



HISTORICAL BACKGROUND ON ACCELERATED PAVEMENT TESTING FOR AIRPORT PAVEMENTS



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BACKGROUND

- Responsibility for design and construction of military airfield was assigned to the Corps of Engineers in November of 1940.
- Concern for flexible pavement design method for heavier loadings. (B-17, B-24, larger B-29)
- Promising methods used “bearing capacity” of subgrade as basic design input.
- Means for determination of “bearing capacity” remained in question.



BACKGROUND

- Because of war emergency faced, plate-bearing test and assessment of subgrade shear strength were not suited to military field needs.
- It was concluded that an established empirical highway design method should be adopted and further developed.
- Continue work for a rational design method.



SELECTION OF CBR METHOD

- CBR method had been correlated with service behavior and construction methods (1928-1942).
- Could quickly be adapted to airfield pavement design for immediate use.
- Method was thought to be reasonable and as sound as any of the methods investigated.
- CBR could be assessed using simple portable test equipment in the laboratory or in the field.



SINGLE-WHEEL CRITERIA

- Curves for 7,000-lb and 12,000-lb wheel loads.
- Extrapolations were made and curves provided for 25,000, 40,000, and 70,000 lb wheel loads
 - Middlebrooks & Bertram: equivalent values of maximum shear stress at pertinent depths for various loads.
 - O. J. Porter: allowable deformations for various loads.
 - Casagrande: relationships between relative size of loaded areas.
- Similar results for the three means of extrapolation.
- Derived a set of CBR values versus thickness curves for single-wheel aircraft for wheel loads from 4,000 to 70,000 lb.



SINGLE-WHEEL CRITERIA

- These design curves were subject to verification by extensive accelerated traffic tests on existing pavements of known composition and specially constructed full-scale test sections.
- Stockton No. 1 Tests – the design curves were deemed satisfactory with only minor adjustments in the high CBR range.



B-36



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SINGLE-WHEEL CRITERIA

- In anticipation of B-36 aircraft (single-wheel main gear), 1946 revision added design curves for 150,000-lb single wheel loads.
- This led to Stockton No. 2 Tests (1945-1948).
- Single Tire test loads of 150,000-lbs and 200,000-lbs for verification of the extrapolations to such large loads.

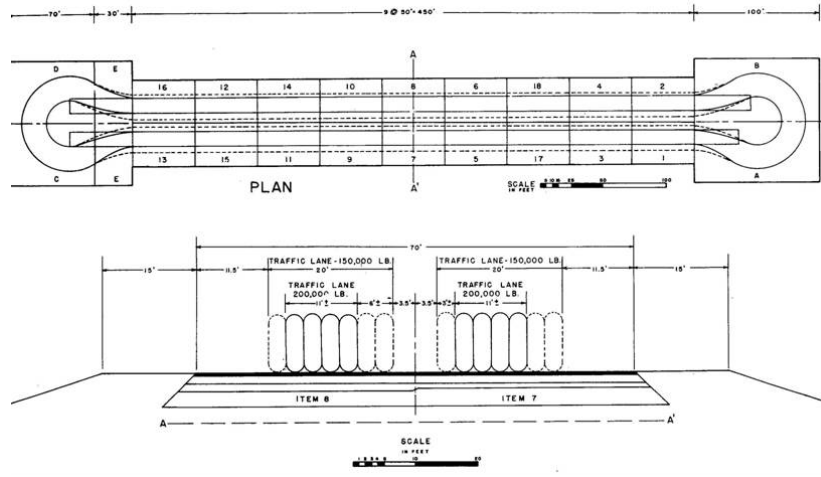
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STOCKTON No. 2 TESTS (1945-1948)

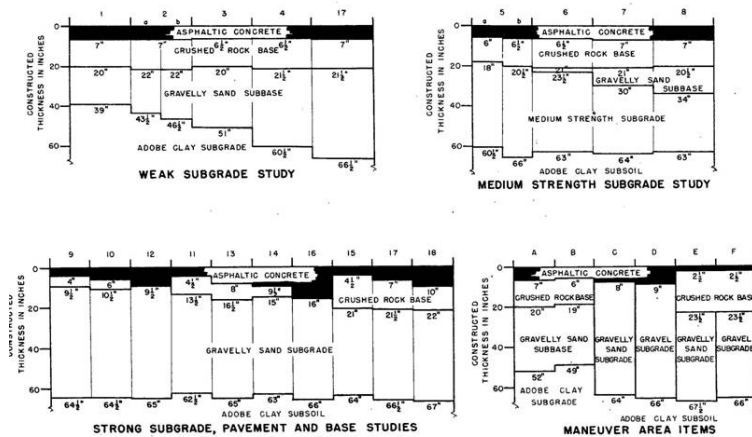


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STOCKTON No. 2 TESTS (1945-1948)



NOTE: THICKNESSES SHOWN
ARE CONSTRUCTED THICKNESSES.

AS CONSTRUCTED THICKNESSES

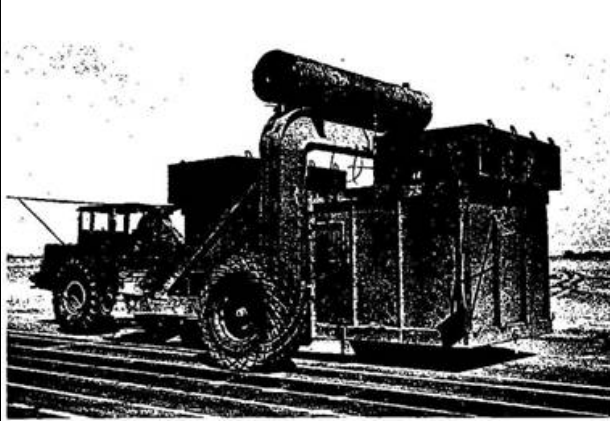
STOCKTON TEST NO 2
SCHEMATIC LAYOUT OF
ITEMS ARRANGED IN
STUDY GROUPS

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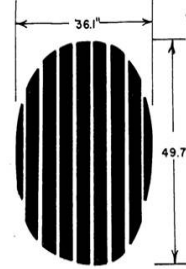


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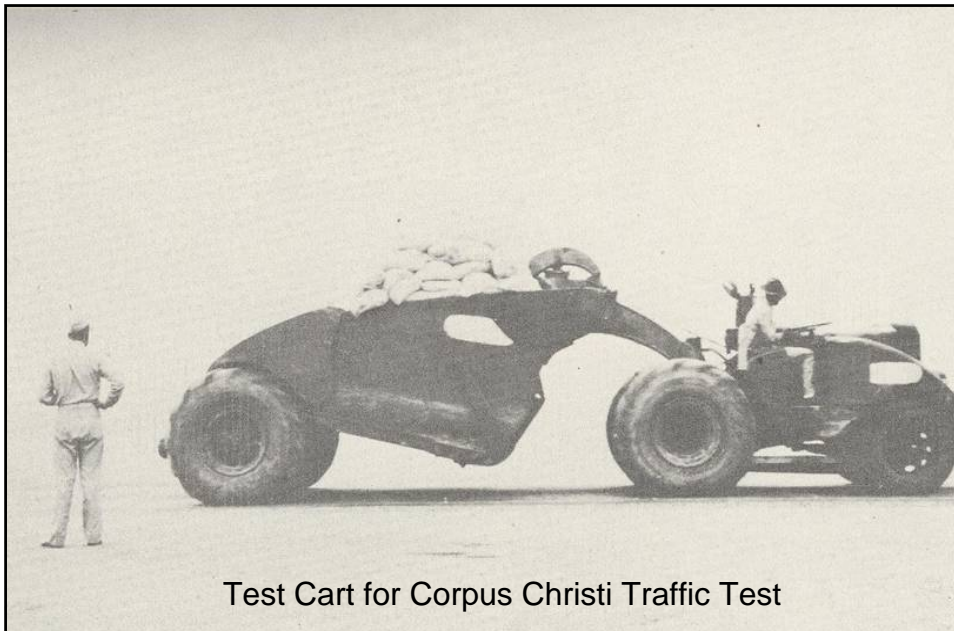
STOCKTON No. 2 TESTS (1945-1948)



SIDE VIEW OF TEST RIG LOADED TO 200,000 POUNDS

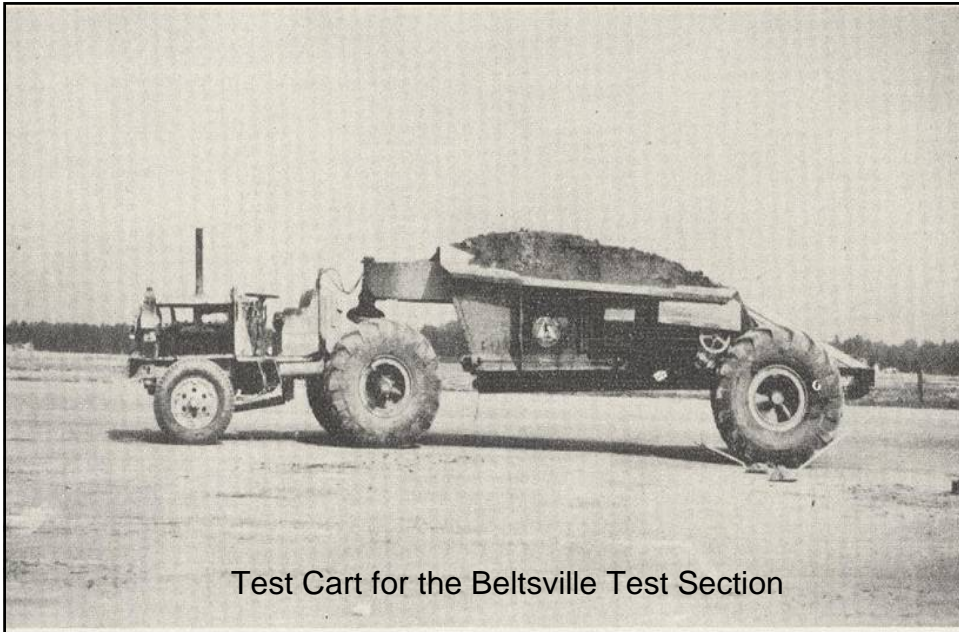


WHEEL LOAD (LB) 200,000
CONTACT AREA (IN ²) 1501 (GROSS)
CONTACT	
PRESSURE (PSI) 133
TIRE INFLATION	
PRESSURE (PSI) 149
DEFLECTION (IN) 9 1/2

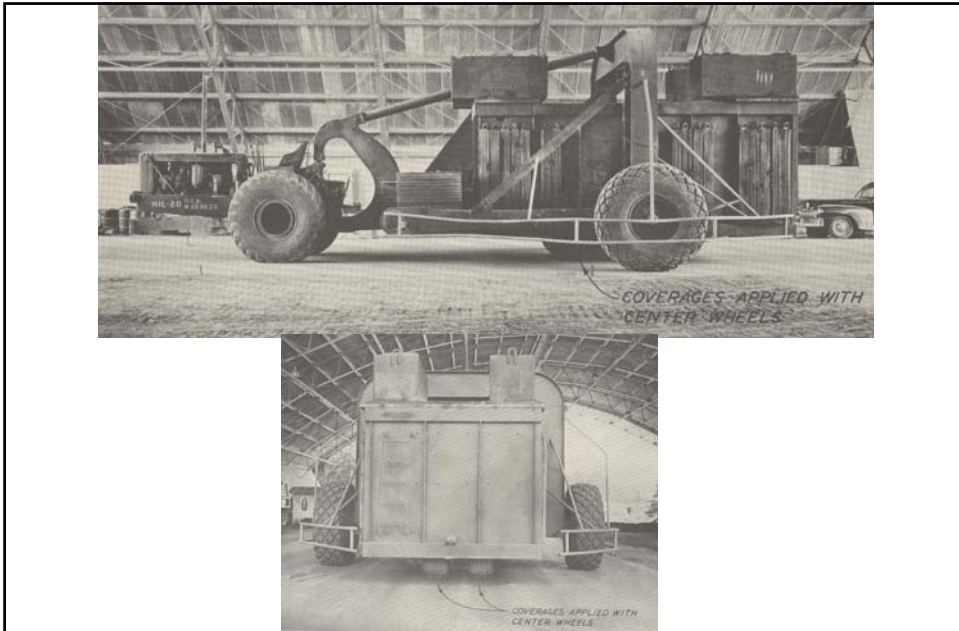


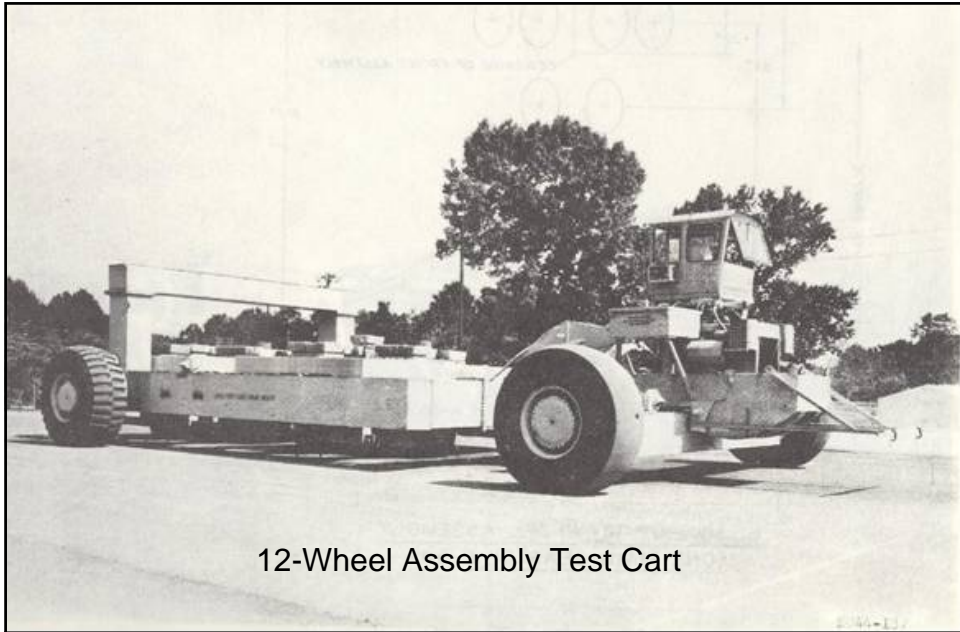
Test Cart for Corpus Christi Traffic Test





Test Cart for the Beltsville Test Section





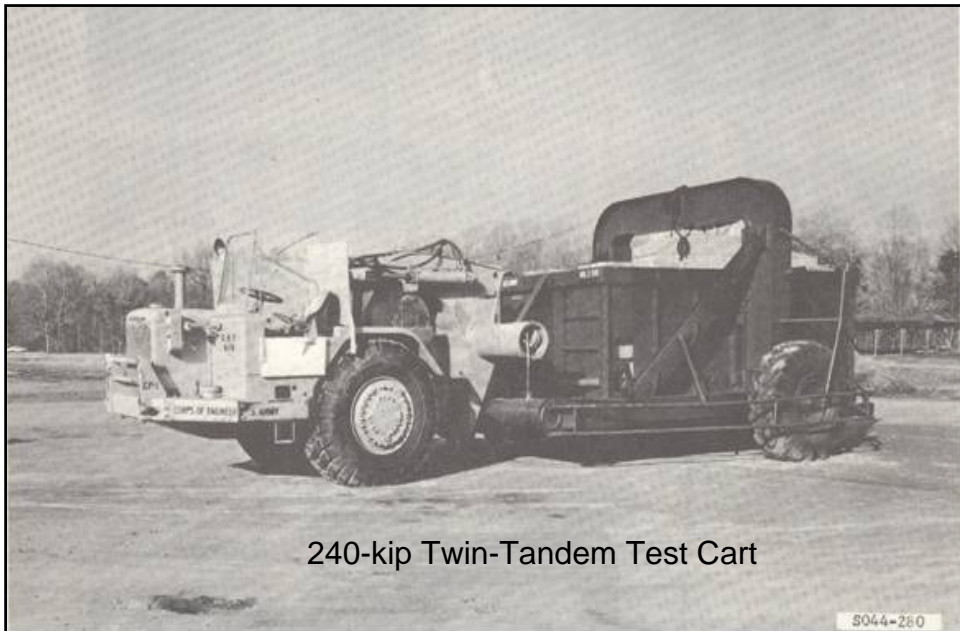
12-Wheel Assembly Test Cart

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240-kip Twin-Tandem Test Cart

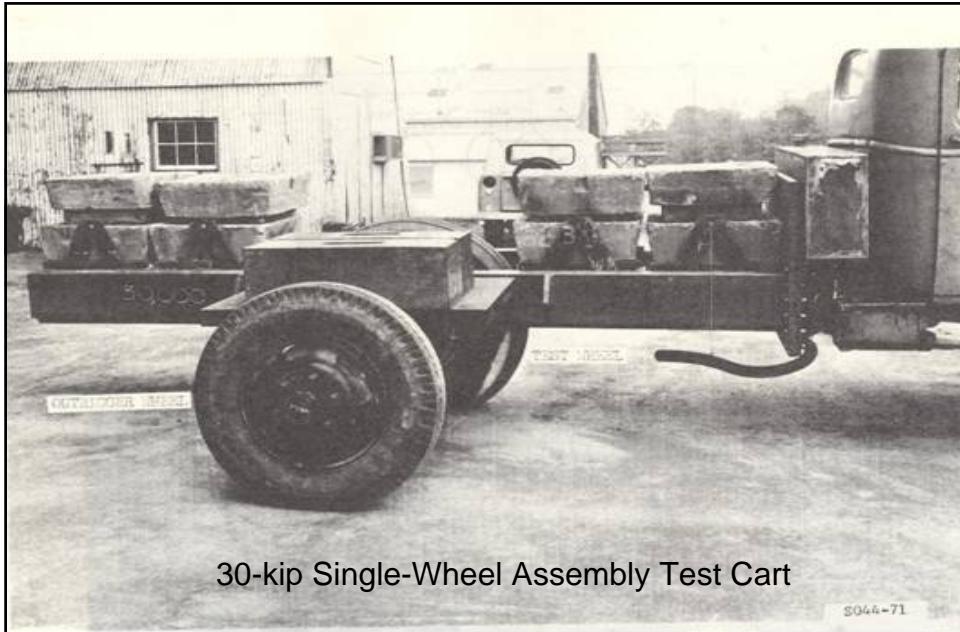
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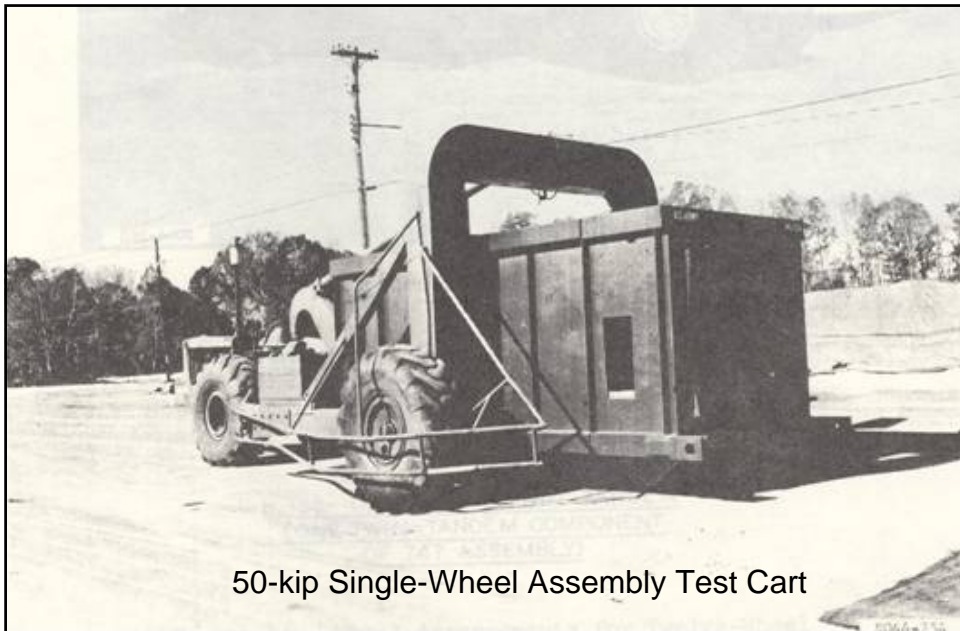
30-kip Single-Wheel Assembly Test Cart

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50-kip Single-Wheel Assembly Test Cart

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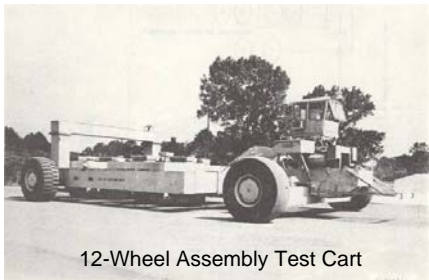


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MWHGL TESTS (1970)

- Tests were initiated in 1968 and testing was completed in 1970.
- Validate existing design criteria, modify these criteria, or establish new criteria for the design of pavements for MWHGL
- USACE WES, Vicksburg, MS.
- Trafficked with four different loadings to represent heavy aircraft loadings.



12-Wheel Assembly Test Cart



240-kip Twin-Tandem Test Cart



30-kip Single-Wheel Assembly Test Cart

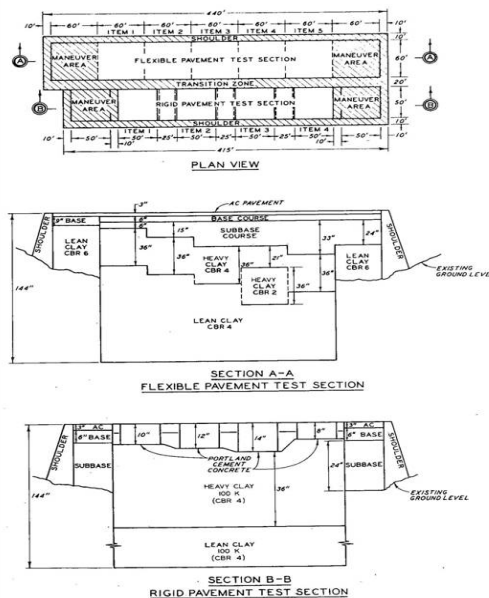


50-kip Single-Wheel Assembly Test Cart



MWHGL TESTS (1970)

- Distinction was made between settlement due to compaction and distortion due to shear deformation.
- A pavement item was considered failed when either of the following conditions occurred:
 - Surface upheaval of the pavement adjacent to the traffic lane reached 1 in. or more;
 - Surface cracking occurred to the point that the pavement was no longer waterproof.



CBR EQUATION

- Pre MWHGL Equation:

$$t = \alpha \sqrt{\frac{P}{8.1 CBR} - \frac{A}{\pi}}$$

$$\alpha = (0.23 \log_{10} C + 0.15)$$

- Post-MWHGL equation:

$$t = \alpha (A_c)^{0.5} [-0.0481 - 1.1562 (\log CBR/P) - 0.6414 (\log CBR/P)^2 - 0.473 (\log CBR/P)^3]$$



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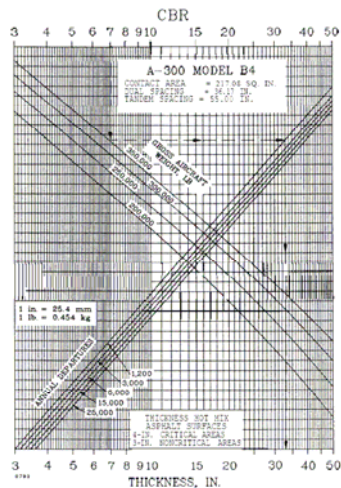


FIGURE 3-4 FLEXIBLE PAVEMENT DESIGN CURVES, A-300 MODEL B4

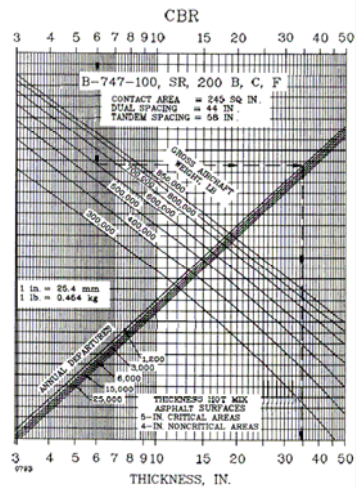


FIGURE 3-5 FLEXIBLE PAVEMENT DESIGN CURVES, B-747-100, SR, 200 B, C, F



ACCELERATED PAVEMENT TESTING

FLEXIBLE PAVEMENT

Accelerated Traffic Tests at Stockton Airfield
High-Pressure Tire Tests
Multiple-Wheel Landing Gear Tests
Multiple-Wheel Heavy Gear Load (MWHGL)
Study of Behavior of Bituminous-Stabilized Pavement Layers
Comparative Performance of Structural Layers in Flexible Pavement Systems
Evaluation of Structural Layers in Flexible Pavements
Geogrid Reinforced Base Courses For Flexible Pavements
Natchitoches Municipal Airport
Richmond Army Air Base Traffic Tests
Lewiston Satellite Airfield Traffic Tests
Grenier Field Traffic Tests
Corpus Christi Traffic Tests
Beltsville Maryland Traffic Test



ACCELERATED PAVEMENT TESTING

RIGID PAVEMENT

Lockbourne Test Track No. 1
Lockbourne No. 2 – Experimental Mat
Lockbourne No. 2 – Modification
Lockbourne No. 3 – Overlay Study
Sharonville Test No. 1
Sharonville No. 2
Sharonville No. 3
Heavy Wheel Load Test-Channelized
Sharonville Heavy-Load Test Track
Multiple-Wheel Heavy Gear Load – Rigid Pavements
Comparative Performance of Structural Layers in Rigid Pavement Systems
Strengthening of Keyed Longitudinal Construction Joints in Rigid Pavements
Macdill Field Traffic Tests



SUMMARY

- 30 year period beginning in the 1940s.
- Testing performed by USACE.
- Tests involved full-scale aircraft loading on both flexible and rigid pavements, and overlays.
- Performance data obtained from these tests form the basis of rigid and flexible pavement design and evaluation models incorporated in both Federal Aviation Agency and Tri-Services manuals.

