AGGAA

ASSOCIATION OF GEORGIA GENERAL AVIATION AIRPORTS

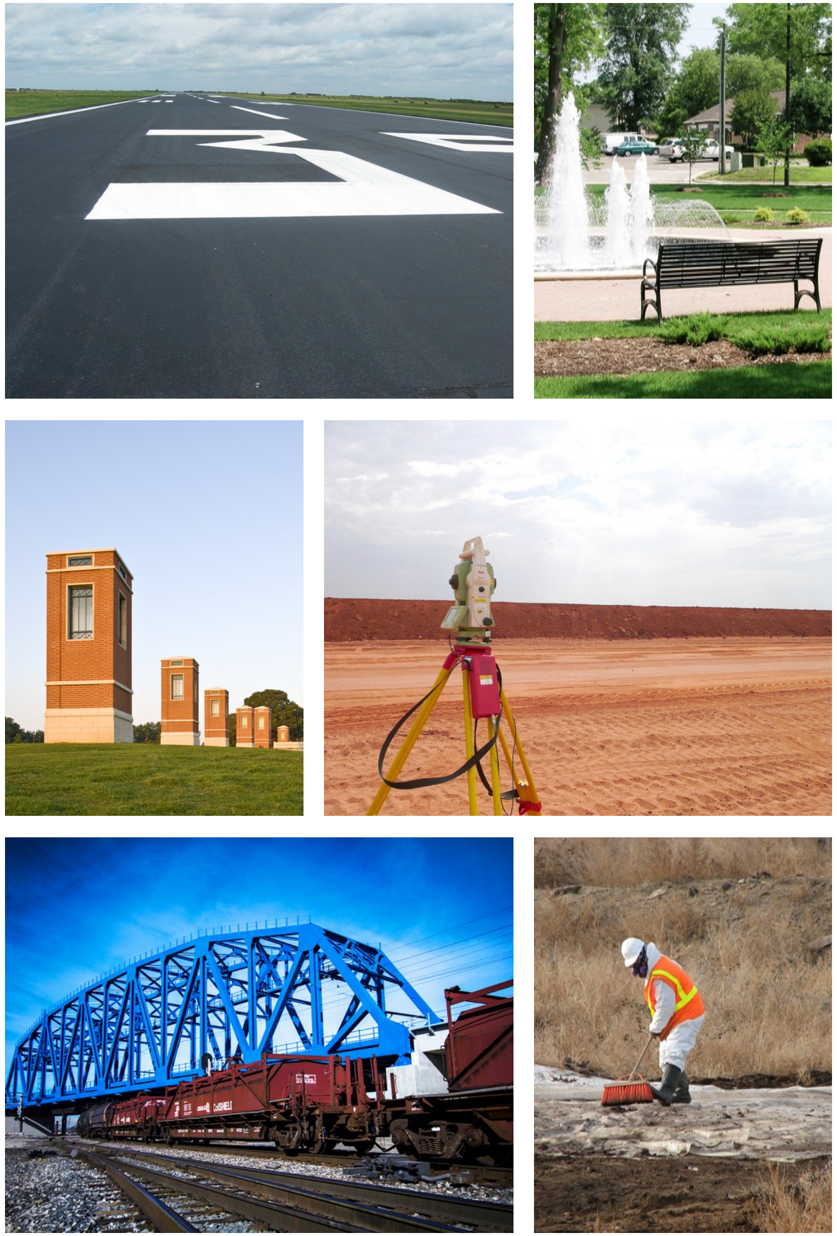
Airport Pavements- From the Ground Up

AGGAA 1st Annual Conference

Breakout Session #3

Jason Wright M.S., PE

benesch



Benesch-Services

- Roadway/Bridges
- Municipal
- Buildings
- Railroad
- Water Services
- Geotechnical
- Environmental
- Aviation
- Value Engineering
- Landscape Architecture
- Site Development

benesch 75 years

Presentation Outline

Airport Pavement Design

- Brief History of Airfield Pavement Design
- Airfield Pavement Condition Rating System
- Repair And Rehabilitation Methods
- Designing Airfield Pavements- FAARFIELD 2.0
- Fleet Mix Determination
- Design Outputs-Final Pavement Design

History of FAA Pavement Design

- 1958- FAA adopted a policy of limiting aircraft for federal pavements to a pavement section designed to serve a 350,000-pound airplane with a DC-8-50 series landing gear configuration.
- Indented to make future airplanes equipped with landing gears that would not stress pavements more than the referenced 350,000-pound airplane

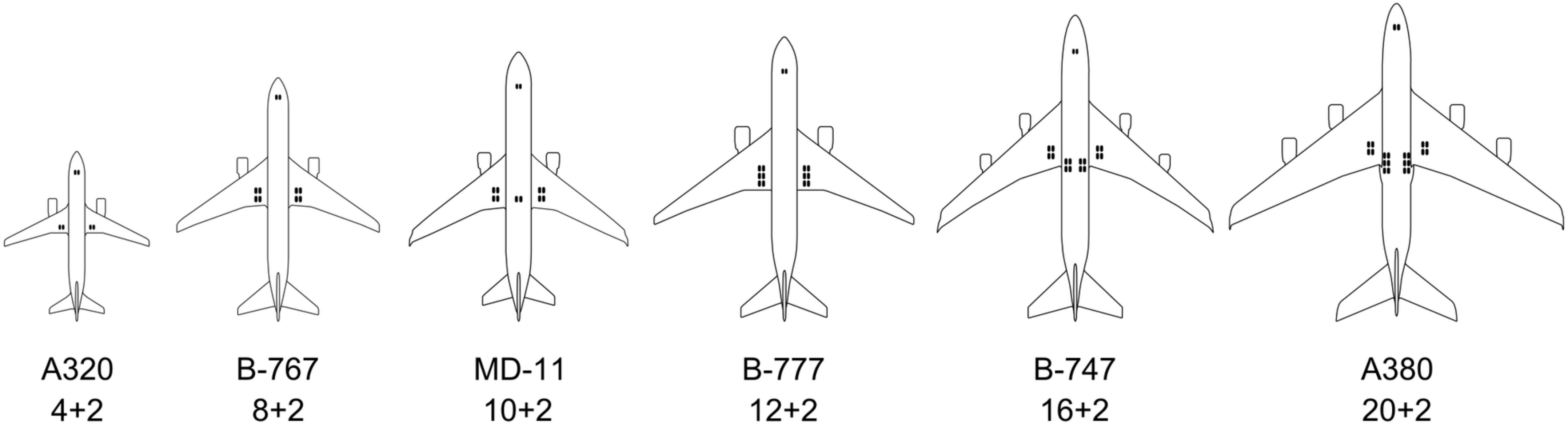
History of FAA Pavement Design

- Airplane followed the 1958 policy though exceeding 350,000 pounds through new gear configurations.

History of FAA Pavement Design

- With this change in philosophy and increasing airplane weights, airfield pavements must be designed to withstand increased loading conditions

- Historical FAA pavement design based on methods of analysis that resulted from empirical research and field performance

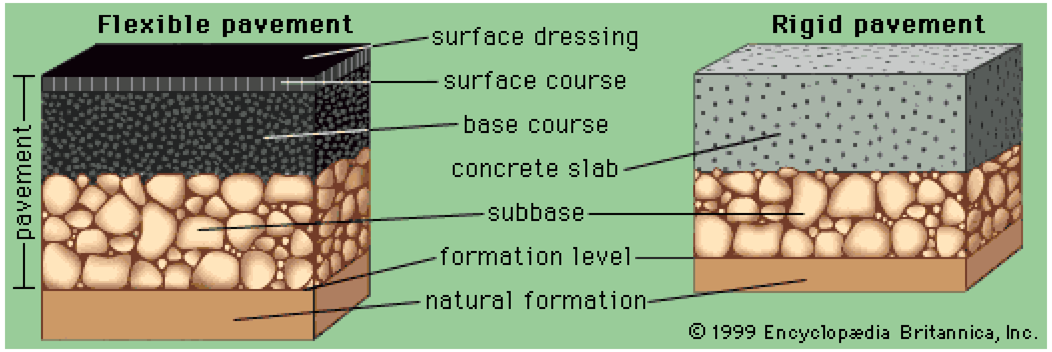


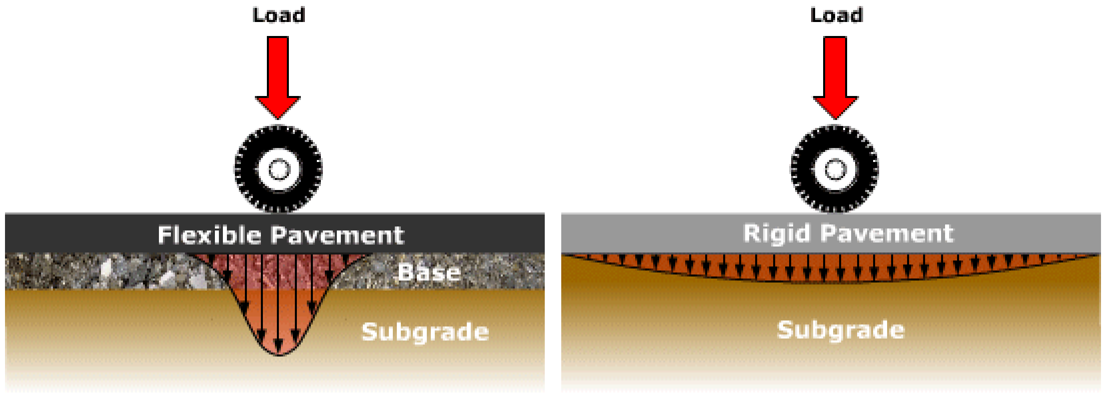
FAA Pavement Design

- FAARFIELD was published in 2009 and accompanied AC 150/5320-6E
- FAA Rigid and Flexible Iterative Elastic Layered Design
- Mixed both empirical testing with mechanistic design
- Validated through full scale testing in full-scale traffic tests at the FAA National Airport Pavement Test Facility
- FAARFIELD 2.0 Published in 2021 and accompanied AC 150/5320-6G

Types of Airfield Pavements

- Flexible Pavements (Asphalt)
- Rigid Pavements (Concrete)
- Flexible Overlay
- Rigid Overlay





How Airfield Pavement Projects are Determined

New Pavement Projects

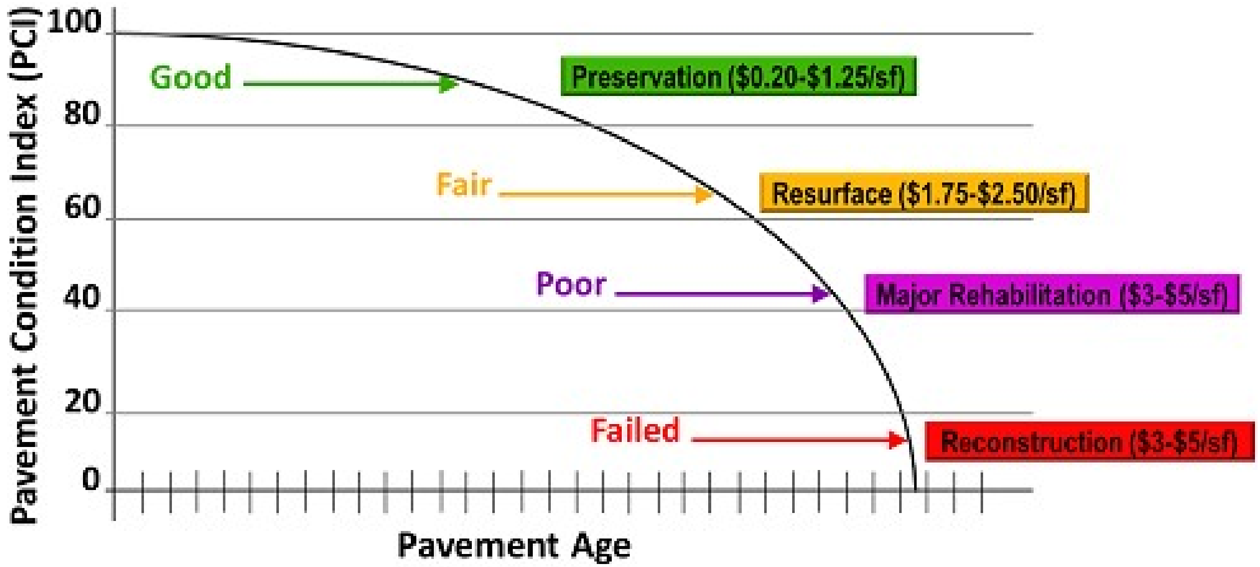
- CIP Projects for airport expansion
- Includes, Runway Extensions, Apron Expansion projects, New Parallel Taxiways, Etc.

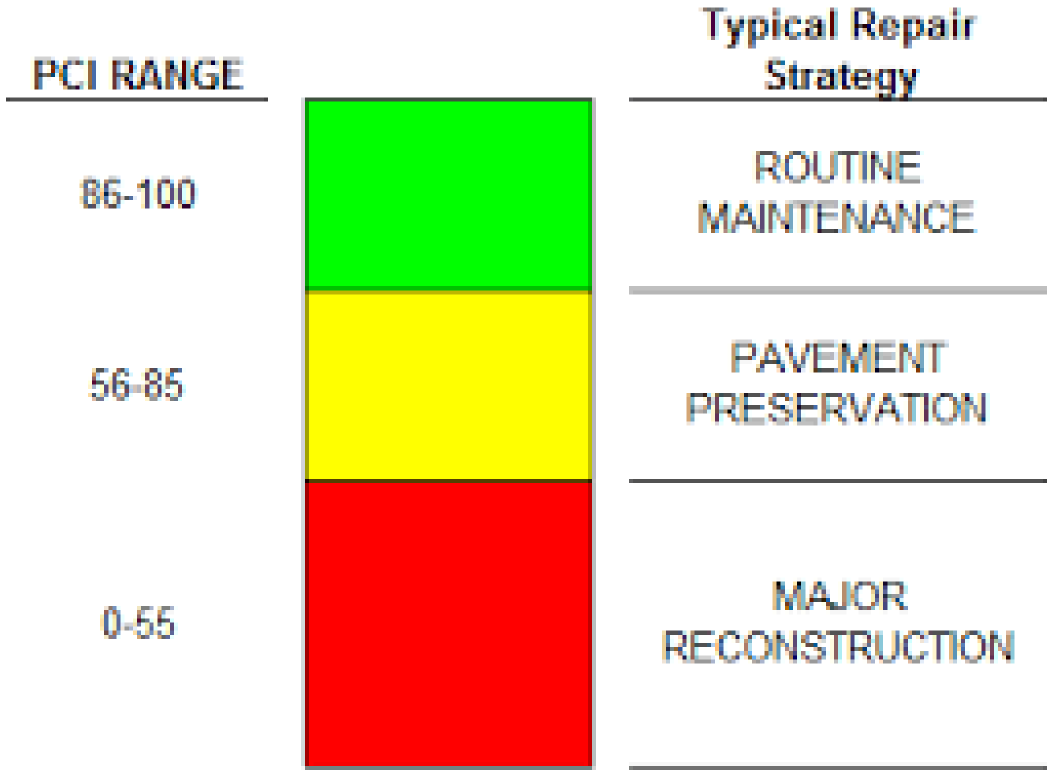
Existing Pavement Maintenance, Repair, and Strengthening

- Based off existing pavement condition to ensure airfield safety

Airfield Pavement Condition Index (PCI)

- Rated 0-100
- Used to program repair/maintenance on airfields





GDOT Statewide Airport Pavement Management System (APMS)

- Established in 1998 to monitor health of airport pavement in the state of Georgia
- Includes 94 general aviation airports & 8 commercial service airports
- Pavements Evaluated every 5 years with last evaluation in 2018

Airfield Pavements Maintenance- AC 150/5380-6B

- Maintenance includes any regular work necessary to preserve existing airport pavements in good condition

Flexible Pavement Maintenance

- Crack Sealing
- Fog Sealing
- Chip Sealing

Rigid Pavement Maintenance

- Crack Sealing
- Patching
- Joint Seal Replacement
- Airfield Rubber Removal

Airfield Pavement- Repair and Rehabilitation Methods

- Flexible Pavement
  - Crack repair
  - Partial and full Depth Repair
  - Mill & Overlay
  - Reconstruction-Includes Base
  - Full Depth Reclamation

- Rigid Pavement
  - Full Slab Replacement
  - Partial Slab Replacement
  - Full Depth Repair

New Airfield Pavements

AC 150/5320-6G-Airport

Pavement Design & Evaluation

- The FAA recommends the guidance and standards in this AC for airport pavement design and evaluation
- However, use of the standards in this AC is mandatory for all projects funded under the Airport Improvement Program (AIP)

Contents

- Soil Investigations & Evaluation
- Pavement Design Procedure
- Pavement Structural Evaluation

Airport Pavement Design Standards

- AC 150/5320-6G-Airport Pavement Design and Evaluation
  - Used for General Aviation, Commercial Airports
  - FAARFIELD Design Software

FAA Minimum Layer thicknesses

Table 3-3. Minimum Layer Thickness for Flexible Pavement Structures[1]

Layer Type	FAA Specification Item	Maximum Aircraft Gross Weight Operating on Pavement, lbs (kg)		
		<60,000 (27,215)	< 100,000 (45,360)	≥100,000 (45,360)
Asphalt Surface[2]	P-401/P-403	3 in (75 mm)	4 in (100 mm)	4 in (100 mm)
Stabilized Base[3]	P-401 or P-403; P-304; P-306[3]	Not Required	Not Required	5 in (125 mm)
Crushed Aggregate Base[5,6]	P-209, P-211	Not Required	6 in (150 mm)	6 in (150 mm)
Aggregate Base[5,6]	P-207, P-208, P-210, P-212, P-213, P-219	6 in (75 mm)	n/a	n/a
Drainable Base (When Used)	P-307, P-407[7]	Not Required	6 in (150 mm) when used	6 in (150 mm) when used
Subbase[6,8]	P-154	6 in (150 mm) (if required)	6 in (150 mm) (If required)	6 in (150 mm) (if required)

Notes:
1. Structural design must be completed to determine layer thicknesses required to support actual traffic.
2. P-403 as surface course when all aircraft less than 60,000 lbs (27215 kg). P-404-Fuel Resistant Hot Mix Asphalt may be used to replace the top 1 1/2 in (75 mm) to 3 in (75mm) of P-401or P-403 where a fuel resistant surface is needed; structurally, P-404 considered same as P-401.
3. See paragraph 3.5, Stabilized Base Course, for requirements and limitations.
4. Use of P-304 or P-306 requires measures to control potential for reflective cracking.
5. P-208, P-210, P-212, P-213, limited to pavements designed for gross loads of 60,000 pounds (27,215 kg) or less or for use as subbase.
6. P-207, P-219 require laboratory testing to establish if it will perform as a base or subbase. If CBR > 100 may be used as a stabilized base, If CBR > 80 may be used in place of P-209, CBR >60 in place of P-208. Both may be used as a subbase under stabilized base.
7. See EB 102, *Asphalt Treated Permeable Base.*
8. P-154, when structural thickness of subbase required by FAARFIELD is less than 6 in, eliminate subbase in FAARFIELD and calculate thickness of base.

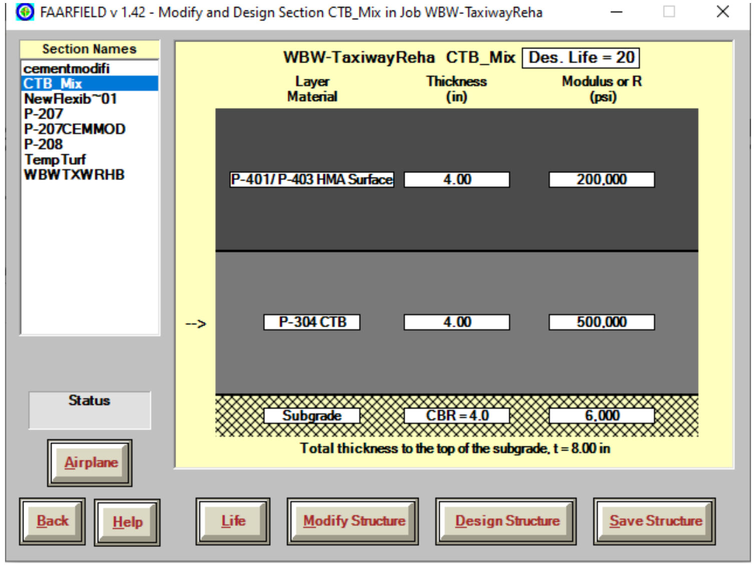
Table 3-4. Minimum Layer Thickness for Rigid Pavement Structures[1]

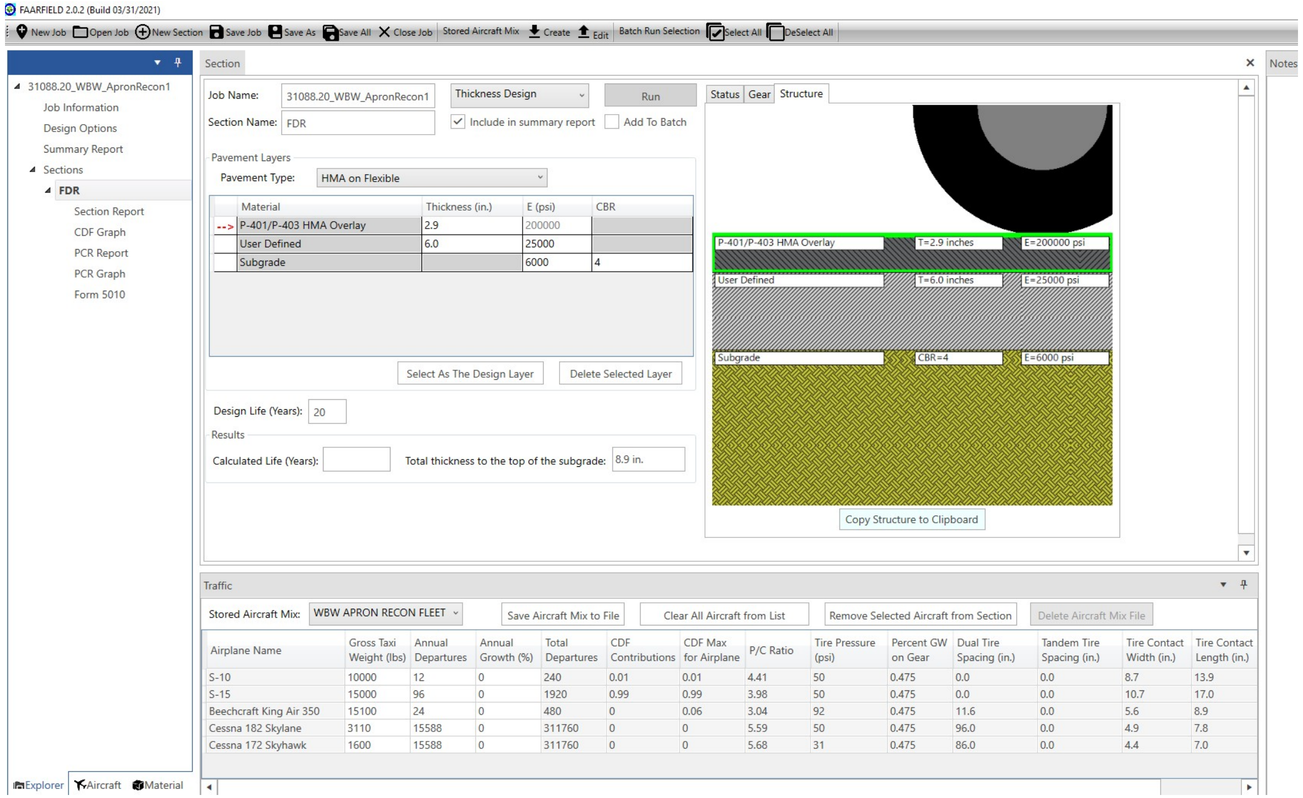
Layer Type	FAA Specification Item	Maximum Aircraft Gross Weight Operating on Pavement, lbs (kg)		
		<60,000 (27,215)	< 100,000 (45,360)	≥ 100,000 (45,360)
Rigid Surface[2]	P-501, Cement Concrete Pavement	6 in (150 mm)[2]	6 in (150 mm)[2]	6 in (150 mm)[2]
Drainable Base (When Used)	P-407[5], P-307		6 in (150 mm) when used	6 in (150 mm) When used
Stabilized Base[3]	P-401 or P-403; P-304; P-306	Not Required	Not Required	5 in (125 mm)
Base[4]	P-209, P-207, P-208, P-210, P-211, P-212, P-213, P-219, P-220	Not Required	6 in (150 mm)	6 in (150 mm)
Subbase[5]	P-154	6 in (100 mm)	As needed for frost or to create working platform	As needed for frost or to create working platform

Notes:
1. Complete structural design to determine rigid surface layer thickness required to support actual traffic.
2. Use greater of FAARFIELD thickness to the nearest 0.5 inch (10 mm), or minimum layer thickness, if all aircraft < 30,000 lbs (11,520 kg) 5 in (125 mm) minimum thickness.
3. See paragraph 3.5, Stabilized Base Course, for requirements and limitations. P-220 may be used under concrete with minimum thickness of 12" and when concrete thickness is increased by 3"
4. P-207, P-219 require laboratory testing to establish if it will perform as a base or subbase. If CBR > 80 may be used in place of P-209, CBR >60 in place of P-208. Both may be used as a subbase under stabilized base.
5. Any base material may be used as a subbase.
6. See EB 102, *Asphalt Treated Permeable Base Course.*

FAARFIELD 2.0

- Released June 2020 in conjunction with FAA AC 150/5320-6G
- New Graphical User Interface
- Updated Aircraft Library
- Added Vehicle Editor





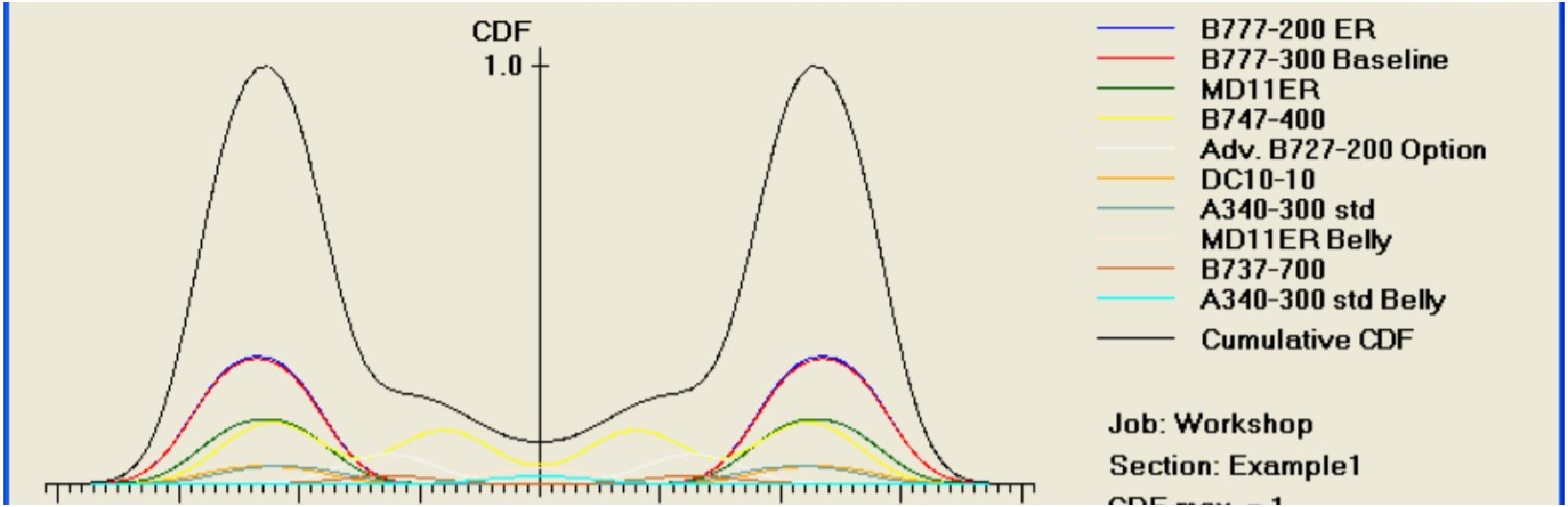
Aircraft Traffic-Fleet Mix Determination

- Pavement Design/Performance based on allowable load repetitions to failure
- Standard designs based on years of traffic
- Designs typically based on departures only (arrivals ignored), with some exceptions
- Use complete fleet mix, not just design aircraft
- FAARfield Library includes 190 airplane models

Traffic

	Aircraft	Wingspan (ft)	MTOW [lbs]	Empty Weights [lbs]	Fuel Capacity [lbs]	Estimated Fuel %	Weight For Pavement Design	Based & Transient Aircraft: Visits Per MONTH	Operations Per Month (Visits x 2)	Departures Per MONTH (Same as Visits)	Departures Per YEAR	Faarfield
Light	Pilatus PC-12	53.00	10,450	5,867	2,704	80%	9,909	30	60	30	360	S-10
	Cessna CJ3 (Model 525B)	53.30	13,870	8,720	4,710	80%	12,928	20	40	20	240	S-15
	King Air 350	57.92	15,000	10,000	3,611	80%	14,278	15	30	15	180	x
	Beechjet 400	43.50	16,100	10,050	4,912	80%	15,118	15	30	15	180	x
	Phenom 300	53.17	17,968	11,583	5,353	80%	16,897	40	80	40	480	S-15
Medium (Small)	Lear 55	43.83	21,500	13,000	6,705	80%	20,159	4	8	4	48	x
	Cessna XLS's (Model 560)	56.30	20,200	12,300	6,740	80%	18,852	40	80	40	480	S-20
	Lear 60	43.75	23,500	14,640	7,910	80%	21,918	15	30	15	180	D-20
	Cessna Citation Sovereign	72.33	30,775	18,300	11,390	80%	28,497	30	60	30	360	D-25
	Hawker 800XP	54.33	28,000	15,670	10,000	80%	26,000	15	30	15	180	x
	Gulfstream G200	58.08	35,450	19,200	15,000	80%	32,450	15	30	15	180	D-30
	Cessna Citation X	63.58	35,700	21,600	13,097	80%	33,081	15	30	15	180	x
	Challenger 300	63.83	38,850	23,349	14,150	80%	36,020	20	40	20	240	D-35
	Falcon 50	61.88	38,800	20,200	17,000	80%	35,400	10	20	10	120	x
	Falcon 900	63.40	45,500	22,600	22,000	80%	41,100	10	20	10	120	x
	Falcon 2000's	63.40	41,000	20,735	12,155	80%	38,569	7	14	7	84	x
	Challenger-CL-604	64.33	48,200	27,200	21,000	80%	44,000	10	20	10	120	x
	Gulfstream III	77.83	70,200	38,000	30,000	80%	64,200	5	10	5	60	x
	E-145/Legacy	65.75	48,501	39,462	9,183	80%	46,664	3	6	3	36	ERJ-145 ER
Medium (Large)	Gulfstream II	68.83	66,000	36,500	28,000	80%	60,400	1	2	1	12	x
	Gulfstream IV	77.83	75,000	35,500	38,000	80%	67,400	10	20	10	120	x
	Falcon 7X	86.00	70,000	34,072	31,940	80%	63,612	5	10	5	60	D-75
	Gulfstream V	93.33	90,900	46,200	41,300	80%	82,640	5	10	5	60	x
	Gulfstream 650	99.58	99,600	52,040	44,200	80%	90,760	4	8	4	48	D-100
	Bombardier Global 7000	104.00	106,250	62,500	47,450	80%	96,760	5	10	5	60	D-100
Atlantic Aviation Fill-ins	Fuel Truck (1500 gal)		34,000			75%	34,000	1500	3000	1500	18000	
	Fuel Truck (3000 gal)		55,400			75%	46,850	400	800	400	4800	
	Fuel Truck (5000 gal)		71,000			75%	93,700	200	400	200	2400	
	Tractor Trailer Refueler (8000 gal??)					100%		18	36	18	216	
	Helicopters	33' to 47'	10,000			80%	10,000	100	200	100	1200	
	Challenger CL-350	69.00	40,600	28,200	14,150	80%	37,770	30	60	30	360	D-40
	Cessna Citation Lattitude	72.33	30,800	18,656	11,394	80%	28,521	30	60	30	360	D-30
	Bombardier Global 7500	104.00	106,250	62,500	47,450	80%	96,760	8	16	8	96	D-100

Cumulative Damage Factor (CDF)



- CDF is the basis for pavement design determinations
- Sums damage contributed from each aircraft
- When CDF = 1 (100%), design life is exhausted
- Must input fleet mix, NOT equivalent departures of design aircraft

Example FAARFIELD Design Outputs

Job Name: 19022032 LGC T-Hangar

Section Name: Option 2- 4"AC over GAB

Thickness Design | Run

☑ Include in summary report ☐ Add To Batch

Pavement Layers

Pavement Type: HMA on Aggregate

Material	Thickness (in.)	E (psi)	CBR
P-401/P-403 HMA Surface	4.0	200000	
P-209 Crushed Aggregate	6.9	16598	
Subgrade		4500	3

Select As The Design Layer | Delete Selected Layer

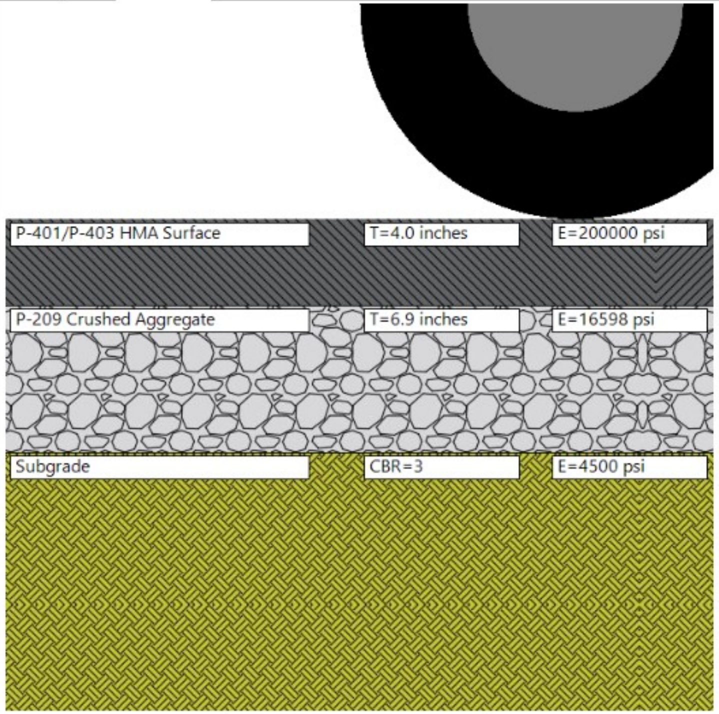
Design Life (Years): 20

Results

Calculated Life (Years):

Total thickness to the top of the subgrade: 10.9 in.

Status | Gear | Structure



Copy Structure to Clipboard

Traffic

Stored Aircraft Mix: Fleet Mix-All Super T-Hanga

Save Aircraft Mix to File | Clear All Aircraft from List | Remove Selected Aircraft from Section | Delete Aircraft Mix File

Airplane Name	Gross Taxi Weight (lbs)	Annual Departures	Annual Growth (%)	Total Departures	CDF Contributions	CDF Max for Airplane	P/C Ratio	Tire Pressure (psi)	Percent GW on Gear	Dual Tire Spacing (in.)	Tandem Tire Spacing (in.)	Tire Contact Width (in.)	Tire Contact Length (in.)
S-12.5	10905	1040	0	20800	0.08	0.08	3.78	44	0.475	0.0	0.0	9.7	15.6
S-5	5290	2080	0	41600	0	0	4.54	53	0.475	0.0	0.0	6.2	9.8
S-15	15653	156	0	3120	0.92	0.92	3.62	52	0.475	0.0	0.0	10.7	17.0

Questions?

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