

FAARFIELD 1.4

Design Examples – Rigid

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By: David R. Brill. P.E., Ph.D.

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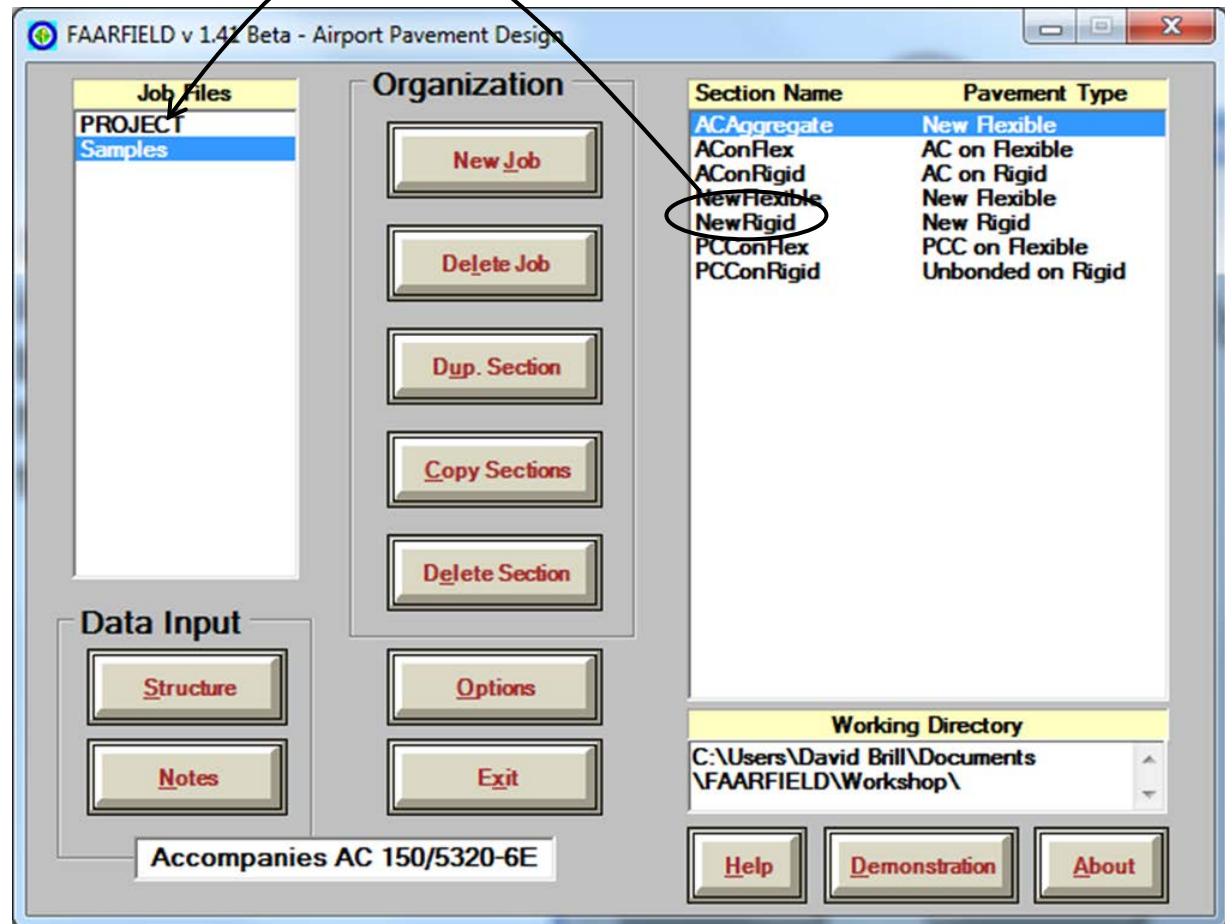


Federal Aviation
Administration



New Rigid Example Set-Up

Create a new section in job PROJECT by dragging section NewRigid in Samples to PROJECT.



New Rigid Pavement Design Example

- **Pavement Structure:**
 - PCC Slab, P-501, $R = 4.85 \text{ MPa psi}$
 - Cement-Treated Base, P-304, 150 mm thick
 - Crushed Aggregate Base, P-209, 200 mm thick
 - Subgrade $k = 27 \text{ MPa/m}$
- **Traffic Mix:**
 - 10-Aircraft Mix includes B777, A340, A380
 - Same traffic mix as flexible example.

Change Pavement Structure

In Structure window,
click on Modify
Structure

FAARFIELD v 1.41 Beta - Modify and Design Section NewRigid in Job PROJECT

Section Names
NewFlexible
NewRigid

PROJECT NewRigid Des. Life = 20

Layer Material	Thickness (mm)	Modulus or R (MPa)
PCC Surface	355.6	4.83
P-306 Econocrete	152.4	4,826.33
P-209 Cr Ag	152.4	517.11
Subgrade	k = 46.8	103.42

Total thickness to the top of the subgrade, t = 660.4 mm

Status

Airplane

Back Help Life **Modify Structure** Design Structure Save Structure

Change Pavement Structure

Change R to 4.85 MPa

Change base layer to
150 mm CTB, P-304

Change P-209 layer
thickness to 200 mm.

Change subgrade k to
27 Mpa/m

Click “End Modify”

FAARFIELD v 1.41 Beta - Modifying Section NewRigid in Job PROJECT

Section Names
NewFlexible
NewRigid

PROJECT NewRigid Des. Life = 20

Layer Material	Thickness (mm)	Modulus or R (MPa)
PCC Surface	355.6	4.83
P-306 Econocrete	152.4	4,826.33
P-209 Cr Ag	152.4	517.11
Subgrade	k = 46.8	103.42

Total thickness to the top of the subgrade, t = 660.4 mm

Modifying Structure

Airplane

Back Help Life End Modify Add/Delete Layer Save Structure

Change Pavement Structure

Click “Save Structure”

FAARFIELD v 1.41 Beta - Modify and Design Section NewRigid in Job PROJECT

Section Names
NewFlexible
NewRigid

PROJECT NewRigid Des. Life = 20

Layer Material	Thickness (mm)	Modulus or R (MPa)
PCC Surface	355.6	4.85
P-304 CTB	150.0	3,447.38
P-209 Gr Ag	200.0	517.11
Subgrade	k = 27.0	51.03

Total thickness to the top of the subgrade, t = 705.6 mm

Status

Airplane

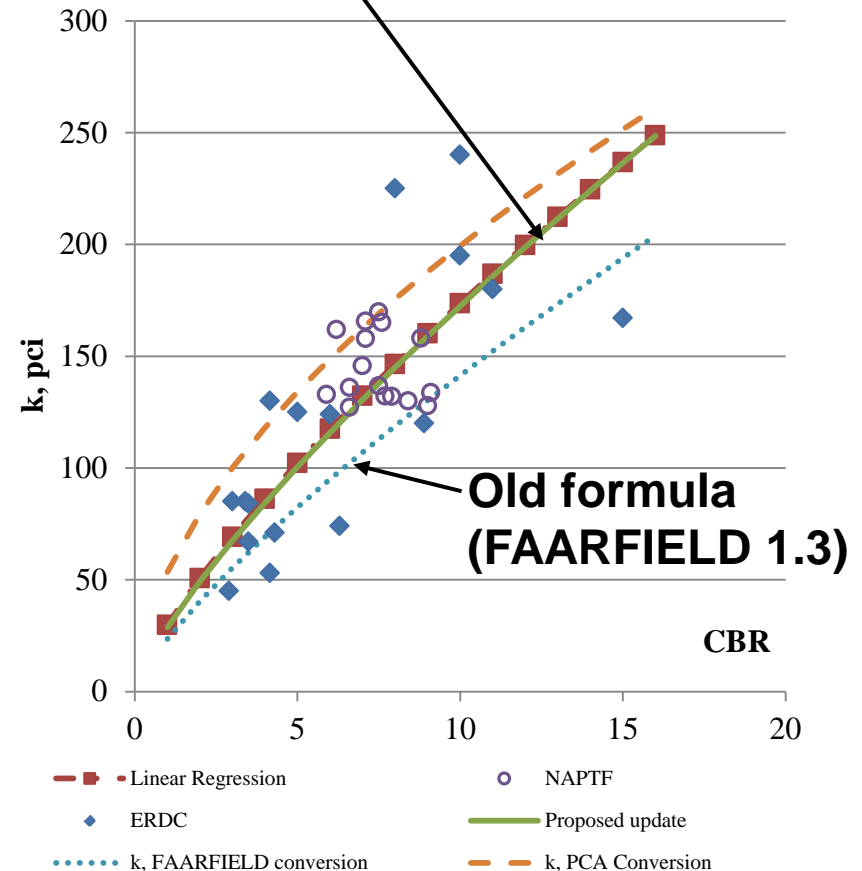
Back Help Life Modify Structure Design Structure Save Structure

Converting Subgrade k -Value to E



- FAARFIELD automatically converts k to E , and vice-versa.
- The new conversion formula used in FAARFIELD 1.4 is:
 $k = 28.6926 \times \text{CBR}^{0.7788}$
where: $\text{CBR} = E / 1500$
(E in psi, and k in psi/inch).
- Improved agreement with field correlations.
- Less conservative than previous formula when converting from CBR data.

New conversion formula
(FAARFIELD 1.4)



Enter Traffic Mixture

Same traffic mix as flexible example.

Use the “Float” Function.

Click on section “NewFlexible” to display the previous flexible design.

FAARFIELD v 1.41 Beta - Modify and Design Section NewRigid in Job PROJECT

Section Names

- NewFlexible
- NewRigid

PROJECT NewRigid Des. Life = 20

Layer Material	Thickness (mm)	Modulus or R (MPa)
PCC Surface	355.6	4.85
P-304 CTB	150.0	3,447.38
P-209 Cr Ag	200.0	517.11
Subgrade	k = 27.0	51.03

Total thickness to the top of the subgrade, t = 705.6 mm

Status

Airplane

Back Help Life Modify Structure Design Structure Save Structure

Enter Traffic Mixture

Click on “Airplane”
in section
NewFlexible.

FAARFIELD v 1.41 Beta - Modify and Design Section NewFlexible in Job PROJECT

Section Names
NewFlexible
NewRigid

PROJECT NewFlexible Des. Life = 20

Layer Material	Thickness (mm)	Modulus or R (MPa)
P-401/P-403 HMA Surface	100.0	1,378.95
P-401/P-403 St (flex)	127.0	2,757.90
→		
P-209 Cr Ag	561.5	493.97
Subgrade		
Subgrade	CBR = 8.0	82.74

Total thickness to the top of the subgrade, t = 788.5 mm

Status

Airplane

Back Help Life Modify Structure Design Structure Save Structure

Enter Traffic Mixture

Click on “Save to Float.” This stores the entire airplane list in memory.

Then click “Back”

Click “NewRigid” to return to the rigid section.

Airplane Name (11)	Gross Taxi Weight (tns)	Annual Departures	% Annual Growth
A320-100	68.400	600	0.00
A340-600 std	366.200	1,000	0.00
A340-600 std Belly	366.200	1,000	0.00
A380	562.000	300	0.00
B737-800	79.243	2,000	0.00
B747-400	397.801	400	0.00
B747-400ER	414.130	300	0.00
B757-300	124.058	1,200	0.00

Float Airplanes

- A320-100
- A340-600 std
- A340-600 std Belly
- A380
- B737-800
- B747-400
- B747-400ER
- B757-300

Enter Traffic Mixture

Click on “Airplane”
in section
NewRigid.

FAARFIELD v 1.41 Beta - Modify and Design Section NewRigid in Job PROJECT

Section Names
NewFlexible
NewRigid

PROJECT NewRigid Des. Life = 20

Layer Material	Thickness (mm)	Modulus or R (MPa)
PCC Surface	355.6	4.85
P-304 CTB	150.0	3,447.38
P-209 Cr Ag	200.0	517.11
Subgrade	k = 27.0	51.03

Total thickness to the top of the subgrade, t = 705.6 mm

Status

Airplane

Back Help Life Modify Structure Design Structure Save Structure

Enter Traffic Mixture

Hit “Clear List” and
Yes to clear the
default airplane list.

Then click “Add
Float.”

FAARFIELD v 1.41 Beta - Create or Modify Airplanes for Section NewRigid in Job PROJECT

Airplane Group	Airplane Name (3)	Gross Taxi Weight (tns)	Annual Departures	% Annual Growth	De
Generic	DC10-10	207.745	2,263	0.00	45
	B747-200B	377.842	832	0.00	10
	Combi Mixed				
	B777-200 ER	287.804	425	0.00	8

Library Airplanes

- SWL-50
- S-30
- S-45
- S-50
- S-60
- S-75
- D-50
- D-75
- D-100
- D-150
- D-200
- 2D-100
- 2D-150
- 2D-200
- 2D-300
- 2D-400

Buttons: Add, Remove, Save List, Clear List, Save to Float, Add Float, Back, Help, CDF Graph, View Gear

Float Airplanes

- A320-100
- A340-600 std
- A340-600 std Belly
- A380
- B737-800
- B747-400
- B747-400ER
- B757-300

Enter Traffic Mixture

The float airplane list now appears in the design aircraft table.

Scroll over to reveal additional columns of information.

FAARFIELD v 1.41 Beta - Create or Modify Airplanes for Section NewRigid in Job PROJECT

Airplane Group	Airplane Name (11)	Gross Taxi Weight (tns)	Annual Departures	% Annual Growth
Generic	A320-100	68.400	600	0.00
Airbus	A340-600 std	366.200	1,000	0.00
Boeing	A340-600 std Belly	366.200	1,000	0.00
McDonnell Douglas	A380	562.000	300	0.00
Other Commercial	B737-800	79.243	2,000	0.00
General Aviation	B747-400	397.801	400	0.00
Military	B747-400ER	414.130	300	0.00
Non-Airplane Vehicles	B757-300	124.058	1,200	0.00
NAPTF				

Library Airplanes

- SWL-50
- S-30
- S-45
- S-50
- S-60
- S-75
- D-50
- D-75
- D-100
- D-150
- D-200
- 2D-100
- 2D-150
- 2D-200
- 2D-300
- 2D-400

Buttons: Add, Remove, Save List, Clear List, Save to Float, Add Float, Back, Help, CDF Graph, View Gear

Float Airplanes

- A320-100
- A340-600 std
- A340-600 std Belly
- A380
- B737-800
- B747-400
- B747-400ER
- B757-300

Viewing Airplane Information

Values in CDF and P/C ratio columns will be zero when airplanes are first entered.

Save the list when finished, then click the Back button.

Airplane Name (11)	CDF Contribution	CDF Max for Airplane	P/C Ratio
A320-100	0.00	0.00	0.00
A340-600 std	0.00	0.00	0.00
A340-600 std Belly	0.00	0.00	0.00
A380	0.00	0.00	0.00
B737-800	0.00	0.00	0.00
B747-400	0.00	0.00	0.00
B747-400ER	0.00	0.00	0.00
B757-300	0.00	0.00	0.00

Run the Design

Click “Design Structure”

FAARFIELD v 1.41 Beta - Modify and Design Section NewRigid in Job PROJECT

Section Names
NewFlexible
NewRigid

PROJECT NewRigid Des. Life = 20

Layer Material	Thickness (mm)	Modulus or R (MPa)
PCC Surface	355.6	4.85
P-304 CTB	150.0	3,447.38
P-209 Cr Ag	200.0	517.11
Subgrade	k = 27.0	51.03

Total thickness to the top of the subgrade, t = 705.6 mm

Status

Airplane

Back Help Life Modify Structure Design Structure Save Structure

Running the Design

During the design process, the “Design Running” clock will appear.

For rigid designs, the design will normally take a few minutes. Don’t interrupt the process.

The screen display will change with each iteration.

FAARFIELD v 1.41 Beta - Designing Section NewRigid in Job PROJECT

Section Names
NewFlexible
NewRigid

PROJECT NewRigid Des. Life = 20

Layer Material	Thickness (mm)	Modulus or R (MPa)
PCC Surface	506.5	4.85
P-304 CTB	150.0	3,447.38
P-209 Cr Ag	200.0	178.24
Subgrade	k = 27.0	51.03

N = 0; PCC CDF = 1.00; t = 856.5 mm

Design Running 00:00:30

Airplane

Back Help Life Modify Structure Design Structure Interrupt Design

Final Design

FAARFIELD v 1.41 Beta - Modify and Design Section

Section Names
NewFlexible
NewRigid

Design Stopped
260.86; 260.47

Airplane

Back Help Life Modify Structure Design Structure Save Structure

PRO
Layer
Material

	(mm)	(MPa)
PCC Surface	506.5	4.85
P-304 CTB	150.0	3,447.38
P-209 Cr Ag	200.0	178.24
Subgrade	k = 27.0	51.03

N = 0; PCC CDF = 1.00; t = 856.5 mm

Thickness should be rounded to nearest 1 cm (510 mm).

PCC Stresses for Rigid Design



- **FAARFIELD 1.4** compares maximum edge stress and interior stress for all airplanes.
- The larger value is used in design.
- Output file *NikePCC.out* lists stress values:

Aircraft No. 5 B737-800

PCC SLAB Edge HOR STRESS	PCC SLAB Interior HOR STRESS
245.3775	236.6298
PCC SLAB HOR STRESS	
245.3775	

Aircraft No. 11 B787-8

PCC SLAB Edge HOR STRESS	PCC SLAB Interior HOR STRESS
324.2925	398.8099
PCC SLAB HOR STRESS	
398.8099	

B737-800:

Design Stress = Edge Stress

B787-8:

Design Stress = Interior Stress

PCC Overlay Design

- **PCC overlay will be placed on an existing PCC slab.**
- **Assume the previous traffic mix.**
- **Existing PCC slab:**
 - 360 mm P-501, $R = 4.85$ Mpa.
 - $SCI = 80$ for existing slab.
- **New slab: assume $R = 4.5$ Mpa.**
- **All other design inputs same as previous example.**

Adding an Overlay

In “Modify” mode, change the thickness of the P-501 concrete layer to 360 mm.

FAARFIELD v 1.41 Beta - Modifying Section NewRigid in Job PROJECT

Section Names
NewFlexible
NewRigid

PROJECT NewRigid Des. Life = 20

Layer Material	Thickness (mm)	Modulus or R (MPa)
PCC Surface	506.4	4.85
P-304 CTB	150.0	3,447.38
P-209 Cr Ag	200.0	178.24
Subgrade	k = 27.0	51.03

N = 0; PCC CDF = 1.00; t = 856.4 mm

Modifying Structure

Airplane

Back Help Life End Modify Add/Delete Layer Save Structure

Adding an Overlay

Next, click on
“Add/Delete Layer.”

FAARFIELD v 1.41 Beta - Modifying Section NewRigid in Job PROJECT

Section Names
NewFlexible
NewRigid

PROJECT NewRigid Des. Life = 20

Layer Material	Thickness (mm)	Modulus or R (MPa)
PCC Surface	360.0	4.85
P-304 CTB	150.0	3,447.38
P-209 Cr Ag	200.0	178.24
Subgrade	k = 27.0	51.03

N = 0; PCC CDF = 1.00; t = 710.0 mm

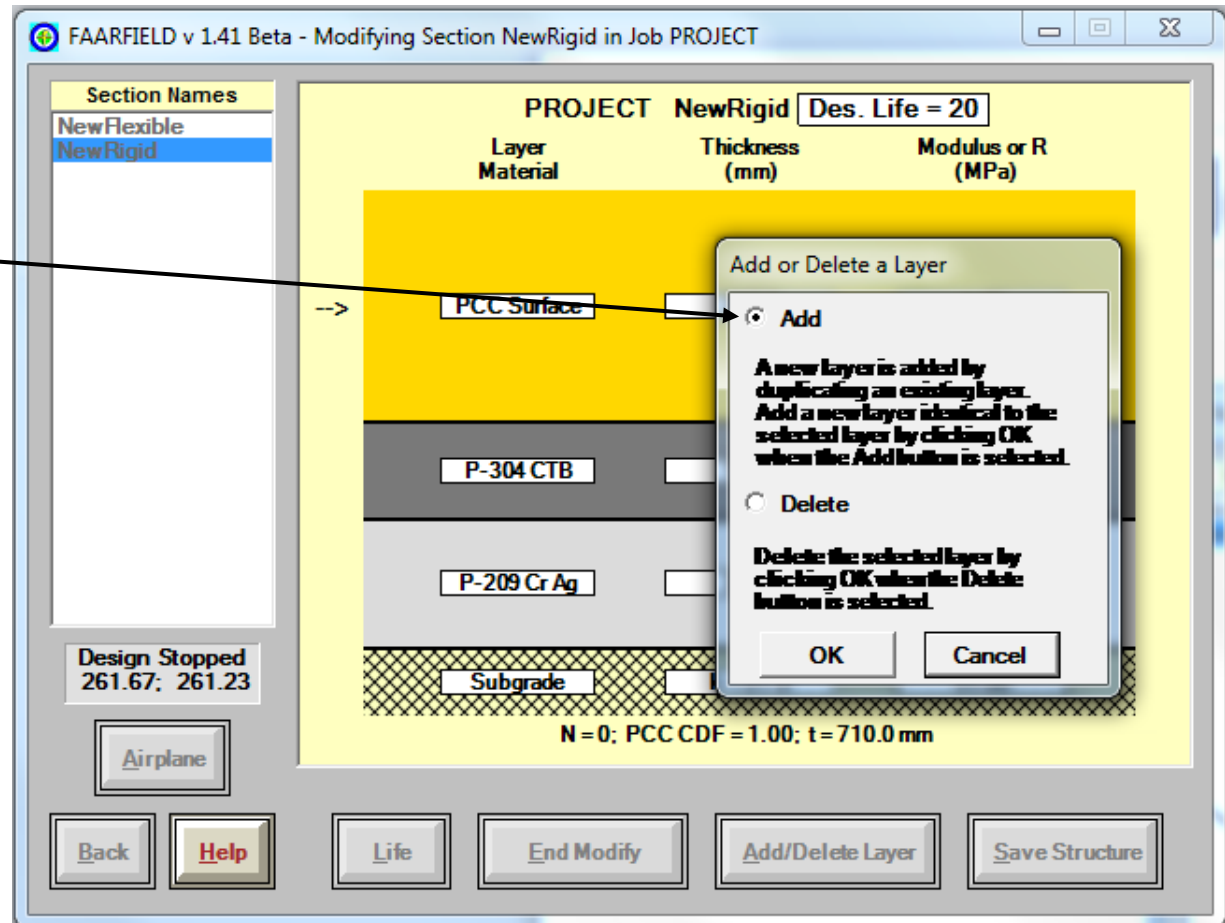
Design Stopped
261.67; 261.23

Airplane

Back Help Life End Modify Add/Delete Layer Save Structure

Adding an Overlay

Click on the PCC Surface layer and select “Add” from the dialog box.



Adding an Overlay

The screen will display a message “Non-Standard Structure.”

Click on the top layer material to bring up the “Layer Type Selection” dialog box.

FAARFIELD v 1.41 Beta - Modifying Section NewRigid in Job PROJECT

Section Names

- NewFlexible
- NewRigid

Design Stopped
261.67; 261.23

Airplane

Back Help Life End Modify Add/Delete Layer Save Structure

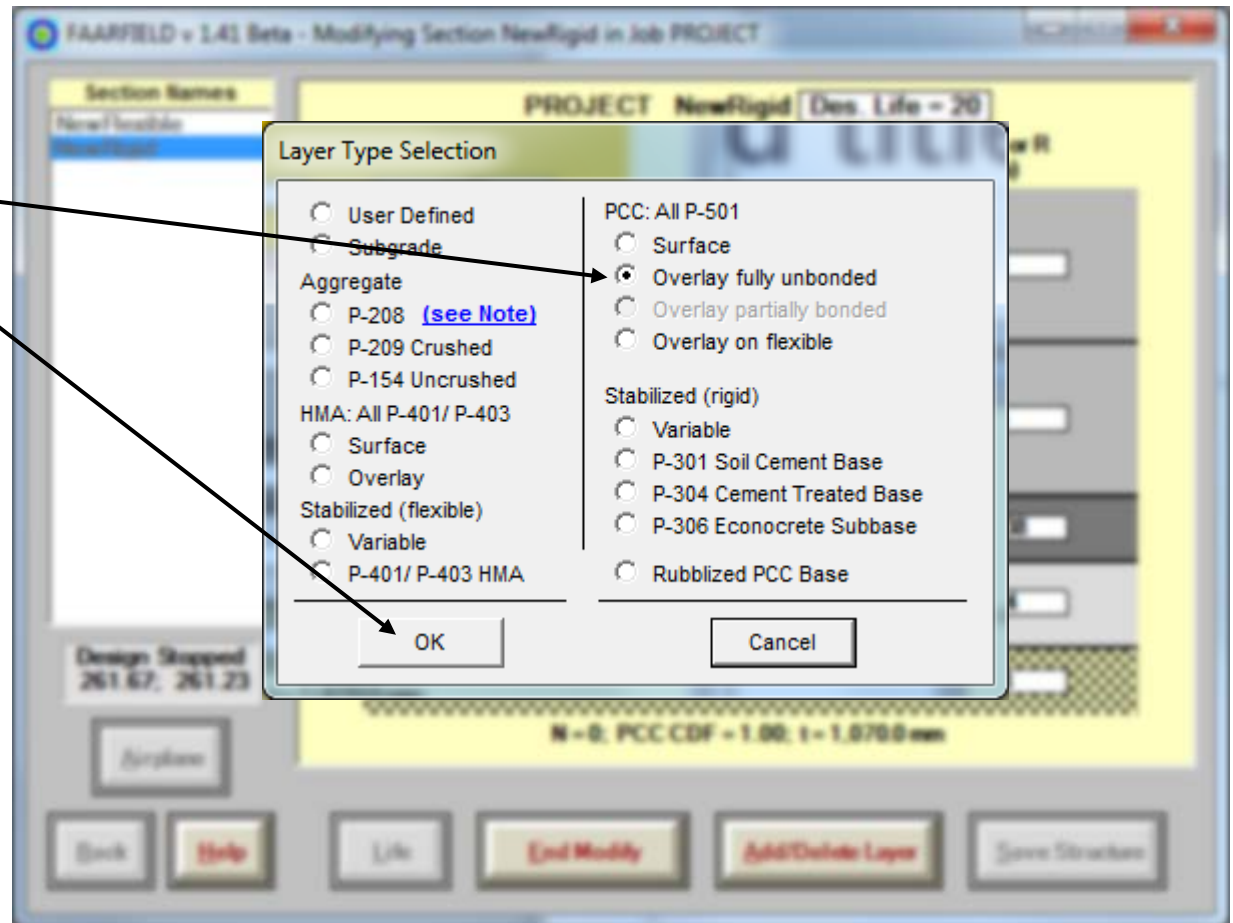
PROJECT NewRigid Des. Life = 20

Layer Material	Thickness (mm)	Modulus or R (MPa)
PCC Surface	360.0	4.85
Non-Standard Structure		
PCC Surface	360.0	4.85
P-304 CTB	150.0	3,447.38
P-209 Cr Ag	200.0	178.24
Subgrade	k = 27.0	51.03

N = 0; PCC CDF = 1.00; t = 1,070.0 mm

Adding an Overlay

Select “Overlay fully unbonded” and click OK.



Adding an Overlay

Change SCI to 80.

Change *R* to 4.50 MPa for overlay PCC.

Click End Modify.

FAARFIELD v 1.41 Beta - Modifying Section NewRigid in Job PROJECT

Section Names: NewFlexible, NewRigid

PROJECT NewRigid Des. Life = 20 SCI = 80 %CDFU = 100

Layer Material	Thickness (mm)	Modulus or R (MPa)
PCC Overlay Unbond	360.0	4.50
PCC Surface	360.0	4.85
P-304 CTB	150.0	3,447.38
P-209 Cr Ag	200.0	178.24
Subgrade	k = 27.0	51.03

N = 0; Str Life = 0.0 yrs; t = 1,070.0 mm

Design Stopped 261.67; 261.23

Airplane

Back Help Life End Modify Add/Delete Layer Save Structure

Design the Structure

Click Design Structure.

FAARFIELD v 1.41 Beta - Modify and Design Section NewRigid in Job PROJECT

Section Names
NewFlexible
NewRigid

PROJECT NewRigid Des. Life = 20 SCI = 80 %CDFU = 100

Layer Material	Thickness (mm)	Modulus or R (MPa)
PCC Overlay Unbond	360.0	4.50
PCC Surface	360.0	4.85
P-304 CTB	150.0	3,447.38
P-209 Cr Ag	200.0	178.24
Subgrade	k = 27.0	51.03

N = 0; Str Life = 0.0 yrs; t = 1,070.0 mm

Design Stopped
261.67; 261.23

Airplane

Back Help Life Modify Structure Design Structure Save Structure

Final Overlay Design

FAARFIELD v 1.41 Beta - Modify and Design Section N

Section Names
NewFlexible
NewRigid

Design Stopped
779.64; 408.86

Airplane

Back Help Life Modify Structure Design Structure Save Structure

PROJECT NewRigid

Layer Material	Thickness (mm)	Modulus or R (MPa)
PCC Overlay Unbond	441.1	4.50
PCC Surface	360.0	4.85
P-304 CTB	150.0	3,447.38
P-209 Cr Ag	200.0	178.24
Subgrade	k = 27.0	51.03

N = 1; Str Life = 20.0 yrs; t = 1,151.0 mm

Thickness should be rounded to nearest 1 cm (440 mm).

Thank You! ¡Muchas Gracias!

<http://www.airporttech.tc.faa.gov/>
david.brill@faa.gov

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