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December 15, 2017

Mark Wayne, Ph.D., P.E.
Director of Application Technology
Tensar International Corporation
2500 Northwinds Pkwy
Suite 500
Alpharetta, GA 30009
mwayne@tensarcorp.com

Re: In Situ Performance Verification of Geogrid-Stabilized Aggregate Layer
Using Automated Plate Load Testing
Union Pacific Rail Road (UPRR) Intermodal Facility Test Sections, Los Angeles, CA

Dear Dr. Wayne,

At the request of Tensar Corporation, Ingios Geotechnics, Inc. conducted Automated Plate Load Tests (APLTs) on the test sections constructed at the Union Pacific Railroad (UPRR) Intermodal Facility in Los Angeles, CA (1041 Richmond St.) on December 12-13, 2017. Side-by-side test sections of about 150 ft length and 13 ft width consisting of a control section (no geogrid) and a TX8 geogrid stabilized section were constructed. The control section consisted of 11 to 11.5 in. of compacted recycled aggregate base course (ABC), while the geogrid section consisted of 4.5 to 5 in. of compacted recycled ABC over TX8 geogrid. The test beds were constructed prior to our arrival at the site, and were reportedly constructed in a comparable manner over the existing subgrade layer.

In situ testing included cyclic APLTs on the surface of ABC layer to determine composite, base layer, and subgrade layer resilient modulus (M_r) values, permanent deformation (δ_p), and static PLTs to determine static modulus of subgrade reaction (k) values and strain modulus (E_v) values. Dynamic cone penetrometer (DCP) tests were performed at each test location to determine profiles of penetration resistance. A sample of the ABC material collected from a loose windrow on-site consisted of recycled aggregate materials with maximum particle size of 1.5 in. and 5% passing the No. 200 sieve. The material is classified as well graded gravel with sand (GW and A-1-a). The in situ moisture content measured from the field sample was 5.2%. The TX8 geogrid is a multi-axial geogrid with hexagonal structure and triangular apertures.

Five cyclic APLTs (1,100 cycles) were conducted in each of the control and TX8 geogrid sections with six different applied cyclic stresses for each test. One cyclic APLT was conducted in each of the sections with 10,000 cycles at one cyclic stress (about 25 psi). Deflection basin measurements were obtained at three positions extending away from the 12 in. loading plate (2r, 3r, and 4r, where r is the plate radius). One static APLT using 12 in. diameter loading plate was performed in each of the control and TX8 geogrid sections to determine E_v strain modulus per DIN 18134 test standard. One static APLT using 30

in. diameter loading plate was performed in each of the control and TX8 geogrid sections to determine *k* values per AASHTO T221. All tests were performed on the surface of the ABC layer.

Results from cyclic APLTs conducted at six different stress levels were used to determine the in situ "universal" model (AASHTO 2015), the in situ k_1*, k_2*, and k_3* model parameters for the composite ($M_{r\text{-}comp}$) and stabilized aggregate base ($M_{r\text{-}Base}$) and subgrade layers ($M_{r\text{-}SG}$). Results from 12 in. plate static APLT were used to determine initial and reload strain moduli values (E_{v1} and E_{v2}). Results from 30 in. plate static APLT were used to determine initial and reload modulus of subgrade reaction values (k_1 and k_2). Summaries of individual test result are provided in the Appendix.

The layered analysis performed in determining $M_{r\text{-}Base}$ and $M_{r\text{-}SG}$ was based on Odemark's method of equivalent thickness and Boussinesq's elastic solution for linear-elastic materials. The applied cyclic stresses at the subgrade/base layer interface were calculated using the KENLAYER elastic layer analysis program. Several tests demonstrated higher subgrade layer modulus compared to the base layer modulus, which is typically considered a limitation of layered analysis theory. At this site, DCP test results at several test locations reached refusal within or near the top of the subgrade layer. Subgrade moduli values are generally very high at this site, yet variable.

The following assumptions were made in calculating the M_r values (12 in. diameter loading plate):

1. Shape factor, f = 8/3 for a rigid plate on granular material.
2. Poisson's ratio, v = 0.40 for aggregate base and subgrade material.
3. Plate bending correction, $F_{Bending}$ = 1 (No correction). The 12 in. diameter plate used in this study is 1 in. thick and has a 6 in. diameter steel loading pedestal centered on the plate.
4. Future saturation correction, $F_{Saturation}$ = 1 (No correction). Laboratory testing is needed to determine this correction factor, else field saturation is required in situ.

The results presented herein represent a selected number of measurements per sample group that was requested by Tensar. Statistical determination of the minimum number of measurements requires knowledge of the coefficient of variation within a sample group and the difference between mean values of the selected sample groups. Determination of statistical input parameters needed for calculating statistical sample sizes was beyond the scope of this study. As a result, these test results are applicable to the specific testing point locations.

We appreciate the opportunity to provide Automated Plate Load Testing on your project. If you have any questions, please do not hesitate to contact us.

Sincerely,

David White, Ph.D., P.E. (IA, MN, KY, TN)
President and Chief Engineer

Pavana Vennapusa, Ph.D., P.E. (IA, TX)
Lead Engineer

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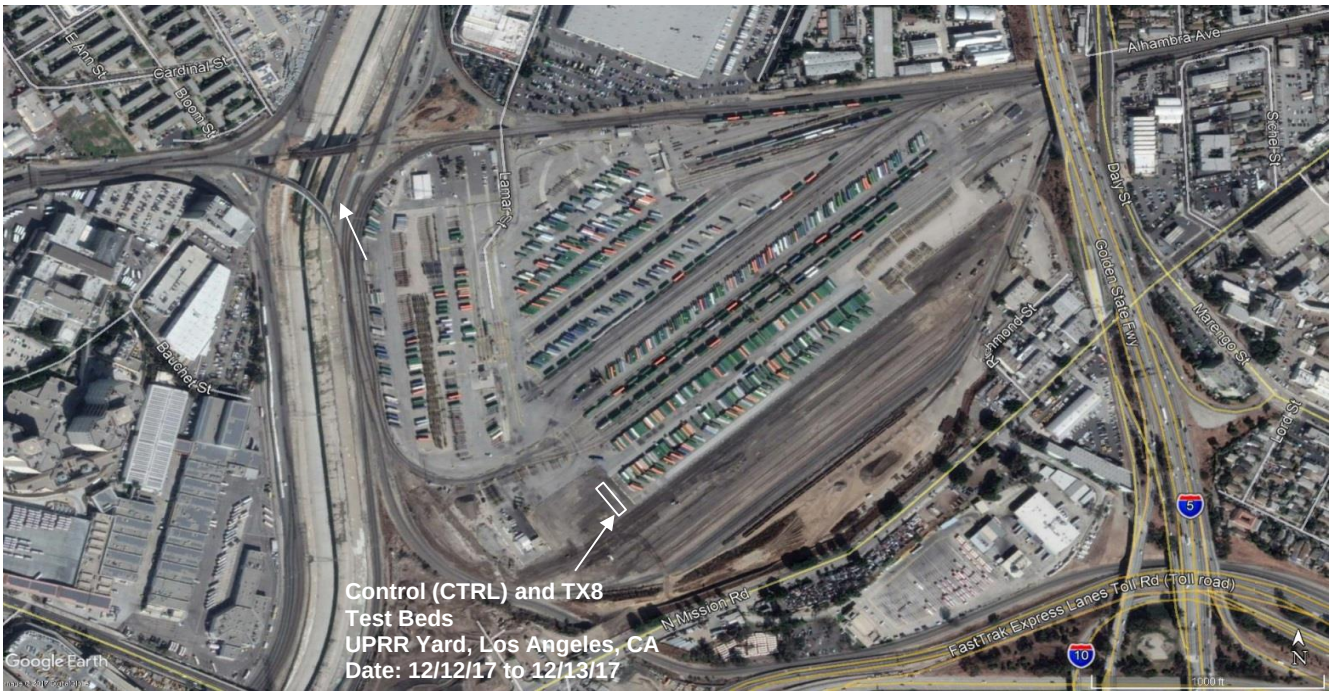
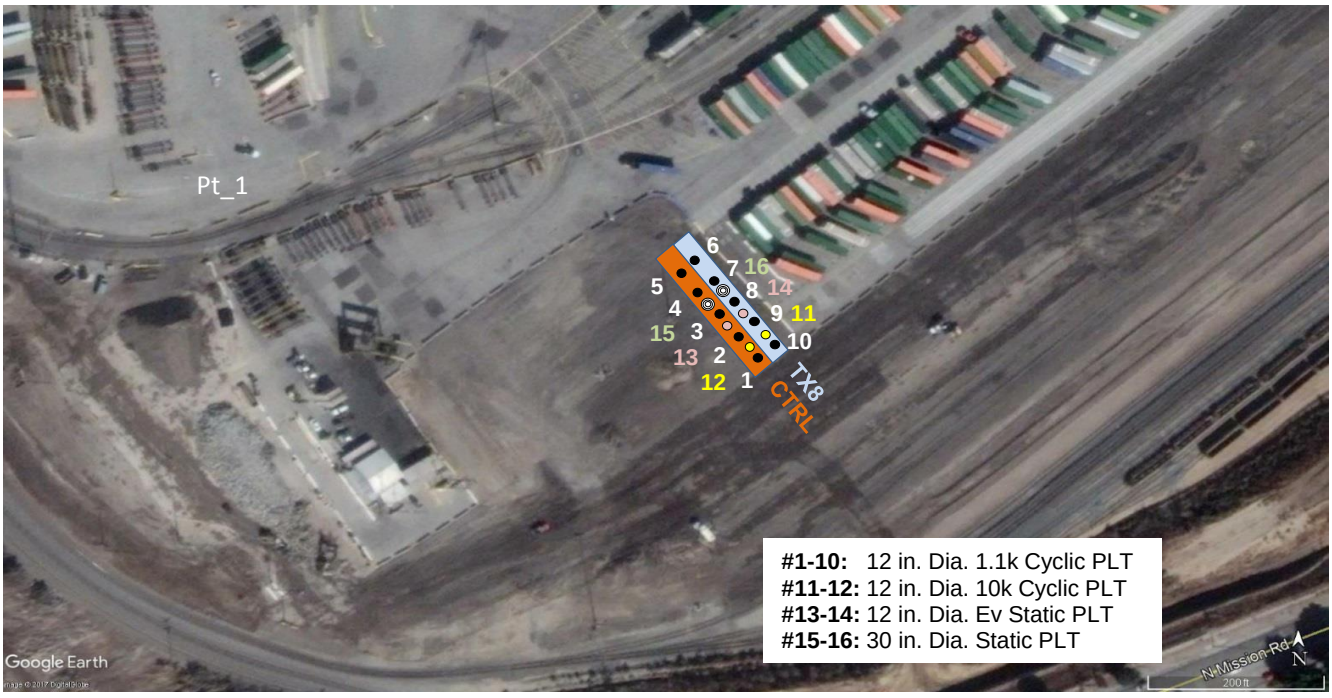
Attachments:

Aerial Image with In Situ Test Locations and Pictures
Composite Resilient Modulus Test Results
Layered Resilient Modulus Test Results
Strain Modulus Test Results
Static Plate Load Test (30 in.) Results
Dynamic Cone Penetrometer Test Results
Gradation Test Results on ABC Material

Project Location and Test Locations





Test Locations	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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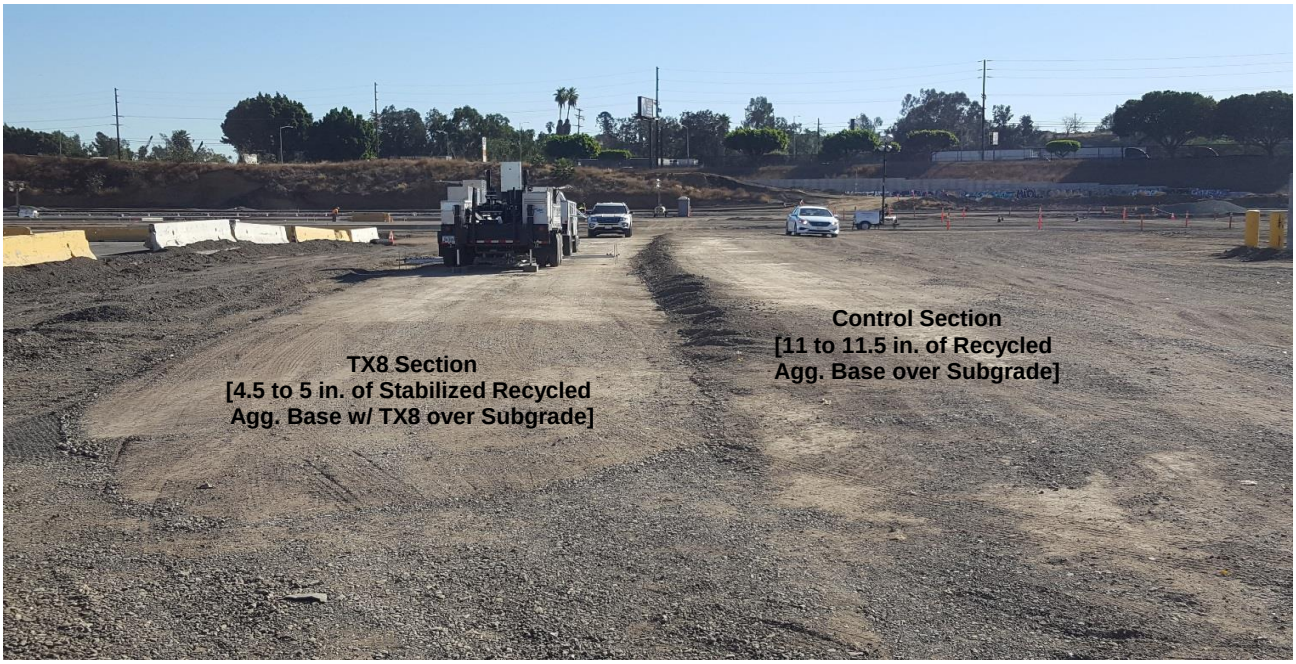
Site Conditions and Pictures



Pictures

Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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Site Conditions and Pictures

Pictures	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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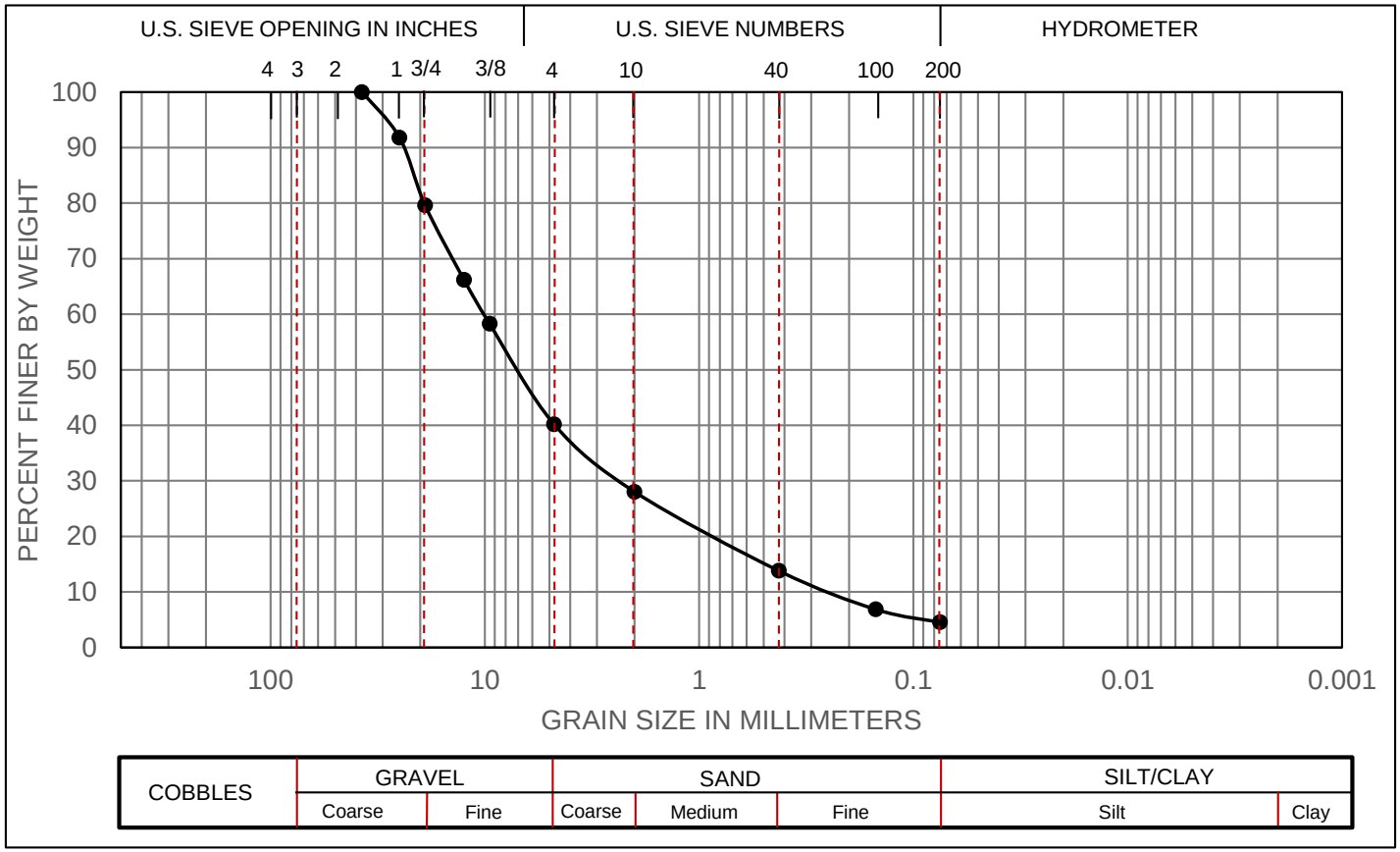
GRAIN SIZE DISTRIBUTION
ASTM D422/C136



Gradation Summary

% Gravel	59.8
% Sand	35.6
% Fines	4.6
D_{10} (mm)	0.274
D_{30} (mm)	2.448
D_{50} (mm)	7.330
D_{60} (mm)	10.156
D_{85} (mm)	21.654
C_u	37.0
C_c	2.2

Atterberg Limits

LL	NP
PL	NP
PI	NP

Classification

AASHTO:	A-1-a
USCS:	GW

MATERIAL: Recycled crushed agggregate (natural moisture content = 5.2%)

LOCATION: Near PT4 on control test bed from 2 to 6 in. depth **TESTED BY:** DW

SAMPLE DATE: 12/13/2017 **TEST DATE:** 12/14/2017

Gradation and Soil Classification Test Results

Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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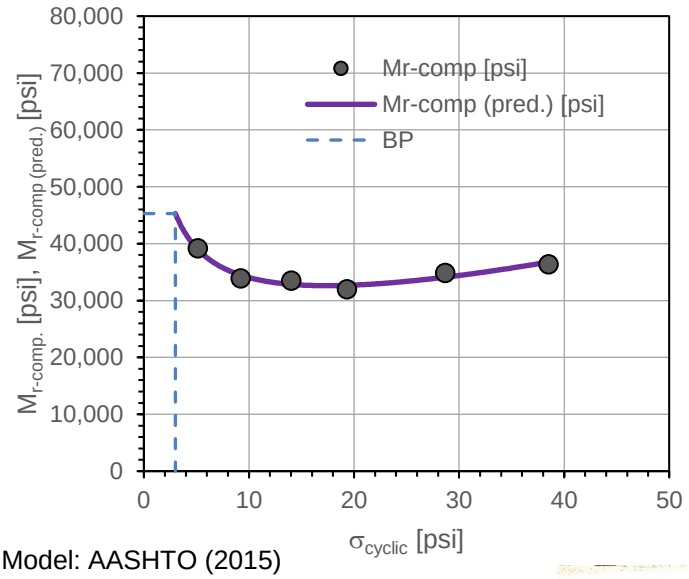
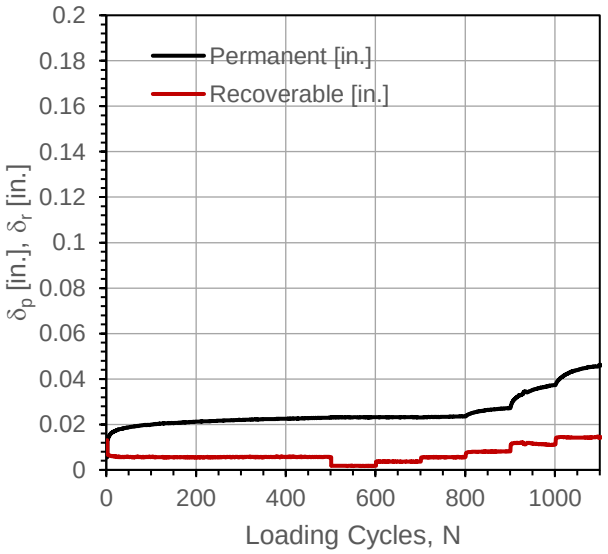
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent (5, 10, 15, 20, 30, 40)				
Date:	12/12/2017	Time:	9:11:24 AM	Test ID	**CTRL_Pt1**
Tested By	DW, PV, HG	Location:	UPRR - Los Angeles	Sta.	NA
Latitude,N:	34.057575	Longitude,W:	118.222310	Elev. (ft):	297
Comments:	11.5 in. recycled concrete aggregate over subgrade.				

Step	N	σ_{cyclic} [psi]	$M_{r\text{-}comp}$ [psi]	$M_{r\text{-}comp\ (pred.)}$ [psi]	δ_p [in.]	$\Delta\delta_p$ [in.]	d =Δlog(δ_p)/ Δlog(N)	Near-linear Elastic
Conditioning	500	14.02	---	---	0.0230	---	0.102	---
1	100	5.14	39,200	38,976	0.0231	0.0001	0.002	Y
2	100	9.21	33,900	34,466	0.0231	0.0000	0.002	Y
3	100	14.02	33,513	32,841	0.0236	0.0006	0.379	Y
4	100	19.33	31,974	32,672	0.0272	0.0042	0.573	Y
5	100	28.70	34,869	34,103	0.0373	0.0143	0.560	N
6	100	38.52	36,391	36,759	0.0462	0.0232	0.647	N





Model: AASHTO (2015)

$$M_{r-comp} = k_1^* P_a \left(\frac{\theta}{P_a}\right)^{k_2^*} \left(1 + \frac{\tau_{oct}}{P_a}\right)^{k_3^*}$$

Parameter	Value	P-Value
k^*_1	2,158.5	9.49E-08
k^*_2	-0.377	8.19E-03
k^*_3	2.407	9.72E-03
Adj. R^2	0.921	
Std. Error [psi]	689	

$M_{r\text{-}comp\ (pred.)\text{-}BP}$ [psi]	45,285
$\sigma_{cyclic\text{-}BP}$ [psi]	3.0

In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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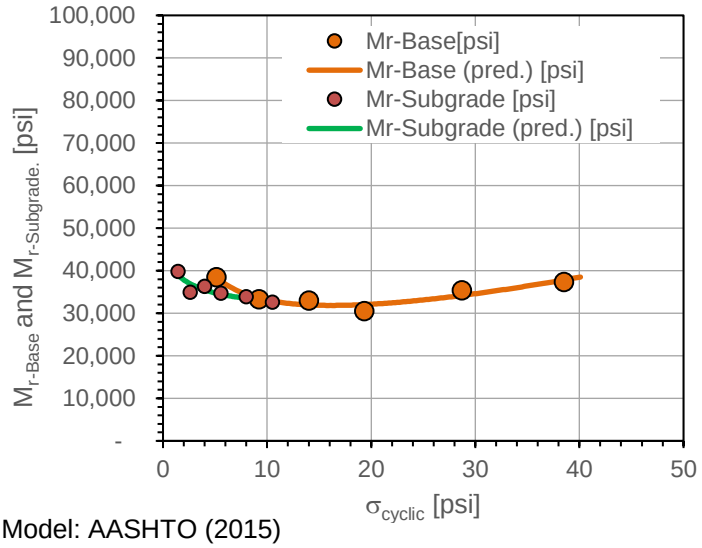
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent (5, 10, 15, 20, 30, 40)				
Date:	12/12/2017	Time:	9:11:24 AM	Test ID	**CTRL_Pt1**
Tested By	DW, PV, HG	Location:	UPRR - Los Angeles	Sta.	NA
Latitude, N:	34.057575	Longitude, W:	118.222310	Elev. (ft):	297
Comments:	11.5 in. recycled concrete aggregate over subgrade.				

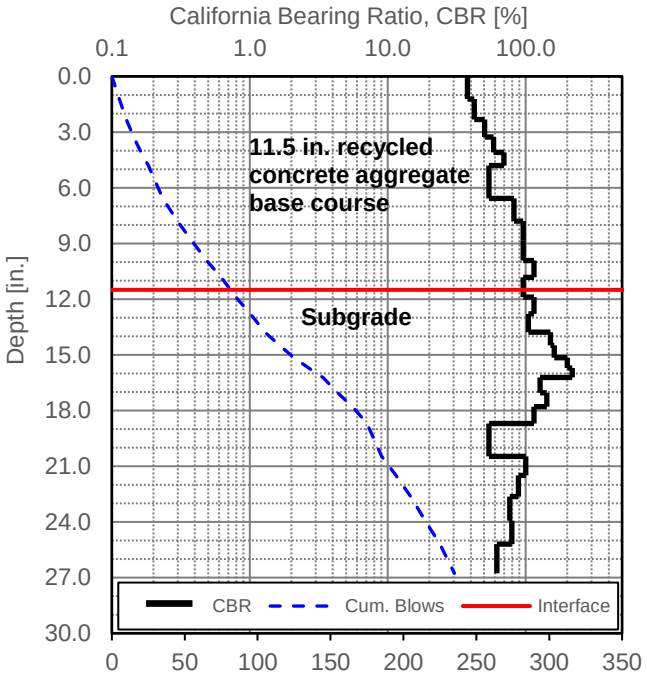
Step	N	$\sigma_{cyclic\_surface}$ [psi]	$M_{r\text{-}Base}$[psi]	$M_{r\text{-}Base\ (pred.)}$ [psi]	$\sigma_{cyclic\_Int.}$ [psi]	$M_{r\text{-}Subgrade}$ [psi]	$M_{r\text{-}Subgrade\ (pred.)}$ [psi]	Modulus Ratio
Conditioning	500	14.02	---	---	---	---	---	---
1	100	5.14	38,475	38,450	1.45	39,868	38,939	0.97
2	100	9.21	33,283	33,535	2.61	34,981	36,924	0.95
3	100	14.02	33,023	31,952	4.00	36,315	35,472	0.91
4	100	19.33	30,488	32,037	5.55	34,700	34,462	0.88
5	100	28.70	35,400	34,171	7.98	33,892	33,520	1.04
6	100	38.52	37,386	37,830	10.52	32,624	32,983	1.15

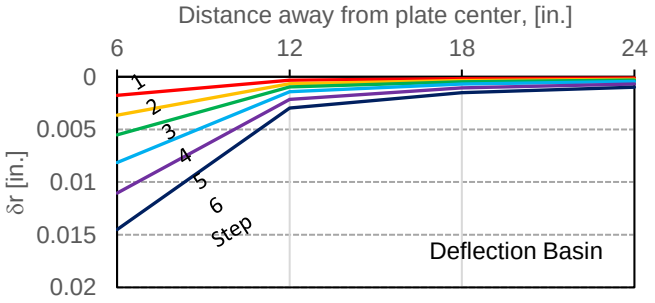


Model: AASHTO (2015)

$$M_r = k_1^* P_a \left(\frac{\theta}{P_a}\right)^{k_2^*} \left(1 + \frac{\tau_{oct}}{P_a}\right)^{k_3^*}$$

Parameter	Value	P-Value
$k^*_{1\ (Base)}$	2036.0	4.56E-07
$k^*_{2\ (Base)}$	-0.442	2.19E-02
$k^*_{3\ (Base)}$	2.999	2.19E-02
Adj. R^2	0.851	
Std. Error [psi]	1094	
$k^*_{1\ (Subgrade)}$	2150.2	3.55E-05
$k^*_{2\ (Subgrade)}$	-0.167	3.23E-01
$k^*_{3\ (Subgrade)}$	0.784	6.92E-01
Adj. R^2	0.775	
Std. Error [psi]	1064	





In-situ Resilient Modulus [Mr]: Cyclic Loading, Layered Analysis, Stress-Dependent	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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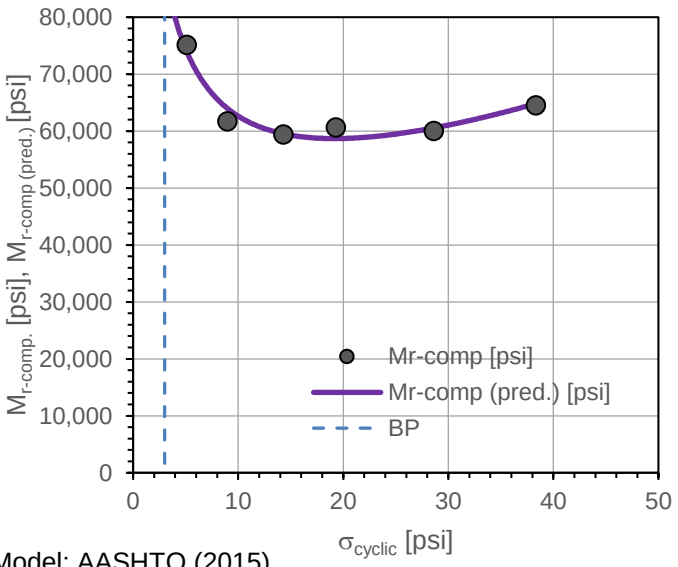
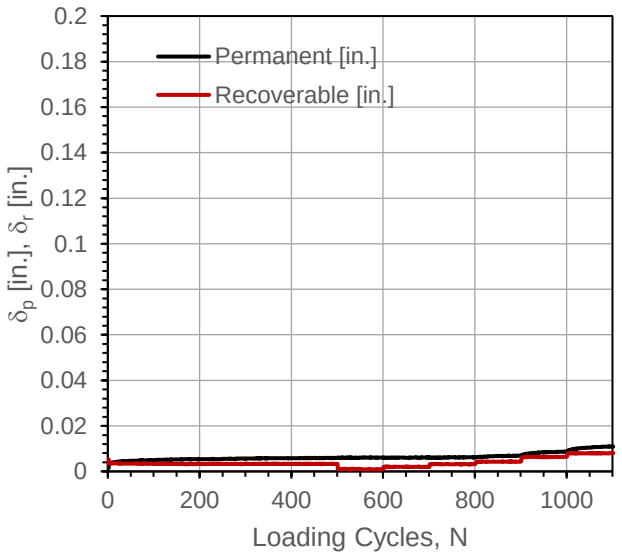
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent (5, 10, 15, 20, 30, 40)				
Date:	12/12/2017	Time:	9:48:33 AM	Test ID	**CTRL_Pt2**
Tested By	DW, PV, HG	Location:	UPRR - Los Angeles	Sta.	NA
Latitude,N:	34.057640	Longitude,W:	118.222340	Elev. (ft):	282
Comments:	11.5 in. recycled concrete aggregate over subgrade.				

Step	N	σ_{cyclic} [psi]	$M_{r\text{-}comp}$ [psi]	$M_{r\text{-}comp\ (pred.)}$ [psi]	δ_p [in.]	$\Delta\delta_p$ [in.]	d =Δlog(δ_p)/ Δlog(N)	Near-linear Elastic
Conditioning	500	14.31	---	---	0.0059	---	0.116	---
1	100	5.11	75,157	73,941	0.0061	0.0002	0.091	Y
2	100	8.98	61,745	63,982	0.0062	0.0002	0.125	Y
3	100	14.31	59,424	59,525	0.0062	0.0002	0.200	Y
4	100	19.30	60,678	58,686	0.0069	0.0010	0.492	Y
5	100	28.63	60,059	60,557	0.0087	0.0027	0.438	Y
6	100	38.36	64,555	64,822	0.0110	0.0050	0.469	Y





Model: AASHTO (2015)

$$M_{r-comp} = k_1^* P_a \left(\frac{\theta}{P_a}\right)^{k_2^*} \left(1 + \frac{\tau_{oct}}{P_a}\right)^{k_3^*}$$

Parameter	Value	P-Value
k^*_1	4,019.6	1.49E-07
k^*_2	-0.430	1.04E-02
k^*_3	2.529	1.56E-02
Adj. R^2	0.924	
Std. Error [psi]	1,551	

$M_{r\text{-}comp\ (pred.)\text{-}BP}$ [psi]	88,034
$\sigma_{cyclic\text{-}BP}$ [psi]	3.0

In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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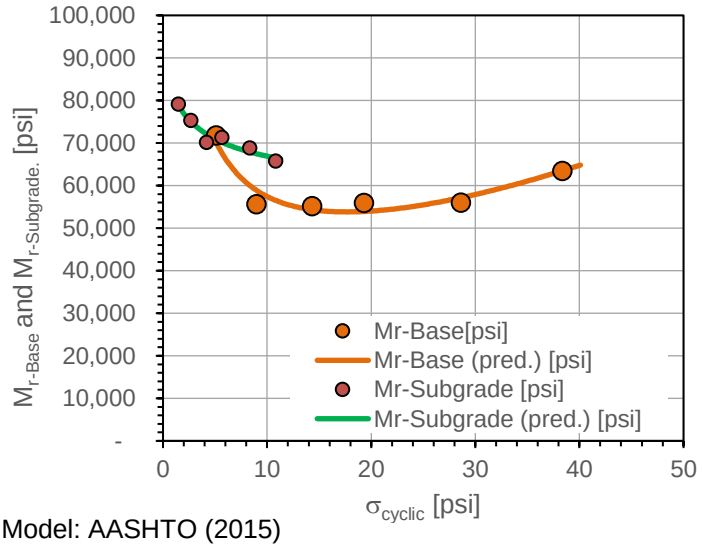
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent (5, 10, 15, 20, 30, 40)				
Date:	12/12/2017	Time:	9:48:33 AM	Test ID	**CTRL_Pt2**
Tested By	DW, PV, HG	Location:	UPRR - Los Angeles	Sta.	NA
Latitude, N:	34.057640	Longitude, W:	118.222340	Elev. (ft):	282
Comments:	11.5 in. recycled concrete aggregate over subgrade.				

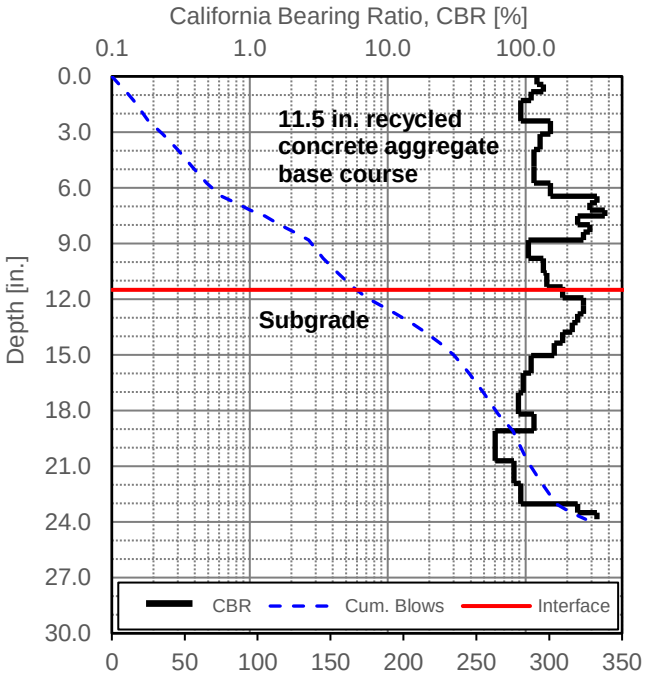
Step	N	$\sigma_{cyclic\_surface}$ [psi]	$M_{r\text{-}Base}$[psi]	$M_{r\text{-}Base\ (pred.)}$ [psi]	$\sigma_{cyclic\_Int.}$ [psi]	$M_{r\text{-}Subgrade}$ [psi]	$M_{r\text{-}Subgrade\ (pred.)}$ [psi]	Modulus Ratio
Conditioning	500	14.31	---	---	---	---	---	---
1	100	5.11	71,813	70,208	1.46	79,183	78,881	0.91
2	100	8.98	55,676	58,878	2.66	75,318	75,085	0.74
3	100	14.31	55,222	54,324	4.19	70,117	72,094	0.79
4	100	19.30	55,943	53,910	5.66	71,395	70,178	0.78
5	100	28.63	56,018	57,161	8.34	68,859	67,886	0.81
6	100	38.36	63,482	63,476	10.83	65,816	66,513	0.96

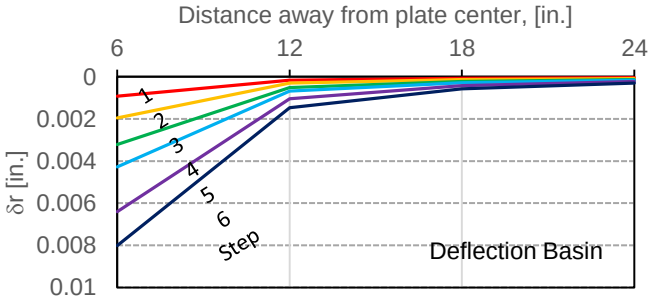


Model: AASHTO (2015)

$$M_r = k_1^* P_a \left(\frac{\theta}{P_a}\right)^{k_2^*} \left(1 + \frac{\tau_{oct}}{P_a}\right)^{k_3^*}$$

Parameter	Value	P-Value
$k^*_{1\ (Base)}$	3541.8	4.66E-07
$k^*_{2\ (Base)}$	-0.549	1.45E-02
$k^*_{3\ (Base)}$	3.465	1.80E-02
Adj. R^2	0.895	
Std. Error [psi]	2020	
$k^*_{1\ (Subgrade)}$	4561.5	4.46E-06
$k^*_{2\ (Subgrade)}$	-0.137	1.78E-01
$k^*_{3\ (Subgrade)}$	0.385	7.21E-01
Adj. R^2	0.924	
Std. Error [psi]	1276	





In-situ Resilient Modulus [Mr]: Cyclic Loading, Layered Analysis, Stress-Dependent	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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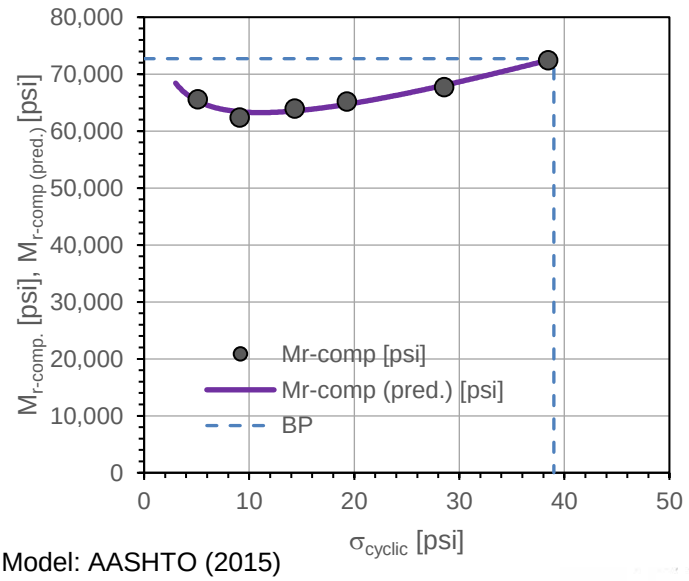
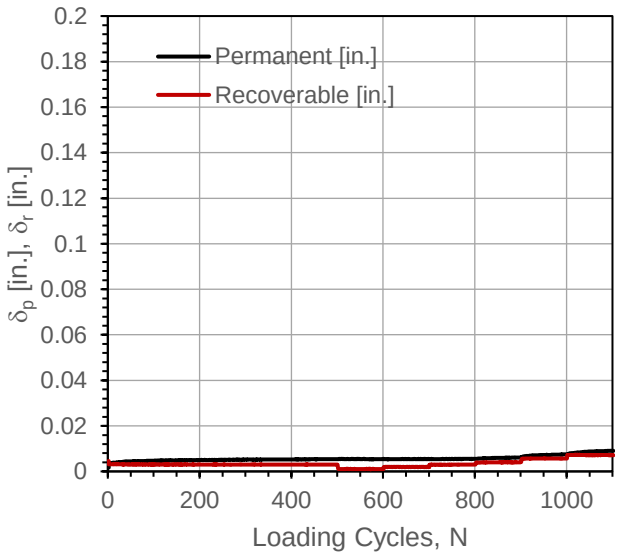
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent (5, 10, 15, 20, 30, 40)				
Date:	12/12/2017	Time:	10:21:47 AM	Test ID	**CTRL_PT3**
Tested By	DW, PV, HG	Location:	UPRR - Los Angeles	Sta.	NA
Latitude,N:	34.057671	Longitude,W:	118.222400	Elev. (ft):	283
Comments:	11.5 in. recycled concrete aggregate over subgrade.				

Step	N	σ_{cyclic} [psi]	$M_{r\text{-}comp}$ [psi]	$M_{r\text{-}comp\ (pred.)}$ [psi]	δ_p [in.]	$\Delta\delta_p$ [in.]	d =Δlog(δ_p)/ Δlog(N)	Near-linear Elastic
Conditioning	500	14.33	---	---	0.0054	---	0.099	---
1	100	5.13	65,632	65,245	0.0054	0.0000	-0.123	Y
2	100	9.11	62,411	63,394	0.0055	0.0001	0.075	Y
3	100	14.33	63,962	63,534	0.0055	0.0002	0.165	Y
4	100	19.30	65,200	64,702	0.0061	0.0007	0.428	Y
5	100	28.58	67,756	68,062	0.0075	0.0021	0.381	Y
6	100	38.46	72,449	72,460	0.0091	0.0037	0.550	Y





Model: AASHTO (2015)

$$M_{r-comp} = k_1^* P_a \left(\frac{\theta}{P_a}\right)^{k_2^*} \left(1 + \frac{\tau_{oct}}{P_a}\right)^{k_3^*}$$

Parameter	Value	P-Value
k^*_1	4,009.8	8.25E-09
k^*_2	-0.143	1.53E-02
k^*_3	1.351	6.11E-03
Adj. R^2	0.967	
Std. Error [psi]	633	

$M_{r\text{-}comp\ (pred.)\text{-}BP}$ [psi]	72,715
$\sigma_{cyclic\text{-}BP}$ [psi]	39.0

In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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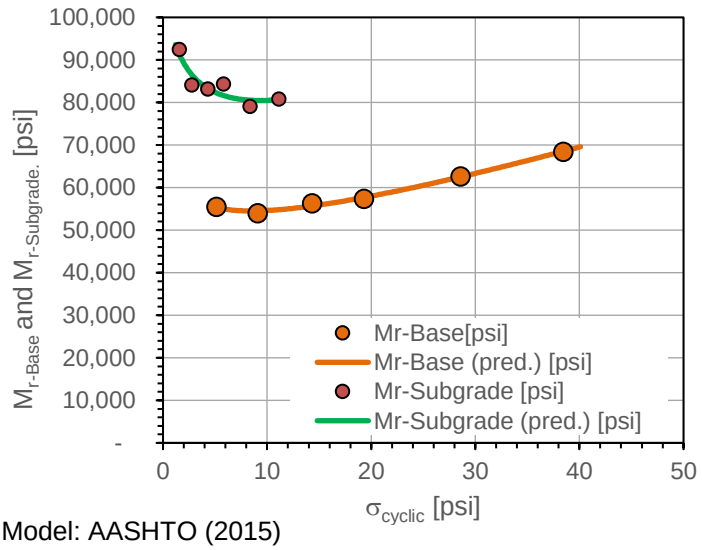
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent (5, 10, 15, 20, 30, 40)				
Date:	12/12/2017	Time:	10:21:47 AM	Test ID	**CTRL_PT3**
Tested By	DW, PV, HG	Location:	UPRR - Los Angeles	Sta.	NA
Latitude, N:	34.057671	Longitude, W:	118.222400	Elev. (ft):	283
Comments:	11.5 in. recycled concrete aggregate over subgrade.				

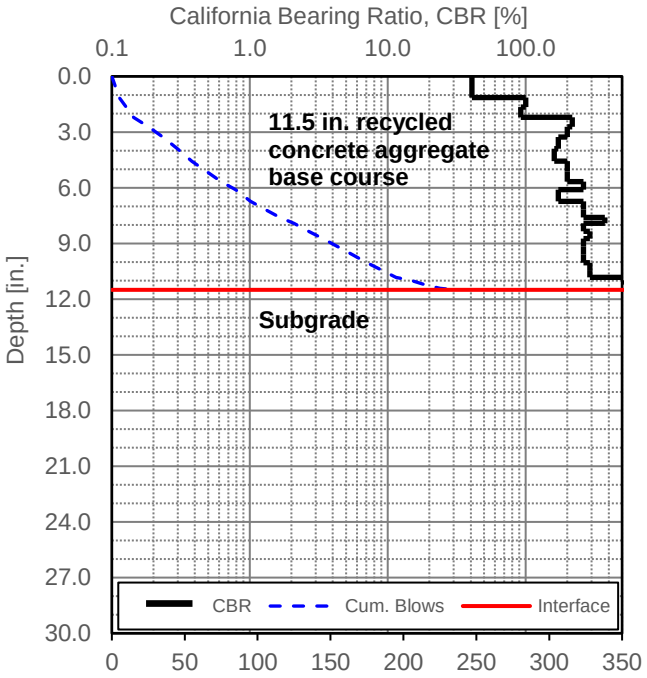
Step	N	$\sigma_{cyclic\_surface}$ [psi]	$M_{r\text{-}Base}$[psi]	$M_{r\text{-}Base\ (pred.)}$ [psi]	$\sigma_{cyclic\_Int.}$ [psi]	$M_{r\text{-}Subgrade}$ [psi]	$M_{r\text{-}Subgrade\ (pred.)}$ [psi]	Modulus Ratio
Conditioning	500	14.33	---	---	---	---	---	---
1	100	5.13	55,501	55,316	1.58	92,491	91,291	0.60
2	100	9.11	53,979	54,537	2.77	84,126	86,525	0.64
3	100	14.33	56,293	55,680	4.31	83,104	83,272	0.68
4	100	19.30	57,386	57,673	5.80	84,356	81,634	0.68
5	100	28.58	62,657	62,508	8.37	79,088	80,534	0.79
6	100	38.46	68,444	68,540	11.12	80,838	80,645	0.85

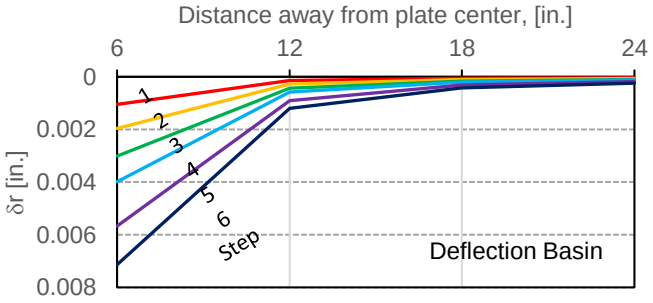


Model: AASHTO (2015)

$$M_r = k_1^* P_a \left(\frac{\theta}{P_a}\right)^{k_2^*} \left(1 + \frac{\tau_{oct}}{P_a}\right)^{k_3^*}$$

Parameter	Value	P-Value
$k^*_{1\ (Base)}$	3330.2	4.82E-09
$k^*_{2\ (Base)}$	-0.144	8.56E-03
$k^*_{3\ (Base)}$	1.734	1.65E-03
Adj. R^2	0.993	
Std. Error [psi]	456	
$k^*_{1\ (Subgrade)}$	4744.0	9.71E-06
$k^*_{2\ (Subgrade)}$	-0.205	1.45E-01
$k^*_{3\ (Subgrade)}$	1.551	3.10E-01
Adj. R^2	0.805	
Std. Error [psi]	1864	





In-situ Resilient Modulus [Mr]: Cyclic Loading, Layered Analysis, Stress-Dependent	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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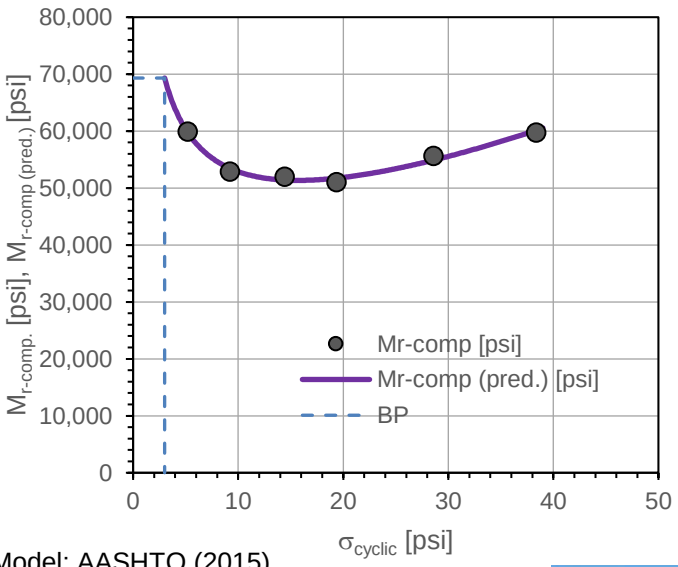
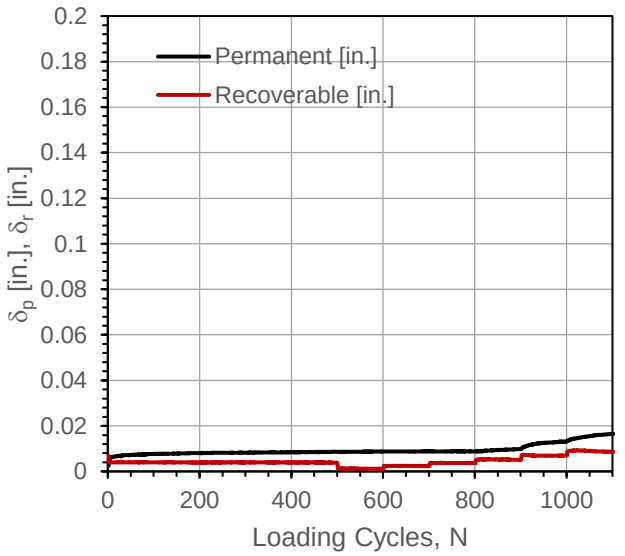
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent (5, 10, 15, 20, 30, 40)				
Date:	12/12/2017	Time:	10:52:43 AM	Test ID	**CTRL_PT4**
Tested By	DW, PV, HG	Location:	UPRR - Los Angeles	Sta.	NA
Latitude,N:	34.057728	Longitude,W:	118.222460	Elev. (ft):	285
Comments:	11.5 in. recycled concrete aggregate over subgrade.				

Step	N	σ_{cyclic} [psi]	$M_{r\text{-}comp}$ [psi]	$M_{r\text{-}comp\ (pred.)}$ [psi]	δ_p [in.]	$\Delta\delta_p$ [in.]	d =Δlog(δ_p)/ Δlog(N)	Near-linear Elastic
Conditioning	500	14.42	---	---	0.0086	---	0.081	---
1	100	5.21	59,934	59,712	0.0088	0.0001	0.219	Y
2	100	9.23	52,918	53,448	0.0089	0.0002	0.071	Y
3	100	14.42	52,021	51,401	0.0087	0.0001	-0.015	Y
4	100	19.36	51,061	51,729	0.0098	0.0012	0.606	Y
5	100	28.60	55,638	54,897	0.0132	0.0045	0.534	Y
6	100	38.39	59,788	60,158	0.0165	0.0078	0.578	Y





Model: AASHTO (2015)

$$M_{r-comp} = k_1^* P_a \left(\frac{\theta}{P_a}\right)^{k_2^*} \left(1 + \frac{\tau_{oct}}{P_a}\right)^{k_3^*}$$

Parameter	Value	P-Value
k^*_1	3,279.3	1.79E-08
k^*_2	-0.378	1.96E-03
k^*_3	2.629	1.81E-03
Adj. R^2	0.970	
Std. Error [psi]	673	

$M_{r\text{-}comp\ (pred.)\text{-}BP}$ [psi]	69,318
$\sigma_{cyclic\text{-}BP}$ [psi]	3.0

In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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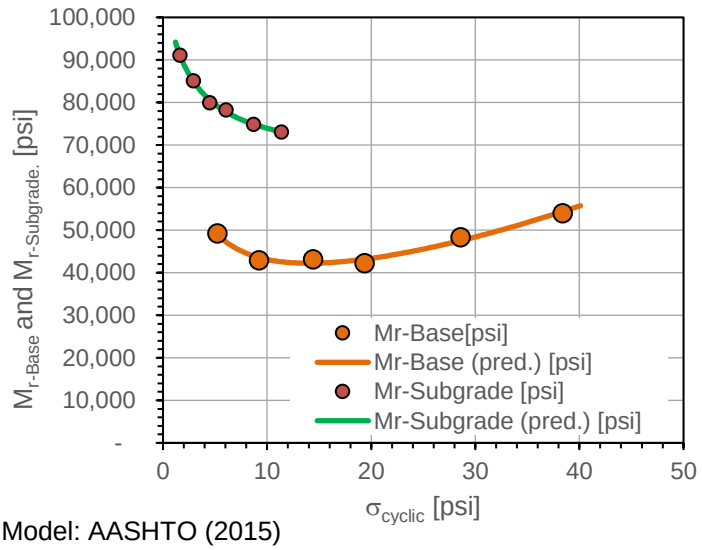
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent (5, 10, 15, 20, 30, 40)				
Date:	12/12/2017	Time:	10:52:43 AM	Test ID	**CTRL_PT4**
Tested By	DW, PV, HG	Location:	UPRR - Los Angeles	Sta.	NA
Latitude, N:	34.057728	Longitude, W:	118.222460	Elev. (ft):	285
Comments:	11.5 in. recycled concrete aggregate over subgrade.				

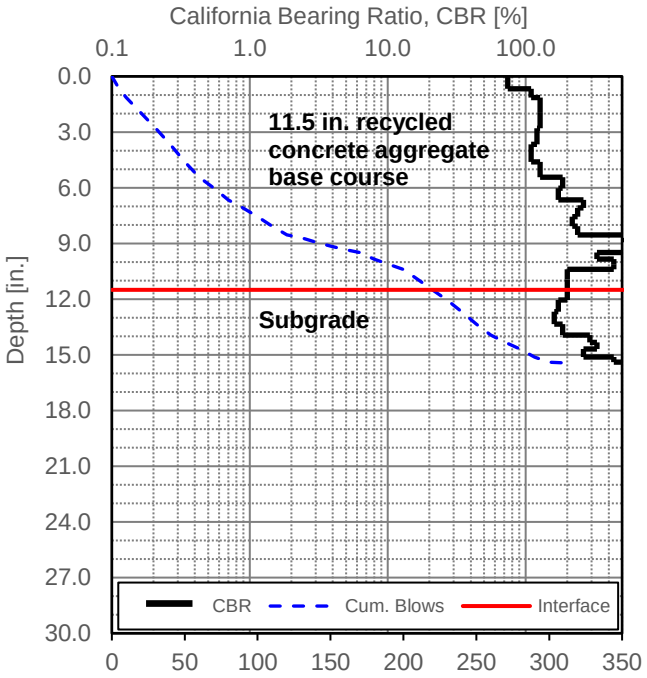
Step	N	$\sigma_{cyclic\_surface}$ [psi]	$M_{r\text{-}Base}$[psi]	$M_{r\text{-}Base\ (pred.)}$ [psi]	$\sigma_{cyclic\_Int.}$ [psi]	$M_{r\text{-}Subgrade}$ [psi]	$M_{r\text{-}Subgrade\ (pred.)}$ [psi]	Modulus Ratio
Conditioning	500	14.42	---	---	---	---	---	---
1	100	5.21	49,270	49,065	1.63	91,134	91,107	0.54
2	100	9.23	42,971	43,545	2.92	85,149	84,984	0.50
3	100	14.42	43,135	42,231	4.52	79,898	80,535	0.54
4	100	19.36	42,230	43,173	6.06	78,297	77,784	0.54
5	100	28.60	48,345	47,538	8.68	74,903	74,894	0.65
6	100	38.39	53,989	54,360	11.38	73,093	73,166	0.74

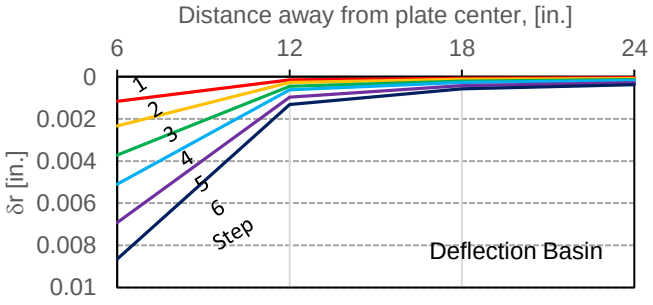


Model: AASHTO (2015)

$$M_r = k_1^* P_a \left(\frac{\theta}{P_a}\right)^{k_2^*} \left(1 + \frac{\tau_{oct}}{P_a}\right)^{k_3^*}$$

Parameter	Value	P-Value
$k^*_{1\ (Base)}$	2540.6	6.74E-08
$k^*_{2\ (Base)}$	-0.451	3.87E-03
$k^*_{3\ (Base)}$	3.460	2.69E-03
Adj. R^2	0.967	
Std. Error [psi]	839	
$k^*_{1\ (Subgrade)}$	4873.1	9.33E-08
$k^*_{2\ (Subgrade)}$	-0.207	2.78E-03
$k^*_{3\ (Subgrade)}$	0.811	5.76E-02
Adj. R^2	0.996	
Std. Error [psi]	418	





In-situ Resilient Modulus [Mr]: Cyclic Loading, Layered Analysis, Stress-Dependent	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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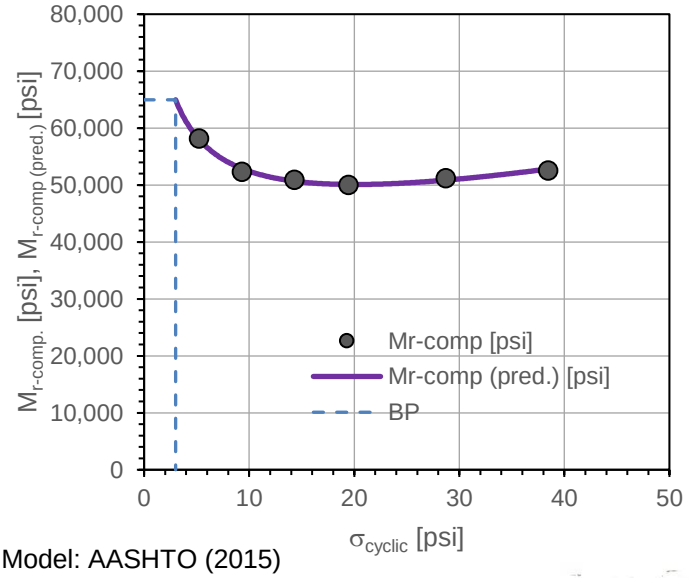
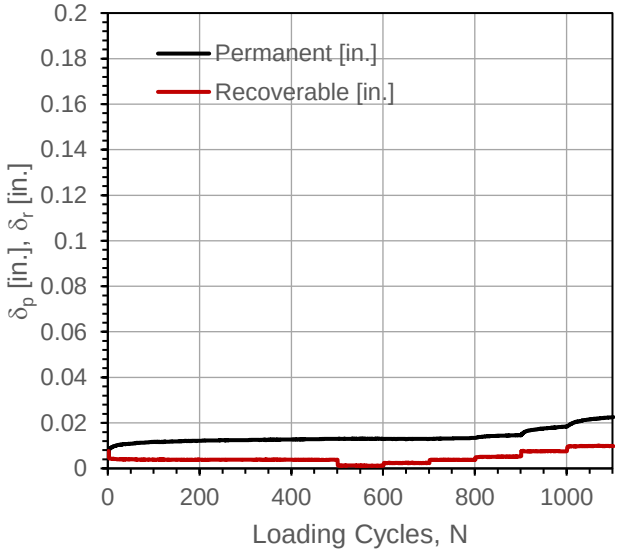
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent (5, 10, 15, 20, 30, 40)				
Date:	12/12/2017	Time:	11:23:30 AM	Test ID	**CTRL_PT5**
Tested By	DW, PV, HG	Location:	UPRR - Los Angeles	Sta.	NA
Latitude,N:	34.057800	Longitude,W:	118.222500	Elev. (ft):	282
Comments:	11.0 in. recycled concrete aggregate over subgrade.				

Step	N	σ_{cyclic} [psi]	$M_{r\text{-}comp}$ [psi]	$M_{r\text{-}comp\ (pred.)}$ [psi]	δ_p [in.]	$\Delta\delta_p$ [in.]	d =Δlog(δ_p)/ Δlog(N)	Near-linear Elastic
Conditioning	500	14.31	---	---	0.0130	---	0.084	---
1	100	5.25	58,217	57,964	0.0130	0.0000	0.015	Y
2	100	9.32	52,337	52,881	0.0130	0.0000	0.016	Y
3	100	14.31	50,926	50,676	0.0134	0.0004	0.405	Y
4	100	19.45	50,036	50,098	0.0146	0.0017	0.479	Y
5	100	28.72	51,202	50,860	0.0184	0.0054	0.464	Y
6	100	38.46	52,583	52,816	0.0225	0.0095	0.605	N





Model: AASHTO (2015)

$$M_{r-comp} = k_1^* P_a \left(\frac{\theta}{P_a}\right)^{k_2^*} \left(1 + \frac{\tau_{oct}}{P_a}\right)^{k_3^*}$$

Parameter	Value	P-Value
k^*_1	3,460.5	3.37E-09
k^*_2	-0.266	1.13E-03
k^*_3	1.505	1.90E-03
Adj. R^2	0.983	
Std. Error [psi]	381	

$M_{r\text{-}comp\ (pred.)\text{-}BP}$ [psi]	64,968
$\sigma_{cyclic\text{-}BP}$ [psi]	3.0

In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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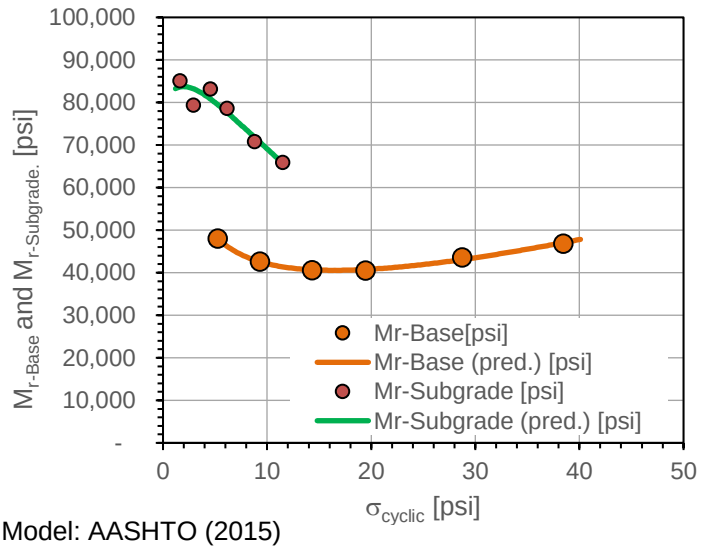
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent (5, 10, 15, 20, 30, 40)				
Date:	12/12/2017	Time:	11:23:30 AM	Test ID	**CTRL_PT5**
Tested By	DW, PV, HG	Location:	UPRR - Los Angeles	Sta.	NA
Latitude, N:	34.057800	Longitude, W:	118.222500	Elev. (ft):	282
Comments:	11.0 in. recycled concrete aggregate over subgrade.				

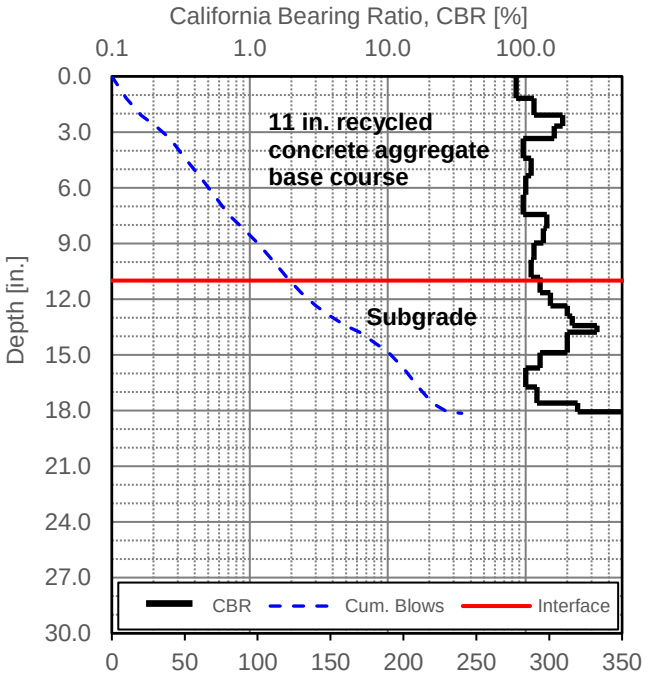
Step	N	$\sigma_{cyclic\_surface}$ [psi]	$M_{r\text{-}Base}$[psi]	$M_{r\text{-}Base\ (pred.)}$ [psi]	$\sigma_{cyclic\_Int.}$ [psi]	$M_{r\text{-}Subgrade}$ [psi]	$M_{r\text{-}Subgrade\ (pred.)}$ [psi]	Modulus Ratio
Conditioning	500	14.31	---	---	---	---	---	---
1	100	5.25	48,084	48,071	1.63	85,133	83,656	0.56
2	100	9.32	42,617	42,548	2.92	79,419	83,219	0.54
3	100	14.31	40,605	40,682	4.56	83,154	80,825	0.49
4	100	19.45	40,492	40,757	6.14	78,672	77,681	0.51
5	100	28.72	43,594	43,077	8.79	70,849	71,806	0.62
6	100	38.46	46,817	47,071	11.48	65,932	65,829	0.71

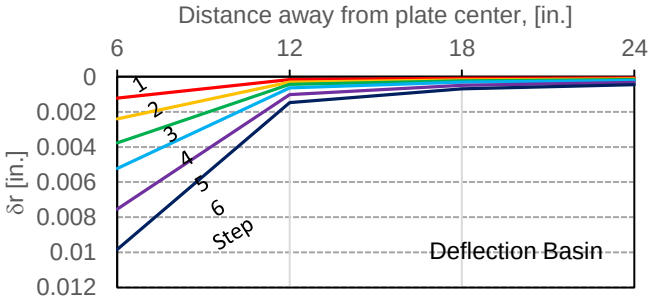


Model: AASHTO (2015)

$$M_r = k_1^* P_a \left(\frac{\theta}{P_a}\right)^{k_2^*} \left(1 + \frac{\tau_{oct}}{P_a}\right)^{k_3^*}$$

Parameter	Value	P-Value
$k^*_{1\ (Base)}$	2624.7	3.86E-09
$k^*_{2\ (Base)}$	-0.402	3.42E-04
$k^*_{3\ (Base)}$	2.687	3.51E-04
Adj. R^2	0.990	
Std. Error [psi]	321	
$k^*_{1\ (Subgrade)}$	7540.1	1.42E-05
$k^*_{2\ (Subgrade)}$	0.145	3.34E-01
$k^*_{3\ (Subgrade)}$	-3.581	9.89E-02
Adj. R^2	0.890	
Std. Error [psi]	2341	





In-situ Resilient Modulus [Mr]: Cyclic Loading, Layered Analysis, Stress-Dependent	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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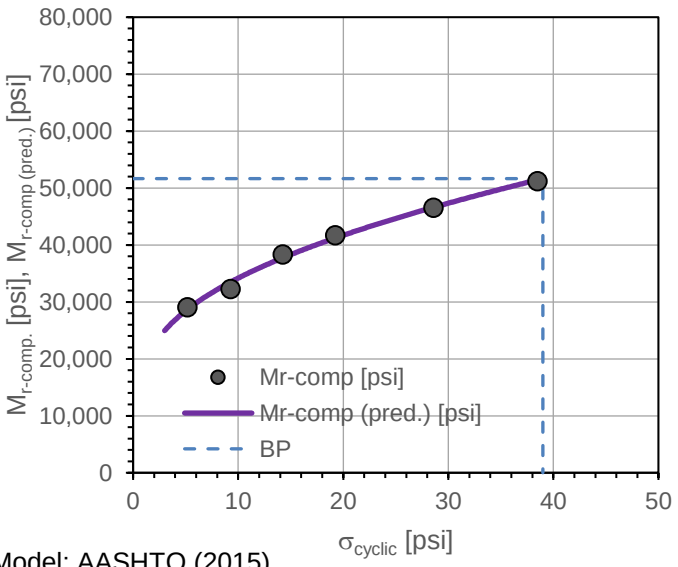
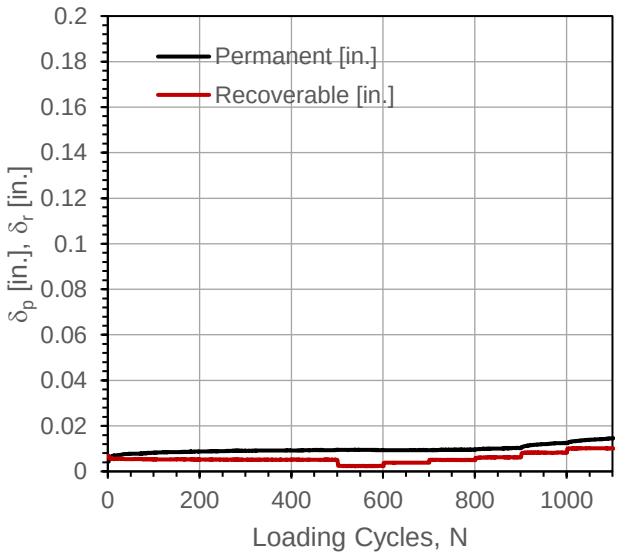
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent (5, 10, 15, 20, 30, 40)				
Date:	12/12/2017	Time:	11:56:28 AM	Test ID	**TX8_PT6**
Tested By	DW, PV, HG	Location:	UPRR - Los Angeles	Sta.	NA
Latitude,N:	34.057838	Longitude,W:	118.222470	Elev. (ft):	292
Comments:	4.5 in. recycled concrete aggregate stabilized with TX8 geogrid over subgrade.				

Step	N	σ_{cyclic} [psi]	$M_{r\text{-}comp}$ [psi]	$M_{r\text{-}comp\ (pred.)}$ [psi]	δ_p [in.]	$\Delta\delta_p$ [in.]	d =$\Delta\log(\delta_p)/\Delta\log(N)$	Near-linear Elastic
Conditioning	500	14.24	---	---	0.0094	---	0.092	---
1	100	5.18	29,099	28,693	0.0094	0.0000	-0.152	Y
2	100	9.28	32,274	33,495	0.0093	-0.0001	0.059	Y
3	100	14.24	38,368	37,741	0.0096	0.0002	0.288	Y
4	100	19.24	41,737	41,217	0.0104	0.0010	0.349	Y
5	100	28.61	46,540	46,615	0.0125	0.0031	0.445	Y
6	100	38.51	51,209	51,432	0.0145	0.0051	0.547	Y





Model: AASHTO (2015)

$$M_{r-comp} = k_1^* P_a \left(\frac{\theta}{P_a}\right)^{k_2^*} \left(1 + \frac{\tau_{oct}}{P_a}\right)^{k_3^*}$$

Parameter	Value	P-Value
k^*_1	2,009.1	1.18E-07
k^*_2	0.241	3.34E-02
k^*_3	0.342	4.91E-01
Adj. R^2	0.992	
Std. Error [psi]	769	

$M_{r\text{-}comp\ (pred.)\text{-}BP}$ [psi]	51,655
$\sigma_{cyclic\text{-}BP}$ [psi]	39.0

In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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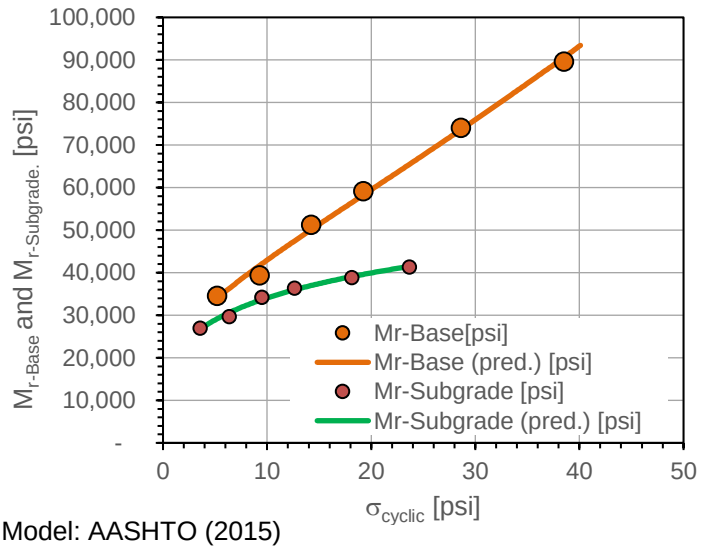
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent (5, 10, 15, 20, 30, 40)				
Date:	12/12/2017	Time:	11:56:28 AM	Test ID	**TX8_PT6**
Tested By	DW, PV, HG	Location:	UPRR - Los Angeles	Sta.	NA
Latitude, N:	34.057838	Longitude, W:	118.222470	Elev. (ft):	292
Comments:	4.5 in. recycled concrete aggregate stabilized with TX8 geogrid over subgrade.				

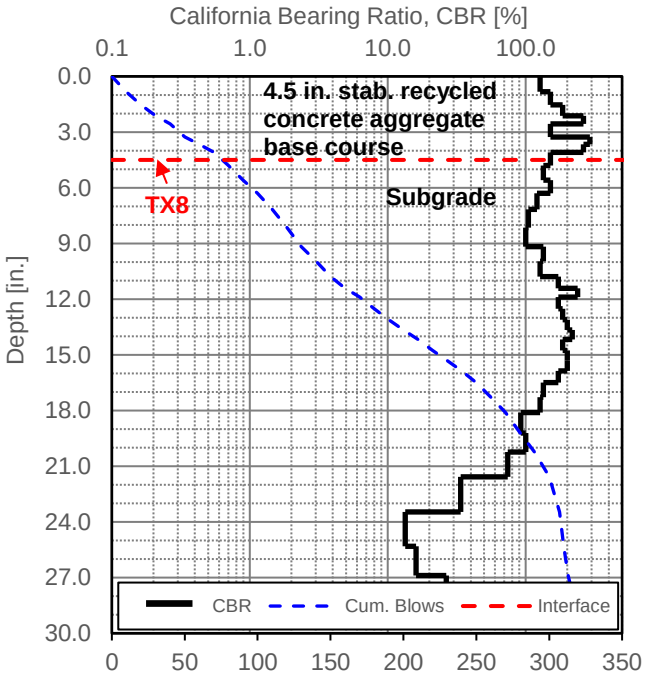
Step	N	$\sigma_{cyclic\_surface}$ [psi]	$M_{r\text{-}Base}$[psi]	$M_{r\text{-}Base\ (pred.)}$ [psi]	$\sigma_{cyclic\_Int.}$ [psi]	$M_{r\text{-}Subgrade}$ [psi]	$M_{r\text{-}Subgrade\ (pred.)}$ [psi]	Modulus Ratio
Conditioning	500	14.24	---	---	---	---	---	---
1	100	5.18	34,621	33,855	3.57	26,989	26,692	1.28
2	100	9.28	39,403	41,709	6.36	29,679	30,599	1.33
3	100	14.24	51,278	50,108	9.50	34,145	33,660	1.50
4	100	19.24	59,212	58,252	12.62	36,402	35,971	1.63
5	100	28.61	74,062	73,627	18.12	38,903	39,075	1.90
6	100	38.51	89,626	90,598	23.68	41,355	41,451	2.17

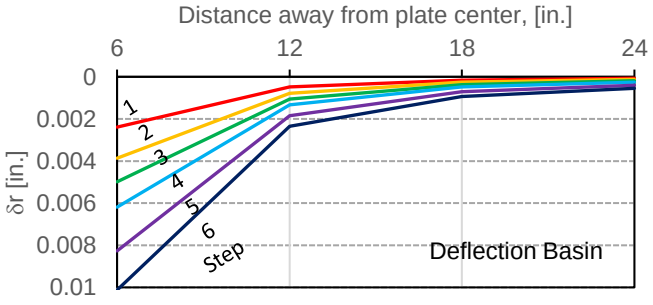


Model: AASHTO (2015)

$$M_r = k_1^* P_a \left(\frac{\theta}{P_a}\right)^{k_2^*} \left(1 + \frac{\tau_{oct}}{P_a}\right)^{k_3^*}$$

Parameter	Value	P-Value
$k^*_{1\ (Base)}$	2191.8	4.02E-07
$k^*_{2\ (Base)}$	0.234	9.73E-02
$k^*_{3\ (Base)}$	1.770	7.61E-02
Adj. R^2	0.995	
Std. Error [psi]	1526	
$k^*_{1\ (Subgrade)}$	2147.5	7.50E-07
$k^*_{2\ (Subgrade)}$	0.268	2.59E-02
$k^*_{3\ (Subgrade)}$	-0.183	7.21E-01
Adj. R^2	0.988	
Std. Error [psi]	587	





In-situ Resilient Modulus [Mr]: Cyclic Loading, Layered Analysis, Stress-Dependent	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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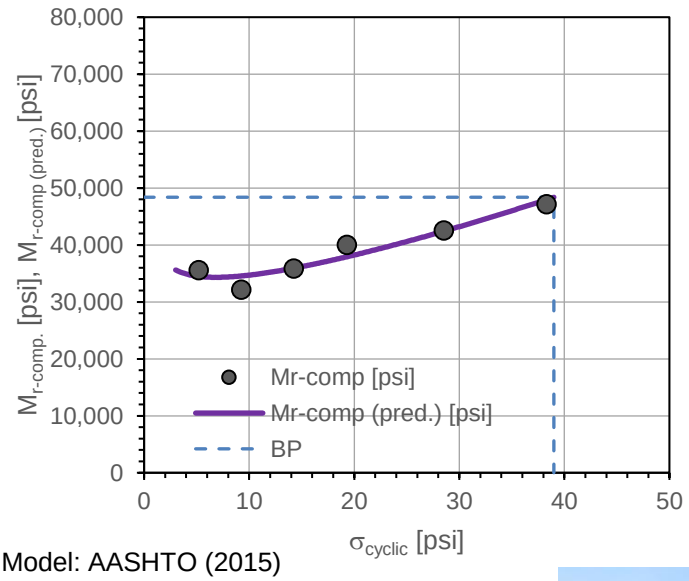
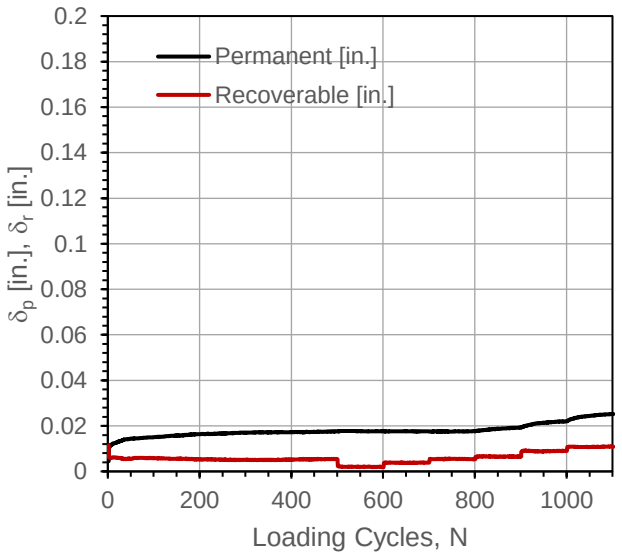
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent (5, 10, 15, 20, 30, 40)				
Date:	12/12/2017	Time:	12:27:15 PM	Test ID	**TX8_PT7**
Tested By	DW, PV, HG	Location:	UPRR - Los Angeles	Sta.	NA
Latitude,N:	34.057796	Longitude,W:	118.222420	Elev. (ft):	305
Comments:	5.0 in. recycled concrete aggregate stabilized with TX8 geogrid over subgrade.				

Step	N	σ_{cyclic} [psi]	$M_{r\text{-}comp}$ [psi]	$M_{r\text{-}comp\ (pred.)}$ [psi]	δ_p [in.]	$\Delta\delta_p$ [in.]	d =Δlog(δ_p)/ Δlog(N)	Near-linear Elastic
Conditioning	500	14.25	---	---	0.0176	---	0.106	---
1	100	5.20	35,626	34,487	0.0177	0.0000	-0.109	Y
2	100	9.25	32,163	34,557	0.0176	0.0000	0.020	Y
3	100	14.25	35,895	35,929	0.0176	0.0000	0.136	Y
4	100	19.30	40,040	37,928	0.0193	0.0016	0.617	Y
5	100	28.54	42,554	42,427	0.0219	0.0043	0.573	Y
6	100	38.32	47,166	47,972	0.0252	0.0076	0.605	Y





Model: AASHTO (2015)

$$M_{r-comp} = k_1^* P_a \left(\frac{\theta}{P_a}\right)^{k_2^*} \left(1 + \frac{\tau_{oct}}{P_a}\right)^{k_3^*}$$

Parameter	Value	P-Value
k^*_1	2,029.8	1.21E-06
k^*_2	-0.147	3.73E-01
k^*_3	2.155	1.09E-01
Adj. R^2	0.898	
Std. Error [psi]	1,706	

$M_{r\text{-}comp\ (pred.)\text{-}BP}$ [psi]	48,383
$\sigma_{cyclic\text{-}BP}$ [psi]	39.0

In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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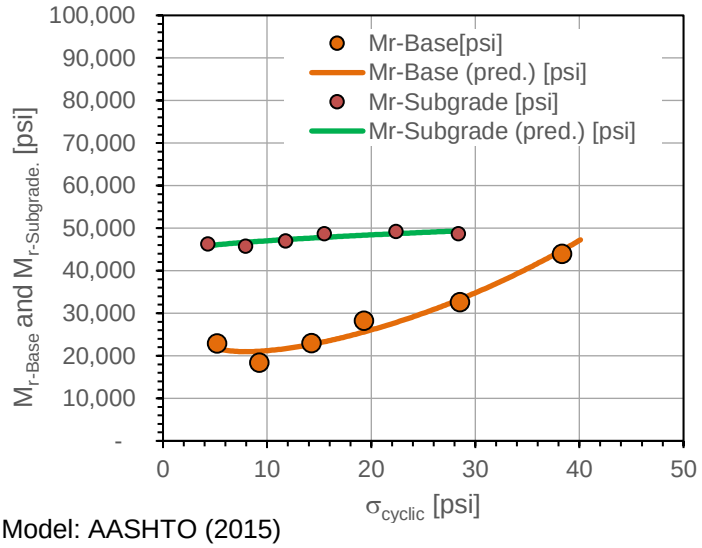
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent (5, 10, 15, 20, 30, 40)				
Date:	12/12/2017	Time:	12:27:15 PM	Test ID	**TX8_PT7**
Tested By	DW, PV, HG	Location:	UPRR - Los Angeles	Sta.	NA
Latitude, N:	34.057796	Longitude, W:	118.222420	Elev. (ft):	305
Comments:	5.0 in. recycled concrete aggregate stabilized with TX8 geogrid over subgrade.				

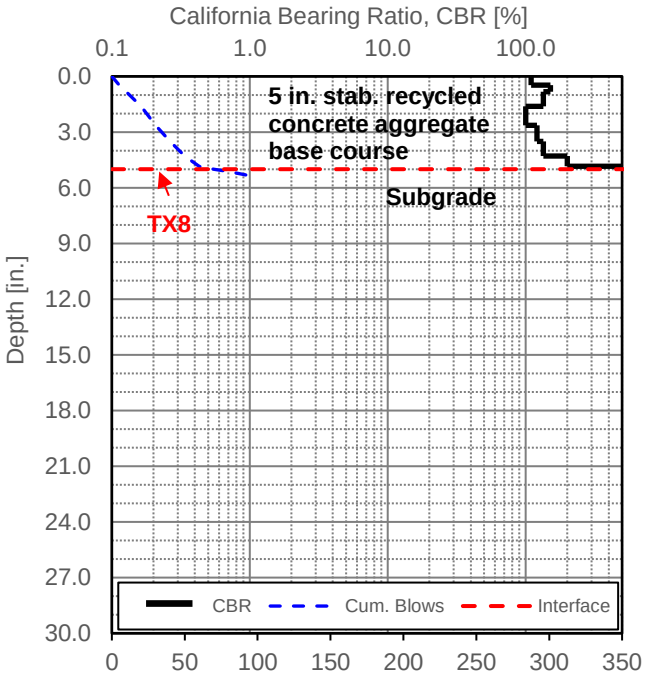
Step	N	$\sigma_{cyclic\_surface}$ [psi]	$M_{r\text{-}Base}$[psi]	$M_{r\text{-}Base\ (pred.)}$ [psi]	$\sigma_{cyclic\_Int.}$ [psi]	$M_{r\text{-}Subgrade}$ [psi]	$M_{r\text{-}Subgrade\ (pred.)}$ [psi]	Modulus Ratio
Conditioning	500	14.25	---	---	---	---	---	---
1	100	5.20	22,942	21,679	4.29	46,302	45,868	0.50
2	100	9.25	18,441	21,071	7.91	45,757	46,658	0.40
3	100	14.25	23,003	22,690	11.80	46,981	47,311	0.49
4	100	19.30	28,290	25,593	15.50	48,700	47,843	0.58
5	100	28.54	32,636	33,294	22.38	49,255	48,696	0.66
6	100	38.32	43,999	44,764	28.36	48,757	49,348	0.90

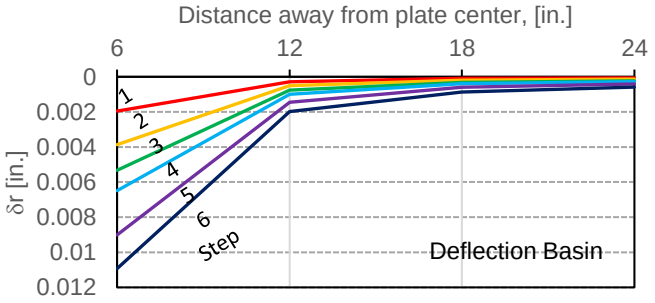


Model: AASHTO (2015)

$$M_r = k_1^* P_a \left(\frac{\theta}{P_a}\right)^{k_2^*} \left(1 + \frac{\tau_{oct}}{P_a}\right)^{k_3^*}$$

Parameter	Value	P-Value
$k^*_{1\ (Base)}$	1008.0	1.00E-05
$k^*_{2\ (Base)}$	-0.433	1.92E-01
$k^*_{3\ (Base)}$	5.497	5.18E-02
Adj. R^2	0.951	
Std. Error [psi]	2054	
$k^*_{1\ (Subgrade)}$	3112.8	2.60E-07
$k^*_{2\ (Subgrade)}$	0.018	7.83E-01
$k^*_{3\ (Subgrade)}$	0.143	7.19E-01
Adj. R^2	0.709	
Std. Error [psi]	695	





In-situ Resilient Modulus [Mr]: Cyclic Loading, Layered Analysis, Stress-Dependent	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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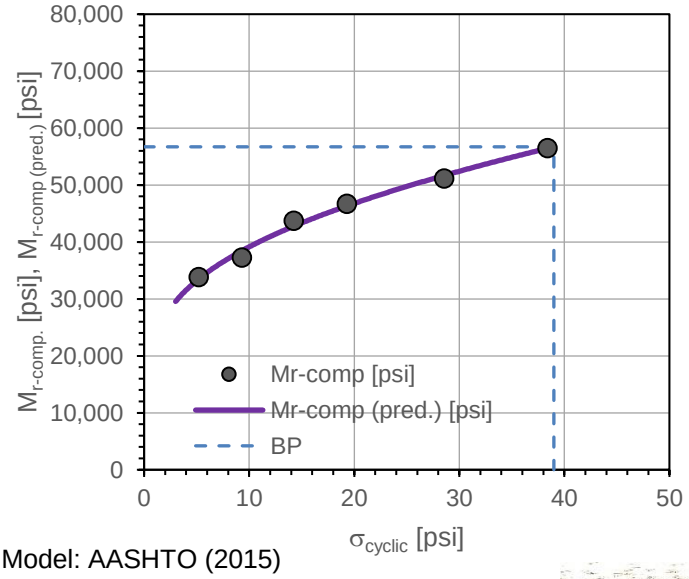
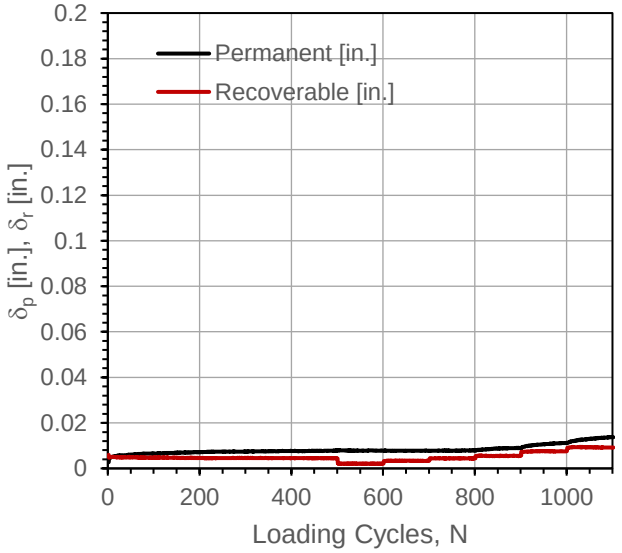
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent (5, 10, 15, 20, 30, 40)				
Date:	12/12/2017	Time:	12:59:32 PM	Test ID	**TX8_PT8**
Tested By	DW, PV, HG	Location:	UPRR - Los Angeles	Sta.	NA
Latitude,N:	34.057728	Longitude,W:	118.222370	Elev. (ft):	297
Comments:	5.0 in. recycled concrete aggregate stabilized with TX8 geogrid over subgrade.				

Step	N	σ_{cyclic} [psi]	$M_{r\text{-}comp}$ [psi]	$M_{r\text{-}comp\ (pred.)}$ [psi]	δ_p [in.]	$\Delta\delta_p$ [in.]	d =$\Delta\log(\delta_p)/\Delta\log(N)$	Near-linear Elastic
Conditioning	500	14.25	---	---	0.0078	---	0.106	---
1	100	5.21	33,874	33,523	0.0078	0.0000	-0.109	Y
2	100	9.33	37,268	38,486	0.0077	-0.0001	0.020	Y
3	100	14.25	43,757	42,782	0.0079	0.0001	0.136	Y
4	100	19.31	46,704	46,338	0.0090	0.0012	0.617	Y
5	100	28.58	51,153	51,684	0.0113	0.0035	0.573	Y
6	100	38.39	56,531	56,436	0.0138	0.0060	0.605	Y





Model: AASHTO (2015)

$$M_{r-comp} = k_1^* P_a \left(\frac{\theta}{P_a}\right)^{k_2^*} \left(1 + \frac{\tau_{oct}}{P_a}\right)^{k_3^*}$$

Parameter	Value	P-Value
k^*_1	2,334.6	9.60E-08
k^*_2	0.215	4.01E-02
k^*_3	0.317	5.03E-01
Adj. R^2	0.990	
Std. Error [psi]	861	

$M_{r\text{-}comp\ (pred.)\text{-}BP}$ [psi]	56,710
$\sigma_{cyclic\text{-}BP}$ [psi]	39.0

In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent

Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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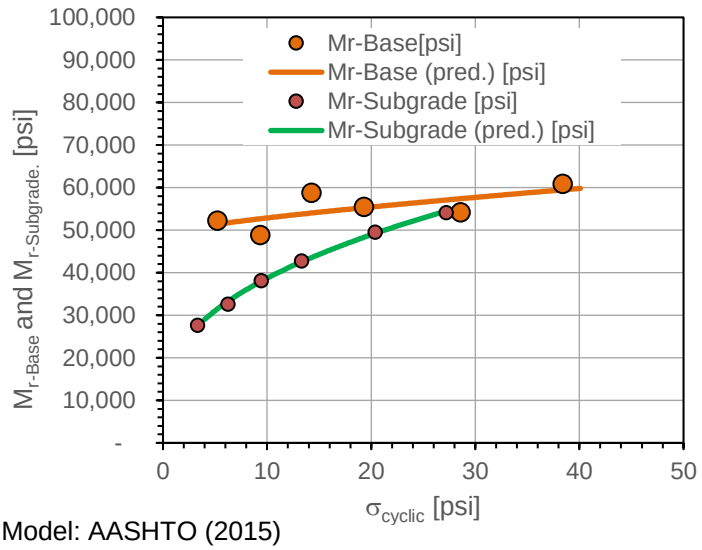
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent (5, 10, 15, 20, 30, 40)				
Date:	12/12/2017	Time:	12:59:32 PM	Test ID	**TX8_PT8**
Tested By	DW, PV, HG	Location:	UPRR - Los Angeles	Sta.	NA
Latitude, N:	34.057728	Longitude, W:	118.222370	Elev. (ft):	297
Comments:	5.0 in. recycled concrete aggregate stabilized with TX8 geogrid over subgrade.				

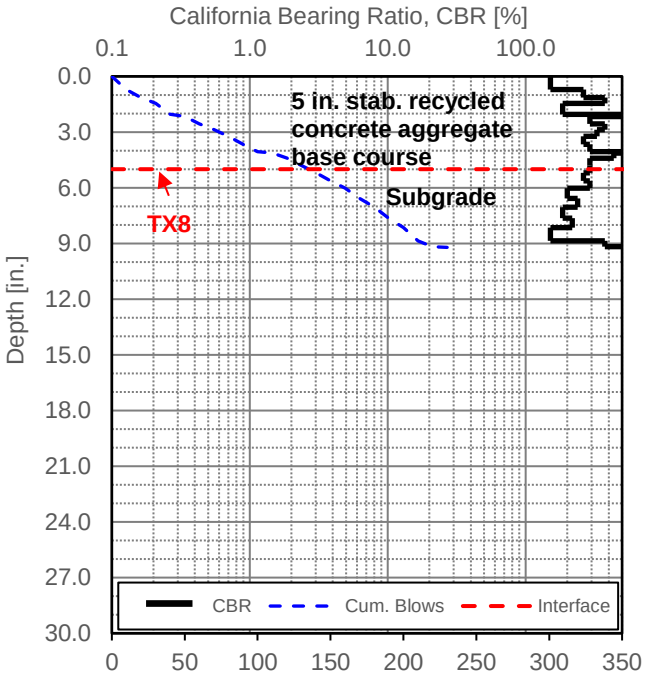
Step	N	$\sigma_{cyclic\_surface}$ [psi]	$M_{r\text{-}Base}$[psi]	$M_{r\text{-}Base\ (pred.)}$ [psi]	$\sigma_{cyclic\_Int.}$ [psi]	$M_{r\text{-}Subgrade}$ [psi]	$M_{r\text{-}Subgrade\ (pred.)}$ [psi]	Modulus Ratio
Conditioning	500	14.25	---	---	---	---	---	---
1	100	5.21	52,264	51,370	3.31	27,631	27,416	1.89
2	100	9.33	48,912	52,678	6.23	32,660	33,242	1.50
3	100	14.25	58,833	54,017	9.46	38,101	37,992	1.54
4	100	19.31	55,485	55,272	13.30	42,814	42,531	1.30
5	100	28.58	54,208	57,386	20.37	49,541	49,213	1.09
6	100	38.39	60,940	59,457	27.21	54,178	54,521	1.12

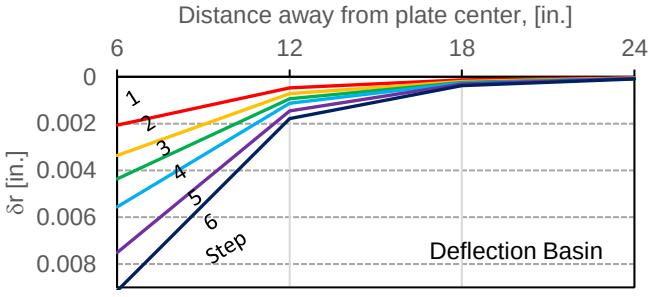


Model: AASHTO (2015)

$$M_r = k_1^* P_a \left(\frac{\theta}{P_a}\right)^{k_2^*} \left(1 + \frac{\tau_{oct}}{P_a}\right)^{k_3^*}$$

Parameter	Value	P-Value
$k^*_{1\ (Base)}$	3429.1	2.36E-06
$k^*_{2\ (Base)}$	0.015	9.41E-01
$k^*_{3\ (Base)}$	0.401	7.74E-01
Adj. R^2	0.338	
Std. Error [psi]	2445	
$k^*_{1\ (Subgrade)}$	2277.5	8.56E-08
$k^*_{2\ (Subgrade)}$	0.322	2.20E-03
$k^*_{3\ (Subgrade)}$	0.145	5.57E-01
Adj. R^2	0.998	
Std. Error [psi]	419	





In-situ Resilient Modulus [Mr]: Cyclic Loading, Layered Analysis, Stress-Dependent	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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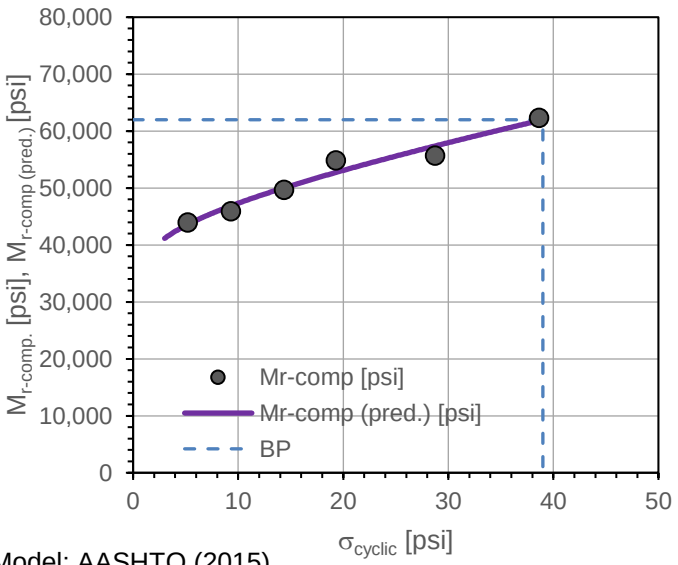
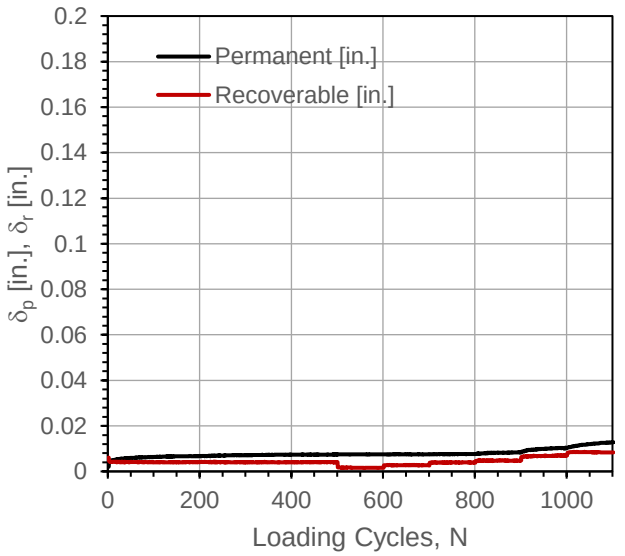
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent (5, 10, 15, 20, 30, 40)				
Date:	12/12/2017	Time:	1:31:14 PM	Test ID	**TX8_PT9**
Tested By	DW, PV, HG	Location:	UPRR - Los Angeles	Sta.	NA
Latitude,N:	34.057686	Longitude,W:	118.222330	Elev. (ft):	295
Comments:	5.0 in. recycled concrete aggregate stabilized with TX8 geogrid over subgrade.				

Step	N	σ_{cyclic} [psi]	$M_{r\text{-}comp}$ [psi]	$M_{r\text{-}comp\ (pred.)}$ [psi]	δ_p [in.]	$\Delta\delta_p$ [in.]	d =Δlog(δ_p)/ Δlog(N)	Near-linear Elastic
Conditioning	500	14.38	---	---	0.0074	---	0.115	---
1	100	5.21	43,954	43,609	0.0075	0.0001	-0.005	Y
2	100	9.32	45,949	46,870	0.0076	0.0002	0.137	Y
3	100	14.38	49,698	50,039	0.0077	0.0003	0.135	Y
4	100	19.30	54,902	52,738	0.0084	0.0011	0.432	Y
5	100	28.75	55,715	57,384	0.0103	0.0030	0.474	Y
6	100	38.66	62,351	61,848	0.0128	0.0054	0.527	Y





Model: AASHTO (2015)

$$M_{r-comp} = k_1^* P_a \left(\frac{\theta}{P_a}\right)^{k_2^*} \left(1 + \frac{\tau_{oct}}{P_a}\right)^{k_3^*}$$

Parameter	Value	P-Value
k^*_1	2,903.2	1.87E-07
k^*_2	0.077	4.03E-01
k^*_3	0.668	3.01E-01
Adj. R^2	0.953	
Std. Error [psi]	1,455	

$M_{r\text{-}comp\ (pred.)\text{-}BP}$ [psi]	61,994
$\sigma_{cyclic\text{-}BP}$ [psi]	39.0

In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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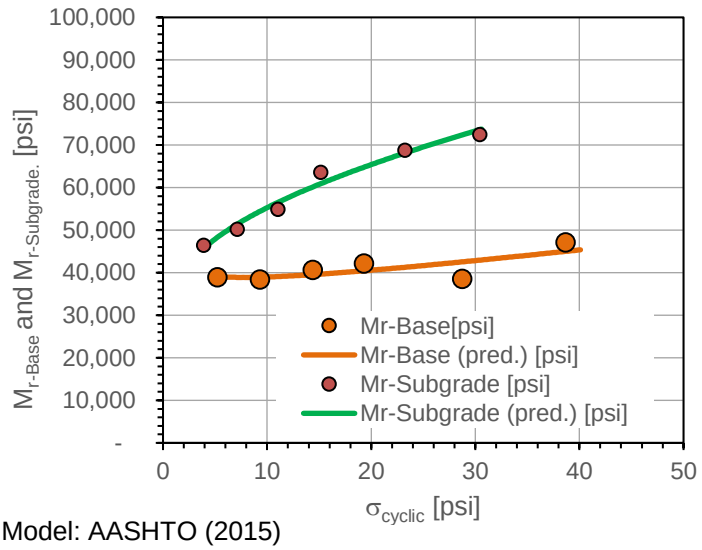
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent (5, 10, 15, 20, 30, 40)				
Date:	12/12/2017	Time:	1:31:14 PM	Test ID	**TX8_PT9**
Tested By	DW, PV, HG	Location:	UPRR - Los Angeles	Sta.	NA
Latitude, N:	34.057686	Longitude, W:	118.222330	Elev. (ft):	295
Comments:	5.0 in. recycled concrete aggregate stabilized with TX8 geogrid over subgrade.				

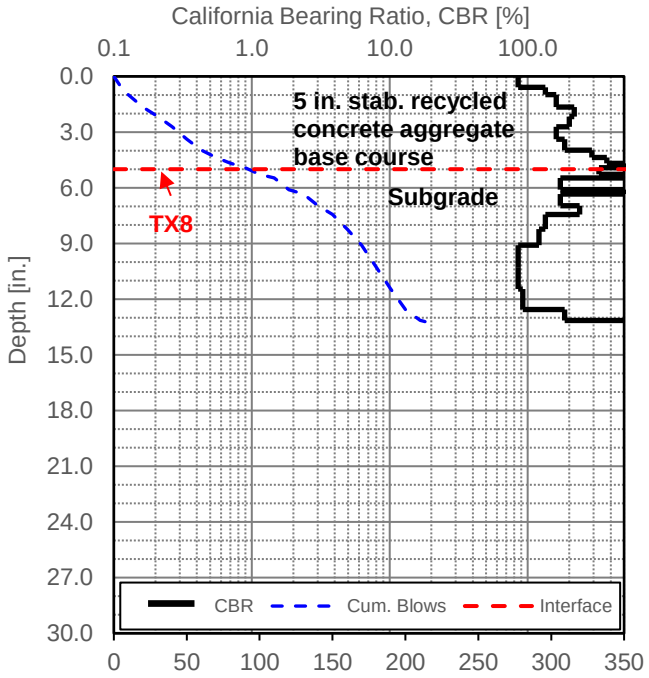
Step	N	$\sigma_{cyclic\_surface}$ [psi]	$M_{r\text{-}Base}$[psi]	$M_{r\text{-}Base\ (pred.)}$ [psi]	$\sigma_{cyclic\_Int.}$ [psi]	$M_{r\text{-}Subgrade}$ [psi]	$M_{r\text{-}Subgrade\ (pred.)}$ [psi]	Modulus Ratio
Conditioning	500	14.38	---	---	---	---	---	---
1	100	5.21	38,954	39,099	3.91	46,471	45,748	0.84
2	100	9.32	38,394	38,951	7.12	50,203	51,399	0.76
3	100	14.38	40,680	39,541	11.04	54,844	56,526	0.74
4	100	19.30	42,169	40,439	15.14	63,599	60,909	0.66
5	100	28.75	38,541	42,543	23.24	68,819	68,127	0.56
6	100	38.66	47,150	45,003	30.43	72,515	73,630	0.65

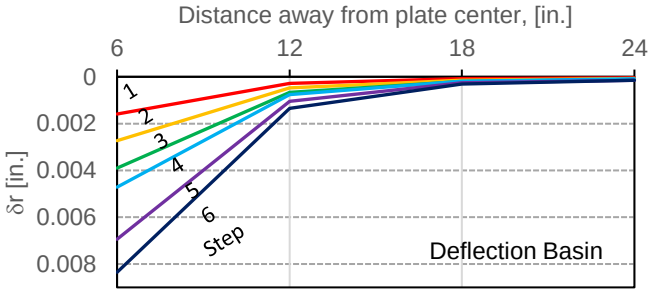


Model: AASHTO (2015)

$$M_r = k_1^* P_a \left(\frac{\theta}{P_a}\right)^{k_2^*} \left(1 + \frac{\tau_{oct}}{P_a}\right)^{k_3^*}$$

Parameter	Value	P-Value
$k^*_{1\ (Base)}$	2480.2	2.10E-06
$k^*_{2\ (Base)}$	-0.078	6.85E-01
$k^*_{3\ (Base)}$	1.017	4.51E-01
Adj. R^2	0.441	
Std. Error [psi]	1789	
$k^*_{1\ (Subgrade)}$	3315.2	1.21E-06
$k^*_{2\ (Subgrade)}$	0.178	1.59E-01
$k^*_{3\ (Subgrade)}$	0.400	5.43E-01
Adj. R^2	0.969	
Std. Error [psi]	1834	





In-situ Resilient Modulus [Mr]: Cyclic Loading, Layered Analysis, Stress-Dependent	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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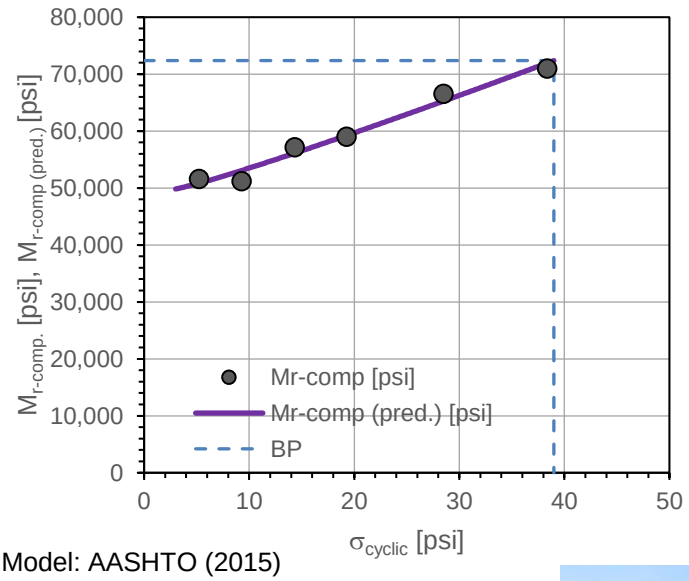
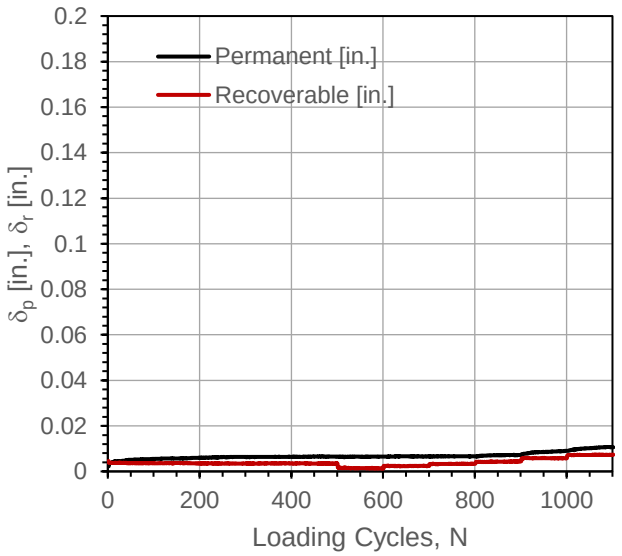
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent (5, 10, 15, 20, 30, 40)				
Date:	12/12/2017	Time:	2:03:23 PM	Test ID	**TX8_PT10**
Tested By	DW, PV, HG	Location:	UPRR - Los Angeles	Sta.	NA
Latitude,N:	34.057663	Longitude,W:	118.222310	Elev. (ft):	285
Comments:	5.0 in. recycled concrete aggregate stabilized with TX8 geogrid over subgrade.				

Step	N	σ_{cyclic} [psi]	$M_{r\text{-}comp}$ [psi]	$M_{r\text{-}comp\ (pred.)}$ [psi]	δ_p [in.]	$\Delta\delta_p$ [in.]	d =$\Delta\log(\delta_p)/\Delta\log(N)$	Near-linear Elastic
Conditioning	500	14.35	---	---	0.0065	---	0.129	---
1	100	5.25	51,624	50,863	0.0065	0.0000	0.046	Y
2	100	9.28	51,211	53,084	0.0066	0.0001	0.138	Y
3	100	14.35	57,180	56,136	0.0066	0.0001	0.059	Y
4	100	19.28	59,030	59,241	0.0072	0.0007	0.453	Y
5	100	28.52	66,558	65,280	0.0090	0.0026	0.430	Y
6	100	38.37	71,010	71,954	0.0107	0.0043	0.623	Y





Model: AASHTO (2015)

$$M_{r-comp} = k_1^* P_a \left(\frac{\theta}{P_a}\right)^{k_2^*} \left(1 + \frac{\tau_{oct}}{P_a}\right)^{k_3^*}$$

Parameter	Value	P-Value
k^*_1	3,208.8	1.30E-07
k^*_2	-0.018	8.20E-01
k^*_3	1.322	7.18E-02
Adj. R^2	0.970	
Std. Error [psi]	1,383	

$M_{r\text{-}comp\ (pred.)\text{-}BP}$ [psi]	72,384
$\sigma_{cyclic\text{-}BP}$ [psi]	39.0

In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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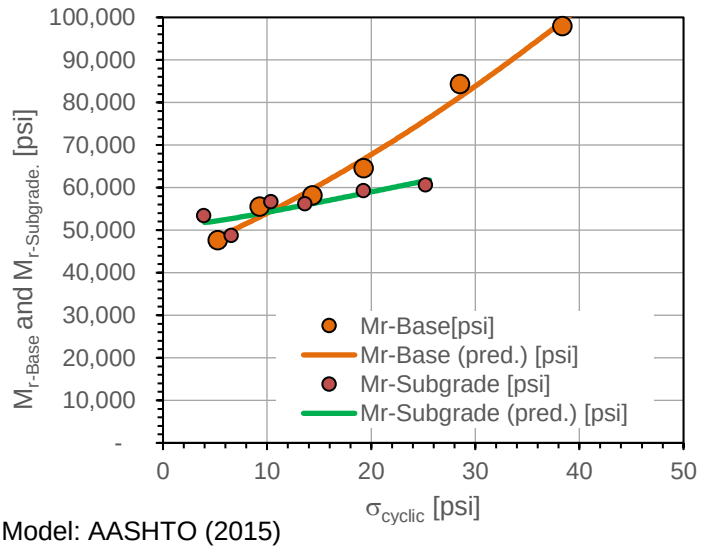
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, Composite, Stress-Dependent (5, 10, 15, 20, 30, 40)				
Date:	12/12/2017	Time:	2:03:23 PM	Test ID	**TX8_PT10**
Tested By	DW, PV, HG	Location:	UPRR - Los Angeles	Sta.	NA
Latitude, N:	34.057663	Longitude, W:	118.222310	Elev. (ft):	285
Comments:	5.0 in. recycled concrete aggregate stabilized with TX8 geogrid over subgrade.				

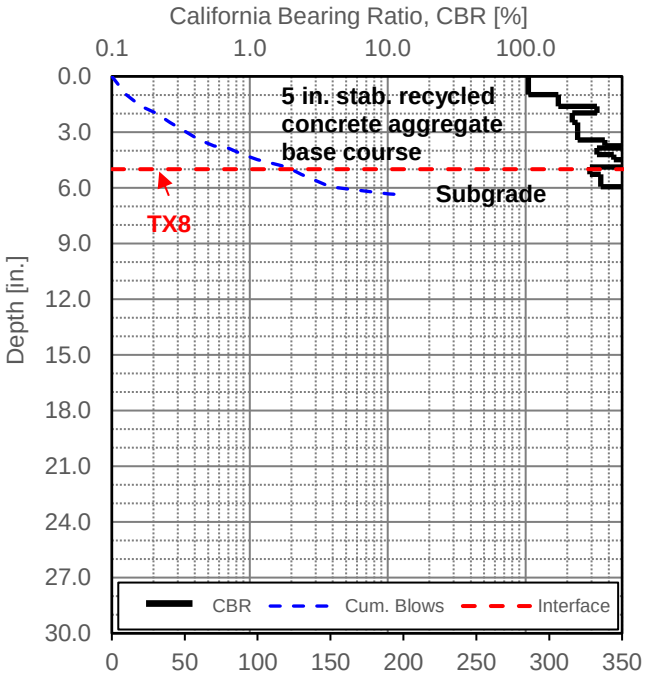
Step	N	$\sigma_{cyclic\_surface}$ [psi]	$M_{r\text{-}Base}$[psi]	$M_{r\text{-}Base\ (pred.)}$ [psi]	$\sigma_{cyclic\_Int.}$ [psi]	$M_{r\text{-}Subgrade}$ [psi]	$M_{r\text{-}Subgrade\ (pred.)}$ [psi]	Modulus Ratio
Conditioning	500	14.35	---	---	---	---	---	---
1	100	5.25	47,686	48,401	3.89	53,435	51,763	0.89
2	100	9.28	55,579	53,091	6.56	48,813	52,713	1.14
3	100	14.35	58,220	59,679	10.36	56,687	54,359	1.03
4	100	19.28	64,575	66,685	13.61	56,249	55,881	1.15
5	100	28.52	84,404	81,316	19.25	59,294	58,625	1.42
6	100	38.37	97,973	99,085	25.21	60,679	61,584	1.61

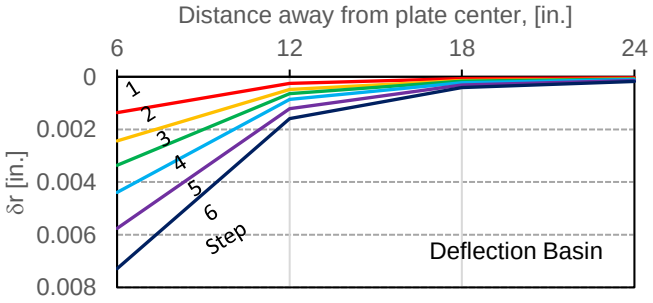


Model: AASHTO (2015)

$$M_r = k_1^* P_a \left(\frac{\theta}{P_a}\right)^{k_2^*} \left(1 + \frac{\tau_{oct}}{P_a}\right)^{k_3^*}$$

Parameter	Value	P-Value
$k^*_{1\ (Base)}$	2840.4	4.67E-07
$k^*_{2\ (Base)}$	-0.022	8.49E-01
$k^*_{3\ (Base)}$	2.632	3.65E-02
Adj. R^2	0.984	
Std. Error [psi]	2438	
$k^*_{1\ (Subgrade)}$	3297.1	9.21E-06
$k^*_{2\ (Subgrade)}$	-0.027	8.86E-01
$k^*_{3\ (Subgrade)}$	0.851	5.17E-01
Adj. R^2	0.661	
Std. Error [psi]	2168	





In-situ Resilient Modulus [Mr]: Cyclic Loading, Layered Analysis, Stress-Dependent	
Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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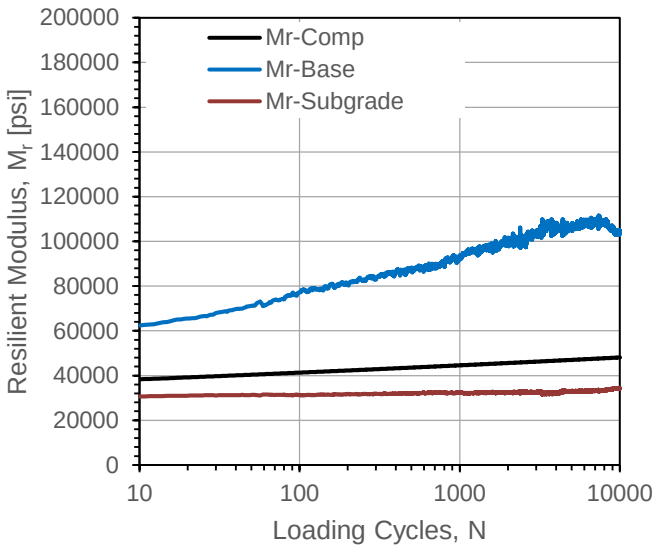
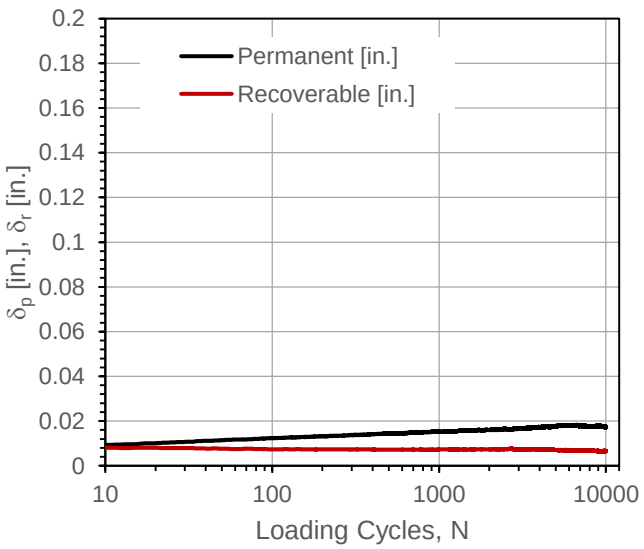
Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, 10k cycles, Composite and 2-Layered Analysis				
Date:	12/12/2017	Time:	4:57:18 PM	Test ID	**TX8_PT11_10k**
Tested By	DW, HG, PV	Location:	URRR - Los Angeles	Sta.	NA
Latitude, N:	34.057685	Longitude, W:	118.222307	Elev. (ft):	298
Comments:	5.0 in. recycled concrete aggregate stabilized with TX8 geogrid over subgrade. Cyclic testing using 0.15s load time and 0.45s dwell time.				





σ_{cyclic} = **24.2** psi

Permanent Deformation Prediction Parameters

C =	**0.0087**	
d =	**0.0809**	
R^2 =	**0.9317**	
N^* =	**1,251**	Cycles
δ_p at N^* =	**0.0155**	in.
Adj. δ_p at N^* =	**0.0068**	in.

Model: $\delta_p = CN^d$

δ_p = permanent deformation

C = plastic deformation after first cycle

d = scaling component

N = Number of loading cycles

N^* = Number of loading cycles at $\Delta\delta_p$ = 1E-06 in./cycles

Adj. δ_p at $N^* = \delta_p$ at $N^* - C$

N_x = Number of loading cycles to achieve δ_p of x in.

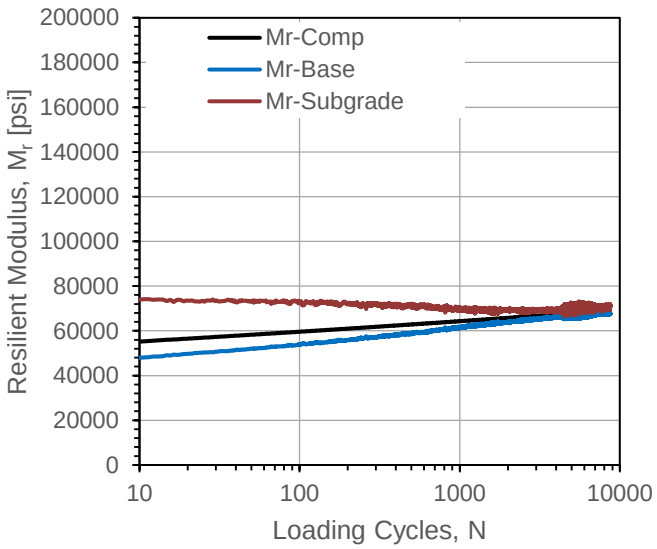
$N_{0.05}$ =	**>>10,000,000**	Cycles
$N_{0.1}$ =	**>>10,000,000**	Cycles
$N_{0.15}$ =	**>>10,000,000**	Cycles
$N_{0.20}$ =	**>>10,000,000**	Cycles
$N_{0.25}$ =	**>>10,000,000**	Cycles
$N_{0.30}$ =	**>>10,000,000**	Cycles
$N_{0.40}$ =	**>>40,000,000**	Cycles
$N_{0.50}$ =	**>>40,000,000**	Cycles

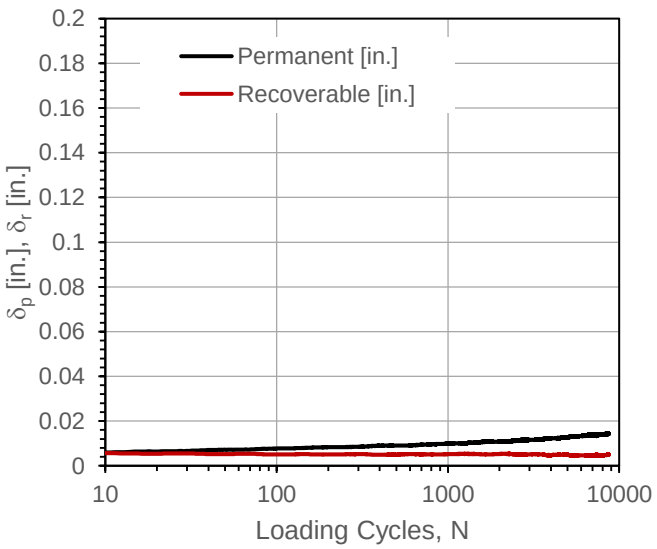
In-situ Resilient Modulus [9,950-10,000 cycles]

$M_{r\text{-comp}}$ =	**48,086**	psi
$M_{r\text{-Base}}$ =	**104,166**	psi
$M_{r\text{-Subgrade}}$ =	**34,300**	psi
δ_p at end of 10,000 cycles =	**0.017**	in.

Automated Plate Load Test [APLT]

Test:	In-situ Resilient Modulus [Mr]: Cyclic Loading, 10k cycles, Composite and 2-Layered Analysis				
Date:	12/13/2017	Time:	9:28:52 AM	Test ID	**CTRL_PT12_10k**
Tested By	DW, HG, PV	Location:	URRR - Los Angeles	Sta.	NA
Latitude, N:	34.057653	Longitude, W:	118.222338	Elev. (ft):	307
Comments:	11.5 in. recycled concrete aggregate over subgrade.				
Cyclic testing using 0.15s load time and 0.45s dwell time.					





σ_{cyclic} = **24.3** psi

Permanent Deformation Prediction Parameters

C =	**0.0036**	
d =	**0.1499**	
R^2 =	**0.9714**	
N^* =	**1,621**	Cycles
δ_p at N^* =	**0.0108**	in.
Adj. δ_p at N^* =	**0.0072**	in.

Model: $\delta_p = CN^d$

δ_p = permanent deformation

C = plastic deformation after first cycle

d = scaling component

N = Number of loading cycles

N^* = Number of loading cycles at $\Delta\delta_p$ = 1E-06 in./cycles

Adj. δ_p at $N^* = \delta_p$ at $N^* - C$

N_x = Number of loading cycles to achieve δ_p of x in.

$N_{0.05}$ =	**>>10,000,000**	Cycles
$N_{0.1}$ =	**>>10,000,000**	Cycles
$N_{0.15}$ =	**>>10,000,000**	Cycles
$N_{0.20}$ =	**>>10,000,000**	Cycles
$N_{0.25}$ =	**>>10,000,000**	Cycles
$N_{0.30}$ =	**>>10,000,000**	Cycles
$N_{0.40}$ =	**>>40,000,000**	Cycles
$N_{0.50}$ =	**>>40,000,000**	Cycles

In-situ Resilient Modulus [9,950-10,000 cycles]

$M_{r\text{-comp}}$ =	**69,065**	psi
$M_{r\text{-Base}}$ =	**67,795**	psi
$M_{r\text{-Subgrade}}$ =	**71,114**	psi
δ_p at end of 10,000 cycles =	**0.014**	in.

Automated Plate Load Test [APLT]

Test:	In-Situ Strain Modulus Test [DIN 18134, 2001]: Two Loading Cycles.				
Date:	12/13/2017	Time:	11:33:16 AM	Test ID	**CTRL_PT13**
Tested By	PV, HG, JV	Location:	UPRR - Los Angeles	Sta.	NA
Latitude:	34.05773	Longitude:	118.22242	Elev. (ft):	296
Comments:	11.5 in. recycled concrete aggregate over subgrade.				

Cycle	Stage	Load Step	Target Applied Force (N)	Target Applied Stress (MPa)	Actual Applied Stress (MPa)	Deformation (mm)			Average Def. (mm)
						Sensor 1	Sensor 2	Sensor 3	
0	Seating	0	755	0.01	*0.01*	0.0611	0.0595	0.0432	**0.0546**
Zero load and deformation sensors after applying the seating stress.									
1	Seating	0	0	0.00	*0.000*	*0.0000*	*0.0000*	*0.0000*	**0.0000**
1	Load	1	6087	0.08	*0.087*	*0.2440*	*0.2520*	*0.1673*	**0.2211**
1	Load	2	12175	0.17	*0.170*	*0.3987*	*0.3924*	*0.2873*	**0.3594**
1	Load	3	18237	0.25	*0.253*	*0.5257*	*0.5299*	*0.3866*	**0.4807**
1	Load	4	24299	0.33	*0.339*	*0.6427*	*0.6522*	*0.4680*	**0.5876**
1	Load	5	30386	0.42	*0.419*	*0.7557*	*0.7548*	*0.5454*	**0.6853**
1	Load	6	36473	0.50	*0.496*	*0.8464*	*0.8522*	*0.6119*	**0.7702**
1	Unload	7	18262	0.25	*0.242*	*0.7793*	*0.7831*	*0.5468*	**0.7031**
1	Unload	8	9106	0.12	*0.123*	*0.7066*	*0.7107*	*0.4888*	**0.6354**
1	Unload	9	0	0.00	*0.000*	*0.4645*	*0.4787*	*0.3098*	**0.4177**
2	Load	10	6087	0.08	*0.087*	*0.5788*	*0.5790*	*0.3986*	**0.5188**
2	Load	11	12175	0.17	*0.170*	*0.6704*	*0.6610*	*0.4595*	**0.5970**
2	Load	12	18237	0.25	*0.253*	*0.7336*	*0.7378*	*0.5188*	**0.6634**
2	Load	13	24299	0.33	*0.336*	*0.7977*	*0.8020*	*0.5705*	**0.7234**
2	Load	14	30386	0.42	*0.419*	*0.8472*	*0.8586*	*0.6181*	**0.7746**
2	Load	15	36473	0.50	*0.502*	*0.8879*	*0.8989*	*0.6510*	**0.8126**
2	Unload	16	18262	0.25	*0.225*	*0.5921*	*0.5894*	*0.3982*	**0.5266**
3	Unload	17	9106	0.12	*0.000*	*0.4887*	*0.4844*	*0.3122*	**0.4284**

Plate radius, *r*: *152.4* mm

$$E_v = 1.5 \cdot r \times \frac{1}{a_1 + a_2 \sigma_{o\max}}$$

Polynomial Fit Parameters

First Cycle

a_2	-1.456
a_1	2.221
R^2	0.997

Second Cycle

a_2	-0.761
a_1	1.163
R^2	0.999

Calculations

First Cycle

E_{v1}	153	**MPa**
E_{v1}	22,135	**psi**

Second Cycle

E_{v2}	291	**MPa**
E_{v2}	42,225	**psi**

E_{v2} / E_{v1} 1.91

In-situ Strain Modulus (E_{v1} and E_{v2})

Project Name: UPRR - 1041 Richmond St.
Project ID: TIC-00030
Location: Los Angeles, CA

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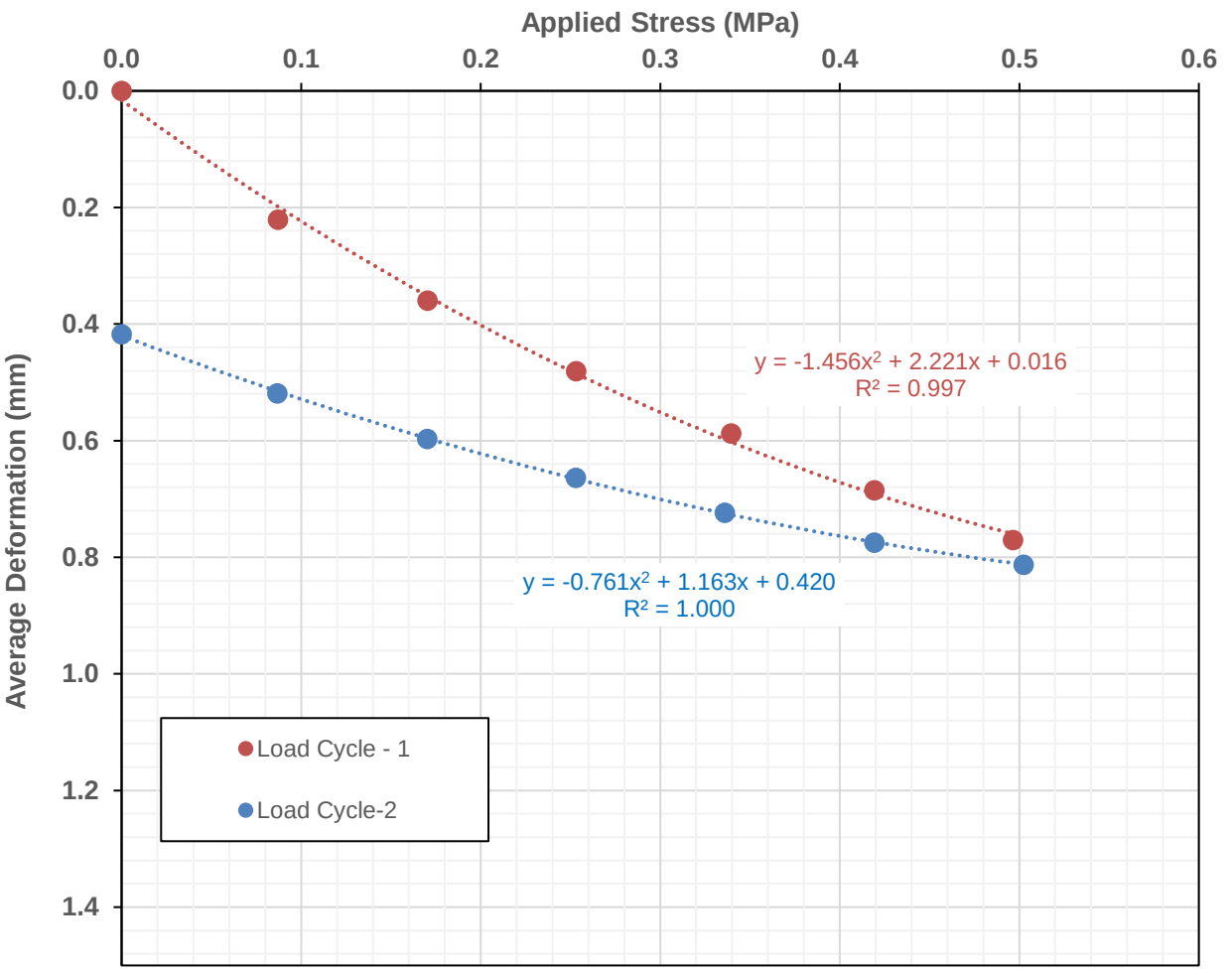
Applied Stress (MPa)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Average Deformation (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
y = -1.456x² + 2.221x + 0.016
R² = 0.997
y = -0.761x² + 1.163x + 0.420
R² = 1.000
Load Cycle - 1
Load Cycle-2

Automated Plate Load Test [APLT]

Test:	In-Situ Strain Modulus Test [DIN 18134, 2001]: Two Loading Cycles.				
Date:	12/13/2017	Time:	12:10:14 PM	Test ID	**TX8_PT14**
Tested By	PV, HG, JV	Location:	UPRR - Los Angeles	Sta.	NA
Latitude:	34.05775	Longitude:	-118.22238	Elev. (ft):	301
Comments:	5.0 in. recycled concrete aggregate stabilized with TX8 over subgrade.				

Cycle	Stage	Load Step	Target Applied Force (N)	Target Applied Stress (MPa)	Actual Applied Stress (MPa)	Deformation (mm)			Average Def. (mm)
						Sensor 1	Sensor 2	Sensor 3	
0	Seating	0	755	0.01	*0.01*	0.1038	0.0852	0.1267	**0.1052**
Zero load and deformation sensors after applying the seating stress.									
1	Seating	0	0	0.00	*0.000*	*0.0000*	*0.0000*	*0.0000*	**0.0000**
1	Load	1	6087	0.08	*0.089*	*0.3126*	*0.2496*	*0.3296*	**0.2973**
1	Load	2	12175	0.17	*0.172*	*0.4766*	*0.3977*	*0.4942*	**0.4562**
1	Load	3	18237	0.25	*0.255*	*0.6240*	*0.5124*	*0.5911*	**0.5759**
1	Load	4	24299	0.33	*0.339*	*0.7301*	*0.6259*	*0.7090*	**0.6883**
1	Load	5	30386	0.42	*0.432*	*0.8445*	*0.7316*	*0.7894*	**0.7885**
1	Load	6	36473	0.50	*0.504*	*0.9405*	*0.8124*	*0.8793*	**0.8774**
1	Unload	7	18262	0.25	*0.255*	*0.8666*	*0.7398*	*0.8060*	**0.8041**
1	Unload	8	9106	0.12	*0.127*	*0.7890*	*0.6596*	*0.7247*	**0.7245**
1	Unload	9	0	0.00	*0.000*	*0.5154*	*0.3706*	*0.4603*	**0.4487**
2	Load	10	6087	0.08	*0.089*	*0.6625*	*0.5333*	*0.6280*	**0.6079**
2	Load	11	12175	0.17	*0.172*	*0.7487*	*0.6191*	*0.7171*	**0.6949**
2	Load	12	18237	0.25	*0.254*	*0.8116*	*0.6753*	*0.7673*	**0.7514**
2	Load	13	24299	0.33	*0.337*	*0.8761*	*0.7275*	*0.8143*	**0.8060**
2	Load	14	30386	0.42	*0.421*	*0.9378*	*0.7701*	*0.8575*	**0.8551**
2	Load	15	36473	0.50	*0.504*	*0.9957*	*0.8240*	*0.9107*	**0.9101**
2	Unload	16	18262	0.25	*0.045*	*0.5475*	*0.4006*	*0.5101*	**0.4861**
3	Unload	17	9106	0.12	*0.000*	*0.4786*	*0.3307*	*0.4425*	**0.4173**

Plate radius, *r*: *152.4* mm

$$E_v = 1.5 \cdot r \times \frac{1}{a_1 + a_2 \sigma_{o\,max}}$$

Polynomial Fit Parameters

First Cycle

a_2	-2.224
a_1	2.758
R^2	0.992

Second Cycle

a_2	-1.177
a_1	1.446
R^2	0.981

Calculations

First Cycle

E_{v1}	140	**MPa**
E_{v1}	20,239	**psi**

Second Cycle

E_{v2}	268	**MPa**
E_{v2}	38,880	**psi**

E_{v2} / E_{v1} 1.92

In-situ Strain Modulus (E_{v1} and E_{v2})

Project Name: UPRR - 1041 Richmond St.
Project ID: TIC-00030
Location: Los Angeles, CA

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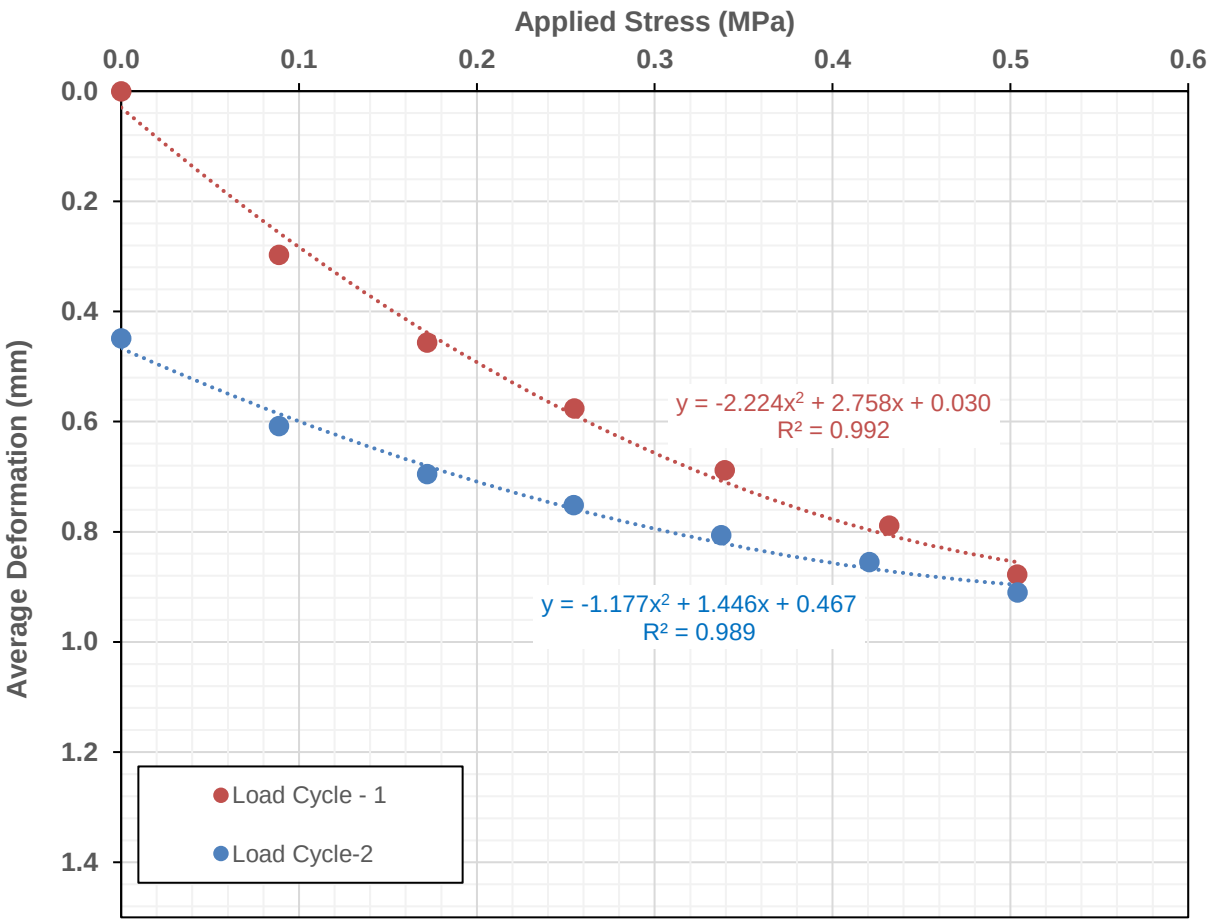
Applied Stress (MPa)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Average Deformation (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
y = -2.224x² + 2.758x + 0.030
R² = 0.992
y = -1.177x² + 1.446x + 0.467
R² = 0.989
Load Cycle - 1
Load Cycle-2

Automated Plate Load Test [APLT]

Test:	In-Situ Static Plate Load Test: Two Loading Cycles.				
Date:	12/13/2017	Time:	1:28:47 PM	Test ID	TX8_PT15
Tested By	DW, HG, PV	Location:	UPRR - Los Angeles	Sta.	NA
Latitude:	34.05781	Longitude:	118.22243	Elev. (ft):	294
Comments:	5 in. recycled concrete aggregate stabilized with TX8 geogrid over subgrade.				

Cycle	Stage	Load Step	Target Applied Load (lbs)	Target Applied Stress (psi)	Actual Applied Stress (psi)	Deformation (in.) Sensor 1	Sensor 2	Sensor 3	Average Def. (in.)
0	Seating	0	707	1	1.38	0.0041	0.0058	0.0079	0.0059
Zero load and deformation sensors after applying the seating stress.									
1	Seating	0	0	0	0.00	0.0000	0.0000	0.0000	0.0000
1	Load	1	1767	2.5	2.49	0.0059	0.0063	0.0088	0.0070
1	Load	2	3534	5	4.99	0.0109	0.0118	0.0138	0.0122
1	Load	3	5301	7.5	7.59	0.0141	0.0157	0.0185	0.0161
1	Load	4	7069	10	10.02	0.0178	0.0193	0.0224	0.0198
1	Load	5	8836	12.5	12.45	0.0212	0.0231	0.0263	0.0235
1	Load	6	10603	15	14.55	0.0244	0.0258	0.0295	0.0266
1	Unload	7	7069	10	9.55	0.0222	0.0237	0.0272	0.0244
1	Unload	8	3534	5	4.64	0.0194	0.0216	0.0244	0.0218
1	Unload	9	1767	2.5	2.48	0.0179	0.0187	0.0219	0.0195
2	Load	10	3534	5	4.99	0.0190	0.0207	0.0241	0.0213
2	Load	11	7069	10	9.98	0.0218	0.0238	0.0278	0.0245
2	Load	12	10603	15	14.66	0.0245	0.0274	0.0315	0.0278
2	Unload	13	1767	2.5	2.12	0.0172	0.0194	0.0229	0.0198
2	Unload	14	0	0	0.00	0.0154	0.0162	0.0194	0.0170

Plate Diameter:	30.0	in.
Shape factor:	2.67	
Material Type:	B	A = Cohesive, B = Granular, C = Intermediate
Poisson's ratio:	0.35	
Design Stress: (assumed)	10.0	psi
Target Deformation:	0.05	in.

AASHTO T222 Method
PCA Design Criteria

k_{u1} (pci) @ design stress: **395**
k_u (pci) @ δ = 0.05 in.: **NA***
**0.05 in. deformation not achieved*

Modulus at target deformation

Stress @ δ = 0.05 in.(psi): **NA***
**0.05 in. deformation not achieved*

E_1 (psi)	NA
k'_u (pci)	NA
k_u (pci)	NA

Modulus at target/design applied stress

First Loading Cycle

δ_1 (in.)	0.0198
E_1 (psi)	13,873
k'_{u1} (pci)	505
k_{u1} (pci)	395

Second Loading Cycle

δ_2 (in.)	0.0066
E_2 (psi)	31,683
k'_{u2} (pci)	1,520
k_{u2} (pci)	903
E_2 / E_1 or k_2 / k_1 Ratio	2.3

Plate Bending Correction for

$$k'_u \geq 100 \text{ and } 1{,}000 \text{ pci}$$

$$k_u = -39.9178 + 5.5076\,[k'_u]^{0.7019}$$

In-situ Modulus of Subgrade Reaction (k) and Elastic Modulus

Project Name: UPRR - 1041 Richmond St.
Project ID: TIC-00030
Location: Los Angeles, CA

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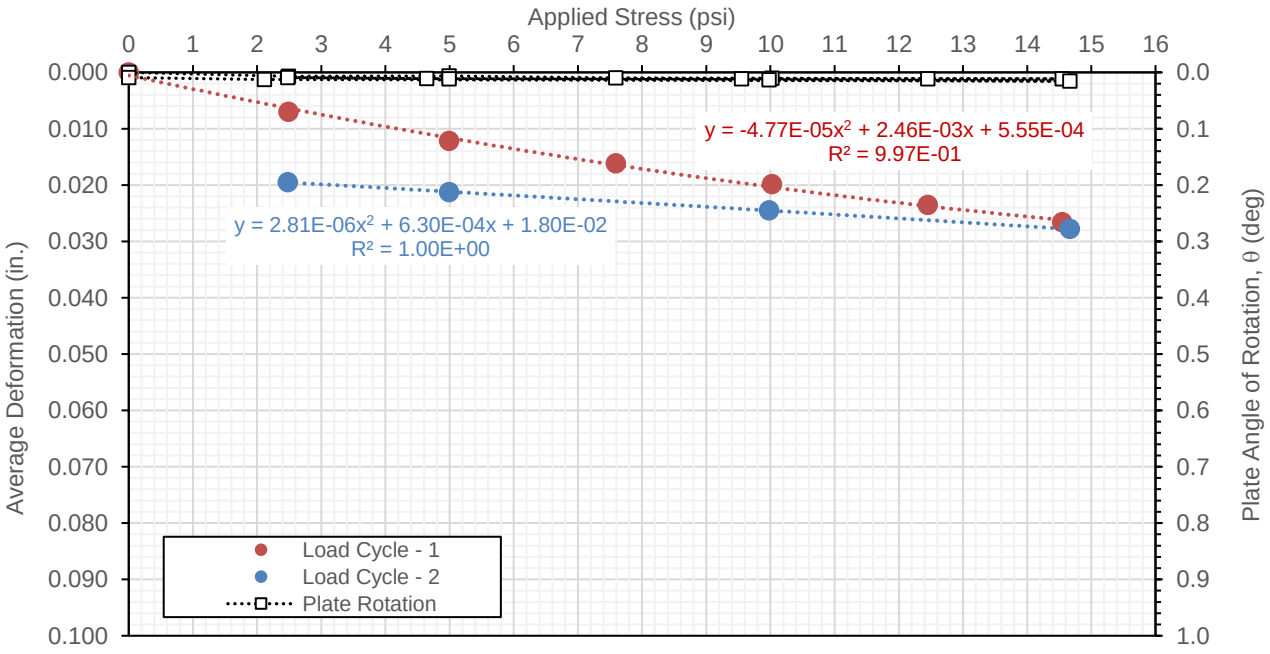
Polynomial Fit Parameters

First Cycle		*Second Cycle*			
a_1	-4.77E-05	a_1	2.81E-06	θ_{max} (deg)	0.0156
a_2	2.46E-03	a_2	6.30E-04		
R^2	1.00	R^2	1.00		

NOTES:
1. Test performed per AASHTO T222/ASTM D1196.
2. k-value determined using:
   (a) calculated stress at 0.05 in. plate deformation (d) for first loading cycle, per PCA design guidelines, and
   (b) for a defined target stress and calculating corresponding plate deformations using polynomial fit parameters.



Automated Plate Load Test [APLT]

Test:	In-Situ Static Plate Load Test: Two Loading Cycles.				
Date:	12/13/2017	Time:	2:21:52 PM	Test ID	CTRL_PT16
Tested By	DW, HG, PV	Location:	UPRR - Los Angeles	Sta.	NA
Latitude:	34.05782	Longitude:	118.22248	Elev. (ft):	318
Comments:	11.5 in. recycled concrete aggregate over subgrade.				

Cycle	Stage	Load Step	Target Applied Load (lbs)	Target Applied Stress (psi)	Actual Applied Stress (psi)	Deformation (in.) Sensor 1	Sensor 2	Sensor 3	Average Def. (in.)
0	Seating	0	707	1	1.42	0.0058	0.0059	0.0180	0.0099
Zero load and deformation sensors after applying the seating stress.									
1	Seating	0	0	0	0.00	0.0000	0.0000	0.0000	0.0000
1	Load	1	1767	2.5	2.49	0.0088	0.0065	0.0178	0.0110
1	Load	2	3534	5	5.08	0.0132	0.0116	0.0322	0.0190
1	Load	3	5301	7.5	7.67	0.0166	0.0170	0.0437	0.0258
1	Load	4	7069	10	10.12	0.0205	0.0223	0.0532	0.0320
1	Load	5	8836	12.5	12.51	0.0223	0.0259	0.0621	0.0368
1	Load	6	10603	15	14.30	0.0254	0.0298	0.0700	0.0417
1	Unload	7	7069	10	9.32	0.0229	0.0281	0.0686	0.0399
1	Unload	8	3534	5	4.50	0.0201	0.0260	0.0652	0.0371
1	Unload	9	1767	2.5	2.50	0.0164	0.0243	0.0635	0.0347
2	Load	10	3534	5	4.99	0.0178	0.0254	0.0646	0.0359
2	Load	11	7069	10	10.00	0.0214	0.0273	0.0677	0.0388
2	Load	12	10603	15	14.11	0.0254	0.0317	0.0731	0.0434
2	Unload	13	1767	2.5	2.00	0.0170	0.0249	0.0654	0.0358
2	Unload	14	0	0	0.00	0.0112	0.0225	0.0610	0.0315

Plate Diameter:	30.0	in.
Shape factor:	2.67	
Material Type:	B	A = Cohesive, B = Granular, C = Intermediate
Poisson's ratio:	0.35	
Design Stress: (assumed)	10.0	psi
Target Deformation:	0.05	in.

AASHTO T222 Method
PCA Design Criteria

k_{u1} (pci) @ design stress: **275**
k_u (pci) @ δ = 0.05 in.: **NA***
**0.05 in. deformation not achieved*

Modulus at target deformation

Stress @ δ = 0.05 in.(psi): NA*
**0.05 in. deformation not achieved*

E_1 (psi)	NA
k'_u (pci)	NA
k_u (pci)	NA

Modulus at target/design applied stress

First Loading Cycle

δ_1 (in.)	0.0313
E_1 (psi)	9,667
k'_{u1} (pci)	319
k_{u1} (pci)	275

Second Loading Cycle

δ_2 (in.)	0.0045
E_2 (psi)	41,965
k'_{u2} (pci)	2,235
k_{u2} (pci)	1,196
E_2 / E_1 or k_2 / k_1 Ratio	4.3

Plate Bending Correction for

$$k'_u \geq 100 \text{ and } 1{,}000 \text{ pci}$$

$$k_u = -39.9178 + 5.5076\,[k'_u]^{0.7019}$$

In-situ Modulus of Subgrade Reaction (k) and Elastic Modulus

Project Name: UPRR - 1041 Richmond St.
Project ID: TIC-00030
Location: Los Angeles, CA

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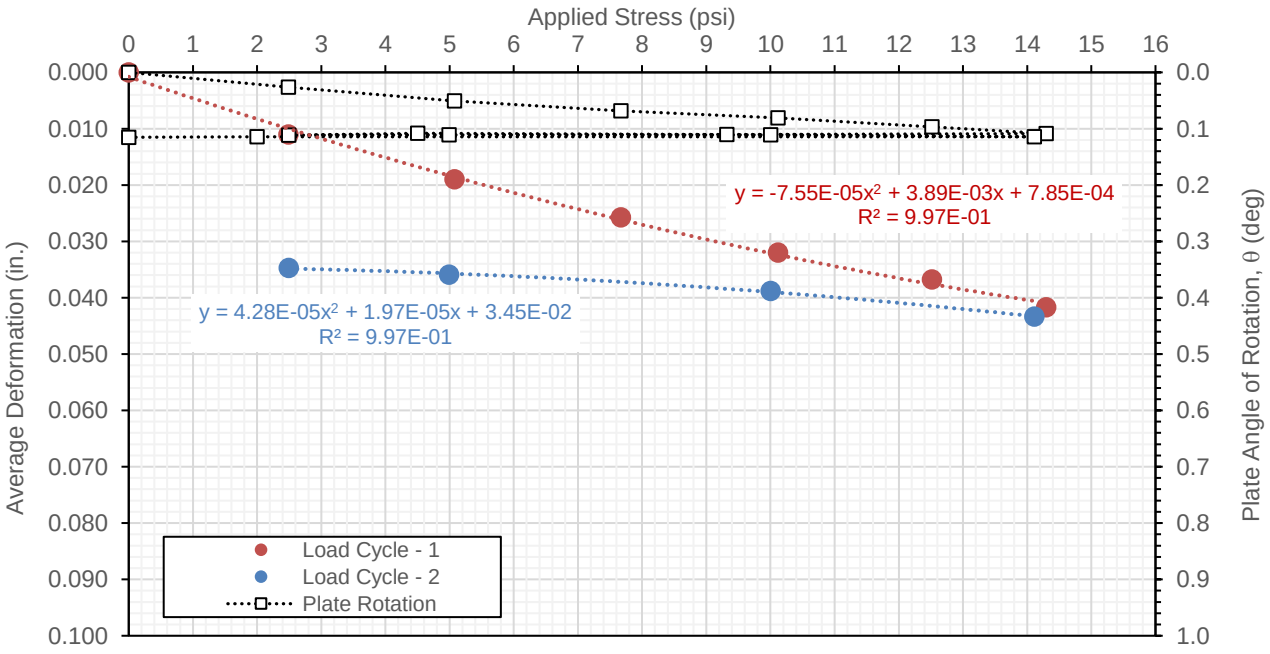
Polynomial Fit Parameters

First Cycle		*Second Cycle*			
a_1	-7.55E-05	a_1	4.28E-05	θ_{max} (deg)	0.1152
a_2	3.89E-03	a_2	1.97E-05		
R^2	1.00	R^2	1.00		

NOTES:
1. Test performed per AASHTO T222/ASTM D1196.
2. k-value determined using:
   (a) calculated stress at 0.05 in. plate deformation (d) for first loading cycle, per PCA design guidelines, and
   (b) for a defined target stress and calculating corresponding plate deformations using polynomial fit parameters.



Date of Test	12/12/2017	Test ID	CTRL_Pt1	Operator	PV, HG	ASTM	D6951
Latitude	34.05758		Longitude	118.222310		Elevation (ft)	297
Location	UPRR - Los Angeles		Station	NA			
Comments	11.5 in. thick recycled concrete aggregate base over subgrade.						

Parameter	DPI (mm/blow)	CBR (%)	E_{CBR}, Elastic Modulus (ksi) (non stress-dependent)	$S_{u\text{-}CBR}$, Bearing Capacity (psf)
Avg. Top Layer [0-11.5 in.]	3.6	70.6	38.9	9,226
Avg. Bottom Layer [11.5 to 23.5 in.]	2.4	111.9	52.3	12,531
Ratio of Avg.0-11.5 in./11.5 to 23.5 in.	1.5	0.6	0.7	0.7
Stdev Top Layer [0-11.5 in.]	1.4	26.6	20.8	4,827
Stdev. Bottom Layer [11.5-23.5 in.]	0.9	46.9	30.0	7,033

NOTES:

Subgrade is classified as non-CL

[1]$CBR = 292/DPI^{1.12}$

[1]$CBR = 1/(0.017019DPI)^2$

for CL soils with CBR < 10

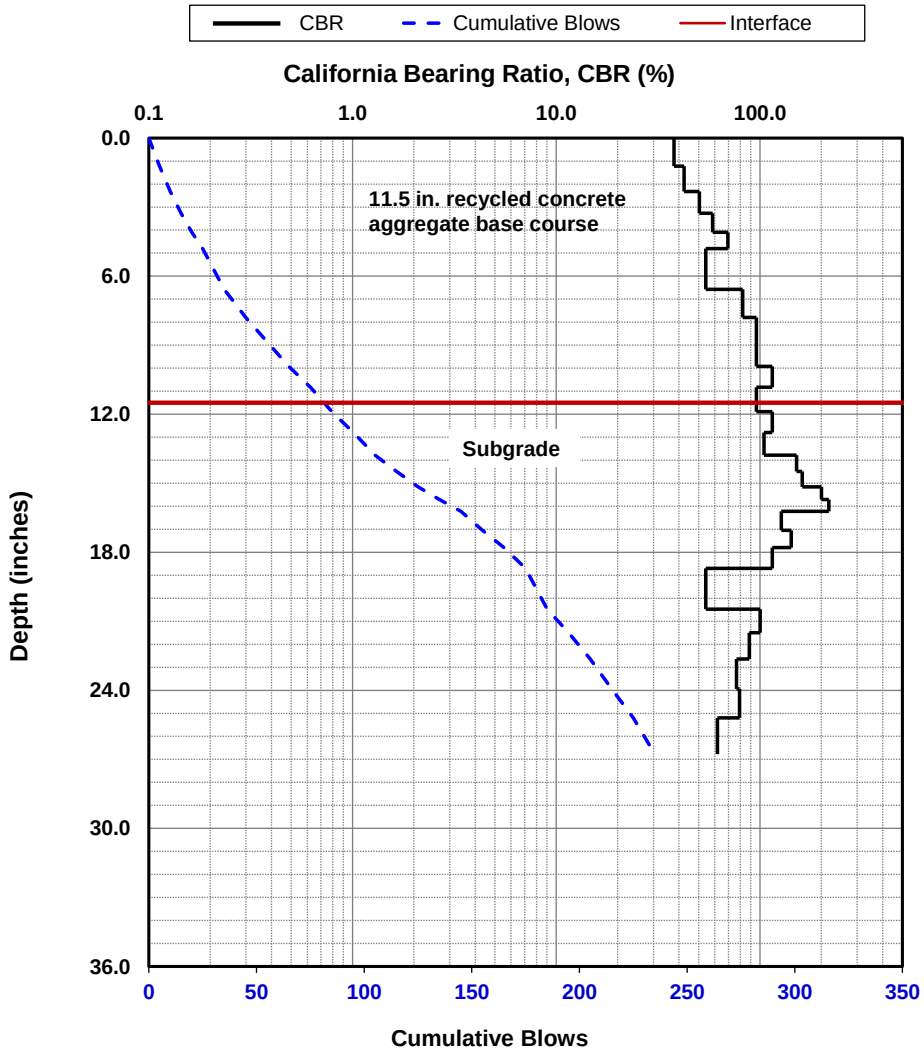
[2]$E\ (ksi) = (17.6\ CBR^{0.64}) \times 0.1450377$

[3]$S_u\ (psf) = (3.794 \times CBR^{0.664}) \times 144$

[1] ASTM D6951-03

[2]Powell et al. (1986)

[3]Portland Cement Assoc. (1955)



Dynamic Cone Penetrometer (DCP) Test Results

Project Name: UPRR - 1041 Richmond St.

Project ID: TIC-00030

Location: Los Angeles, CA

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Date of Test	12/12/2017	Test ID	CTRL_Pt2	Operator	PV, HG	ASTM	D6951
Latitude	34.05764		Longitude	118.222340		Elevation (ft)	282
Location	UPRR - Los Angeles		Station	NA			
Comments	11.5 in. thick recycled concrete aggregate base over subgrade.						

Parameter	DPI (mm/blow)	CBR (%)	E_{CBR}, Elastic Modulus (ksi) (non stress-dependent)	$S_{u\text{-}CBR}$, Bearing Capacity (psf)
Avg. Top Layer [0-11.5 in.]	1.7	157.9	65.2	15,746
Avg. Bottom Layer [11.5 to 23.5 in.]	2.0	132.9	58.3	14,041
Ratio of Avg.0-11.5 in./11.5 to 23.5 in.	0.9	1.2	1.1	1.1
Stdev Top Layer [0-11.5 in.]	0.6	85.6	44.0	10,487
Stdev. Bottom Layer [11.5-23.5 in.]	1.0	84.0	43.5	10,353

NOTES:

Subgrade is assuming as non-CL

[1]$CBR = 292/DPI^{1.12}$

[1]$CBR = 1/(0.017019DPI)^2$

for CL soils with CBR < 10

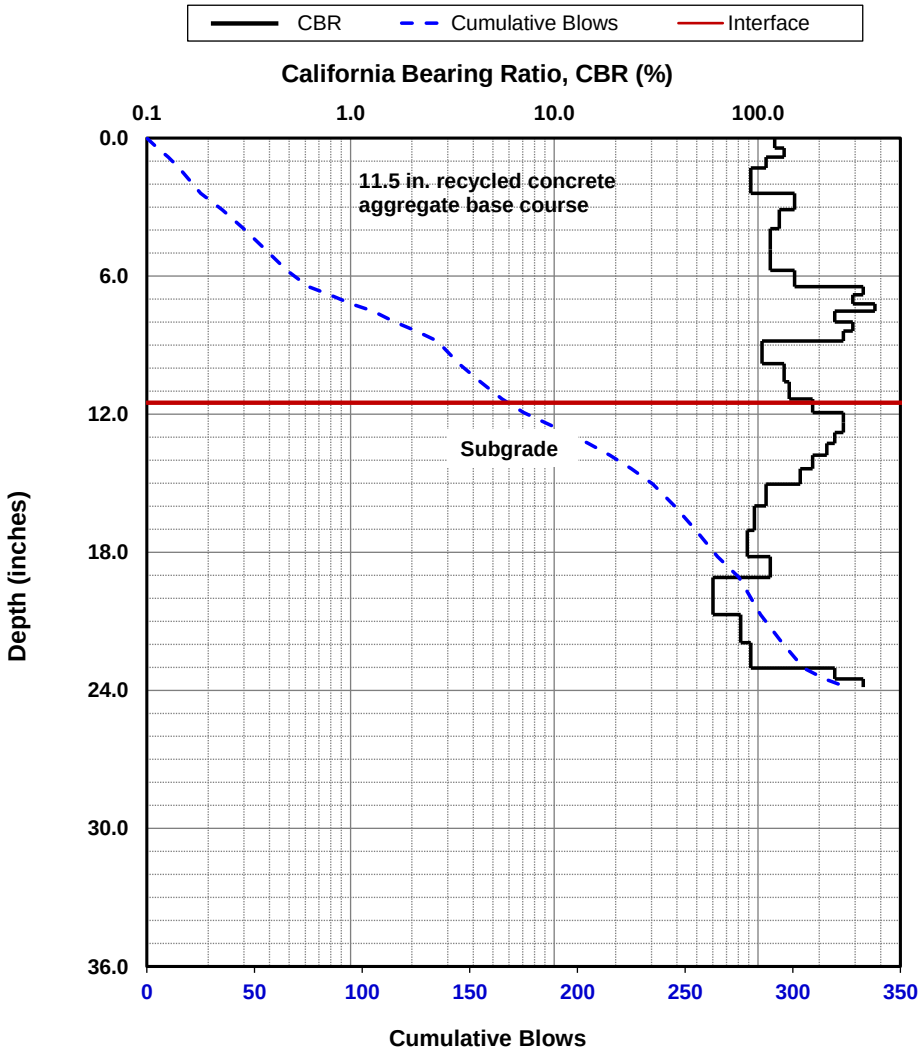
[2]$E\ (ksi) = (17.6\ CBR^{0.64}) \times 0.1450377$

[3]$S_u\ (psf) = (3.794 \times CBR^{0.664}) \times 144$

[1] ASTM D6951-03

[2]Powell et al. (1986)

[3]Portland Cement Assoc. (1955)



Dynamic Cone Penetrometer (DCP) Test Results

Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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Date of Test	12/12/2017	Test ID	CTRL_Pt3	Operator	PV, HG	ASTM	D6951
Latitude	34.05767		Longitude	118.222400		Elevation (ft)	283
Location	UPRR - Los Angeles		Station	NA			
Comments	11.5 in. thick recycled concrete aggregate base over subgrade.						

Parameter	DPI (mm/blow)	CBR (%)	E_{CBR}, Elastic Modulus (ksi) (non stress-dependent)	$S_{u\text{-}CBR}$, Bearing Capacity (psf)
Avg. Top Layer [0-11.5 in.]	1.3	219.8	80.5	19,611
Avg. Bottom Layer [11.5 to 23.5 in.]	Refusal	Refusal	Refusal	Refusal
Ratio of Avg.0-11.5 in./11.5 to 23.5 in.	NA	NA	NA	NA
Stdev Top Layer [0-11.5 in.]	1.4	172.9	69.0	16,723
Stdev. Bottom Layer [11.5-23.5 in.]	Refusal	Refusal	Refusal	Refusal

NOTES:

Subgrade is assuming as non-CL

[1]$CBR = 292/DPI^{1.12}$

[1]$CBR = 1/(0.017019DPI)^2$

for CL soils with CBR < 10

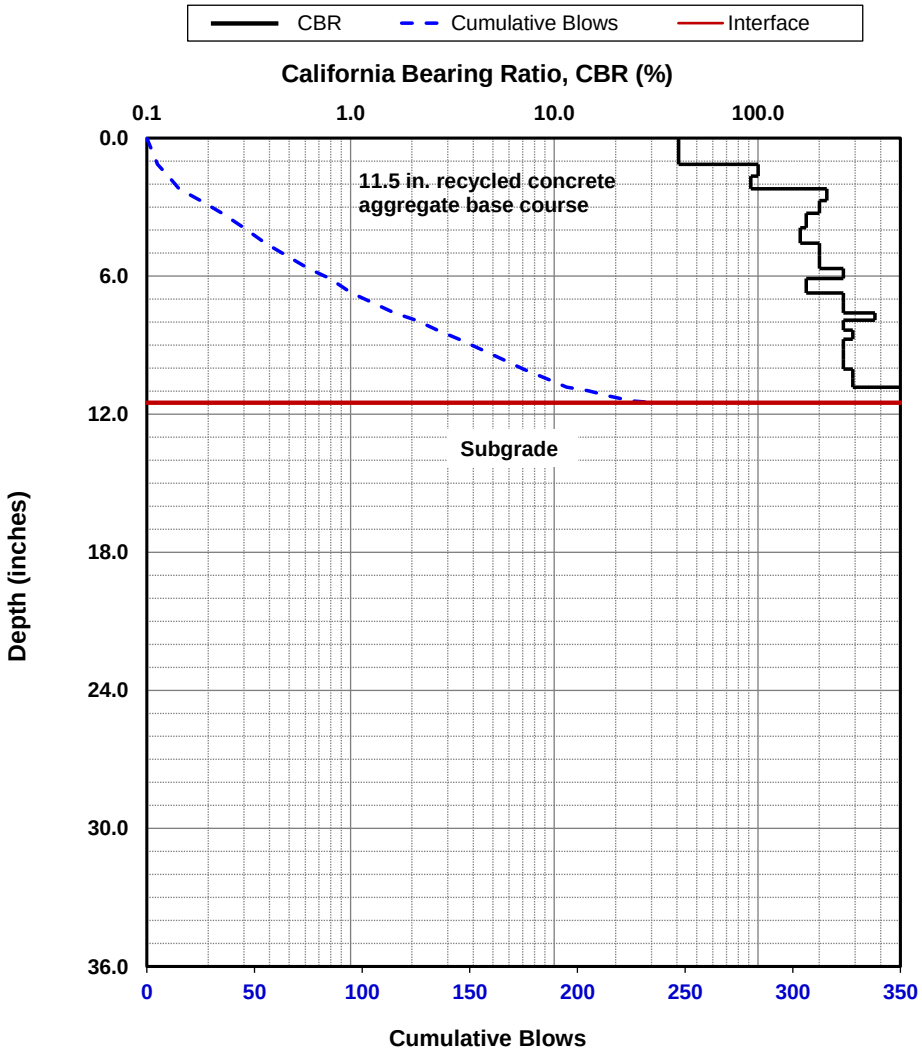
[2]$E\ (ksi) = (17.6\ CBR^{0.64}) \times 0.1450377$

[3]$S_u\ (psf) = (3.794 \times CBR^{0.664}) \times 144$

[1] ASTM D6951-03

[2]Powell et al. (1986)

[3]Portland Cement Assoc. (1955)



Dynamic Cone Penetrometer (DCP) Test Results

Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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Date of Test	12/12/2017	Test ID	CTRL_PT4	Operator	PV, HG	ASTM	D6951
Latitude	34.05773		Longitude	118.222460		Elevation (ft)	285
Location	UPRR - Los Angeles		Station	NA			
Comments	11.5 in. thick recycled concrete aggregate base over subgrade.						

Parameter	DPI (mm/blow)	CBR (%)	E_{CBR}, Elastic Modulus (ksi) (non stress-dependent)	$S_{u\text{-}CBR}$, Bearing Capacity (psf)
Avg. Top Layer [0-11.5 in.]	1.3	212.7	78.8	19,188
Avg. Bottom Layer [11.5 to 23.5 in.]	Refusal	Refusal	Refusal	Refusal
Ratio of Avg.0-11.5 in./11.5 to 23.5 in.	NA	NA	NA	NA
Stdev Top Layer [0-11.5 in.]	0.9	228.4	82.5	20,123
Stdev. Bottom Layer [11.5-23.5 in.]	Refusal	Refusal	Refusal	Refusal

NOTES:

Subgrade is assuming as non-CL

[1]$CBR = 292/DPI^{1.12}$

[1]$CBR = 1/(0.017019DPI)^2$

for CL soils with CBR < 10

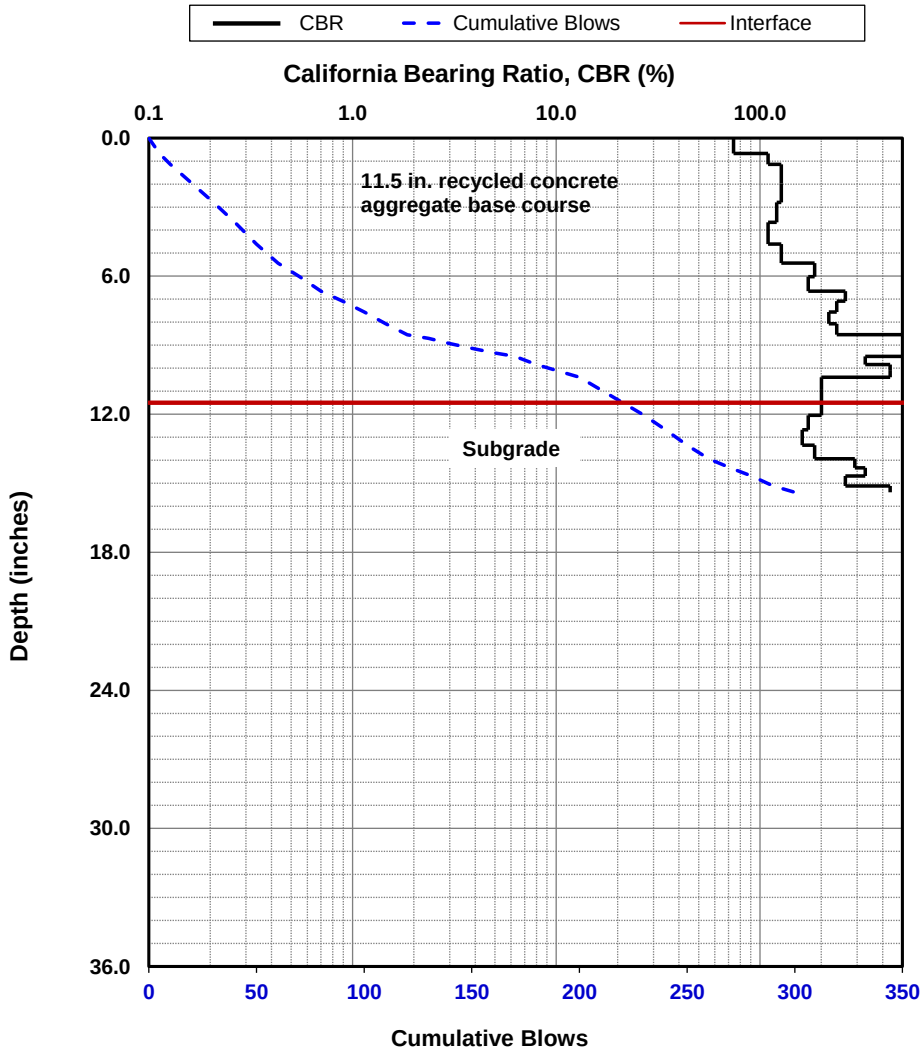
[2]$E\ (ksi) = (17.6\ CBR^{0.64}) \times 0.1450377$

[3]$S_u\ (psf) = (3.794 \times CBR^{0.664}) \times 144$

[1] ASTM D6951-03

[2]Powell et al. (1986)

[3]Portland Cement Assoc. (1955)



Dynamic Cone Penetrometer (DCP) Test Results

Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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Date of Test	12/12/2017	Test ID	CTRL_PT5	Operator	PV, HG	ASTM	D6951
Latitude	34.05780		Longitude	118.222500		Elevation (ft)	282
Location	UPRR - Los Angeles		Station	NA			
Comments	11.0 in. thick recycled concrete aggregate base over subgrade.						

Parameter	DPI (mm/blow)	CBR (%)	E_{CBR}, Elastic Modulus (ksi) (non stress-dependent)	$S_{u\text{-}CBR}$, Bearing Capacity (psf)
Avg. Top Layer [0-11 in.]	2.3	115.3	53.3	12,783
Avg. Bottom Layer [11 to 23 in.]	Refusal	Refusal	Refusal	Refusal
Ratio of Avg.0-11 in./11 to 23 in.	NA	NA	NA	NA
Stdev Top Layer [0-11 in.]	0.5	30.1	22.5	5,236
Stdev. Bottom Layer [11-23 in.]	Refusal	Refusal	Refusal	Refusal

NOTES:

Subgrade is assuming as non-CL

[1]$CBR = 292/DPI^{1.12}$

[1]$CBR = 1/(0.017019DPI)^2$

for CL soils with CBR < 10

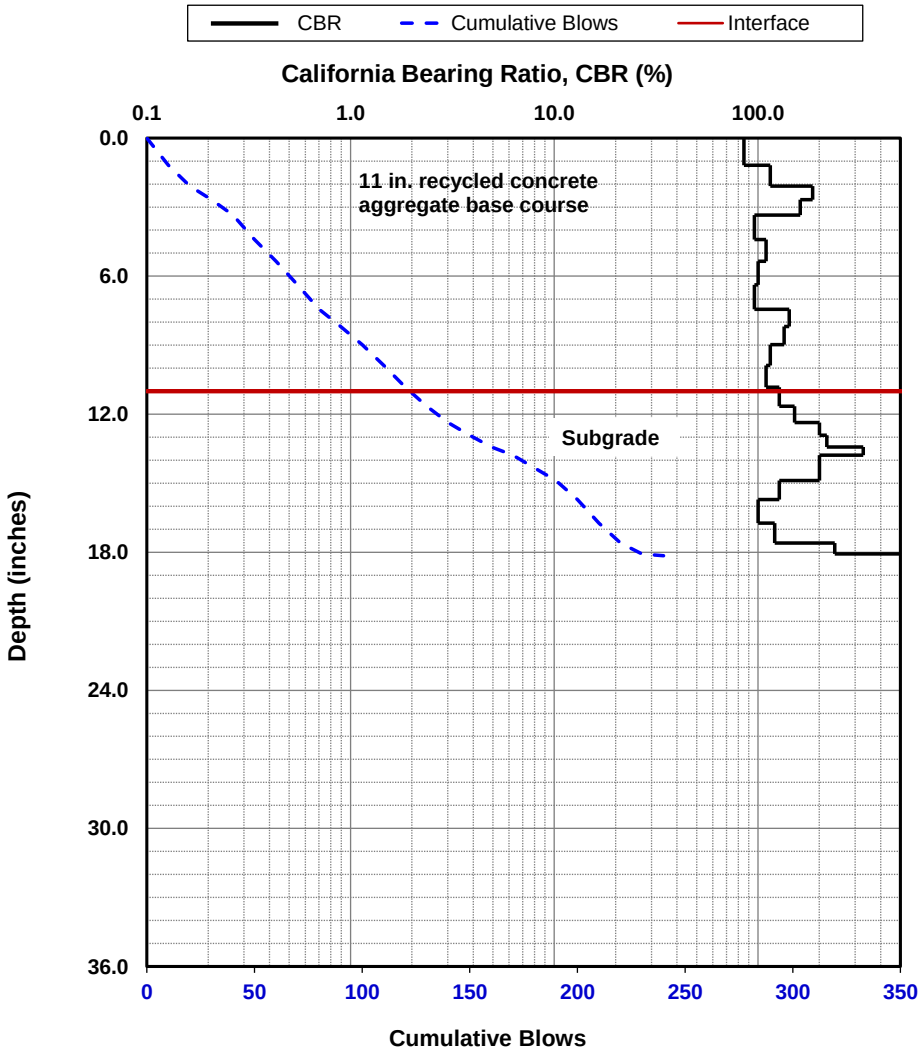
[2]$E\ (ksi) = (17.6\ CBR^{0.64}) \times 0.1450377$

[3]$S_u\ (psf) = (3.794 \times CBR^{0.664}) \times 144$

[1] ASTM D6951-03

[2]Powell et al. (1986)

[3]Portland Cement Assoc. (1955)



Dynamic Cone Penetrometer (DCP) Test Results

Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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Date of Test	12/12/2017	Test ID	TX_PT6	Operator	PV, HG	ASTM	D6951
Latitude	34.05784		Longitude	118.222470		Elevation (ft)	292
Location	UPRR - Los Angeles		Station	NA			
Comments	4.5 in. recycled concrete aggregate stabilized with TX8 geogrid over subgrade.						

Parameter	DPI (mm/blow)	CBR (%)	E_{CBR}, Elastic Modulus (ksi) (non stress-dependent)	$S_{u\text{-}CBR}$, Bearing Capacity (psf)
Avg. Top Layer [0-4.5 in.]	1.5	182.0	71.4	17,305
Avg. Bottom Layer [4.5 to 16.5 in.]	1.7	156.3	64.7	15,641
Ratio of Avg.0-4.5 in./4.5 to 16.5 in.	0.9	1.2	1.1	1.1
Stdev Top Layer [0-4.5 in.]	0.4	64.5	36.8	8,694
Stdev. Bottom Layer [4.5-16.5 in.]	0.4	40.4	27.2	6,373

NOTES:

Subgrade is classified as non-CL

[1]$CBR = 292/DPI^{1.12}$

[1]$CBR = 1/(0.017019DPI)^2$

for CL soils with CBR < 10

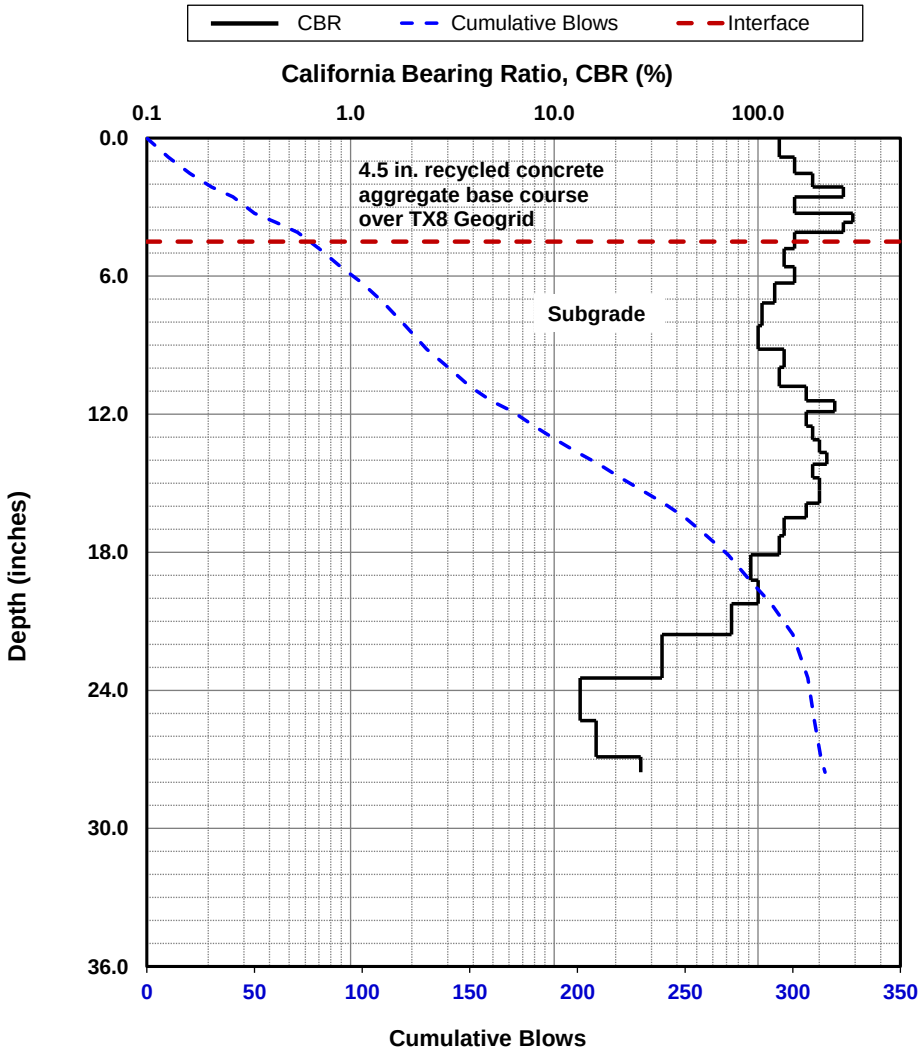
[2]$E\ (ksi) = (17.6\ CBR^{0.64}) \times 0.1450377$

[3]$S_u\ (psf) = (3.794 \times CBR^{0.664}) \times 144$

[1] ASTM D6951-03

[2]Powell et al. (1986)

[3]Portland Cement Assoc. (1955)



Dynamic Cone Penetrometer (DCP) Test Results

Project Name: UPRR - 1041 Richmond St.

Project ID: TIC-00030

Location: Los Angeles, CA

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Date of Test	12/12/2017	Test ID	TX_PT7	Operator	PV, HG	ASTM	D6951
Latitude	34.05780		Longitude	118.222420		Elevation (ft)	305
Location	UPRR - Los Angeles		Station	NA			
Comments	5 in. thick recycled concrete aggregate base stabilized with TX8 over subgrade.						

Parameter	DPI (mm/blow)	CBR (%)	E_{CBR}, Elastic Modulus (ksi) (non stress-dependent)	$S_{u\text{-}CBR}$, Bearing Capacity (psf)
Avg. Top Layer [0-5 in.]	1.8	149.8	63.0	15,208
Avg. Bottom Layer [5 to 17 in.]	Refusal	Refusal	Refusal	Refusal
Ratio of Avg.0-5 in./5 to 17 in.	NA	NA	NA	NA
Stdev Top Layer [0-5 in.]	0.7	229.4	82.8	20,179
Stdev. Bottom Layer [5-17 in.]	Refusal	Refusal	Refusal	Refusal

NOTES:

Subgrade is classified as non-CL

[1]$CBR = 292/DPI^{1.12}$

[1]$CBR = 1/(0.017019DPI)^2$

for CL soils with CBR < 10

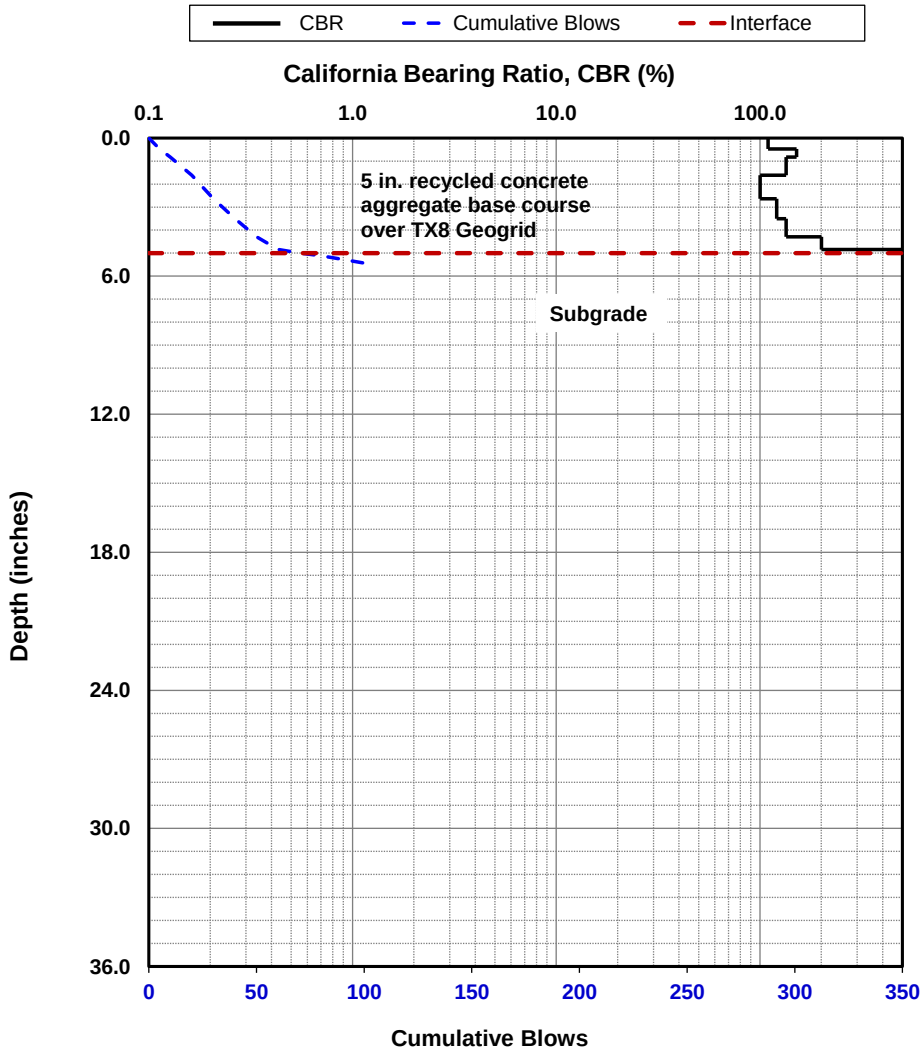
[2]$E\ (ksi) = (17.6\ CBR^{0.64}) \times 0.1450377$

[3]$S_u\ (psf) = (3.794 \times CBR^{0.664}) \times 144$

[1] ASTM D6951-03

[2]Powell et al. (1986)

[3]Portland Cement Assoc. (1955)



Dynamic Cone Penetrometer (DCP) Test Results

Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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Date of Test	12/12/2017	Test ID	TX_PT8	Operator	PV, HG	ASTM	D6951
Latitude	34.05773		Longitude	118.222370		Elevation (ft)	297
Location	UPRR - Los Angeles		Station	NA			
Comments	5.0 in. thick recycled concrete aggregate base stabilized with TX8 over subgrade.						

Parameter	DPI (mm/blow)	CBR (%)	E_{CBR}, Elastic Modulus (ksi) (non stress-dependent)	$S_{u\text{-}CBR}$, Bearing Capacity (psf)
Avg. Top Layer [0-5 in.]	0.9	311.9	100.7	24,744
Avg. Bottom Layer [5 to 17 in.]	Refusal	Refusal	Refusal	Refusal
Ratio of Avg.0-5 in./5 to 17 in.	NA	NA	NA	NA
Stdev Top Layer [0-5 in.]	0.5	434.5	124.5	30,840
Stdev. Bottom Layer [5-17 in.]	Refusal	Refusal	Refusal	Refusal

NOTES:

Subgrade is classified as non-CL

[1]$CBR = 292/DPI^{1.12}$

[1]$CBR = 1/(0.017019DPI)^2$

for CL soils with CBR < 10

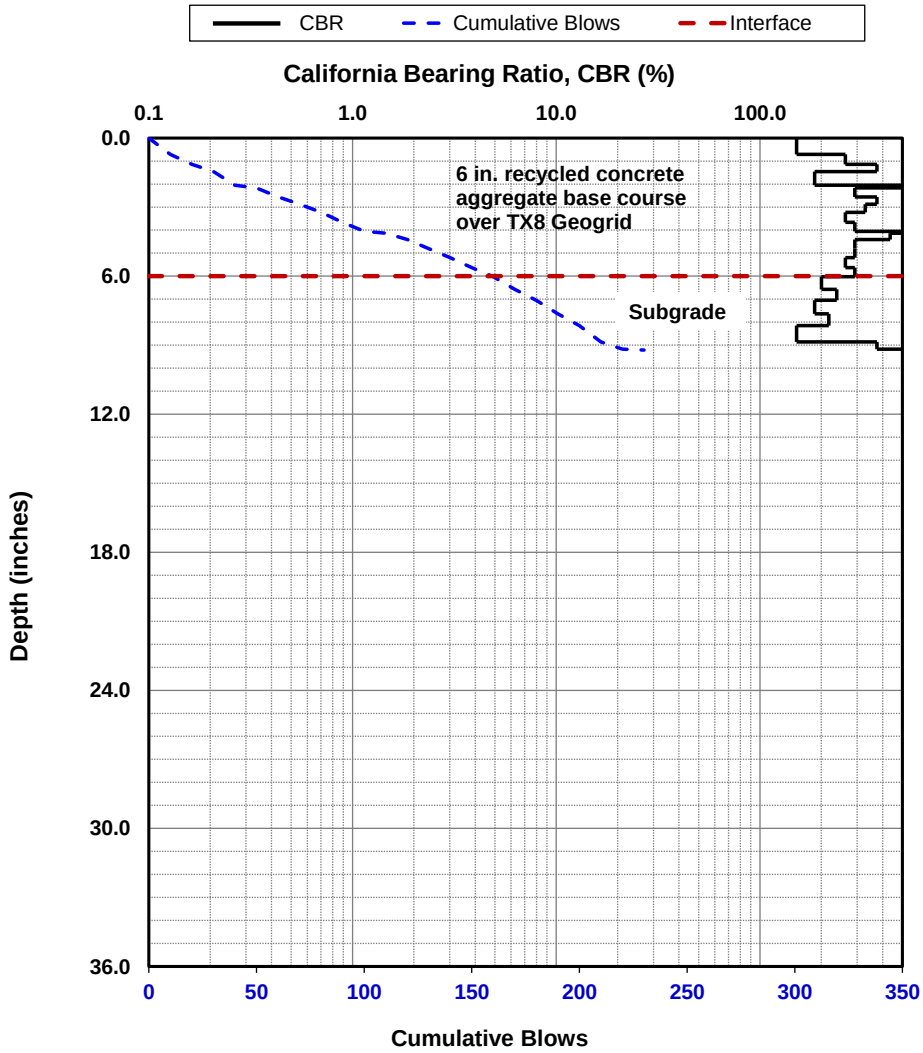
[2]$E\ (ksi) = (17.6\ CBR^{0.64}) \times 0.1450377$

[3]$S_u\ (psf) = (3.794 \times CBR^{0.664}) \times 144$

[1] ASTM D6951-03

[2]Powell et al. (1986)

[3]Portland Cement Assoc. (1955)



Dynamic Cone Penetrometer (DCP) Test Results

Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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Date of Test	12/12/2017	Test ID	TX_PT9	Operator	PV, HG	ASTM	D6951
Latitude	34.05769		Longitude	118.222330		Elevation (ft)	295
Location	UPRR - Los Angeles		Station	NA			
Comments	5.0 in. thick recycled concrete aggregate base stabilized with TX8 over subgrade.						

Parameter	DPI (mm/blow)	CBR (%)	E_{CBR}, Elastic Modulus (ksi) (non stress-dependent)	$S_{u\text{-}CBR}$, Bearing Capacity (psf)
Avg. Top Layer [0-5 in.]	1.4	202.1	76.3	18,551
Avg. Bottom Layer [5 to 17 in.]	Refusal	Refusal	Refusal	Refusal
Ratio of Avg.0-5 in./5 to 17 in.	NA	NA	NA	NA
Stdev Top Layer [0-5 in.]	0.8	130.3	57.6	13,860
Stdev. Bottom Layer [5-17 in.]	Refusal	Refusal	Refusal	Refusal

NOTES:

Subgrade is classified as non-CL

[1]$CBR = 292/DPI^{1.12}$

[1]$CBR = 1/(0.017019DPI)^2$

for CL soils with CBR < 10

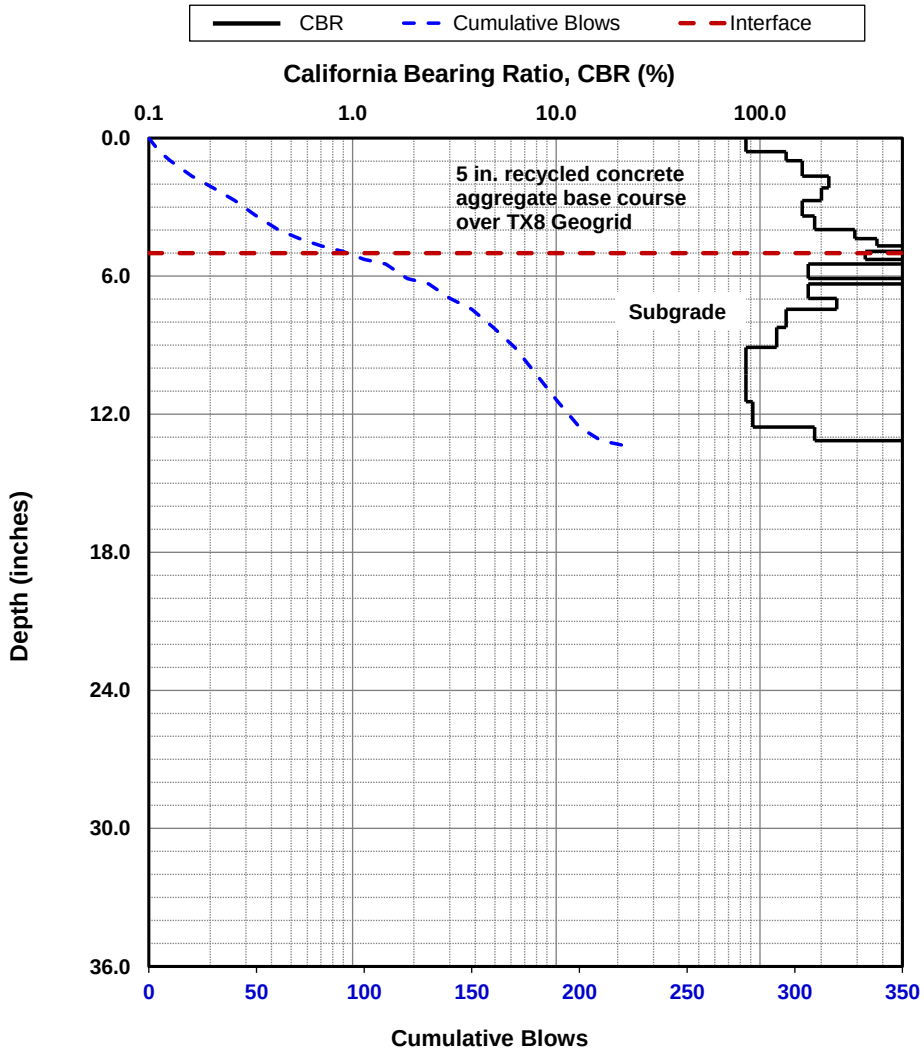
[2]$E\ (ksi) = (17.6\ CBR^{0.64}) \times 0.1450377$

[3]$S_u\ (psf) = (3.794 \times CBR^{0.664}) \times 144$

[1] ASTM D6951-03

[2]Powell et al. (1986)

[3]Portland Cement Assoc. (1955)



Dynamic Cone Penetrometer (DCP) Test Results

Project Name: UPRR - 1041 Richmond St.

Project ID: TIC-00030

Location: Los Angeles, CA

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Date of Test	12/12/2017	Test ID	TX_PT10	Operator	PV, HG	ASTM	D6951
Latitude	34.05766		Longitude	118.222310		Elevation (ft)	285
Location	UPRR - Los Angeles		Station	NA			
Comments	5.0 in. thick recycled concrete aggregate base stabilized with TX8 over subgrade.						

Parameter	DPI (mm/blow)	CBR (%)	E_{CBR}, Elastic Modulus (ksi) (non stress-dependent)	$S_{u\text{-}CBR}$, Bearing Capacity (psf)
Avg. Top Layer [0-5 in.]	1.0	281.5	94.3	23,114
Avg. Bottom Layer [5 to 17 in.]	Refusal	Refusal	Refusal	Refusal
Ratio of Avg.0-5 in./5 to 17 in.	NA	NA	NA	NA
Stdev Top Layer [0-5 in.]	0.7	283.4	94.7	23,220
Stdev. Bottom Layer [5-17 in.]	Refusal	Refusal	Refusal	Refusal

NOTES:

Subgrade is classified as non-CL

[1]$CBR = 292/DPI^{1.12}$

[1]$CBR = 1/(0.017019DPI)^2$

for CL soils with CBR < 10

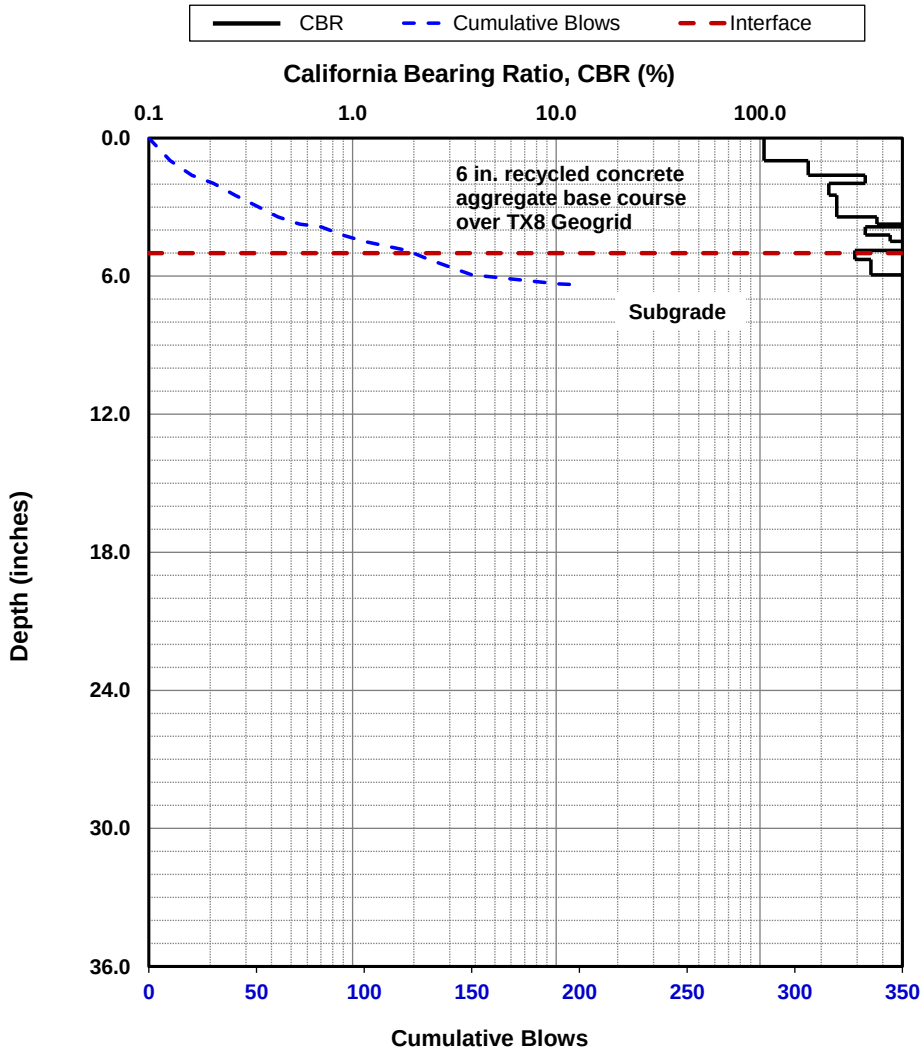
[2]$E\ (ksi) = (17.6\ CBR^{0.64}) \times 0.1450377$

[3]$S_u\ (psf) = (3.794 \times CBR^{0.664}) \times 144$

[1] ASTM D6951-03

[2]Powell et al. (1986)

[3]Portland Cement Assoc. (1955)



Dynamic Cone Penetrometer (DCP) Test Results

Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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Date of Test	12/12/2017	Test ID	TX_PT11	Operator	PV, HG	ASTM	D6951
Latitude	34.05769		Longitude	118.222307		Elevation (ft)	298
Location	UPRR - Los Angeles		Station	NA			
Comments	5.0 in. thick recycled concrete aggregate base stabilized with TX8 over subgrade.						

Parameter	DPI (mm/blow)	CBR (%)	E_{CBR}, Elastic Modulus (ksi) (non stress-dependent)	$S_{u\text{-}CBR}$, Bearing Capacity (psf)
Avg. Top Layer [0-5 in.]	1.4	194.8	74.5	18,103
Avg. Bottom Layer [5 to 17 in.]	Refusal	Refusal	Refusal	Refusal
Ratio of Avg.0-5 in./5 to 17 in.	NA	NA	NA	NA
Stdev Top Layer [0-5 in.]	0.9	343.3	107.1	26,374
Stdev. Bottom Layer [5-17 in.]	Refusal	Refusal	Refusal	Refusal

NOTES:

Subgrade is classified as non-CL

[1]$CBR = 292/DPI^{1.12}$

[1]$CBR = 1/(0.017019DPI)^2$

for CL soils with CBR < 10

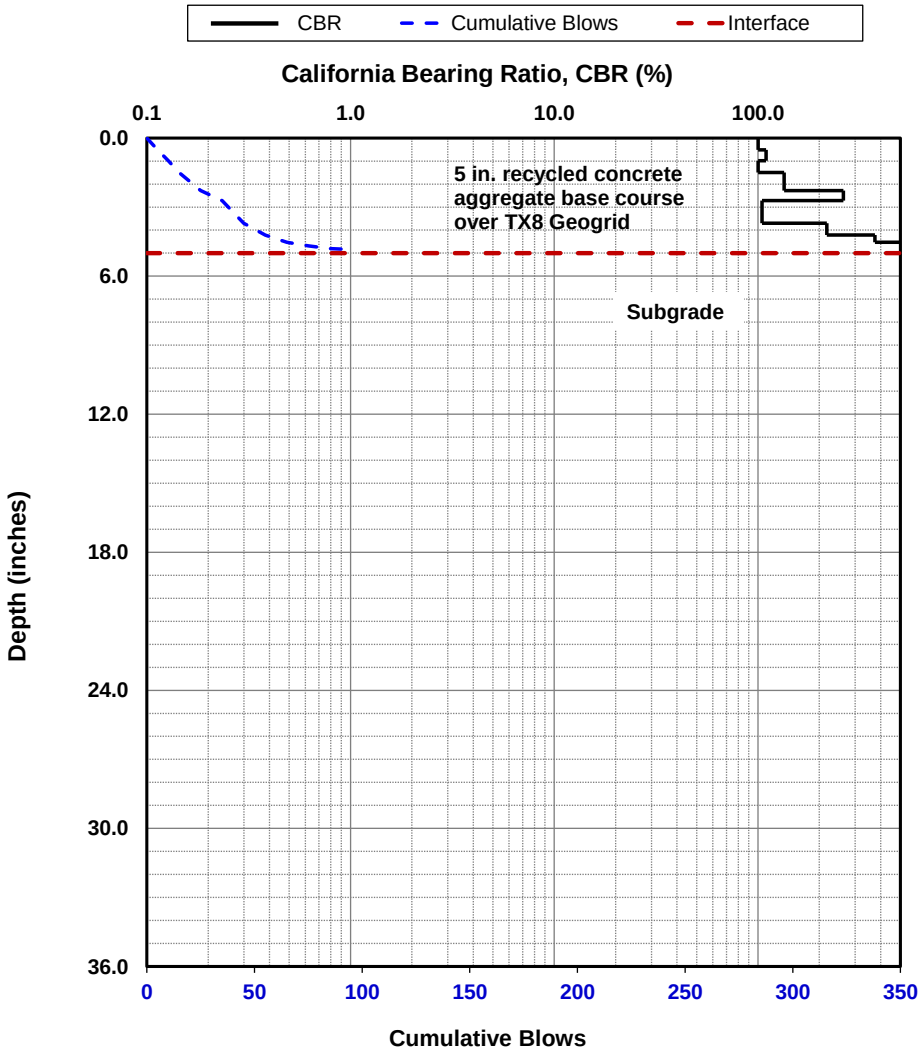
[2]$E\ (ksi) = (17.6\ CBR^{0.64}) \times 0.1450377$

[3]$S_u\ (psf) = (3.794 \times CBR^{0.664}) \times 144$

[1] ASTM D6951-03

[2]Powell et al. (1986)

[3]Portland Cement Assoc. (1955)



Dynamic Cone Penetrometer (DCP) Test Results

Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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Date of Test	12/13/2017	Test ID	CTRL_PT12	Operator	PV, HG	ASTM	D6951
Latitude	34.05765		Longitude	118.222338		Elevation (ft)	307
Location	UPRR - Los Angeles		Station	NA			
Comments	11.5 in. thick recycled concrete aggregate base over subgrade.						

Parameter	DPI (mm/blow)	CBR (%)	E_{CBR}, Elastic Modulus (ksi) (non stress-dependent)	$S_{u\text{-}CBR}$, Bearing Capacity (psf)
Avg. Top Layer [0-11.5 in.]	1.8	150.0	63.1	15,219
Avg. Bottom Layer [11.5 to 23.5 in.]	Refusal	Refusal	Refusal	Refusal
Ratio of Avg.0-11.5 in./11.5 to 23.5 in.	NA	NA	NA	NA
Stdev Top Layer [0-11.5 in.]	0.6	59.6	34.9	8,248
Stdev. Bottom Layer [11.5-23.5 in.]	Refusal	Refusal	Refusal	Refusal

NOTES:

Subgrade is classified as non-CL

[1]$CBR = 292/DPI^{1.12}$

[1]$CBR = 1/(0.017019DPI)^2$

for CL soils with CBR < 10

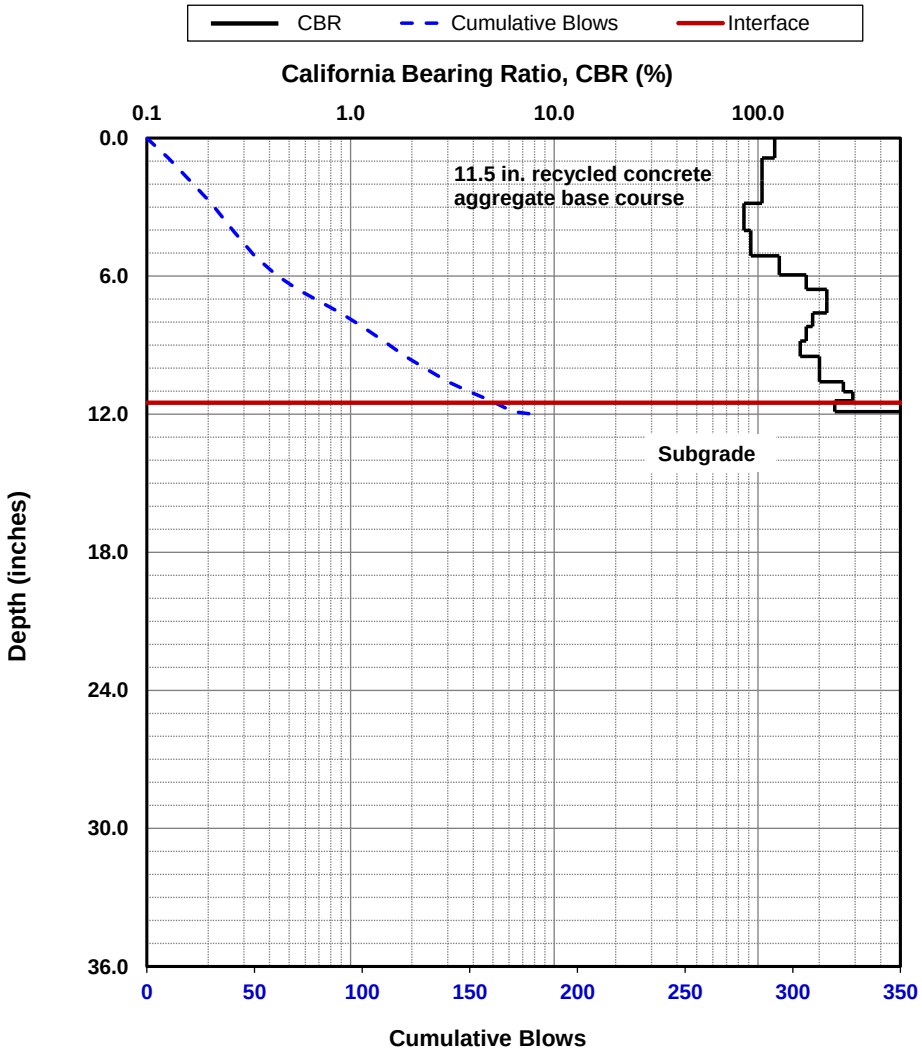
[2]$E\ (ksi) = (17.6\ CBR^{0.64}) \times 0.1450377$

[3]$S_u\ (psf) = (3.794 \times CBR^{0.664}) \times 144$

[1] ASTM D6951-03

[2]Powell et al. (1986)

[3]Portland Cement Assoc. (1955)



Dynamic Cone Penetrometer (DCP) Test Results

Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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Date of Test	12/13/2017	Test ID	CTRL_PT13	Operator	PV, HG	ASTM	D6951
Latitude	34.05773		Longitude	118.222420		Elevation (ft)	296
Location	UPRR - Los Angeles		Station	NA			
Comments	11.5 in. thick recycled concrete aggregate base over subgrade.						

Parameter	DPI (mm/blow)	CBR (%)	E_{CBR}, Elastic Modulus (ksi) (non stress-dependent)	$S_{u\text{-}CBR}$, Bearing Capacity (psf)
Avg. Top Layer [0-11.5 in.]	1.5	190.4	73.4	17,830
Avg. Bottom Layer [11.5 to 23.5 in.]	Refusal	Refusal	Refusal	Refusal
Ratio of Avg.0-11.5 in./11.5 to 23.5 in.	NA	NA	NA	NA
Stdev Top Layer [0-11.5 in.]	0.8	145.0	61.7	14,880
Stdev. Bottom Layer [11.5-23.5 in.]	Refusal	Refusal	Refusal	Refusal

NOTES:

Subgrade is classified as non-CL

[1]$CBR = 292/DPI^{1.12}$

[1]$CBR = 1/(0.017019DPI)^2$

for CL soils with CBR < 10

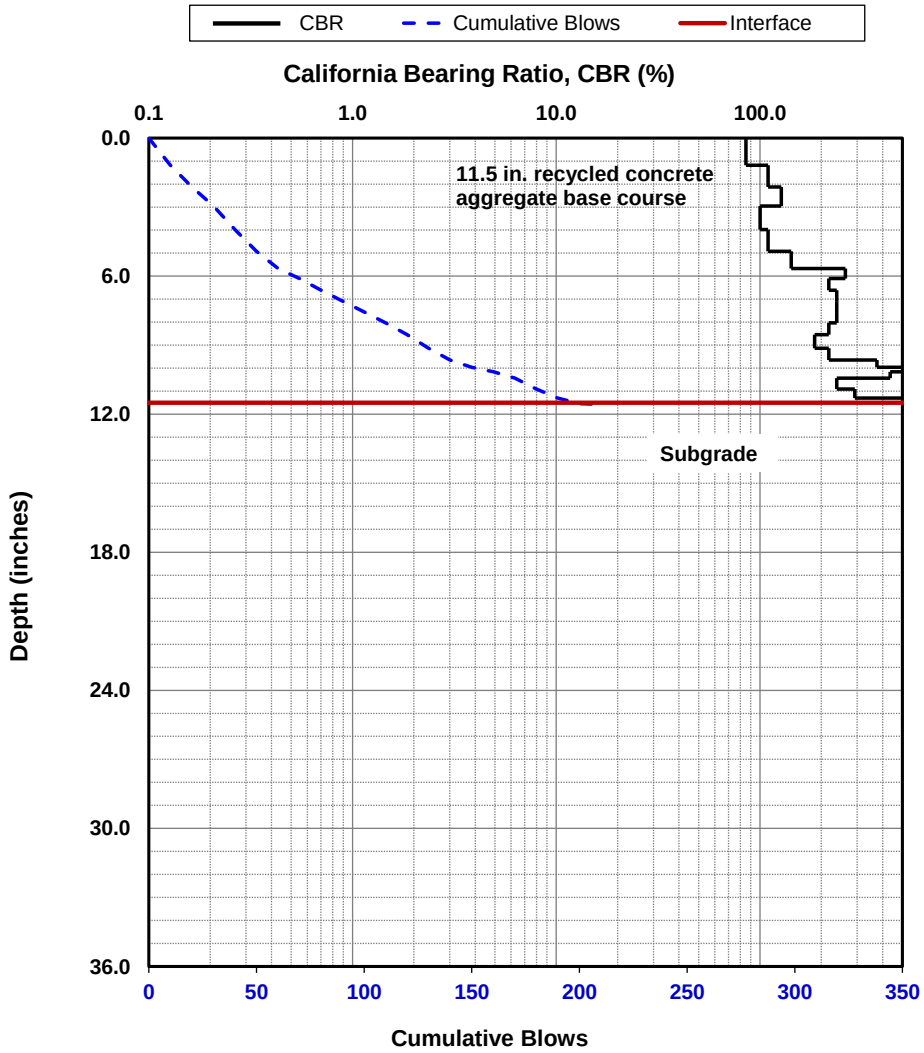
[2]$E\ (ksi) = (17.6\ CBR^{0.64}) \times 0.1450377$

[3]$S_u\ (psf) = (3.794 \times CBR^{0.664}) \times 144$

[1] ASTM D6951-03

[2]Powell et al. (1986)

[3]Portland Cement Assoc. (1955)



Dynamic Cone Penetrometer (DCP) Test Results

Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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Date of Test	12/12/2017	Test ID	TX_PT14	Operator	PV, HG	ASTM	D6951
Latitude	34.05775		Longitude	118.222380		Elevation (ft)	301
Location	UPRR - Los Angeles		Station	NA			
Comments	5 in. thick recycled concrete aggregate base stabilized with TX8 over subgrade.						

Parameter	DPI (mm/blow)	CBR (%)	E_{CBR}, Elastic Modulus (ksi) (non stress-dependent)	$S_{u\text{-}CBR}$, Bearing Capacity (psf)
Avg. Top Layer [0-5 in.]	1.2	233.7	83.7	20,429
Avg. Bottom Layer [5 to 17 in.]	Refusal	Refusal	Refusal	Refusal
Ratio of Avg.0-5 in./5 to 17 in.	NA	NA	NA	NA
Stdev Top Layer [0-5 in.]	0.4	88.9	45.1	10,756
Stdev. Bottom Layer [5-17 in.]	Refusal	Refusal	Refusal	Refusal

NOTES:

Subgrade is classified as non-CL

[1]$CBR = 292/DPI^{1.12}$

[1]$CBR = 1/(0.017019DPI)^2$

for CL soils with CBR < 10

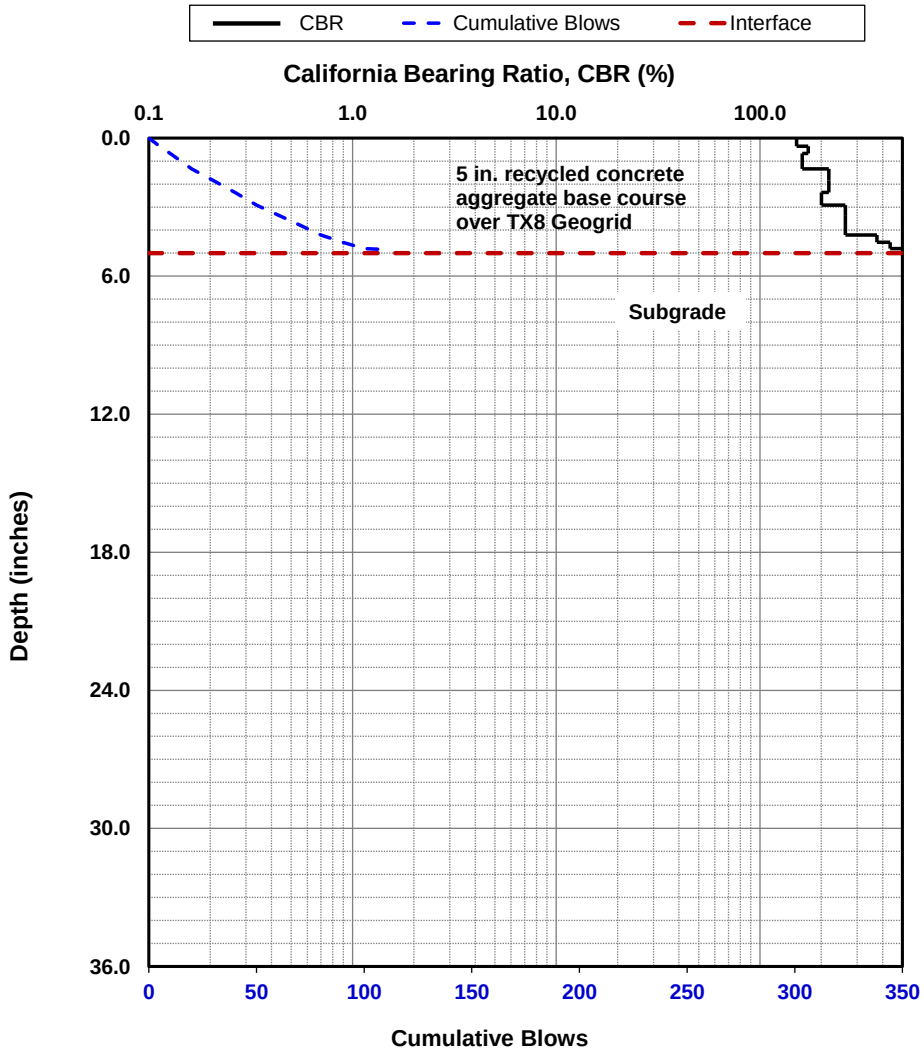
[2]$E\ (ksi) = (17.6\ CBR^{0.64}) \times 0.1450377$

[3]$S_u\ (psf) = (3.794 \times CBR^{0.664}) \times 144$

[1] ASTM D6951-03

[2]Powell et al. (1986)

[3]Portland Cement Assoc. (1955)



Dynamic Cone Penetrometer (DCP) Test Results

Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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Date of Test	12/13/2017	Test ID	TX_PT15	Operator	PV, HG	ASTM	D6951
Latitude	34.05781		Longitude	118.222430		Elevation (ft)	294
Location	UPRR - Los Angeles		Station	NA			
Comments	5.0 in. recycled concrete aggregate stabilized with TX8 geogrid over subgrade.						

Parameter	DPI (mm/blow)	CBR (%)	E_{CBR}, Elastic Modulus (ksi) (non stress-dependent)	$S_{u\text{-}CBR}$, Bearing Capacity (psf)
Avg. Top Layer [0-5 in.]	2.1	125.0	56.1	13,482
Avg. Bottom Layer [5 to 17 in.]	1.5	192.6	74.0	17,967
Ratio of Avg.0-5 in./5 to 17 in.	1.5	0.6	0.8	0.8
Stdev Top Layer [0-5 in.]	0.5	33.1	24.0	5,576
Stdev. Bottom Layer [5-17 in.]	0.6	100.8	48.9	11,691

NOTES:

Subgrade is classified as non-CL

[1]$CBR = 292/DPI^{1.12}$

[1]$CBR = 1/(0.017019DPI)^2$

for CL soils with CBR < 10

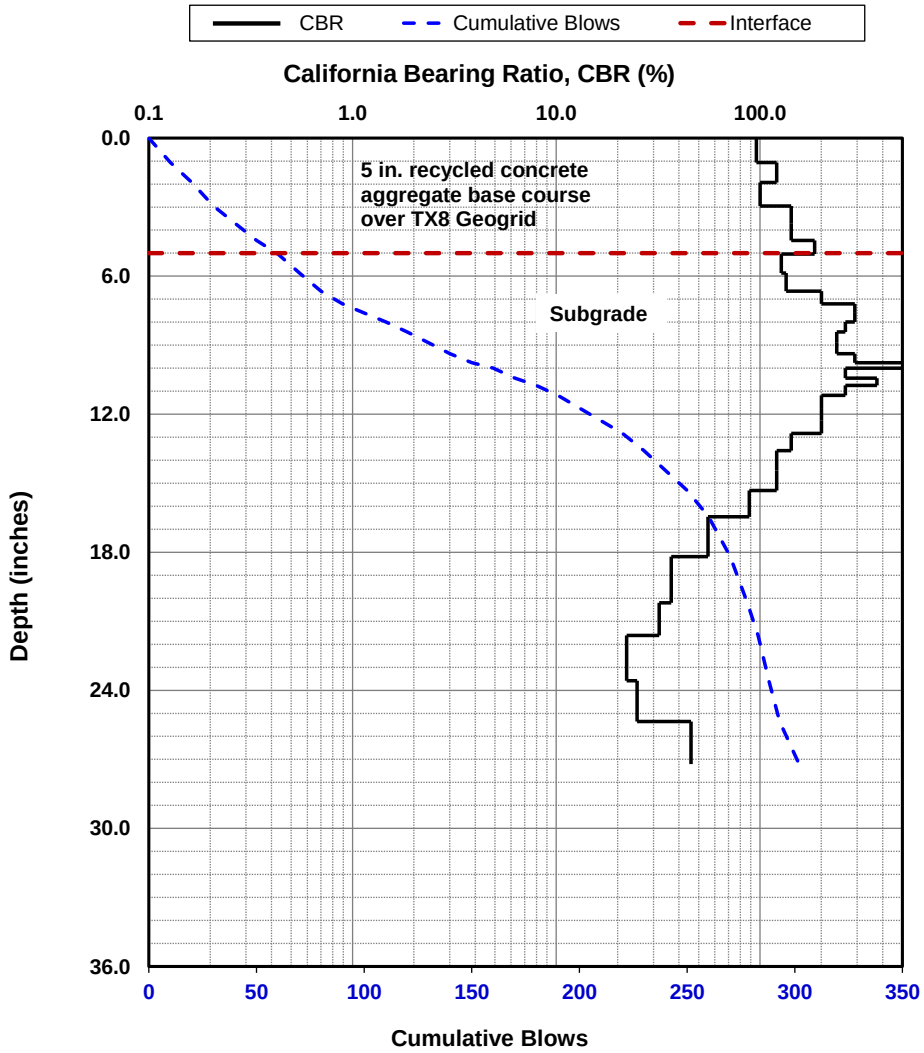
[2]$E\ (ksi) = (17.6\ CBR^{0.64}) \times 0.1450377$

[3]$S_u\ (psf) = (3.794 \times CBR^{0.664}) \times 144$

[1] ASTM D6951-03

[2]Powell et al. (1986)

[3]Portland Cement Assoc. (1955)



Dynamic Cone Penetrometer (DCP) Test Results

Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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Date of Test	12/13/2017	Test ID	CTRL_PT16	Operator	PV, HG	ASTM	D6951
Latitude	34.05782		Longitude	118.222477		Elevation (ft)	318
Location	UPRR - Los Angeles		Station	NA			
Comments	11.5 in. thick recycled concrete aggregate base over subgrade.						

Parameter	DPI (mm/blow)	CBR (%)	E_{CBR}, Elastic Modulus (ksi) (non stress-dependent)	$S_{u\text{-}CBR}$, Bearing Capacity (psf)
Avg. Top Layer [0-11.5 in.]	2.1	125.5	56.2	13,517
Avg. Bottom Layer [11.5 to 23.5 in.]	Refusal	Refusal	Refusal	Refusal
Ratio of Avg.0-11.5 in./11.5 to 23.5 in.	NA	NA	NA	NA
Stdev Top Layer [0-11.5 in.]	1.5	94.6	46.9	11,205
Stdev. Bottom Layer [11.5-23.5 in.]	Refusal	Refusal	Refusal	Refusal

NOTES:

Subgrade is classified as non-CL

[1]$CBR = 292/DPI^{1.12}$

[1]$CBR = 1/(0.017019DPI)^2$

for CL soils with CBR < 10

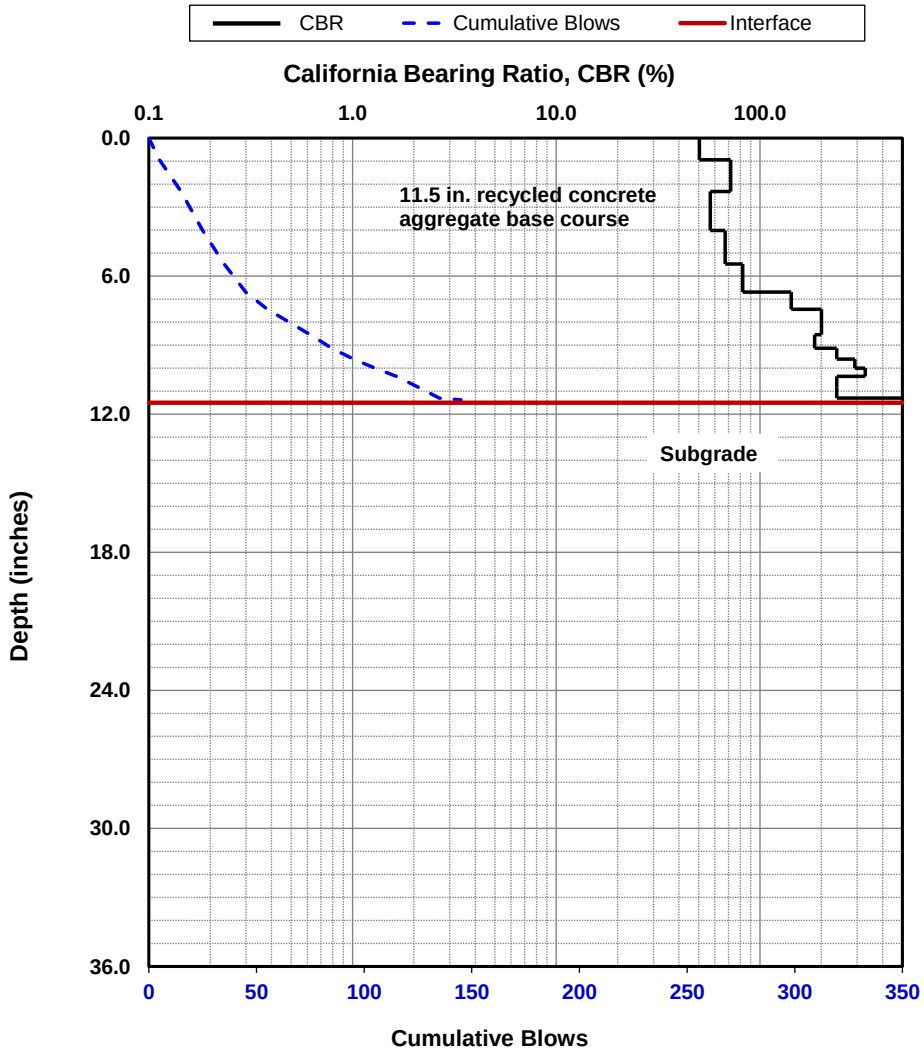
[2]$E\ (ksi) = (17.6\ CBR^{0.64}) \times 0.1450377$

[3]$S_u\ (psf) = (3.794 \times CBR^{0.664}) \times 144$

[1] ASTM D6951-03

[2]Powell et al. (1986)

[3]Portland Cement Assoc. (1955)



Dynamic Cone Penetrometer (DCP) Test Results

Project Name:	UPRR - 1041 Richmond St.
Project ID:	TIC-00030
Location:	Los Angeles, CA

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