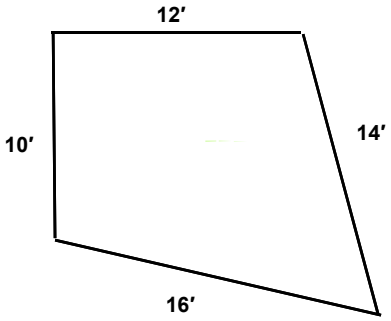
Examples of Quantity Calculations Issues

Rectangle with Four Uneven Sides

Area calculated by averaging opposite sides and multiplying the averages. Used mostly for sections of Sidewalks and Bridge Impact Panels.

Figure 1



Area = ((10′ + 14′)/2) X ((12′ + 16′)/2) = 12′ X 14′ = 168 square feet

Not a valid method of calculation.

Figure 1:

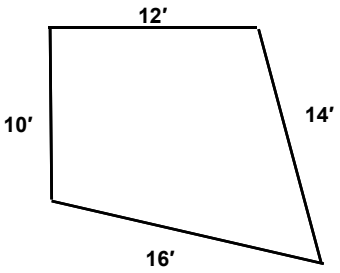
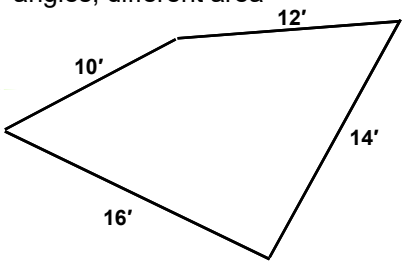


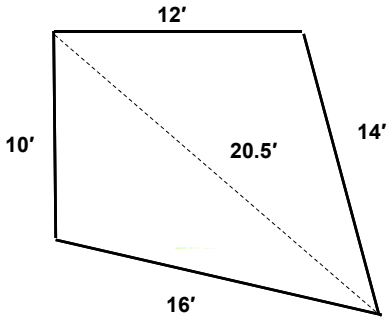
Figure 2:

Same side lengths, different angles, different area



Acceptable Area Calculations

Figure 1



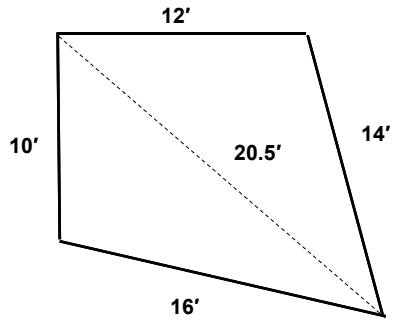
Measure diagonal distance between two opposite corners to make two triangles.

Use these formulas to calculate each triangle.

s = (a + b + c) ÷ 2

Area = $\sqrt{s(s-a)(s-b)(s-c)}$

Example:



Triangle 1: s = (12 + 14 + 20.5) ÷ 2 = **23.25 Feet**

Area 1 = $\sqrt{23.25(23.25-12)(23.25-14)(23.25-20.5)}$

= $\sqrt{23.25(11.25)(9.25)(2.75)}$ = $\sqrt{6{,}653.50}$

= 81.6 Square Feet

Triangle 2: s = (10 + 16 + 20.5) ÷ 2 = **23.25 feet**

Area 2 = $\sqrt{23.25(23.25-10)(23.25-16)(23.25-20.5)}$

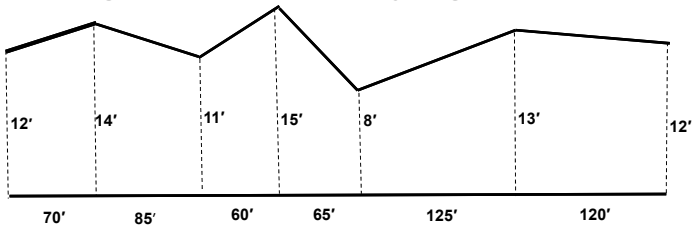
= $\sqrt{23.25(13.25)(7.25)(2.75)}$ = $\sqrt{6{,}142.00}$

= 78.4 Square Feet

Total Area = 81.6 + 78.4 = 160.0 Square Feet

Note: Use of the "GNSS Survey Tablets" for measurement of odd shaped surface areas should eliminate problems with calculating these areas in the future.

Calculating Areas with Varying Widths



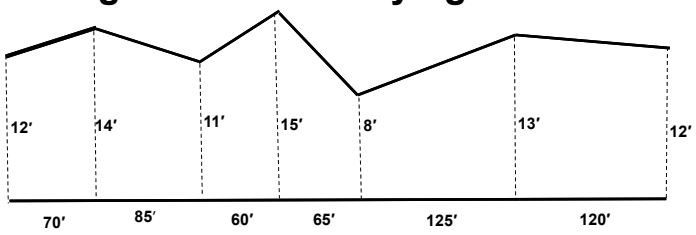
Areas with varying widths are often calculated by averaging the widths and multiplying by the total length. (Used in measuring area for subgrade stabilization seeding, geotextile fabric, and mulch.)

Area = ((12 + 14 + 11 + 15 + 8 + 13 + 12) ÷ 7) X 525

= 12.1 x 524 = 6,375.0 Square Feet

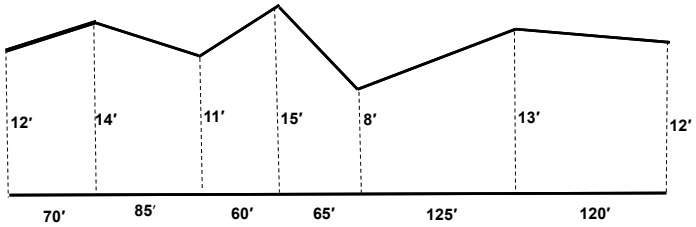
Not a valid method of calculation.

Calculating Areas with Varying Widths



The distance between each width is different. Each segment has to be calculated individually. (Average each pair of widths and multiply by the individual distance between.)

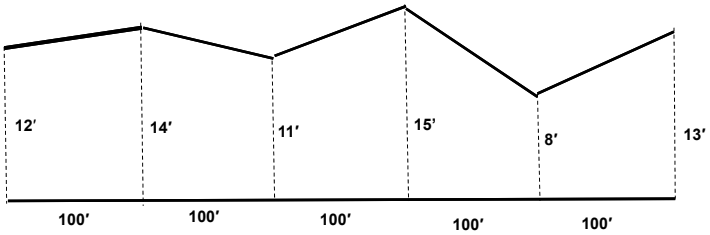
Correct Area Calculations



Segment A = ((12 + 14) ÷ 2) x 70 = 13.0 x 70 = 910.0
Segment B = ((14 + 11) ÷ 2) x 85 = 12.5 x 85 = 1,062.5
Segment C = ((11 + 15) ÷ 2) x 60 = 13.0 x 60 = 780.0
Segment D = ((15 + 8) ÷ 2) x 75 = 11.5 x 65 = 747.5
Segment E = ((8 + 13) ÷ 2) x 125 = 10.5 x 125 = 1,312.5
Segment F = ((13 + 12) ÷ 2) x 120 = 12.5 x 120 = 1,500.0

Total Area = 910.0 + 1,062.5 + 780.0 + 747.5 + 1,312.5 + 1,500.0
= 6,312.5 Square Feet

Equal Distance between Width Measurements



If the length between each width measurement is uniformed for each segment, the average of the widths multiplied by the total length **is still not valid**. The following is a formula for calculating the total area in this case:

Area = (((a + f) ÷ 2) + b + c + d) x Segment Length*

Area = (((12 + 13) ÷ 2) + 14 + 11 + 15 + 8) x 100
= 60.5 x 100 = 6,050 Square Feet

*Formula from 1992 ODOT Field Survey Manual

Asphalt Cement Calculation

During a project the total quantity of asphalt can be miscalculated due several reasons, some are:

- Paynotes from more than one Inspector can cause both Inspectors and CAS to lose track of what's been paid or not been paid.
- Miscalculating asphalt for small amounts of ACP. This happens more at beginning and end of paving.

Small Quantity & Statspec

Small quantity of asphalt is calculated and paid the first month of paving as small quantity based on the Mix Design's target value. (Not enough testing to run a Statspec Lot.)

Later, asphalt is calculated for the same Mix Design using Statspec after a minimum of 3 sets of sublot tests have been completed.

There needs to be good communication between the QCCS and the CAS. The asphalt that was paid in the beginning under small quantity needs to be deducted from the Statspec asphalt total.

Double payment of asphalt can add up quickly to a large overpayment.

Small Quantity & Statspec Example

1,500 tons ACP x 5.7% (Asphalt Target Value) = 85.50 tons of asphalt.

At $500.00 per ton, the first month payment is $42,750.00.

If not deducted as part of a new Lot, this amount could be double paid.

The reverse can also happen:

Small quantities of asphalt calculated and paid at start of paving. These payments are to remain small quantity for various reasons and not become part of larger Statspec Lot.

A Statspec Lot is later calculated. Small quantities of asphalt calculated earlier are deducted from the Statspec quantity and absorbed into the new Lot.

This becomes an under payment to the Contractor.

RAP & Tank Sticking

Tank sticking cannot be used to calculate asphalt pay quantities when an ACP Mix design contains RAP material. Tank sticking method does not include the asphalt in the RAP.

Need to use the Ignition Method to determine asphalt content.

Quick Check of Asphalt Pay Quantities

A quick check of the asphalt quantity paid to date:

Total Asphalt paid ÷ Total ACP Paid

If the percent of asphalt calculated
is significantly lower or higher
than the Mix Design's target value or test results,
a review of the asphalt pay quantities
needs to be made.

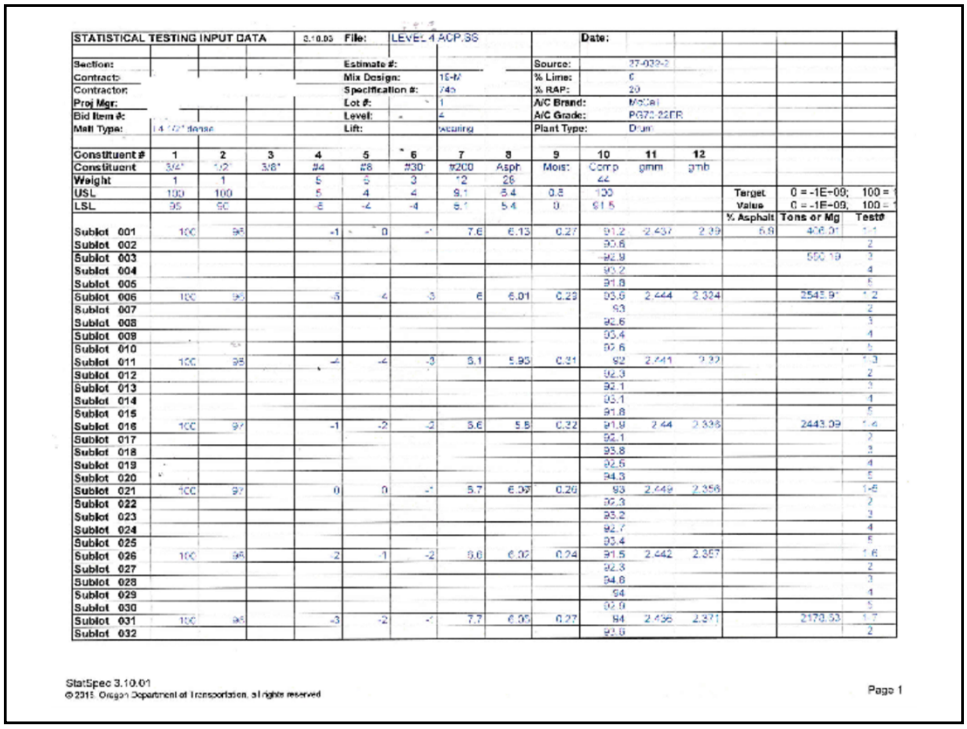
Statspec & Adjustments to JMF Target Values

When adjustments are made to JMF target values after paving of an ACP Lot has started, test results for modified constituents are entered into Statspec as a ± value of the difference between the original or modified target values and the test result.

Errors are made when the individual entering the ± value differences confuses the positive/negative values and starts entering the opposite sign for each test result.

When this happens, Statspec calculates an incorrect "Mean," Standard Deviation," and "Pay Factor" for each constituent. It then calculates an incorrect "Composite Pay Factor" and "Bonus Adjustment" for the entire Lot.

If the Asphalt Content target value is also adjusted, and incorrect ± signs are entered, not only can the "Bonus Adjustment" be affected, but the asphalt pay quantity for the ACP Lot can be incorrect.



STATISTICAL TESTING INPUT DATA — 3.10.03 — File: LEVEL 4 ACP.SS — Date:

Section:				Estimate #:					Source:						
Contract:				Mix Design:					% Lime:						
Contractor:				Specification #:					% RAP:						
Proj Mgr:				Lot #:					A/C Brand:						
Bid Item #:				Level:					A/C Grade:						
Mat'l Type:				Lift:					Plant Type:						
Constituent #	1	2	3	4	5	6	7	8	9	10	11	12			
Constituent	3/4"	1/2"	3/8"	#4	#8	#30	#200	Asph	Mois	Comp	gmm	gmb			
Weight	1	1		5	5	3	1.2	2.6		44					
USL	100	100		5	4	4	9.1	5.4	0.5	100			Target Value	0 = -1E-00; 0 = -1E-09;	100 =
LSL	95	90		-5	-4	-4	5.1	5.4	0	91.5			% Asphalt	Tons or Mg	Test#
Sublot 001	100	98		-1	0	-1	7.6	6.13	0.27	91.2	2.437	2.39	5.8	406.01	1
Sublot 002										90.6					2
Sublot 003										92.9				550.19	3
Sublot 004										93.2					4
Sublot 005										91.8					5
Sublot 006	100	99		-3	-4	-3	6	6.01	0.29	93.6	2.444	2.324		3543.91	1-2
Sublot 007										93					2
Sublot 008										92.6					3
Sublot 009										93.4					4
Sublot 010										92.6					5
Sublot 011	100	98		-4	-4	-3	5.1	5.95	0.21	92	2.441	2.33			1-3
Sublot 012										92.3					2
Sublot 013										92.1					3
Sublot 014										93.1					4
Sublot 015										91.8					5
Sublot 016	100	97		-1	-2	-2	5.6	5.8	0.22	91.9	2.44	2.335		2443.39	1-4
Sublot 017										92.1					2
Sublot 018										93.8					3
Sublot 019										92.5					4
Sublot 020										94.3					5
Sublot 021	100	97		0	0	-1	5.7	6.09	0.26	93	2.449	2.358			1-5
Sublot 022										92.3					2
Sublot 023										93.2					3
Sublot 024										92.7					4
Sublot 025										93.4					5
Sublot 026	100	98		-2	-1	-2	5.8	6.02	0.24	91.5	2.442	2.357			1-6
Sublot 027										92.3					2
Sublot 028										94.6					3
Sublot 029										94					4
Sublot 030										92.9					5
Sublot 031	100	96		-3	-2	-1	7.7	6.09	0.27	94	2.456	2.371		2178.53	1-7
Sublot 032										93.9					2

StatSpec 3.10.01

Page 1

Recommendation

To assure the correct ± sign is determined, subtract the Target Value from the Test Result:

- If the Target Value is higher than the Test Result the difference is negative. Target value for #4 aggregate constituent is 50 and Sublot test result is 47, a negative difference of -3 is entered.
- If the Target Value is lower than the Test Result the difference is positive. Target value for #4 aggregate constituent is 50 and Sublot test result is 52, a positive difference of 2 is entered.
- If the Target Value and the Test Result the same value, 0 is entered.

Cold Plane Pavement Removal (Computer-Generated Spreadsheets)

These are common errors found in computer-generated spreadsheets. A spreadsheet can give clean, accurate, and easy to read quantity calculation. Errors can still creep in, a quick visual check of input and calculated information may help find them.

The following are some examples found on spreadsheets for calculation of Cold Plane Pavement Removal.

Cold Plane Pavement Removal (Computer-Generated Spreadsheets)

Misplaced Decimal Point – Spreadsheet page shows most grinding width measured between 17.2 and 17.8 feet. One entry listed 176.0 feet. This increased the pay quantity by more than 5 times in the 300 foot sections before and after this entry.

Project:
Hwy Name :
Contract Bid Item #
County
Bid Item Description Cold Plane Pavement Removal, 1-3 Inches Deep

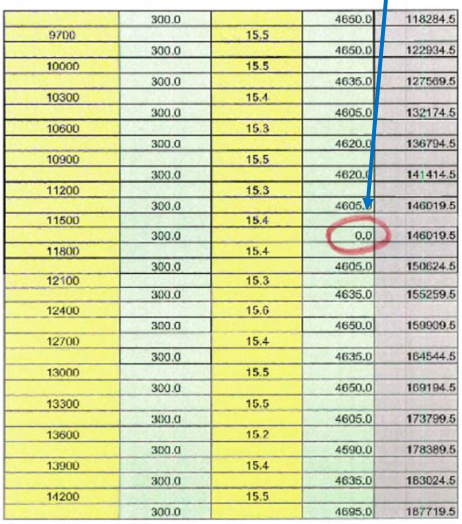
Sta. Location:	409+00 to 315+00 NB C lane	Disposal Site #1	
Date of Starting	6/3/2019	Work Shift: Night	
Depth in Inches	1-3 inches	Units: SqYds	

A Station/MP	B Length	C	D SqFt Area	Running Total
Inspectors Field		Inspectors Field	Line Area Formula	
	ABS(B=A1-A3)		D=ROUND((C1+C3)/2,2)*B2	
40800		17.5		
	300.0		5250.0	
40500		17.5		
	300.0		5295.0	10545.0
40200		17.8		
	300.0		5250.0	15795.0
39900		17.2		
	300.0		5235.0	21030.0
39600		17.7		
	300.0		5280.0	26310.0
39300		17.5		
	300.0		29025.0	55335.0
39000		176.0		
	300.0		29040.0	84375.0
38700		17.6		
	300.0		5295.0	89670.0
38400		17.7		
	300.0		5295.0	94965.0

Cold Plane Pavement Removal (Computer Generated Spreadsheets)

Missing Area Formula – Spreadsheet page shows a calculated area of 0.0 square feet, and 4,620.0 square feet should have been calculated for an average width of 15.4 feet times a length of 300.0 feet.

Somehow the Area Formula was removed from the spreadsheet. Because the template for this spreadsheet was used for more grinding calculations, the 0.0 square foot showed up more than once in the paynotes.



	300.0		4690.0	118284.5
9700		15.5		
	300.0		4650.0	122934.5
10000		15.5		
	300.0		4635.0	127569.5
10300		15.4		
	300.0		4605.0	132174.5
10600		15.3		
	300.0		4620.0	136794.5
10900		15.5		
	300.0		4620.0	141414.5
11200		15.3		
	300.0		4605.0	146019.5
11500		15.4		
	300.0		0.0	146019.5
11800		15.4		
	300.0		4605.0	150624.5
12100		15.3		
	300.0		4635.0	155259.5
12400		15.6		
	300.0		4650.0	159909.5
12700		15.4		
	300.0		4635.0	164544.5
13000		15.5		
	300.0		4650.0	169194.5
13300		15.5		
	300.0		4605.0	173799.5
13600		15.2		
	300.0		4590.0	178389.5
13900		15.4		
	300.0		4635.0	183024.5
14200		15.5		
	300.0		4695.0	187719.5

Cold Plane Pavement Removal (Computer Generated Spreadsheets)

Spreadsheet Incorrectly Ended – This issue was found more than once. The final Station 79+30 was entered by mistake into the Length Column and the Area Formula read it as the last section of grinding at 7,930 feet long. This calculated a payment area of 48,373.0 square feet (5,374.8 Square Yards) instead of 0.0.

4600		12.2		
	300.0		3630.0	35381.0
4900		12.0		
	300.0		3600.0	38981.0
5200		12.0		
	300.0		3705.0	42686.0
5500		12.7		
	300.0		3780.0	46466.0
5800		12.5		
	300.0		3735.0	50201.0
6100		12.4		
	300.0		3720.0	53921.0
6400		12.4		
	300.0		3705.0	57626.0
6700		12.3		
	300.0		3675.0	61301.0
7000		12.2		
	300.0		3660.0	64961.0
7300		12.2		
	300.0		3660.0	68621.0
7600		12.2		
	330.0		4026.0	72647.0
7930		12.2		
	7930.0		48373.0	121020.0
	13836.0			

Column D Accumulated SqFt 121020.0 SqFt AREA = Width X Length = SqFt

Accumulative SqFt/9 = SqYd 123446.7 SqYd AREA = SqFt/9 = SqYd

Quantities measured in place by Inspector

Gaps and Overlaps in Cold Plane Pavement Removal

On projects with large amounts of grinding, not all work may be performed continuously. Also, other factors may add to the possibility of gaps and overlaps in the calculations and payments:

- Multiple paynotes over several months
- Multiple lanes
- More than one Inspector
- Paynotes turned in just before uploads

Gaps and Overlaps in Cold Plane Pavement Removal

On larger projects, it might help to generate a listing of pavement removal by station as work progresses.

- Keep track by lane, if more than one.
- Look for overlaps in grinding, should be no longer than 20 feet between end of grinding one shift and start of the next shift.
- Look for gaps in grinding that should have been completed.

Some of this may not be resolved until end of work after all paynotes have been submitted.

Case of Gaps between Spreadsheets

Five spreadsheets were generated for 12,850 feet of continuous grinding performed during one work shift. Width measurements were taken at 100-foot intervals.

Between each of the five consecutive spreadsheets, where the stationing for one spreadsheet ended, the stationing for the next spreadsheet started 100 feet from the end of the last spreadsheet.

This caused the grinding of 100-foot segments not to be calculated for payment between each consecutive spreadsheet.