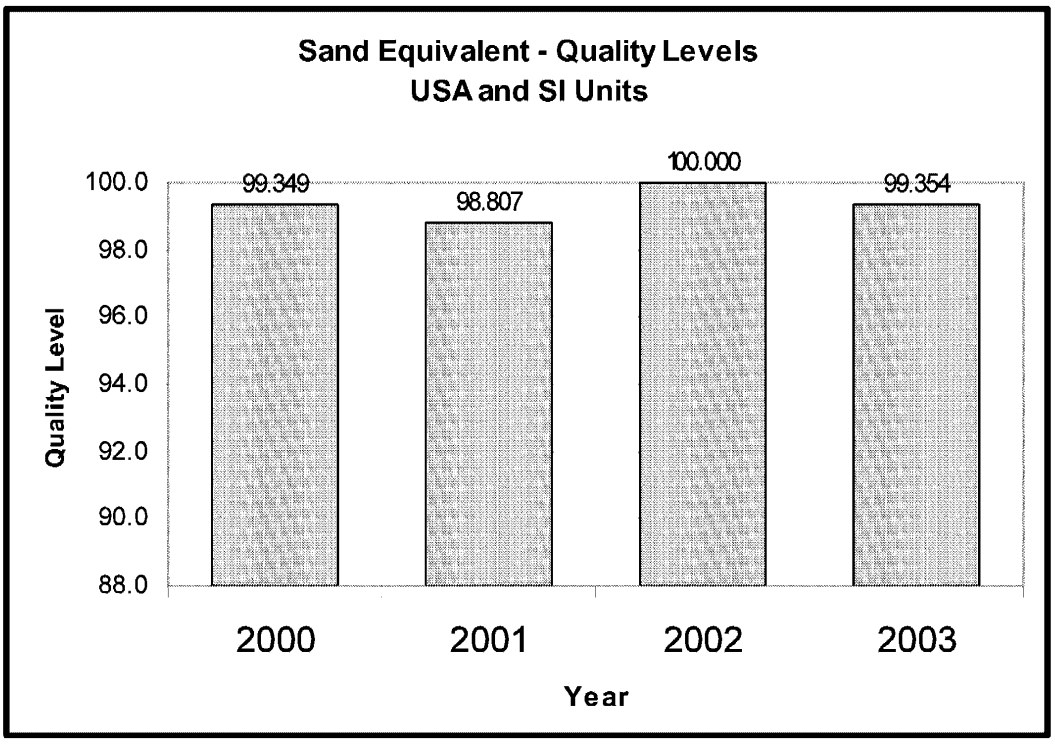

Figure 6. Sand Equivalent Quality Levels

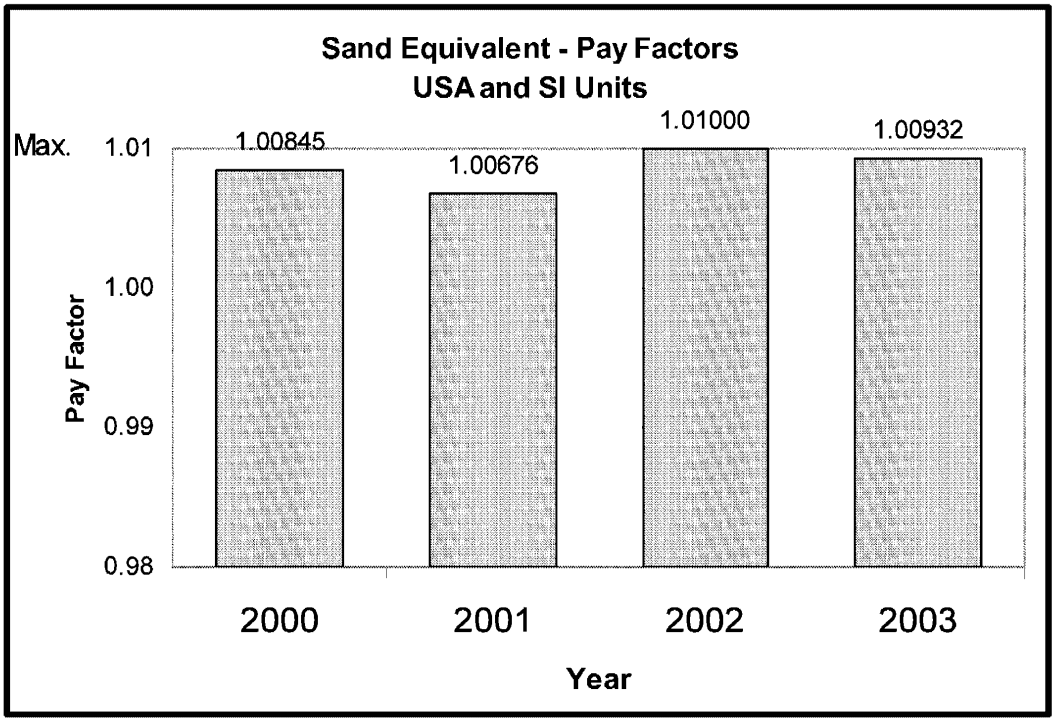

Figure 7. Sand Equivalent Pay Factors

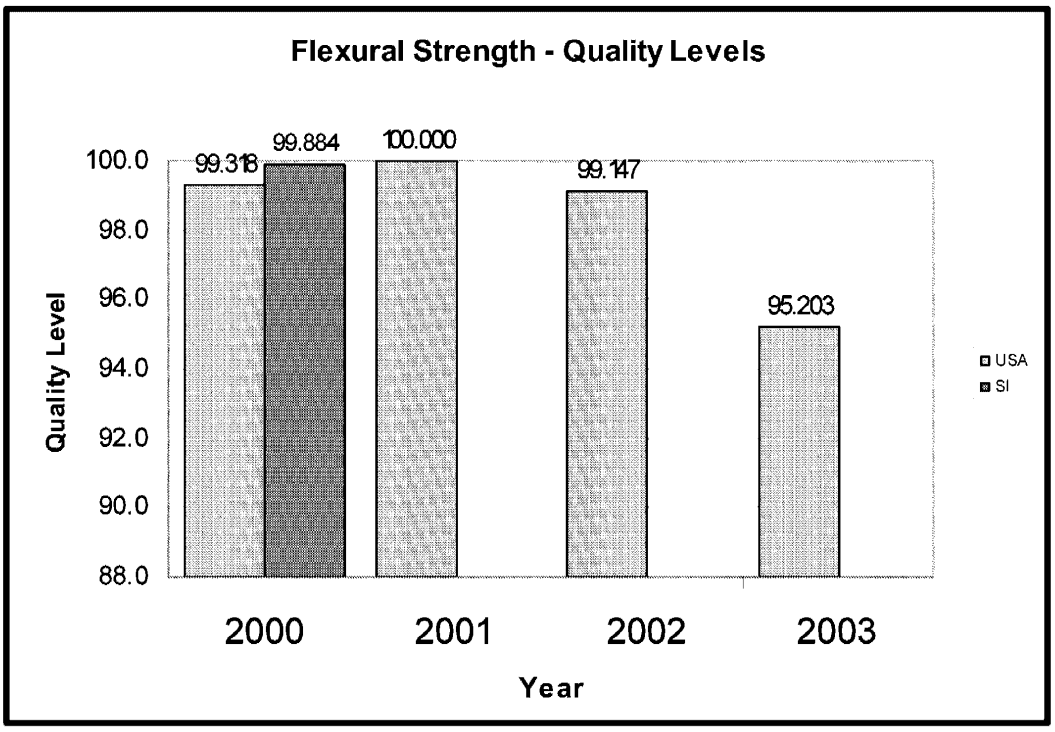

Figure 8. Flexural Strength Quality Levels

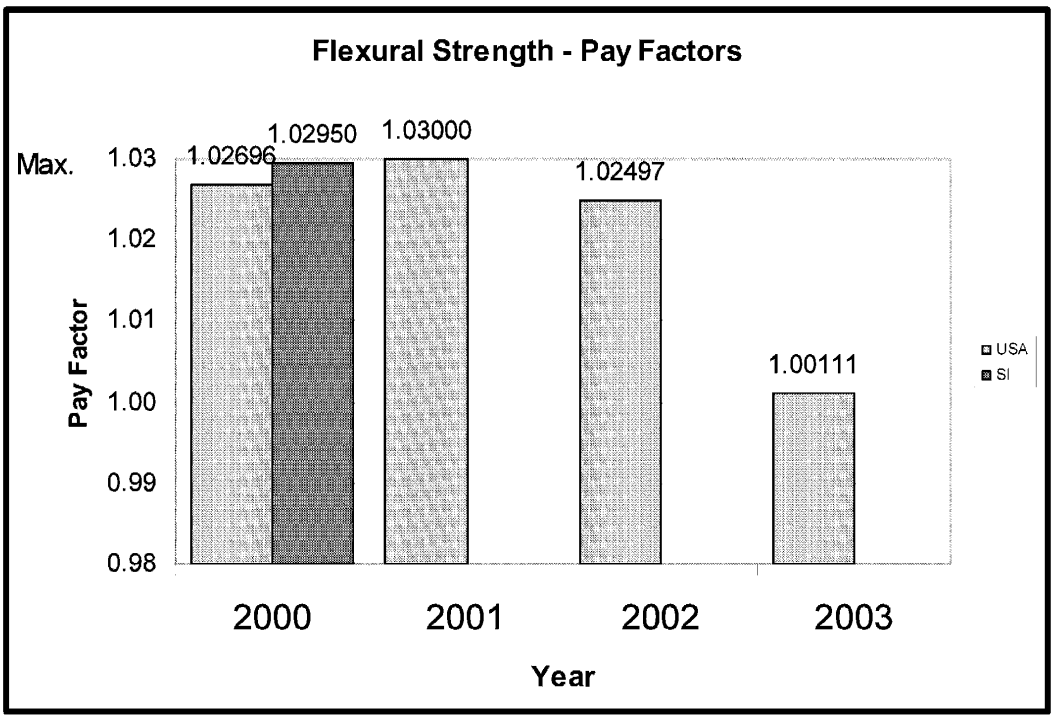

Figure 9. Flexural Strength Pay Factors

5.5 Test Element Quality Levels 2000 through 2003

Figures 10 and 11 show the comparison of the quality levels between the elements. Figure 10 shows each year's results and Figure 11 shows the weighted average for the four-year period. All of the test elements have very good quality levels with only one of the calculated quality levels below 97% within specification. The difference between elements is fairly small. The largest difference within any year is just over 4%. The largest difference over the four-year time period is approximately 1.5%. The good results shown in an element is not at the expense of another element. No one test element has significantly lower quality levels than of the others.

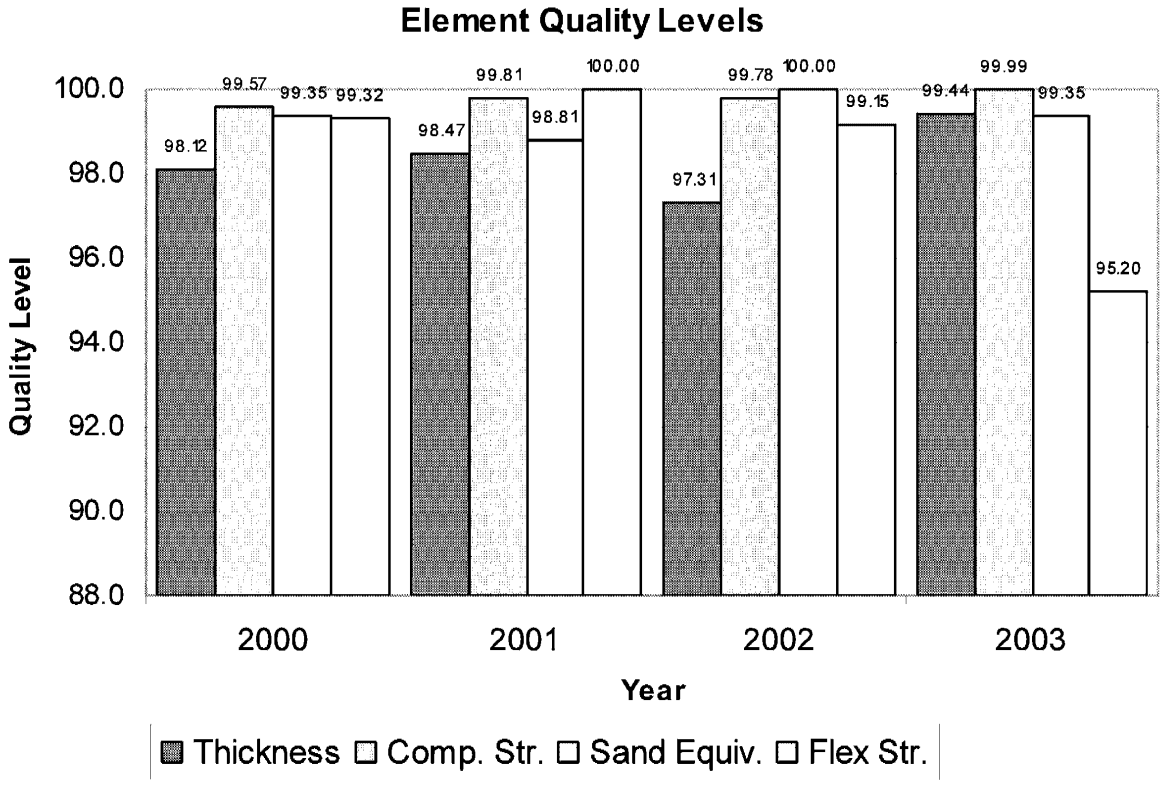

Figure 10. Quality Levels by Test Element

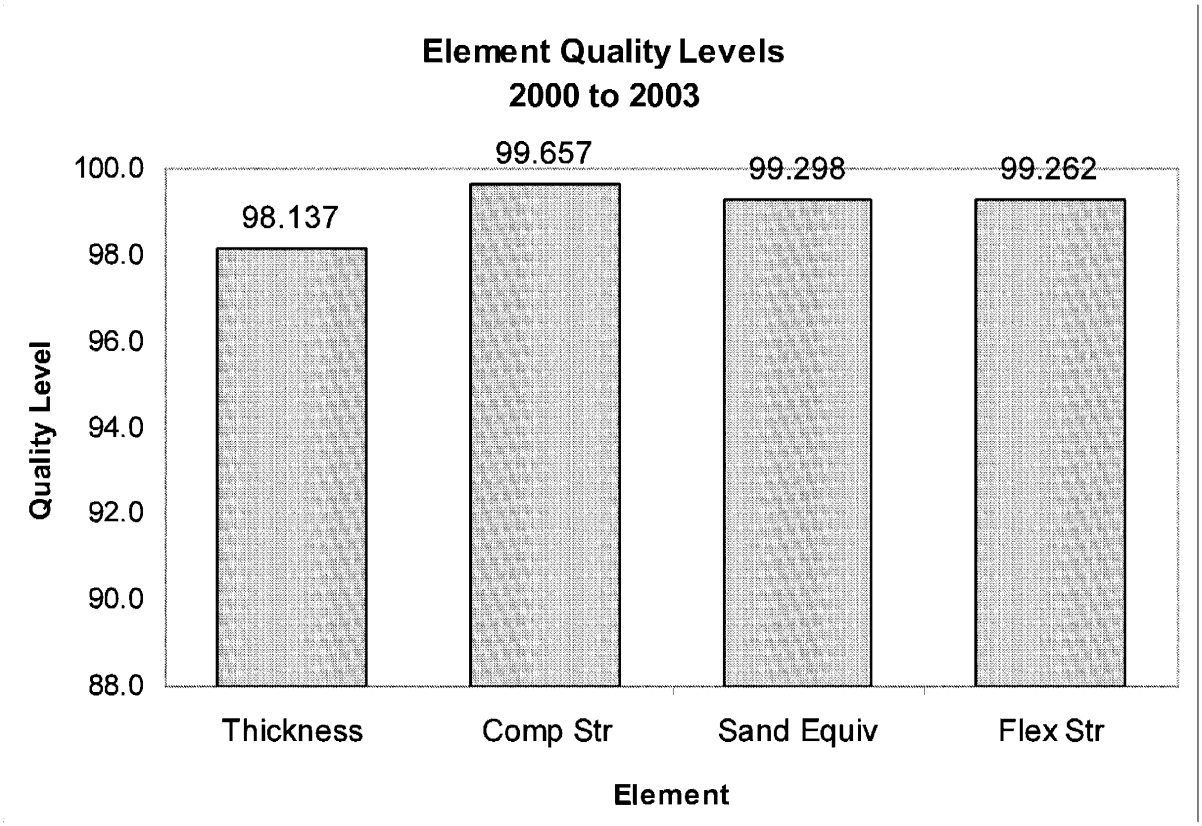

Figure 11. 2000 through 2003 Quality Levels by Test Element

5.6 Recap Reports for Data 2000 through 2003

Additional information on the calculations presented previously in this report can be found in the reports contained in Appendix A. A listing of projects for each year is contained in Report 1. Additional project information can be found in this report. The Calculated Pay Factor Composite and Incentive/Disincentive Payment information for each project is detailed in Report 2. The weighted average is calculated for CPFC and the average I/DP for all of the projects are given. The maximum and minimum values are also shown. The totals for each year are also calculated. A recap report for each of the test elements is also contained in Appendix A, Reports 3 to 6. These reports group the data by year and by testing unit, USA or SI, and are the best for comparing the data from year to year. The weighted average is calculated for quality level, pay factor, I/DP, mean to target value, standard deviation, and standard deviation minus V factor. The best and worst result is also given for each of the evaluations. Detailed reports for these elements appear in Appendices B, C, D, and E.

Note - The best or worst results displayed in the reports do not necessarily come from the same process. The calculations for quality level and pay factor are dependent on the number of test results included in the process and vary slightly with the number of tests. Also, the calculation for quality level is dependent on both the standard deviation of the process and the mean for the process as it relates to the specification limits. A low standard deviation does not necessarily mean a high quality level. Likewise, a larger standard deviation does not necessarily mean a lower quality level.

5.7 Detailed Reports for Yearly Data 2000 through 2003

Appendices B, C, D, & E contain a series of detailed reports for the each of the years 2000 through 2003. Reports covering: project data, thickness, compressive strength, sand equivalent, & flexural strength are presented in each of the appendices. All of the data used in the yearly calculations can be found in these reports. The project data report contains all of the test data for each project sorted by test element and then by process number. This is the only report which contains all of a project's data. Quality levels are not calculated on

processes that contain less than three tests. These processes are excluded from the reports that contain quality level evaluations. The calculation of CPFC is detailed for each project in the project data report. This report is the best report to review when concerned about any single project. Reports 8, 9, 10, and 11 are detailed reports for the thickness, compressive strength, sand equivalent, and flexural strength elements. All of the test data for each process by year is detailed in these reports. Detailed reports covering project listing, and Calculated Pay Factor Composite & Incentive/Disincentive Payment are found in Appendix A.

6.0 SUMMARY

The projects evaluated from 2000 through 2003 have shown good test results. In 2000 two projects received the maximum incentive of 5%. There was a total of ten projects that received better than 4.5% incentive from 2000 through 2003. The weighted average over the four-year period is 3.943%. Most of the yearly quality levels reported for the individual test elements are better than 98%. The worst is just slightly under 93% within specification. A very high percentage of the material being produced is within specification limits. The quality levels for the four-year time period are better than 99% in the compressive strength, sand equivalent, & flexural strength elements. The quality level in the thickness element is above 98%. Two factors govern the calculation for quality level for a process: the mean as it relates to the specification limits and the standard deviation. When evaluating the material to see how the mean compares to the specification limits we see the mean is well in excess of the lower specification limits and is usually above the calculated target value for the element, shown positive values in the mean to target value calculations. As the mean moves away from the specification limits the chance of the material being in specification increases. The second factor is the variability of the material or its standard deviation in comparison to the historical value, the V value. In most cases the material currently being produced has less variability than that historically produced. This is shown by negative values in the standard deviations minus V factor calculations. Good control of the material is being practiced and the results are exceeding those of the historical values. The difference between the quality levels reported in the four test elements is small. The difference is less than 2% over the four-year period. The two strength elements show the best quality levels but the difference between those and the worst is small. No one element has significantly better quality levels as compared to the other test elements.

7.0 UPDATES AND CONTACT

The QC database will be updated as additional project data is received. Project data that was received after the cut-off date was not able to be included in this report. If you have any questions concerning this report please contact Eric Chavez at 303 757-9308, Eric.Chavez@dot.state.co.us. If you find any errors in the project data please report them to Eric Chavez.

REFERENCES

Standard Recommended Practice for *Acceptance Sampling Plans for Highway Construction*, AASHTO Designation: R9-97 (2000)

Appendix A

Recap Reports for Project Data 2000 through 2003

Project Listing by Year/Subaccount

Criteria: Projects with Bid Dates from 1/1/2000 to 12/31/2003.

2000

Subacct.	Bid Date	Test Criteria	Reg.	Project Code	Location	Plan Quant	Units	Supplier
11848	08/10/00	Flex	1	NH 2854-068	Foxton Rd to Eagle	170,717	USA	11
11849	05/04/00	Flex	1	IM 0704-184	I-70, Byers - East	197,453	USA	12
11985	11/30/00	Flex	4	STA C370-004	US 6 & 385 Phillips	278,806	USA	14
12056	08/31/00	Comp	6	IMB 0761-172	I-76 & 120 th Ave	133,999	SI	15
12317	03/23/00	Comp	2	NH 2872-012	Wiley Jct - East	204,138	SI	5
12541	06/29/00	Comp	6	SP 2254-062	I-225 & Parker, Phase III	93,509	SI	9
12583	01/27/00	Comp	2	IM 0251-155	SH 50/SH47/I-25 Interchan	59,965	SI	13
12636	06/15/00	Flex	1	IM 0252-324	I-25 Climb Lanes	293,036	Si	5
12644	10/26/00	Comp	4	IM 0761-041	I-76 Sterling to Atwood	440,682	USA	12
12847	09/28/00	Comp	4	NH 2873-104	US 287 s/o SH 60 to 402	130,901	USA	10
13210	12/14/00	Comp	6	STA 1211-053	SH 121 C-470 to Parkhill	148,556	USA	5
93222	04/20/00	Comp	6	IM 2706-030	270 Phases II & III	108,722	USA	7

Compressive Strength:	**8**	**Units, USA:**	**7**	**Compressive:**	**1,320,472**
Flexural Strength:	**4**	**SI:**	**5**	**Flexural:**	**940,012**
Total:	**12**			**Total Plan Quantity:**	**2,260,484**

2001

Subacct.	Bid Date	Test Criteria	Reg.	Project Code	Location	Plan Quant	Units	Supplier
12390	08/16/01	Comp	2	IM 0851-002	SH 85 Fountain Int	26,705	USA	15
12489	05/24/01	Flex	1	C 0405-023	Jct SH 94 East & West	233,277	USA	5
12614	07/26/01	Comp	6	NH 0831-080	SH 83 Hampden to I-225	39,288	SI	9
12638	05/31/01	Comp	6	C 2706-031	SH 270 Phase IV	35,985	USA	7
13275	09/06/01	Comp	6	IM 0761-182	I-76 & 96th Ave.	63,819	USA	10
13294	08/09/01	Comp	1	NH 0831-084	SH 83 Whitetopping	109,535	USA	10
13390	01/11/01	Comp	2	IM 0252-342	I-25 Nevada/Tejon	72,644	SI	11

Compressive Strength:	**6**	**Units, USA:**	**5**	**Compressive:**	**347,976**
Flexural Strength:	**1**	**SI:**	**2**	**Flexural:**	**233,277**
Total:	**7**			**Total Plan Quantity:**	**581,253**

2002

Subacct.	Bid Date	Test Criteria	Reg.	Project Code	Location	Plan Quant	Units	Supplier
13278	12/12/02	Comp	6	STA 2873-112	SH 287 (Federal)	18,903	USA	10
13480	06/27/02	Comp	2	IM 0252-347	I-25 @ Monument Inter	111,318	SI	11
13529	07/25/02	Flex	4	STU 1192-011	Ken Pratt Blvd	157,674	USA	12
13573	04/18/02	Comp	6	NH 2254-064	Iliff and I-225	36,044	USA	9
13804	08/01/02	Comp	6	IM 0252-354	I-25/Broadway Viaduct	9,409	USA	9
13831	10/10/02	Flex	6	IM 0761-184	I-76 @ 88th Ave	77,247	USA	12

Compressive Strength:	**4**	**Units, USA:**	**5**	**Compressive:**	**175,674**
Flexural Strength:	**2**	**SI:**	**1**	**Flexural:**	**234,921**
Total:	**6**			**Total Plan Quantity:**	**410,595**

2003

Subacct.	Bid Date	Test Criteria	Reg.	Project Code	Location	Plan Quant	Units	Supplier
13858	02/20/03	Comp	6	STA 1211-056	104th & Wadsworth	102,013	USA	12
13897	02/27/03	Flex	1	NH 0852-088	US 85 - Sedalia	39,431	USA	17

Compressive Strength:	**1**	**Units, USA:**	**2**	**Compressive:**	**102,013**
Flexural Strength:	**1**	**SI:**	**0**	**Flexural:**	**39,431**
Total:	**2**			**Total Plan Quantity:**	**141,444**

Totals: 1/1/2000 to 12/31/2003.

Compressive Strength:	**19**	**Units, USA:**	**19**	**Compressive:**	**1,946,135**
Flexural Strength:	**8**	**SI:**	**8**	**Flexural:**	**1,447,641**
Total:	**27**			**Total Plan Quantity:**	**3,393,776**

Calculated Pay Factor Composite and I/DP by Year

Criteria: Projects with Bid Dates from 1/1/2000 to 12/31/2003.

PFC is back calculated from the Project's I/DP.

A Calculated Average Unit Price is used in the calculation.

2000	Subacct.	Bid Date	Region	Test Criteria	Units	Quantity	Ave. Price	CPFC	Project IDP
	13210	12/14/00	6	Comp	USA	155,409	$19.50	1.04995	$151,378.90
	11848	08/10/00	1	Flex	USA	171,047	$29.04	1.04921	$244,413.18
	12317	03/23/00	2	Comp	SI	206,382	$27.30	1.04915	$276,907.26
	12644	10/26/00	4	Comp	USA	439,889	$22.00	1.04561	$441,429.80
	11849	05/04/00	1	Flex	USA	102,150	$25.52	1.04386	$114,488.88
	11985	11/30/00	4	Flex	USA	288,305	$19.52	1.04103	$230,921.84
	93222	04/20/00	6	Comp	USA	114,585	$34.91	1.03732	$149,290.22
	12636	06/15/00	1	Flex	SI	309,605	$30.25	1.03282	$306,074.51
	12847	09/28/00	4	Comp	USA	130,376	$18.19	1.03115	$73,873.03
	12583	01/27/00	2	Comp	SI	43,698	$38.27	1.02804	$53,400.73
	12541	06/29/00	6	Comp	SI	93,976	$43.84	1.02665	$109,774.89
	12056	08/31/00	6	Comp	SI	133,449	$32.59	1.00953	$41,430.93
	Number of Projects: 12				**Total:**	2,188,871	**Max.**	1.04995	$441,429.80
							Min.	1.00953	$41,430.93
								Weighted Ave.	**Average**
								1.039379	$182,782.01

2001	Subacct.	Bid Date	Region	Test Criteria	Units	Quantity	Ave. Price	CPFC	Project IDP
	12489	05/24/01	1	Flex	USA	232,911	$26.22	1.05000	$305,316.23
	13275	09/06/01	6	Comp	USA	63,347	$32.00	1.05000	$101,346.69
	12638	05/31/01	6	Comp	USA	34,871	$34.00	1.04970	$58,924.49
	13294	08/09/01	1	Comp	USA	105,000	$20.00	1.04766	$100,084.14
	12390	08/16/01	2	Comp	USA	26,360	$41.69	1.03969	$43,617.66
	12614	07/26/01	6	Comp	SI	38,790	$47.67	1.02543	$47,034.10
	13390	01/11/01	2	Comp	SI	72,080	$45.65	1.00618	$20,318.88
	Number of Projects: 7				**Total:**	573,359	**Max.**	1.05000	$305,316.23
							Min.	1.00618	$20,318.88
								Weighted Ave.	**Average**
								1.041908	$96,663.17

Calculated Pay Factor Composite and I/DP by Year

2002	Subacct.	Bid Date	Region	Test Criteria	Units	Quantity	Ave. Price	CPFC	Project IDP
	13480	06/27/02	2	Comp	SI	111,177	$42.36	1.04529	$213,295.38
	13278	12/12/02	6	Comp	USA	16,609	$38.00	1.04390	$27,708.11
	13831	10/10/02	6	Flex	USA	92,389	$27.25	1.03869	$97,410.14
	13573	04/18/02	6	Comp	USA	60,000	$42.00	1.03794	$77,016.21
	13529	07/25/02	4	Flex	USA	137,704	$21.10	1.02834	$82,355.03
	13804	08/01/02	6	Comp	USA	9,390	$39.87	1.01008	$3,772.66
	Number of Projects: 6				**Total:**	427,269	**Max.**	1.04529	$213,295.38
							Min.	1.01008	$3,772.66
								Weighted Ave.	**Average**
								1.036540	$83,592.92

2003	Subacct.	Bid Date	Region	Test Criteria	Units	Quantity	Ave. Price	CPFC	Project IDP
	13858	02/20/03	6	Comp	USA	99,575	$14.35	1.04929	$70,430.27
	13897	02/27/03	1	Flex	USA	46,095	$24.47	1.01668	$18,814.20
	Number of Projects: 2				**Total:**	145,670	**Max.**	1.04929	$70,430.27
							Min.	1.01668	$18,814.20
								Weighted Ave.	**Average**
								1.038971	$44,622.24

Totals: *1/1/2000 to 12/31/2003.*

			CPFC	IDP
Number of Projects: 27	**Total:**	3,335,169	**Max.**	1.05000	$441,429.80
			Min.	1.00618	$3,772.66
			Weighted Ave.	1.039433	$128,178.83

Thickness Information, Recap by Year

Criteria: Projects with Bid Dates from 1/1/2000 to 12/31/2003.

Processes with less than 3 tests not included.

2000 USA

TV = PT + (0.65 * V)

			Quality Level	Pay Factor	I/DP	X - TV	St. Dev.	V	StDev - V
Processes:	17	**Best:**	100.000	1.02000	$95,397.03	0.440	0.189	0.400	-0.211
Tests:	388	**Worst:**	96.496	1.00999	$304.05	-0.261	0.434	0.400	0.034
SY:	1,355,922	**Weighted Ave.:**	98.913	1.01608	$29,192.70	0.148	0.330	0.400	-0.070

2001 USA

TV = PT + (0.65 * V)

			Quality Level	Pay Factor	I/DP	X - TV	St. Dev.	V	StDev - V
Processes:	6	**Best:**	100.000	1.02000	$122,108.43	0.543	0.272	0.400	-0.128
Tests:	152	**Worst:**	97.190	1.00876	$5,053.27	0.104	0.410	0.400	0.010
SY:	462,489	**Weighted Ave.:**	99.713	1.01909	$39,614.45	0.364	0.326	0.400	-0.074

2002 USA

TV = PT + (0.65 * V)

			Quality Level	Pay Factor	I/DP	X - TV	St. Dev.	V	StDev - V
Processes:	9	**Best:**	100.000	1.02000	$50,163.59	0.740	0.001	0.400	-0.399
Tests:	141	**Worst:**	53.919	0.83813	($12,872.77)	-0.510	1.058	0.400	0.658
SY:	311,092	**Weighted Ave.:**	96.524	1.00911	$9,254.43	0.154	0.416	0.400	0.016

2003 USA

TV = PT + (0.65 * V)

			Quality Level	Pay Factor	I/DP	X - TV	St. Dev.	V	StDev - V
Processes:	5	**Best:**	100.000	1.02000	$18,684.77	0.553	0.239	0.400	-0.161
Tests:	55	**Worst:**	98.096	1.01456	$1,904.64	0.112	0.482	0.400	0.082
SY:	145,670	**Weighted Ave.:**	99.438	1.01839	$9,102.23	0.357	0.316	0.400	-0.084

USA Totals: 1/1/2000 to 12/31/2003.

TV = PT + (0.65 * V)

			Quality Level	Pay Factor	I/DP	X - TV	St. Dev.	V	StDev - V
Processes:	37	**Best:**	100.000	1.02000	$122,108.43	0.740	0.001	0.400	-0.399
Tests:	736	**Worst:**	53.919	0.83813	($12,872.77)	-0.510	1.058	0.400	0.658
SY:	2,275,173	**Weighted Ave.:**	98.783	1.01589	$23,317.94	0.206	0.340	0.400	-0.060

2000 SI

			Quality Level	Pay Factor	TV = PT + (0.65 * V) I/DP	X - TV	St. Dev.	V	StDev - V
Processes:	22	**Best:**	100.000	1.02000	$102,409.92	12.070	3.819	10.000	-6.181
Tests:	329	**Worst:**	73.238	0.93874	($102,559.00)	-5.250	16.137	10.000	6.137
m2:	775,262	**Weighted Ave.:**	96.735	1.00654	$6,944.59	3.231	9.477	10.000	-0.523

2001 SI

			Quality Level	Pay Factor	TV = PT + (0.65 * V) I/DP	X - TV	St. Dev.	V	StDev - V
Processes:	6	**Best:**	100.000	1.02000	$13,774.44	13.500	10.000	10.000	0.000
Tests:	106	**Worst:**	87.807	0.96833	($44,735.99)	-2.750	14.094	10.000	4.094
m2:	103,776	**Weighted Ave.:**	92.957	0.99448	($4,683.94)	2.673	11.912	10.000	1.912

2002 SI

			Quality Level	Pay Factor	TV = PT + (0.65 * V) I/DP	X - TV	St. Dev.	V	StDev - V
Processes:	3	**Best:**	99.874	1.01964	$54,439.94	6.830	8.462	10.000	-1.538
Tests:	65	**Worst:**	98.158	1.01474	$10,026.46	5.500	11.410	10.000	1.410
m2:	109,507	**Weighted Ave.:**	99.562	1.01859	$28,502.51	6.433	9.057	10.000	-0.943

SI Totals: 1/1/2000 to 12/31/2003.

			Quality Level	Pay Factor	TV = PT + (0.65 * V) I/DP	X - TV	St. Dev.	V	StDev - V
Processes:	31	**Best:**	100.000	1.02000	$102,409.92	13.500	3.819	10.000	-6.181
Tests:	500	**Worst:**	73.238	0.93874	($102,559.00)	-5.250	16.137	10.000	6.137
m2:	988,545	**Weighted Ave.:**	96.652	1.00661	$6,780.16	3.527	9.686	10.000	-0.314

Compressive Strength Information, Recap by Year

Criteria: Projects with Bid Dates from 1/1/2000 to 12/31/2003.

Processes with less than 3 tests not included.

2000 USA

TV = LSL + (1.65 * V)

			Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Processes:	14	**Best:**	100.000	1.02000	$79,188.51	6,298	4,860	1,438	133.3	400.0	-266.7
Tests:	139	**Worst:**	97.071	1.01609	$925.63	4,613	4,860	-247	872.9	400.0	472.9
Sq Yds:	835,946	**Weighted Ave.:**	99.893	1.01979	$26,761.18	5,698	4,860	838	410.7	400.0	10.7

2001 USA

TV = LSL + (1.65 * V)

			Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Processes:	6	**Best:**	100.000	1.02000	$41,717.55	6,837	4,860	1,977	426.6	400.0	26.6
Tests:	103	**Worst:**	99.507	1.01859	$836.27	5,210	4,860	350	755.1	400.0	355.1
Sq Yds:	229,578	**Weighted Ave.:**	99.949	1.01985	$21,187.68	6,050	4,860	1,190	544.3	400.0	144.3

2002 USA

TV = LSL + (1.65 * V)

			Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Processes:	10	**Best:**	100.000	1.02000	$20,994.75	7,123	4,860	2,263	266.3	400.0	-133.7
Tests:	67	**Worst:**	90.650	1.00753	$186.91	5,051	4,860	191	1,251.6	400.0	851.6
Sq Yds:	94,573	**Weighted Ave.:**	99.834	1.01958	$7,627.09	6,010	4,860	1,150	450.5	400.0	50.5

2003 USA

TV = LSL + (1.65 * V)

			Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Processes:	3	**Best:**	100.000	1.02000	$18,645.62	5,337	4,860	477	132.0	400.0	-268.0
Tests:	26	**Worst:**	99.985	1.01996	$3,296.52	4,787	4,860	-73	380.0	400.0	-20.0
Sq Yds:	99,575	**Weighted Ave.:**	99.990	1.01997	$9,512.37	5,183	4,860	323	305.7	400.0	-94.3

USA Totals 1/1/2000 to 12/31/2003.

TV = LSL + (1.65 * V)

			Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Processes:	33	**Best:**	100.000	1.02000	$79,188.51	7,123	4,860	2,263	132.0	400.0	-268.0
Tests:	335	**Worst:**	90.650	1.00753	$186.91	4,613	4,860	-247	1,251.6	400.0	851.6
Sq Yds:	1,259,672	**Weighted Ave.:**	99.906	1.01980	$18,381.53	5,745	4,860	885	429.7	400.0	29.7

2000 SI

		Quality Level	Pay Factor	I/DP	TV = LSL + (1.65 * V) Mean	TV	X - TV	St. Dev.	V	StDev - V
Processes: 13	Best:	100.000	1.02000	$112,678.94	47.420	34.554	12.866	2.069	2.760	-0.691
Tests: 165	Worst:	78.500	0.96615	($25,259.60)	33.533	34.554	-1.021	9.679	2.760	6.919
m2: 460,645	Weighted Ave.:	98.987	1.01751	$19,789.71	40.577	34.554	6.023	2.917	2.760	0.157

2001 SI

		Quality Level	Pay Factor	I/DP	TV = LSL + (1.65 * V) Mean	TV	X - TV	St. Dev.	V	StDev - V
Processes: 7	Best:	100.000	1.02000	$28,250.73	45.776	34.554	11.222	2.994	2.760	0.234
Tests: 112	Worst:	97.941	1.01176	$2,646.59	36.900	34.554	2.346	5.104	2.760	2.344
m2: 106,566	Weighted Ave.:	99.524	1.01884	$13,089.84	42.424	34.554	7.870	3.835	2.760	1.075

2002 SI

		Quality Level	Pay Factor	I/DP	TV = LSL + (1.65 * V) Mean	TV	X - TV	St. Dev.	V	StDev - V
Processes: 8	Best:	100.000	1.02000	$21,400.57	48.100	34.554	13.546	1.501	2.760	-1.259
Tests: 61	Worst:	95.510	1.01102	$1,021.91	35.100	34.554	0.546	3.357	2.760	0.597
m2: 100,047	Weighted Ave.:	99.735	1.01947	$10,225.51	42.713	34.554	8.159	2.488	2.760	-0.272

SI Totals: 1/1/2000 to 12/31/2003.

		Quality Level	Pay Factor	I/DP	TV = LSL + (1.65 * V) Mean	TV	X - TV	St. Dev.	V	StDev - V
Processes: 28	Best:	100.000	1.02000	$112,678.94	48.100	34.554	13.546	1.501	2.760	-1.259
Tests: 338	Worst:	78.500	0.96615	($25,259.60)	33.533	34.554	-1.021	9.679	2.760	6.919
m2: 667,258	Weighted Ave.:	99.185	1.01802	$15,382.11	41.192	34.554	6.638	2.999	2.760	0.239

Sand Equivalent Information, USA and SI, Recap by Year

Criteria: Projects with Bid Dates from 1/1/2000 to 12/31/2003.

Processes with less than 3 tests not included.

2000

					TV = LSL + (1.65 * V)					
		Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Processes: 24	Best:	100.000	1.01000	$56,342.29	98.60	86.60	12.00	0.577	4.000	-3.423
Tests: 311	Worst:	90.960	0.98756	($18,808.65)	81.70	86.60	-4.90	5.500	4.000	1.500
SY/m2: 1,284,132	Weighted Ave.:	99.349	1.00845	$12,393.35	91.23	86.60	4.63	2.018	4.000	-1.982

2001

					TV = LSL + (1.65 * V)					
		Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Processes: 12	Best:	100.000	1.01000	$21,000.00	97.40	86.60	10.80	1.121	4.000	-2.879
Tests: 203	Worst:	90.728	0.97113	($19,999.42)	85.70	86.60	-0.90	5.994	4.000	1.994
SY/m2: 336,144	Weighted Ave.:	98.807	1.00676	$5,204.15	92.32	86.60	5.72	2.458	4.000	-1.542

2002

					TV = LSL + (1.65 * V)					
		Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Processes: 10	Best:	100.000	1.01000	$28,466.54	95.30	86.60	8.70	0.500	4.000	-3.500
Tests: 118	Worst:	100.000	1.01000	$93.48	90.70	86.60	4.10	2.309	4.000	-1.691
SY/m2: 134,080	Weighted Ave.:	100.000	1.01000	$5,549.74	91.34	86.60	4.74	1.282	4.000	-2.718

2003

					TV = LSL + (1.65 * V)					
		Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Processes: 3	Best:	100.000	1.01000	$9,179.79	91.20	86.60	4.60	1.528	4.000	-2.472
Tests: 27	Worst:	97.551	1.00755	$1,648.67	82.30	86.60	-4.30	4.236	4.000	0.236
SY/m2: 99,575	Weighted Ave.:	99.354	1.00932	$4,439.52	88.58	86.60	1.98	3.522	4.000	-0.478

Totals: 1/1/2000 to 12/31/2003.

					TV = LSL + (1.65 * V)					
		Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Processes: 49	Best:	100.000	1.01000	$56,342.29	98.60	86.60	12.00	0.500	4.000	-3.500
Tests: 659	Worst:	90.728	0.97113	($19,999.42)	81.70	86.60	-4.90	5.994	4.000	1.994
SY/m2: 1,853,931	Weighted Ave.:	99.298	1.00830	$8,749.10	91.30	86.60	4.70	2.125	4.000	-1.875

Flexural Strength Information, Recap by Year

Criteria: Projects with Bid Dates from 1/1/2000 to 12/31/2003.

Processes with less than 3 tests not included.

2000 Totals USA		Quality Level	Pay Factor	I/DP	TV = LSL + (V * 1.65) Mean	TV	X - TV	St. Dev	V	StDev - V
Processes: 11	**Best:**	100.000	1.03000	$163,383.72	707.6	652.5	55.1	9.363	50.000	-40.637
Tests: 152	**Worst:**	74.096	0.90964	($4,522.63)	601.9	652.5	-50.6	47.730	50.000	-2.270
SY: 711,869	**Weighted Ave.:**	99.318	1.02696	$42,807.91	679.8	652.5	27.3	34.593	50.000	-15.407

2001 Totals USA		Quality Level	Pay Factor	I/DP	TV = LSL + (V * 1.65) Mean	TV	X - TV	St. Dev	V	StDev - V
Processes: 2	**Best:**	100.000	1.03000	$182,487.27	752.7	652.5	100.2	47.776	50.000	-2.224
Tests: 27	**Worst:**	100.000	1.03000	$720.53	720.0	652.5	67.5	55.678	50.000	5.678
SY: 232,911	**Weighted Ave.:**	100.000	1.03000	$91,603.90	752.6	652.5	100.1	47.807	50.000	-2.193

2002 Totals USA		Quality Level	Pay Factor	I/DP	TV = LSL + (V * 1.65) Mean	TV	X - TV	St. Dev	V	StDev - V
Processes: 2	**Best:**	99.911	1.02962	$76,979.93	694.7	652.5	42.2	23.188	50.000	-26.812
Tests: 62	**Worst:**	98.128	1.01877	$47,246.55	632.9	652.5	-19.6	61.074	50.000	11.074
SY: 215,555	**Weighted Ave.:**	99.147	1.02497	$62,113.24	659.4	652.5	6.9	39.426	50.000	-10.574

2003 Totals USA		Quality Level	Pay Factor	I/DP	TV = LSL + (V * 1.65) Mean	TV	X - TV	St. Dev	V	StDev - V
Processes: 2	**Best:**	100.000	1.03000	$2,856.96	693.5	652.5	41.0	33.421	50.000	-16.579
Tests: 41	**Worst:**	94.860	0.99905	($979.29)	683.2	652.5	30.7	70.386	50.000	20.386
SY: 46,095	**Weighted Ave.:**	95.203	1.00111	$938.84	683.9	652.5	31.4	67.922	50.000	17.922

USA Totals: 1/1/2000 to 12/31/2003		Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev	V	StDev - V
Processes: 17	**Best:**	100.000	1.03000	$182,487.27	752.7	652.5	100.2	9.363	50.000	-40.637
Tests: 282	**Worst:**	74.096	0.90964	($4,522.63)	601.9	652.5	-50.6	70.386	50.000	20.386
SY: 1,206,430	**Weighted Ave.:**	99.262	1.02620	$45,894.06	690.3	652.5	37.8	39.281	50.000	-10.719

Flexural Strength Information, Recap by Year

2000 Totals SI		Quality Level	Pay Factor	I/DP	TV = LSL + (V * 1.65) Mean	TV	X - TV	St. Dev	V	StDev - V
Processes: 3	Best:	100.000	1.03000	$81,340.03	5,092.0	4,499.3	592.8	211.000	345.000	134.000
Tests: 33	Worst:	99.809	1.02918	$25,084.51	4,507.0	4,499.3	7.8	416.000	345.000	71.000
m2: 154,219	Weighted Ave.:	99.884	1.02950	$45,229.93	4,701.8	4,499.3	202.6	287.667	345.000	-57.333

SI Totals: 1/1/2000 to 12/31/2003		Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev	V	StDev - V
Processes: 3	Best:	100.000	1.03000	$81,340.03	5,092.0	4,499.3	592.8	211.000	345.000	134.000
Tests: 33	Worst:	99.809	1.02918	$25,084.51	4,507.0	4,499.3	7.8	416.000	345.000	71.000
m2: 154,219	Weighted Ave.:	99.884	1.02950	$45,229.93	4,701.8	4,499.3	202.6	287.667	345.000	-57.333

Appendix B

Reports for 2000 Projects

Project Data

Criteria: Projects with Bid Dates from 1/1/00 to 12/31/00.

11848 *NH 2854-068* *Foxton Rd to Eagle* *Region: 1* *Supplier: 14*

Bid Date: 8/10/2000 *Criteria: Flex* *Units: USA* *Total Bid: $21,100,930.37*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	10.00	$29.04	171,047	44	99.801	1.01921	$95,397.03	10.353	10.260	0.093	0.273	0.400	-0.127

Flexural Strength

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	IDP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	10.00	$29.04	171,047	18	100.000	1.03000	$149,016.15	663.600	652.500	11.100	9.363	50.000	-40.637

Project Totals: 11848

	Tests:	Quant:	IDP:
Thickness	44	171,047	$95,397.03
Comp Str.			
Sand Equivalent			
Flexural St.	18	171,047	$149,016.15
Plan Quant:		170,717	$244,413.18

Sum of Quantities:	342,094.0
Ave Quant:	171,047
Ave Price from Thickness:	$29.04

Project I/DP *Ave Price* *Ave Tons*

CPFC ($244,413.18 / ($29.04 * 171,047)) + 1 = 1.04921

Comments:

11849 *IM 0704-184* *I-70, Byers - East* *Region: 1* *Supplier: 12*

Bid Date: 5/4/2000 *Criteria: Flex* *Units: USA* *Total Bid: $8,286,657.80*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	11.00	$24.53	62,865	22	99.923	1.01978	$30,502.70	11.552	11.260	0.292	0.335	0.400	-0.065
2	8.00	$48.82	2,665	4	100.000	1.02000	$2,601.46	8.158	8.260	-0.102	0.189	0.400	-0.211
3	13.00	$25.53	36,620	12	100.000	1.02000	$18,697.24	13.678	13.260	0.418	0.284	0.400	-0.116

Flexural Strength

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	IDP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	11.00	$24.90	79,916	32	99.517	1.02710	$53,927.02	666.563	652.500	14.063	39.112	50.000	-10.888
2	11.00	$24.90	17,809	11	99.989	1.02995	$13,283.09	685.455	652.500	32.955	42.922	50.000	-7.078
3	11.00	$24.90	2,010	8	74.096	0.90964	($4,522.63)	601.875	652.500	-50.625	47.730	50.000	-2.270
4	8.00	$48.82	2,665	2			$0.00		652.500			50.000	

Project Totals: 11849

	Tests:	Quant:	IDP:
Thickness	38	102,150	$51,801.40
Comp Str.			
Sand Equivalent			
Flexural St.	53	102,400	$62,687.48
Plan Quant:		197,453	$114,488.88

Sum of Quantities:	204,550.0
Ave Quant:	102,275
Ave Price from Thickness:	$25.52

Project I/DP *Ave Price* *Ave Tons*

CPFC ($114,488.88 / ($25.52 * 102,275)) + 1 = 1.04386

Comments: Quantities and prices?

11985 *STA C370-004* *US 6 & 385 Phillips* *Region: 4* *Supplier: 14*

Bid Date: 11/30/2000 *Criteria: Flex* *Units: USA* *Total Bid: $7,033,260.32*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	8.00	$19.52	276,046	76	97.712	1.01085	$58,460.13	8.389	8.260	0.129	0.399	0.400	-0.001
2	8.00	$19.52	7,480	15	99.790	1.01940	$2,832.44	8.687	8.260	0.427	0.434	0.400	0.034
3	8.00	$19.52	779	4	100.000	1.02000	$304.05	8.700	8.260	0.440	0.245	0.400	-0.155
4	8.00	$19.52	4,000	4	100.000	1.02000	$1,561.21	8.525	8.260	0.265	0.427	0.400	0.027

Flexural Strength

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	IDP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	8.00	$19.52	280,825	29	99.968	1.02981	$163,383.72	707.600	652.500	55.100	44.413	50.000	-5.587
2	8.00	$19.52	7,480	10	100.000	1.03000	$4,380.29	694.000	652.500	41.500	27.669	50.000	-22.331

Project Totals: 11985

	Tests:	Quant:	IDP:
Thickness	99	288,305	$63,157.83
Comp Str.			
Sand Equivalent Flexural St.	39	288,305	$167,764.01
Plan Quant:		278,806	$230,921.84

Sum of Quantities:	576,610.0
Ave Quant:	288,305
Ave Price from Thickness:	$19.52

Project I/DP *Ave Price* *Ave Tons*

CPFC ($230,921.84 / ($19.52 * 288,305)) + 1 = 1.04103

Comments:

12056 *IMB 0761-172* *I-76 & 120 th Ave* *Region: 6* *Supplier: 4*

Bid Date: 8/31/2000 *Criteria: Comp* *Units: SI* *Total Bid: $19,237,802.68*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
2	275.00	$33.00	9,415	12	100.000	1.02000	$6,213.58	291.670	281.500	10.170	8.682	10.000	-1.318
3	290.00	$33.50	15,347	19	97.479	1.01280	$6,578.39	298.750	296.500	2.250	10.009	10.000	0.009
4	315.00	$34.00	10,860	11	95.895	1.00827	$3,054.33	330.250	321.500	8.750	15.431	10.000	5.431
5	330.00	$32.25	97,827	38	90.189	0.96749	$102,559.00)	336.510	336.500	0.010	12.834	10.000	2.834

Compresive Strength

TV = LSL + (V * 1.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std Dev - V
2	275.00	$33.00	9,415	12	100.000	1.02000	$6,213.59	41.758	34.554	7.204	2.675	2.760	-0.085
3	290.00	$33.50	15,347	25	100.000	1.02000	$10,281.98	41.542	34.554	6.988	2.697	2.760	-0.063
4	315.00	$34.00	10,860	14	99.962	1.01989	$7,344.17	39.842	34.554	5.288	3.583	2.760	0.823
5	330.00	$32.25	97,827	42	99.983	1.01993	$62,883.80	39.812	34.554	5.258	2.945	2.760	0.185

Sand Equivalent

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	X - TV	St Dev	V	St Dev - V
2	275.00	$33.00	9,415	12	100.000	1.01000	$3,106.95	90.50	86.60	3.90	2.276	4.000	-1.724
3	290.00	$33.50	15,347	25	100.000	1.01000	$5,141.25	90.70	86.60	4.10	2.610	4.000	-1.390
4	315.00	$34.00	10,860	14	96.349	1.00479	$1,767.17	87.30	86.60	0.70	4.250	4.000	0.250
5	330.00	$32.25	97,827	43	99.977	1.00995	$31,404.72	89.00	86.60	2.40	2.734	4.000	-1.266

Project Totals: 12056

	Tests:	Quant:	IDP:
Thickness	80	133,449	($86,712.70)
Comp Str.	93	133,449	$86,723.54
Sand Equivalent	94	133,449	$41,420.09
Flexural St.			
Plan Quant:		133,999	$41,430.93

Sum of Quantities: 400,347.0
Ave Quant: 133,449
Ave Price from Thickness: $32.59

Project I/DP *Ave Price* *Ave Tons*

CPFC ($41,430.93 / ($32.59 * 133,449)) + 1 = 1.00953

Comments:

12317 *NH 2872-012* *Wiley Jct - East* *Region: 2* *Supplier: 5*

Bid Date: 3/23/2000 *Criteria: Comp* *Units: SI* *Total Bid: $10,791,141.30*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	275.00	$27.30	196,350	62	99.776	1.01911	$102,409.92	288.810	281.500	7.310	8.640	10.000	-1.360
2	275.00	$27.30	3,344	4	100.000	1.02000	$1,825.37	291.880	281.500	10.380	4.732	10.000	-5.268
3	275.00	$27.30	3,344	4	100.000	1.02000	$1,825.37	279.380	281.500	-2.120	4.270	10.000	-5.730
4	275.00	$27.30	3,344	4	100.000	1.02000	$1,825.37	293.130	281.500	11.630	7.739	10.000	-2.261

Compresive Strength

TV = LSL + (V * 1.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std Dev - V
1	275.00	$27.30	206,382	25	100.000	1.02000	$112,678.94	41.876	34.554	7.322	2.254	2.760	-0.506

Sand Equivalent

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	X - TV	St Dev	V	St Dev - V
1	275.00	$27.30	206,382	25	100.000	1.01000	$56,342.29	89.10	86.60	2.50	2.068	4.000	-1.932

Project Totals: 12317

	Tests:	Quant:	IDP:
Thickness	74	206,382	$107,886.03
Comp Str.	25	206,382	$112,678.94
Sand Equivalent	25	206,382	$56,342.29
Flexural St.			
Plan Quant:	204,138		$276,907.26

Sum of Quantities:	619,146.0
Ave Quant:	206,382
Ave Price from Thickness:	$27.30

Project I/DP *Ave Price* *Ave Tons*

CPFC ($276,907.26 / ($27.30 * 206,382)) + 1 = **1.04915**

Comments:

12541 *SP 2254-062* *I-225 & Parker, Phase III* *Region: 6* *Supplier: 4*

Bid Date: 6/29/2000 *Criteria: Comp* *Units: SI* *Total Bid: $47,844,551.57*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	265.00	$36.30	20,555	7	100.000	1.02000	$14,922.93	281.790	271.500	10.290	5.537	10.000	-4.463
2	300.00	$47.50	3,772	2		1.00000	$0.00		306.500			10.000	
3	240.00	$42.50	33,051	10	95.201	1.00629	$8,832.92	249.500	246.500	3.000	12.349	10.000	2.349
4	240.00	$47.00	6,160	2		1.00000	$0.00		246.500			10.000	
5	265.00	$49.50	21,337	7	100.000	1.02000	$21,123.63	283.570	271.500	12.070	9.449	10.000	-0.551
6	315.00	$48.80	9,101	3	100.000	1.02000	$8,880.36	320.000	321.500	-1.500	4.330	10.000	-5.670

Compresive Strength

TV = LSL + (V * 1.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std Dev - V
1	265.00	$36.30	20,555	3	78.500	0.96615	($25,259.60)	33.533	34.554	-1.021	3.921	2.760	1.161
2	300.00	$47.50	3,772	1		1.00000	$0.00		34.554			2.760	
3	240.00	$42.50	33,051	4	100.000	1.02000	$28,086.33	36.300	34.554	1.746	2.702	2.760	-0.058
4	240.00	$47.00	6,160	1		1.00000	$0.00		34.554			2.760	
5	265.00	$49.50	21,337	3	100.000	1.02000	$21,118.35	37.367	34.554	2.813	5.811	2.760	3.051
6	315.00	$48.80	9,101	2		1.00000	$0.00		34.554			2.760	

Sand Equivalent

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	X - TV	St Dev	V	St Dev - V
1	265.00	$36.30	20,555	3	100.000	1.01000	$7,461.47		86.60			4.000	
2	300.00	$47.50	3,772	1		1.00000	$0.00		86.60			4.000	
3	240.00	$42.50	33,051	4	100.000	1.01000	$14,046.68	89.30	86.60	2.70	5.500	4.000	1.500
4	240.00	$47.00	6,160	1		1.00000	$0.00		86.60			4.000	
5	265.00	$49.50	21,337	3	100.000	1.01000	$10,561.82	95.30	86.60	8.70	0.577	4.000	-3.423
6	315.00	$48.80	9,101	2		1.00000	$0.00		86.60			4.000	

Project Totals: 12541

	Tests:	Quant:	IDP:
Thickness	31	93,976	$53,759.84
Comp Str.	14	93,976	$23,945.08
Sand Equivalent	14	93,976	$32,069.97
Flexural St.			
Plan Quant:		93,509	$109,774.89

Sum of Quantities: 281,928.0
Ave Quant: 93,976
Ave Price from Thickness: $43.84

Project I/DP *Ave Price* *Ave Tons*

CPFC ($109,774.89 / ($43.84 * 93,976)) + 1 = **1.02665**

Comments:

12583 *IM 0251-155* *SH 50/SH47/I-25 Interchan* *Region: 2* *Supplier: 12*

Bid Date: 1/27/2000 *Criteria: Comp* *Units: SI* *Total Bid: $17,416,939.28*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	210.00	$34.40	1,701	3	100.000	1.02000	$1,170.00	218.330	216.500	1.830	3.819	10.000	-6.181
2	250.00	$36.60	7,152	10	95.570	1.00734	$1,922.11	256.750	256.500	0.250	10.412	10.000	0.412
3	250.00	$36.60	52	1		1.00000	$0.00		256.500			10.000	
4	250.00	$36.60	490	1		1.00000	$0.00		256.500			10.000	
5	260.00	$37.20	5,724	4	73.238	0.93874	($13,043.63)	261.250	266.500	-5.250	16.137	10.000	6.137
6	275.00	$38.00	4,964	4	100.000	1.02000	$3,771.70	279.380	281.500	-2.120	9.437	10.000	-0.563
7	300.00	$39.40	22,777	16	94.974	1.00564	$5,062.36	306.410	306.500	-0.090	10.286	10.000	0.286
8	300.00	$39.40	838	2		1.00000	$0.00		306.500			10.000	

Compresive Strength

TV = LSL + (V * 1.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std Dev - V
1	210.00	$34.40	1,799	3	100.000	1.02000	$1,237.40	38.767	34.554	4.213	7.206	2.760	4.446
2	210.00	$34.40	590	1		1.00000	$0.00		34.554			2.760	
3	210.00	$34.40	64	1		1.00000	$0.00		34.554			2.760	
4	250.00	$36.60	5,700	5	96.042	1.01472	$3,070.71	44.440	34.554	9.886	9.679	2.760	6.919
5	250.00	$36.60	245	2		1.00000	$0.00		34.554			2.760	
6	250.00	$36.60	490	1		1.00000	$0.00		34.554			2.760	
7	260.00	$37.20	10,825	9	100.000	1.02000	$8,053.80	42.556	34.554	8.002	2.069	2.760	-0.691
8	260.00	$37.20	45	1		1.00000	$0.00		34.554			2.760	
9	250.00	$36.60	18	1		1.00000	$0.00		34.554			2.760	
10	275.00	$38.00	5,300	5	100.000	1.02000	$4,026.99	47.420	34.554	12.866	4.480	2.760	1.720
11	300.00	$39.40	22,247	15	100.000	1.02000	$17,529.76	43.587	34.554	9.033	3.448	2.760	0.688
12	300.00	$39.40	826	1		1.00000	$0.00		34.554			2.760	
13	300.00	$39.40	838	2		1.00000	$0.00		34.554			2.760	
14	300.00	$39.40	120	1		1.00000	$0.00		34.554			2.760	
15	300.00	$39.40	77	1		1.00000	$0.00		34.554			2.760	

Sand Equivalent

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	X - TV	St Dev	V	St Dev - V
1	210.00	$34.40	2,755	6	100.000	1.01000	$947.72	87.80	86.60	1.20	1.329	4.000	-2.671
2	210.00	$34.40	125	1		1.00000	$0.00		86.60			4.000	
3	250.00	$36.60	7,830	10	100.000	1.01000	$2,865.78	87.70	86.60	1.10	2.710	4.000	-1.290
4	250.00	$36.60	37	2		1.00000	$0.00		86.60			4.000	
5	250.00	$36.60	490	1		1.00000	$0.00		86.60			4.000	
6	260.00	$37.20	10,211	7	100.000	1.01000	$3,798.49	87.60	86.60	1.00	1.718	4.000	-2.282
7	260.00	$37.20	45	1		1.00000	$0.00		86.60			4.000	
8	260.00	$37.20	81	1		1.00000	$0.00		86.60			4.000	
9	260.00	$37.20	81	1		1.00000	$0.00		86.60			4.000	
10	275.00	$38.00	5,696	6	100.000	1.01000	$2,164.48	88.50	86.60	1.90	1.517	4.000	-2.483
11	275.00	$38.00	522	2		1.00000	$0.00		86.60			4.000	

12	300.00	$39.40	27,485	20	99.994	1.00999	$10,823.06	88.30	86.60	1.70	2.573	4.000	-1.427
13	300.00	$39.40	236	2		1.00000	$0.00		86.60			4.000	
14	300.00	$39.40	838	2		1.00000	$0.00		86.60			4.000	

Project Totals: 12583		**Tests:**	**Quant:**	**IDP:**		
	Thickness	41	43,698	($1,117.46)	**Sum of Quantities:**	149,314.0
	Comp Str.	49	49,184	$33,918.66	**Ave Quant:**	49,771
	Sand Equivalent	62	56,432	$20,599.53	**Ave Price**	
	Flexural St.				**from Thickness:**	$38.27
	Plan Quant:		59,965	$53,400.73		

Project I/DP *Ave Price* *Ave Tons*

CPFC ($53,400.73 / ($38.27 * 49,771)) + 1 = **1.02804**

Comments: Final quantities not equal.

12636 *IM 0252-324* *I-25 Climb Lanes* *Region: 1* *Supplier: 5*

Bid Date: 6/15/2000 *Criteria: Flex* *Units: Si* *Total Bid: $26,693,265.72*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	320.00	$29.82	202,545	63	99.207	1.01683	$101,636.04	327.820	326.500	1.320	7.533	10.000	-2.467
2	320.00	$29.83	56,775	25	89.409	0.97810	($37,072.01)	322.400	326.500	-4.100	9.986	10.000	-0.014
3	320.00	$29.82	20,710	10	95.548	1.00728	$4,495.86	330.750	326.500	4.250	12.913	10.000	2.913
4	320.00	$29.82	12,929	7	100.000	1.02000	$7,710.86	335.360	326.500	8.860	10.842	10.000	0.842
5	320.00	$29.82	536	1			$0.00		326.500			10.000	
6	320.00	$38.00	16,110	6	91.792	1.00358	$2,194.54	327.920	326.500	1.420	13.548	10.000	3.548

Flexural Strength

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	IDP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	320.00	$29.82	28,040	6	100.000	1.03000	$25,084.51	5,092.000	4,499.250	592.750	416.000	345.000	71.000
2	320.00	$29.82	32,713	7	100.000	1.03000	$29,265.26	4,507.000	4,499.250	7.750	211.000	345.000	-134.000
3	320.00	$29.82	93,466	20	99.809	1.02918	$81,340.03	4,653.000	4,499.250	153.750	276.000	345.000	-69.000
4	320.00	$29.82	100,386	18	96.216	1.01378	$41,257.53	647.500	652.500	-5.000	45.090	50.000	-4.910
5	320.00	$29.82	21,564	12	100.000	1.03000	$19,291.15	669.200	652.500	16.700	30.289	50.000	-19.711
6	320.00	$29.82	9,003	3	100.000	1.03000	$8,054.08	633.300	652.500	-19.200	45.369	50.000	-4.631
7	320.00	$29.82	7,052	4	99.197	1.02839	$5,970.88	603.800	652.500	-48.700	22.867	50.000	-27.133
8	320.00	$38.00	14,777	7	100.000	1.03000	$16,845.78	704.300	652.500	51.800	41.274	50.000	-8.726

Project Totals: 12636

	Tests:	Quant:	IDP:
Thickness	112	309,605	$78,965.29
Comp Str.			
Sand Equivalent			
Flexural St.	77	307,001	$227,109.22
Plan Quant:		293,036	$306,074.51

Sum of Quantities:	616,606.0
Ave Quant:	308,303
Ave Price from Thickness:	$30.25

Project I/DP *Ave Price* *Ave Tons*

CPFC ($306,074.51 / ($30.25 * 308,303)) + 1 = 1.03282

Comments: Tested both USA & SI units. Final quantities?

12644 *IM 0761-041* *I-76 Sterling to Atwood* *Region: 4* *Supplier: 12*

Bid Date: 10/26/2000 *Criteria: Comp* *Units: USA* *Total Bid: $21,197,303.87*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	12.50	$28.34	17,484	1		1.00000	$0.00		12.760			0.400	
2	8.50	$21.52	194,041	50	99.942	1.01977	$82,542.87	8.998	8.760	0.238	0.290	0.400	-0.110
3	8.50	$24.77	10,699	1		1.00000	$0.00		8.760			0.400	
4	12.50	$28.34	18,892	6	100.000	1.02000	$10,707.99	12.983	12.760	0.223	0.354	0.400	-0.046
5	8.50	$24.77	9,951	4	100.000	1.02000	$4,928.49	8.800	8.760	0.040	0.294	0.400	-0.106
6	8.50	$20.97	188,822	49	98.464	1.01386	$54,864.80	8.888	8.760	0.128	0.372	0.400	-0.028

Compresive Strength

TV = LSL + (V * 1.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std Dev - V
1	12.50	$28.34	17,484	5	97.071	1.01609	$7,972.68	5,550.000	4,860.000	690.000	872.869	400.000	472.869
2	8.50	$21.52	168,010	25	100.000	1.02000	$72,309.24	6,044.300	4,860.000	1,184.300	475.716	400.000	75.716
22	8.50	$21.52	26,031	5	100.000	1.02000	$11,201.16	5,746.000	4,860.000	886.000	547.202	400.000	147.202
3	8.50	$24.77	10,699	5	100.000	1.02000	$5,298.96	6,094.000	4,860.000	1,234.000	462.526	400.000	62.526
4	12.50	$28.34	18,892	6	100.000	1.02000	$10,707.99	6,222.900	4,860.000	1,362.900	563.404	400.000	163.404
5	8.50	$24.77	9,951	4	100.000	1.02000	$4,928.49	5,530.000	4,860.000	670.000	431.586	400.000	31.586
6	8.50	$20.97	188,822	22	100.000	1.02000	$79,188.51	5,702.300	4,860.000	842.300	346.368	400.000	-53.632

Sand Equivalent

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	X - TV	St Dev	V	St Dev - V
1	12.50	$28.34	17,484	5	100.000	1.01000	$4,954.97	98.60	86.60	12.00	0.894	4.000	-3.106
2	8.50	$21.52	194,041	26	100.000	1.01000	$41,758.42	97.80	86.60	11.20	1.317	4.000	-2.683
3	8.50	$24.77	10,699	5	100.000	1.01000	$2,650.14	97.20	86.60	10.60	1.304	4.000	-2.696
4	12.50	$28.34	18,892	4	100.000	1.01000	$5,353.99	96.30	86.60	9.70	1.893	4.000	-2.107
5	8.50	$24.77	9,951	4	100.000	1.01000	$2,464.86	94.00	86.60	7.40	1.414	4.000	-2.586
6	8.50	$20.97	188,822	25	100.000	1.01000	$39,596.24	94.20	86.60	7.60	1.344	4.000	-2.656

Project Totals: 12644	Tests:	Quant:	IDP:		
Thickness	111	439,889	$153,044.15	Sum of Quantities:	1,319,667.0
Comp Str.	72	439,889	$191,607.03	Ave Quant:	439,889
Sand Equivalent	69	439,889	$96,778.62	Ave Price from Thickness:	$22.00
Flexural St.					
Plan Quant:		440,682	$441,429.80		

Project I/DP *Ave Price* *Ave Tons*

CPFC ($441,429.80 / ($22.00 * 439,889)) + 1 = **1.04561**

Comments: Thickness set to 1.0 two processes, F & P.

12847 *NH 2873-104* *US 287 s/o SH 60 to 402* *Region: 4* *Supplier: 10*

Bid Date: 9/28/2000 *Criteria: Comp* *Units: USA* *Total Bid: $8,759,789.75*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	7.00	$39.00	1,187	3	100.000	1.02000	$925.63	7.400	7.260	0.140	0.000	0.400	-0.400
2	9.00	$18.00	84,000	21	98.166	1.01476	$22,315.05	8.999	9.260	-0.261	0.199	0.400	-0.201
3	9.00	$18.00	45,189	13	99.998	1.01999	$16,262.93	9.225	9.260	-0.035	0.210	0.400	-0.190

Compresive Strength

TV = LSL + (V * 1.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std Dev - V
1	7.00	$39.00	1,187	3	100.000	1.02000	$925.63	4,613.300	4,860.000	-246.700	178.979	400.000	-221.021
2	9.00	$18.00	84,000	22	99.579	1.01880	$28,419.74	5,092.300	4,860.000	232.300	364.312	400.000	-35.688
3	9.00	$18.00	45,189	13	99.938	1.01982	$16,122.51	5,322.300	4,860.000	462.300	425.679	400.000	25.679

Sand Equivalent

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	X - TV	St Dev	V	St Dev - V
1	7.00	$39.00	1,187	3	100.000	1.01000	$462.93	81.70	86.60	-4.90	0.577	4.000	-3.423
2	9.00	$18.00	84,000	22	90.960	0.98756	($18,808.65)	82.40	86.60	-4.20	1.817	4.000	-2.183
3	9.00	$18.00	45,189	13	99.235	1.00891	$7,247.26	82.10	86.60	-4.50	0.954	4.000	-3.046

Project Totals: 12847

	Tests:	Quant:	IDP:
Thickness	37	130,376	$39,503.61
Comp Str.	38	130,376	$45,467.88
Sand Equivalent	38	130,376	($11,098.46)
Flexural St.			
Plan Quant:		130,901	$73,873.03

Sum of Quantities:	391,128.0
Ave Quant:	130,376
Ave Price from Thickness:	$18.19

Project I/DP *Ave Price* *Ave Tons*

CPFC ($73,873.03 / ($18.19 * 130,376)) + 1 = 1.03115

Comments: 7" thickness tests excluded.

13210 *STA 1211-053* *SH 121 C-470 to Parkhill* *Region: 6* *Supplier: 5*

Bid Date: 12/14/2000 *Criteria: Comp* *Units: USA* *Total Bid: $4,923,611.98*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	6.00	$19.50	80,000	20	99.975	1.01993	$31,085.43	6.569	6.260	0.309	0.323	0.400	-0.077
2	6.00	$19.50	75,409	19	99.993	1.01998	$29,379.20	6.632	6.260	0.372	0.327	0.400	-0.073

Compresive Strength

TV = LSL + (V * 1.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std Dev - V
1	6.00	$19.50	80,000	8	100.000	1.02000	$31,200.00	5,746.300	4,860.000	886.300	467.911	400.000	67.911
2	6.00	$19.50	75,409	7	100.000	1.02000	$29,409.51	4,764.300	4,860.000	-95.700	133.274	400.000	-266.726

Sand Equivalent

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	X - TV	St Dev	V	St Dev - V
1	6.00	$19.50	155,409	15	100.000	1.01000	$30,304.76	89.60	86.60	3.00	2.667	4.000	-1.333

Project Totals: 13210

	Tests:	Quant:	IDP:
Thickness	39	155,409	$60,464.63
Comp Str.	15	155,409	$60,609.51
Sand Equivalent	15	155,409	$30,304.76
Flexural St.			
Plan Quant:	148,556		$151,378.90

Sum of Quantities:	466,227.0
Ave Quant:	155,409
Ave Price from Thickness:	$19.50

Project I/DP *Ave Price* *Ave Tons*

CPFC ($151,378.90 / ($19.50 * 155,409)) + 1 = 1.04995

Comments:

93222 *IM 2706-030* *270 Phases II & III* *Region: 6* *Supplier: 4*

Bid Date: 4/20/2000 *Criteria: Comp* *Units: USA* *Total Bid: $20,935,636.04*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	10.50	$35.00	4,323	1			$0.00		10.760			0.400	
2	12.00	$34.52	98,116	25	96.496	1.00999	$33,832.95	12.324	12.260	0.064	0.410	0.400	0.010
3	11.00	$38.00	12,146	3	100.000	1.00000	$0.00	11.433	11.260	0.173	0.153	0.400	-0.247

Compresive Strength

TV = LSL + (V * 1.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std Dev - V
1	10.50	$35.00	4,323	2		1.00000	$0.00		4,860.000			400.000	
2	12.00	$34.52	98,116	11	100.000	1.02000	$67,735.90	6,298.200	4,860.000	1,438.200	419.519	400.000	19.519
3	11.00	$38.00	12,156	3	100.000	1.02000	$9,236.25	6,213.300	4,860.000	1,353.300	815.128	400.000	415.128

Sand Equivalent

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	X - TV	St Dev	V	St Dev - V
1	10.50	$35.00	4,323	2		1.00000	$0.00		86.60			4.000	
2	12.00	$34.52	98,116	11	100.000	1.01000	$33,869.64	92.30	86.60	5.70	2.649	4.000	-1.351
3	11.00	$38.00	12,146	3	100.000	1.01000	$4,615.48	93.70	86.60	7.10	1.155	4.000	-2.845

Project Totals: 93222

	Tests:	Quant:	IDP:
Thickness	29	114,585	$33,832.95
Comp Str.	16	114,595	$76,972.15
Sand Equivalent	16	114,585	$38,485.12
Flexural St.			
Plan Quant:		108,722	$149,290.22

Sum of Quantities:	343,765.0
Ave Quant:	114,588
Ave Price from Thickness:	$34.91

Project I/DP *Ave Price* *Ave Tons*

CPFC ($149,290.22 / ($34.91 * 114,588)) + 1 = 1.03732

Comments: No thickness tests taken on 10.5"

2000 Number of Projects 12

Thickness, Process Information by Year

Criteria: Projects with Bid Dates from 1/1/2000 to 12/31/2000.

Processes with less than 3 tests not included.

2000 Thickness, USA

TV = PT + (0.65 * V)

Subacct.	Item (inch)	Price	Quant	Tests	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	Std Dev - V
11849	8.00	$48.82	2,665	4	100.000	1.02000	$2,601.46	8.158	8.260	-0.102	0.189	0.400	-0.211
11985	8.00	$19.52	779	4	100.000	1.02000	$304.05	8.700	8.260	0.440	0.245	0.400	-0.155
11849	13.00	$25.53	36,620	12	100.000	1.02000	$18,697.24	13.678	13.260	0.418	0.284	0.400	-0.116
12644	8.50	$24.77	9,951	4	100.000	1.02000	$4,928.49	8.800	8.760	0.040	0.294	0.400	-0.106
12644	12.50	$28.34	18,892	6	100.000	1.02000	$10,707.99	12.983	12.760	0.223	0.354	0.400	-0.046
11985	8.00	$19.52	4,000	4	100.000	1.02000	$1,561.21	8.525	8.260	0.265	0.427	0.400	0.027
12847	9.00	$18.00	45,189	13	99.998	1.01999	$16,262.93	9.225	9.260	-0.035	0.210	0.400	-0.190
13210	6.00	$19.50	75,409	19	99.993	1.01998	$29,379.20	6.632	6.260	0.372	0.327	0.400	-0.073
13210	6.00	$19.50	80,000	20	99.975	1.01993	$31,085.43	6.569	6.260	0.309	0.323	0.400	-0.077
12644	8.50	$21.52	194,041	50	99.942	1.01977	$82,542.87	8.998	8.760	0.238	0.290	0.400	-0.110
11849	11.00	$24.53	62,865	22	99.923	1.01978	$30,502.70	11.552	11.260	0.292	0.335	0.400	-0.065
11848	10.00	$29.04	171,047	44	99.801	1.01921	$95,397.03	10.353	10.260	0.093	0.273	0.400	-0.127
11985	8.00	$19.52	7,480	15	99.790	1.01940	$2,832.44	8.687	8.260	0.427	0.434	0.400	0.034
12644	8.50	$20.97	188,822	49	98.464	1.01386	$54,864.80	8.888	8.760	0.128	0.372	0.400	-0.028
12847	9.00	$18.00	84,000	21	98.166	1.01476	$22,315.05	8.999	9.260	-0.261	0.199	0.400	-0.201
11985	8.00	$19.52	276,046	76	97.712	1.01085	$58,460.13	8.389	8.260	0.129	0.399	0.400	-0.001
93222	12.00	$34.52	98,116	25	96.496	1.00999	$33,832.95	12.324	12.260	0.064	0.410	0.400	0.010

2000 Totals

			Quality Level	Pay Factor	I/DP	X - TV	St. Dev.	V	StDev - V
Projects:	7								
Processes:	17	**Best:**	100.000	1.02000	$95,397.03	0.440	0.189	0.400	-0.211
Tests:	388	**Worst:**	96.496	1.00999	$304.05	-0.261	0.434	0.400	0.034
SY:	1,355,922	**Weighted Ave.:**	98.913	1.01608	$29,192.70	0.148	0.330	0.400	-0.070

2000 Thickness, SI

TV = PT + (0.65 * V)

Subacct.	Proc. No.	Item (mm)	Price	Quant	Tests	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	Std Dev - V
12583	1	210.0	$34.40	1,701	3	100.000	1.02000	$1,170.00	218.3	216.5	1.830	3.819	10.000	-6.181
12317	3	275.0	$27.30	3,344	4	100.000	1.02000	$1,825.37	279.4	281.5	-2.120	4.270	10.000	-5.730
12541	6	315.0	$48.80	9,101	3	100.000	1.02000	$8,880.36	320.0	321.5	-1.500	4.330	10.000	-5.670
12317	2	275.0	$27.30	3,344	4	100.000	1.02000	$1,825.37	291.9	281.5	10.380	4.732	10.000	-5.268

Thickness 2000

Subacct.	Proc. No.	Item (mm)	Price	Quant	Tests	Quality Level	Pay Factor	I/DP	TV = PT + (0.65 * V) Mean	TV	X - TV	St. Dev.	V	Std Dev - V
12541	1	265.0	$36.30	20,555	7	100.000	1.02000	$14,922.93	281.8	271.5	10.290	5.537	10.000	-4.463
12317	4	275.0	$27.30	3,344	4	100.000	1.02000	$1,825.37	293.1	281.5	11.630	7.739	10.000	-2.261
12056	2	275.0	$33.00	9,415	12	100.000	1.02000	$6,213.58	291.7	281.5	10.170	8.682	10.000	-1.318
12583	6	275.0	$38.00	4,964	4	100.000	1.02000	$3,771.70	279.4	281.5	-2.120	9.437	10.000	-0.563
12541	5	265.0	$49.50	21,337	7	100.000	1.02000	$21,123.63	283.6	271.5	12.070	9.449	10.000	-0.551
12636	4	320.0	$29.82	12,929	7	100.000	1.02000	$7,710.86	335.4	326.5	8.860	10.842	10.000	0.842
12317	1	275.0	$27.30	196,350	62	99.776	1.01911	$102,409.92	288.8	281.5	7.310	8.640	10.000	-1.360
12636	1	320.0	$29.82	202,545	63	99.207	1.01683	$101,636.04	327.8	326.5	1.320	7.533	10.000	-2.467
12056	3	290.0	$33.50	15,347	19	97.479	1.01280	$6,578.39	298.8	296.5	2.250	10.009	10.000	0.009
12056	4	315.0	$34.00	10,860	11	95.895	1.00827	$3,054.33	330.3	321.5	8.750	15.431	10.000	5.431
12583	2	250.0	$36.60	7,152	10	95.570	1.00734	$1,922.11	256.8	256.5	0.250	10.412	10.000	0.412
12636	3	320.0	$29.82	20,710	10	95.548	1.00728	$4,495.86	330.8	326.5	4.250	12.913	10.000	2.913
12541	3	240.0	$42.50	33,051	10	95.201	1.00629	$8,832.92	249.5	246.5	3.000	12.349	10.000	2.349
12583	7	300.0	$39.40	22,777	16	94.974	1.00564	$5,062.36	306.4	306.5	-0.090	10.286	10.000	0.286
12636	6	320.0	$38.00	16,110	6	91.792	1.00358	$2,194.54	327.9	326.5	1.420	13.548	10.000	3.548
12056	5	330.0	$32.25	97,827	38	90.189	0.96749	($102,559.00)	336.5	336.5	0.010	12.834	10.000	2.834
12636	2	320.0	$29.83	56,775	25	89.409	0.97810	($37,072.01)	322.4	326.5	-4.100	9.986	10.000	-0.014
12583	5	260.0	$37.20	5,724	4	73.238	0.93874	($13,043.63)	261.3	266.5	-5.250	16.137	10.000	6.137

2000 SI Totals

Projects: 5
Processes: 22
Tests: 329
m2: 775,262

	Quality Level	Pay Factor	I/DP	X - TV	St. Dev.	V	StDev - V
Best:	100.000	1.02000	$102,409.92	12.070	3.819	10.000	-6.181
Worst:	73.238	0.93874	($102,559.00)	-5.250	16.137	10.000	6.137
Weighted Ave.:	96.735	1.00654	$6,944.59	3.231	9.477	10.000	-0.523

Compressive Strength, Process Information by Year

Criteria: Projects with Bid Dates from 1/1/2000 to 12/31/2000.

Processes with less than 3 tests not included.

2000 Compresive Strength, USA

TV = LSL + (1.65 * V)

Sub.	Item (inch)	Price	Quant	Tests	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St Dev	V	Std Dev - V
13210	6.00	$19.50	75,409	7	100.000	1.02000	$29,409.51	4,764	4,860	-96	133.3	400.0	-266.7
12847	7.00	$39.00	1,187	3	100.000	1.02000	$925.63	4,613	4,860	-247	179.0	400.0	-221.0
12644	8.50	$20.97	188,822	22	100.000	1.02000	$79,188.51	5,702	4,860	842	346.4	400.0	-53.6
93222	12.00	$34.52	98,116	11	100.000	1.02000	$67,735.90	6,298	4,860	1,438	419.5	400.0	19.5
12644	8.50	$24.77	9,951	4	100.000	1.02000	$4,928.49	5,530	4,860	670	431.6	400.0	31.6
12644	8.50	$24.77	10,699	5	100.000	1.02000	$5,298.96	6,094	4,860	1,234	462.5	400.0	62.5
13210	6.00	$19.50	80,000	8	100.000	1.02000	$31,200.00	5,746	4,860	886	467.9	400.0	67.9
12644	8.50	$21.52	168,010	25	100.000	1.02000	$72,309.24	6,044	4,860	1,184	475.7	400.0	75.7
12644	8.50	$21.52	26,031	5	100.000	1.02000	$11,201.16	5,746	4,860	886	547.2	400.0	147.2
12644	12.50	$28.34	18,892	6	100.000	1.02000	$10,707.99	6,223	4,860	1,363	563.4	400.0	163.4
93222	11.00	$38.00	12,156	3	100.000	1.02000	$9,236.25	6,213	4,860	1,353	815.1	400.0	415.1
12847	9.00	$18.00	45,189	13	99.938	1.01982	$16,122.51	5,322	4,860	462	425.7	400.0	25.7
12847	9.00	$18.00	84,000	22	99.579	1.01880	$28,419.74	5,092	4,860	232	364.3	400.0	-35.7
12644	12.50	$28.34	17,484	5	97.071	1.01609	$7,972.68	5,550	4,860	690	872.9	400.0	472.9

2000 USA Totals:

Projects: 4
Processes: 14
Tests: 139
Sq Yds: 835,946

	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Best:	100.000	1.02000	$79,188.51	6,298	4,860	1,438	133.3	400.0	-266.7
Worst:	97.071	1.01609	$925.63	4,613	4,860	-247	872.9	400.0	472.9
Weighted Ave.:	99.893	1.01979	$26,761.18	5,698	4,860	838	410.7	400.0	10.7

2000 Compresive Strength, SI

TV = LSL + (1.65 * V)

Subacct.	Item (mm)	Price	Quant	Tests	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St Dev	V	Std Dev - V
12583	260	$37.20	10,825	9	100.000	1.02000	$8,053.80	42.556	34.554	8.002	2.069	2.760	-0.691
12317	275	$27.30	206,382	25	100.000	1.02000	$112,678.94	41.876	34.554	7.322	2.254	2.760	-0.506
12056	275	$33.00	9,415	12	100.000	1.02000	$6,213.59	41.758	34.554	7.204	2.675	2.760	-0.085
12056	290	$33.50	15,347	25	100.000	1.02000	$10,281.98	41.542	34.554	6.988	2.697	2.760	-0.063
12541	240	$42.50	33,051	4	100.000	1.02000	$28,086.33	36.300	34.554	1.746	2.702	2.760	-0.058

Compressive Strength Process Information

TV = LSL + (1.65 * V)

Subacct.	Item (mm)	Price	Quant	Tests	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St Dev	V	Std Dev - V
12583	300	$39.40	22,247	15	100.000	1.02000	$17,529.76	43.587	34.554	9.033	3.448	2.760	0.688
12583	275	$38.00	5,300	5	100.000	1.02000	$4,026.99	47.420	34.554	12.866	4.480	2.760	1.720
12541	265	$49.50	21,337	3	100.000	1.02000	$21,118.35	37.367	34.554	2.813	5.811	2.760	3.051
12583	210	$34.40	1,799	3	100.000	1.02000	$1,237.40	38.767	34.554	4.213	7.206	2.760	4.446
12056	330	$32.25	97,827	42	99.983	1.01993	$62,883.80	39.812	34.554	5.258	2.945	2.760	0.185
12056	315	$34.00	10,860	14	99.962	1.01989	$7,344.17	39.842	34.554	5.288	3.583	2.760	0.823
12583	250	$36.60	5,700	5	96.042	1.01472	$3,070.71	44.440	34.554	9.886	9.679	2.760	6.919
12541	265	$36.30	20,555	3	78.500	0.96615	($25,259.60)	33.533	34.554	-1.021	3.921	2.760	1.161

2000 SI Totals:

Projects: 4
Processes: 13
Tests: 165
m2: 460,645

	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Best:	100.000	1.02000	$112,678.94	47.420	34.554	12.866	2.069	2.760	-0.691
Worst:	78.500	0.96615	($25,259.60)	33.533	34.554	-1.021	9.679	2.760	6.919
Weighted Ave.:	98.987	1.01751	$19,789.71	40.577	34.554	6.023	2.917	2.760	0.157

Sand Equivalent, Process Information, USA and SI

Criteria: Projects with Bid Dates from 1/1/2000 to 12/31/2000.

Processes with less than 3 tests not included.

2000 Sub.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	TV = LSL + (1.65 * V) Mean	TV	X - TV	St Dev	V	St Dev - V
12541	265.00	$49.50	21,337	3	100.000	1.01000	$10,561.82	95.30	86.60	8.70	0.577	4.000	-3.423
12847	7.00	$39.00	1,187	3	100.000	1.01000	$462.93	81.70	86.60	-4.90	0.577	4.000	-3.423
12644	12.50	$28.34	17,484	5	100.000	1.01000	$4,954.97	98.60	86.60	12.00	0.894	4.000	-3.106
93222	11.00	$38.00	12,146	3	100.000	1.01000	$4,615.48	93.70	86.60	7.10	1.155	4.000	-2.845
12644	8.50	$24.77	10,699	5	100.000	1.01000	$2,650.14	97.20	86.60	10.60	1.304	4.000	-2.696
12644	8.50	$21.52	194,041	26	100.000	1.01000	$41,758.42	97.80	86.60	11.20	1.317	4.000	-2.683
12583	210.00	$34.40	2,755	6	100.000	1.01000	$947.72	87.80	86.60	1.20	1.329	4.000	-2.671
12644	8.50	$20.97	188,822	25	100.000	1.01000	$39,596.24	94.20	86.60	7.60	1.344	4.000	-2.656
12644	8.50	$24.77	9,951	4	100.000	1.01000	$2,464.86	94.00	86.60	7.40	1.414	4.000	-2.586
12583	275.00	$38.00	5,696	6	100.000	1.01000	$2,164.48	88.50	86.60	1.90	1.517	4.000	-2.483
12583	260.00	$37.20	10,211	7	100.000	1.01000	$3,798.49	87.60	86.60	1.00	1.718	4.000	-2.282
12644	12.50	$28.34	18,892	4	100.000	1.01000	$5,353.99	96.30	86.60	9.70	1.893	4.000	-2.107
12317	275.00	$27.30	206,382	25	100.000	1.01000	$56,342.29	89.10	86.60	2.50	2.068	4.000	-1.932
12056	275.00	$33.00	9,415	12	100.000	1.01000	$3,106.95	90.50	86.60	3.90	2.276	4.000	-1.724
12056	290.00	$33.50	15,347	25	100.000	1.01000	$5,141.25	90.70	86.60	4.10	2.610	4.000	-1.390
93222	12.00	$34.52	98,116	11	100.000	1.01000	$33,869.64	92.30	86.60	5.70	2.649	4.000	-1.351
13210	6.00	$19.50	155,409	15	100.000	1.01000	$30,304.76	89.60	86.60	3.00	2.667	4.000	-1.333
12583	250.00	$36.60	7,830	10	100.000	1.01000	$2,865.78	87.70	86.60	1.10	2.710	4.000	-1.290
12541	240.00	$42.50	33,051	4	100.000	1.01000	$14,046.68	89.30	86.60	2.70	5.500	4.000	1.500
12583	300.00	$39.40	27,485	20	99.994	1.00999	$10,823.06	88.30	86.60	1.70	2.573	4.000	-1.427
12056	330.00	$32.25	97,827	43	99.977	1.00995	$31,404.72	89.00	86.60	2.40	2.734	4.000	-1.266
12847	9.00	$18.00	45,189	13	99.235	1.00891	$7,247.26	82.10	86.60	-4.50	0.954	4.000	-3.046
12056	315.00	$34.00	10,860	14	96.349	1.00479	$1,767.17	87.30	86.60	0.70	4.250	4.000	0.250
12847	9.00	$18.00	84,000	22	90.960	0.98756	($18,808.65)	82.40	86.60	-4.20	1.817	4.000	-2.183

2000 SE Totals:

Projects: 8
Processes: 24
Tests: 311
SY/m2: 1,284,132

	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Best:	100.000	1.01000	$56,342.29	98.60	86.60	12.00	0.577	4.000	-3.423
Worst:	90.960	0.98756	($18,808.65)	81.70	86.60	-4.90	5.500	4.000	1.500
Weighted Ave.:	99.349	1.00845	$12,393.35	91.23	86.60	4.63	2.018	4.000	-1.982

Flexural Strength Process Information by Year

Criteria: Projects with Bid Dates from 1/1/2000 to 12/31/2000.
Processes with less than 3 tests not included.

2000 Flexural Strength, USA

TV = LSL + (V * 1.65)

Subacct.	Item (inch)	Price	Quant.	Tests	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St Dev	V	StD Dev - V
11848	10.00	$29.04	171,047	18	100.000	1.03000	$149,016.15	663.6	652.5	11.1	9.363	50.000	-40.637
11985	8.00	$19.52	7,480	10	100.000	1.03000	$4,380.29	694.0	652.5	41.5	27.669	50.000	-22.331
12636	320.00	$29.82	21,564	12	100.000	1.03000	$19,291.15	669.2	652.5	16.7	30.289	50.000	-19.711
12636	320.00	$38.00	14,777	7	100.000	1.03000	$16,845.78	704.3	652.5	51.8	41.274	50.000	-8.726
12636	320.00	$29.82	9,003	3	100.000	1.03000	$8,054.08	633.3	652.5	-19.2	45.369	50.000	-4.631
11849	11.00	$24.90	17,809	11	99.989	1.02995	$13,283.09	685.5	652.5	33.0	42.922	50.000	-7.078
11985	8.00	$19.52	280,825	29	99.968	1.02981	$163,383.72	707.6	652.5	55.1	44.413	50.000	-5.587
11849	11.00	$24.90	79,916	32	99.517	1.02710	$53,927.02	666.6	652.5	14.1	39.112	50.000	-10.888
12636	320.00	$29.82	7,052	4	99.197	1.02839	$5,970.88	603.8	652.5	-48.7	22.867	50.000	-27.133
12636	320.00	$29.82	100,386	18	96.216	1.01378	$41,257.53	647.5	652.5	-5.0	45.090	50.000	-4.910
11849	11.00	$24.90	2,010	8	74.096	0.90964	($4,522.63)	601.9	652.5	-50.6	47.730	50.000	-2.270

2000 USA Totals:

Projects: 4
Processes: 11
Tests: 152
SY: 711,869

	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev	V	StDev - V
Best:	100.000	1.03000	$163,383.72	707.6	652.5	55.1	9.363	50.000	-40.637
Worst:	74.096	0.90964	($4,522.63)	601.9	652.5	-50.6	47.730	50.000	-2.270
Weighted Ave.:	99.318	1.02696	$42,807.91	679.8	652.5	27.3	34.593	50.000	-15.407

2000 Flexural Strength, SI

TV = LSL + (V * 1.65)

Subacct.	Item (mm)	Price	Quant.	Tests	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St Dev	V	StD Dev - V
12636	320.0	$29.82	32,713	7	100.000	1.03000	$29,265.26	4,507.0	4,499.3	7.8	211.00	345.00	-134.00
12636	320.0	$29.82	28,040	6	100.000	1.03000	$25,084.51	5,092.0	4,499.3	592.8	416.00	345.00	71.00
12636	320.0	$29.82	93,466	20	99.809	1.02918	$81,340.03	4,653.0	4,499.3	153.8	276.00	345.00	-69.00

2000 SI Totals:

Projects: 1
Processes: 3
Tests: 33
m2: 154,219

	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev	V	StDev - V
Best:	100.000	1.03000	$81,340.03	5,092.0	4,499.3	592.8	211.00	345.00	-134.00
Worst:	99.809	1.02918	$25,084.51	4,507.0	4,499.3	7.8	416.00	345.00	71.00
Weighted Ave.:	99.884	1.02950	$45,229.93	4,701.8	4,499.3	202.6	287.67	345.00	-57.33

Appendix C

Reports for 2001 Projects

Project Data

Criteria: Projects with Bid Dates from 1/1/01 to 12/31/01.

12390 *IM 0851-002* *SH 85 Fountain Int* *Region: 2* *Supplier: 16*

Bid Date: 8/16/2001 *Criteria: Comp* *Units: USA* *Total Bid: $9,391,326.82*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	8.00	$40.38	12,929	21	99.212	1.01775	$9,265.09	8.530	8.260	0.270	0.410	0.400	0.010
2	11.00	$42.95	13,431	28	97.190	1.00876	$5,053.27	11.364	11.260	0.104	0.410	0.400	0.010

Compresive Strength

TV = LSL + (V * 1.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std Dev - V
1	8.00	$40.38	12,929	21	99.507	1.01859	$9,705.63	5,761.900	4,860.000	901.900	651.188	400.000	251.188
2	11.00	$42.95	13,431	28	99.963	1.01985	$11,452.18	5,868.200	4,860.000	1,008.200	544.855	400.000	144.855

Sand Equivalent

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	X - TV	St Dev	V	St Dev - V
1	8.00	$40.38	12,929	21	96.181	1.00455	$2,372.88	90.30	86.60	3.70	5.994	4.000	1.994
2	11.00	$42.95	13,431	28	100.000	1.01000	$5,768.61	90.90	86.60	4.30	1.380	4.000	-2.620

Project Totals: 12390

	Tests:	Quant:	IDP:
Thickness	49	26,360	$14,318.36
Comp Str.	49	26,360	$21,157.81
Sand Equivalent	49	26,360	$8,141.49
Flexural St.			
Plan Quant:		26,705	$43,617.66

Sum of Quantities:	79,080.0
Ave Quant:	26,360
Ave Price from Thickness:	$41.69

Project I/DP *Ave Price* *Ave Tons*

CPFC ($43,617.66 / ($41.69 * 26,360)) + 1 = 1.03969

Comments:

12489 *C 0405-023* *Jct SH 94 East & West* *Region: 1* *Supplier: 5*

Bid Date: 5/24/2001 *Criteria: Flex* *Units: USA* *Total Bid: $8,859,815.09*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	10.75	$26.22	232,911	58	99.999	1.02000	$122,108.43	11.553	11.010	0.543	0.307	0.400	-0.093

Flexural Strength

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	IDP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	10.75	$26.22	231,995	24	100.000	1.03000	$182,487.27	752.700	652.500	100.200	47.776	50.000	-2.224
2	10.75	$26.22	916	3	100.000	1.03000	$720.53	720.000	652.500	67.500	55.678	50.000	5.678

Project Totals: 12489

	Tests:	Quant:	IDP:
Thickness	58	232,911	$122,108.43
Comp Str.			
Sand Equivalent			
Flexural St.	27	232,911	$183,207.80
Plan Quant:		233,277	$305,316.23

Sum of Quantities: 465,822.0
Ave Quant: 232,911
Ave Price from Thickness: $26.22

Project I/DP *Ave Price* *Ave Tons*

CPFC ($305,316.23 / ($26.22 * 232,911)) + 1 = **1.05000**

Comments: Concrete Paving System

12614 *NH 0831-080* *SH 83 Hampden to I-225* *Region: 6* *Supplier: 9*

Bid Date: 7/26/2001 *Criteria: Comp* *Units: SI* *Total Bid: $12,528,333.33*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	240.00	$48.03	14,343	4	100.000	1.02000	$13,774.44	260.000	246.500	13.500	10.000	10.000	0.000
2	240.00	$70.23	374	1		1.00000	$0.00		246.500			10.000	
3	265.00	$44.41	20,143	6	87.893	0.98803	($10,709.65)	268.750	271.500	-2.750	11.911	10.000	1.911
4	265.00	$60.94	3,930	1		1.00000	$0.00		271.500			10.000	

Compresive Strength

TV = LSL + (V * 1.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std Dev - V
1	240.00	$48.03	14,343	4	100.000	1.02000	$13,774.44	37.900	34.554	3.346	2.994	2.760	0.234
2	240.00	$70.23	374	1		1.00000	$0.00		34.554			2.760	
3	265.00	$44.41	20,143	6	98.027	1.01605	$14,360.42	36.900	34.554	2.346	4.058	2.760	1.298
4	265.00	$60.94	3,930	1		1.00000	$0.00		34.554			2.760	

Sand Equivalent

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	X - TV	St Dev	V	St Dev - V
1	240.00	$48.03	14,343	4	100.000	1.01000	$6,888.94	91.00	86.60	4.40	4.163	4.000	0.163
2	240.00	$70.23	374	1		1.00000	$0.00		86.60			4.000	
3	265.00	$44.41	20,143	6	100.000	1.01000	$8,945.51	88.70	86.60	2.10	1.506	4.000	-2.494
4	265.00	$60.94	3,930	1		1.00000	$0.00		86.60			4.000	

Project Totals: 12614

	Tests:	Quant:	IDP:
Thickness	12	38,790	$3,064.79
Comp Str.	12	38,790	$28,134.86
Sand Equivalent	12	38,790	$15,834.45
Flexural St.			
Plan Quant:		39,288	$47,034.10

Sum of Quantities:	116,370.0
Ave Quant:	38,790
Ave Price from Thickness:	$47.67

Project I/DP *Ave Price* *Ave Tons*

CPFC ($47,034.10 / ($47.67 * 38,790)) + 1 = 1.02543

Comments:

12638 *C 2706-031* *SH 270 Phase IV* *Region: 6* *Supplier: 3*

Bid Date: 5/31/2001 *Criteria: Comp* *Units: USA* *Total Bid: $8,495,150.72*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	12.50	$34.00	34,871	11	99.895	1.01970	$23,356.07	12.873	12.760	0.113	0.313	0.400	-0.087

Compresive Strength

TV = LSL + (V * 1.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std Dev - V
1	12.50	$34.00	34,871	8	100.000	1.02000	$23,712.28	6,685.000	4,860.000	1,825.000	481.723	400.000	81.723

Sand Equivalent

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	X - TV	St Dev	V	St Dev - V
1	12.50	$34.00	34,871	8	100.000	1.01000	$11,856.14	92.10	86.60	5.50	1.727	4.000	-2.273

Project Totals: 12638

	Tests:	Quant:	IDP:
Thickness	11	34,871	$23,356.07
Comp Str.	8	34,871	$23,712.28
Sand Equivalent	8	34,871	$11,856.14
Flexural St.			
Plan Quant:		35,985	$58,924.49

Sum of Quantities:	104,613.0
Ave Quant:	34,871
Ave Price from Thickness:	$34.00

Project I/DP *Ave Price* *Ave Tons*

CPFC ($58,924.49 / ($34.00 * 34,871)) + 1 = 1.04970

Comments:

13275 *IM 0761-182* *I-76 & 96th Ave.* *Region: 6* *Supplier: 10*

Bid Date: 9/6/2001 *Criteria: Comp* *Units: USA* *Total Bid: $4,343,434.34*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	12.50	$32.00	63,347	13	100.000	1.02000	$40,537.22	12.931	12.760	0.171	0.272	0.400	-0.128

Compresive Strength

TV = LSL + (V * 1.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std Dev - V
1	12.50	$32.00	62,040	22	100.000	1.02000	$39,702.16	6,836.800	4,860.000	1,976.800	755.087	400.000	355.087
2	12.50	$32.00	1,307	3	100.000	1.02000	$836.27	5,210.000	4,860.000	350.000	595.567	400.000	195.567

Sand Equivalent

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	X - TV	St Dev	V	St Dev - V
1	12.50	$32.00	63,347	13	100.000	1.01000	$20,271.04	97.40	86.60	10.80	1.121	4.000	-2.879

Project Totals: 13275

	Tests:	Quant:	IDP:
Thickness	13	63,347	$40,537.22
Comp Str.	25	63,347	$40,538.43
Sand Equivalent	13	63,347	$20,271.04
Flexural St.			
Plan Quant:	63,819		$101,346.69

Sum of Quantities:	190,041.0
Ave Quant:	63,347
Ave Price from Thickness:	$32.00

Project I/DP *Ave Price* *Ave Tons*

CPFC ($101,346.69 / ($32.00 * 63,347)) + 1 = 1.05000

Comments:

13294 *NH 0831-084* *SH 83 Whitetopping* *Region: 1* *Supplier: 10*

Bid Date: 8/9/2001 *Criteria: Comp* *Units: USA* *Total Bid: $4,543,880.70*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	5.75	$20.00	105,000	21	99.228	1.01779	$37,366.59	6.221	6.010	0.211	0.383	0.400	-0.017

Compresive Strength

TV = LSL + (V * 1.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std Dev - V
1	5.75	$20.00	105,000	21	99.953	1.01987	$41,717.55	5,443.800	4,860.000	583.800	426.620	400.000	26.620

Sand Equivalent

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	X - TV	St Dev	V	St Dev - V
1	5.75	$20.00	105,000	21	100.000	1.01000	$21,000.00	94.30	86.60	7.70	2.129	4.000	-1.871

Project Totals: 13294

	Tests:	Quant:	IDP:
Thickness	21	105,000	$37,366.59
Comp Str.	21	105,000	$41,717.55
Sand Equivalent	21	105,000	$21,000.00
Flexural St.			
Plan Quant:		109,535	$100,084.14

Sum of Quantities:	315,000.0
Ave Quant:	105,000
Ave Price from Thickness:	$20.00

Project I/DP *Ave Price* *Ave Tons*

CPFC ($100,084.14 / ($20.00 * 105,000)) + 1 = 1.04766

Comments:

13390 *IM 0252-342* *I-25 Nevada/Tejon* *Region: 2* *Supplier: 12*

Bid Date: 1/11/2001 *Criteria: Comp* *Units: SI* *Total Bid: $26,646,684.30*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	230.00	$38.16	20,437	19	98.410	1.01546	$12,053.82	240.390	236.500	3.890	10.009	10.000	0.009
2	210.00	$52.41	13,220	28	94.840	0.99892	($747.91)	218.570	216.500	2.070	11.576	10.000	1.576
3	210.00	$52.41	5,202	27	97.074	1.00830	$2,261.66	223.520	216.500	7.020	12.752	10.000	2.752
4	290.00	$46.42	30,431	22	87.807	0.96833	($44,735.99)	296.360	296.500	-0.140	14.094	10.000	4.094
5	190.00	$47.43	2,790	6	100.000	1.02000	$2,646.59	215.000	196.500	18.500	0.000	10.000	-10.000

Compresive Strength

TV = LSL + (V * 1.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std Dev - V
1	225.00	$38.16	20,437	19	100.000	1.02000	$15,596.37	44.874	34.554	10.320	4.219	2.760	1.459
2	210.00	$52.41	13,301	29	99.965	1.01986	$13,843.19	44.534	34.554	9.980	4.719	2.760	1.959
3	210.00	$52.41	5,121	26	97.941	1.01176	$3,157.17	40.087	34.554	5.533	5.104	2.760	2.344
4	290.00	$46.42	30,431	22	100.000	1.02000	$28,250.73	45.776	34.554	11.222	3.266	2.760	0.506
5	190.00	$47.43	2,790	6	100.000	1.02000	$2,646.59	45.267	34.554	10.713	3.399	2.760	0.639

Sand Equivalent

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	X - TV	St Dev	V	St Dev - V
1	225.00	$38.16	20,437	19	91.455	0.99058	($7,347.09)	86.00	86.60	-0.60	4.435	4.000	0.435
2	210.00	$52.41	13,220	28	90.728	0.97113	($19,999.42)	85.70	86.60	-0.90	4.345	4.000	0.345
3	210.00	$52.41	5,202	27	94.413	0.99604	($1,080.76)	85.80	86.60	-0.80	3.711	4.000	-0.289
4	290.00	$46.42	30,431	22	99.168	1.00881	$12,450.63	88.30	86.60	1.70	3.682	4.000	-0.318
5	190.00	$47.43	2,790	6	100.000	1.01000	$1,323.30	88.20	86.60	1.60	2.137	4.000	-1.863

Project Totals: 13390

	Tests:	Quant:	IDP:
Thickness	102	72,080	($28,521.83)
Comp Str.	102	72,080	$63,494.05
Sand Equivalent	102	72,080	($14,653.34)
Flexural St.			
Plan Quant:		72,644	$20,318.88

Sum of Quantities: 216,240.0
Ave Quant: 72,080
Ave Price from Thickness: $45.65

Project I/DP *Ave Price* *Ave Tons*

CPFC ($20,318.88 / ($45.65 * 72,080)) + 1 = 1.00618

Comments: Thickness process 5 excluded.

2001 Number of Projects 7

Thickness, Process Information by Year

Criteria: Projects with Bid Dates from 1/1/2001 to 12/31/2001.

Processes with less than 3 tests not included.

2001 Thickness, USA

TV = PT + (0.65 * V)

Subacct.	Item (inch)	Price	Quant	Tests	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	Std Dev - V
13275	12.50	$32.00	63,347	13	100.000	1.02000	$40,537.22	12.931	12.760	0.171	0.272	0.400	-0.128
12489	10.75	$26.22	232,911	58	99.999	1.02000	$122,108.43	11.553	11.010	0.543	0.307	0.400	-0.093
12638	12.50	$34.00	34,871	11	99.895	1.01970	$23,356.07	12.873	12.760	0.113	0.313	0.400	-0.087
13294	5.75	$20.00	105,000	21	99.228	1.01779	$37,366.59	6.221	6.010	0.211	0.383	0.400	-0.017
12390	8.00	$40.38	12,929	21	99.212	1.01775	$9,265.09	8.530	8.260	0.270	0.410	0.400	0.010
12390	11.00	$42.95	13,431	28	97.190	1.00876	$5,053.27	11.364	11.260	0.104	0.410	0.400	0.010

2001 Totals

		Quality Level	Pay Factor	I/DP	X - TV	St. Dev.	V	StDev - V
Projects:	5							
Processes:	6	**Best:**	100.000	1.02000	$122,108.43	0.543	0.272	0.400	-0.128
Tests:	152	**Worst:**	97.190	1.00876	$5,053.27	0.104	0.410	0.400	0.010
SY:	462,489	**Weighted Ave.:**	99.713	1.01909	$39,614.45	0.364	0.326	0.400	-0.074

2001 Thickness, SI

TV = PT + (0.65 * V)

Subacct.	Proc. No.	Item (mm)	Price	Quant	Tests	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	Std Dev - V
12614	1	240.0	$48.03	14,343	4	100.000	1.02000	$13,774.44	260.0	246.5	13.500	10.000	10.000	0.000
13390	1	230.0	$38.16	20,437	19	98.410	1.01546	$12,053.82	240.4	236.5	3.890	10.009	10.000	0.009
13390	3	210.0	$52.41	5,202	27	97.074	1.00830	$2,261.66	223.5	216.5	7.020	12.752	10.000	2.752
13390	2	210.0	$52.41	13,220	28	94.840	0.99892	($747.91)	218.6	216.5	2.070	11.576	10.000	1.576
12614	3	265.0	$44.41	20,143	6	87.893	0.98803	($10,709.65)	268.8	271.5	-2.750	11.911	10.000	1.911
13390	4	290.0	$46.42	30,431	22	87.807	0.96833	($44,735.99)	296.4	296.5	-0.140	14.094	10.000	4.094

2001 SI Totals

		Quality Level	Pay Factor	I/DP	X - TV	St. Dev.	V	StDev - V
Projects:	2							
Processes:	6	**Best:**	100.000	1.02000	$13,774.44	13.500	10.000	10.000	0.000
Tests:	106	**Worst:**	87.807	0.96833	($44,735.99)	-2.750	14.094	10.000	4.094
m2:	103,776	**Weighted Ave.:**	92.957	0.99448	($4,683.94)	2.673	11.912	10.000	1.912

Compressive Strength, Process Information by Year

Criteria: Projects with Bid Dates from 1/1/2001 to 12/31/2001.

Processes with less than 3 tests not included.

2001 Compresive Strength, USA

TV = LSL + (1.65 * V)

Sub.	Item (inch)	Price	Quant	Tests	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St Dev	V	Std Dev - V
12638	12.50	$34.00	34,871	8	100.000	1.02000	$23,712.28	6,685	4,860	1,825	481.7	400.0	81.7
13275	12.50	$32.00	1,307	3	100.000	1.02000	$836.27	5,210	4,860	350	595.6	400.0	195.6
13275	12.50	$32.00	62,040	22	100.000	1.02000	$39,702.16	6,837	4,860	1,977	755.1	400.0	355.1
12390	11.00	$42.95	13,431	28	99.963	1.01985	$11,452.18	5,868	4,860	1,008	544.9	400.0	144.9
13294	5.75	$20.00	105,000	21	99.953	1.01987	$41,717.55	5,444	4,860	584	426.6	400.0	26.6
12390	8.00	$40.38	12,929	21	99.507	1.01859	$9,705.63	5,762	4,860	902	651.2	400.0	251.2

2001 USA Totals:

Projects: 4
Processes: 6
Tests: 103
Sq Yds: 229,578

	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Best:	100.000	1.02000	$41,717.55	6,837	4,860	1,977	426.6	400.0	26.6
Worst:	99.507	1.01859	$836.27	5,210	4,860	350	755.1	400.0	355.1
Weighted Ave.:	99.949	1.01985	$21,187.68	6,050	4,860	1,190	544.3	400.0	144.3

2001 Compresive Strength, SI

TV = LSL + (1.65 * V)

Subacct.	Item (mm)	Price	Quant	Tests	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St Dev	V	Std Dev - V
12614	240	$48.03	14,343	4	100.000	1.02000	$13,774.44	37.900	34.554	3.346	2.994	2.760	0.234
13390	290	$46.42	30,431	22	100.000	1.02000	$28,250.73	45.776	34.554	11.222	3.266	2.760	0.506
13390	190	$47.43	2,790	6	100.000	1.02000	$2,646.59	45.267	34.554	10.713	3.399	2.760	0.639
13390	225	$38.16	20,437	19	100.000	1.02000	$15,596.37	44.874	34.554	10.320	4.219	2.760	1.459
13390	210	$52.41	13,301	29	99.965	1.01986	$13,843.19	44.534	34.554	9.980	4.719	2.760	1.959
12614	265	$44.41	20,143	6	98.027	1.01605	$14,360.42	36.900	34.554	2.346	4.058	2.760	1.298
13390	210	$52.41	5,121	26	97.941	1.01176	$3,157.17	40.087	34.554	5.533	5.104	2.760	2.344

2001 SI Totals:

Projects: 2
Processes: 7
Tests: 112
m2: 106,566

	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Best:	100.000	1.02000	$28,250.73	45.776	34.554	11.222	2.994	2.760	0.234
Worst:	97.941	1.01176	$2,646.59	36.900	34.554	2.346	5.104	2.760	2.344
Weighted Ave.:	99.524	1.01884	$13,089.84	42.424	34.554	7.870	3.835	2.760	1.075

Sand Equivalent, Process Information, USA and SI

Criteria: Projects with Bid Dates from 1/1/2001 to 12/31/2001.

Processes with less than 3 tests not included.

2001

Sub.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV = LSL + (1.65 * V) TV	X - TV	St Dev	V	St Dev - V
13275	12.50	$32.00	63,347	13	100.000	1.01000	$20,271.04	97.40	86.60	10.80	1.121	4.000	-2.879
12390	11.00	$42.95	13,431	28	100.000	1.01000	$5,768.61	90.90	86.60	4.30	1.380	4.000	-2.620
12614	265.00	$44.41	20,143	6	100.000	1.01000	$8,945.51	88.70	86.60	2.10	1.506	4.000	-2.494
12638	12.50	$34.00	34,871	8	100.000	1.01000	$11,856.14	92.10	86.60	5.50	1.727	4.000	-2.273
13294	5.75	$20.00	105,000	21	100.000	1.01000	$21,000.00	94.30	86.60	7.70	2.129	4.000	-1.871
13390	190.00	$47.43	2,790	6	100.000	1.01000	$1,323.30	88.20	86.60	1.60	2.137	4.000	-1.863
12614	240.00	$48.03	14,343	4	100.000	1.01000	$6,888.94	91.00	86.60	4.40	4.163	4.000	0.163
13390	290.00	$46.42	30,431	22	99.168	1.00881	$12,450.63	88.30	86.60	1.70	3.682	4.000	-0.318
12390	8.00	$40.38	12,929	21	96.181	1.00455	$2,372.88	90.30	86.60	3.70	5.994	4.000	1.994
13390	210.00	$52.41	5,202	27	94.413	0.99604	($1,080.76)	85.80	86.60	-0.80	3.711	4.000	-0.289
13390	225.00	$38.16	20,437	19	91.455	0.99058	($7,347.09)	86.00	86.60	-0.60	4.435	4.000	0.435
13390	210.00	$52.41	13,220	28	90.728	0.97113	($19,999.42)	85.70	86.60	-0.90	4.345	4.000	0.345

2001 SE Totals:

Projects: 6
Processes: 12
Tests: 203
SY/m2: 336,144

	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Best:	100.000	1.01000	$21,000.00	97.40	86.60	10.80	1.121	4.000	-2.879
Worst:	90.728	0.97113	($19,999.42)	85.70	86.60	-0.90	5.994	4.000	1.994
Weighted Ave.:	98.807	1.00676	$5,204.15	92.32	86.60	5.72	2.458	4.000	-1.542

Flexural Strength Process Information by Year

Criteria: Projects with Bid Dates from 1/1/2001 to 12/31/2001.
Processes with less than 3 tests not included.

2001 Flexural Strength, USA

Subacct.	Item (inch)	Price	Quant.	Tests	Quality Level	Pay Factor	I/DP	TV = LSL + (V * 1.65) Mean	TV	X - TV	St Dev	V	StD Dev - V
12489	10.75	$26.22	231,995	24	100.000	1.03000	$182,487.27	752.7	652.5	100.2	47.776	50.000	-2.224
12489	10.75	$26.22	916	3	100.000	1.03000	$720.53	720.0	652.5	67.5	55.678	50.000	5.678

2001 USA Totals:

Projects: 1
Processes: 2
Tests: 27
SY: 232,911

	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev	V	StDev - V
Best:	100.000	1.03000	$182,487.27	752.7	652.5	100.2	47.776	50.000	-2.224
Worst:	100.000	1.03000	$720.53	720.0	652.5	67.5	55.678	50.000	5.678
Weighted Ave.:	100.000	1.03000	$91,603.90	752.6	652.5	100.1	47.807	50.000	-2.193

Appendix D

Reports for 2002 Projects

Project Data

Criteria: Projects with Bid Dates from 1/1/02 to 12/31/02.

13278 *STA 2873-112* *SH 287 (Federal)* *Region: 6* *Supplier: 10*

Bid Date: 12/12/2002 *Criteria: Comp* *Units: USA* *Total Bid: $2,648,202.40*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	11.00	$38.00	16,609	50	99.539	1.01815	$11,458.30	11.649	11.260	0.389	0.415	0.400	0.015

Compresive Strength

TV = LSL + (V * 1.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std Dev - V
1	11.00	$38.00	289	1		1.00000	$0.00		4,860.000			400.000	
2	11.00	$38.00	213	1		1.00000	$0.00		4,860.000			400.000	
3	11.00	$38.00	4,867	10	99.963	1.01989	$3,679.26	5,575.000	4,860.000	715.000	547.849	400.000	147.849
4	11.00	$38.00	8,488	27	99.195	1.01678	$5,412.08	5,050.700	4,860.000	190.700	370.654	400.000	-29.346
5	11.00	$38.00	371	2		1.00000	$0.00		4,860.000			400.000	
6	11.00	$38.00	1,582	4	100.000	1.02000	$1,202.02	6,730.000	4,860.000	1,870.000	458.766	400.000	58.766
7	11.00	$38.00	246	3	100.000	1.02000	$186.91	7,123.300	4,860.000	2,263.300	266.333	400.000	-133.667
8	11.00	$38.00	553	2		1.00000	$0.00		4,860.000			400.000	

Sand Equivalent

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	X - TV	St Dev	V	St Dev - V
1	11.00	$38.00	289	1		1.00000	$0.00		86.60			4.000	
2	11.00	$38.00	213	1		1.00000	$0.00		86.60			4.000	
3	11.00	$38.00	4,867	10	100.000	1.01000	$1,849.46	94.90	86.60	8.30	0.994	4.000	-3.006
4	11.00	$38.00	8,488	27	100.000	1.01000	$3,225.44	94.10	86.60	7.50	1.292	4.000	-2.708
5	11.00	$38.00	371	2		1.00000	$0.00		86.60			4.000	
6	11.00	$38.00	1,582	4	100.000	1.01000	$601.16	95.30	86.60	8.70	0.500	4.000	-3.500
7	11.00	$38.00	246	3	100.000	1.01000	$93.48	95.00	86.60	8.40	1.000	4.000	-3.000
8	11.00	$38.00	553	2		1.00000	$0.00		86.60			4.000	

Project Totals: 13278		Tests:	Quant:	IDP:		
	Thickness	50	16,609	$11,458.30	Sum of Quantities:	49,827.0
	Comp Str.	50	16,609	$10,480.27	Ave Quant:	16,609
	Sand Equivalent	50	16,609	$5,769.54		
	Flexural St.				Ave Price from Thickness:	$38.00
	Plan Quant:		18,903	$27,708.11		

Project I/DP *Ave Price* *Ave Tons*

CPFC ($27,708.11 / ($38.00 * 16,609)) + 1 = **1.04390**

Comments: Uses Fast Track pavement.

13480 *IM 0252-347* *I-25 @ Monument Inter* *Region: 2* *Supplier: 5*

Bid Date: 6/27/2002 *Criteria: Comp* *Units: SI* *Total Bid: $19,878,331.73*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	260.00	$41.85	25,599	15	99.874	1.01964	$21,041.12	272.000	266.500	5.500	8.462	10.000	-1.538
2	300.00	$42.06	67,681	30	99.781	1.01912	$54,439.94	313.330	306.500	6.830	8.718	10.000	-1.282
3	250.00	$41.93	16,227	20	98.158	1.01474	$10,026.46	262.750	256.500	6.250	11.410	10.000	1.410
4	315.00	$66.57	1,670	2			$0.00		321.500			10.000	

Compresive Strength

TV = LSL + (V * 1.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std Dev - V
1	300.00	$42.06	6,578	4	100.000	1.02000	$5,532.03	47.600	34.554	13.046	2.883	2.760	0.123
2	260.00	$41.85	3,811	1			$0.00		34.554			2.760	
3	260.00	$41.85	21,788	14	100.000	1.02000	$18,235.64	43.914	34.554	9.360	2.458	2.760	-0.302
4	300.00	$42.06	25,052	12	100.000	1.02000	$21,073.03	44.508	34.554	9.954	2.774	2.760	0.014
5	250.00	$41.93	6,423	9	100.000	1.02000	$5,386.33	43.044	34.554	8.490	2.810	2.760	0.050
6	315.00	$66.57	1,670	2			$0.00		34.554			2.760	
7	250.00	$41.93	2,682	2			$0.00		34.554			2.760	
8	250.00	$41.93	5,903	6	95.510	1.01102	$2,727.73	35.100	34.554	0.546	3.357	2.760	0.597
9	300.00	$42.06	25,442	10	100.000	1.02000	$21,400.57	39.380	34.554	4.826	2.149	2.760	-0.611
10	300.00	$42.06	2,967	1			$0.00		34.554			2.760	
11	300.00	$42.06	7,642	3	100.000	1.02000	$6,426.84	45.033	34.554	10.479	1.501	2.760	-1.259
12	250.00	$41.93	1,219	3	100.000	1.02000	$1,021.91	48.100	34.554	13.546	2.339	2.760	-0.421

Sand Equivalent

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	X - TV	St Dev	V	St Dev - V
1	260.00	$41.85	25,599	15	100.000	1.01000	$10,713.18	90.90	86.60	4.30	1.438	4.000	-2.562
2	300.00	$42.06	67,681	30	100.000	1.01000	$28,466.54	90.70	86.60	4.10	1.143	4.000	-2.857
3	250.00	$41.93	16,227	20	100.000	1.01000	$6,804.06	90.90	86.60	4.30	1.553	4.000	-2.447
4	315.00	$66.57	1,670	2			$0.00		86.60			4.000	

Project Totals: 13480		Tests:	Quant:	IDP:		
	Thickness	67	111,177	$85,507.52	Sum of Quantities:	333,531.0
	Comp Str.	67	111,177	$81,804.08	Ave Quant:	111,177
	Sand Equivalent	67	111,177	$45,983.78	Ave Price	
	Flexural St.				from Thickness:	$42.36
	Plan Quant:	111,318		$213,295.38		

Project I/DP *Ave Price* *Ave Tons*

CPFC ($213,295.38 / ($42.36 * 111,177)) + 1 = 1.04529

Comments:

13529 *STU 1192-011* *Ken Pratt Blvd* *Region: 4* *Supplier: 12*

Bid Date: 7/25/2002 *Criteria: Flex* *Units: USA* *Total Bid: $11,133,682.51*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	8.00	$21.10	137,704	48	95.896	1.00358	$10,413.78	8.406	8.260	0.146	0.469	0.400	0.069

Flexural Strength

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	IDP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	8.00	$21.10	123,166	17	99.911	1.02962	$76,979.93	632.900	652.500	-19.600	23.188	50.000	-26.812
2	8.00	$21.10	4,776	2		0.95000	($5,038.68)		652.500			50.000	
3	8.00	$21.10	6,820	1		1.00000	$0.00		652.500			50.000	
4	8.00	$21.10	2,942	1		1.00000	$0.00		652.500			50.000	

Project Totals: 13529		Tests:	Quant:	IDP:		
	Thickness	48	137,704	$10,413.78	Sum of Quantities:	275,408.0
	Comp Str.				Ave Quant:	137,704
	Sand Equivalent				Ave Price	
	Flexural St.	21	137,704	$71,941.25	from Thickness:	$21.10
	Plan Quant:	157,674		$82,355.03		

Project I/DP *Ave Price* *Ave Tons*

CPFC ($82,355.03 / ($21.10 * 137,704)) + 1 = 1.02834

Comments: Flex Str processes?

13573 *NH 2254-064* *Iliff and I-225* *Region: 6* *Supplier: 4*

Bid Date: 4/18/2002 *Criteria: Comp* *Units: USA* *Total Bid: $8,094,501.13*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	12.00	$42.00	20,000	4	90.119	1.00682	$5,731.70	12.250	12.260	-0.010	0.540	0.400	0.140
2	12.00	$42.00	5,000	1		1.00000	$0.00		12.260			0.400	
3	13.00	$42.00	35,000	7	94.251	1.00850	$12,499.21	13.286	13.260	0.026	0.466	0.400	0.066

Compresive Strength

TV = LSL + (V * 1.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std Dev - V
1	12.00	$42.00	25,000	5	100.000	1.02000	$20,994.75	6,072.000	4,860.000	1,212.000	353.935	400.000	-46.065
2	12.00	$42.00	5,000	1		1.00000	$0.00		4,860.000			400.000	
3	13.00	$42.00	25,000	5	100.000	1.02000	$20,994.75	6,582.000	4,860.000	1,722.000	445.163	400.000	45.163
4	13.00	$42.00	20,000	4	100.000	1.02000	$16,795.80	5,692.500	4,860.000	832.500	495.202	400.000	95.202

Sand Equivalent

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	X - TV	St Dev	V	St Dev - V
1	12.00	$42.00	5,000	1		1.00000	$0.00		86.60			4.000	
2	12.00	$42.00	5,000	1		1.00000	$0.00		86.60			4.000	

Project Totals: 13573

	Tests:	Quant:	IDP:
Thickness	12	60,000	$18,230.91
Comp Str.	15	75,000	$58,785.30
Sand Equivalent	2	10,000	$0.00
Flexural St.			
Plan Quant:		36,044	$77,016.21

Sum of Quantities:	145,000.0
Ave Quant:	48,333
Ave Price from Thickness:	$42.00

Project I/DP *Ave Price* *Ave Tons*

CPFC ($77,016.21 / ($42.00 * 48,333)) + 1 = **1.03794**

Comments: Final quantities not equal. Furn & Place.

13804 *IM 0252-354* *I-25/Broadway Viaduct* *Region: 6* *Supplier: 4*

Bid Date: 8/1/2002 *Criteria: Comp* *Units: USA* *Total Bid: $9,818,081.20*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	13.50	$41.92	6,043	3	100.000	1.02000	$5,065.18	13.987	13.760	0.227	0.176	0.400	-0.224
2	10.00	$41.40	932	3	100.000	1.02000	$771.50	11.000	10.260	0.740	0.001	0.400	-0.399
3	8.00	$34.16	2,328	3	53.919	0.83813	($12,872.77)	7.750	8.260	-0.510	1.058	0.400	0.658
4	8.00	$34.16	87	4	100.000	1.02000	$59.42	8.750	8.260	0.490	0.354	0.400	-0.046

Compresive Strength

TV = LSL + (V * 1.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std Dev - V
1	13.50	$41.92	6,043	3	100.000	1.02000	$5,065.18	6,080.000	4,860.000	1,220.000	459.239	400.000	59.239
2	10.00	$41.40	932	3	90.650	1.00753	$290.59	5,583.300	4,860.000	723.300	251.612	400.000	851.612
3	8.00	$34.16	2,415	3	100.000	1.02000	$1,649.52	5,716.700	4,860.000	856.700	901.462	400.000	501.462

Sand Equivalent

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	X - TV	St Dev	V	St Dev - V
1	13.50	$41.92	6,043	3	100.000	1.01000	$2,533.23	94.00	86.60	7.40	2.000	4.000	-2.000
2	10.00	$41.40	932	3	100.000	1.01000	$385.85	90.70	86.60	4.10	2.309	4.000	-1.691
3	8.00	$34.16	2,415	3	100.000	1.01000	$824.96	90.70	86.60	4.10	0.577	4.000	-3.423

Project Totals: 13804

	Tests:	Quant:	IDP:
Thickness	13	9,390	($6,976.67)
Comp Str.	9	9,390	$7,005.29
Sand Equivalent	9	9,390	$3,744.04
Flexural St.			
Plan Quant:		9,409	$3,772.66

Sum of Quantities:	28,170.0
Ave Quant:	9,390
Ave Price from Thickness:	$39.87

Project I/DP *Ave Price* *Ave Tons*

CPFC ($3,772.66 / ($39.87 * 9,390)) + 1 = 1.01008

Comments:

13831 *IM 0761-184* *I-76 @ 88th Ave* *Region: 6* *Supplier: 12*

Bid Date: 10/10/2002 *Criteria: Flex* *Units: USA* *Total Bid: $4,803,222.82*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	12.50	$27.25	92,389	19	99.974	1.01993	$50,163.59	12.974	12.760	0.214	0.294	0.400	-0.106

Flexural Strength

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	IDP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	12.50	$27.25	92,389	45	98.128	1.01877	$47,246.55	694.700	652.500	42.200	61.074	50.000	11.074

Project Totals: 13831

	Tests:	Quant:	IDP:
Thickness	19	92,389	$50,163.59
Comp Str.			
Sand Equivalent Flexural St.	45	92,389	$47,246.55
Plan Quant:		77,247	$97,410.14

Sum of Quantities: 184,778.0
Ave Quant: 92,389
Ave Price from Thickness: $27.25

Project I/DP *Ave Price* *Ave Tons*

CPFC ($97,410.14 / ($27.25 * 92,389)) + 1 = 1.03869

Comments: 5 year warranty

2002 Number of Projects 6

Thickness, Process Information by Year

Criteria: Projects with Bid Dates from 1/1/2002 to 12/31/2002.

Processes with less than 3 tests not included.

2002 Thickness, USA

TV = PT + (0.65 * V)

Subacct.	Item (inch)	Price	Quant	Tests	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	Std Dev - V
13804	10.00	$41.40	932	3	100.000	1.02000	$771.50	11.000	10.260	0.740	0.001	0.400	-0.399
13804	13.50	$41.92	6,043	3	100.000	1.02000	$5,065.18	13.987	13.760	0.227	0.176	0.400	-0.224
13804	8.00	$34.16	87	4	100.000	1.02000	$59.42	8.750	8.260	0.490	0.354	0.400	-0.046
13831	12.50	$27.25	92,389	19	99.974	1.01993	$50,163.59	12.974	12.760	0.214	0.294	0.400	-0.106
13278	11.00	$38.00	16,609	50	99.539	1.01815	$11,458.30	11.649	11.260	0.389	0.415	0.400	0.015
13529	8.00	$21.10	137,704	48	95.896	1.00358	$10,413.78	8.406	8.260	0.146	0.469	0.400	0.069
13573	13.00	$42.00	35,000	7	94.251	1.00850	$12,499.21	13.286	13.260	0.026	0.466	0.400	0.066
13573	12.00	$42.00	20,000	4	90.119	1.00682	$5,731.70	12.250	12.260	-0.010	0.540	0.400	0.140
13804	8.00	$34.16	2,328	3	53.919	0.83813	($12,872.77)	7.750	8.260	-0.510	1.058	0.400	0.658

2002 Totals

			Quality Level	Pay Factor	I/DP	X - TV	St. Dev.	V	StDev - V
Projects:	5								
Processes:	9	**Best:**	100.000	1.02000	$50,163.59	0.740	0.001	0.400	-0.399
Tests:	141	**Worst:**	53.919	0.83813	($12,872.77)	-0.510	1.058	0.400	0.658
SY:	311,092	**Weighted Ave.:**	96.524	1.00911	$9,254.43	0.154	0.416	0.400	0.016

2002 Thickness, SI

TV = PT + (0.65 * V)

Subacct.	Proc. No.	Item (mm)	Price	Quant	Tests	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	Std Dev - V
13480	1	260.0	$41.85	25,599	15	99.874	1.01964	$21,041.12	272.0	266.5	5.500	8.462	10.000	-1.538
13480	2	300.0	$42.06	67,681	30	99.781	1.01912	$54,439.94	313.3	306.5	6.830	8.718	10.000	-1.282
13480	3	250.0	$41.93	16,227	20	98.158	1.01474	$10,026.46	262.8	256.5	6.250	11.410	10.000	1.410

2002 SI Totals

			Quality Level	Pay Factor	I/DP	X - TV	St. Dev.	V	StDev - V
Projects:	1								
Processes:	3	**Best:**	99.874	1.01964	$54,439.94	6.830	8.462	10.000	-1.538
Tests:	65	**Worst:**	98.158	1.01474	$10,026.46	5.500	11.410	10.000	1.410
m2:	109,507	**Weighted Ave.:**	99.562	1.01859	$28,502.51	6.433	9.057	10.000	-0.943

Compressive Strength, Process Information by Year

Criteria: Projects with Bid Dates from 1/1/2002 to 12/31/2002.

Processes with less than 3 tests not included.

2002 Compresive Strength, USA

TV = LSL + (1.65 * V)

Sub.	Item (inch)	Price	Quant	Tests	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St Dev	V	Std Dev - V
13278	11.00	$38.00	246	3	100.000	1.02000	$186.91	7,123	4,860	2,263	266.3	400.0	-133.7
13573	12.00	$42.00	25,000	5	100.000	1.02000	$20,994.75	6,072	4,860	1,212	353.9	400.0	-46.1
13573	13.00	$42.00	25,000	5	100.000	1.02000	$20,994.75	6,582	4,860	1,722	445.2	400.0	45.2
13278	11.00	$38.00	1,582	4	100.000	1.02000	$1,202.02	6,730	4,860	1,870	458.8	400.0	58.8
13804	13.50	$41.92	6,043	3	100.000	1.02000	$5,065.18	6,080	4,860	1,220	459.2	400.0	59.2
13573	13.00	$42.00	20,000	4	100.000	1.02000	$16,795.80	5,693	4,860	833	495.2	400.0	95.2
13804	8.00	$34.16	2,415	3	100.000	1.02000	$1,649.52	5,717	4,860	857	901.5	400.0	501.5
13278	11.00	$38.00	4,867	10	99.963	1.01989	$3,679.26	5,575	4,860	715	547.8	400.0	147.8
13278	11.00	$38.00	8,488	27	99.195	1.01678	$5,412.08	5,051	4,860	191	370.7	400.0	-29.3
13804	10.00	$41.40	932	3	90.650	1.00753	$290.59	5,583	4,860	723	1,251.6	400.0	851.6

2002 USA Totals:

Projects: 3
Processes: 10
Tests: 67
Sq Yds: 94,573

	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Best:	100.000	1.02000	$20,994.75	7,123	4,860	2,263	266.3	400.0	-133.7
Worst:	90.650	1.00753	$186.91	5,051	4,860	191	1,251.6	400.0	851.6
Weighted Ave.:	99.834	1.01958	$7,627.09	6,010	4,860	1,150	450.5	400.0	50.5

2002 Compresive Strength, SI

TV = LSL + (1.65 * V)

Subacct.	Item (mm)	Price	Quant	Tests	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St Dev	V	Std Dev - V
13480	300	$42.06	7,642	3	100.000	1.02000	$6,426.84	45.033	34.554	10.479	1.501	2.760	-1.259
13480	300	$42.06	25,442	10	100.000	1.02000	$21,400.57	39.380	34.554	4.826	2.149	2.760	-0.611
13480	250	$41.93	1,219	3	100.000	1.02000	$1,021.91	48.100	34.554	13.546	2.339	2.760	-0.421
13480	260	$41.85	21,788	14	100.000	1.02000	$18,235.64	43.914	34.554	9.360	2.458	2.760	-0.302
13480	300	$42.06	25,052	12	100.000	1.02000	$21,073.03	44.508	34.554	9.954	2.774	2.760	0.014
13480	250	$41.93	6,423	9	100.000	1.02000	$5,386.33	43.044	34.554	8.490	2.810	2.760	0.050
13480	300	$42.06	6,578	4	100.000	1.02000	$5,532.03	47.600	34.554	13.046	2.883	2.760	0.123
13480	250	$41.93	5,903	6	95.510	1.01102	$2,727.73	35.100	34.554	0.546	3.357	2.760	0.597

Compressive Strength Process Information

TV = LSL + (1.65 * V)

Subacct.	Item (mm)	Price	Quant	Tests	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St Dev	V	Std Dev - V

2002 SI Totals:

		Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Projects:	1									
Processes:	8	**Best:**	100.000	1.02000	$21,400.57	48.100	34.554	13.546	1.501	2.760	-1.259
Tests:	61	**Worst:**	95.510	1.01102	$1,021.91	35.100	34.554	0.546	3.357	2.760	0.597
m2:	100,047	**Weighted Ave.:**	99.735	1.01947	$10,225.51	42.713	34.554	8.159	2.488	2.760	-0.272

Sand Equivalent, Process Information, USA and SI

Criteria: Projects with Bid Dates from 1/1/2002 to 12/31/2002.

Processes with less than 3 tests not included.

2002 Sub.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	TV = LSL + (1.65 * V) Mean	TV	X - TV	St Dev	V	St Dev - V
13278	11.00	$38.00	1,582	4	100.000	1.01000	$601.16	95.30	86.60	8.70	0.500	4.000	-3.500
13804	8.00	$34.16	2,415	3	100.000	1.01000	$824.96	90.70	86.60	4.10	0.577	4.000	-3.423
13278	11.00	$38.00	4,867	10	100.000	1.01000	$1,849.46	94.90	86.60	8.30	0.994	4.000	-3.006
13278	11.00	$38.00	246	3	100.000	1.01000	$93.48	95.00	86.60	8.40	1.000	4.000	-3.000
13480	300.00	$42.06	67,681	30	100.000	1.01000	$28,466.54	90.70	86.60	4.10	1.143	4.000	-2.857
13278	11.00	$38.00	8,488	27	100.000	1.01000	$3,225.44	94.10	86.60	7.50	1.292	4.000	-2.708
13480	260.00	$41.85	25,599	15	100.000	1.01000	$10,713.18	90.90	86.60	4.30	1.438	4.000	-2.562
13480	250.00	$41.93	16,227	20	100.000	1.01000	$6,804.06	90.90	86.60	4.30	1.553	4.000	-2.447
13804	13.50	$41.92	6,043	3	100.000	1.01000	$2,533.23	94.00	86.60	7.40	2.000	4.000	-2.000
13804	10.00	$41.40	932	3	100.000	1.01000	$385.85	90.70	86.60	4.10	2.309	4.000	-1.691

2002 SE Totals:

Projects: 3
Processes: 10
Tests: 118
SY/m2: 134,080

	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Best:	100.000	1.01000	$28,466.54	95.30	86.60	8.70	0.500	4.000	-3.500
Worst:	100.000	1.01000	$93.48	90.70	86.60	4.10	2.309	4.000	-1.691
Weighted Ave.:	100.000	1.01000	$5,549.74	91.34	86.60	4.74	1.282	4.000	-2.718

Flexural Strength Process Information by Year

Criteria: Projects with Bid Dates from 1/1/2002 to 12/31/2002.
Processes with less than 3 tests not included.

2002 Flexural Strength, USA

Subacct.	Item (inch)	Price	Quant.	Tests	Quality Level	Pay Factor	I/DP	Mean	TV = LSL + (V * 1.65) TV	X - TV	St Dev	V	StD Dev - V
13529	8.00	$21.10	123,166	17	99.911	1.02962	$76,979.93	632.9	652.5	-19.6	23.188	50.000	-26.812
13831	12.50	$27.25	92,389	45	98.128	1.01877	$47,246.55	694.7	652.5	42.2	61.074	50.000	11.074

2002 USA Totals:

		Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev	V	StDev - V
Projects:	2									
Processes:	2	**Best:**	99.911	1.02962	$76,979.93	694.7	652.5	42.2	23.188	50.000	-26.812
Tests:	62	**Worst:**	98.128	1.01877	$47,246.55	632.9	652.5	-19.6	61.074	50.000	11.074
SY:	215,555	**Weighted Ave.:**	99.147	1.02497	$62,113.24	659.4	652.5	6.9	39.426	50.000	-10.574

Appendix E

Reports for 2003 Projects

Project Data

Criteria: Projects with Bid Dates from 1/1/03 to 12/31/03.

13858 *STA 1211-056* *104th & Wadsworth* *Region: 6* *Supplier: 12*

Bid Date: 2/20/2003 *Criteria: Comp* *Units: USA* *Total Bid: $2,758,250.50*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	6.00	$14.35	65,107	17	100.000	1.02000	$18,684.77	6.765	6.260	0.505	0.272	0.400	-0.128
2	6.00	$14.35	11,489	4	100.000	1.02000	$3,296.52	6.813	6.260	0.553	0.239	0.400	-0.161
3	6.00	$14.35	22,979	5	100.000	1.02000	$6,593.32	6.550	6.260	0.290	0.326	0.400	-0.074

Compresive Strength

TV = LSL + (V * 1.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std Dev - V
1	6.00	$14.35	65,107	17	99.985	1.01996	$18,645.62	5,336.500	4,860.000	476.500	379.983	400.000	-20.017
2	6.00	$14.35	11,489	3	100.000	1.02000	$3,296.52	4,786.700	4,860.000	-73.300	231.805	400.000	-168.195
3	6.00	$14.35	22,979	6	100.000	1.02000	$6,594.97	4,945.000	4,860.000	85.000	132.023	400.000	-267.977

Sand Equivalent

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	X - TV	St Dev	V	St Dev - V
1	6.00	$14.35	65,107	17	99.876	1.00983	$9,179.79	91.20	86.60	4.60	4.236	4.000	0.236
2	6.00	$14.35	11,489	3	100.000	1.01000	$1,648.67	82.30	86.60	-4.30	1.528	4.000	-2.472
3	6.00	$14.35	22,979	7	97.551	1.00755	$2,490.09	84.30	86.60	-2.30	2.498	4.000	-1.502

Project Totals: 13858

	Tests:	Quant:	IDP:
Thickness	26	99,575	$28,574.61
Comp Str.	26	99,575	$28,537.11
Sand Equivalent	27	99,575	$13,318.55
Flexural St.			
Plan Quant:	102,013		$70,430.27

Sum of Quantities: 298,725.0
Ave Quant: 99,575
Ave Price from Thickness: $14.35

Project I/DP *Ave Price* *Ave Tons*

CPFC ($70,430.27 / ($14.35 * 99,575)) + 1 = **1.04929**

Comments:

13897 *NH 0852-088* *US 85 - Sedalia* *Region: 1* *Supplier: 12*

Bid Date: 2/27/2003 *Criteria: Flex* *Units: USA* *Total Bid: $4,573,000.00*

Thickness

TV = PT + (V * 0.65)

Proc. No.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	10.00	$24.00	43,023	23	98.096	1.01456	$15,031.89	10.372	10.260	0.112	0.387	0.400	-0.013
2	8.00	$31.00	3,072	6	100.000	1.02000	$1,904.64	8.700	8.260	0.440	0.482	0.400	0.082

Flexural Strength

TV = LSL + (V * 1.65)

Proc.	Item in/mm	Price	Quant	Tests	QL	PF	IDP	Mean	TV	Mean - TV	St Dev	V	Std. Dev. - V
1	10.00	$24.00	43,023	31	94.860	0.99905	($979.29)	683.200	652.500	30.700	70.386	50.000	20.386
2	8.00	$31.00	3,072	10	100.000	1.03000	$2,856.96	693.500	652.500	41.000	33.421	50.000	-16.579

Project Totals: 13897

	Tests:	Quant:	IDP:
Thickness	29	46,095	$16,936.53
Comp Str.			
Sand Equivalent			
Flexural St.	41	46,095	$1,877.67
Plan Quant:		39,431	$18,814.20

Sum of Quantities:	92,190.0
Ave Quant:	46,095
Ave Price from Thickness:	$24.47

Project I/DP *Ave Price* *Ave Tons*

CPFC ($18,814.20 / ($24.47 * 46,095)) + 1 = 1.01668

Comments:

2003 Number of Projects 2

Thickness, Process Information by Year

Criteria: Projects with Bid Dates from 1/1/2003 to 12/31/2003.

Processes with less than 3 tests not included.

2003 Thickness, USA

TV = PT + (0.65 * V)

Subacct.	Item (inch)	Price	Quant	Tests	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	Std Dev - V
13858	6.00	$14.35	11,489	4	100.000	1.02000	$3,296.52	6.813	6.260	0.553	0.239	0.400	-0.161
13858	6.00	$14.35	65,107	17	100.000	1.02000	$18,684.77	6.765	6.260	0.505	0.272	0.400	-0.128
13858	6.00	$14.35	22,979	5	100.000	1.02000	$6,593.32	6.550	6.260	0.290	0.326	0.400	-0.074
13897	8.00	$31.00	3,072	6	100.000	1.02000	$1,904.64	8.700	8.260	0.440	0.482	0.400	0.082
13897	10.00	$24.00	43,023	23	98.096	1.01456	$15,031.89	10.372	10.260	0.112	0.387	0.400	-0.013

2003 Totals

			Quality Level	Pay Factor	I/DP	X - TV	St. Dev.	V	StDev - V
Projects:	2								
Processes:	5	**Best:**	100.000	1.02000	$18,684.77	0.553	0.239	0.400	-0.161
Tests:	55	**Worst:**	98.096	1.01456	$1,904.64	0.112	0.482	0.400	0.082
SY:	145,670	**Weighted Ave.:**	99.438	1.01839	$9,102.23	0.357	0.316	0.400	-0.084

Compressive Strength, Process Information by Year

Criteria: Projects with Bid Dates from 1/1/2003 to 12/31/2003.

Processes with less than 3 tests not included.

2003 Compresive Strength, USA

TV = LSL + (1.65 * V)

Sub.	Item (inch)	Price	Quant	Tests	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St Dev	V	Std Dev - V
13858	6.00	$14.35	22,979	6	100.000	1.02000	$6,594.97	4,945	4,860	85	132.0	400.0	-268.0
13858	6.00	$14.35	11,489	3	100.000	1.02000	$3,296.52	4,787	4,860	-73	231.8	400.0	-168.2
13858	6.00	$14.35	65,107	17	99.985	1.01996	$18,645.62	5,337	4,860	477	380.0	400.0	-20.0

2003 USA Totals:

Projects: 1
Processes: 3
Tests: 26
Sq Yds: 99,575

	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Best:	100.000	1.02000	$18,645.62	5,337	4,860	477	132.0	400.0	-268.0
Worst:	99.985	1.01996	$3,296.52	4,787	4,860	-73	380.0	400.0	-20.0
Weighted Ave.:	99.990	1.01997	$9,512.37	5,183	4,860	323	305.7	400.0	-94.3

Sand Equivalent, Process Information, USA and SI

Criteria: Projects with Bid Dates from 1/1/2003 to 12/31/2003.

Processes with less than 3 tests not included.

2003

Sub.	Item in/mm	Price	Quant	Tests	QL	PF	I/DP	Mean	TV = LSL + (1.65 * V) TV	X - TV	St Dev	V	St Dev - V
13858	6.00	$14.35	11,489	3	100.000	1.01000	$1,648.67	82.30	86.60	-4.30	1.528	4.000	-2.472
13858	6.00	$14.35	65,107	17	99.876	1.00983	$9,179.79	91.20	86.60	4.60	4.236	4.000	0.236
13858	6.00	$14.35	22,979	7	97.551	1.00755	$2,490.09	84.30	86.60	-2.30	2.498	4.000	-1.502

2003 SE Totals:

Projects: 1
Processes: 3
Tests: 27
SY/m2: 99,575

	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev.	V	StDev - V
Best:	100.000	1.01000	$9,179.79	91.20	86.60	4.60	1.528	4.000	-2.472
Worst:	97.551	1.00755	$1,648.67	82.30	86.60	-4.30	4.236	4.000	0.236
Weighted Ave.:	99.354	1.00932	$4,439.52	88.58	86.60	1.98	3.522	4.000	-0.478

Flexural Strength Process Information by Year

Criteria: Projects with Bid Dates from 1/1/2003 to 12/31/2003.
Processes with less than 3 tests not included.

2003 Flexural Strength, USA

Subacct.	Item (inch)	Price	Quant.	Tests	Quality Level	Pay Factor	I/DP	TV = LSL + (V * 1.65) Mean	TV	X - TV	St Dev	V	StD Dev - V
13897	8.00	$31.00	3,072	10	100.000	1.03000	$2,856.96	693.5	652.5	41.0	33.421	50.000	-16.579
13897	10.00	$24.00	43,023	31	94.860	0.99905	($979.29)	683.2	652.5	30.7	70.386	50.000	20.386

2003 USA Totals:

Projects: 1
Processes: 2
Tests: 41
SY: 46,095

	Quality Level	Pay Factor	I/DP	Mean	TV	X - TV	St. Dev	V	StDev - V
Best:	100.000	1.03000	$2,856.96	693.5	652.5	41.0	33.421	50.000	-16.579
Worst:	94.860	0.99905	($979.29)	683.2	652.5	30.7	70.386	50.000	20.386
Weighted Ave.:	95.203	1.00111	$938.84	683.9	652.5	31.4	67.922	50.000	17.922

Appendix F

Revision to Sections 105, 106, & 412, Quality of Portland Cement Concrete Pavement

REVISION OF SECTIONS 105, 106 AND 412
QUALITY OF PORTLAND CEMENT CONCRETE PAVEMENT (ALTERNATIVE STRENGTH CRITERIA)

Sections 105, 106 and 412 of the Standard Specifications are hereby revised for this project as follows:

Subsection 105.03 shall include the following:

Conformity to the Contract of all Portland Cement Concrete Pavement, Item 412, will be determined in accordance with the following:

When the Engineer finds that the materials furnished, the work performed, or the finished product does not conform with the Contract, or the Pay Factor (PF) for an element's process is less than 0.75 but that reasonably acceptable work has been produced, the Engineer will determine the extent of the work that will be accepted and remain in place. The Engineer will use a Contract Modification Order to document the justification for allowing the work to remain in place and the price adjustment that will be applied.

When the Engineer finds the materials furnished, work performed, or the finished product is not in conformity with the Contract, or the PF for an element's process is less than 0.75 and has resulted in an inferior or unsatisfactory product, the work or material shall be removed and replaced or otherwise corrected by and at the expense of the Contractor. When the PF for any process is 0.75 or greater, the finished quantity of work represented by the process will be accepted at the calculated pay factor.

Materials will be sampled and tested by the Contractor and the Department in accordance with Section 106 and with procedures contained in the Department's Field Materials Manual. The approximate quantity represented by each sample will be as set forth in Section 106, Tables 106-3 and 106-4. Additional samples may be selected and tested at the Engineer's discretion.

(a) Incentive/Disincentive Payments (I/DP) will be made based on a statistical analysis that yields Pay Factors (PF) and Quality Levels (QL). The PF and QL will be made based on test results for the three elements of compressive strength, sand equivalent, and pavement thickness (compressive strength criteria) or the two elements of flexural strength and pavement thickness (flexural strength criteria). The Contractor shall choose whether compressive strength or flexural strength criteria will be used and indicate the choice in writing to the Engineer when the initial proposed mix design is submitted to the Engineer. Once the selection of acceptance criteria is made, they shall remain the acceptance criteria for all processes for the duration of the project.

    Incentive/ Disincentive payment will not be made for thickness of concrete pavement furnished by the Contractor and placed by others.

    If the Contractor chooses compressive strength criteria then the QL will be calculated for the elements of compressive strength, sand equivalent and pavement thickness on a process basis. If the Contractor chooses flexural strength criteria, then the QL will be calculated for the elements of flexural strength and pavement thickness on a process basis. A separate process will be established for an element when a change in the process affects that element. A process will consist of the test results from a series of random samples. Test results determined to have sampling or testing errors will not be used. All materials produced will be assigned to a process. A change in process is defined as a change that affects the element involved. Changes in mix design, material source, design pavement thickness, or the method being utilized to place the pavement are considered changes in process. The following is provided to clarify changes in processes for each element:

    1. Construction of mainline pavement, including the shoulders if placed with the mainline, is a single process, providing there are no changes in process as described above.

2. Construction of ramps, acceleration and deceleration lanes, shoulders placed separately and areas requiring hand work are considered separate processes.
3. A change in the mix design is a process change for the compressive strength element or the flexural strength element, but is not a process change for the pavement thickness element.

(b) When it is necessary to represent material by one or two tests, each individual test shall have a PF computed in accordance with the following:

If the value of the test is at or above the lower tolerance limit, then PF = 1.000. If the value of the test is below the lower tolerance limit, then:

$$PF = 1.00 - [0.25(T_L - T_0)/V]$$

where: PF = pay factor.
V= V factor from Tables 105-6 and 105-7.
T_0 = the individual test value.
T_L= lower tolerance limit.

(c) The following procedures will be used to compute Incentive/Disincentive Payments (I/DP), quality levels (QL), and pay factors (PF) for processes represented by three or more tests:

1. Quality Level (QL) will be calculated according to CP-71.
2. Compute the PF for the process. When the process has been completed, the number of tests (Pn) it includes shall determine the formula to be used to compute the final pay factor in accordance with the following:

A. For compressive strength and pavement thickness:
When $3 \le Pn \le 5$
If $QL \ge 85$, then $PF = 1.00 + (QL - 85)0.001333$
If $QL < 85$, then $PF = 1.00 + (QL - 85)0.005208$

When $6 \le Pn \le 9$
If $QL \ge 90$, then $PF = 1.00 + (QL - 90)0.002000$
If $QL < 90$, then $PF = 1.00 + (QL - 90)0.005682$

When $10 \le Pn \le 25$
If $QL \ge 93$, then $PF = 1.00 + (QL - 93)0.002857$
If $QL < 93$, then $PF = 1.00 + (QL - 93)0.006098$

When $Pn \ge 26$
If $QL \ge 95$, then $PF = 1.00 + (QL - 95)0.004000$
If $QL < 95$, then $PF = 1.00 + (QL - 95)0.006757$

B. For flexural strength:
When $3 \le Pn \le 5$
If $QL \ge 85$, then $PF = 1.00 + (QL - 85)0.002000$
If $QL < 85$, then $PF = 1.00 + (QL - 85)0.005208$

When $6 \le Pn \le 9$
If $QL \ge 90$, then $PF = 1.00 + (QL - 90)0.003000$
If $QL < 90$, then $PF = 1.00 + (QL - 90)0.005682$

When $10 \le Pn \le 25$
If $QL \ge 93$, then $PF = 1.00 + (QL - 93)0.004286$
If $QL < 93$, then $PF = 1.00 + (QL - 93)0.006098$

When Pn ≥ 26
If QL ≥ 95, then PF = 1.00 + (QL - 95)0.006000
If QL < 95, then PF = 1.00 + (QL - 95)0.006757

C. For sand equivalent:
When 3 ≤ Pn ≤ 5
If QL ≥ 85, then PF = 1.00 + (QL - 85)0.000667
If QL < 85, then PF = 1.00 + (QL - 85)0.005208

When 6 ≤ Pn ≤ 9
If QL ≥ 90, then PF = 1.00 + (QL - 90)0.001000
If QL < 90, then PF = 1.00 + (QL - 90)0.005682

When 10 ≤ Pn ≤ 25
If QL ≥93, then PF = 1.00 + (QL - 93)0.001429
If QL < 93, then PF = 1.00 + (QL - 93)0.006098

When Pn ≥ 26
If QL ≥ 95, then PF = 1.00 + (QL - 95)0.002000
If QL < 95, then PF = 1.00 + (QL - 95)0.006757

3. Compute the I/DP for the process:

I/DP = (PF-1)(QR)(UP)

where: QR = Quantity Represented by the process.
UP = Unit Price bid for the Item.

The total I/DP for an element shall be computed by accumulating the individual I/DP for each process of that element.

(d) As acceptance test results become available, they will be used to calculate accumulated QL and Incentive/Disincentive Payments (I/DP) for each element and for the item. The Contractor's test results and the accumulated calculations shall be made available to the Engineer upon request. The Engineer's test results and the calculations will be made available to the Contractor as early as reasonably practical. Numbers from the calculations shall be carried to significant figures and rounded according to AASHTO Standard Recommended Practice R-11, Rounding Method.

I/DP will be made to the Contractor in accordance with subsection 412.24(a). During production, interim I/DP will be computed for information only. The Pn will change as production continues and test results accumulate. The Pn at the time an I/DP is computed shall determine the formula to be used.

(e) The Contractor will not have the option of accepting a price reduction or disincentive in lieu of producing specification material. Continued production of non-specification material will not be permitted. Material which is obviously defective may be isolated and rejected without regard to sampling sequence or location within a process.

Table 105-6
"V" FACTORS AND INCENTIVE PAYMENTS
COMPRESSIVE STRENGTH CRITERIA

Element	V factor	Maximum Incentive Payment	Lower Tolerance Limit, T_L
Compressive Strength	2760 kPa (400 psi)	2.00%	28 day strength, Table 601-1
Pavement Thickness	10 mm (0.4 inch)	2.00%	Plan Thickness –10 mm (-0.4")
Sand Equivalent	4%	1.00%	80%

Table 105-7
"V" FACTORS AND INCENTIVE PAYMENTS
FLEXURAL STRENGTH CRITERIA

Element	V factor	Maximum Incentive Payment	Lower Tolerance Limit, T_L
Flexural Strength	345 kPa (50 psi)	3.00%	3930 kPa (570 psi)
Pavement Thickness	10 mm (0.4 inch)	2.00%	Plan Thickness –10 mm (-0.4")

Subsection 106.03 shall include the following:

All Portland Cement Concrete Pavement, Item 412, shall be tested in accordance with the following process control and acceptance testing procedures:

(a) *Process Control Testing.* The Contractor shall be responsible for process control testing of all elements listed in Table 106-3 or 106-4. Process control testing shall be performed at the expense of the Contractor. If the Contractor chooses flexural strength criteria, then the Quality Control testing for flexural strength shall be performed at the expense of the Contractor. The Contractor shall develop a quality control plan (QCP) in accordance with the following:

1. Quality Control Plan. For each element listed in Tables 106-3 or 106-4, the QCP must provide adequate details to ensure that the Contractor will perform process control. The Contractor shall submit the QCP to the Engineer at the preconstruction conference. The Contractor shall not start any work on the project until the Engineer has approved the QCP in writing.

   A. Frequency of Tests or Measurements. The QCP shall indicate a random sampling frequency, which shall not be less than that shown in Table 106-3 or 106-4. The process control tests shall be independent of acceptance tests.

   B. Test Result Chart. Each process control test result, the appropriate area, volume and the tolerance limits shall be plotted. The chart shall be posted daily at a location convenient for viewing by the Engineer.

   C. Quality Level Chart. The QL for each element in Table 106-3 or 106-4 shall be plotted. The QL will be calculated in accordance with the procedure in CP 71 for Determining Quality Level. The QL will be calculated on tests 1 through 3, then tests 1 through 4, then tests 1 through 5, then thereafter the last five consecutive test results. The area of material represented by the last test result shall correspond to the QL.

D. F-test and t-test Charts. If the Contractor chooses flexural strength criteria, then the results of F-test and t-test analysis between the Department's verification tests of flexural strength and the Contractor's quality control tests of flexural strength shall be shown on charts. The F-test and t-test will be calculated in accordance with standard statistical procedures using all verification tests and quality control tests completed to date. When a verification test is completed, the F-test and t-test calculations will be redone. The area of material represented by the last test result shall correspond to the F-test and t-test. A warning value of 5% and an alert value of 1% shall be shown on each chart. The chart shall be posted daily at a location convenient for viewing by the Engineer.

2. Point of Sampling. The material for process control testing shall be sampled by the Contractor using approved procedures. Acceptable procedures are Colorado Procedures, AASHTO and ASTM. The order of precedence is Colorado Procedures, AASHTO procedures and then ASTM procedures. The location where material samples will be taken shall be indicated in the QCP.

3. Testing Standards. The QCP shall indicate which testing standards will be followed. Acceptable standards are Colorado Procedures, AASHTO and ASTM. The order of precedence is Colorado Procedures, AASHTO procedures and then ASTM procedures.

   The compressive strength test for process control will be the average strength of two test cylinders cast in plastic molds from a single sample of concrete, cured under standard laboratory conditions, and tested three to seven days after molding. The trial mix proposed and conducted by the Contractor for mix design approval shall include compressive strength data including the curing time for compressive strength process control tests. CDOT may participate in the process control testing for compressive strength at a frequency determined by the Engineer.

4. Testing Supervisor Qualifications. The person in charge of and responsible for the process control testing shall be identified in the QCP. This person shall be present on the project and possess one or more of the following qualifications:

   A. Registration as a Professional Engineer in the State of Colorado.
   B. Registration as an Engineer in Training in the State of Colorado with two years of paving experience.
   C. A Bachelor of Science in Civil Engineering or Civil Engineering Technology with three years of paving experience.
   D. National Institute for Certification in Engineering (NICET) certification at level III or higher in the subfields of Transportation Engineering Technology, Highway Materials or Construction Materials Testing Engineering Technology, Concrete and four years of paving experience.

5. Technician Qualifications. Technicians performing tests, if other than the person in responsible charge, shall meet the requirements of Colorado Procedure 10.

6. Testing Equipment. All of the testing equipment used to conduct process control testing shall conform to the standards specified in the test procedures and be in good working order. If the Contractor chooses flexural strength criteria, then the Contractor shall provide the following equipment and supplies which will not be paid for separately but shall be included in the work:

   A. A separate, temperature controlled facility of at least 28 m^2 (300 square feet) usable space. This facility shall be used exclusively for the molding, storage and testing of concrete test specimens as required. This facility shall be provided in addition to other facilities required in Section 620. The storage facility shall have sufficient water storage capacity for curing all required test specimens. The storage facility shall provide separate storage tanks for each type of required testing. Each storage tank shall have a continuously recording thermometer and sufficient blank charts for the project. Temperatures of each storage tank shall be recorded for the duration of the project.

   B. A machine for testing flexural strength of concrete specimens. The machine shall be used only for flexural strength tests. The machine shall be model number F-250F manufactured by Forney with a DFM/IV digital monitor or an approved equal. Both the Contractor and the Engineer will use this

machine for testing concrete specimens. The machine and the flexural strength assembly shall be of a rigid construction. The applied vertical load shall be uniformly distributed to the third points and uniformly across the width of the beam (transverse distribution). Uniform distribution of the load is defined as less than a 3 percent variation in the load between each of the nine strain gages placed in the middle third section of the tension face for loads from 4450 to 44 500 N (1,000 to 10,000 pounds). One firm that can evaluate and assess the ability of the machine to distribute the load evenly is Construction Technology Laboratories, Skokie Illinois (847)965-7500 (Paul Okamoto), other firms may be capable of evaluating and assessing the load distribution of the machine. The Engineer must approve the firm prior to assessing the machine. The machine shall be ready for use and calibration two days before paving begins. After the machine has been calibrated and accepted by the Engineer it shall not be moved until all portland cement concrete paving and flexural strength acceptance tests have been completed.

C. Beam molds for molding all test specimens required. This shall include all testing described in subsection 106.03.

7. Reporting and Record Keeping. The Contractor shall report the results of the tests to the Engineer in writing at least once per day. The Contractor shall make provisions such that the Engineer can inspect quality control work in progress, including sampling, testing, plants, documentation and the Contractor's testing facilities at any time.

(b) *Acceptance Testing.* Acceptance testing frequencies shall be in accordance with Table 106-3 or Table 106-4. Except for flexural strength, acceptance tests will be conducted by and at the expense of the Department. Acceptance sampling and testing procedures will be in accordance with the Department's Field Materials Manual with the following exceptions and inclusions:

A split sample from an acceptance test shall not be used for a process quality control test. The Engineer shall designate the location where samples are to be taken. Samples shall be taken by the Contractor. The Engineer will be present during the sampling and take possession of all acceptance samples. Samples transported in different containers will be combined and mixed before molding specimens. All materials are subject to inspection and testing at all times.

Pavement thickness acceptance will be determined by cores.

The compressive strength test for acceptance will be the average compressive strength of three test cylinders cast in plastic molds from a single sample of concrete and cured under standard laboratory conditions prior to testing. If the compressive strength of any one specimen differs from the average by more than 10%, that specimen will be deleted and the average strength will be determined using the remaining two specimens. Each set of three cylinders will be tested at 28 days after molding.

Acceptance tests for flexural strength shall be the Contractor's quality control tests. The flexural strength tests shall be the average flexural strength of four test beams. The test beams shall be prepared according to AASHTO T 23 with the following additional requirements: Specimens shall be consolidated by internal vibration without the vibrator being inserted in the center six inches of the specimen's long dimension. After the initial curing, specimens shall be stored in a moist condition at 23 °C ± 2 °C (73.4 °F ± 3 °F). The flexural strength of each specimen shall be measured according to AASHTO T 97 with the following additional requirements: If the flexural strength of only one specimen differs from the average by more than 10%, that specimen shall be deleted and the average strength shall be determined using the remaining three specimens. If the flexural strength of more than one specimen differs from the average by more than 10%, the test value shall be the average of all four specimens. Each set of four beams shall be tested at 28 days after molding. Specimens shall be properly centered in the machine for each test. Leather shims shall be used in each test. The loading rate shall remain constant after the initial loading of a maximum of 4450 N (1000 pounds) has been applied.

(c) *Verification Testing.* Verification testing will be used only when the Contractor chooses flexural strength criteria and is the responsibility of the Department. The Department will determine the locations where

samples or measurements are to be taken. The maximum quantity of material represented by each test result and the minimum number of test results shall be in accordance with Table 106-4. The location of sampling shall be based on a stratified random procedure.

Verification sampling and testing procedures will be in accordance with Sections 105, 106, 412 and the Schedule for Minimum Materials Sampling, Testing and Inspection in the Department's Field Materials Manual, CP-13. Samples for verification and acceptance testing shall be taken by the Contractor in accordance with the designated method and shall be taken in the presence of the Engineer.

An analysis of test results will be performed after all test results are known using the t-test and F-test statistical methods using an alpha value set at 0.05. If either the above t-test and F-test analysis shows a significant difference then the following items shall be checked; comparison of beam fracture locations and types, computations and flexural testing machine outputs, curing tank temperature charts, slump and air contents, plant batch tickets for major changes, review of sampling, molding, testing procedures, along with IAT check tests and any other investigations that may clarify the significant differences. If after a review of the data no reasons can be determined for the significant difference, the Department's test data shall be used for determining Quality Levels and I/DP according to the methods in this Section.

(d) *Check Testing.* The Contractor and the Engineer shall conduct a check testing program (CTP) prior to the placement of any concrete pavement. The check testing program will include a conference directed by the Region Materials Engineer of the Contractor's testers and the Department's testers concerning methods, procedures and equipment for compressive or flexural strength testing. Check testing shall be completed before any portland cement concrete pavement is placed. A set of three cylinders or four beams will be molded by both the Contractor and the Department's project testers from a split sample. The specimens will be sampled, molded and cured for seven days and tested for compressive or flexural strength according to the procedures of Section 106. The Department's Independent Assurance Tester will also mold, cure and test a set of three cylinders or four beams, but the Independent Assurance Test results will not be entered in the check testing analysis. If the results of the check tests do not meet the following criteria, then the check testing will be repeated until the following criteria are met:

1. The average of the Contractor's test results and the average of the Department's test results shall be within 10% of the average of all test results.
2. Each specimen test result shall be within 15% of the average of all test results.

When the compressive strength criteria is chosen, a check test must also be conducted on the sand equivalent test. A set of 5 sand equivalents will be run by both the Contractor's and the Department's project tester, from a split sample. The average of the absolute differences between the process control and the acceptance testing personnel will be compared to the acceptable limits shown in Table 13-1 of CP-13. The CTP will be continued until the acceptance and process control test results are within the permissible ranges shown in Table 13-1 of CP-13.

During production, split samples of randomly selected acceptance tests will be compared to the permissible ranges shown in Table 13-1 of CP-13. The minimum frequency will be as shown in Table 106-3.

If production has been suspended and then resumed, the Engineer may order a CTP between process control and acceptance testing persons to assure the test results are within the permissible ranges shown in Table 106-5. Check test results shall not be included in process control testing. The Region Materials Engineer shall be called upon to resolve differences if a CTP shows unresolved differences beyond the ranges shown in Table 13-1 of CP-13.

(e) Independent Assurance Tests (IAT) for flexural strength will be performed at a frequency of 1/50 000 m^2 (1/50,000 sq. yds). The sample for the IAT will be a split sample of the Contractor's quality control test. The Department's representative performing verification tests shall also use a split sample of the Contractor's quality control test and participate in the IAT. The IAT for flexural strength will be the average flexural strength of four test beams prepared according to the requirements of Section 106 and cured for seven days.

(f) *Testing Schedule.* All samples used to determine I/DP by quality level formulas in accordance with Section 105, will be selected by a stratified random process.

TABLE 106-3
TESTING SCHEDULE - ITEM 412 PORTLAND CEMENT CONCRETE PAVEMENT, COMPRESSIVE STRENGTH CRITERIA

Element	Minimum Testing Frequency Contractor's Process Control	Minimum Testing Frequency CDOT Acceptance Testing
Aggregate Gradation and Fractured Faces	1/10 000 m^2 (1/10,000 sq. yds.) or one/day if less than 10 000 m^2 (10,000 sq. yds.) are placed in a day	None
Slump	First three loads each day, then as needed for control.	Witness by the Engineer.
Compressive Strength, Air Content, ★Yield and Sand Equivalent	1/2500 m^2 (1/2500 sq. yds.) or one/day if less than 2500 m^2 (2500 sq. yds.) are placed in a day.	Minimum of 1/day. If the project total < 50 000 m^2 (50,000 sq. yds.), then a minimum of ten tests. If the project total ≥50 000 m^2 (50,000 sq. yds.), then 1/5000 m^2 (1/5,000 sq. yds.).
Pavement Thickness	In accordance with subsection 412.21.	Minimum of 1/day. If the project total < 50 000 m^2 (50,000 sq. yds.), then a minimum of ten tests. If the project total ≥ 50 000 m^2 (50,000 sq. yds.), then 1/5000 m^2 (1/5000 sq. yds.).
Pull Test Joints	Minimum of six transverse and six longitudinal joint locations in each 760 m (2500 linear feet).	Witness by the Engineer.
Load Transfer Dowel Bar Placement	Minimum of six transverse joint locations in each each 760 m (2500 lineal feet).	Witness by the Engineer.
Tining Depth	1 per 160 m (528 linear feet) in each lane and shoulder wider than 2.4 m (8 feet).	Witness by the Engineer.

★Yield is for information only.

TABLE 106-4
TESTING SCHEDULE - ITEM 412 PORTLAND CEMENT CONCRETE PAVEMENT, FLEXURAL STRENGTH CRITERIA

Element	Minimum Testing Frequency Contractor's Process Control	Minimum Testing Frequency CDOT Acceptance Testing
Aggregate Gradation and Sand Equivalent	For the first five days, 1/10 000 m^2 (1/10,000 sq. yds.) or one/day if less than 10 000m^2 (10,000 sq. yds.) are placed in a day. After 5 days, 1/40 000 m^2 (1/40,000 sq. yds.).	None
Slump	First three loads each day, then as needed for control.	Witness by the Engineer.
Water Cement Ratio	First three loads each day, then 1/500 m^3 (1/500 cu. yds.).	First three loads each day, then 1/2000 m^3 (1/2000 cu. yds.).
Air Content and ★Yield	1/2500 m^2 (1/2500 sq. yds.) or one/day if less than 2500 m^2 2500 sq. yds. are placed in a day.	Minimum of 1/day. If the project total < 50 000 m^2 (50,000 sq. yds.), then a minimum of ten tests. If the project total ≥ 50 000 m^2 (50,000 sq. yds.), then 1/5000 m^2 (1/5000 sq. yds.).
Flexural Strength	1/2500 m^2 (1/2500 sq. yds.) or one/day if less than 2500 m^2 2500 sq. yds. are placed in a day.	One verification test per four quality control tests performed by the Contractor. (Approximately 1/10 000 m^2 [1/10,000 sq. yds.]).
Compressive Strength	1/10 000 m^2 (1/10,000 sq. yds.).	None
Pavement Thickness	In accordance with subsection 412.21.	Minimum of 1/day. If the project total < 50 000 m^2 (50,000 sq. yds.), then a minimum of ten tests. If the project total ≥ 50 000 m^2 (50,000 sq. yds.), then 1/5000 m^2 (1/5000 sq. yds.).
Pull Test Joints	Minimum of six transverse and six longitudinal joint locations in each 760 m (2500 linear feet).	Witness by the Engineer.
Load Transfer Dowel Bar Placement	Minimum of six transverse joint locations in each 760 m (2500 linear feet).	Witness by the Engineer.
Tining Depth	1 per 160 m (1 per 528 linear feet) in each lane and shoulder wider than 2.4 m (8 feet).	Witness by the Engineer.

★Yield is for information only.

REVISION OF SECTIONS 105, 106 AND 412
QUALITY OF PORTLAND CEMENT CONCRETE PAVEMENT (ALTERNATIVE STRENGTH CRITERIA)

In subsection 412.21, delete the fifth through tenth paragraphs and replace with the following:

The lower tolerance limit (T_L) for pavement thickness shall be Plan Thickness (PT) minus 10 mm (0.4 inches). This T_L shall be used in the formulas in Section 105 for Incentive/Disincentive Payments (I/DP), Quality Levels (QL) and Pay Factor (PF) determinations. Any pavement thickness test value that exceeds the PT by more than 25 mm (1.0 inch) shall be assigned a value of PT + 25 mm (1.0 inch) for the purpose of calculating the QL, PF and I/DP.

Coring frequency shall be in accordance with subsection 106.03. Core locations shall be determined by a random procedure so that each area has a randomly selected coring location. One core will be taken at each location.

Where the new portland cement concrete pavement overlays an existing roadway, cores for measuring pavement thickness shall be determined by a stratified random procedure in the longitudinal direction and by the point of minimum required thickness in the lateral direction as shown in the plans. If existing field conditions show a condition where the point of minimum thickness in the lateral direction as shown in the plans is not appropriate, the Contractor shall identify the location and extent of the area to the Engineer at least 24 hours before paving. The Engineer may exclude this area from pavement thickness measurements for incentive/disincentive payments.

Pavement thickness tests will be evaluated in accordance with subsection 105.03.

Additional cores will be taken at the direction of the Engineer as follows:

(1) One additional core at the location of each process control (PC) test that is less than T_L but greater than PT minus 25 mm (1.0 inch). If the length of the additional core is greater than T_L, no additional actions will be taken and the original randomly selected acceptance test core will be used to compute I/DP for the process that includes this material.

(2) If the additional core or any randomly selected core is less than T_L but greater than PT minus 25 mm (1.0 inch), the area represented by this core shall become a separate process and this core will not be used to compute an I/DP. Four additional randomly selected cores will be taken within the area represented by this core. The four additional cores will be used to compute an I/DP in accordance with Section 105. Cores taken at locations not randomly determined, such as process control cores will not be used to compute I/DP.

(3) When the measurement of any core is less than PT (Plan Thickness) minus 25 mm (1.0 inch), whether randomly located or not, the area represented by this core shall become a separate process and this core will not be used to compute an I/DP. The actual thickness of the pavement in this area will be determined by taking exploratory cores. Cores shall be taken at intervals of 4.6 m (15 feet) or less, parallel to the centerline in each direction from the affected location until two consecutive cores are found in each direction which are not less than PT minus 25 mm (1.0 inch).

    Pavement areas found to be less than PT minus 25 mm (1.0 inch) shall be removed and replaced at the Contractor's expense. Exploratory cores taken at the Contractor's expense will be used to determine the extent of deficient pavement for pavement removal.

    When the removal and replacement have been completed, four additional randomly selected cores will be taken within the area represented by this core. The four additional cores will be used to compute an I/DP in accordance with subsection 105.03. Exploratory cores will not be used to compute I/DP.

    The Contractor shall repair all core holes by filling them with an approved non-shrink high strength grout.

Subsection 412.24(a) shall include the following:

Incentive/Disincentive Payments (I/DP) will not be made on interim estimates. I/DP will be made when the concrete pavement or a major phase of the concrete pavement has been completed and all the data for computing the I/DP is available.

REVISION OF SECTIONS 105, 106 AND 412
QUALITY OF PORTLAND CEMENT CONCRETE PAVEMENT (ALTERNATIVE STRENGTH CRITERIA)

Delete subsection 412.24(b) and replace with the following:

(b) Where the pavement thickness is more than Plan Thickness (PT) minus 25 mm (1.0 inch), I/DP for the element of pavement thickness will be applied to the contract unit price in accordance with subsections 105.03 and 412.21. I/DP for other elements will be applied to the contract unit in accordance with Sections 105 and 412.

Adjustments in payment because of deviations in air content will be in accordance with subsection 601.17 using $\$131/m^3$ ($100.00 per cu. yd.) for the unit bid price.

Appendix G

Colorado Procedure 71 Determining Quality Level

Colorado Procedure 71-01

Standard Practice for

Determining Quality Level (Percent Within Tolerance Limits)

1. SCOPE

1.1 Use this procedure with Quality Assurance type specifications where Pay Factors or acceptance decisions are based on Quality Level (QL), defined as percent within specification (tolerance) limits. QL is a measure of quality of a lot or process.

1.2 QL represents the percentage of the population (lot or process) that falls above a single lower limit, below a single upper limit, or between the upper and lower limits of double-limit specifications.

1.3 For this procedure to be meaningful, select all samples by random or stratified random procedures. Perform all testing and measuring strictly in accordance with standard acceptable practices. When used for contractual purposes, do all sampling and testing in accordance with the applicable specifications.

1.4 Manual, computer assisted, and mathematical procedures are described. Where contractual pay factors are based on QL, use only the computer assisted procedure.

2. SUMMARY OF METHOD

2.1 The method involves calculating statistical parameters from three or more representative measurements, test results, or values for each specified element in a lot or sample. The arithmetic average (mean) value of the sample is calculated. As a measure of variability, the sample Standard Deviation is calculated. Using these results, the distance from the sample mean to each limit is divided by the standard deviation, which yields the Quality Index.

2.2 The incomplete beta function ratio, using sample sizes and quality indices as variables, is used in the computer version to calculate areas under the beta distribution. With variables typical for QL determinations, the beta distribution (Figure 71-1) is similar to the normal distribution (Figure 71-2).

2.3 The total area under the beta distribution outside the specification limits is the fraction defective which is then multiplied by 100 to yield the percent defective; this subtracted from 100 gives the percent within limits.

2.4 Table 71-1 contains values for percent within limits as related to sample sizes and quality indices. The table was developed from mathematical calculations and is used in the manual method to estimate QL.

3. MANUAL PROCEDURE

3.1 Determine the arithmetic mean and standard deviation for the several test results from the lot for each element being evaluated. Compute these as shown in Equations 3.1 and 3.2.

$$\bar{X} = \frac{\Sigma X}{n} \qquad \textbf{Equation 3.1}$$

$$s = \sqrt{\frac{\Sigma (X - \bar{X})^2}{n - 1}} \qquad \textbf{Equation 3.2}$$

Where:

$\bar{X}$ = Sample mean,
S = Summation of,
X = Individual test value to X_n,
n = Total number of test values,
s = Sample standard deviation.

3.2 Compute the upper quality index (Q_u) per Equation 3.3.

$$Q_u = \frac{T_u - \bar{X}}{s} \qquad \textbf{Equation 3.3}$$

Where:
Q_u = Upper quality index,
T_u = Upper specification limits.

3.2.1 Determine P_u (percent within the upper specification limit which corresponds to a given Q_u) from Table 71-1. If desired, P_u may be interpolated to the nearest 0.1. Where T_u is not specified, P_u will be 100.

3.3 Compute the lower quality index (Q_L) per Equation 3.4.

$$Q_L = \frac{\bar{X} - T_L}{s} \qquad \textbf{Equation 3.4}$$

Where:
Q_L = Lower quality index,
T_L = Lower specification limits.

3.3.1 Determine P_L (percent within the lower specification limit which corresponds to a given Q_L) from Table 71-1. If desired, P_L may be interpolated to the nearest 0.1. Where T_L is not specified, P_L will be 100.

3.4 Compute QL (the total percent within specification limits) per Equation 3.5.

$$QL = (P_u + P_L) - 100 \qquad \textbf{Equation 3.5}$$

3.5 The manual method for determining QL essentially conforms to the applicable portions of AASHTO Standard Recommended Practice R 9, Acceptance Sampling Plans for Highway Construction.

3.6 A sample calculation is provided at the end of this procedure demonstrating the calculation of Quality Level and Pay Factors using this manual procedure.

4. COMPUTER ASSISTED PROCEDURE

4.1 The calculations for determining Quality Level may be performed by using the latest versions of the Departments quality level programs.

4.2 In the quality level programs, the areas under the beta distribution are calculated from the incomplete beta function ratio by assigning the variables used in Equations 3.1 through 3.4. The procedure is as described in *Numerical Recipes in C*[1], *Chapter 6.* A detailed discussion of the theories involved is provided by Willenbrock and Kopac in *TRR 691, Process Control in the Construction Industry*[2].

4.3 All numbers from the calculations are carried to significant figures and round according to AASHTO Standard Recommended Practice R 11, using the Rounding Method.

4.4 Where contractual pay factors are based on QL use the computer-assisted procedure only.

MATHEMATICAL PROCEDURE - Adapted from *Resolution of beta-distribution equations for quality level analysis...*[3]

5.1 In order to evaluate the necessary quality parameters, the integral

$$I_n = \frac{1}{B(\frac{n}{2} - 1, \frac{n}{2} - 1)} \int_0^g t^{\frac{n}{2} - 2} (1 - t)^{\frac{n}{2} - 2} dt \qquad \textbf{Equation 5.1}$$

must be evaluated. In equation 5.1 B(n/2-1,n/2-1) is generally referred to as the complete beta-function (or just the beta-function) with parameters n/2-1,n/2-1, and the integral is the incomplete beta-function. Together they form the beta distribution from a random variable. The beta function is defined by

$$B(\frac{n}{2} - 1, \frac{n}{2} - 1) = \int_0^1 t^{\frac{n}{2} - 2} (1 - t)^{\frac{n}{2} - 2} dt, \qquad \textbf{Equation 5.2}$$

and the upper limit ?n 5.1 is given by

$$g = \frac{1}{2} - \frac{Q\sqrt{n}}{2(n - 1)} \qquad \textbf{Equation 5.3}$$

where Q is the quality index defined in Equations 3.3 and 3.4 and n is the sample size.

5.2 For small sample sizes no numerical integration is necessary as the integral may be economically evaluated in close form. In particular we have:

$$I_3 = \frac{1}{2} + \frac{1}{p} \sin^{-1}(2g - 1) \qquad \textbf{Equation 5.4}$$

$$I_4 = g \qquad \textbf{Equation 5.5}$$

$$I_5 = \frac{1}{2} + \frac{1}{p} \sin^{-1}(2g - 1) + \frac{2}{p} \sqrt{g - g^2}\,(2g - 1) \qquad \textbf{Equation 5.6}$$

$$I_6 = 3g^2 - 2g^3 \qquad \textbf{Equation 5.7}$$

$$I_7 = \frac{1}{2} + \frac{1}{p} \sin^{-1}(2g - 1) - \frac{2}{3p} \sqrt{g - g^2}\,(2g - 1)(8g^2 - 8g - 3) \qquad \textbf{Equation 5.8}$$

$$I_8 = 10g^3 - 15g^4 + 6g^5 \qquad \textbf{Equation 5.9}$$

These expressions are small enough to be used with some hand calculators. As the value of n increases the calculations become more complex. With the availability of personal computers, we include the equation for information and recommend the use of personal computers.

TABLE 71-1

Upper Quality Index Qu or Lower Quality Index QL															
P_u or P_L %	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10 to n=11	n=12 to n=14	n=15 to n=18	n=19 to n=25	n=26 to n=37	n=38 to n=69	n=70 to n= 200	n= 201 to n=x
100	1.16	1.50	1.79	2.03	2.23	2.39	2.53	2.65	2.83	3.03	3.20	3.38	3.54	3.70	3.83
99		1.47	1.67	1.80	1.89	1.95	2.00	2.04	2.09	2.14	2.18	2.22	2.26	2.29	2.31
98	1.15	1.44	1.60	1.70	1.76	1.81	1.84	1.86	1.91	1.93	1.96	1.99	2.01	2.03	2.05
97		1.41	1.54	1.62	1.67	1.70	1.72	1.74	1.77	1.79	1.81	1.83	1.85	1.86	1.87
96	1.14	1.38	1.49	1.55	1.59	1.61	1.63	1.65	1.67	1.68	1.70	1.71	1.73	1.74	1.75
95		1.35	1.44	1.49	1.52	1.54	1.55	1.56	1.58	1.59	1.61	1.62	1.63	1.63	1.64
94	1.13	1.32	1.39	1.43	1.46	1.47	1.48	1.49	1.50	1.51	1.52	1.53	1.54	1.55	1.55
93		1.29	1.35	1.38	1.40	1.41	1.42	1.43	1.44	1.44	1.45	1.46	1.46	1.47	1.47
92	1.12	1.26	1.31	1.33	1.35	1.36	1.36	1.36	1.37	1.37	1.39	1.39	1.40	1.40	1.40
91	1.11	1.23	1.27	1.29	1.30	1.30	1.31	1.31	1.32	1.32	1.33	1.33	1.33	1.34	1.34
90	1.10	1.20	1.23	1.24	1.25	1.25	1.26	1.26	1.26	1.27	1.27	1.27	1.28	1.28	1.28
89	1.09	1.17	1.19	1.20	1.20	1.21	1.21	1.21	1.21	1.22	1.22	1.22	1.22	1.22	1.23
88	1.07	1.14	1.15	1.16	1.16	1.16	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17
87	1.06	1.11	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.13	1.13
86	1.04	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
85	1.03	1.05	1.05	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
84	1.01	1.02	1.01	1.01	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.99
83	1.00	0.99	0.98	0.97	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.95	0.95	0.95
82	0.97	0.96	0.95	0.94	0.93	0.93	0.93	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
81	0.96	0.93	0.91	0.90	0.90	0.89	0.89	0.89	0.89	0.88	0.88	0.88	0.88	0.88	0.88
80	0.93	0.90	0.88	0.87	0.86	0.86	0.86	0.85	0.85	0.85	0.85	0.84	0.84	0.84	0.84
79	0.91	0.87	0.85	0.84	0.83	0.82	0.82	0.82	0.82	0.81	0.81	0.81	0.81	0.81	0.81
78	0.89	0.84	0.82	0.80	0.80	0.79	0.79	0.79	0.78	0.78	0.78	0.78	0.77	0.77	0.77
77	0.87	0.81	0.78	0.77	0.76	0.76	0.76	0.75	0.75	0.75	0.75	0.74	0.74	0.74	0.74
76	0.84	0.78	0.75	0.74	0.73	0.73	0.72	0.72	0.72	0.71	0.71	0.71	0.71	0.71	0.71
75	0.82	0.75	0.72	0.71	0.70	0.70	0.69	0.69	0.69	0.68	0.68	0.68	0.68	0.68	0.67
74	0.79	0.72	0.69	0.68	0.67	0.66	0.66	0.66	0.66	0.65	0.65	0.65	0.65	0.64	0.64
73	0.76	0.69	0.66	0.65	0.64	0.63	0.63	0.63	0.62	0.62	0.62	0.62	0.62	0.61	0.61
72	0.74	0.66	0.63	0.62	0.61	0.60	0.60	0.60	0.59	0.59	0.59	0.59	0.59	0.58	0.58
71	0.71	0.63	0.60	0.59	0.58	0.57	0.57	0.57	0.57	0.56	0.56	0.56	0.56	0.55	0.55
70	0.68	0.60	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.53	0.53	0.53	0.53	0.53	0.52
69	0.65	0.57	0.54	0.53	0.52	0.52	0.51	0.51	0.51	0.50	0.50	0.50	0.50	0.50	0.50
68	0.62	0.54	0.51	0.50	0.49	0.49	0.48	0.48	0.48	0.48	0.47	0.47	0.47	0.47	0.47
67	0.59	0.51	0.47	0.47	0.46	0.46	0.46	0.45	0.45	0.45	0.45	0.44	0.44	0.44	0.44
66	0.56	0.48	0.45	0.44	0.44	0.43	0.43	0.43	0.42	0.42	0.42	0.42	0.41	0.41	0.41
65	0.52	0.45	0.43	0.41	0.41	0.40	0.40	0.40	0.40	0.39	0.39	0.39	0.39	0.39	0.39
64	0.49	0.42	0.40	0.39	0.38	0.38	0.37	0.37	0.37	0.36	0.36	0.36	0.36	0.36	0.36
63	0.46	0.39	0.37	0.36	0.35	0.35	0.35	0.34	0.34	0.34	0.34	0.34	0.33	0.33	0.33
62	0.43	0.36	0.34	0.33	0.32	0.32	0.32	0.32	0.31	0.31	0.31	0.31	0.31	0.31	0.31
61	0.39	0.33	0.31	0.30	0.30	0.29	0.29	0.29	0.29	0.29	0.28	0.28	0.28	0.28	0.28
60	0.36	0.30	0.28	0.27	0.27	0.27	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.25	0.25
59	0.32	0.27	0.25	0.25	0.24	0.24	0.24	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.23
58	0.29	0.24	0.23	0.22	0.21	0.21	0.21	0.21	0.21	0.21	0.20	0.20	0.20	0.20	0.20
57	0.25	0.21	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
56	0.22	0.18	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.15	0.15
55	0.18	0.15	0.14	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
54	0.14	0.12	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
53	0.11	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
52	0.07	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
51	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE: When Q_u or Q_L falls between table values, estimate P_u or P_L to the closest 0.10.

TABLE 71-1

Upper Quality Index Qu or Lower Quality Index QL

P_u or P_L %	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10 to n=11	n=12 to n=14	n=15 to n=18	n=19 to n=25	n=26 to n=37	n=38 to n=69	n=70 to n= 200	n= 201 to n=x
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	-0.04	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.02
48	-0.07	-0.06	-0.06	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
47	-0.11	-0.09	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08
46	-0.14	-0.12	-0.11	-0.11	-0.11	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10
45	-0.18	-0.15	-0.14	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13
44	-0.22	-0.18	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15
43	-0.25	-0.21	-0.20	-0.19	-0.19	-0.19	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18
42	-0.29	-0.24	-0.23	-0.22	-0.21	-0.21	-0.21	-0.21	-0.21	-0.21	-0.20	-0.20	-0.20	-0.20	-0.20
41	-0.32	-0.27	-0.25	-0.25	-0.24	-0.24	-0.24	-0.24	-0.23	-0.23	-0.23	-0.23	-0.23	-0.23	-0.23
40	-0.36	-0.30	-0.28	-0.27	-0.27	-0.27	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26	-0.25	-0.25
39	-0.39	-0.33	-0.31	-0.30	-0.30	-0.29	-0.29	-0.29	-0.29	-0.29	-0.28	-0.28	-0.28	-0.28	-0.28
38	-0.43	-0.36	-0.34	-0.33	-0.32	-0.32	-0.32	-0.32	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31
37	-0.46	-0.39	-0.37	-0.36	-0.35	-0.35	-0.35	-0.34	-0.34	-0.34	-0.34	-0.34	-0.33	-0.33	-0.33
36	-0.49	-0.42	-0.40	-0.39	-0.38	-0.38	-0.37	-0.37	-0.37	-0.36	-0.36	-0.36	-0.36	-0.36	-0.36
35	-0.52	-0.45	-0.43	-0.41	-0.41	-0.40	-0.40	-0.40	-0.40	-0.39	-0.39	-0.39	-0.39	-0.39	-0.39
34	-0.56	-0.48	-0.45	-0.44	-0.44	-0.43	-0.43	-0.43	-0.42	-0.42	-0.42	-0.42	-0.41	-0.41	-0.41
33	-0.59	-0.51	-0.47	-0.47	-0.46	-0.46	-0.46	-0.45	-0.45	-0.45	-0.45	-0.44	-0.44	-0.44	-0.44
32	-0.62	-0.54	-0.51	-0.50	-0.49	-0.49	-0.48	-0.48	-0.48	-0.48	-0.47	-0.47	-0.47	-0.47	-0.47
31	-0.65	-0.57	-0.54	-0.53	-0.52	-0.52	-0.51	-0.51	-0.51	-0.50	-0.50	-0.50	-0.50	-0.50	-0.50
30	-0.68	-0.60	-0.57	-0.56	-0.55	-0.55	-0.54	-0.54	-0.54	-0.53	-0.53	-0.53	-0.53	-0.53	-0.52
29	-0.71	-0.63	-0.60	-0.59	-0.58	-0.57	-0.57	-0.57	-0.57	-0.56	-0.56	-0.56	-0.56	-0.55	-0.55
28	-0.74	-0.66	-0.63	-0.62	-0.61	-0.60	-0.60	-0.60	-0.59	-0.59	-0.59	-0.59	-0.59	-0.58	-0.58
27	-0.76	-0.69	-0.66	-0.65	-0.64	-0.63	-0.63	-0.63	-0.62	-0.62	-0.62	-0.62	-0.62	-0.61	-0.61
26	-0.79	-0.72	-0.69	-0.68	-0.67	-0.66	-0.66	-0.66	-0.66	-0.65	-0.65	-0.65	-0.65	-0.64	-0.64
25	-0.82	-0.75	-0.72	-0.71	-0.70	-0.70	-0.69	-0.69	-0.69	-0.68	-0.68	-0.68	-0.68	-0.68	-0.67
24	-0.84	-0.78	-0.75	-0.74	-0.73	-0.73	-0.72	-0.72	-0.72	-0.71	-0.71	-0.71	-0.71	-0.71	-0.71
23	-0.87	-0.81	-0.78	-0.77	-0.76	-0.76	-0.76	-0.75	-0.75	-0.75	-0.75	-0.74	-0.74	-0.74	-0.74
22	-0.89	-0.84	-0.82	-0.80	-0.80	-0.79	-0.79	-0.79	-0.78	-0.78	-0.78	-0.78	-0.77	-0.77	-0.77
21	-0.91	-0.87	-0.85	-0.84	-0.83	-0.82	-0.82	-0.82	-0.82	-0.81	-0.81	-0.81	-0.81	-0.81	-0.81
20	-0.93	-0.90	-0.88	-0.87	-0.86	-0.86	-0.86	-0.85	-0.85	-0.85	-0.85	-0.84	-0.84	-0.84	-0.84
19	-0.96	-0.93	-0.91	-0.90	-0.90	-0.89	-0.89	-0.89	-0.89	-0.88	-0.88	-0.88	-0.88	-0.88	-0.88
18	-0.97	-0.96	-0.95	-0.94	-0.93	-0.93	-0.93	-0.92	-0.92	-0.92	-0.92	-0.92	-0.92	-0.92	-0.92
17	-1.00	-0.99	-0.98	-0.97	-0.96	-0.96	-0.96	-0.96	-0.96	-0.96	-0.96	-0.96	-0.95	-0.95	-0.95
16	-1.01	-1.02	-1.01	-1.01	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-0.99	-0.99	-0.99
15	-1.03	-1.05	-1.05	-1.04	-1.04	-1.04	-1.04	-1.04	-1.04	-1.04	-1.04	-1.04	-1.04	-1.04	-1.04
14	-1.04	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08
13	-1.06	-1.11	-1.12	-1.12	-1.12	-1.12	-1.12	-1.12	-1.12	-1.12	-1.12	-1.12	-1.12	-1.13	-1.13
12	-1.07	-1.14	-1.15	-1.16	-1.16	-1.16	-1.17	-1.17	-1.17	-1.17	-1.17	-1.17	-1.17	-1.17	-1.17
11	-1.09	-1.17	-1.19	-1.20	-1.20	-1.21	-1.21	-1.21	-1.21	-1.22	-1.22	-1.22	-1.22	-1.22	-1.23
10	-1.10	-1.20	-1.23	-1.24	-1.25	-1.25	-1.26	-1.26	-1.26	-1.27	-1.27	-1.27	-1.28	-1.28	-1.28
9	-1.11	-1.23	-1.27	-1.29	-1.30	-1.30	-1.31	-1.31	-1.32	-1.32	-1.33	-1.33	-1.33	-1.34	-1.34
8	-1.12	-1.26	-1.31	-1.33	-1.35	-1.36	-1.36	-1.36	-1.37	-1.37	-1.39	-1.39	-1.40	-1.40	-1.40
7		-1.29	-1.35	-1.38	-1.40	-1.41	-1.42	-1.43	-1.44	-1.44	-1.45	-1.46	-1.46	-1.47	-1.47
6	-1.13	-1.32	-1.39	-1.43	-1.46	-1.47	-1.48	-1.49	-1.50	-1.51	-1.52	-1.53	-1.54	-1.55	-1.55
5		-1.35	-1.44	-1.49	-1.52	-1.54	-1.55	-1.56	-1.58	-1.59	-1.61	-1.62	-1.63	-1.63	-1.64
4	-1.14	-1.38	-1.49	-1.55	-1.59	-1.61	-1.63	-1.65	-1.67	-1.68	-1.70	-1.71	-1.73	-1.74	-1.75
3		-1.41	-1.54	-1.62	-1.67	-1.70	-1.72	-1.74	-1.77	-1.79	-1.81	-1.83	-1.85	-1.86	-1.87
2	-1.15	-1.44	-1.60	-1.70	-1.76	-1.81	-1.84	-1.86	-1.91	-1.93	-1.96	-1.99	-2.01	-2.03	-2.05
1		-1.47	-1.67	-1.80	-1.89	-1.95	-2.00	-2.04	-2.09	-2.14	-2.18	-2.22	-2.26	-2.29	-2.31
0	-1.16	-1.50	-1.79	-2.03	-2.23	-2.39	-2.53	-2.65	-2.83	-3.03	-3.20	-3.38	-3.54	-3.70	-3.83

NOTE: When Q_u or Q_L falls between table values, estimate P_u or P_L to the closest 0.10.

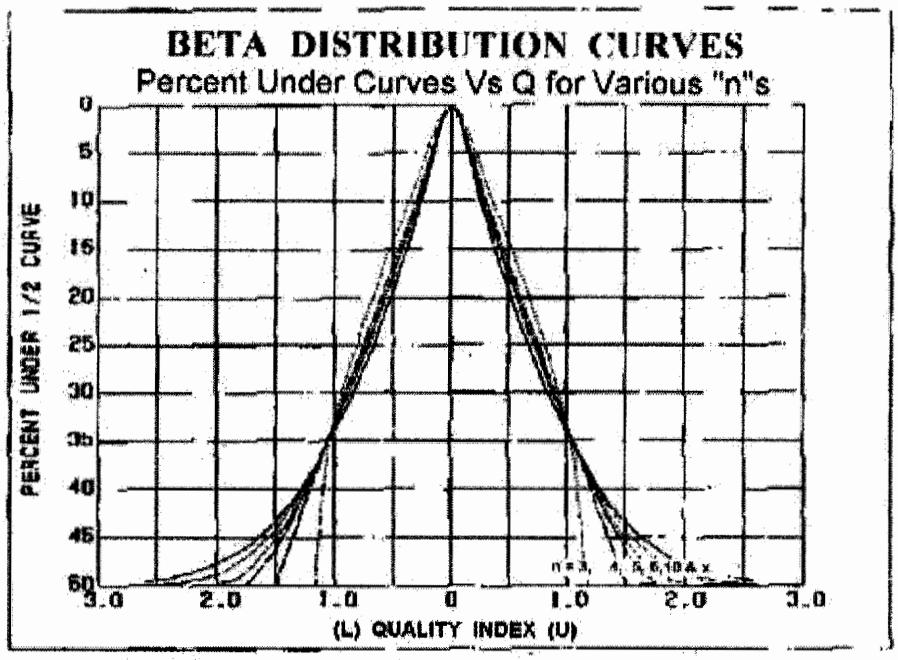

FIGURE 71-1

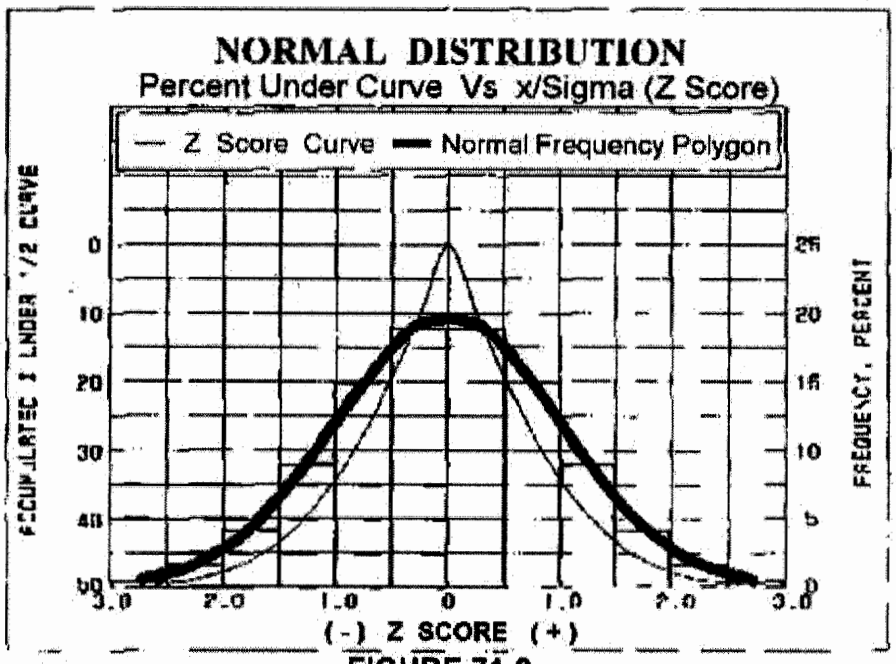

FIGURE 71-2

Footnotes:

1. Numerical Recipes in C, the Art of Scientific Computing; by W. H. Press, B.P. Flannery, S. A. Teukolsky and W.T. Vetterling. Cambridge University Press, The Pitt Bldg, Trumpington Street, CB2 1RP, 40 West 20th St., New York, NY 10011. Copyright 1988.

2. Development of a Highway Acceptance Plan, by Jack H. Willenbrock, Pennsylvania State University and Peter A. Kopac, Federal Highway Administration. TRR 691, Process Control in the Construction Industry, National Academy of Sciences, Washington, D.C. 1978.

3. Resolution of Beta-Distribution Formulas for Quality Level Analysis, a report to the Colorado Department of Transportation from the Colorado Workshop on Mathematical Problems in Industry, prepared by F. Jay Bourland, Department of Mathematics, Colorado State University and Alistair Fitt, Department of Mathematics, University of Southampton.