STATE OF OHIO
DEPARTMENT OF TRANSPORTATION
SUPPLEMENT 1033
HIPERPAV REQUIREMENTS FOR CONCRETE PAVEMENT

April 18, 2008

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1033.01   **Scope**.   This supplement provides guidelines to HIPERPAV II 3.0 software.   Use this software when determining if early age cracking of Portland Cement Concrete Pavement will happen during paving operations.

1033.02   **Acquiring Software**.   HIPERPAV II 3.0 software is a computer program initially developed by FHWA research.   The software predicts if and when early age cracking in Portland Cement Concrete Pavement will occur within the first 72 hours of construction. The software uses environmental, material, design and construction condition inputs in its evaluation.

Acquire a copy of the software from

The Transtec Group, Inc.
1012 East 38 ½ Street
Austin, Texas 78751
Web Page: http://www.transtecinc.com/

Cost of the software is incidental to 451

1033.03   **Contractor submittal Requirements for HIPERPAV II 3.0**

Conforming to the requirements of 451.08, HIPERPAV II 3.0 will be used on all concrete pavement projects to evaluate early age cracking of concrete pavement.

An individual HIPERPAV file will be provided for each scheduled concrete pavement pour.   Develop the HIPERPAV file to include all inputs to properly run the file and document that early age cracking will not happen for the scheduled concrete pour.   Each HIPERPAV file will include contractor determined strategies that cover all variables (i.e. weather, change in concrete temperature, construction time) that could influence early age cracking of the pavement.

Provide the completed HIPERPAV file and print outs to the Engineer at least 24 hours before the actual concrete pour.

Upload the file into the Engineer's HIPERPAV software and go over the inputs used and the print outs. Agree on the inputs and the file's strategy runs to validate the scheduled paving time, materials, processes and environment will not create early age cracking in the pavement to be placed. If the Engineer does not agree, make modifications to the file's strategies to show either the concrete pavement can be placed without cracking or a delay of the pour is required.

To help with the input into the HIPERPAV software, input guidelines with screen examples are provided in this supplement. The user should also open the HIPERPAV software; select the help menu; select user's manual; and print out the manual.

1033.04   ODOT standard input requirements for HIPERPAV II 3.0

A completed HIPERPAV software file will require both inputs specified by the Department and Contractor selected inputs.

1033.05 provides an initial example for creating a HIPERPAV file for a concrete pour. It includes required inputs and examples and details on inputting the information into the software. While the 1033.05 example has all the Department standard inputs incorporated in the example a separate list is provided below. The list includes the HIPERPAV screen name, the input requirement and the 1033.05 section where the screen and input can be seen.

Supplement Section	HIPERPAV Screen Name	ODOT required input
1033.05.A	New Project Screen	select: "Early Age JPCP option"
1033.05.B	Project Information Screen	Project name = project number and date Project ID = Route and county Begin Sta. = beginning pavement section for this file run. End Sta. = ending pavement section for this file run.
1033.05.C	Geography	Find and select the location of the project on the geography map
1033.05.D	Monthly Weather Data	select the option: "estimate Monthly Data from Location"
1033.05.E	Strategy Information	use a Reliability Level of "95%" input for user name: Contractor or Sub-contractor (if paving performed by a sub contractor)
1033.05.F	Design Geometry	Input the Slab thickness, the Slab width and the Transverse joint spacing
1033.05.G	Design Dowels	No input (screen not used)

Supplement Section	HIPERPAV Screen Name	ODOT required input
1033.05.H	Design Slab Support	select and input "Material Type" used as support for the concrete pavement for "Subgrade properties" the thickness of design plan's support material for the concrete pavement and the modulus associated with that support material as listed in 1033.05.H for Subgrade Stiffness Type to select "Use Subgrade Modulus" and input a value of "7200 psi" for Axial Restraint select "Estimate from Material Type
1033.05.I	Materials and Mix Design Cement	select "ASTM Cement Type Classification" and input the type of ASTM cement being used for "Blaine Fineness Index" to select the option "Estimate from Cement Type"
1033.05.J	Materials and Mix Design PCC Mix	inputting the coarse aggregate to be used in the concrete mix inputting the admixtures to be used selecting flyash type inputting the concrete mix design's batch proportions
1033.05.K	Materials and Mix Design PCC Properties	select "compressive strength" for Strength Type and input the 28 Day Strength (STR) in psi for Strength Coefficients select the option "Estimate from Strength Type" for PCC 28 Day Modulus select the option "Estimate from Strength" for PCC Ultimate Shrinkage select the option "Estimate from Mix" for Coefficient of Thermal Expansion select the option "Estimate from Aggregate type"
1033.05.L	Materials and Mix Design Maturity Data	minimum requirement: select the option "Default Strength Gain"
1033.05.M	Construction	Strength for opening to traffic – Use 2500 psi Complete all inputs on this screen with contractor selected information
1033.05.N	Environment	This is a unique input. The screen provides the weather estimates for the actual pour date and the next 72 hours. ODOT input requirement is the screen be completed with validated temperature, humidity and wind speed data. 1033.05.N provides a method to validate the computer inputted items.
1033.05.O	Analysis	No inputs required. This is HIPERPAV's output screen

1033.05 Input example for HIPERPAV II 3.0 including standard inputs

A standard HIPERPAV II 3.0 file will require both Contractor driven inputs and standard inputs.

A. New Project. This screen has three project options. As ODOT does little CRCP (continuously reinforced concrete pavement), the standard option will be Early Age JPCP
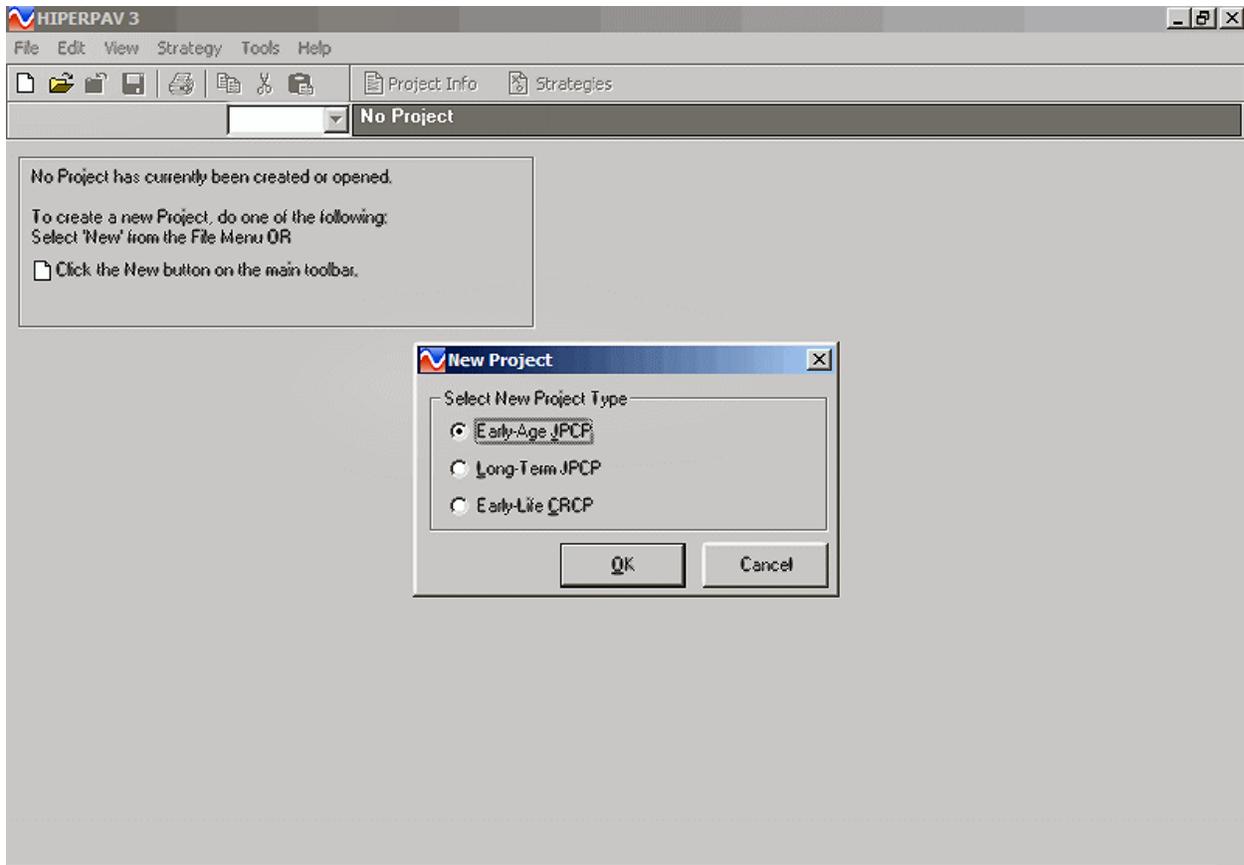
The Long Term JPCP option is not applicable to a construction project. "Early-life CRCP" will also not be applicable as ODOT pavement design is not continuously reinforced.

Select "Early-life JPCP" and Hit OK. The program will comment on no "new Strategy" has been created. Next the project information screen shown in 1033.04 B will appear.

B. Project Information Screen. The HIPERPAV II 3.0 project information screen will look like:
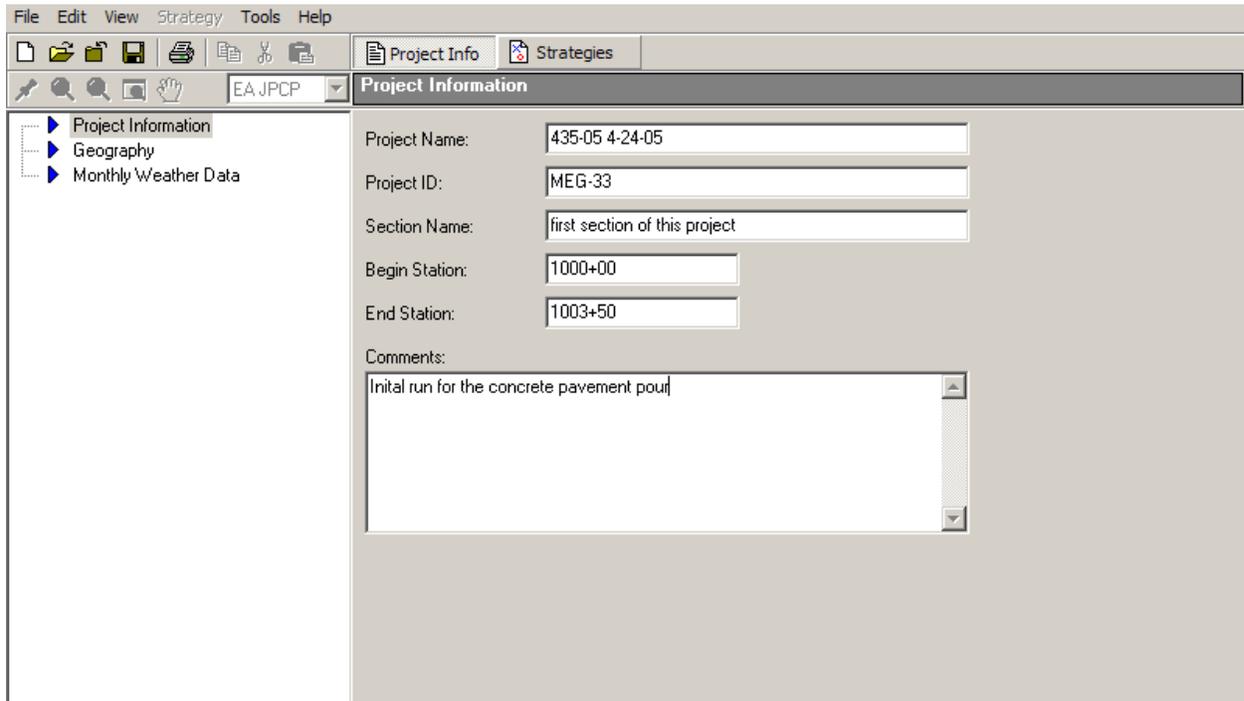
Complete the required input information for the Project Design file. Fill in the project name (project number and date), Project ID (Route and county), and beginning and ending pavement section for this file run.

USER NOTE: The left portion of the screen is similar to sub-directory areas or drives in windows. Note the blue arrow and the darkened area over "project information". At the top of the screen note the depressed area called project info. These are shortcuts to HIPERPAV screens and sections you can use as you become more familiar with this simple program.

Save the file using the Project name [project number and date of pour]. Go up to file; pull down the menu to "save as"; and the screen will comedown with filename matching what you put in the "project name" and below file name you will see "save as type" which lists HIPERPAV 3.0 project (*.hp3). If the project name and date is correct hit the "Save" button.

Saving the file should return you to the same view as above. Now move your mouse arrow to the left and move the arrow over geography. The arrow should turn to a hand with one finger pointing up. Now hit the left mouse key and the screen in 1033.03C will appear.

C.   Geography   The geography screen provides historic temperatures in the pavement pours location. While initially it is a big map you can expand the map out to find the actual county the route and the pour will be in. To select the county first move the mouse arrow to the left portion of the menu and pick the magnifying glass with the cross (plus sign).

Now move the magnifying glass over the map. You will see names of cities come up, like Columbus Ohio when the magnifying glass is over Columbus. Hit the left mouse key button and the map expands. Repeat this until you can find your general location (county) in the state for the concrete pavement pour.

Now move the magnifying glass back to the left portion of the menu and select the yellow pin to the left of the magnifying glass with the "plus".   Select the pin by clicking the left mouse button.
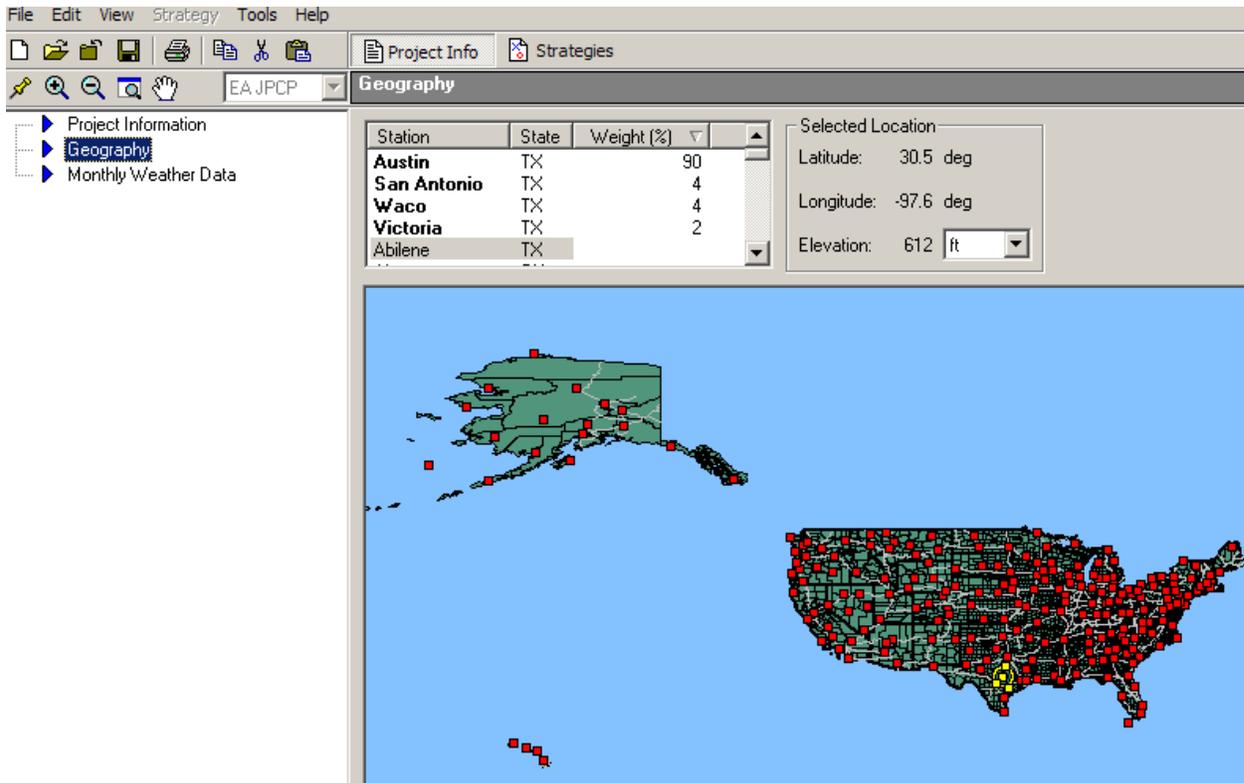
Move the pin back to where your county is and hit your left mouse button. The following message should come up. Hit the "Yes" button.
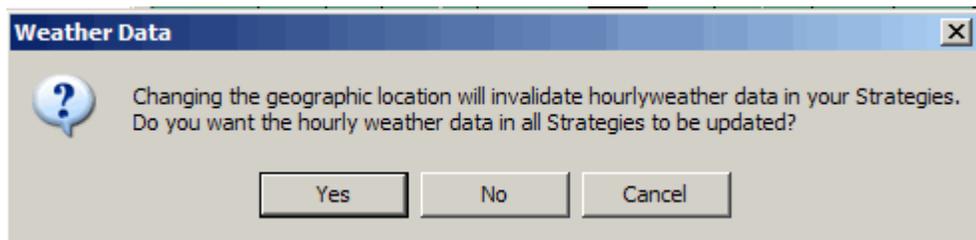
The local average temperature data for that area has now been selected. If the county does not have direct city temperature data the program will average the location temperatures from the nearest cities.

D.   **Monthly Weather Data**   Go back to the left portion of the screen. Move the mouse over Monthly Weather Data and double click the left mouse button. The below screen will appear.

	Rainfall
January	1.8
February	2.4
March	1.9
April	2.9
May	4.5
June	3.4
July	1.8
August	2.1
September	3.3
October	3.5
November	2.1
December	2.3
Total	**32**

- ▶ Project Information
- ▶ Geography
- ▶ Monthly Weather Data

◉ Estimate Monthly Data from Location (load values from database)
○ User-Defined

Unit: inches

Rainfall (inches)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Month
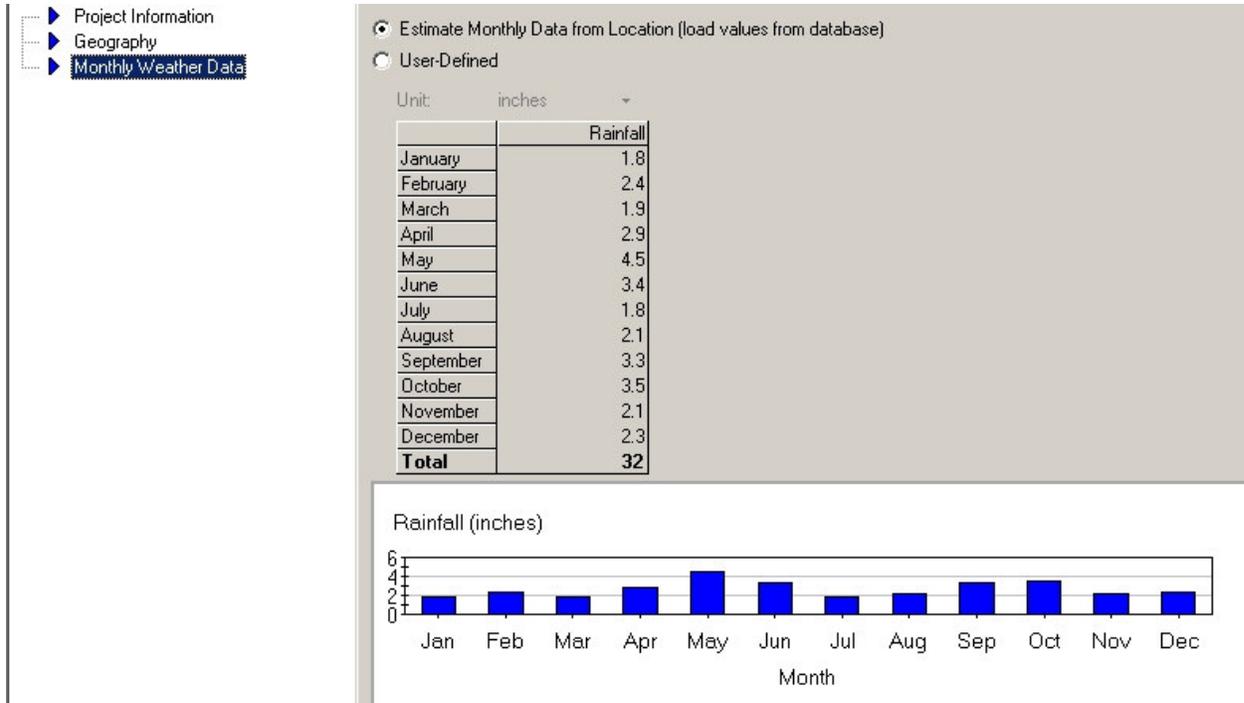
This screen shows average rainfall in area. Select the option to "estimate Monthly Data from Location"

E.   Strategy Information   Move the mouse arrow to the top center of the menu and select "Strategies".   ⊠ Strategies   .   Double click the left mouse button and the below screen should appear.

Input Name of user – contractor or sub contractor (if the paving is done by a sub contractor)

Revise and use reliability level to = 95%

Move the mouse arrow over the save button 🖫 and hit the left mouse button.

F.   Design Geometry Move the mouse arrow to the left portion of the screen over the word "Geometry" under design. Double click the left mouse button and the below screen will appear.
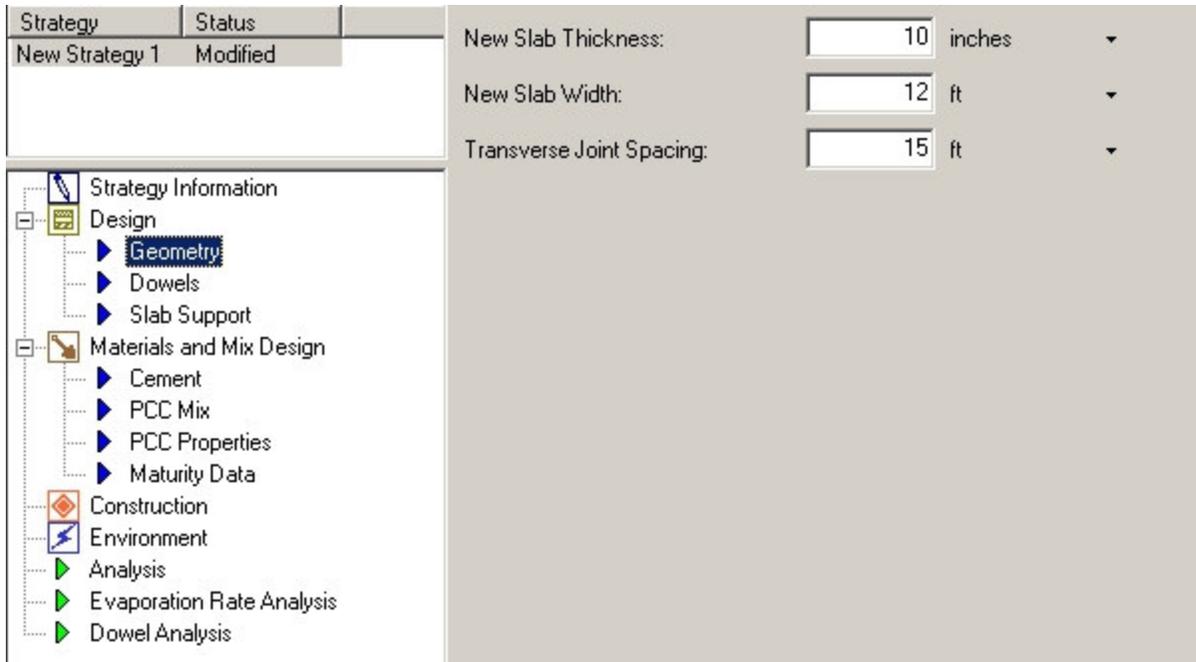
Complete the required input based on project requirements.

USER NOTE: if constructing a ramp the width may be wider than 12 feet. If pouring two lanes at a time the width would be wider than 12 feet.

Move the mouse arrow over the save button and click the left mouse key. (if the information in the screen is not changed saving is not required)

Move the mouse arrow over the word "Dowels" in the left portion of the screen and double click the left mouse button.

G. Design Dowels The below screen should appear.
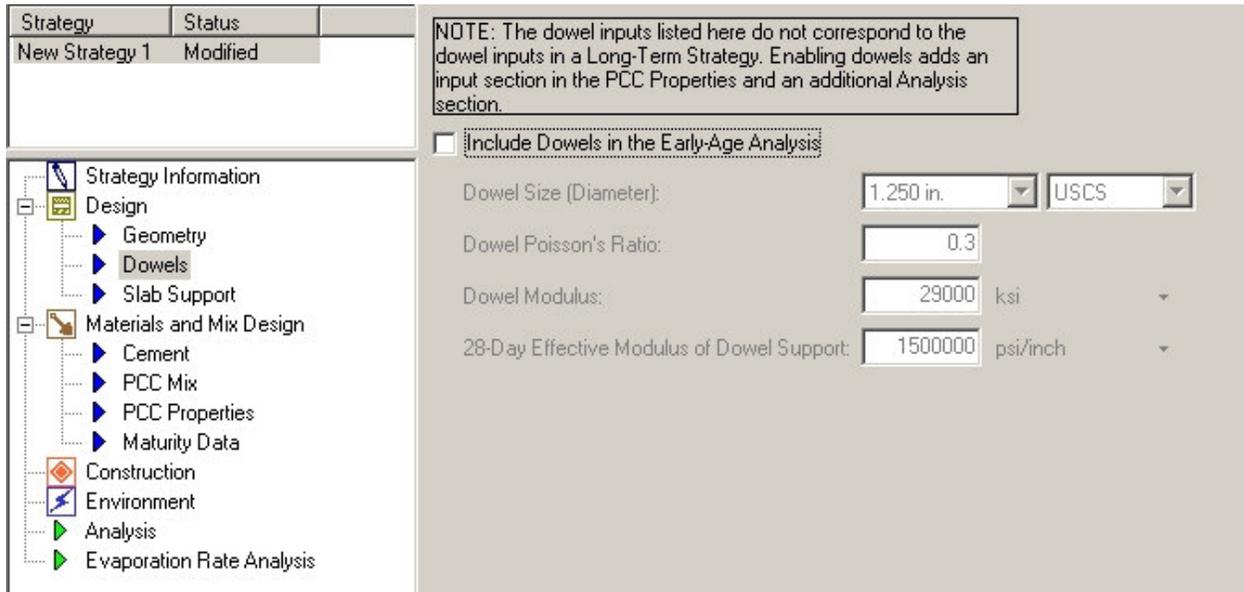
No input required. Do not include Dowels in the Early Age analysis.

Move the mouse arrow over the word "Slab Support" in the left portion of the screen and double click the left mouse button

H. Design Slab Support The screen below should now be on the computer.
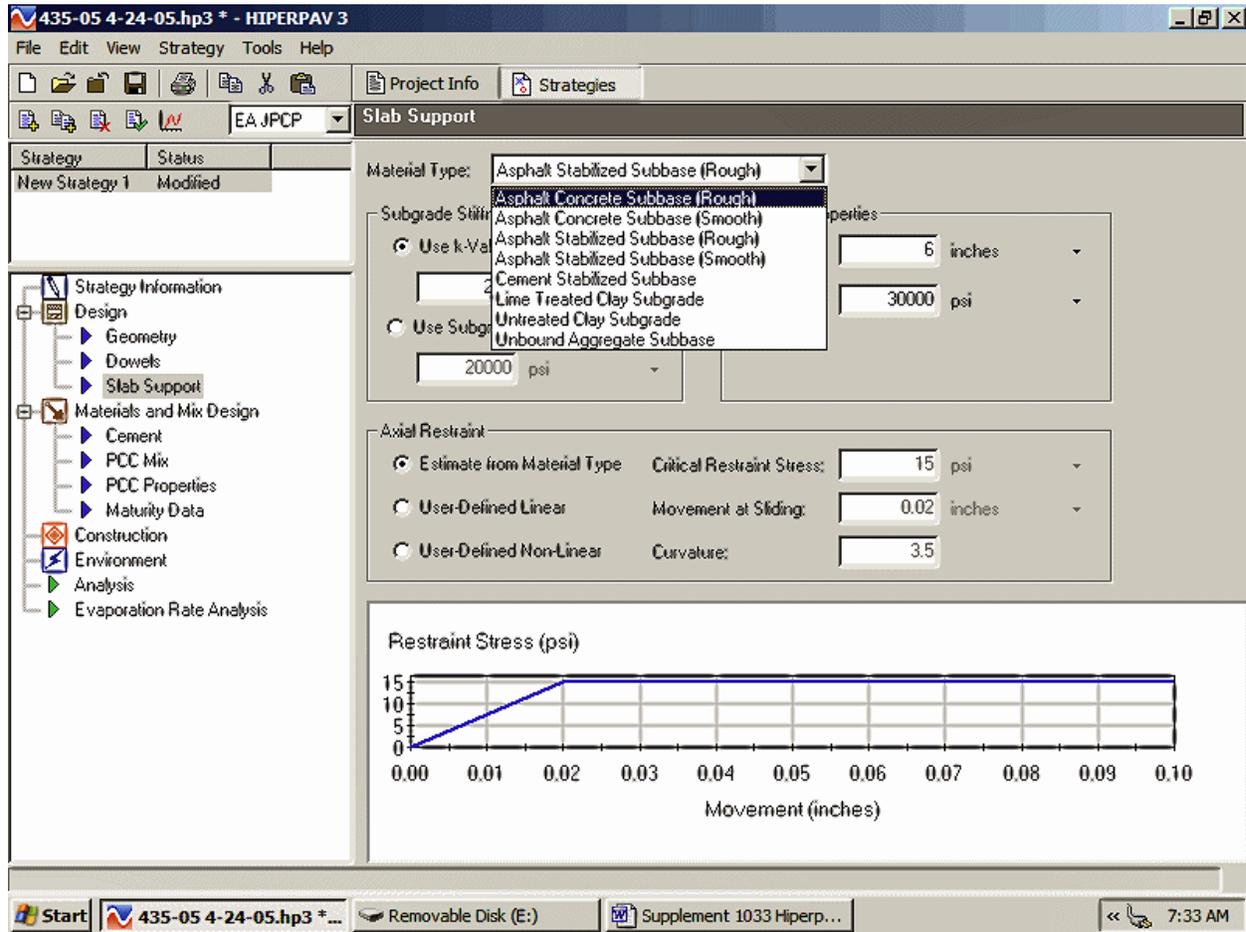
Material Type: This is a pull down menu. Select the proper type of support for the pavement.
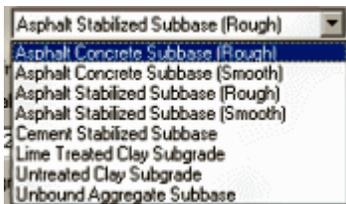
Asphalt concrete subbase (rough)	Modulus = 300,000 psi
Asphalt concrete subbase (smooth)	Modulus = 300,000 psi
Asphalt stabilized subbase (rough)	Modulus = 200,000 psi
Asphalt stabilized subbase (smooth)	Modulus = 200,000 psi
Cement Stablized subbase	Modulus = 1,200,000 psi
Lime treated Clay subgrade	(ODOT does not accept)
Untreated Clay Subgrade	(ODOT does not accept)
Unbound Aggregate Subbase	Modulus = 30,000 psi

Unbound Aggregate Subbase is ODOT 304

Go to subbase properties and input the thickness for the subbase and the Modulus value listed in the above table.

Now go to the "Subgrade Stiffness type". Move the mouse arrow over "Use subgrade Modulus" and hit the left mouse button. The "Use subgrade Modulus should be outlined with a dotted line and the circle in front of "Use subgrade Modulus" should be darkened.
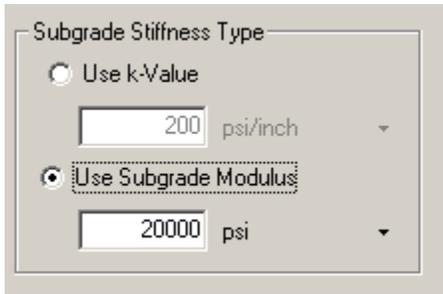
Subgrade Stiffness Type
- ○ Use k-Value
    - [200] psi/inch ▾
- ⊙ Use Subgrade Modulus
    - [20000] psi ▾

Input a "Use Subgrade Modulus" of 7200 psi

Move the mouse arrow down to "Axial Restraint" and position the mouse arrow over the words "Estimate from Material Type".   Hit the left mouse button. The "Estimate from Material Type" will now be outlined with a dotted line and the circle in front of the words will be filled.
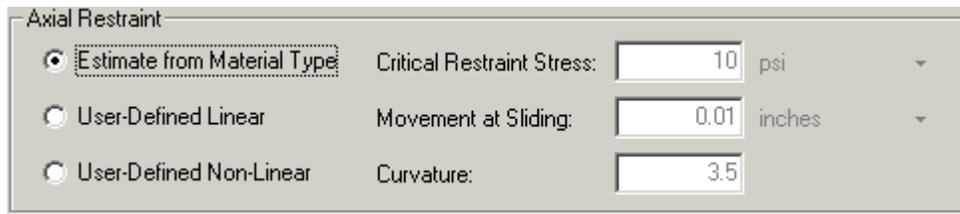
Axial Restraint
- ⊙ Estimate from Material Type   Critical Restraint Stress: [10] psi ▾
- ○ User-Defined Linear   Movement at Sliding: [0.01] inches ▾
- ○ User-Defined Non-Linear   Curvature: [3.5]

USER NOTE: Get a feel for the software by selecting other types of material types. Then look at the "restraint stress" graph below axial restraint. The "restraint stress" graphs will change when you change the material type.

I.   Materials and Mix Design Cement Move the mouse arrow over the words "Materials and Mix Design" ⊢▧ Materials and Mix Design in the left portion of the screen and double click the left mouse button. You will see a heading screen. No information is required as there isn't any to fill in.

Move the mouse arrow to the left over the word "Cement" ▶ Cement in the left portion of the screen and double click the left mouse button. You will see the below screen.
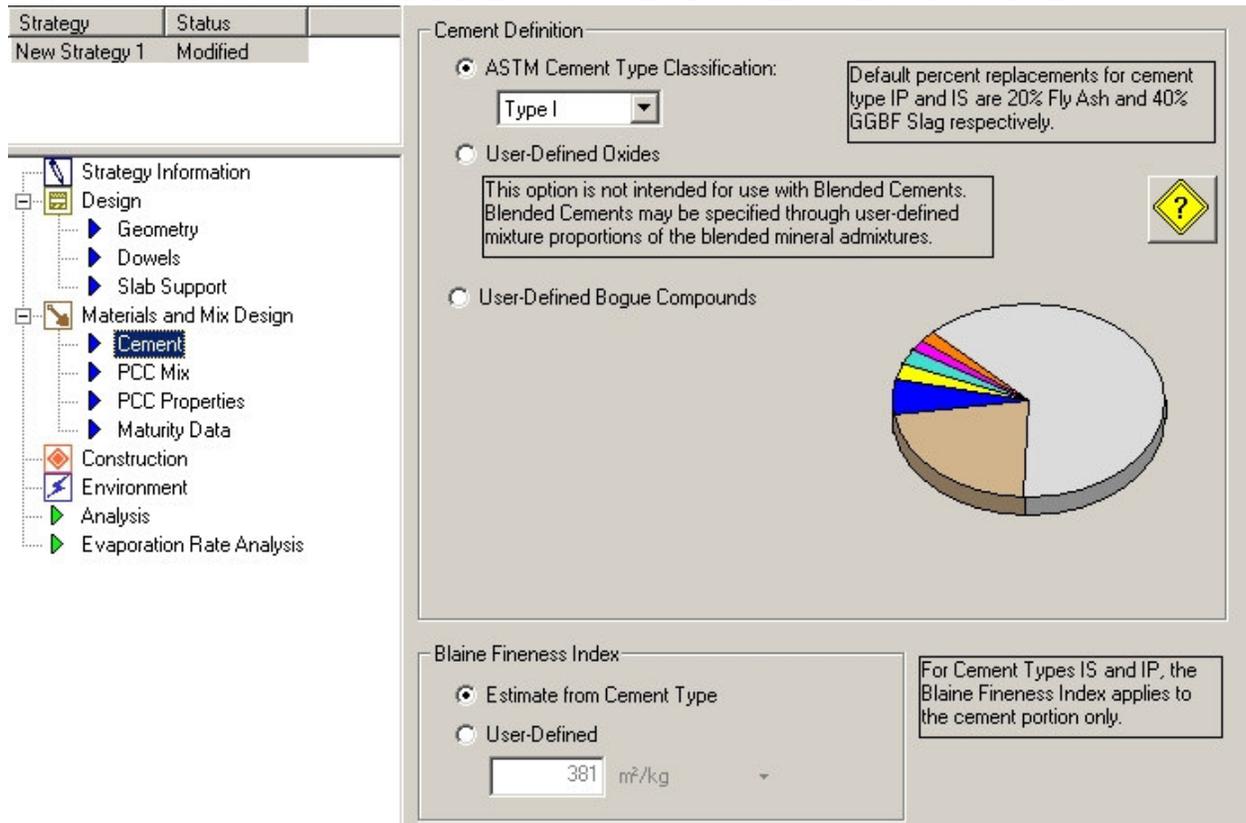
(a)   For concrete pavement projects using standard ODOT mixes
Move the mouse arrow over the words "ASTM Cement Type Classification" and hit the left mouse button. The "ASTM Cement Type Classification" will now be outlined with a dotted line and the circle in front of the words will be filled.

Move the mouse arrow over the pull down menu arrow ▾ and hit the left button on the mouse. A menu below will fold down.

Type I ▾	For Class C and all options select "Type 1". Confirm with cement supplier that this is the material being provided.
Type I	
Type IP	
Type IS	NOTE: Do not select "Type 1P or 1S" even if using pozzolans in the concrete.
Type II	
Type III	Type 1P and 1S are cement factory blended cements.
Type V	

(b)   For ODOT type MS or FS mixes,

Select the type of cement being supplied. Type 1 is normally used but Type III cement is a high early strength cement and may sometimes be supplied. Check with concrete supplier.

(c)   For concrete pavement projects using Contractor developed mix designs (QC-QA type specifications)

Contractor has two options:

Option 1

Move the mouse arrow over the words "ASTM Cement Type Classification" and hit the left mouse button. The "ASTM Cement Type Classification" will now be outlined with a dotted line and the circle in front of the words will be filled.

Move the mouse arrow over the pull down menu arrow ▾ and hit the left button on the mouse. A menu below will fold down.

select the cement type specified in the approved mix
NOTE: Do not select "Type 1P or 1S" even if using pozzolans in the concrete.
Type 1P and 1S are cement factory blended cements.

Option 2

Move the mouse arrow over the words "User Defined Bogue Compounds" and hit the left mouse button. The "User Defined Bogue Compounds" will now be outlined with a dotted line and the circle in front of the words will be filled and the screen will change to show the following:

Using cement manufacturer certified data, input the percent contents for each compound.

If choosing option 2, provide certified test data to the Engineer.

For all concrete mixes:

Move the mouse arrow down to Blaine Fineness index and over the words "Estimate from cement type" hit the left mouse button. The "Estimate from Cement Type" will now be outlined with a dotted line and the circle in front of the words will be filled in.

Blaine Fineness Index
- ● Estimate from Cement Type
- ○ User-Defined
  - 385 m²/kg

For Cement Types IS and IP, the Blaine Fineness Index applies to the cement portion only.

J.   Materials and Mix Design PCC Mix   Move the mouse arrow to the left over the words "PCC Mix" `▶ PCC Mix` in the left portion of the screen and double click the left mouse button. You will see the below screen.
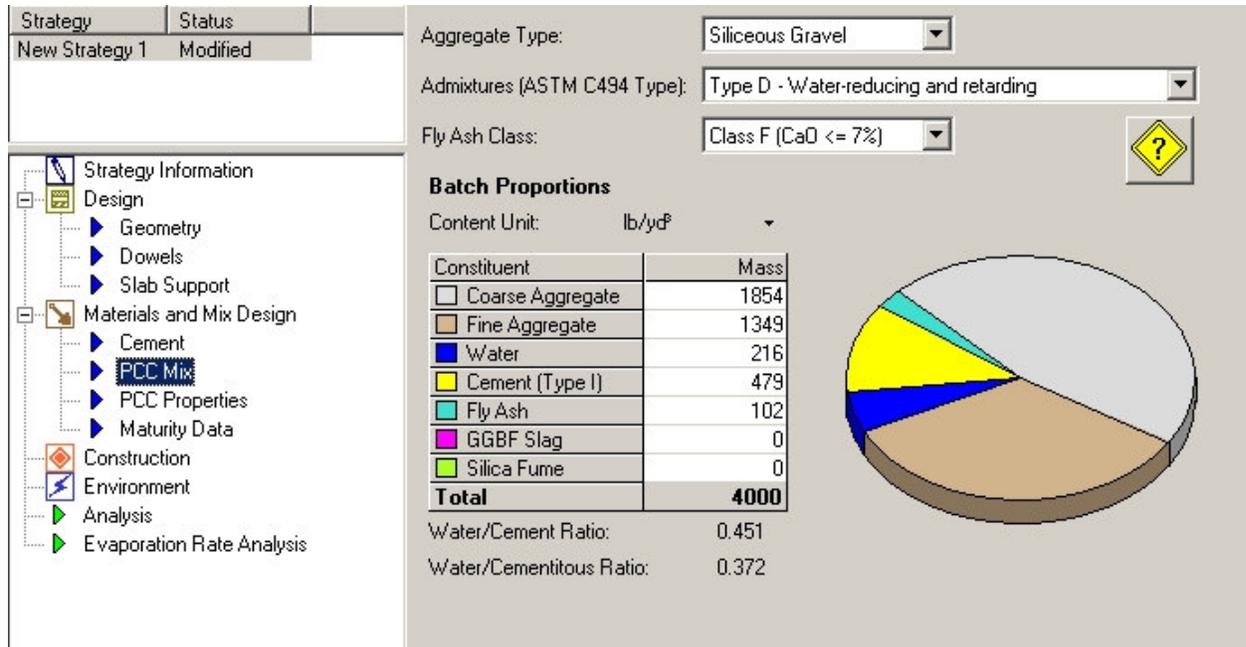
Strategy	Status
New Strategy 1	Modified

- Strategy Information
- Design
  - Geometry
  - Dowels
  - Slab Support
- Materials and Mix Design
  - Cement
  - **PCC Mix**
  - PCC Properties
  - Maturity Data
- Construction
- Environment
- Analysis
- Evaporation Rate Analysis

Aggregate Type: Siliceous Gravel

Admixtures (ASTM C494 Type): Type D - Water-reducing and retarding

Fly Ash Class: Class F (CaO <= 7%)

Batch Proportions

Content Unit: lb/yd³

Constituent	Mass
☐ Coarse Aggregate	1854
☐ Fine Aggregate	1349
■ Water	216
☐ Cement (Type I)	479
☐ Fly Ash	102
■ GGBF Slag	0
☐ Silica Fume	0
Total	**4000**

Water/Cement Ratio: 0.451
Water/Cementitous Ratio: 0.372

Input Aggregate Type: From the pulldown menu select what is being used for the concrete mix. ODOT options: Either Limestone or Siliceous Gravel

Admixtures. With the mouse arrow select the admixture pulldown screen arrow `▼` and the below pulldown menu will appear.

```
None
Type B - Retarding
Type C - Accelerating
Type D - Water-reducing and retarding
Type E - Water-reducing and accelerating
Type G - Water-reducing, high range, and retarding
```

Select what is to be used for the project. Air entrainment is not (for this software) an Admixture.

Fly Ash Class: Determine class by information available from the Department's web page: www.dot.state.oh.us/testlab/applists/cement/flyash.htm Find your flyash supplier on the list and in the second column of the list "Class Code" will be either type F or Type C. Select from the hiperpav pull down menu based on that list. For Type F select "Type F (CaO < 7.0%)

Batch Proportions = input what is being used for the project. Use SSD weights corrected for specific gravity.

Move the mouse over the save 🖫 button and click the mouse's left button.

K.   Materials and Mix Design PCC Properties   Move the mouse arrow to the left over the words "PCC Properties" ▶ PCC Properties in the left portion of the screen and double click the left mouse button. You will see the below screen.
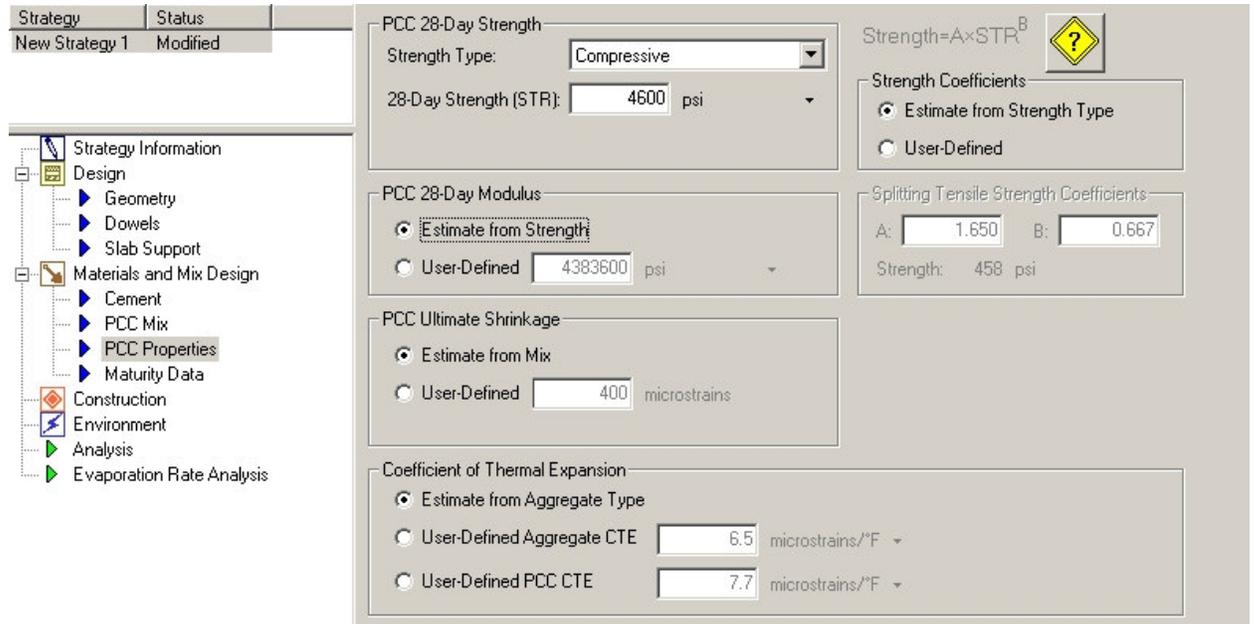
Strength Type	Move mouse arrow over the arrow ▾. Hit the let mouse button and when the pull down menu appears select "Compressive"
Strength Coefficients	Move the mouse arrow over "Estimate from Strength Type" and hit the mouse's left button.
28 day Strength	Input the following compressive strengths. For gravel mixes (not crushed) 4600 psi For limestone mixes 5200 psi For QC/QA mixes contact the laboratory
PCC 28 day modulus	Move the mouse arrow over "Estimate from Strength" and hit the mouse's left button. The words "Estimate from strength" will be outlined with a dotted line and the circle in front should be filled.
PCC Ultimate Shrinkage	Move the mouse arrow over "Estimate from Mix" and hit the mouse's left button. The words "Estimate from Mix" will be outlined with a dotted line and the circle in front should be filled
Coefficient of Thermal Expansion	Move the mouse arrow over "Estimate from Aggregate Type" and hit the mouse's left button. The words "Estimate from Aggregate Type" will be outlined with a dotted line and the circle in front should be filled

L.   Materials and Mix Design Maturity Data   Move the mouse arrow to the left over the words "Maturity Data" ▶ Maturity Data in the left portion of the screen and double click the left mouse button. You will see the below screen.
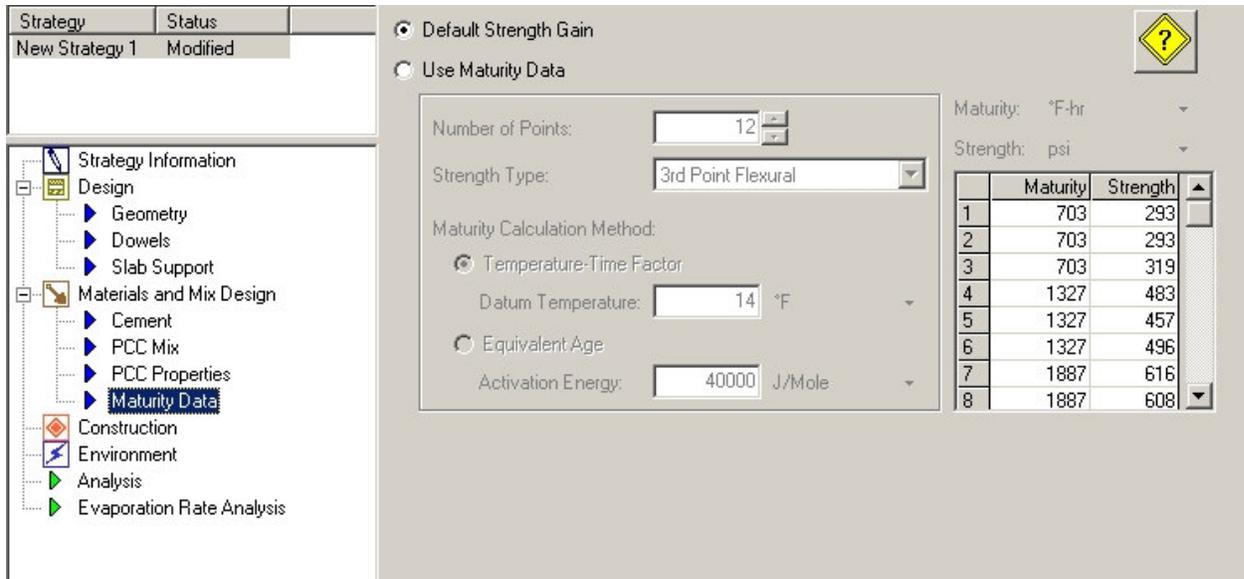
Move the mouse arrow over "Default Strength Gain" and hit the mouse's left button. The words "Default Strength Gain" will be outlined with a dotted line and the circle in front should be filled.

USER NOTE: If an actual maturity curve has been developed for the mix, select "Use Maturity Data: and input the actual maturity data.

M. Construction   Move the mouse arrow to the left over the words "Construction" ⬦ **Construction** in the left portion of the screen and double click the left mouse button. You will see the below screen.

Use project inputs to complete this screen

"Initial PCC Mix Temperature" input in degrees Fahrenheit (F). Estimate based on experience and whether temperature.

USER NOTE: As Initial temperature of the concrete is an estimate, adjust the initial temperature and perform multiple runs of HIPERPAV to assure covering the expected range of concrete temperatures will be performed.

"Initial Support Layer Temperature" input in degrees Fahrenheit (F). Use a surface thermometer to measure the base temperature. Do not use air temperature.

"Curing Method". Move mouse arrow over pull down menu arrow ⬇ and select method of curing.

```
Single Coat Liquid Curing Compound    ▼
None
Single Coat Liquid Curing Compound
Double Coat Liquid Curing Compound
Triple Coat Liquid Curing Compound
Plastic (Polyethylene) Sheeting
Cotton Mats or Burlap
Polyethylene Sheet and Cotton Mat
```

USER NOTE: Curing method may be a modification if HIPERPAV runs show that early age cracking of the pavement will happen.

"Sawcutting". Move mouse arrow over the option words that will be used and perform selection and input, except use the "No Sawing" option on the first Strategy to check if the concrete pavement has possible cracking problems

USER NOTE: The initial strategy should be with no sawcutting to provide a baseline for the pavement operation. Upon completing the initial strategy create additional strategies and input the sawcutting operations to be used.

Sawcutting options may also be changed when performing multiple HIPERPAV runs to assure pavement performs. Options in different HIPERPAV runs may be selected to assure concrete pavement performance.

"Strength for Opening to Traffic". Move mouse arrow over "Display Strength for opening to traffic and click the mouse's left button. The words "Display strength for opening to traffic" will be outlined in a dotted box. A check mark will appear in the box to the left of the words.

Go down to the pull down arrow ⬇ on "Strength Type" and select Compressive from the pull down menu. Go up to "strength and input 2500 psi.

```
┌ Strength for Opening to Traffic ──────────────────
│  ☑ Display strength for opening to traffic?
│
│   Strength:          2500  psi        ▾      ⬦?⬦
│
│   Strength Type:   Compressive            ▼
│
└──────────────────────────────────────────────
```
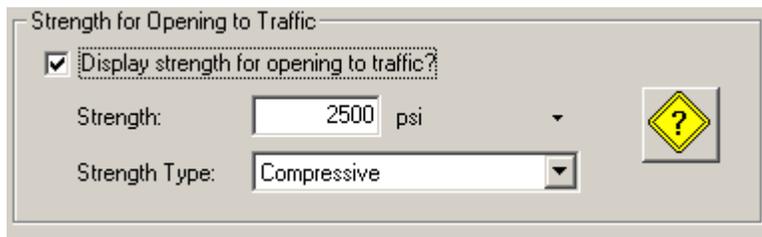
N.   **Environment**   Move the mouse arrow to the left over the words "Environment" ⚡ Environment in the left portion of the screen and double click the left mouse button. You will see the below screen.
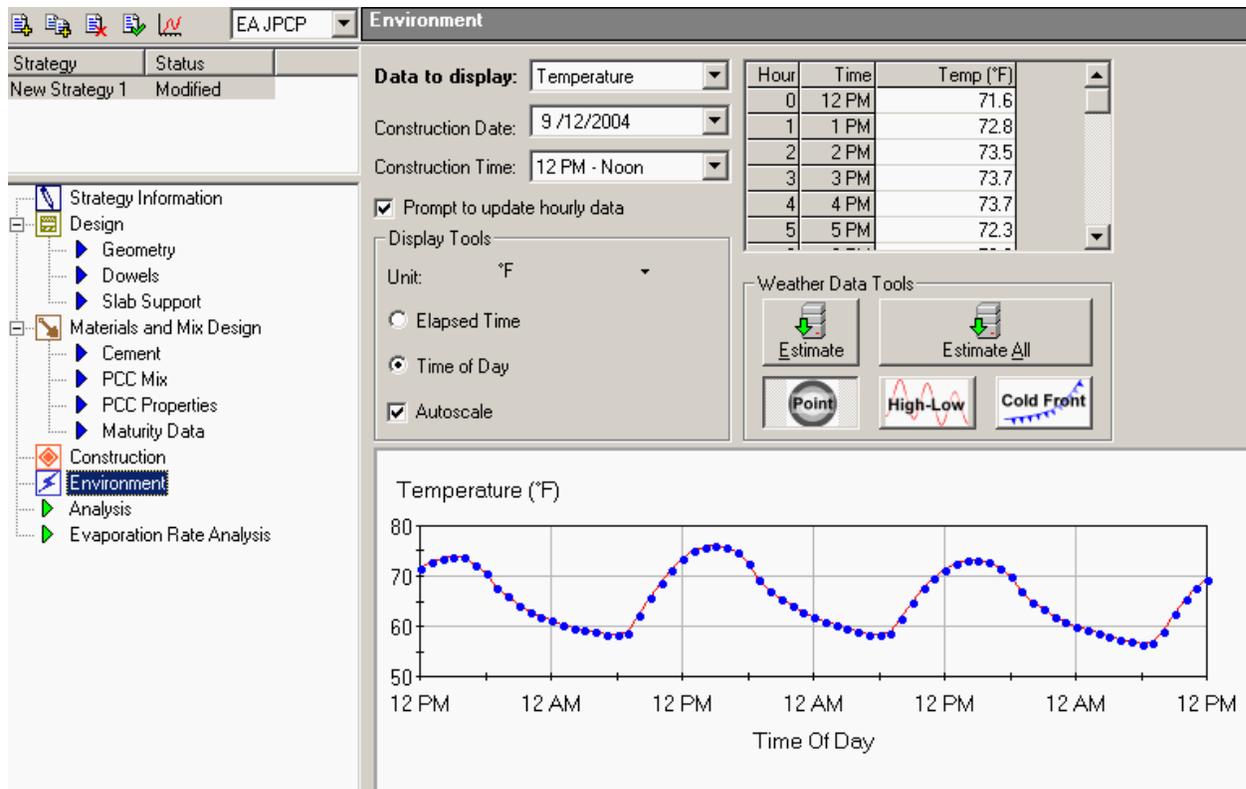
This screen pulls historic temperature data from a local environmental conditions database. This information is based on the selection made for a specific county location under 1033.C Geography.

The temperature information can also be self generated by inputting your own data.

Step 1: input the date of pour "Construction Date"

Step 2: Input "Construction time".

User Note: Changing "Construction time" will change the temperature graph as it changes the Time of Day baseline to match.

Step 3a: Go to "Data to Display" Select "Temperature" in the pull down menu. Note in the graph that the temperature for 72 hours is shown.

Step 3b: Go to "Data to Display" Select "Wind Speed" in the pull down menu. Note in the graph that the wind speed for 72 hours is shown.

Step 3c: Go to "Data to Display" Select "Humidity" in the pull down menu. Note in the graph that the humidity for 72 hours is shown

Step 3d: Go to "Data to Display" Select "Cloud Cover" in the pull down menu. Note in the graph that the cloud cover for 72 hours is shown

User Note: Steps 3a thru 3d show the four different data types that "Data to Display" has. All four(4) types are estimated from historical data.   All data can and should be changed to show the actual conditions expected on the day of the pour and the following 72 hours (3 days).

To assure against cracking the estimated temperatures will need to verified and changed if they don't match the predictions for the location. This is critical!

Step 4: Perform step 3a. Look at the temperature graph and it's projections for high and low temperatures for the three days. To assure against cracking the estimated temperatures will need to verified and changed if they don't match the predictions for the location. This is critical!

Verify that temperatures are accurate for the date of pour by checking the predicted local temperatures as follows:

1. Go to the web and type in www.noaa.gov/wx.html. This is the National Oceanic and Atmospheric Administration's weather website. It will look like the following:

2. On the left you will see "Today's Weather" Position the mouse in the block below and type in the ZIP CODE or City, State where the pour is. Hit Enter.

3. The screen below will appear with a three day and more weather prediction for the local area

4. Check the graph's high and low temperatures versus what is predicted. If not within 2 degrees change the temperatures to reflect the NOAA weather predictions. Since the temperatures in this example are <u>NOT THE SAME</u> the temperatures need to be changed. To change the temperature data perform the following.

a   Move the mouse arrow to the button that says "High Low" and hit that button. The environment screen temperature will change by adding red dots to the high low temperatures.
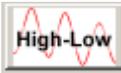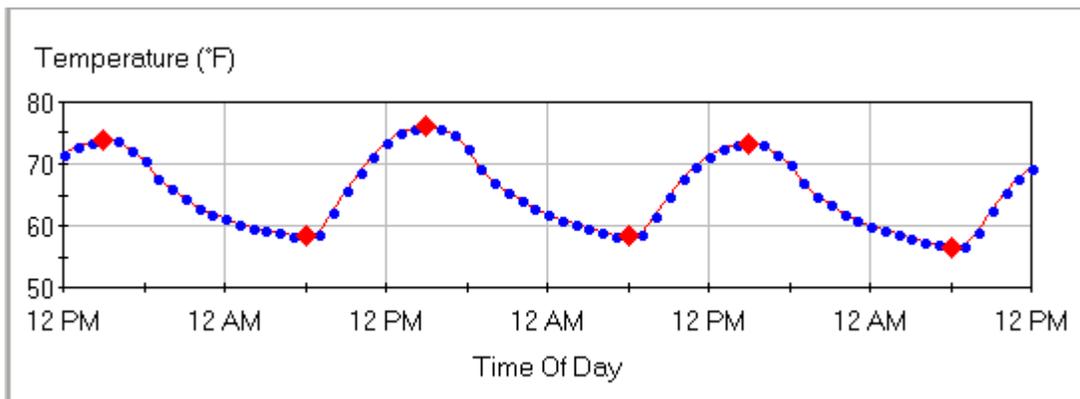
b   Move the mouse over the ☑ Autoscale and uncheck the box. Move the mouse arrow over the red diamonds and hold down the left mouse b button. Now move the mouse up and down and the red diamond will move with the mouse arrow. Look up at the Hour – Time – Temperature – Type. You will see the Type shows high and low. You can change high low temperatures by either moving the mouse arrow up or down dragging the red diamond or inputting the temperatures directly in the table for high or low for each day.

c   Go back and reset the autoscale by clicking the left button of your mouse after the mouse arrow is over the box. The graph will adjust.

USER NOTE: If beginning temperature points on the graph before the pour appear high, move the mouse over the (Point) button.   Now you can go back to the graph points and move the graph points with the mouse. Adjust the points before the pour to reflect expected temperatures before the concrete pavement placement.

d   The temperature graph should now look like below graph.
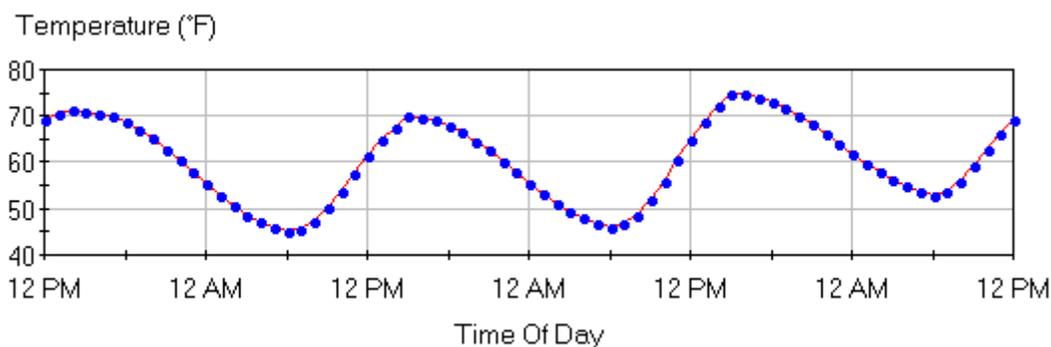
e   Move the mouse and hit the "high – low" button and the graph should look like this.
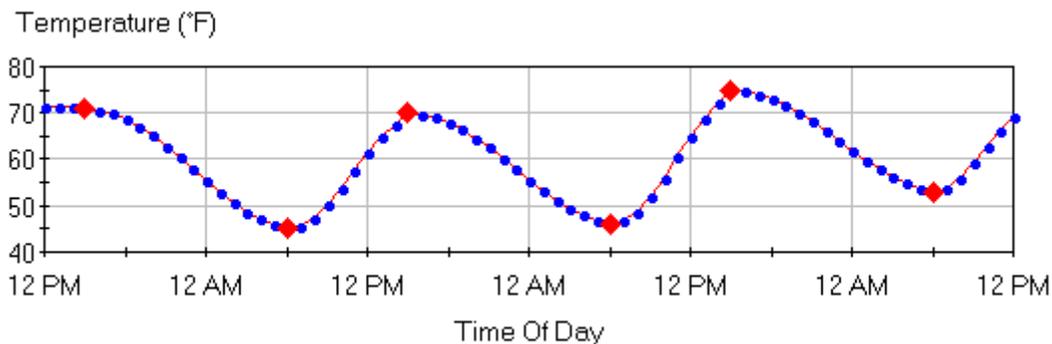
f   Hit the save button.

g   Move mouse up to **Data to display:** [Wind Speed ▼] and select "Wind Speed" from the pull down menu. The graph will now show wind speed. If not showing high low red diamonds, hit the high – low button.

h   Compare the high low wind speed to the NOAA predictions for each day. If not matching then change based on using the higher wind speed of the prediction for each day based on the NOAA 3 day weather predictions for highs and lows.

Detailed 7-day Forecast

This Afternoon: Partly cloudy, with a high near 71. West wind around 6 mph.

Tonight: Mostly clear, with a low around 45. Light north wind.

Saturday: A chance of showers, with thunderstorms also possible after noon. Partly cloudy, with a high near 70. Calm wind becoming west between 7 and 10 mph. Chance of precipitation is 40%. New rainfall amounts between a tenth and quarter of an inch possible.

Saturday Night: A slight chance of showers and thunderstorms before 8pm. Partly cloudy, with a low near 46. West wind around 6 mph becoming calm. Chance of precipitation is 20%.

Sunday: Mostly sunny, with a high near 75. Calm wind becoming north around 5 mph.

Sunday Night: Partly cloudy, with a low around 53.

Monday: A chance of showers, with thunderstorms also possible after noon. Partly cloudy, with a high near 79. Chance of precipitation is 40%.

Monday Night: A chance of showers and thunderstorms. Mostly cloudy, with a low around 54. Chance of precipitation is 40%.

Tuesday: A chance of showers and thunderstorms. Mostly cloudy, with a high near 78. Chance of precipitation is 40%.

Tuesday Night: A chance of showers and thunderstorms before 8pm, then a chance of showers, mainly between 8pm and 10pm. Mostly cloudy, with a low near 56. Chance of precipitation is 40%.

i   Go into the hourly time wind block and change the highs, the lows.   Change wind speed patterns to match predictions by moving high low values on the chart.
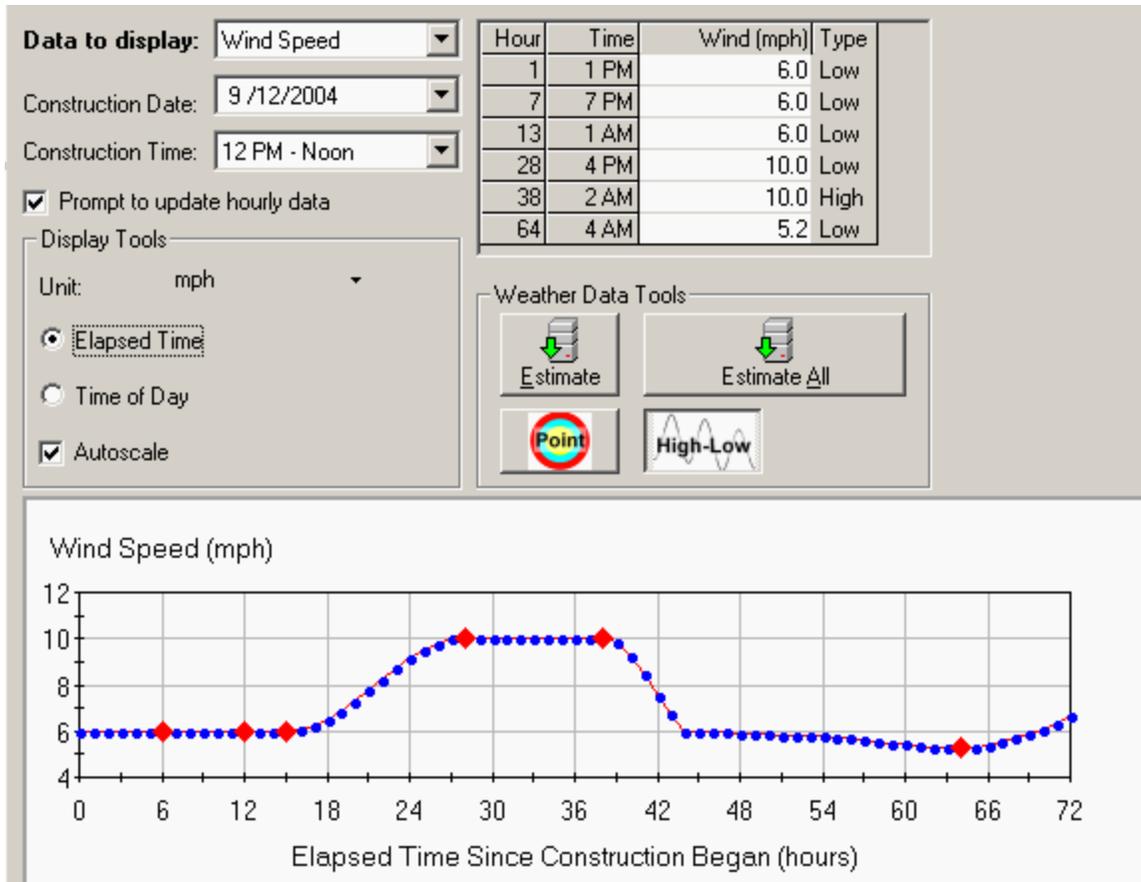
j   Move mouse up to **Data to display:** Humidity ▼ and select "Humidity" from the pull down menu. The graph will now show humidity percent. If not showing high low red diamonds, hit the high – low button.

k   Compare the high low humidity to the NOAA predictions for each day. If not matching then change based on using the humidity from the 48 hour information. Predict out for the other 24 hours.

Data to display: Humidity ▼

Construction Date: 9 /12/2004 ▼

Construction Time: 12 PM - Noon ▼

☑ Prompt to update hourly data

— Display Tools —

◉ Elapsed Time

○ Time of Day

☑ Autoscale

Hour	Time	Humidity (%)	Type
2	2 PM	60.6	Low
18	6 AM	81.0	High
28	4 PM	60.3	Low
42	6 AM	86.1	High
52	4 PM	71.0	Low
66	6 AM	95.7	High

— Weather Data Tools —

Estimate   Estimate All

Point   High-Low

Humidity (%)

Elapsed Time Since Construction Began (hours)

l   Move the mouse up to **Data to display:** Cloud Cover ▼ and select "Cloud Cover" from the pull down menu. Cloud cover percents will now be show on the graph. Change so the high low values are shown.

m   Compare the high low cloud cover to the NOAA predictions for each day. Make revisions if necessary based on the NOAA predictions by moving the high lows.

n   Move the mouse arrow to the left and double click on ▸ **Analysis**

o   Move the mouse arrow up to the top of the HIPERPAV screen over the word **Strategy** and hit the mouse's left button. A pulldown menu should appear.

Add
Copy
Delete
Rename
Validate
Use This Strategy As Default
Use Original Defaults
Run Analysis   F5
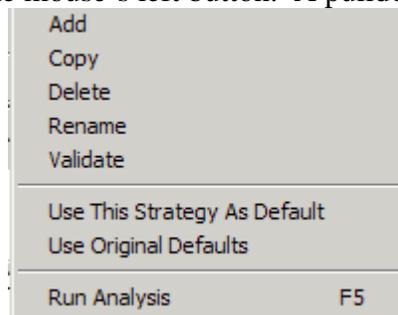
p   Using the mouse select the validate menu.   This will check the file and will

change the Strategy and Status to

Strategy	Status
New Strategy 1	Validated

.

O.   **Analysis**   Move the mouse arrow over to following icon . Click the left button on the mouse and you will see the analysis screen come up as HIPERPAV runs
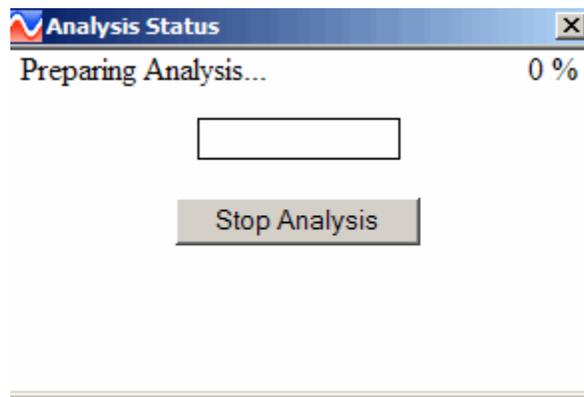
The analysis will be completed and the following screen should appear.
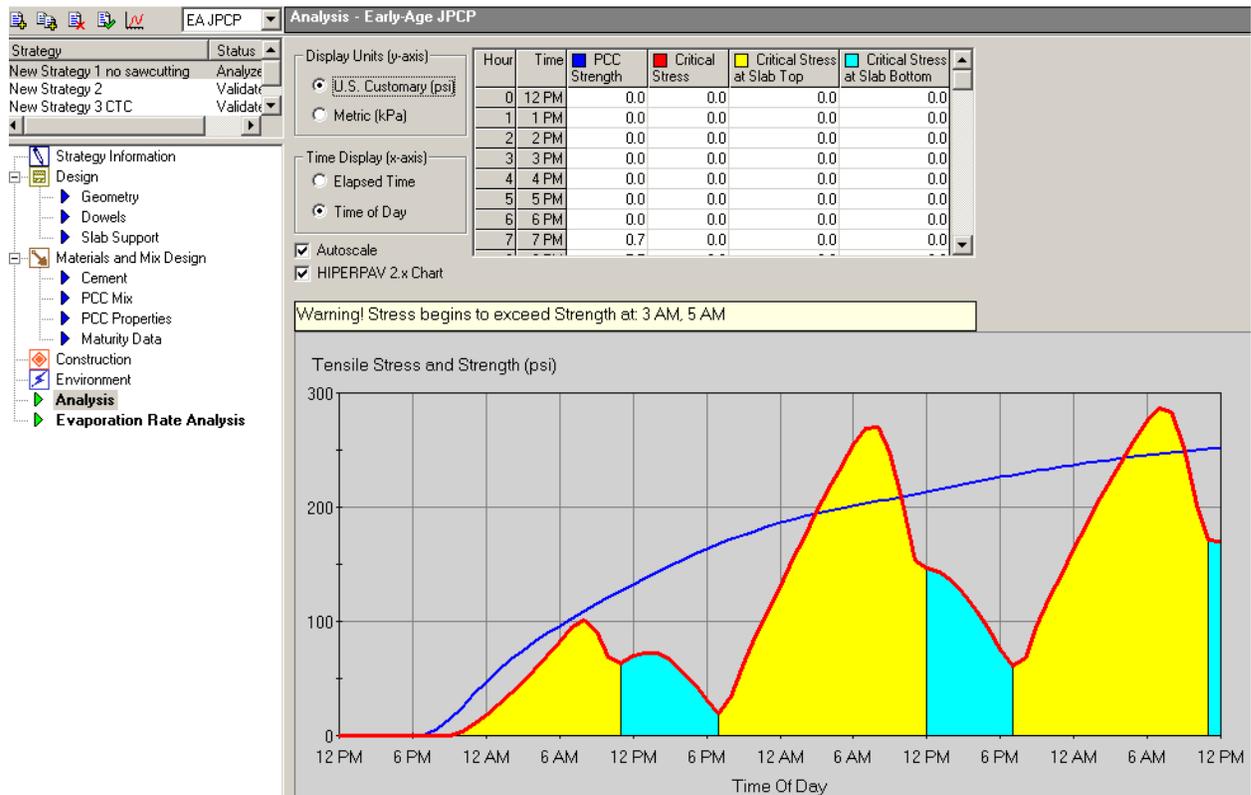
If the blue line is crossed the yellow or blue area the tensile strength of the concrete pavement has been exceeded and failure "CRACKING" will occur. In this case it hasn't.

P.   Reading Analysis outputs   The completed analysis screen values can be read per hour of the operation and time. Move the mouse over to the right of the table of values and select the [▼]. Hold the left mouse button down and the table will move so that you will be able to see each hour's values. Stop when the 36 hour is at the top of the table. You should see the below information.

Hour	Time	■ PCC Strength	■ Critical Stress	□ Critical Stress at Slab Top	□ Critical Stress at Slab Bottom
36	12 AM	186.2	131.0	131.0	25.9
37	1 AM	189.1	152.9	152.9	33.2
38	2 AM	191.9	174.5	174.5	41.3
39	3 AM	194.3	195.8	195.8	50.0
40	4 AM	196.6	216.4	216.4	59.4
41	5 AM	198.8	236.0	236.0	69.4
42	6 AM	200.9	254.5	254.5	79.8
43	7 AM	203.0	268.4	268.4	91.0

The values you should be reading are PCC Strength of "186.2" psi @ 36 hours. Critical Stress of "131.0" @ 36 hours. Critical Stress at Slab Top "131.0" @ 36 hours.

Notice failure values starting @ 39 hours.

Determine values anywhere on the graph presentation by putting your mouse over the PCC Strength graph line, the Critical stress at Slab top line, or the Critical stress at slab bottom line.
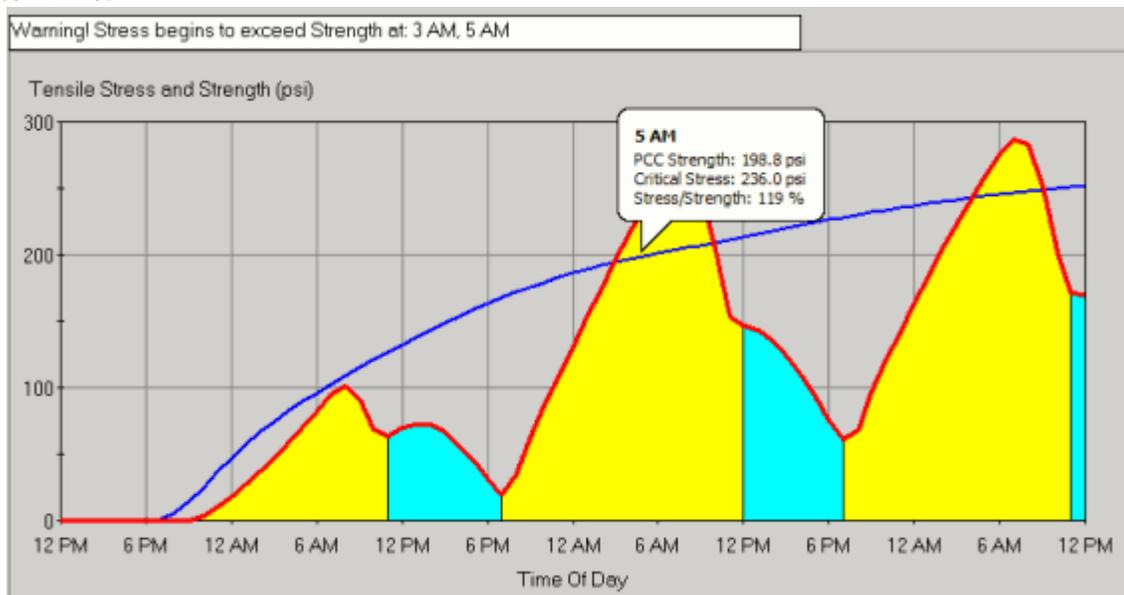
WHEN THE CRITICAL STRESS TO CONCRETE STRENGTH IS 98 PERCENT OR HIGHER CORRECTIONS WILL BE NEEDED.

1033.06 Analysis of Additional Strategies

To assure early age cracking will not happen, run additional strategies of HIPERPAV by changing variables that could reasonably be expected to modify during the paving operation.

The first strategy run in 1033.05 was the "no sawcutting" Strategy.

To run additional strategies perform the following steps

Step 1: Copy Strategy 1 and rename by moving the mouse arrow up to Strategy in the top menu and pull down the following:
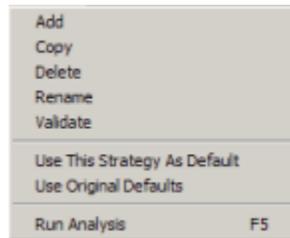
Add
Copy
Delete
Rename
Validate

Use This Strategy As Default
Use Original Defaults

Run Analysis   F5

Step 2: Select the Copy. A "copy of new strategy 1"

Strategy	Status
Copy of New Strategy 1	New
New Strategy 1	Analyzed

will appear.

Step 3: Move the mouse over "Copy of New Strategy 1". Right click and select in the menu that appears "rename". Change the file name to "New Strategy 2".

Step 4: For this example of revising and creating different strategies, move the mouse down and select ⬥ Construction . In the construction screen select "User defined sawing age". Input 10 hours.

Step 5   Hit Save button

Step 6   Go to strategy menu; pull down and select "validate" to validate Strategy 2.

Step 7   Go to Analysis. Run Analysis. The graph below shows the results of strategy 2.

The new analysis passes but the graph has definitely changed.
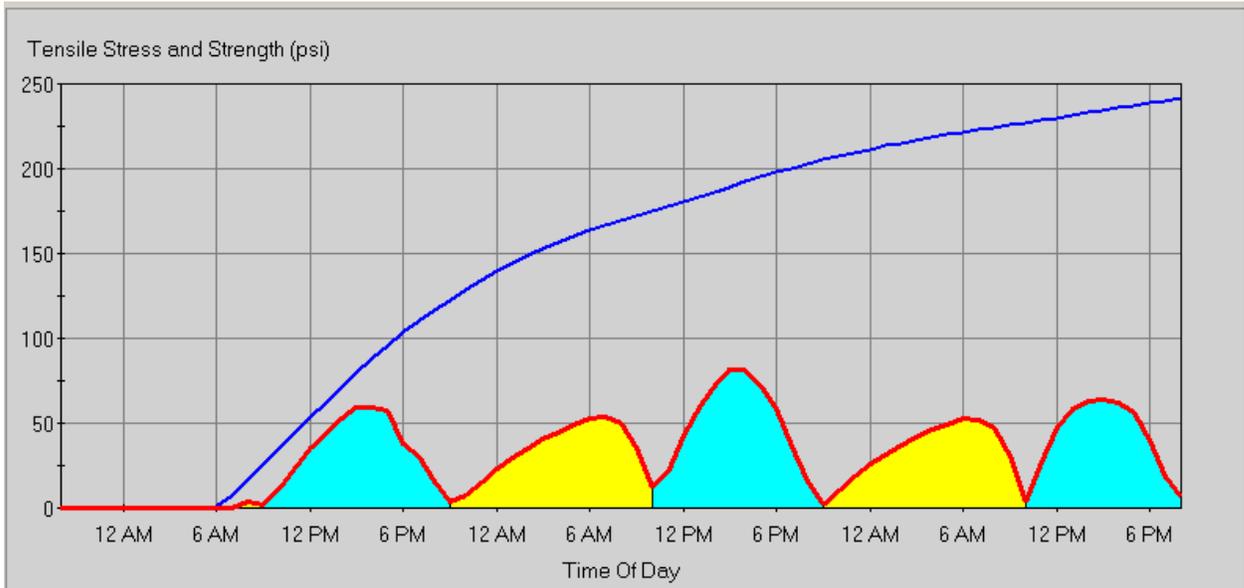
The user will create as many different strategies as required to provide the Engineer assurance the placed concrete pavement will not crack.

Another possible strategy. Change the start of construction time for the concrete pavement by 8 hours

Step1: Move the mouse arrow up to `Strategy` in the top menu and pull down the following:
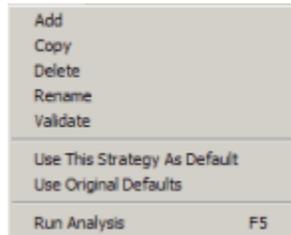
Add
Copy
Delete
Rename
Validate

Use This Strategy As Default
Use Original Defaults

Run Analysis   F5

Step 2: Select the Copy. A "copy of new strategy 2"

Strategy	Status
Copy of New Strategy 2	New
New Strategy 1 no sawcutting	Validated
New Strategy 2	Analyzed
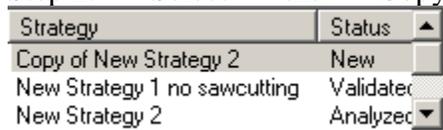
will appear.

Step 3: Move the mouse over "Copy of New Strategy 2". Right click and select in the menu that appears "rename". Change the file name to "New Strategy 3 CTC" CTC stands for construction time change.

Step 4 Move the mouse and select `Environment`. Go to "Construction Time" and change to 8 PM. When asked if the weather data should be estimated select yes.

Step 5   Change the weather data. {See earlier sections} using HI LOW values.

USER NOTE: Highlighting Strategy 1 will allow access to the original inputted weather data. Go back to Strategy 3 and either work the HI LOW or input all values..

Step 5   Hit Save button

Step 6   Go to strategy menu; pull down and select "validate" to validate Strategy 3 CTC.

Step 7   Go to Analysis. Run Analysis

See the graph below. The new analysis passes but the graph has definitely changed.
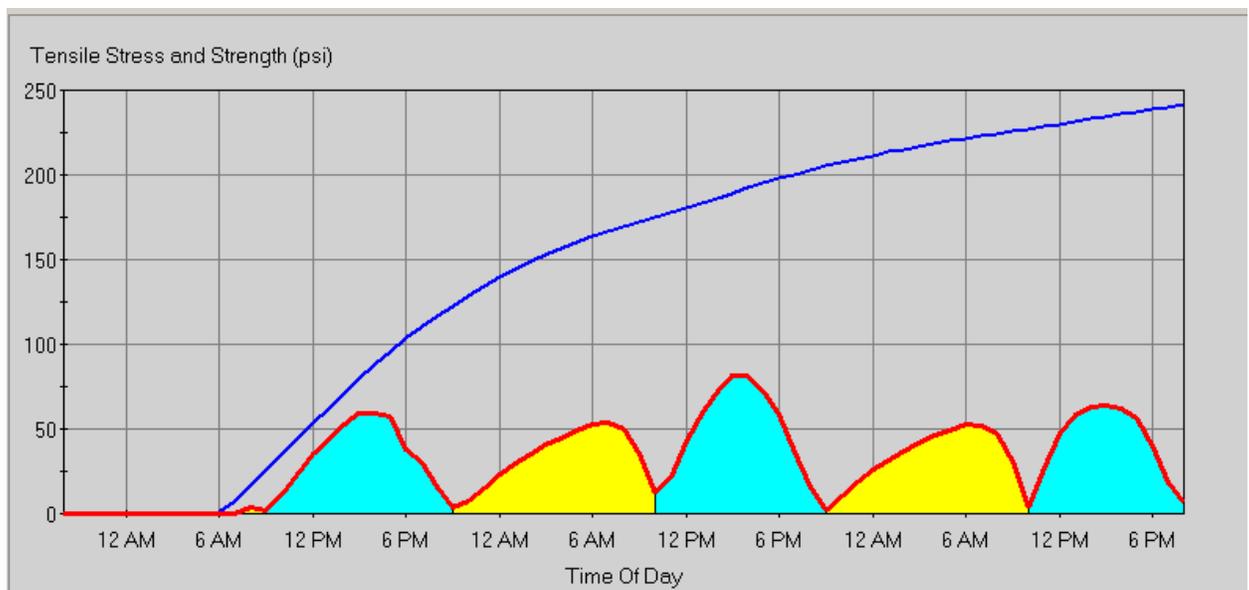
The maximum tensile stress in the pavement (blue for bottom stress) is now in the bottom of the pavement rather than the top. The concrete's strength at 12 PM to about 4 PM is much closer to causing possible cracking problems

Run additional strategies to determine early age pavement cracking will not be a concern.

This list includes some suggested additional strategies. This list does not include all possible strategies that may need to be run.

1.   Strategy   1 – After completing all inputs, including when the concrete pavement placement will start, select ◈ Construction and set sawcutting to the "no sawing" option. [This is the example performed in 1033.05]

2.   Strategy 2 – Copy strategy 1 and rename. Select ◈ Construction and set sawcutting to the option to be actually used. [Output shown in 1033.06]

3. Strategy 3 – Copy strategy 2 and rename. Select ⚡ Environment and change the "Construction time" to when the pour will be completed. Re-adjust temperature, wind, and humidity

4. Strategy 4 – Copy strategy 2 and rename. Select ◈ Construction and change "Initial Support Layer Temperature" to the lowest value expected. [When the support temperature is much different than air or concrete temperatures concrete pavement will be more likely to crack.]

5. Strategy 5 – Copy strategy 3 and rename. Select ◈ Construction and change "Initial Support Layer Temperature" to the lowest value expected. [When the support temperature is much different than air or concrete temperatures concrete pavement will be more likely to crack.]

6. Strategy 6 – Copy strategy 4 and rename. Select ▶ PCC Properties and change "compressive strength". Lower 28 day compressive strengths will mean lower early age compressive strength.

7. Strategy 7 – Copy Strategy 5 and rename. Select ▶ PCC Properties and change "compressive strength". Lower 28 day compressive strengths will mean lower early age compressive strength.

8. Additional strategies may include changing
   A. Changing temperatures
   B. Changing wind
   C. Changing curing methods

After running the strategies you have determined will influence the pour and possible early age cracking, assure that all strategies passed. Then print out the inputs and the results for each strategy run of HIPERPAV II 3.0 and provide the print out and the file to the Engineer before the actual concrete pour.

If the software predicts slab cracking will occur when using standard construction practices and early entry sawing, modify the construction practices, the selected concrete mix design, the curing or the time of paving to eliminate the predicted slab cracking.

1033.07 Required Submittal of Outputs

Provide the Engineer with a completed file with all strategies that should be run in the software. Also provide a printout of the outputs for each strategy.

Create print outs and reports for each strategy by selecting the strategy and then going under the file menu and selecting print. A report format will appear. A separate report is needed for each strategy. The Engineer may determine that just the file with all strategies can be submitted rather than the file and printouts.

Discuss with the Engineer the various strategies that were run to determine the possible variables for the pour. Upload the data file and run all strategies (or show in the output that

all strategies were acceptable). Run any additional strategies, with variable changes, that the Engineer determines is needed to assure early age cracking does not develop.