FAARFIELD 1.4

Updates, Improvements and New Capabilities

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Federal Aviation Administration
Airport Technology R&D Program

- **Research conducted at the FAA William J. Hughes Technical Center, Atlantic City, NJ, USA.**
- **Sponsor: FAA Office of Airport Safety and Standards (AAS-100), Washington, DC.**
- **Provide support for development of FAA pavement standards (Advisory Circulars).**

Airport Technology R&D Branch, ANG-E26

Dr. Michel Hovan, Branch Manager

- **Airport Safety Section ANG-E261**
  - **Jim Patterson**, Manager
  - Visual Guidance
  - Runway Surface Technology
  - Aircraft Rescue and Firefighting (ARFF)
  - Wildlife Hazard Mitigation
  - Runway Incursion Reduction
  - Planning and Design for New Large Aircraft (NLA)
- **Airport Pavement Section ANG-E262**
  - **Jeffrey Gagnon**, Manager
  - Airport Pavement Design and Evaluation
  - Aircraft/Airport Compatibility
  - Advanced Pavement Materials Research
  - Airport Pavement Maintenance and Management

Federal Aviation Administration
Airport Pavement R&D Program

- **R&D products are relied on worldwide by ICAO, aircraft industry & airport authorities.**

- **Four major R&D focal areas:**
  1. Pavement thickness design.
  2. Aircraft/airport compatibility.
  3. Airport pavement maintenance & management.
  4. Advanced pavement materials.

National Airport Pavement Test Facility (NAPTF)

- **Fully enclosed facility for accelerated traffic testing of airport pavements.**
- **Full-scale pavement structures and landing gear loads with programmed wander.**
- **Opened in 1999.**
- **Total construction contract was $21M.**
  - $14M from FAA
  - $7M from Boeing Co. under FAA/Boeing CRDA.

Heavy Vehicle Simulator – Airport Version (HVS-A)

- **Wheel loads - 10,000 to 100,000 lbs.**
- **Pavement temperatures up to 150°F**
- **Test speeds - 0.17 to 5 mph**
- **Single and Dual-Wheel configuration.**
  - Single wheel is radial aircraft tires size 52x21.0R22
  - Dual wheel assembly is designed to accommodate smaller tires (B-737-800)
- **Manufactured in USA by Dynatest.**

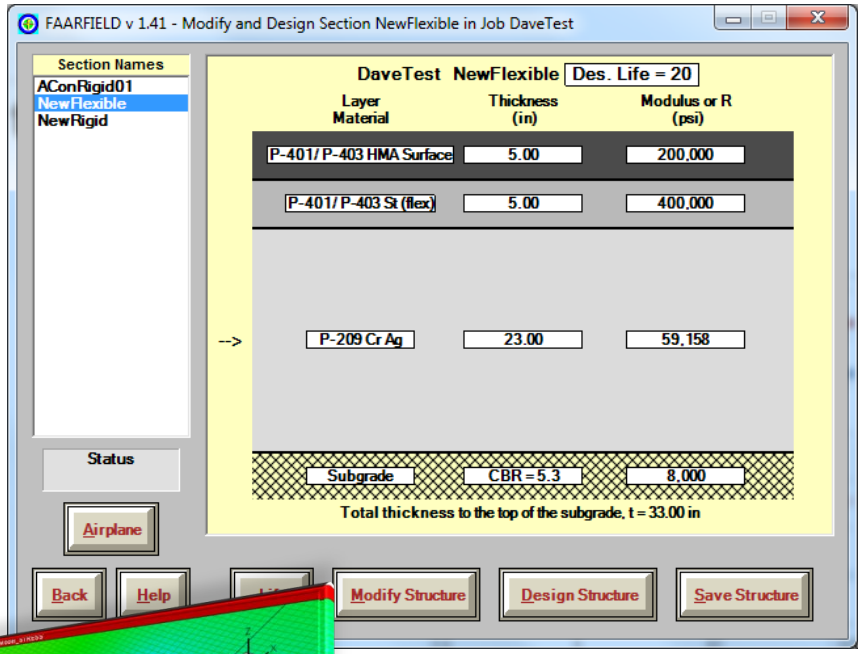
FAA Pavement Computer Programs

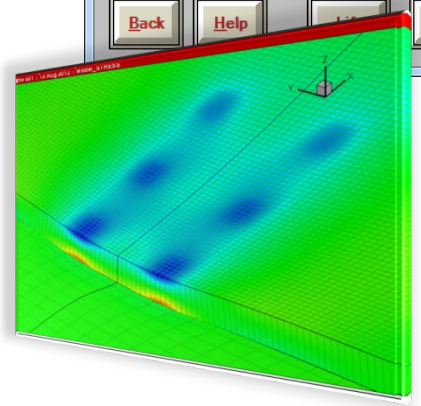
BAKFAA	Layered elastic back-calculation software for FWD
COMFAA 3.0	Pavement strength reporting (ACN-PCN)
FAA PAVEAIR	Web-based airport pavement management system
FAARFIELD 1.3	Pavement thickness design and evaluation
LEAF	Layered elastic analysis program (run from BAKFAA)
ProFAA	Airport pavement roughness and profile analysis
ProGROOVE	Groove analysis from longitudinal runway profile

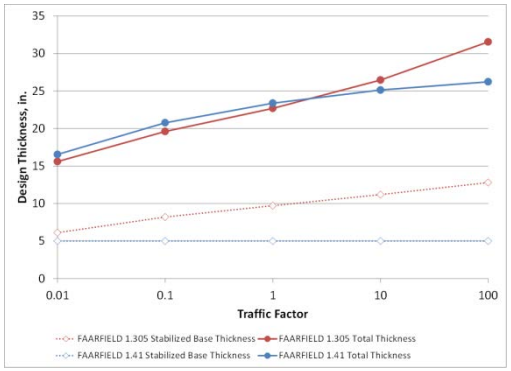
- **All programs are free to download, freely distributable, and available from: www.airporttech.tc.faa.gov/naptf/download/**
- **FAA PAVEAIR web site: https://faapaveair.faa.gov/**

FAARFIELD 1.4

- **Beta version now available.**
- **Plan to release with next change to AC 150/5320-6E.**
- **Many significant changes.**
- **Reduces excess design conservatism.**
- **New design-based compaction procedure.**
- **Incorporates results of full-scale tests at the National Airport Pavement Test Facility.**







FAARFIELD – What Is It?

Federal
Aviation
Administration
Rigid and
Flexible
Iterative
Elastic
Layered
Design

- **FAARFIELD is the new FAA airport pavement thickness design program.**
- **FAARFIELD superseded LEDFAA 1.3 as the standard design procedure in FAA Advisory Circular (AC) 150/5320-6E.**
- **Officially released September 30, 2009.**
- **Current version is 1.305 (posted 1/18/11)**

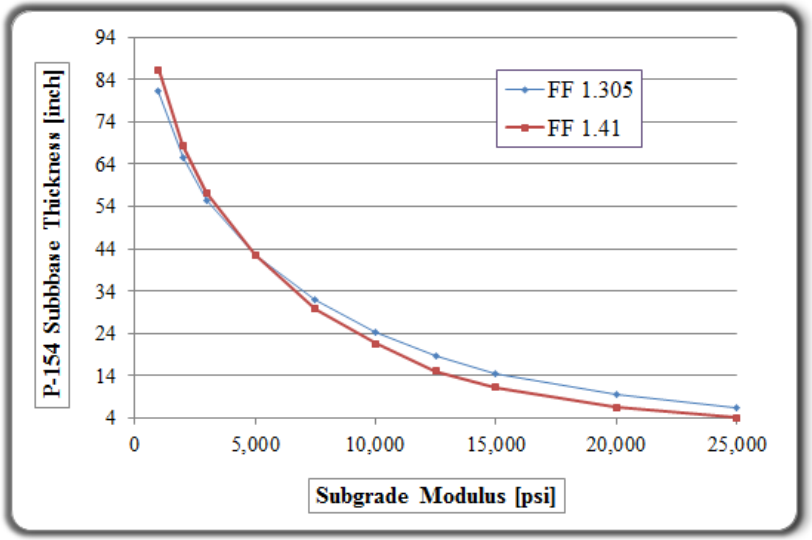
FAARFIELD 1.4 – What's New?

FAARFIELD 1.4 has:

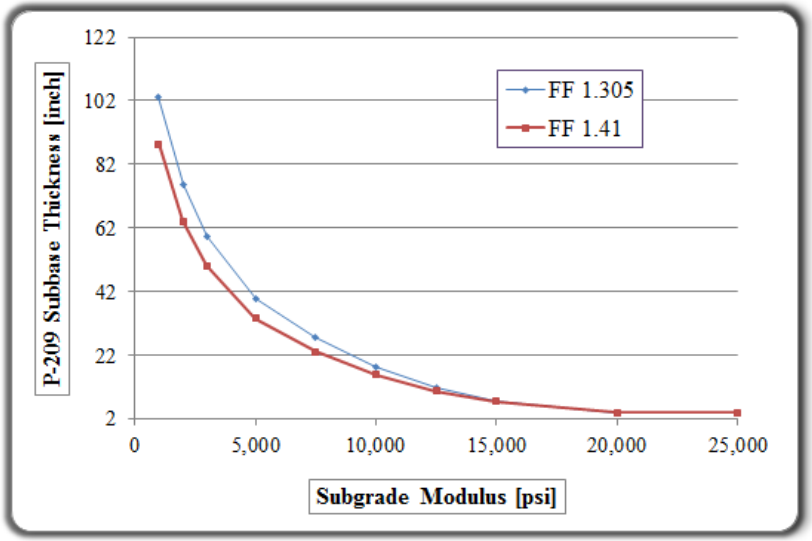
- **Completely revised flexible and rigid failure models based on newest full-scale test data.**
- **Reduced excess stabilized base thickness requirement.**
- **Improved, more accurate 3D finite element model.**
- **Completely rewritten concrete overlay design procedure.**
- **Automated, software-based compaction criteria.**
- **Updated aircraft library aligned with COMFAA 3.0.**
- **Support for user-defined gear configurations.**
- **Advanced, energy-based asphalt fatigue models.**
- **All data files now stored in document directories.**

Flexible Pavements

- **New thickness designs are generally less conservative than FAARFIELD 1.305 designs for the same inputs.**
- **More compatible with COMFAA 1.3 (ACN-PCN method).**



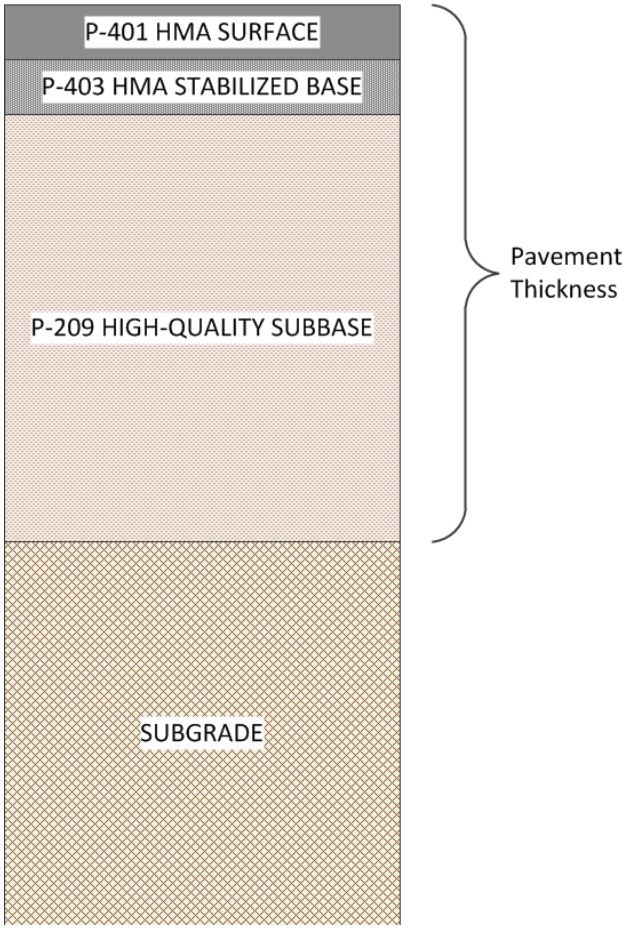
Conventional Flexible Pavement Comparison



Stabilized Flexible Pavement Comparison

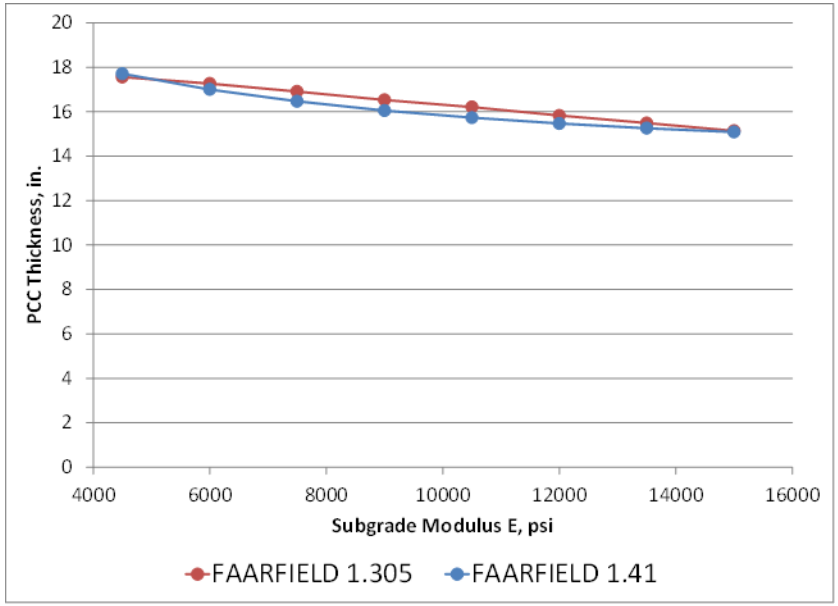
Flexible Base Thickness

- **The minimum stabilized base thickness is still 12.7 cm (5 inches).**
- **No additional stabilized base thickness requirement when improved subbase material (P-209) is used.**
- **Additional thickness requirement applies only if standard subbase (P-154) is used.**

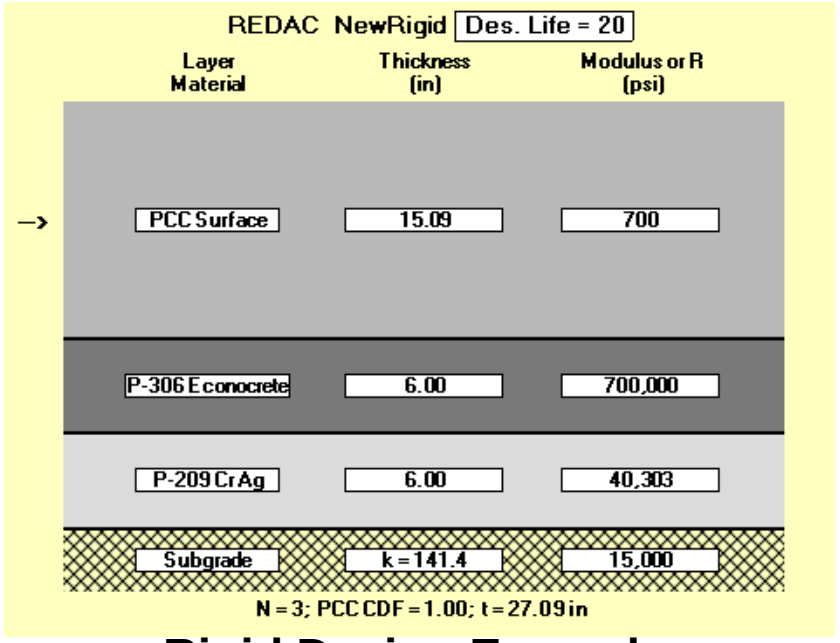


Rigid Pavements

- **New thickness designs are generally less conservative than FAARFIELD 1.305 designs for the same inputs.**
- **New calibrations incorporate CC6 failure data.**



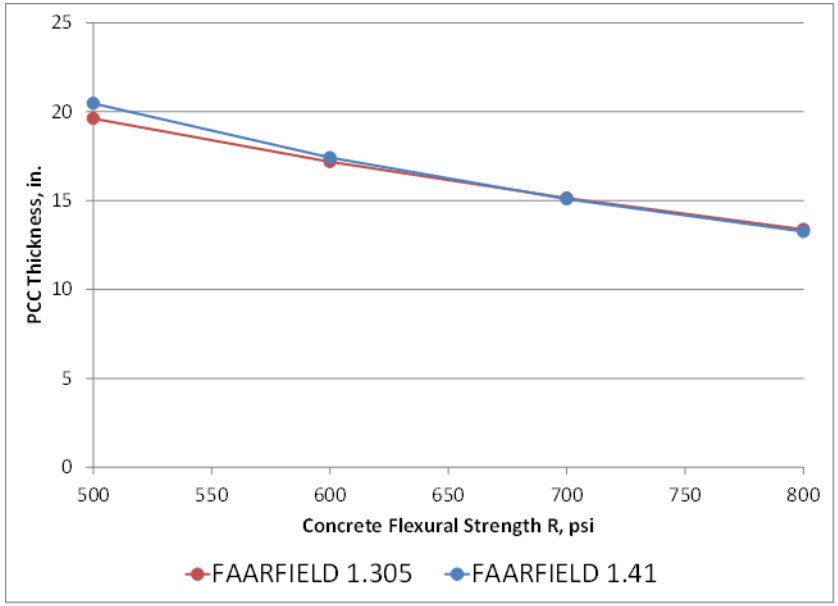
Effect of Subgrade Modulus *E*



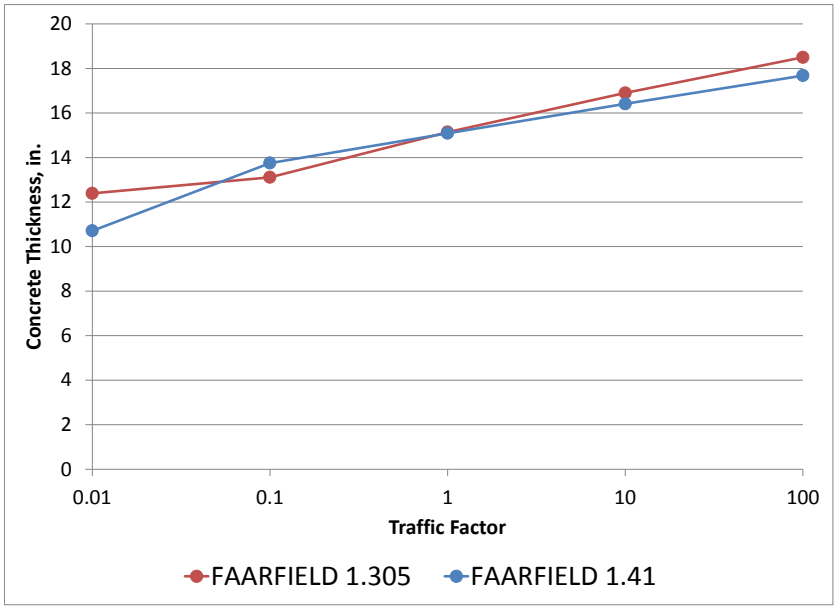
Rigid Design Example

Improved Rigid Failure Model

- **Sensitivity to factors such as concrete strength, traffic level and subgrade support is similar to current version.**



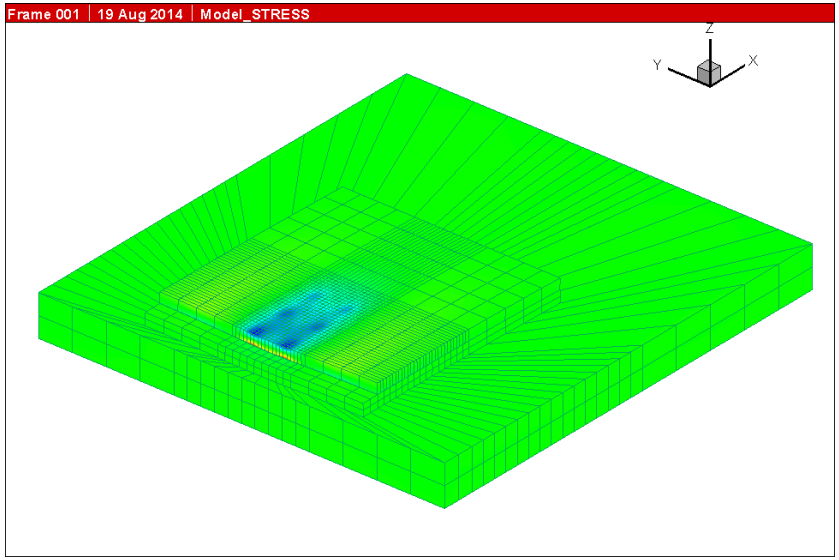
Effect of Concrete Flex Strength



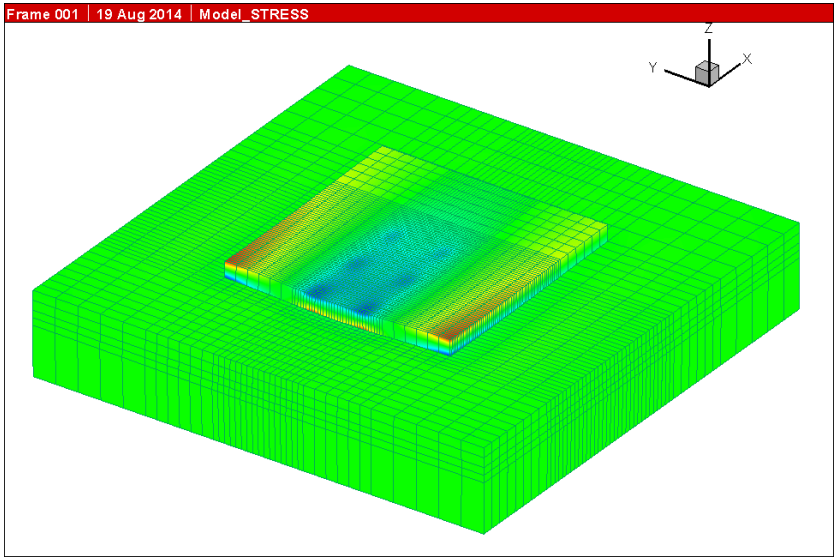
Effect of Traffic

Improved 3D Finite Element Mesh

- More accurate stress results.
- Improved infinite foundation model.
- Still one slab model with assumed 25% load transfer.



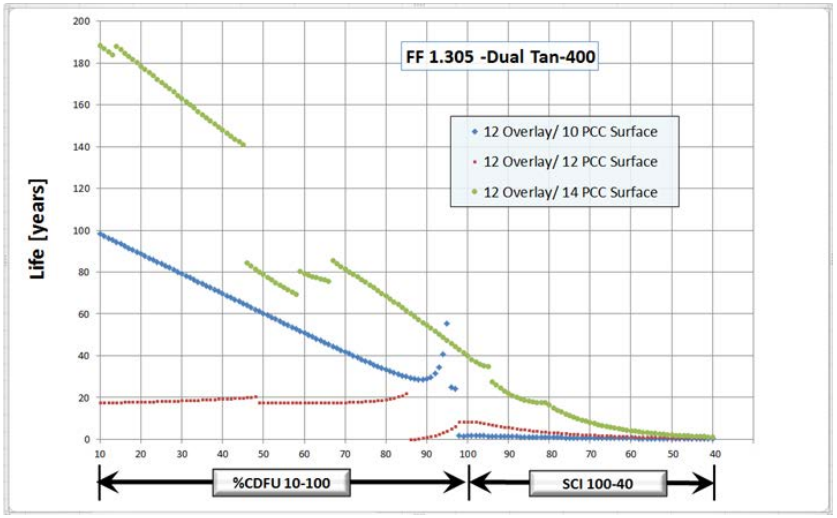
FAARFIELD 1.305



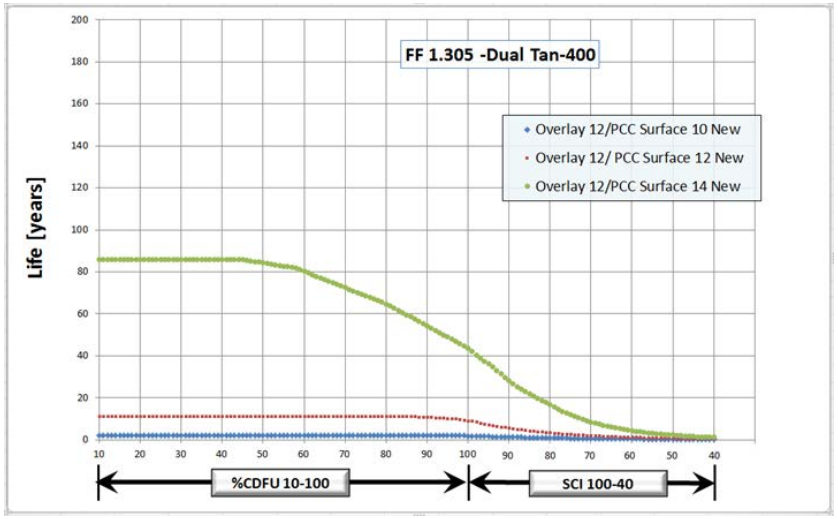
FAARFIELD 1.41

Rigid Overlay Design Procedure

- **Completely rewrote overlay life program module.**
- **Eliminated gaps and illogical results, especially for overlays on new or undamaged PCC.**



FAARFIELD 1.305



FAARFIELD 1.41

Automated Compaction Criteria

Computes compaction control points for rigid & flexible pavements.

FAARFIELD v 1.41 - Notes and Information for Job REDAC

Section Names

- NewFlexible
- NewRigid

Design Information for Section NewRigid

Subgrade Compaction Requirements

NonCohesive Soil

Percent Maximum Dry Density(%)	Depth of compaction from pavement surface (in)	Depth of compaction from top of subgrade (in)	Critical Airplane for Compaction
100	0 - 16	--	B777-200 ER
95	16 - 70	0 - 43	B777-200 ER
90	70 - 183	43 - 156	B747-200B Combi Mixed

Cohesive Soil

Percent Maximum Dry Density(%)	Depth of compaction from pavement surface (in)	Depth of compaction from top of subgrade (in)	Critical Airplane for Compaction
95	0 - 16	--	B777-200 ER
90	16 - 28	0 - 1	B777-200 ER
85	28 - 96	1 - 69	B747-200B Combi Mixed
80	96 - 178	69 - 151	B747-200B Combi Mixed

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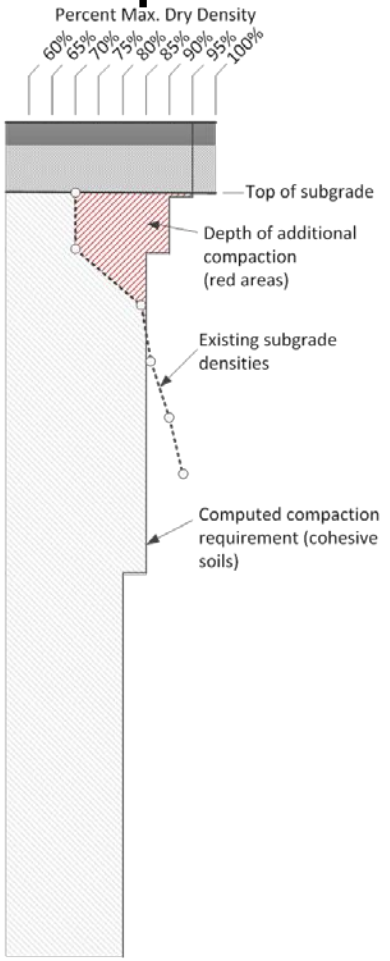
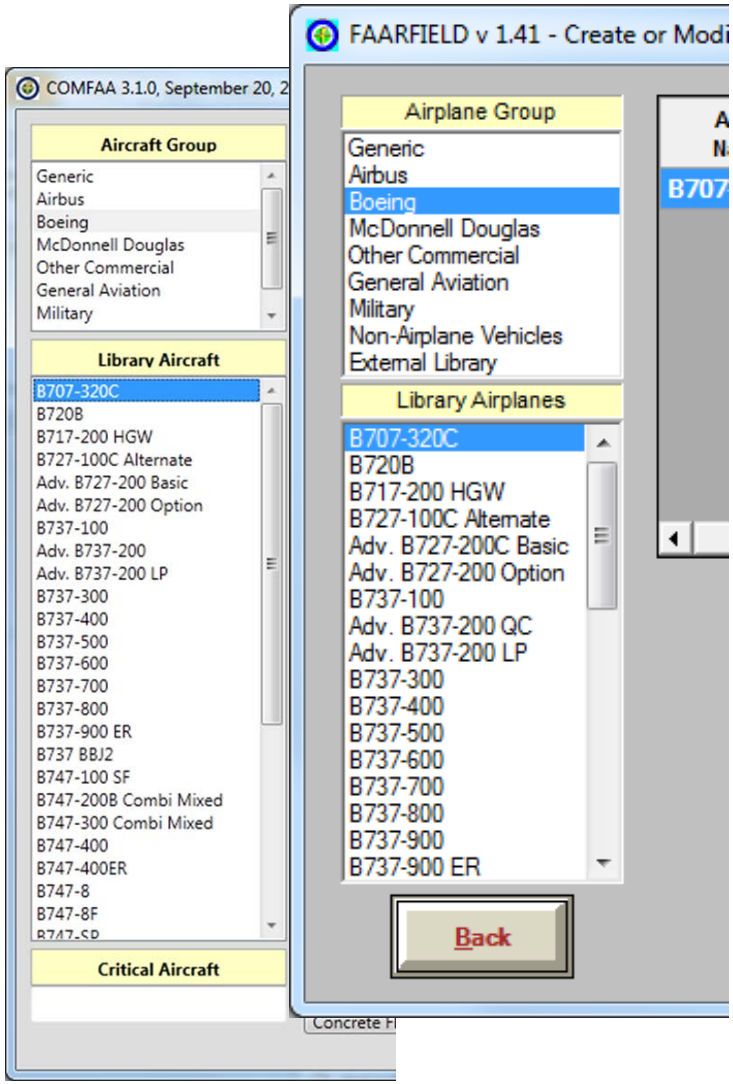


Aircraft Libraries

- **Aligned the aircraft libraries in COMFAA and FAARFIELD to the extent possible.**
- **Used the most current data from manufacturers.**
- **Included new aircraft:**
  - A350-900 (Preliminary)
  - B747-8
  - B787-9
  - Embraer Fleet



Changes to Design Guidance

- **Deployment of FAARFIELD 1.4 in next AC will require changes to parts of AC 150/5320-6E.**
- **Partial list of recommended changes:**
  - New guidance for applying automated compaction criteria.
  - Changes to HMA fatigue criteria (new RDEC energy model).
  - Revised shoulder design criteria.
  - Modify conversion from CBR to *k*-value.
  - Modified *k*-values for reduced subgrade strength (frost design)
  - Guidance for use of external aircraft library.
  - Modify Type A1 (reinforced isolation) joint detail.
  - Update all design examples.

FAARFIELD 1.4 System/Software Requirements

Minimum

- Windows XP or higher
- 2 GHz processor
- 2 GB RAM
- 200 MB of available space on hard drive.

Recommended

- Windows 7 or higher*
- 3 GHz processor
- 4 GB RAM
- 64-bit operating system**

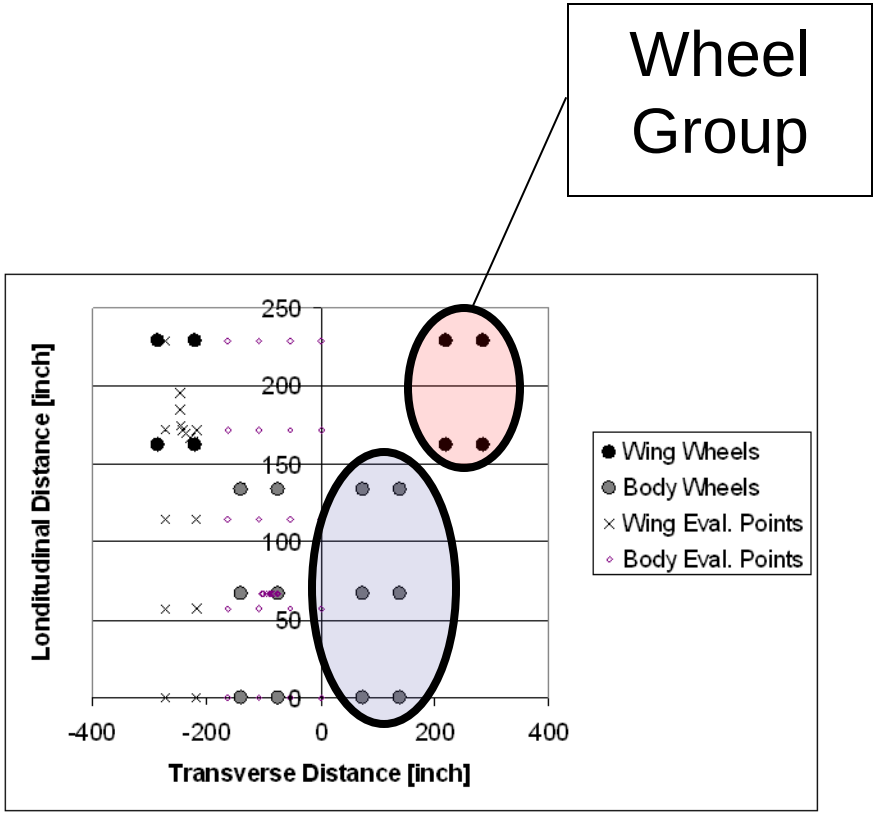
Notes:
***FAARFIELD 1.4 has not been fully tested on Windows 8.**
****FAARFIELD 1.4 supports 32-bit or 64-bit Windows operating systems.**

Changes in Data File Storage

- **All data files are now stored in document directories by default.**
  - Job files
  - External aircraft library files
  - Output files.
  - C:\Users\[User Name]\Documents\FAARFIELD
- **Previously, data files (including job files) were stored in the program directory.**
  - Required unrestricted read/write access for user.
  - Risk of data loss when changing/upgrading PC.

External Aircraft Library

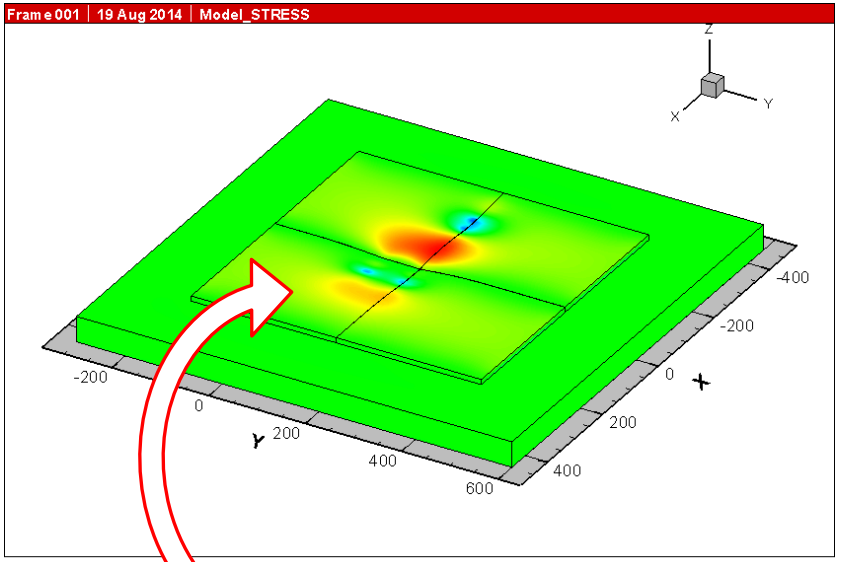
- **A new feature allows users to specify arbitrary gear geometries in the external library.**
  - Coded as “X” in the external library.
  - Allows multiple wheel groups to be defined.
- **Uses rewritten internal pass/coverage computation routine.**
- **New user guidance for the external library.**

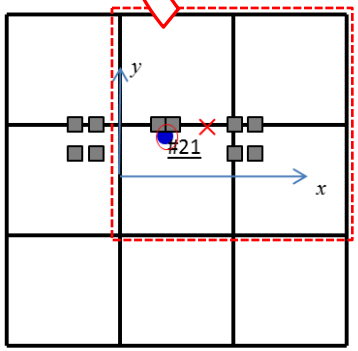


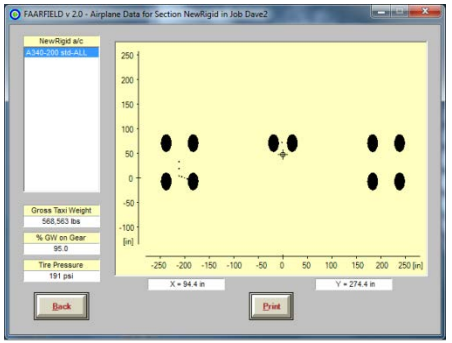
In this example, the externally defined A380 main gear gives the identical result as the internally stored airplane.

Future Developments

- **FAARFIELD 2.0 (Rigid)**
  - Multiple-slab mesh.
  - Variable joint spacing.
  - Shear load transfer.
  - Slab curling.
  - Top-down slab stress.
- **New rigid design considers:**
  - True slab size.
  - Design thermal gradient.
  - Critical position for full gear.
  - Maximum tensile stress on slab surface.
- **Currently in development.**







Thank You! ¡Muchas Gracias!

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Acknowledgments:

FAA Airport Technology R&D Branch:
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