ICAO AERODROME PAVEMENT WORKSHOP

Design Examples Using FAARFIELD 2.1

Presented to: ICAO Aerodrome Pavement Workshop
Dakar, Senegal

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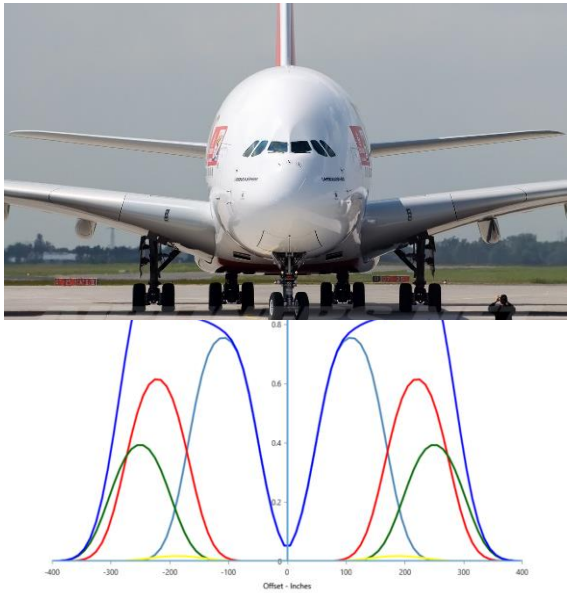
Date: 24 October 2024

Federal Aviation Administration



FAARFIELD 2.1

Flexible Pavement Design Example

Flexible Pavement Design Example

A flexible pavement is being designed for a new runway at a commercial airport in Washington, D.C. Based on the information obtained from the Airport Master Plan, the new runway is expected to handle the traffic mix presented in Table 1. Eight soil borings were performed for this project, the results of which are presented in Table 2.

Table 1. Aircraft traffic mix for flexible pavement design example.

Aircraft	Departure Weight, kg	Arrival Weight, kg	Annual Departures
S-30	13,608	10,206	8000
Fokker F-100	44,452	34,019	6500
B737-300	62,822	52,163	5000
B767-300 ER	158,757	131,541	3200
A380-800	544,310	462,664	400
B777-300	263,083	237,682	1500

Table 2. Soil boring results for flexible pavement design example.

Boring No.	UCSC Soil Type	Moisture Content, %	Optimal MC, %	Dry unit weight, kN/m^3	Water Table Depth, m	CBR, %
B-1	SC	12.2	10.4	20.26	3	10.6
B-2	SC	14.4	12.2	19.57	3	7.2
B-3	SC	16.5	9.6	20.80	2.5	8.4
B-4	CL	15.8	13.5	18.88	2.0	6.3
B-5	CL	17.0	14.5	19.24	2.4	4.8
B-6	CL	16.2	13.8	18.96	1.7	5.9
B-7	CL	16.8	12.6	19.48	1.4	4.2
B-8	CL	14.2	12.8	20.14	1.8	6.4
Average:						
Std. Deviation:						

Flexible Pavement Design Example

1. **What do the soil boring results tell us about the in situ soil properties? What subgrade support value do you recommend for design?**
2. **What type and thickness of base/subbase materials do you recommend? Are positive drainage features required?**
3. **Should the pavement be designed for aircraft arrival or departure weights? What is the required flexible pavement thickness for the runway? What is the most demanding aircraft?**
4. **Perform a sensitivity analysis on the following variables:**
   - Average annual departures of most demanding aircraft (+/- 10 percent of departures).
   - Departure weight of the most demanding aircraft (+/- 10 percent of weight).
   - Subgrade modulus (+/- 10 percent of modulus).

Flexible Pavement Design Example

1. **What do the soil boring results tell us about the in-situ soil properties? What subgrade support value do you recommend for design?**
2. **What type and thickness of base/subbase materials do you recommend? Are positive drainage features required?**
3. **Should the pavement be designed for aircraft arrival or departure weights? What is the required flexible pavement thickness for the runway? What is the most demanding aircraft?**

Boring No.	UCSC Soil Type	Moisture Content, %	Optimal MC, %	Dry unit weight, kN/m^3	Water Table Depth, m	CBR, %
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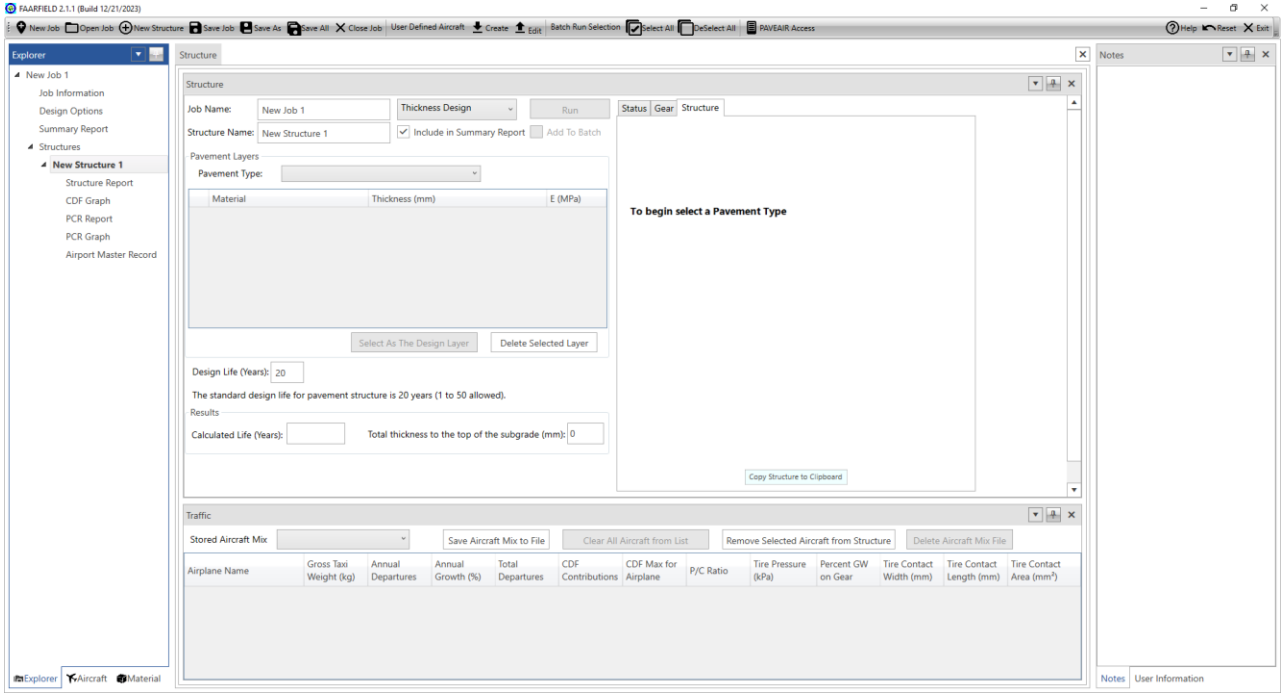
B-7	CL	16.8	12.6	19.48	1.4	4.2
B-8	CL	14.2	12.8	20.14	1.8	6.4
Average:		**15.4**	**12.4**	**19.66**	**2.3**	**6.7**
Std. Deviation:		**1.7**	**1.7**	**0.68**	**0.6**	**2.0**

Starting Screen – No Job Files Created

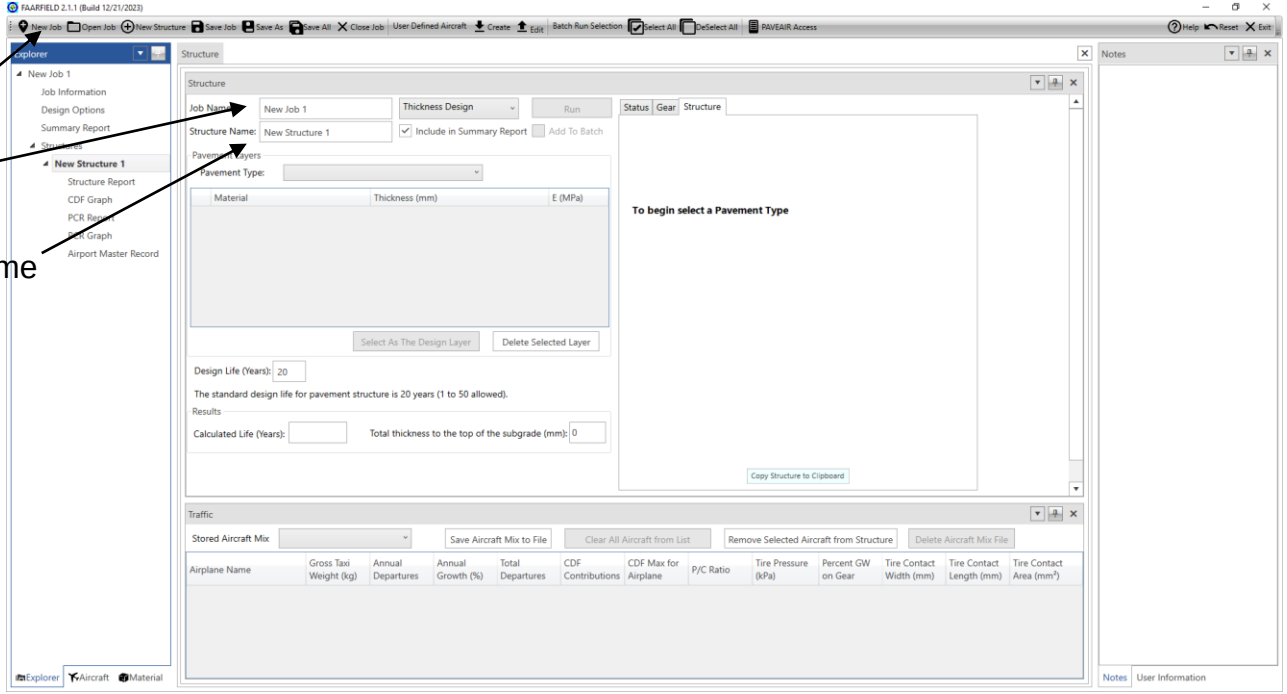


Creating/Naming a Job File

Click “New Job”

Enter Job Name

Enter Section Name



Selecting Structure

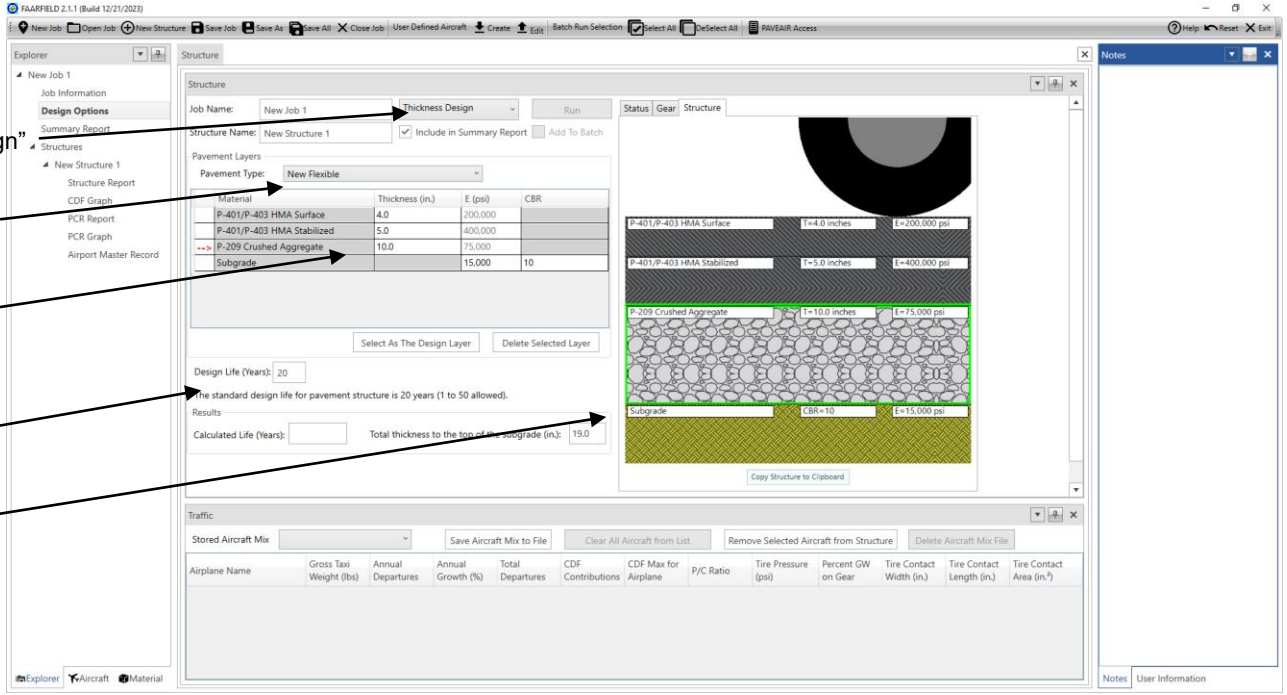
Select “Thickness Design”

Select Pavement Type as “New Flexible”

Default pavement structure details in table

Default pavement Design Life

Default pavement structure for “New Flexible”



Design Options

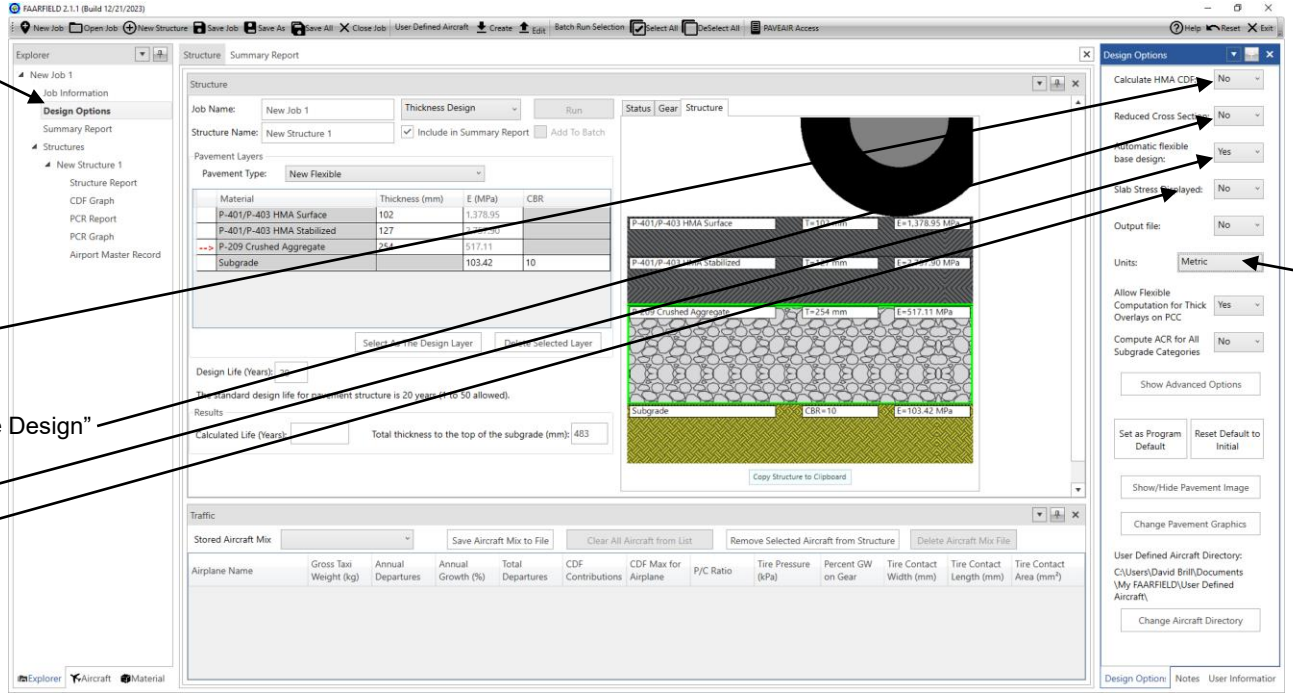
Click “Design Options”

Select Option for “HMA CDF”

“Automatic Flexible Base Design”

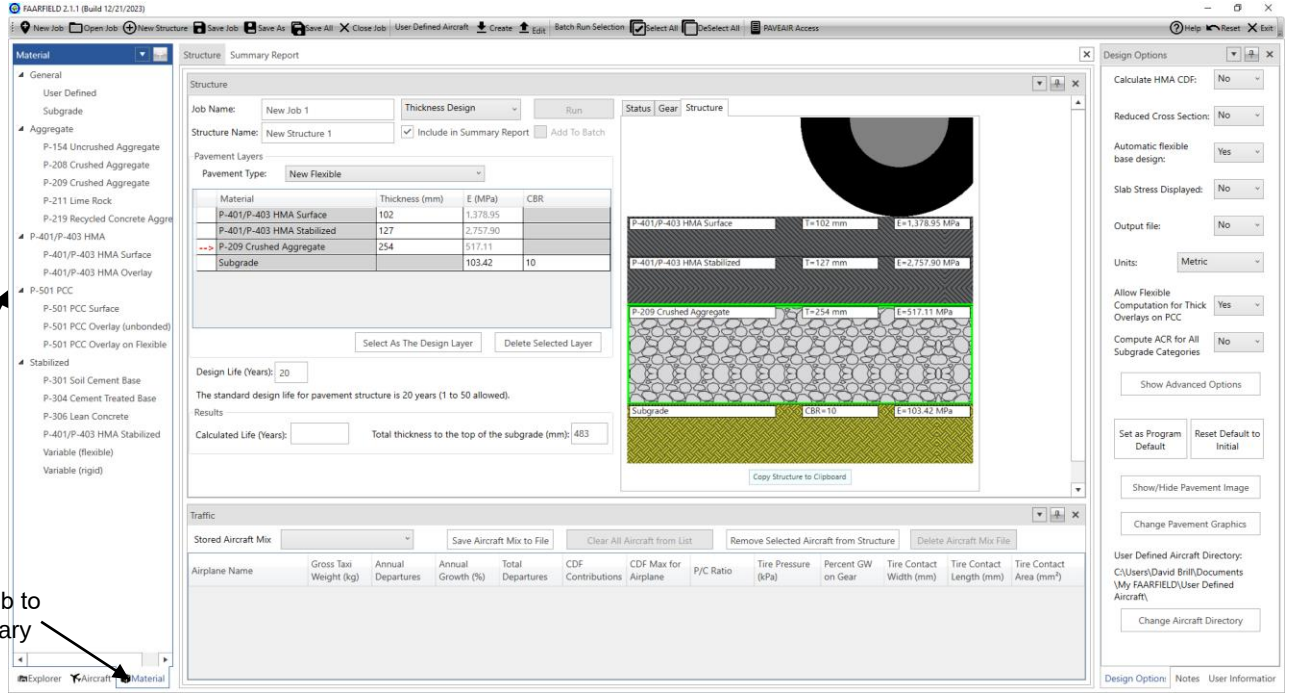
“Output File”

“Units”



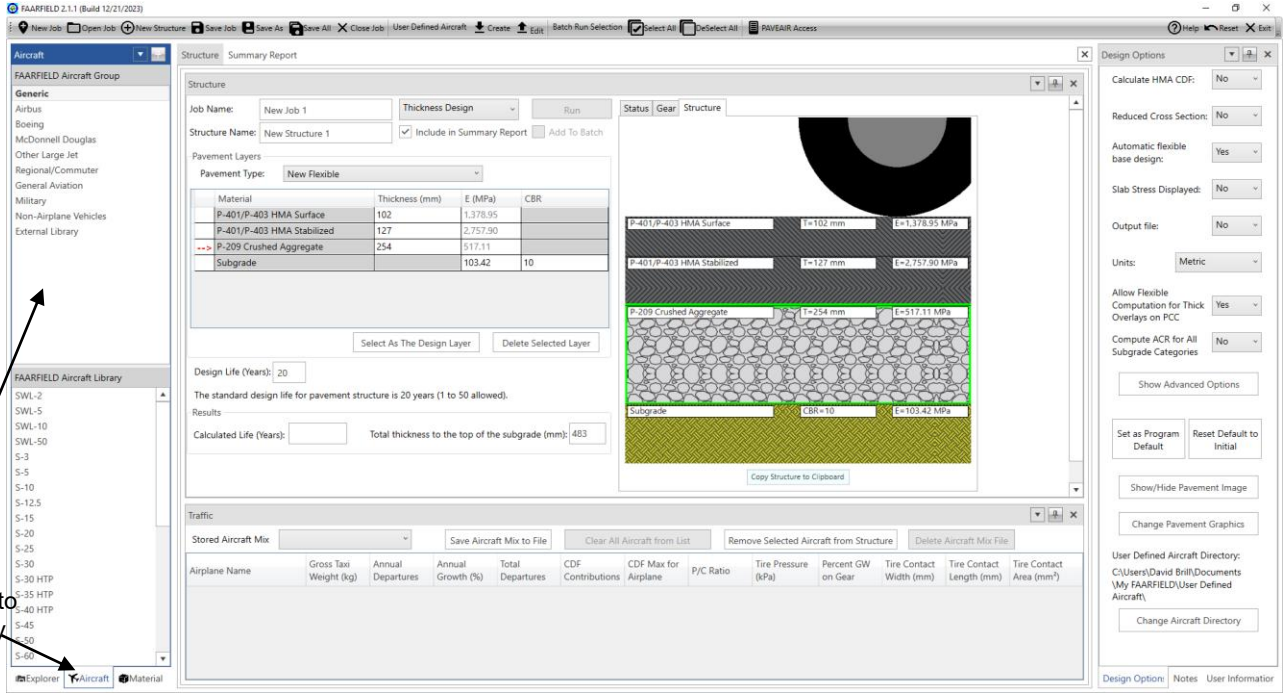
Set Units to “Metric”

Materials Library – Layer Types



Click “Materials” tab to open materials library

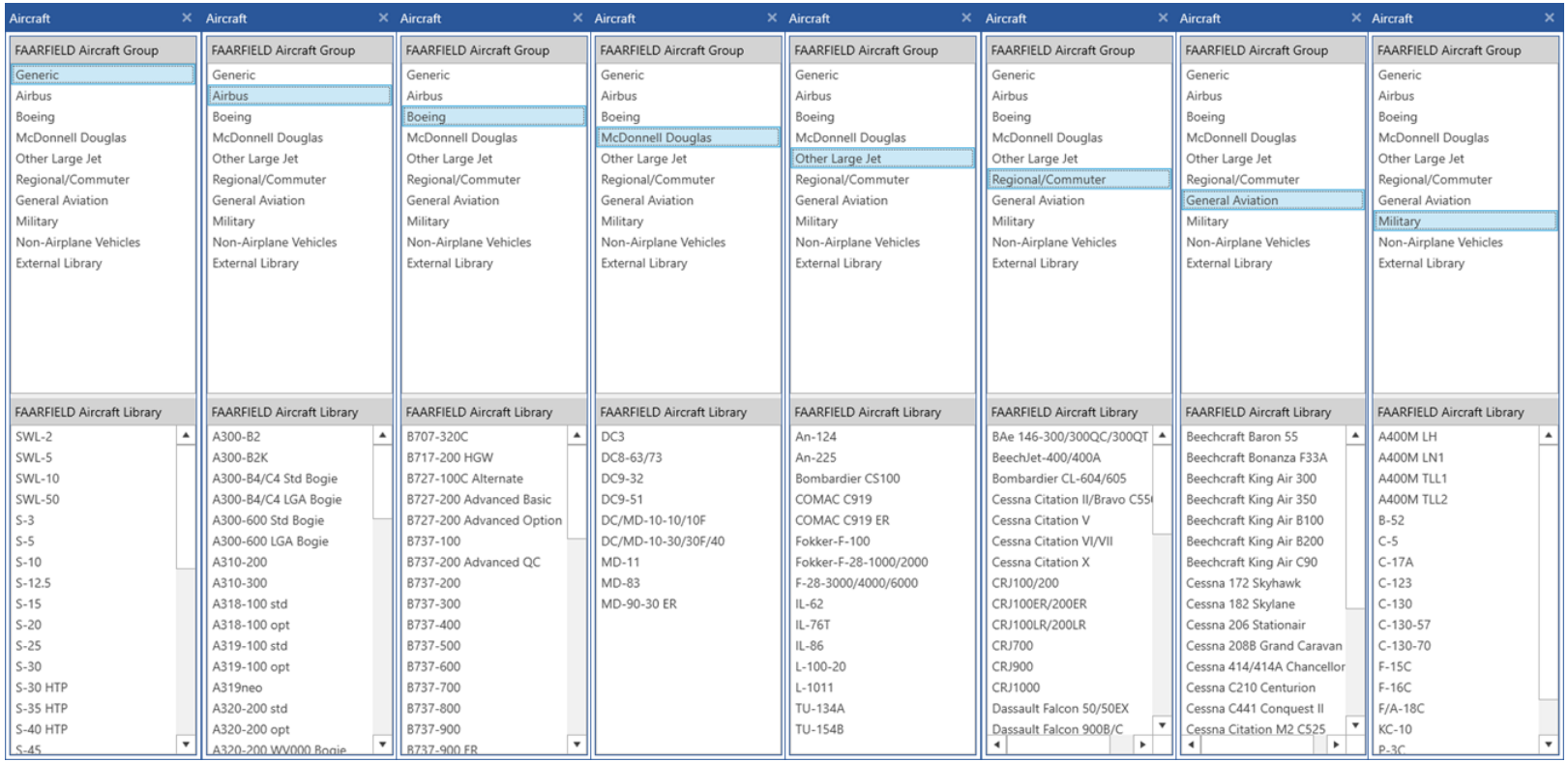
Aircraft Library



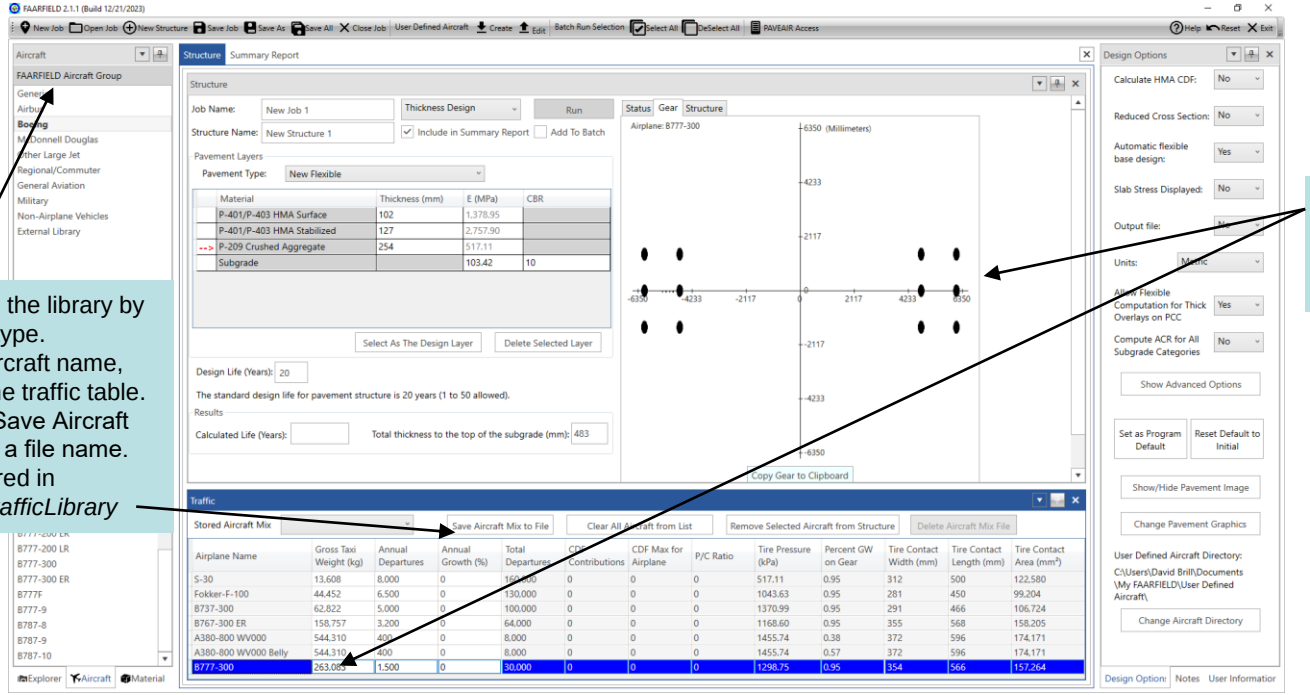
Click “Aircraft” tab to open aircraft library

Aircraft Library –

Completely reorganized and updated for the FAARFIELD 2.0 release



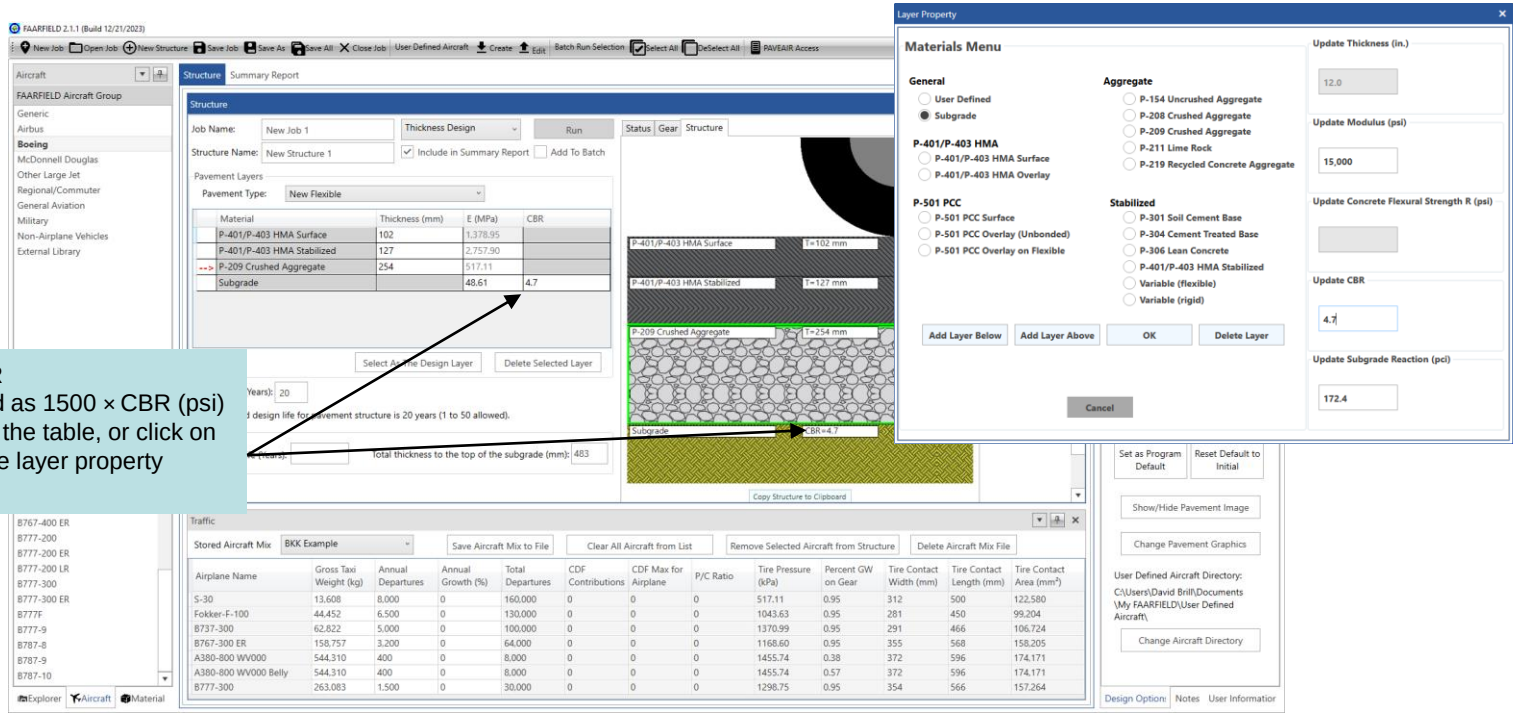
Creating Aircraft Traffic Mix



- Select aircraft from the library by aircraft group and type.
- Double-click the aircraft name, or drag/drop into the traffic table.
- Once done, click “Save Aircraft Mix to File.” Give it a file name.
- Traffic files are stored in *My FAARFIELD/TrafficLibrary*

Highlight an aircraft to display gear geometry. (Gear geometry displays in window.)

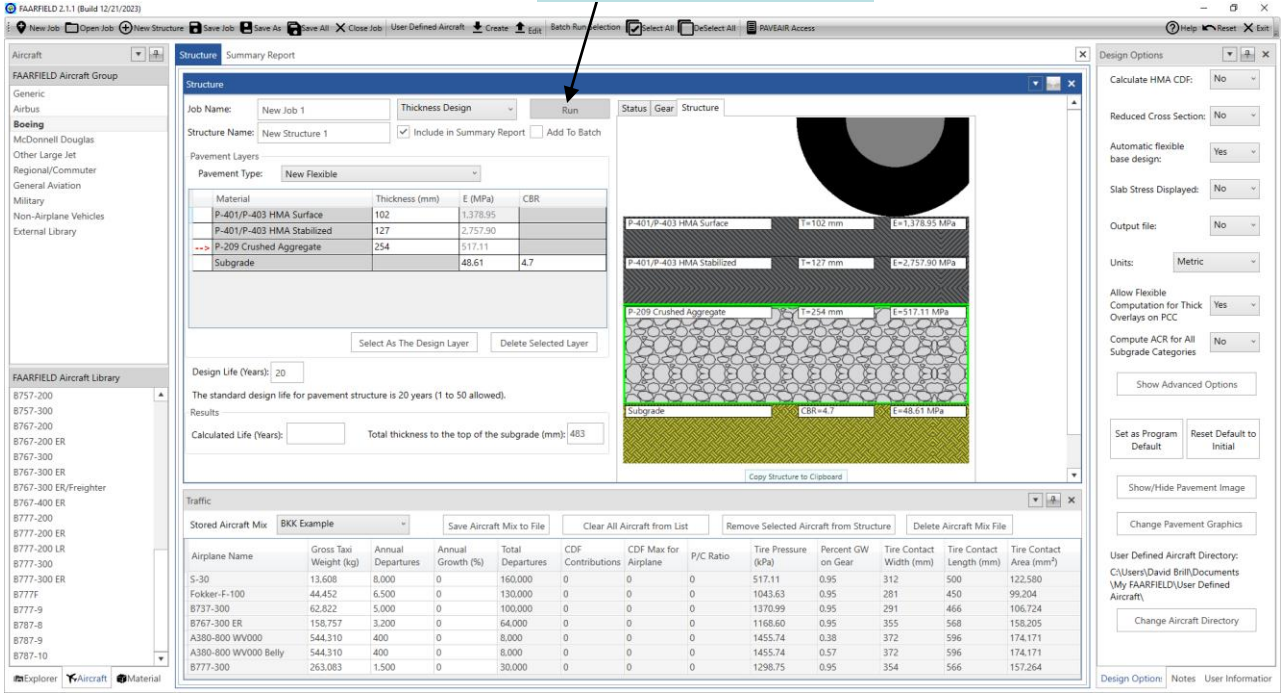
Subgrade CBR



- Enter Subgrade CBR
- Modulus is computed as 1500 × CBR (psi)
- Enter data directly in the table, or click on a layer to bring up the layer property dialog box.

Performing Pavement Thickness Design

Click “Run” to start pavement thickness design



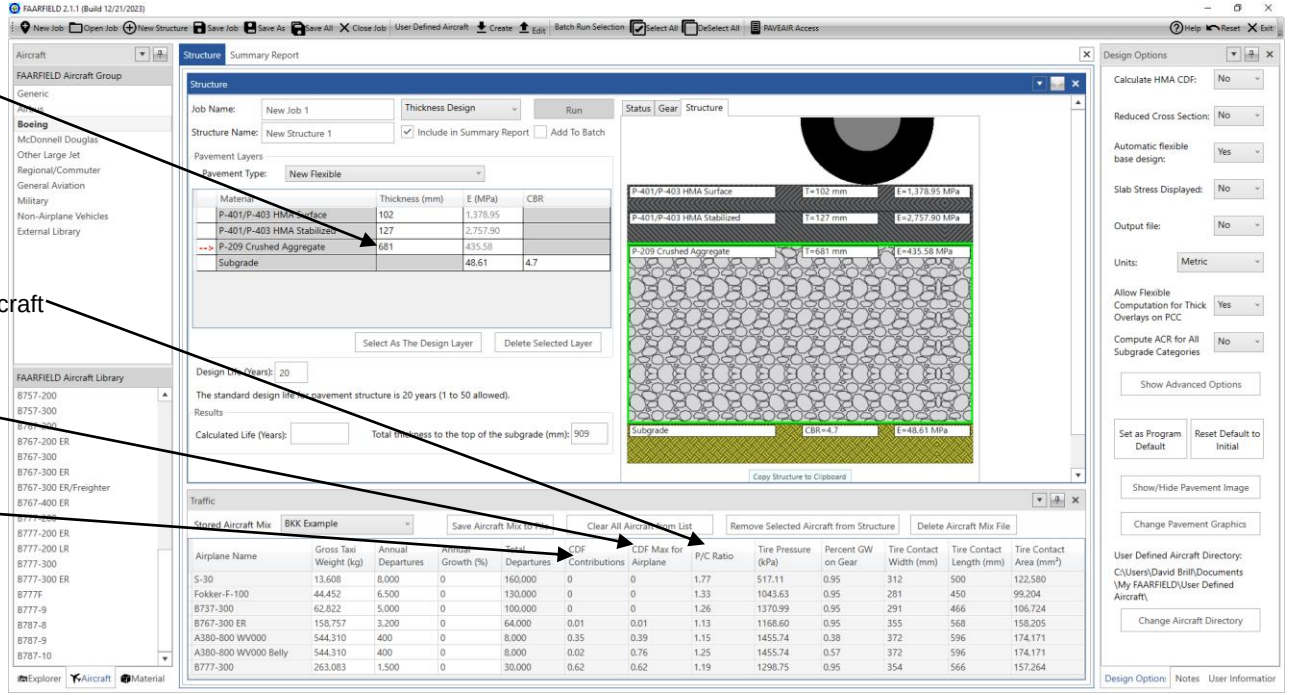
Completed Pavement Thickness Design

P-209 Thickness was designed

P/C Ratio for each aircraft

CDF max. for aircraft

CDF contribution of each aircraft



CDF Chart

Job Name: New Job 1

Structure: New Structure 1

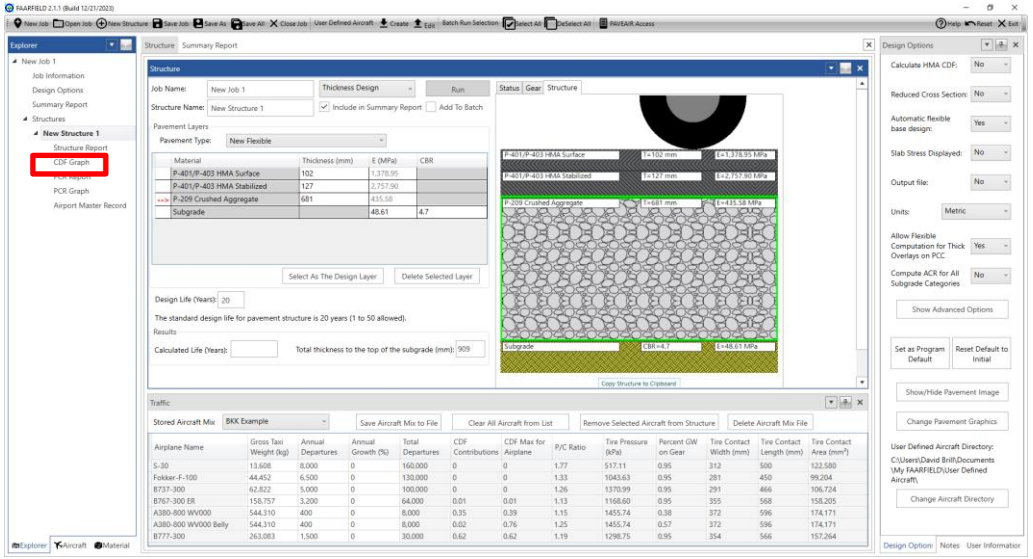
Analysis Type: New Flexible

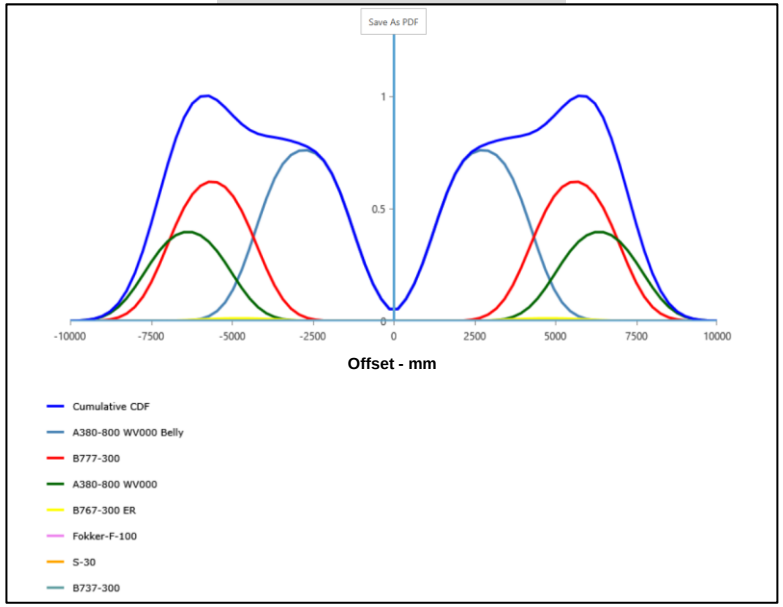
Analysis Run Time: 2024-01-30 09:15:41

Last Run: Thickness Design

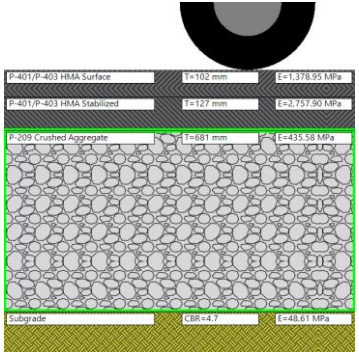
Design Life = 20.0 Years

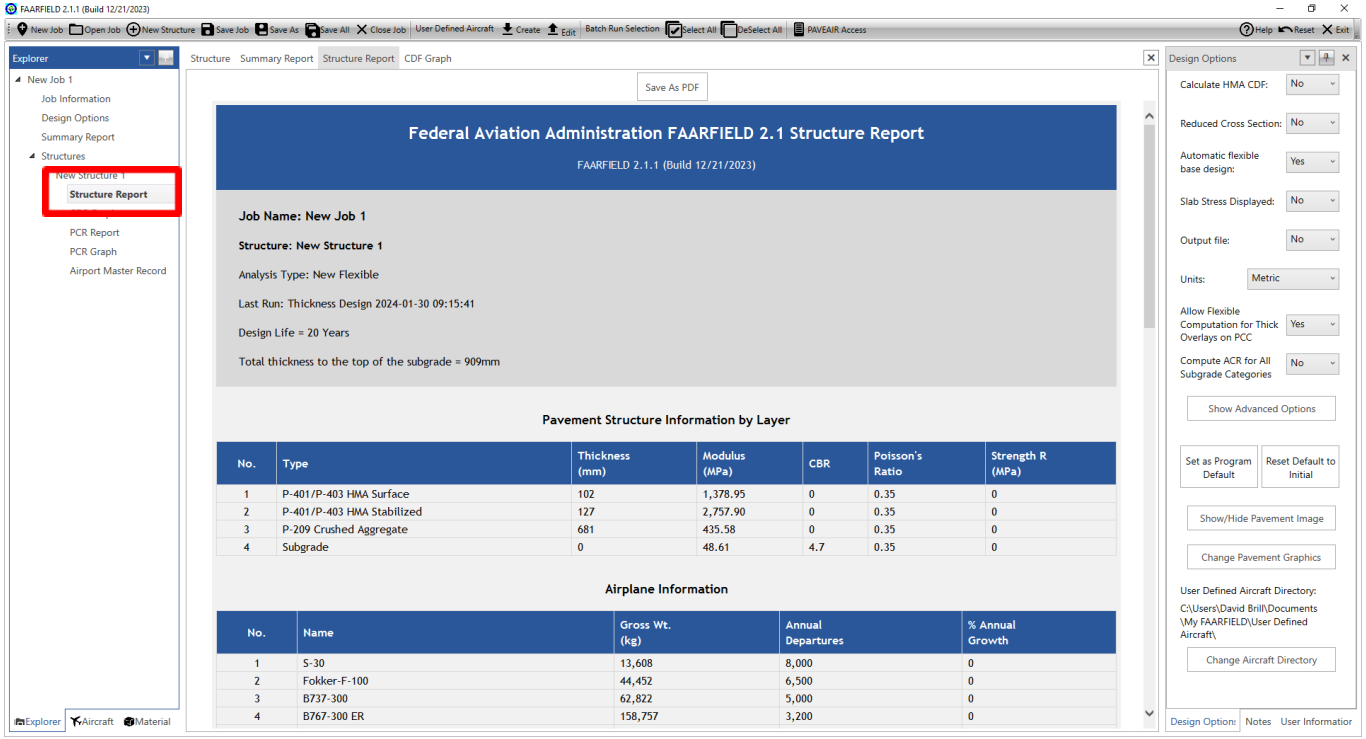
Total thickness to the top of the subgrade = 909mm



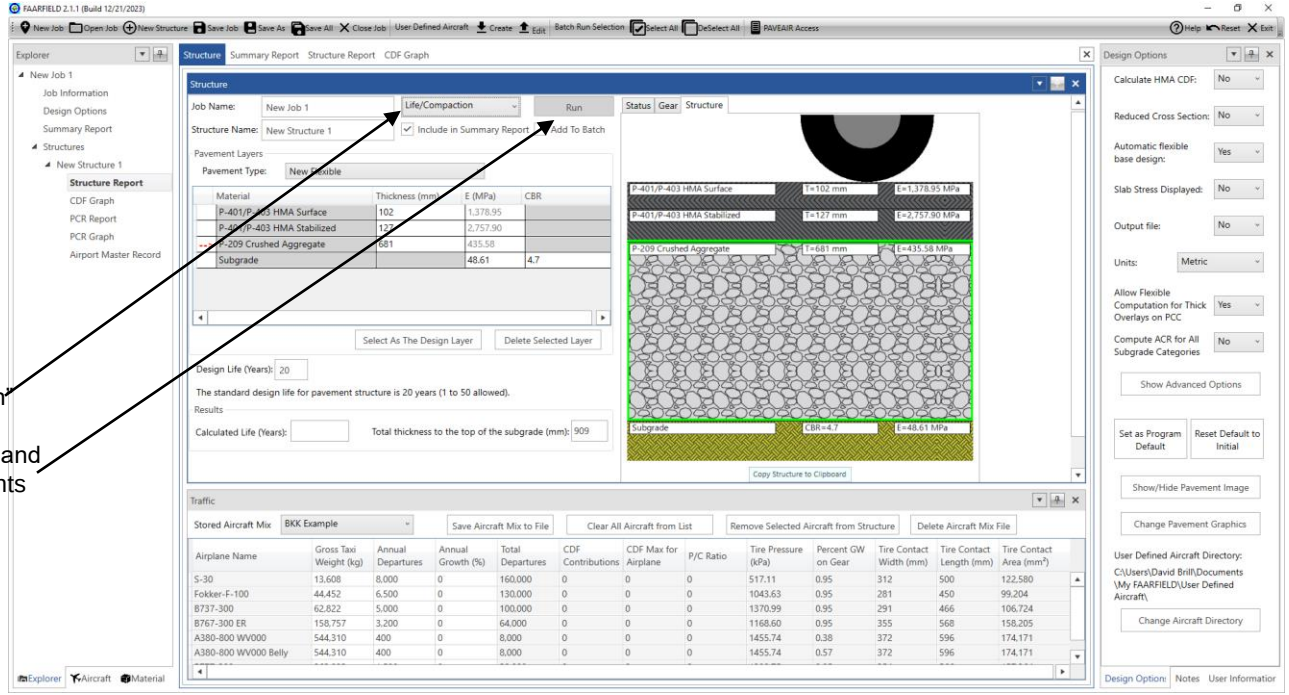


Structure Report





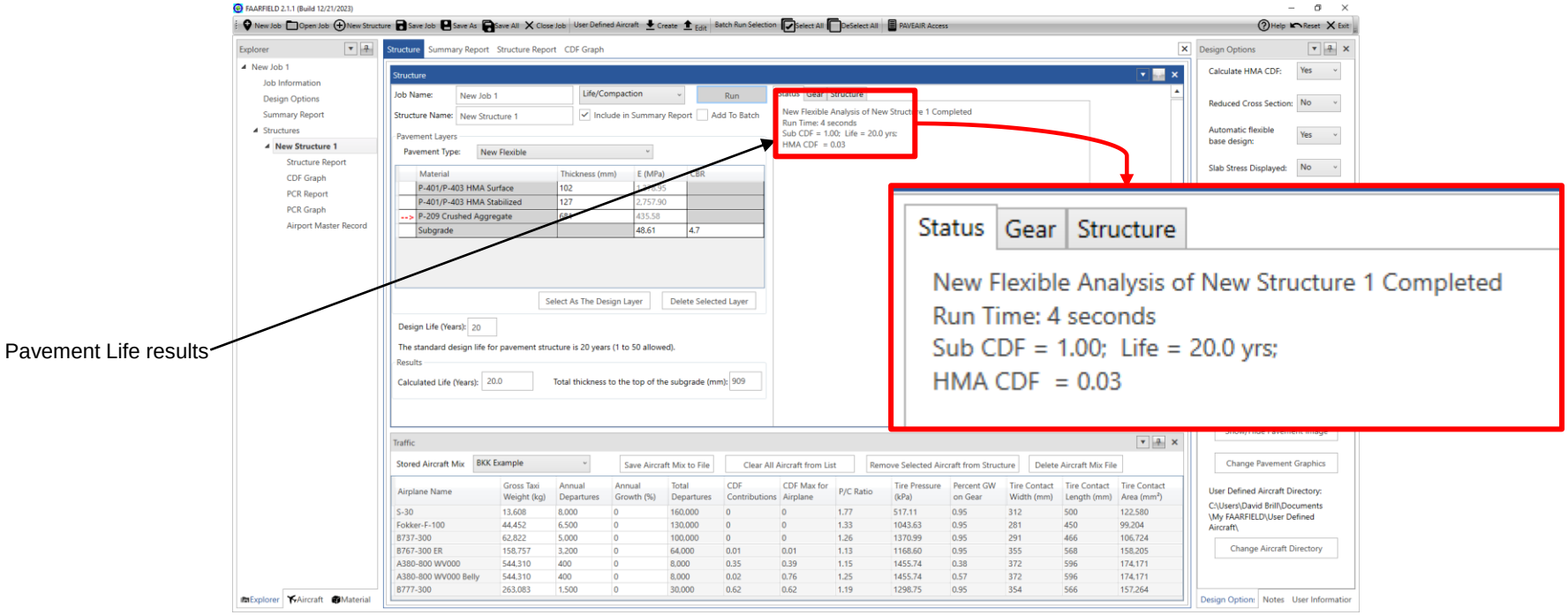
Life/Compaction



Select “Life/Compaction”

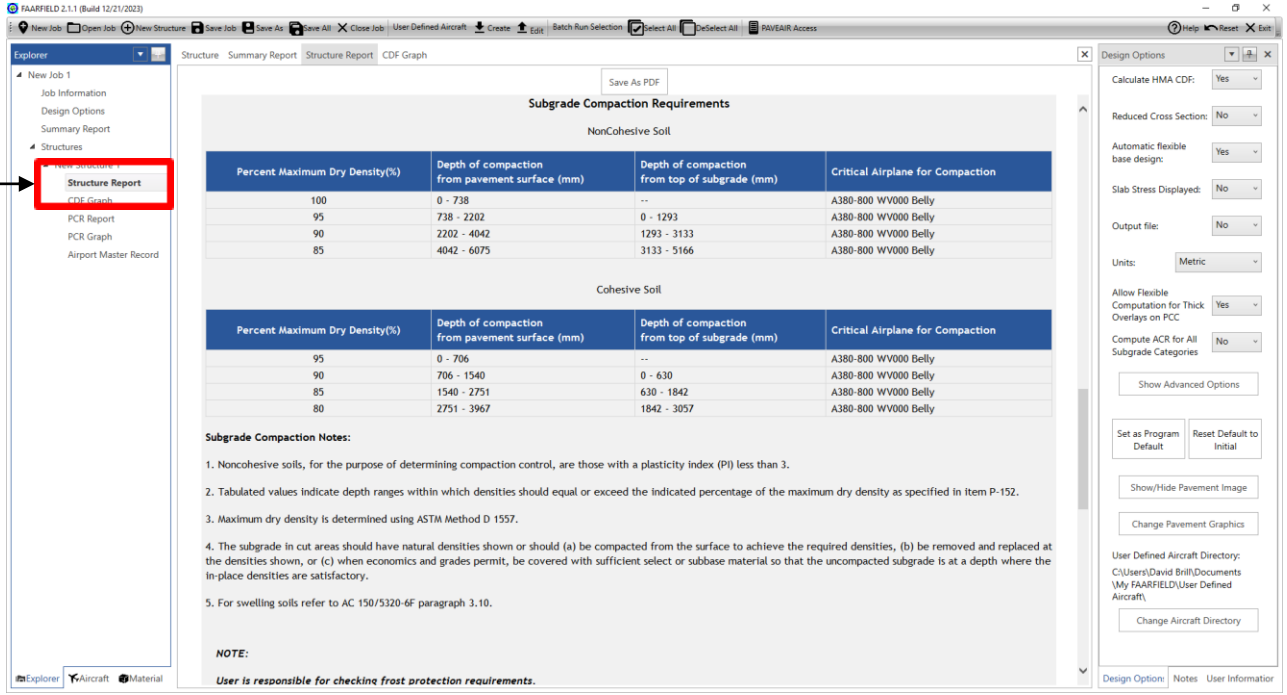
Click “Run” to start Life and Compaction requirements

Life/Compaction



Compaction Requirements

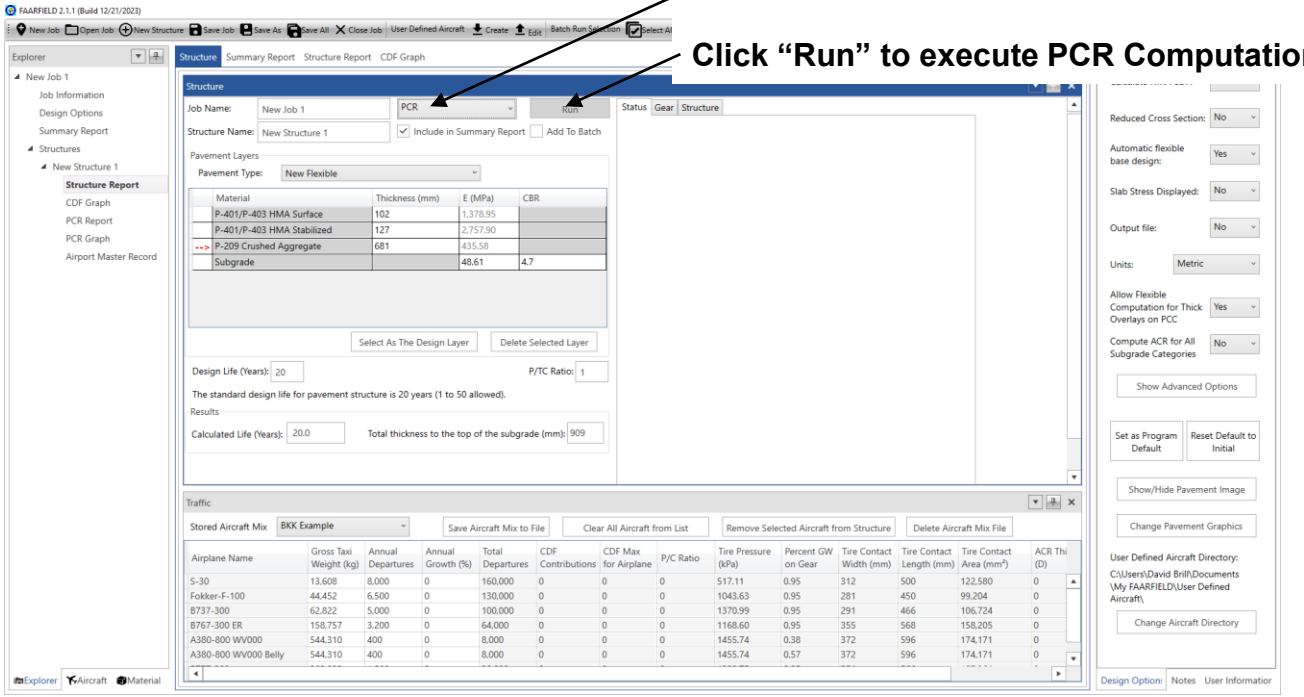
Section Report



PCR

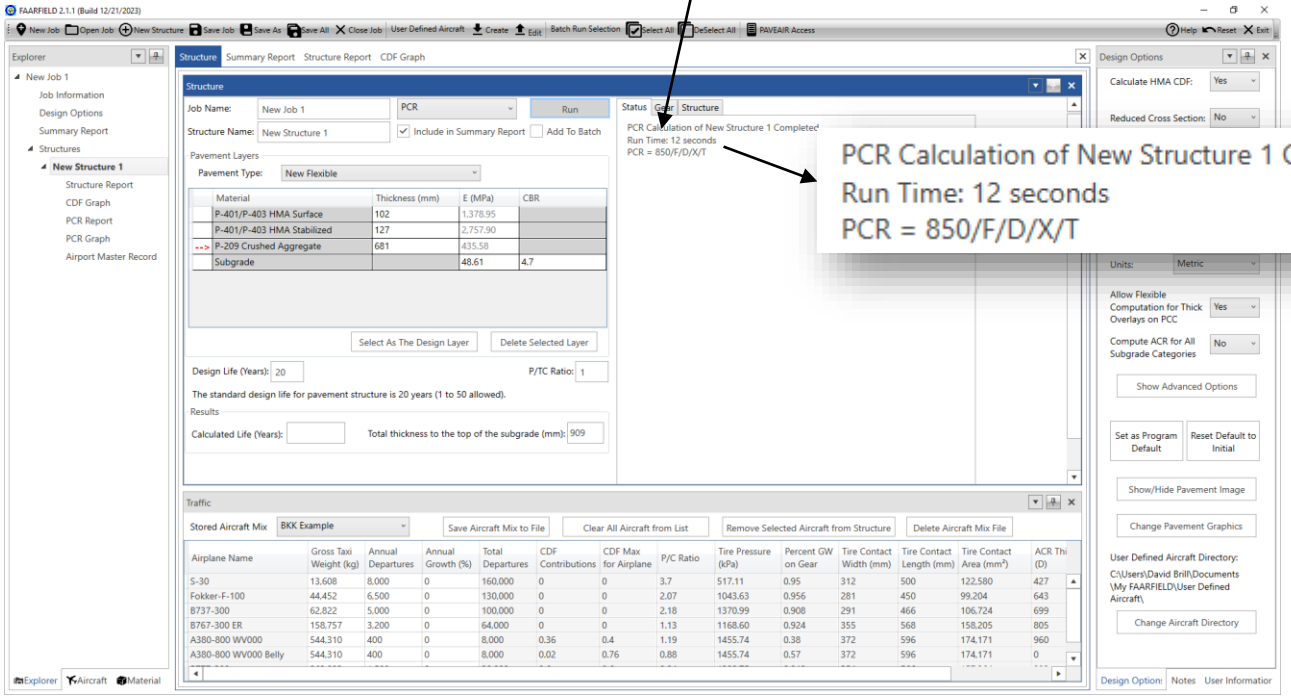
Select “PCR” in the function drop-down box.

Click “Run” to execute PCR Computations

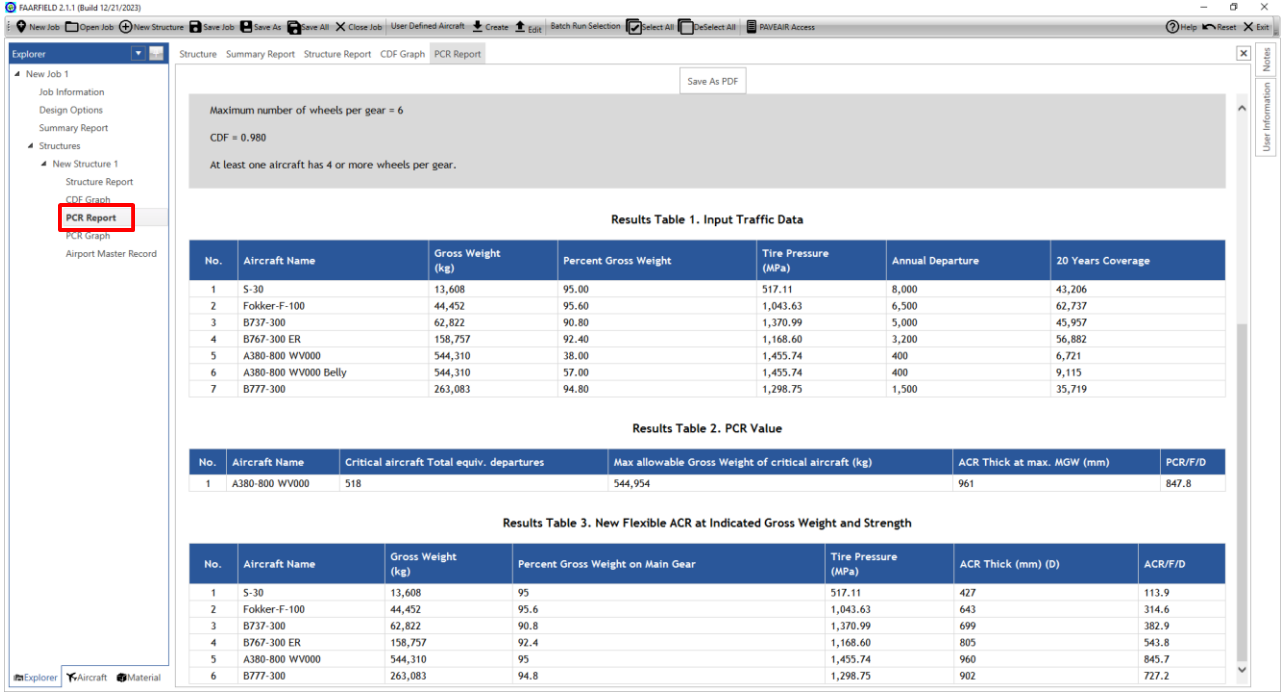


PCR

Results of PCR computations



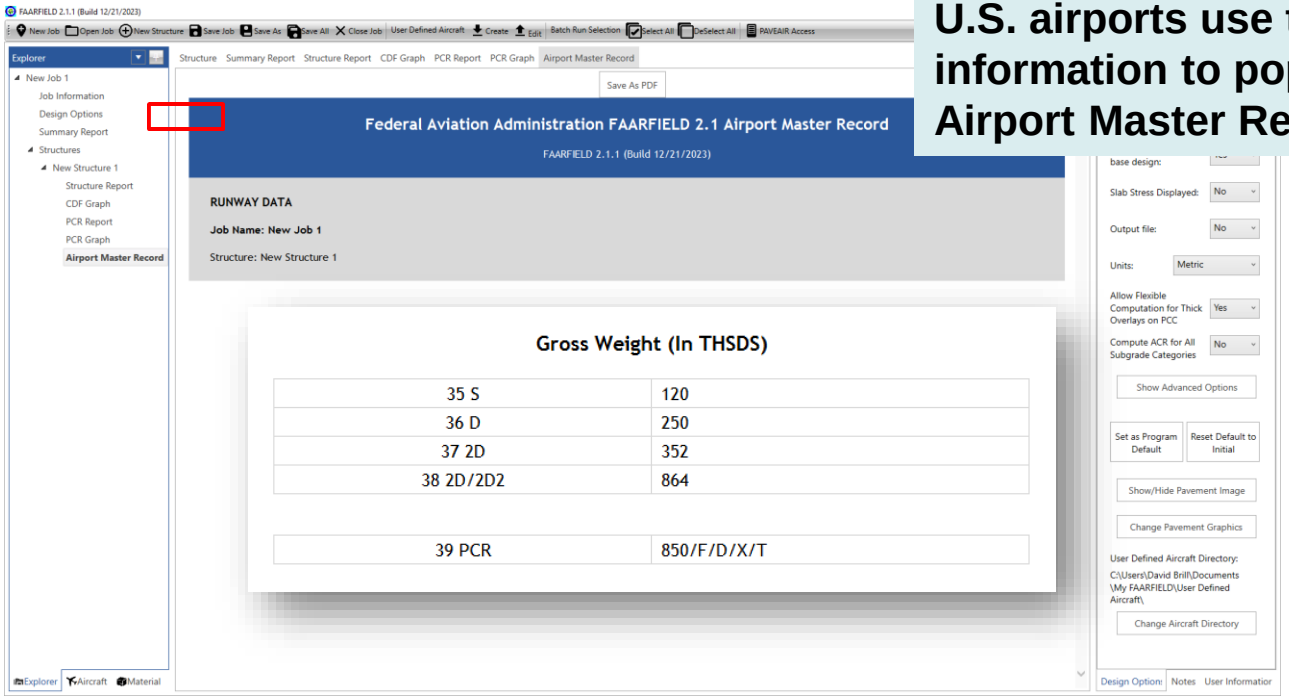
PCR Report


FAARFIELD 2.1.1 (Build 12/21/2023)
Explorer
New Job 1
Job Information
Design Options
Summary Report
Structures
New Structure 1
Structure Report
CDF Graph
PCR Report
PCR Graph
Airport Master Record
Structure
Summary Report
Structure Report
CDF Graph
PCR Report
Save As PDF
Maximum number of wheels per gear = 6
CDF = 0.980
At least one aircraft has 4 or more wheels per gear.
Results Table 1. Input Traffic Data
No. | Aircraft Name | Gross Weight (kg) | Percent Gross Weight | Tire Pressure (MPa) | Annual Departure | 20 Years Coverage
1 | S-30 | 13,608 | 95.00 | 517.11 | 8,000 | 43,206
2 | Fokker-F-100 | 44,452 | 95.60 | 1,043.63 | 6,500 | 62,737
3 | B737-300 | 62,822 | 90.80 | 1,370.99 | 5,000 | 45,957
4 | B767-300 ER | 158,757 | 92.40 | 1,168.60 | 3,200 | 56,882
5 | A380-800 WV000 | 544,310 | 38.00 | 1,455.74 | 400 | 6,721
6 | A380-800 WV000 Belly | 544,310 | 57.00 | 1,455.74 | 400 | 9,115
7 | B777-300 | 263,083 | 94.80 | 1,298.75 | 1,500 | 35,719
Results Table 2. PCR Value
No. | Aircraft Name | Critical aircraft Total equiv. departures | Max allowable Gross Weight of critical aircraft (kg) | ACR Thick at max. MGW (mm) | PCR/F/D
1 | A380-800 WV000 | 518 | 544,954 | 961 | 847.8
Results Table 3. New Flexible ACR at Indicated Gross Weight and Strength
No. | Aircraft Name | Gross Weight (kg) | Percent Gross Weight on Main Gear | Tire Pressure (MPa) | ACR Thick (mm) (D) | ACR/F/D
1 | S-30 | 13,608 | 95 | 517.11 | 427 | 113.9
2 | Fokker-F-100 | 44,452 | 95.6 | 1,043.63 | 643 | 314.6
3 | B737-300 | 62,822 | 90.8 | 1,370.99 | 699 | 382.9
4 | B767-300 ER | 158,757 | 92.4 | 1,168.60 | 805 | 543.8
5 | A380-800 WV000 | 544,310 | 95 | 1,455.74 | 960 | 845.7
6 | B777-300 | 263,083 | 94.8 | 1,298.75 | 902 | 727.2
Explorer
Aircraft
Material
Notes
User Information

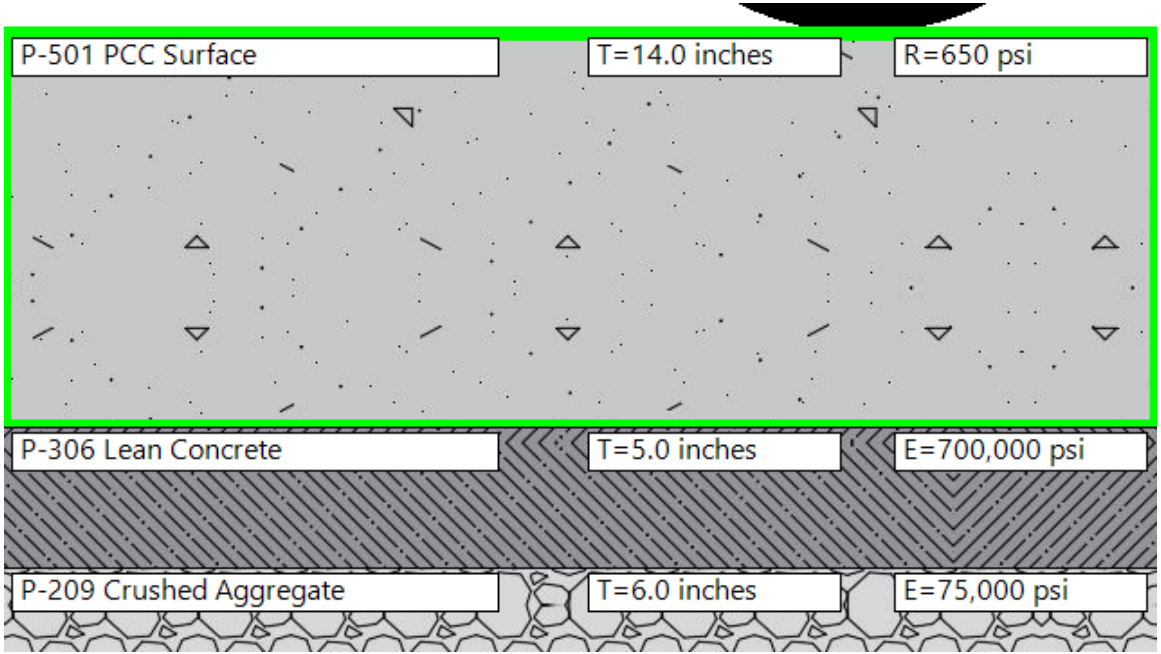
PCR Graph

- **Black horizontal line represents PCR.**
- **Blue vertical bars represent ACR of individual aircraft.**
- **PCR is just sufficient to allow unrestricted operations, consistent with thickness design.**

Airport Master Record

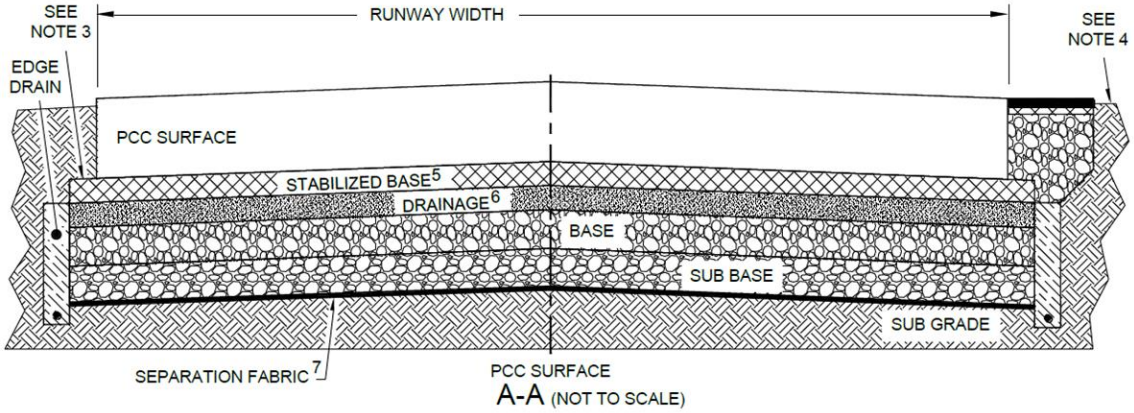


U.S. airports use this information to populate the Airport Master Record (AMR)



Rigid Pavement Design Example Using FAARFIELD 2.1

Typical Rigid Pavement



NOTES:

1. RUNWAY, TAXIWAY AND SHOULDER WIDTHS; TRANSVERSE SLOPES, ETC. PER AC 150/ 5300-13, AIRPORT DESIGN
2. SURFACE, BASE, PCC, ETC. THICKNESS PER AC 150/5320-6.
3. STABILIZED BASE, BASE AND SUBBASE MINIMUM 12 INCHES [30CM] UP TO 36 INCHES [90 CM] BEYOND FULL STRENGTH PAVEMENT.
4. CONSTRUCT A 1.5 INCH [4 CM] DROP BETWEEN PAVED AND UNPAVED SURFACES.
5. WHEN REQUIRED, SEE PARAGRAPH 3.5.
6. LOCATION AND NEED FOR DRAINAGE LAYER AS RECOMMENCED BY GEOTECHNICAL AND PAVEMENT ENGINEER.
7. WHEN RECOMMENDED BY GEOTECHNICAL AND PAVEMENT ENGINEER.

Rigid Pavement Design in FAARFIELD

- **Considers only one mode of failure for rigid pavement, bottom-up cracking of the concrete slab.**
- **Cracking is controlled by limiting the horizontal stress at the bottom of the concrete slab.**
- **The rigid pavement design model does not explicitly consider failure of subbase and subgrade layers.**

Rigid Pavement Failure Model

- **FAARFIELD rigid failure model:**

$$DF = \left[\frac{F_s' bd}{(1-\alpha)(d-b)+F_s' b}\right] \times \log C + \left[\frac{(1-\alpha)(ad-bc)+bc}{(1-\alpha)(d-b)+F_s' b}\right]$$

where:

$SCI = \alpha \times 100 \quad 0 \le \alpha \le 1$

DF = design factor = R/σ

R = concrete flexural strength (ASTM C78)

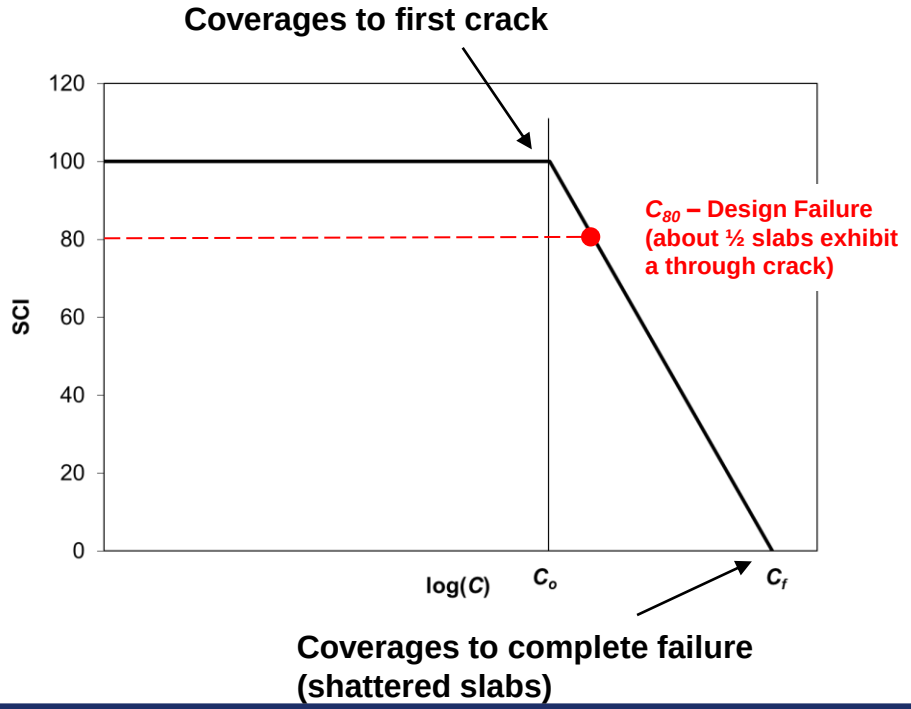
σ = max. computed tensile stress

C = coverages

F_s' = compensation factor for stabilized base

a, b, c, d = parameters determined by full-scale test

- **DF is linear in log(*C*).**



Concrete Flexural Strength

- **Design flexural strength between 600 and 750 psi (4.14 to 5.17 MPa) is recommended for most airfield applications.**
- **Avoid design flexural strengths higher than 750 psi (5.17 MPa), unless it can be shown that higher strength mixes are produced by normal methods using local materials, i.e., without relying on excessive cement contents or additives likely to negatively impact durability.**
- **The strength used in thickness design is different than the strength used for material acceptance in P-501.**
  - Design strength can be 5% higher than specified 28-day strength.

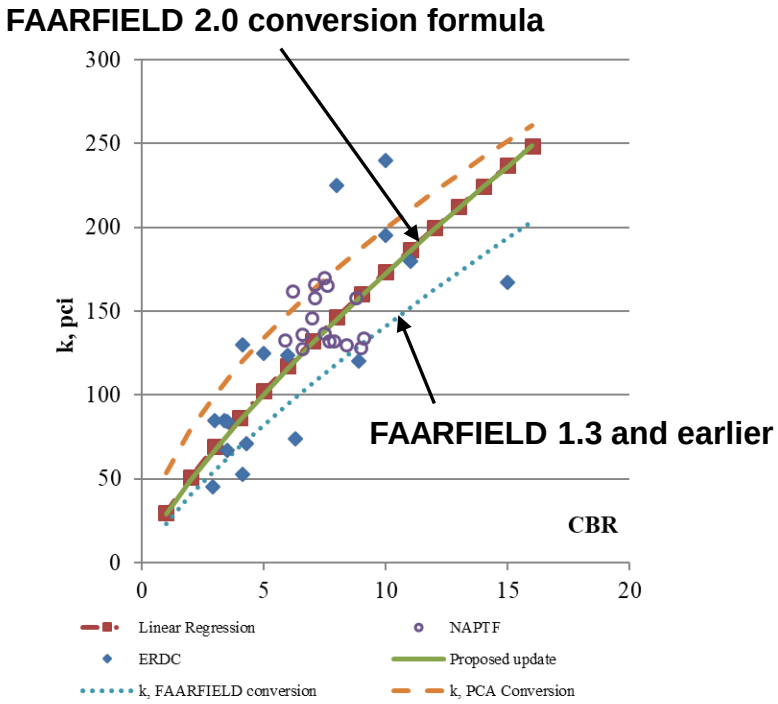
Subgrade Modulus

- **FAARFIELD automatically converts *k* to *E*, and vice-versa.**
- **The conversion formula implemented in FAARFIELD 2.0 is:**

$$k = 28.6926 \times \mathrm{CBR}^{0.7788}$$

where: $\mathrm{CBR} = E / 1500$
(*E* in psi, and *k* in psi/inch).

- **Compared to the earlier formula:**
  - Improved agreement with field correlations
  - less conservative when converting from CBR data.



Rigid Pavement Design Example

A rigid pavement is being designed for a new runway at a commercial airport in Dakar, Senegal. Based on the information obtained from the Airport Master Plan, the new runway is expected to handle the traffic mix presented in Table 1. Eight soil borings were performed for this project, the results of which are presented in Table 2. The specified 28-day strength (ASTM C78) is 4.27 MPa.

Table 1. Aircraft traffic mix for rigid pavement design example.

Aircraft	Departure Weight, kg	Arrival Weight, kg	Annual Departures
S-30	13,608	10,206	8000
Fokker F-100	44,452	34,019	6500
B737-300	62,822	52,163	5000
B767-300 ER	158,757	131,541	3200
A380-800	544,310	462,664	400
B777-300	263,083	237,682	1500

Same as flexible example!

Table 2. Soil boring results for rigid pavement design example.

Boring No.	UCSC Soil Type	Moisture Content, %	Optimal MC, %	Dry unit weight, kN/m^3	Water Table Depth, m	CBR, %
B-1	SC	12.2	10.4	20.26	3	10.6
B-2	SC	14.4	12.2	19.57	3	7.2
B-3	SC	16.5	9.6	20.80	2.5	8.4
B-4	CL	15.8	13.5	18.88	2.0	6.3
B-5	CL	17.0	14.5	19.24	2.4	4.8
B-6	CL	16.2	13.8	18.96	1.7	5.9
B-7	CL	16.8	12.6	19.48	1.4	4.2
B-8	CL	14.2	12.8	20.14	1.8	6.4
Average:						
Std. Deviation:						

Rigid Pavement Design Example

1. **What do the soil boring results tell us about the in-situ soil properties? What subgrade support value do you recommend for design?**

   Mean CBR – 6.7 Standard Deviation – 2.04

   Design CBR – 4.7 E_{SG} ~ 47 MPa (5 CBR)

1. **What type and thickness of base/subbase materials do you recommend? Are positive drainage features required?**
2. **What flexural strength of concrete would you use for the design?**

   AC 150/5320-6G allows 5 percent above specified 28-day strength for design.

   Given 28-day strength = 4.27 MPa, the allowable design strength is 1.05 × 4.27 = 4.48 MPa.

   Use 4.48 MPa in the FAARFIELD design.

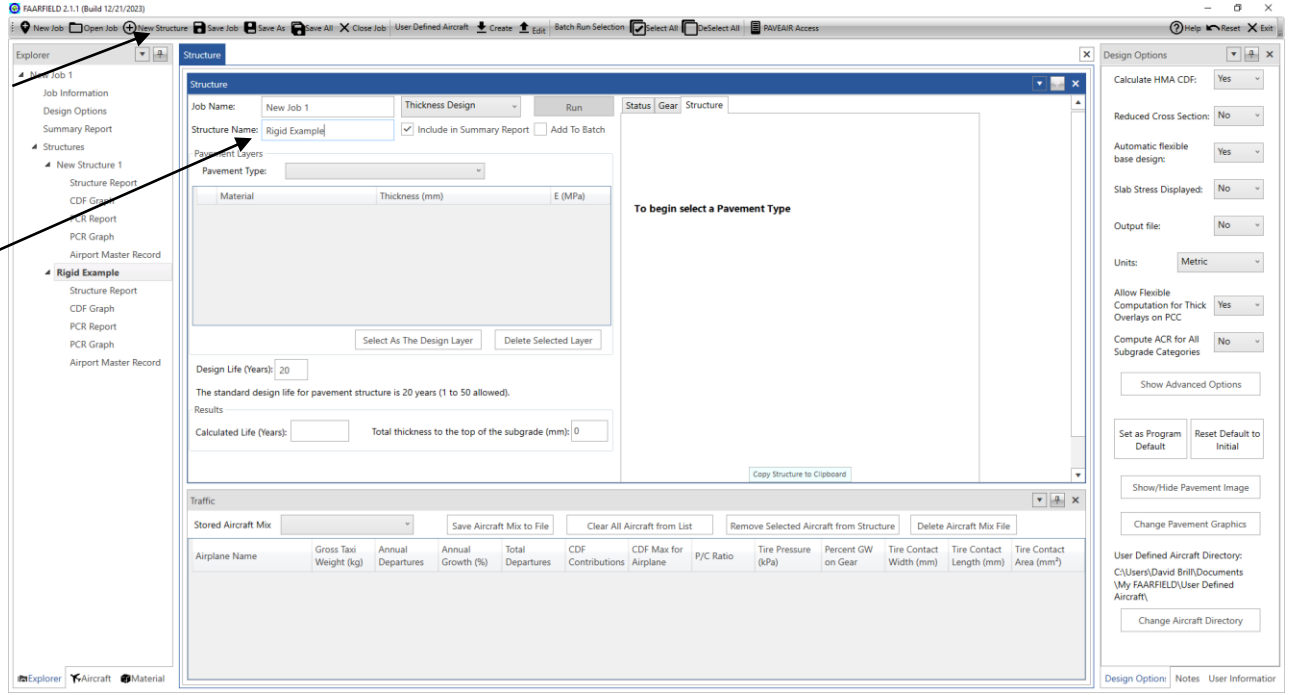
1. **Should the pavement be designed for aircraft arrival or departure weights? What is the required flexible pavement thickness for the runway? What is the most demanding aircraft?**

Boring No.	UCSC Soil Type	Moisture Content, %	Optimal MC, %	Dry unit weight, kN/m^3	Water Table Depth, m	CBR, %
B-1	SC	12.2	10.4	20.26	3	10.6
B-2	SC	14.4	12.2	19.57	3	7.2
B-3	SC	16.5	9.6	20.80	2.5	8.4
B-4	CL	15.8	13.5	18.88	2.0	6.3
B-5	CL	17.0	14.5	19.24	2.4	4.8
B-6	CL	16.2	13.8	18.96	1.7	5.9
B-7	CL	16.8	12.6	19.48	1.4	4.2
B-8	CL	14.2	12.8	20.14	1.8	6.4
Average:		**15.4**	**12.4**	**19.66**	**2.3**	**6.7**
Std. Deviation:		**1.7**	**1.7**	**0.68**	**0.6**	**2.0**

Creating/Naming a Structure

Click on “New Structure”

Enter Structure Name”



Select Pavement Type

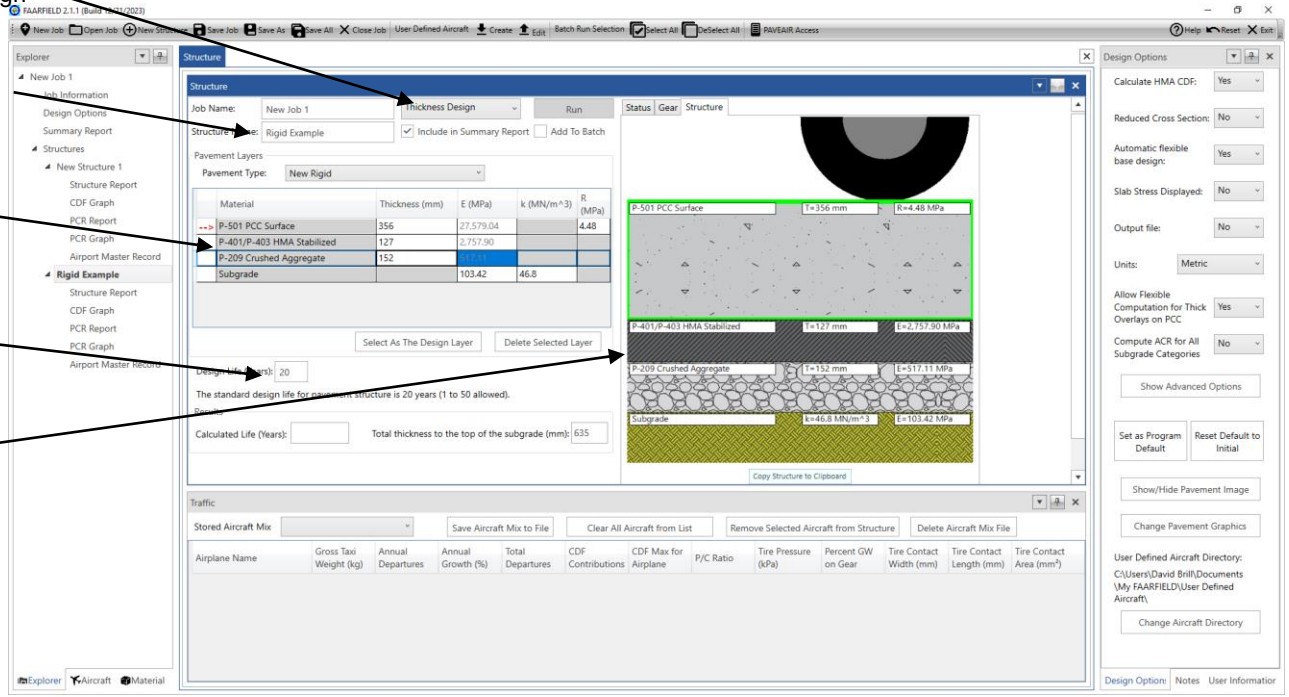
Select “Thickness Design”

Select Pavement Type as “New Rigid”

Default pavement structure details in table

Default pavement life (20 years)

Default pavement structure for “New Rigid” type

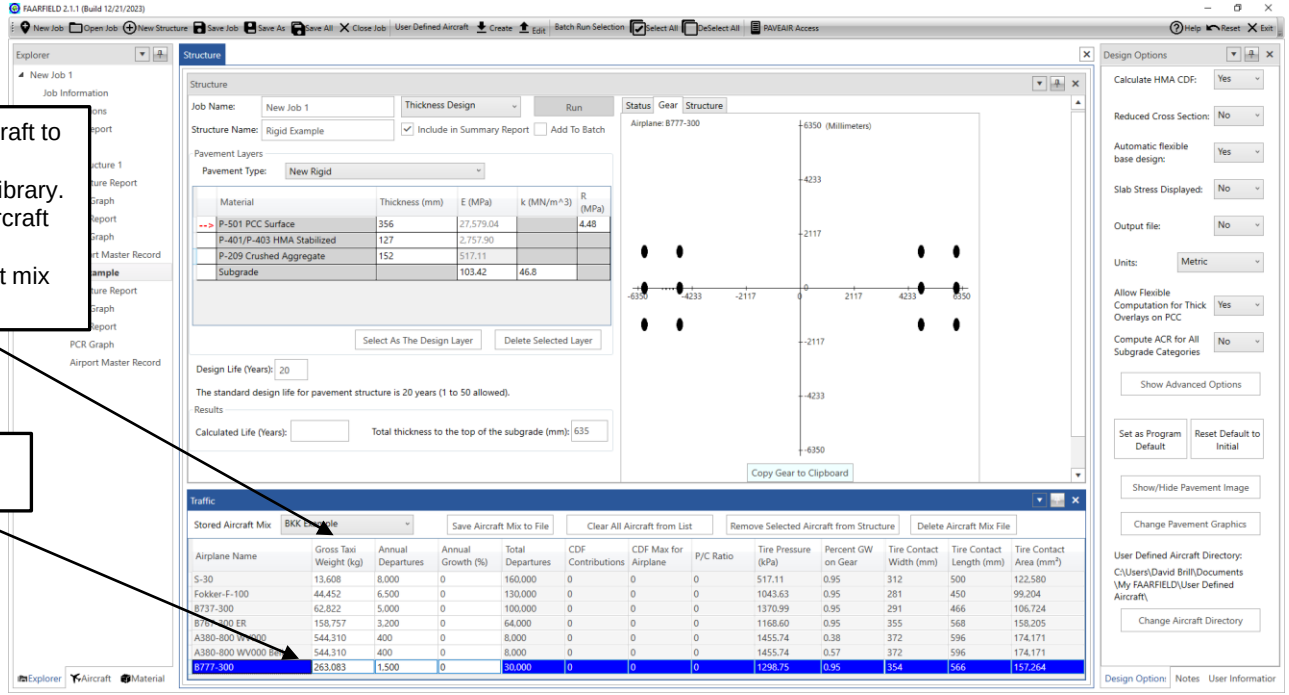


Creating Aircraft Traffic Mix

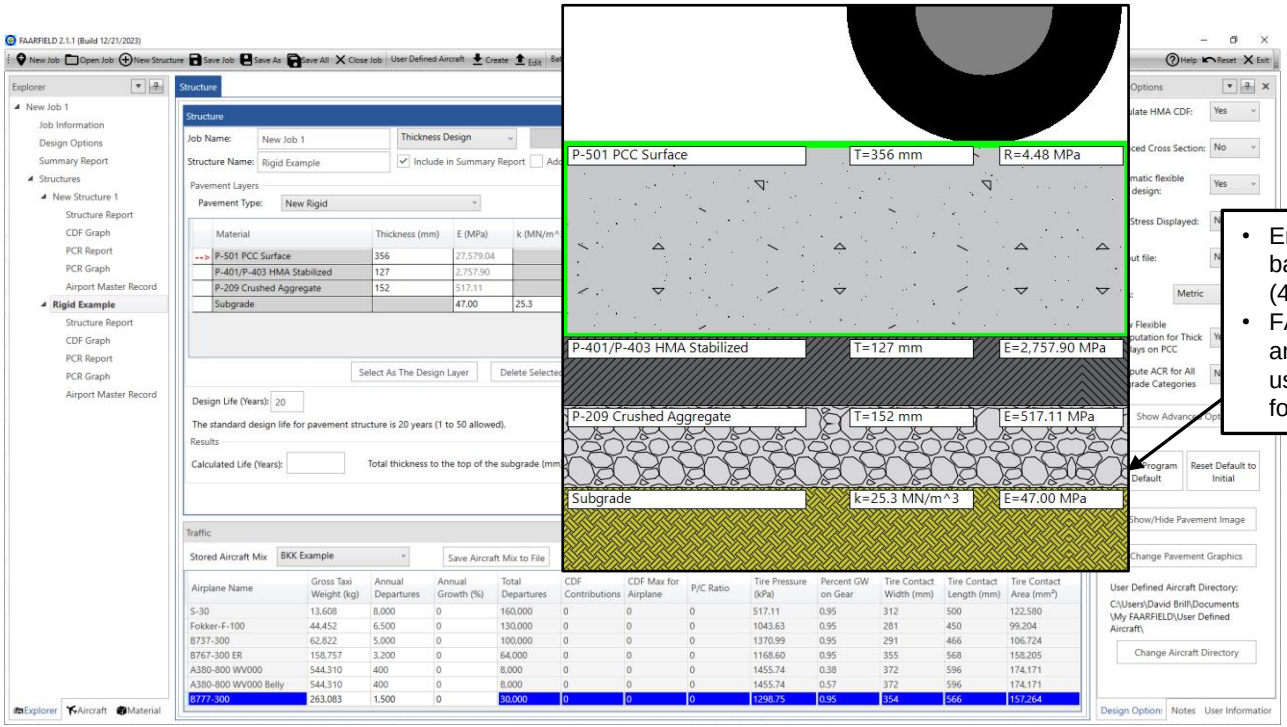
Several ways to add aircraft to the traffic table:

- Pick aircraft from the library. Double click on the aircraft name or drag/drop.
- Select a stored aircraft mix from the drop-down.

Select an aircraft to display gear geometry.

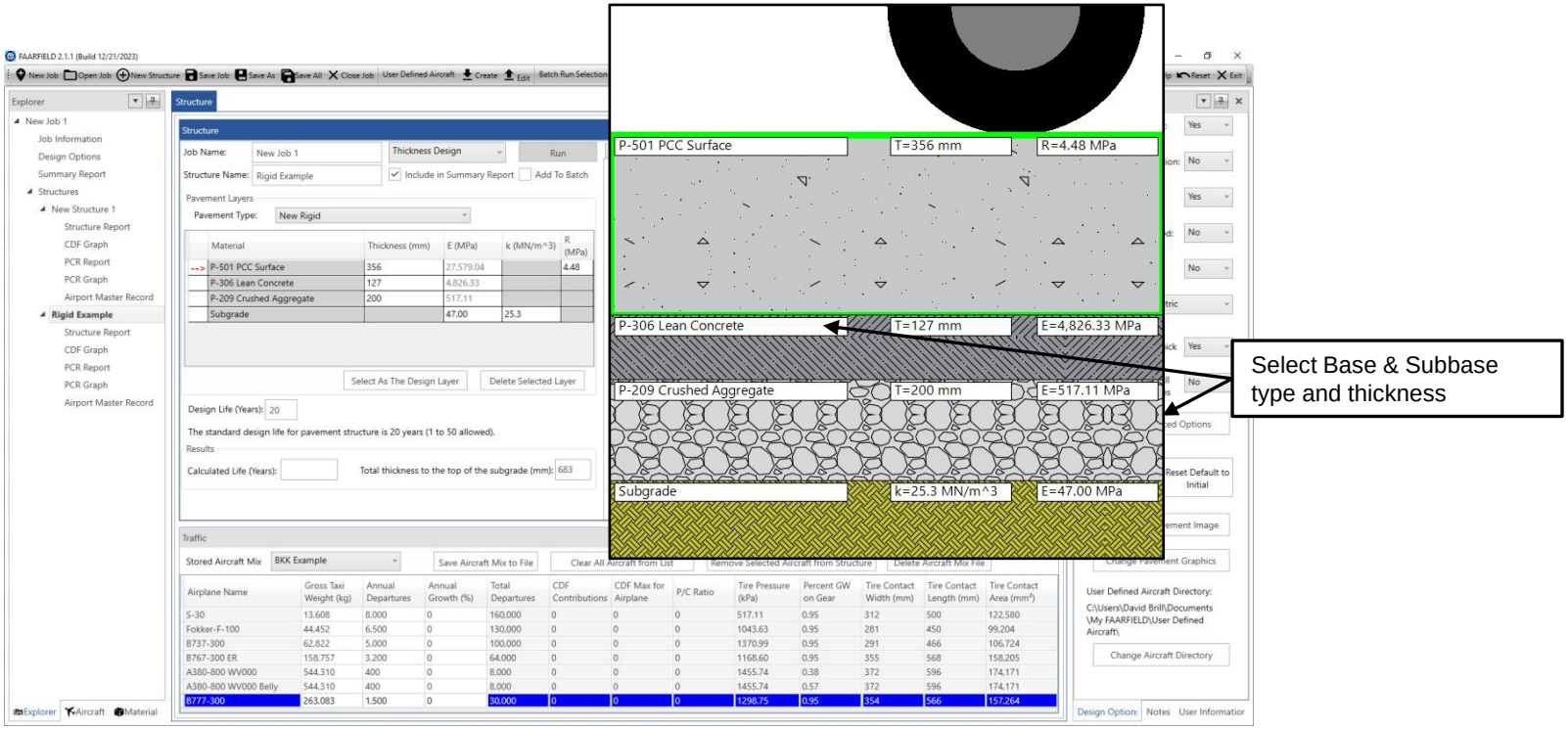


Modify Default Layer Properties

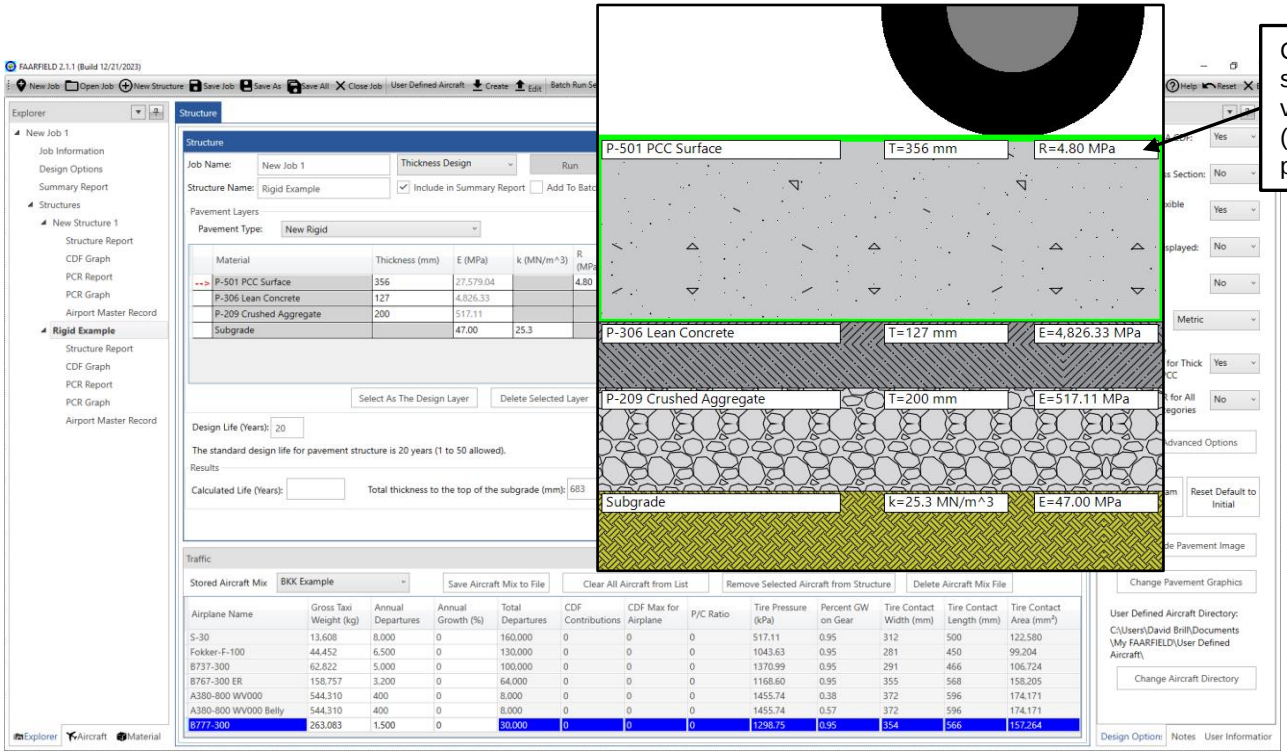


- Enter the modulus value based on design CBR (47 MPa).
- FAARFIELD computes an equivalent k-value using the conversion formula.

Modify Default Layer Properties

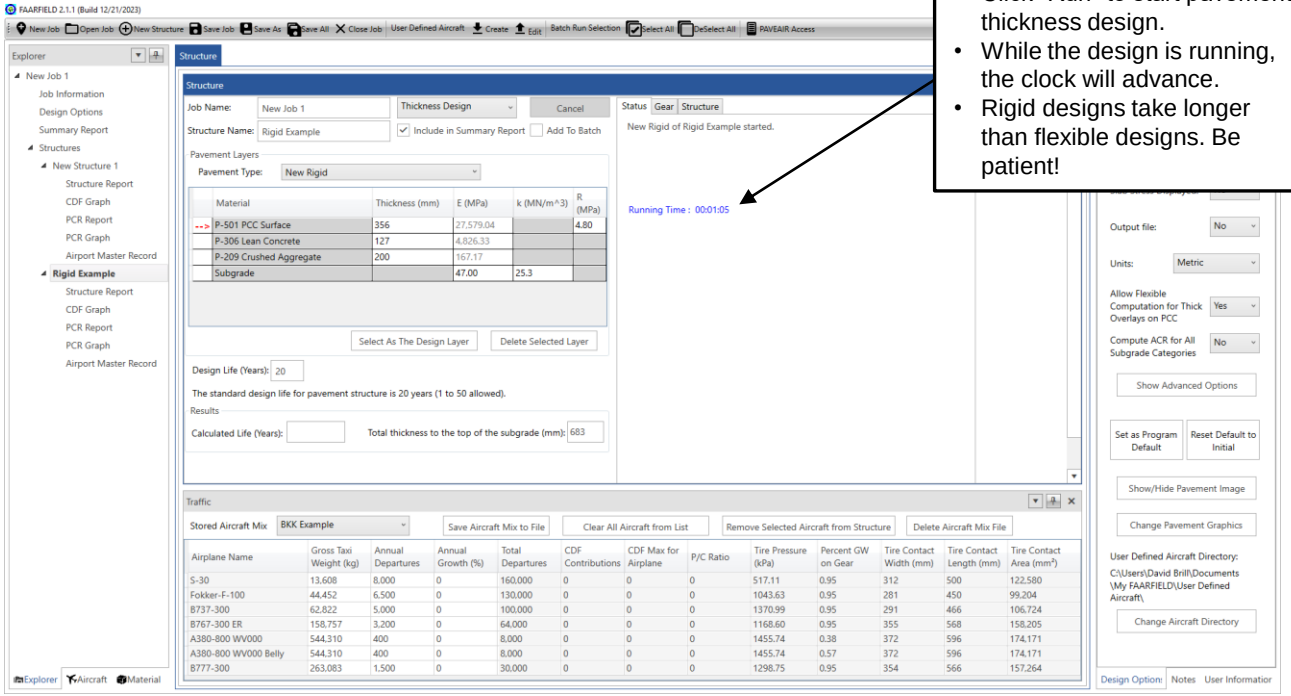


Modify Default Layer Properties



Change flexural strength from default value to R =700 psi (as determined on a previous slide).

Run Pavement Thickness Design



- Click “Run” to start pavement thickness design.
- While the design is running, the clock will advance.
- Rigid designs take longer than flexible designs. Be patient!

Completed Pavement Thickness Design

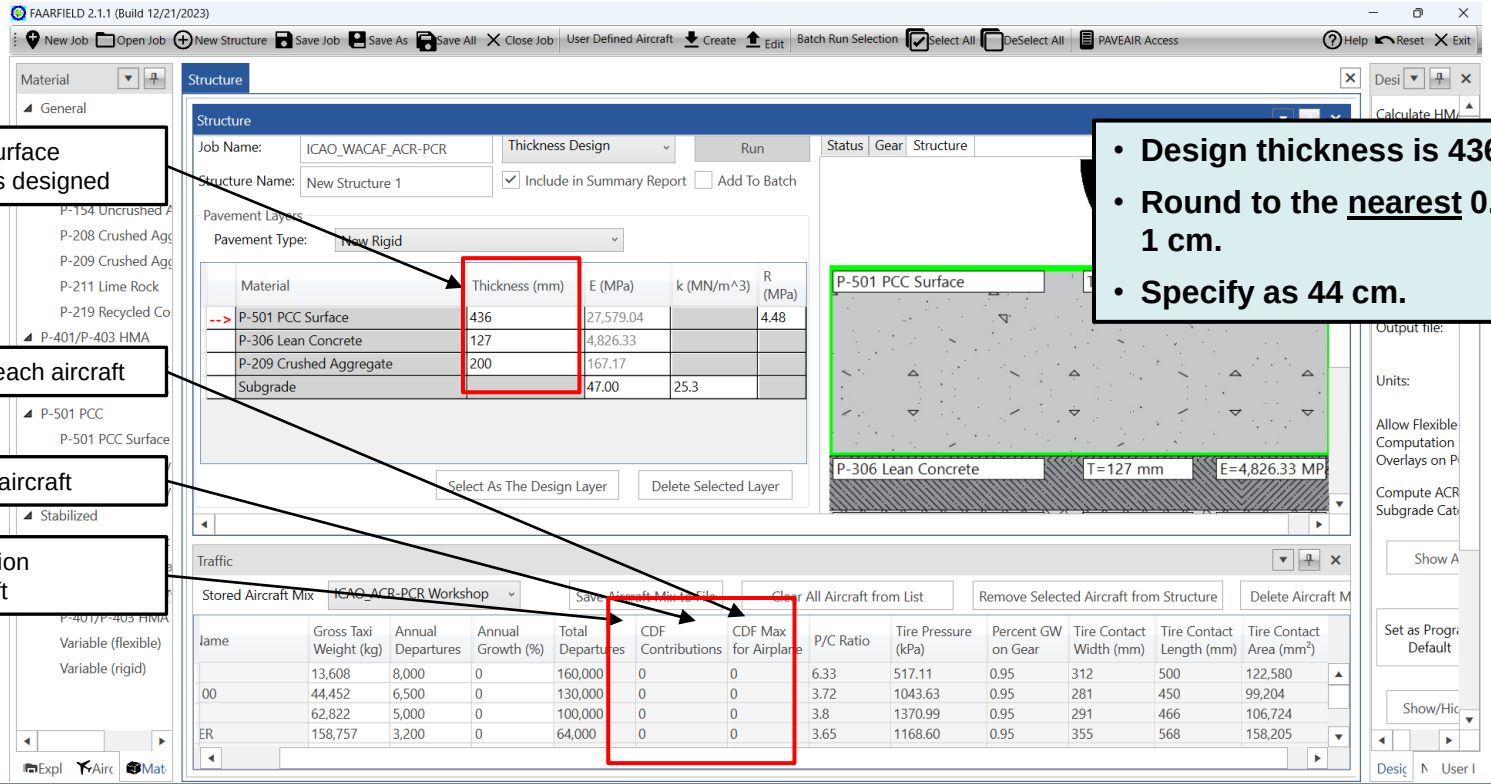
P-501 PCC Surface Thickness was designed

P/C Ratio for each aircraft

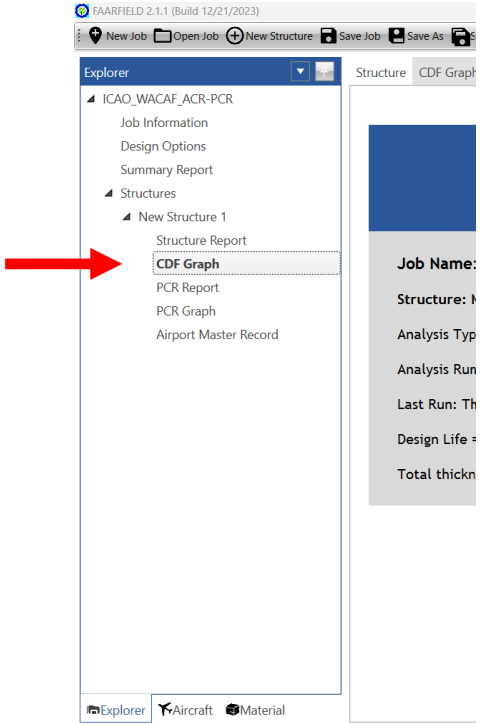
CDF max. for aircraft

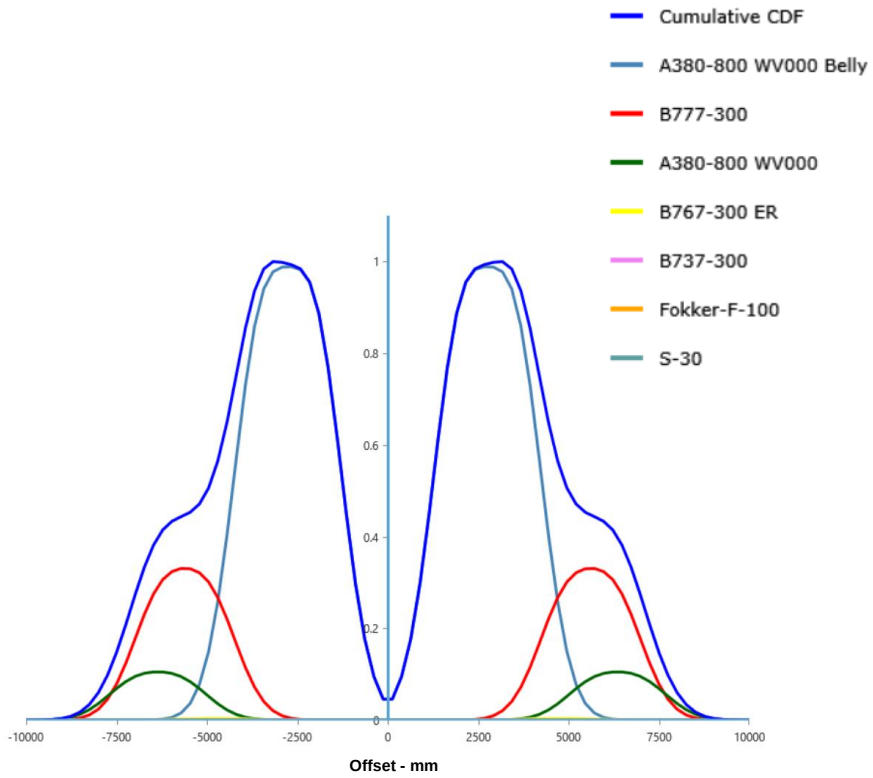
CDF contribution of each aircraft

- **Design thickness is 436 mm**
- **Round to the <u>nearest</u> 0.5 in or 1 cm.**
- **Specify as 44 cm.**



CDF Chart


FAARFIELD 2.1.1 (Build 12/21/2023)
New Job
Open Job
New Structure
Save Job
Save As
Explorer
ICAO_WACAF_ACR-PCR
Job Information
Design Options
Summary Report
Structures
New Structure 1
Structure Report
CDF Graph
PCR Report
PCR Graph
Airport Master Record
Structure
CDF Graph
Job Name:
Structure:
Analysis Typ
Analysis Run
Last Run: Th
Design Life =
Total thickn
Explorer
Aircraft
Material


Cumulative CDF
A380-800 WV000 Belly
B777-300
A380-800 WV000
B767-300 ER
B737-300
Fokker-F-100
S-30
1
0.8
0.6
0.4
0.2
0
-10000
-7500
-5000
-2500
0
2500
5000
7500
10000
Offset - mm

Rigid Pavement Example – Results

1. **What do the soil boring results tell us about the in situ soil properties? What subgrade support value do you recommend for design?**

   Mean CBR = 6.7 Standard Deviation = 2.04 Design CBR = 4.7 E_{SG} = 47 MPa

2. **What type and thickness of base/subbase materials do you recommend? Are positive drainage features required?**

3. **What flexural strength of concrete would you use for the design?**

   AC 150/5320-6G allows 5 percent above specified 28-day strength for design.

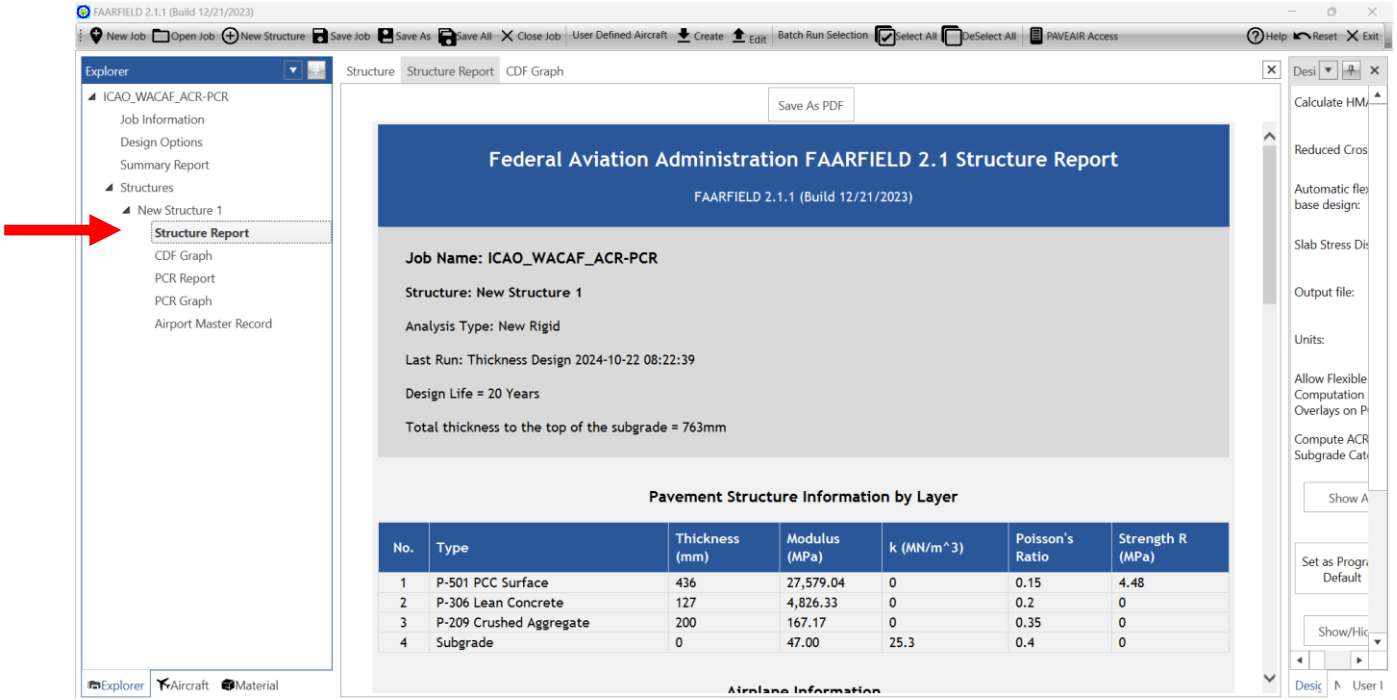
   Given 28-day strength = 4.27 MPa, the allowable design strength = 1.05 × 4.27 = 4.48 MPa.

   Use *R* = 4.48 MPa in the FAARFIELD design.

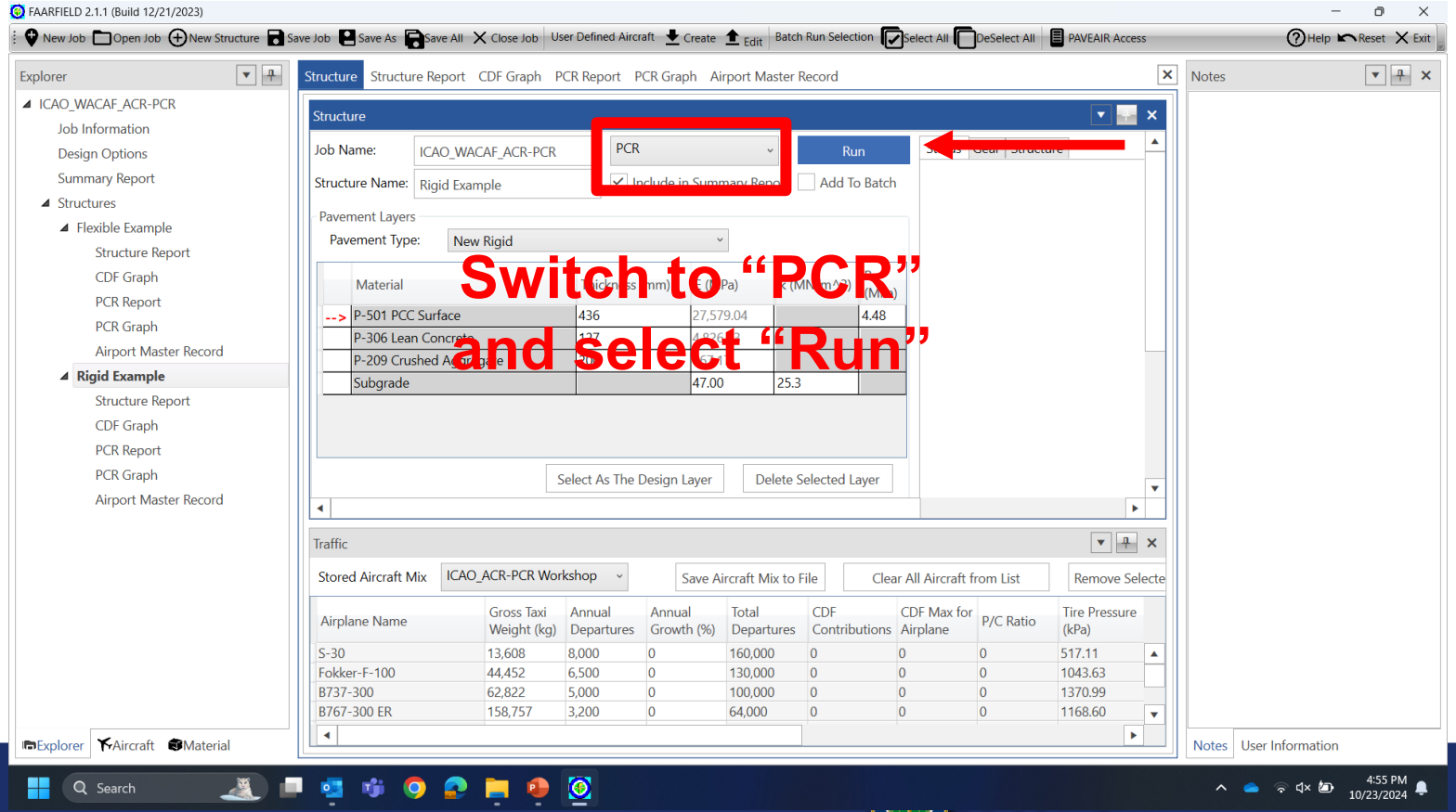
4. **Should the pavement be designed for aircraft arrival or departure weights? What is the required PCC slab thickness for the runway? What is the most demanding aircraft?**

   For the given inputs, FAARFIELD 2.1 gives a slab thickness 44 cm.
   The most demanding aircraft is the Airbus 380-800, for which the belly gear (6-wheels) contributes 98% of the CDF on the critical strip.

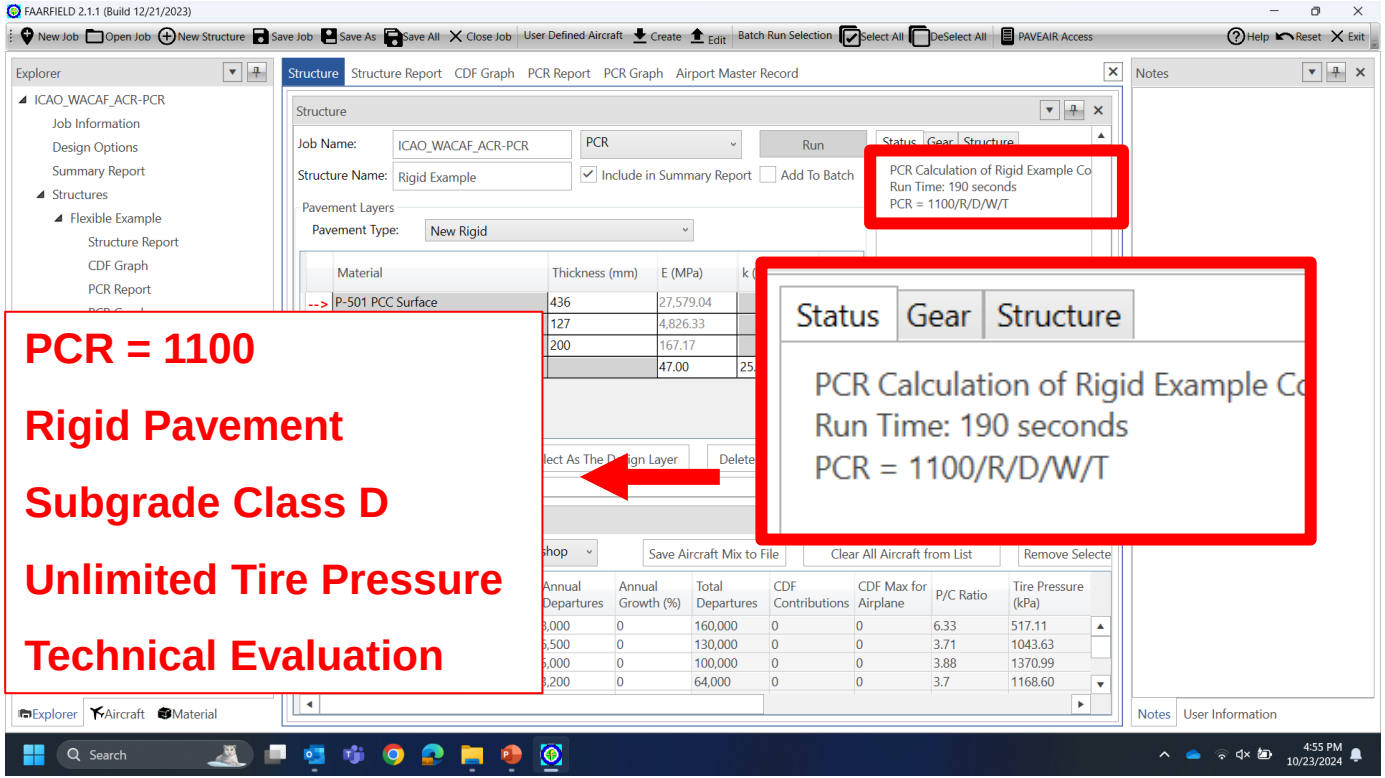
Structure Report



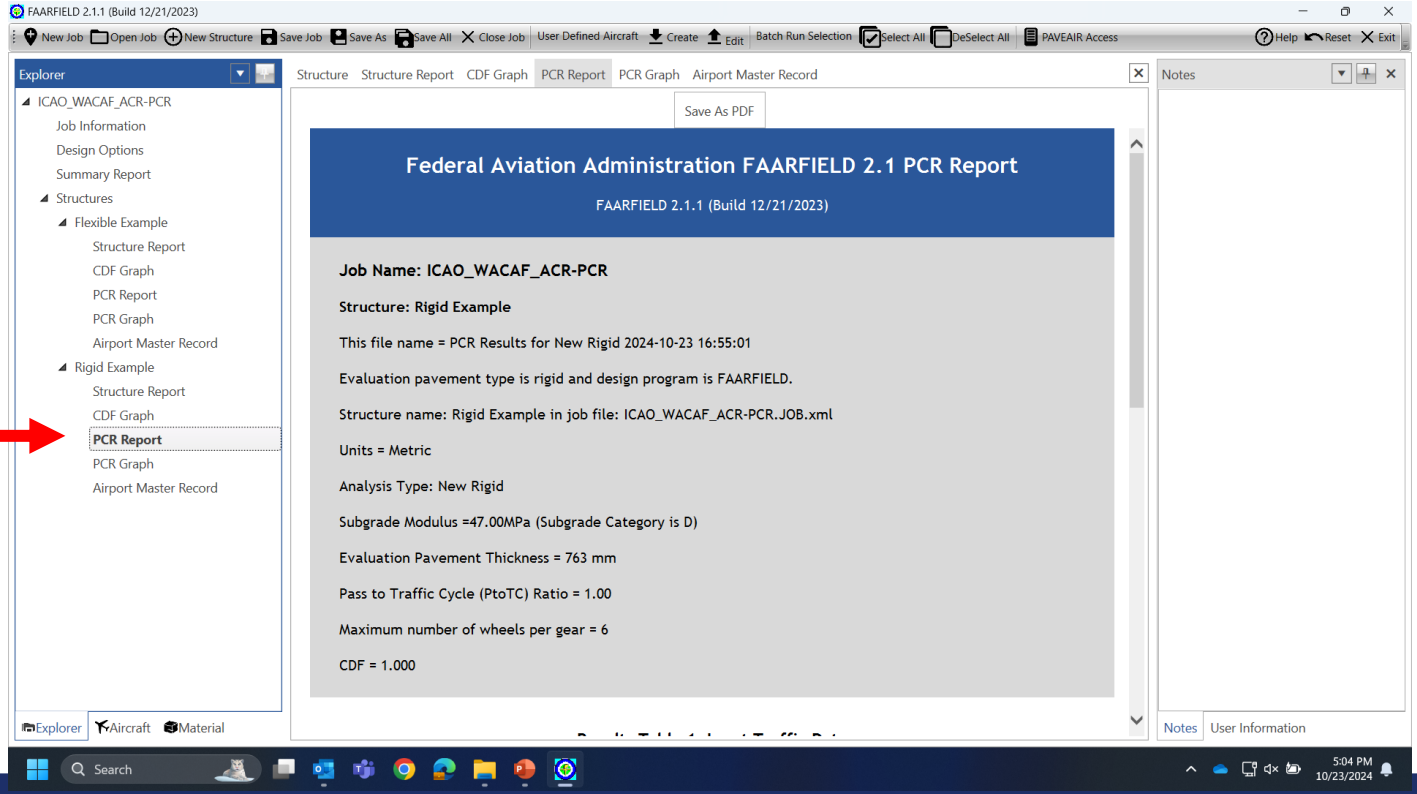
PCR


FAARFIELD 2.1.1 (Build 12/21/2023)
New Job
Open Job
New Structure
Save Job
Save As
Save All
Close Job
User Defined Aircraft
Create
Edit
Batch Run Selection
Select All
DeSelect All
PAVEAIR Access
Help
Reset
Exit
Explorer
ICAO_WACAF_ACR-PCR
Job Information
Design Options
Summary Report
Structures
Flexible Example
Structure Report
CDF Graph
PCR Report
PCR Graph
Airport Master Record
Rigid Example
Structure Report
CDF Graph
PCR Report
PCR Graph
Airport Master Record
Structure
Structure Report
CDF Graph
PCR Report
PCR Graph
Airport Master Record
Job Name:
ICAO_WACAF_ACR-PCR
PCR
Run
Structure Name:
Rigid Example
Add To Batch
Pavement Layers
Pavement Type:
New Rigid
Material
P-501 PCC Surface
436
27,579.04
4.48
P-306 Lean Concrete
P-209 Crushed Aggregate
Subgrade
47.00
25.3
Select As The Design Layer
Delete Selected Layer
Switch to “PCR”
and select “Run”
Notes
Traffic
Stored Aircraft Mix
ICAO_ACR-PCR Workshop
Save Aircraft Mix to File
Clear All Aircraft from List
Remove Selecte
Airplane Name
Gross Taxi Weight (kg)
Annual Departures
Annual Growth (%)
Total Departures
CDF Contributions
CDF Max for Airplane
P/C Ratio
Tire Pressure (kPa)
S-30
13,608
8,000
0
160,000
0
0
0
517.11
Fokker-F-100
44,452
6,500
0
130,000
0
0
0
1043.63
B737-300
62,822
5,000
0
100,000
0
0
0
1370.99
B767-300 ER
158,757
3,200
0
64,000
0
0
0
1168.60
Explorer
Aircraft
Material
Notes
User Information
Search
4:55 PM
10/23/2024

PCR


PCR = 1100
Rigid Pavement
Subgrade Class D
Unlimited Tire Pressure
Technical Evaluation
Status
Gear
Structure
PCR Calculation of Rigid Example Co
Run Time: 190 seconds
PCR = 1100/R/D/W/T

PCR



Federal Aviation Administration

Rigid ACR-PCR: PCR Report

- **Detailed results can be viewed from <u>PCR Report</u>**
  - Found in Navigation Pane
- **PCR report includes:**
  1. Traffic Inputs
  2. PCR Summary
  3. ACR Summary

Results Table 2. PCR Value

No.	Aircraft Name	Critical aircraft Total equiv. departures	Max allowable Gross Weight of critical aircraft (kg)	ACR Thick at max. MGW (mm)	PCR/R/D
1	A380-800 WV000	403	544,310	522	1098.8

Results Table 3. New Rigid ACR at Indicated Gross Weight and Strength

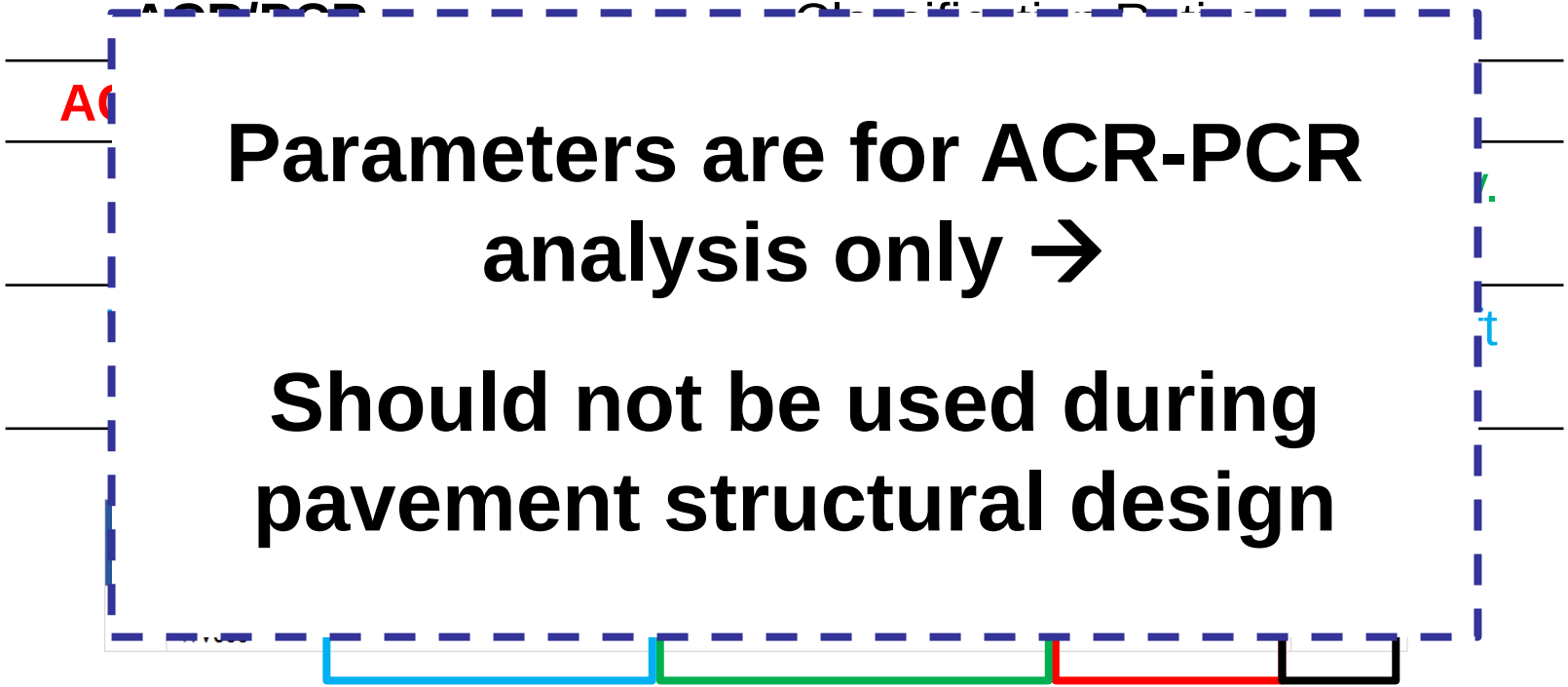
No.	Aircraft Name	Gross Weight (kg)	Percent Gross Weight on Main Gear	Tire Pressure (MPa)	ACR Thick (mm) (D)	ACR/R/D
1	S-30	13,608	95	517.11	147	92.6
2	Fokker-F-100	44,452	95.6	1,043.63	279	315.4
3	B737-300	62,822	90.8	1,370.99	323	423.4
4	B767-300 ER	158,757	92.4	1,168.60	386	601.9
5	A380-800 WV000	544,310	95	1,455.74	523	1098.8
6	B777-300	263,083	94.8	1,298.75	470	893.9

Rigid ACR-PCR: PCR Report

ACR/PCR	Classification Rating
ACR Thickness	ACR Pavement Reference Thickness
MAGW	Aircraft Weight that Converts Total Equiv. Departures to CDF = 1.0
Total Equiv. Departures	Number of Departures for Critical Aircraft that provides same CDF as Aircraft Mix

No.	Aircraft Name	Critical aircraft Total equiv. departures	Max allowable Gross Weight of critical aircraft (kg)	ACR Thick at max. MGW (mm)	PCR/R/D
1	A380-800 WV000	403	544,310	522	1098.8

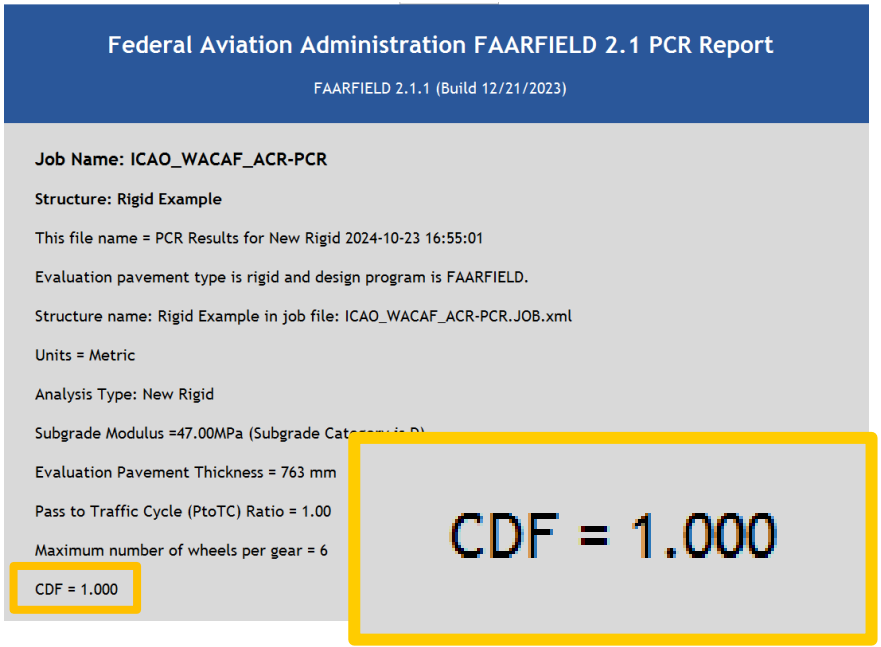
Rigid ACR-PCR: PCR Report



Rigid ACR-PCR: PCR Report

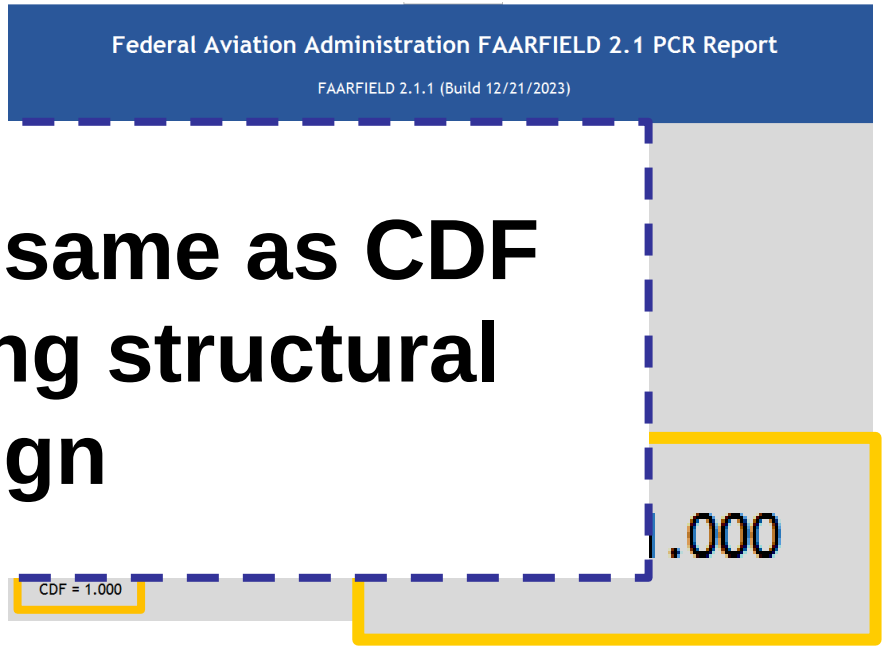
- **Cumulative Damage Factor (CDF) is also reported in <u>PCR Report</u> summary**

- **<u>CDF Conditions:</u>**
  - **CDF ≤ 1.0** → ACR ≤ PCR for all aircraft
  - **CDF > 1.0** → Operating restrictions necessary



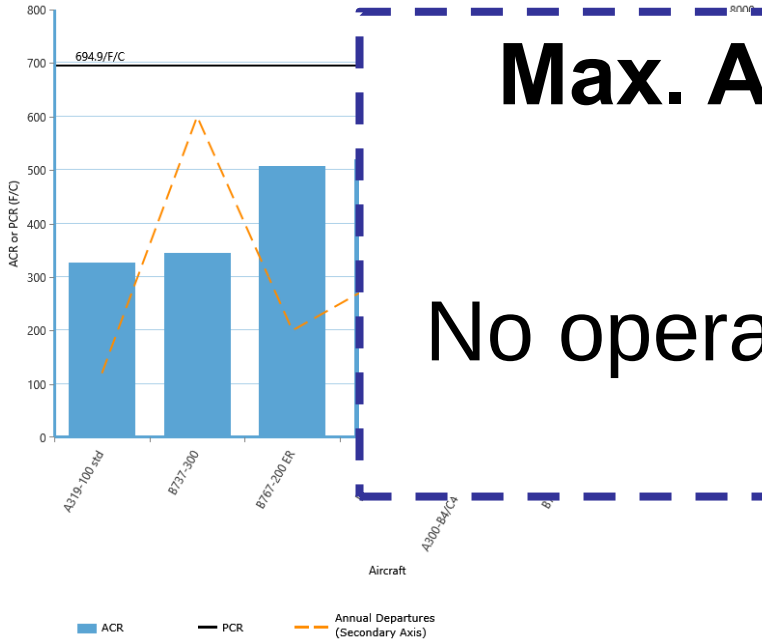
Rigid ACR-PCR: PCR Report

- **Cumulative Damage Factor (CDF) is also reported in PCR**
- **CDF**
  - **C**
    a
  - **CDF > 1.0** → Operating restrictions necessary



CDF is not the same as CDF obtained during structural design

Rigid ACR-PCR: PCR Report



Max. ACR ≤ PCR for all aircraft

No operating restrictions are necessary

Results Table 2. PCR Value

					ACR Thick at max. MGW (mm)	PCR/R/D
					522	1098.8

ght and Strength

					ACR Thick (mm) (D)	ACR/R/D
					147	92.6
					279	315.4
					323	423.4
4	B767-300 ER	158,757	92.4	1,168.60	386	601.9
5	A380-800 WV000	544,310	95	1,455.74	523	1098.8
6	B777-300	263,083	94.8	1,298.75	470	893.9

Overlay Design Example Using FAARFIELD 2.1

FAARFIELD Overlay Design

- **HMA Overlays on Flexible Pavement**
  - Same as designing a new flexible pavement, except the design layer is the HMA overlay.
- **PCC Overlays on Flexible Pavement**
  - Same principle as new rigid design.
- **HMA Overlays on Rigid Pavement**
- **PCC Overlays on Rigid Pavement**
  - More complex than new rigid pavement design.
  - Both slabs (base PCC and overlay) deteriorate with applied traffic. Stresses are computed for both slabs.
  - E-modulus of the base slab is a function of reduced SCI.

FAARFIELD Overlay Design –
PCC on Rigid Overlays

- **Fully bonded overlays**
  - Treat as a new rigid pavement design.
  - Thickness of overlay slab is $h_{overlay} = h_{design} - h_{exist}$.
- **Unbonded overlay**
  - Bond breaker or leveling course is used.
- **Partially bonded overlay**
  - Not a standard design in AC 150/5320-6F.
  - Default in FAARFIELD is off.
  - May be enabled from the Options window, but displays a “Non Standard Structure” message.

FAARFIELD Overlay Design –
HMA on Rigid Overlays

- **See AC 150/5320-6G, Paragraphs 4.7.5.5 & 4.7.5.6**
- **Current design procedure does not address reflection cracking.**
- **Default model assumes base concrete pavement continues to deteriorate under traffic, reaching a terminal SCI at end of life.**
- **Thick asphalt overlays on existing rigid pavements.**
  - Applies only when the overlay thickness exceeds the concrete thickness.
  - Can treat as a flexible design where the existing concrete acts as a high-quality base material.
  - Program performs both designs - reports the one that gives the thinner overlay.

FAARFIELD Overlay Design

Required Inputs

- **Existing rigid pavement condition is characterized by the Structural Condition Index (SCI).**
  - SCI derived from PCI as determined by ASTM D 5340, Airport Pavement Condition Index Surveys. AC 150/5320-6G, par. 4.7.5.3, gives guidance on SCI.
  - SCI is computed using only structural components from the PCI survey.
- **SCI = 80 is the FAA definition of structural failure. This is equivalent to 50% of the slabs in a section exhibiting a full-width structural crack)**
- **For existing pavements with structural damage (SCI < 100)**
  - The user inputs a value of SCI for the existing pavement.
  - The range of allowable values is SCI 67 – 100.
  - The Help file also gives approximate formulas for relating SCI to C_r and C_b factors in earlier FAA design methods.

FAARFIELD – PCC Unbonded Overlay Design Structural Condition Index (SCI)

Rigid Pavement Distress Types Used to Calculate SCI

Distress	Severity Level
Corner Break	Low, Medium, High
Longitudinal/Transverse/Diagonal Cracking	Low, Medium, High
Shattered Slab	Low, Medium, High
Shrinkage Cracks (cracking partial width of slab)*	Low
Spalling–Joint	Low, Medium, High

*** Used only to describe a load-induced crack that extends only part of the way across a slab. The SCI does not include conventional shrinkage cracks due to curing or other non load-related problems.**

Cumulative Damage Factor Used (CDFU)

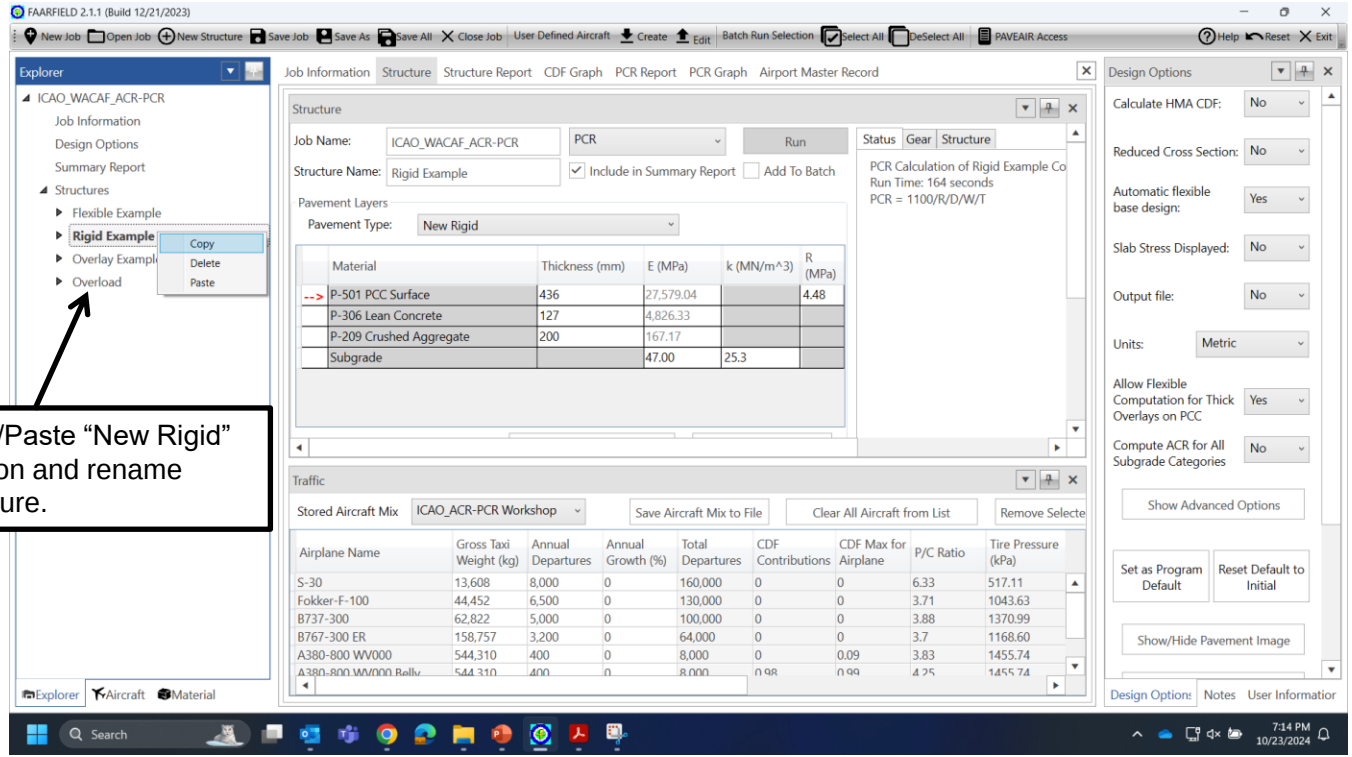
For existing pavements where SCI=100 (no structural distress):

- **There is no visible distress contributing to reduction in SCI (no structural distress types). However, some pavement life has been consumed by the applied traffic.**
- **The amount of pavement life consumed before the onset of cracking is the percent CDF Used (%CDFU).**
- **Need to estimate a value of %CDFU.**
- **The Help file gives guidance on estimating %CDFU using the Life key.**

HMA on Rigid Overlay Example

- **HMA overlay will be placed on an existing PCC slab**
- **Assume the previous traffic mix.**
- **Existing PCC slab:**
  - Assume SCI = 67 for existing slab.
- **All other design inputs same as previous example.**

Create a New Structure

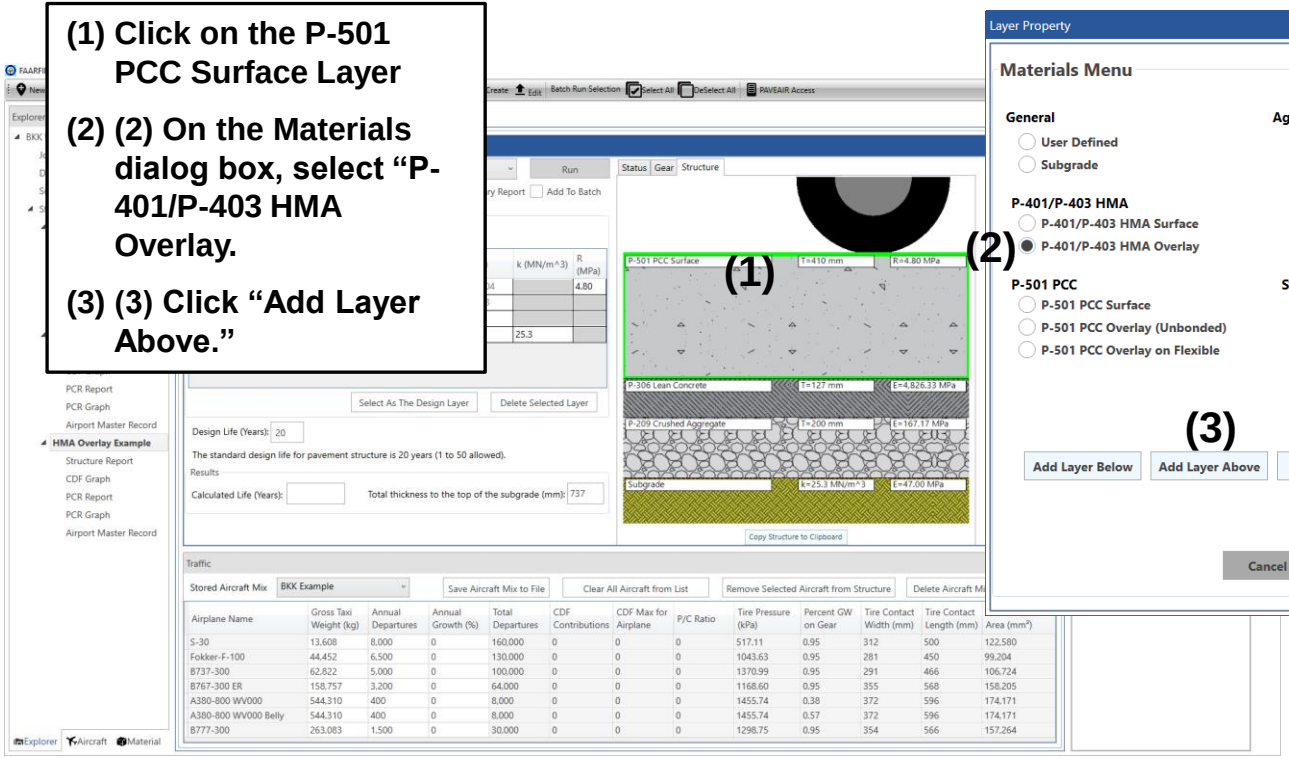


Modify the Structure

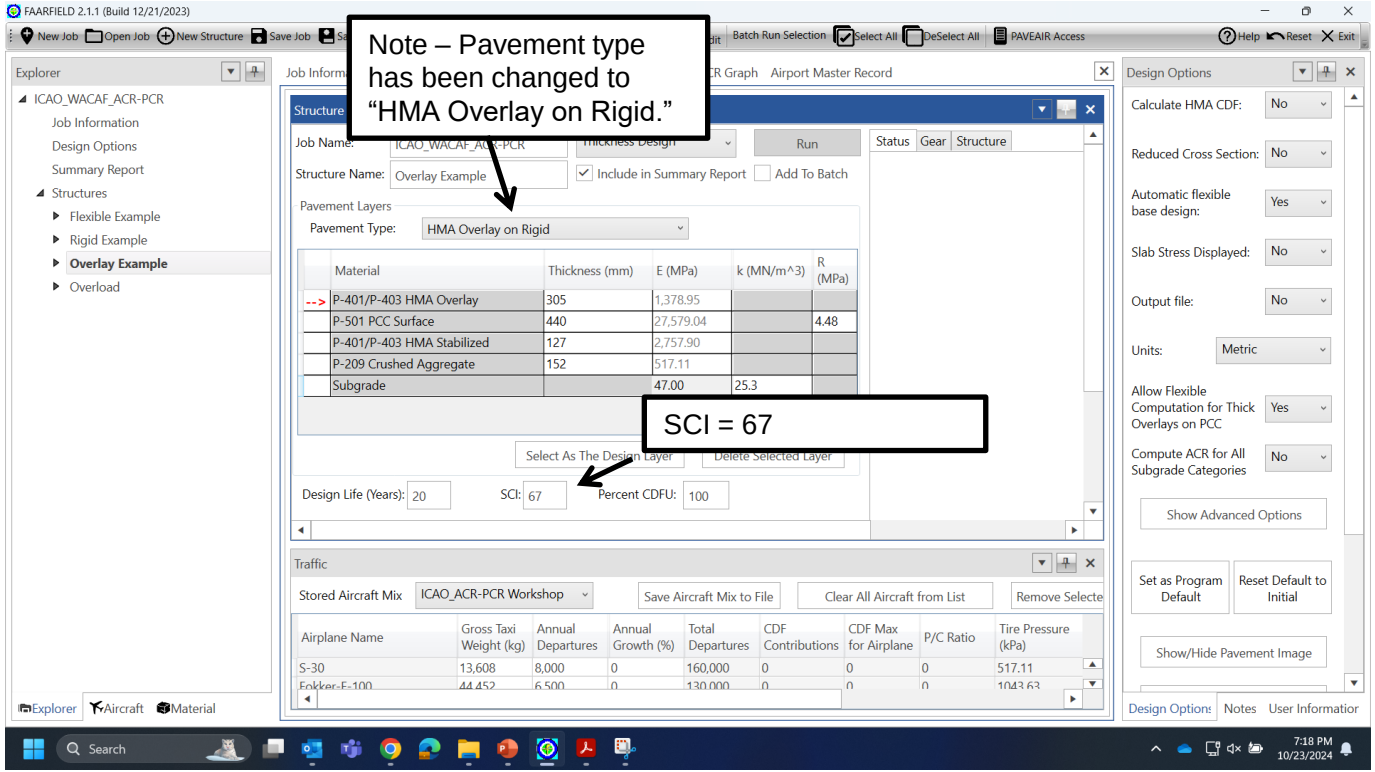
(1) Click on the P-501 PCC Surface Layer

(2) (2) On the Materials dialog box, select “P-401/P-403 HMA Overlay.

(3) (3) Click “Add Layer Above.”

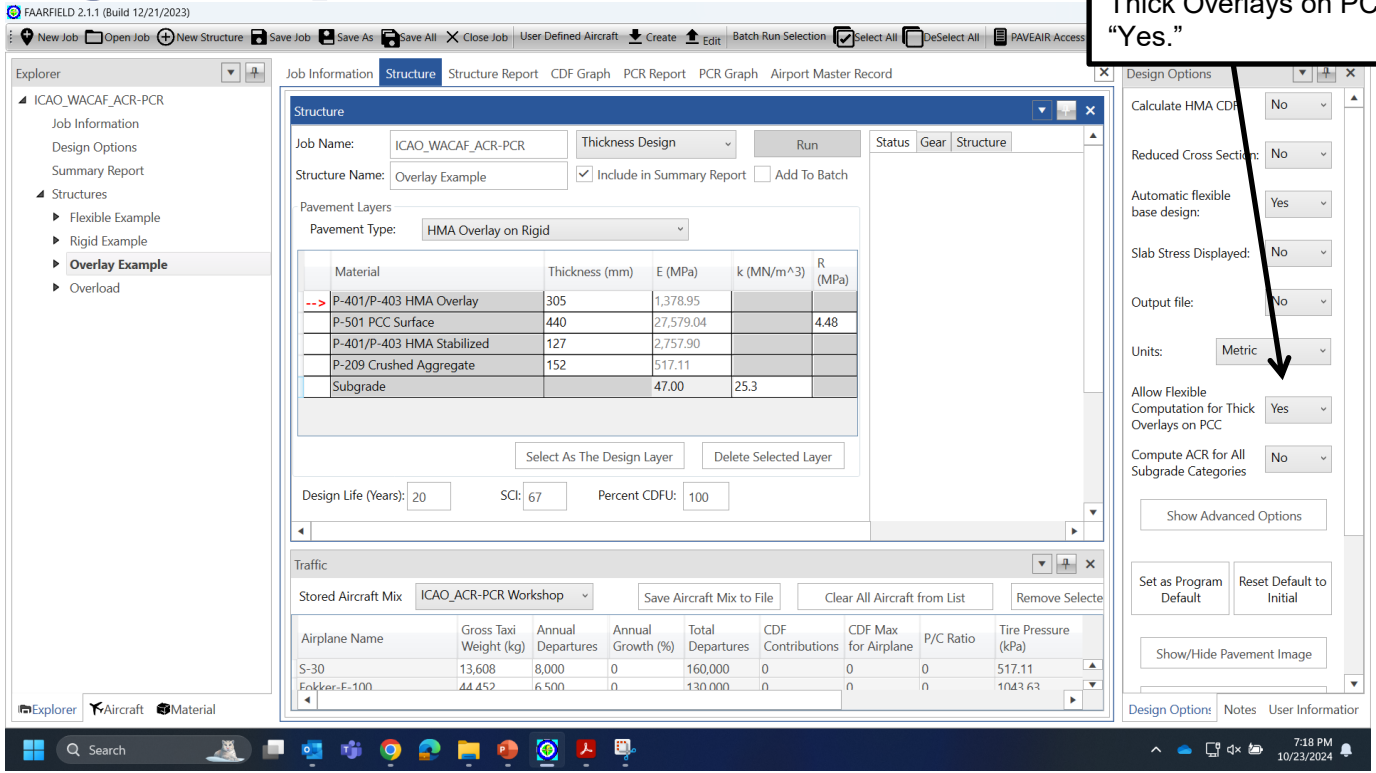


Modify the Structure

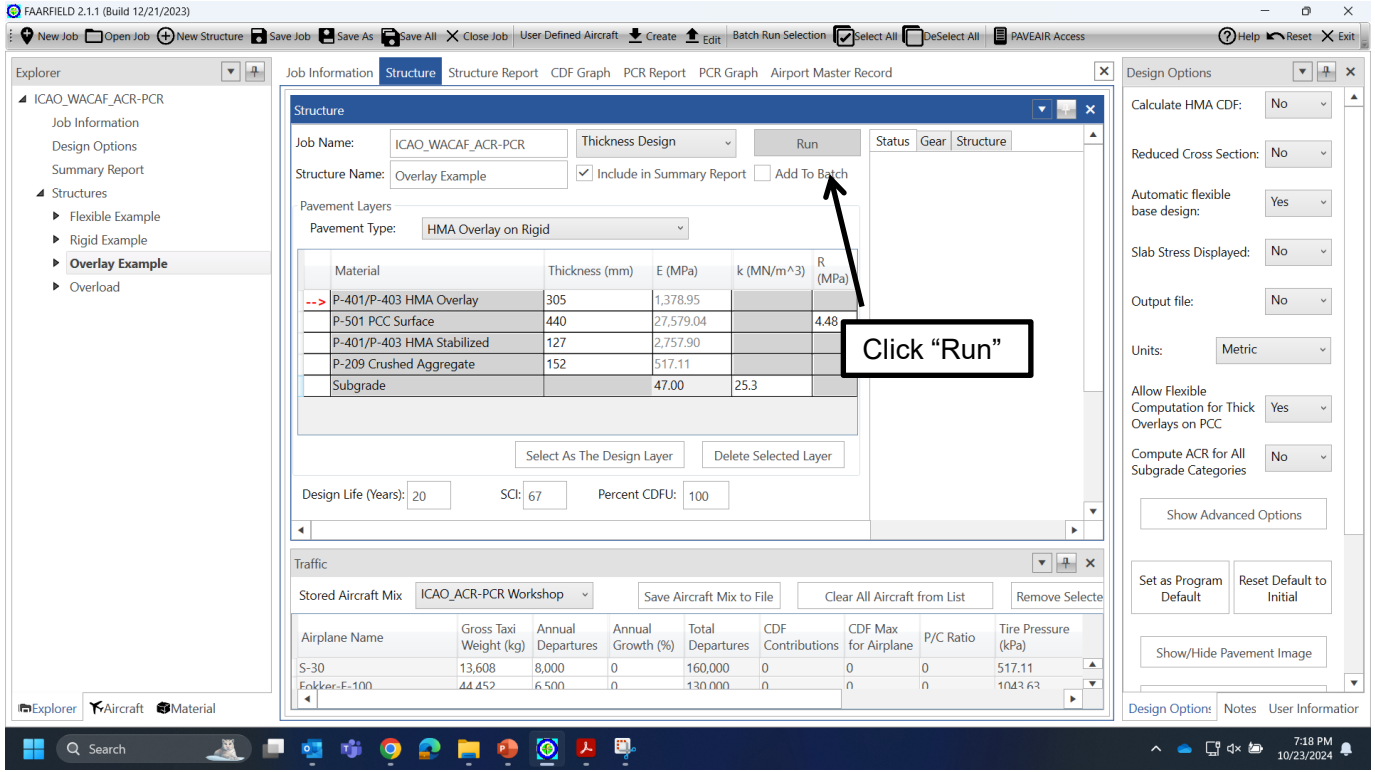


Design Options

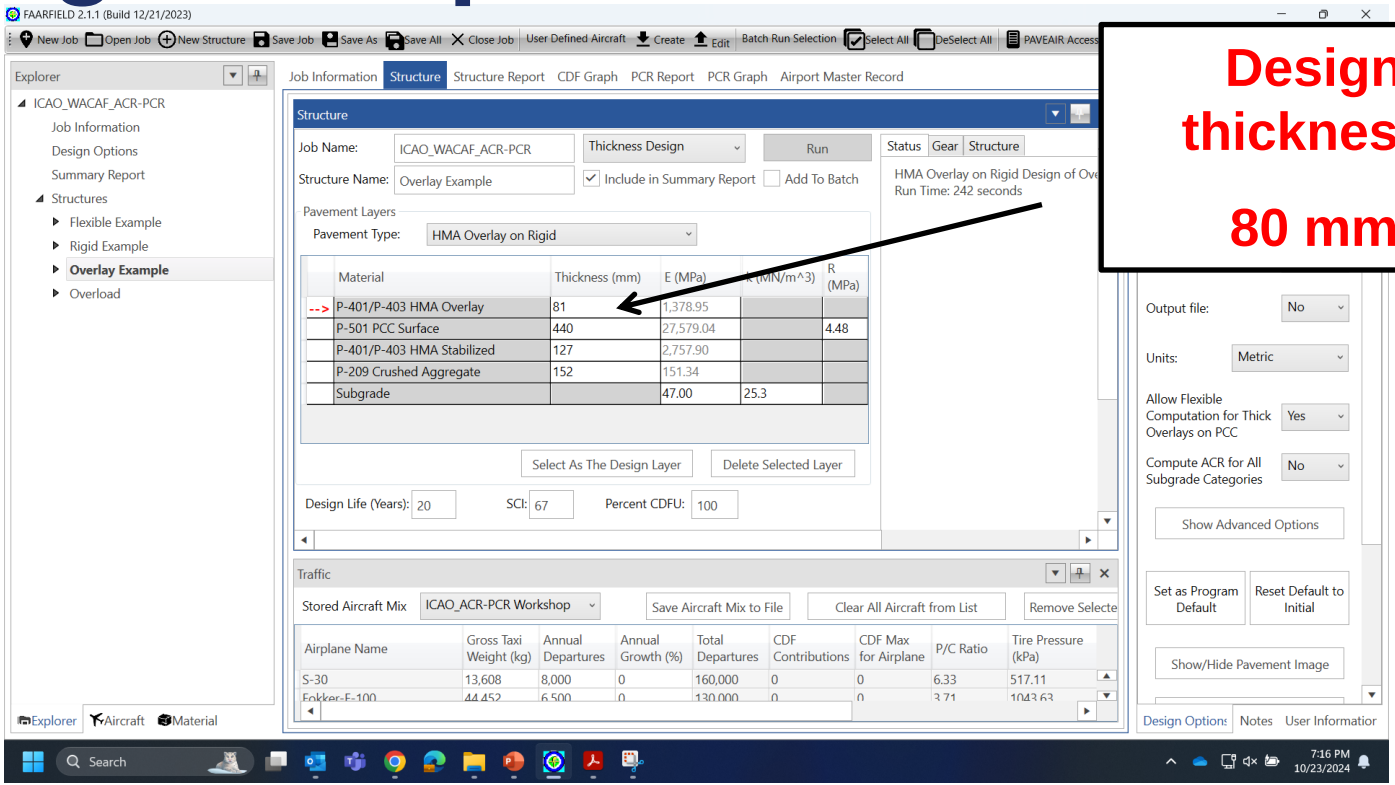
Design Options – Make sure "Allow Flexible Computation for Thick Overlays on PCC" is set to "Yes."



Run Overlay Design



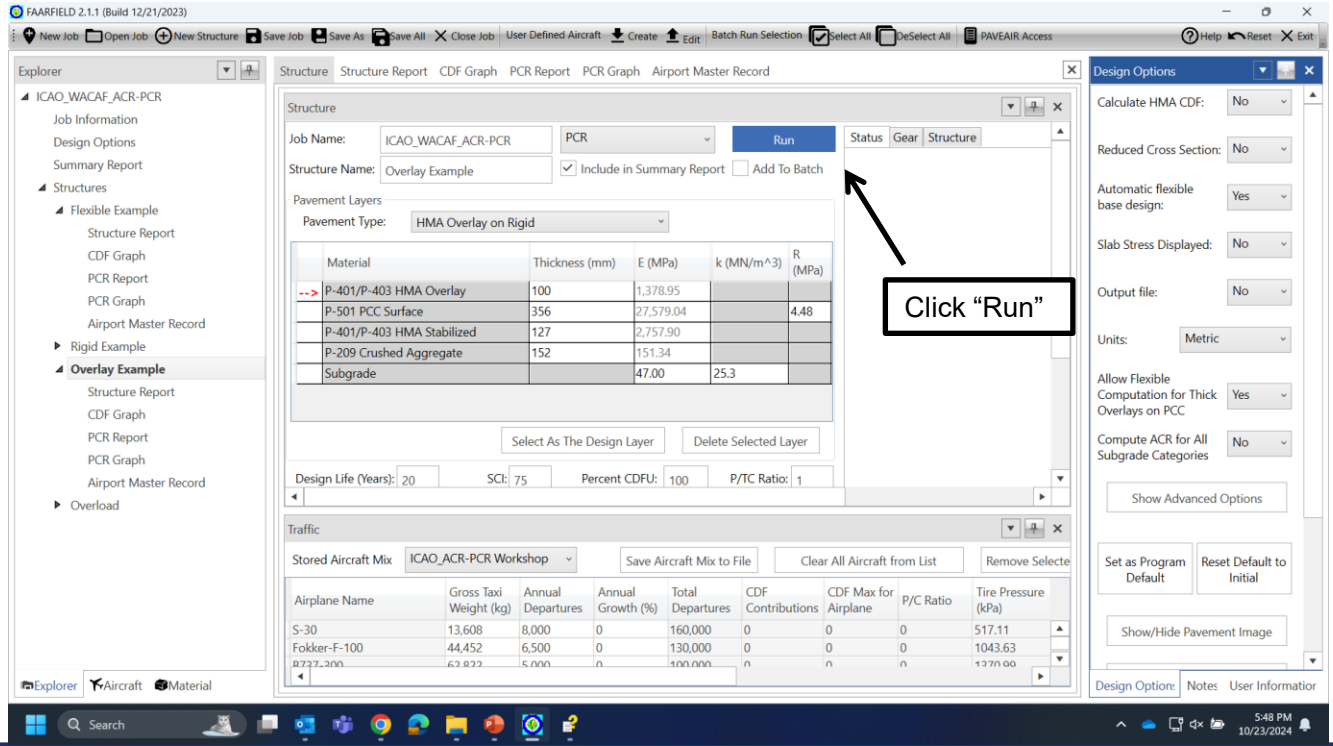
Design Complete



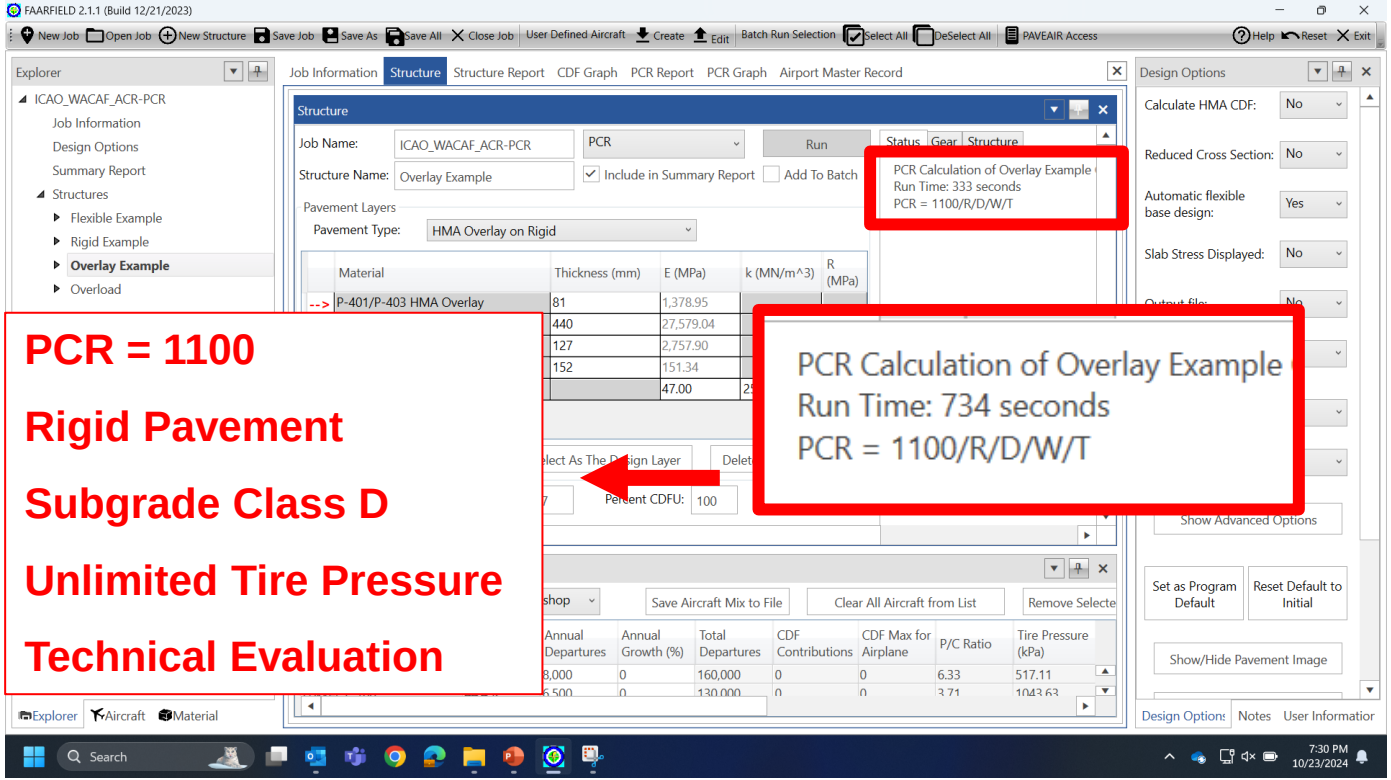
Design thickness:

80 mm

Run Overlay PCR Evaluation



Run Overlay PCR Evaluation



Thank You!

Acknowledgments:

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D'Lorah Small, Harold Honey, Jeff Crislip, Harold Muniz-Ruiz

ARA:
Tim Parsons; Richard Speir; Dr. Ali Z. Ashtiani; Dr. Kairat Tuleubekov

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