Illinois Department of Transportation

DOCUMENTATION WORKBOOK

SPECIFIC TASK TRAINING PROGRAM

Conducted by the

ILLINOIS CENTER FOR TRANSPORTATION (ICT)
AND
IDOT BUREAU OF CONSTRUCTION

FY 2027

WORKBOOK TABLE OF CONTENTS

Workbook Page 1.....Documents in Effect and Order of Control Problem
Workbook Page 2.....Maximum Payment for Tons Example
Workbook Page 3.....HMA Yield Checks for Binder Course
Workbook Page 4.....HMA BC Theoretical Tons Daily Yield Check
Workbook Page 5.....Thickness Determination Problem
Workbook Page 6.....Traffic Control Surveillance Problem
Workbook Page 7.....Structure Excavation Problem
Workbook Page 8.....Trench Backfill Diagram
Workbook Pages 9-11.....Trench Backfill Example
Workbook Page 12.....Trench Backfill Problem
Workbook Page 13.....Complete the IDR
Workbook Page 14.....Blank IDR
Workbook Page 15.....Surface Variation Problem
Workbook Page 16.....Traffic Control Adjustment Problem 1
Workbook Page 17.....Traffic Control Adjustment Problem 2
Workbook Page 18.....Electrical Signal Cable Problem
Workbook Page 19.....Prime Coat Problem
Workbook Pages 20-21.....Pavement Patching Problem
Workbook Page 22.....HMA Surface Course Example
Workbook Page 23.....HMA Surface Course Adjusted Plan Quantity Example
Workbook Page 24.....HMA Surface Yield and Max Pay Problem
Workbook Page 25.....Drilled Shaft Problem
Workbook Page 26.....Solution to Workbook Page 1
Workbook Page 27.....Solution to Workbook Page 5
Workbook Page 28.....Solution to Workbook Page 6
Workbook Page 29.....Solution to Workbook Page 7
Workbook Page 30.....Solution to Workbook Page 12
Workbook Page 31.....Solution to Workbook Page 14
Workbook Page 32.....Solution to Workbook Page 15
Workbook Page 33.....Solution to Workbook Page 16
Workbook Page 34.....Solution to Workbook Page 17
Workbook Page 35-36.....Solution to Workbook Page 18
Workbook Page 37-38.....Solution to Workbook Page 19
Workbook Page 39.....Solution to Workbook Page 20-21
Workbook Page 40.....Example of DECREASE in Quantity
Workbook Page 41.....Solution to Workbook Page 24
Workbook Page 42.....Solution to Workbook Page 25
Workbook Page 43-44.....Behind The Spec
Workbook Page 45-47.....Supplemental Problem: Tack Coat
Workbook Page 48-49.....Supplemental Problem: Traffic Control Surveillance
Workbook Page 50-51.....Supplemental Problem: Surface Treatments
Workbook Page 52-53.....Supplemental Problem: Structure Excavation
Workbook Page 54-57.....Supplemental Problem: Max Pay
Workbook Page 58-60.....Supplemental Problem: Trench Backfill
Workbook Page 61-63.....Supplemental Problem: Traffic Control Price Adj
Workbook Page 64-65.....Supplemental Problem: Pavement Patching
Workbook Page 66-67...Supplemental Problem: HMA Surface Adj & Max Pay

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DETERMINE DOCUMENTS IN EFFECT AND ORDER OF CONTROL

Answer on Page 26

Project Information: Letting Date: **November 9, 2018** Construction Start Date: **May 2, 2019**

For the above project, rank highest to lowest the documents order of control for those in effect.

____Standard Specifications for Road and Bridge Construction
Adopted April 1, 2016

____Plans (signed August 2, 2018)

____Supplemental Specifications and
___Recurring Special Provisions
Adopted January 1, 2018

____Supplemental Specifications and
___ Recurring Special Provisions
Adopted January 1, 2019

____Contract Special Provisions

Circle the higher level item according to coordination of contract documents.

Scaled Dimensions *VS.* Calculated Dimensions

Detail Plans *VS.* Standard Plans

Standards with Revision Numbers listed in the Index of Sheets

VS.

Standard Numbers listed elsewhere

MAXIMUM PAYMENT for TONS EXAMPLE

Agg Base Cse TY B

Plan Quantity = 7783 Tons

Revised Plan Quantity = 7850 Tons

7850 x 1.08 = 8478 Tons

Contractor delivered 8496.0 Tons

What is the final payment?

Workbook Page 2

HMA Yield Checks Binder Course

width (ft) x length (ft) x (1sy/9sf) x (112lb/sy-in) x (1 ton/2000lb) x thickness (in) = theoretical tons

$$\text{YIELD} = \frac{\text{DELIVERED}}{\text{THEORETICAL}} \quad \text{X } 100 = \%$$

For HMA Binder, verify unit weight via District Materials Office, Plans or Special Provisions

HMA BC Theoretical Tons
Daily Yield Check

$$\frac{(12\text{ ft})\,(7{,}860\text{ ft})\,(1\text{sy}/9\text{sf})\,(112\text{ lbs/sy in})\,(1.5\text{ in})}{2{,}000\text{ lbs/ton}} = 880.3\text{ tons}$$

$$\text{Yield} = \frac{\text{Delivered}}{\text{Theoretical}} \times 100 = \frac{897.9}{880.3} = 102.0\%$$

Workbook Page 4

Thickness Determination Problem

Answer on Page 27

How many depth checks
are required for PCC
sidewalk that measures
1000 ft in length by 4 ft wide?

Traffic Control Surveillance Problem

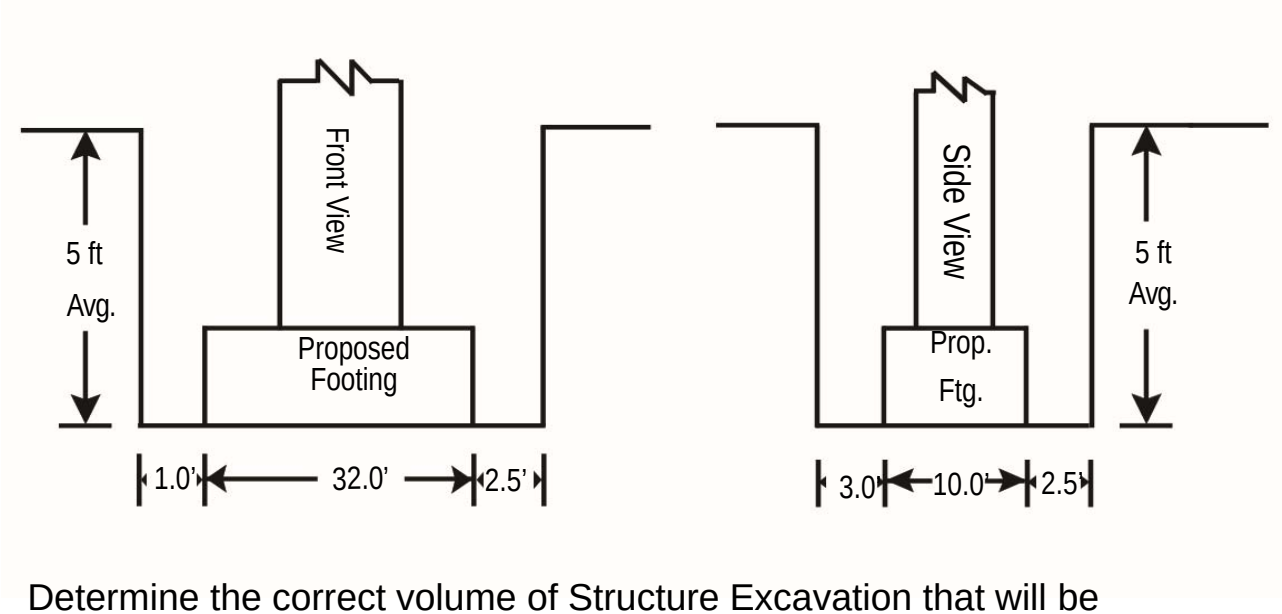
Answer on Page 28

The contractor was required to perform traffic control surveillance from Tuesday afternoon until Thursday morning. The contractor worked from 7:00 a.m. to 4:30 p.m. each workday. The contractor performed the inspections and completed the BC 2240's as required. What will the total pay be for these days of Surveillance based on the Standard Specifications?

Structure Excavation Problem

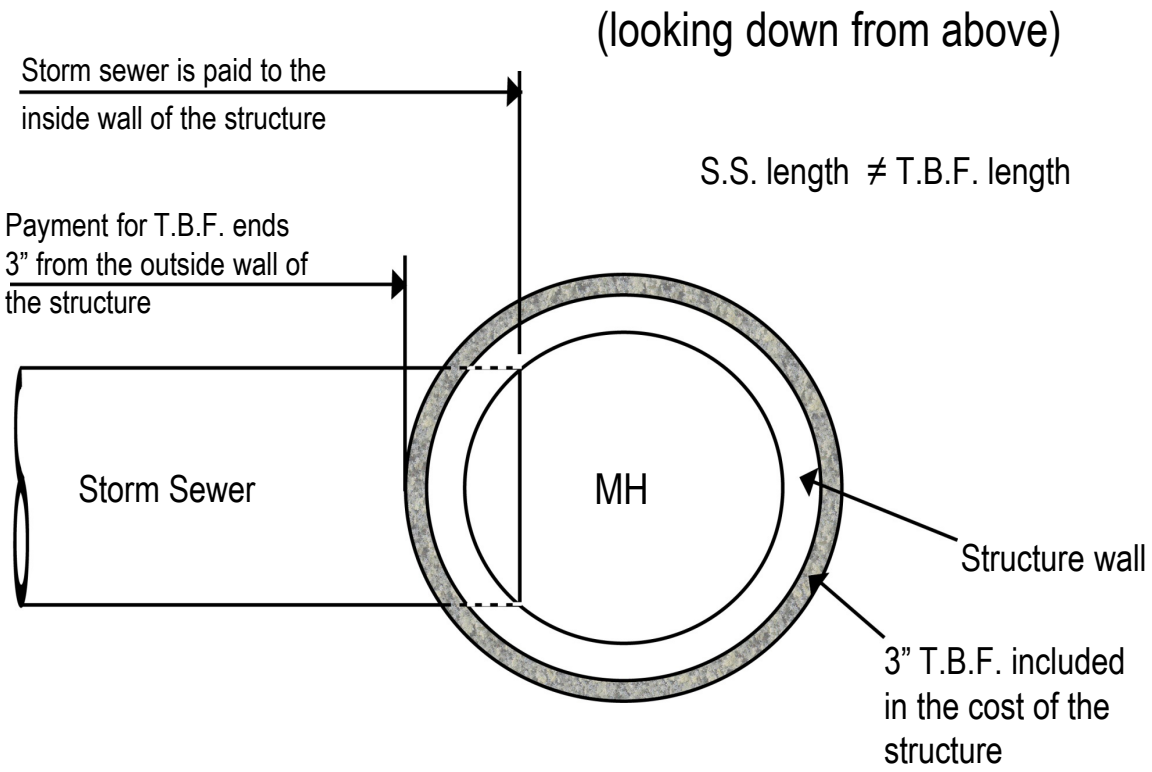
Answer on Page 29

The contractor has excavated for a proposed footing as shown below:



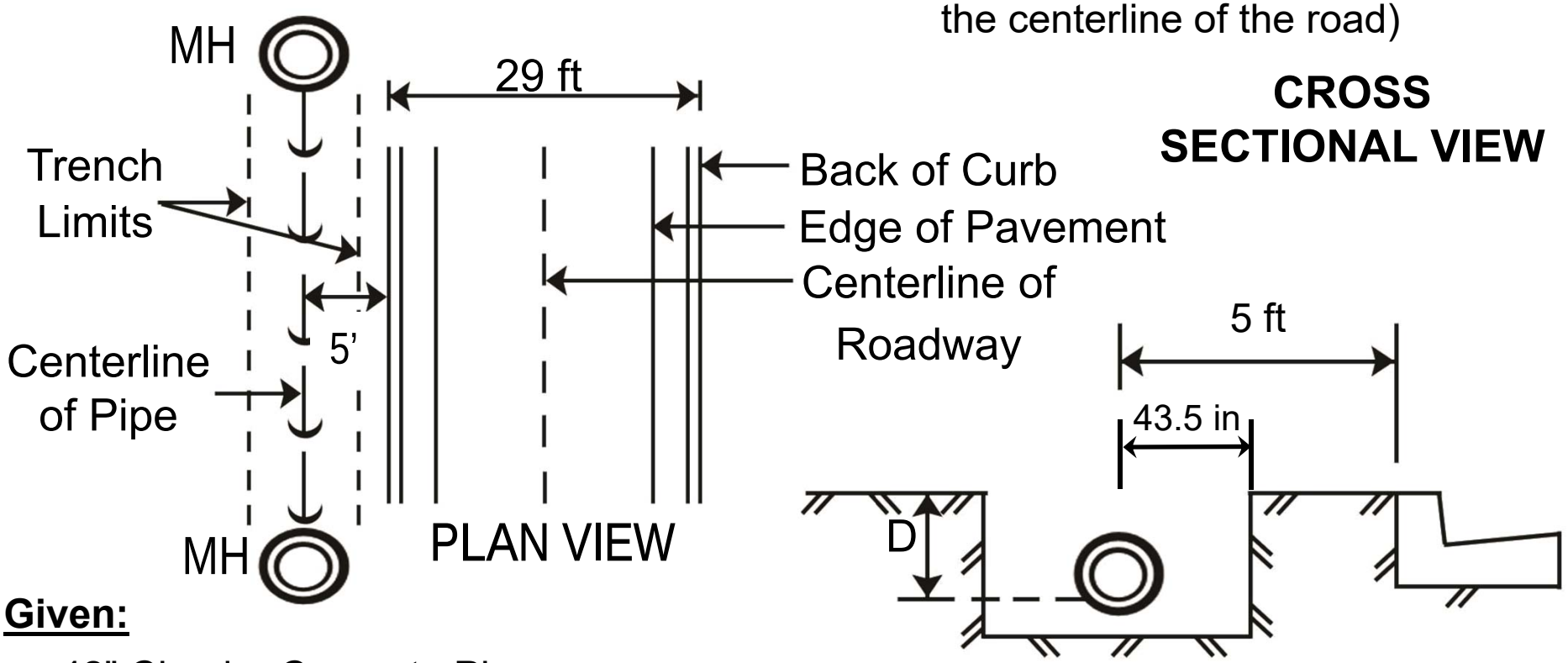
Determine the correct volume of Structure Excavation that will be used as final payment to the contractor at this location.

Trench Backfill Diagram



Trench Backfill Example

(for pipe running parallel to the centerline of the road)



Given:

42" Circular Concrete Pipe

Average Depth from subgrade to invert of the pipe = 6.8'

Trench Length = 75' from outside face of manhole to outside face of manhole

Contractor's Excavated Trench Width = 7' 4"

Centerline of Pipe Run is 5' behind the back of curb

Determine:

Allowable Pay Quantity for Trench Backfill

Trench Backfill Solution

1. Need to determine if any part of allowable trench width falls within 2 ft of the back of curb.

   Centerline of pipe is given as 5 ft or 60 in from the back of curb.

   60” - 43.5” = 16.5” which is the dimension from the inside of the trench to the back of the curb.

   Since 16.5” < 24”, must use trench backfill.

2. Determine allowable pay length:

   Length given is 75 ft. from outside face of manhole to outside face of manhole.

   According to Article 602.12, 6” greater than the diameter of the structure will be backfilled and incidental to the installation of the structure.

   Therefore 3” on each manhole location is incidental backfill, and allowable pay length is 75’ - 3” - 3” = 74.5’

Trench Backfill Solution (cont.)

3. Check excavated width against allowable trench width.

   Allowable trench width →

   Since D = 6.8’ (>5.0 ft.),

   Width = 18” + Wall + ID + Wall + 18”

   Width = 18” + 4.5” + 42” + 4.5” + 18” = 87”

   Excavated width = 7’ 4” = 88”

   Since excavated width > allowable trench width, we can use backfill tables.

   D = 6.8’ and ID of pipe = 42”

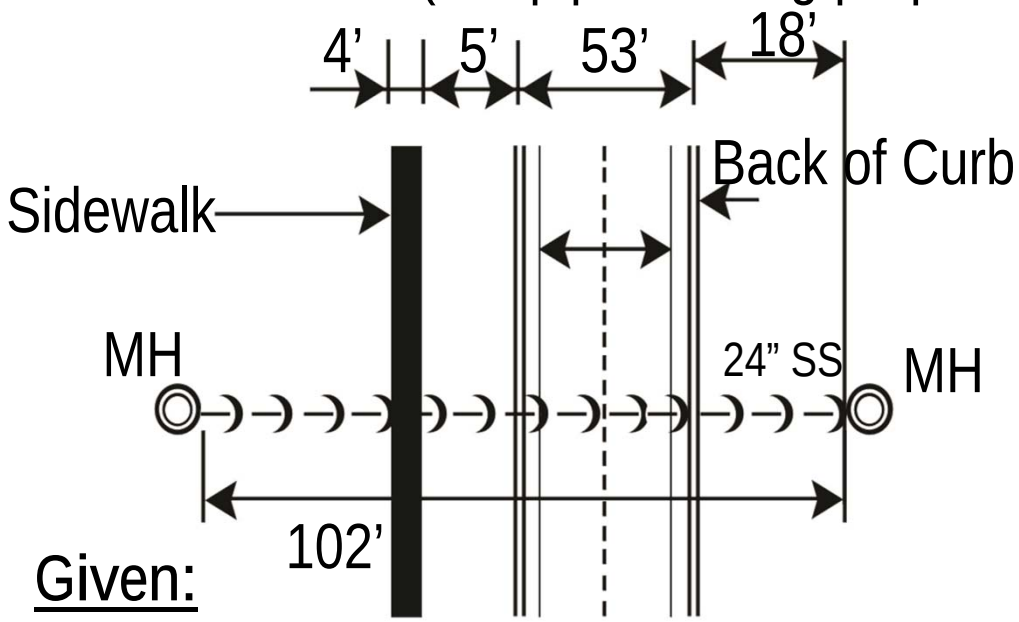
4. From table, cu. yd./lin ft. x Allowable Pay Length = Trench Backfill

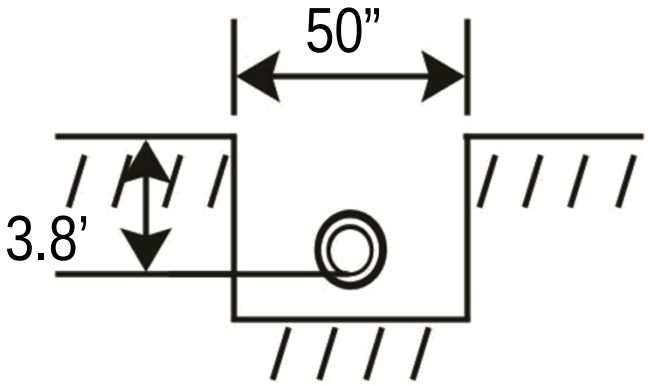
   Volume 1.093 x 74.5’ = <u>81.4 cu yds</u>.

Trench Backfill Problem

Answer on Page 31

(For pipe running perpendicular to the centerline of the road)





Given:

- 24” Circular Concrete Pipe
- Average Depth from subgrade to invert = 3.8’
- Contractor’s Excavated Trench Width = 50”

Determine: Show your calculation on the IDR on Workbook Page 14

- Allowable Pay **Length** for the Trench Backfill
- Maximum allowable trench width
- Allowable Pay **Quantity** for Trench Backfill

Complete the IDR provided on Workbook Page 14

- Todays Date, Contract #96345
- United Construction (Prime)
- Weather is clear, 67 degrees
- Pay item number for Trench Backfill is 20800150
- Location Station 100+00
- Show calculation on the IDR since it is your primary source of Documentation

Workbook Page 13

Illinois Department of Transportation

Inspector's Daily Report

County

Section

Route

District

Contract No.

Job No.

Project

Date _____

Contractor or Sub. _____

Weather _____

	Initial(s)	Date
Inspected by:	_____	_____
Measured by:	_____	_____
Calculated by:	_____	_____
Checked by:	_____	_____

Item Code #	Fund Code (Opt.)	Item	Location	Quantity and Units	Evidence of Material Inspection (Optional)	Posted in Q Book

This is: ☐ an estimated progress measurement (item no.: _____)

☐ a final field measurement (item no.: _____)

Remarks: (e.g., instruction to Contractor, special problems, sketches with dimensions for final measurements, computations, number of persons working, hours worked) Use reverse side, if needed.

BC 628 (Rev. 8/04)

Answer on Page 31

Surface Variation Problem

Answer on Page 32

You are working on a 2 lane milling and bituminous resurfacing project that is 15,000 feet long. The contractor's bid price is $87.00 per ton for the surface mix. As per plan, the contractor mills 1.5 inch of existing surface and then places a 1.5 inch lift of binder and a 1.5 inch lift of surface. Upon the completion of the work you recorded in both lanes a total of 17 surface variations. How much money will be deducted from the contract for the surface variations?

Traffic Control Price Adjustment Problem 1
Art.701.20
Answer on Page 33

Your contractor was performing contract work under Traffic Control Standard 701411. The awarded contract value of this work was $214,305.00. The final value of the completed work under this standard is $248,593.00. The unit price for this pay item is $27,500.00. What is the adjusted unit price for Traffic Control Standard 701411?

Also, what is the pay item number for the additional adjustment?

Traffic Control Price Adjustment Problem 2

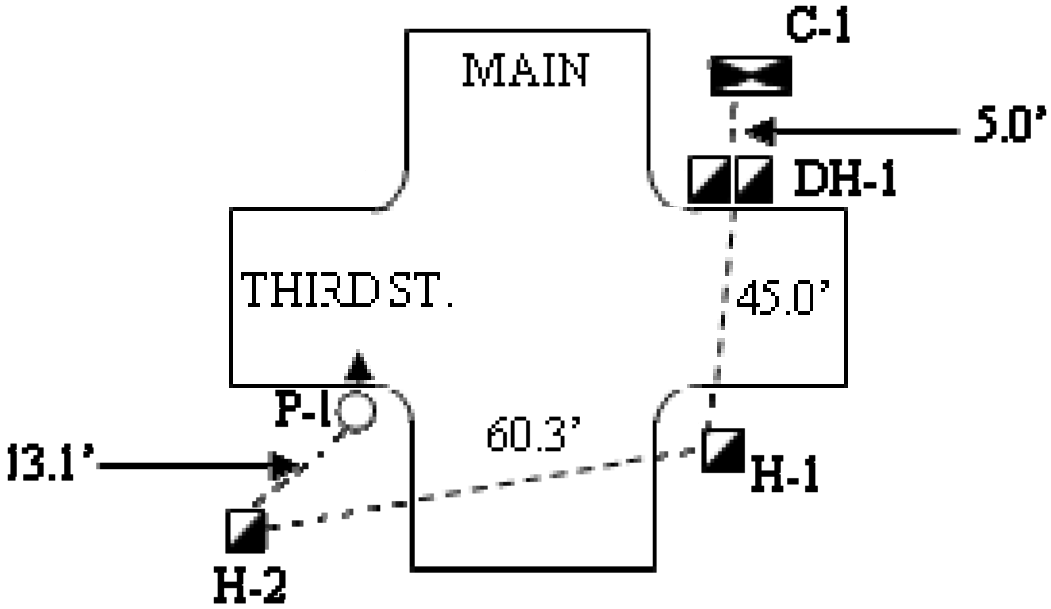
Answer on Page 34

Your contractor was performing contract work under Traffic Control Standard 701411. The awarded contract value of this work was $214,305.00. The final value of the completed work under this standard is $180,017.00. The unit price for this pay item is $27,500.00. What is the unit price adjustment for Traffic Control Standard 701411?

Electrical Signal Cable Problem

Answer on Page 35-36

Given the following information, what is the pay length for the electrical signal cable?



*PRIME/**TACK** COAT EXAMPLE PROBLEM*

Answer on Page 37-38

Bill of Lading Information	
Residue =	60.0 %
Wt. of Emulsion =	35,200 lbs
Wt. of Added Water =	15,080 lbs

Jobsite Information	
Initial Distributor Weight =	33,473 lbs
Final Distributor Weight =	15,020 lbs
Length of Paving =	12,713 ft
Width of Paving =	12 ft
Required Application Rate =	0.05 lbs/sq ft

Given the data above, determine the following:	
Residual Asphalt Applied =	
Actual Residual Asphalt Application Rate =	
Theoretical Residual Asphalt =	
Max Pay Residual Asphalt =	
Pay Quantity =	

(Next page intentionally left blank for problem workspace.)

(This page intentionally left blank for problem workspace.)

Pavement Patching Problem

Answer on Page 39

You are the inspector on a section of two-lane road in Madison County. The contractor is performing pavement patching operations today and the pay items used for the patching are as follows:

44200108 Pavement Patching, Type II, 10”
44200112 Pavement Patching, Type III, 10”

Yesterday you laid out 3 patches in the northbound lane. The patch at Station 246+52 is 12’ wide by 8.0’ long. The patch at Station 1247+23 is 12.0’ wide by 9.0’ long. The patch at Station 1247+79 is 12’ wide by 11.0’ long.

After the patching operations for these 3 patches are complete, you measure the patches. The in-place dimensions are as follows:

Station	Width	Length	Depth
1246+52	12.0’	8.0’	10”
1247+23	12.0’	10.0’	10.2”
1247+79	12.0’	11.0’	12”

You have received the required material inspection documentation.

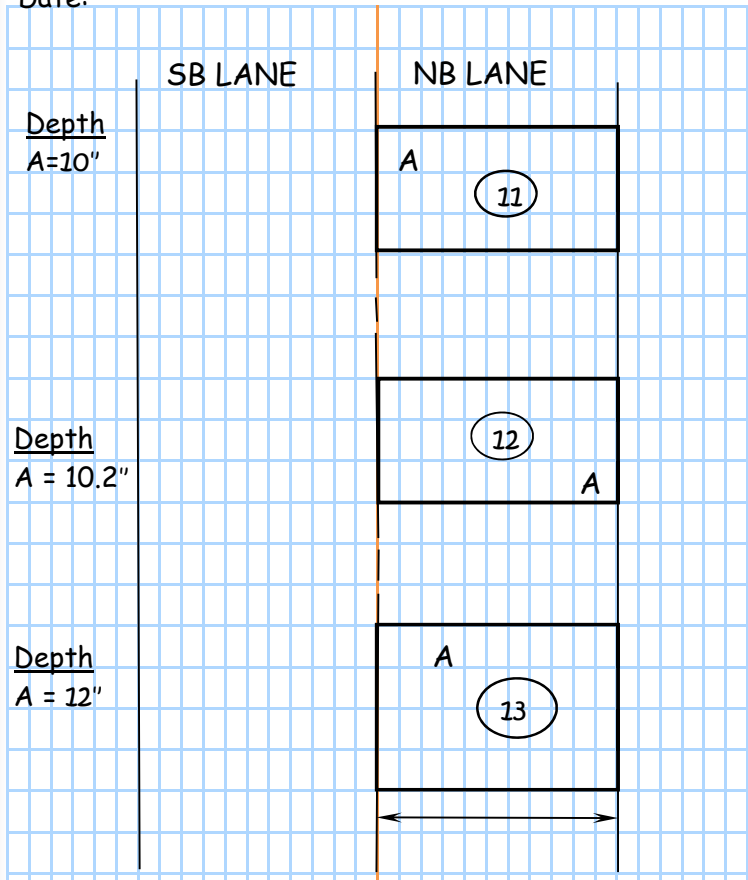
Complete the field book entries on the next page and total the page for these items.

F.B. #3, P 22

PAVEMENT PATCHING 10

Date:

Patch #	44200108 TYPE 2	44200112 TYPE 3	CALCULATIONS
(11) 1246+52			
(12) 1247+23			
(13) 1247+79			
PAGE TOTALS			



Evidence of Mat'l Insp: Plant Report, Tickets & Test

Meas. By: Date:
Calc. By:
Chkd. By:

Answer on Page 39

HMA SC Example (as specified by Engineer)

1. Calculate new theoretical tonnage

Plan Quantity = 229 Tons	Measured in field
Plan Length = 1,022 FT	Length = 1,027.5 FT
Plan Width = 24 FT	Width = 24 FT
Plan Thickness = 1.5 inches	Thick = 1.5 inches

$$\frac{112 \text{ lbs/sy-in} \times 1027.5 \text{ ft} \times 24 \text{ ft} \times 1.5 \text{ in}}{9 \text{ sf/sy} \times (2000 \text{ lbs/ton})} = 230.2 \text{ tons}$$

HMA SC Example

2. Calculate the adjustment (Article 406.13)

Gmb = 2.37 U = 112lbs/sy-in Constant = 46.8

$$C = \frac{2.37 \times 46.8}{112} = 0.990$$

Adjusted Qty: 0.990 x 230.2 = <u>227.9 tons</u>

3. Calculate the max pay (Article 406.13)

Max Pay: 227.9 x 1.03 = <u>234.7 tons</u>

HMA Surface Max Pay

Answer on Page 41

Given:

G_{mb} = 2.360

Length = 10,110.0 ft

Width = 24.0 ft

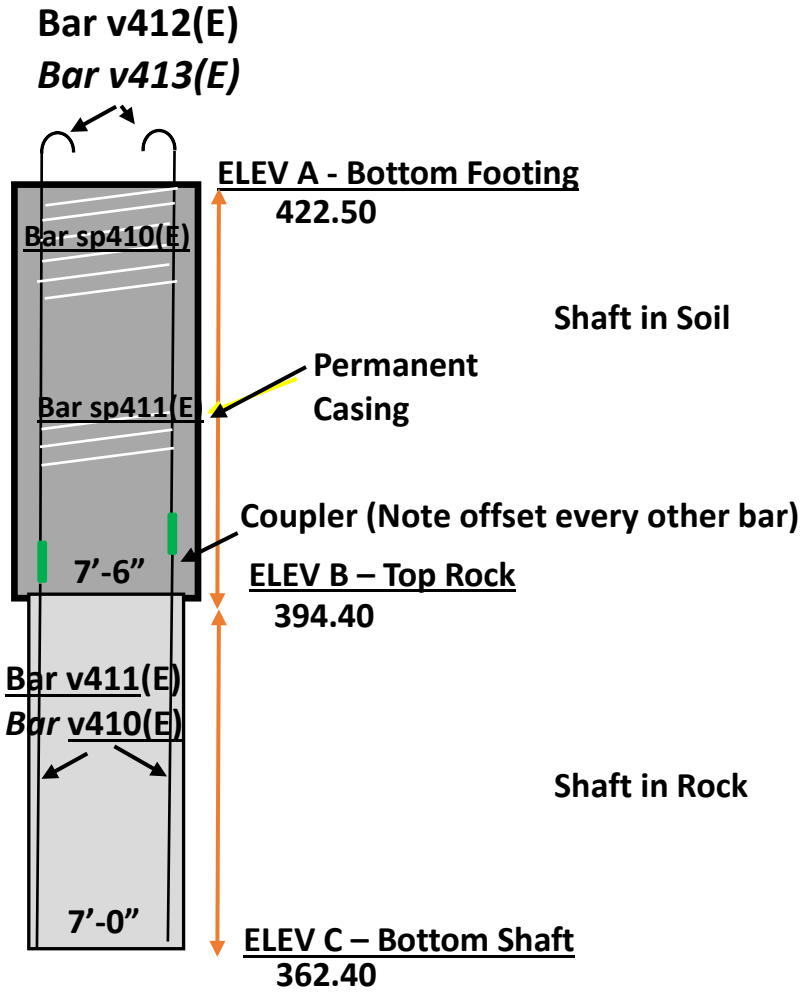
Thickness = 1.5 inch

Delivered = 2310 tons

Is the contractor exceeding the maximum payment quantity?

Drilled Shaft Problem

Answer on Page 42



Calculate the volumes of concrete in the drilled shaft per Art 516

ANSWER TO DOCUMENTS IN EFFECT AND ORDER OF CONTROL**, Page 1**

Project Information: Letting Date: November 9, 2018 Construction Start Date: May 2, 2019

For the above project, rank highest to lowest the documents in effect and order of control.

__5__ Standard Specifications for Road and Bridge Construction
Adopted April 1, 2016

__2__ Plans (signed August 2, 2018)

__4__ Supplemental Specifications and
_3_ Recurring Special Provisions
Adopted January 1, 2018

____ Supplemental Specifications and
___ Recurring Special Provisions
Adopted January 1, 2019

Adopted after letting - does not apply

__1__ Contract Special Provisions

Circle the higher level item according to coordination of contract documents.

Scaled Dimensions *VS.* Calculated Dimensions

Detail Plans *VS.* Standard Plans

Standards with Revision Numbers listed in the Index of Sheets

VS.

Standard Numbers listed elsewhere

Thickness Determination Problem

Answer to Workbook Page 5

How many depth checks
are required for PCC
sidewalk that measures
1000 ft in length by 4 ft wide?

Refer to Documentation Guide Section "Thickness Determination Schedule" Pages A-16 to A-19

Page A-18 lists PCC Sidwalk Minimum Frequency as
1 per 1,000 sf

Square Feet = 4 ft x 1000 ft = 4,000 sf ~ minimum of 4 checks via before/after elevations by survey or measurements from reference elevation such as stringline, form line or edge of pavement.

Answer to Workbook Page 6

Tues 4:30 p.m. to Wed 7:00 a.m. = 14.5 hours

Wed 4:30 p.m. to Thurs 7:00 a.m. = 14.5 hours

14.5 hours + 14.5 hours = 29 hours

29 hours / 24 hours per day =

1.21 Calendar Days for Traffic Control Surveillance

Structure Excavation Solution - Workbook Page 7

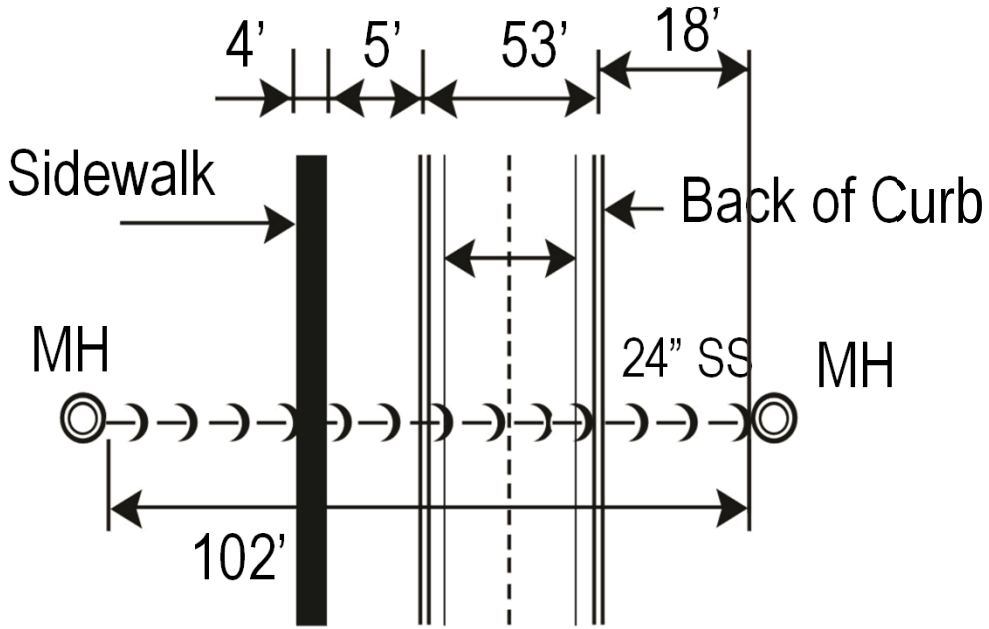
According to Article 502.12, horizontal dimensions will not extend beyond vertical planes 2’ outside of the edges of footings. Also, if the contractor did not excavate to the 2’ limit, you cannot pay the contractor for work they did not do. Therefore, the pay dimensions are as follows:

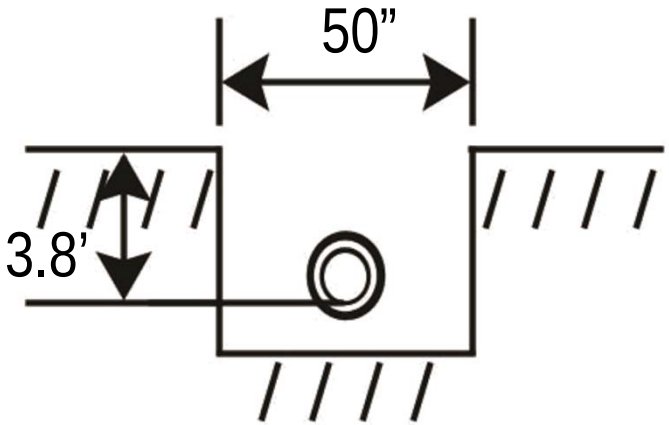
Length = 1.0’ + 32.0’ + 2.0’ = 35.0’
Width = 2.0’ + 10.0’ + 2.0’ = 14.0’
Depth = 5.0’ (given)

Volume =(35.0 x 14.0 x 5.0) x 1/27 = <u>90.7 cubic yards</u>

Trench Backfill Problem Answer – Workbook Page 12

(For pipe running perpendicular to the centerline of the road)





Allowable Pay Length = 2’ + 4’ + 2’ + 2’ + 53’ + 2’ = 65’

Maximum allowable trench width = 9” + OD + 9” = 9” +3” + 24” + 3” + 9” = 48”

Actual trench width exceeds maximum, therefore use Trench Backfill tables.

From Table: 0.323 cy/ft

Trench Backfill = 65’ x 0.323 = 21.0 cubic yards

Answer Workbook Page 14

Illinois Department of Transportation

Inspector's Daily Report

County

Section

Route

District

Contract No. 96345

Job No.

Project

Date Todays date

Contractor or Sub. United Construction

Weather Clear, 67°

	Initial(s)	Date
Inspected by:		
Measured by:	Your Initials & Dates	
Calculated by:		
Checked by:		

Item Code #	Fund Code (Opt.)	Item	Location	Quantity and Units	Evidence of Material Inspection (Optional)	Posted in Q Book
20800150		Trench Backfill	100 + 00	21.0 CY	List and Tick	

This is: an estimated progress measurement (item no.: _____)

√ a final field measurement (item no.: 20800150)

Remarks: (e.g., instruction to Contractor, special problems, sketches with dimensions for final measurements, computations, number of persons working, hours worked) Use reverse side. if needed.

BC 628 (Rev. 8/04)

Allowable Pay Length = 2’ + 4’ + 2’ + 2’ + 53’ + 2’ = 65’

Maximum allowable trench width = 9” + OD + 9” = 9” +3” + 24” + 3” + 9” = 48”

Actual trench width exceeds maximum, therefore use Trench Backfill tables.

From Table: 0.323 cy/ft

Trench Backfill = 65’ x 0.323 = 21.0 cubic yards

Workbook Page 31

Surface Variation Problem

Answer Workbook page 15

Solution: (Per Article 406.11)

1) Since the existing surface was milled, it is considered ‘reprofiled’

2) Per the chart, the cost of 2 tons of mix shall be deducted for each variation

3) Calculation:

($87.00 per ton x 2 tons per surface variation) x 17 surface variations = $2,958.00

Traffic Control Price Adjustment Problem 1

Answer Workbook Page 16

See calculation file for Original and Final contract amounts of items under 701411

Original Value: $214,305.00

Final Value: $248,593.00

Unit Price: $27,500.00

$$X = \frac{(248{,}593 - 214{,}305)}{(214{,}305)} = 0.160 \text{ Increase} > 0.10$$

Adjusted Unit Price = $0.25P + 0.75P\,(1 \pm (X - 0.1))$

$= 0.25\,(27{,}500) + 0.75\,(27{,}500)\,(1+(0.16-0.10))$

$= 0.25\,(27{,}500) + 0.75\,(27{,}500)\,(1.06)$

$= 6{,}875.00 + 21{,}862.50 =$ **$28,737.50**

Unit price difference: $28,737.50 - $27,500 =$1,237.50

Add new pay item # XXX03100 for $1,237.50

Traffic Control Price Adjustment Problem 2

Answer Workbook Page 17

See calculation file for Original and Final contract amounts of items under 701411

Original Value: $214,305.00

Final Value: $180,017.00

Unit Price: $27,500.00

$$X = \frac{(180{,}017 - 214{,}305)}{(214{,}305)} = -0.160 \text{ Decrease} > 0.10$$

Adjusted Unit Price = $0.25P + 0.75P\,(1 \pm (X - 0.1))$

= 0.25 (27,500) + 0.75 (27,500) (1-(0.16-0.10))

= 0.25 (27,500) + 0.75 (27,500) (0.94)

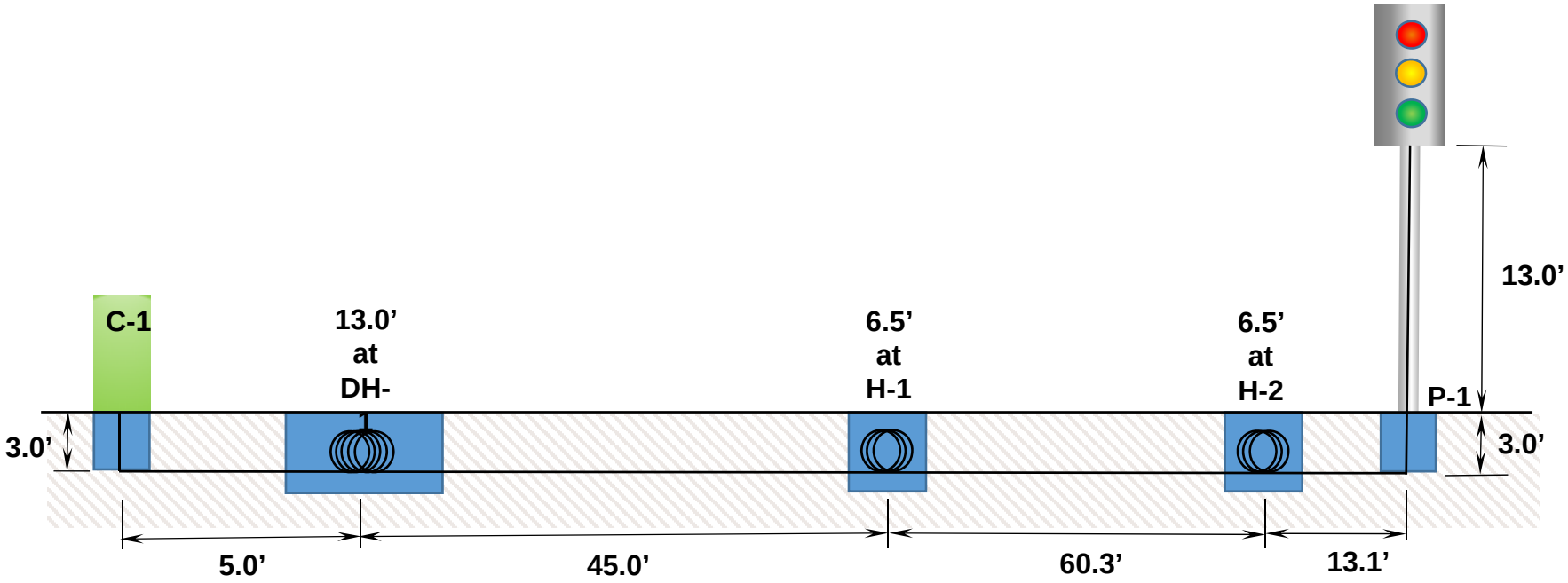
= 6,875.00 + 19,387.50 = **$26,262.50**

Unit price difference: $26,262.50 - $27,500 = - $1,237.50

Add new pay item # XXX03100 for - $1,237.50

Electrical Signal Cable Problem

Answer Workbook Page 18



Pay Length = 3.0' + 5.0’ + 13.0' + 45.0' + 6.5' + 60.3' + 6.5' + 13.1' + 3.0' + 13.0' = 168.4'

Answer Workbook Page 18

Electrical Signal Cable Problem

From	To	Horizontal Measure	Slack Pg. 732	Vertical Pg. 734
C-1	DH-1	5.0’	13.0’	3.0’
DH-1	H-1	45.0’	6.5’	X
H-1	H-2	60.3’	6.5’	X
H-2	P-1	13.1’	X	3.0’
P-1	Signal	X	X	13.0’
	Sub-Total	123.4’	26.0’	19.0’

Pay Total = 123.4’ + 26.0’ + 19.0’ = ***168.4’***

*Answer to Prime/**Tack** Coat Problem Workbook Page 19*

Bill of Lading Information		
Residue =	60.0 %	A
Wt. of Emulsion =	35,200 lbs	E
Wt.of Added Water=	15,080 lbs	D

Jobsite Information		
Initial Distributor Weight =	33,473 lbs	B
Final Distributor Weight =	15,020 lbs	C
Length of Paving =	12,713 ft	
Width of Paving =	12 ft	
Required Application Rate =	0.05 lbs/sq ft	

Given the data above, determine the following:	
Residual Asphalt Applied =	7750 lbs
Actual Residual Asphalt Application Rate =	0.0508 lbs/sq ft
Theoretical Residual Asphalt =	7628 lbs
Max Pay Residual Asphalt =	8009 lbs
Pay Quantity =	7750 lbs

*Answer to Prime/**Tack** Coat Problem Workbook Page 19*

New % Residual Asphalt =

$$\frac{\text{E (Wt. Emulsion)} \times \text{A (\% Residue)}}{\text{E (Wt. Emulsion)} + \text{D (Wt. Added Water)}} = \frac{(35{,}200) \times (0.600)}{(35{,}200 + 15{,}080)} = 0.420$$

Pounds of Residual Asphalt Applied =

$$(\text{New \% Residual Asphalt}) \times (\text{B - C}) = (\text{Initial Wt.} - \text{Final Wt.})$$

$$0.420 \times (33{,}473 - 15{,}020) = 7750 \text{ lbs}$$

1. Application Area = (Length) x (Width) = 12,713 ft x 12 ft = 152,556 sq ft
2. Actual Application Rate = (Wt. Residual Asphalt) / (Area) = 7750 lbs/ 152,556 sq ft = **0.0508 lbs/sq ft**
3. Theo. Wt. Residual Asphalt = (Area) x (Application Rate) = 152,556 sq ft x 0.05 lbs/sq ft = **7628 lbs**
4. Max Pay = (Theoretical) x 105% = 7628 lbs x 1.05 = **8009 lbs**
5. Pay Quantity = **7750 lbs**

Answer to Workbook Page ***20-21***

PAVEMENT PATCHING 10

Patch #	44200108 TYPE 2	44200112 TYPE 3	CALCULATIONS
(11) 1246+52	10.7		$\frac{(8.0' \times 12.0')}{9}$ = 10.7 S.Y.
(12) 1247+23	12.0		9.0' x 12.0' x 1/9 = 12.0 S.Y. No adjustment
(13) 1247+79	16.9		11'.0 x 12'.0 x 1/9 = 14.7 SY Patch Depth Increase $\frac{(12" - 10")}{10"}$ = 20% 15% Increase of S.Y. ∴ Increase Qty by 15 % ∴ Pay = 14.7 x 1.15 = 16.9 S.Y.
PAGE TOTALS	39.6 S.Y.	0	

F.B. #3, P 22

ACE Construction

DATE:

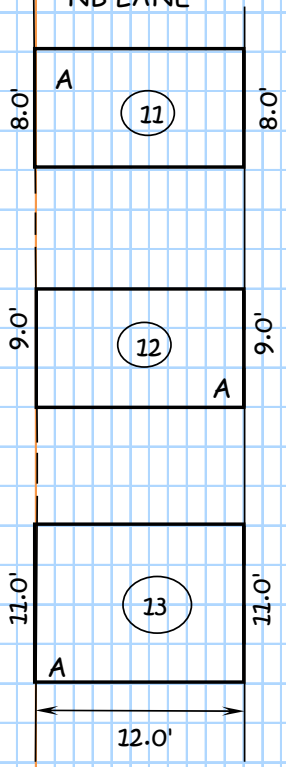
SB LANE NB LANE

Depth
A=10"

Depth
A = 10.2"

Meas. 10.0' wide both sides

Depth
A = 12"



Evidence of Mat'l Insp: Plant Report, Tickets & Test

Meas. By: Date:

Calc. By:

Chkd. By:

Workbook Page 39

Example of DECREASE in Quantity

F.B. #3, P 22

PAVEMENT PATCHING 10

ACE Construction

DATE:

Patch #	44200108 TYPE 2	44200112 TYPE 3	CALCULATIONS
(11) 1246+52	10.7		$\frac{(8.0' \times 12.0')}{9}$ = 10.7 S.Y.
(12) 1247+23	12.0		9.0' x 12.0' x 1/9 = 12.0 S.Y. No adjustment
(13) 1247+79	13.2		11'.0 x 12'.0 x 1/9 = 14.7 SY Patch Depth Decrease $\frac{(8.2'' - 10'')}{10''}$ = -18% ∴ Decrease Qty by 10 % Pay = 14.7 x (1 - 0.10) = 13.2 S.Y.
10% Decrease of S.Y.			
PAGE TOTALS	35.9 S.Y.	0	

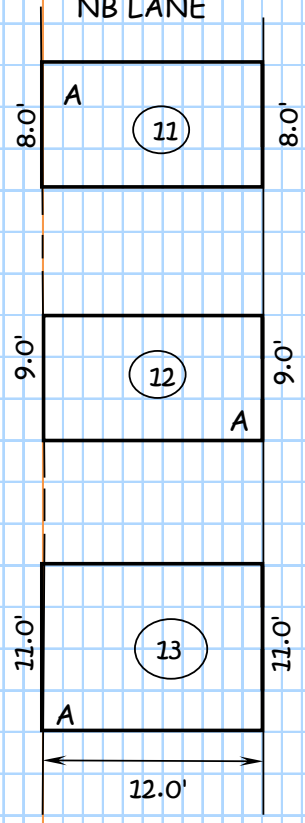
SB LANE NB LANE

Depth
A=10"

Depth
A = 10.2"

Meas. 10.0' wide both sides

Depth
A = 8.2"



Evidence of Mat'l Insp: Plant Report, Tickets & Test

Meas. By: Date:

Calc. By:

Chkd. By:

Workbook Page 40

Answer to Workbook Page 24 - HMA Surface Max Pay

$$\frac{112 \text{ lbs/sy-in} \times 10{,}110 \text{ ft} \times 24 \text{ ft} \times 1.5 \text{ in}}{9 \text{ sf/sy} \times (2000 \text{ lbs/ton})} = \underline{2264.6 \text{ tons}}$$

$$C = \frac{2.360 \times 46.8}{112} = 0.986$$

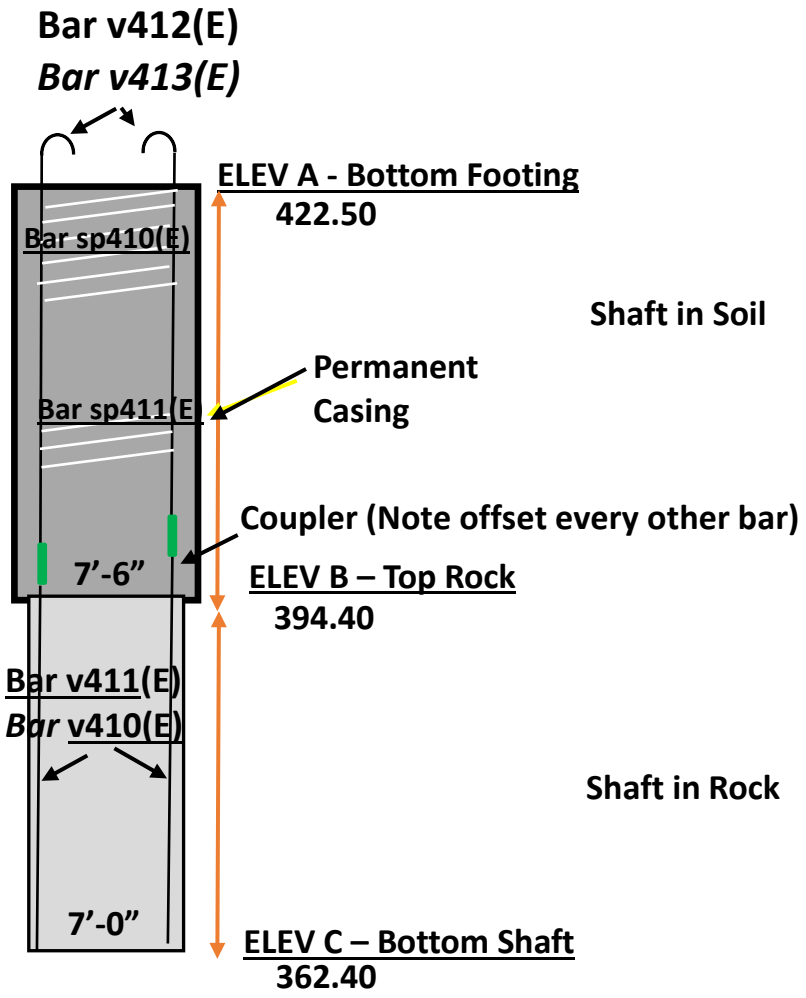
Adjusted Qty: 0.986 x 2264.6 = <u>2232.9 tons</u>

2232.9 *theoretical tons for the surface area*

1.03 x 2232.9 *tons* = <u>2299.9 *tons*</u>

Contractor is exceeding the maximum amounts

Answer to Workbook Page 25
Drilled Shaft Problem



Drilled Shaft in soil

Height of shaft = ELEV A – ELEV B

= 422.5 – 394.40 = 28.1 ft

Diameter of shaft = 7.5 ft

Volume of Shaft in soil = Volume of cylinder

$= (\pi \, x \, r^2) \, x \, Height \, of \, cylinder$

$= (\pi \, x \, [\frac{7.5 \, ft}{2}]^2) \, x \, 28.1 \, ft$

$= (3.1416 \, x \, [3.75 \, ft]^2) \, x \, 28.1 \, ft$ *= 1241.4 cu ft*

1241.4 cu ft/27 cu ft/Cu Yd = ***46.0 Cu Yd***

Drilled Shaft in rock

Height of shaft = ELEV B – ELEV C

= 394.40 – 362.40 = 32.00 ft

Diameter of shaft = 7.0 ft

Volume of Shaft in rock = Volume of cylinder

$= (\pi \, x \, r^2) \, x \, Height \, of \, cylinder$

$= (\pi \, x \, [\frac{7.0 \, ft}{2}]^2) \, x \, 32.00 \, ft$

$= (3.1416 \, x \, [3.5 \, ft]^2) \, x \, 32.0 \, ft$ *= 1231.5 cu ft*

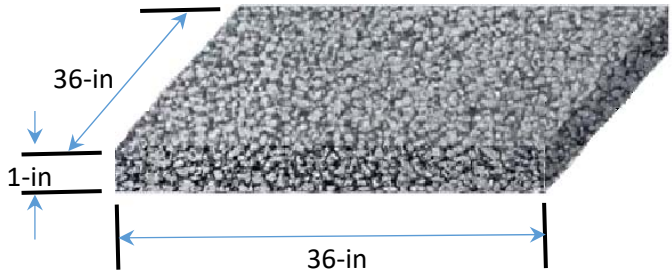
1231.5 cu ft/27 cu ft/Cu Yd = ***45.6 Cu Yd***

Workbook Page 42

Supplemental Information and Practice Problems

BEHIND THE SPECS

Hot Mix Asphalt Surface Course Adjustment: The typical unit weight of Hot Mix Asphalt binder mix and surface mix (prior to bulk gravity correction) is 112 pounds per square yard per 1-in of thickness (112 lb/sy yd/in). This unit weight is representative of typical limestone and dolomite aggregate HMA mixes which are most commonly found in Illinois. As a result, most plans show 112 lb/sq yd/in for the unit weight of the HMA. The plans should always be checked to see if this or another value was used to determine plan quantity.



One Square Yard of HMA One Inch Thick Weighs 112 Pounds for Limestone and Dolomite Mixes

Article 406.13 provides for the adjustment of plan quantities based upon the properties of the actual HMA surface mix used on the job.

$$Adjusted\ Plan\ Quantity = C\ x\ quantity\ shown\ on\ the\ plans\ or\ as\ specified\ by\ the\ Engineer$$

Where C =: English: $C = \frac{G_{mb}\ x\ 46.8}{U}$

And Where: G_{mb} = average bulk specific gravity from the approved mix design

U = unit weight of surface course shown on the plans in lb/sq yd/in.

46.8 = English constant*

The goal of Article 406.13 is to add or remove quantities from the project so the resulting cross section will be the thickness shown on the plans. For example, the plan quantity was determined by use of the typical unit weight of 112 lb/sq yd/in to provide a surface course thickness of 2.0 inches. If the mix being supplied uses an air cooled blast furnace slag (lighter than limestone) the resulting mix will be much lighter than the plan quantity and result in a surface thickness greater than 2.0-inches. Some material must be removed or the pavement will be higher than desired. Likewise if a steel slag aggregate (heavier than limestone) is being used in the HMA, the mix will be heavier than plan quantity and result in a thinner pavement surface, so material must be added.

* This constant is derived from the weight of water in one sq yd that is one inch in depth.

The standard weight for one cubic foot of water is 62.4 lbs. A square yard one inch in depth contains 9/12 of a cubic foot or 0.75 cf. The constant is determined as follows:

$$0.75\ \frac{cf}{sq\ yd/in} * 62.4\ lbs/cf = 46.8\ \frac{lbs}{sq\ yd/in}$$

The Factor "C" is unitless and results in the tons needed for surface thickness shown on the plans.

BEHIND THE SPECS

Determination of Gallons: With the adoption of the 2016 Standard Specifications most gallon pay items were eliminated. However, there may be some active projects under older specifications that would require pay in gallons. Also, most distributers of liquids utilize metering systems that utilize application rates in gallons per square yard. To provide a check on the application rates, the plan quantities and rates may require conversion to gallons or gallons per square yard as checks.

For Water:

$$Gallons = \frac{weight\ (lb)}{8.328\ lb/Gal}$$

For other liquids the specific gravity of the material must be included

$$Gallons = \frac{weight\ (lb)}{Specific\ Gravity\ x\ 8.328\ lb/Gal}$$

$$Gallons = \left(Application\ Rate\ \frac{gal}{area}\right) x\ Area$$

$$TON = Sp\ Gr\ x\ 8.328\frac{lb}{gal}\ x\ Gallons\ x\ \frac{ton}{2000\ lb}$$

Supplemental Problem 1 - Tack Coat Application

The plans call for a tack coat to be applied at a rate of 0.05 lb/sq ft residual asphalt of an SS-1hP emulsion on a milled HMA surface. A review of the plans determined the area to receive the tack coat is 359,472 sq ft., which at a rate of 0.05 lb per sq ft confirms the plan quantity of 17,974 lb residual asphalt.

The contractor requested water to be added by the producer (Urban Asphalt) who provided the resulting material as noted on the bill of lading. The contractor used a small distributor truck to spread the material. The distributor arrived at the job site empty and was filled several times to complete the tack coat work. Once completed, the remaining material was off loaded back into the transport truck. A final weight of 36,960 lb was determined at a local scale for the transport truck.

As an application rate check, a 1 ft x 1 ft piece of cardboard with heavy washers taped to the underside was used to sample the tack coat rate. The weight of the cardboard plus washers was 499 grams. After the distributer covered the cardboard it was dried and found to weigh 522 grams.

Bill of Lading
Urban Asphalt
Downtown, IL
August 2, 2018

Material:	SS-1hP
Gravity:	1.01
Residue Asphalt %:	59.00%
Emulsion:	34,322 lb
Water Added	10,678 lb
Gross:	78,680 lb
Tare:	33,680 lb
Net:	45,000 lb

Stoney Creek Coal and Grain
Outback, IL
August 2, 2018

GROSS	36,960 lb
TARE	------

Determine the following:

What is the max pay quantity?

What is the pay quantity?

For the material provided, what is the application rate the distributor driver should be applying in gallon/sq yd?

What was the residual application rate indicated by the sample?

What was the average application rate for the job?

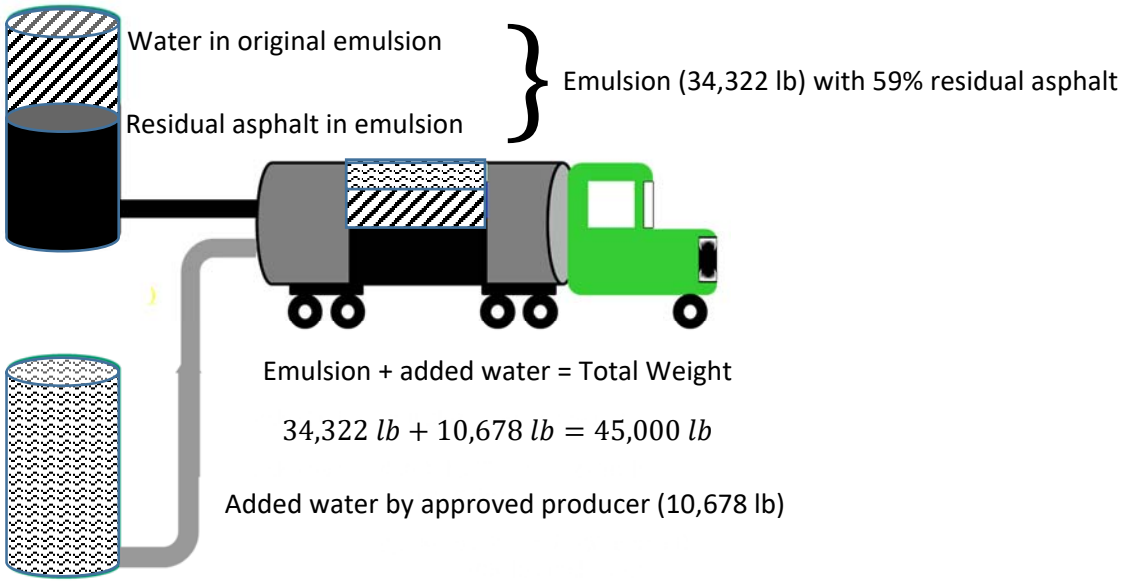
Supplemental Problem 1 - Tack Coat Application Answer

What is the max pay quantity?

105% - Per Art. 406.13(b) Ref to Art 1032 or Page A-15 of the Documentation of Contract Quantities Guide. Plan quantity confirmed to be 17,974 lb = (0.05 lb/sq ft x 359,472 sq ft)

$$Max\ Pay = 1.05\ x\ 17{,}974\ lb = \underline{\mathbf{18{,}873\ lb}}$$

What is the pay quantity?



Method 1

1a. *Wt. Applied = (Gross Wt.) – (Final Wt.) = 78,680 lb – 36,960 lb =* ***41,720 lb***

1b. $\%\ Emulsion = \frac{Wt.Emulsion}{Total\ Wt.} = \frac{34{,}322\ lb}{45{,}000\ lb} =$ ***0.7627***

1c. *Wt. Emulsion Applied = (Wt. Applied) x (% Emulsion) = 41,720 lb x 0.7627 = 31,820 lb*

1d. *Wt. Residual Asphalt = (Wt. Emulsion Applied) x (% Residue)*

= 31,820 lb x 0.590 = ***18,774 lb***

Method 2

2a. $Residual\ Percent\ of\ Blend = \frac{(Wt.Emulsion)\ x\ (Residual\ Asphalt\ \%)}{Net\ Weight}$

$Residual\ Percent\ of\ Blend = \frac{34{,}322\ lb\ x\ 0.590}{45{,}000} =$ ***0.450***

2b. *Wt. Residual Asphalt = (Wt. Applied) x (Residual Percent of Blend)*

= 41,720 lb x 0.450 = ***18,774 lb***

2c. **Pay quantity = 18,774 lb – Less than 18,873 lb max pay**

For the material provided, what would be the application rate the distributor driver should be applying in gallon/sq yd?

3. *Determine Specific Gravity of blended material.*

4. *Blended Specific Gravity (SG) =*

$$\frac{(Wt.Emulsion\ x\ SG\ Emulsion)+(Wt.Water\ x\ SG\ Water)}{Net\ Weight} =$$

$$\frac{(34{,}322\ lb\ x\ 1.01)+(10{,}678\ lb\ x\ 1.00)}{45{,}000\ lb} = \underline{\textbf{\textit{1.008}}}$$

Note: SG of water is 1.00

5. *Residual Asphalt per Gallon of Blended Material =*

8.328 lb/gal x (Combined SG) x (Residual Percent of Blended Material –from Step 2a) =

Residual Asphalt per Gallon of Blended Material = 8.328 lb/gal x 1.008 x 0.45 = 3.78 lb/gal

6. *Application Rate of Blended Material in Gallons per sq yd =*

$$\left(\frac{Residual\ Rate}{Residual\ Asphalt\ per\ Gallon\ of\ Blended\ Material}\right)\ x\ 9\ \frac{sq\ ft}{sq\ yd} =$$

$$\left(\frac{0.05\ \frac{lb}{sq\ ft}}{3.78\frac{lb}{gal}}\right)\ x\ 9\ \frac{sq\ ft}{sq\ yd} = \quad \underline{\textbf{\textit{0.12 gal/sq yd}}}$$

The distributor should apply the blended material at **0.12 gal/sq yd**

What was the residual application rate indicated by the sample?

7. *Wt. Residual Asphalt on Sample=*

(Wt. Residual Asphalt, Cardboard and Washers) – (Wt. Cardboard and Washers) =

522 g – 499 g = 23 g

Converting to pounds $\frac{23g}{453.59\frac{g}{lb}} =$ *0.0507 lb*

8. *Application Rate =* $\frac{Wt.\ Residual\ Asphalt\ on\ Sample}{Sample\ Size} =$

Residual Asphalt Rate Applied = $\frac{0.0507\ lb}{1\ sq\ ft} = \underline{\textbf{\textit{0.051 lb/sq ft}}}$

What was the average application rate for the job?

9. *Average Rate Applied =* $\frac{Wt.Residual\ Asphalt}{Area} =$

$$\frac{18{,}774\ lb}{359{,}472\ sq\ ft.} = \underline{\textbf{\textit{0.052 lb/sq ft.}}}$$

Illinois Department of Transportation

Traffic Control Surveillance Report

Contractor	Contract No.	Date
FAST PATCH, LLC	AB 123	TH 9/13/18 Fri 9/14/18

Time of Inspection	Signature	Weather	Comments and/or Corrective Action
Midnight	9/14/18 KT Perry	Clear - Calm 60F	Drive Through @ 12:15A Shift Change - All OK
1 A.M.			
2 A.M.			
3 A.M.	KT Perry	Clear - Calm 57F	Drive Through @ 3:00A All OK
4 A.M.			
5 A.M.			
6 A.M.	KT Perry	Clear - Calm 57F	Final Drive Through @ 6:45A All OK
7 A.M.			Work Start @ 7:00 AM
8 A.M.			
9 A.M.			
10 A.M.			
11 A.M.			
Noon			
1 P.M.			
2 P.M.			
3 P.M.			
4 P.M.			WORK END @ 5:00P 9/13/18
5 P.M.	Alex T. Smith	CLOUDY-WINDY - 75F	DRIVE THROUGH CHECK - ALL OK @5:15P
6 P.M.			
7 P.M.			
8 P.M.	Alex T. Smith	CLOUDY - VERY WINDY	BARRELS MOVED BACK IN PLACE @8:20P
9 P.M.			
10 P.M.			
11 P.M.	Alex T. Smith	CLOUDY - CALM 65F	DRIVE THROUGH CHECK - ALL OK @ 11:45P

Distribution: Contractor
Resident

Completed forms must be turned in to the Resident the next working day.

BC 2240 (Rev. 9/97)

Supplemental Problem 2 – Traffic Control Surveillance

The contractor was required to perform traffic control surveillance from the end of the workday on Thursday to start of work the next day. The contractor has established work hours from 7:00 am to 5:00 pm each workday. The contractor performed the inspections providing the completed BC 2240's as shown.

This was the only period of surveillance for the week. What will the total pay be for the surveillance for these two days based on the Standard Specifications?

Supplemental Problem 2 – Traffic Control Surveillance Answer

Refer to Traffic Control Surveillance Art. 701.20 (g). Time needs to be converted from hours to calendar days.

Thursday 9/13 from 5:00 pm to midnight = 7 hrs.

Friday 9/14 from midnight to 7:00 am = 7 hrs.

Total = 14 hrs.

Converting to calendar day = 14 hrs/24 hrs/day

= **0.58 calendar day.**

Supplemental Problem 3 – Surface Treatment

Bituminous Surface Treatments (Section 403): Given a project that is 5.2 mi long with a width of 24 ft is to receive an A-1 Seal Coat. The Bituminous Material specified is CRS-2 with a CA-16 Seal Coat Aggregate. Application rates are specified as 0.34 gal/sq yd for CRS-2 and 19 lb/sq yd for CA-16. The plans call for 106 Tons of CRS-2 and 695 Tons of CA-16. The bill of lading for the CRS-2 provided indicated that the gravity (specific gravity) of the CRS-2 is 1.02.

As a check, determine the tons of CRS-2 and CA-16 along with max pay needed to complete the work.

Supplemental Problem 3 – Surface Treatment Answer

1. Determine area of application:

$$Area = Length\ x\ Width$$

$$Area\ (sq\ yd) = \frac{5.2\ mi\ x\ 5{,}280\ \frac{ft}{mi}\ x\ 24\ ft}{9\ \frac{sq\ ft}{sq\ yd}}$$

$$\underline{Area = \mathbf{73{,}216}\ sq\ yd}$$

2. Determine gallons of CRS-2 to be applied:

$$Gallons = Rate\ (\frac{gal}{sq\ yd})\ x\ Area\ (sq\ yd)$$

$$Gallons = 0.34\ \frac{gal}{sq\ yd}\ x\ 73{,}216\ sq\ yd = \ \underline{\textbf{\textit{24,893 gallons}}}$$

3. Convert gallons to tons:

$$TON = Sp\ Gr\ x\ 8.328\ \frac{lb}{gal}\ x\ Gallons\ x\ \frac{ton}{2000\ lb}$$

$$TON = 1.02\ x\ 8.328\ \frac{lb}{gal}\ x\ 24{,}893\ \ gal\ x\ \frac{ton}{2000\ lb} = \underline{\textbf{\textit{105.73 ton}}}$$

Max Pay of 105%: 1.05 x 105.88 ton= ***111.02 on***

4. Determine tons of CA 16:

$$Tons = Area\ x\ Rate$$

$$Tons = 19\ \frac{lb}{sq\ yd}\ x\ \frac{ton}{2000\ lb}\ x\ 73{,}216\ sq\ yd = \underline{\textbf{\textit{695.5 ton}}}$$

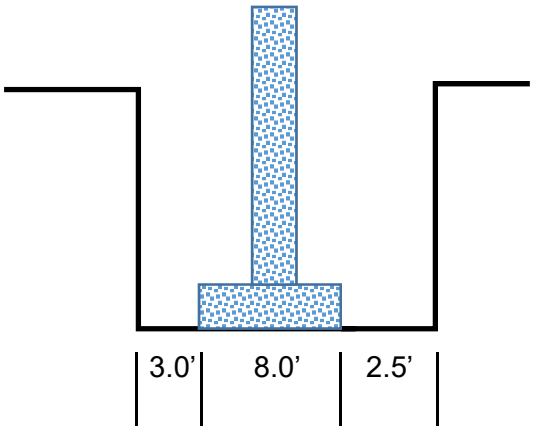
Max pay of 110%: 1.10 x 695.5 ton = ***765.2 ton***

Supplemental Problem 4 – Structure Excavation

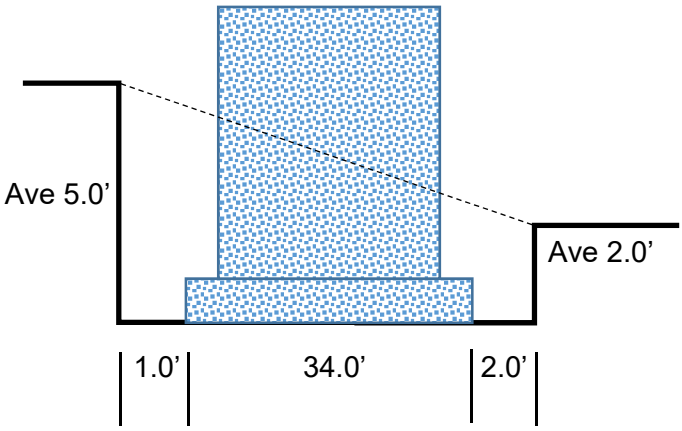
Field measurements for the excavation the contractor dug for a proposed footing are shown below:

Determine the volume of the Structure Excavation pay item that will be used as final payment to the contractor for this part of the work. (Not to scale)

North View Pier 1



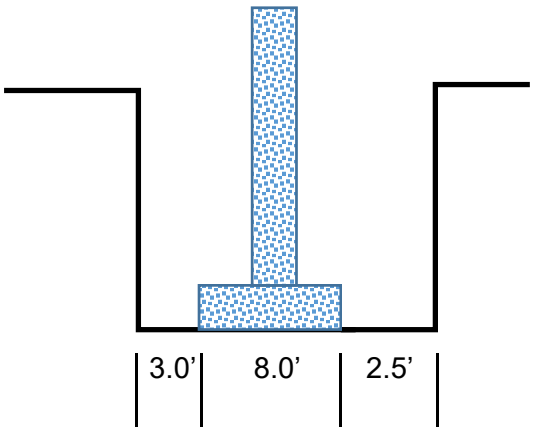
East View Pier 1



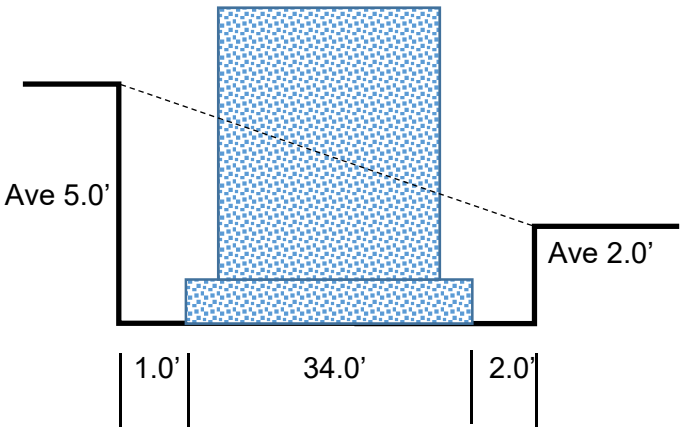
Supplemental Problem 4 – Structure Excavation Answer

(Not to scale)

North View Pier 1



East View Pier 1



Per Article 502.12 (b): "Horizontal dimensions will not extend beyond vertical planes 2 ft outside of the edges of footings..."

Pay Dimensions =

North: 2.0' + 8.0' + 2.0' = 12.0 ft East: 1.0' + 34.0' + 2.0' = 37.0 ft

Note: East end area is in shape of trapezoid. In this case the volume is determined by calculating the end area of the East side (trapezoid) multiplied by the length of the excavation (North side).

Volume:

$$Volume = \frac{h1 + h2}{2} \; x \; width \; x \; length$$

Where:

h1 = 5.0', h2 = 2.0', width = 37.0' (East pay dimension), and length = 12.0' (North pay dimension)

$$Volume = \frac{5\ ft + 2\ ft}{2} \; x \; 37\ ft \; x \; 12.0\ ft$$

$$Volume = 3.5\ ft \; x \; 37\ ft \; x \; 12\ ft$$

$$Volume = 1{,}554.0\ cu\ ft$$

Pay item is in cubic yards, so must convert by dividing by 27 cu ft/ cu yd

$$Volume = \frac{1{,}554.0\ cu\ ft}{27 \frac{cu\ ft}{cu\ yd}}$$

$$\underline{\boldsymbol{Volume = 57.6\ cu\ yd}}$$

Supplemental Problem 5 – Maximum Payment

For each Pay Item determine the maximum percent pay, the Standard Specification Reference Article and Documentation Guide Reference source (if available).

Seeding Items

ITEM	UNIT	MAX PERCENT PAY	REF. SOURCE (SPEC)	REF. SOURCE (DOC GUIDE)
NITROGEN FERTILIZER NUTRIENT	POUND (KILOGRAM)			
PHOSPHORUS FERTILIZER NUTRIENT	POUND (KILOGRAM)			
POTASSIUM FERTILIZER NUTRIENT	POUND (KILOGRAM)			

Aggregate Items

ITEM	UNIT	MAX PERCENT PAY	REF. SOURCE (SPEC)	REF. SOURCE (DOC GUIDE)
AGGREGATE SHOULDERS (TYPE A or B)	TON (M TON)			
AGGREGATE WEDGE SHOULDERS (TYPE B)	TON (M TON)			
AGGREGATE SURFACE COURSE (TYPE A or B)	TON (M TON)			
AGGREGATE BASE COURSE (TYPE A or B)	TON (M TON)			
AGGREGATE BASE COURSE REPAIR	TON (M TON)			
COVER COAT AGGREGATE	TON (M TON)			
SEAL COAT AGGREGATE	TON (M TON)			
GANULAR EMBANKMENT SPECIAL	TON (M TON)			
POROUS GRANULAR EMBANKMENT	TON (M TON)			
SUBBASE GRANULAR MATERIAL (TYPE A, B or C)	TON (M TON)			
AGRICULTURAL GROUND LIMESTONE	TON (M TON)			

Supplemental Problem 5 – Maximum Payment (Cont.)

Bituminous Materials Items

ITEM	UNIT	MAX PERCENT PAY	REF. SOURCE (SPEC)	REF. SOURCE (DOC GUIDE)
BITUMINOUS MATERIALS (PRIME COAT)	TON (M TON)			
BITUMINOUS MATERIALS (COVER AND SEAL COAT)	TON (M TON)			
BITUMINOUS MATERIALS (PRIME COAT)	POUND* (KILOGRAM) *Residual			
BITUMINOUS MATERIALS (TACK COAT)	POUND* (KILOGRAM) *Residual			

Hot Mix Asphalt Items

ITEM	UNIT	MAX PERCENT PAY	REF. SOURCE (SPEC)	REF. SOURCE (DOC GUIDE)
MIX FOR CRACKS, JOINTS AND FLANGWAYS	TON (M TON)			
INCIDENTAL HMA SURFACING	TON (M TON)			
LEVEL BINDER (MACHINE AND HAND)	TON (M TON)			
HMA BINDER COURSE	TON (M TON)			
HMA SURFACE COURSE	TON (M TON)			

Supplemental Problem 5 – Maximum Payment Answer

Seeding Items

ITEM	UNIT	MAX PERCENT PAY	REF. SOURCE (SPEC)	REF. SOURCE (DOC GUIDE)
NITROGEN FERTILIZER NUTRIENT	POUND (KILOGRAM)	103%	Art. 250.09	A-15
PHOSPHORUS FERTILIZER NUTRIENT	POUND (KILOGRAM)	103%	Art. 250.09	A-15
POTASSIUM FERTILIZER NUTRIENT	POUND (KILOGRAM)	103%	Art. 250.09	A-15

Aggregate Items

ITEM	UNIT	MAX PERCENT PAY	REF. SOURCE (SPEC)	REF. SOURCE (DOC GUIDE)
AGGREGATE SHOULDERS (TYPE A or B)	TON (M TON)	108%	Art. 481.09 Ref. to Art. 311.08	A-15
AGGREGATE WEDGE SHOULDERS (TYPE B)	TON (M TON)	108%	Art. 481.09 Ref. to Art. 311.08	None
AGGREGATE SURFACE COURSE (TYPE A or B)	TON (M TON)	108%	Art. 402.12 Ref. to Art. 311.08	A-15
AGGREGATE BASE COURSE (TYPE A or B)	TON (M TON)	108%	Art. 351.11 Ref. to Art. 311.08(b)	A-15
AGGREGATE BASE COURSE REPAIR	TON (M TON)	108%	Art 358.06 Ref. to Art 311.08(b)	A-15
COVER COAT AGGREGATE	TON (M TON)	110%	Art. 403.15	A-15
SEAL COAT AGGREGATE	TON (M TON)	110%	Art. 403.15	A-15
GANULAR EMBANKMENT SPECIAL	TON (M TON)	108%	Art. 206.07 Ref. to Art. 311.08	A-15
POROUS GRANULAR EMBANKMENT	TON (M TON)	108%	Art 207.04 Ref. to Art 311.08(b)	A-15
SUBBASE GRANULAR MATERIAL (TYPE A, B or C)	TON (M TON)	108%	311.08	A-15
AGRICULTURAL GROUND LIMESTONE	TON (M TON)	108%	Art. 250.09	A-15

Supplemental Problem 5 – Maximum Payment Answer (Cont.)

Bituminous Materials Items

ITEM	UNIT	MAX PERCENT PAY	REF. SOURCE (SPEC)	REF. SOURCE (DOC GUIDE)
BITUMINOUS MATERIALS (PRIME COAT)	TON (M TON)	105%	Art. 403.15	A-15
BITUMINOUS MATERIALS (COVER AND SEAL COAT)	TON (M TON)	105%	Art. 403.15	A-15
BITUMINOUS MATERIALS (PRIME COAT)	POUND* (KILOGRAM) *Residual	105%	Art. 406.13(b) Ref to Art 1032	A-15
BITUMINOUS MATERIALS (TACK COAT)	POUND* (KILOGRAM) *Residual	105%	Art. 406.13(b) Ref to Art 1032	A-15

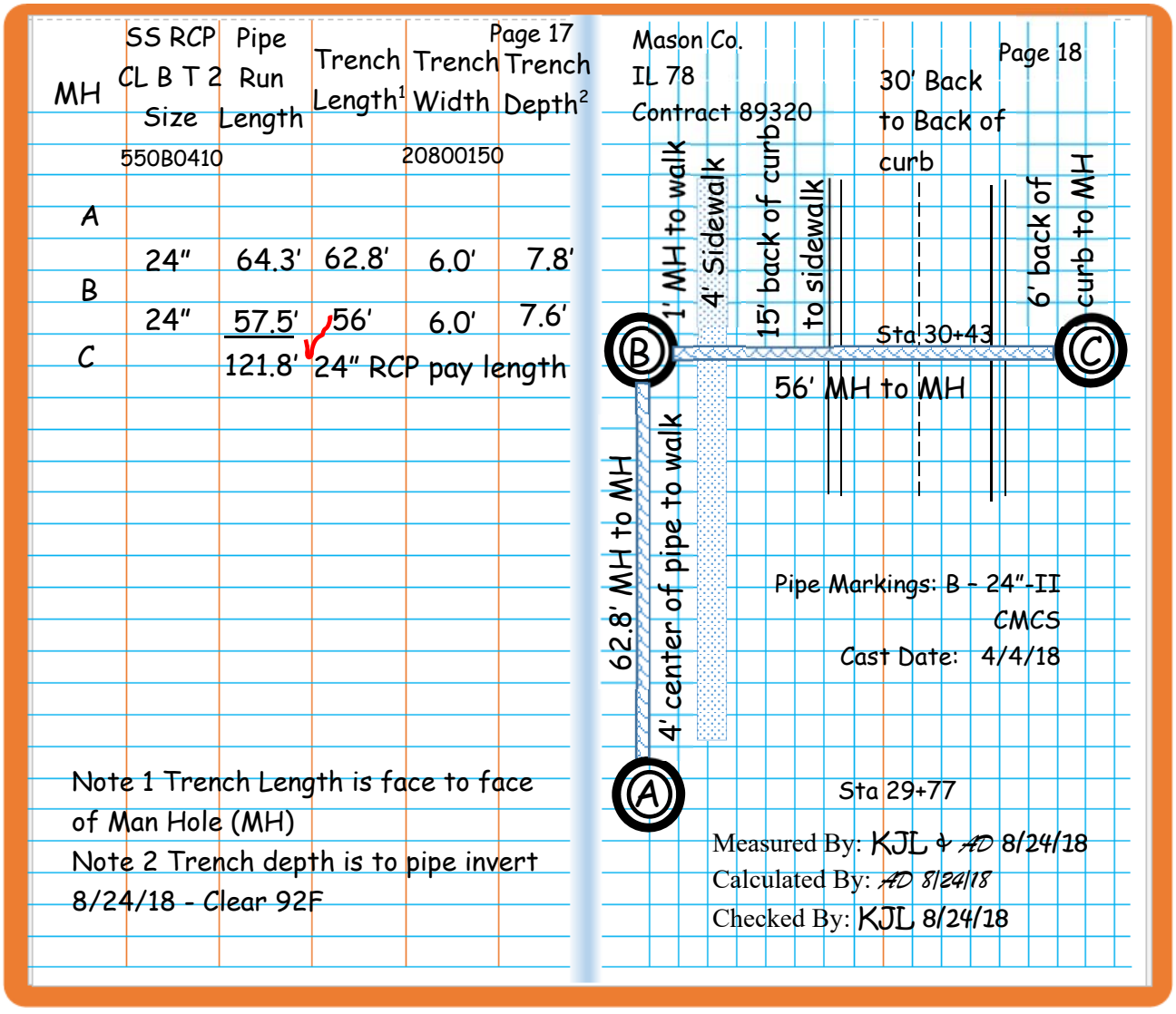
Hot Mix Asphalt Items

ITEM	UNIT	MAX PERCENT PAY	REF. SOURCE (SPEC)	REF. SOURCE (DOC GUIDE)
MIX FOR CRACKS, JOINTS AND FLANGWAYS	TON (M TON)	103%	406.13(b)	A-15
INCIDENTAL HMA SURFACING	TON (M TON)	103%	408.04 Ref to Art. 406.13	A-15
LEVEL BINDER (MACHINE AND HAND)	TON (M TON)	103%	406.13(b)	A-15
HMA BINDER COURSE	TON (M TON)	103%	406.13(b)	A-15
HMA SURFACE COURSE	TON (M TON)	103%	406.13(b)	A-15

Supplemental Problem 6 – Trench Backfill

It is 8/24/18 and you have been documenting storm sewer work on IL 78 being installed by Atlas Paving, LLC, who is the prime contractor on the project. You inspected the pipe supplied by County Materials (CMCS mark on pipe) prior to being installed and have the required documentation. The Trench Backfill was supplied by Cullinan – East Peoria. From field notes, fill out the IDR that shows allowable pay Length, maximum allowable trench width and allowable pay Quantity for Trench Backfill from Manhole A to B and B to C. Also show the pay quantity for the storm sewer pipe on the IDR. Include all calculations or a reference to calculations. Include the required evidence of Material Inspection for each item. You are the Inspector and your staff assisted with the work as noted in the Field Book.

Field Book 1



Illinois Department of Transportation

Inspector's Daily Report

County

Section

Route

District

Contract No.

Job No.

Project

JOB STAMP

Date _____

Contractor or Sub. _____

Weather _____

	Initial(s)	Date
Inspected by:		
Measured by:		
Calculated by:		
Checked by:		

Item Code #	Fund Code (Opt.)	Item	Location	Quantity and Units	Evidence of Material Inspection (Optional)	Posted in Q Book

This is: ☐ an estimated progress measurement (item no.: _____)

☐ a final field measurement (item no.: _____)

Remarks: (e.g., instruction to Contractor, special problems, sketches with dimensions for final measurements, computations, number of persons working, hours worked) Use reverse side, if needed.

Printed 9/25/2018

BC 628 (Rev. 8/04)

Illinois Department of Transportation

Inspector's Daily Report

County

Section

Route

District

Contract No.

Job No.

Project

JOB STAMP

Date 8/24/2018

Contractor or Sub. Atlas Paving, LLC

Weather Clear, 92F

	Initial(s)	Date
Inspected by:		8/24/2018
Measured by:	MJL EAD	8/24/2018
Calculated by:	AD	8/24/2018
Checked by:	MJL	8/24/2018

Item Code #	Fund Code (Opt.)	Item	Location	Quantity and Units	Evidence of Material Inspection (Optional)	Posted in Q Book
20800150		Trench Backfill	MH A to B & MH B to C	131.7 CU YD	LIST and TICK - (Cullinan - East Peoria)	
			Sta 29+77 to 30+33			
550B0410		SS RCP CL B T II 24"	MH A to B & MH B to C	121.8 LN FT	LIST and MARK (CMCS)	
			Sta 29+77 to 30+33			

This is: ☐ an estimated progress measurement (item no.: _____)

☒ a final field measurement (item no.: 20800150, 550B0410)

Remarks: (e.g., instruction to Contractor, special problems, sketches with dimensions for final measurements, computations, number of persons working, hours worked) Use reverse side, if needed.

See F Book 1 Pg 17 & 18 for Pipe/Trench Measurements and Pipe length Calc's Allowable trench width for table: 24"+3"+3+18"+18" = 66" - Dug 72" Use Table

MH A to B trench parallel and within 2' of sidewalk - Pay for Trench Backfill entire length.

Pay length (A to B)= Dist MH A to MH B less backfill at face of MH A and B (3" each) = 62.8 LF - 2 x (3"/12 in/ft) = 62.3' For 7.8' depth from Table 1.294 CY/LF

Pay Length (B to C) - only pay within 2' of roadway or sidewalk less backfill at face of MH B = 1'+4'+2'-(3"/12 in/ft)+(2'+30'+2') =40.75'. For 7.6' Depth 1.253 CY/LF

Total Volume Trench Backfill = Pay Length x Volume Factor = (62.3 LF x 1.294CY/LF) + (40.75 LN FT x 1.253 CY/LF = 131.7 CU YD

BC 628 (Rev. 8/04)

Supplemental Problem 7 -Traffic Control Price Adjustment

You have been assigned two contracts (A2345 and B6789) on I-55 that are a few miles apart that are very similar in work. The same contractor was the successful bidder on the two projects. Both contracts are utilizing Standard 701411 for traffic control in the ramp areas.

As work progresses, Contract A2345 encounters additional work and time that results in a change order to complete the needed work. In the end, the contractor's schedule utilizing Standard 701411 increased from the planned 15 working days to 21 working days. The awarded contract value of the work that Standard 701411 was protecting was $178,349.00. The final value of the work completed under the standard was $207,342.00. The unit price for the pay item of the standard was $14,500.00.

Contract B6789 had some changes that resulted in elimination of some work that Standard 791411 was protecting. The contractor schedule for using Standard 701411 was reduced from 15 working days to 14 working days. The awarded contract value of the work that Standard 701411 was protecting was $130,243.00. The elimination of a pay item resulted in cost savings, but roughly the same construction time. The final cost of the work under the standard was $72,018. The unit price for the pay item of the standard was $14,500.00.

Per Article 701.20 what will be the adjusted unit price for Traffic Control Standard 701411 for each of these contracts.

Supplemental Problem 7 -Traffic Control Price Adjustment Answer

Determine if an adjustment is warranted: Change must exceed 10% of the original work cost.

$$X = \left| \frac{Final\$ - \ Orginal\$}{Orginal\$} \right|$$

Note |value| indicates that the resulting value is to be a positive value even if the calculated result is negative. This is termed the “absolute value” of the calculation.

For **Contract A2345:**

$$X = \left| \frac{\$207{,}342 - \$178{,}349}{\$178{,}349} \right| = \ 0.163$$

$$(X - 0.1) = 0.063 \quad Greater\ than\ 0 - \ Therefore\ adjust\ by\ increasing\ the\ unit\ price$$

$$Adjusted\ unit\ price = 0.25P + 0.75P\left(1 \ \pm (X - 0.1)\right)$$

Note the price will be increased so “+” is used

$$Adjusted\ unit\ price = 0.25\ x\ \$14{,}500 + 0.75\ x\ \$14{,}500\ (1 + (0.163 - 0.1))$$

$$= \$3{,}625 + \$10{,}875(1 + 0.063)$$

$$= \$3{,}625 + \$10{,}875\ x\ 1.063 = \$15{,}185.13$$

Unit price difference is $15,185.13 - $14,500 = **$685.13** – This value would be used on new pay item #XXX03100 as an addition

For **Contract B6789:**

$$X = \left|\frac{\$72{,}018 - \$130{,}243}{\$130{,}243}\right| = |-0.447| = 0.447$$

Note the absolute value of -0.447 is 0.447, a positive value

$$(X - 0.1) = 0.347 \quad Greated\ than\ 0 - \ Therefore\ adjust\ by\ decreasing\ the\ unit\ price$$

$$Adjusted\ unit\ price = 0.25P + 0.75P\big(1\ \pm (X - 0.1)\big)$$

Note the price will be decreased so "-" is used

$$Adjusted\ unit\ price = 0.25\ x\ \$14{,}500 + 0.75\ x\ \$14{,}500\ (1 - (0.447 - 0.1))$$

$$= \$3{,}625 + \$10{,}875(1 - 0.347)$$

$$= \$3{,}625 + \$10{,}875\ x\ 0.653 = \$10{,}726.38$$

Unit price difference: $10,726.38 - $14,500 = -$3,773.62 – This value would be used on new pay item #XXX03100 as a deduction.

SPECIAL NOTE: The contractor's planned and actual time of standard use are not part of the above adjustment. However, good diary records should capture the setup and take down time of traffic control. The changes to the contract resulted in the elimination of a pay item. See Article 104.02. In this case, Traffic control standard 701411 as a percent of the original contract price is:

$$\frac{Adjusted\ unit\ price}{Contract\ unit\ price}\ x\ 100 = Percent\ of\ Contract\ unit\ price$$

$$\frac{\$10{,}726.38}{\$14{,}500}x100 = 74.0\%$$

Knowing that the work had changed significantly in value with the impacted work changing more than 125% or reduced to under 75% of the original contract value, the impacted items should have their price renegotiated prior to the start of the revised work. The renegotiated prices should have included the work under Traffic Control Standard 701411 which should have been checked prior to start of the work so any needed adjustments could be agreed upon prior to the start of work. In the event that this part of the work was not renegotiated, you have documented the actual usage which would be helpful in the resolution of any contractor claims.

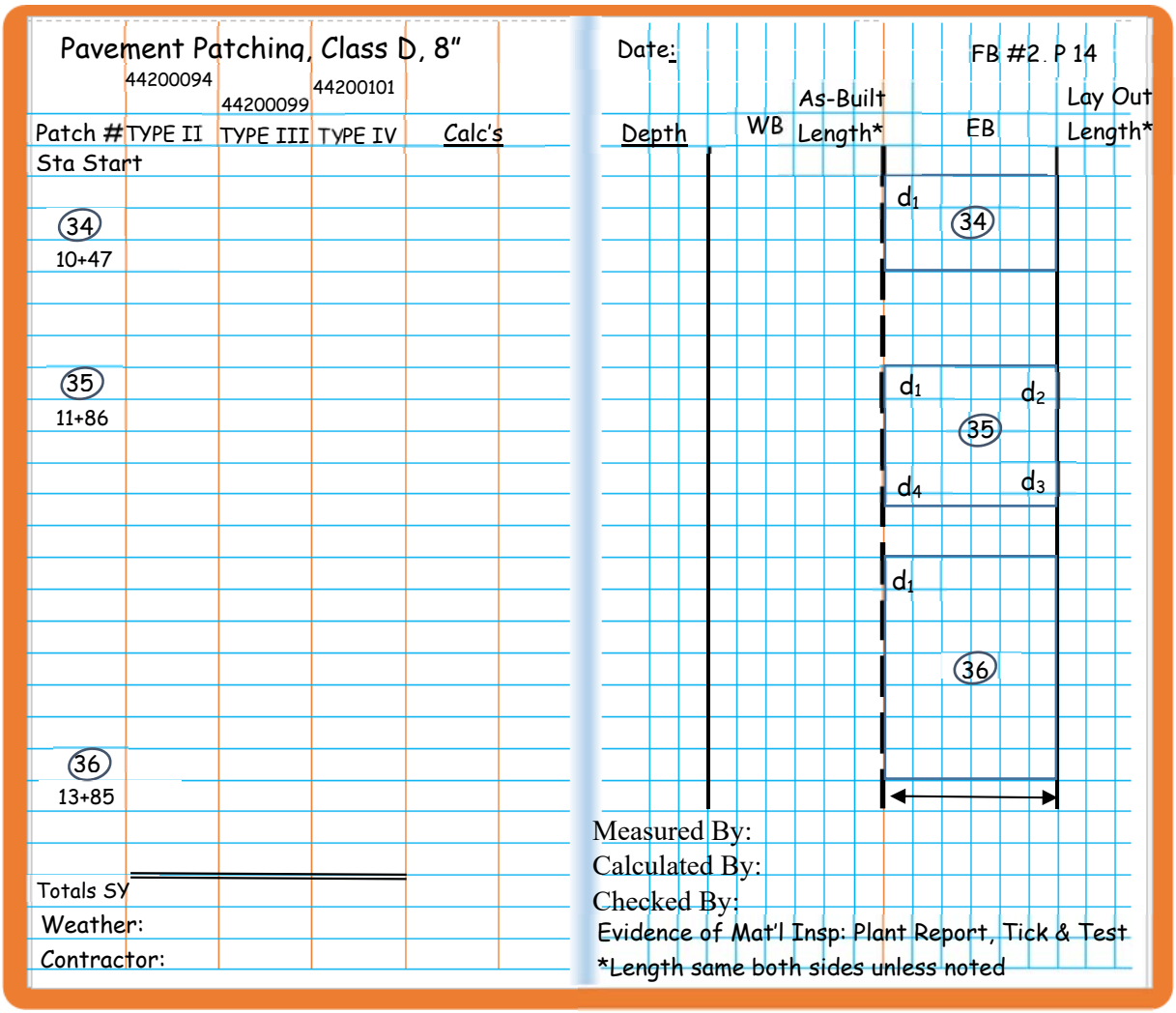
The information gathered would show that the time/work effort required to provide Traffic Control Standard 701411 was within 10% of the original contract proposal (contractor's schedule vs. actual), thus the contractor likely has a valid claim to the unit price as bid for the standard.

Supplemental Problem 8 –Pavement Patching

You are the inspector on a pavement patching operation by, Fast Patch, LLC. On 6/5/2018, you laid out 3 patches (#'s 34, 35 and 36) in the eastbound lane and recorded your notes in your field book for Class D Pavement Patching Type II, III and IV, 8". On Patch #35 the contractor elected to increase the patch length 1 ft to avoid sawing through dowel bars. The pavement is 12 ft wide. The weather was sunny and 82F at the time of pour. You measure the final patch dimensions just prior to pouring as follows:

Station	Lay Out Width	Lay Out Length	As-Built Length	As-Built Depth, d_1, d_2, d_3, d_4
10+47	12.0'	6'	6'	8.2"
11+86	12.0'	11'	12'	11.2, 12.0, 10.8, 11.5
13+85	12.0'	30'	30'	8.0"

Fill out your field book as the source document using the information above.



Supplemental Problem 8 –Pavement Patching Answer

Pavement Patching, Class D, 8"

44200094 44200099 44200101

Patch #	TYPE II	TYPE III	TYPE IV	Calc's
Sta Start				
(34) 10+47	8.0			$\frac{6.0' \times 12.0'}{9}$ = 8.0SY
(35) 11+86	17.6			$\frac{11.0' \times 12.0'}{9}$ = 14.7SY
(36) 13+85		40.0		$\frac{30.0' \times 12.0'}{9}$ = 40.0SY
Totals SY	25.6		40.0	

No length Adjustment due to Contractor's adjustment

Thickness Adjustment

$\frac{(11.4" - 8.0")}{8.0"}$ =42.5% - greater than 30%

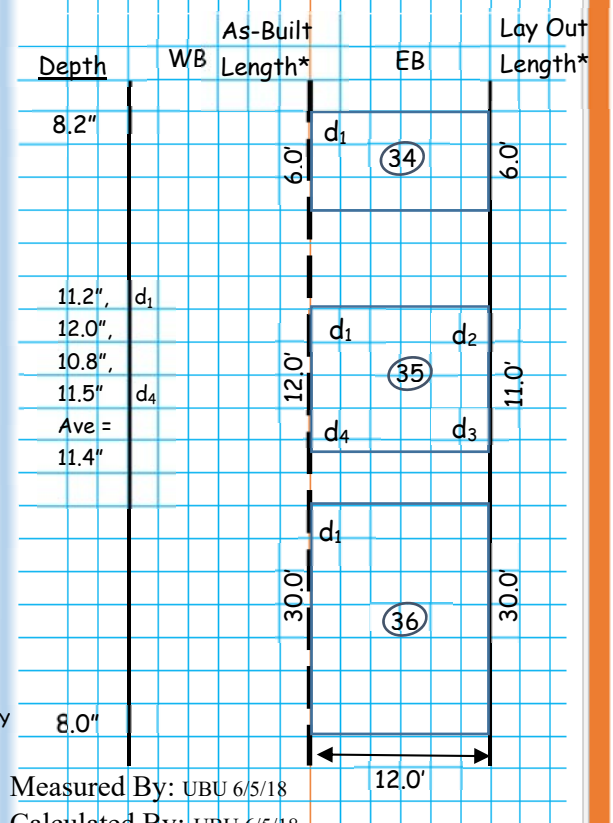
Per Art 442.10 increase quantity 20% 1.20 x 14.7 SY = 17.6 SY Use

Note Keep as Type II

Weather: Sunny, 82F

Contractor: Fast Patch, LLC

Date: 6/5/18 FB #2. P 14



Measured By: UBU 6/5/18

Calculated By: UBU 6/5/18

Checked By: (by others)

Evidence of Mat'l Insp: Plant Report, Tick & Test

*Length same both sides unless noted

Supplemental Problem 9 –HMA Surface Max Pay Answer

Your project is a short mill and fill HMA resurfacing safety project to construct a high friction pavement surface in front of a recently opened Portillo's, which has a high frequency of skid accidents. The project is 850 ft in length and includes two 12 ft lanes in each direction and a 12 ft turn lane for a total width of 60 ft. The plans show a surface thickness of 1.5 in using the pay item POLYMERIZED HOT-MIX ASPHALT SURFACE COURSE, MIXTURE F, N 90. The plans indicate the unit weight used in determining quantities was 112 lb/sy/in, which provided a plan quantity of 476 Tons. The contractor submitted a HMA mixture utilizing steel slag in the aggregate blend to meet the Mixture F friction aggregate requirements. As a result, the bulk specific gravity (G_{mb}) of the approved HMA mix design is 2.613. The contractor bid the material at $92.45/ton and provided 541 Tons.

Determine the following:

Check plan quantity of the work.

Original total bid cost for the surface work.

Adjusted Plan Quantity for the mix provided.

Maximum payment Quantity.

Contractor payment quantity and amount

Supplemental Problem 9 –HMA Surface Max Pay Answer

Check plan quantity of the work.

$$Tons = Area(SY)x\ \frac{(Thickness\ in\ Inches)\ x\left(Unit\ Weight\ of\ HMA\ per\ \frac{SY}{inch}\right)}{2000lb/ton}$$

$$Area = \frac{60\ ft\ x\ 850\ ft}{9\ SF/SY} = \frac{51{,}000\ SF}{9\ SF/SY} = 5{,}666.7\ \text{SY}$$

$$Tons = 5{,}666.7\ SY\ x\frac{(1.5\ in)x\ \left(112(\frac{lb}{SY})/in\right)}{2000lb/ton} = 5{,}666.7\ SY\ x\ 0.084\frac{ton}{SY} = 476\ ton$$

476 tons of HMA matches plan quantity

Original total bid cost for the surface work.

$$\text{Total bid} = \text{Plan Quantity x Unit Price} = 476\ \text{Ton x}\ \$92.45/\text{Ton} = \$44{,}006.20$$

Adjusted Plan Quantity for the mix provided.

The bulk specific gravity (G_{mb}) of the mix provided in this case is 2.613 (note sometimes this will be referred to as "little d").

Per 406.13

$$Adjusted\ Plan\ Quantity = C\ x\ Plan\ or\ Engineer's\ Specified\ Quantity$$

$$C = \frac{\text{Gmb}\ x\ 46.8}{U}$$

Where for this project:

G_{mb} = 2.613 from the approved mix design
U = 112 lb/sy/in unit weight of surface course shown on plans

$$C = \frac{2.613\ x\ 46.8}{112\frac{lb}{sy}/in} = 1.092$$

$$Adjusted\ Plan\ Quantity = 1.092\ x\ 476\ tons = \mathbf{520\ tons}$$

Maximum payment Quantity.

Per Article 406.13(b) Max payment is 103%

Max pay = 1.03 x Adjusted Plan Quantity = 1.03 x 520 tons = **536 tons**

Contractor payment quantity and amount.

Contractor provided 541 tons HMA which exceeded maximum payment quantity of 536 tons. Payment to be based on 103% limit of **536 tons**.

Payment amount = $92.45 x payment quantity = $92.45 x 536 tons = **$49,553.20**