2002 Design Guide
Preparing for Implementation

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2003 NCUAPG Annual Meeting

Excerpts from the 2002 Guide Implementation Package

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2002 Design Guide Presentation Overview

- Need for Design Guide
- NCHRP 1-37A - Status
- Guide Basics
- Asphalt
- Implementation Steps

Change Is Needed!

- If we keep doing things the way we have been doing them, we will continue to get the same results we have been getting.
  - "No one I know is satisfied with the performance and costs of our pavements".

Changes in our approach!

- The 2002 Design Guide represents a major change in the way we do design. It brings the designer closer to reality and considers traffic, structural features, materials, construction, and climate far more than ever before.
- This means the designer now will be more involved in the design and expected performance of their pavements.

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Future Changes!

- The 2002 Design Guide provides a framework for continuous improvement over the years to come to keep up with changes in trucking, materials, computers, construction, design concepts, and so on.

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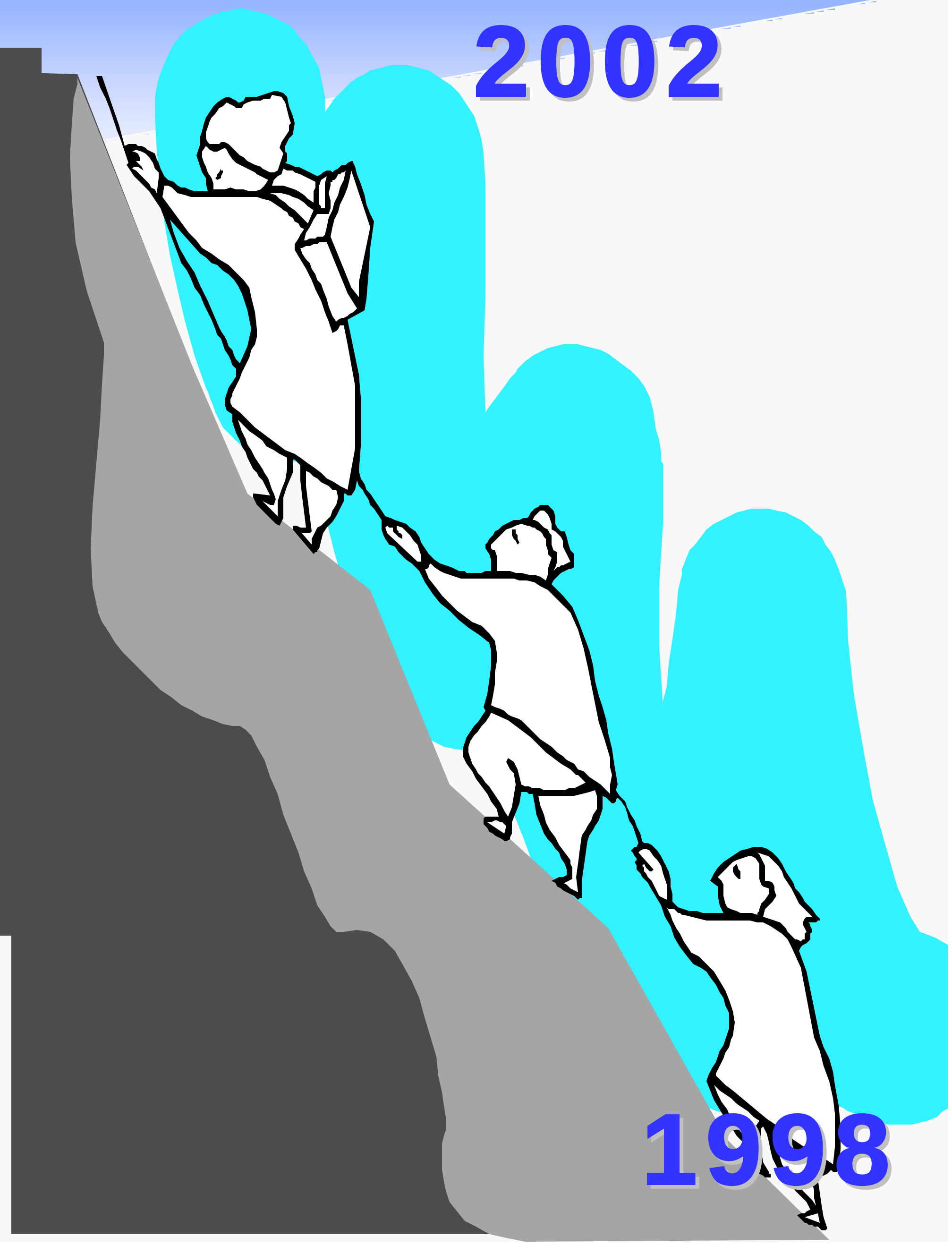
1. Structural response models
2. Materials characterization
3. Traffic characterization
4. Climate effects
5. Mechanistic distress models
6. Smoothness models
7. Calibration of models
8. Rehabilitation design
9. Design reliability
10. Design Guide text
11. Software
12. Training-Implementation



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So What's Left?

Apr 03

Finalizing 2002 Guide

Finalizing Training Materials & Implementation

Debugging Software

Completion of Calibration

Finalizing Reliability

Jan. 03

Guide Basics: Development Requirements

- Apply/enhance of existing state-of-the-art technology.
- Common design parameters across pavement types:
  - Materials & soils characterization
  - Climate parameters
  - Traffic characterization
  - Design reliability

Asphalt & PCC Pavements Treated Alike As Far As Possible!

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Products You Will See:

- Manuals
- Software

- Guidelines
- Recommended tests
- Implementation Materials
- Training Materials

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1-37A Copy No. ____________

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DESIGN OF NEW AND REHABILITATED PAVEMENT STRUCTURES

DRAFT FINAL REPORT

Part 1 - Introduction
&
Part 2 - Design Inputs

Prepared for
National Cooperative Highway Research Program
Transportation Research Board
National Research Council

NCHRP

TRANSPORTATION RESEARCH BOARD
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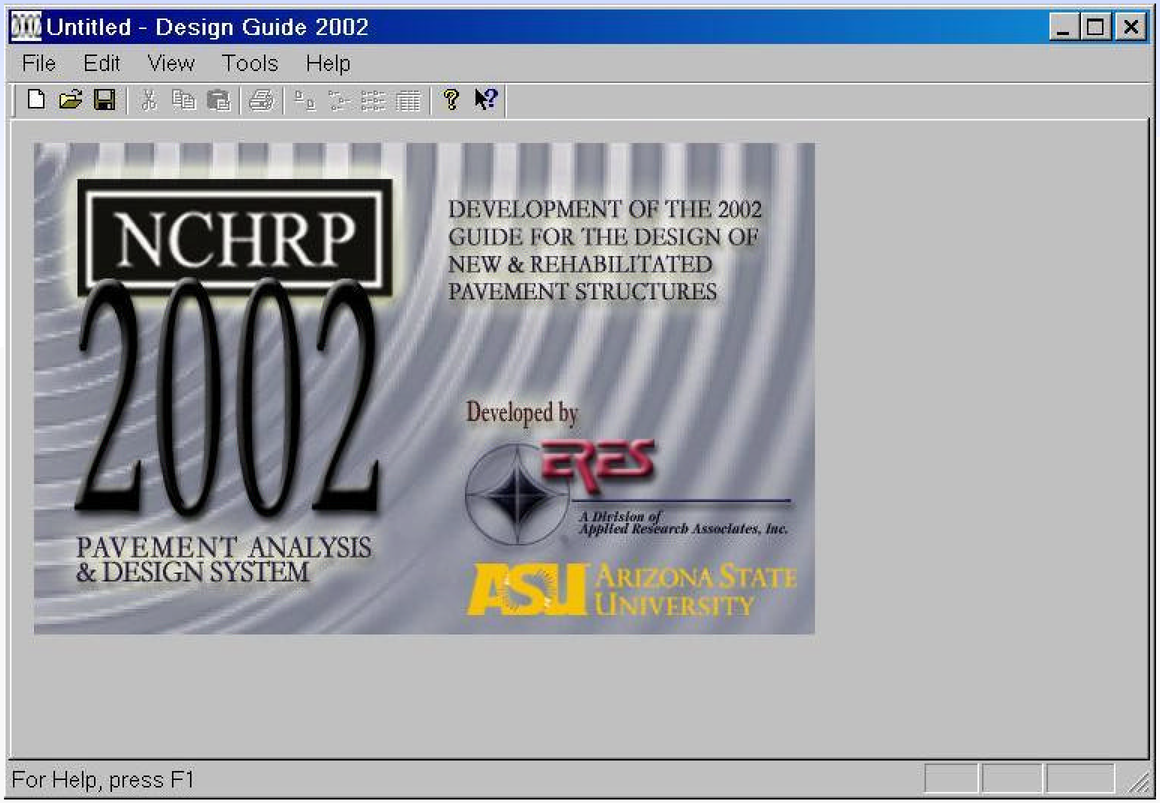
2002 DESIGN GUIDE SOFTWARE



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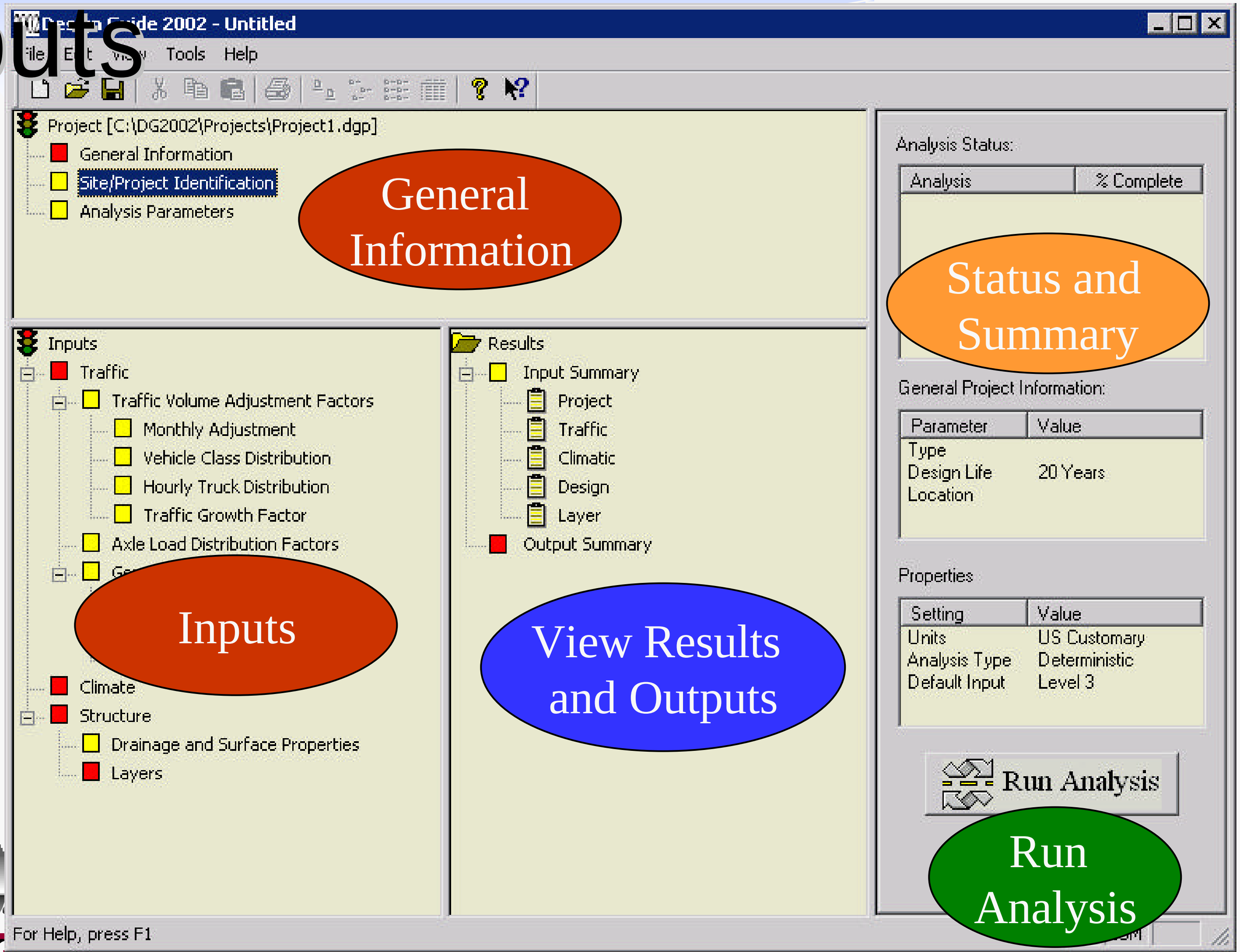
Layout Convenient for Providing Inputs



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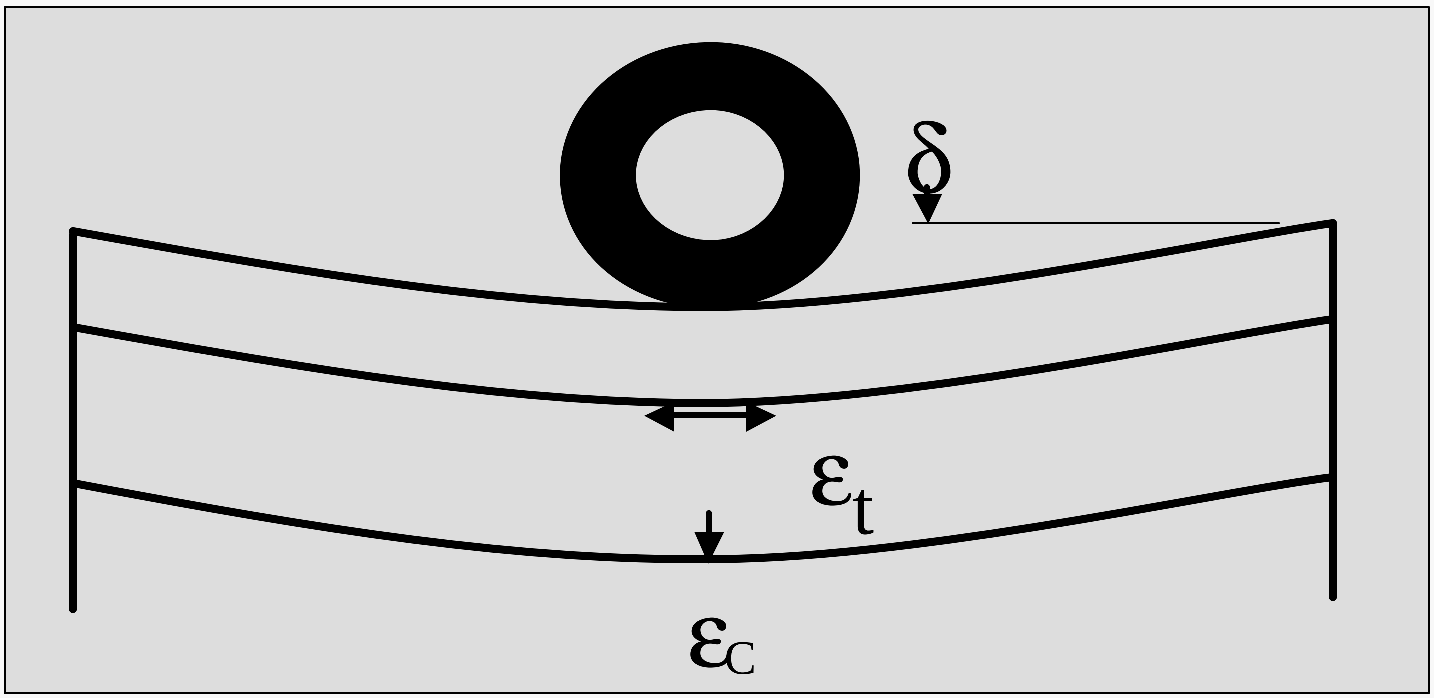
Guide Basics:

Develop the 2002 Guide for design of new and rehabilitated pavement structures based on M-E principles.



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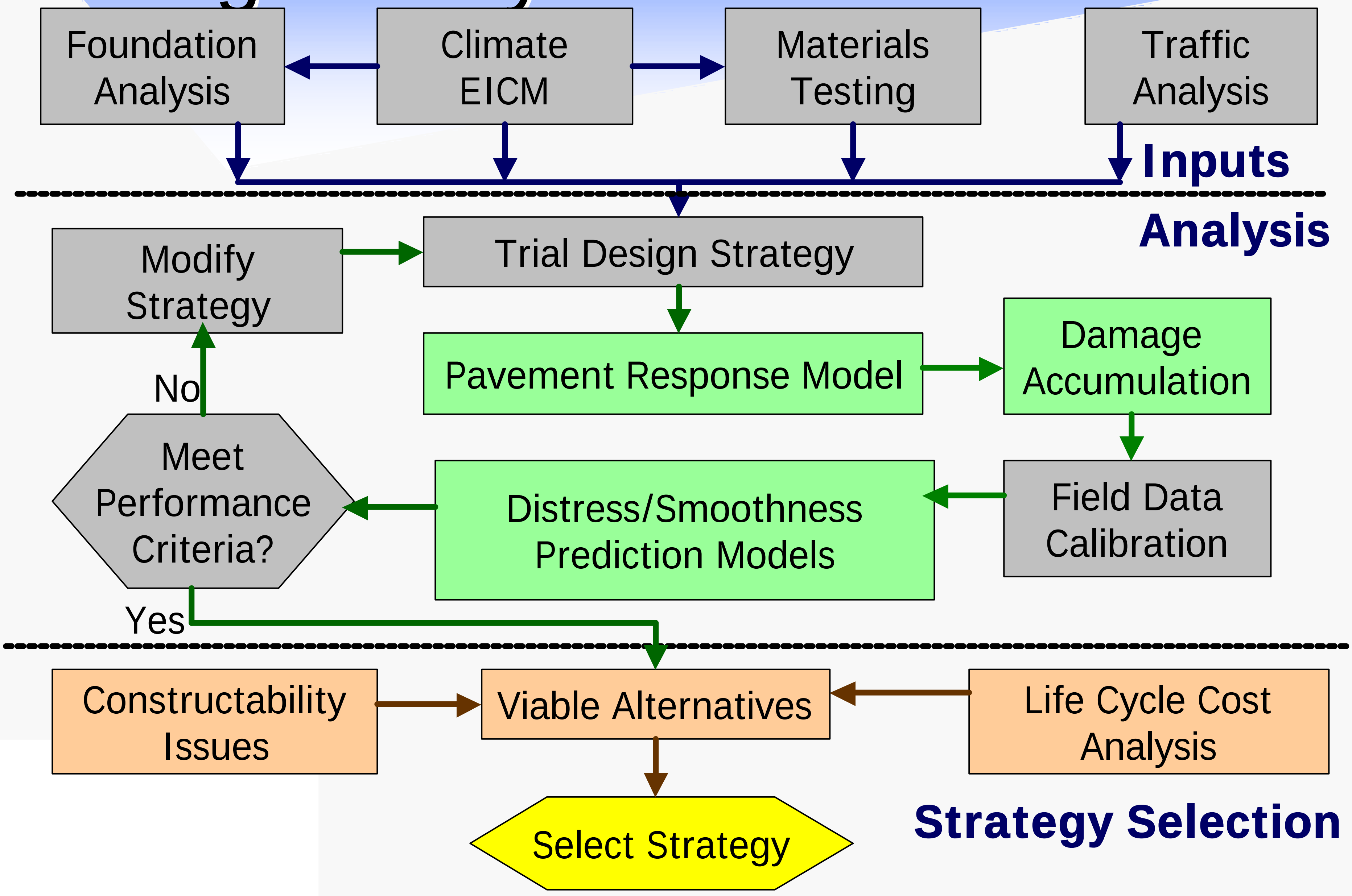
Design/Analysis Process



Flexible Pavement Performance

Design Inputs:

The 2002 Guide will use a hierarchical approach to determine design inputs.

Input Level	Determination of Input Values	Knowledge of Input Parameter
1	Project/Segment Specific Measurements	Excellent
2	Correlations/Regression equations, Regional values	Good
3	Defaults, Educated Guess	Fair - Poor

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Input Parameter Categories:

1. Traffic
2. Materials
3. Climate
4. Design reliability
5. Structure/trial design
6. Performance

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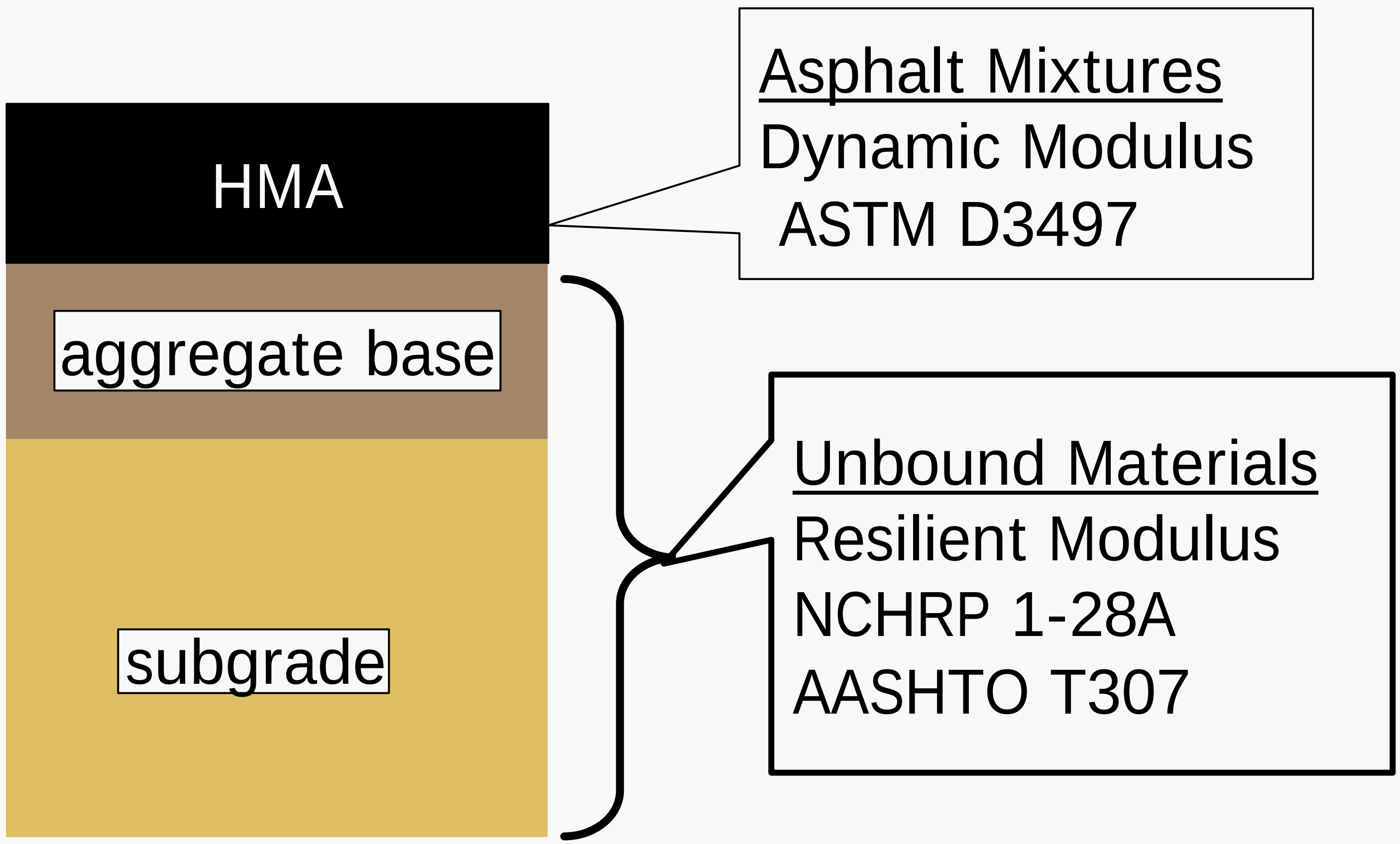
Materials Characterization HMAC

- Modulus of Elasticity



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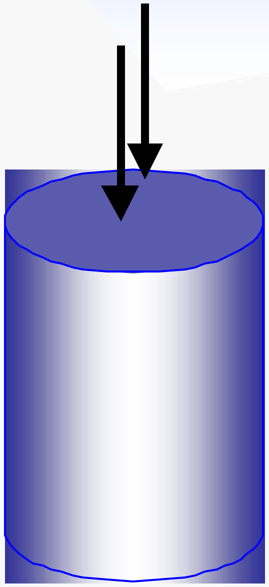
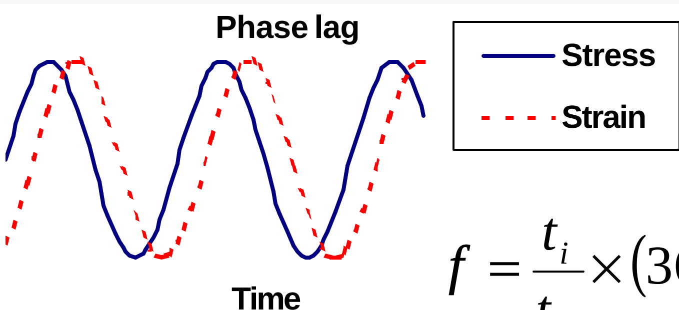
HMA Mixture: Dynamic (Complex) Modulus



$$|E^*| = \frac{\sigma_0}{\varepsilon_0}$$

Adjusted for temperature & time of loading.

$\lvert E^*\rvert$	= Dynamic modulus
σ_o	= Maximum (peak) dynamic stress
ε_o	= Peak recoverable axial strain



$$f = \frac{t_i}{t_p} \times (360)$$

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HMA Materials Data:

Material	Parameter	Level 1	Level 2	Level 3
Mix	Master Curve	Mix Specific	Not Required	Not Required
	IDT-Creep/Strength	Mix Specific	Reduced Testing	Reduced Testing
	Air Voids	Not Required	Mix Design	Specification
Asphalt	G*/Phase Angle	AASHTO MP1 Binder Test	AASHTO MP1 Binder Test	Not Required
	Pen./Vis./SG.	Not Required	Mix Design	Not Required
	Type (PG, Vis.)	Not Required	Not Required	Specification
Aggr.	Effective SG.	Not Required	Mix Design	Quarry Specific
	Gradation	Not Required	Mix Design	Specification

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- Poisson’s Ratio
- Moisture Susceptibility

Predictive Equation for Dynamic Modulus

$$\log E^* = -1.249937 + 0.02932\rho_{200} - 0.001767(\rho_{200})^2 - 0.002841\rho_4 - 0.058097V_a$$
$$- 0.802208\left(\frac{V_{beff}}{V_{beff} + V_a}\right) + \frac{3.871977 - 0.0021\rho_4 + 0.003958\rho_{38} - 0.000017(\rho_{38})^2 + 0.005470\rho_{34}}{1 + e^{(-0.603313 - 0.313351\log(f) - 0.393532\log(\eta))}}$$

where:

E^*	=	dynamic modulus, 10^5 psi.
η	=	bitumen viscosity, 10^6 Poise.
f	=	loading frequency, Hz.
V_a	=	air void content, %.
V_{beff}	=	effective bitumen content, % by volume.
ρ_{34}	=	cumulative % retained on the ¾ in sieve.
ρ_{38}	=	cumulative % retained on the 3/8 in sieve.
ρ_4	=	cumulative % retained on the No. 4 sieve.
ρ_{200}	=	% passing the No. 200 sieve.

Material Testing Required – AC Binder Characterization

Test	Level	Specification
Penetration	1, 2	ASTM D 5 AASHTO T 49
Viscosity at 60^{o}C	1, 2	ASTM D 2171 AASHTO T 202
Viscosity at 135^{o}C	1, 2	ASTM D 2170 AASHTO T 201
Brookfield Viscosity	1, 2	AASHTO T P48
Softening Point	1, 2	AASHTO T 3 ASTM D 36
Shear Modulus	1, 2	AASHTO T P5

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Material Testing Required – Asphalt Mix Characterization

Test	Level	Explanation
Complex Modulus	1	(On gyratory compacted specimens)
Indirect Creep	1	Needed for thermal cracking analysis (on gyratory compacted specimens)
Permanent Deformation	Special analysis	Needed for regional calibration (on gyratory compacted specimens)
Fatigue Cracking	Special analysis	Needed for regional calibration (on flexural beam samples)

Flexible Pavement Structures

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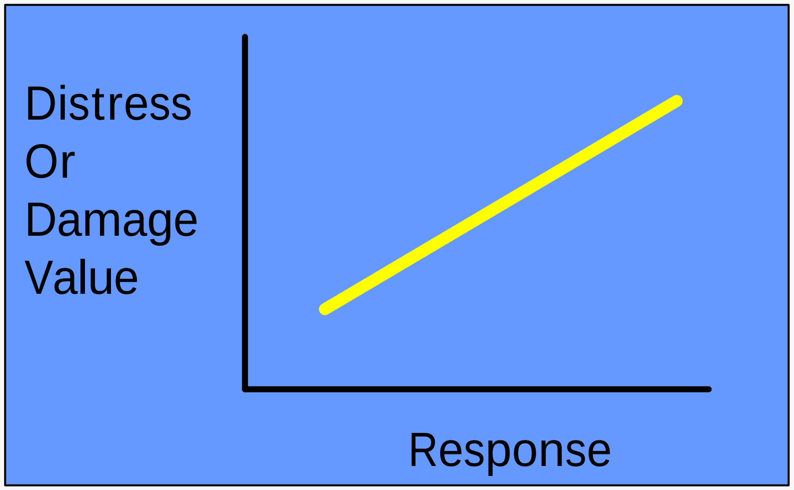
Predicted Performance

Flexible Pavements

- **Fatigue cracking**
  - Bottom-up and Top-down
- **Permanent Deformation (rutting)**
  - Bound and unbound layers
- **Thermal Fracture**
- **Smoothness, IRI**



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Implementation Steps

1. Agency acceptance/adoption
2. Training on design procedure
3. Establish design input procedures
4. Obtain needed equipment
5. State validation & calibration

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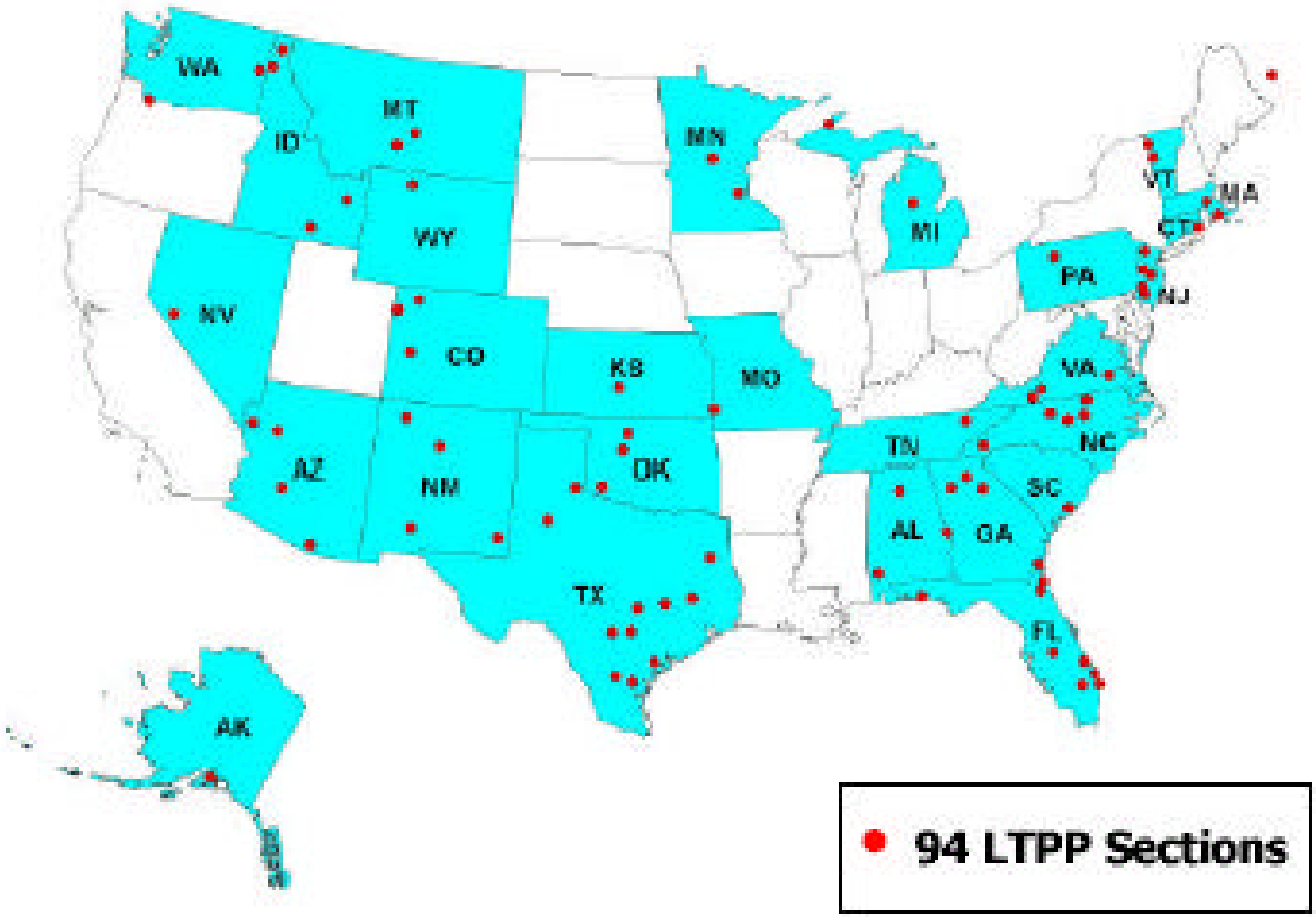
LTPP Sections Used to Calibrate New Asphalt Concrete Pavement Design



Website:
www.2002designguide.com

For more information see the Design Guide Website and NCHRP 1-37A project reports

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