



Implementation of Portable Weigh-in-Motion (WIM) Technology on Texas Highways: Workshop

Product 5-6940-01-P2

Cooperative Research Program

TEXAS A&M TRANSPORTATION INSTITUTE
COLLEGE STATION, TEXAS

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<https://tti.tamu.edu/documents/5-6940-01-P2.zip>



Project 5-6940-01

Implementation of Portable Weigh-in-Motion (WIM) Technology on Texas Highways

Workshop



by

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Date TBA | 01:00 – 5:00 PM

Outline

- ❑ Introduction
- ❑ Portable WIM System Components
- ❑ Portable WIM Site Selection & Preparation
- ❑ Portable WIM Installation, Setup, & Calibration
- ❑ Portable WIM Data Collection
- ❑ Troubleshooting & General Maintenance
- ❑ Data Processing & Analysis
- ❑ Generation of FPS & TxME Traffic Input
- ❑ The MS Access Traffic Data Storage System
- ❑ Case Studies
- ❑ Discussion

Introduction

- Background
- Technical Objectives

Background

- Need for accurate axle load spectra data (vehicle weights) to ensure optimal pavement designs
- Limited number of permanent WIM stations on Texas road network
- Need for alternatives to supplement the limited permanent WIM stations
- **Portable WIM** offers a cost-effective & practical supplement for rapidly measuring & collecting site-specific project traffic data (load spectra)



Technical Objectives

- 1) Portable WIM implementation & provision of traffic data support to the TxDOT districts
- 2) Standardized procedures & guidelines for the portable WIM – site selection, installation, calibration, site maintenance, & data processing/analysis
- 3) Site-specific traffic measurements & truck-loading quantification on selected highways



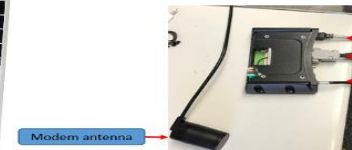
Portable WIM System Components

- Main System Components
- Additional Accessories

Main System Components

Enhanced hybrid portable WIM (Hp-WIM) system:

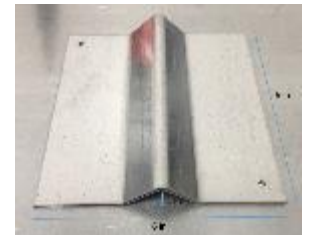
- Data logger/recorder – TRS unit
- Piezoelectric (PZT) sensors
- Piezo-channel box & modem
- Solar panel & battery (12V)
- Mastic & pocket tapes
- Static weigh scales
- Off-the-shelf custom-made (in-house) components including metal-plates
- Metal-protective box
- Customized solar charger controller



Modem antenna

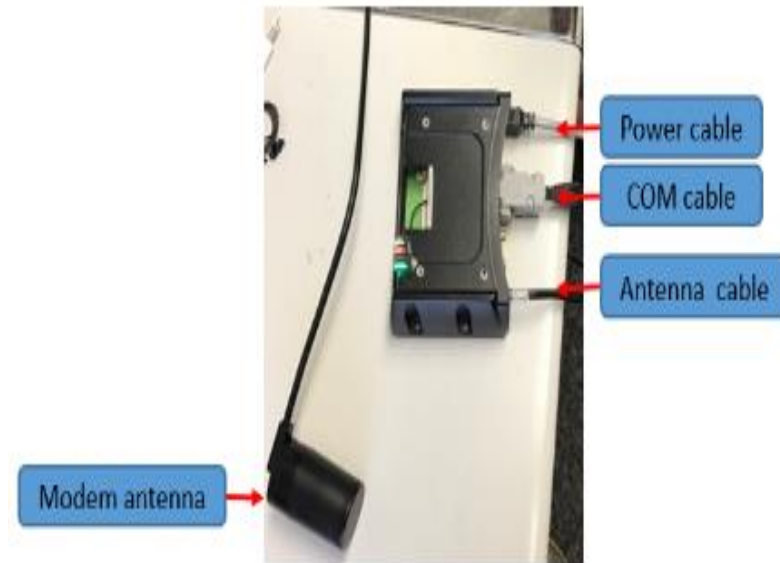


Power cable
COM cable
Antenna cable



Additional Accessories

- Modem Communication System
- Accessories & Hand Tools



Portable WIM Site Selection & Preparation

- Site Selection & Preparation
- Installation Schematics

Site Selection & Preparation

Site selection & PVMNT surface profile

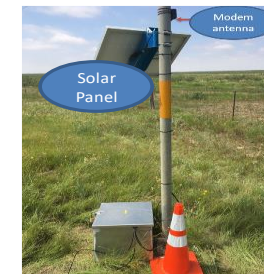
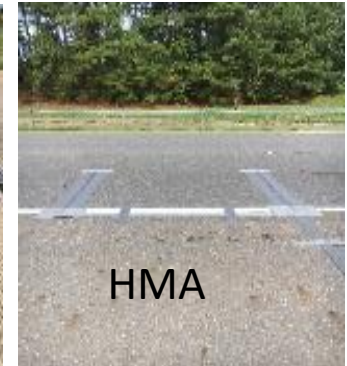
- Straight level flat section
- Dry & clean PVMNT surface without debris
- No serious or major surface distress like cracking, rutting, potholes, etc.
- Preferably warm PVMNT surface ($> 50\text{ }^{\circ}\text{F}$)
- Different installation methods for Summer vs Winter

Other considerations & Hwy preps

- 200 ft away from bridges, intersections, curves, etc.
- Avoid intersections & area w/ heavy congestion
- Roadside pole availability is preferred

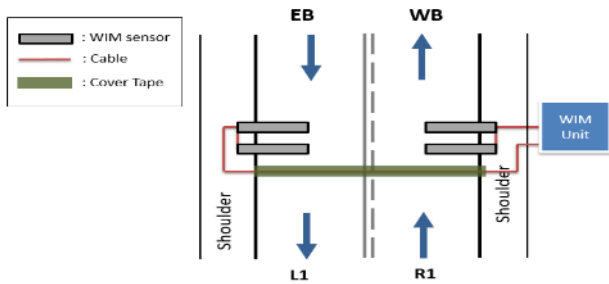
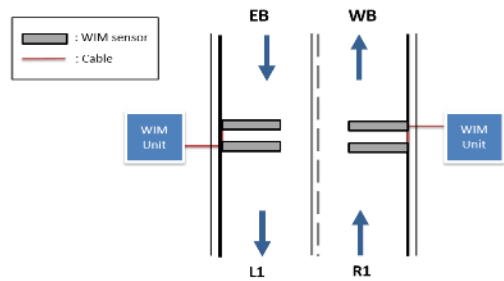
Portable WIM Inspection

- TRS unit (battery)
- 12-volt battery
- TRS unit diagnostic test

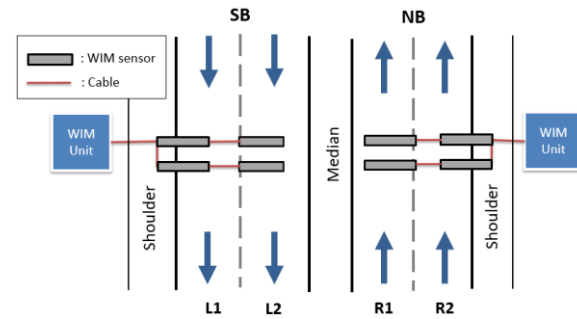
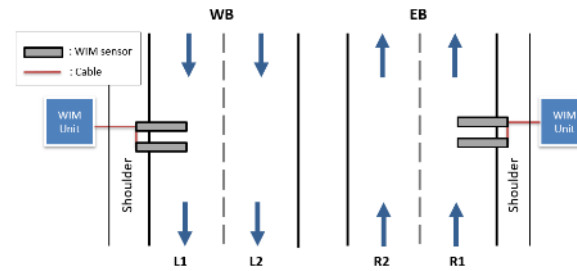


Installation Schematics

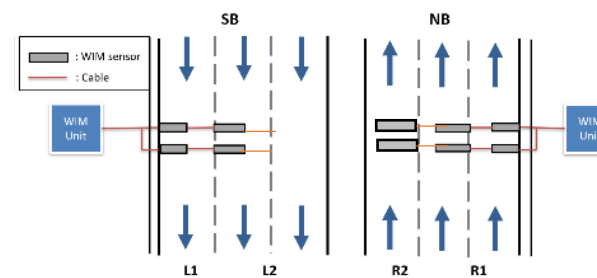
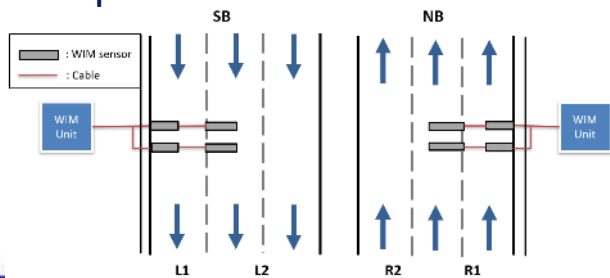
Single lane in each direction



Two lanes in both directions




Multiple lanes in both directions



Portable WIM Installation, Setup, & Calibration

- Installation & setup
- Calibration
- Removal



NO cutting,
digging, coring, or
trenching of the
pavement !!!

Portable WIM Installation



[Click the picture to see instruction video of portable WIM installation](#)

Takes about 1.5 hrs | Detailed guidelines can be found in Portable WIM Installation workshop material!!

Portable WIM Calibration

- 1) Onsite Calibration
- 2) Unit auto self calibration
- 3) Post calibration



Onsite Calibration (Corpus Christi)

Class06



Class09



Class10



Portable WIM Removal

- 1) Takes about 25~30 minutes per lane
- 2) Disconnect all portable WIM system components
- 3) Cut the road tapes & peel it off
- 4) Pull off the plates
- 5) Put all disposal materials in a trash bag



Portable WIM Data Collection

- Data Collection
- Demo Video

Portable WIM Data Collection

- Traffic measurements = min 7 days (up to more than a year with a periodic maintenance)
- Manual Retrieval through USB



USB drive & TRS unit



USB drive in TRS unit



Select F1 for all data



Select Y for yes

- Remote Retrieval through Modem

- Modem setup
- Road reporter setup



TRS Data Collection (Demo in US 87 Site)



US 87 (Austin District) = Installed since Dec 2019

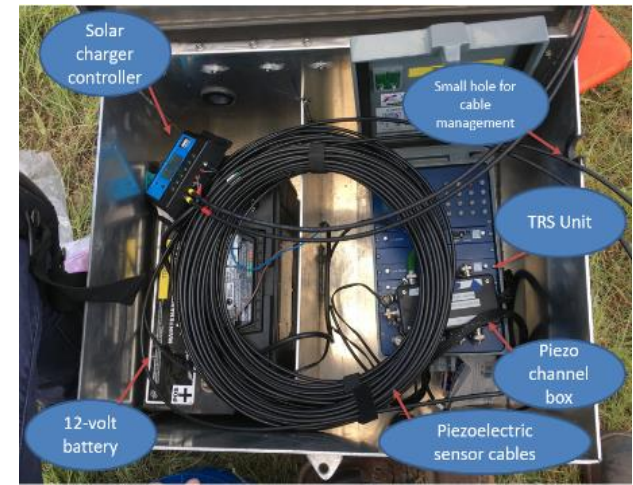
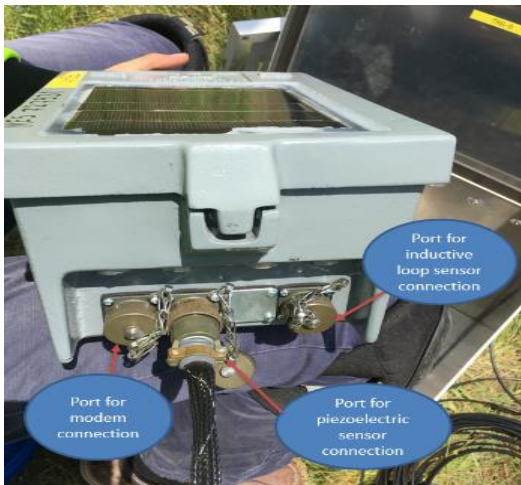
[Click the picture to see demo video of TRS data collection](#)

Troubleshooting & General Maintenance

- Troubleshooting
- Portable WIM Maintenance

Troubleshooting

- TRS unit is not turning on
- TRS unit is not counting
- TRS unit is not getting charged by the 12-volt battery
- Modem unit is not functioning properly



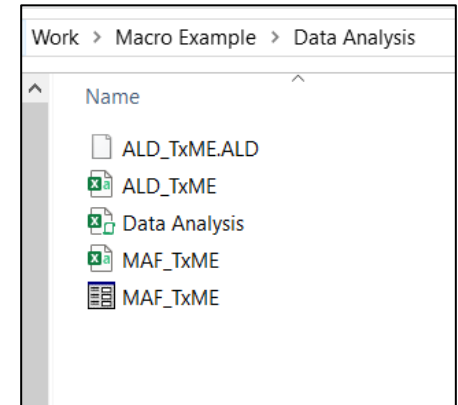
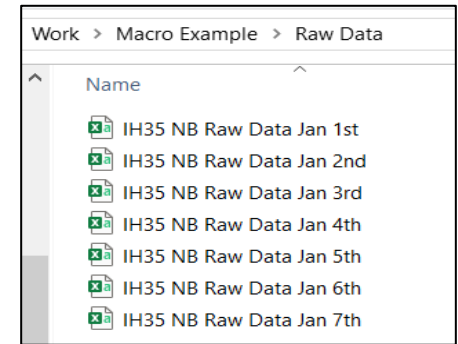
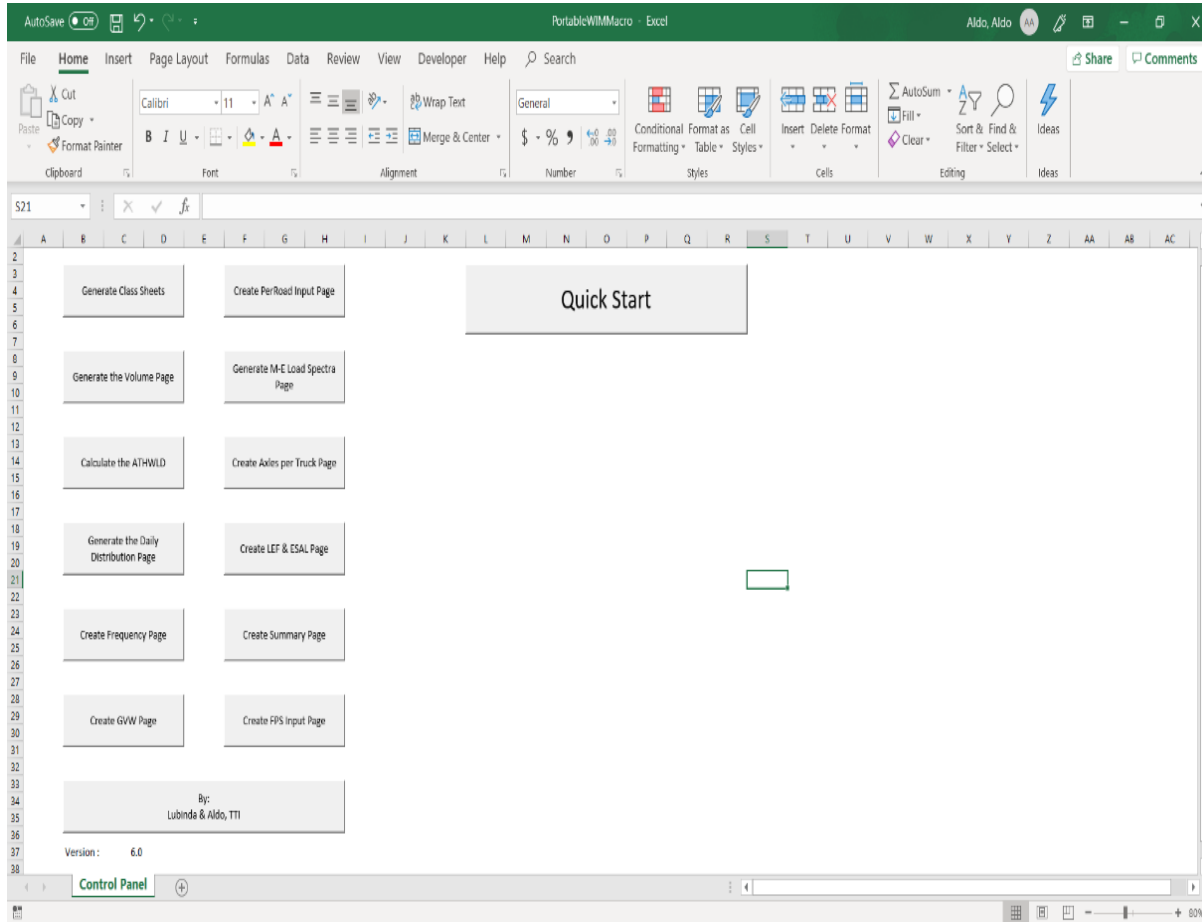
General Maintenance

- Check TRS battery & 12-volt battery regularly
- Routine maintenance of site include
 - Quality control of applied road tapes
 - Ensure the unit is recording & capturing proper data
 - TRS unit is being charged by the SCC
 - Check the TRS unit battery capacity & weight calibration

Data Processing & Analysis

- Portable WIM Macro
- Data Analysis File

Portable WIM Macro (Demo)



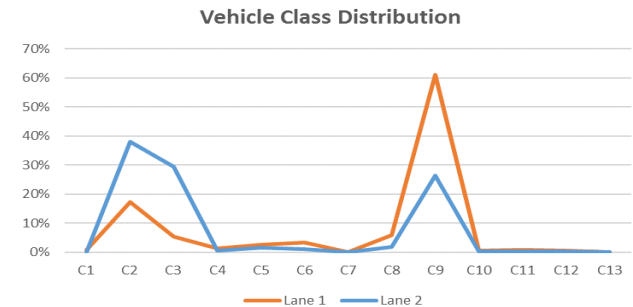
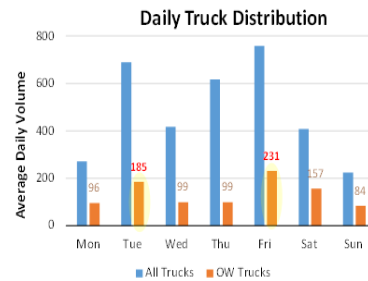
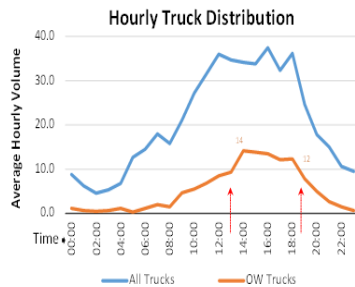
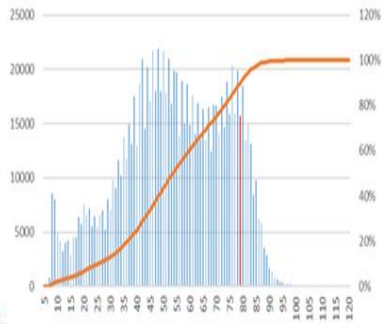
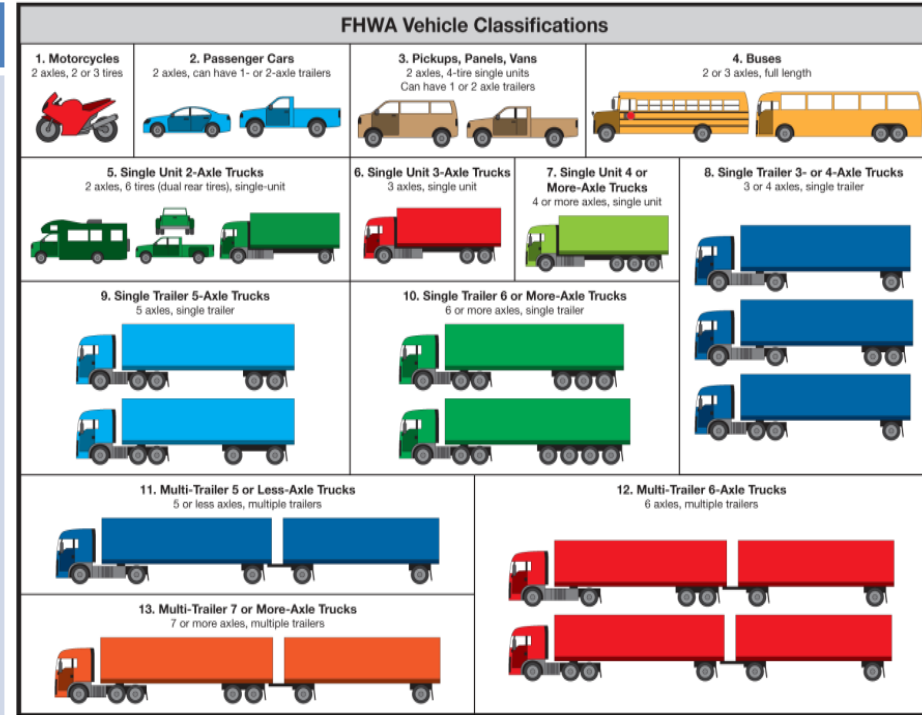
Portable WIM Macro

(a) General Traffic Data

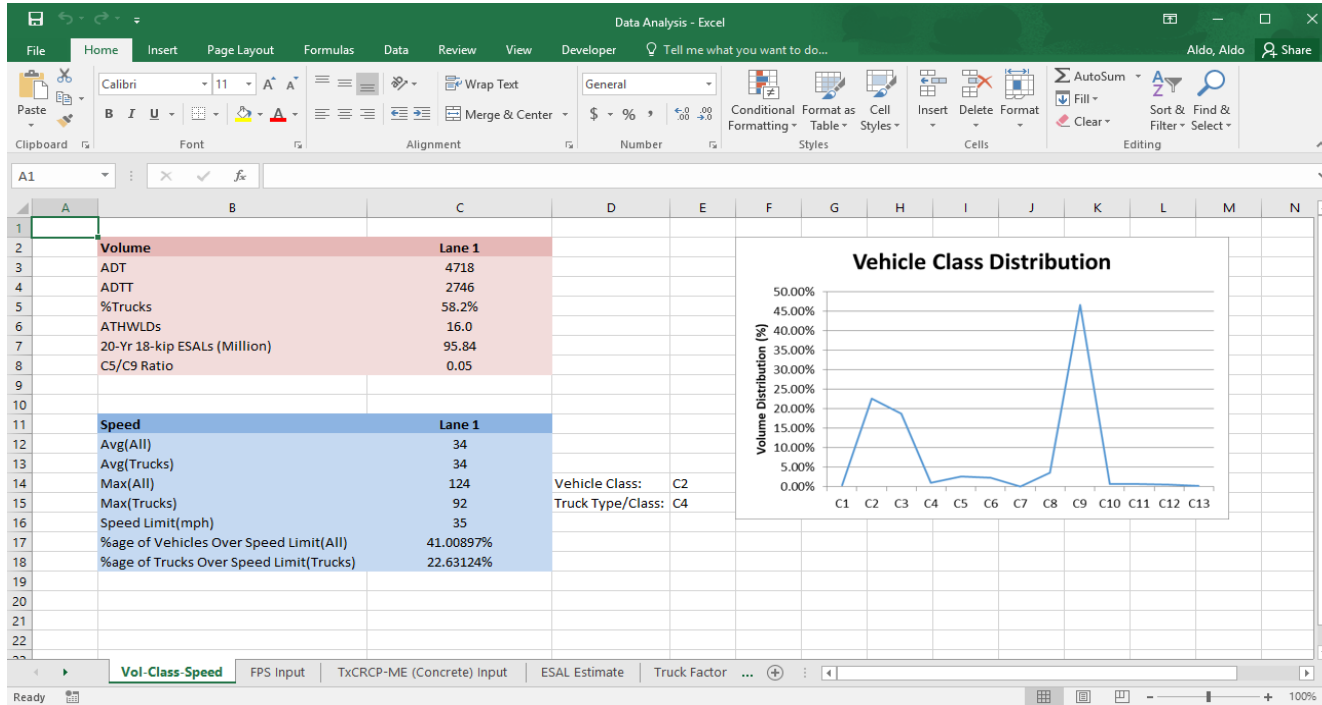
- 1) Volume counts (ADT, ADTT, %Trucks, etc)
- 2) Vehicle speed
- 3) Vehicle classification (VCD)
- 4) Hourly & daily distributions
- 5) Vehicle weights (GVW)
- 6) Axle load distribution
- 7) Overweight's & overloading statistics
- 8) ATHWLDs
- 9) LEFs & TFs
- 10) Etc.

(b) Software/M-E Inputs

- 1) FPS
- 2) TxCRCP-ME (Concrete)
- 3) TxM-E
- 4) TxACOL
- 5) TxCrackPro
- 6) AASHTOWare
- 7) PerRoad



Data Analysis File



Featured worksheets include:

- Vol-Class-Speed
- FPS Input
- TxCRCP-ME Input
- ESAL Estimate
- Truck Factor
- Volume
- Hourly Distribution
- Daily Distribution
- Truck Overweight Statistics
- ATHWLD
- Weight Summary & GVW
- Etc.

Generation of FPS & TxME Traffic Input

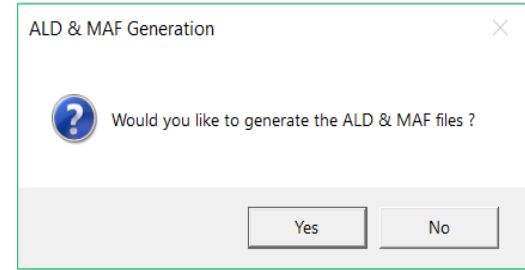
- FPS
- TxME
- TxCRCP-ME

	Value	Comment
Design Life (Years)	20	Can be changed as desired (typical = 20 years)
Annual Growth Rate (%)	3.0	Can be changed as desired (typical range = 2.5 to 5.0%)

FPS Input Parameters

Parameter	Value	Comment
ADT-Beginning	8565	ADT (Both directions) at the beginning of the design period
ADT-END	20 Yrs 15470	ADT (Both directions) at the end of the design period
18 kip ESALs (million)	20 Yrs 5.41	Design lane ESALs
Avg. vehicle speed (mph)	64.14	Approach speed assumed to be equal to operational speed
% trucks in ADT	11.1%	
ATHWLD	10.25	Kips
% Tandem Axles	36.53%	

- The Portable WIM Macro generates TxME input on “Level 1: Load Spectra”
- The macro generates Axle Load Distribution (.ALD) & Monthly Adjustment Factor (.MAF) files



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	January	4	100	30.71417	8.874681	0	0	12.81777	0	0	0	23.00068	8.913614	8.720379
2	January	5	100	21.38568	22.38972	6.657313	11.09287	6.576651	5.820179	6.519436	4.004078	4.32256	1.471284	7.193429
3	January	6	100	1.509032	1.64058	0	0	1.829221	4.185177	22.01838	23.25255	19.78184	10.01613	5.983062
4	January	7	100	0	0	0	0	0	0	0	0	31.36517	48.42342	6.520648
5	January	8	100	30.37896	18.58255	6.285326	10.92097	6.555036	8.909195	4.461667	4.59579	3.927997	1.646599	0.583706
6	January	9	100	0.128603	0.288307	1.516667	1.255208	3.692454	8.389278	23.00409	24.61551	12.59774	5.876618	5.040024
7	January	10	100	2.155894	1.507689	0	0	1.408695	3.696183	12.60941	11.88465	19.46776	19.55843	8.451273
8	January	11	0	0	0	0	0	0	0	0	0	0	0	0
9	January	12	0	0	0	0	0	0	0	0	0	0	0	0
10	January	13	100	0	0	0	0	0	0	0	25.11289	0	0	21.77723
11	February	4	100	36.26275	4.083664	0	0	13.60623	0	0	0	22.51837	8.757198	8.348693
12	February	5	100	22.74723	22.21942	6.85818	10.59494	5.89427	6.240213	6.505979	4.57692	4.157624	1.484431	2.412537
13	February	6	100	1.612899	1.836495	0	0	1.861684	3.951197	23.0754	23.06467	20.25602	9.429846	5.836736
14	February	7	100	0	0	0	0	0	0	0	0	37.20821	43.24602	6.364233
15	February	8	100	28.2949	19.25256	6.607712	10.88973	6.920391	9.245013	4.587498	4.743922	4.007536	1.694312	0.523653
16	February	9	100	0.11922	0.289405	1.661195	1.222388	3.623163	8.006373	22.08466	24.9231	12.78983	5.834291	4.983305
17	February	10	100	1.43306	1.622429	0	0	1.541362	4.30638	12.52864	13.23709	20.15514	20.537	7.784582
18	February	11	0	0	0	0	0	0	0	0	0	0	0	0
19	February	12	0	0	0	0	0	0	0	0	0	0	0	0
20	February	13	100	0	0	0	0	0	0	0	26.20256	0	0	20.32545
21	March	4	100	35.71429	7.142857	0	0	14.28571	0	0	0	21.42857	7.142857	7.142857
22	March	5	100	23.21429	21.875	6.473214	12.05357	5.803571	7.366071	6.696429	4.464286	3.571429	1.5625	2.678571
23	March	6	100	1.923077	1.923077	0	0	1.923077	3.846154	23.07692	23.07692	19.23077	9.615385	5.769231

Traffic Input

Level 2: ESALs Level 1: Load Spectra

Level 1: Load Spectra

General Traffic Information

Annual Average Daily Truck Traffic (Two-Way AADTT):

Percent in Design Direction (%):

Percent in Design Lane (%):

Operational Speed (mph):

Axle Configuration

Axle Tire

Single Tire Pressure (psi):

Dual Tire Pressure (psi):

Dual Tire Spacing (in):

Axle spacing

Tandem Axle (in):

Tridem Axle (in):

Quad Axle (in):

TxCRCR-ME

CRCP DESIGN PROGRAM BASED ON MECHANISTIC-EMPIRICAL PRINCIPLES			
Developed under TxDOT Research Project 0-5832			
Version: <u>TxCRCR-ME v07b</u>			
A. Project Identification		D. Concrete Layer Information	
District		Thickness of Concrete Layer (in.)	
County		28-Day Modulus of Rupture (psi)	570
Highway			
CSJ		E. Support Layers Information	
Direction		Soil Classification System	USCS
Station (Begin)		Soil Classification of Subgrade	
Station (End)		Base Type	CTB
		Base Thickness (in.)	6
		Modulus of Base Layer (ksi)	
B. Design Parameters		Composite K (psi/in.)	0
Design Life (year)	30		
Number of Punchouts per Mile	10		
C. Design Traffic			
Total Number of Lanes in One Direction			
Total Design Traffic in One Direction (million ESALs)			
Input	Temperature	Soil Classification	K-Table
	Composite K	S-Table	Stress
	Analysis Result	Final Result	Time vs. Punchout

TxCRCR-ME Input Parameters	Value	Comment
Design Life (Years)	30	Can be changed as desired (typical = 30 years)
Annual Growth Rate (%)	3.0	Can be changed as desired (typical range = 2.5 to 5.0%)
Assumed concrete slab thickness in Inches (t)	8.0	Can be changed as desired
Number of Lanes in one direction	1	
18 kip ESALs (million)	30 Yrs 12.18	Design Lane ESALs

The MS Access Traffic Data Storage System

- Structure of T-DSS
- Traffic Volume & Classification
- FPS Traffic Input
- Traffic Weights & Overloading Data

Structure of T-DSS

The Prototype T-DSS (MS Access)

The screenshot shows the Microsoft Access interface for the T-DSS database. The ribbon includes tabs for File, Home, Create, External Data, Database Tools, and Help. The navigation pane on the left lists various tables and screens. The main window displays a screen titled "TxDOT Project 0-6940" with a header "The Texas M-E Traffic Data Storage System Project# 0-6940: The T-DSS". Below the header is the Texas Department of Transportation logo and a list of data categories: Traffic Volume/ESALs, FPS Traffic Input Data, TxME Traffic Input Data-Level1, TxME Traffic Input Data-Level2, and Traffic Weight/Overloading Data. Project Managers are listed as Sonya Badgley, Hua Chen, and Enad Mahmoud. The PI/Research Supervisor is Lubinda F. Walubita. The Texas Transportation Institute logo is also present.

Prototype MS Access Traffic Data Storage System = T-DSS



T-DSS Data (Volume)

District	County	HWY	LaneDirection	LaneDesignation	TotalN	Year	Month#	Analysis Period (Day)	Season	ADT	%Trucks	ADTT	Growth Factor (Gr)(%)	Estimated 20-Yr ADT
Corpus Ch	Live Oak	US 281	NB	Outside (L1)	1	2017	Apr 13 - Apr 29		17 Spring	1345	77.20%	1039	3.00%	2429
Corpus Ch	Live Oak	US 281	SB	Outside (L1)	1	2017	Apr 13 - Apr 29		17 Spring	2774	43.90%	1218	3.00%	5009
Corpus Ch	Live Oak	US 281	NB	Outside (L1)	1	2018	Oct 26 2017 - Mar		70 Winter	4383	22.10%	971	3.00%	7917
Corpus Ch	Live Oak	US 281	SB	Outside (L1)	1	2018	Oct 26 2017 - Mar		70 Winter	4817	28.60%	1376	3.00%	8701
Austin	Travis	IH 35	NB	Outside (L1)	2	2018	May 7 - May 13		7 Summer	23204	8.50%	1978	3.00%	41909
Austin	Travis	IH 35	NB	Inside (L2)	2	2018	May 7 - May 13		7 Summer	17590	22.40%	3935	3.00%	31769
Austin	Travis	IH 35	SB	Outside (L1)	2	2018	May 21,22,25,26,27,30,31		7 Summer	24943	8.00%	1990	3.00%	45050
Austin	Travis	IH 35	SB	Inside (L2)	2	2018	May 21,22,25,26,27,30,31		7 Summer	22841	20.20%	4606	3.00%	41253
El Paso	Culberson	RM 652	WB	Outside (L1)	1	2019	Mar 21 - Mar 30		10 Spring	897	16.00%	143	3.25%	3403
El Paso	Culberson	RM 652	EB	Outside (L2)	1	2019	Mar 21 - Mar 30		10 Spring	892	15.53%	138	3.25%	3381
El Paso	Culberson	RM 652	WB	Outside (L1)	1	2019	Mar 21 - Mar 30		10 Spring	1062	29.30%	312	3.25%	4029
El Paso	Culberson	RM 652	EB	Outside (L2)	1	2019	Mar 21 - Mar 30		10 Spring	1050	32.30%	339	3.25%	3982
El Paso	Culberson	RM 652	WB	Outside (L1)	1	2019	Mar 21 - Mar 28		8 Spring	1244	41.80%	520	3.25%	4717
Odessa	Loving	SH 302	WB	Outside (L1)	1	2019	Mar 22 - Mar 24		3 Spring	3742	46.40%	1737	3.00%	13518
Odessa	Reeves	US 285	NB	Outside (L1)	1	2019	Mar 25 - Mar 31		7 Spring	3895	39.70%	1546	3.00%	14069
Odessa	Reeves	US 285	SB	Outside (L2)	1	2019	Mar 25 - Mar 31		7 Spring	4453	37.80%	1682	3.00%	16084
Odessa	Loving	RM 652	EB	Outside (L2)	1	2019	Mar 26 - Apr 1		7 Spring	1782	44.80%	799	3.00%	6439
Odessa	Loving	RM 652	WB	Outside (L1)	1	2019	Mar 26 - Apr 1		7 Spring	2150	42.30%	910	3.00%	7765
Austin	Blanco	US 281	SB	Outside (L1)	1	2019	Apr 18 - May 1		14 Spring	3852	9.90%	383	3.00%	13915
Austin	Blanco	US 281	NB	Outside (L1)	1	2019	Apr 18 - May 1		14 Spring	5342	7.90%	422	3.00%	19296
Amarillo	Moore	FM 281	EB	Outside (L2)	1	2019	Jun 01 - Jun 07		7 Summer	1316	22.50%	296	3.00%	4043
Amarillo	Moore	FM 281	WB	Outside (L2)	1	2019	Jun 01 - Jun 07		7 Summer	923	37.60%	347	3.00%	4043
San Angel	Glasscock	SH 137	NB	Outside (L2)	1	2019	Jun 19 - Jun 25		7 Summer	1621	30.20%	489	3.00%	5856
San Angel	Glasscock	SH 137	SB	Outside (L2)	1	2019	Jun 19 - Jun 25		7 Summer	2407	30.80%	742	3.00%	8694
Abilene	Jones	US 277	NB	Outside (L2)	1	2019	Jul 17 - Jul 23		7 Summer	2019	16.30%	329	3.00%	14318
Abilene	Jones	US 277	SB	Outside (L2)	1	2019	Jul 17 - Jul 24		8 Summer	1945	17.00%	330	3.00%	7159
Austin	Travis	IH 35	NB	Outside (L1), Middl	3	2019	Sep 27 - Oct 10		11 Fall	24530	13.70%	3361	2.50%	241172
Austin	Travis	IH 35	SB	Outside (L1), Middl	1	2019	Sep 27 - Oct 04		8 Fall	22594	14.80%	3335	2.50%	232367
Atlanta	Harrison	IH 20	WB	Outside (L1)	2	2019	Oct 17 - Oct 23		7 Fall	11000	39.90%	4390	2.50%	71478
Atlanta	Harrison	IH 20	EB	Outside (L1)	2	2019	Oct 22 - Oct 28		7 Fall	10811	41.30%	4467	2.50%	71478
Odessa	Midland	SH 349	SB	Outside (L1)	1	2019	Oct 30 - Nov 06		8 Fall	3378	30.20%	1020	3.00%	12203
Odessa	Winkler	SH 302	EB	Outside (L2)	1	2019	Nov 01- Nov 07		7 Fall	5581	31.70%	1768	3.00%	20161
Waco	Hamilton	SH 36	WB	Outside (L1)	1	2019	Dec 12 - Dec 19		8 Winter	2166	16.50%	357	3.00%	7824
Waco	Hamilton	SH 36	EB	Outside (L3)	1	2019	Dec 14 - Dec 19		6 Winter	2036	14.40%	293	3.00%	7356
Austin	Gillespie	US 87	NB	Outside (L2)	1		Dec 13 - Feb 12		40 Winter	2329	9.90%	231	3.00%	8412
Austin	Gillespie	US 87	SB	Outside (L1)	1		Dec 13 - Feb 04		32 Winter	2435	10.40%	253	3.36%	9433
Waco	Hamilton	US 281	NB	Outside (L2)	1	2019	Dec 14 - Dec 19		6 Winter	3454	7.10%	247	3.00%	12477
Waco	Hamilton	US 281	SB	Outside (L2)	1	2019	Dec 14 - Dec 19		6 Winter	3417	7.70%	262	3.00%	12343
Bryan	Madison	US 190	EB	Outside (L2)	1	2020	July 17 - July 23		7 Summer	4245	10.80%	457	3.00%	15469
Bryan	Madison	US 190	WB	Outside (L1)	1	2020	July 16 - July 23		8 Summer	4320	11.10%	479	3.00%	15470

T-DSS Data (FPS)

District	County	HWY	LaneDirectic	LaneDesignc	Year	Month	Analys	Season	ADTbegin	ADTend-20Y	20Yr 18-kips	Avg Vehicle Spe	%Trucks in ADT	ATHWLD (kips)
Corpus Christi	Live Oak	US 281	SB	Outside (L1)	2018	Feb 01 - Feb 09	9	Winter	4953	8946	35.88	33.0	30.40%	12.74
Corpus Christi	Live Oak	US 281	NB	Outside (L1)	2017	Apr 13 - Apr 29	17	Spring	1345	2429	47.59	33.4	77.20%	13
Corpus Christi	Live Oak	US 281	SB	Outside (L1)	2017	Apr 13 - Apr 29	17	Spring	2774	5009	36.38	35.1	43.90%	10
Corpus Christi	Live Oak	US 281	NB	Outside (L1)	2018	Oct 26 2017 - Mar	70	Winter	4383	7917	34.60	31.0	22.10%	19.4
Corpus Christi	Live Oak	US 281	SB	Outside (L1)	2018	Oct 26 2017 - Mar	70	Winter	4817	8701	31.40	35.0	28.60%	11.3
Austin	Travis	IH 35	NB	Outside (L1)	2018	May 7 - May 13	7	Summer	23204	41909	68.25	36.0	8.50%	20.61
Austin	Travis	IH 35	NB	Inside (L2)	2018	May 7 - May 13	7	Summer	17590	31769	92.77	38.0	22.40%	21.6
El Paso	Culberson	RM 652	WB	Outside (L1)	2019	Mar 21 - Mar 30	10	Spring	1795	3403	1.77	62.0	16.00%	9.51
El Paso	Culberson	RM 652	EB	Outside (L2)	2019	Mar 21 - Mar 30	10	Spring	1783	3381	1.18	63.0	15.50%	9.26
El Paso	Culberson	RM 652	WB	Outside (L1)	2019	Mar 21 - Mar 30	10	Spring	2125	4029	3.89	63.0	29.30%	10.45
El Paso	Culberson	RM 652	EB	Outside (L2)	2019	Mar 21 - Mar 30	10	Spring	2100	3982	4.19	64.0	32.30%	10.12
El Paso	Culberson	RM 652	WB	Outside (L1)	2019	Mar 21 - Mar 28	8	Spring	2488	4717	5.47	60.0	41.80%	10.06
Odessa	Loving	SH 302	WB	Outside (L1)	2019	Mar 22 - Mar 24	3	Spring	7485	13518	31.51	73.0	46.40%	13.86
Odessa	Reeves	US 285	NB	Outside (L1)	2019	Mar 25 - Mar 31	7	Spring	7789	14069	26.75	58.0	39.70%	13.84
Odessa	Reeves	US 285	SB	Outside (L2)	2019	Mar 25 - Mar 31	7	Spring	8905	16084	21.21	59.0	37.80%	13.4
Odessa	Loving	RM 652	EB	Outside (L2)	2019	Mar 26 - Apr 1	7	Spring	3565	6439	12.80	59.0	44.80%	12.19
Odessa	Loving	RM 652	WB	Outside (L1)	2019	Mar 26 - Apr 1	7	Spring	4299	7765	15.18	56.0	42.30%	12.27
Austin	Blanco	US 281	SB	Outside (L1)	2019	Apr 18 - May 1	14	Spring	7704	13915	10.24	57.0	9.90%	15.22
Austin	Blanco	US 281	NB	Outside (L1)	2019	Apr 18 - May 1	14	Spring	10684	19296	7.13	63.0	7.90%	15.08
Amarillo	Moore	FM 281	EB	Outside (L2)	2019	Jun 01 - Jun 07	7	Summer	2238	4043	4.52	64.0	22.50%	12.15
Amarillo	Moore	FM 281	WB	Outside (L2)	2019	Jun 01 - Jun 07	7	Summer	2238	4043	7.97	60.0	37.60%	13.2
San Angelo	Glasscock	SH 137	NB	Outside (L2)	2019	Jun 19 - Jun 25	7	Summer	3242	5856	5.18	53.0	30.20%	13.38
San Angelo	Glasscock	SH 137	SB	Outside (L2)	2019	Jun 19 - Jun 25	7	Summer	4814	8694	9.94	57.0	30.80%	14.47
Abilene	Jones	US 277	NB	Outside (L2)	2019	Jul 17 - Jul 23	7	Summer	7928	14318	4.05	64.0	16.30%	12.59
Abilene	Jones	US 277	SB	Outside (L2)	2019	Jul 17 - Jul 24	8	Summer	3964	7159	5.43	63.0	17.00%	13.07
Austin	Travis	IH 35	NB	Outside (L1), M	2019	Sep 27 - Oct 10	11	Fall	147181	241172	50.89	59.7	13.70%	14.98
Austin	Travis	IH 35	SB	Outside (L1), M	2019	Sep 27 - Oct 04	8	Fall	141807	232367	47.91	59.3	14.80%	14.8
Atlanta	Harrison	IH 20	WB	Outside (L1)	2019	Oct 17 - Oct 23	7	Fall	43621	71478	43.05	70.8	39.90%	11.6
Atlanta	Harrison	IH 20	EB	Outside (L1)	2019	Oct 22 - Oct 28	7	Fall	43621	71478	49.71	70.3	41.30%	12.4
Odessa	Midland	SH 349	SB	Outside (L1)	2019	Oct 30 - Nov 06	8	Fall	6757	12203	14.79	62.1	30.20%	12.33
Odessa	Winkler	SH 302	EB	Outside (L2)	2019	Nov 01 - Nov 07	7	Fall	11163	20161	26.83	57.3	31.70%	13.52
Waco	Hamilton	SH 36	WB	Outside (L1)	2019	Dec 12 - Dec 19	8	Winter	4332	7824	4.45	20.0	16.50%	9.76
Waco	Hamilton	SH 36	EB	Outside (L3)	2019	Dec 14 - Dec 19	6	Winter	4073	7356	3.34	21.0	14.40%	9.42
Austin	Gillespie	US 87	NB	Outside (L2)		Dec 13 - Feb 12	40	Winter	4658	8412	2.71	61.1	9.90%	11.61
Austin	Gillespie	US 87	SB	Outside (L1)		Dec 13 - Feb 04	32	Winter	4871	9433	4.17	60.6	10.40%	11.57
Waco	Hamilton	US 281	NB	Outside (L2)	2019	Dec 14 - Dec 19	6	Winter	6908	12477	2.76	30.9	7.10%	10.21
Waco	Hamilton	US 281	SB	Outside (L2)	2019	Dec 14 - Dec 19	6	Winter	6834	12343	3.44	24.8	7.70%	9.99
Bryan	Madison	US 190	EB	Outside (L2)	2020	July 17 - July 23	7	Summer	8565	15469	5.51	64.3	10.80%	10.35
Bryan	Madison	US 190	WB	Outside (L1)	2020	July 16 - July 23	8	Summer	8565	15470	5.41	64.1	11.10%	10.2

T-DSS Data (Overweight Statistics)

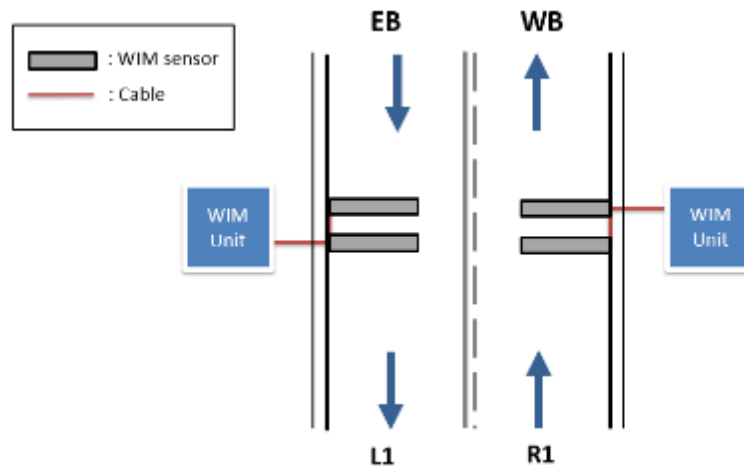
District	County	HWY	Direction	Lane	Year	Month#	Analysis Per	ADT	%Trucks	ADTT	%Overweight-Truck	Avg_DailyOverweight-Truck Count	Overweight-Peak Day
Brownwood	Comanche	SH 6	NB	Outside (L1)	2017	May 18 - May 27	7	1059	22.40%	237	5.91%	14	Wednesday, Thursday
Odessa	Midland	FM 1787	SB	Outside (L1)	2017	Aug 08 - Aug 14	7	1337	33.85%	452	17.05%	77	Thursday, Friday
Odessa	Midland	FM 1787	SB	Outside (L1)	2017	Aug 08-14, and	8	1311	30.20%	396	16.70%	66	Thursday, Friday
Fort Worth	Wise	SH 114	EB	Outside (L1)	2017	Jul 19 - Jul 25	7	2900	47.10%	1367	35.12%	480	Thursday, Friday
Brownwood	Comanche	SH 6	NB	Outside (L1)	2017	May 17 - July 5	50	931	22.10%	206	23.33%	48	Wednesday, Thursday
Laredo	Dimmit	FM 468	EB	Outside (L1)	2017	Oct 10 - Oct 25	16	690	47.30%	326	55.75%	182	Friday, Monday
Laredo	Dimmit	FM 468	EB	Outside (L1)	2018	Feb 01 - Feb 28	28	889	40.07%	362	45.59%	165	Thursday, Friday
Laredo	Dimmit	FM 468	EB	Outside (L1)	2018	Oct 10 - Mar 22	164	860	41.40%	357	49.60%	177	Monday, Friday
Corpus Christi	Live Oak	US 281	NB	Outside (L1)	2018	Feb 01 - Feb 09	9	4354	33.30%	1450	36.00%	522	Tuesday, Friday
Corpus Christi	Live Oak	US 281	SB	Outside (L1)	2018	Feb 01 - Feb 09	9	4953	30.40%	1508	37.73%	569	Thursday, Friday
Corpus Christi	Live Oak	US 281	NB	Outside (L1)	2017	Apr 13 - Apr 29	17	1345	77.20%	1039	50.55%	525	Tuesday, Wednesday
Corpus Christi	Live Oak	US 281	SB	Outside (L1)	2017	Apr 13 - Apr 29	17	2774	43.90%	1218	38.85%	473	Tuesday, Wednesday
Corpus Christi	Live Oak	US 281	NB	Outside (L1)	2018	Oct 26 2017 - M	70	4383	22.10%	971	36.34%	353	Tuesday, Friday
Corpus Christi	Live Oak	US 281	SB	Outside (L1)	2018	Oct 26 2017 - M	70	4817	28.60%	1376	22.31%	338	Wednesday, Thursday
Austin	Travis	IH 35	NB	Outside (L1)	2018	May 7 - May 13	7	23204	8.50%	1978	26.69%	528	Tuesday, Wednesday
Austin	Travis	IH 35	NB	Inside (L2)	2018	May 7 - May 13	7	17590	22.40%	3935	24.37%	959	Monday, Tuesday
Austin	Travis	IH 35	SB	Outside (L1)	2018	May 21,22,25,2	7	24943	8.00%	1990	5.83%	116	Thursday, Friday
Austin	Travis	IH 35	SB	Inside (L2)	2018	May 21,22,25,2	7	22841	20.20%	4606	10.96%	505	Wednesday, Thursday
Austin	Blanco	US 281	SB	Outside (L1)	2019	Apr 18 - May 1	14	3852	9.90%	383	32.70%	123	Thursday
Austin	Blanco	US 281	NB	Outside (L1)	2019	Apr 18 - May 1	14	5342	7.90%	422	18.30%	77	Wednesday
Amarillo	Moore	FM 281	EB	Outside (L2)	2019	Jun 01 - Jun 07	7	1316	22.50%	296	26.68%	79	Wednesday
Amarillo	Moore	FM 281	WB	Outside (L2)	2019	Jun 01 - Jun 07	7	923	37.60%	347	34.28%	119	Friday
San Angelo	Glasscock	SH 137	NB	Outside (L2)	2019	Jun 19 - Jun 25	7	1621	30.20%	489	10.84%	53	Wednesday
San Angelo	Glasscock	SH 137	SB	Outside (L2)	2019	Jun 19 - Jun 25	7	2407	30.80%	742	13.34%	99	Thursday
Abilene	Jones	US 277	NB	Outside (L2)	2019	Jul 17 - Jul 23	7	2019	16.30%	329	12.44%	41	Wednesday
Abilene	Jones	US 277	SB	Outside (L2)	2019	Jul 17 - Jul 24	8	1945	17.00%	330	18.47%	61	Wednesday
Austin	Travis	IH 35	NB	Outside (L1)	2019	Sep 27 - Oct 10	11	24530	13.70%	3361	27.24%	916	Thursday
Austin	Travis	IH 35	SB	Outside (L1)	2019	Sep 27 - Oct 04	8	22594	14.80%	3335	21.50%	717	Saturday
Atlanta	Harrison	IH 20	WB	Outside (L1)	2019	Oct 17 - Oct 23	7	11000	39.90%	4390	5.22%	229	Wednesday
Atlanta	Harrison	IH 20	EB	Outside (L1)	2019	Oct 22 - Oct 28	7	10811	41.30%	4467	10.32%	461	Friday
Odessa	Midland	SH 349	SB	Outside (L1)	2019	Oct 30 - Nov 06	8	3378	30.20%	1020	19.91%	203	Monday
Odessa	Winkler	SH 302	EB	Outside (L2)	2019	Nov 01 - Nov 07	7	5581	31.70%	1768	14.87%	263	Wednesday
Waco	Hamilton	SH 36	WB	Outside (L1)	2019	Dec 12 - Dec 19	8	2166	16.50%	357	1.68%	6	Wednesday
Waco	Hamilton	SH 36	EB	Outside (L3)	2019	Dec 14 - Dec 19	6	2036	14.40%	293	4.43%	13	Thursday
Austin	Gillespie	US 87	NB	Outside (L2)		Dec 13 - Feb 12	40	2329	9.90%	231	14.73%	34	Wednesday
Austin	Gillespie	US 87	SB	Outside (L1)		Dec 13 - Feb 04	32	2435	10.40%	253	25.00%	63	Tuesday
Waco	Hamilton	US 281	NB	Outside (L2)	2019	Dec 14 - Dec 19	6	3454	7.10%	247	5.27%	13	Tuesday
Waco	Hamilton	US 281	SB	Outside (L2)	2019	Dec 14 - Dec 19	6	3417	7.70%	262	14.10%	37	Tuesday
Bryan	Madison	US 190	EB	Outside (L2)	2020	July 17 - July 23	7	4245	10.80%	457	12.46%	57	Wednesday
Bryan	Madison	US 190	WB	Outside (L1)	2020	July 16 - July 23	8	4320	11.10%	479	8.76%	42	Monday

Demonstration Case Studies

- FM 281 (Amarillo District)
- US 190 (Bryan District)
- IH 35 (Austin District)

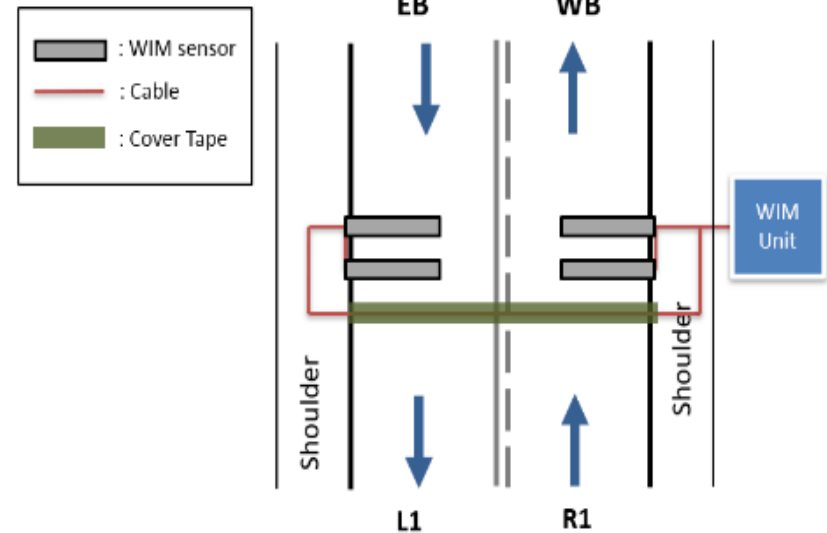
FM 281 (Amarillo District)

Portable WIM System was deployed for each direction on a single lane highway



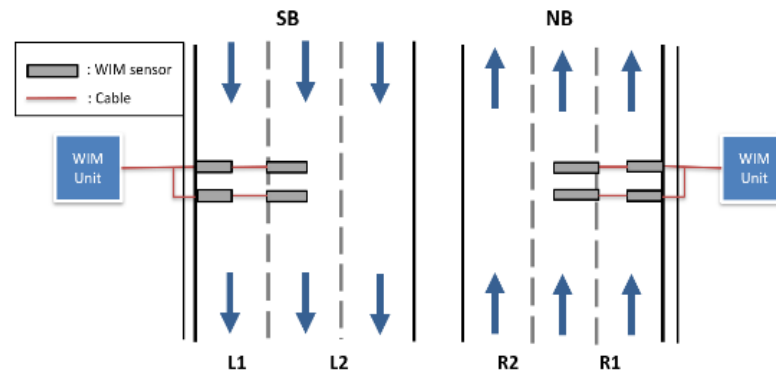
US 190 (Bryan District)

- A set of polymer piezo sensors on a single lane road for each direction
- A single portable WIM system was deployed to capture traffic data for both directions



IH 35 (Austin District)

- Portable WIM system was deployed for each direction on 3-lane highways
- A set of 6-ft polymer piezo sensors were installed on outside lane & middle lane for each direction



Summary

Summary & Key Findings

- 1) Portable WIM = cost-effective & practical supplement for site-specific traffic data collection (volume counts, speed, VCD, & vehicle weight measurements)
- 2) Data collection = min 7 days up to more than a year (with periodic maintenance)
- 3) Macros & algorithms = able to compute & generate M-E traffic inputs for both flexible & concrete PVMNTs
- 4) T-DSS = convenient & readily accessible MS Access storage platform for M-E traffic data access

Comments & Discussions

