

Traffic and the 2002 Pavement Design Guide

by

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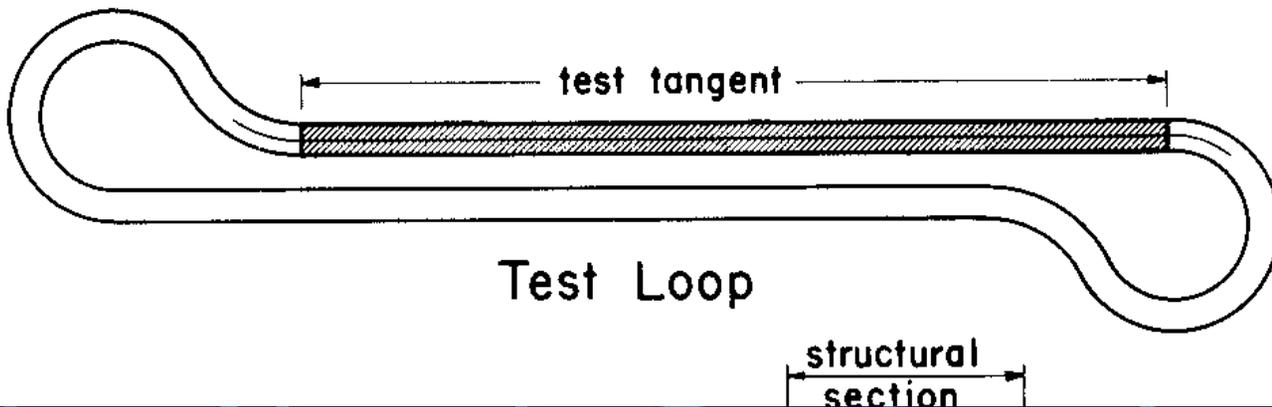
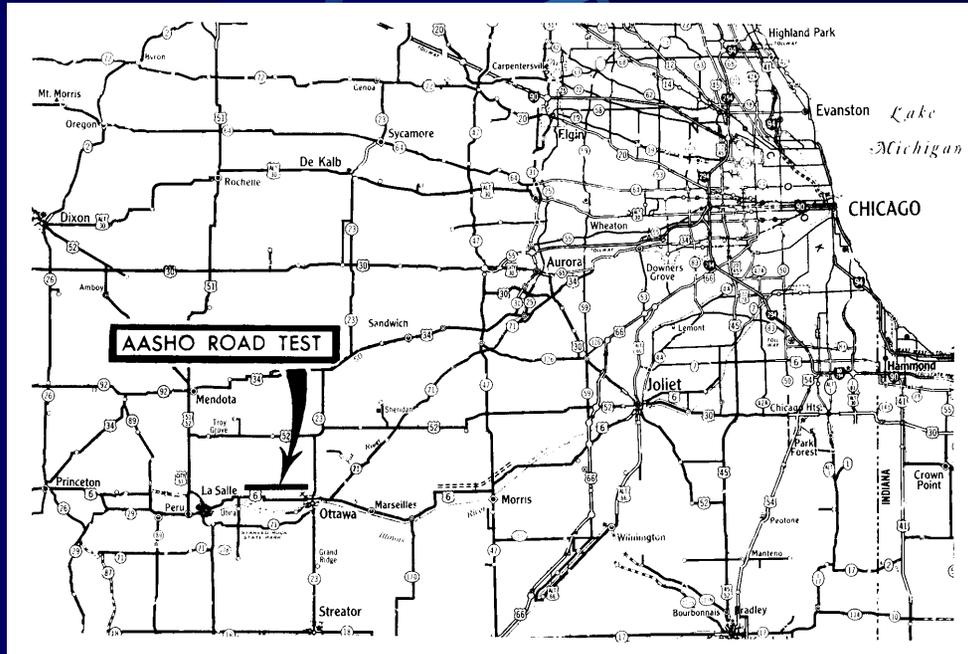
NATMEC

May 15, 2002

AASHTO Pavement Design Guide

- Several editions:
 - 1961 Interim Guide
 - 1972
 - 1986
 - Resilient modulus, rehabilitation, reliability
 - 1993
 - Improved rehabilitation
 - Current version
- Empirical design methodology based on AASHO Road Test in the late 1950s

AASHO Road Test (late 1950s)



(AASHO, 1961)

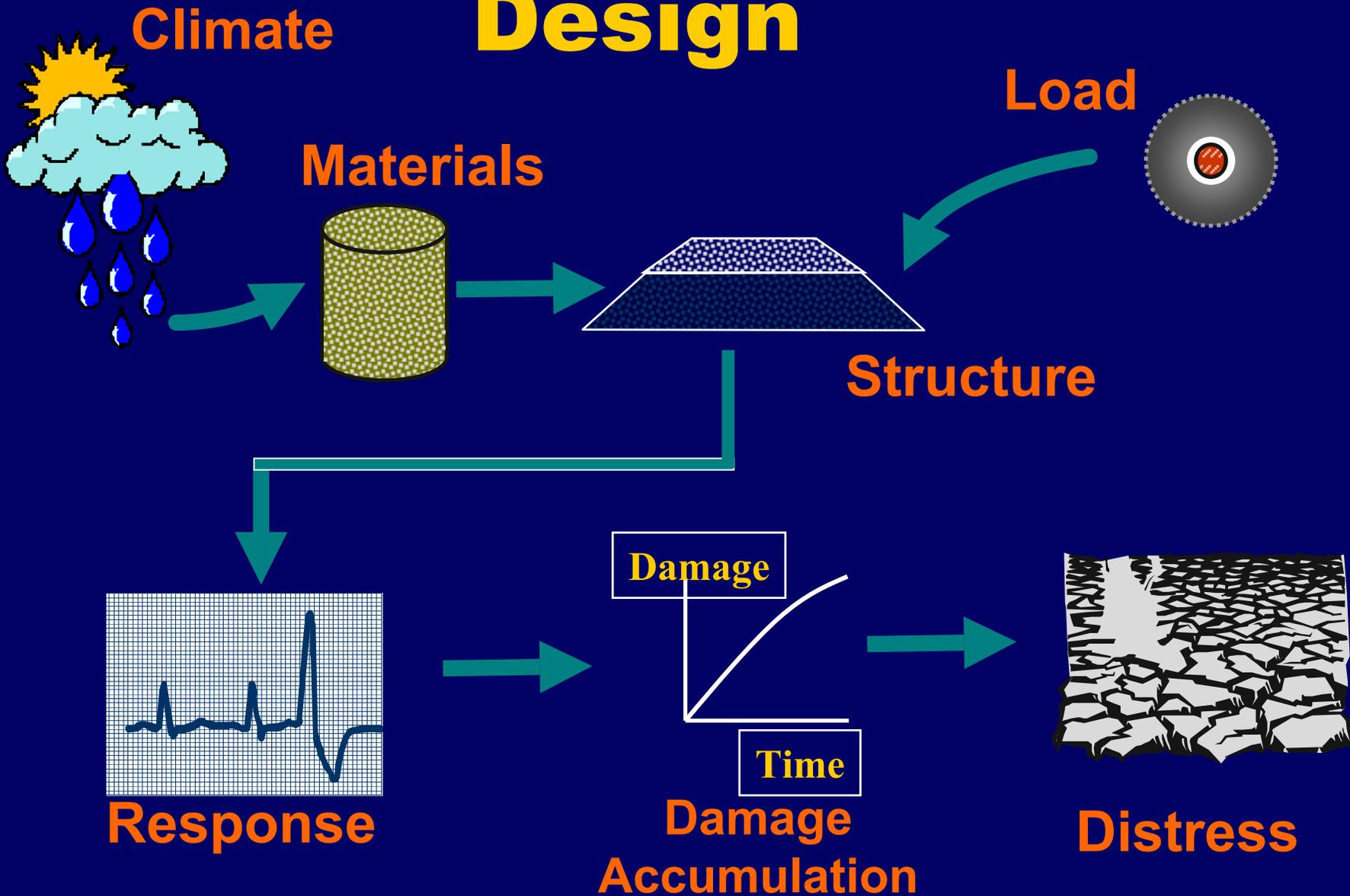
1950s Vehicle Loads...



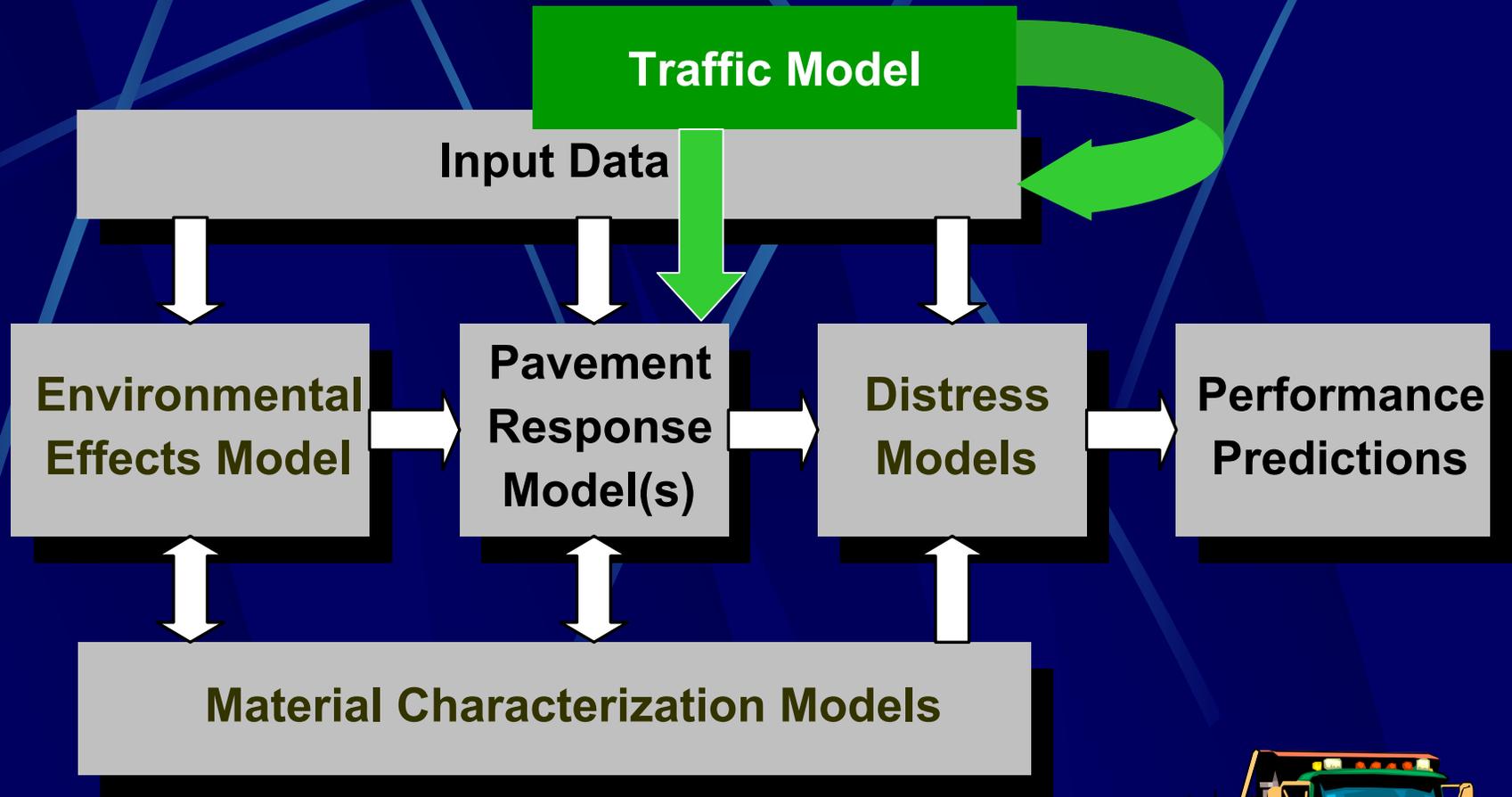
Figure 23. Test vehicles, showing typical axle arrangements and loadings.

(AASHO, 1961)

Mechanistic-Empirical Design

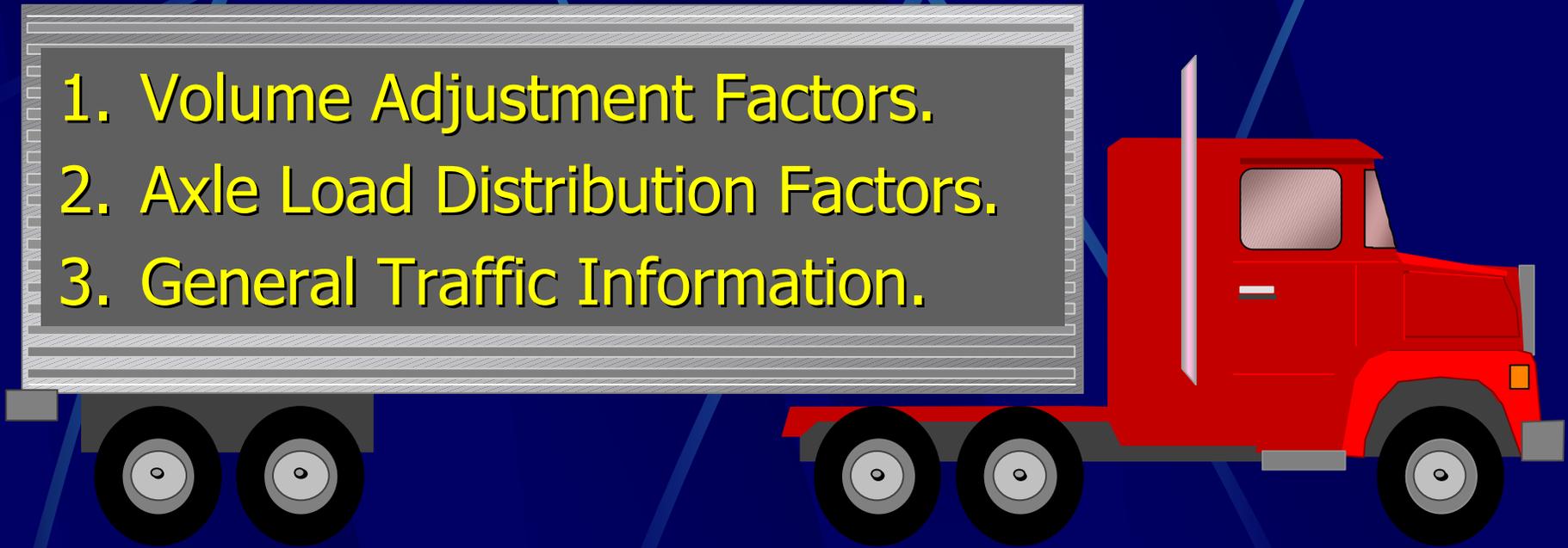


2002 Design Process



Traffic Module – Input Categories

1. Volume Adjustment Factors.
2. Axle Load Distribution Factors.
3. General Traffic Information.



What traffic inputs are needed for design?

2002 Design Inputs

A MAJOR CHANGE

- **The 2002 guide will use a hierarchical approach for determining design inputs.**
 - **Level of effort consistent with the importance of the project.**

Traffic Hierarchical Input Levels:

Input Level	Input Values	Knowledge of Parameters
1	Segment Specific AVC & WIM Measurements	Good
2a	Segment Specific AVC & Regional WIM Measurements	Fair
2b	Regional AVC & WIM Measurements	Fair
3	Site Specific Vehicle Count Data w/Defaults – Educated Guess	Poor



Traffic Module Inputs - Overview

Input Parameters	Input Level			
	1	2a	2b	3
AADTT for Base Year	√	√	√	
Truck Distribution Factors for Base Year	√	√	√	
Axle Load Distribution by Truck & Axle Type	√	√	√	
Monthly Distribution Factors	√	√	√	√
Hourly Distribution Factors	√	√	√	√

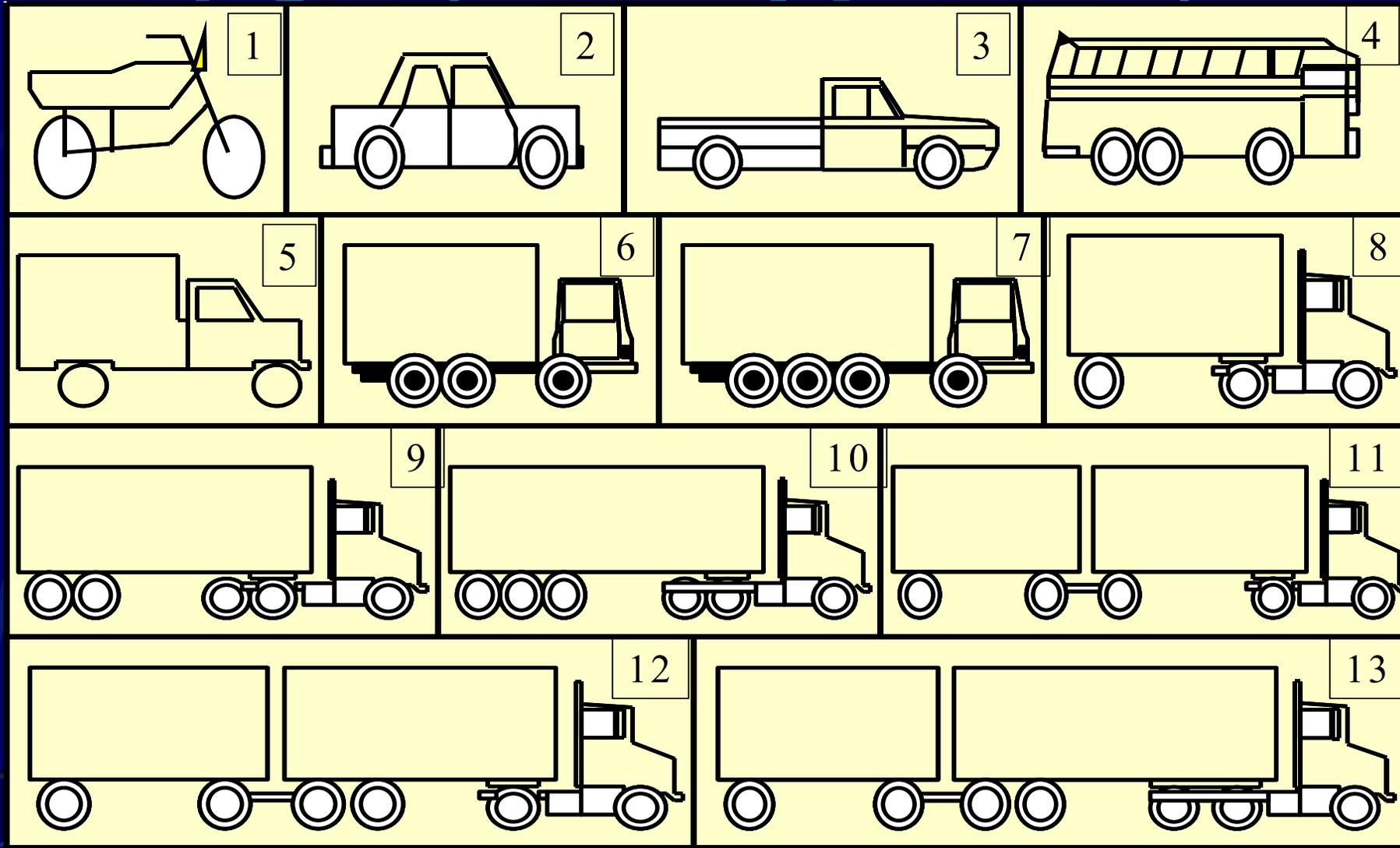
Traffic Module Inputs - Overview

Input Parameters	Input Level			
	1	2a	2b	3
AADT for Base Year				√
Percent Trucks for Base Year				√
Truck Traffic Classification Factor				√
Directional Distribution Factor	√	√	√	√
Lane Distribution Factor	√	√	√	√
Truck Traffic Growth Function/Factor	√	√	√	√

Traffic Module Inputs - Overview

Input Parameters	Input Level			
	1	2a	2b	3
No. of Axle Types per Truck Class	√	√	√	
Axle Spacing	√	√	√	
Axle Load Groups	√	√	√	√
Tire Spacing/Axle Configuration	√	√	√	√
Tire Pressure	√	√	√	√

Current Traffic Data Requirements —FHWA Vehicle Classification



AADTT: Average Annual Daily Truck Traffic

● Definition:

- The average daily number of trucks (vehicle classes 4-13) expected over the base year.

● Calculated:

- From AVC/WIM data or trip generation studies.
- By averaging the number of trucks measured over multiple 24-hour periods of time in each season/month & weighted between weekends & weekdays.

	1	2	3
Input Level	√	√	

AADT: Average Annual Daily Traffic

● Definition:

- The average daily number of vehicles (vehicle classes 1-13) expected over the base year.

● Calculated:

- From vehicle count data or trip generation studies.
- By averaging the number of vehicles measured over multiple periods of time in each season/month & weighted between weekends & weekdays.

	1	2	3
Input Level			√

Percent Trucks

● Definition:

- The percent of trucks (vehicle classes 4-13) in the traffic stream that are expected over the base year.

● Calculated:

- From vehicle count data or trip generation studies.
- By dividing the number of trucks by the total number of vehicles on a day & averaged for each season/month & weighted between weekends & weekdays.

	1	2	3
Input Level			√

Truck Traffic Classification Factor

- Definition:

- A factor that is used to group or classify roadways with similar truck traffic compositions and loading characteristics.
- 17 Groups defined from LTPP data.

- Defined by functional classification & vehicle count data or trip generation studies.

	1	2	3
Input Level			√

Truck Traffic Classification Group in the Same Functional Class Defined by:

- Percentage of buses
- Percentage of single unit trucks
- Percentage of single-trailer trucks
- Percentage of multi-trailer trucks



General Description for the TTC Groups

Buses	Commodities Transported Primarily by:		TTC Group No.
	Multi-Trailer	Single-Trailers & Single-Units	
Low to None, <2%	High Amounts of Multi-Trailer Trucks, >10%	Predominately single-trailer trucks	5
		High percentage single-trailer trucks	8
		Mixed traffic w/greater % of single-trailers	11
		Mixed traffic – about equal percentages	13
		Predominantly single-unit trucks	16
	Moderate Amounts of Multi-Trailer Trucks, 2-10%	Predominantly single-trailer trucks	3
		Mixed traffic w/greater % single-trailers	7
		Mixed traffic – about equal percentages	10
		Predominantly single-unit trucks	15

General Description for the TTC Groups

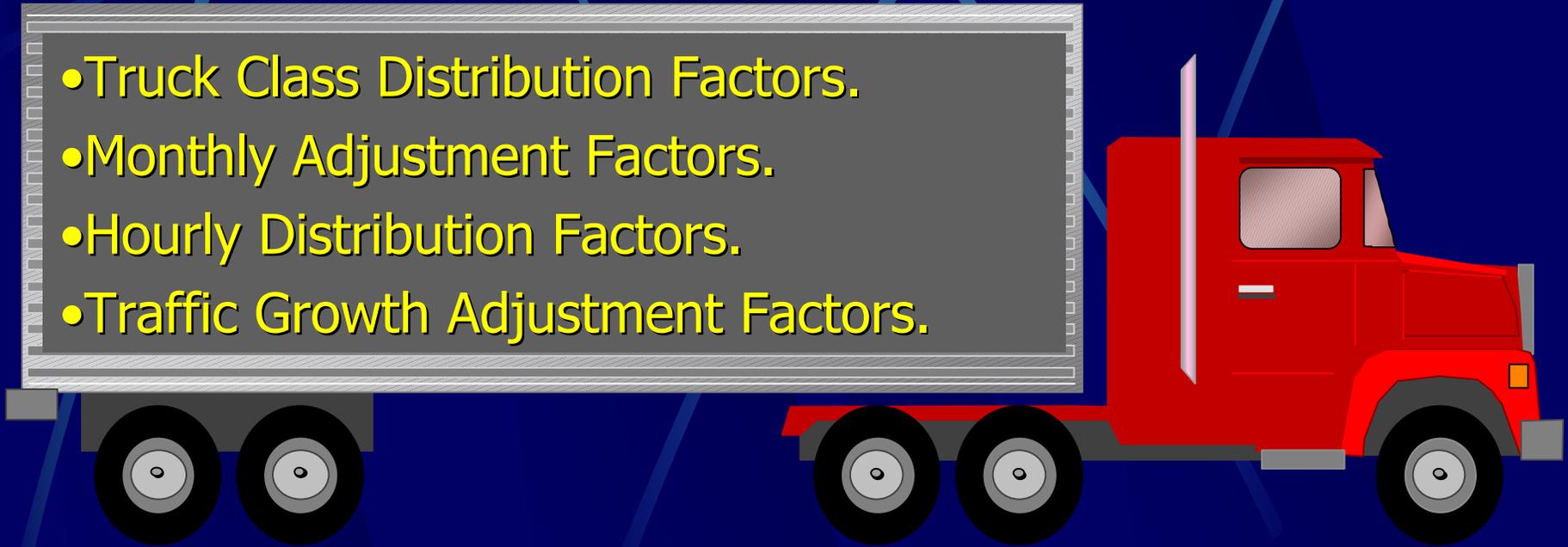
Buses	Commodities Transported Primarily by:		TTC Group No.
	Multi-Trailer	Single-Trailers & Single-Units	
Low to Moderate >2%	Low to None, <2%	Predominantly single-trailer trucks	1
		Mostly single-trailers, low % single-units	2
		Mostly single-trailers, moderate % single-units	4
		Mixed traffic w/greater % single-trailer trucks	6
		Mixed traffic – about equal percentages	9
		Mixed traffic w/greater % single-unit trucks	12
		Predominantly single-unit trucks	14
Bus Route, >25%	Low to None, <2%	Mixed truck traffic – about equal percentages	17

Defaults for Level 3 Inputs that are Dependent on the TTC Group

- Truck Distribution Factors
- Axle Load Distribution
Factors

Truck Traffic Volume Adjustment Factors

- Truck Class Distribution Factors.
- Monthly Adjustment Factors.
- Hourly Distribution Factors.
- Traffic Growth Adjustment Factors.



Truck Distribution Factors



- Definition:

- The normalized distribution of truck types expected over the base year.

- Calculated:

- From AVC/WIM data or trip generation studies.
- By dividing the number of trucks in a class by the total number of trucks on an average day in the base year.

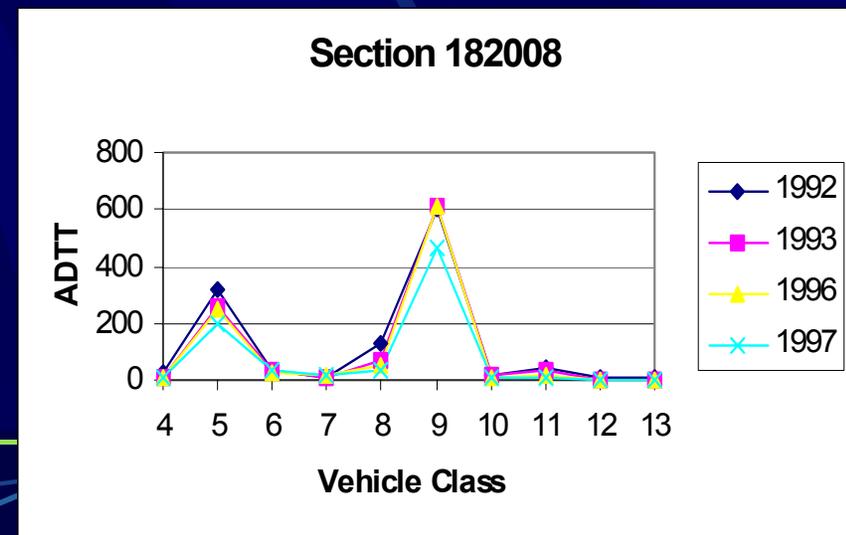
	1	2	3
Input Level	√	√	

Truck Distribution Factors



● Defaults:

- Normalized distributions for Level 3 defined from LTPP data.
- Factors dependent on truck traffic classification group.



Monthly Distribution Factors

● Definition:

- A ratio to adjust the average annual daily truck traffic into monthly truck traffic.

● Calculated:

- From AVC/WIM or traffic count data measured over time.
- By dividing the average monthly daily truck traffic by the AADTT for a particular year.

	1	2	3
Input Level	√	√	√

Hourly Distribution Factors

● Definition:

- The percentage of the average annual daily truck traffic (AADTT) within each hour of the day.

● Calculated:

- From hourly AVC/WIM or vehicle count data measured over time.
- By dividing the average annual truck traffic within a particular hour by the AADTT.

	1	2	3
Input Level	√	√	√

Time of Day or Hourly Distribution Default Values:

Time of Day Interval	% Daily Truck Traffic	Hourly Distribution Factor
Midnight to 6 AM	14.0	0.023
6 AM to 10 AM	19.8	0.050
10 AM to 4 PM	35.1	0.070
4 PM to 8 PM	18.5	0.046
8 PM to Midnight	12.6	0.032

Truck Traffic Growth Over the Design Period

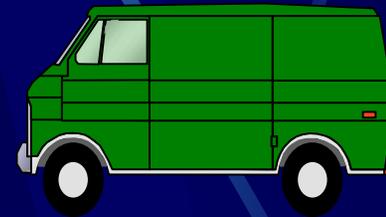
- Alternate Functions for Increases in Truck Volume:
 - No Growth
 - Linear
 - Compound
- Growth Considered for each Truck Class Separately.
- Opening Date = The date that the roadway is opened to traffic, excluding construction traffic.

Directional Distribution Factors

Percentage of truck traffic traveling in one direction

Design for worst case!

← 47%



53% →

Input Level	1	2	3
	√	√	√

Lane Distribution Factors

- Definition:

- The percentage of the average annual daily truck traffic in one lane along the roadway.

- Calculated:

- From AVC or traffic count data measured over time.
- By dividing the average annual daily truck traffic in one lane by the AADTT in one direction for a particular year.

	1	2	3
Input Level	√	√	√

Lane Distribution Factors

- Assumption:
 - Lane distribution factors are constant with time and for all truck classes.
- Defined for the predominant type of truck.
- Defaults for multi-lane roadways:

Total Number of Lanes, Both Directions	Lane Distribution Factor
2	1.0
4	0.9
6	0.6
6+	0.5

Axle Load Distribution Factors

Truck Class and Load
Group Dependent



Axle Load Distribution

● Definition:

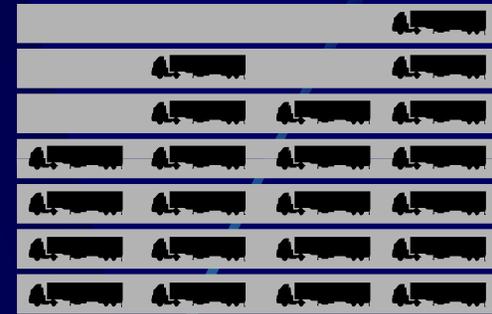
- The number of axles in each load interval by axle type for a specific truck class.

● Calculated:

- From WIM data.
- By averaging the daily number of axles measured within each load interval of an axle type for a truck class divided by the total number of axles for all load intervals.

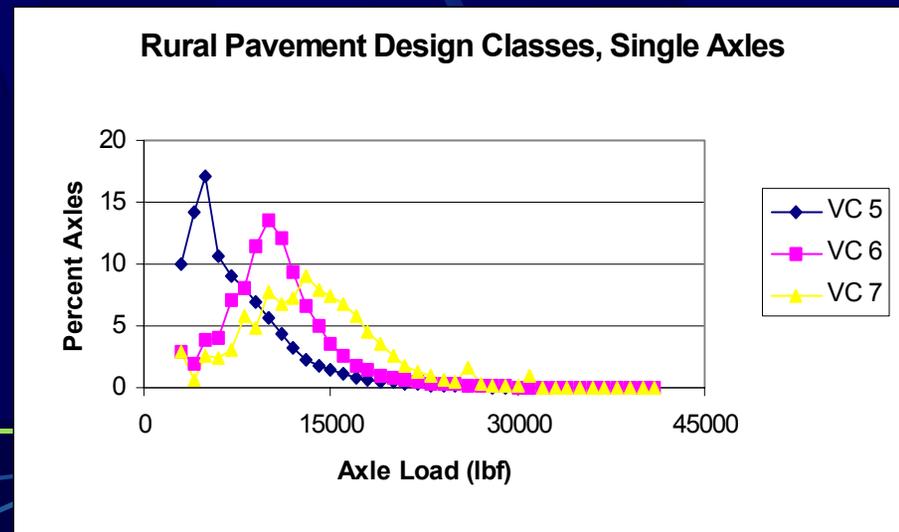
	1	2	3
Input Level	√	√	

Axle Load Distribution



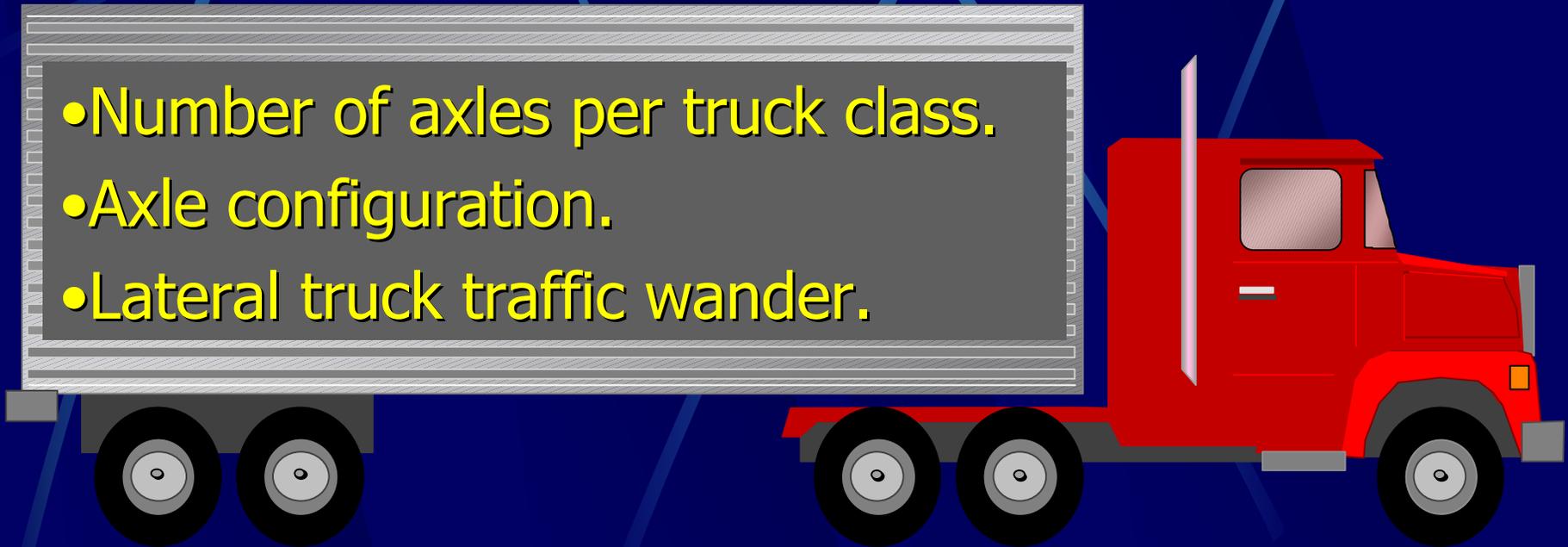
Defaults:

- Normalized distributions for Level 3 defined from LTPP data.
- Factors dependent on the Truck Traffic Classification Group.



General Truck Traffic Information

- Number of axles per truck class.
- Axle configuration.
- Lateral truck traffic wander.



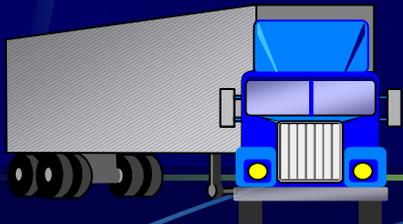
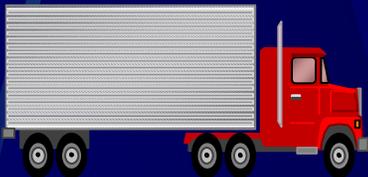
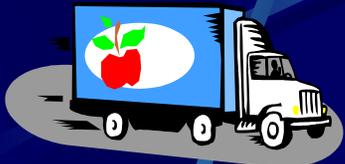
Number of Axles per Axle Type Per Truck Class

- Definition:

- The average number of axles for each axle type within each truck class.

- Calculated:

- From WIM data measured over time.
- By dividing the total number of a specific axle type measured for a truck class by the total number of trucks in that class.



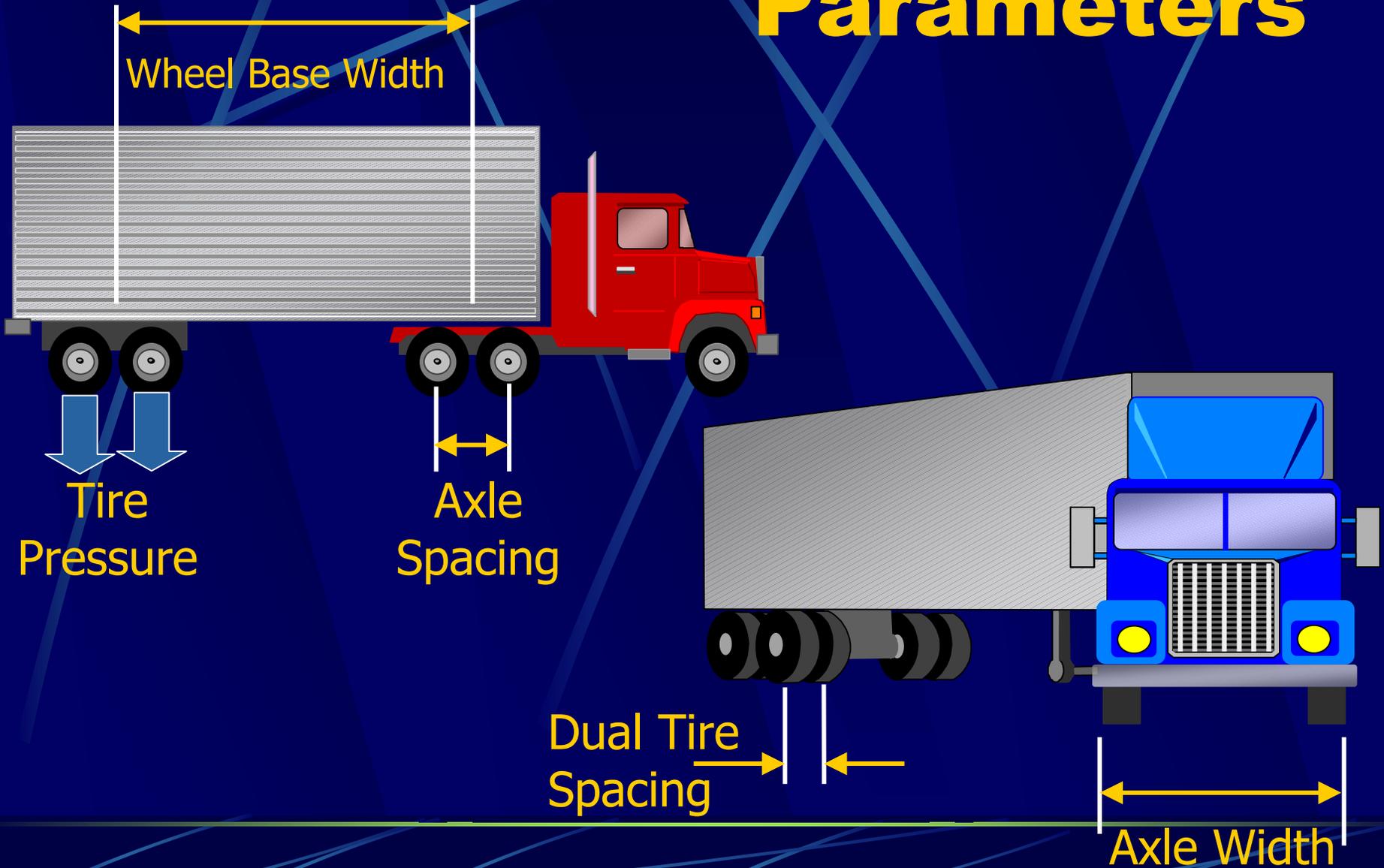
	1	2	3
Input Level	√	√	

Number of Axles per Axle Type Per Truck Class

- Assumption:
 - The number of axles for each axle type are constant with time.
- Default Values for Level 3 Defined from LTPP Data.

Truck Class	Single Axles	Tandem Axles	Tridem Axles
4	1.55	0.94	0.00
5	1.98	0.64	0.00
6	0.96	0.94	0.13
7	1.01	1.15	0.91
8	2.35	1.00	0.60
9	1.11	1.95	0.79
10	1.28	1.06	0.99
11	4.13	0.97	0.45
12	3.43	0.95	0.67
13	1.65	1.60	0.99

Axle Configuration Parameters



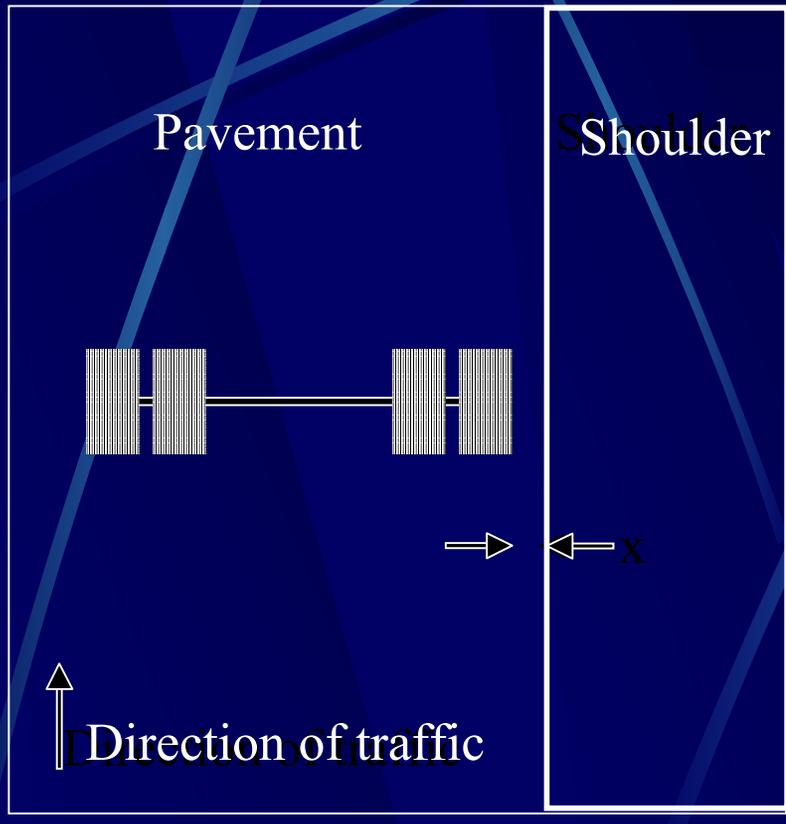
Tire Pressure

● Definition:

- The hot inflation pressure of the tire.
- It is assumed that the hot inflation pressure equals the contact pressure.

	1	2	3
Input Level	√	√	√

Traffic Wander



Used to calculate pavement responses & the number of axle load applications over a point for predicting distress & performance.

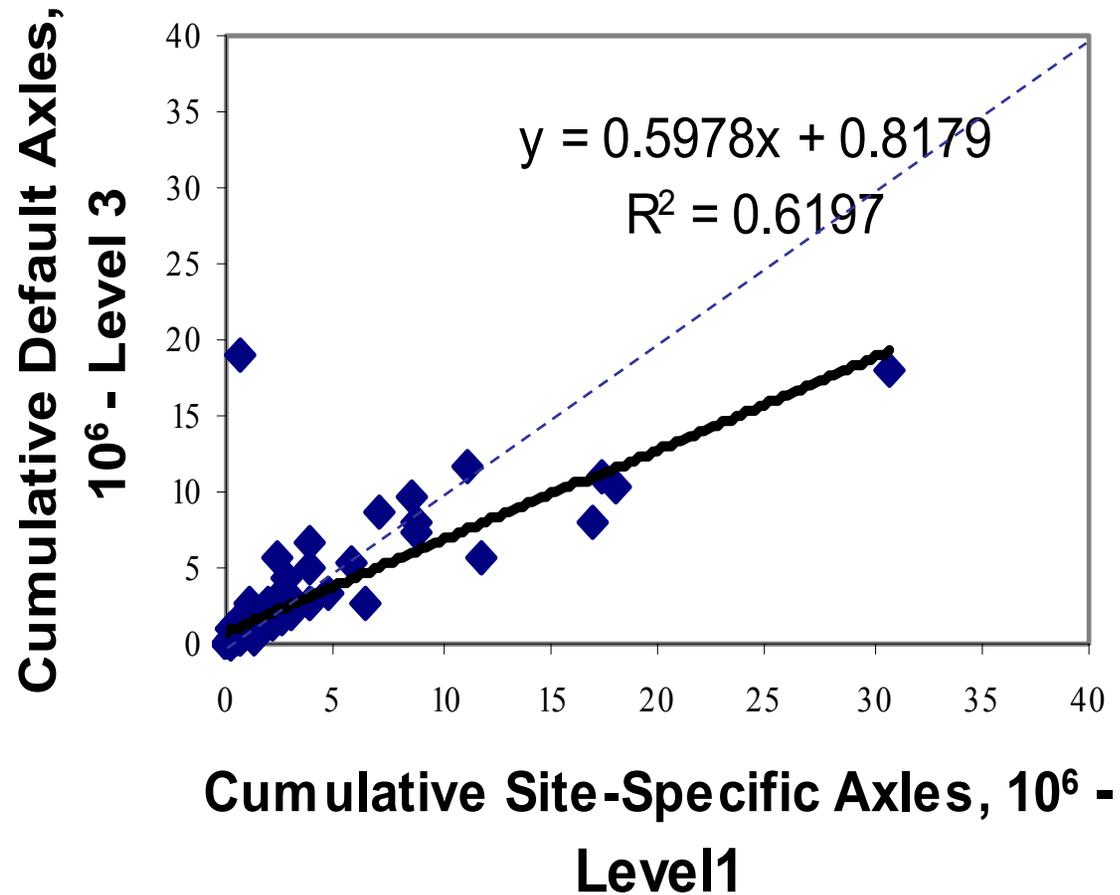
- Mean wheel location = 18 in.
- Standard deviation = 10 in.
- Design lane width.

Traffic Module Output Files

Year	Month	Hour	Axle Type	Load Group				
				0-2	2-4	4-6	x-y
k	j	l	Single					
			Tandem					
			Tridem					
			Quad					

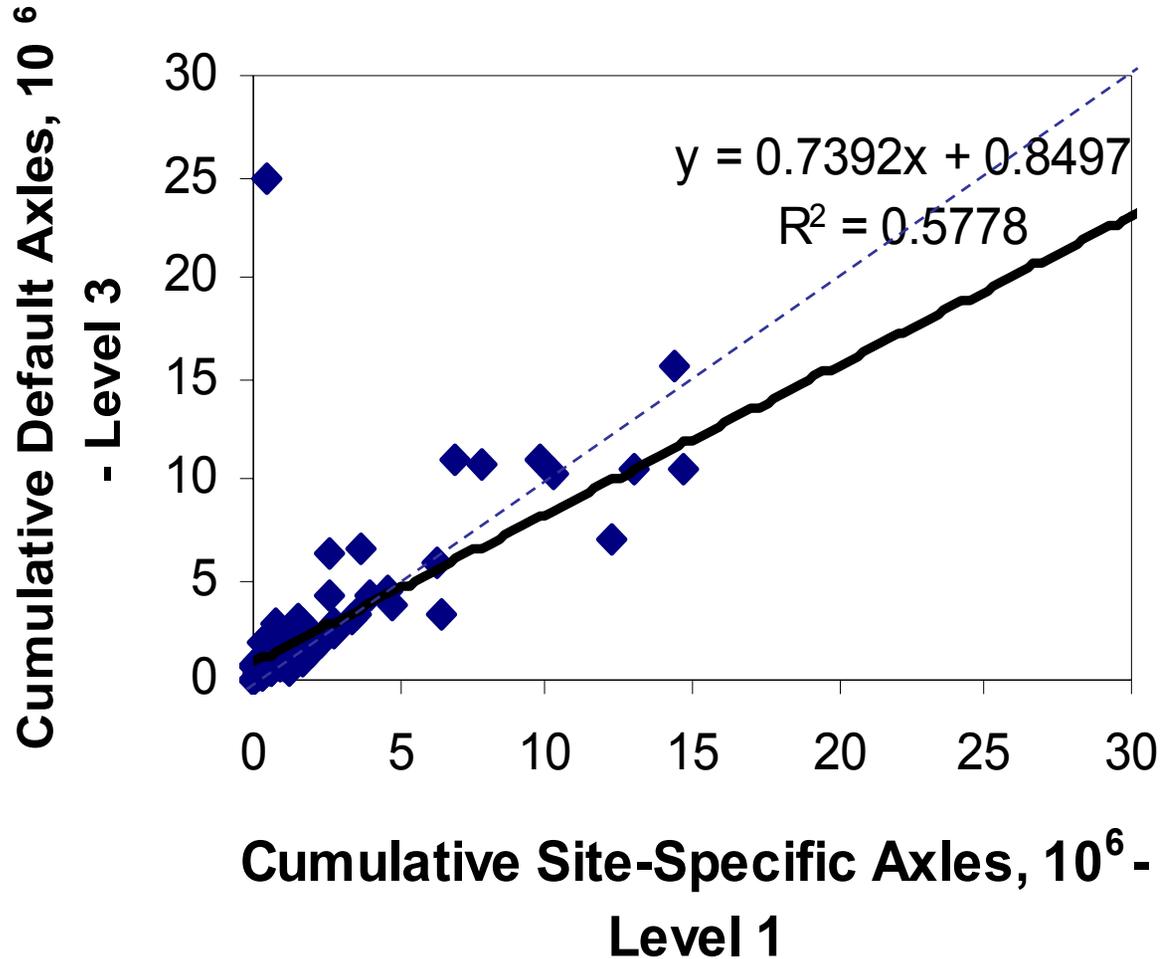
**Is there an advantage
to collecting Level 1
data over Level 3?**

Heavier LTPP Single Axles



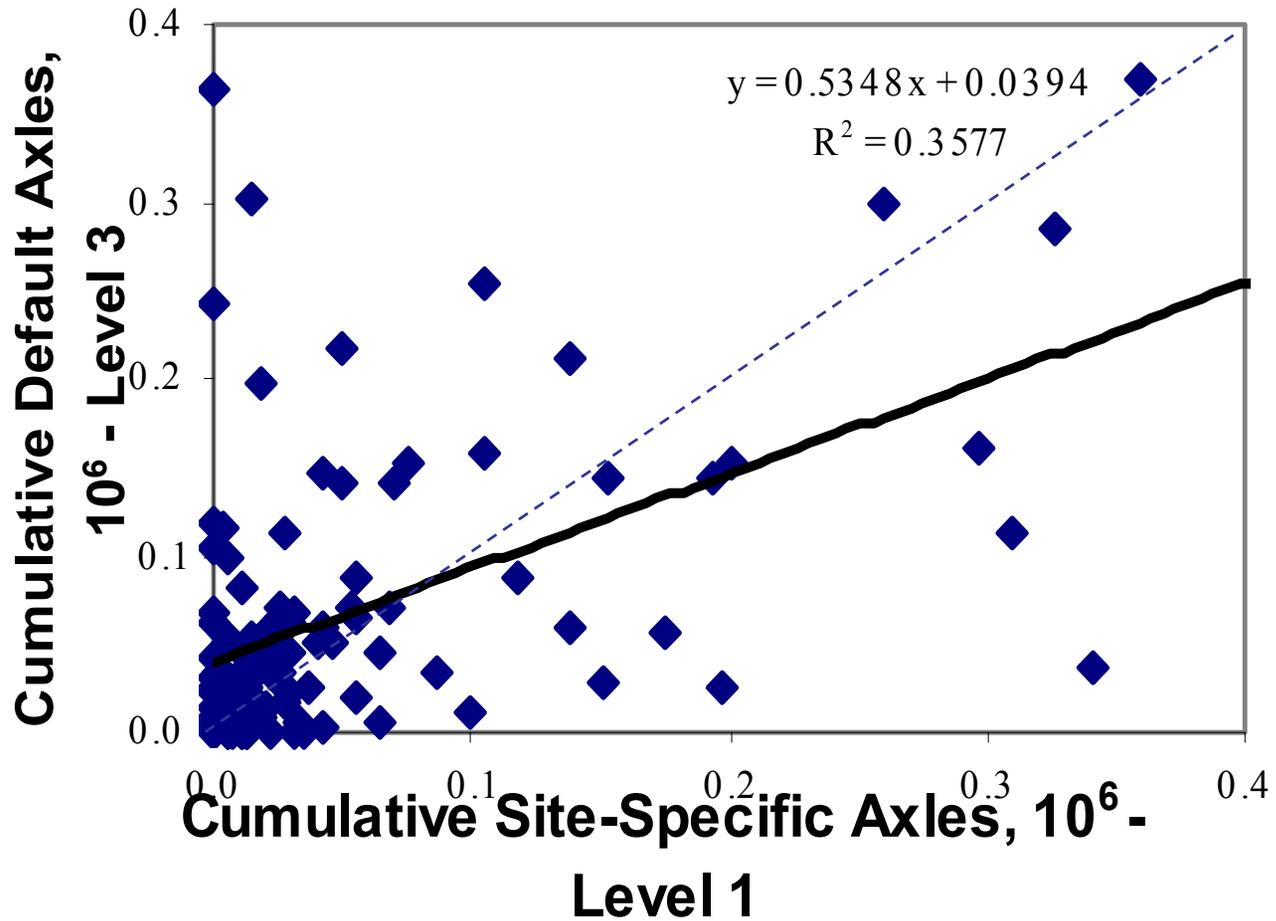
Level 3 under predicts and fair correlations

Heavier LTPP Tandem Axles



Level 3 under predicts and fair correlations

Heavier LTPP Tridem Axles



2002 Pavement Design Guide

Traffic Module Summary

- Extensive computations within traffic module for incremental damage accumulation.
- Module is flexible allowing user to use other default values.
- Default values based on LTPP data collected over time.
- Historical traffic data is required, but is consistent with requirements from LTPP and FHWA.
- Level 1 data is more reliable than Level 3.

Website:

www.2002designnguide.com

