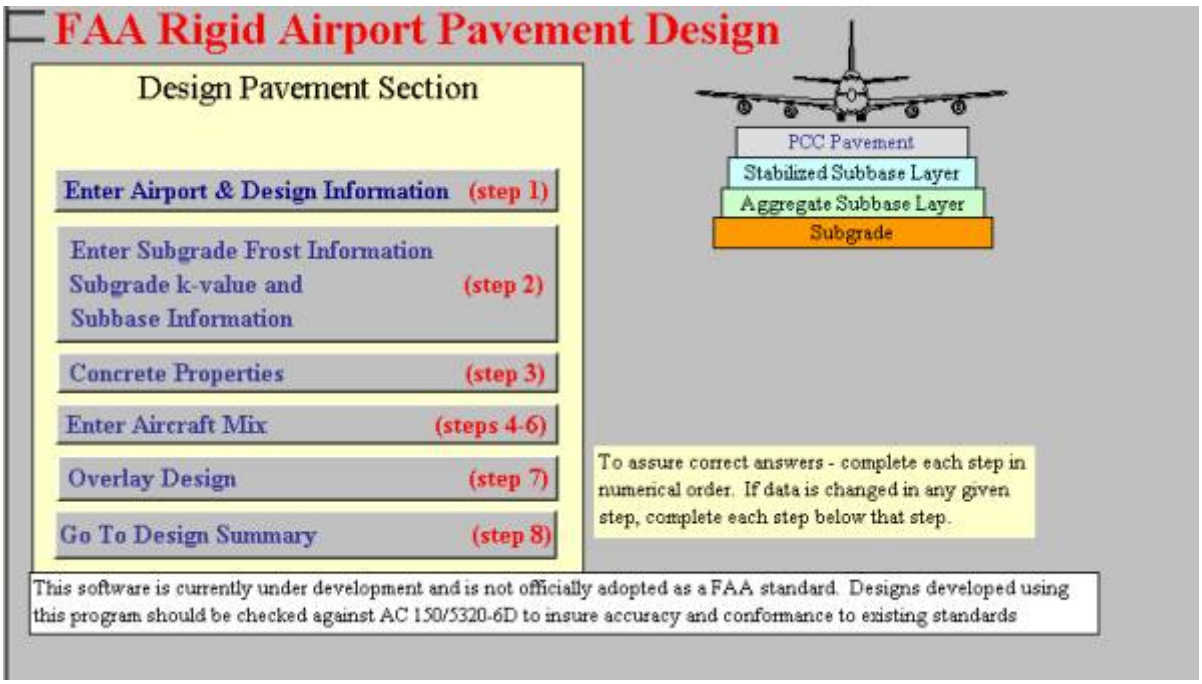
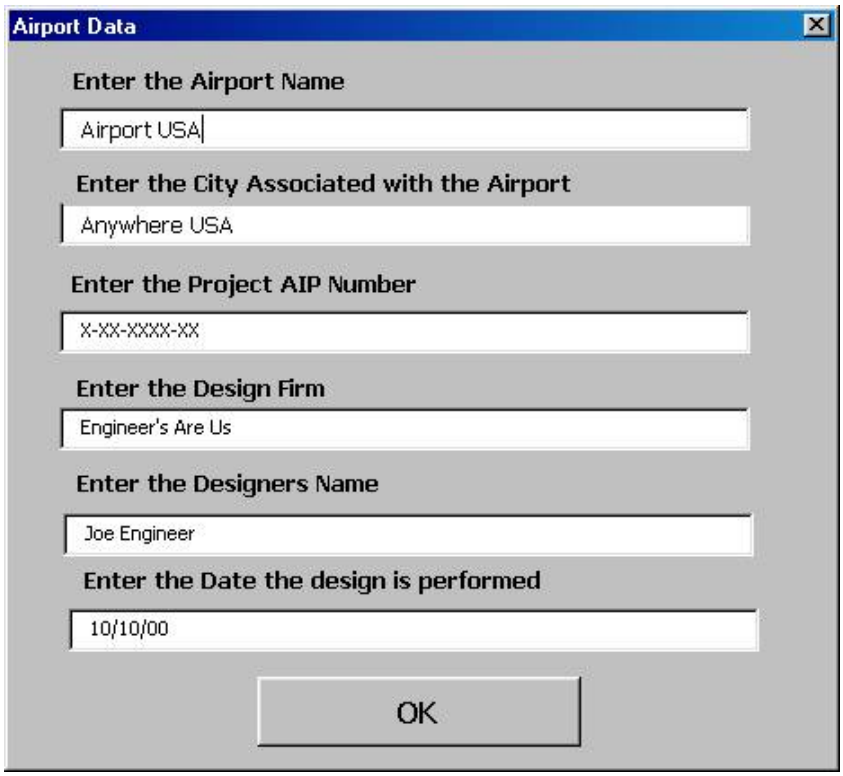
Rigid Pavement Design Spreadsheet: R805FAA.xls

This spreadsheet was designed to produce Rigid pavement design thickness' in accordance with FAA Advisory Circular AC 150/5320-6D, Airport Pavement Design and Evaluation.

The spreadsheet breaks the design process into 8 steps and is designed to prompt the user for design input parameters during each step. Users are encouraged to complete the design by following the individual steps in numerical order. Since thickness computations are based upon values gathered during each step, completion of the steps in numerical order assures that the proper values are assigned for the respective variables. Once all steps have been completed, the user may go back and modify the input values of any step, then skip directly to step 8 to see the results of the variable change.



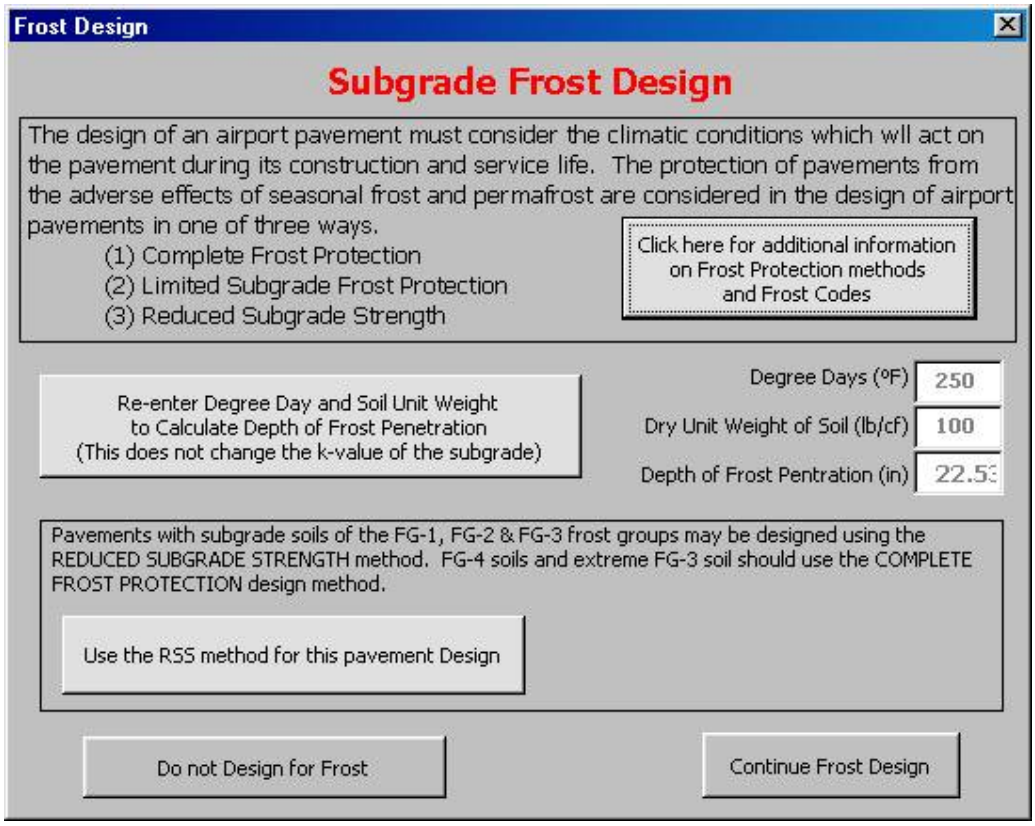
STEP 1. General Airport/Project Information - Displayed with Output



Provides general project data which is displayed with the design summary.

This information is optional and does not affect numerical calculations.

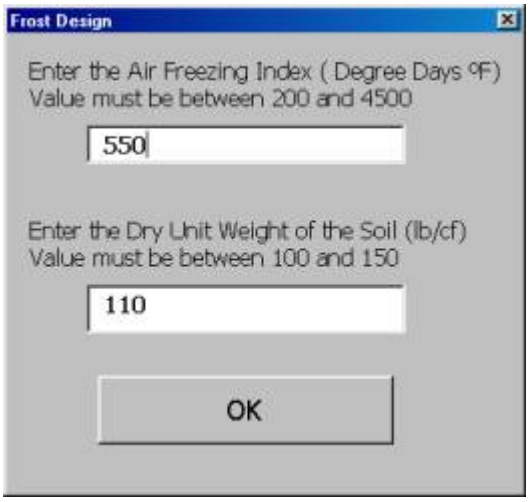
STEP 2. Subgrade Support Information



The user must determine what level of frost protection will be provided to the pavement section. The spreadsheet can determine the required thickness for the non-frost condition and the Reduced Subgrade Support conditions. If the user elects to use the RSS method they should click the button labeled "Use the RSS method for this pavement Design". The program will over-ride the input values for subgrade modulus (k-values) with predetermined values in accordance with the following table

Frost Code	Reduced Subgrade k-value
F-1	50
F-2	35
F-3	25
F-4	Not Applicable

These values represent a weakened subgrade during the frost thaw period. Note that the RSS method is no longer applicable when F-4 Frost code soils are encountered. When F-4 soils are involved, the user must protect against frost weakening by improving the subgrade materials within the anticipated frost depth.



Frost depth information is in tabular form as provided by the Corp of Engineers in 1986. Frost depth values are simple interpolations of the tabular data.

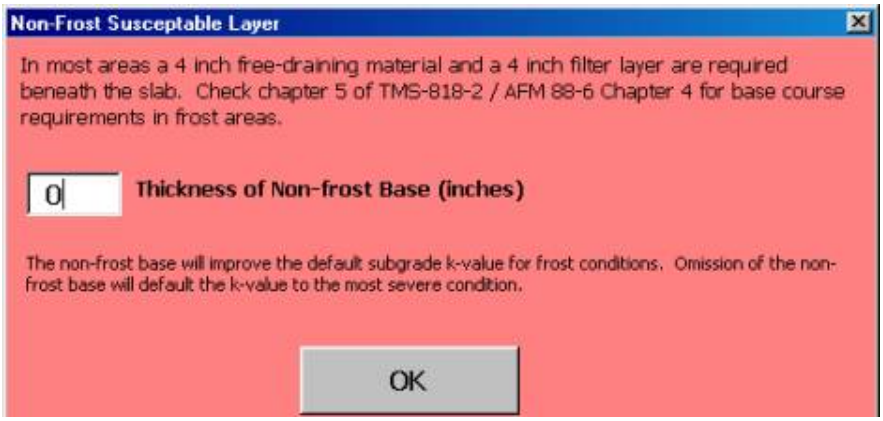
Frost Penetration (Inches)

	Soil Unit Weight lb/cf			
Degree Days	**100**	**115**	**125**	**150**
200	20.5	21.5	23.8	25.5
400	27.5	30.5	35	38.5
600	34	38	44.5	49
800	40	44.5	54	59
1000	45	51	62	69
2000	69.5	79	102	113
3000	92	105	140	156
4000	115	130	177	205
4500	125	145	197	225

If Complete Subgrade Protection or Limited Subgrade Protection are desired, the user may enter the Degree-Days and Soil Unit Weight to determine the depth of frost penetration. This information does not affect the thickness calculations.

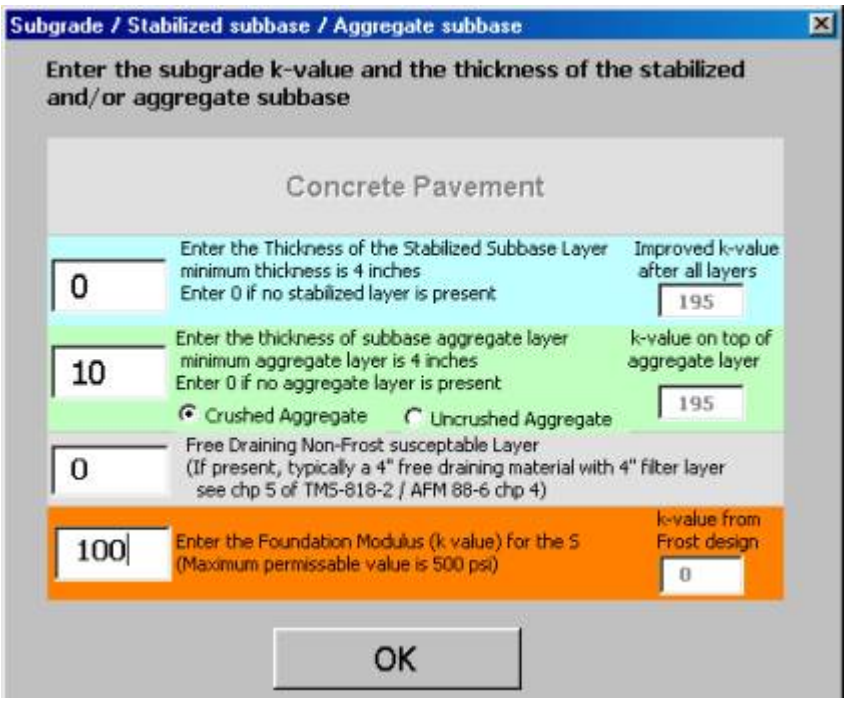
The final pavement section should be checked against the required depth for complete frost protection. If additional thickness is required, it should be constructed of non-frost susceptible material.

When the user elects to design the pavement based upon the Reduced Subgrade Support (RSS) method they will be asked for a thickness of a free draining material beneath the slab. This layer is not discussed in AC 150/5320-6D but is recommended for design in Chapter 5 of TMS-818-2 / AFM 88-6 "Pavement Design for Seasonal Frost Conditions." If the designer elects to include this layer, it will improve the subgrade k-value above the default frost values. If the pavement section requires a stabilized base layer the free draining material should be below the bound layer. The free draining material should never be "sandwiched" between relatively impervious bound layers.



The user then selects the subgrade soil frost code. The frost code determines the minimum subgrade support value as shown above and as detailed in Table 3-1 of AC 150/5320-6D.

Since the use of the Reduced Subgrade Support method is no longer permitted with F-4 soils, the spreadsheet will not allow RSS for F-4 soils. If the user wishes to verify previous designs, then may do so by designing a non-frost section with a manually reduced subgrade support value.

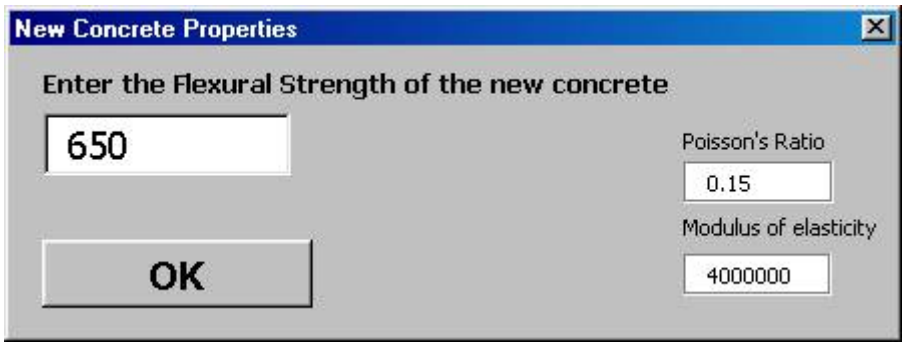


To complete the subgrade data input, the user should enter the subgrade k value and the thickness of all stabilized and non-stabilized layers. The improved k-value will appear at the thickness of each layer is entered. If the design uses the RSS method for frost design, the k-value will default to the k-value determined by the soil frost code.

The user must also input the thickness of any subbase layers. The thickness of un-bound aggregate or stabilized layers must be determined by the user. Minimum thickness requirements are provided in AC 150/5320-6D, paragraphs 326 and 327. Other factors such as constructability may determine the minimum subbase requirements.

STEP 3. Concrete Properties

The user should enter the Flexural Strength of the new concrete. The Poisson's Ratio and Modulus of Elasticity may also be modified in the spreadsheet, however the default values are recommended and represent the values assumed in AC 150/5320-6D. Thickness designs performed with modified values for Poisson's Ration or Modulus of elasticity will not be consistent with the requirements of AC 150/5320-6D.

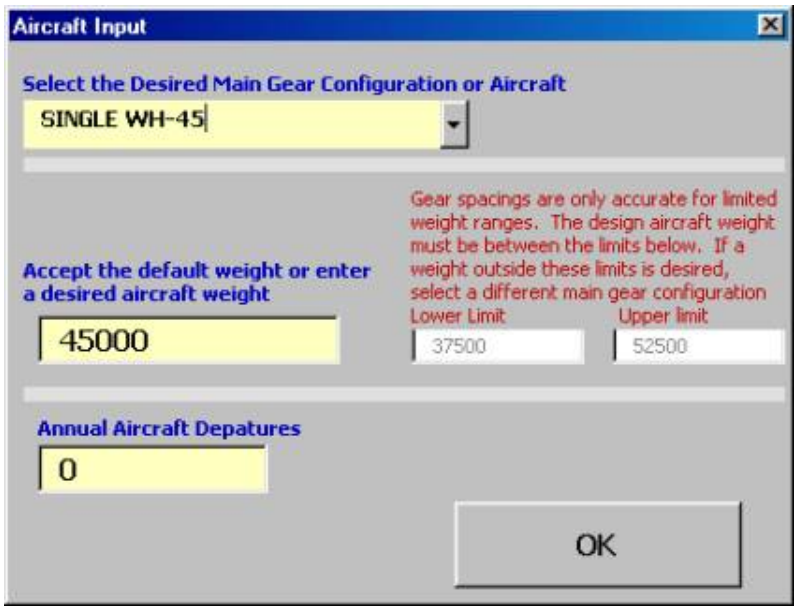


There is considerable debate regarding the age of the concrete in relationship to the flexural strength. Previous guidance had recommended that a 90 day flexural strength be specified for design purposes. Current guidance recommends that the design flexural strength of the concrete be based upon the age and strength the concrete will be required to have when it is scheduled to be opened to traffic.

STEP 4. Enter Aircraft Data

The user can enter up to 21 aircraft in the traffic mix. The aircraft selection is limited to those aircraft originally listed in the R806faa.exe program. Any combination of aircraft may be selected and aircraft types may be repeated.

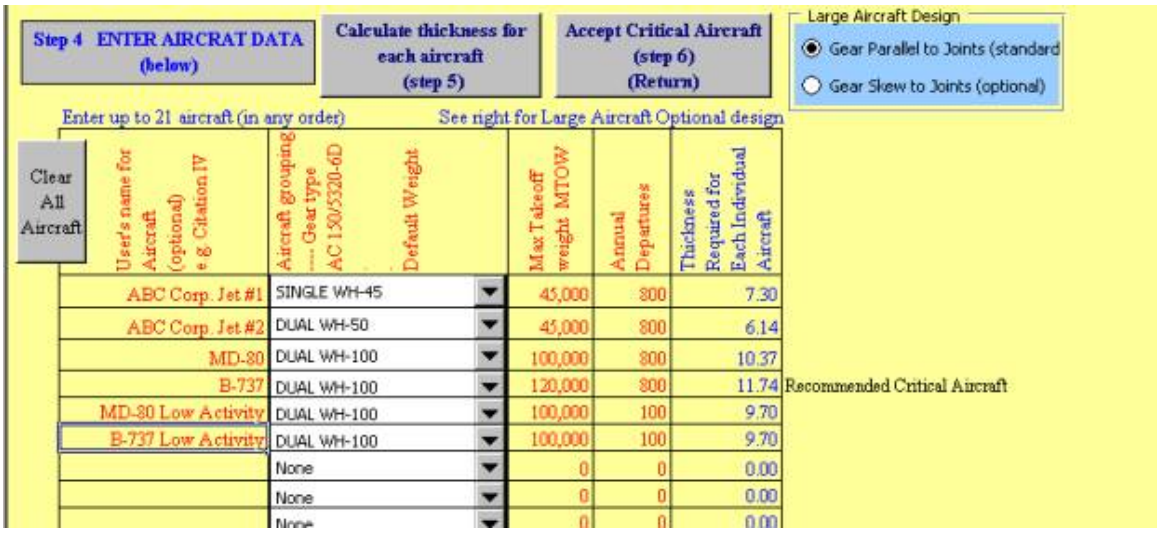
The user may also select whether to use the optional design method discussed in AC 150/5320-6D, paragraph 332b, which considers aircraft gear skewed relative to the concrete joints.



The program will prompt the user for aircraft weight and annual operations. Since each gear type is based upon a reasonable anticipated weight for the gear configuration, the program will limit the permissible weight range. If desired, the user may over-write these values directly in the spreadsheet. The user is cautioned to observe the weight limitations and select gear configurations appropriately. Greater thickness requirements will result from overloading a small gear versus under loading a larger gear. For example, a dual wheel aircraft weighing 125,000 pounds could be input as a DUAL100 or a DUAL150 aircraft.

The user can assign a local name to an aircraft for ease of identification. Local names can be entered directly into the spreadsheet. This is particularly useful when numerous aircraft are from a common gear configuration but vary in weight.

STEP 5. Calculate Thickness for Each Aircraft



Step 5 calculates and displays the required pavement thickness for each aircraft in the mixture and determines the most demanding (critical) aircraft.

This step is provided for the user's information and may be skipped as it is repeated by step 6.

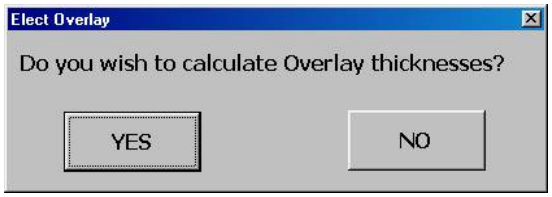
This step is particularly useful when analyzing the impact of one design variable. Suppose the user wants to see the impact of increasing weight while keeping annual departures constant. By entering the same aircraft multiple times and varying the weight, the user can immediately see the change in thickness required for each change in weight. Likewise, any variable can be changed while holding other variables constant.

STEP 6. Accept Critical Aircraft (Return)

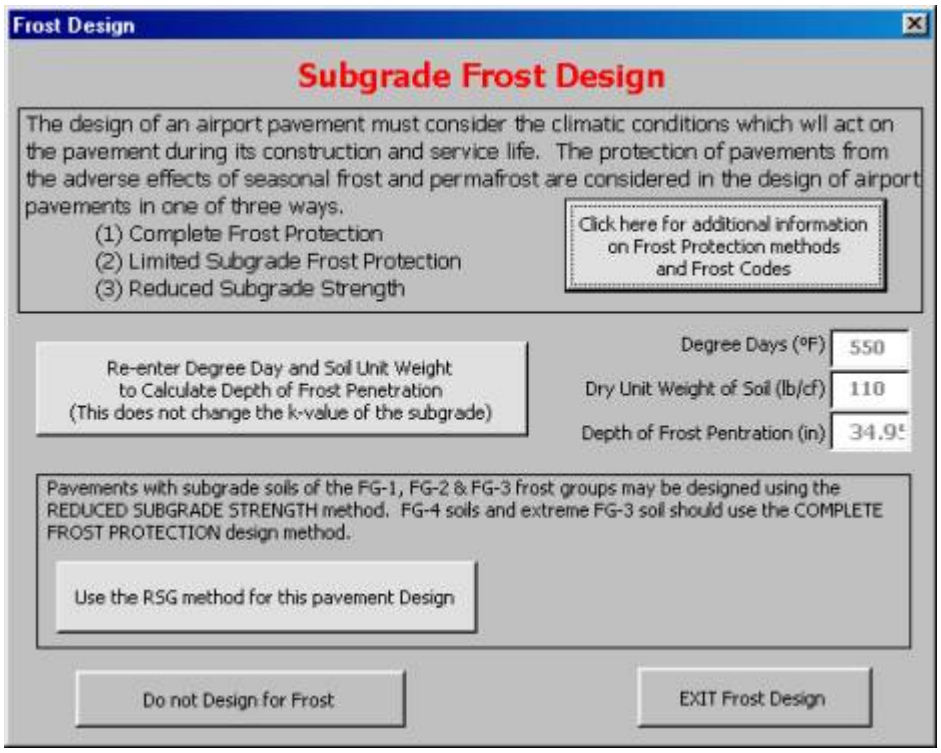
This step repeats step 5 and accepts the aircraft data entered. The user is returned to the initial program entry screen.

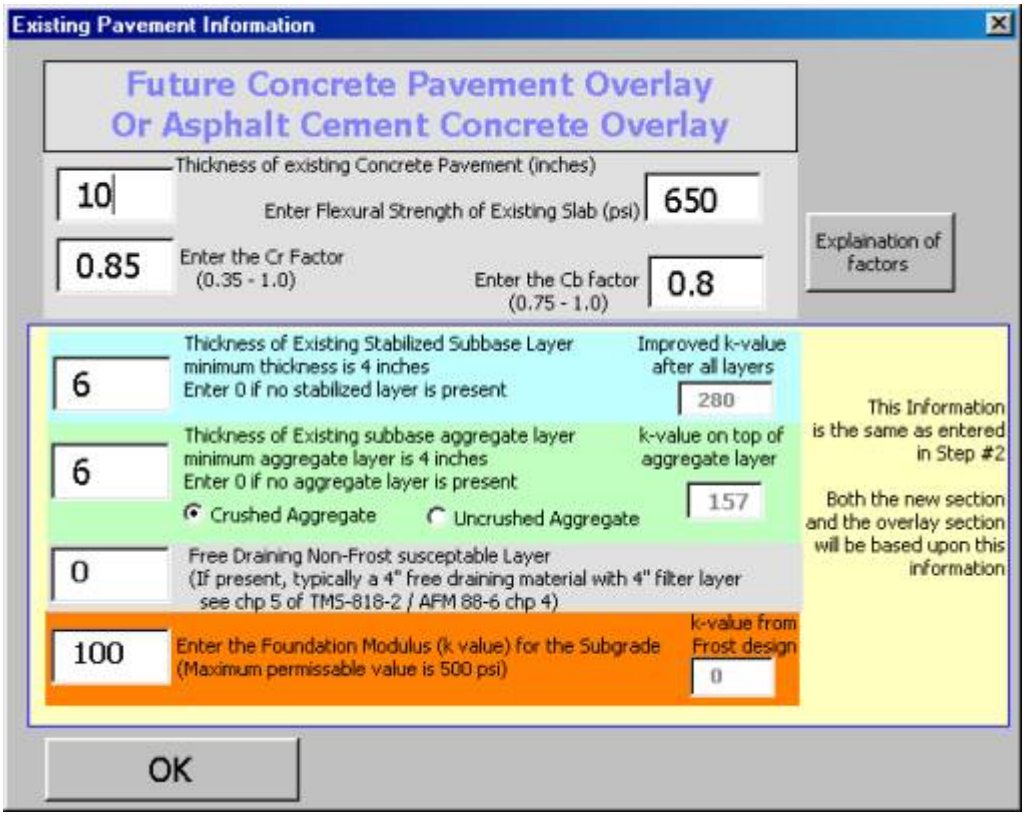
STEP 7. Overlay Design

The user is asked if they wish to calculate overlay thickness. If the user answers no, the data in the overlay section of the summary page will be eliminated. The program defaults to this conditions to avoid erroneous overlay design. It the users answers yes, the program will prompt the user for subgrade information.



The subgrade Frost design will re-appear and should be answered as appropriate.





Much of the information presented in Step #2 is repeated for the users to view and/or modify as appropriate. In addition to the subgrade information, the user is prompted for information regarding the properties and condition of the existing pavement.

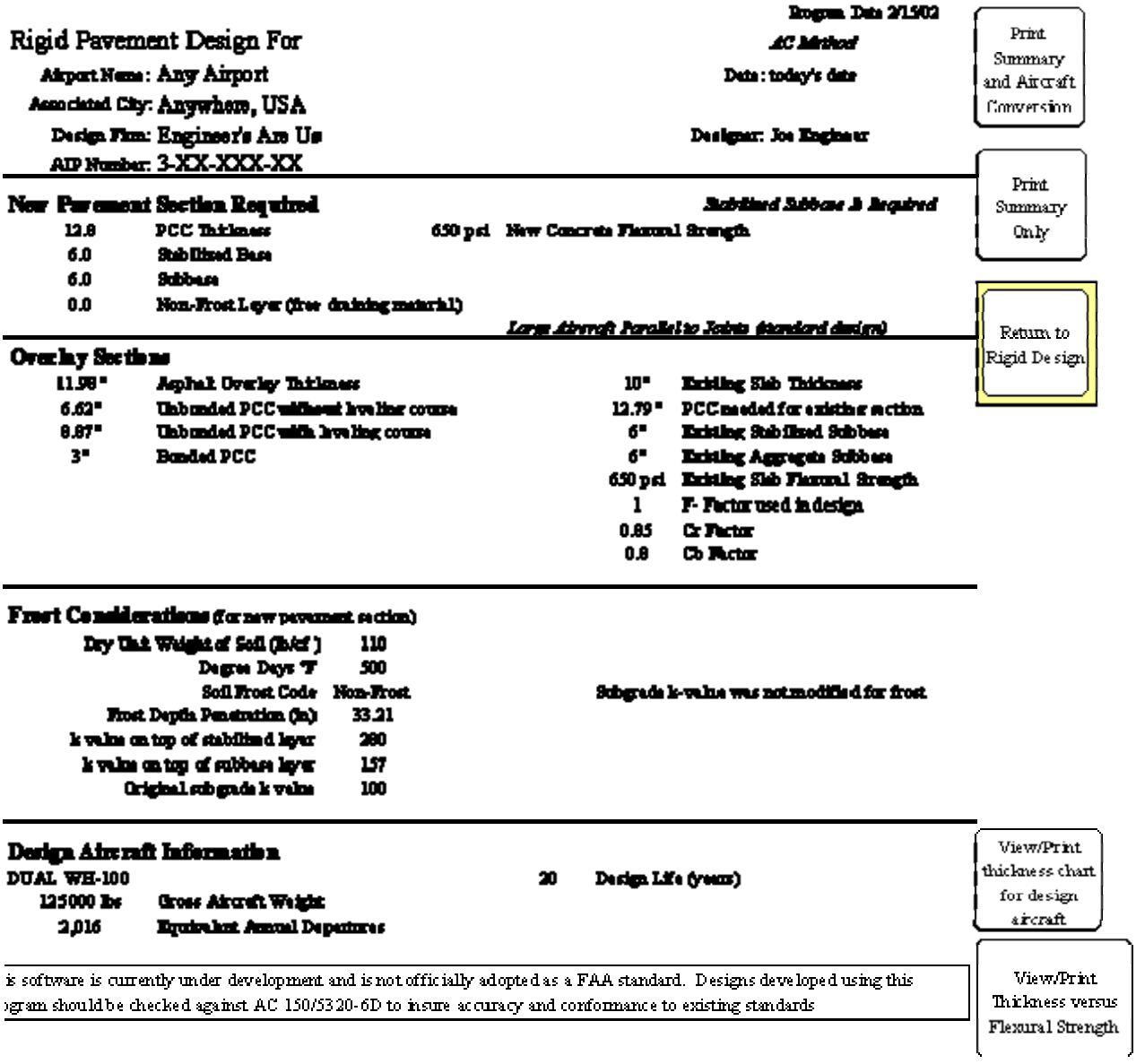
STEP 8. Go To Design Summary

Step 8 takes the user to the summary sheet

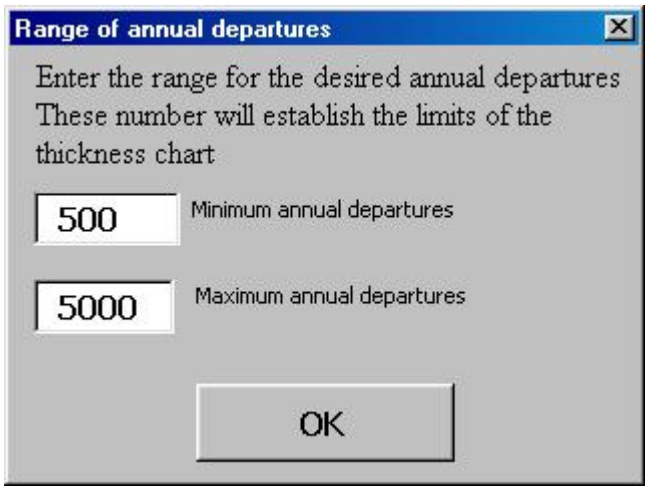
All information regarding the design is displayed on the summary sheet.
The summary display is dynamic and will change depending upon design features. e.g. if a stabilized base is required, a note will appear on the summary sheet to indicate the requirement.

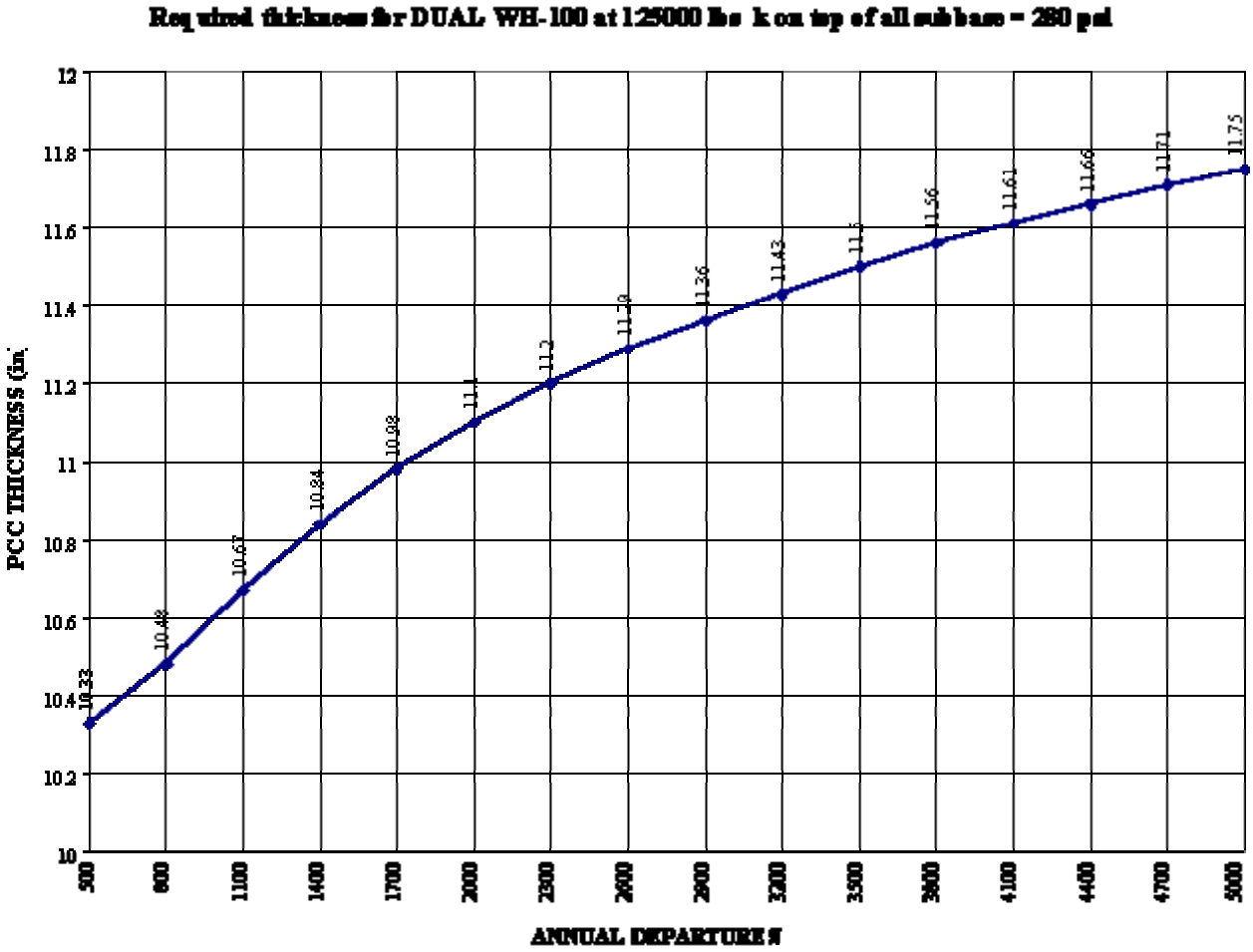
From the summary sheet, the user is permitted to print the summary and/or the aircraft mix.

The user may also elect to view a plot of annual departures versus required total thickness or a plot of flexural strength versus required total thickness for the design aircraft. These plots provide an indication of how sensitive the design is to changes in concrete flexural strength or annual departures.



To prepare the thickness chart for the design aircraft the program will prompt the user for the minimum and maximum number of annual departures. These values will determine the limits of the thickness chart.





To prepare the thickness versus flexural strength chart the program will prompt the user for the range of flexural strength These values will determine the limits of the chart.