MONITOR ADMINISTRATION

1996 - 1997

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(Continued)

PCC STRUCTURAL

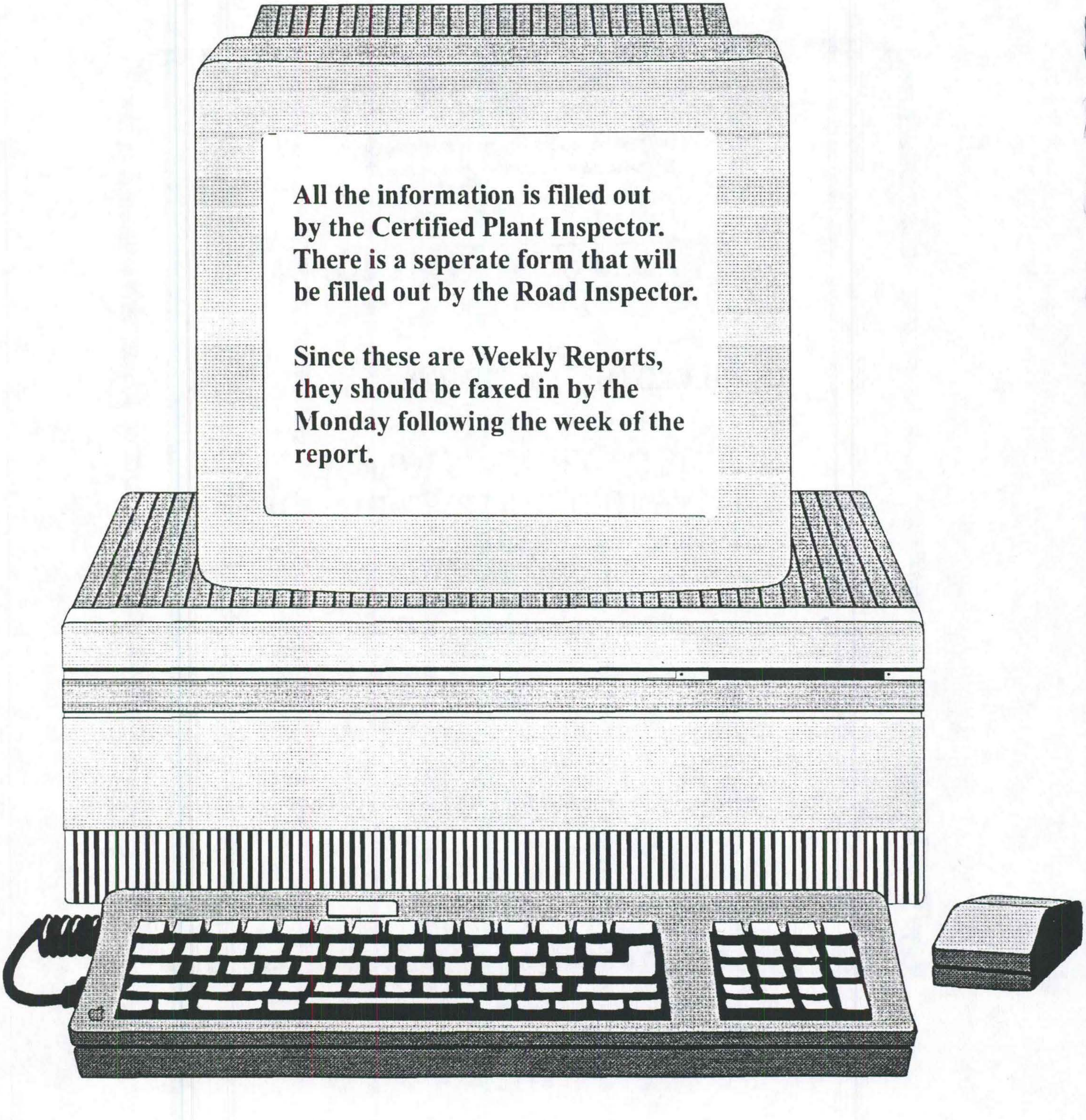
WEEKLY REPORT

FILLED OUT BY THE CPI.

SOME INFORMATION WILL BE GIVEN TO THE CPI BY THE GRADE INSPECTOR.

1. % USED
2. WATER ADDED

NEW COMPUTER FORM



STRUCTURAL COLDFEED SAMPLES

As a Monitor, you need to run the first sample of the week for the first three weeks. Then 10% of the project after that, unless there happen to be failures.

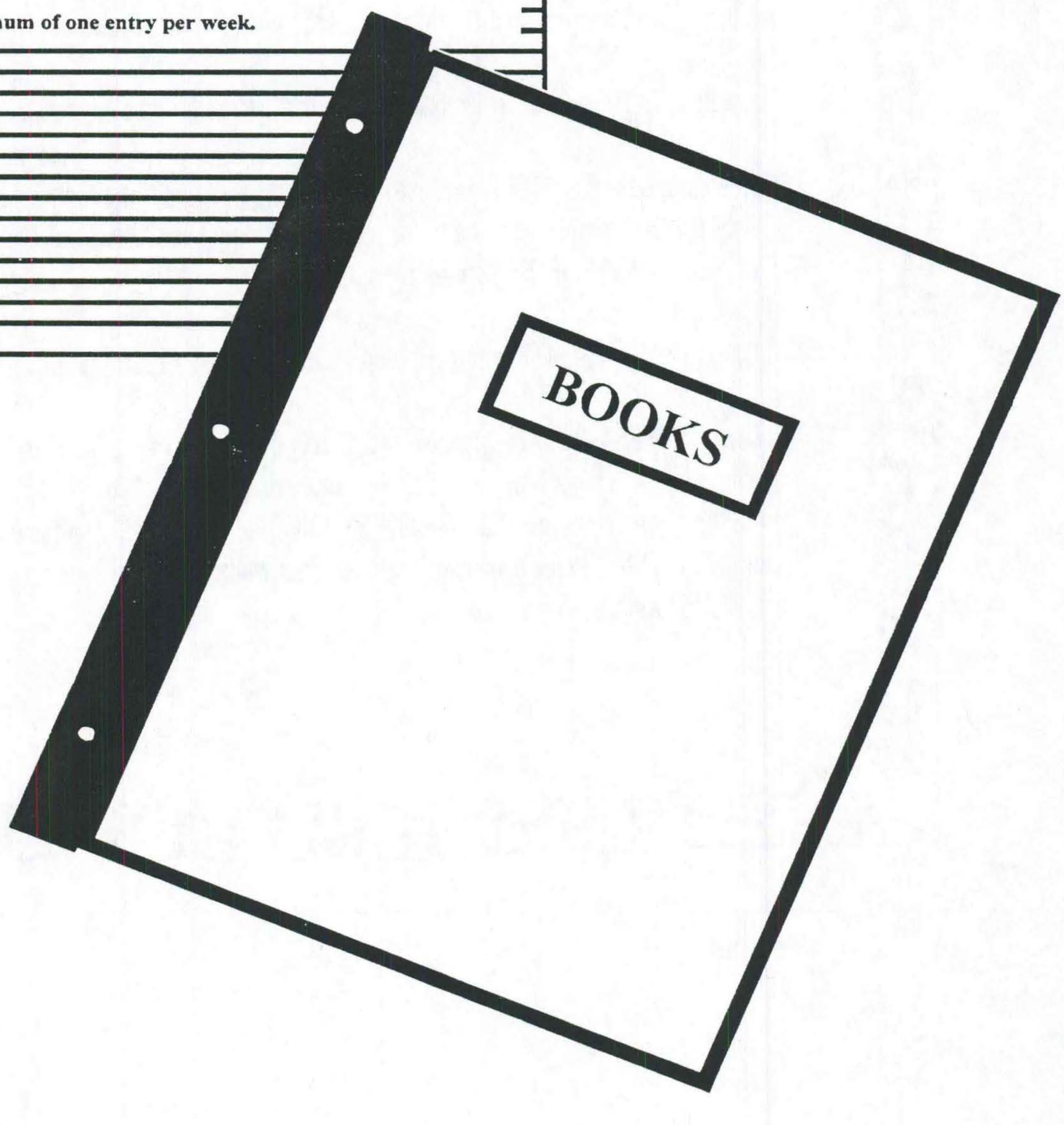
On these split samples, remember to do an IM 216 gradation comparison.

Remember, the Certified Plant Inspector should be getting three samples a week. Split the first sample, hang on to the other two for backups. Also, the CPI needs to "roll the dice" for their random samples.

On the E240 or M240 Form there is only space for the CPI's gradation test result.

Form E200 or M200, Acceptance Gradation in 216 comparison, needs to be filled out by the Monitor. This is how you, as a Monitor, report out any of your Coldfeed gradations. On this form you may put the monitor's results, and then directly on the following line, put the Certified Plant Inspector's results. This makes it very simple for you to do an I.M. 216 Gradation comparison.

Certified Plant Inspectors should keep up their books or computer daily, due to the Monitor being able to check them any day of the week. Monitoring once a week is the minimum. The CPI should keep a pretty good daily diary, since the Monitor is usually at the plant only once a week. This makes it easy for the Monitor to know what has happened during that week. As a Monitor, you will have a minimum of one entry per week.



SPECIFIC GRAVITY

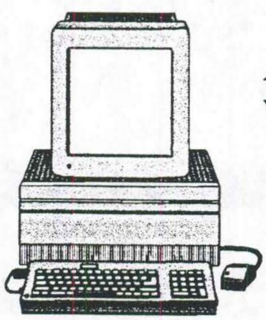
MOISTURES

THE MONITOR WILL RUN THESE TESTS ONLY IF THE CERTIFIED PLANT INSPECTOR IS HAVING PROBLEMS.

ADMIXTURES

Obtain Computer Report from Central Materials once a month. These report lot numbers that have been tested. If the lot number is on this report there is no need to get another sample of this material. If the lot number is not on this list or it did not comply, you need to get the appropriate size of sample (IM 204) and send it to the Central Materials Lab for testing.

This report is distributed by Central Materials via your office computer. It covers the following:



- Air Entrainments
- Water Reducers
- Retarders
- Paint Beads
- White Curing Compound

CEMENT

FLYASH

THE ASSURANCE DEPARTMENT OR THE AREA INSPECTOR SHOULD BE GETTING SAMPLES OF THESE.

PCC PAVING

DAILY PAVING REPORT: FORM E240 or M240

Filled out by the CPI.

Monitor will check it over. The Road Inspector will notify the CPI of information pertaining to the road.

1. **% Used**
2. **Water Added**

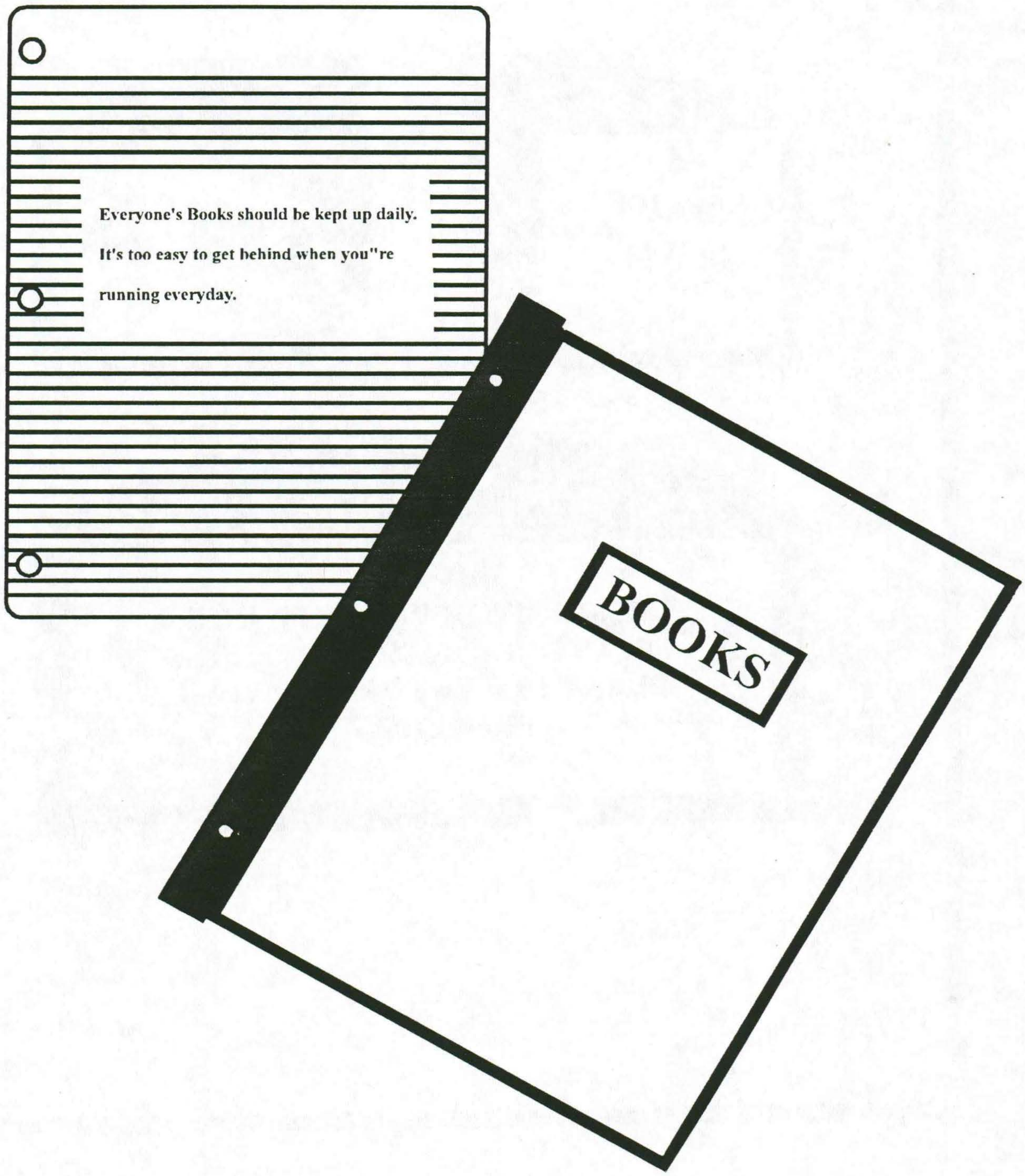
These should be faxed in within four hours of the following working day.

COLDFEEDS

Monitor will run the first three days of paving, then 10% of the project from there on.

CPI needs to run the first one everyday. CPI also needs to catch two more everyday and hold onto them for backups. Remember to "roll the dice " for random gradation samples, done by the CPI. The CPI may have to run two samples on a given day.

There is no space given to the Monitor on this report for their gradation results. Remember to use Form E200 or M200 (same one used for weekly report).


Everyone's Books should be kept up daily.
It's too easy to get behind when you"re
running everyday.
BOOKS

SPECIFIC GRAVITY

MOISTURES

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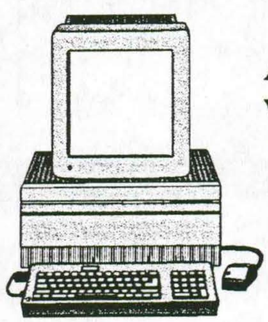


Air Entrainments
Water Reducers
Retarders
Paint Beads
White Curing Compound

CEMENT

FLYASH

THE ASSURANCE DEPARTMENT OR THE AREA INSPECTOR SHOULD BE GETTING SAMPLES OF THESE.

START OF ANY PCC PROJECT:

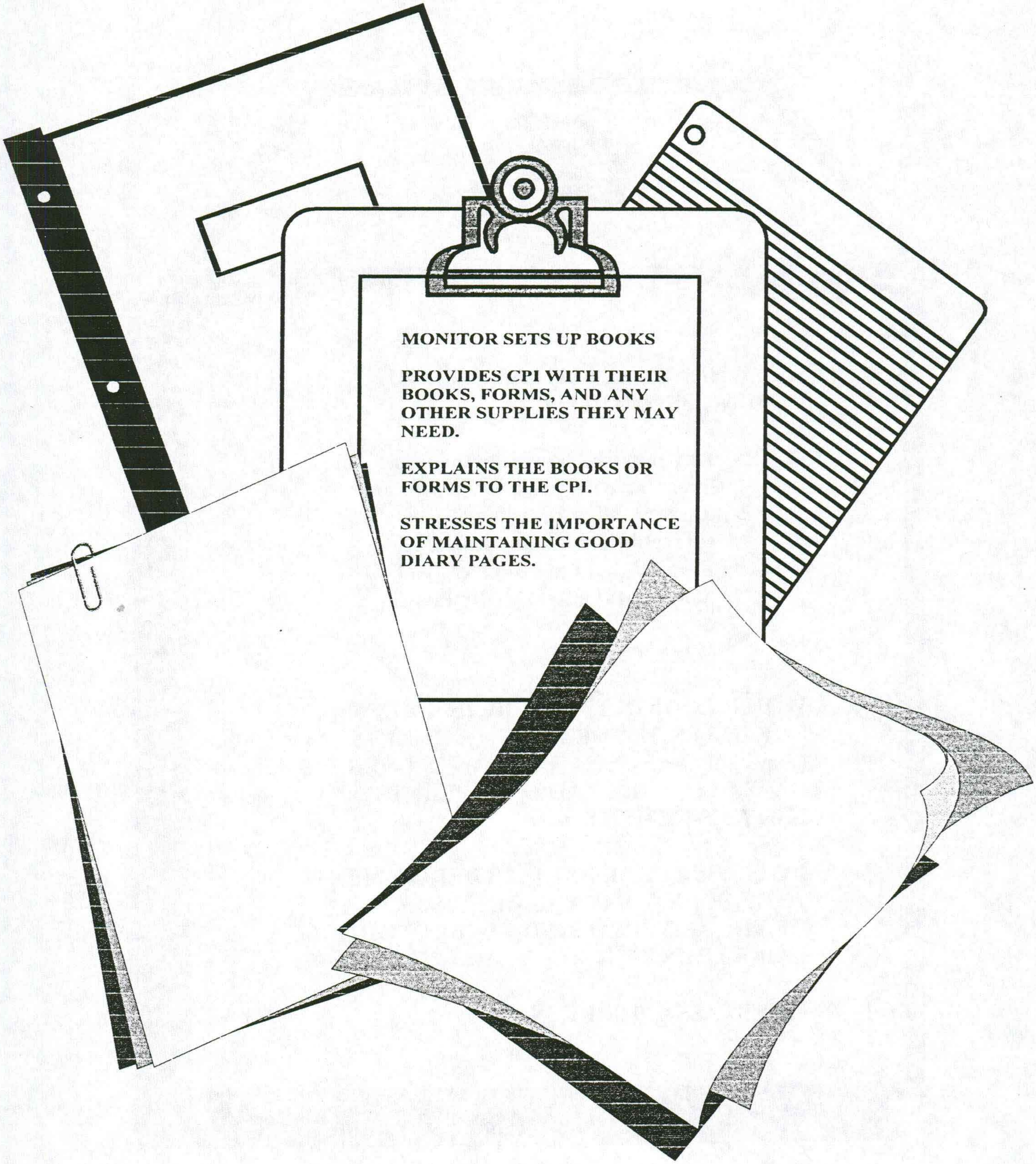
BEFORE ANY POUR

MONITOR SETS UP BOOKS

PROVIDES CPI WITH THEIR BOOKS, FORMS, AND ANY OTHER SUPPLIES THEY MAY NEED.

EXPLAINS THE BOOKS OR FORMS TO THE CPI.

STRESSES THE IMPORTANCE OF MAINTAINING GOOD DIARY PAGES.



ASK WHERE THE MATERIAL IS ALL COMING FROM:

- Any material hauled to the plant must have proper documentation.
- Take a look at the tickets- all correct information on tickets?
- Remind them to keep a copy of all tickets at the Ready Mix Plant.

WHILE LOOKING AT TICKETS, CHECK THE DATES OF THE CEMENT TICKETS (Especially early Spring projects) - IF OVER 30 DAYS OLD, THE READY MIX PLANT CANNOT USE THIS CEMENT.

NOTIFY YOUR MATERIALS DEPARTMENT. THEY WILL COME AND GET A SAMPLE OF THE MATERIAL AND TAKE IT TO THEIR LAB TO RUN TESTS.

MUST PASS #20 SCREEN.

- IS THE PLANT CERTIFIED TO DO STATE WORK?

- CALIBRATION MUST BE DONE YEARLY. THIS IS DONE BY THE MATERIALS DEPARTMENT.

- CALIBRATION SHEET MUST BE VISUAL AT THE READY MIX PLANT.

GO LOOK AT THE STOCKPILES.

THE SPECIFIC GRAVITY TEST IS RUN BY THE CPI UNLESS THEY ARE HAVING PROBLEMS, THEN THE MONITOR WOULD RUN ONE.

*ALLOWED +- .02 OFF GIVEN SP.GR.

ALWAYS HAVE YOUR T-203 SECTION WITH YOU.

* THIS IS A LIST OF QUARRIES AND PITS.

  You can look up the materials you are using to check for Specific Gravity.

* IF THERE IS A DWU, YOU NEED TO CONTACT THE AREA INSPECTOR OR THE MATERIALS DEPARTMENT.

METRIC

ABSOLUTE VOLUMES????

CONVERTING????

SAFETY FIRST

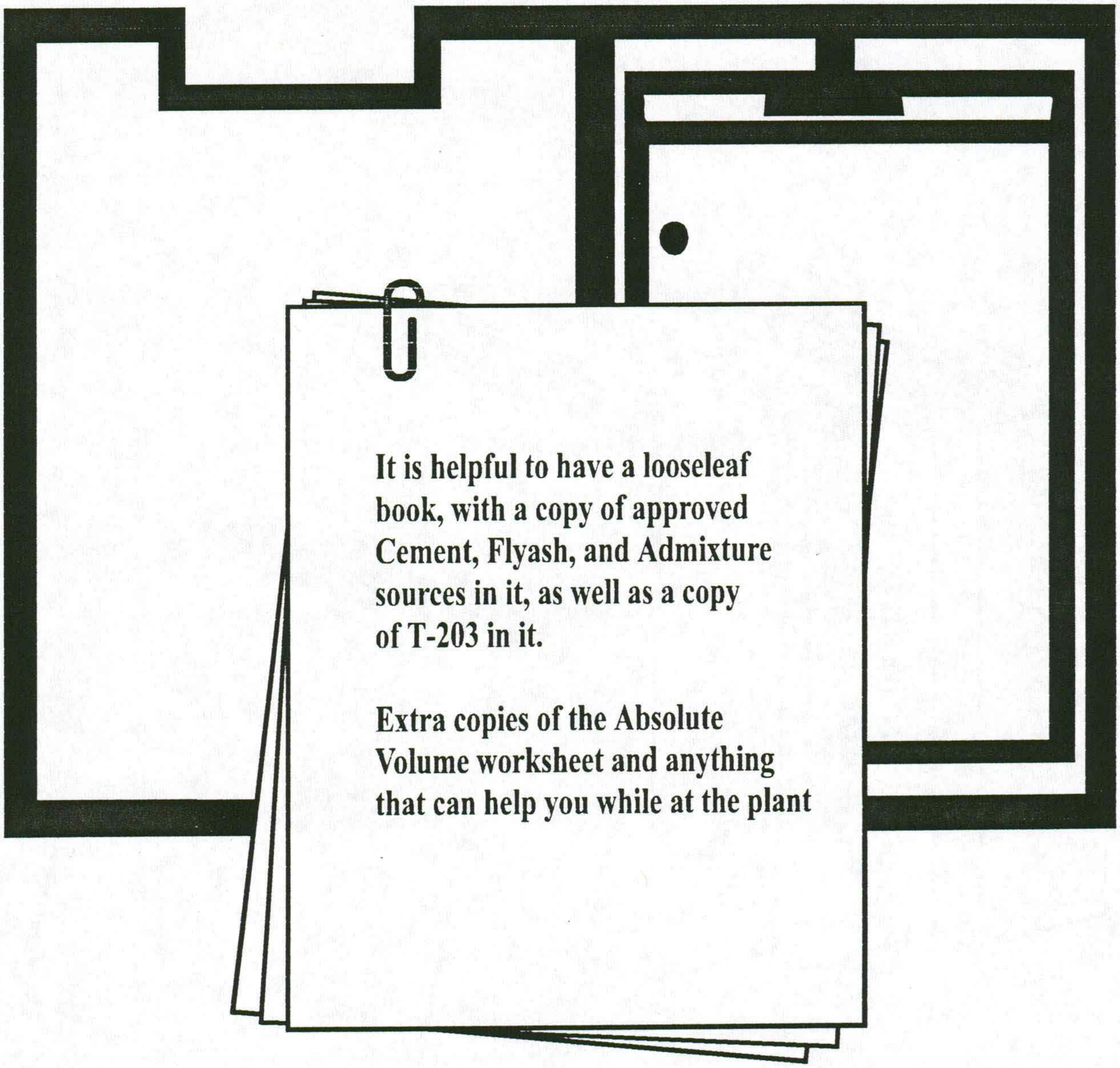
MAKE SURE EVERYTHING IS SAFE WHERE THE CPI CATCHES THEIR GRADATIONS.

THE PERSON CATCHING THE COLDFEED SAMPLES HAS TO BE LEVEL I AGGREGATE CERTIFIED.

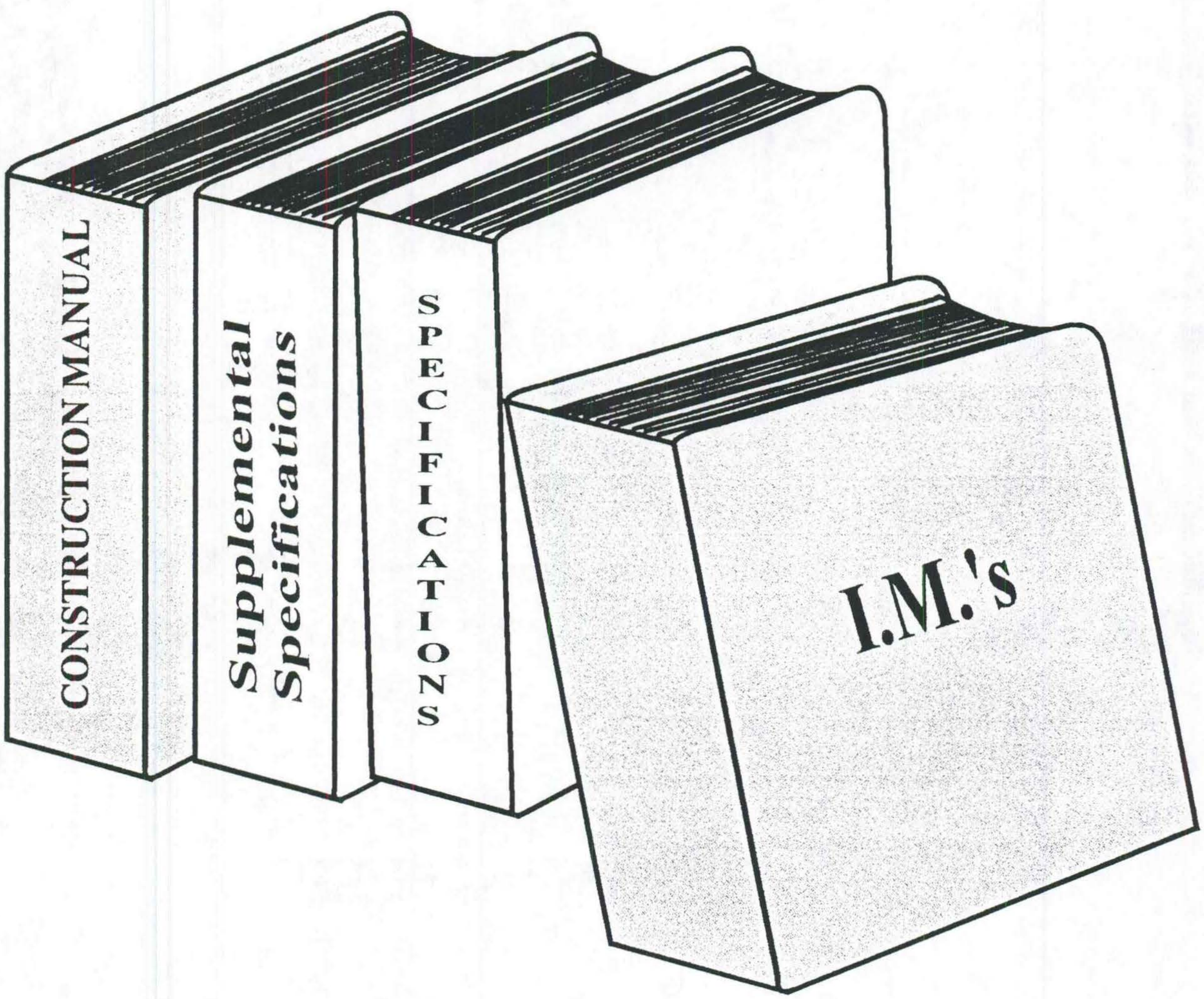
IF THE PROJECT HAS SMALL QUANTITIES, ASK YOUR ENGINEER IF TESTING MAY BE WAIVED.

NO GRADATIONS, SPECIFIC GRAVITIES, OR MOISTURES WOULD BE RUN.

FOR SPECIFIC GRAVITIES YOU WOULD USE T -203 ANSWER, AND BATCH PERSON USUALLY KNOWS WHERE THEY ARE FOR MOISTURES, DUE TO COMMERCIAL LOADS.


It is helpful to have a looseleaf book, with a copy of approved Cement, Flyash, and Admixture sources in it, as well as a copy of T-203 in it.
Extra copies of the Absolute Volume worksheet and anything that can help you while at the plant

Instead of hauling all of your I.M.'s with you, have your Specifications book (either green or orange) and a copy of the latest Supplementals, and your Construction Manual in your vehicle.



Check Admixture tanks.

Are they correctly set up?

- Minimum of 5 minutes each day per 100 gallons.
- Cirulation pump (1/3 h.p. pump motor)
- 5/8" inside diameter hose (minimum requirement)
- Stream of air bubbles will not be acceptable.

Make sure the Plant circulates any material before pour.

Ask Batch person when they add the Admixtures.

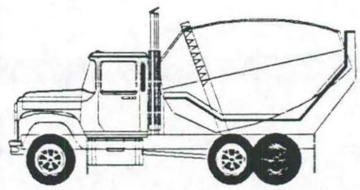
Retarder and Water Reducer shall be introduced into the mixer after all other ingredients are in the mixer.

FIRST DAY OF POURING

* BE THERE BEFORE POUR BEGINS

* CHECK OVER BATCH WEIGHTS

* WITNESS SCALE CHECKS



READY MIX TRUCKS

* METAL PLATE (RATED RPM) NEEDS TO BE ON EVERY TRUCK, AND YOU NEED TO BE ABLE TO READ IT. IF NOT ON TRUCK, TELL THEM IT NEEDS TO BE ON BEFORE NEXT POUR. IT IS YOUR CALL IF THIS POUR SHOULD BE USED OR NOT.

* ARE THE TRUCKS CERTIFIED?

  They should have a card in the cab of truck, with the date and sifgnature of who did the inspection of the truck.

* CLIMB UP AND LOOK INTO THE DRUM OF THE TRUCK YOURSELF. ARE THE FINS CLEAN AND HAVE NO HOLES?

* OBSERVE MIXING TIME OF LOADS.

* MAKE SURE TRUCKS ARE GETTING ALL THEIR "REVS" BEFORE THEY LEAVE THE PLANT

  - According to IM 527, it states BEFORE leaving plant, not M.O.R. (Mixing On Road).

  - 70 and 90 are the Rev counts.

* WATCH LOADER OPERATOR

  Is the person working the piles correctly?

* SCALE CHECKS BEING DONE ONCE EACH 1/2 DAY. IF YOU HAVE A SMALL POUR YOU CAN ALSO USE COMMERCIAL LOADS.

* CPI FILLING OUT TRUCK TICKETS PROPERLY?

    One copy stays at plant, the other copy goes with truck driver to give to the Road Inspector.

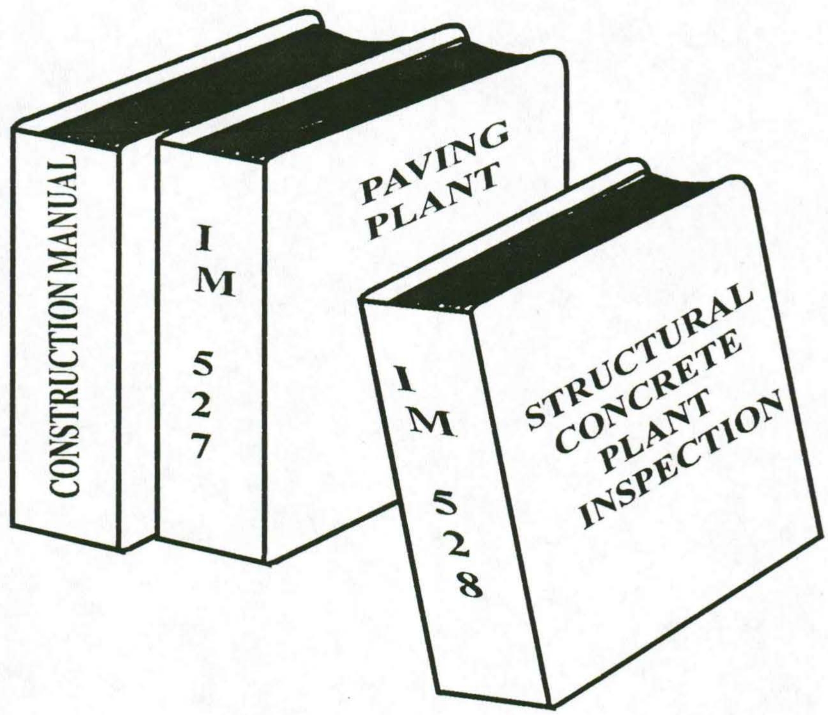
* MAKE SURE DISCHARGE TIME IS ON EVERY TICKET - THIS IS HOW THE ROAD INSPECTOR KNOWS TO REJECT THE LOAD OR NOT (I.M. 527).

* **GUIDE THE CPI THROUGH THE REPORT FOR THE FIRST DAYS POUR IF NEEDED.**

* **IF WORKING WITH FLOWABLE MORTAR, NEED MIX DESIGN NUMBER.**

* **MAKE SURE THE CPI KEEPS ALL SAMPLE BACKUPS, UNTIL YOU TELL THEM THEY CAN GET RID OF THEM.**

GOOD REFERENCES



PAVING PLANT

* NOT TOO MUCH DIFFERENT WHEN AT PAVING PLANT. YOU'LL HAVE A CEMENT YIELD TO LOOK OVER - CPI FILLS THIS OUT.

* GRADATIONS WILL BE DIFFERENT.

* REPORTS WILL BE MADE DAILY RATHER THAN WEEKLY.

WEEKLY CHECKS: STRUCTURAL

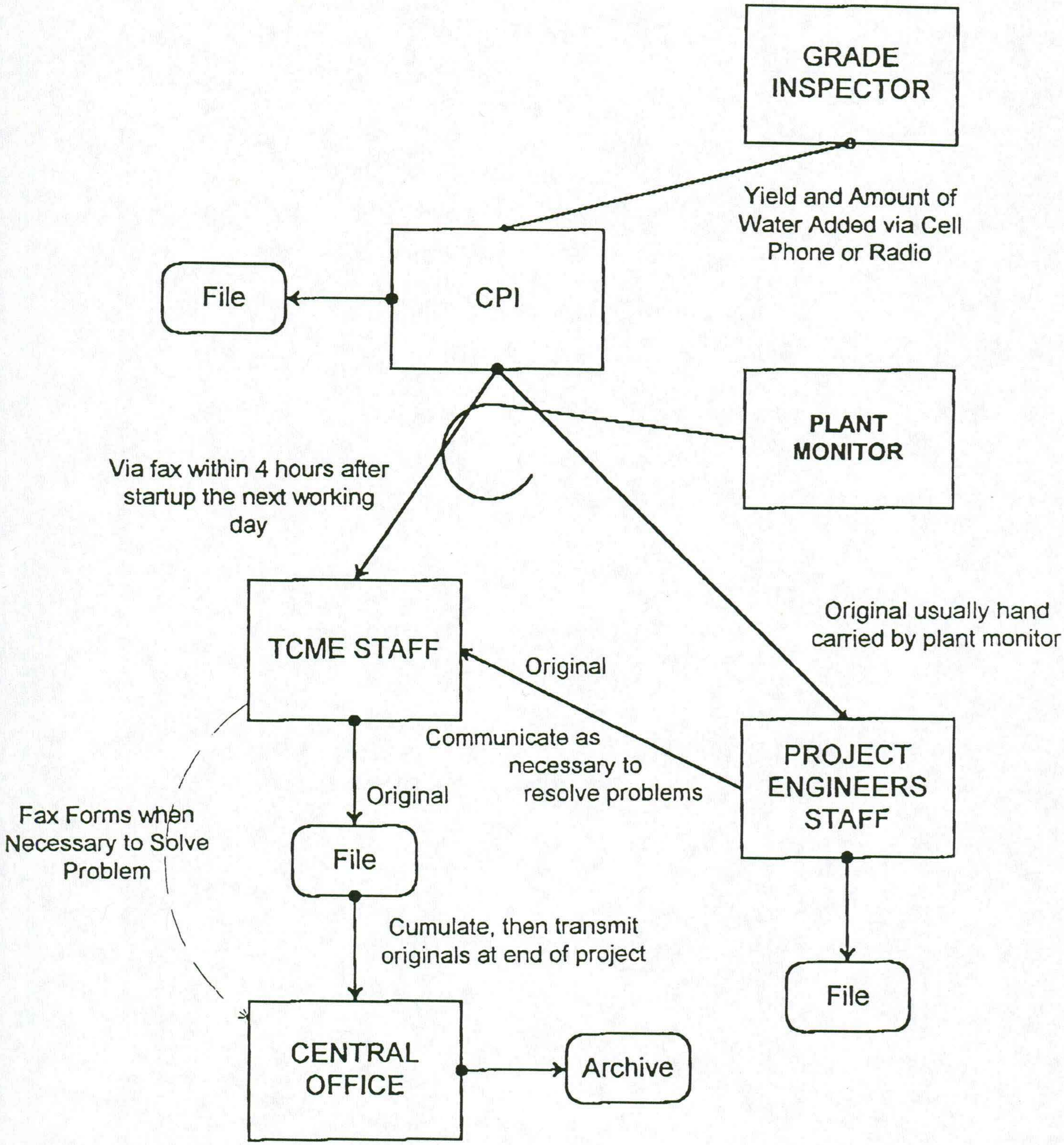
* REPORTS AND BOOK ENTRIES
* PROPORTION CONTROLS
  - Scale Weights/ Scale Operations
  - Admixture Dispensers
  - Mixing Time
* STOCKPILES

DAILY CHECKS: PAVING

* ALL ABOVE LISTED ITEMS FOR STRUCTURAL
* CEMENT YIELDS

ASSURANCE CHECKS

* CPI WILL GET THE ASSURANCE SAMPLES AND SPLIT THEM
* EITHER THE MONITOR OR WHOEVER IS RUNNING THE ACCEPTANCE GRADATION WILL RUN HALF OF THE ASSURANCE SPLIT, NOT THE CPI..
* HAVE READY: ALL TICKETS
* IF YOU KNOW A POUR IS GOING TO BE A SMALLER ONE, NOTIFY ASSURANCE. THEY MAY WAIT AND COME TO A LARGER POUR LATER ON.



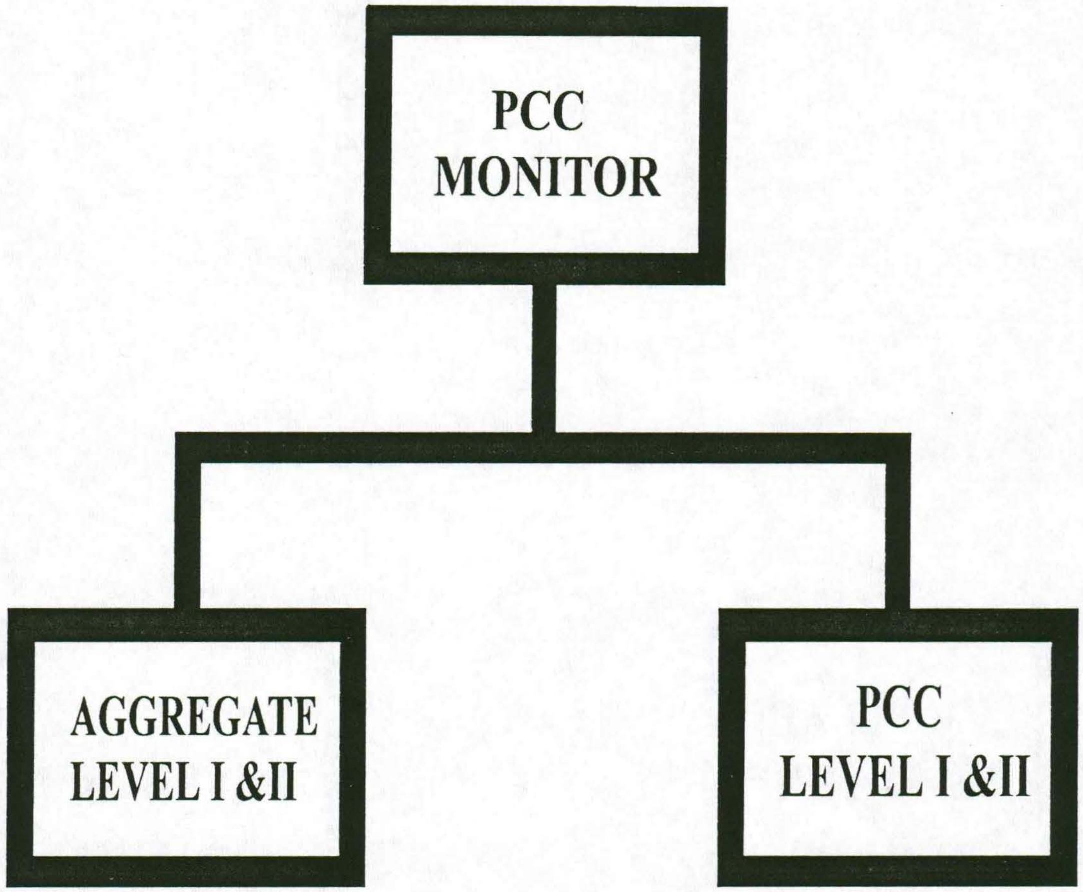
Flowchart for PCC Plant Page (e240 or m240)

QUESTIONS

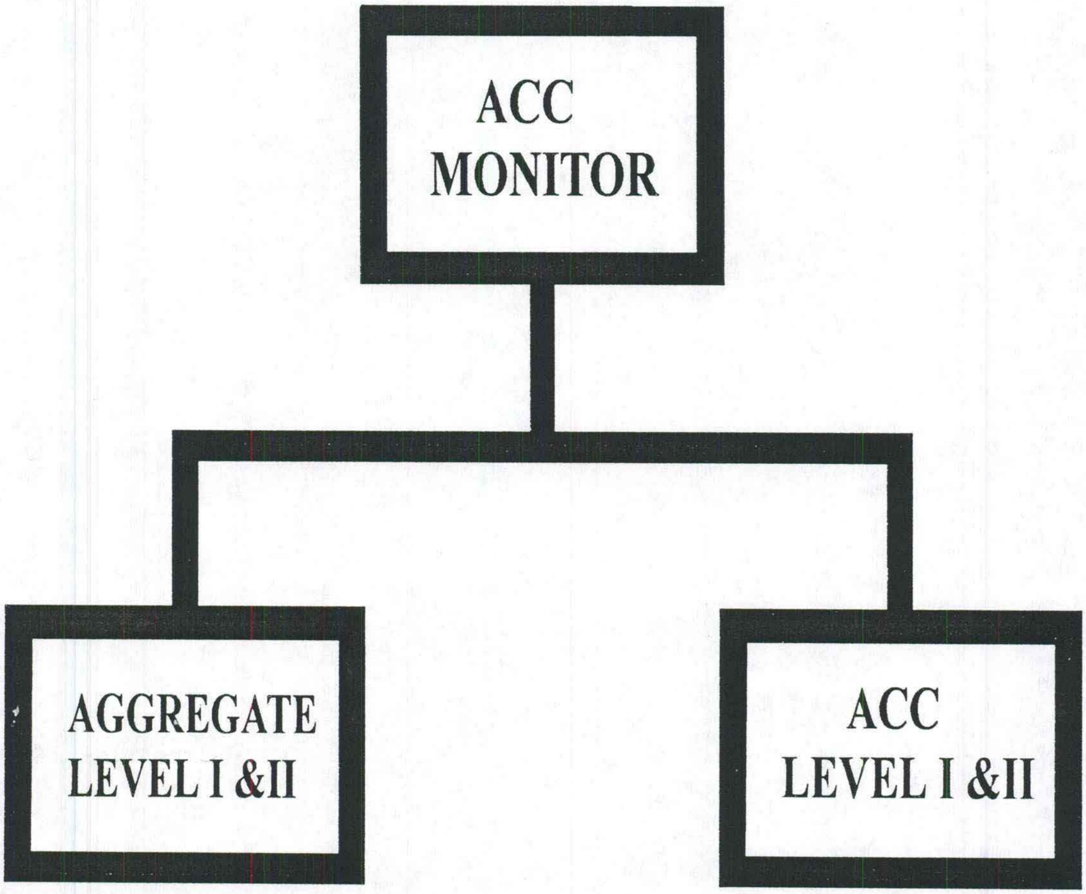
PROBLEMS

EXPERIENCES

REQUIREMENTS



DO NOT HAVE TO HAVE TEN DAYS EXPERIENCE TO BE A MONITOR



DO NOT HAVE TO HAVE TEN DAYS EXPERIENCE TO BE A MONITOR

REFERENCES

GENERAL

PCC

I.M.'S

I.M. 527 PAVING PLANT INSPECTION

I.M. 528 STRUCTURAL CONCTRETE PLANT INSPECTION

I.M. 529 P.C.C. CONCRETE PROPORTIONS

CONSTRUCTION MANUAL:

APPENDICES:

3 -2.1	MONITOR DUTIES PCC
3 -3.1	MONITOR DUTIES PCC

CHAPTERS:

11-47 to 11-56	MONITOR DUTIES PCC
3-3 to 3- 14	MONITOR DUTIES PCC

ACC

CONSTRUCTION MANUAL:

APPENDIX
3-4.1 to 3-4.4 MONITOR DUTIES ACC

CHAPTER
8-1 to 8-32 MONITOR DUTIES ACC

I.M.'S

I.M. 208 app. C	Interlaboratory Correlation Testing
I.M 510 app. A	QMA Test Equipment
I.M. 214 app. A	Asphalt Inspection Duties
I.M. 322	Method of Sampling Uncompacted Asphalt
I.M. 323	Method of Sampling Asphaltic Materials (What Size of Container and What Kind of Container to Use for the Different Samples)
I.M. 508	Asphaltic Plant Inspection
I.M. 508 app. B	Weighing Equipment
I.M. 511	Outline of Responsibilities
I.M. 511 QMA	Outline of Responsibilities

DUTIES

MONITOR DUTIES

- Set up looseleaf Books

- Take Books, Forms, Job Mix, and any supplies to the plant before project begins.

  Contracting authority, which is the DOT or County, will supply boxes, 3 oz. tins, and papercups to the Contractor for that project.

- Check over the QMA Lab. I.M. (?)

  NEIM - Something new in '96. They have an AC Specialist who will go out to the Labs and check over everything. They also check over the Materials Lab.

- Get familiar with the plant and the personnel, as well as Stockpiles, Bins (bin dividers), Sampling locations, and AC storage.

- At the PRE-CON, suggest that the QMA Lab Technician should keep current Supplemental Specifications and current I.M.'s in the QMA Lab.

- Plant Calibration is done by the Contractor and witnessed by the Materials ACC Technician. The Monitor is not required to be there during Calibration.

- If need extra copies of 955 or 956, may want to call the ACC Tech. and have them bring to them to the Calibration.

- Monitor Tank Stick once a week.

- Sensitivity Test first day and once a week there after.

- Run first Gradation Split for the first three days, and 10% of the project there after.

MONITOR DUTIES (Continued)

- DO NOT stay in the trailor or your truck all day. Get out and walk around the Plant. Go into the Control Trailor. Check the gate settings - keep an eye on these during the day.
- Monitor the Mix temperatures - Need to tarp
- See that Aggregate are getting properly coated (you can usually see inside the truck boxes).
- If a truck uses a distillate, the trucks will have to sit for 5 hours with their boxes in an upward position.
- Check to see that the person doing the Sampling off the road is doing it properly.
- Monitor, or whoever the TC designates, "Rolls the Dice" for which box is to be sent to Materials.
- Monitor will let CPI know when they can throw away any Aggregate samples.
- Materials Lab will let the QMA Lab Technician know when they can throw away their boxes and pills.
- The Mix Design (956) is given to a certain project. An approved 956 for one project may not be used for another project without the approval of your Materials Lab or ACC Technician. There are different criteria that need to be met.
- Assurance samples are independent from the daily lot sample.
- Check any Materials tickets.
- Use truck ticket weights on liquid asphalt tankers (no longer have to get a weight before they unload and after they unload).

MONITOR DUTIES (Continued)

- **You do not need individual truck tickets from every truck if a Plant is set up in a Quarry from which you may be getting products. The Scale person may give you a daily total sheet for each Material.**

- **Loosesleaf pages - No longer have the large Tankstick sheets on the walls.**

- **Computer Tankstick - Just enter your numbers and the computer calculates everything for you.**

- **Minimum FBR = 0.30**

- **Gradation Test Results - The #200 Sieve should not go below 3.0. This is the daily result, not what is submitted for the Job Mix.**

QUESTIONS

PROBLEMS

EXPERIENCES

ACC NON QMA

GENERAL

DAILY FORMS: E241 or M241

* Mostly completed by Certifed Plant Inspector.

* Always a day behind at the Plant due to the fact that roadway cores are usually cut the following working day.

* Report should be faxed in within four hours of the next working day, unless you have any kind of failures.

SAMPLING

AC SAMPLES (Liquid)

CPI gets a 3 oz. tin of 1/40 ton of Asphalt (not 1/40 ton of Mix).

MIX (Hotbox)

- Sampled by QMA tech. or CPI on QMA projects.
- First Sample each day is sent to the Materials Lab directly for testing.

GRADATIONS

- Run the first Split Sample of the first three days of production, and then 10% of the project thereafter. (Split is between CPI and Monitor.)

- The CPI will run the first one everyday, and then get two more throughout the day for backups.
  Random Gradations - The CPI "Rolls the Dice" to see if they have to run an extra Gradation everyday.

- For some projects, the CPI will run the Split of the first sample, and then will elect to run the Split of the second or third sample everyday. They must tag the other half of the Split for the Monitor.

- All backups should be kept at the Plant site until the Monitor tells the CPI which ones they can throw.

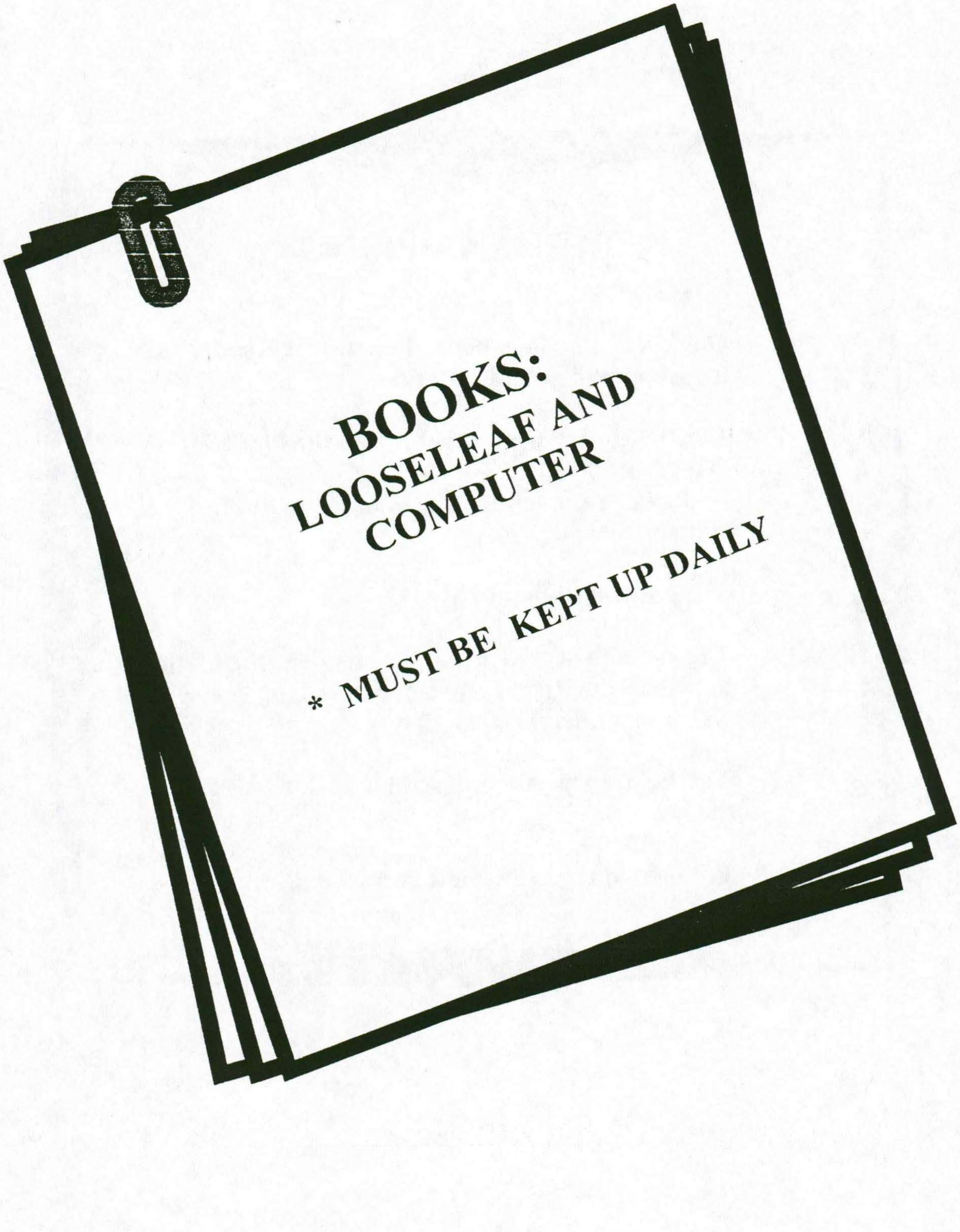
- On Daily Asphalt Plant Report - Form E241 or M241 (handwritten one), there is a location for the Monitor to enter their Gradation results.
- The Monitor still needs to report their Gradations on Form E201 or M201.
  Put Monitor's results, and then directly below, put the CPI's results. Then do the Gradation comparison, according to I.M. 216.

DENSITY CORES

On Non-QMA projects, the Monitor will weigh the Cores and calculate the Densities.

Make sure you get the Cores ready to be sent into your Materials Department.

- **The Lab will hold onto them.**
- **They randomly choose a set per week to run.**
- **Then they will see how close they correlate with the fields' answers.**

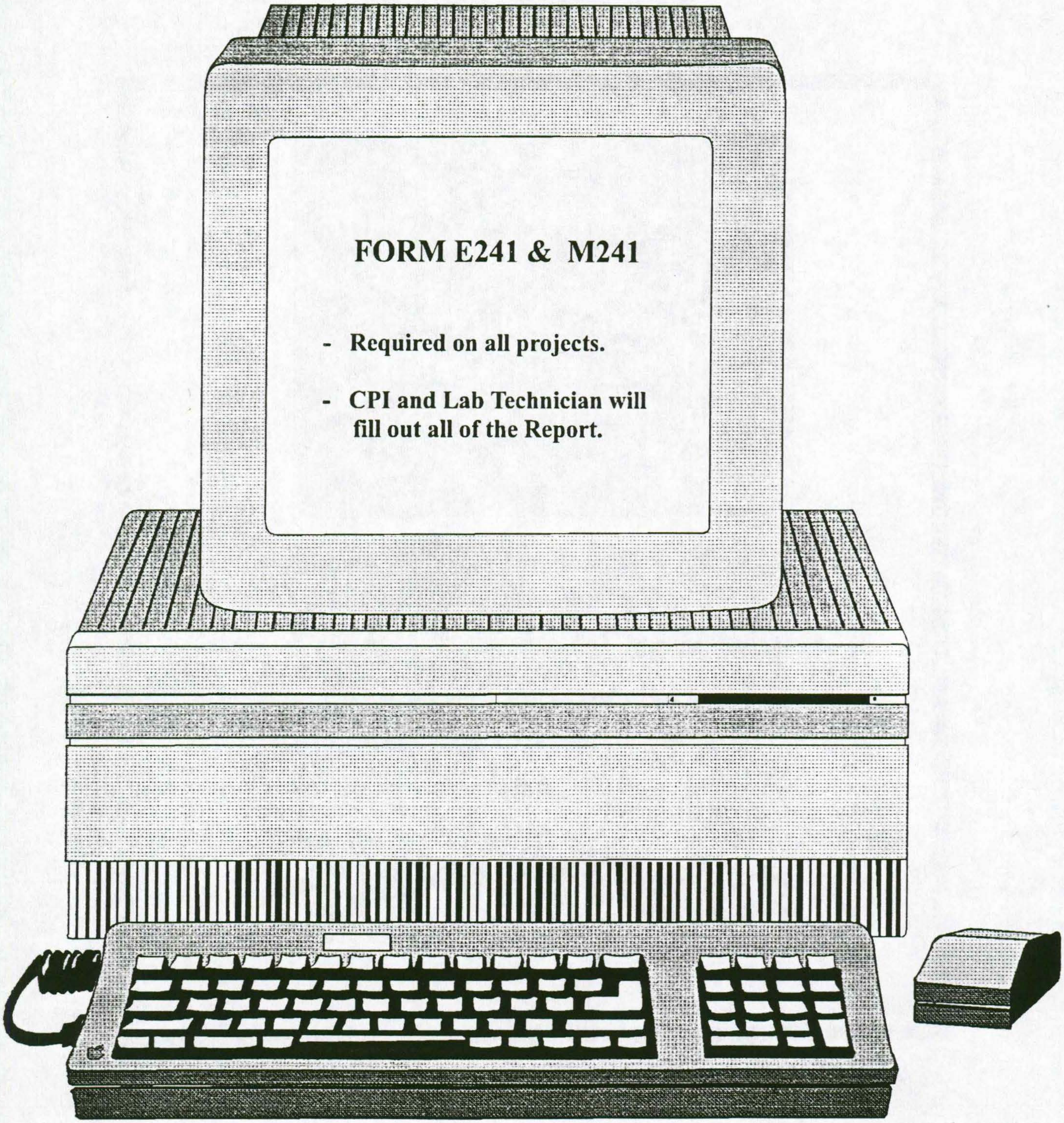

BOOKS:
LOOSELEAF AND
COMPUTER
* MUST BE KEPT UP DAILY

TACK SAMPLING

- One every 10,000 gallons. Usually the Road Inspector will get this sample.
- The tickets will usually come into the Plant.
- Make out Sample Identification Form #193, and an envelope.
- Sample according to I.M. 323.
- You can either give the Superintendent the bottle to take to the Road Inspector for you, or you can give it to a reliable truck driver.
- The Road Inspector will send it back to the Plant the same way.
- Put the paperwork with it and send it in.

ACC QMA

GENERAL


FORM E241 & M241
- Required on all projects.
- CPI and Lab Technician will fill out all of the Report.

SAMPLING

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MIX (Hotbox)

- **Sampled by QMA tech. or CPI on QMA projects.**
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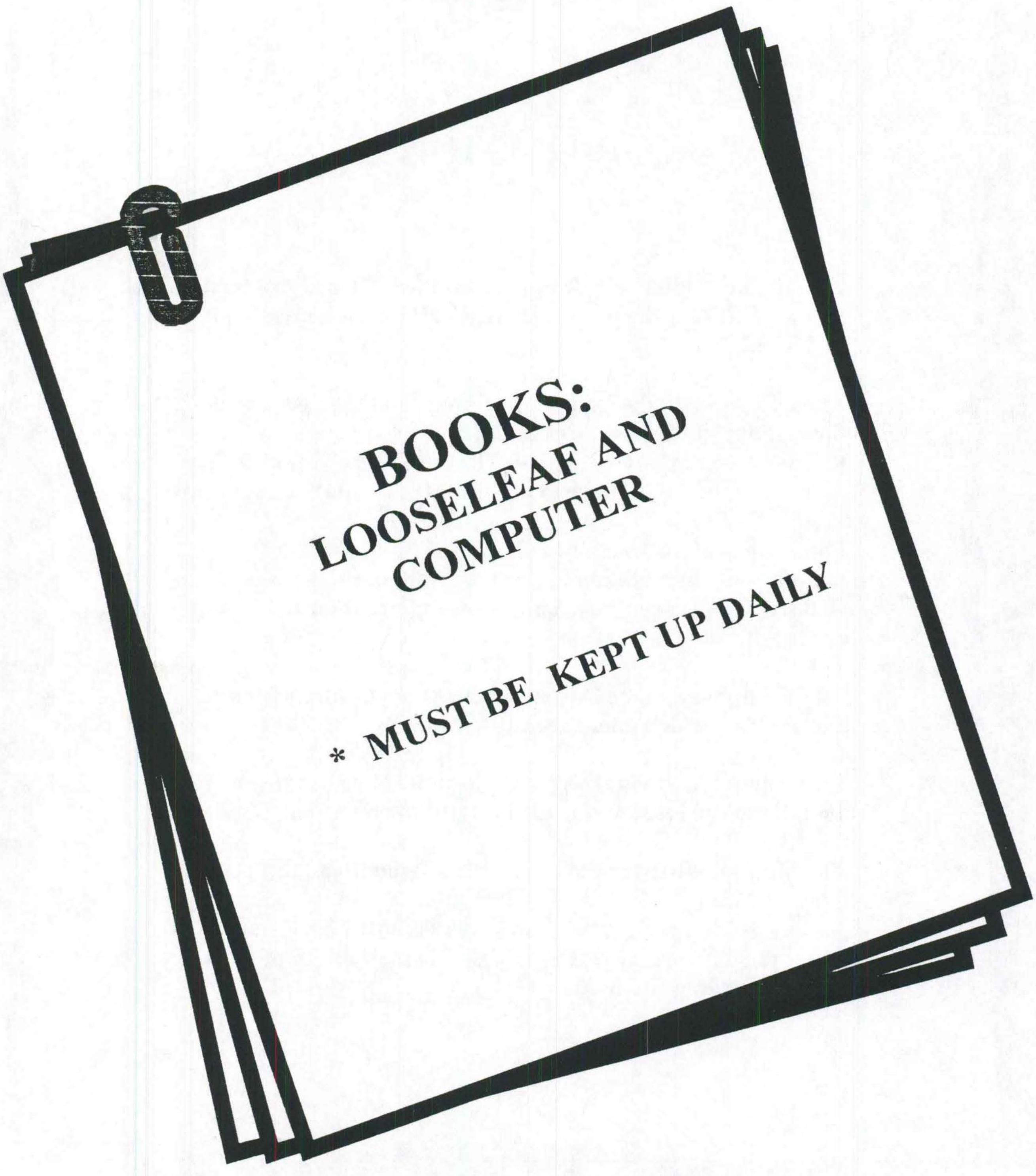

BOOKS:
LOOSELEAF AND
COMPUTER
* MUST BE KEPT UP DAILY

CHARTS (QMA LAB TECH)

- ***Must be kept up daily.***
- ***Everyone looks at these when they come to the Lab.***
- ***The charts provide information on the quality of the Mix.***
- ***They show moving averages.***
- ***If the moving average goes out on the voids, the Contractor needs to stop and make a change to try to bring the average back in.***

If no change is made and they keep running, knowing the moving average is out, shut them down, and it is a 50%penalty of the mix laid.

DENSITY CORES

- CPI weighs the Cores and calculates the Densities.
- As a Monitor, observe the process at least once a week.
- CPI gets the Cores ready to be sent to the Materials Lab.
- Remember, a copy of the Report must be sent in with the Cores.

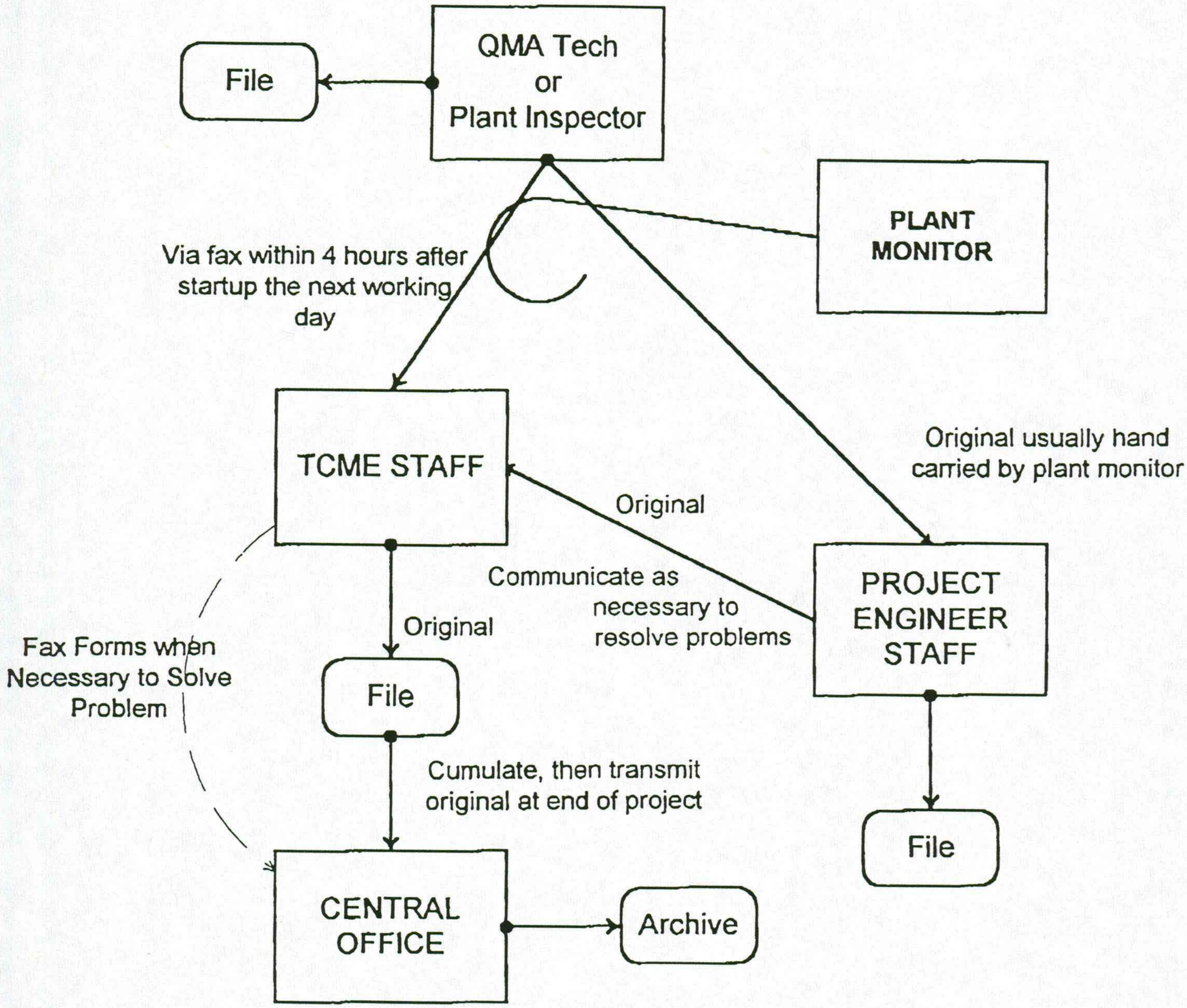
MIX

- The QMA Lab Tech. will get four boxes daily (depending on tonnage).

- They will break these down in their Lab Trailors. Some sort of sample needs to go to the Materials Lab for correlation testing everyday.

- Each area may be different in what they want sent in, so you will have to call and find out what they want.

- Always keep in touch with your Materials Lab. If they are having problems, they may want more.



Flowchart for ACC Plant Page (form e241 or m241)

QUESTIONS

PROBLEMS

EXPERIENCES

METHOD OF TESTING THE STRENGTH OF PORTLAND CEMENT CONCRETE USING THE MATURITY METHOD

GENERAL

This I.M. outlines the procedure for using the maturity concept as a non-destructive method to determine concrete strength.

This is a two step procedure. First, a relationship must be established between the maturity values and the concrete strength as measured by destructive methods (that is, through testing of beams or cylinders). The development of the maturity-strength curve shall be done in the field at the beginning of construction using project materials and the project proportioning and mixing equipment. The second step is the instrumentation of the concrete to be measured. Temperature probes are installed in the concrete and the temperature is measured. From those measurements, along with the age at which the measurements were taken, maturity values are determined. A maturity meter or temperature measuring device and a computer or calculator may also be used to determine the maturity values.

THE MATURITY CONCEPT

The hydration of cement and gain in strength of the concrete are dependent on both curing time and temperature. Thus, the strength of the concrete may be expressed as some function of time and temperature. This information can then be used to determine the strength of concrete without conducting physical tests. The time-temperature function commonly used is the maturity concept proposed by Nurse-Saul (ASTM C1074),

$$M(^\circ C \times hours) = \sum[(T - T_0)\Delta t] \quad (1)$$

where M is the maturity in degree °C-hours [M is also termed the time-temperature factor (TTF)], Δt is the time interval in hours (or days), T is the average concrete temperature during the time interval Δt, and T_0 is the datum temperature at which concrete ceases to gain strength with time. The value of T_0 = -10°C (14°F) is most commonly used. As a result, Eq. (1) becomes

$$M(^\circ C \times hours) = \sum[(T + 10)\Delta t] \quad (2)$$

ESTABLISHMENT OF MATURITY-STRENGTH RELATIONSHIP

To establish a maturity-strength relationship for a concrete mix, a maturity meter or a thermal meter and a hydraulic testing machine are needed. The following procedure is recommended:

1. Cast eight (8) 152 mm X 152 mm X 508 mm (6" x 6" x 20") beams. Test the entrained air content and slump of the concrete being used to cast the beams. Record these values. The concrete shall meet specifications.

2. Embed a thermal couple wire near each end of a test beam (when flexural strength is to be determined) to monitor the temperature. This beam will be the last to be tested. A probe shall be inserted near each of the beam ends to the approximate mid-depth and such that they are approximately 75 mm (three inches) from each side and each end. Loop the wire around the beam box handles to prevent the wire from being inadvertently pulled out of the beam. The average of the two readings will be used in the development of the maturity-strength curve. When the thermal meter is used, the measured temperature should be substituted into Eq. (2) to obtain values of maturity. The Maturity Data Recording Sheet at the end of this I.M. may be used in this determination. When a maturity meter is used, the values are computed by the meter. Eight (8) test specimens shall be tested as described in #4 below.

3. Cure all beams in a pit of wet sand. Cast, cure, and test the beams at the plant site. This will allow a maturity meter to be protected from the weather and theft. The meter can be stored in a lab trailer or vehicle with the probes run outside to the beam in the sand pit.

4. Determine maturity values and strength at four different ages. Test two specimens for strength at each age and calculate the average strength at each age. The maturity value shall be calculated from a temperature reading at the time the specimen is tested for strength. The tests shall be spaced such that they are performed at somewhat consistent intervals of time and span a range in strength that includes the opening strength desired. The table below gives suggested maturity values for each test of three standard mixture classes. This is only a guide and may need to be modified, depending on specific mixtures and conditions.

Maturity Values (TTF)

	Test 1	Test 2	Test 3	Test 4
B Mix	1500	3500	5500	7500
C Mix	1000	2000	3000	4000
F Mix	500	1000	1500	2500
FF Mix	500	1000	1500	2000
M Mix with CaCl	100	200	300	400

These values assume opening strength of 3.45 MPa (500 psi) for the B and C mixtures, 2.80 MPa (400 psi) for F mixtures, 2.40 MPa (350 psi) for FF mixtures, and a five hour opening for the M mixture with calcium chloride. If the maturity curve is intended to be used to determine the time to begin joint sawing, testing must begin at lower maturity values.

The first test (Test 1), for Class C mixes, normally would be performed at an age of approximately 8 to 12 hours when warm, summer temperatures prevail. During cooler conditions, the first test may be performed at the beginning of the day following casting of test specimens.

Additional test specimens may be cast at a later time and tested at earlier ages to add data to the strength-maturity relationship as an aid to determining the appropriate time to saw.

5. Plot the measured strength against the corresponding values of maturity at different ages, as determined by the maturity meter or by hand methods. Use a computer/calculator program to determine maturity-strength relationship. This is the maturity-strength curve to be used in the field. The TTF number corresponding to the opening strength shall be determined by the contractor and independently verified by the Engineer.

Since the influence of maturity on strength of concrete is somewhat different for various mixes, a maturity-strength relationship established for one mix shall not be used for another mix.

FIELD PROCEDURE

Placement of the temperature probes

Strip the coating from the each end of the two wires and twist the ends together before inserting them into the fresh concrete. Insert the temperature probe into the concrete until the end is at approximately the pavement mid-depth and 0.5 m (1.6 ft) from the edge of the pavement. The wire ends are the point at which the temperature measurement is taken. Insertion may be accomplished by attaching the wire ends to a wooden dowel and embedding it into the slab. Check to ensure the concrete is consolidated around the dowel. The portion of the dowel that protrudes above the pavement should be cut or broken off after the testing is completed.

Probes may be placed at any point along the pavement slab. A minimum of two probes shall be placed in each day's placement. On days when there is a large difference between daytime high temperatures and nighttime low temperatures, placing probes near the beginning of the day's run and at a point near the midday location would provide helpful information. This would be helpful to those sawing the pavement as well as those determining the opening time. It has been found that the concrete does not always gain strength at the same rate. Therefore the concrete placed during the middle of the day can gain strength faster than the concrete placed at the beginning of the day.

Data Collection
The other probe wire ends, not placed in the concrete, shall be connected to a plug, unless the temperature measuring device must be connected to the probe directly with bare wires. The plug is then inserted into the maturity meter or thermal meter. Normally a thermal meter can be used to collect field data. Be careful to connect the copper wire to the copper plug prong (+).

When a thermal meter is used, the wire is connected to the meter each time a temperature is taken. Then the wire is disconnected and the value recorded. A Maturity Data Recording Sheet is provided at the end of this Materials I.M. which may be used to record the temperature readings and calculate the maturity values.

Do not disconnect the wire from the maturity meter until the test is completed. The data collection must be uninterrupted. Also the maturity meter must by protected from rain or water. If water finds its way inside the meter, permanent damage will result.

Once the wires are placed, an initial temperature of the concrete shall be taken and recorded, when a thermal meter is being used. Temperature readings should be taken in the morning and late afternoon, when one first arrives on the project and before one leaves for the day, as a minimum for standard B and C mixtures. For the fast setting mixtures, readings should be taken every few hours, depending on weather conditions and mixture. If a maturity meter is being used, it should be connected to the probe as soon as possible to begin data collection.

Measuring the maturity
The maturity number can be read directly from the maturity meter or calculated from the temperature readings obtained by the thermal meter. This number is then used to enter the strength-maturity chart that was established as described above and a strength is then determined.

Note: An instruction sheet will accompany each maturity meter. It is important to follow these instructions to initialize the instrument.

MATURITY DATA RECONDING SHEET

Project No.: ____________ County: ____________________

Pavement Thickness: ______

TTF for Traffic Opening	Station: ____________ Air (%): ____________ Slump: ____________ Air Temp: ____________	Station: ____________ Air (%): ____________ Slump: ____________ Air Temp: ____________

Date	Time	Site 1				Site 2			
		Age (hour)	Temp (°C)	ΔTTF (°C-h)	TTF	Age (hour)	Temp (°C)	ΔTTF (°C-h)	TTF
		0				0			

$$\Delta TTF_i = \left(\frac{Temp_i + Temp_{i+1}}{2} + 10 \right) (Age_i - Age_{i-1})$$

SAMPLE

MATURITY DATA RECONDING SHEET

Project No.: FM-67(25)--55-67 **County:** Monona
Pavement Thickness: 8 in.

TTF for Traffic Opening	Site 1	Site 2
7500 °C-hour	Station: 1100 Air (%): 6.5 Slump: 2 in. Air Temp: 75 °F	Station: Air (%): Slump: Air Temp:

Date	Time	Site 1				Site 2			
		Age (hour)	Temp (°C)	ΔTTF (°C-h)	TTF	Age (hour)	Temp (°C)	ΔTTF (°C-h)	TTF
8/12/95	9:00 am	0	31	0	0	0			
	10:00 am	1	31	41	41				
	1:00 pm	4	36	131	172				
	4:00 pm	7	33	134	306				
8/13/95	9:00 am	24	28	689	994				
	4:00 pm	31	42	315	1309				
8/14/95	9:00 am	48	37	842	2151				
	4:00 pm	55	38	333	2483				
8/15/95	9:00 am	72	22	680	3163				

$$\Delta TTF_i = \left(\frac{Temp_i + Temp_{i+1}}{2} + 10\right)(Age_i - Age_{i-1})$$

METHOD OF TESTING THE STRENGTH OF PORTLAND CEMENT CONCRETE USING THE MATURITY METHOD

GENERAL

This I.M. outlines the procedure for using the maturity concept as a non-destructive method to determine concrete strength.

This is a two step procedure. First, a relationship must be established between the maturity values and the concrete strength as measured by destructive methods (that is, through testing of beams or cylinders). The development of the maturity-strength curve shall be done in the field at the beginning of construction using project materials and the project proportioning and mixing equipment. The second step is the instrumentation of the concrete to be measured. Temperature probes are installed in the concrete and the temperature is measured. From those measurements, along with the age at which the measurements were taken, maturity values are determined. A maturity meter or temperature measuring device and a computer or calculator may also be used to determine the maturity values.

The Contractor and the Agency shall jointly develop a plan for performing the maturity testing. The plan shall include:

1. The time and location of the development of the maturity curve. Both the Contractor and Agency personnel shall work together in the development of the curve.
2. The frequency and location of the temperature monitoring probes in the constructed pavement. The contractor and agency personnel shall work together in the temperature monitoring process.

THE MATURITY CONCEPT

The hydration of cement and gain in strength of the concrete are dependent on both curing time and temperature. Thus, the strength of the concrete may be expressed as some function of time and temperature. This information can then be used to determine the strength of concrete without conducting physical tests. The time-temperature function commonly used is the maturity concept proposed by Nurse-Saul (ASTM C1074),

$$M(^{\circ}C \times hours) = \sum [(T - T_0)\Delta t] \quad (1)$$

where M is the maturity in degree °C-hours [M is also termed the time-temperature factor (TTF)], Δt is the time interval in hours (or days), T is the average concrete temperature during the time interval Δt, and T_0 is the datum temperature at which concrete ceases to gain strength with time. The value of T_0 = -10°C (14°F) is most commonly used. As a result, Eq. (1)

becomes

$$M(^{\circ}C \times hours) = \sum[(T + 10)\Delta t] \qquad (2)$$

ESTABLISHMENT OF MATURITY-STRENGTH RELATIONSHIP

To establish a maturity-strength relationship for a concrete mix, a maturity meter or a thermal meter and a hydraulic testing machine are needed. The following procedure shall be used:

1. Cast a minimum of twelve (12) 152 mm X 152 mm X 508 mm (6 in. x 6 in. x 20 in.) beams, as per I.M. 328. Test the entrained air content and slump of the concrete being used to cast the beams, as per I.M. 327. Record these values. The concrete shall meet specifications.

2. Embed a thermal couple wire near each end of a test beam (when flexural strength is to be determined) to monitor the temperature. This beam will be the last to be tested. A probe shall be inserted near each of the beam ends to the approximate mid-depth and such that they are approximately 75 mm (three in.) from each side and each end. Loop the wire around the beam box handles to prevent the wire from being inadvertently pulled out of the beam. The average of the two readings will be used in the development of the maturity-strength curve. When the thermal meter is used, the measured temperature should be substituted into Eq. (2) to obtain values of maturity. The Maturity Data Recording Sheet at the end of this I.M. may be used in this determination. When a maturity meter is used, the values are computed by the meter. Twelve (12) test specimens shall be tested as described in #4 below.

3. Cast, cure, and test the beams at the plant site. This will allow a maturity meter to be protected from the weather and theft. The meter can be stored in a lab trailer or vehicle with the probes run outside to the beam in the sand pit. The beams shall be covered with plastic immediately after casting and prior to form removal. If possible, wet burlap should be placed over the surface of the beams under the plastic. The forms shall be removed the following day. Cure all beams in a pit of wet sand after form removal, until they are tested.

4. Determine maturity values and strength at four different ages. Test a minimum of two specimens for strength at each age and calculate the average strength at each age. The maturity value shall be calculated from a temperature reading at the time the specimen is tested for strength. The tests shall be spaced such that they are performed at somewhat consistent intervals of time and span a range in strength that includes the opening strength

desired. The table below gives suggested maturity values for each test of three standard mixture classes. This is only a guide and may need to be modified, depending on specific mixtures and conditions.

Approximate Maturity Values (TTF)

	Test 1	Test 2	Test 3	Test 4
B Mix	1500	3500	5500	7500
C Mix	750	1500	2500	3500
F Mix	500	1000	1500	2500
FF Mix	500	1000	1500	2000
M Mix with CaCl	100	200	300	400

These values assume opening strength of 3.45 MPa (500 psi) for the B and C mixtures, 2.80 MPa (400 psi) for F mixtures, 2.40 MPa (350 psi) for FF mixtures, and a five hour opening for the M mixture with calcium chloride. If the maturity curve is intended to be used to determine the time to begin joint sawing, testing must begin at lower maturity values.

The first test (Test 1), for Class C mixes, normally would be performed at an age of approximately 12 hours when hot, summer temperatures prevail. During cooler conditions, the first test may be performed at the beginning of the day following casting of test specimens.

Additional test specimens may be cast at a later time and tested at earlier ages to add data to the strength-maturity relationship as an aid to determining the appropriate time to saw.

5. Plot the measured strength against the corresponding values of maturity at different ages, as determined by the maturity meter or by hand methods. Use a computer program provided by the Transportation Center Materials Concrete Technician to determine maturity-strength relationship. The TTF number corresponding to the opening strength shall be used to determine when the pavement has reached opening strength. An example of the Maturity-Strength Development form, generated by the computer program, is included at the end of this I.M.

Since the influence of maturity on strength of concrete is somewhat different for various mixes, a maturity-strength relationship established for one mix shall not be used for another mix.

FIELD PROCEDURE

Equipment

1. 12 - 152 mm x 152 mm x 508 mm (6 in. x 6 in. x 20 in.) beam molds.
2. 1 each shovel (square point), rubber hammer or equivalent, and wood float or equivalent.
3. 1 each hydraulic testing machine
4. 1 each maturity meter
5. 1 each hand-held thermometer
6. Type T thermocouple wire
7. Connectors

The following equipment has been used in this work and the manufacturer's address and phone numbers are provided for information purposes. Similar equipment is available from other manufacturers.

Maturity Meter Model H-2680	Humboldt Mfg. Co. 7300 W. Agatite Avenue Norride, IL 60656 (708)456-6300
Hand-held Thermometer Model HH-25TC	Omega Engineering, Inc. One Omega Drive Box 4047 Stanford, CT 06907-0047 (203)359-1660
Type T Thermocouple Wire	Watlow-Gordon Richmond, IL 60071 (815)678-2211

Placement of the temperature probes

Strip the coating from the each end of the two wires and twist the ends together before inserting them into the fresh concrete. Insert the temperature probe into the concrete until the end is at approximately the pavement mid-depth and 0.5 m (1.6 ft) from the edge of the pavement. The wire ends are the point at which the temperature measurement is taken. Insertion may be accomplished by attaching the wire ends to a wooden dowel and embedding it into the slab. Check to ensure the concrete is consolidated around the dowel. The portion of the dowel that protrudes above the pavement should be cut or broken off after the testing is completed.

Probes may be placed at any point along the pavement slab. A minimum of two probes shall be placed in each day's placement. On days when there is a large difference between daytime high temperatures and nighttime low temperatures, placing probes near the beginning of the day's run and at a point near the midday location would provide helpful information. This would be helpful to those sawing the pavement as well as those determining the opening time. It has been found that the concrete does not always gain strength at the same rate. Therefore the concrete placed during the middle of the day can gain strength faster than the concrete placed at the beginning of the day.

Data Collection
The other probe wire ends, not placed in the concrete, shall be connected to a plug, unless the temperature measuring device must be connected to the probe directly with bare wires. The plug is then inserted into the maturity meter or thermal meter. Normally a thermal meter can be used to collect field data. Be careful to connect the copper wire to the copper plug prong (+).

When a thermal meter is used, the wire is connected to the meter each time a temperature is taken. Then the wire is disconnected and the value recorded. A Maturity Data Recording Sheet is provided at the end of this Materials I.M. which may be used to record the temperature readings and calculate the maturity values.

Do not disconnect the wire from the maturity meter until the test is completed. The data collection must be uninterrupted. Also the maturity meter must by protected from rain or water. If water finds its way inside the meter, permanent damage will result.

Once the wires are placed, an initial temperature of the concrete shall be taken and recorded, when a thermal meter is being used. Temperature readings should be taken in the morning and late afternoon, when one first arrives on the project and before one leaves for the day, as a minimum for standard B and C mixtures. For the fast setting mixtures, readings should be taken every few hours, depending on weather conditions and mixture. If a maturity meter is being used, it should be connected to the probe as soon as possible to begin data collection.

Measuring the maturity
The maturity number can be read directly from the maturity meter or calculated from the temperature readings obtained by the thermal meter. This number is then used to enter the strength-maturity chart that was established as described above and a strength is then determined. Note: An instruction sheet will accompany each maturity meter. It is important to follow these instructions to initialize the instrument.

Verification
Once per month, verification tests shall be conducted to determine if concrete strength is being represented by the current maturity curve. Cast and cure three (3) beams using the same procedure and manner as used to develop the current maturity curve. Test all three beams at a

maturity value which is the value determined to represent the opening strength of the pavement. If the average of these tests is within ±50 psi of the strength set for the opening, the test shall be considered as validating the current maturity curve. If the average value is not within these limits, a new maturity curve shall be developed.

MATURITY DATA RECORDING SHEET

Project No.: ______________________ County: ________________

Pavement Thickness: ___________

TTF for Traffic Opening	Station: ______________	Station: ______________
	Air (%): ______________	Air (%): ______________
	Slump: ______________	Slump: ______________
	Air Temp: ______________	Air Temp: ______________

Date	Time	Site 1				Site 2			
		Age (hour)	Temp (°C)	TTF (°C-h)	TTF	Age (hour)	Temp (°C)	TTF (°C-h)	TTF
		0				0			

$$TTF_i=\left(\frac{Temp_i+Temp_{i+1}}{2}+10\right)(Age_i-Age_{i-1})$$

SAMPLE

MATURITY DATA RECORDING SHEET

Project No.: FM-67(25)--55-67 County: Monona

Pavement Thickness: 8 in.

TTF for Traffic Opening	Site 1	Site 2
7500 °C-hour	Station: 1100 Air (%): 6.5 Slump: 2 in. Air Temp: 75 °F	Station: Air (%): Slump: Air Temp:

Date	Time	Site 1				Site 2			
		Age (hour)	Temp (°C)	TTF (°C-h)	TTF	Age (hour)	Temp (°C)	TTF (°C-h)	TTF
8/12/85	9:00 am	0	31	0	0	0			
	10:00 am	1	31	41	41				
	1:00 pm	4	36	131	172				
	4:00 pm	7	33	134	306				
8/13/95	9:00 am	24	28	689	994				
	4:00 pm	31	42	315	1309				
8/14/95	9:00 am	48	37	842	2151				
	4:00 pm	55	38	333	2483				
8/15/95	9:00 am	72	22	680	3163				

$$TTF_i = \left(\frac{Temp_i + Temp_{i+1}}{2} + 10\right)(Age_i - Age_{i-1})$$

MATURITY - STRENGTH DEVELOPMENT

CURVE #: 1
PROJ. #: STP-5-4(27)--2C-91

MATERIALS STAFF:
CONTRACTOR:

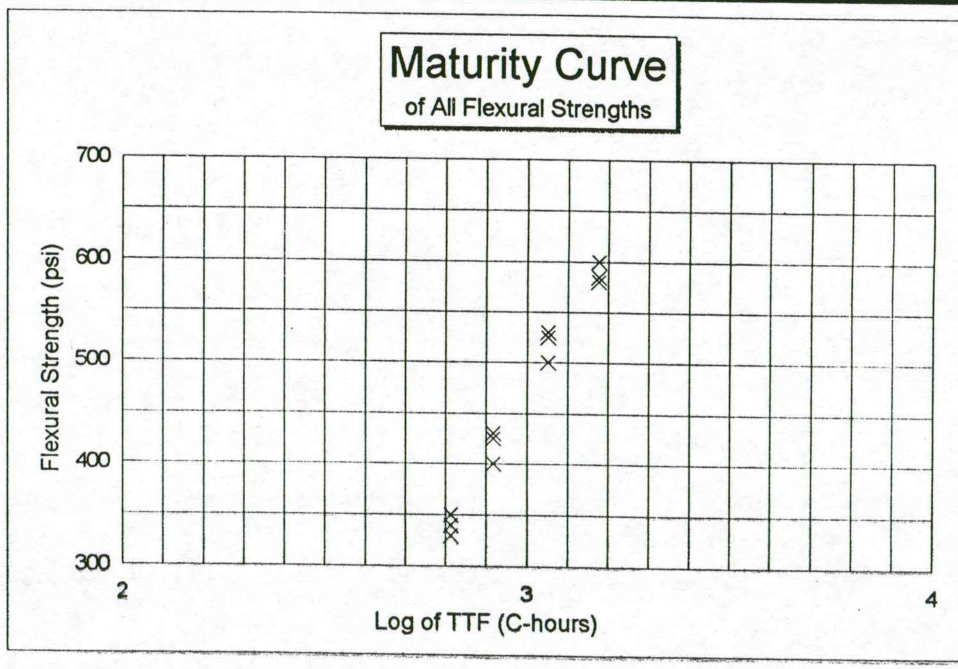
INSPECTOR:
DATE:

BEAM #	LOAD AT BREAK (lbs)	TABLE VALUE (lbs)	BREAK LOCATION (in)	WIDTH (in)	DEPTH (in)	FLEXURAL COEFFICIENT	FLEXURAL STRENGTH	AGE AT BREAK (DAYS)	TTF CH 1	TTF CH 2	AVERAGE TTF
1	3000	3100	0.5	5.98	6.02	0.124586	350		650	650	650
2	3100	3250	0.5	6.00	6.01	0.124584	340		650	650	650
3	3050	3150	0.5	6.00	6.02	0.124171	330		650	650	650
4	3450	3400	0.5	5.98	6.00	0.125418	425		800	850	825
5	3550	3450	0.5	6.00	6.00	0.125000	400		800	850	825
6	3500	3425	0.5	6.00	6.00	0.125000	430		800	850	825
7	4000	4100	0.5	5.98	6.00	0.125418	525		1100	1150	1125
8	3990	4000	0.5	5.98	6.00	0.125418	500		1100	1150	1125
9	4000	4100	0.5	6.00	6.00	0.125000	530		1100	1150	1125
10	4600	4650	0.5	6.00	6.00	0.125000	580		1500	1500	1500
11	4700	4680	0.5	6.00	6.00	0.125000	585		1500	1500	1500
12	4750	4700	0.5	5.98	6.00	0.125418	600		1500	1500	1500

78

AIR: 9.4%
SLUMP: 2 1/2"
w/c: 0.410
MIX: C3WRC20
FLY ASH: Council Bluffs
CEMENT: Ash Grove
COARSE AGGREGATE: Durham Mine
FINE AGGREGATE: Vandalia
WATER REDUCER: Daratard 17
Add. Rate: 2 oz./100 lbs.
AIR ENTRAINER: Daravair 1400
Add. Rate: 6 oz./100 lbs.

TTF FOR 500 PSI: **1092**



MATURITY

- Fresh concrete gains strength as a result of the exothermic reactions between water and cement or cement hydration.

- The extent of cement hydration in a concrete mixture, and therefore strength, is a function of the temperature history of the concrete mixture. This relation of time and temperature is maturity or the time-temperature factor (TTF).

Maturity Method

Maturity is a technique for estimating concrete strength based on the assumption that samples of a given concrete attain equal strength if they attain equal maturity values. There are three steps involved in the maturity method.

1. **Development of Strength-Maturity Relationship**

2. **Determination of Maturity Value for Opening Strength**

3. **Determination of Maturity Value in Slab or Structure**

Estimates of Strength are Based on Two Important Assumptions

1. **There is always sufficient moisture for continued hydration - ie. Proper curing procedures.**

2. **The concrete in the structure is the same as that used to develop the strength-maturity relationship.**

Maturity Function

Mathematical expression for evaluating maturity or time-temperature factor (TTF) from the recorded temperature history of the concrete

Nurse-Saul Equation (ASTM C1074)

$$\textit{Maturity or TTF}\ (^\circ C\cdot hrs) = \sum (T - T_0)\cdot \Delta t$$

where,

T = *average temperature over time interval* Δt

T_0 = *-10 °C, datum temperature at which concrete ceases to gain strength*

Δt = *time interval in hours*

Rewritten as

$$\textit{Maturity or TTF}\ (^\circ C\cdot hrs) = \sum (T + 10)\cdot \Delta t$$

Establishing Strength - Maturity Relationship
(I.M. 383)

- Cast twelve (12) 152×152×508 mm (6"×6"×20") beams

- Place two thermocouple wires, one near each end of one beam to approximately mid-depth. Loop the wire around the beam box handles to prevent the wires from inadvertently being pulled out. Begin recording temperature with the maturity meter.

- Beams should be covered with wet burlap or plastic until they are able to be stripped from the forms and cured in a wet sand pit.

- At four different ages test three (3) beams for flexural strength and record the TTF reading from the maturity meter before testing each specimen. For Class C mixes, the first set of beams will need to be tested the following day after casting (~18-24 hrs.). During hot summer weather, the first set may need to be tested earlier (~12 hrs.).

Establishing Strength - Maturity Relationship
(I.M. 383) continued

- **Test the remaining beams at the approximate maturity values given in I.M. 383, or ~12-24 hrs. between tests depending on weather conditions. Be sure that the tests are spaced over intervals of time that span a range in strength that covers the desired target strength. Some adjustment of the testing intervals may be required to ensure that the target strength is covered.**

- **Plot the TTF values vs. the strength values. Determine the TTF value which corresponds to the target strength. The TTF may also be calculated, using a calculator or computer, by performing a linear regression between the strength and the log(TTF).**

MATURITY METER
CURVE #4

PROJECT #: STP-5-4(27)--2C-91

DATE BEAMS MADE: 08/20/96

BEAM #	LOAD AT BREAK (lbs)	TABLE VALUE (lbs)	BREAK LOCATION (in)	WIDTH (in)	DEPTH (in)	FLEXURAL COEFFICIENT	FLEXURAL STRENGTH	AVERAGE FLEXURAL STRENGTH	AGE AT BREAK (DAYS)	TTF CH 1	TTF CH 2	AVERAGE TTF
1	3450	3400		5.98	6.02	0.124586	424	427		750	800	775
2	3550	3450		6.00	6.01	0.124584	430	427		750	800	775
3	4000	4100		6.00	6.02	0.124171	509	505		1100	1150	1125
4	3990	4000		5.98	6.00	0.125418	502	505		1100	1150	1125
5	4600	4650		6.00	6.00	0.125000	581	581		1500	1500	1500
6	4600	4650		6.00	6.00	0.125000	581	581		1500	1500	1500
7	5100	5150		5.98	6.00	0.125418	646	652		1900	1950	1925
8	5150	5200		5.98	6.00	0.125418	652	652		1900	1950	1925
9	5200	5250		5.98	6.00	0.125418	658	652		1900	1950	1925

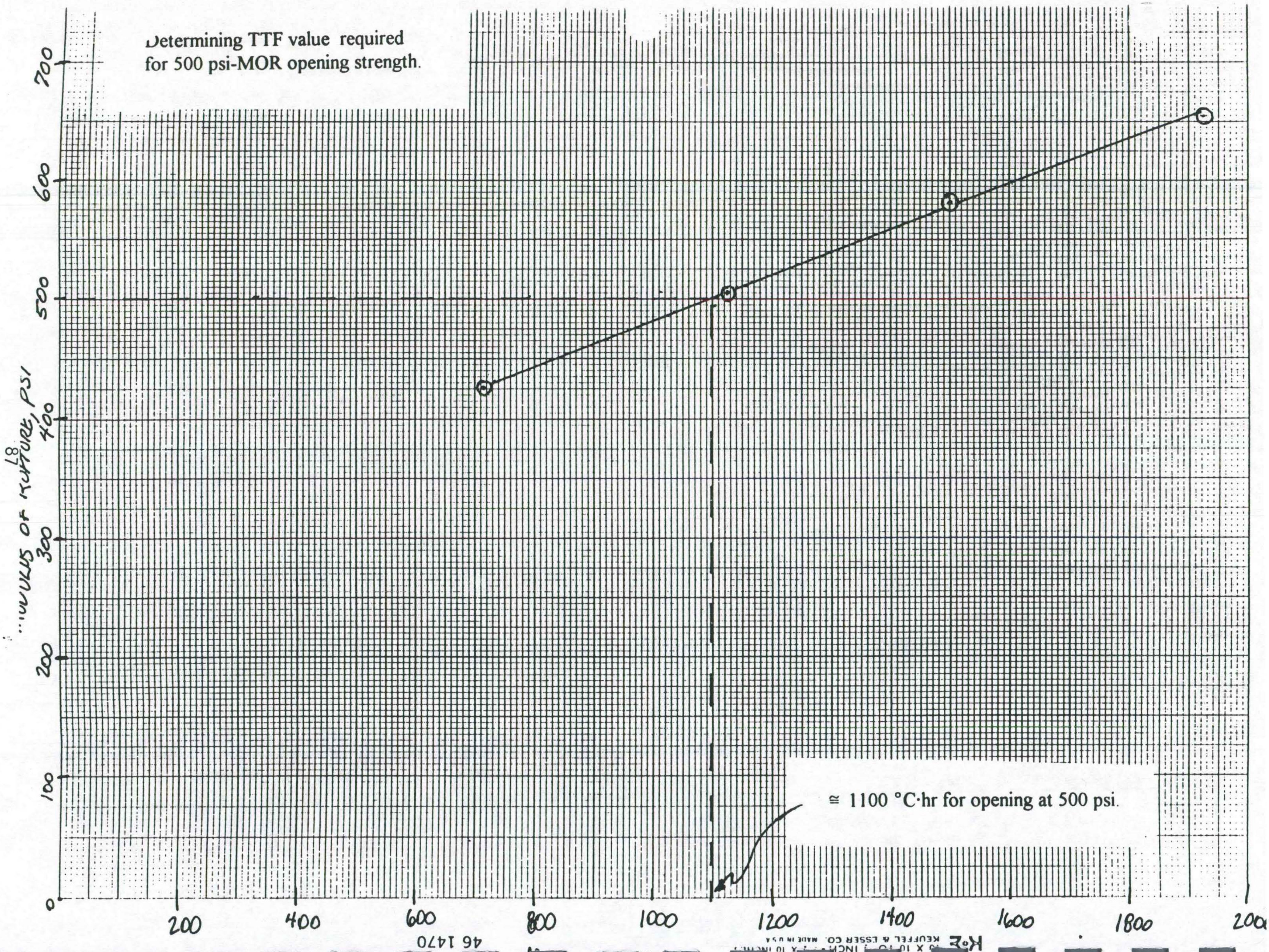
AIR: 9.4 %
SLUMP: 2 1/2"

MIX: C-3WR-C20
FLY ASH: COUNCIL BLUFFS
CEMENT: ASH GROVE
COARSE AGGREGATE: KASER CORP @ DURHAM MINE
FINE AGGREGATE: HALLET MATERIALS @ VANDALIA
WATER REUDCER: DARATARD 17
AIR ENTRAINER: DARAVAIR 1400
TTF FOR 500 PSI: 1065

MATERIALS STAFF: ERIC COWLES
SHANE TYMKOWICZ

INSPECTOR: STEVE HUBLER

CONTRACTOR: CEDAR VALLEY


Determining TTF value required
for 500 psi-MOR opening strength.
≅ 1100 °C·hr for opening at 500 psi.
700
600
500
400
300
200
100
0
200
400
600
800
1000
1200
1400
1600
1800
46 1470
KEUFFEL & ESSER CO. MADE IN U.S.A.

Given:

Maturity Values (TTF)	Average Flexural Strengths (psi)
435	180
616	363
1749	509
1922	565

Plot the Maturity vs. Strength curve and determine the TTF value for opening strength of 500 psi.

Determining Maturity (TTF) in Slab Using Temperature Data

- Maturity (TTF) of the slab or structure may be calculated using a hand held digital thermometer. The procedure is the nearly the same as that using the maturity meter except that the maturity value (TTF) is calculated.
- Place the thermocouple wire mid-depth into the slab approximately 1 foot in from the edge. Record the initial temperature and time.
- Continue to monitor the temperature at some interval of time and calculate the TTF. It would be preferable to monitor the temperature hourly, but realistically the temperature should be monitored 2 to 3 times per day.
- When the calculated TTF value reaches the required TTF for 500 psi, as determined with the strength-maturity relationship, it may be assumed that the strength in the structure is sufficient to open.

Maturity or TTF (°C·hr)

$$= \sum(((Temp_1 + Temp_2)/2) + 10) \times \Delta t_{hrs})$$

= Sum of (Average Temperature in °C +10) × (time,hrs in hours)

Readings

Age (hrs.)	Temp ,°C	TTF	Sum of TTF
0	34.6	0	
12	34.6	535	0 + 535 = 535
23	42.9	536	535 + 536 = 1071
37	30.7	655	655 + 1071 = 1726

TTF @ 12 hours = ((34.6 + 34.6)/2 +10) × (12 - 0)
= (34.6 + 10) × 12
= 535

TTF @ 23 hours = ((34.6 + 42.9)/2 + 10) × (23 - 12)
= (38.75 + 10) × 11
= 536

TTF @ 37 hours = ((30.7 + 42.9)/2 +10) × (37 - 23)
= (36.8 + 10) × 14
= 655

Project : STP-5-4(27)--2C-91
County : Warren
Date Paved: 08/03/96
From Sta: 119+95 To Sta:

%Air : 6.5
Slump : 2.25
Mix: C3WRC20

Cement: Ash Grove
Fly Ash: Council Bluffs
Coarse: Durham
Fine: Vandalia
WR: WRDA-82

TTF Required to Open : 1150

Date	Time	Age (hours)	Temp (deg C)	TTF at age (deg C-hr)	Sum TTF (deg C-hr)
		0.00	34.6		0
		12.00	34.6	535	535
		23.00	42.9	536	1071
		37.00	30.7	655	1727
				0	0
				0	0
				0	0
				0	0
				0	0
				0	0
				0	0
				0	0
				0	0
				0	0
				0	0
				0	0
				0	0
				0	0
				0	0

TTF 1727

Value in box should be equal to or greater than required TTF.

Given:

Temp (°C)	Age (hrs)
22.2	0.0
19.0	16.5
26.5	23.5
15.9	39.5
20.2	46.0
14.8	63.0

Calculate the maturity value (TTF) for each time interval and the TTF sum value.

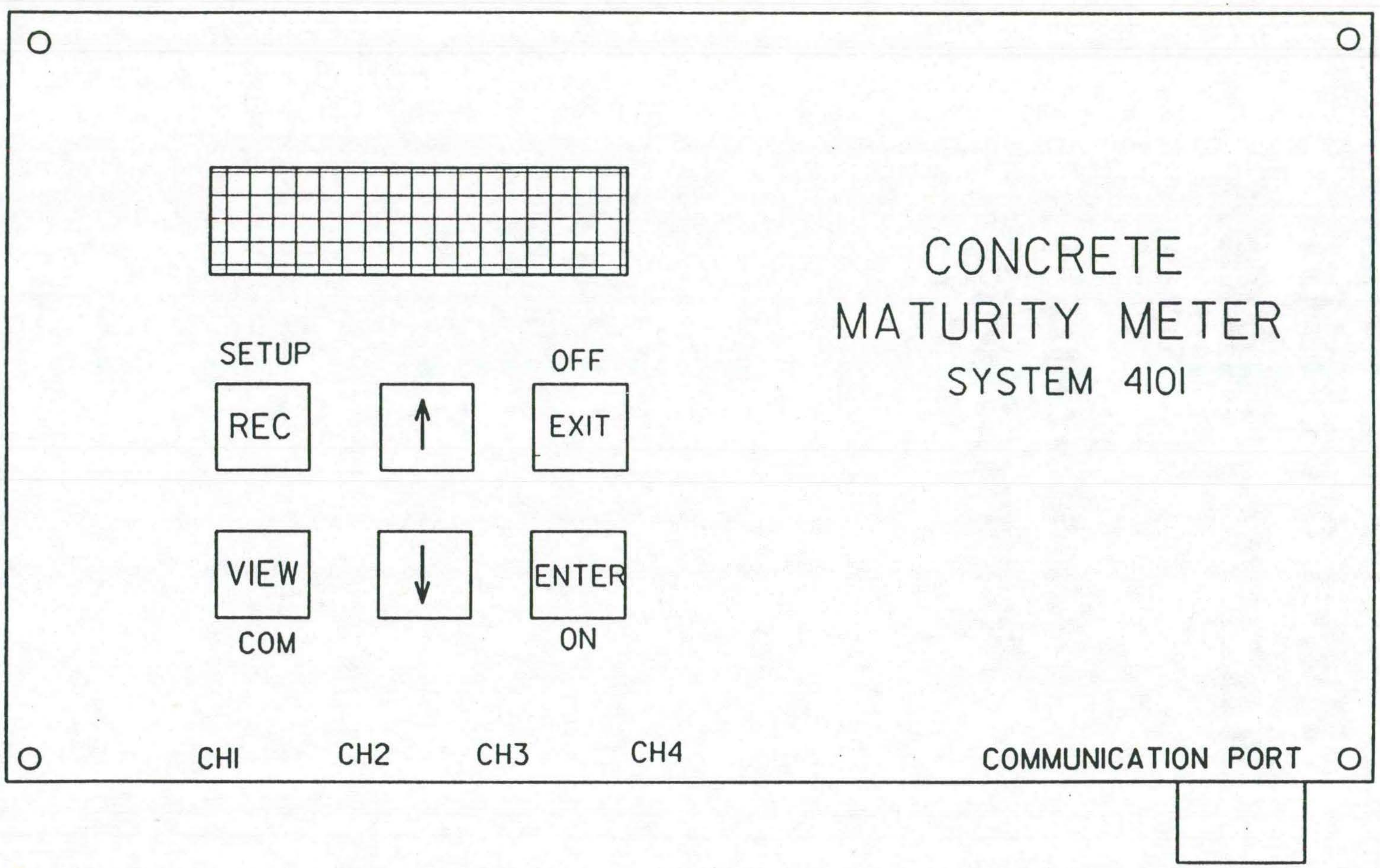
Given:

Temp (°C)	Age (hrs)
19.6	0.0
17.9	14.0
22.9	20.0
17.1	38.5
21.3	44.0
20.4	86.5

Calculate the maturity value (TTF) for each time interval and the TTF sum value.

Humboldt 4101
Maturity Meter

Operating Instructions


CONCRETE
MATURITY METER
SYSTEM 4101
SETUP
REC
OFF
EXIT
VIEW
COM
ENTER
ON
CH1
CH2
CH3
CH4
COMMUNICATION PORT

Humboldt 4101 Maturity Meter - Operation

To display current TTF

	Displays
Press **Enter**	**Current Values** **Ch 1 Temp:**
Press **Enter**	**Ch 1 TTF:**

Press ↑ to display other channels 2, 3, & 4.
Press **Exit** at any time to turn off display or return to previous display.

To Begin Recording

	Displays
Press **Enter**	**Current Values** **Ch 1 Temp:**
Press **REC**	**1. Start**
Press **Enter**	**Recording On . . .**

To Stop Recording

	Displays
Press **Enter**	**Current Values** **Ch 1 Temp:**
Press **REC**	**1. Start**
Press ↑	**2. Stop**
Press **Enter**	**Recording OFF. . .**

To Erase Data

	Displays
Press **Enter**	**Current Values** **Ch 1 Temp:**
Press **REC**	**1. Start**
Press ↓	**3. Erase Data**
Press **Enter**	**Erasing Data . . .**

Humboldt 4101 Maturity Meter - Operation cont'd.

To View Recorded Data

	Displays
Press **Enter**	**Current Values** **Ch. 1 Temp:**
Press **View**	**1. Recorded Data**
Press **Enter**	

Press ↑ to scroll through data.

To View Meter Status

	Displays
Press **Enter**	**Current Values** **Ch. 1 Temp:**
Press **View**	**1. Recorded Data**
Press ↑	**2. Meter Status**
Press **Enter**	**Displays Days Available and Battery Voltage Should be checked each time before recording to determine available memory and battery voltage (should be greater than 5.5 volts).**

Procedure To Download Data From Humboldt 4101 Maturity Meter
Windows 3.1

1. Plug 9 pin connector (for IBM PC's) into serial port in computer and other end into communication port on the Maturity Meter.

Computer

2. Under **Accessories** - select **Terminal**

3. Under **Terminal** - select **Settings** -
   Communications

4. Select **COM1:**
   Display should be set to the following:

Baud Rate	9600
Data Bits	8
Stop Bits	2
Parity	None
Flow Control	Xon/Xoff

   Click "**OK**"

5. Select **Transfers**
   Receive Text Files

6. Box will display - Select or create file in desired directory.

7. Box will display with - **Receiving: "filename.txt"** in lower right corner.

Maturity Meter

8.

Press **Enter**	Displays "PRESENT VALUES"
Press **View** Twice	Displays "1. OUTPUT DATA"
Press **Enter**	Data from each channel will display in box on terminal display.

Computer

9. Select **Stop** on lower left corner.

   Select **File**
   Save

APPENDIX A
FORMS

PLANT MONITOR DOCUMENTATION

PLANT INSPECTOR ______________________ CERTIFICATE # ____________

ACC PLANT __________ PCC PLANT __________

COUNTY ______________________ PROJECT NUMBER ____________

CONTRACTOR ______________________________

PLANT LOCATION ______________________________

DATES OF PLANT INSPECTION

FROM ______________________ TO ______________________

TOTAL DAYS ____________

DISCREPANCIES (Improper procedures, unresolved test discrepancies, or failure to perform inspection duties):

Corrective action taken by contractor for discrepancies:

______________________ Plant Monitor ____________ Date

* If there are no comments above, plant inspection will be considered acceptable.

1 copy - Transportation Center Materials

TECHNICAL TRAINING AND CERTIFICATION PROGRAM
(DAILY WORK HISTORY)

NAME ______________________

ADDRESS __________________________

CITY _______________ STATE ______ ZIP CODE ________

TELPHONE _______________ CERT NO.__________

ACC ______

PCC ______

WORK HISTORY

LOCATION OF PLANT: ____

DUTIES PERFORMED: HOURS

____ ______

____ ______

____ ______

____ ______

____ ______

____ ______

____ ______

DATE DUTIES WERE PERFORMED: ______________________________

SUPERVISOR (CERTIFIED PLANT INSPECTOR): ______________________

AGENCY: ____

REMARKS: ____

____

____

____

FORWARD TO THE TRANSPORTATION CENTER - MATERIALS

UNSATISFACTORY PERFORMANCE NOTICE

Issued To: ______________________________ Date: ________________

____

____

This notice is to inform you that your performance as a Certified Inspector/Technician was unsatisfactory for the reason listed below. After receipt of two such notices you may be given a three month suspension. After three notices, you are subject to decertification(I.M. 213).

This notice will be placed in your permanent file with the Transportation Center in which you reside. It will also be placed on the statewide computer file.

The goal of the Technical Training and Certification Program(TTCP) is to work with contractors, producers, cities and counties to continually improve the quality on Iowa's construction projects. We hope you will work with us to achieve this goal.

Unsatisfactory Performance: ____

____

____

____

____

____

____

____

Transportation Center Materials Engineer

cc: Program Director
TCCP Coordinator

CERTIFIED AGGREGATE TECHNICIAN EVALUATIONS

Name ______________________ **Certification No.** __________ **Date** __________

Location ______________________ **Producer** ______________________

Material ______________________ **Intended Use** ______________________

Lab No.	Identification of Samples			Sieve Analysis–Percent Passing										
			_ mm _ in.	26.5 mm 1 in.	19 mm ¾ in.	13.2 mm ½ in.	9.5 mm ⅜ in.	4.75 mm No. 4	2.36 mm No. 8	1.18 mm No.16	600 μm No. 30	300 μm No. 50	150 μm No. 100	75 μm No. 200
Production Limits		Max.												
		Min.												

	YES	NO
1. Does Tech have proper equipment?	____	____
2. Does Tech have current specifications?	____	____
3. Is Tech familiar with Form 821278?	____	____
4. Is Tech familiar with WHS procedures?	____	____
5. Is Tech knowledgeable of I.M.s? I.M.-204-209-301-302-303-304-306, etc.	____	____

	GOOD	FAIR	POOR
1. Proper care of equipment	____	____	____
2. Sampling Procedure	____	____	____
3. Splitting Procedure	____	____	____
4. Sieving to completion	____	____	____
5. Computing gradations	____	____	____
6. Report preparation & distribution	____	____	____

COMMENTS ____

____

____

cc: Technician
Transportation Center
Area Inspector
Producer

Signature ______________________

PRE CONSTRUCTION MEETING FOR ASPHALT

DATE____________ PROJECT(S)______________________________

COUNTY____________________CONTRACTOR____________________
CONSULTANT OR RESIDENT ENGINEER____________________
PROJECT INSPECTOR______________________________
CERTIFIED PLANT INSPECTION REQUIRED? YES__________ NO__________
PLANT INSPECTOR____________________MONITOR____________________
AGG ACCEPTANCE TESTING BY_______________LOCATION_______________
STARTING DATE_________________CALIBRATION DATE_________________
SUBCONTRACTOR____________________WORK____________________
SUBCONTRACTOR____________________WORK____________________
SUBCONTRACTOR____________________WORK____________________
CONCRETE SOURCE, MIX, & USE______________________________
PROJECT SUPERINTENDENT______________________________
PLANT TYPE____________________POLLUTION CONTROL_______________
WEIGHING SYSTEM:AUTO_______SEMI AUTO______WEIGH MASTER________
PLANT SITE____

MATERIALS IN MIX INCLUDING R.A.P.

MATERIALS COMPLY WITH SHALE, ABSORPTION, AND SKID REQUIREMENTS

SIZE________**MIX TYPE**________**CLASS**________**COURSE**________

%IN MIX	MATL.& SIZE	PRODUCER	SOURCE	BEDS

COMPACTION REQUIREMENT? CLASS 1__________ CLASS 2__________

SIZE________**MIX TYPE**________**CLASS**________**COURSE**________

%IN MIX	MATL.& SIZE	PRODUCER	SOURCE	BEDS

COMPACTION REQUIREMENT? CLASS 1__________ CLASS 2__________

SPRINKLE AGGREGATE SOURCE______________________________
ASPHALT CEMENT SOURCE______________________________
ASPHALT TACK SOURCE______________________________
OTHER AGG SOURCES FOR PROJECT______________________________

MISCELLANEOUS INSPECTION NEEDED(TREES,LIGHTING,INTAKES,PIPE,ETC)

ADVANCE NOTICE TO ASSURANCE OF ANY SCHEDULED CONCRETE POURS
GRADATIONS, BOX SAMPLES, AND DENSITY CORES TO MASON CITY **ASAP**
DOES SMOOTHNESS SPEC. APPLY? YES __________ NO __________
PROFILOMETER TESTING BY______________________________

DOT Monitoring Program for Asphaltic Concrete Paving Plant Inspection and Quality Management Asphalt (QMA)

The A.C. Plant Inspector's Guide provides an overview of the duties and responsibilities of A.C. Plant Inspectors or certified Bituminous Lab Technician when *SS-5127* applies. It is intended to provide a general outline of inspection activities. IT IS ESSENTIAL THAT ANYONE USING THIS GUIDE REFER TO THE SPECIFICATIONS, IM'S, AND CONSTRUCTION MANUAL SECTIONS FOR A COMPLETE DESCRIPTION OF REQUIREMENTS.

Before production begins, the contractor's certified plant inspector and the *Engineer* should discuss these duties, documentation, sampling and testing plans to ensure compliance with Article 2521 and/or SS-5127 and IM 214. Any noncompliance or work quality deficiency shall be immediately reported to the contractor's superintendent and the resident construction engineer. The contractor shall be required to take corrective action. The monitoring requirements are minimum and should be increased if deficiencies occur until the problems are resolved. *Monitoring activities identified by an asterisk "*" to be performed by the Transportation Center Materials AC technician. Construction and materials personnel, upon mutual agreement, may shift monitoring responsibilities between each other to accommodate problems with personnel availability through greater schedule flexibility.*

Certified Plant Inspection/QMA	Minimum Monitoring Requirement	References
Stockpiles Observe construction of stockpiles to prevent segregation, contamination, & intermingling.	Inspect before construction begins & once a week thereafter.	Article 2303.04 " 2303.02 IM 508
Plant Erection Inspect material bin foundations. Assure sampling locations are safe & convenient.	*Inspect for evidence of settlement. Inspect prior to calibration.	Article 2001.06 " 1107.07
Plant Equipment Check interlocks on aggregate feeders & AC delivery systems, screens for removal of oversize material, AC storage tank, tank stick, & general condition of all plant equipment.	*Inspect all plant & testing equipment prior to calibration (including lab trailer *& QMA equipment*).	Article 2001.22 " 2303.02 " 2520 " 2521 IM 508, App A
Perform check weighing & vertification weighing as per prescribed frequency.	Monitor first day & once a week thereafter. *Check truck tare weights the first day a truck is used on the project when platform scales are used.*	Const. Man. 3.50 Article 2001.07 IM 508

DOT Monitoring Program for Asphaltic Concrete Paving Plant Inspection and Quality Management Asphalt (QMA) - Continued

Certified Plant Inspection/QMA	Minimum Monitoring Requirement	References
Plant Calibration		
Observe calibration & obtain copy of all calibration data.	*Observe calibration.	IM 508
Obtain copy of job mix formula & "Proportions and Production Limits" (Form 820955).	*Review calibration data and job mix formula.*	
Check cold feed bins for method of adjustment.	Inspect method for securing bin gate settings.	
Discuss mix designs & plant controls with Transportation Center Materials personnel.	Participate in discussion.	
Plant Sampling & Testing		
Obtain 3 aggregate samples per lot, split only the sample(s) to be tested, determine & record process control gradation. Forward split samples to Transportation Center Materials Lab with Form 820193. Determine moisture content of all aggregates including RAP.	Witness at least 1 of first 3 process samples of each mix design & minimum of 10% of remaining samples. Perform acceptance testing frequency as per I.M. 204. *Monitor for correlation.*	Const. Man. 3.21 Const. Man. 3.22 Article 2534 IM 508, IM 216
Obtain AC samples & forward to Transportation Center Materials Lab	Observe *sampling* first day & weekly thereafter.	IM 204
Monitor condition of density cores & core thickness.	Identify random core locations, observe core cutting, transport to field lab, determine & record core densities, and Q.I. Issue noncompliance if necessary. Forward cores to Transportation Center Materials Lab with Form 820193.	Article 2303.12 IM 320 IM 321
QMA Only		
Determine and record core densities and Q.I. Properly store cores for random checking by Transportation Center Materials personnel.	Witness first density determination & minimum 10% of remaining sets. *Transportation Center Lab to test 1 set per week.*	SS-5127 IM 320 IM 321

DOT Monitoring Program for Asphaltic Concrete Paving Plant Inspection and Quality Management Asphalt (QMA) - Continued

Certified Plant Inspection/QMA	Minimum Monitoring Requirement	References
Documentation		
Prepare daily plant report (Form 820007). *FAX a copy to the TCME.*	*Review entries the first day and weekly thereafter.*	IM 508
Document all checks, tests, & quantities in field book in format provided by residency.	*Review entries the first day and weekly thereafter.*	
Determine & calculate asphalt pay quantity daily.	*Review entries the first day and weekly thererafter.*	IM 509
Maintain & monitor control charts.	Monitor daily.	IM 508
Check for approved sources & certifications for all materials (including material transferred from other projects) & document deliveries.	*Check* once per week.	
Assure total certified quantities are sufficient for tons produced	*Check* once per week.	
Maintain file of all certified material tickets, worksheets, and forms submitted *to be made available to the agency upon request.*	Obtain file of plant reports and control charts at end of project.	Article 2521
QMA		
Maintain control charts & data sheets. Document all mix control changes. Document correlation results. *FAX a copy of the Summary sheet to the TCME daily.*	*Monitor control charts and summary sheet by the plant monitor or grade inspector daily.* Obtain copies of control charts and summary sheets at the end of the project.	SS-5127
Mix Control		
Monitor coating of aggregates & mixing time.	Observe each day of production by monitor or grade inspector.	Article 2303.04 IM 508
Monitor & record air, AC, & mix temperatures on 2-hour intervals.	Check *once per week at random.*	Article 2303.04 " 2303.09
Monitor truck loading procedures, amount of mix maintained in silo, & operation of hopper/silo gates to avoid segregation.	Observe *one per week at random.*	Article 2303.09 IM 508
Check aggregate proportions, interlocks, & cold feed bin gate settings daily	Check first day & weekly thereafter	IM 508 IM 511

DOT Monitoring Program for Asphaltic Concrete Paving Plant Inspection and Quality Management Asphalt (QMA) - Continued

Certified Plant Inspection/QMA	Minimum Monitoring Requirement	References
Inspect trucks for proper/improper use of cleaning fluids	Monitor *at random.*	Article 2303.09
Prepare boxes & Form 820193 (Samples Submitted) & send to road for hot samples.		
Asphalt Delivery Determine quantities on hand & calculate AC added by tank stick or weighing. Compare with brodie meter daily.	Monitor *1st day & once per week at random.*	IM 509 Article 2303.25
ACC Mixture Sampling (QMA) Responsible for proper and random sampling of hot ACC mixture behind paver. Sampling frequency in accordance with SS-5127.	*Monitor daily by plant monitor or grade inspector.*	IM 322 SS-5127

DOCUMENTATION SAMPLE

PLANT INSPECTION DUTIES	DATE MONITORED	DISCREPANCIES AND CORRECTIVE ACTION BY DATE OF INSPECTION
List Duties Per IM214	Check Items Monitored	Date Monitored By:

[redacted] 90 [redacted] wa D[redacted]rtm[redacted] of [redacted]sp[redacted]tion [redacted] Cou[redacted]

CALIBRATION OF PLANT EQUIPMENT
Cold Feed and Asphalt Cement Delivery
(Continuous - Batch - Drum)

Project ______________________

Contract No. ______________________

Date ______________________

Proj. Eng. ______________________

Contractor ______________ Plant Location ______________ Material ID ________ & %______ Moisture ______%

Plant Type and Name ______________ Pollution Control ______________ Material ID ________ & %______ Moisture ______%

Mix Type ______________ Class ______________ Mix Size ______________ Material ID ________ & %______ Moisture ______%

Asphalt Type and Grade ______________ RPM Feeder/ RPM Plant/Master ______________ Plant Set For ______________ TPH Material ID ________ & %______ Moisture ______%

Bin Number Material ID												
Pump vernier setting/gate opening in inches/Dial setting												
Run number	1	2	3	1	2	3	1	2	3	1	2	3
Revolutions delivered/Time delivered												
Total wet weight aggregate delivered/TPH wet												
Total weight A.C. delivered Total dry weight aggregate delivered/TPH Dry												
Dry weight per revolution												
Dry weight per minute												
Average dry weight per (Minute-Rev.)/Tach set point												

Date scale was certified ______________________

____

____

The above data is furnished as set forth in the Standard Specifications for plant operations, for informational purposes only. The Contracting Authority makes no representations as to accuracy, either expressed or implied, which are to be construed to relieve the Contractor from the responsibiity to comply with the specifications.

Calibrated by ______________________ Witnessed by ______________________
Name Name

Contractor ______________________ Title ______________________

Distribution: White Copy - Plant Inspector; Canary Copy - Contractor; Pink Copy - District Materials Engineer; Goldenrod Copy - Project Engineer
Send Copy To: Central Materials on City and County Projects.

[redacted]orm 820[redacted]
[redacted]95

Iowa Department of Transportation

CALIBRATION OF PLANT EQUIPMENT
(DRUM MIX PLANT)

County ______________________

Project ______________________

Date ______________________

Proj. Eng. ______________________

Contractor ______________________ Plant Location ______________________

Plant Type and Name ______________________ Pollution Control ______________________

Mix Type ______________________ Class ______________________ Mix Size ______________________

Asphalt Type and Grade ______________________ Temperature °F ______________________ A.C. kg/L (lb/Gal) ______________________

WEIGHT BELT				A.C. PUMP				WEIGHT SILO			
Run Number	1	2	3	Run Number	1	2	3	Run Number	1	2	3
Span				Meter Er. liters (Gals.)							
Fine Zero				Corrected liters (Gals.)							
Total weight aggregate kg (lbs.)				Metered kg (lbs.)				Total weight kg (lbs.)			
Truck total weight aggregate kg (lbs.)				Truck kg (lbs.)				Truck kg (lbs.)			
Difference				Difference				Difference			
% Error				% Error				% Error			

Date scale was certified ______________________

____

____

____

The above data is furnished as set forth in the Standard Specifications for plant operations, for informational purposes only. The Contracting Authority makes no representations as to accuracy, either expressed or implied, which are to be construed to relieve the Contractor from the responsibiity to comply with the specifications.

Calibrated by ______________________ Witnessed by ______________________
Name Name

Contractor ______________________ Title ______________________

Distribution:
White Copy - Plant Inspector
Canary Copy - Contractor
Pink Copy - Transportation Center Materials Engineer
Goldenrod Copy - Project Engineer

Send copy to Central Materials on city and county projects.

Form 820009
12-92

Iowa Department of Transportation

HIGHWAY DIVISION

Reclaimed Asphalt Certified Report

Date ____________________

Owner of RAP ____________________

Material Description: Salvaged from Highway No. ____________________ Dates of Removal ____________________

From ____________________ To ____________________

Original Project No. ____________________ Year Built ____________________

Surface Course: Size __________ Type __________ Class of Mix __________ Depth __________

Base or Binder: Size __________ Type __________ Class of Mix __________ Depth __________

Stockpile Description: Location: ____________________

____

Section __________ Township __________ Range __________ County __________

Lab. No.	Identification of Sample	% A.C. Extract	Gradation: 1/1000 T Minimum 3 Tests									
			19mm (¾)	13.2mm (.0530)	9.5mm (⅜)	4.75mm (4)	2.36mm (8)	1.18mm (16)	600µm (30)	300µm (50)	150µm (100)	75 µm (200)
Average of Samples												

Stockpile Photo *(Optional)*

Note: Stockpile photo will be used for future identification and should show stockpile size, shape, and relation to surroundings. Larger photos may be attached to the back of this form. All photos should have location printed on the back.

Note: Use additional sheets if necessary for complete gradation information.

Tons in Stockpile ____________________ Weighed __________ Estimated __________

Direction of Picture ____________________

Type of Protection ____________________

Certified by ____________________

____

Verified by ____________________
Iowa DOT Inspector

Copies to: Owner; District Materials; Area Inspector; Project Engineer.

9/96

DAILY ACC PLANT PAGE

Form E241

Project No.: ______ Mix Design No.: ______ Mix Type: ______ Page No.: ______

County: ______ Contractor: ______ Class: ______ Report No.: ______

Contract ID.: ______ Recycle Source: ______ Size: ______ Design Marshall Blows: ______

Hot Box I.D. No.:						
Date Sampled:						
Target & Gradation ID:	Target					
1" Sieve						
3/4" Sieve						
1/2" Sieve						
3/8" Sieve						
* #4 Sieve						
Moving Average						
* #8 Sieve						
Moving Average						
#16 Sieve						
* #30 Sieve						
Moving Average						
#50 Sieve						
#100 Sieve						
* #200 Sieve						
Moving Average						
Compliance (Y/ N)						
Intended Added, % AC						
Tank Meas., % AC						
Intended Total, % AC						
Total, % AC						
Marshall Sp. Grav.:						
Max. Sp. Grav.:						
Marshall Voids						
* Moving Avg. (N=4)						
Time						
Station						
Side						
Sample Ton						
Sublot Tons						
Tons to Date						
Fines / Bitumen Ratio						
QUALITY CONTROL ACTIONS: 1.) AC Changes 2.) Cold Feed Adjust. 3.) Moisture Adjust. 4.) Etc.						

Time	7:00	9:00	11:00	1:00	3:00	5:00	7:00
Air Temp. (°F)							
A.C. Temp. (°F)							
Mix Temp. (°F)							

Date Placed: ______ Date Tested: ______

Course Placed: ______ Tested By: ______

Density Record

Core No.:	1	2	3	4	5	6	7
Station							
CL Reference							
W 1 Dry							
W 2 in H20							
W 3 Wet							
Difference							
Field Density							
% Density							
% Voids							
Thickness							

Avg. % Field Voids: ______ Avg. Field Density: ______

Marshall Sp. G (Lot Avg.): ______ Avg. % Density: ______

Max. Sp. G (Lot Avg.): ______ Specified Density %: ______

Q.I. = ______ -- ______ = ______

Low Outlier: ______ High Outlier: ______ New Q.I. = ______

Film Thickness (FT): ______ VMA: ______

Remarks: ______

C.P.I.: ______ ______ Cert. No.

QMA Tech: ______ ______ Cert. No.

PRE CONSTRUCTION MEETING FOR STRUCTURES AND P.C. PAVING

DATE__________________ PROJECT______________________________

DESIGN ___________________________CONTRACT_____________________

COUNTY_____________________ CONTRACTOR_________________________

CONSULTANT OR RESIDENT ENGINEER______________________________

PROJECT INSPECTOR____

CERTIFIED PLANT INSPECTION REQUIRED? YES__________NO_____________

PLANT INSPECTOR___________________MONITOR INSPECTOR_____________

AGG ACCEPTANCE TESTING BY_________________LOCATION________________

TYPE OF WORK (STRUCTURE)____________(P.C. PAVING)________________

SUBCONTRACTOR________________________WORK___________________________

SUBCONTRACTOR________________________WORK___________________________

SUBCONTRACTOR________________________WORK___________________________

ASPHALT MIX AND PLANT? ____

STARTING DATE____

READY MIX OR PAVING PLANT LOCATION_________________________________

IF PAVING QUANTITIES TOTAL MORE THAN 6000 SQ. FT. AUTOMATIC CEMENT BATCHING IS REQUIRED!!!____________________________________

PROJECT SUPERINTENDENT____

MIXES____

APPROXIMATE CALIBRATION DATE______________________________________

MATERIALS IN MIXES

COARSE AGG SOURCE________________________________DURABILITY_________

FINE AGG SOURCE____

CEMENT SOURCE____

FLY ASH SOURCE____

MIXING WATER SOURCE____

OTHER AGG SOURCES FOR PROJECT_____________________________________

____

____

MISCELLANEOUS INSPECTION NEEDED (TREES,LIGHTING,INTAKES,PIPE,ETC)

____

____

NOTIFY AREA INSPECTOR FOR MONITOR OF STEEL (BLACK,EPOXY)
NOTIFY INSPECTOR FOR MONITOR OF PILING, GUARD RAIL, GALVANIZING
ADVANCE NOTICE TO ASSURANCE OF SCHEDULED POURS & TO WITNESS CORES
ADVANCE NOTICE TO ASSURANCE OF ANY SCHEDULED ASPHALT WORK
WILL THERE BE A PRE POUR? PLEASE NOTIFY IF YES
ADMIXTURE TESTED IF HELD OVER THE WINTER
WILL CORE LOCATIONS BE REQUIRED?
DOES SMOOTHNESS SPEC APPLY? YES _____________ NO_______________
PROFILOMETER TESTING BY____

DOT Monitoring Program for Portland Cement Concrete Paving Plant Inspection

Plant Inspection Duties per IM 214 and 527	Minimum Monitoring Requirements by Construction Personnel
Stockpiles 1. Proper stockpiling procedures 2. Prevention of intermingling of aggregates 3. Prevention of contamination 4. Prevention of segregation	Inspect before production starts and weekly thereafter
Plant Facilities 1. Assures plant safety 2. Check for equipment compliance 3. Proper laboratory location and facilities	Inspect before calibration. (Check that plant inspector has the proper batch weight tables, current manuals, instructions, and specifications. Inspect transit mixers.)
Calibration 1. Be present during calibration 2. Have appropriate batch weights	Plant calibration is observed by Transportation Center Materials personnel and plant monitor
Cement, Fly Ash, and Aggregate Delivery and Admixtures 1. Check for proper source and certification 2. Document quantities delivered 3. Monitor condition of shipments	Audit before production starts and weekly thereafter
Plant Sampling 1. Check aggregate gradations 2. Check aggregate moisture 3. Check aggregate specific gravity	1. Witness sampling and splitting of at least 1 of the first 3 samples of each aggregate and a *minimum* of 10% of the remaining samples. Provide documentation of these witnessed samples on Form 820193. Perform acceptance testing frequency as per I.M. 204. Also verify that the sampling and testing plan is in compliance with Construction Manual 3.22. 2 & 3. Witness once during first week of production. If problems develop, run one test to verify the plant inspector's results.

DOT Monitoring Program for Portland Cement Concrete Paving Plant Inspection (Continued)

Plant Inspection Duties per IM 214 and 527	Minimum Monitoring Requirements by Construction Personnel
Proportion Control	
1. Check scale weights and scale operation	Audit and/or observe weekly
2. Check admixture dispensers	
3. Check mixing time and revolutions	
4. Check cement yield	
Concrete Tests	
1. Cure flexural test specimens	1. Observe curing facility weekly
2. Test flexural specimens	2. Observe one beam break weekly
Test Equipment	
1. Clean and maintain scales, screens, pycnometers, beam molds, and laboratory facility	Examine weekly
Documentation	
1. Prepare daily plant reports	1. Audit daily
2. Document all checks and test results in field book	2 & 3. Audit weekly Separate diary to be maintained on items monitored
3. Maintain daily diary of work activities	

DOT Monitoring Program for Structural Concrete Plant Inspection

Plant Inspection Duties per IM 214 and 528	Minimum Monitoring Requirements by Construction Personnel
Stockpiles 1. Proper stockpiling procedures 2. Prevention of intermingling of aggregates 3. Prevention of contamination 4. Prevention of segregation	Inspect weekly during production
Plant Facilities 1. Assures plant safety 2. Check for equipment compliance 3. Proper laboratory location and facilities	Inspect once during first week of production. (Check that the plant inspector has current manuals, instructions, and specifications. Inspect transit mixers.)
Calibration 1. Have appropriate batch weights 2. Check plant calibration 3. Plant monitor involvement	Plant calibration is observed by Transportation Center Materials personnel
Cement, Fly Ash, and Aggregate Delivery and Admixtures 1. Check for proper source and certification 2. Document quantities delivered 3. Monitor condition of shipments	Audit weekly during production
Plant Sampling 1. Check aggregate gradations 2. Check aggregate moisture 3. Check aggregate specific gravity	1. Witness sampling and splitting of at least 1 of the first 3 samples of each aggregate and a *minimum* of 10% of the remaining samples. Provide documentation of these witnessed samples on Form 820193. Perform acceptance testing frequency as per I.M. 204. Also verify that the sampling and testing plan is in accordance with Construction Manual 3.22 2 & 3. Witness once during first week of production. If problems develop, run one test to verify plant inspector's results

DOT Monitoring Program for Structural Concrete Plant Inspection (Continued)

Plant Inspection Duties per IM 214 and 528	Minimum Monitoring Requirements by Construction Personnel
Proportion Control	
1. Check scale weights and scale operation 2. Check admixture dispensers 3. Check mixing time and revolutions	Audit weekly during production. (Check batch weights during initial inspection.)
Concrete Tests	
1. Cure flexural test specimens	1. Observe curing facility weekly 2. Test flexural specimens
Test Equipment	
1. Clean and maintain scales, screens, pycnometers, beam molds, and laboratory facility	Inspect weekly during production
Documentation	
1. Prepare weekly 211B reports 2. Document all checks and test results in field book 3. Maintain daily diary of work activities	Audit weekly during production. Maintain a separate diary of items monitored.

Form 820150 12-94

- ☐ Materials
- ☐ Transportation Center
- ☐ Project Engineer
- ☐ Contractor

Iowa Department of Transportation

OFFICE OF MATERIALS

PORTLAND CEMENT CONCRETE

County ______________

Mix. No. __________ Cement Wt. (kg/m^3) (lbs/cy) __________ Project ______________

Adjusted Cement (kg/m^3) (lbs/cy) __________ Source ______________ Sp. Gr. __________

IM491.17 Fly Ash (kg/m^3) (lbs/cy) __________ Source (C/F) ______________ Sp. Gr. __________

IMT-203 Fine Aggr. Source ______________ Sp. Gr. __________

IMT-203 Coarse Aggr. Source ______________ Spr. Gr. __________

Water (kg/m^3) (lbs/cy) = Design w/c (wt cement + wt Ash)

Absolute Volumes

Cement	$(kg/m^3) \div$ (Sp. Gr. x 1000) (lbs/cy) $\div$ (Sp. Gr. x 62.4 x 27)	= 0.________
Fly Ash	$(kg/m^3) \div$ (Sp. Gr. x 1000) (lbs/cy) $\div$ (Sp. Gr. x 62.4 x 27)	= 0.________
Water	$(kg/m^3) \div$ (Sp. Gr. x 1000) (lbs/cy) $\div$ (1.00 x 62.4 x 27)	= 0.________
Air		0.060
	Subtotal	0.________
	1.000 - Subtotal	= 0.________
	Total	= 1.000
	Fine Aggregate (1.000 - Subtotal) x % in mix	= 0.________
	Coarse Aggregate (1.000 - Subtotal) x % in mix	= 0.________
	Aggregate Total	0.________

Aggregate Weights

Fine Aggr.	(abs vol.) x Sp. Gr. x 1000 (abs vol.) x Sp. Gr. x 62.4 x 27	= ________ kg/m^3 lbs/cy
Coarse Aggr.	(abs vol.) x Sp. Gr. x 1000 (abs vol.) x Sp. Gr. x 62.4 x 27	= ________ kg/m^3 lbs/cy

Summary

- Cement ______________ kg/m^3 (lbs/cy)
- Fly Ash ______________ kg/m^3 (lbs/cy)
- Water ______________ kg/m^3 (lbs/cy)
- Fine Aggr. ______________ kg/m^3 (lbs/cy)
- Coarse Aggr. ______________ kg/m^3 (lbs/cy)

9/96

PCC Plant Page

Form E240

Page: ________

Project No.: ____________________ County: ____________________ Report No.: ________

Plant Name: ____________________ Weather: ____________________ Date This Report: ________

Contractor / Sub: ____________________ Min. Temp. (°F): ________ Date Of Last Report: ________

Contract ID.: ____________________ Max. Temp. (°F): ________ Design No.: ________

Check One (x)		Check One (x)		
Central Mix		Paving		(Send Daily or End of Lot)
Ready Mix		Structure		(Send Weekly or End of Lot)
Mobile Mix				(Send Weekly or End of Lot)

Year / Date	Mix Number	Time Start	Time Stop	Batched (CY)	% of Est. Used	Fine Aggregate Moist. (%)	Fine Aggregate T-203 Sp. G.	Fine Aggregate Dry Wt. (lbs)	Coarse Aggregate Moist. (%)	Coarse Aggregate T-203 Sp. G.	Coarse Aggregate Dry Wt. (lbs)	Actual Quantities Used Per CY (in pounds) Cement	Fly Ash	Fine	Coarse	Water In Agg.	Water Plant	Water Grade	Avg. W/C Ratio	Max. W/C Ratio

COARSE SAMPLE / Wash

Sieve Accuracy= | Sieve Accuracy= | Sieve Accuracy=

Orig. Dry Weight (OD Wt.): | Orig. Dry Weight (OD Wt.): | Orig. Dry Weight (OD Wt.):

Dry Wt. Washed (D Wt. W): | Dry Wt. Washed (D Wt. W): | Dry Wt. Washed (D Wt. W):

	Sieve Size	Wt. Retd.	% Retd.	% Retd.	% Psg.	Wt. Retd.	% Retd.	% Retd.	% Psg.	Wt. Retd.	% Retd.	% Retd.	% Psg.	Specs.	Avg.
C O A R S E	1 1/2 "														
	1 "														
	3/4 "														
S A M P L E	1/2 "														
	3/8 "														
	#4														
	#8														
	Pan														
	Total														
W a s h	#200														
	Wash Loss		OD Wt.:				OD Wt.:				OD Wt.:				
	Pan		D Wt. W.:				D Wt. W.:				D Wt. W.:				
	Total														

Check One (x):	Today	Week	Total
Concrete Batched(CY)			
Cement Batched(Tons)			

	Brand / Source	Rate	Lot No.
Air Entrain:			
Wat. Red:			
Retarder:			
Cal. Chlor:			
Superplas:			

Concrete Treatment (x)		lbs / CY
Ice		
Heated Water		
Heated Materials		

FINE SAMPLE

Sieve Accuracy= | Sieve Accuracy= | Sieve Accuracy=

Orig. Dry Weight: | Orig. Dry Weight: | Orig. Dry Weight:

Dry Wt. Washed: | Dry Wt. Washed: | Dry Wt. Washed:

Washing Loss: | Washing Loss: | Washing Loss:

	Sieve Size	Wt. Retd.	% Retained	Final	% Passing	Wt. Retd.	% Retained	Final	% Passing	Wt. Retd.	% Retained	Final	% Passing	Specs.	Avg.
F I N E	3/8 "														
	#4														
	#8														
	#16														
S A M P L E	#30														
	#50														
	#100														
	#200														
	Wash														
	Pan														
	Total														
	Less + #4														
	Date Reported (DR):					(DR):				(DR):					
	Tested By/Date (TB/D):					(TB/D):				(TB/D):					

Mobile Mixer	
Cement Meter	Water Meter

Remarks

C.P.I.: ____________________ Cert. No. ________

Monitor: ____________________ ________

Form 820912M
5-95

Iowa Department of Transportation

Office of Materials

PORTLAND CEMENT SHIPMENT YIELD REPORT

Page ________ of ________

Report No. ________

Date ________

County ________ Source ________ Contract No. ________

Project ________ Contractor ________

Plant Location ________

	Date	Type	Invoice No.	Mass Billed *(Mg)*		Date	Type	Invoice No.	Mass Billed *(Mg)*		Date	Type	Invoice No.	Mass Billed *(Mg)*
1					21					41				
2					22					42				
3					23					43				
4					24					44				
5					25					45				
6					26					46				
7					27					47				
8					28					48				
9					29					49				
10					30					50				
11					31					51				
12					32					52				
13					33					53				
14					34					54				
15					35					55				
16					36					56				
17					37					57				
18					38					58				
19					39					59				
20					40					60				

Mix No.	kg Cement per m^3	m^3 Batched	Cement Batched *(Mg)*
Left in Scale *(Mg)*	This Check (+)		+
	Previous Yield Check (-)		-
	Total Weighed *(Batch Scale)*		

Total Billed Mass *(Mg)*:

$$\text{Yield Percent} = \frac{\text{Total Mg Batched}}{\text{Total Mg Billed}} \times 100$$

$$\frac{(\_\_\_\_\_\_\_\_)}{(\_\_\_\_\_\_\_\_)} \times 100 = \_\_\_\_\_\_ \%$$

____
Plant Inspector

Distribution: White Copy-Materials Office; Yellow Copy-Transportation Center Materials Office; Pink Copy-Project Engineer; Goldenrod-Inspector

Form 820907
4-94

Iowa Department of Transportation

TRANSIT MIXER
CONDITION CERTIFICATION

In accordance with requirements of Iowa Department of Transportation Standard Specifications Section 2001.21B this certifies the herein described transit mixer was examined on the date shown and was found to be in proper working condition, the fins and blades were not damaged or worn excessively, and the drum interior was free of hardened concrete buildup.

Unit Identification No. ______________________

Home Base ______________________

Owner ______________________

Mixer Manufacturer ______________________

Serial Number ______________________

MMB Rating (Mixing, Cu. Yd.) ____________ Year New ____________

Truck Manufacturer ______________________

Model ______________________

Year ____________ Color ____________

Date ____________ Signature ____________

Date ____________ Signature ____________

Date ____________ Signature ____________

Date ____________ Signature ____________

Date ____________ Signature ____________

Date ____________ Signature ____________

Date ____________ Signature ____________

Date ____________ Signature ____________

Date ____________ Signature ____________

Date ____________ Signature ____________

Date ____________ Signature ____________

Date ____________ Signature ____________

Date ____________ Signature ____________

Form 820020
6-83

Iowa Department of Transportation

MOBILE MIXER CALIBRATION

Contractor/Owner ________ County ________ Calibrated By: ________
Mixer Serial No. ________ Project No. ________ Date ________
Operating Speed ________ Design No. ________ Inspector ________

MATERIALS AND SETTINGS

Material	Source	Sp. Gr.	Dry Weight	Wet Weight	Gate Setting
Cement					
*Sand					
*Rock					
Water					
Water Reducer					
Air Entraining Agent					

* *(Optional moisture content - Sand 3% Rock 0.5%)*

Determine **CEMENT METER COUNT.** *Run: 50 count ± Model 60 Magnum unit*
100 count ± Standard unit

Trial	1	2	3	4	5	Totals
Counts						
Gross Weight						
Tare Weight						
Net Weight						
Time (sec.)						

Total Pounds / Total Count = ( ) / ( ) = ________ Lb. / Meter Count

94 lb. cement / Lb./Meter Count = 94 lb. / ( ) = ________ Counts / Bag

AIR ENTRAINING AGENT DILUTION RATE ________

Admixtures

Time per bag = (Counts/Bag) x Total seconds / Total counts = ________ Sec./Bag

Water Reducer

Dosage Required (oz./bag) ________
Dilution rate ________
Dilution Req'd (total oz./bag) ________

Sand weight / 1 Bag = Wet weight / 8.75 = ________ / 8.75 = ________ Lb. / Bag

Divide this by the Count/Bag from Step 1.

( ) Lb./Bag / ( ) Count/Bag = ________ Lb. / Count

This is the target value.

The tolerance limits are:

Upper = ( ) x 1.02 = ________
Lower = ( ) x 0.98 = ________

The calibration check average is:

Sum of checks / No. of checks = ( ) / ( ) = ________ Lb. / Count

Trial	1	2	Check	Check	Check	Check
Setting						
Counts						
Gross weight						
Tare weight						
Net weight						
Time (sec.)						
Lb./Count						

Rock weight / 1 Bag = Wet weight / 8.75 = ________ / 8.75 = ________ Lb. / Bag

Divide this by the Count/Bag from Step 1.

( ) Lb./Bag / ( ) Count/Bag = ________ Lb. / Count

This is the target value.

The tolerance limits are:

Upper = ( ) x 1.02 = ________
Lower = ( ) x 0.98 = ________

The calibration check average is:

Sum of checks / No. of checks = ( ) / ( ) = ________ Lb. / Count

Trial	1	2	Check	Check	Check	Check
Setting						
Counts						
Gross weight						
Tare weight						
Net weight						
Time (sec.)						
Lb./Count						

Form 820907
4-94

Iowa Department of Transportation

TRANSIT MIXER
CONDITION CERTIFICATION

In accordance with requirements of Iowa Department of Transportation Standard Specifications Section 2001.21B this certifies the herein described transit mixer was examined on the date shown and was found to be in proper working condition, the fins and blades were not damaged or worn excessively, and the drum interior was free of hardened concrete buildup.

Unit Identification No. ______________________

Home Base ______________________

Owner ______________________

Mixer Manufacturer ______________________

Serial Number ______________________

MMB Rating (Mixing, Cu. Yd.) ______________ Year New ______________

Truck Manufacturer ______________________

Model ______________________

Year ______________ Color ______________

Date ______________ Signature ______________

Date ______________ Signature ______________

Date ______________ Signature ______________

Date ______________ Signature ______________

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