Illinois Department of Transportation

Airport Construction

Documentation Manual

June 2014

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Section A

GENERAL REQUIREMENTS

The policies contained in this section represent the minimum pay item quantity documentation required for airport construction projects administered by the Illinois Department of Transportation, Division of Aeronautics (Division).

USE OF THE BCM SYSTEM FOR DOCUMENTATION

Project records shall be maintained on a system known as the Bureau of Construction Management System (BCM). BCM gives the Resident Engineer/Technician (Resident) a Quantity Book, as well as Construction Reports (pay estimates).

PROJECT DIARY (AER 36) Example, page F-1

The Project Diary is one of the most essential records kept on the job. The Resident or a designated representative is required to keep a daily diary on each contract. The diary forms shall be kept in a three-ring binder, and this will constitute the official project diary.

The diary shall be in the format illustrated in Attachment F of the Agreement for Architectural, Engineering and Planning Services for Airports. There must be a separate diary for each contract. Entries must start at the beginning of the binder. All entries must be in order by date. All entries throughout the diary must be in ink.

AER 35, Diary Cover Sheet, shall be the first page in the diary. The cover sheet must include the year, the name and signature of the Resident (and designated representative, if applicable), the complete official designation of the project, and the name of the Contractor. (Example, page F-2). This may seem nonessential, but diaries have been thrown out of court because they were not properly identified.

The Division's return address must be noted on the cover sheet so that it may be returned if ever lost: 1 Langhorne Bond Drive, Springfield, IL 62707-8415.

A list of all personnel assigned to the job or who work on the job shall be entered on the cover sheet of the diary (print full name). Each person shall put his/her initials after his/her name.

An entry must be made in the project diary for each day of the project, including weekends and holidays, except when the project is officially suspended. Entries must begin on the day the Contractor begins work or 10 days after the official Notice to Proceed, whichever is first.

The diary need not repeat the detailed entries reported on AER 628 Inspector's Daily Report (IDR) but should contain only general information about these operations. The diary should contain a day to day record of all significant items relating to the project. Since it may become important evidence in future claims or litigation it is essential that the diary be complete.

The diary shall not be used as a Quantity Book or field book; only a reference to the work in progress is sufficient.

A complete legible diary will be accepted in court if the need arises. Diary entries made by the Resident do not need to be signed or initialed. Only entries in a project diary made by someone other than the Resident or designated representative need to be signed by the person making that entry.

Information entered in the diary must never be erased, whited-out, or eradicated in any manner. To correct information already entered, cross out information to be changed. The information changed should be initialed and dated by the person making the change.

A partial list of items to be noted in a project diary is:

1. Weather
2. Progress Schedule Controlling Item of Work and actual work done by the Contractor's forces during the day.
3. A workable/non-workable statement, based solely on the controlling item.
4. Number of persons working.
5. Calendar Days charged and reason for partial or non-working/workable days.
6. Safety Plan inspections and changes.
7. Important orders, discussions, or meetings with Contractor(s).
8. Official visitors and inspections.
9. Opening or closing runways, taxiways, or other airport facilities.
10. Work or materials rejected and reasons.
11. Time of shutting down or resuming of work and explanations.
12. Account of any time spent by the Contractor's workers or equipment on disputable items of work.
13. Length and cause of any delay.
14. Arrival and departure of major equipment.
15. Record of important e-mails, faxes, and telephone calls.
16. Unusual conditions, if any, such as high water, bridge or pavement failures, slides, accidents/injuries, damage to aircraft as a result of construction, etc.
17. Approval for extra work.

Copies of daily project diary entries shall be submitted to the Division on a bi-weekly basis. At the completion of the project, the diary shall be filed as a part of the permanent job records.

THE QUANTITY BOOK

Instructions pertaining to contract quantities are found in Sections 40-02 through 40-04 and Section 90 in the Standard Specifications for Construction of Airports (Specifications) and the Method of Measurement and Basis of Payment articles for each construction pay item.

For each contract you will be issued a Quantity Book in which contract items are to be posted. The Quantity Book is to be considered the cornerstone of the complete record keeping structure you will be building in the field. The daily quantities posted here will be referred to when each pay estimate is prepared.

Quantity Book Cover Sheet (BC 623) – Example, page F-3. The cover sheet in the Quantity Book shall either be filled in by a rubber stamp, typewriter or neatly printed in ink. For state-run projects, the "Address" at the bottom of the page refers to the Illinois Division of Aeronautics, 1 Langhorne Bond Drive, Springfield, IL 62707-8415.

Index of Sheets (BC 624) – The computerized index is prepared in the same item-to-item order as the first pay estimate. If additional line items are later added to the contract, they can be added at the end of the index, under the appropriate fund type and pay item number.

Quantity Sheet (BC 625) – Example, pages F-4, F-5, and F-6. The job designation block and the upper left-hand side of Form BC 625 will be automatically filled in by computer following project award. A separate sheet will be provided for each pay estimate line item. The Division's Contract Section has extra blank forms, which are to be used for added pay estimate line items, or if additional pages are needed for any established line item. These extra sheets will require the Resident to fill in by hand the complete job designation and quantity information. The lines provided for authorization additions and deductions are to be completed as authorizations are submitted and approved. The final total quantity in the authorization box should be identical to the final measured and approved amount completed and accepted.

The column headed "Date" should be the dates the quantity was placed.

The "Station to Station, Location, or Description" shall describe the actual area/location where the item was placed.

Quantities placed are to be kept daily when the particular pay item is constructed. The column "To Date" shall show the cumulative total of the item as additional days of work are entered. This tabulation procedure will facilitate the checking of material inspection reports and plan quantities for additions and deductions so that the Authorization of Contract Changes (AER 51, example, pages F-32 and F-33) may be kept current.

When the pay item is complete, the quantity shall be marked **final** after the last entry on the quantity book page. (Example, page F-4)

"Evidence of Material Inspection" – An entry must be made in this column each time an entry is made in the quantity column. Evidence of material inspection, as described in the *Manual for Documentation of Airport Materials*, shall be items such as a State of Illinois stamp number, inspection report, plant report, or other information, written or visual, to indicate that the material is satisfactory. Acceptable entries can be found in Section C of this manual. The evidence of inspection required in the *Manual for Documentation of Airport Materials* should be strictly adhered to for both Progress and Final Documentation and must lead to a verifiable source of the information required. All delivery tickets shall be retained in the project files.

Also, the Division's project Statement of Final Materials Certification, which is prepared during project closeout, can be expedited if the inspector would list under "Evidence of Material Inspection" such additional information as: the name of the plant, quarry or manufacturer of the material together with any identifying marks, imprints, or tags on the material. In any case, the name of the producer of the material must either be noted in this column, or cross- referenced in the project files. For example, if evidence of material inspection is noted only as "Approved Source & Tickets," then the producer's name must be noted on the delivery tickets. If the producer's name is not noted on the tickets, then it must be noted with the evidence of material inspection in the Quantity Book.

"Source of Progress Documentation" – Except for Lump Sum, Each, Pair and Calendar Month items, each entry in the Quantity Book must be supported by either progress or final documentation. This column is to be used to cross reference the source document (i.e., IDR

number, Field Book and page number, etc.). The Quantity Book is the start of the audit trail for all information required to support all progress and final payments for each item.

"Source of Documentation for Final Quantity" – Except for Lump Sum, Each, Pair and Calendar Month items, this area must sufficiently identify the source documents which support the final quantity for the subject pay item. This area may also be used to cross-reference to other supporting documentation such as depth checks. **Please note that reference to one location, if possible, greatly simplifies the process**.

FIELD INSPECTION REPORTS/SOURCE DOCUMENTATION

Each inspector is to provide a concise, accurate, daily account of the contractor's work so it may be recorded and furnished to the Resident at the end of each working day. This record is to be completed by the inspector actually doing the inspection for the Resident and filed in the project records. This record may be documented using any of the appropriate documents listed under Final Documentation, page A-20.

Source documentation is required for all quantities of work for which payment will be made. The source document shall contain all information necessary to identify the contractor or subcontractor performing the work, date work was completed, location of work ("Plan Locations" is **not** sufficient), quantity of work completed and depth checks (if required). The document can also be used to record material inspection. The source document shall also contain initials and dates for all parties involved in inspecting and measuring the work and calculating and checking the quantity of work completed. This information may be documented using any of the appropriate documents listed under Final Documentation, page A-20.

INSPECTOR'S DAILY REPORT (IDR) (AER 628)

When an Inspector's Daily Report (IDR) (Example, pages F-7 through F-14) is used to document the work, the completed IDRs shall be kept in chronological order and filed in a binder. If an IDR other than IDOT's AER 628 is used, it must contain all of the same information covered on AER 628. Additionally, **all** data used to arrive at the reported quantities must be shown.

When a field book is used to document a pay item, all quantities for that particular pay item shall be kept in consecutive pages in the field book with page totals, and the field book index kept up to date.

When a calculation file is used to document a pay item, all quantities for a particular pay item shall be kept in consecutive pages and filed in a binder, with pay item number and cross references clearly marked.

When weight tickets are used to document a pay item, all tickets pertaining to that pay item shall be kept separately from other project tickets (i.e. separate envelopes/folders).

FIELD BOOKS

All field books that are to become part of the permanent job records will conform to the following:

1. Field books will be hard cover, bound books.

2. The inside cover must show the complete project designation (job stamp) and the return address for the Division.
3. If more than one field book will be included in the project records, the cover must also show identification (for example, F.B. #1) for cross-referencing purposes. The outside cover shall also show the project designation.
4. Field books shall be indexed. The index (page number reference) must be up to date at all times, and shall contain coded pay item number(s) and description(s) as applicable. (Example, page F-15*)*.

Use of a field book is required for permanent survey records, layout records and cross-sections.

PAVING SUMMARY FORMS

Use of the following forms is **required for each day of paving**:

1. PCC Paving Daily Record AER 2531 *(*Example, pages F-22 - F-23*)*
2. Hot-Mix Asphalt (HMA) Paving Daily Record AER 2529 (Example, pages F-16 - F-21*)*

INITIALS AND DATES

All documents will include the initials of the person(s) who performed each of the tasks involved in inspecting and documenting the work, as well as the date(s) each task was performed. **"Inspected by" (when applicable)**, **"Measured by", "Calculated by" and "Checked by" initials and dates are required,** and must be **hand-written** on all source documentation. Each person will initial his/her own work, except when more than one person performs the same task, one of those persons may also record the initials of each of the other persons involved in that task.

When a document refers to another document, the referencing document does not need to repeat the initials and dates shown on the referenced document.

PLAN QUANTITY ACCEPTANCE (AER 981) Example, page F-24

As stated in Section 90-02, payment to the Contractor will be made only for the actual quantities of work performed and accepted or materials furnished in accordance with the contract. Most final pay quantities will be based directly on measurements and calculations performed by the Resident in the field. However, for a number of pay items, the Method of Measurement specified in the contract documents allows the Division and the Contractor to agree in writing that the plan quantity is accurate and will be used for the final quantity.
The agreement is based on three points:

1. The plans accurately reflect the existing jobsite conditions, insofar as existing conditions will affect the final quantity of the agreed to items,
2. the plan quantity was accurately calculated; and
3. the work will be built to the lines, grades and dimensions shown on the plans, insofar as they pertain to the pay quantity of the agreed to items.

Form AER 981, Agreement on Accuracy of Plan Quantities, is to be used for this agreement. This form lists most of the items in the Specifications for which agreement to contract quantities is permitted. Extra spaces are available on the form for other items allowed by the contract documents. In accordance with the Specifications, this agreement must be in writing for any given item before any work is started which would affect the measurements for that item.

The main purpose of the AER 981 is to save the Resident time in documenting the accuracy of the final quantity paid to the contractor. The AER 981 is an acknowledgment by the Contractor and the Division for certain pay items that the plan quantity is accurate.

Even with the executed AER 981, however, errors are still possible, and the Specifications make two provisions for this. First, if the plans have been altered or some other development arises which calls into question the applicability of the plan quantity, either party has the right to request in writing within 10 days and thereby cause the quantities involved to be measured.

Second, if an error has been discovered after the work has started, then that portion of the quantity which is affected by the error will be measured and the final quantity will be adjusted accordingly. In order for this provision to apply, however, the plans must distinguish where the individual quantities apply. This situation could arise, for example, if the plans indicate the quantity of trench backfill required for each run of storm sewer. If the layout for one of the runs is altered, then the trench backfill would have to be measured for that run only, and the final quantity for trench backfill would be adjusted by the measured difference for that run.

For items agreed to, the source of documentation for final quantity noted in the Quantity Book will be "AER 981." If errors are found or changes are made to the plan quantity after the work has begun on an agreed item, adjustments to the plan quantity must be documented with appropriate measurements. The final pay quantity will then be the agreed plan quantity plus or minus the documented adjustment to the plan quantity. In this case, the source of documentation for final quantity noted in the Quantity Book will be the AER 981, as well as the measurements and calculations used to document the adjustment to plan quantity.

Even though the AER 981 is signed and approved by the Division, the Resident is responsible for administering the agreement correctly. When the Resident cites the AER 981 as the source of documentation for the final quantity, the Resident is stating that the three points mentioned above have been satisfied. The AER 981 is merely an alternate means of documenting the accuracy of final pay quantities; it does not mean that the Resident can ignore the actual quantities of work performed.

As the work progresses on the AER 981 pay items, the Resident shall document how the estimated progress quantities compare to the plan quantities. **It should be noted that the Resident is required to use and document an acceptable method for estimating quantities for progress payments.** If, during construction, the estimated payments are disproportionate to the Contractor's actual progress on the items, then the Resident shall investigate the reason for the discrepancy. Work on the item in question shall cease until the reason for the discrepancy is determined.

For some of the items for which the Specifications allow agreement to contract quantities, such agreement may not be appropriate in all situations. In general the following restrictions apply:

1. Granular backfill, such as PGE, for undercuts must be measured by before and after cross sections. If the plan quantity for excavation includes undercut for PGE, then the excavation quantity may be agreed to only if the plans distinguish the undercut quantity from the rest of the excavation. In this case, the estimated undercut quantity should be noted on the AER 981, and it will be adjusted for the actual measured quantity.
2. If the plans contain both earth and rock excavation, and they are contiguous, plan quantities cannot be accepted for the rock excavation unless the unit prices for earth and rock excavation are the same. Otherwise, it will be necessary for the actual quantity of rock excavation to be determined by before and after cross sections. Then, the previously agreed plan quantity of earth excavation will be adjusted by the measured difference in rock excavation. As with the undercut example above, the plan estimate for rock excavation should be noted on the AER 981.
3. Plan quantity shall not be agreed to for any item for which the unit of measure is TON.

PROGRESS DOCUMENTATION

In order to properly document the quantities shown on partial payment estimates, progress entries in the Quantity Book are required. These daily quantities can be based upon either estimates or final measurements. In either case, progress documentation must be kept on file (preferably on the Inspector's Daily Report or in a field book) to indicate how the quantity was established. Make cross-reference notes in the Progress Documentation Source column of the Quantity Book.

The following guidelines can be used in establishing estimated quantities. Quantities that are estimated should be labeled as such. If a method other than one of those shown below is used to estimate a quantity, the method must be documented, and be clear and reasonable as determined by good engineering practice. **Items that are estimated must be final measured before final payment is made.**

Excavation Pay Items – cubic yards (CY) – Example, pages D-1 & F-9

1. Estimate percentages of plan balance quantities;
2. Upgrade quantities as balance volumes are completed, or
3. Use load counts, when available. Use 80% of struck capacity (see Section D for capacities).
4. Other

Concrete Items – cubic yards (CY)

1. Extract the daily volumes from your computation check file, or
2. Use a reasonable percentage (typically 90%) of actual delivered concrete.
3. Upgrade each completed structural item with the plan Bill-of-Materials quantity.
4. Other

Reinforcement Bars – pound (LB)

1. Establish a LB/CY factor from plan quantities; use it as concrete volumes are placed or as the bars are tied in place.
2. Upgrade each completed structural item with the plan Bill-of-Materials quantity.
3. Other

Pipe Pay Items – linear foot (LF)

1. Count and record pipe sections as installed.
2. Upgrade completed runs with plan quantities.

Length and Area Pay Items – LF, square yard (SY), and square foot (SF)

1. Base computations on paced dimensions.
2. Station to Station staked dimensions.
3. Plan quantity schedules.

Each and Lump Sum Items

If payment is to be made when the item is partially completed, record station or location, date and estimated percentage of completion in the Quantity Book.

Topsoil Excavation and Placement

Since this pay item pertains to that material obtained from within the limits of the airport and is measured in cubic yards in its original position, for progress documentation purposes it may be necessary to pay 50% of the volume computed by method of average end areas in its original position upon completion of the excavation. The remaining 50% of the volume shall be paid after the placing and finishing of the topsoil to the lines, grades, and the minimum thickness shown on the plans.

ITEMS THAT MUST BE FINAL MEASURED

As previously stated, when progress documentation for an item is based on estimates that item must be final measured before final payment is made. While payments for most items can be estimated under some circumstances, some types of work require that final measurements be taken each day. Information needed to determine final quantities for such pay items must be obtained at the time the work is done as it will be difficult or impractical to compute quantities with acceptable accuracy at a later date. Examples: removal items, piling, most weight ticket items, trench backfill, and similar items which, when covered, are impossible to measure later.

USE OF COMPUTERS FOR FINAL DOCUMENTATION

The use of computers to determine final quantities is encouraged especially for excavation quantities, reinforcement bars and area items. If computer printouts are used to support pay item quantities paid, the following information is required for proper documentation:

A. Compiled calculation programs verified and approved for use by the Division
    1. Pay item number, description, and contract number
    2. Printout of the input data, initialed and dated by the person who checked the input
    3. Hard-copy of the results

B. Electronic spreadsheets
    1. Printout of the spreadsheet. The printout must show:
        a. pay item number and description
        b. the input data
        c. description of how the results are calculated (e.g. sample formulas)
        d. calculation results (if applicable)
        e. cross-references to any other referenced documents

2. The hard-copy of the spreadsheet must be initialed and dated by:
   a. the person who prepared the spreadsheet, and
   b. the person who checked the spreadsheet printout or the person who checked the formulas embedded in the spreadsheet. (i.e. “Prepared By:” and either “Checked By” or “Formulas Checked By” initials and dates.)

   In addition, if field measurements are entered directly in the spreadsheet, the printout must include “Measured By” initials and dates.

C. Other programs not verified and approved for use by the Division (i.e. field survey data coupled with the use of CADD software to calculate final quantities). Because the Division has no way of knowing the accuracy of other programs, the following general rules apply:
   1. A record of the original field measurements (if applicable) must be included in the project files;
   2. The measurements, or a computer-interpolated version of the measurements, must be in the same format as would normally be required if the measurement had been recorded manually (e.g. station, offset and elevation for cross-section data, or length and width for rectangular field measurements). In other words, the raw data must be in, or be put in, a format that could be understood by the reviewer;
   3. The program must be identified, including version numbers;
   4. Input data, if entered manually, must be checked;
   5. The preparer may be required to demonstrate that the results are correct. This may be accomplished by manually calculating a sample of the results, under the supervision of the Division;
   6. All other documentation requirements shall apply.

The documentation for each item shall be kept on file and marked with the item number for easy cross reference.

EXTRA WORK (Section 90-05) Example, pages F-25 through F34
(See *Equipment Watch Rental Rate Blue Book at www.equipmentwatch.com*)

Agreed Unit Price Items:
To establish a new unit price item will require a letter of agreement from the Contractor and an answering authorization from the Engineer.

Force Account:
The Engineer must have copies of:

1. Proper authorization by the Division (approval letter).
2. **Daily** copies of Form AER 635, Extra Work Daily Report, prepared by the Resident or Inspector, jointly signed with the contractor, recording labor, equipment, and material used.
3. Contractor's bill. The format should be in accordance with the Specifications and clearly indicate actual costs (with proof) and applicable allowed mark-ups.
4. Balancing authorization (AER 51), with all AER 635 forms and **back-up information attached.**

MATERIAL ALLOWANCE Example, pages F-35 through F-38

Payment may be made for materials such as structural steel on the basis of a material allowance if the Contractor requests payment for materials in storage. (See Article 90-08 of the Specifications).

The pay estimate should be accompanied by Form AER 49, Materials on Hand Affidavit; Form AER 131, Statement of Material on Hand; and material supplier invoices and freight bills.

Before payment can be made to the Contractor we need copies of proof that the Contractor has paid for the material. Rubber stamp "Paid" will not do. To pay the Contractor for the new materials on hand, the pay estimate must be accompanied by AER 49, AER 131, a copy of canceled check or paid invoice signed and dated, and material supplier invoices & freight bills. To adjust for material used as work progresses, submit AER 131 with the pay estimate as backup for remaining material on hand.

MAXIMUM PAYMENT Example, page F-4

Throughout the Specifications there are numerous references to pay items on which final payment cannot be made for more than a maximum percentage over awarded and/or adjusted plan quantity. The following is a listing of Pay Items and the applicable percentage that limits maximum payment. (Generally, maximum payment percentages apply only to those Pay Items paid for on the basis of volume or weight.)

ITEMS WITH "MAXIMUM PAY" PERCENTAGES

EMULSIFIED ASPHALT		GAL	105%
AGGREGATE BASE COURSE		TON	108%
BITUMINOUS CONCRETE BASE COURSE		TON	103%
BITUMINOUS CONCRETE SURFACE COURSE		TON	103%
BITUMINOUS MATERIALS PRIME COAT		GAL	105%
BLOTTER AGGREGATE	(NOT AGGREGATE PRIME COAT)	TON	110%
BITUMINOUS MATERIAL	(COVER & SEAL COATS)	GAL	105%
COVER COAT AGGREGATE		TON	110%
SEAL COAT AGGREGATE		TON	110%
BITUMINOUS MATERIALS	(ROAD MIX OR SEAL COAT)	GAL	105%
GRANULAR EMBANKMENT		TON	108%
POROUS GRANULAR EMBANKMENT		TON	108%

Daily yield checks should be run on these items so that the Contractor can be notified when he/she is exceeding the maximum specified amounts of quantity. The limit of the final amount paid shall be plan quantity plus (or minus) theoretical quantities approved by authorization, multiplied by the above percentage.

YIELD CHECKS

A yield check is a calculation to determine if the correct amount of material was used in the work:

$$\text{Yield (\%)} = \frac{\text{Quantity of material delivered}}{\text{Theoretical quantity required}} \text{ X } 100$$

Frequent yield checks are a good engineering practice, and they may help uncover problems in the work early in the project. Yield checks documented by inspectors provide a timely and valuable source of information to the Resident.

While performing yield checks are highly recommended for all materials used in the work, they are required to be documented for the following items:

Item	Minimum Frequency
HMA Paving	Frequently, each day of paving
PCC Paving	At end of each day of paving

Also, many items include materials for which the contract specifies the application rate of the material. Ensuring the correct application of such a material is an important part of inspecting and approving the pay item work. The Resident's signature on the pay estimate assures the Division that the materials and procedures used were in accordance with the specifications for each pay item paid for on that estimate. Application rates shall be calculated and documented. There must be enough information in the project records that the application rate can be verified if the need arises.

THICKNESS DETERMINATION SCHEDULE

In order to clarify the requirements for thickness determinations, compiled data from the Specifications is summarized in the Thickness Determination Schedule, page A-11. The Schedule refers to the specification section, the minimum frequency for making checks, the source documents for recording the thickness and the method of measurement. It should be pointed out that the minimum checking frequency may not be sufficient to verify plan thickness and should be increased as conditions dictate. There are many time-honored engineering methods for determining thickness; such as, before and after rod and level shots, before and after stringline measurements, direct probe, and measurements of density holes. All are acceptable; however, **blanket statements such as "all sidewalk was 4 inches or deeper" and "all patches were 9 inches" are NOT acceptable. Actual measurements must be recorded**. In addition, some items such as full-depth HMA and PCC pavement may require that cores will be taken and measured.

Thickness deficiencies identified by the Resident during construction should immediately be brought to the attention of the Contractor and corrective actions taken. Thickness deficiencies identified during or after placement will be confirmed by coring and will require adjusted prices or removal and replacement in accordance with the Specifications. Large contract deductions or removals are the Division's last resort; therefore, attention to detail including thickness is very important during construction.

The schedule also includes miscellaneous items marked "All Others." This category covers the many square foot, square yard, and linear foot items. Control and documentation of the depth of these items is also very important and should be handled in the same manner as all other items listed.

The location (station and offset etc.) of each thickness measurement should be clearly noted on the source document. The location of the source document, whether it is field books or IDRs, must be clearly indexed and referenced through the Quantity Book.

Thickness determinations are a Division policy requirement. The use of proper procedures for thickness determinations will significantly reduce the chances for unacceptable work.

Type of Construction	Section Preference	Minimum Frequency	Document Record	Method of Measurement
BASE COURSES				
Agg. Base Course	208/209	1 per 1500 SY	F.B., IDR	1/
Bit. Base Course	403	1 per 350 SY *	F.B., IDR, AER 2529	1/, 3/
Soil Cement	155	1 per 1350 SY	F.B., IDR	1/
SUBBASES				
Subbase Gran Material	**	1 per 1350 SY	F.B., IDR	1/
Bit. Aggregate Mixture	**	1 per 350 SY	F.B., IDR	1/, 10/
Cement Agg. Mixture	**	1 per 350 SY	F.B., IDR	1/, 9/
Pozzolanic Agg. Mixture	**	1 per 350 SY	F.B., IDR	1/, 9/
Cement Agg. Mixture II	**	1 per 350 SY	F.B., IDR	1/, 9/
PAVEMENT & SURFACE COURSES				
Agg. Surface Course	402.06 **	1 per 1350 SY	F.B., IDR	1/
PCC Pavement	501	1 per 350 SY *	F.B., IDR, AER 2531	1/, 4/, 5/
Bit. Concrete Full Depth	401/403	1 per 350 SY *	F.B., IDR, AER 2529	1/, 5/
Porous Friction Course	402	1 per 3000 SY *	F.B., IDR, AER 2529	1/, 5/
ALL OTHERS				
PCC Sidewalk	501	1 per 1000 SF	F.B., IDR	1/
PCC Curb, Gutter, Combination Curb & Gutter	754	1 per 250 LF	F.B., IDR	1/, 11/
PCC Paved Ditch	754	1 per 250 LF	F.B., IDR	1/
Top Soil	905	1 per 2500 SY	F.B., IDR	12/
Lime Treated Subgrade	155	1 per 2000 SY or min. 2 per day	F.B., IDR	13/

Note: Thickness check shall include the entire typical cross section at the locations designated.

* This does not pertain to bituminous leveling courses. Cores may be required:
In addition to making field thickness measurements, the Construction and Materials Section may require cores to be cut and independent measurements be made. The core results will be the basis for adjustment in unit prices for deficient pavement.

** If specified, follow Specifications for that item.

Note: For items using aggregate of class RR3 or larger, the Resident has the option of documenting either depth checks or yield checks. Documenting depth checks is not required for removal-only items.

1/ Thickness determinations shall be documented by before and after cross sections or before and after measurements from an established reference elevation such as a stringline, form line or edge of pavement.

2/ Intentionally left blank

3/ Thickness determinations will be made during and after placement of the material and recorded at the frequency shown in this table. Thin base course, as determined by core measurements, will require an adjustment in the contract unit price.

4/ Thickness determinations shall be made during (in the plastic state) and after placement of the material and recorded at the frequency shown in this table. Thin pavement, as determined by core measurements, will require an adjustment in the contract unit price.

5/ Thickness determinations shall be made after placement of the top lift of bituminous surface course and after placement of the surface course as a minimum requirement. Thickness determinations shall be made at intermediate lifts of the bituminous surface course as required to maintain control of the placement operation. All thickness checks shall be recorded at the frequency shown in this table. Thin pavement, as determined by core measurements, will require an adjustment in the contract unit price.

6/ Intentionally left blank

7/ Intentionally left blank

8/ Intentionally left blank

9/ Thickness determinations shall be made during and after placement of the material and recorded at the frequency shown in this table. Subbase areas less than 90% of the plan nominal thickness shall be brought to the nominal thickness by increasing the thickness of the PCC pavement or by removal and replacement with new mixture. When continuously reinforced concrete pavement is to be constructed, correction shall be removal and replacement only. However, the surface elevation of the completed subbase shall not exceed the surface elevation shown on the plans or established by the Engineer by more than 3/16 in.

10/ Thickness determinations shall be made during and after placement of the material and recorded at the frequency shown in this table. Subbase areas less than 90% of the plan nominal thickness shall be brought to the nominal thickness by increasing the thickness of the PCC pavement, by placing additional bituminous aggregate mixture or by removal and replacement with new mixture. The surface elevation of the completed subbase shall not exceed the surface elevation shown on the plans or established by the Engineer by more than 3/16 in.

11/ Thickness may be determined at the edge of pavement, back of curb, slipform template, or any other location at which the thickness of the item can be verified.

12/ Thickness determinations shall be documented by before and after cross sections or before and after measurements from an established reference elevation such as a stringline, form line or edge of pavement or by measuring the depth in a hole dug in the completed work.

13/ Thickness shall be verified at the start of the operation through continuous monitoring and communication with the Contractor. Once the specified processing thickness is obtained, it shall be frequently checked. Physical confirmation/observation of thickness and the presence of lime is required at the frequency shown in the table (e.g., test pits, Shelby tubes, etc.).

DOCUMENTATION OF PAY QUANTITIES BASED ON WEIGHT TICKETS

Pay quantities established based on truck weight tickets are not directly measured by Division representatives. For this reason, the following steps are taken to ensure that the quantities shown on the weight ticket are accurate:

1. The total weight of a truck cannot be obtained by adding separate axle weighings (see Obtaining Tare and Gross Weights of Trucks below).
2. The scale must be checked by the Department of Agriculture (DOA). Permanent scales are to be checked every 12 months and temporary scales are to be checked at each setup. A check by a DOA-approved commercial scale company will be acceptable if the DOA is unable to provide a current inspection. The date on the decal, identification number on the decal and location of the scale shall be recorded in the Quantity Book (example, page F-5). **No payment is to be made for items measured on an unapproved scale.**
3. A representative is to be at the scale to witness the weighings and initial the tickets. This requirement may be waived under certain conditions (see Daily Tare Weights, Automatic Ticket Printers, Weekly Independent Weight Checks, and Small Quantities).
4. Every effort should be made to personally collect and initial all delivery tickets for tonnage pay items, however, the inspector is only to initial those tickets that he/she personally collects. A memorandum shall be written to the contract file explaining why the inspector was not present in witnessing the delivery of the material. A daily yield check shall be conducted to justify the total amount placed.

For certain materials, a correction factor is to be applied to the pay quantity shown on the tickets (see Aggregate Moisture Correction and Agricultural Ground Limestone Correction).

For Bituminous Prime/Tack Coat (paid as Gallons calculated from weight tickets), use the calculation on page B-1. Supplier ticket densities (lbs/gal) are often calculated with a weight of water different than what is acceptable to the Division.

Obtaining Tare and Gross Weights of Trucks

All materials, which are paid for on the basis of truck weights, shall be weighed in accordance with the following procedure. Reference for this procedure is the Illinois Weights and Measures Act, which refers to the National Bureau of Standards Handbook 44.

"A vehicle or a coupled vehicle combination shall be commercially weighed on a vehicle scale only as a single draft. That is, the total weight of such a vehicle or combination shall not be determined by adding together the results obtained by separately and not simultaneously weighing each end of such vehicle or individual elements of such coupled combination. However:

1. the weight of a coupled combination may be determined by uncoupling the various elements (tractor, semitrailer, trailer), weighing each unit separately as a single draft, and adding together the results, or
2. the weight of a vehicle or coupled-vehicle combination may be determined by adding together the weights obtained while all individual elements are resting simultaneously on more than one scale platform."

Daily Tare Weights Example, page F-39

To determine the pay weight of material delivered by truck, both gross and tare weights must be measured. Ordinarily, both measurements are to be witnessed by a representative of the Division. Frequently, however, the contractor's or supplier's loading operations make weighing each truck twice burdensome. For this reason, the Division permits the tare weights of each truck to be measured a minimum of once each day, and the measured tare weight of each is then to be used for the remainder of the day.

When daily tare weights are used, the inspector is to witness and record the tare weights for each truck used in that day's supply operation. The inspector's record must identify each truck, the tare weight of the truck, and whether the driver was in the truck during the measurement. Form AER 1465, Truck Tare Weights, is available for this use. (See Small Quantities and Automatic Ticket Printers)

Weight Checks

A weight check is a comparison of the net weight of material shown on the delivery ticket to the net weight measured on another scale. The purpose of a weight check is to give some assurance that the amount of material paid for, as shown on the delivery tickets, is the amount of material delivered to the job site.

For HMA tonnage items, contractors determine the shipping weight either by direct weighing or by using the nominal batch weights. The Specifications require that scales used to measure HMA be equipped with automatic printers. For batch plants the Specifications also allow the use of the batch weights, instead of direct scale measurement, when surge or storage bins are not used. There are three types of weight checks described in the following sections, one for weekly Independent Weight Checks, and two types (which should be alternated) for ticket weights determined from batch weights. All three types require re-weighing the net weight of the material on the selected truck. The difference between them is the source of the weight for comparison with the independent scales.

QC Checks by Contractor

On contracts having HMA pay items, the contractor is also required to perform scale checks and independent weight checks as part of the QC process. Scale checks performed by the contractor are for the purpose of ensuring the accuracy of the scale equipment. The procedures used by the contractor are the same as used by state representatives for performing the three types of weight checks described in the section above, except the contractor may use the approved platform scales at the plant site or a commercial scale approved by the Engineer. The plant scale must not be the scale used for the original measurement, but may be owned or controlled by the contractor or material supplier. QC checks performed by the contractor do not satisfy the requirement for independent weight checks to be performed by consultant personnel.

Automatic Ticket Printers

An automatic ticket printer is defined as follows:

The automatic printer shall be an integral part of the scale equipment or the scale and printer shall be directly connected in a manner that will prohibit the manual entry of weights except as provided in 1. below.

1. If the platform scale equipment measures gross weight, the printer will record the gross weight as a minimum. Tare and net weights shall be shown on weight tickets and may be printed automatically or entered manually.
2. If scale equipment on a platform scale zeroes out the truck tare automatically, the printer shall record the net weight as a minimum.
3. If the scale equipment on a surge bin weigh hopper zeroes automatically after discharging each batch, the printer shall record the net weight as a minimum.
4. If the scale equipment on surge bins automatically shuts down the feed system and weighs the amount in the silo before and after discharge, the printer shall record the net weight as a minimum.

For any weights recorded by an automatic ticket printer, no inspector will be required to witness the weighing and initial the ticket at the scale location. If tare weights or net weights are not automatically measured, then an inspector must still witness and record the tare weights (see Daily Tare Weights).

Weekly Independent Weight Checks (AER 2367) Example, page F-40

A weekly random check, regardless of project duration, must be performed by a consultant representative to verify the actual weight of material delivered. Independent weight checks are to be performed as follows:

1. The check weights will be measured on an independent, approved platform scale other than the scale on which the original measurement is performed and not owned or controlled by the contractor or material supplier. The independent scale must be approved, and the DOA decal information is to be recorded in the Quantity Book.
2. Trucks are to be selected after leaving the plant, preferably at the paving location. Inspections should be unannounced and randomly scheduled. Under no circumstances should the inspector report to the plant and request a truck be loaded for an independent weight check.
3. Gross and tare weights must be measured and recorded, so that the actual net weight of material can be determined. The Consultant shall ensure the independent scale has been zeroed prior to determining both the gross and tare weights.
4. The independently measured net weight must agree with the weight shown on the tickets within a tolerance of 0.50 percent (0.70 percent for aggregate):

$$\text{Tolerance (\%)} = \frac{\text{(delivery ticket net weight – weight check net weight)}}{\text{weight check net weight}} \text{ X } 100$$

5. The independent weight check results are to be recorded and placed in the job file available for inspection, with corrective action taken for deviations from tolerance noted. See Section 90-01 of the Specifications.
6. Independent weight checks must be performed at least once per week per scale (this includes any scale and batch weights) when any item is placed for which payment is based on weight tickets. If the same scale is used for several contracts during the week, a weight check performed for any one of the contracts will be sufficient for all of the contracts, as long as a copy of the check is included in the records for each of the projects. (See Small Quantities)
7. The contractor must respond to the Engineer, in writing, within 7 calendar days as to the cause and correction of the deficient scale.

Note:

1. The DOA performs maintenance checks of scales that have current decals. If a scale is still legal, but needs adjustment, the DOA puts a blue tag on the scale. If the scale is too far out of adjustment, the scale is not usable. Do not use either of these scales as an Independent Check scale.
2. The Office of Quality Compliance and Review (OQCR) is conducting random weight checks utilizing portable scales. These weight checks do not satisfy the Weekly Independent Weight Check requirement outlined above. If the difference between the weights shown on the delivery ticket and the weights determined by the portable scales exceed the level of assurance established by the OQCR, the Resident will be notified by the OQCR to initiate an additional random independent weight check. The notification will specify the period of time and/or other criteria which should be followed by the Resident.

Documentation for Payment of Hot-Mix Asphalt Based on Batch Weights

The Specifications provide for measurement of the mixtures by either weighing the mixtures on approved platform scales or on the basis of plant batch weights. When measured on the basis of plant batch weights, occasional checks shall be made by weighing full truckloads of the mixture on the approved platform scale at the plant site, or on a commercial scale approved by the Engineer. This check serves two purposes:

1. To check the accuracy of the scales, either batch, surge bin or the platform scales; or
2. The accuracy of batching the mixture.

The frequency of check weighing shall be a minimum of one per week; however, when the plant is in continuous daily operation, the frequency preferably should be one per day.

The accuracy of the scales should be checked by observing the actual scale weight of the batches produced and comparing the total with the net weight of a truck load from the platform scale. Variation between these weights of more than 0.5 percent would indicate the batch scales or the platform scales should be checked by DOA.

Scale Accuracy Check (0.5% Tolerance)

1.	Tare a truck on an approved platform scale	1500 LB
2.	As you observe the scale dial stopping on or near the present scale face marker, record the <u>actual</u> accumulative aggregate weight. Add in the mineral filler and paving asphalt weights.	3,979.0 3,981.0 4,129.0 3,979.0 4,108.0 <u>4,113.0</u> 24,289 LB
3.	Gross the truck on the platform scale.	39,401 LB

$$\text{Tolerance } 0.5\% = \frac{\text{net wt. } (3-1) - \text{summation of weighed batches}}{\text{net wt. } (3-1)} \times 100$$

$$= \frac{24{,}401 - 24{,}289}{24{,}401} \times 100$$

$$= 0.46\% \text{ O.K.}$$

The accuracy of batching the mixture should be randomly checked with the batch weights compared to the platform scales. The results, with an allowance for accuracy in weighing, should be checked within 0.5 percent of the gross load on the platform scale. If batch weights vary more than 0.5 percent, the batch scales should be recalibrated.

Batching Accuracy Check (0.5% Tolerance)

1. On an approved platform scale weigh a random truck after it has been loaded. 37,840.0 LB
2. Empty it on the job.
3. Tare the returning truck on the platform scale. 14,191.0 LB
   Actual net weight = 23,649.0 LB
4. Record the load ticket. 23,999.0 LB

$$\text{Tolerance } 0.5\% = \frac{\text{load ticket (4)} - \text{actual net weight } (1-3)}{\text{actual net weight}} \times 100$$

$$= \frac{23{,}999 - 23{,}649}{23{,}649} \times 100 = 1.48\% \text{ recheck and/or recalibrate}$$

The Specifications also require the batch scales to be calibrated at the beginning of each construction season and at other times as deemed necessary by the Engineer. The accuracy certification will be by DOA.

The calibration and check weighing results are to be recorded and placed in the job file available for inspection with corrective action taken for deviations from tolerance noted.

Each of the above checks can be run on alternate occasions. Report these accuracy checks on Independent Truck Weight Check Form AER 2367. Results shall be placed in the job file.

Aggregate Moisture Correction

To correct the scale weight of 208/209 aggregate items, where a moisture deduction is applicable, the following formulas shall be used:

$$\text{actual moisture} = \frac{(\text{wet weight of sample}) - (\text{dry weight of sample})}{(\text{dry weight of sample})}$$

$$\text{pay weight} = \frac{(\text{scale weight}) \times (1 + \text{allowable moisture})}{(1 + \text{actual moisture})}$$

Samples shall be taken/tested on a daily basis (exception, see Small Quantities).

Note: Actual moisture content test results shall be rounded to the nearest 0.1%.

Agricultural Ground Limestone Correction

The pay weight for Agricultural Ground Limestone is to be adjusted using a source correction factor for the source of the agricultural limestone. This correction factor is located on the DOA's website at www.agr.state.il.us/news/pub/Limestonebooklet.html.

The adjusted pay weight is to be calculated as follows:

adjusted pay weight = (ticket weight) / (4 year source correction factor)

Small Quantities

Witnessing the weighing and initialing of weight tickets at the scale site for materials paid on the basis of weight tickets shall have a high priority. However, due to logistics between sources and jobsites, small quantities may be accepted providing the receiving inspector is satisfied that prior to accepting the material the weight appears satisfactory.

Limits on accepting the Contractor's or Supplier's weight tickets in accordance with this section are as follows:

1. Aggregates - Not to exceed approximately 500 tons per day.
2. Hot-Mix Asphalt - Should not exceed 250 tons per day.
3. Bituminous materials – not to exceed approximately 4 tons or 1000 gallons per day.
4. Other materials consistent with this section.

Unlimited quantities for the following items:

1. Fertilizer Nutrients
2. Calcium Chloride
3. Hydrated lime for lime stabilized soil
4. Agricultural ground limestone

In the case the above conditions are met, the following applies:

1. No inspector will be required to be present at the scale to witness the weighing and initial the tickets.
2. No inspector will be required to witness and record tare weights for that day (if otherwise applicable).
3. No independent weight checks (if otherwise applicable) will be required as a result of that day's delivery of material.
4. No moisture determination will be required (if otherwise applicable) for that day.

Individual Load Ticket Waiver for Recycled Aggregates Paid on Square Yard or Cubic Yard Basis

When recycled PCC or bituminous concrete is allowed for use in lieu of virgin aggregate for a square yard or cubic yard pay item and the material is crushed/milled, graded and properly tested, the requirement for individual load tickets can be waived. Instead, the Contractor can provide a daily tabulation of each truck used to provide this material. This tabulation will contain,

at a minimum, the truck number, struck capacity (volume calculation), number of loads delivered for each vehicle and the total calculated volume for the day. Eighty percent of this calculated volume can then be used for yield check determinations.

Progress documentation quantities should also use 80% of the daily volume determined above for estimating cubic yard items. Station to station length times the average width calculation can be used for estimating square yard items. Depth check measurements and documentation are still required. Final documentation of the quantity will consist of field measurements and calculations or Agreement on Accuracy of Plan Quantities using Form AER 981. Verbal approval by the Construction and Materials Engineer, properly documented in the diary and quantity book, is evidence of material inspection for progress payments. Final Evidence of Material Inspection should be noted in the quantity book as “Material and gradation approved by Construction and Materials Engineer”. Copies of gradation testing data must be in the Resident’s final job records.

ROUNDING

Rounding with whole numbers: The rounding digit is defined as follows: When asked to round to the closest tens - the rounding digit is the second number to the left (ten's place). When asked to round to the nearest hundred - the third place from the left (hundreds place) is the rounding digit.

Rule 1. Determine what your rounding digit is and look to the right side of it. If the digit is 0, 1, 2, 3 or 4 do not change the rounding digit. All digits that are on the right hand side of the requested rounding digit will become 0.

Rule 2. Determine what your rounding digit is and look to the right of it. If the digit is 5, 6, 7, 8 or 9, your rounding digit rounds up by one number. All digits that are on the right hand side of the requested rounding digit will become 0.

Rounding with decimals: When rounding numbers involving decimals, the following apply:

Rule 1. Determine what the rounding digit is and look to the right side of it. If that digit is 4, 3, 2 or 1, simply drop all digits to the right of it.

Rule 2. Determine what the rounding digit is and look to the right side of it. If that digit is 5, 6, 7, 8 or 9, add one to the rounding digit and drop all digits to the right of it.

FINAL DOCUMENTATION

The final quantity for all items appearing in the Quantity Book must be cross-referenced to one of the following which will serve as documentation and which will show measurements and calculations used in determining the final quantity.

Note: Calendar Month, Each, Pair, and Lump Sum items entered directly into the Quantity Book will not require a cross reference but these items will require a cross- reference if documented on a source document other than the Quantity Book.

1. Field measurement books. (hardback only)
2. Inspector's Daily Report if identified as a "final field measurement."

3. Cross-section paper for cross-sections only.
4. Weight tickets bound and summarized by means of an adding machine tape. Example, page F-41.
5. Project diary for calendar month or calendar day items.
6. Calculation files for such items as concrete structures and reinforcement bars.
7. Agreement on Accuracy of Plan Quantity, AER 981.
8. Force account file with Extra Work Daily Report, AER 635, and contractor's invoice.
9. Built According to Standard #_____
10. Computer printout.

The cross-referenced note(s) for final measurements and calculations shall be placed at the bottom of the Quantity Book page, and should be made only to the document(s) containing the information used in obtaining the final quantity. On items requiring depth checks, the final source of documentation in the quantity book shall include a reference to the depth check documentation location.

All calculations made to determine final pay quantities must be checked by someone other than the preparer.

All documents in the project files must be identified with the project designation (contract number or job stamp), except that documents identified above (Quantity Book, project diary and field books) and any document circulated outside the field office must contain the complete project designation (job stamp).

In addition, if an individual document includes more than one (loose-leaf) page, then each page should indicate that it belongs to the same document. This could be indicated, for example, by noting such information as the date, IDR number or “page __ of __.”

DOCUMENTATION REVIEW BY THE DIVISION

The Division of Aeronautics is responsible for conducting both progress and final documentation reviews of airport contracts. The final documentation review will take place after the completion of a project. The Engineer of Construction and Materials or an appointed representative will examine randomly selected airport construction contracts for both progress and final documentation in accordance with the Standard Specifications for Construction of Airports, this manual, and all other pertinent contract documents.

A detailed audit record will be reported on Form AER 1013 for progress documentation reviews and on Form AER 1014 for final documentation reviews.

Residents are to address all noted major deficiencies within 14 days on a progress review and within 30 days on a final review. The Resident shall notify the Engineer of Construction and Materials by letter indicating when all deficiencies have been corrected, describing specifically how each deficiency was corrected.

In addition, project audits for both Progress and Final Documentation may be conducted by additional State and/or Federal Agencies.

Section B

FINAL DOCUMENTATION REQUIREMENTS

BY PAY UNIT

The following is a general breakdown of most pay units showing the degree of accuracy for measuring each and information required for documenting each. It is acceptable to leave final quantities to the same accuracy as the daily quantities.

PAY UNIT	ACCURACY OF MEASUREMENT	REQUIRED DOCUMENTATION
Acre *Seeding & Mulching* *page F-7*	1. Summation of **final** quantity to the nearest **0.01** acre.	1. Field measurements used to calculate the final quantity Area (acre) = $\frac{\text{L (ft) x W (ft)}}{43{,}560}$ 2. Form AER 981 (where applicable)
Calendar Month	1. Monthly or fraction thereof. 2. Summation of **final** quantity to the nearest **0.5** month.	1. Project Diary entry or Quantity Book entry on the date the office or lab is ready for use, and 2. Monthly entries in the Quantity Book, and 3. Quantity Book or Project Diary entry on the date the Contractor was notified the office or lab would no longer be needed.
Cubic Yard *Trench Backfill* *page F-8* *Unclassified Ex* *page F-9*	1. **Final** quantity of <u>concrete</u> rounded to Nearest **0.1** cubic yard. * 2. All other items measured to the nearest **0.1** cubic yard **daily** and the **final** quantity summarized to the nearest cubic **yard***. * Note: Individual dimensions shall be Measured to the nearest 0.01 ft.	1. Field measurements used to calculate the final quantity or the statement "built to plan dimensions" when they are used to calculate the final quantity, along with calculations. OR "Built according to Standard ____" statement. OR Form AER 981 (where applicable) with calculations for daily estimates. 2. Depth checks (where applicable).
Each, Pair or Lump Sum *Eng. Field Office* *page F-10*	1. Each, Pair	1. Recorded by Station or location and date in the Quantity Book.
Gallon *Prime Coat* *page F-11*	1. Summation of **final** quantity to nearest **gallon**.	1. Calculations based upon initialed weight tickets and Specific Gravity corrected to 60 F, which is given on the shipping or storage ticket. Vol (gallon) = $\frac{\text{net wt. (lbs)}}{8.328 \text{ x Sp. Gr.}}$ or 2. Volumetric meter ticket, if the ticket contains proper information in accordance with the Specifications. 3. Record of the DOA decal date, I.D. number, and scale location.

PAY UNIT	ACCURACY OF MEASUREMENT	REQUIRED DOCUMENTATION
Linear Foot *RCP* *page F-8*	1. **Each** run measured to the nearest **0.1** ft. 2. Summation of final quantity to nearest foot.	1. Field measurements. 2. Depth checks (where applicable).
Pound	1. Summation of **final** quantity to nearest **pound**.	1. Calculations based on Bill-of-Materials. OR Weight tickets or bag counts, accompanied by conversion calculations (Fertilizer Nutrients). OR Form AER 981 (where applicable)
Square Foot or Square Yard *PCC Sidewalk* *page F-12* *Pavement Milling* *page F-13*	1. **Individual** areas measured to the nearest **0.1** sq. ft. or **0.1** sq. yd. * 2. Summation of **final** quantity to nearest **ton** except where otherwise shown. * Note: <u>Individual</u> dimensions shall be measured to the nearest <u>0.01 ft.</u>	1. Field measurements used to calculate the final quantity or the statement, "built to plan dimensions" when they are used to calculate the final quantity, along with calculations. OR Form AER 981 (where applicable) 2. Depth checks (if applicable). 3. Yield checks (if applicable).
Ton *Turfing Lime* *page F-14*	1. Nearest **0.1** tons **daily**. 2. Summation of **final** quantity to nearest **ton** except where otherwise shown.	1. Weight tickets showing the material, date and weight, and 2. Daily tare weights on each truck recorded and retained (see "Small Quantities"), and 3. Daily adding machine tape showing: job designation, pay item, date, location, net weight and pay weight corrected for moisture and/or 4-year lime conversion factor, if required, with "Calc By:" and "Checked By:" initials and dates, and 4. Record of the Department of Agriculture decal date and identification number in the Quantity Book or a record of a DOA-approved commercial scale company, and 5. Scale check for HMA batch plants or when automatic printer tickets are used in lieu of scale inspector, and 6. Tickets shall have the jobsite and scale inspector's initials on them. Scale inspector's initials are not needed for small quantities (see "Small Quantities").

PAY UNIT	ACCURACY OF MEASUREMENT	REQUIRED DOCUMENTATION
Unit Diameter	1. Summation of **final** quantity to nearest **unit diameter**.	1. If a tree tape was used, make a note of this with your field measurements. If a tree tape was not used, the actual field measurements must be shown along with calculations for the appropriate Unit Diameter. Unit Dia. = circumference (in.) / (English) Π (Note: Π = 3.1416) and 2. Calculations

Section C

FINAL DOCUMENTATION REQUIREMENTS

BY PAY ITEM

EVIDENCE OF MATERIAL INSPECTION

Much of the material delivered to a typical construction project has been pre-inspected or may have been produced under a Department-approved Quality Control program.
Evidence of Materials Inspection is the minimum proof that Method of Acceptance sampling and testing has been performed. Note that in addition to this, all manufactured items must have verification of compliance with the Buy American Act. Evidence of Materials Inspection categories are listed below.

1. CERT (CERT) – Manufacturer's written certification that indicates material complies with the specifications or contract.
2. ILL OK (IL OK, ILOK) – Material is stamped by an IDOT Inspector with an "IL OK" stamp indicating prior inspection and acceptance. An inspection tag may be used as Evidence of Materials Inspection and approval.
3. LA 15 (LA15) – This Department form is a supplier's certification indicating material is from approved stock. The form is sometimes used as a Bill of Lading to indicate prior approval. The form should include supplier, proper contract/job designation, material description, manufacturer, specific approved material (test ID number, lots, or batches), and quantity.
4. LIST (LIST) – The material appears on a current list of Department-approved products or approved sources found at the Department's web site, www.dot.il.gov, under "Doing Business/Materials". Contact the inspecting Highway District's Materials Office for information on aggregates.
5. TEST (TEST) – Approved test result available via the MISTIC system or from locally performed lab or field tests (e.g., soil density).
6. TICKET (TICK) – A ticket from an approved source indicating Department material or aggregate gradation, job designation, purchaser, and weight (if applicable).
7. VISUAL (VIS) – A Resident memo denoting visual inspection is required in the project file, and input into MISTIC is required.
8. N/A or "None" when no materials are involved. (i.e. Engineers Field Office, and removal items)

NOTE: The following elements are required for evidence of material inspection for both Portland Cement Concrete and HMA mixtures:

1. Plant Approval,
2. Approved Mix Design, and
3. Plant Production Adequately Monitored.

The Resident shall have the Plant approval letter, Job Mix Formula (JMF) and JMF Mix Design approval letter, and applicable reports consistent with the Manual for the Documentation of Airport Materials on file in order to substantiate the evidence of material inspection requirements.

SECTION	ITEM	PAY UNIT	REQUIRED DOCUMENTATION	*EVIDENCE OF MATERIAL INSPECTION
101	Airport Rotating Beacons	Each	Station Locations	Approved Shop Drawings
103	Beacon Towers	Each	Station Locations	Approved Shop Drawings
106	Light Poles, Light Fixtures	Each	Station Locations	Approved Shop Drawings
107	Airport Wind Cones	Each	Station Locations	Approved Shop Drawings
108	Installation of Underground Cable for Airports	Foot	• Field Measurements • Station to Station groupings listing individual measurements.	Approved Shop Drawings
109	Airport Electrical Vault and Vault Equipment	Each L.S.	Station Locations	Approved Shop Drawings
110	Installation of Airport Underground Electrical Duct	Foot	• Field Measurements • Station Locations	Approved Shop Drawings
119	Airport Obstruction Light	Each	Station Locations	Approved Shop Drawings
125	Airport Lighting Systems, Signs	Each	Station Locations	Approved Shop Drawings
151	Tree Clearing	Each	• Field Measurements • Station to Station groupings listing individual measurements. • Tree tape or computations. If a tree tape is used it must be indicated.	N/A or None
151	Clearing & Grubbing	Acre	• Form AER 981, or • Measurements and calculations based on the horizontal area within the limits specified on the plans or by the Engineer.	N/A or None
152	Unclassified Excavation	CY	• From AER 981, or • Before and after cross-sections and calculations.	N/A or None

SECTION	ITEM	PAY UNIT	REQUIRED DOCUMENTATION	*EVIDENCE OF MATERIAL INSPECTION
152	Solid Rock Excavation	CY	• Before and after cross-sections and calculations, or • When the unit prices of Rock Excavation and Earth Excavation are identical, authorized approval can be obtained for a Plan Quantity Agreement for both, Form AER 981.	N/A or None
152	Common Excavation	CY	• From AER 981, or • Before and after cross-sections and calculations.	N/A or None
152	Borrow Excavation	CY	Before and after cross-sections and calculations.	Soil from off Airport: Letter of approval from Construction & Materials Engineer; Gradation Analysis
152	Geotechnical Fabric for Ground Stabilization	SY	In-place measurements and calculations.	CERT
152	Exploration Trench	Foot	• In-place measurements of the open trench. • Depth checks.	N/A or None
155	Lime	Ton	• Weight tickets initialed at jobsite. • Daily tabulated weight totals on calculator tape. • Platform scale tickets used in weight checks.	Approved source and TICK
155	Soil Processing	SY	• Form AER 981, or • In-place measurements and calculations. Width not to exceed plan dimensions. • Depth checks.	Soil density reports, TEST

SECTION	ITEM	PAY UNIT	REQUIRED DOCUMENTATION	*EVIDENCE OF MATERIAL INSPECTION
156	Erosion Control	LS, Foot, Each, SY	In-place measurements and, if appropriate, calculations.	Approved source or CERT
161 / 162	Temporary Fencing	Foot	In-place field measurements.	N/A or None
161	Woven Wire Fence	LF	In-place measurements along fence from outside to outside of end posts, excluding the length occupied by gates.	ILL Tag or LA15 100% domestic steel origin
161 / 162	Gates	Each	Field measured and counted for each size and type.	ILL Tag or LA15 100% domestic steel origin
162	Chain Link Fence	LF	In-place measurements along fence outside to outside of end posts, excluding the length occupied by gates.	ILL Tag or LA15 100% domestic steel origin
208	Porous Granular Embankment	Ton	• Weight tickets with moisture correction. • 108% maximum pay.	Approved source & TICK Density Reports
208	Porous Granular Embankment	CY	Before and after cross-sections and calculations	Approved source & TICK Density Reports
208 / 209	Aggregate Base Course	Ton	• Weight tickets with moisture correction, if required. • 108% maximum pay. • Surface variation tests.	Approved source & TICK Density Reports
208 / 209	Aggregate Base Course	SY	• Form AER 981 • In-place surface measurements and calculations. Width not to exceed plan dimensions. • Depth checks. • Surface variation tests.	Approved source & TICK Density Reports

SECTION	ITEM	PAY UNIT	REQUIRED DOCUMENTATION	*EVIDENCE OF MATERIAL INSPECTION
209	Aggregate Shoulders	SY	• In-place surface measurements and calculations. Width not to exceed plan dimensions. • Depth checks.	Approved source & TICK Density Reports
217	Aggregate-Turf Pavement	SY	• Form AER 981. or • In-place surface measurements and calculations. Width not to exceed plan dimensions. • Depth checks.	Approved source & TICK Density Reports
401	Bituminous Pavement Grooving	SY, SF	• Form AER 981, or • In-place surface measurements and calculations.	N/A or None
401 / 402 / 403	Mix for Cracks & Joints & Bituminous Base Course & Bituminous Concrete Surface Course & Porous Friction Course	Ton	For all Plants: • Weight tickets initialed at jobsite. • Daily tabulated weight totals on calculator tape. • Platform scale tickets used in weight checks. • Dept. of Agriculture decal information, for platform, surge bin and surge bin hopper scales used. • 103% maximum pay. • Paving Summary (Form AER 2529) • Surface variation tests.	Plant report and Tickets (QC/QA), or Approved plant, Approved mix design and Plant adequately monitored Acceptance testing via cores or nuclear density Check sample test(s)

SECTION	ITEM	PAY UNIT	REQUIRED DOCUMENTATION	*EVIDENCE OF MATERIAL INSPECTION
403	Stabilized Subbase	Ton	For all Plants: • Weight tickets initialed at jobsite. • Daily tabulated weight totals on calculator tape. • Platform scale tickets used in weight checks. • Dept. of Agriculture decal information, for platform, surge bin and surge bin hopper scales used. • 103% maximum pay.	Plant report and Tickets (QC/QA), or Approved plant, Approved mix design and Plant adequately monitored Acceptance testing via nuclear density testing
501	PCC Pavement	SY	In-place surface measurements and calculations. Width not to exceed plan dimensions. Depth checks. Paving Summary (Form AER 2531)	Plant report and Tickets (QC/QA), or Approved plant, Approved mix design and Plant adequately monitored. Acceptance testing CERT for: Rebar, Dowels, Expansion Joint, Chemical Adhesive
501	PCC Pavement Grooving	SY, SF	• Form AER 981, or • In-place surface measurements and calculations.	N/A or None
501	Concrete Removal	CY	Field measurements and calculations	N/A or None

SECTION	ITEM	PAY UNIT	REQUIRED DOCUMENTATION	*EVIDENCE OF MATERIAL INSPECTION
602 / 603 / 800	Bituminous Materials Prime Coat Bituminous Tack Coat Emulsified Asphalt	Gal	• Weight tickets and calculations, or • DOA-approved meter tickets corrected for temp. Not truck distributor meter. • 105% maximum pay.	Bill of lading from certified source, or LIST and Bill of lading
609	Bituminous Material Applied	Gal	• Weight tickets and calculations, or • DOA-approved meter tickets corrected for temp. Not truck distributor meter. • 105% maximum pay.	Bill of lading from certified source, or LIST and Bill of lading
609 / 625	Cover Coat Aggregate & Seal Coat Aggregate	Ton	• Weight tickets with moisture correction. • 110% maximum pay.	Approved source and TICK, or LIST & TICK
609	Aggregate & Seal Coat Aggregate	Ton	• Weight tickets with moisture correction. • 108% maximum pay for Aggregate. • 110% maximum pay for Seal Coat Aggregate.	Approved source and TICK, or
610	Concrete Structures	CY	• Form AER 981, or • Calculations in permanent file verifying plan, or revised, quantity, and • A statement indicating the structure was built in accordance with plan dimensions or a sketch showing measured dimensions.	Plant report and Tickets (QC/QA), or Approved plant, Approved mix design and plant adequately monitored Acceptance testing

SECTION	ITEM	PAY UNIT	REQUIRED DOCUMENTATION	*EVIDENCE OF MATERIAL INSPECTION
610	Reinforcement Bars	LB	• Form AER 981, or • Calculations in permanent file verifying plan, or revised, quantity. Use the table given in Article 508.07 of the Standard Specifications for Road and Bridge Construction.	Certified Producer and Mill analysis 100% domestic steel origin
620	Pavement Marking	SF	• Form AER 981, or • Calculations of SF based on Contract Specifications.	LA15 and Supplier notification that material was taken from tested and approved lots or batches. Lots or batches must be identified and quantity in gallons of each color must be verified.
625	Tar Emulsion Seal Coat	SY	• Form AER 981, or • In-place measurements and calculations.	Bill of lading from certified source, or (LIST or TEST) and Bill of lading
701	Trench Backfill	CY	• Form AER 981, or • Trench measurements and calculations. As per Item 107-3.5 of the Standard Specifications for Construction of Airports.	Approved source and TICK, or LIST and TICK Density Testing
701	Precast Concrete Box Culvert	LF	In-place measurements.	LIST and Approved shop drawings
701	Storm Sewer	LF	In-place measurements. See Item 701-4.1 regarding the method of measuring at drainage structures	Concrete: LIST Plastic: IL OK or Tag Clay: LA15 or IL OK or TEST

SECTION	ITEM	PAY UNIT	REQUIRED DOCUMENTATION	*EVIDENCE OF MATERIAL INSPECTION
702	Slotted Drains	LF	In-place measurements. See Item 701-4.1 regarding the method of measuring at drainage structures	Plastic: IL OK or Tag Metal: IL OK or LA15
705	Porous Granular Backfill	CY	• Form AER 981, or • Trench measurements and calculations. As per Item 701-3.5. Dimensions used in calculations shall not exceed maximum allowable. See Article 550.04 of the Standard Specifications for Road and Bridge Construction for maximum trench width. • Trench measurements and calculations using the Standard Tables Section E (for concrete pipe only).	Approved source and TICK, or LIST and TICK Density Testing
705	Pipe Underdrain	LF	Calculations based on LF per size and type of pipe.	Plastic: IL OK or Tag
751	Manholes & Catch Basins & Inlets	Each	Field measured and counted for each size and type.	Concrete: Plant report and tickets (QC/QA), or Approved Plant, Approved Mix design and plant adequately monitored. Pre-Cast: Approved source and shop drawings. Brick & Mortar: See Item 751-2.2 Metal: Stamped Certified or IL OK

SECTION	ITEM	PAY UNIT	REQUIRED DOCUMENTATION	*EVIDENCE OF MATERIAL INSPECTION
752	Concrete Headwall	Each	• Statement, "Built according to Standard _____," or • If a standard headwall is not used, computations verifying the plan quantity are required. • Field measured and counted for each size.	Plant report and Tickets (QC/QA), or Approved plant, Approved mix design and Plant adequately monitored Pre-Case: Approved source and shop drawings
752	Grating	Each	Field measured and counted for each size.	Casings: IL OK or Tag or LA15 and CERT Welded Steel: IL OK or Tag or LA15
754	Concrete Curb	LF	• In-place field measurements along the fence. • Depth checks.	Plant report and Tickets (QC/QA), or Approved plant, Approved mix design and Plant adequately monitored Acceptance testing
754	Concrete Gutter & Comb. Concrete Curb & Gutter & Pave Ditch & Flumes	LF	• In-place field measurements in the flow line. • Depth checks.	Plant report and Tickets (QC/QA), or Approved plant, Approved mix design and Plant adequately monitored Acceptance testing
901	Lime & Fertilizer	Acre	See requirements for these pay items listed in Item 901.	Approved source and guaranteed analysis.

SECTION	ITEM	PAY UNIT	REQUIRED DOCUMENTATION	*EVIDENCE OF MATERIAL INSPECTION
901	Seeding	Acre	• Form AER 981, or • Slope measurements of the surface area seeded and calculations.	CERT and results of seed analysis signed by Registered Seed Technologist
904	Sodding	SY	• Form AER 981, or • In-place surface measurements and calculations.	Approved source and TICK
905	Topsoiling	CY	• Form AER 981, or • Surface measurements of all authorized areas and calculations.	None, if on site, otherwise sample indicating pH, organic content, and gradation.
905	Topsoiling	SY	• Form AER 981, or • Surface measurements of all authorized areas and calculations. • Depth checks.	None, if on site, otherwise sample indicating pH, organic content, and gradation.
908	Mulching	Acre	• Form AER 981, or • In-place surface measurements and calculations.	VIS CERT, if manufactured

* Material certification / inspection shall be completed ***prior*** to incorporation of material into the project. This list was created to compliment the required material certification / inspections / testing in the "Manual for Documentation of Airport Materials". The "Manual for Documentation of Airport Materials" shall be referenced for ***all*** materials certification / inspection / testing issues.

Section D

REFERENCE TABLES

ESTIMATING DAILY EARTH VOLUMES WITH LOAD COUNTS

Page A-6 of this Manual presents a concept called "Progress Documentation." Simply stated, it is necessary to provide documented entries in the Quantity Book as work progresses, even though final measurements will usually be provided after the pay item is completed. Therefore, with many pay items, the progress documentation may be based upon nothing more than a recorded estimate of work done.

This paper deals with a method of estimating Excavation pay items.

On the following pages (D-2 through D-7) is a table of hauling volumes of most of all the motor scrapers and hauling units presently being used in the State. If a piece of equipment not in Section D is being used and the Contractor is estimating earth volumes by load count, have the Contractor provide a specification sheet for the piece(s) of equipment. The specification sheet will provide struck capacities. Information can also be obtained from the Equipment Watch SpecFinder website. The following example indicates the procedure, which may be used in estimating earth volumes utilizing the enclosed table.

1. Obtain the daily load count from the Contractor. Spot-check occasionally.

2. From the following table, select the struck capacity for the model being used.

3. Multiply the product of the load count and struck capacity by 80%. (This factor may vary somewhat with various materials and loading procedures.)

   Example: 70 loads hauled by a CAT 621

   The day's volume = 70 loads x 14 cy x 80% = 784 cy

4. It is suggested that the above information and calculations be recorded on the Inspector's Daily Report (Form AER 628. Example, page F-9).

Model	# Axles	Engine Make	Engine Model	Drive H.P.	Shift Type	Type	Weight	Type	Standard Hauling Unit Cubic Yards Struck	Heaped	Years Built From	To
Allis-Chalmers Manufacturing Company				rated								
TS-160	2	AC	TDS516	155	DD	MS	28,500	Scraper	7	9.5		1961
								R. Dump	7.7	12		
TS-160	2	AC	TDS516	155	DD	MS	28,500	Scraper	8.5	11		1962
								R. Dump	7.7	12		
TS-160	2	AC	11000	175	DD	MS	28,800	Scraper	8.5	11		1963
								R. Dump	7.7	12		
TS-200	2	AC	TD779	176	DD	MS	38,560	Scraper	10	13		1956
TS-260	2	AC	TD844	200	DD	MS	39,600	Scraper	11	14		19589
								R. Dump	11	15		
TS-260	2	AC	16000	230	DD	MS	44,800	Scraper	12.5	17		1962
								R. Dump	11	15		
TS-260	2	AC	15000	300	TQ	PS	45,300	Scraper	14	19		1963
								R. Dump	11	15		
260 DD	2	AC	19000	296	DD	MS	46,800	Scraper	15	20		1967
		AC	19000	296	DD	MS	48,600	R. Dump	22	26		1968
260	2	AC	19000	296	TQ	PS	48500	Scraper	15	20		1968
		AC	19000	296	TQ	PS	50,360	R. Dump	22	26		1968
260A	2	AC	21000	300*	TQ	PS	51,200	Scraper	15	20		Current
								R. Dump	22	26		Current
								B. Dump	18	22		Current
260EA	2	AC	21000	300*	TQ	PS	59,300	E. Scraper		23		Current
260E	2	AC	19000	294	TQ	PS	58,000	Elevating Scraper		23		1968
TS-300	2	Buda	6DAS-844	280	DD	MS		Scraper	14	18		1955
TS-360	2	AC	TDS844	280	DD	MS	49,000	Scraper	15	20		1962
TS-360(H)	2	AC	21000	340	DD	MS	64,000	Scraper	22.3	30		1963
460 B	2	AC	25000	353	TQ	PS	78,500	Scraper	24	33		1968
460B	2	AC	25000	353	TQ	PS	72,900	R. Dump	30	35		1968
460C	2	GMC	12V-71N	422*	TQ	PS	86,200	Scraper	24	33		Current
								R. Dump	30	35		Current
								B Dump	27	32		Current
562 C	2	AC (2)	25000	706	TQ	PS	122,750	Scraper	33	44		1967
Caterpillar Tractor Company												
DW10	3	Cat	D318	90	DD	MS	35,450	Scraper	7	9	1941	1946
							23,040	Wagon	8.9	14		
DW10	3	Cat	D318	100	DD	MS	35,240	Scraper	7	9	1946	1947
							28,237	Wagon	8.9	14		
DW10	3	Cat	D318	115	DD	MS	33,365	Scraper	8.7	10	1947	1954
							28,237	Wagon	8.9	14		
DW15	3	Cat	D326	150	DD	MS	41,430	Scraper	10	12.5	1954	1955
								Wagon	11.5	17.5		
DW15C	3	Cat	D326	164	DD	MS	42,370	Scraper	10	12.5	1955	1957
							31,965	Wagon	11.5	17.5		
DW15E	3	Cat	D326	166	DD	MS	42,940	Scraper	13	18	1957	1960
DW15F	3	Cat	D326	166	DD	MS	42,940	Scraper	13	18	1960	1961
								Wagon	14.1	15.6		
DW20	3	Cat	D337F	206	DD	MS	50,900	Scraper	14	22	1951	1955
							40,830	Wagon	18	23		
DW20E	3	Cat	D337F	230	DD	MS	57,400	Scraper	18	25	1955	1958
							48,060	Wagon	20	30		
DW20F	3	Cat	D337F	265	DD	MS	59,240	Scraper	18	25	1958	1959
								Wagon	20.5	22.5		
DW20G	3	Cat	D337F	300	DD	MS	57,720	Scraper	19.5	27	1959	1960
								Scraper	24	34		
								Wagon	20.5	22.5		
DW21	2	Cat	D337F	206	DD	MS	54,650	Scraper	15	20	1951	1955
DW21C	2	Cat	D337F	230	DD	MS	58,670	Scraper	18	25	1955	1958
DW21D	2	Cat	D337F	265	DD	MS	58,010	Scraper	18	25	1958	1959
DW21G	2	Cat	D337F	300	DD	MS	59,980	Scraper	19.5	27	1959	1960
613	2	Cat	3160	150	TQ	PS	27,200	Elevating Scraper		11	1969	Current
619	2	Cat	D326	200	DD	MS	47,150	Scraper	14	18	1959	1960
619C	2	Cat	D340	250	DD	MS	47,500	Scraper	14	18	1960	1966
621	2	Cat	D336	300	TQ	PS	52,000	Scraper	14	20	1966	Current
627	2	Cat	D333/D333	225/225	TQ	PS	63,500	Scraper	14	20	1968	Current
630A	3	Cat	D343	335	TD	PS	69,300	Scraper	21	28	1960	1961
								Scraper	24	29		
630A-482	3	Cat	D343	335	TD	PS	79,000	Scraper	27	35	1960	1961
								Wagon	32	38	1961	1961
630B	3	Cat	D343A	400	TD	PS	78,800	Scraper	21	30	1961	1969
631A	2	Cat	D343A	335	TD	PS	66,700	Scraper	21	28	1960	1961
631B	2	Cat	D343	360	TD	PS	80,300	Scraper	21	30	1962	Current
631C	2	Cat	D343	400	TQ	PS	75,400	Scraper	21	30	1970	Current
632	3	Cat	D343	360	TD	PS	86,910	Scraper	28	38	1961	1964
								Elevating				
633	2	Cat	D343	360	TD	PS		Scraper		32	1970	Current
								Elevating				

Model	# Axles	Engine Make	Engine Model	Drive H.P.	Shift Type	Type	Weight	Type	Standard Hauling Unit Cubic Yards Struck	Heaped	Years Built From	To
633C	2	Cat	D343	415	TQ	PS	86,500	Scraper		32	1970	Current
637	2	Cat	D343/D333	415/225	TQ	PS	86,900	Scraper	21	30	1970	Current
641	2	Cat	D346	500	TD	PS	99,500	Scraper	28	38	1962	Current
641B	2	Cat	D346	550	TQ	PS	102,500	Scraper	28	38	1970	Current
650	3	Cat	D346	500	TD	PS	120,400	Scraper	32	44	1962	Current
650B	3	Cat	D346	550	TQ	PS	101,700	Scraper	32	44	1970	Current
651	2	Cat	D346	500	TD	PS	108,700	Scraper	32	44	1962	Current
651B	2	Cat	D346	550	TQ	PS	115,700	Scraper	32	44	1970	Current
657	2	Cat	D346/343A	500/360	TD	PS	128,900	Scraper	32	44	1962	Current
657B	2	Cat	D346/D343	550/400	TQ	PS	131,800	Scraper	32	44	1970	Current
660	3	Cat	S346	500	TD	PS	117,200	Scraper	40	54	1962	1970
					TD	PS	123,500	Wagon	55	64	1965	1970
660B	3	Cat	D346	550	TQ	PS	110,300	Scraper	40	54	1970	Current
666	3	Cat	D346/D343A	500/400	TD	PS	136,600	Scraper	40	54	1962	Current
666B	3	Cat	D346/D343	550/400	TQ	PS	130,800	Scraper	40	54	1970	Current
J619	2	Cat	D340	250	TD	PS	60,390	Elevating Scraper		20	1964	1966
J621	2	Cat	D336	300	TQ	PS	65,000	Elevating Scraper		21.5	1966	Current
Clark Equipment Company												
110	2	Cum	C-175-C	162	TQ	PS	31,200	Scraper	8	10.5		1961
110	2	Cum	C-175-C	162	TQ	PS	34,850	Scraper	9.6	12.5	1960	1962
110	2	Cum	C-175-Cl	162	TQ	PS	34,850	Scraper	10.4	13.5	1958	1965
							34,580	Wagon	8.3	10	1958	1965
110	2	GM	6V-53	170	TQ	PS	34,850	Scraper	10.4	13.5	1962	1965
							34,580	Wagon	8.3	10	1962	1965
110-H	2	GM	4-71N	160	TQ	PS	33,300	Elevating Scraper		11	1969	Current
110H-T	2	GM	4-71N	320	TQ	PS	52,062	Elevating Scraper		16	1970	Current
110-12	2	GM	6V-53N	178	TQ	PS	37,850	Elevating Scraper		12	1965	1968
110-14	2	GM	6V-71N	288	TQ	PS	37,850	Elevating Scraper		14	1967	Current
210	2	Cum	NTO-6-C	262	TQ	PS	44,000	Scraper	12.7	18		
210	2	Cum	NTO-6-C	262	TQ	PS	45,900	Scraper	13.5	19		1961
210	2	Cum	NTO-6-C	262	TQ	PS	48,590	Scraper	14	19	1960	1962
210	2	Cum	NTO-6-Cl	262	TQ	PS	49,600	Scraper	15	20	1957	Current
							51,925	Wagon	16	20	1959	Current
210-Self-Loading	2	GM	8V-71	290	TQ	PS	50,725	Scraper	15	20	1964	1967
210	2	GM	8V-71	290	TQ	PS	49,600	Scraper	15	20	1961	Current
							51,925	Wagon	16	23	1961	Current
210-H	2	Cum		335	TQ	PS		Elevating Scraper		23	1967	Current
310	2	Cum	NFT-6-Bl	375	TQ	PS	70,000	Scraper	20	27	1957	1959
310	2	GM	12V-71	420	TQ	PS	76,300	Scraper	21.6	29	1959	1965
310(III)	2	GM	12V-71N	475	TQ	PS	81,800	Scraper	24.4	32	1965	Current
310-H	2	GM	12V-71N	475	TQ	PS	92,000	Elevating Scraper		31	1967	Current
Curtiss Wright Construction Machinery				net								
CW-27	2	GM	4055C	143	DD	MS	32,500	Scraper	7	10	1958	1961
CW-215	2	Cum	HRS-6	240	DD	MS	54,000	Scraper	15	21	1958	1961
CW-220	2	GM	6-110T	375*	TQ	PS	69,000	Scraper	20	27	1958	1961
CW-226	2	GM	6-110T	375	TQ	PS	85,500	Scraper	26	36	1958	1961
CW-320	1	Cum	NRT-6	300	DD	MS	64,500	Scraper	20	27	1958	1961
Deere & Company				rated								
840 Elevating	3	Deere		76	DD	MS	20,330	Scraper		7.5	1962	1965
5010 Elevating	3	Deere		127	DD	MS	28,850	Scraper		8	1961	1965
JD760 Elevating	3	Deere		143	DD	MS	30,650	Scraper		9	1965	1969
JD760A	3	Deere		152	TQ	PS	32,250	Scraper		9.5	1969	Current
JD860	2	GM	6-71	215	TQ	PS	42,300	Scraper		15	1969	Current
Euclid, Inc.				rated								
76FDR-18SH	3	Cum	NH		TQ	PS		Scraper	12	16		1957
76FDR-89W	3	Cum	NH		TQ	PS		B. Dump	13	19		1957
77FDR-18SH	3	GM	6-71		TQ	PS		Scraper	12	16		1957
77FDT-89W	3	GM	6-71		TQ	PS		B. Dump	13	19		1961
22TDT-21SH	3	GM	6-110		TQ	PS		Scraper	15.5	21		1956
22TDT-122W	3	GM	6-110		TQ	PS		B. Dump	17	25.5		1956
23TDT	3	GM	6-110		TQ	PS		Scraper	15.5	21		1956
23TDT-122W	3	GM	6-110		TQ	PS		B. Dump	17	25.5		1961
28TDT-22SH	3	Cum	NRT		TQ	PS		Scraper	15.5	21		1956
28TDT	3	Cum	NRT		TQ	PS		B. Dump	17	25.5		1959
14TDT-21SH	3	Cum			TQ	PS		Scraper	15.5	21		1955
15TDT-22SH	3	Tw Cum	NH		TQ	PS		Scraper	18	24		1955
16TDT-23SH	3	Tw GM	6-71		TQ	PS		Scraper	18	24		1956
37LDT-137W	3	GM	6-110T		TQ	PS		B. Dump	30	46		1960

Model	# Axles	Engine Make	Engine Model	Drive H.P.	Shift Type	Type	Weight	Type	Standard Hauling Unit Cubic Yards Struck	Heaped	Years Built From	To
34LDT-141W	3	GM	12V-71		TQ	PS		B. Dump	40	62		1960
34LDT-144W	3	GM	12V-71		TQ	PS		B. Dump	40	62		1962
36LDT-141W	3	Cum	NVH		TQ	PS		B. Dump	40	62		1960
36LDT-144W	3	Cum	NVH		TQ	PS		B. Dump	40	62		1962
SS-18 (23TDT-36SH)	3	GM	12V-71		TQ	PS	71,300	Scraper	18	25		1961
SS-18 (14RDR-36SH)	3	Cum			TQ	PS	56,900	Scraper	18	25		1961
SS-24 (28LDT-32SH)	3	GM	6-110		TQ	PS		Scraper	24	32		1959
SS-24 (33LDT-32SH)	3	Cum	NRTO-6-Bl		TQ	PS		Scraper	24	32		1959
SS-24 (37LDT-32SH)	3	GM	6-110T		TQ	PS	69,000	Scraper	24	32		1960
SS-24 (34LDT-32SH)	3	GM	12V-71		TQ	PS	71,300	Scraper	24	32		1963
SS-23 (36LDT-32SH	3	Cum	NVH		TQ	PS	74,500	Scraper	24	32		1963
SS-28 (49LDT-53SH)	3	GM	12V-71N	475	TQ	PS	90,800	Scraper	28	38		1966
SS-28 (36LDT-53SH)	3	Cum	NVH-12	450	TQ	PS	92,700	Scraper	28	38		1966
SS-33 (34LDT-42SH)	3	GM	12V-71		TQ	PS	88,000	Scraper	33	43		1961
SS-40 (34LDT-47SH)	3	GM	12V-71		TQ	PS	99,400	Scraper	40	52		1962
SS-40 (36LDT-47SH)	3	Cum	NVH		TQ	PS	101,000	Scraper	40	52		1962
SS-40 (49LDT-52SH)	3	GM	12V-71N	475	TQ	PS	101,500	Scraper	40	52		1968
SS-40 (36LDT-52SH)	3	Cum		450	TQ	PS	102,100	Scraper	40	52		1967
B-63 (49LDT-144W)	3	GM	12V-71N		TQ	PS		Wagon	42	64		1964
B-63 (36LDT-144W)	3	Cum	NVH		TQ	PS		Wagon	42	64		1964
B-100 (201LDT-146W)	3	GM	16V-71N	607	TQ	PS	110,100	Wagon	60	78		Current
B-100 (201LDT-201W)	3	GM	16V-71N	607	TQ	PS	113,900		60	78		Current
B-100 (46LDT-146W)	3	Cum	VT-12-635	600	TQ	PS	110,100	Wagon	60	78		Current
B-110 (201LDT-201W)	3	GM	16V-71N	607	TQ	PS	116,900		67.5	85		Current
SS-24 (49LDT-77SH)	3	GM		475	TQ	PS	78,300	Scraper	24	32		1968
SS-24 (36LDT-77SH)	3	Cum		450	TQ	PS	79,000	Scraper	24	32		1967
B-63 (49LDT-147W)	3	GM		475	TQ	PS		Wagon	42	64		Current
B-63 (36LDT-147W)	3	Cum		450	TQ	PS		Wagon	42	64		1967
B-63 (203LDT-147W)	3	GM	12V-71N	440	TQ	PS	77,375		42	56		Current
B-70 (203LDT-147W)	3	GM	12V-71N	440	TQ	PS	79,000		47	62		Current
FWD-Wagner				max								
WSC-4 (LS-8)	3	GM	4-53	125	TQ	PS	29,000	Elevating Scraper		8	1966	1968
Hancock Division-Clark Equipment Company												
292B	2	GM	4-71N	160	TQ	PS	33,300	Elevating Scraper		11	1966	1969
292C	2	GM	4-71N	160	TQ	PS	34,000	Elevating Scraper		11	1969	Current
294	2	GM(2)	4-71N(2)	160	TQ	PS	52,000	Elevating Scraper		16	1969	Current
International Harvester Company				flywheel					**(International Construction Equipment)**			
2T-55/2S-55	2	Cum	HRB-600	165	DD	MS	37,600	Scraper	10	13	1954	1955
55 (551)	2	Cum	HR-6-B1	175	DD	MS	40,865	Scraper	10.3	14	1955	1962
2T-75/2S-75	2	Cum	NHB-600	200	DD	MS	51,800	Scraper	14	18	1954	1955
75 (751)	2	Cum	NTO-6-Bl	262	DD	MS	54,345	Scraper	15	20	1955	1962
270	2	IH	DVT-573B	266	TQ	PS	44,540	Scraper	14	19	1962	Current
295	2	IH	DT-817	385	TQ	PS	77,130	Scraper	24	34	1959	1961
295	2	IH	DT-817	375	TQ	PS	77,160	Scraper	24	34	1961	1963
295-B	2	IH	DT-817	394	TQ	PS	72,950	Scraper	24	32	1962	1968
295-B	2	IH	DT-817B	396	TQ	PS	74,340	Scraper	24	32	1968	Current
495	3	IH	DT-817	385	TQ	PS	75,580	Scraper	24	34	1958	1961
495	3	IH	DTI-817	375	TQ	PS	76,610	Scraper	24	34	1961	1965
495	3	IH	DT-817	385	TQ	PS	59,480	Wagon	27	40.5	1958	1961
495	3	IH	DTI-817	375	TQ	PS	60,600	Wagon	27	40.5	1961	1965
E-200	2	IH	DT-407	135	TQ	PS	26,900			9.5	1966	Current
E-211	2	IH	DT-407	150	TQ	PS	27,450	Elevating		11	1969	Current
E-270	2	IH	DVT-573B	266	TQ	PS	51,700	Scrapers		21	1965	Current
E-295	2	IH	DT-817B	396	TQ	PS	88,060			32	1968	Current
M-R-S Manufacturing Company				rated								
150	4	Cum		210	DD	MS		Cable	15	18	1952	1961
150	4	Cum		280	DD	MS		Cable	20	24	1961	1971
190	4	Cum		288	DD	MS		Cable	16	20	1955	1961
190	4	Cum		430	DD	MS		Hydraulic	30	40	1961	1968
200	4	Cum		335	DD	MS		Cable	18	24	1959	1961
200	4	Cum		500	DD	MS		Hydraulic	38	46.5	1962	1971
200	4	Cum		525	DD	MS		Cable	34	41	1956	1952
200	4	Cum		525	DD	MS		Hydraulic	38	48	1958	1959
250	4	Cum		635	DD	MS		Hydraulic	40	50	1960	1962
250	4	Cum		635	DD	MS		Hydraulic	48	58	1962	Current
190 Twin	4	Cum (2)		860	TQ	PS		Hydraulic	43	53		Current
250 B Twin	4	Cum (2)		1065	TQ	PS		Hydraulic	48-58	55-65		Current
250	3	Cum		635	TQ	PS		B. Dump	140 ton			Current
1-80T	3	GM		141	DD	MS		Elevating			1965	1969
1-80S	3	GM		159	DD	MS		Elevating			1965	1969
1-90S	3	GM		186	TQ	PS		Elevating			1966	Current
1-100S-100ES	3	GM		290	TQ	PS		Elevating			1968	Current

Model	# Axles	Engine Make	Engine Model	Drive H.P.	Shift Type	Type	Weight	Type	Standard Hauling Unit Cubic Yards Struck	Heaped	Years Built From	To
1-105S-105ES	3	GM		373	TQ	PS		Elevating			1968	Current
1-105KS-100ES	3	GM		422	TQ	PS		Elevating			1971	Current
1-110S-110ES	3	GM		482	TQ	PS		Elevating			1971	Current
TEREX Division- General Motors Corporation												
S-7 (3UOT-26SH)	2	GM	4-71	148	TQ	PS	26,590	Scraper	7	9	1955	1970
S-11E	2	GM	4-71N	160	TQ	PS	33,300	E. Scraper		11	1969	Current
S-12 (78FOT-29SH)	2	GM	6-71	227	TQ	PS	46,100	Scraper	12	16	1955	1962
S-7H/S-12E	2	GM	4-71	148	TQ	PS	33,370	E. Scraper		12	1965	1969
S-18 (27LOT-28SH)	2	GM	6-110	336	TQ	PS	68,400	Scraper	18	25	1955	1956
S-18 (30LOT-28SH)	2	GM	6-110	336	TQ	PS	66,700	Scraper	18	25	1957	1958
S-18 (30LOT-46SH)	2	GM	6-110	336	TQ	PS	67,000	Scraper	18	25	1958	1961
S-24 (39LOT-46SH)	2	GM	12V-71	432	TQ	PS	72,860	Scraper	24	32	1961	1962
S-24 (39LOT-55SH)	2	GM	12V-71	432	TQ	PS	75,000	Scraper	24	32	1962	1965
S-24 (39LOT76SH)	2	GM	12V-71	432	TQ	PS	79,350	Scraper	24	32	1966	1968
S-24 (49LOT-76SH)	2	GM	12V-71T	465	TQ	PS	80,850	Scraper	24	32	1969	Current
S-28 (38LOT-50SH)	2	GM	12V-71N	475	TQ	PS	91,400	Scraper	28	40	1963	1966
S-32 (47LOT-79SH)	2	GM	12V-71T	525	TQ	PS	107,000	Scraper	32	43	1967	Current
S-35E (47LOT-90SH)	2	GM	12V-71T	500	TQ	PS	98,900	E. Scraper		35	1968	Current
TS-14 (6UOT-38SH)	2 (2)		4-71	296	TQ	PS	53,300	Scraper	14	20	1959	1964
TS-14 (7UOT-61SH)	2 (2)		4-71	296	TQ	PS	53,300	Scraper	14	20	1964	1966
TS-14 (13UOT-81SH)	2 (2)		4-71N	320	TQ	PS	53,300	Scraper	14	20	1967	Current
TS-14 Tandem (7UOT-63SH-62SH)	3 (3)		4-71	444	TQ	PS	93,600	Scraper	28	40	1965	1966
TS-14 Tandem (13UOT-82SH-83SH)	3 (3)		4-71N	480	TQ	PS	93,600	Scraper	28	40	1967	1969
TS-18 (29LOT-27SH)	2 (2)		6-71	436	TQ	PS	78,200	Scraper	18	25	1955	1957
TS-18 (33 TOT-92SH)	2	GM	8V-71N 6V-71N	556	TQ	PS	72,000	Scraper	18	23	1971	Current
TS-24 (31LOT-33SH)	2	GM	6-110 6-71	554	TQ	PS	76,100	Scraper	24	32	1957	1962
TS-24 (31LOT-56SH)	2	GM	6-110 6-71	563	TQ	PS	82,800	Scraper	24	32	1963	1965
TS-24 (39LOT-56SH)	2	GM	12V-71 6-71	659	TQ	PS	84,800	Scraper	24	32	1963	1965
TS-24 (43LOT-78SH)	2	GM	12V-71 6-71	659	TQ	PS	91,000	Scraper	24	32	1966	1971
TS-24 (43 LOT-78SH)	2	GM	12V-71N 6-71N	672	TQ	PS	91,000	Scraper	24	32	1971	Current
TS-32 (47LOT-80SH)	2	GM	12V-71T 8V-71T	875	TQ	PS	124,500	Scraper	32	43	1966	Current
WABCO				rated								
D Roadster	2	GM	4-71	122				Scraper	5.9	7		1953
Tournapull (Step Gear)								R. Dump	7	8		
Tournapull (Step Gear)	2	GM	4-71	122				Scraper	6.6	7.5		1954
								R. Dump	7	8		
		GM	4-71	138				Scraper	6.6	7.5		1958
								R. Dump	7	8		
D Tournapull (Step Gear or Power Shift)	2	GM	4-71	143			23,750	Scraper	7.3	9		1960
								R. Dump	7	8		
		GM	4-71	148			23,070	Scraper	7.3	9		1969
								R. Dump	7	8		
109A	2	GM	4-71N	160		PS	23,070	Scraper	7.3	9		Current
111A	2	GM	4-71N	160		PS	30,300	Elevating Scraper		11		Current
C Roadster	2	Cum	HRB-600	165				Scraper	11	14		1950
Tournapull (Step Gear)		Buda	6DC-844	180				R. Dump	13	17		
								Scraper	11	14		1950
								R. Dump	13	17		
		GM	6-71	186				Scraper	11	14		1951
								R. Dump	13	17		
C Tournamatic (Power Shift)	2	GM	6-71	186				Scraper	12.2	16		1953
								R. Dump	13	17		
								B. Dump	14	16		
C Tournapull (Step Gear or Power Shift)	2	Buda	A-8DA-844	200			43,860	Scraper	12.2	18		1955
								R. Dump	14.7	22		
								B. Dump	14	16		
		GM	6-71	208			43,860	Scraper	12.2	18		157
								R. Dump	14.7	22		
		GM	6-71	210			46,860	Scraper	12.2	18		1957
								R. Dump	14.7	22		
		Cum	HBIS-600	200			43,860	Scraper	12.2	18		1958
								R. Dump	14.7	22		
		GM	6-71	218			43,860	Scraper	12.2	18		1958
								R. Dump	14.7	22		
		Cum	HBIS-600	210			43,860	Scraper	12.2	18		1959
								R. Dump	14.7	22		
		GM	6-71	226			43,860	Scraper	12.2	18		1959
								R. Dump	14.7	22		

Model	# Axles	Engine Make	Engine Model	Drive H.P.	Shift Type	Type	Weight	Type	Standard Hauling Unit Cubic Yards Struck	Heaped	Years Built From	Years Built To
229 F	2	GM	8V-71N	318		PS	52,600	Scraper	15	21		Current
C-222A	2	GM	8V-71	290			57,050	Elevating Scraper	21			1967
222F	2	GM	8V-71N	318		PS	58,200	Elevating Scraper		22		Current
V Powered C Tournapull (Step Gear)	2	GM	8V-71	270			43,860	Scraper	12.2	18		1959
								R. Dump	14.7	22		
C500 Tournapull (Power Shift)	2	GM	8V-71	290			55,630	Scraper Tandem	16	21		1967
							73,820	Scraper	32	42		
B Tournapull (Step Gear)	2	Cum	HRBIS-600	293				Scraper	18	25		1956
								R. Dump	23	27		
		GM	6-110	300			68,900	Scraper	19.1	27		1957
								R. Dump	23	27		
		Cum	NRT-6-BI	300			68,900	Scraper	19.1	27		1957
								R. Dump	23	27		
		GM	6-110	325			62,750	Scraper	21	28		1958
								R. Dump	23	27		
		GM	6-110	335			62,750	Scraper	21	28		1960
								R. Dump	23	27		
B Tournapull (Power Shift)	2	Cum	NRTO-6-BI	335			68,900	Scraper	19.1	27		1959
								R. Dump	23	27		
B Tournapull (Step Gear or Power Shift)	2	Cum	NRTO-6-BI	335			68,900	Scraper	19.1	27		1959
								R. Dump	23	27		
		GM	6-110T	360			62,750	Scraper	21	28		1959
								R. Dump	23	27		
		GM	12V-71	430			70,500	Scraper	23	29		1962
								R. Dump	23	27		
B-70 Tournapull (Power Shift)	2	GM	12V-71	475			71,860	Scraper Tandem	25	32		1967
							111,915	Scraper	50	64		
333F	2	GM	12V-71N	475			94,285	Elevating Scraper		32		Current
333FT	2	GM	(2)12V-71TV	965		PS	94,285	Elevating Scraper		34		Current
339F	2	GM	12V-71N	475		PS	86,500	Scraper	25	34		Current
101F	2	Cum	V-504	178		PS	27,900	Elevating		9	1970	Current

ORDER OF ARITHMATIC OPERATIONS

When performing a series of arithmetic operations (i.e. addition, subtraction, division, multiplication, exponents), you must perform those operations in a particular order. There is a mnemonic to help you remember the order – PEMDAS:

P Parentheses
E Exponents
M Multiplication
D Division
A Addition
S Subtraction

If you have a series of operations, do what's in parentheses first, then apply exponents, then do any multiplication or division, and finally do any adding or subtracting.

Example:

$$4 + 3\left(2 - \frac{1}{4}\right) - 2^3 = ?$$

Do what's in parentheses first (find LCD):

$$2 - \frac{1}{4} = \frac{8}{4} - \frac{1}{4} = \frac{7}{4}$$

So now we have:

$$4 + 3\left(\frac{7}{4}\right) - 2^3 = ?$$

Now apply exponents:

$$2^3 = 8$$

So now we have:

$$4 + 3\left(\frac{7}{4}\right) - 8 = ?$$

Now do multiplication:

$$3\left(\frac{7}{4}\right) = \frac{21}{4}$$

So now we have:

$$4 + \frac{21}{4} - 8$$

Now do addition and subtraction (find LCD):

$$4 + \frac{21}{4} - 8$$

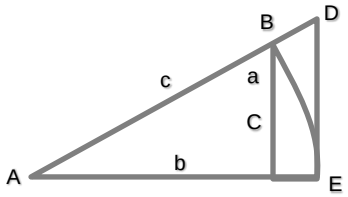
Is the same as:

$$\frac{16}{4} + \frac{21}{4} - \frac{32}{4} = \frac{5}{4}$$

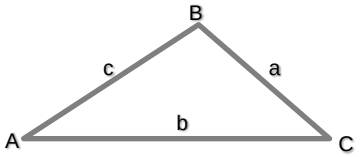
So our answer is:

$$\frac{5}{4}$$

MATHEMATICAL FORMULAS USED BY IDOT



Right Triangle



Oblique Triangle

Right Triangles

$\sin A = \frac{a}{c} = \cos B$

$\cos A = \frac{b}{c} = \sin B$

$\tan A = \frac{a}{b} = \cot B$

$\sec A = \frac{c}{b} = cosec\ B$

$cosec\ A = \frac{c}{a} = \sec B$

$\cot A = \frac{b}{a} = \tan B$

$a = c \sin A = c \cos B = b \tan A = b \cot B = \sqrt{c^2 - b^2}$

$b = c \cos A = c \sin B = a \cot A = a \tan B = \sqrt{c^2 - a^2}$

$c = \frac{a}{\sin A} = \frac{a}{\cos B} = \frac{b}{\sin B} = \frac{b}{\cos A}$

Oblique Triangles

Given	Sought	Formula	
A, B, a	b, c	$b = \frac{a}{\sin A} * \sin B$	$c = \frac{a}{\sin A} * \sin(A + B)$
A, a, b	B, c	$\sin B = \frac{\sin A}{a} * b$	$c = \frac{a \sin(A + arc \sin(b \sin A/a))}{\sin A}$
C, a, b	$\frac{1}{2}(A + B)$ $\frac{1}{2}(A - B)$	$\frac{1}{2}(A + B) = 90^o - \frac{1}{2} C$ $Tan\ \frac{1}{2}(A - B) = \frac{a - b}{a + b} * \tan\frac{1}{2}(A + B)$	
a, b, c	A	$Given\ s = \frac{1}{2}(a + b + c), then:$ $\sin\frac{1}{2} A = \sqrt{\frac{(s-b)(s-c)}{bc}}$ $\cos\frac{1}{2} A = \sqrt{\frac{s\,(s-a)}{bc}}$ $\tan\frac{1}{2} A = \sqrt{\frac{(s-b)(s-c)}{s\,(s-a)}}$ $sin\ A = 2\ \frac{\sqrt{s(s-a)(s-b)(s-c)}}{bc}$	
	Area	$Area = \sqrt{s(s-a)(s-b)(s-c)}$	
c, a, b	Area	$Area = \frac{1}{2}\ ab \sin C$	

Nomenclature

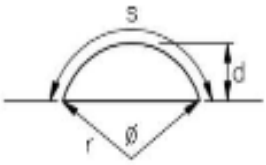
A = total surface area
C = circumference
d = distance
h = height
p = perimeter
r = radius
s = side (edge) length, arc length
V = volume
θ = vertex angle, in radians
$\emptyset$ = central angle, in radians

Circle

$$c = 2\pi\, r$$

$$A = \pi\, r^2 = \frac{c^2}{4\pi}$$

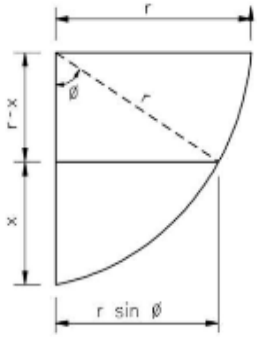
Circular Segment (1)



$$A = \frac{1}{2}r^2(\emptyset - sin - \emptyset)$$

$$\emptyset = \frac{s}{r} = 2\left(arccos\ \frac{r-d}{r}\right)$$

Circular Segment (2)



$$\cos\emptyset = \frac{r-x}{r}$$

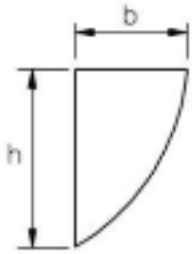
Area of Circle Segment

$$\frac{\emptyset}{360°}\pi r^2$$

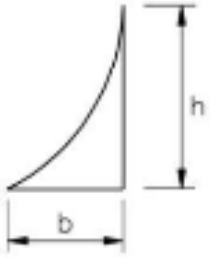
Area of Triangle

$$\frac{1}{2}(r-x)(r\sin\emptyset)$$

Parabola

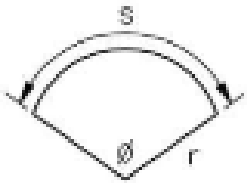


$$A = \frac{2bh}{3}$$



$$A = \frac{1}{3}\ bh$$

Circular Sector

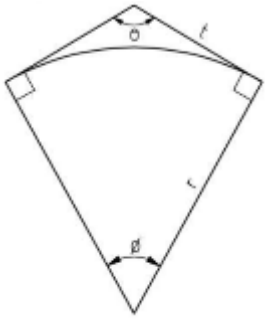


$$A = \frac{1}{2}\,\emptyset\, r^2 = \frac{1}{2}\,sr$$

$$\emptyset = \frac{s}{r}$$

External Area

Total Area – Area of Circle Segment = External Area



$$t = \frac{r}{\tan\frac{\theta}{2}}$$

$$\emptyset = 180° - \theta$$

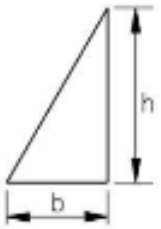
$$Total\ Area = rt = \frac{r^2}{tan\frac{\theta}{2}}$$

$$Area\ of\ Circle\ Seg. = \pi\, r^2\ \frac{\emptyset}{360}$$

$$Ext.\ Area = r^2\left[\frac{1}{tan\frac{\theta}{2}} - \pi\frac{\emptyset}{360}\right]$$

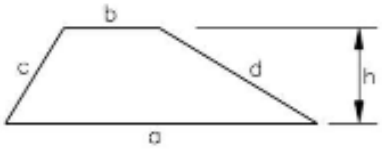
Number of Sides	Name of Polygon
3	triangle
4	rectangle
5	pentagon
6	hexagon
7	heptagon
8	octagon
9	nonagon
10	decagon

Triangle



$$A = \frac{1}{2}\,bh$$

Trapezoid

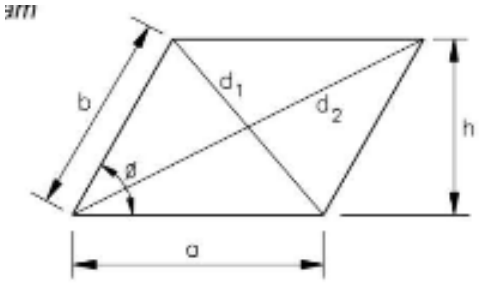


$$p = a + b + c + d$$

$$A = \frac{1}{2}\,h\,(a + b)$$

The trapezoid is isosceles if c = d

Parallelogram



$$p = 2\,(a + b)$$

$$d_1 = \sqrt{a^2 + b^2 - 2ab(\cos \emptyset)}$$

$$d_2 = \sqrt{a^2 + b^2 + 2ab(\cos \emptyset)}$$

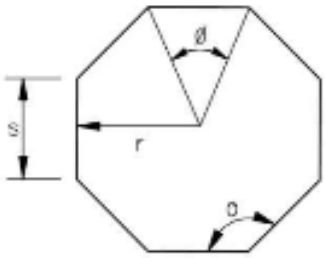
$$d_1^2 + d_2^2 = 2\,(a^2 + b^2)$$

$$A = ah = ab(\sin \emptyset)$$

If a = b, the parallelogram is a rhombus

Regular Polygon

(n equal sides)



$$\emptyset = \frac{2\pi}{n}$$

$$\theta = \frac{\pi\,(n-2)}{n}$$

$$p = ns$$

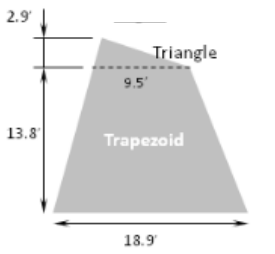
$$s = 2r\left(\tan\left(\frac{\emptyset}{2}\right)\right)$$

$$A = \frac{1}{2}\,nsr$$

EXAMPLES FOR CALCULATION OF AREA

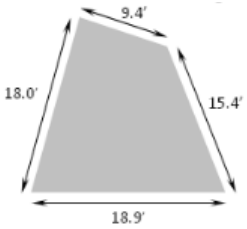
Break areas into geometric shapes that you can calculate and use the correct formulas!

Right



$\frac{2.9'(9.5')}{2} + 13.8' \frac{(9.5' + 18.9')}{2} = 209.7\ SF$
$= 23.3\ SY$

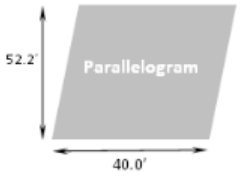
Wrong



$\frac{(18' + 15.4')}{2}\ x\ \frac{(9.4' + 8.9')}{2} = 236.3\ SF$
$= 26.3\ SY$

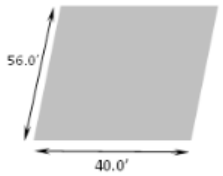
$23.3\ SY \neq 26.3\ SY$

Right



$40.0' x\ 52.2' = 2088.0\ SF$
$= 232.0\ SY$

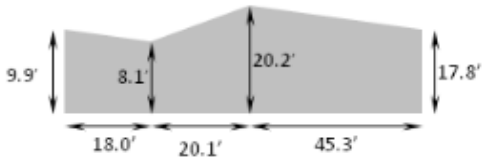
Wrong



$40.0' x\ 56.0' = 2240.0\ SF$
$= 248.8\ SY$

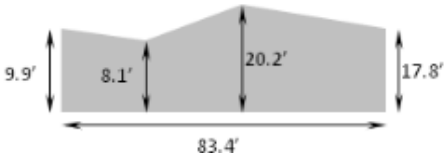
$232.0\ SY \neq 248.8\ SY$

Right



$\frac{(9.9'+8.1')}{2}\ 18.0' + \frac{(8.1'+20.2')}{2}\ 20.1' + \frac{(20.2'+17.8')}{2}\ 45.3' = 1307.1\ SF$
$= 145.2\ SY$

Wrong



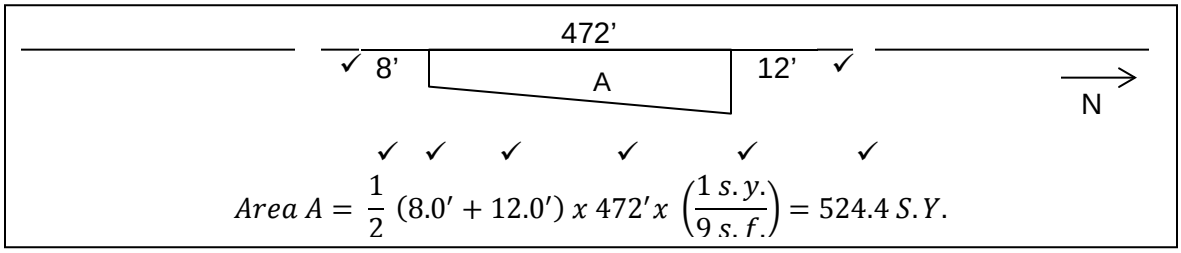
$\frac{(9.9' + 8.1' + 20.2' + 17.8')}{4}\ x\ 83.4' = 1167.6\ SF$
$= 129.7\ SY$

$145.2\ SY \neq 129.7\ SY$

RECOMMENDED CHECKING PROCEDURES

The Checker assumes responsibility for all errors made by the Preparer that are not caught by the Checker!

- DO NOT ERASE ERRORS! Cross out the original entry with a single line and correct.



- Show what you have checked by making small check marks.

- Checking involves much more than punching numbers into a calculator. The following is a partial list of things that the Checker should be reviewing.

  - All items on any sketches were properly labeled, and the measurements were correctly transferred from the original sketch to the equations.
  - The correct equation was used.
  - The Stationing is correct.
  - The Pay Item, Pay Item Number and Fund Code are correct.
  - All necessary yield checks have been made. You should also note if the yield is within the spec. *(If it is out of spec, then an explanation of the factors that would account for the deviation or actions that were taken should be noted.)*
  - The "Quantity and Units" column of the IDR matches the calculated value and the pay item requirements.
  - All numbers have been correctly rounded-off, in accordance with Section B of the Documentation Manual.
  - Each pay item is labeled as an "estimate" or a "final measurement". (A final measurement is one that cannot, or will not, be re-measured.)
  - The date, Contractor/Subcontractor, weather, and job stamp information have been completed on the IDR.
  - "Measured by," "Calculated by" and "Checked by" have been initialed and dated.
  - All tonnage and gallon tickets have been initialed, correctly tallied and bound.
  - The "Evidence of Inspection" has been completed in accordance with the PPG, or Section C of the Documentation Manual.

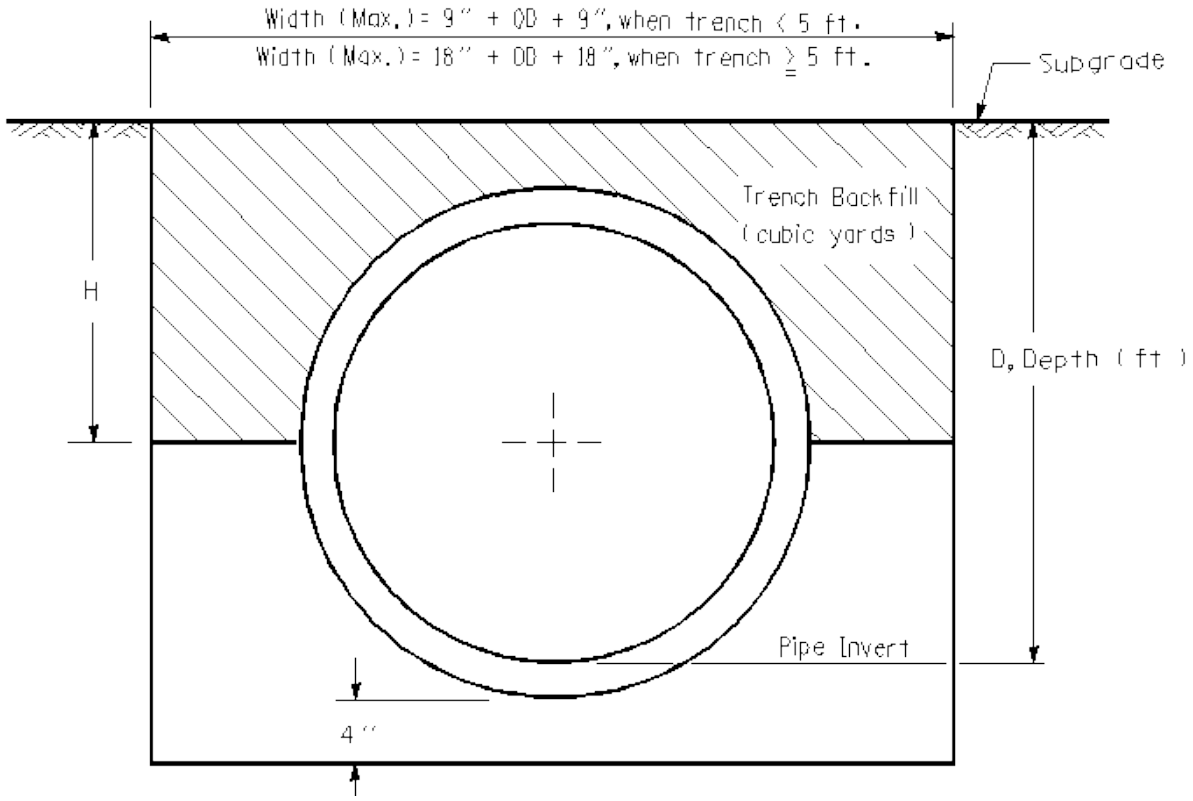
Remember: "Any place a mistake might be made, sooner or later, it will be made!"

Section E

TRENCH BACKFILL TABLES FOR CONCRETE PIPES

These tables can be used by the designer or the field engineer to determine the volume of TRENCH BACKFILL that can be paid for when backfilling storm sewer trenches. Maximum trench widths adopted by the January 1, 2007 Standard Specifications for Road and Bridge Construction are used.

TRENCH BACKFILL TABLE FOR CIRCULAR CONCRETE PIPE



EXAMPLE

Given:	Pipe = 42" Storm Sewer	
	Average Depth, D = 6.8 ft.	
	Trench Length = 84.7 ft.	
Find:	Cubic Yards or TRENCH BACKFILL	
Solution:	From table, CY/LF	= 1.093
	x Trench Length	= x 84.7
	TRENCH BACKFILL	= 92.6 CY

NOTE: If the field engineer measures a width of trench less than the maximum permitted, the values included herein will be of no value. The actual volume of TRENCH BACKFILL used will therefore have to be calculated using the following formula:

$$Cubic\ Yards = \left[(H' x\ W') - \left(\frac{Pipe\ End\ Area}{2}\right) x\ L' x\ 1/27\right]$$

VOLUME OF TRENCH BACKFILL (CY) PER LINEAR FOOT OF STORM SEWER

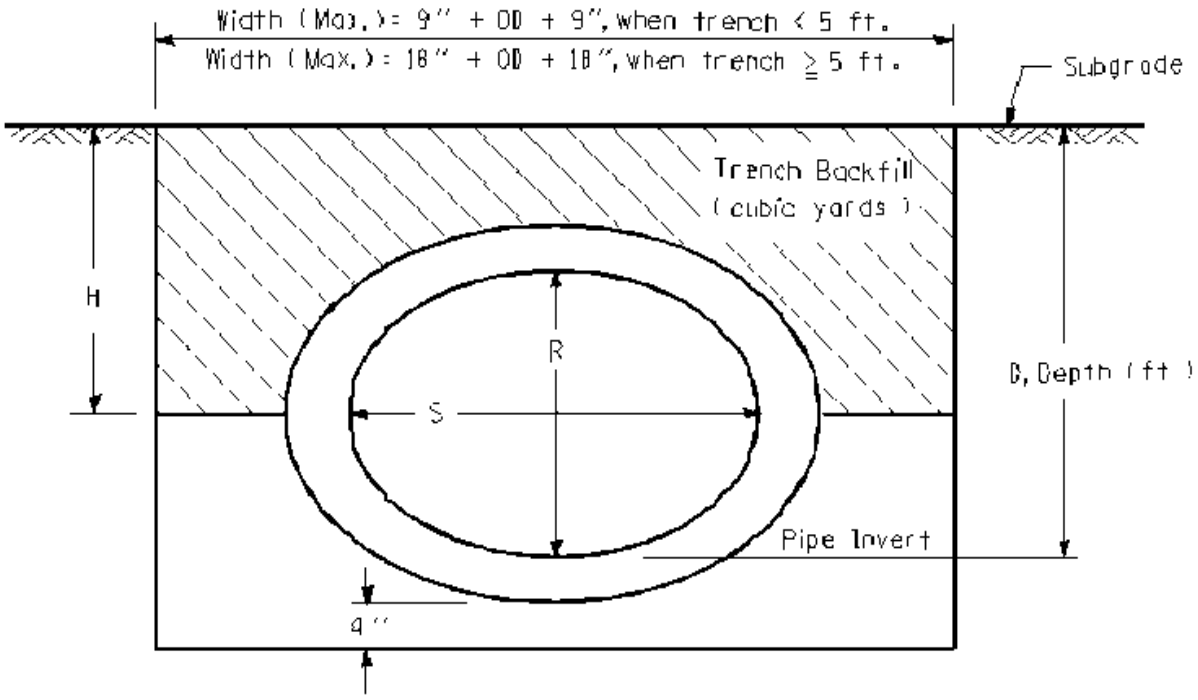
Inside Diameter Wall thickness	8” 1.667”	10” 1.833”	12” 2.00”	15” 2.25”	18” 2.50”	21” 2.75”
2.0	0.138	0.136	0.132	0.121	0.105	0.083
2.2	0.156	0.155	0.152	0.143	0.130	0.111
2.4	0.174	0.175	0.173	0.167	0.155	0.138
2.6	0.192	0.194	0.194	0.190	0.180	0.166
2.8	0.210	0.214	0.215	0.213	0.205	0.193
3.0	0.228	0.234	0.236	0.236	0.231	0.220
3.2	0.246	0.253	0.257	0.259	0.256	0.248
3.4	0.264	0.272	0.278	0.282	0.281	0.275
3.6	0.282	0.292	0.299	0.305	0.307	0.303
3.8	0.300	0.311	0.320	0.329	0.332	0.330
4.0	0.319	0.331	0.341	0.352	0.358	0.358
4.2	0.336	0.350	0.362	0.375	0.383	0.385
4.4	0.354	0.370	0.383	0.398	0.408	0.413
4.6	0.610	0.622	0.632	0.642	0.647	0.647
4.8	0.639	0.653	0.664	0.676	0.684	0.686
5.0	0.668	0.683	0.696	0.711	0.720	0.724
5.2	0.698	0.714	0.728	0.745	0.756	0.763
5.4	0.727	0.745	0.760	0.779	0.793	0.801
5.6	0.756	0.776	0.792	0.813	0.829	0.840
5.8	0.785	0.807	0.824	0.848	0.866	0.879
6.0	0.815	0.837	0.856	0.882	0.902	0.918
6.2	0.844	0.867	0.888	0.916	0.938	0.956
6.4	0.873	0.898	0.921	0.950	0.975	0.994
6.6	0.903	0.929	0.953	0.985	1.011	1.033
6.8	0.932	0.959	0.985	1.019	1.048	1.071
7.0	0.961	0.990	1.017	1.053	1.084	1.110
7.2	0.990	1.021	1.049	1.087	1.121	1.149
7.4	1.019	1.051	1.081	1.122	1.157	1.187
7.6	1.049	1.082	1.113	1.156	1.193	1.226
7.8	1.078	1.113	1.145	1.190	1.230	1.264
8.0	1.107	1.143	1.177	1.224	1.266	1.303
8.2	1.136	1.174	1.209	1.259	1.303	1.342
8.4	1.165	1.205	1.241	1.293	1.340	1.380
8.6	1.195	1.235	1.274	1.328	1.376	1.419
8.8	1.224	1.266	1.306	1.362	1.412	1.458
9.0	1.253	1.297	1.338	1.396	1.449	1.496
9.2	1.282	1.327	1.370	1.430	1.485	1.535
9.4	1.311	1.358	1.402	1.465	1.522	1.574
9.6	1.341	1.389	1.435	1.499	1.558	1.612
9.8	1.370	1.419	1.467	1.533	1.594	1.651
10.0	1.399	1.450	1.499	1.568	1.631	1.689
10.2	1.428	1.481	1.531	1.602	1.667	1.728
10.4	1.457	1.511	1.563	1.636	1.704	1.767
10.6	1.487	1.542	1.595	1.671	1.740	1.805
10.8	1.516	1.573	1.627	1.705	1.776	1.844
11.0	1.545	1.603	1.659	1.739	1.813	1.882
11.2	1.574	1.634	1.691	1.773	1.849	1.921
11.4	1.603	1.665	1.723	1.808	1.886	1.960
11.6	1.633	1.696	1.755	1.842	1.922	1.998
11.8	1.662	1.726	1.788	1.876	1.958	2.037
For each additional 0.2’ depth						
	+0.0292	+0.0307	+0.0321	+0.0343	+0.0364	+0.0386

Inside Diameter Wall thickness	24” 3.00”	27” 3.25”	30” 3.50”	33” 3.75”	36” 4.00”	42” 4.50”
2.4	0.116					
2.6	0.146	0.121				
2.8	0.175	0.152	0.124			
3.0	0.205	0.184	0.158			
3.2	0.235	0.216	0.192	0.163		
3.4	0.264	0.248	0.226	0.199	0.168	
3.6	0.294	0.280	0.260	0.236	0.206	
3.8	0.323	0.311	0.294	0.272	0.244	
4.0	0.353	0.343	0.328	0.308	0.282	0.216
4.2	0.383	0.375	0.362	0.344	0.321	0.259
4.4	0.412	0.407	0.571	0.548	0.520	0.448
4.6	0.642	0.632	0.616	0.595	0.569	0.502
4.8	0.683	0.674	0.661	0.643	0.619	0.556
5.0	0.723	0.717	0.706	0.690	0.668	0.610
5.2	0.764	0.760	0.751	0.737	0.718	0.663
5.4	0.805	0.803	0.796	0.784	0.767	0.717
5.6	0.846	0.846	0.841	0.831	0.816	0.771
5.8	0.886	0.889	0.886	0.879	0.866	0.824
6.0	0.927	0.932	0.931	0.926	0.915	0.878
6.2	0.968	0.975	0.976	0.973	0.964	0.932
6.4	1.009	1.018	1.022	1.020	1.014	0.985
6.6	1.049	1.061	1.067	1.068	1.063	1.039
6.8	1.090	1.103	1.112	1.115	1.113	1.093
7.0	1.131	1.146	1.157	1.162	1.162	1.147
7.2	1.172	1.189	1.202	1.209	1.211	1.200
7.4	1.212	1.232	1.247	1.256	1.261	1.254
7.6	1.253	1.275	1.292	1.304	1.310	1.308
7.8	1.294	1.318	1.337	1.351	1.359	1.361
8.0	1.335	1.361	1.382	1.398	1.409	1.415
8.2	1.375	1.404	1.427	1.445	1.458	1.469
8.4	1.416	1.447	1.473	1.493	1.508	1.523
8.6	1.457	1.490	1.518	1.540	1.557	1.577
8.8	1.498	1.533	1.563	1.587	1.607	1.630
9.0	1.539	1.576	1.608	1.635	1.656	1.684
9.2	1.579	1.619	1.653	1.682	1.706	1.738
9.4	1.620	1.662	1.698	1.729	1.755	1.791
9.6	1.661	1.704	1.743	1.776	1.804	1.845
9.8	1.701	1.747	1.788	1.823	1.854	1.899
10.0	1.742	1.790	1.833	1.871	1.903	1.953
10.2	1.783	1.833	1.878	1.918	1.953	2.006
10.4	1.824	1.876	1.924	1.965	2.002	2.060
10.6	1.864	1.919	1.968	2.012	2.051	2.114
10.8	1.905	1.962	2.013	2.060	2.100	2.167
11.0	1.946	2.005	2.058	2.107	2.150	2.221
11.2	1.987	2.048	2.103	2.154	2.199	2.275
11.4	2.028	2.091	2.148	2.201	2.249	2.328
11.6	2.068	2.133	2.193	2.249	2.298	2.382
11.8	2.109	2.176	2.239	2.296	2.347	2.436
12.0	2.150	2.219	2.284	2.343	2.397	2.490
12.2	2.191	2.262	2.329	2.390	2.446	2.543
For each additional 0.2’ depth:						
	+0.0407	+0.0429	+0.0451	+0.0472	+0.0494	+0.0537

Inside Diameter Wall thickness	48” 5.00”	54” 5.50”	60” 6.00”	66” 6.50”	72” 7.00”	78” 7.50”
4.6	0.414					
4.8	0.472					
5.0	0.530	0.430				
5.2	0.588	0.492				
5.4	0.646	0.555				
5.6	0.704	0.617	0.509			
5.8	0.762	0.679	0.576			
6.0	0.820	0.742	0.643			
6.2	0.878	0.804	0.709	0.594		
6.4	0.936	0.866	0.776	0.665		
6.6	0.994	0.929	0.843	0.736	0.608	
6.8	1.052	0.991	0.909	0.807	0.683	
7.0	1.110	1.053	0.976	0.878	0.759	
7.2	1.168	1.116	1.043	0.949	0.834	0.699
7.4	1.226	1.178	1.109	1.020	0.909	0.778
7.6	1.284	1.240	1.176	1.091	0.985	0.858
7.8	1.342	1.303	1.243	1.162	1.060	0.938
8.0	1.400	1.365	1.309	1.233	1.135	1.017
8.2	1.458	1.428	1.376	1.304	1.211	1.097
8.4	1.517	1.490	1.443	1.375	1.286	1.177
8.6	1.575	1.553	1.510	1.446	1.362	1.257
8.8	1.633	1.615	1.576	1.517	1.437	1.336
9.0	1.691	1.677	1.643	1.588	1.512	1.416
9.2	1.749	1.739	1.710	1.659	1.588	1.495
9.4	1.807	1.802	1.776	1.730	1.663	1.575
9.6	1.865	1.864	1.843	1.801	1.738	1.655
9.8	1.923	1.927	1.910	1.872	1.813	1.734
10.0	1.981	1.989	1.977	1.943	1.889	1.814
10.2	2.039	2.051	2.043	2.014	1.964	1.893
10.4	2.097	2.113	2.110	2.085	2.039	1.973
10.6	2.155	2.176	2.177	2.156	2.115	2.053
10.8	2.213	2.238	2.243	2.227	2.190	2.132
11.0	2.271	2.300	2.310	2.298	2.265	2.212
11.2	2.329	2.363	2.377	2.369	2.341	2.292
11.4	2.387	2.425	2.443	2.440	2.416	2.371
11.6	2.445	2.487	2.509	2.511	2.491	2.451
11.8	2.503	2.550	2.576	2.582	2.566	2.531
12.0	2.561	2.612	2.643	2.653	2.642	2.610
12.2	2.619	2.675	2.709	2.724	2.717	2.690
12.4	2.677	2.738	2.776	2.795	2.792	2.770
12.6	2.735	2.800	2.843	2.866	2.868	2.849
12.8	2.793	2.862	2.909	2.937	2.943	2.929
13.0	2.852	2.925	2.976	3.008	3.018	3.008
13.2	2.910	2.987	3.043	3.079	3.094	3.088
13.4	2.968	3.049	3.110	3.150	3.169	3.168
13.6	3.026	3.111	3.176	3.221	3.244	3.247
13.8	3.084	3.174	3.243	3.292	3.320	3.327
14.0	3.142	3.236	3.310	3.363	3.395	3.407
14.2	3.200	3.298	3.376	3.434	3.470	3.486
12.4	3.258	3.361	3.443	3.505	3.545	3.566
For each additional 0.2’ depth						
	+0.0580	+0.0623	+0.0667	+0.0710	+0.0753	+0.0796

Inside Diameter Wall thickness	84” 8.00”	90” 8.50”	96” 9.00”	102” 9.50”	108” 10.00”
7.8	0.795				
8.0	0.879				
8.2	0.963				
8.4	1.047	0.896			
8.6	1.131	0.984			
8.8	1.215	1.073	0.910	0.726	0.522
9.0	1.299	1.161	1.002	0.823	0.623
9.2	1.382	1.249	1.095	0.920	0.724
9.4	1.466	1.338	1.187	1.017	0.825
9.6	1.550	1.426	1.280	1.114	0.927
9.8	1.634	1.514	1.373	1.211	1.028
10.0	1.718	1.602	1.467	1.307	1.129
10.2	1.802	1.690	1.558	1.404	1.230
10.4	1.886	1.778	1.650	1.501	1.331
10.6	1.970	1.866	1.743	1.598	1.433
10.8	2.054	1.955	1.835	1.695	1.534
11.0	2.138	2.043	1.928	1.792	1.635
11.2	2.222	2.131	2.021	1.889	1.737
11.4	2.306	2.220	2.113	1.986	1.838
11.6	2.390	2.308	2.206	2.083	1.939
11.8	2.474	2.396	2.298	2.180	2.040
12.0	2.558	2.485	2.391	2.277	2.141
12.2	2.642	2.573	2.484	2.374	2.243
12.4	2.726	2.661	2.576	2.471	2.344
12.6	2.810	2.749	2.669	2.567	2.445
12.8	2.894	2.838	2.761	2.664	2.547
13.0	2.978	2.926	2.854	2.761	2.648
13.2	3.062	3.014	2.947	2.858	2.749
13.4	3.146	3.102	3.039	2.955	2.850
13.6	3.230	3.191	3.132	3.052	2.951
13.8	3.314	3.279	3.224	3.149	3.053
14.0	3.398	3.367	3.317	3.246	3.154
14.2	3.482	3.455	3.410	3.343	3.255
14.4	3.566	3.544	3.502	3.440	3.357
14.6	3.649	3.632	3.595	3.537	3.458
14.8	3.733	3.720	3.687	3.634	3.559
15.0	3.817	3.809	3.780	3.730	3.660
15.2	3.901	3.897	3.873	3.827	3.761
15.4	3.985	3.985	3.965	3.924	3.863
15.6	4.069	4.074	4.058	4.021	3.964
15.8	4.153	4.162	4.150	4.118	4.065
16.0	4.237	4.250	4.243	4.215	4.166
16.2	4.321	4.338	4.335	4.312	4.268
16.4	4.405	4.426	4.428	4.409	4.369
16.6	4.488	4.515	4.521	4.506	4.470
16.8	4.572	4.603	4.613	4.603	4.571
17.0	4.656	4.691	4.706	4.699	4.672
17.2	4.740	4.780	4.798	4.796	4.774
17.4	4.824	4.868	4.891	4.893	4.875
17.6	4.908	4.956	4.984	4.990	4.976
For each additional 0.2’ depth:					
	+0.0839	+0.0883	+0.0926	+0.0969	+0.1012

TRENCH BACKFILL TABLE FOR ELLIPTICAL PIPES



EXAMPLE

Given:	Pipe = 38” Rise x 60” Span, Storm Sewer Average Depth, D = 4.6 ft. Trench Length = 82.5 ft.	
Find:	Cubic Yards or TRENCH BACKFILL	
Solution:	From table, CY/LF x Trench Length TRENCH BACKFILL	= 0.645 = x 82.5 = 53.2 CY

NOTE: If the field engineer measures a width of trench less than the maximum permitted, the values included herein will be of no value. The actual volume of TRENCH BACKFILL used will therefore have to be calculated using the following formula:

$$Cubic\ Yards = \left[(H' x\ W') - \left(\frac{Pipe\ End\ Area}{2}\right) x\ L' x\ 1/27\right]$$

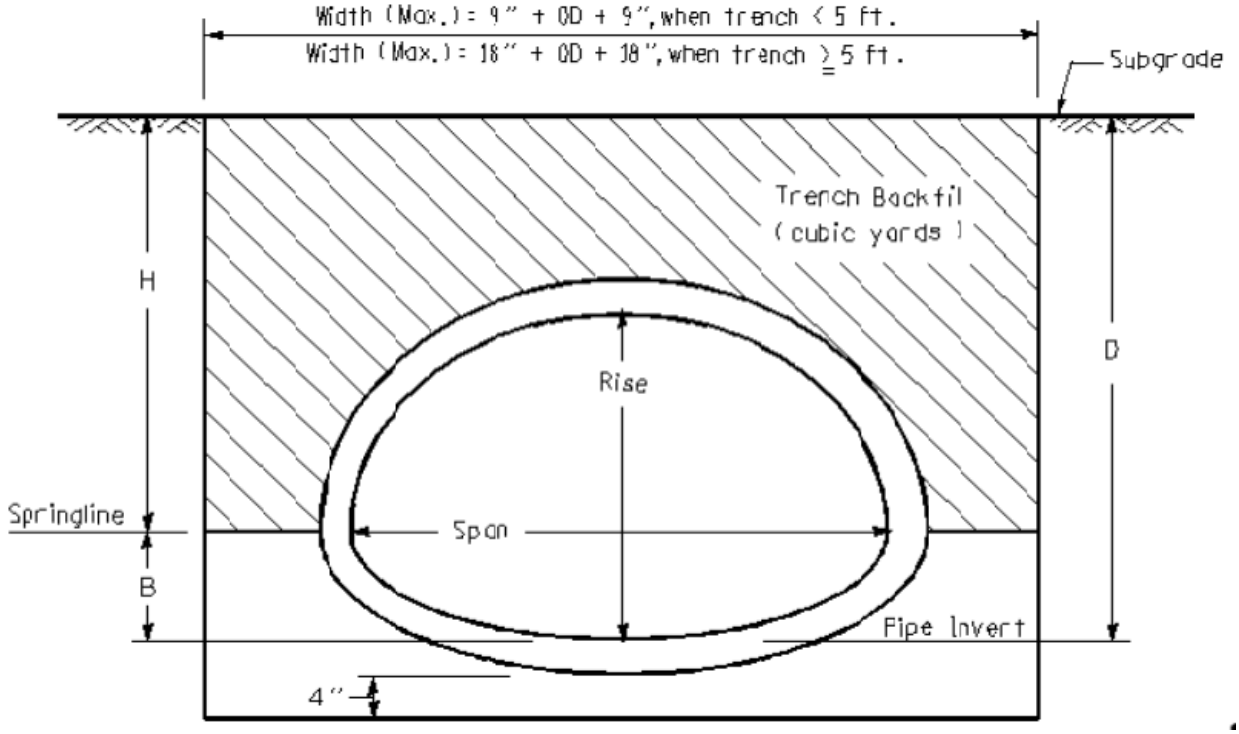
VOLUME OF TRENCH BACKFILL (CY) PER LINEAR FOOT OF ELLIPTICAL STORM SEWER PIPE

Eq. Round Size, in.	18	24	27	30	33	36	39	42
Rise, in.	14	19	22	24	27	29	32	34
Span, in.	23	30	34	38	42	45	49	53
Wall Thickness, in.	2.75	3.25	3.50	3.75	3.75	4.50	4.75	5.00
Pipe End Area, sq. ft.	3.03	5.08	6.49	7.82	9.31	11.19	13.24	15.12
1.4	0.061							
1.6	0.090							
1.8	0.118							
2.0	0.147	0.109						
2.2	0.176	0.143	0.114					
2.4	0.205	0.177	0.150	0.130				
2.6	0.233	0.210	0.186	0.169	0.135			
2.8	0.262	0.244	0.223	0.208	0.176	0.146		
3.0	0.291	0.277	0.259	0.247	0.218	0.191		
3.2	0.319	0.311	0.296	0.286	0.260	0.235	0.196	
3.4	0.348	0.345	0.332	0.326	0.301	0.280	0.243	0.216
3.6	0.377	0.378	0.369	0.365	0.343	0.324	0.290	0.266
3.8	0.406	0.412	0.405	0.404	0.385	0.369	0.337	0.316
4.0	0.434	0.446	0.441	0.443	0.426	0.413	0.384	0.366
4.2	0.463	0.479	0.478	0.482	0.468	0.458	0.432	0.416
4.4	0.492	0.713	0.708	0.710	0.692	0.679	0.649	0.632
4.6	0.743	0.758	0.755	0.761	0.745	0.735	0.708	0.693
4.8	0.783	0.803	0.803	0.811	0.797	0.790	0.766	0.754
5.0	0.823	0.848	0.805	0.861	0.850	0.846	0.824	0.815
5.2	0.863	0.892	0.898	0.912	0.903	0.902	0.883	0.876
5.4	0.903	0.937	0.945	0.962	0.956	0.957	0.941	0.937
5.6	0.943	0.982	0.993	1.012	1.008	1.013	0.999	0.998
5.8	0.982	1.027	1.040	1.063	1.061	1.068	1.058	1.059
6.0	1.022	1.071	1.088	1.113	1.114	1.124	1.116	1.120
6.2	1.062	1.116	1.136	1.163	1.167	1.179	1.174	1.182
6.4	1.102	1.161	1.183	1.214	1.220	1.235	1.233	1.243
6.6	1.142	1.206	1.231	1.264	1.272	1.290	1.291	1.304
6.8	1.181	1.250	1.278	1.314	1.325	1.346	1.349	1.365
7.0	1.221	1.295	1.326	1.364	1.378	1.402	1.408	1.426
7.2	1.261	1.340	1.373	1.415	1.431	1.457	1.466	1.487
7.4	1.301	1.385	1.421	1.465	1.483	1.513	1.524	1.548
7.6	1.341	1.429	1.468	1.515	1.536	1.568	1.583	1.609
7.8	1.381	1.474	1.516	1.566	1.589	1.624	1.641	1.670
8.0	1.420	1.519	1.563	1.616	1.642	1.679	1.699	1.732
8.2	1.460	1.564	1.611	1.666	1.695	1.735	1.758	1.793
8.4	1.500	1.608	1.658	1.717	1.747	1.790	1.816	1.854
8.6	1.540	1.653	1.706	1.767	1.800	1.846	1.874	1.915
8.8	1.580	1.698	1.753	1.817	1.853	1.902	1.933	1.976
9.0	1.619	1.743	1.801	1.868	1.906	1.957	1.991	2.037
For each additional 0.2 ft. depth								
	+0.040	+0.045	+0.048	+0.050	+0.053	+0.056	+0.058	+0.061

Eq. Round Size, in.	**48**	**54**	**60**	**66**	**72**	**78**	**84**	**90**
Rise, in.	38	43	48	53	58	63	68	72
Span, in.	60	68	76	83	91	98	106	113
Wall Thickness, in.	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00
Pipe End Area, sq. ft.	18.98	24.00	29.61	35.45	42.20	49.12	57.02	64.30
3.8	0.258							
4.0	0.312							
4.2	0.367	0.418						
4.4	0.579	0.489						
4.6	0.645	0.561	0.455					
4.8	0.711	0.633	0.532					
5.0	0.777	0.704	0.609	0.490				
5.2	0.843	0.776	0.686	0.572				
5.4	0.909	0.847	0.763	0.654				
5.6	0.975	0.919	0.841	0.736	0.614			
5.8	1.041	0.991	0.918	0.818	0.701			
6.0	1.107	1.062	0.995	0.900	0.789	0.653		
6.2	1.173	1.134	1.072	0.982	0.877	0.745		
6.4	1.239	1.205	1.149	1.064	0.964	0.838	0.694	
6.6	1.305	1.277	1.226	1.146	1.052	0.931	0.792	
6.8	1.371	1.349	1.304	1.228	1.140	1.023	0.891	0.768
7.0	1.437	1.420	1.381	1.311	1.227	1.116	0.989	0.871
7.2	1.503	1.492	1.458	1.393	1.315	1.208	1.087	0.974
7.4	1.570	1.564	1.535	1.475	1.402	1.301	1.185	1.077
7.6	1.636	1.635	1.612	1.557	1.490	1.394	1.283	1.180
7.8	1.702	1.707	1.689	1.639	1.578	1.486	1.381	1.283
8.0	1.768	1.778	1.766	1.721	1.665	1.579	1.480	1.386
8.2	1.834	1.850	1.844	1.803	1.753	1.671	1.578	1.489
8.4	1.900	1.922	1.921	1.885	1.841	1.764	1.676	1.593
8.6	1.966	1.993	1.998	1.967	1.928	1.857	1.774	1.696
8.8	2.032	2.065	2.075	2.049	2.016	1.949	1.872	1.799
9.0	2.098	2.136	2.152	2.132	2.104	2.042	1.970	1.902
9.2	2.164	2.208	2.229	2.214	2.191	2.134	2.068	2.005
6.4	2.230	2.280	2.307	2.296	2.279	2.227	2.167	2.108
9.6	2.296	2.351	2.384	2.378	2.367	2.320	2.265	2.211
9.8	2.362	2.423	2.461	2.460	2.454	2.412	2.363	2.314
10.0	2.428	2.494	2.538	2.542	2.542	2.505	2.461	2.417
10.2	2.494	2.566	2.615	2.624	2.630	2.597	2.559	2.520
10.4	2.560	2.638	2.692	2.706	2.717	2.690	2.657	2.623
10.6	2.626	2.709	2.770	2.788	2.805	2.783	2.755	2.726
10.8	2.692	2.781	2.847	2.870	2.893	2.875	2.854	2.830
11.0	2.758	2.852	2.924	2.953	2.980	2.968	2.952	2.933
11.2	2.824	2.924	3.001	3.035	3.068	3.060	3.050	3.036
11.4	2.891	2.996	3.078	3.117	3.156	3.153	3.148	3.139
For Each additional 0.2 ft. depth:								
	+0.066	+0.072	+0.077	+0.082	+0.088	+0.093	+0.098	+0.103

Eq. Round Size, in.	96	102	108	114	120	132	144
Rise, in.	77	82	87	92	97	106	116
Span, in.	121	128	136	143	151	66	180
Wall Thickness, in.	9.50	9.75	10.00	10.50	11.00	12.00	13.00
Pipe End Area, sq. ft.	73.30	81.66	91.04	101.08	112.28	134.72	159.55
7.2	0.811						
7.4	0.919						
7.6	1.028						
7.8	1.137	0.970					
8.0	1.245	1.084					
8.2	1.354	1.197	1.025				
8.4	1.463	1.310	1.144				
8.6	1.517	1.423	1.262	1.071			
8.8	1.680	1.537	1.381	1.194			
9.0	1.789	1.650	1.499	1.318	1.119		
9.2	1.897	1.763	1.618	1.441	1.248		
9.4	2.006	1.877	1.736	1.564	1.377		
9.6	2.115	1.990	1.855	1.688	1.506		
9.8	2.223	2.103	1.973	1.811	1.635		
10.0	2.332	2.216	2.092	1.935	1.764	1.400	
10.2	2.440	2.330	2.210	2.058	1.893	1.539	
10.4	2.549	2.443	2.329	2.182	2.022	1.679	
10.6	2.658	2.556	2.447	2.305	2.151	1.818	
10.8	2.766	2.669	2.566	2.429	2.280	1.958	1.502
11.0	2.875	2.783	2.684	2.552	2.409	2.097	1.651
11.2	2.984	2.896	2.803	2.676	2.538	2.237	1.801
11.4	3.092	3.009	2.921	2.799	2.667	2.376	1.950
11.6	3.201	3.123	3.040	2.922	2.796	2.516	2.100
11.8	3.310	3.236	3.159	3.046	2.925	2.655	2.249
12.0	3.418	3.349	3.277	3.169	3.054	2.795	2.398
12.2	3.527	3.462	3.396	3.293	3.183	2.934	2.548
12.4	3.636	3.576	3.514	3.416	3.312	3.074	2.697
12.6	3.744	3.689	3.633	3.540	3.441	3.213	2.847
12.8	3.853	3.802	3.751	3.663	3.570	3.353	2.996
13.0	3.961	3.915	3.870	3.787	3.699	3.492	3.145
13.2	4.070	4.029	3.988	3.910	3.828	3.632	3.295
13.4	4.179	4.142	4.107	4.034	3.957	3.771	3.444
13.6	4.267	4.255	4.225	4.157	4.086	3.911	3.593
13.8	4.396	4.369	4.344	4.280	4.215	4.050	3.743
14.0	4.505	4.482	4.462	4.404	4.344	4.190	3.892
14.2	4.613	4.595	4.581	4.527	4.473	4.329	4.042
14.4	4.722	4.708	4.699	4.651	4.602	4.469	4.191
14.6	4.831	4.822	4.818	4.774	4.731	4.608	4.340
14.8	4.939	4.935	4.936	4.898	4.860	4.748	4.490
For each additional 0.2 ft. depth:							
	+0.109	+0.113	+0.119	+0.123	+0.129	+0.140	+0.149

TRENCH BACKFILL FOR ARCH PIPES



W	= Width of Trench (ft.)
D	= Depth from Subgrade to Pipe Invert (ft.)
H	= Height of Trench Backfill Limits (ft.) = (D – B)
B	= Distance from Pipe Invert to Springline (ft.) (See Table)
L	= Length of Trench (ft.)
A	= End Area of Pipe above Springline (Sq. ft.) (See Table)

$$Volume\ (CY) = [(H\ x\ W) - A]\ x\ L\ x\ 1/27$$

This formula shall be used by the designer or field engineer to determine the volume of TRENCH BACKFILL to be paid for when backfilling storm sewer trenches utilizing reinforced concrete ARCH PIPE. Maximum trench widths permitted by Article 550.04 of the Standard Specifications for Road and Bridge Construction are used.

Equivalent Round Size (in.)	Rise (in.)	Span (in.)	Wall Thickness (in.)	End Area Above Springline (sq. ft.)	B (ft.)
15	11.00	18.00	2.25	1.08	0.39
18	13.50	22.00	2.50	1.42	0.50
21	15.50	26.00	2.75	1.94	0.52
24	18.00	28.50	3.00	2.77	0.49
27	22.50	36.25	3.50	4.20	0.64
30	22.50	36.25	3.50	4.20	0.64
36	26.63	43.75	4.00	6.04	0.71
42	31.31	51.13	4.50	8.20	0.84
48	36.00	58.50	5.00	10.67	0.97
54	40.00	65.00	5.50	13.07	1.08
60	45.00	73.00	6.00	16.34	1.22
66	54.00	88.00	7.00	23.76	1.42
72	54.00	88.00	7.00	23.76	1.42
84	62.00	102.00	8.00	32.10	1.55
90	72.00	115.00	8.50	39.65	1.98
96	77.25	122.00	9.00	46.07	2.03
108	87.13	138.00	10.00	59.07	2.24
120	96.88	154.00	11.00	71.05	2.61
132	106.50	168.75	10.00	72.95	3.79

EXAMPLE

Given: Pipe = 30” Round Size Eq. Rise = 22.5’, Span = 36.25”
Average Depth, D = 4.7 ft.
Trench Length = 82.3 ft.
Width, W = 6.6 ft.

Find: Cubic Yards or TRENCH BACKFILL

Solution: From table, End Area, A = 4.20 sq. ft.
B = 0.64 ft.
Pay Height, H = D – B = 4.70 – 0.64 = 4.06 ft.

Volume: $= [(H\ x\ W) - A]\ x\ L\ x\ 1/27$
$= [(4.06)(6.6) - 4.20]\ (82.3)(1/27)$

TRENCH BACKFILL = 68.9 CY

Section F

DOCUMENTATION EXAMPLES

Illinois Department of Transportation

Resident Engineer's Diary

Airport: Quad City International Date: 9/28/2011

Contractor: General Construction IL Project No.: MLI-1234 AIP Project No.: 3-17-0068-39

Temperature: 38-57˚F Wind: 10 mph Weather Conditions: Sunny

Status: ☒ Active ☐ Suspended Jobsite Conditions: ☒ Workable ☐ Non-workable

Controlling Item: AR152410 Unclassified Excavation

Workforce

Consultant (# of people, hours): JPA - 10 hours, KLD - 10 hours

Contractor (# of people, equipment, hours):

General Construction, 15 men @ 9 hours
1-Paver, 1-Backhoe, 3-Rollers, 1-Blade, 1-Bob-Cat

Daily Work

Pay items / General Location:

AR201610 Bit. Base Cse., AR603510 Bit. Tack Coat, AR152410 Unclassified Ex.
Work done on Taxiway B

Instructions to Contractor / Unusual Events:

Fix soft subgrade, some areas too high and had to be trimmed

Verbal Approvals (official & item): IDOT/Div. of Aero approval to repair section of unstable subgrade -- Undercut 1' x 25' x 50' section of subgrade, install oversize rock and CA6, Time and Material

Additional Work (change order, etc.): N/A

Official Visitors: IDOT/Div. of Aeronautics Construction Engineer, Secretary of Transportation

Materials Deliveries (material, quantity, quality) / Testing (test, location, corrective action):

900 ton HMA - AR201610, Emulsion Tack Coat - AR603510

Other: N/A

Calendar Days: 105 Awarded
80 Charged
25 Remaining

DBE Onsite?: (yes or no) No
Own forces used?: ☐
Own equipment used?: ☐

Submitted By: John P. Adams Firm: B.E.S.T. Company Date: 9/28/2011

AER 36 (Rev. 05/11/10)

Illinois Department of Transportation

Diary Cover Sheet

Airport: Quad City International Year: 2011

IL Project No.: MLI-1234 AIP Project No.: 3-17-0068-39

Project Description: Relocate Taxiway A

Contractor Information:

General Construction
500 E. Main St.
Rock Falls, IL 61401
(815) 555-4155

Printed Name: John P. Adams Signature: John P. Adams

☒ Resident Engineer ☐ Resident Technician

If Found, Return to: **Illinois Department of Transportation**
Division of Aeronautics
1 Langhorne Bond Drive
Springfield, IL 62707-8415

Personnel Assigned to Project:

Name	Initials (handwritten)
Carl Wright	CRW
Les Wrong	LNW
Ken Doowit	KLD

AER 35 (Rev. 03/07/11)

Illinois Department of Transportation

Quantity Book Cover Sheet

County

Section Quad City International

Route

District
Contract No. QU001
Job No. MLI-1234

Project 3-17-0068-39

Contractor General Construction
Address 500 E. Main St.
Rock Falls, IL 61401
Phone No. (815) 555-4155

If found please return to the Illinois Department of Transportation

Address Division of Aeronautics
1 Langhorne Bond Dr.
Springfield, IL 62707-8415

Resident *John P. Adams*

BC 623 (Rev. 4/98)

Illinois Department of Transportation

Quantity Sheet

County 161

Section Quad City International

Route

District 02
Contract No. QU001
Job No. SLT-81-001-02

Project 3-17-0068-39

Page 35
Item AR401610
Bituminous Surface Course
Fund AR10P01
Plan Quantity 3397.000
Unit Measure TON
Contract Unit Price 77.08

Authorizations

Number	Date App'vd	Add	Deduct	Total
8	10/4/11	101.9		3,498.9

Cnty	Const Sfty	Quantity
161	AE03	3397.000

Date	Station to Station Location or	Quantities Placed This Date	Quantities Placed To Date	Quantities Placed Pay Est	Evidence of Material Inspection	Progress Document Source
9/8/11	STA 62+03 → 118+27 NB	885.3	885.3		Daily Plant Report & Tickets & Test	Tickets
9/9/11	STA 118+27 → 175+79 NB	905.4	1,790.7		" "	"
9/12/11	STA 175+19 → 119+27 SB	880.4	2,671.1		" "	"
9/13/11	STA 119+29 → 62+03 SB	892.3	3,563.4	#5/3397	" "	"
9/21/11	Deduct for Max Pay	-64.5	3,498.9	#6		
			FINAL			
	Max. Pay = 3,397 tons x 1.03 = 3,498.9 tons → Deduct Pay Qty					
	Quantity Placed 3,563.4 – Max. Pay 3,498.9 = Deduct 64.5					
	The surface was checked and no variations found. See FB #3, p. 35.					

Source of documentation
for final quantity: Tickets

For all tonnage items
weighed on platform scales:
Scales checked by
Dept. Of Agriculture
Date on decal 7/22/11
Identification No. 125764
Scale Location Rock Island
Quarry

Inspection Reports

Date	Mistic Report No. or Source or Manufacturer	Amount	Total to Date	Transferred to Other Code or Remarks

Illinois Department of Transportation

Quantity Sheet

County 161

Section Quad City International

Route

District 02
Contract No. QU001
Job No. SLT-81-001-02

Project 3-17-0068-39

Page 37
Item AR800004
Pavement Patching
Fund AR10P01
Plan Quantity 327.800
Unit Measure SQ YD
Contract Unit Price 64.0000

Authorizations

Number	Date App'vd	Add	Deduct	Total
3	7/28/11	35.4		363.2

Cnty Const Sfty	Quantity
161 AE03	327.800

Date	Station to Station Location or	Quantities Placed			Evidence of Material Inspection	Progress Document Source
		This Date	To Date	Pay Est		
7/11/11	STA 69+34 → 84+21 NB	83.2	83.2		Plant Report & Tickets	FB #3, p. 12
7/12/11	STA 96+13 → 130+01 NB	121.4	204.6		" "	FB #3, p. 12
7/14/11	STA 125+16 → 74+95 SB	95.4	300.0		" "	" , p. 16
7/15/11	STA 74+51 → 62+49 SB	63.2	363.2	#3/327.8	" "	" , p. 24
				#4/363.2		
			FINAL			

Source of documentation
for final quantity: FB #3, p.8-24 for Qtys & Depths

BC 625 (Rev. 4/98)

Illinois Department of Transportation

Inspector's Daily Report (IDR)

Date: 10/25/2011

	Initial(s)	Date
Inspected by:	CRW	10/25/2011
Measured by:	CRW	10/25/2011
Calculated by:	CRW	10/25/2011
Checked by:	LNW	10/25/2011

Airport: Quad City International

Contractor or Sub.: Interstate Landscaping

IL Proj. No.: MLI-1234

Weather: Sunny 90°

AIP Proj. No.: 3-17-0068-39

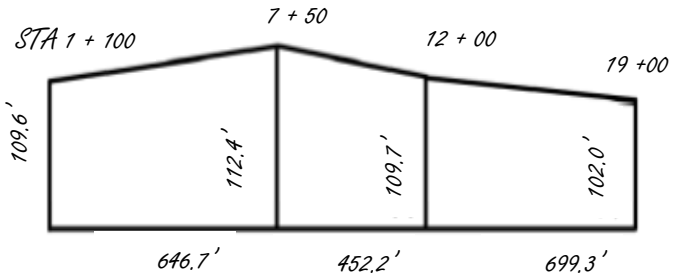
Item Code #	FASC ID	Item	Location	Quantity and Units	Evidence of Material Inspection (Optional)	Posted in Q Book
AR901510		Seeding	Sta 1+00 TO 19+00 LT	4.5 Acre	CERT and results of Seed Analysis from Registered Seed Technologist	✓
AR908510		Mulching	Sta 1+00 TO 19+00 LT	4.5 Acre	VIS	✓

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

☒ a final field measurement (item no.: AR901510, AR908510)

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.

1/2(109.6 + 112.4) x 646.7 = 71,783.7 SF
1/2(112.4 + 109.7) x 452.2 = 50,216.8
1/2(109.7 + 102.0) x 699.3 = 74,020.9
196,021.4 SF
196,021.4 SF x acre = 4.5 AC
43,560 SF



AER 628 (04/23/09)

Illinois Department of Transportation

Inspector's Daily Report (IDR)

Date: 8/15/2011

	Initial(s)	Date
Inspected by:	LNW	8/15/2011
Measured by:	LNW	8/15/2011
Calculated by:	LNW	8/15/2011
Checked by:	CRW	8/16/2011

Airport: Quad City International

IL Proj. No.: MLI-1234

AIP Proj. No.: 3-17-0068-39

Contractor or Sub.: Stan's Sewer Co.

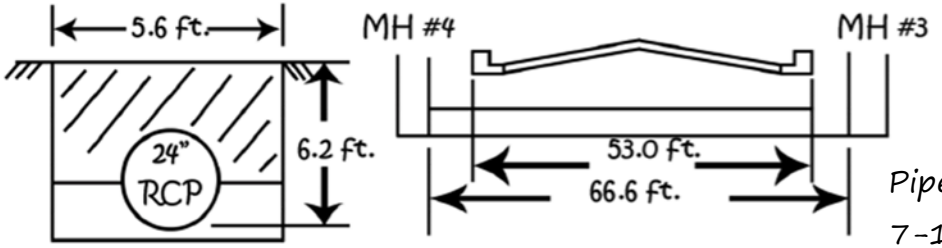
Weather: Clear 70's

Item Code #	FASC ID	Item	Location	Quantity and Units	Evidence of Material Inspection (Optional)	Posted in Q Book
AR701830		Trench Backfill	MH#3 to MH#4	55.2 CY	Approved source & TICK	✓
AR701424		24" RCP, CL III	MH#3 to MH#4	66.6 LF	LIST	✓

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

☒ a final field measurement (item no.: AR701830, AR701424)

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.



Pipe Markings: C-76-III
7-12-07 CMCM

Trench Backfill:
Pay Length = 2' + 53' + 2' = 57.0'
Trench Width > Max Pay Width
Therefore Use Table

$$0.968 \frac{CY}{FT} x\ 57.0' = 55.2\ CY$$

AER 628 (04/23/09)

Illinois Department of Transportation

Inspector's Daily Report (IDR)

9/15

Date: 9/15/2011

	Initial(s)	Date
Inspected by:	CRW	9/15/2011
Measured by:	CRW	9/15/2011
Calculated by:	CRW	9/15/2011
Checked by:	JPA	9/16/2011

Airport: Quad City International

Contractor or Sub.: ACME CONSTR.

IL Proj. No.: MLI-1234

Weather: Clear 90°

AIP Proj. No.: 3-17-0068-39

Item Code #	FASC ID	Item	Location	Quantity and Units	Evidence of Material Inspection (Optional)	Posted in Q Book
AR152410		Unclassified Earth Excavation	2 + 60 TO 17 + 00	7728 CY	N/A	✓

This is: ☒ an estimated progress measurement (item no.: AR152410)

☐ 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.

BY COUNT: 490 LOADS HAULED, 70 LOADS EACH
EQUIPMENT: 4 GMC'S (TS-24) & 3 CATS (621)
TS-24: 4 x 70 LOADS x 24 CY/LOAD x 80% = 5376 CY
621: 3 x 70 LOADS x 14 CY/LOAD x 80% = 2352 CY
TOTAL = 7728 CY

AER 628 (04/23/09)

Illinois Department of Transportation

Inspector's Daily Report (IDR)

Date: 5/5/2011

	Initial(s)	Date
Inspected by:	LNW	5/5/2011
Measured by:	LNW	5/5/2011
Calculated by:	LNW	5/5/2011
Checked by:	CRW	5/5/2011

Airport: Quad City International

Contractor or Sub.: W.E. Build, Inc.

IL Proj. No.: MLI-1234

Weather: Cloudy 61°

AIP Proj. No.: 3-17-0068-39

Item Code #	FASC ID	Item	Location	Quantity and Units	Evidence of Material Inspection (Optional)	Posted in Q Book
AR150510		Eng. Field Office	Jobsite	0.19 LS	N/A	✓

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

☒ a final field measurement (item no.: AR150510)

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.

Job scheduled for 74 calendar days
2 week progress payment from xx/xx/xxxx to xx/xx/xxxx
(Pay Estimate #X) >> 14/74 = 0.19 Lump Sum

AER 628 (04/23/09)

Illinois Department of Transportation

Inspector's Daily Report (IDR)

Date: 9/15/2011

	Initial(s)	Date
Inspected by:	CRW	9/15/2011
Measured by:	CRW	9/15/2011
Calculated by:	CRW	9/15/2011
Checked by:	LNW	9/16/2011

Airport: Quad City International

Contractor or Sub.: ACME

IL Proj. No.: MLI-1234

Weather: Clear 75°

AIP Proj. No.: 3-17-0068-39

Item Code #	FASC ID	Item	Location	Quantity and Units	Evidence of Material Inspection (Optional)	Posted in Q Book
AR602510		Bituminous Prime Coat	STA 1+50 TO 22+50 (Runway 9/27)	2,131 Gallons	Bill of Lading	✓

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

☒ a final field measurement (item no.: AR602510)

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.

Weight Ticket #2604
Specific Gravity on Bill of Lading = 0.913
9/15/2011
Weight of Water = 8.328 lbs./gal.

Distributor Loaded	23,700 lbs.
Distributor After Use	7,500 lbs.
Net Weight of Prime Used	16,200 lbs.

Prime Used = 16,200 lbs. X 1/8.328 X 1/0.913 = 2,131 gal.

AER 628 (04/23/09)

Illinois Department of Transportation

Inspector's Daily Report (IDR)

Date: 8/18/2011

	Initial(s)	Date
Inspected by:	KLD	8/18/2011
Measured by:	KLD	8/18/2011
Calculated by:	KLD	8/18/2011
Checked by:	CRW	8/19/2011

Airport: Quad City International

Contractor or Sub.: B&M Constr

IL Proj. No.: MLI-1234

Weather: Sunny 80°

AIP Proj. No.: 3-17-0068-39

Item Code #	FASC ID	Item	Location	Quantity and Units	Evidence of Material Inspection (Optional)	Posted in Q Book
AR501604		4" PCC Sidewalk	RT 0+00 – RT 5+00	2,500 SF	Plant Report & Tickets	✓

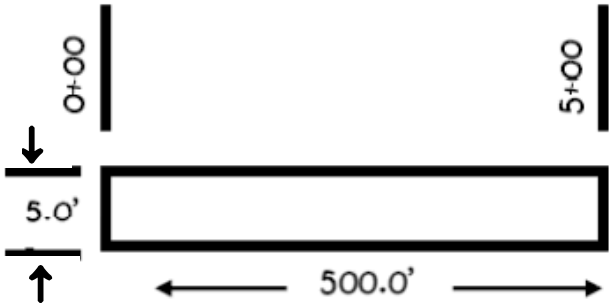
This is: ☐ an estimated progress measurement (item no.:)

☒ a final field measurement (item no.: AR501604)

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.

Depth Checks

Sta. 0+00 = 4 1/8"
1+00 = 4 1/4"
2+00 = 4 1/4"
3+00 = 4 3/8"
4+00 = 4 1/8"
5+00 = 4 1/8"



5.0' x 500.0' = 2,500.0 SF

AER 628 (04/23/09)

Illinois Department of Transportation

Inspector's Daily Report (IDR)

Date: 5/6/2011

	Initial(s)	Date
Inspected by:	LNW	5/6/2011
Measured by:	LNW	5/6/2011
Calculated by:	LNW	5/6/2011
Checked by:	KLD	5/6/2011

Airport: Quad City International

Contractor or Sub.: Wemil Company

IL Proj. No.: MLI-1234

Weather: Sunny 60 F

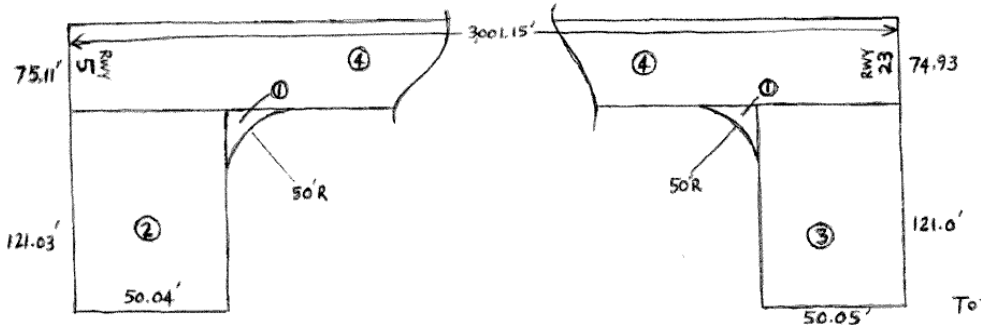
AIP Proj. No.: 3-17-0068-39

Item Code #	FASC ID	Item	Location	Quantity and Units	Evidence of Material Inspection (Optional)	Posted in Q Book
AR401650		Bituminous Pav't Milling	Runway 5/23	26,482 SY	N/A	✓

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

☒ a final field measurement (item no.: AR401650)

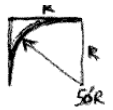
Remarks: (e.g., instruction to Contractor, special problems, sketches with dimensions for final measurements, computations, number of persons working, hours worked) Use reverse side, if needed.



Area Calcs.

① Fillet = 0.215 R^2
= 537.5/9
= 59.7 SY
(2) 59.7 = 119.4 SY

$r^2 - \frac{1}{4}\pi r^2$
$1 - \frac{\pi}{4}$
0.215



② $\frac{50.04' \times 121.03'}{9}$ = 672.9 SY

③ $\frac{50.05' \times 121.0'}{9}$ = 673.0 SY

④ $\frac{75.11' + 74.93'}{2} \times 3001.15'/9$ = 25,016.3 SY

Total = 119.4 + 672.9 + 673.0 + 25,016.3 = 26,481.6 SY

AER 628 (04/23/09)

Illinois Department of Transportation

Inspector's Daily Report (IDR)

			Initial(s)	Date		
Date:	9/1/2011				Airport:	Quad City International
		Inspected by:	CRW	9/1/2011		
Contractor or Sub.:	ACME	Measured by:	CRW	9/1/2011	IL Proj. No.:	MLI-1234
		Calculated by:	CRW	9/1/2011		
Weather:	Cloudy, 50°F	Checked by:	JPA	9/2/2011	AIP Proj. No.:	3-17-0068-39

Item Code #	FASC ID	Item	Location	Quantity and Units	Evidence of Material Inspection (Optional)	Posted in Q Book
AR901540		Turfing Lime	Entire Job	82.0 Tons	Tickets from approved source	✓
					Charleston Stone Co.	
					@ Charleston, IL	
					West Stockpile	
					See Wt. Tickets in File #6	

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

☒ a final field measurement (item no.: AR901540)

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.

Plans require 4 Tons/Acre to be applied to 20 acres.
From Mistic (MIRB 25D): The 4 year conversion factor = 1.28
Total Tons Required = 4 Tons/Acre x 20 Acres x 1.28 = 102.4 Tons
Actual Tons Delivered = 105
Pay Tons = 105/1.28 = 82.0 (Max Pay = 80 Tons x 108% = 86.4 Tons)

AER 628 (04/23/09)

Field Book Example – Inside Cover & Index Pages

Field Book #3

If Found, Please Return to:

Name: Illinois Department of Transportation
Division of Aeronautics
1 Langhorne Bond Drive
Springfield, IL 62707-8415
217-785-8500

161
Quad City International
02
QU001
SLT-81-001-02
3-17-0068-39

This book is published on a fine 50% cotton-content ledger paper, specially treated for maximum archival service, and protected by a water resistant surface sizing.

INDEX OF PAGES

Illinois Department of Transportation

Hot Mix Asphalt (HMA)
Paving Daily Record

Date: 4/11/11

Airport: Lawrenceville-Vincennes IL Project No.: LWV-3700 Mix Design No.: A36831SB

Pay Item No., Description, Pay AR401610, Bituminous Surface Course, Tons

Name: U. B. Dunn Contractor: KrustyKon

☒ Resident Engineer ☐ Resident Technician

Paving Location: Automobile parking lot and entrance road

Inspectors/Visitors: Lou Ferrigno, Carl Weathers, Michael Beign, U.S. Secretary of Transportation Ray LaHood (visited from 10am-Noon)

Process Control

Weather	Time	Temp.	Conditions	Notes
	0400	30 °F	Cloudy	Delayed paving until acceptable light and temperature conditions were present
	0900	50 °F	Sunny	Began paving
	1430	64 °F	Partly Sunny	

Equipment	Manufacturer/Model	Tach Check or Tire		Amplitude
Paver	Barber-Green SA 131	Reed Tach	3000 VPM	
Mat'l Transfer	N/A			
Breakdown Roller	N/A	Reed Tach		☐ High ☐ Med ☐ Lo
Vibratory Roller	Dynapac CC42A	Reed Tach	2400	☐ High ☒ Med ☐ Lo
Pneumatic Roller	Ingram	Tire Pressure	80 psi	
Finish Roller	Gallion V05 2-66b, static mode			

Max. Vib. Roller Speed	2400 VPM / 10 impacts/foot	= 240 ft./min	Max. Paver Speed	240 ft/min / 9 passes	X .9	= 24 ft/min

Paving Check	Time	Temp. in Truck	Temp. Behind Paver	Paver Speed
	0800	295	280	
	1200	290	270	
	1400	310	290	

Independent Weight Check Needed Today: ☒ Yes ☐ No Scale Decal Number: IL27a

Total Running Yield Checks

Starting Station: 1+00 Entrance Road

Time	Total Tons Placed	Check Station	Length Placed (1)	Theo. Tons (2)	Yield % (3)	Time	Total Tons Placed	Check Station	Length Placed (1)	Theo. Tons (2)	Yield % (3)
0930	17.0	2+00	100	14.9	114						
1100	45.0	4+00	300	44.7	101						

(1) Length Placed = Starting Station – Check Station
(2) Theo. Tons = (Length x Mat Width x Lbs./Sq. Yd. X Mat Thickness) + (9 x 2000)
(3) Yield % = (Total Tons Placed ÷ Theo. Tons) x 100

Daily Yield Check

$$\text{Daily Yield} = \frac{\text{Total Actual Tons Placed}}{(^{\text{lbs}}/_{\text{SY x in}})\text{x Length (ft) x Width (ft) x Mat Thickness(in)} \div 18000} \text{ x } 100 =$$

Start Sta. = 1+00, Ending Sta. = 7+70 L = (770 – 100) = 670 ft

Yield = [101.22 tons ÷ (112 × 670 × 12 × 2 ÷ 18000)] × 100 = 101.17%

Paving Discrepancies:

Surface Variations				
Tested by:	LF	Station/Location	Station/Location	Station/Location
Check one below:				
☐	None found today			
☒	Found variations & finish roller was able to correct variations	3+00 to	3+50	
☐	Found variations that require corrective action or deduction.			

Other (segregation, joint transitions/density, tearing/shoving, etc.)		
Issue	**Location**	**Resolution**
Tearing	6+00 to 6+10	Temp too low behind paver (250°); issue corrected at plant Directed contractor to remove and replace

Notes / Calculations

Depth Checks, uncompacted

Proposed 2" Surface – assume additional thickness of 1/4" per inch uncompacted (2" x 1.25 = 2.5")

	1' R of CL	5' R.	10' R.
1+20	2.6"	2.7"	2.7"
2+85	2.5"	2.5"	2.6"
4+70	2.5"	2.6"	2.5"
6+30	2.5"	2.6"	2.6"

Signatures

Measured by: Lou Ferrigno Date: 4/11/11

Calculated by: Michael Beign Date: 4/11/11

Checked by: U. B. Dunn Date: 4/12/11

Illinois Department of Transportation

Hot Mix Asphalt (HMA)
Paving Daily Record

Specification Reference

Note: Not all applicable specs are shown

Date: _____

Airport: _____ Mix Design No.: _____

Pay Item No., Description: _____

Name: _____

☐ Resident Engineer

Paving Location: _____

Inspectors/Visitors: _____

Process Control

Weather	Time	Temp.	Conditions	Notes
		401-4.1		
		401-4.10		Not on wet base, base temp, ambient temp, lighting

Equipment	Manufacturer/Model	Tach Check or Tire		Amplitude
Paver	401-4.4, 401-4.10	Reed Tach		
Mat'l Transfer Device				
Breakdown Roller		Reed Tach		☐ High ☐ Med ☐ Lo
Vibratory Roller		Reed Tach	401-4.11, 10 impacts/foot, 3mph max	
Pneumatic Roller		Tire Pressure	401-4.11 3.5mph max speed, tire pressure	
Finish Roller				

Max. Vib. Roller Speed	____ VPM / ____ impacts/foot = ____ ft./min	Max. Paver Speed	____ ft/min / ____ passes X .9 = ____ ft/min

Paving Check	Time	Temp. in Truck	Temp. Behind Paver	Paver Speed
			401.4.10, 275 F min	

Independent Weight Check Needed Today: ☐ Yes ☐ No Scale Decal Number: 70-01, Doc Man

Total Running Yield Checks

Starting Station: _____

Time	Total Tons Placed	Check Station	Length Placed (1)	Theo. Tons (2)	Yield % (3)	Time	Total Tons Placed	Check Station	Length Placed (1)	Theo. Tons (2)	Yield % (3)

(1) Length Placed = Starting Station – Check Station
(2) Theo. Tons = (Length x Mat Width x Lbs./Sq. Yd. X Mat Thickness) + (9 x 2000)
(3) Yield % = (Total Tons Placed ÷ Theo. Tons) x 100

AER 2529 (Rev. 03/30/11)

Daily Yield Check

$$\text{Daily Yield} = \frac{\text{Total Actual Tons Placed}}{(^{\text{lbs}}/_{\text{SY x in}})\text{x Length (ft) x Width (ft) x Mat Thickness(in)} \div 18000} \text{ x } 100 =$$

Paving Discrepancies:

Surface Variations				
Tested by:		Station/Location	Station/Location	Station/Location
Check one below:				
☐	None found today			
☐	Found variations & finish roller was able to correct variations			
☐	Found variations that require corrective action or deduction.			

Other (segregation, joint transitions/density, tearing/shoving, etc.)		
Issue	**Location**	**Resolution**
		Joints 401-4.12, tearing Table 2 minimum lift thickness

Notes / Calculations

Vertical deviation: 401-4.16 ½" in grade, elevation and cross sections or remove and replace
Thickness Determination: construction documentation manual
Thickness Acceptance 401-4.17
Density Acceptance 401-4.15

Signatures

Measured by: _____ Date: _____
Calculated by: _____ Date: _____
Checked by: _____ Date: _____

Illinois Department of Transportation

Hot Mix Asphalt (HMA)
Paving Daily Record

PFC Specification Reference

Note: Not all applicable specs are shown

Date: _____

Airport: _____ Mix Design No.: _____

Pay Item No., Des: _____

Name: _____

☐ Reside

Paving Location: _____

Inspectors/Visitors: _____

Process Control

Weather	Time	Temp.	Conditions	Notes
				402-4.1: ambient temp, no fog/rain, dry, wind

Equipment	Manufacturer/Model	Tach Check or Tire		Amplitude
Paver	402-4.4	Reed Tach		
Mat'l Transfer Device				
Breakdown Roller		Reed Tach		☐ High ☐ Med ☐ Lo
Vibratory Roller	402-4.5	Reed Tach	Static	
Pneumatic Roller		Tire Pressure	Not Allowed	
Finish Roller				

Max. Vib. Roller Speed	VPM / impacts/foot =	264 ft./min 402-4.10	Max. Paver Speed	ft/min / passes X .9	= 35 ft./min 402-4.4

Paving Check	Time	Temp. in Truck	Temp. Behind Paver	Paver Speed
			402-4.8	

Independent Weight Check Needed Today: ☐ Yes ☐ No Scale Decal Number: N/A for PFC

Total Running Yield Checks

Starting Station: _____

Time	Total Tons Placed	Check Station	Length Placed (1)	Theo. Tons (2)	Yield % (3)	Time	Total Tons Placed	Check Station	Length Placed (1)	Theo. Tons (2)	Yield % (3)

(1) Length Placed = Starting Station – Check Station
(2) Theo. Tons = (Length x Mat Width x Lbs./Sq. Yd. X Mat Thickness) + (9 x 2000)
(3) Yield % = (Total Tons Placed ÷ Theo. Tons) x 100

AER 2529 (Rev. 03/30/11)

Daily Yield Check

Daily Yield = $\frac{\text{Total Actual Tons Placed}}{(^{\text{lbs}}/_{\text{SY x in}})\text{x Length (ft) x Width (ft) x Mat Thickness(in)} \div 18000}$ x 100 =

N/A for PFC

Paving Discrepancies:

Surface Variations 402-4.13				
Tested by:		Station/Location	Station/Location	Station/Location
Check one below:				
☐	None found today			
☐	Found variations & finish roller was able to correct variations			
☐	Found variations that require corrective action or deduction.			

Other (segregation, joint transitions/density, tearing/shoving, etc.)		
Issue	**Location**	**Resolution**
		402-4.11 joints *402-4.14 nonuniform texture, roller marks, bleeding, cracking/shoving, aggregate crushing* *Bleeding is a critical problem to PFC performance – typically caused by temperature issues*

Notes / Calculations

Thickness Determination: construction documentation manual
Acceptance: visual (402-4.14), thickness (402-5.1)

402-4.3 Hauling:
Trucks insulated, tarped at all times
90 min max haul time

402-4.10 no traffic for at least 24 hours, etc.

Signatures

Measured by: _____ Date: _____

Calculated by: _____ Date: _____

Checked by: _____ Date: _____

Illinois Department of Transportation

PCC Paving Daily Record

Date: 4/20/211

Airport: Lawrenceville-Vincennes IL Project No.: LWV-3700 Mix Design No.: A38121C1

Pay Item No., Description , Pay Unit: AR501509, P.C.C. Pavement 9", SY

Name: U. B. Dunn Contractor: Krusty Kon

☒ Resident Engineer ☐ Resident Technician

Inspectors/Visitors: Lou Ferrigno, Carl Weathers, Michael Beign, U.S. Secretary of Transportation Ray LaHood

Paving Location

Runway 9/27, Lane 1 (see April 18 paving record diagram), Sta. 1+00 to 5+00

Theoretical Concrete Volume, CY $= \frac{Area\ (SF)\ x\ t\ (in)}{324}$ [(400' x 12') x 9"] ÷ 324 = 133.33 CY

Theoretical Membrane Curing Volume, Gal $= \frac{Area\ (SF)}{(1\ Gal/150\ SF)}$ (Top Area + Side Area) ÷ 150 = [(400 x 12) + (2 x 400 x 9/12)] ÷ 150 = 36.1 gal.

Quality Assurance

Weather

Time	Air Temp	Weather conditions	Notes
5 am	32° F	Cloudy	Told contractor to delay until temps OK
7 am	42° F	Partly Cloudy	Started paving
1 pm	87° F	Clear, Windy 25mph, 90%	Told contractor to install fogger on paver

Shrink Cracking Likely ☒ Yes ☐ No Starting at 1 pm per PCA nomograph

Equipment (make, model, notes)

Truck: Tata NanoHauler GT ☒ Agitate ☐ Non-agitate Ave. Haul 30 min.

Spreader: N/A

Slip-form Paver: Kenner Pavemax

Cure Sprayer: Clairol Beauti-cure XL

Unusual equipment was reviewed and determined to meet all requirements

Production Monitoring

See AER 7 or AER 15 for	% Air	Slump (in)	Beams/Cylinders	Conc.Temp.˚F

Edge Slump Check: ☒ OK ☐ N/A Notes: Minor issues Sta 1+00 to 2+00 (see reverse for details)

Straight-Edge Testing: ☒ OK ☐ N/A Notes: Issues from Sta 1+00 to 2+00 but were corrected

Post Production Testing

Surface Variation ☒ OK ☐ N/A Notes:

Concrete Daily Yield Check $= \frac{Actual\ CY}{Theoretical\ CY}\ x\ 100$ 140 CY tickets ÷ 133.3 CY theoretical = 105% (OK - paid SY)

Membrane Cure Daily Yield Check $= \frac{(\_\_\_Barrels) * (\_\_\_Gal/Barrell)}{Theoretical\ Gal}\ x\ 100$ Used entire contents of 1 40-gal barrel ÷ 36.1 gal. theoretical = 110%

Measured by: Lou Ferrigno Date: 4/20/11

Calculated by: Michael Beign Date: 4/20/11

Checked by: U. B. Dunn Date: 4/22/11

Other Items Required by Specification

Vertical Deviation Lateral Deviation Thickness Strength Check

AER 2531 (Rev. 03/30/11)

Specification Reference

Note: Not all applicable specs are shown

PCC Paving Daily Record

Date: _____

Airport: _____ Mix Design No.: _____

Pay Item _____

Name: _____

Inspector: _____

Paving Location

Theoretical Concrete Volume, CY $= \frac{Area\ (SF)\ x\ t\ (in)}{324}$

Theoretical Membrane Curing Volume, Gal $= \frac{Area\ (SF)}{(1\ Gal/150\ SF)}$ *501-3.17 A*

Quality Assurance

Weather

Time	Air Temp	Weather conditions	Notes
501-3.9	*501-3.9*		
	501-3.1 C		
	501-3.17		

Shrink Cracking Likely ☐ Yes ☐ No *501-3.1 C*

Equipment (make, model, notes) *501-3.1*

Truck: _____ ☐ Agitate ☐ Non-agitate Ave. Haul _____ min.

Spreader: _____

Slip-form Paver: _____

Cure Sprayer: _____ *501-3.170 A*

Production Monitoring

See AER 7 or AER 15 for	% Air	Slump (in)	Beams/Cylinders	Conc.Temp.˚F

Edge Slump Check: ☐ OK ☐ N/A Notes: _____ *501-3.10 B*

Straight-Edge Testing: ☐ OK ☐ N/A Notes: _____ *501-3.13 F*

Post Production Testing

Surface Variation ☐ OK ☐ N/A Notes: _____ *501-3.16, 501-3.22*

Concrete Daily Yield Check $= \frac{Actual\ CY}{Theoretical\ CY}\ x\ 100$

Membrane Cure Daily Yield Check $= \frac{(\_\_\_Barrels) * (\_\_\_Gal/Barrell)}{Theoretical\ Gal}\ x\ 100$

Measured by: _____ Date: _____

Calculated by: _____ Date: _____

Checked by: _____ Date: _____

Other Items Required by Specification

Vertical Deviation *501-3.22* Lateral Deviation *501-3.22* Thickness * Strength Check *501-3.7, 501-5.3 B*

** Airport Construction Documentation Manual Thickness Determination, 501-5.3 A*

Illinois Department of Transportation

Agreement on Accuracy of Plan Quantities

Airport: Quad City International | IL Project No.: MLI-1234

AIP Project No.: 3-17-0068-39 | BCM Contract No.: QU001

Project Description: Relocate Taxiway A

Pay Item Description	Unit of Measurement	Pay Item Number	Quantity
Clearing	Acre	AR151410	
Clearing & Grubbing	Acre	AR151450	
Unclassified Excavation	C.Y.	AR152410	8,277
Common Excavation	C.Y.	AR152420	
Solid Rock Excavation	C.Y.	AR152430	
Borrow Excavation	C.Y.	AR152440	
Aggregate-Turf Pavement	S.Y.	AR217510	
Bituminous Pavement Grooving	S.Y.	AR401640	
P.C.C. Pavement Grooving	S.Y.	AR501540	
Structural P.C. Concrete	C.Y.	AR610510	
Steel Reinforcement	LB.	AR610520	
Pavement Marking	S.F.	AR620510	
Tar Emulsion Seal Coat	S.Y.	AR625510	
Porous Backfill No. 1	C.Y.	AR705411	
Porous Backfill No. 2	C.Y.	AR705412	
Seeding	Acre	AR901510	2.3
Sodding	S.Y.	AR904510	
Topsoiling (from On Site)	C.Y.	AR905510	
Topsoiling (from Off Site)	C.Y.	AR905520	
Mulching	Acre	AR908510	2.3
Trench Backfill	C.Y.	AR701830	

(And the following items, as permitted by contract provisions):

On-Site Borrow	C.Y.	AR152441	150.0

We hereby agree that when the project is constructed essentially to the lines, grades and dimensions shown on the plans, no further measurement will be required for the above items and payment will be made for the quantities shown in the contract except that if errors are discovered after work has been started, appropriate adjustments will be made.

When the plans have been altered or when disagreement exists between the Contractor and the Engineer as to the accuracy of the plan quantities, either party shall, before any work is started which would affect the measurement, have the right to request in writing and thereby cause the quantities involved to be measured as specified.

Contractor (Name of Firm) General Construction

Signature | Title | Date

Department of Transportation

Chief Airport Construction & Materials Engineer | Date

AER 981 (Rev. 01/18/08)

Illinois Department of Transportation

Extra Work Daily Report

Airport: Quad City International Date: 5/1/2012

Contractor: Smith Construction Company

IL Project No.: MLI-2345 AIP Project No.: 3-17-0068-45

Report No.: 1 BCM Contract No.: QU012

Description and Location of Work: Relocate Storm Sewer Section Sta 00+30

LABOR

Name, Worker Classification	Total Hours Worked
Matt Reilly, Foreman	6
Tim Seitz, Laborer	6
Bernie Henderson, Laborer	6
Earl Roth, Laborer	6
John Graham, Laborer	6
Sarah Reid, Teamster	6
Jeanmarie Smith, Operator	6

EQUIPMENT USED

Description: List Manufacturer, Model, Year Built, Capacity	Number of Hours
2006 Caterpillar 814F Wheel Dozer (240hp)	6
2006 Chevrolet P/U Truck, 4x4 Crew Cab 1/2 Ton	6
2004 On-Hwy Rear Dump Truck 4x4 Diesel 30KGVW	6

MATERIAL USED

Description	Quantity
24” RCP	64 ft.

REMARKS:

APPROVED: John P. Adams ☒ Resident Engineer ☐ Resident Technician

APPROVED: R. L. Smith Contractor’s Representative

Illinois Department of Transportation

Extra Work Daily Report

Airport: Quad City International Date: 5/2/2012

Contractor: Smith Construction Company

IL Project No.: MLI-2345 AIP Project No.: 3-17-0068-45

Report No.: 2 BCM Contract No.: QU012

Description and Location of Work: Relocate Storm Sewer Section Sta 00+30

LABOR

Name, Worker Classification	Total Hours Worked
Matt Reilly, Foreman	8
Tim Seitz, Laborer	8
Bernie Henderson, Laborer	8
Earl Roth, Laborer	8
John Graham, Laborer	8
Sarah Reid, Teamster	8
Jeanmarie Smith, Operator	8

EQUIPMENT USED

Description: List Manufacturer, Model, Year Built, Capacity	Number of Hours
2006 Caterpillar 814F Wheel Dozer (240hp)	8
2006 Chevrolet P/U Truck, 4x4 Crew Cab 1/2 Ton	8
2004 On-Hwy Rear Dump Truck 4x4 Diesel 30KGVW	8

MATERIAL USED

Description	Quantity
Trench Backfill	48.6 tons

REMARKS:

APPROVED: John P. Adams ☒ Resident Engineer ☐ Resident Technician

APPROVED: R. L. Smith Contractor's Representative

Illinois Department of Transportation

Extra Work Daily Report

Airport: Quad City International Date: 5/3/2012

Contractor: Smith Construction Company

IL Project No.: MLI-2345 AIP Project No.: 3-17-0068-45

Report No.: 3 BCM Contract No.: QU012

Description and Location of Work: Relocate Storm Sewer Section Sta 00+30

LABOR

Name, Worker Classification	Total Hours Worked
Matt Reilly, Foreman	8 Reg., 2 OT
Tim Seitz, Laborer	8 Reg., 2 OT
Bernie Henderson, Laborer	8 Reg., 2 OT
Earl Roth, Laborer	8 Reg., 2 OT
John Graham, Laborer	8 Reg., 2 OT
Sarah Reid, Teamster	8
Jeanmarie Smith, Operator	8

EQUIPMENT USED		MATERIAL USED	
Description: List Manufacturer, Model, Year Built, Capacity	Number of Hours	Description	Quantity
2006 Caterpillar 814F Wheel Dozer (240hp)	8		
2006 Chevrolet P/U Truck, 4x4 Crew Cab 1/2 Ton	10	Portland Cement	6 sacks
2004 On-Hwy Rear Dump Truck 4x4 Diesel 30KGVW	8	Aggregate	1.5 tons
		Form Lumber, 1" x 6" x 14'	24 each

REMARKS:

APPROVED: John P. Adams ☒ Resident Engineer ☐ Resident Technician

APPROVED: R. L. Smith Contractor's Representative

AER 635 (Rev. 03/08/11)

GUIDELINES FOR PREPARING FORM AER 635

1. Extra work shall not be started until authorized in writing by the Engineer.

2. This form must be prepared daily and copies will be retained by both the Contractor and the Engineer.

3. Materials used on Force Account work which will be incorporated in the job must meet with satisfactory inspection.

4. The amounts of Labor, Equipment and Materials claimed by the Contractor on his submitted itemized bill which he prepares at the completion of the extra work must agree with the daily amounts shown on this form.

5. Refer to Article 70-05 of the Standard Specifications for Construction of Airports.

SAMPLE OF A FORCE ACCOUNT BILL USING NON-CURRENT BLUEBOOK RATES FOR THE PURPOSE OF SHOWING THE FORM TO BE FOLLOWED.

This sample bill does not establish any policy relative to the amount to be allowed for any particular item (materials, labor, and/or equipment) or as representing actual rates for insurance. Its sole purpose is to standardize the form of force account bills.

Contractor's Letterhead

Route _____ **Section** _____ **County** _____ **Auth. No.** _____

Force Account Bill For Additional Pipe and Collars **Contract Number** _____

Compare dates, hours and all other information with AER 635's

				Total Hours						Payroll Amount Eligible For Unemployment Tax	
				S.T.	O.T.	Rate	Insurance Amount	Payroll Amount	Earnings to Date	F.U.T.	S.U.T.
Matt Reilly, Foreman	6	8	10	22	2	15.60	$374.40	$390.00	$35.000.00	$0.00	$0.00
Tim Seitz, Laborer	6	8	10	22	2	12.50	300.00	312.50	8,000.00	0.00	312.50
Bernie Henderson, Laborer	6	8	10	22	2	12.50	300.00	312.50	6,000.00	312.50	312.50
Earl Roth, Laborer	6	8	10	22	2	12.50	300.00	312.50	7,100.00	212.50	312.50
John Graham, Laborer	6	8	10	22	2	12.50	300.00	312.50	9,100.00	0.00	312.50
Sarah Reid, Truck Driver	6	8	8	22		14.50	319.00	319.00	27,000.00	0.00	0.00
Jeanmarie Smith, Operator	6	8	8	22		17.60	387.20	387.20	40,000.00	0.00	0.00
Subtotals, Labor							$2,280.60	$2,346.20		$525.00	$1,250.00

	* Laborer Pension and Welfare Funds			
	96 hours @ $0.32			30.72
	* Operating Engineer pension and Welfare Funds			
	22 hours @ $0.55			12.10
	Subtotal			$2,389.02
Note 1:	35% of $2,389.02			836.16
	Subtotal			$3,225.18
	Worker's Compensation Insurance	3.48% of $2,280.60	79.36	
	Public Liability and Property Damage Insurance, excluding Payroll of Truck Drivers	2.0% of $1,961.60	39.23	
**	Federal Unemployment Tax	0.8% of $525.00	4.20	
***	State Unemployment Tax	6.8% of $1,250.00	85.00	
	Federal Social Security Tax	7.65% of $2,346.20	179.48	
	Total Payroll Additives		387.27	
Note 2:	10% of $387.27		38.73	
				426.00
	Total Labor			$3,651.18

I hereby certify that the above statement is a copy of that portion of the payroll which applies to the above stated work and that the rates shown for taxes and insurance are actual costs.

(Signed) R. L. Smith

(Contractor)

Page 1 of 2

* These are not suggested rates, as these rates vary widely between Union Locals. This is intended as an example only.

** Do not include costs for employees which have reached the annual ceiling for Federal Unemployment tax (F.U.T.), which is $7,000 in this example.

*** Do not include costs for employees which have reached the annual ceiling for State Unemployment Tax (S.U.T.), which is $11,500 in this example.

Note 1: This example shows the current Airport Standard Specification 90-05.B.1, which allows a 35% mark-up on labor, pension and welfare. The previous Specification allowed a 35% mark-up on labor only. Always confirm which Specification is in effect for a specific project.

Note 2: Allowed under Airport Specification 90-05.B.2

Equipment Expense	1	2	3	Total Hrs.	Rate	Amount
2006 Caterpillar 814F Wheel Dozer, (240 HP)	6	8	8	22	$100.50	$2,211.00
2006 Chevy Light Duty Pickup Truck 4X4 Crew Cab (1/2 ton)	6	8	10	24	$11.86	$284.64
2004 On-Hwy Rear Dump Truck, 4X4, Diesel (30,000 lb GVW)	6	8	8	22	$35.22	$774.84
Total Equipment Expense						$3,270.48

Material Used

24 in. R.C.P., 64 ft. @ $4.30 per ft. (receipted invoice attached)	$275.20
(Trench backfill, 48.6 tons @ $0.85 per ton) (taken from stock)	43.31
Portland cement, 6 sacks @ $1.60 (taken from stock)	9.60
(Aggregate, 1.5 tons @ $1.40 per ton) (taken from stock)	2.10
(Form lumber, 24 pieces, 1x6, 14 feet long @ $1.232 per piece) (receipted invoice attached)	29.57
Less salvage value of form lumber, 50%	(14.79)
Subtotal Material	$342.99
Note 3: Plus 15% on $342.99	51.45
Total Material	$394.44

AFFIDAVIT

This is to certify that the material entered on this force account bill which was taken from stock is shown at our cost.

Smith Construction Co.
(Company)

By R. L. Smith

Total Labor	$3,651.18
Total Equipment Expense	3,270.40
Total Materials	394.44
Total	$7,316.10
Bond 0.75%	54.87
Plus 10% of Bond	5.49
Total Bill	$7,376.46

John P. Adams
Resident

Page 2 of 2

Note 3: Allowed under Airport Specification 9005B.3

Blue Book Rate from the Equipment Watch Website

Compare Similar Models

Configuration for B14F

Power Mode:	**Diesel**	Transmission:	**Powershift**
Dozer Type:	**Straight**	Net Horsepower:	**240.0**
Operator Protection:	**EROPS**		

Equipment Notes: Includes EROPS, unless otherwise noted.

Blue Book Rates

Rate Effective Dates: Jul 1, 2006 - Jun 30, 2007 printable report

*** Non-current (i.e. archived) rates: Jul 1, 2006 - Jun 30, 2007**

** FHWA Rate is equal to the monthly ownership cost divided by 176 plus the hourly estimated operating cost.

	Ownership Costs				Estimated Operating Costs	FHWA Rate **
	Monthly	Weekly	Daily	Hourly	Hourly	Hourly
Published Rates *	$9,780.00	$2,740.00	$685.00	$105.00	$44.15	$99.72
Adjustments						
Region (Illinois: 101.4%)	+$136.92	+$38.36	+$9.59	+$1.47		
Model Year (2006: 100%)	-	-	-	-		
Ownership (100%)	-	-	-	-		
Operating (100%)					-	
Total:	**$9,916.92**	**$2,778.36**	**$694.59**	**$106.47**	**$44.15**	**$100.50**

For details, see Rate Element Allocation

Adjustments

Model Year 2006

Region Illinois

Canadian Regions Alaskan Regions

User Defined

Ownership %

Operating %

Adjust Rates

Illinois Department of Transportation
Division of Aeronautics

Equipment Expense Rate Data

To Be Filled Out by the Contractor and Returned to the Resident Engineer:

Project IL Project Number: _____

BCM Contract Number: _____

Contractor Point of Contact for the data submitted

Company Name: _____

Address: _____

City: _____ State: _____ Zip Code: _____

Telephone: _____ Email: _____

Submitted By: _____

Description of Equipment

Type/Function: _____

Make: _____ Model: _____

Year Manufactured: _____ Fuel Type: _____ Horsepower: _____

Size and/or Capacity: _____

Remarks: _____

_____

Cost of Equipment (For Equipment Not Listed in Blue Book)

Purchase Price: _____ Year Purchased: _____

Estimated or Actual Annual Repair Cost: _____

Estimated or Actual Annual Usage of Equipment in Hours per Year: _____

Additional Comments: _____

_____

_____

The RE shall submit the completed form to Equipmentwatch.com.
This custom rate and all Time & Materials equipment rates shall be agreed to in writing before beginning the work per section 90-05.B.4.a of the Standard Specifications for the Construction of Airports (April 1, 2012 or current).

Illinois Department of Transportation

Authorization of Contract Changes

Authorization No. 2 **FINAL?:** ☒ Yes ☐ No
Date 6/15/2012

Contractor Smith Construction Company
Address Contractor's Address
Proj. Description Install Class E Perimeter Fence

Airport Name: Quad City International
IL Project No.: MLI-2345
Fed Project: 3-17-0068-45
Contract No.: QU012
County: Rock Island
FASC ID: AR00P01

The following change from the plans in constructing the above airport improvement is authorized and directed.

Item No.	*	Item Description	Unit	Quantity	A/D	Unit Price	Addition	Deduction
AR800100	*	Additional Pipe, Time and Mat.	LS	1,000	A	7,376.46	7,376.46	

Original Contract:	Page Subtotals	$ 7,376.46	$ -
Previous Changes:		Net Change	$ 7,376.46
Current Request: $	FASC-ID Subtotal		
Proposed Contract Change to Date: $		Net Change	$ -
	Authorization Totals		
		Net Change	$ -

Please Check One

☒ 1. The circumstances said to necessitate the change in performance were not reasonably foreseeable at the time the contract was signed.

☐ 2. The change is germane as to the original contract as signed.

☐ 3. The change order is in the best interest of the unit of State or local government and is authorized by law.

See Attached Letter of Explanation

Approved

	Signature	Date	Typed Name	Title
Consultant				
Contractor				
IDA			Michael F. Wilhelm, P.E.	Construction & Materials Section
IDA			Steven J. Long, P.E.	Airport Engineering Bureau Chief

Note to Preparer: If additional space is needed, please use a separate sheet.
For multiple FASC ID's, a separate Authorization sheet is required.
Each Authorization sheet must contain all required signatures.
The first addition of an item not in the original contract under the fund type is indicated by an asterisk (*).
Credits are indicated as new pay items (*), with an added quantity (A/D=A), and a negative unit price.

AER 51 (03/08/2011)

Illinois Department of Transportation

Authorization of Contract Changes

Authorization No.	2	**FINAL?:** ☒ Yes ☐ No	Airport Name: Quad City International
Date	6/15/2012		IL Project No.: MLI-2345
			Fed Project: 3-17-0068-45
Contractor	Smith Construction Company		Contract No.: QU012
Address	Contractor's Address		County: Rock Island
Proj. Description	Install Class E Perimeter Fence		FASC ID: AR00P01

SUMMARY OF PROPOSED CHANGES

Item No.	ITEM DESCRIPTION/COMMENTS
AR800100	Additional Pipe, Time and Mat. Add 1 LS IDA Approval Date: 5/1/2012 Relocate Storm Sewer Section – Work done on Time and Material basis.

Illinois Department of Transportation

Material on Hand Affidavit

Date: September 1, 2011

Airport: Quad City International
IL Project No.: MLI-1234

County: Rock Island
AIP Project No.: 3-17-0068-39

Contractor: General Construction
BCM Contract No.: QU001

Project Description: Relocation Taxiway A

Itemized Material Statement

Item of Material	Quantity	Unit Cost	Amount
L-806 Windcone – 8' Lighted	4	1,760.49	7,041.96
MITL – Base Mounted	133	240.14	31,938.62
Taxi Guidance Sign, 2 Character	3	1,248.28	3,744.84
Taxi Guidance Sign, 3 Character	3	1,516.87	4,550.61
Taxi Guidance Sign, 4 Character	6	1,869.33	11,215.98
Taxi Guidance Sign, 5 Character	1	1,808.80	1,808.80

Freight on Material: 0
Total: $60,300.81
Allowed on Estimate No.: 3
Proof of Payment Received: Ck.# 20327 & 20674

I hereby certify that the above material has been received, properly stored, and applicable material certifications and/or shop drawings were received, reviewed, and approved.

John P. Adams

☒ Resident Engineer ☐ Technician

Affidavit
(To Be Completed By Contractor)

State of Illinois

County of _____ ss.

_____ being first duly sworn, deposes and says that he/she is the duly authorized representative of the _____ Company and, as such, has authority to make the following statement.

I hereby certify that the material herein mentioned has been received and stored in a manner satisfactory to a representative of the Illinois Department of Transportation. Further, that said material is to be used for the purpose of constructing the contract captioned above.

I further certify that the within statement is true and correct, and that the purpose of this affidavit is to obtain payment for material in storage.

_____ Contractor

By _____

Subscribed and sworn to before me this _____ day of _____ , _____ .

_____
Notary Public

(Notary Seal) My Commission expires _____

AER 49 (Rev. 04/30/09)

Illinois Department of Transportation

Statement of Material on Hand

Airport: Quad City International
Date: 09/01/11

IL Project No.: MLI-1234
Contractor: General Construction
AIP Project No.: 3-17-0068-39
Pay Estimate #: 10
BCM Contract No.: QU001
(Submit with Resident Engineer's Pay Estimate)
Project Description: Relocate Taxiway A

1 Description of Material (Followed by Pay Items it will be used in)	2 Delivery Units	QUANTITY 3 Total From Form(s) AER 49	4 Paid for in Place to Date	5 (3-4) Remaining in Storage	6 Contractor's $ Cost / Unit	7 (5x6) $ Value
L-806 Windcone – 8', Lighted AR107408	Each	4.00	0.00	**4.00**	$1,760.4900	**$7,041.9600**
MITL – Base Mounted AR125415	Each	133.00	0.00	**133.00**	$240.1400	**$31,938.6200**
Taxi Guidance Sign, 2 Character AR125442	Each	3.00	0.00	**3.00**	$1,248.2800	**$3,744.8400**
Taxi Guidance Sign, 3 Character AR125443	Each	3.00	0.00	**3.00**	$1,516.8700	**$4,550.6100**
Taxi Guidance Sign, 4 Character AR125444	Each	6.00	0.00	**6.00**	$1,869.3300	**$11,215.9800**
Taxi Guidance Sign, 5 Character AR125445	Each	1.00	0.00	**1.00**	$1,808.8000	**$1,808.8000**

Approval: *John P. Adams* *09/01/11*
☒ Resident Engineer ☐ Resident Technician (Signature Required)
Date

Value of Material on Hand: Sum of Column 7 = **$60,300.81**

AER 131 (07/20/11)

Illinois Department of Transportation

Statement of Material on Hand

Airport: Quad City International
Date: 09/01/11

IL Project No.: MLI-1234
Contractor: General Construction
AIP Project No.: 3-17-0068-39
Pay Estimate #: 10
BCM Contract No.: QU001
(Submit with Resident Engineer's Pay Estimate)
Project Description: Relocate Taxiway A

1 Description of Material (Followed by Pay Items it will be used in)	2 Delivery Units	QUANTITY 3 Total From Form(s) AER 49	4 Paid for in Place to Date	5 (3-4) Remaining in Storage	6 Contractor's $ Cost / Unit	7 (5x6) $ Value
L-806 Windcone – 8', Lighted AR107408	Each	4.00	0.00	**4.00**	$1,760.4900	**$7,041.9600**
MITL – Base Mounted AR125415	Each	133.00	65.00	**68.00**	$240.1400	**$16,329.5200**
Taxi Guidance Sign, 2 Character AR125442	Each	3.00	0.00	**3.00**	$1,248.2800	**$3,744.8400**
Taxi Guidance Sign, 3 Character AR125443	Each	3.00	2.00	**1.00**	$1,516.8700	**$1,516.8700**
Taxi Guidance Sign, 4 Character AR125444	Each	6.00	0.00	**6.00**	$1,869.3300	**$11,215.9800**
Taxi Guidance Sign, 5 Character AR125445	Each	1.00	1.00	**0.00**	$1,808.8000	**$0.0000**

Approval: *John P. Adams* *09/01/11*
☒ Resident Engineer ☐ Resident Technician (Signature Required)
Date

Value of Material on Hand: Sum of Column 7 = **$39,849.17**

AER 131 (07/20/11)

COLUMN DESCRIPTIONS

Column 1 Description of Material (Followed by Pay Items it will be used in): Enter the material description as shown on the invoice, and the contract pay item(s) (number & description) in which the material will be incorporated.

Column 2 Delivery Unit: Enter the delivery invoice pay unit.

Column 3 Total from Form(s) AER 49: Enter the total amount of material delivered. Note: Do not report quantities until all required documentation has been received. See Airport Construction Documentation manual section Material Allowance.

Column 4 Paid for In Place to Date: Enter the amount, in delivery invoice pay units, of stockpiled material used in associated pay items completed and paid to date.

Column 5 Remaining in Storage: Automatic calculation of amount of stockpiled material remaining (Column 3 – Column 4). Amount will be in invoice delivery units.

Column 6 Contractor's Cost/Unit: Enter the cost per unit of delivered material used.

Column 7 Value: Automatic calculation of dollar value of unused stockpiled material (Column 5 x Column 6).

Illinois Department of Transportation

Truck Tare Weights

Date: July 25, 2011

Airport: Quad City International
IL Project No.: MLI-1234
County: Rock Island
AIP Project No.: 3-17-0068-39
Contractor: General Construction
BCM Contract QU001
Scale Location: Kinderhook
Material: CA6

Truck or License Number	Name on Truck	Tare Weight	Driver in Truck?
19	Lumley	20,000	☒ Yes ☐ No
44	Lumley	20,500	☒ Yes ☐ No
21	Lumley	20,800	☒ Yes ☐ No
22	Lumley	21,000	☒ Yes ☐ No
43	Lumley	20,100	☒ Yes ☐ No
40	Lumley	20,000	☒ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No

Note: Tare weights of trucks hauling material to Department of Transportation projects must be established daily when pay quantities are determined by platform scale weights.

Department of Agriculture scale decal information:

Date: 2010
Certificate 35044

Les Wrong
Inspector

John P. Adams
☒ Resident Engineer ☐ Resident Technician

AER 1465 (Rev. 03/08/11)

Illinois Department of Transportation

Independent Truck Weight Check

Instructions: At random, select a loaded truck and obtain a loaded weight on an independent scale. Allow the truck to unload then obtain an empty weight.

Ticket Information

Load Ticket Number	52718	Supplier Name	We Pave
Loaded Weight (Gross)	71,100.00	City	Troy Grove
Empty Weight (Tare)	29,480.00	Supplier Code	6212-01
Load Ticket Weight (Net)	41,620.00	Scale Decal No.	004271
		Decal Date	2/11/2011

Independent Scale Information

Loaded Weight (Gross)	71,320.00	Scale Location	Riverstone / Troy Grove
		Scale Decal No.	004495
Empty Weight (Tare)	29,560.00	Decal Date	11/11/2011
		Name of Truck	Sure Thing
Calculated Net Weight	41,760.00	Truck Number	27523

Tolerance -0.33%

Ticket Weight – Independent Weight Check Net Weight / Independent Weight Check Net Weight x 100

Tolerance for bituminous shall not exceed 0.50%.

Calculated	John Adams (Print Name Clearly)	Initials	JA	Date	09/01/2011
Weighs Verified	Les Wrong (Print Name Clearly)	Initials	LW	Date	09/01/2011

If the scale is out of tolerance send a copy of this form within 48 hours to the Office of Quality Compliance and Review, Gene.Thomen@illinois.gov and DOT.ITWC@illinois.gov. If you have any questions, contact Gene Thomen at (217) 558-4617 (office) or (847) 846-3132 (cell).

Resident Engineer shall file this document in the project files.

AER 2367 (Rev. 10/18/10)

Ticket Tape Example, Aggregate Base Course

8-7-09
AR208510
AGG BASE CSE
STA 1+20
TO 19+00

	0.	C
	24,300.	+
Contract 90002	23,700.	+
	22,300.	+
	24,700.	+
	23,500.	+
	22,900.	+
	25,500.	+
	23,700.	+
	23,800.	+
	22,800.	+
	24,000.	+
	23,100.	+
	23,600.	+
	24,100.	+
	23,800.	+
	24,300.	+
	23,400.	+
	24,300.	+
	22,800.	+
	25,600.	+
	23,200.	+
	24,000.	+
	23,900.	+
	547,300	*
	LBS	
	547,300.	
	2,000	=
	273.65	*
	tons	
Actual Moisture	= 220.9 – 206.1 / 206.1	=
	= 0.072	
Pay Wt.	= 273.65 × 1.06 / 1.072	
	= 270.6 TONS	

Calc by: JWS 8-7-09
Check by: RH 8-8-09

This is an example of the documentation requirement for granular pay items paid on a tonnage basis.

This adding machine tape is to be securely bound around the truck tickets for each pay item for each day.

NOTE: Refer to Small Quantities provision in Section A of doc guide. No moisture correction required if less than 500 tons per day, however IDOT reserves right to perform moisture correction on any amounts delivered.