PavementDesigner.org

PavementDesigner.org – Concrete Pavement Design for Municipal, Industrial, and Parking Facilities

16th Pavements and Materials Conference

Tempe, AZ

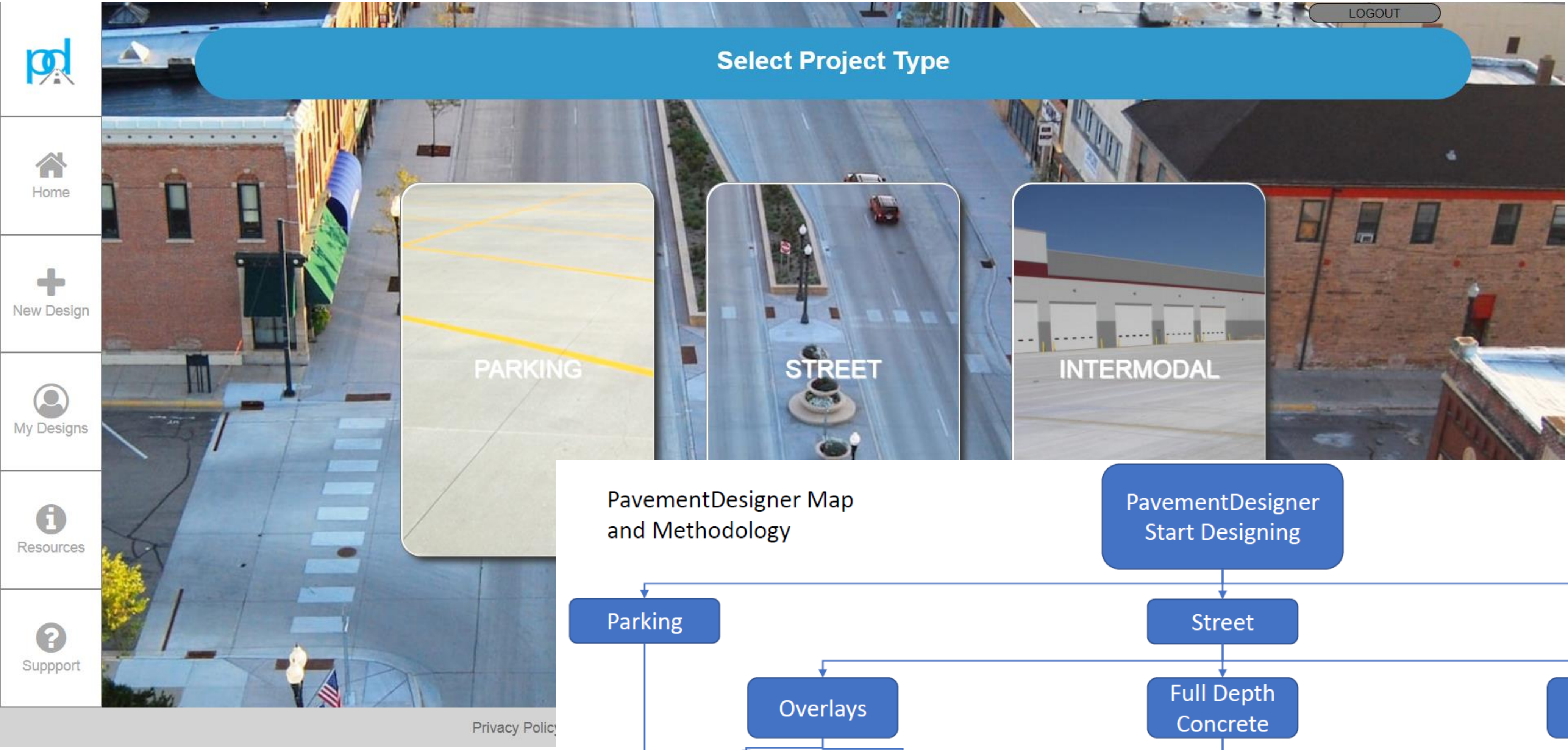
November 20, 2019

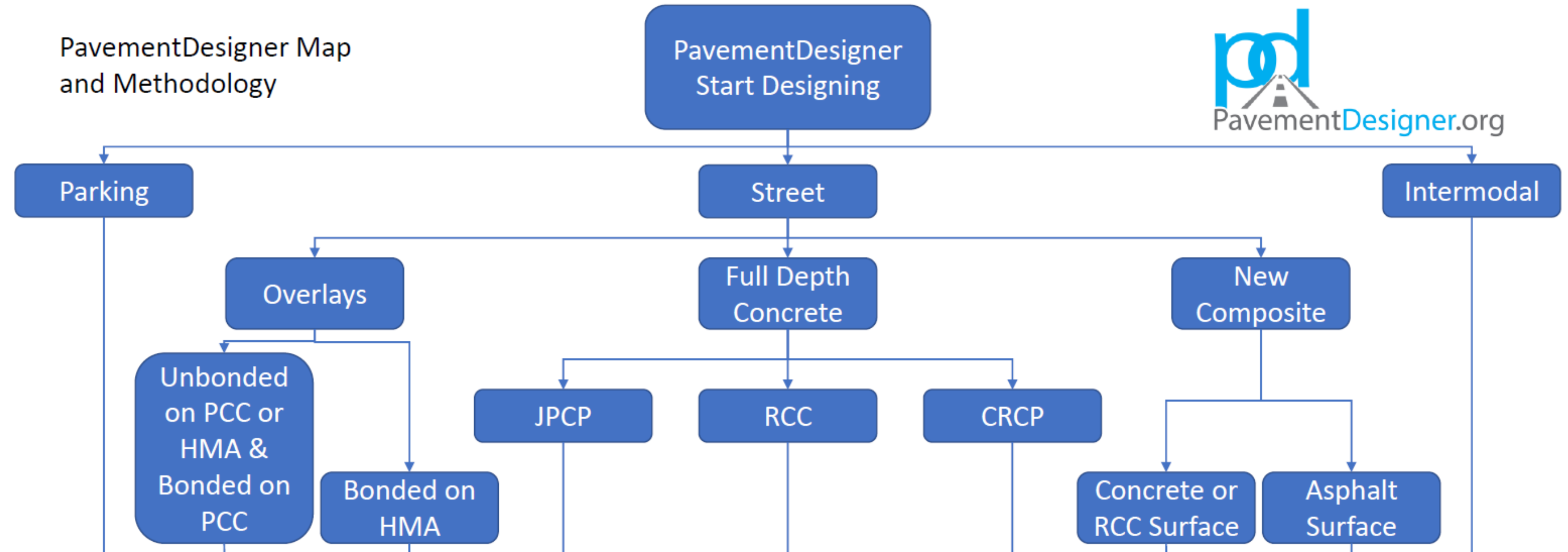
Eric Ferrebee, P.E.

Director of Technical Services

American Concrete Pavement Association

PavementDesigner





PavementDesigner
Project Leaders

- Industry Team Partners
  - Wayne Adaska, P.E.
    - Portland Cement Association
  - Brian Killingsworth, P.E.
    - National Ready Mix Concrete Association
- Additional Support
  - Jim Mack, P.E. & Tyler Speakmon, PhD (CEMEX)
  - Feng Mu, PhD, P.E. (PNA Construction Technologies)
  - Randy Riley, P.E. & Jim Powell, P.E.
    - ACPA State/Chapter Associations

PCA America's Cement Manufacturers™

NRMCA

RMC Research & Education Foundation

ACPA American Concrete Pavement Association

RCC Pavement Council

Overview and Background

- ACPA, NRMCA, and PCA partnership, with a contribution from the RCC Council to develop a website application to design cement-based solutions for:
  - Municipal Streets and Local Roads
  - Parking Lots
  - Intermodal/Industrial Facilities
- Design guidance and tools for:
  - Jointed-Plain Concrete Pavements
  - Continuously Reinforce Concrete Pavement
  - Concrete Overlays
  - Composite Pavements
  - Roller Compacted Concrete
  - Cement Modified Soils
  - Cement-Treated Base
  - Full-Depth Reclamation

ACPA
AMERICAN CONCRETE PAVEMENT ASSOCIATION

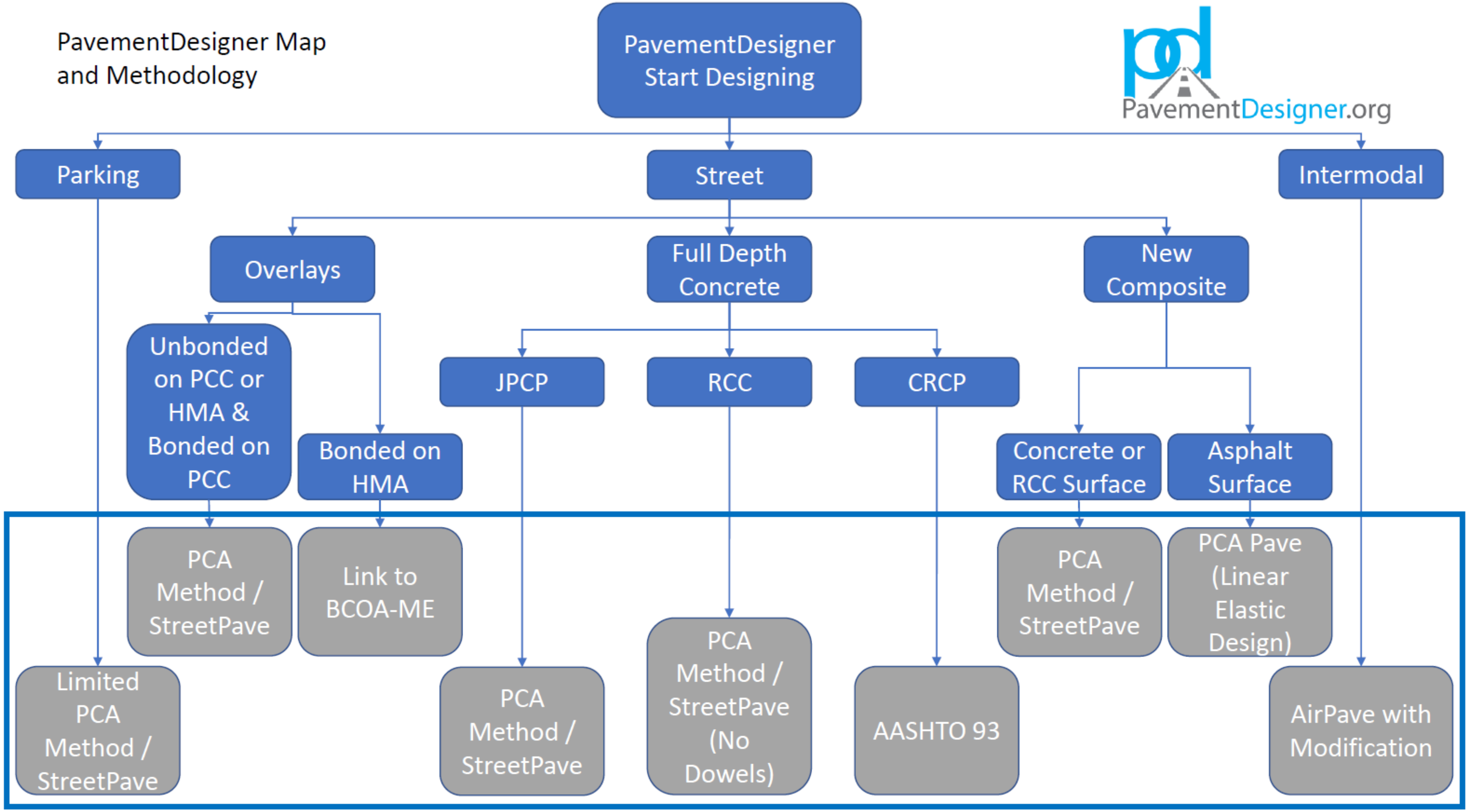
NRMCA

PCA
America's Cement Manufacturers™

RCC Pavement Council

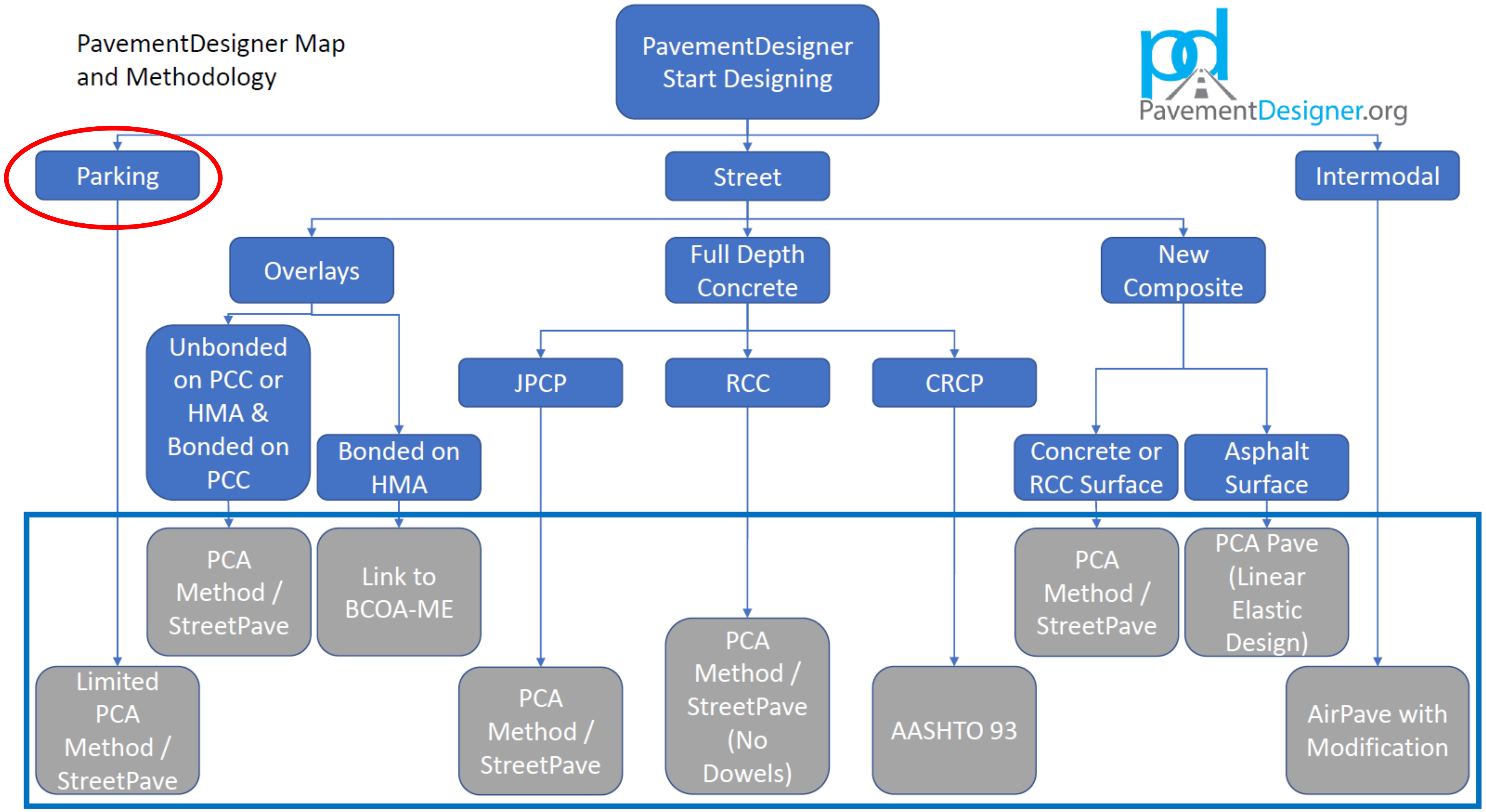
PavementDesigner.org

Bringing Online the Best of the Best Available Design Tools



Summary –

- Primary audience is city, county, and consultant engineers who design pavements
- Secondary audience is professors and students
- Unifies design methods, providing promoters with a single source to direct target audience to for consistent answers
- Fills a design void for some products
- Web-based platform, appealing to existing and future generations of design engineers…
- …with broad industry partner support!
- **FREE** and easily accessible!



PARKING LOTS

Old Ways of Designing Parking Lots

- AASHTO 93
- ACI 330R-08 & 330R-19
  - Guide for Concrete Parking Lots
- StreetPave

ACI 330R-08

Guide for the Design and Construction of Concrete Parking Lots

Reported by ACI Committee 330

American Concrete Institute®

ACI 330

Table 3.1—Subgrade soil types and approximate support values (Portland Cement Association 1984a,b; American Concrete Pavement Association 1982)

Type of soil	Support	k, psi/in.	CBR	R	SSV
Fine-grained soils in which silt and clay-size particles predominate	Low	75 to 120	2.5 to 3.5	10 to 22	2.3 to 3.1
Sands and sand-gravel mixtures with moderate amounts of silt and clay	Medium	130 to 170	4.5 to 7.5	29 to 41	3.5 to 4.9
Sand and sand-gravel mixtures relatively free of plastic fines	High	180 to 220	8.5 to 12	45 to 52	5.3 to 6.1

BR = California bearing ratio; R = resistance value; and SSV = soil support value. 1 psi = 0.0069 MPa, and 1 psi/in. = 0.27 MPa/m.

Table 3.2—Modulus of subgrade reaction k*

Subgrade k value, psi/in.	Sub-base thickness: 4 in.	6 in.	9 in.	12 in.
	Granular aggregate subbase			
50	65	75	85	110
100	130	140	160	190
200	220	230	270	320
300	320	330	370	430
	Cement-treated subbase			
50	170	230	310	390
100	280	400	520	640
200	470	640	830	—
	Other treated subbase			
50	85	115	170	215
100	175	210	270	325
200	280	315	360	400
300	350	385	420	490

*For subbase applied over different subgrades, psi/in. (Portland Cement Association 1984a,b; Federal Aviation Administration 1978).
Note: 1 in. = 25.4 mm, and 1 psi/in. = 0.27 MPa/m.

e 3.4—Twenty-year design thickness recommendations, in. (no dowels)

		k = 500 psi/in. (CBR = 50; R = 86)				k = 400 psi/in. (CBR = 38; R = 80)				k = 300 psi/in. (CBR = 26; R = 67)			
	MOR, psi:	650	600	550	500	650	600	550	500	650	600	550	500
ffic ory*	A (ADTT = 1)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.5
	A (ADTT = 10)	4.0	4.0	4.0	4.5	4.0	4.0	4.5	4.5	4.0	4.5	4.5	4.5
	B (ADTT = 25)	4.0	4.5	4.5	5.0	4.5	4.5	5.0	5.5	4.5	4.5	5.0	5.5
	B (ADTT = 300)	5.0	5.0	5.5	5.5	5.0	5.0	5.5	5.5	5.0	5.5	5.5	6.0
	C (ADTT = 100)	5.0	5.0	5.5	5.5	5.0	5.5	5.5	6.0	5.5	5.5	6.0	6.0
	C (ADTT = 300)	5.0	5.5	5.5	6.0	5.5	5.5	6.0	6.0	5.5	6.0	6.0	6.5
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		k = 200 psi/in. (CBR = 10; R = 48)				k = 100 psi/in. (CBR = 3; R = 18)				k = 50 psi/in. (CBR = 2; R = 5)			
	MOR, psi:	650	600	550	500	650	600	550	500	650	600	550	500
Traffic category*	A (ADTT = 1)	4.0	4.0	4.0	4.5	4.0	4.5	4.5	5.0	4.5	5.0	5.0	5.5
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	C (ADTT = 700)	6.0	6.5	6.5	7.0	6.5	7.0	7.0	7.5	7.0	7.5	8.0	8.5
	D (ADTT = 700)†	7.0	7.0	7.0	7.0	8.0	8.0	8.0	8.0	9.0	9.0	9.0	9.0

*ADTT = average daily truck traffic. Trucks are defined as vehicles with at least six wheels; excludes panel trucks, pickup trucks, and other four-wheel vehicles. Refer to Appendix A.
k = modulus of subgrade reaction; CBR = California bearing ratio; R = resistance value; and MOR = modulus of rupture.

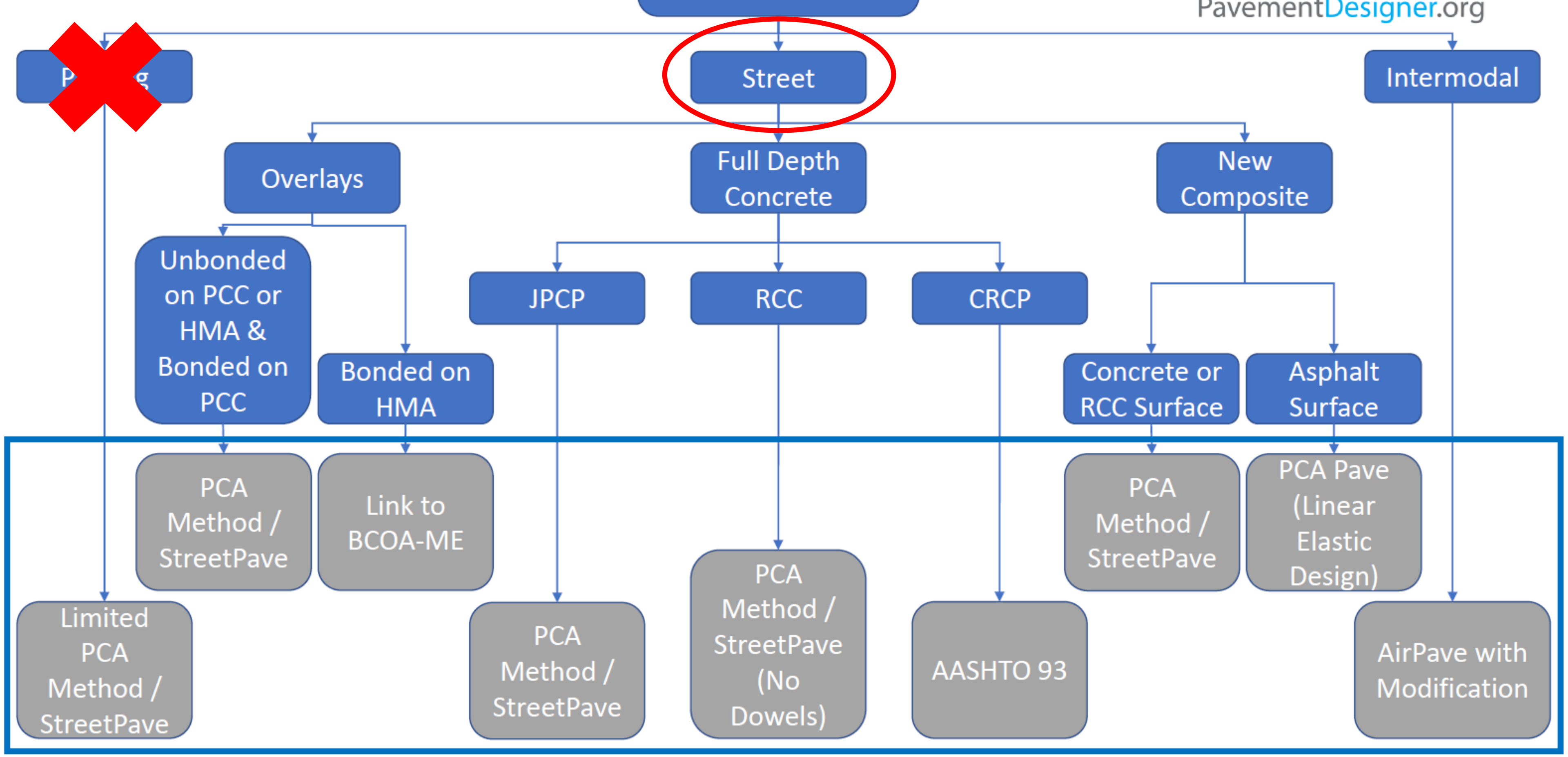
Parking Lot Design

- ACI 330R-08 Guide based on StreetPave (PD's predecessor) design runs
- StreetPave is another accepted design methodology for Parking Lots
- New guide (ACI 330-R18) is based off PD design runs

Parking Lot Design with PavementDesigner

- PavementDesigner's Parking design uses a slightly modified version of the Street's Module for the sake of simplicity
  - Allows for various design lives, reliabilities, and percent slabs cracked at the end of the design life

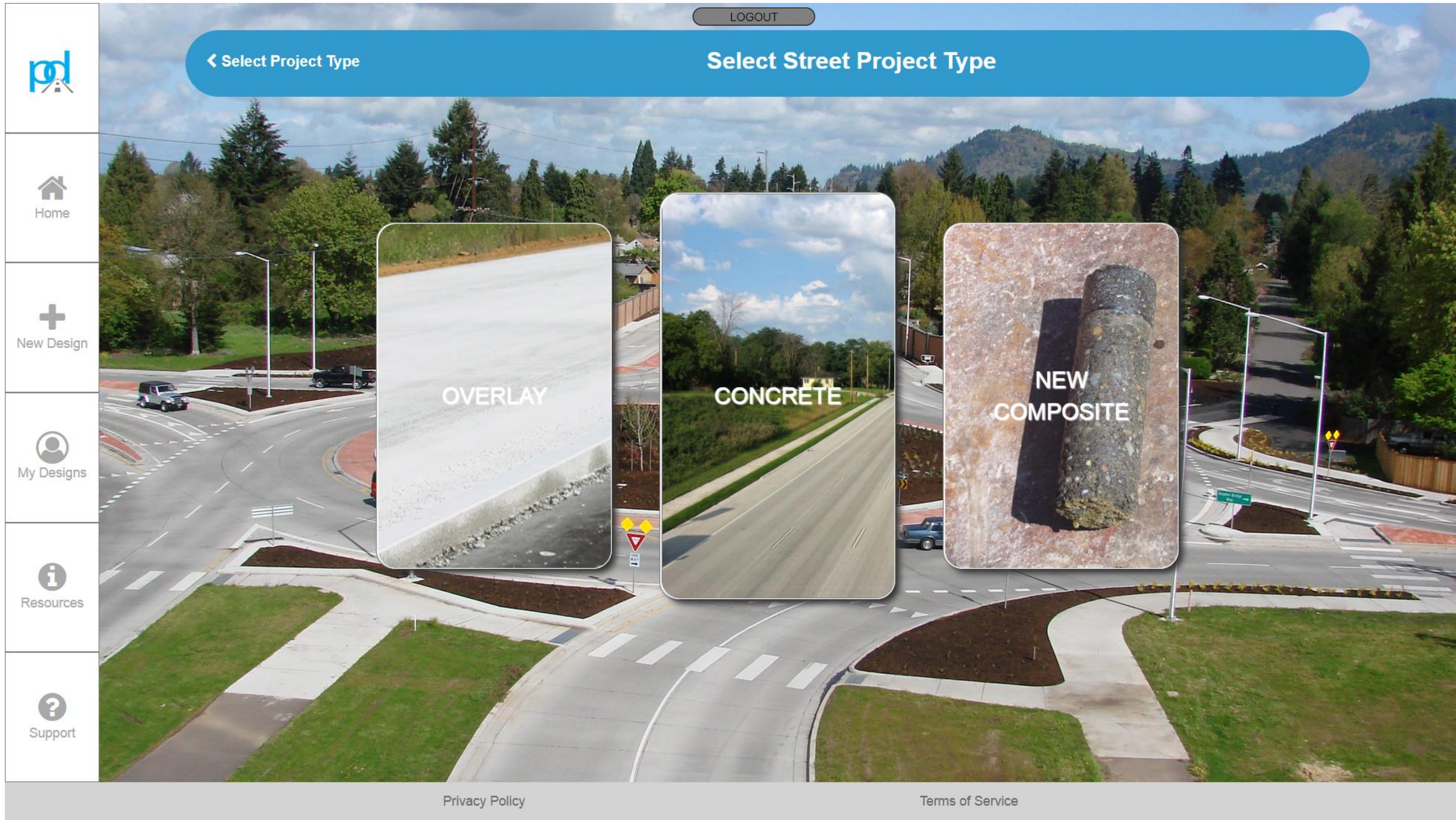
PavementDesigner Map and Methodology



MUNICIPAL STREETS & LOCAL ROADS

Municipal Street Design with PavementDesigner

- Overlays
  - Bonded and Unbonded
  - On Asphalt and Concrete
- Full-Depth Concrete
  - JPCP
  - RCC
  - CRCP
- Composite Pavements

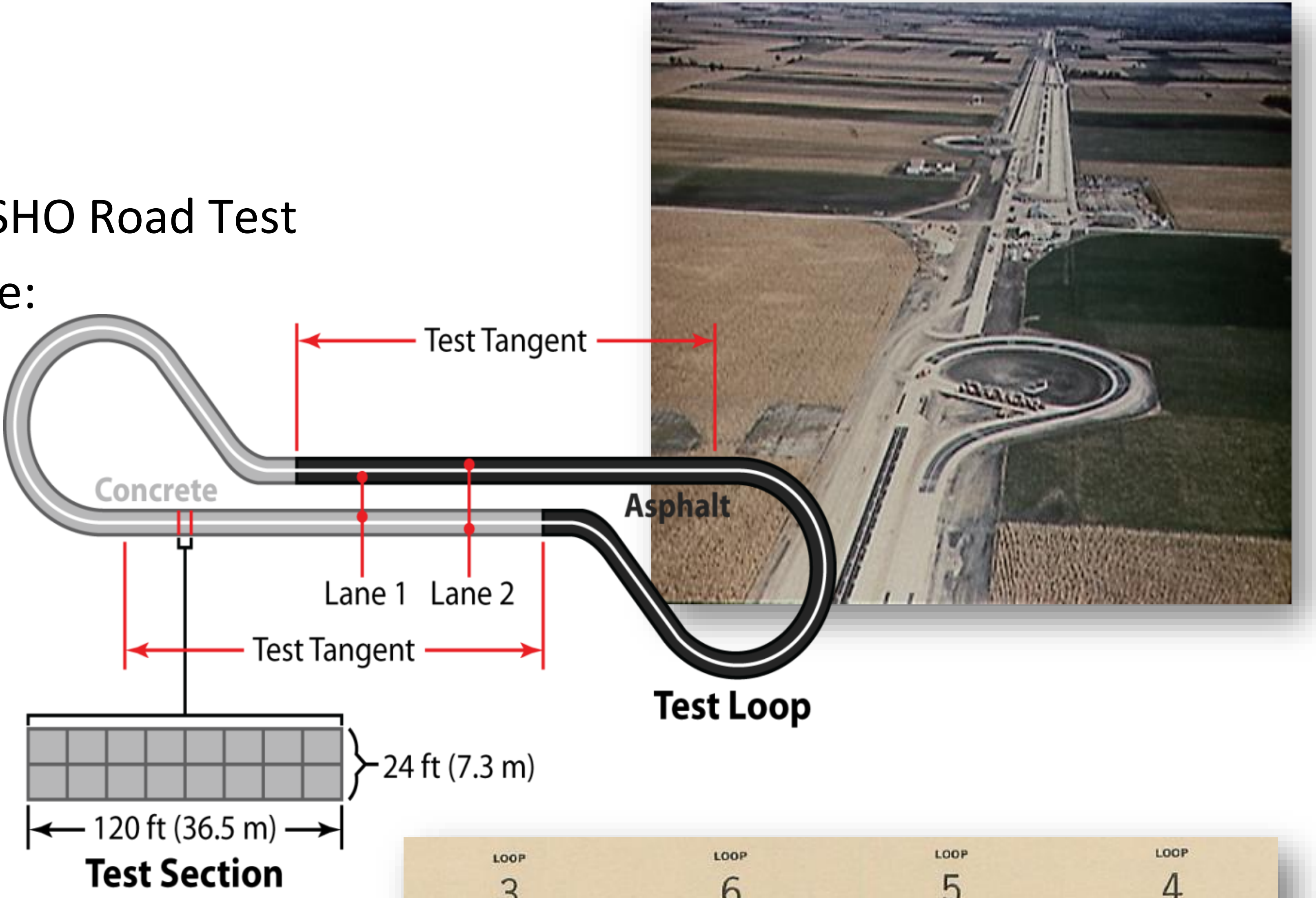


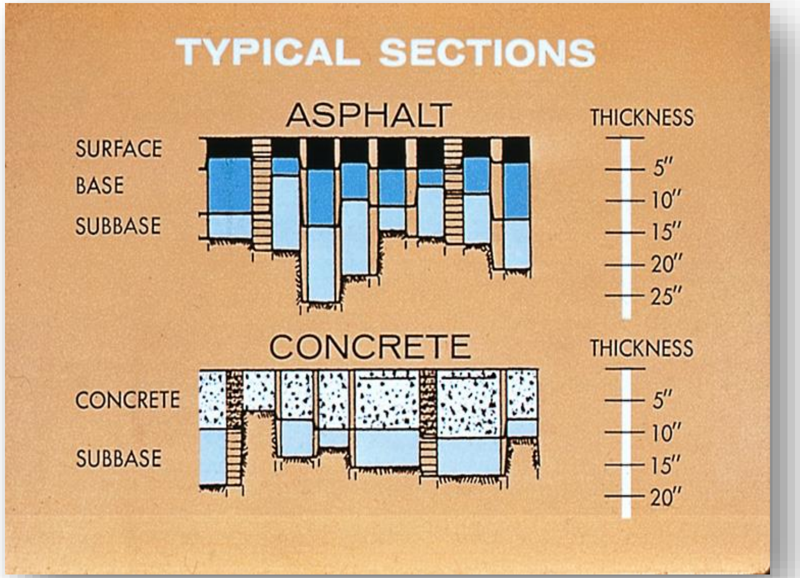
Other Ways of Designing Municipal Streets

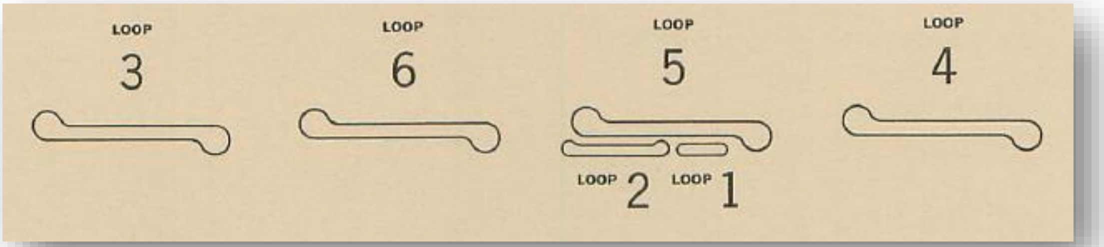
- AASHTO 93
- Pavement ME
- ACI 325.12R-02
  - Guide for Design of Jointed Concrete Pavements for Streets and Local Roads
- StreetPave

AASHTO 93

- Wholly empirical – AASHO Road Test
- Limited inference space:
  - Materials
  - Structural sections
  - Soils
  - Traffic

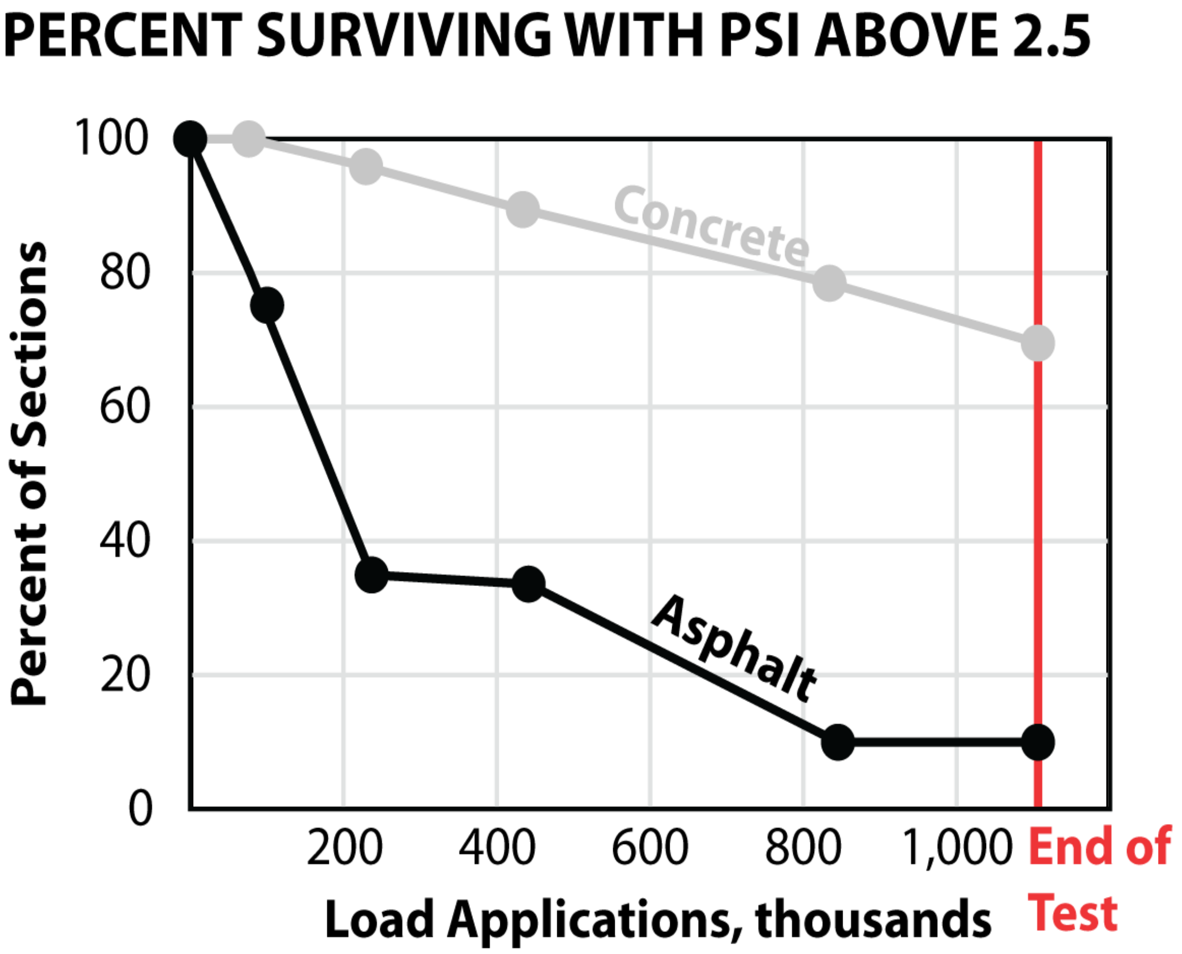






Performance Estimated Subjectively

- **Present Serviceability Index (PSI)**
  - 4.0 – 5.0 = Very Good
  - 3.0 – 4.0 = Good
  - 2.0 – 3.0 = Fair
  - 1.0 – 2.0 = Poor
  - 0.0 – 1.0 = Very Poor
- "Failure" at the Road Test considered @ 1.5
- Typical U.S. state agency terminal serviceability in practice = 2.5



Don’t Just Take My Word…


United States General Accounting Office

GAO

Report to the Secretary of Transportation

November 1997

TRANSPORTATION INFRASTRUCTURE

Highway Pavement Design Guide Is Outdated

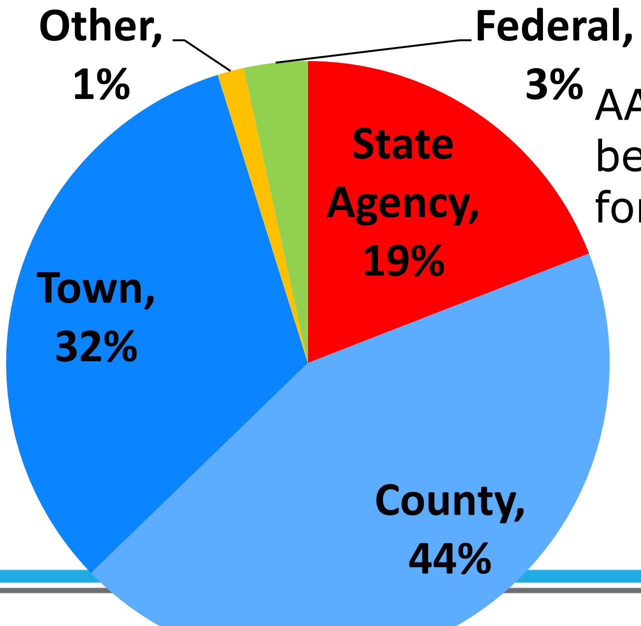
GAO/RCED-98-9

“The current design guide and its predecessors were largely based on design equations empirically derived from the observations AASHTO’s predecessor made during road performance tests completed in 1959-60. Several transportation experts have criticized the empirical data thus derived as outdated and inadequate for today’s highway system. In addition, a March 1994 DOT Office of Inspector General report concluded that the design guide was outdated and that pavement design information it relied on could not be supported and validated with systematic comparisons to actual experience or research.”

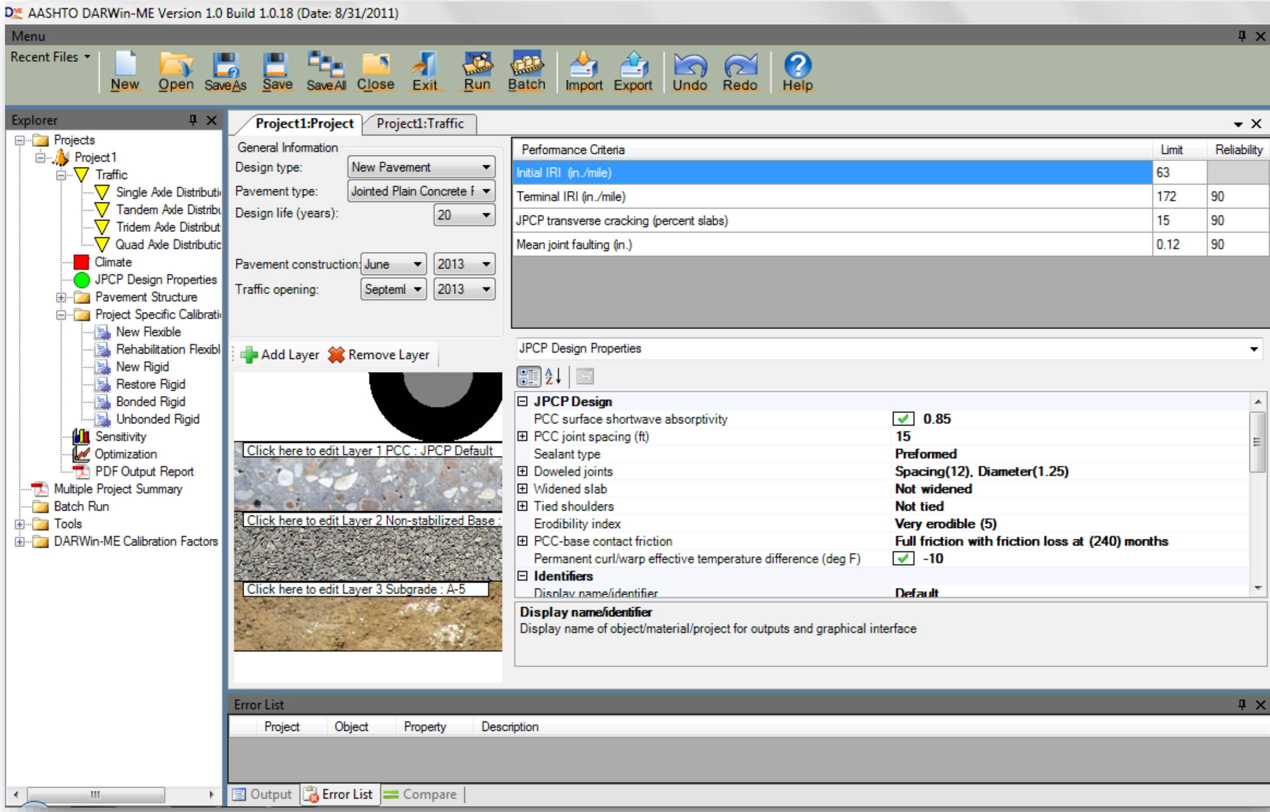
…this is why Pavement ME exists!

AASHTOWare Pavement ME Design

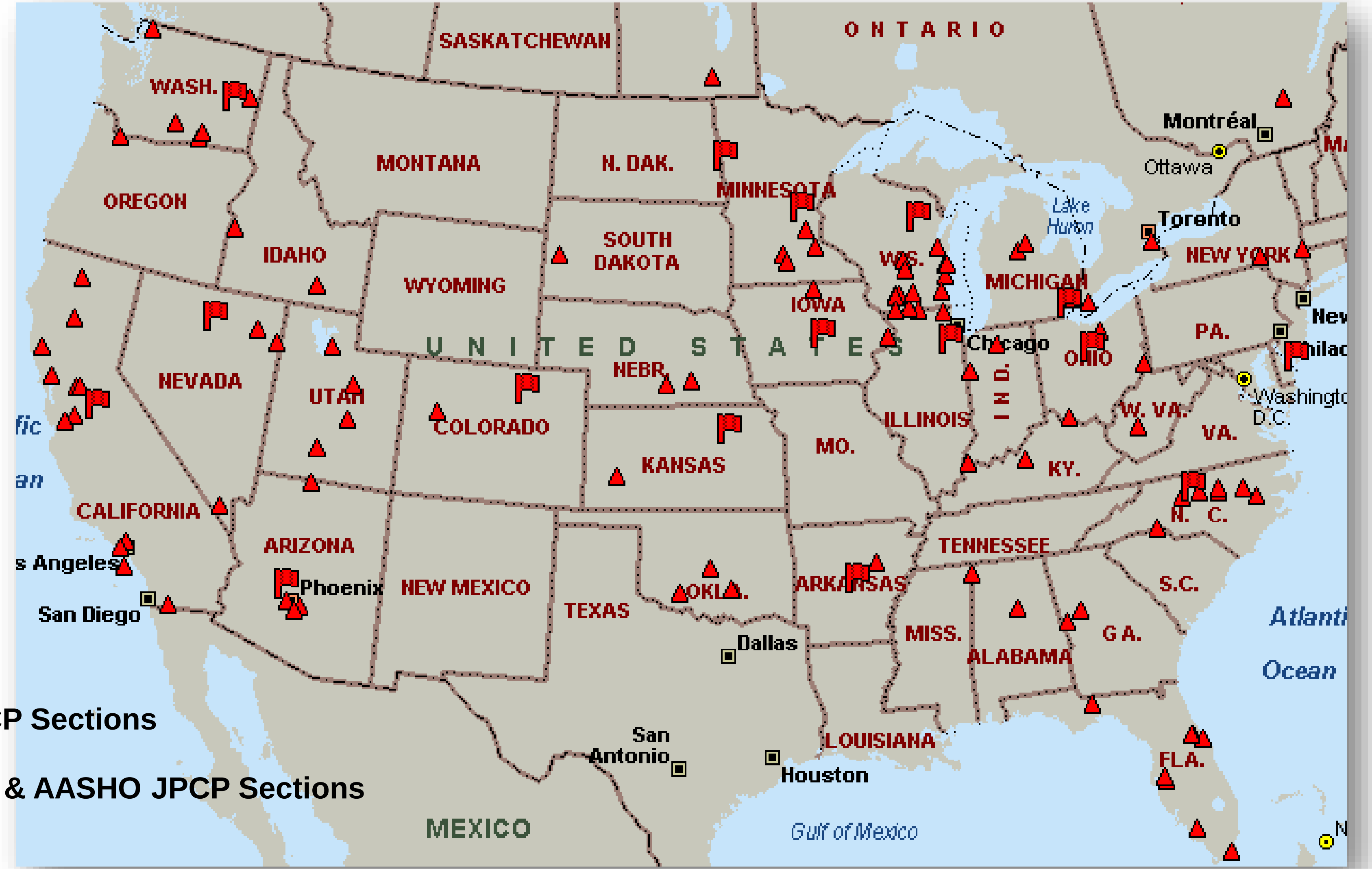
- Developed for Highways
  - NOT street, road, parking lot, etc.
- Complex
- Expensive



AASHTO tools are being developed for these owners…



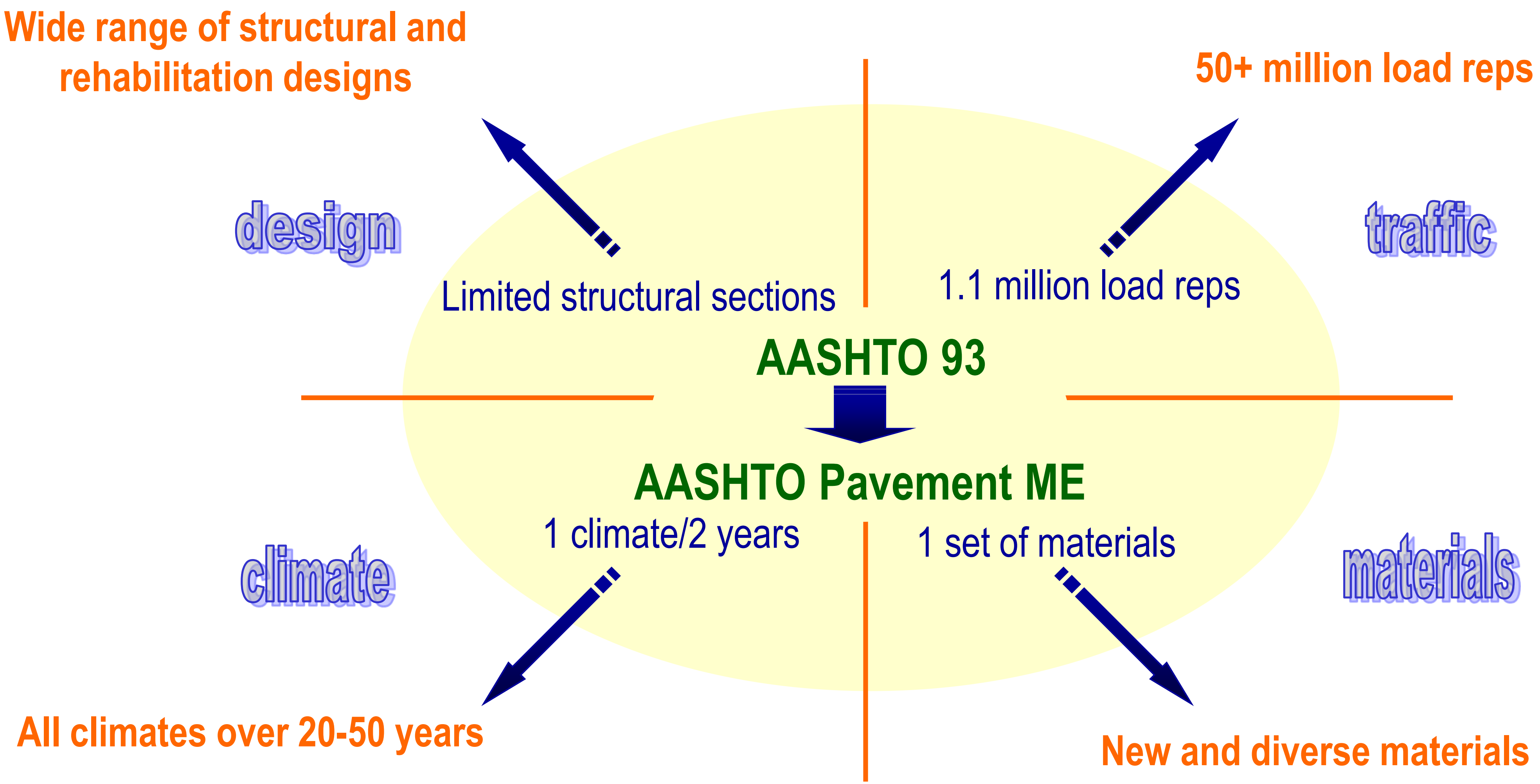
JPCP Calibration – **BIG INF. SPACE!**



LTPP GPS-3 & RPPR JPCP Sections

LTPP SPS-2, MnROAD, & AASHO JPCP Sections

AASHTO 93 vs. ME



OUTPUTS, OUTPUTS, OUTPUTS!!!

ARDOT - I-30
File Name: C:\Users\

Design Inputs

Design Life: 20 years
Design Type: JPCP

Design Structure

Layer type	M
PCC	JPCP D
Flexible	Default
Cement_Base	Cement
Subgrade	A-7-6
Subgrade	A-7-6

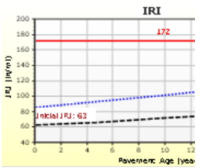
Design Outputs

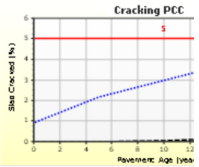
Distress Prediction Su

Dis

Terminal IRI (in/mile)
Mean joint faulting (in)
JPCP transverse cracking

Distress Charts





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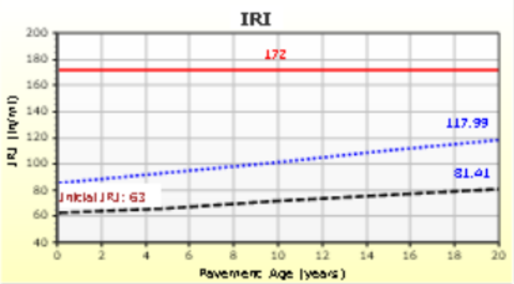
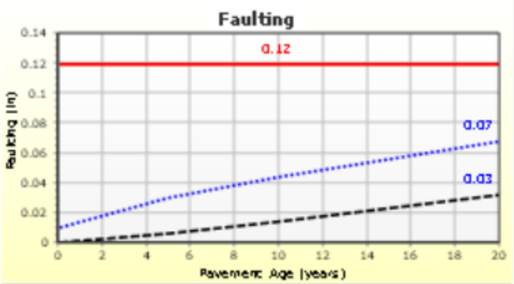
Design Outputs

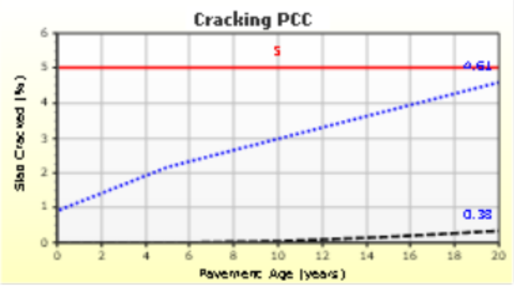
Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in/mile)	172.00	117.99	90.00	99.92	Pass
Mean joint faulting (in)	0.12	0.07	90.00	99.90	Pass
JPCP transverse cracking (percent slabs)	5.00	4.61	90.00	91.91	Pass

Distress Charts







ACI 325

- Limited design charts
- New guide based on PavementDesigner runs

Table 3.4—Twenty-year design thickness recommendations, in. (no dowels)

		k = 500 psi/in. (CBR = 50; R = 86)				k = 400 psi/in. (CBR = 38; R = 80)				k = 300 psi/in. (CBR =26; R = 67)			
	MOR, psi:	650	600	550	500	650	600	550	500	650	600	550	500
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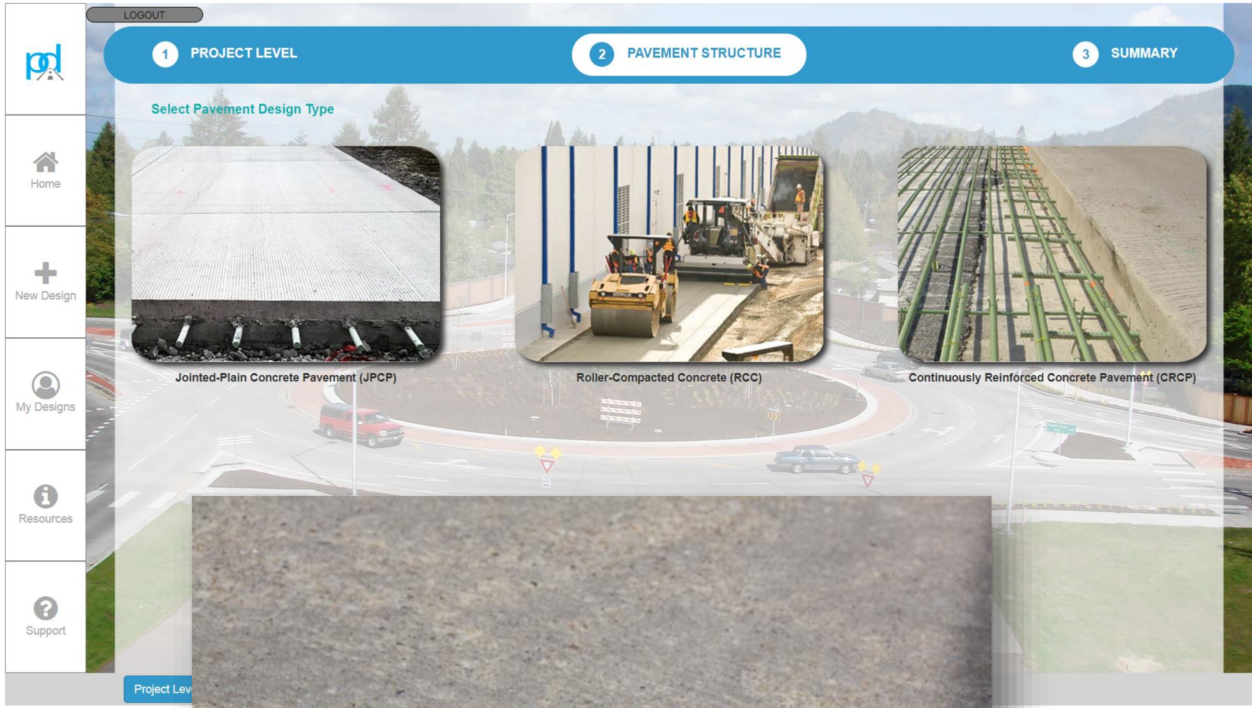
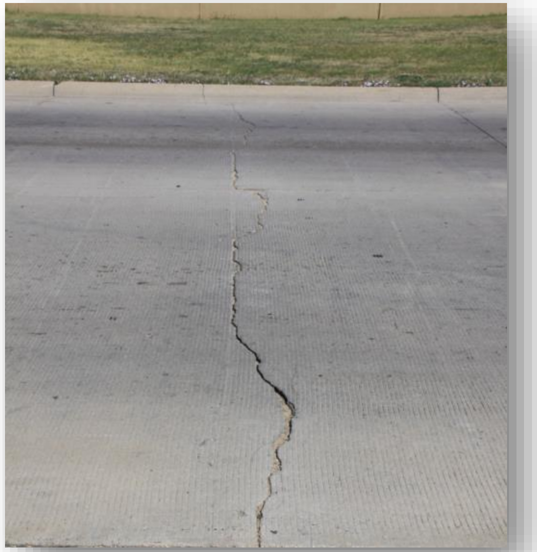
*ADTT = average daily truck traffic. Trucks are defined as vehicles with at least six wheels; excludes panel trucks, pickup trucks, and other four-wheel vehicles. Refer to Appendix A. k = modulus of subgrade reaction; CBR = California bearing ratio; R = resistance value; and MOR = modulus of rupture.

PavementDesigner.org

PavementDesigner for Roadways

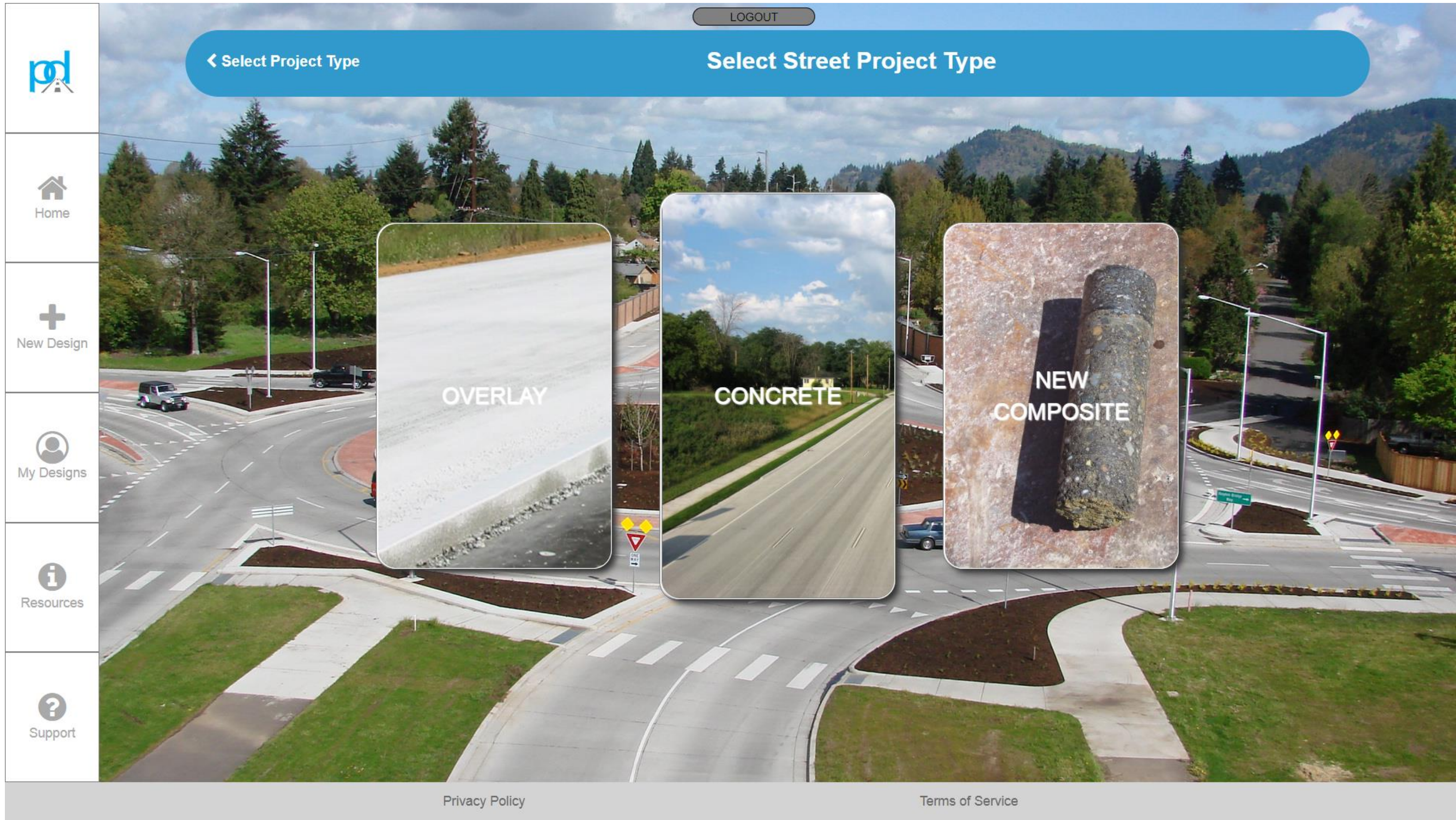
- Roots date back to the 1960s PCA Method
- Tailored for streets and roads
- Failure modes are cracking and erosion





Municipal Street Design with PavementDesigner

- Design for Overland Parkway with ~100 trucks/day
- Existing Subgrade is poorly graded silt (A-5)



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New Design

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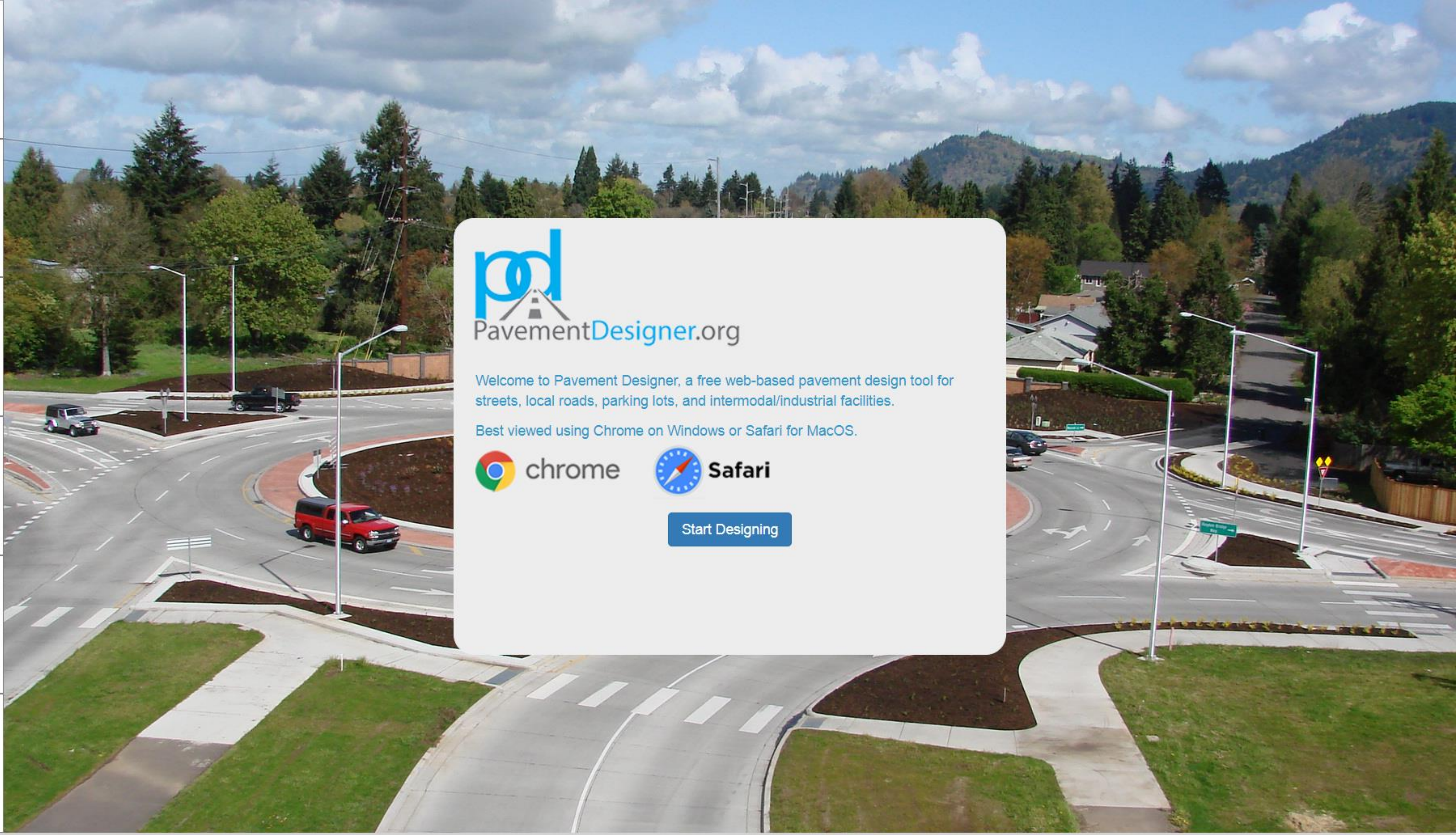


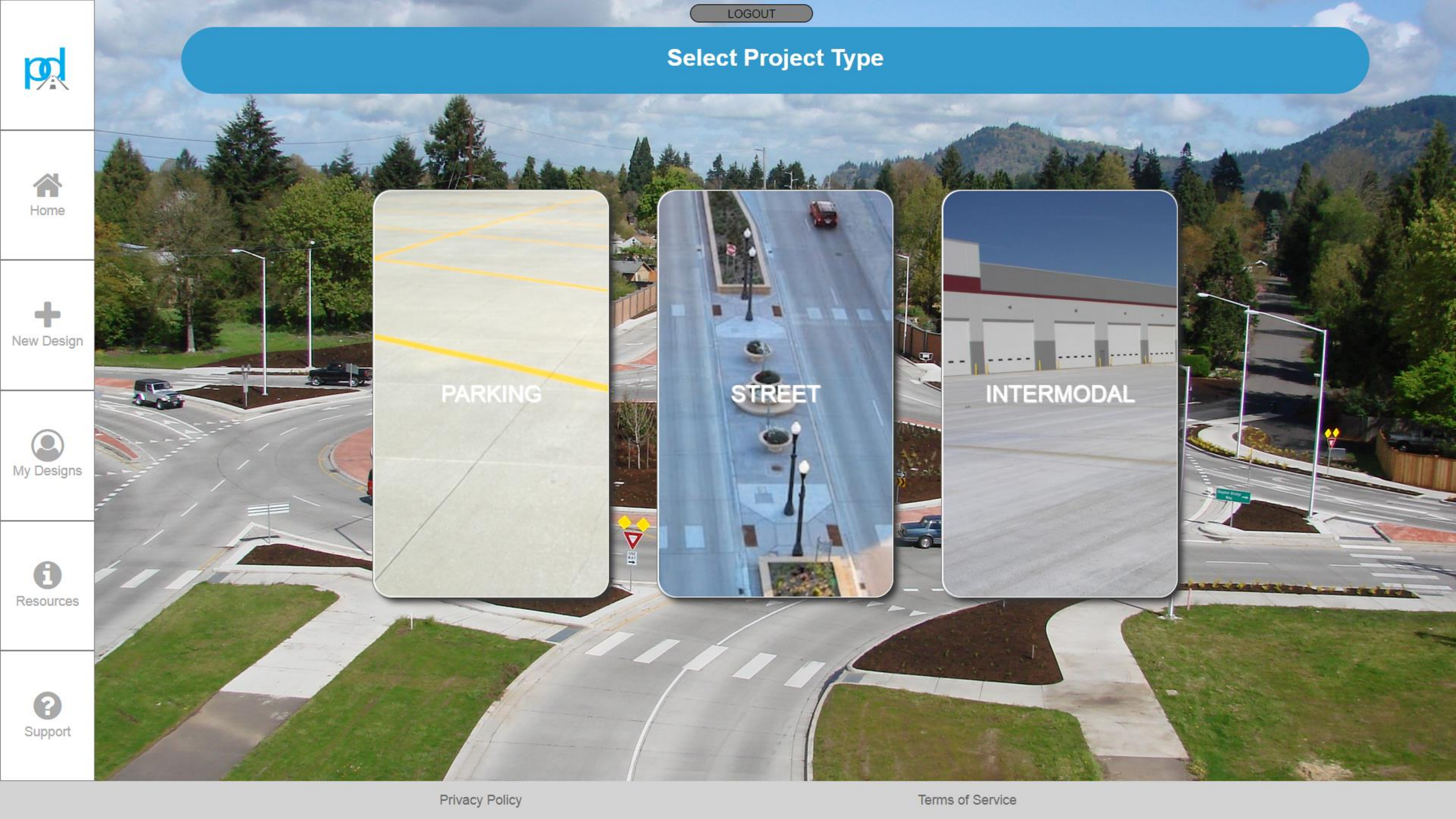
PavementDesigner.org

Welcome to Pavement Designer, a free web-based pavement design tool for streets, local roads, parking lots, and intermodal/industrial facilities.

Best viewed using Chrome on Windows or Safari for MacOS.

chrome Safari

Start Designing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INTERMODAL
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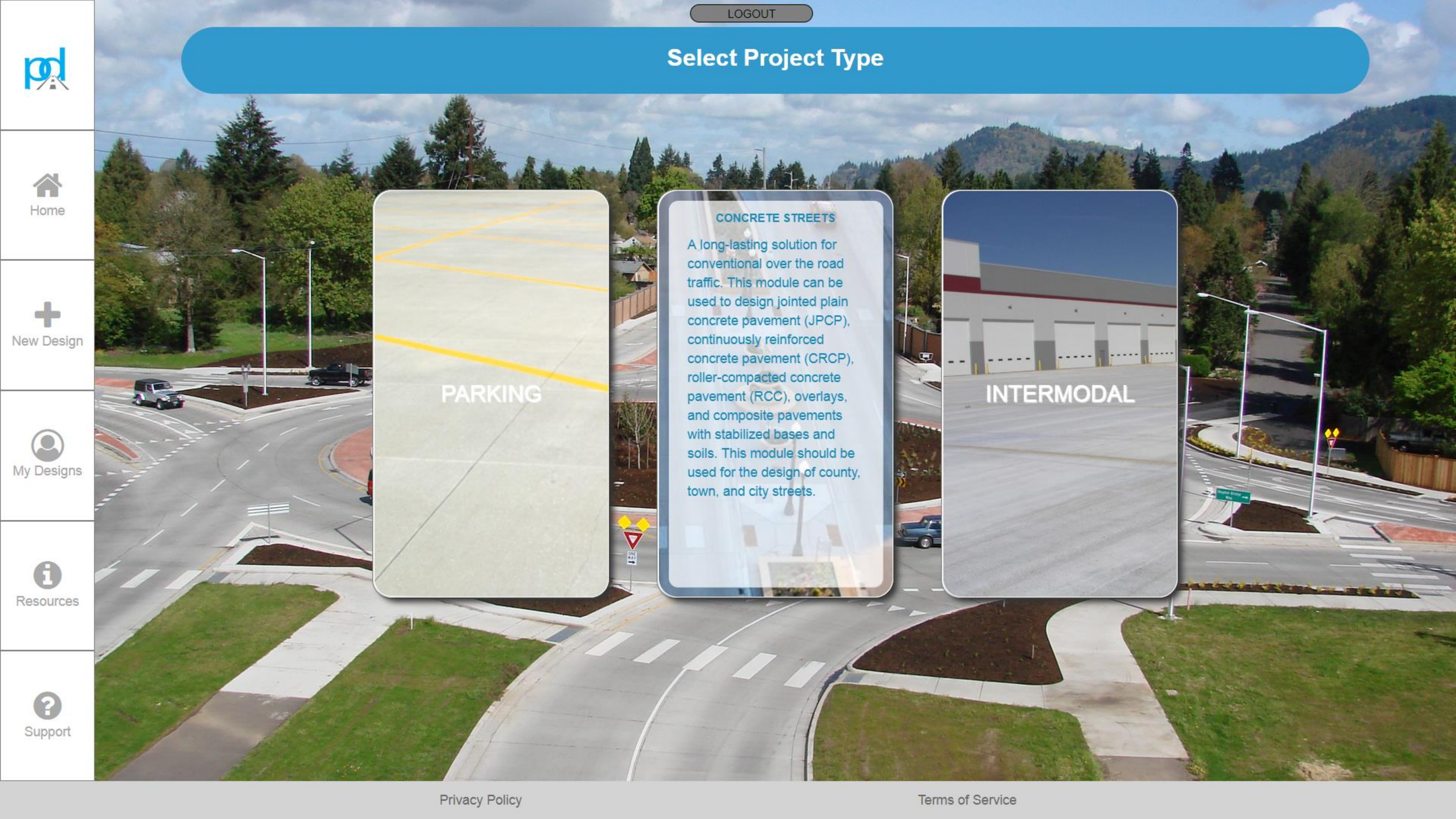
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CONCRETE STREETS
A long-lasting solution for conventional over the road traffic. This module can be used to design jointed plain concrete pavement (JPCP), continuously reinforced concrete pavement (CRCP), roller-compacted concrete pavement (RCC), overlays, and composite pavements with stabilized bases and soils. This module should be used for the design of county, town, and city streets.
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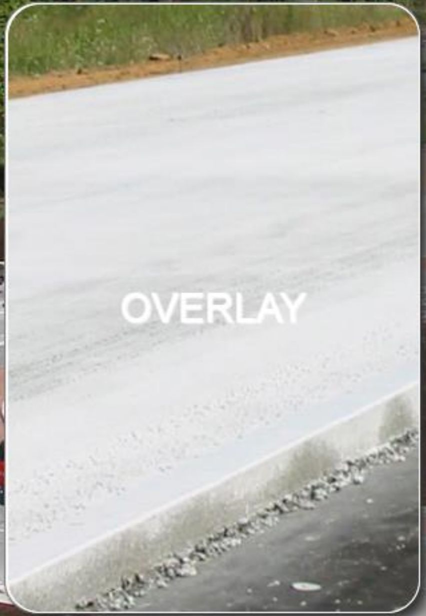
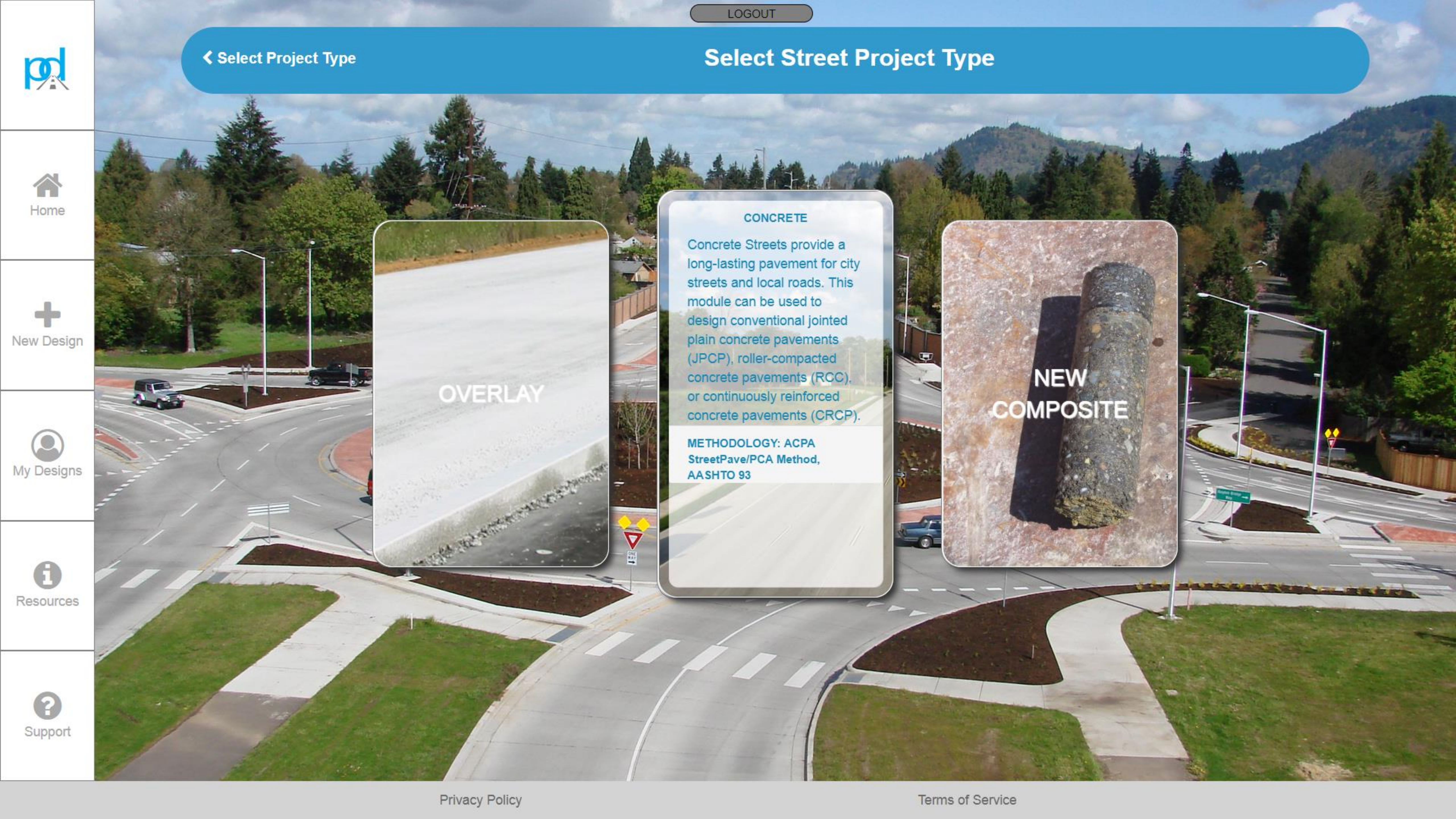
< Select Project Type

Select Street Project Type

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Select Project Type
Select Street Project Type
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OVERLAY
CONCRETE
Concrete Streets provide a long-lasting pavement for city streets and local roads. This module can be used to design conventional jointed plain concrete pavements (JPCP), roller-compacted concrete pavements (RCC), or continuously reinforced concrete pavements (CRCP).
METHODOLOGY: ACPA StreetPave/PCA Method, AASHTO 93
NEW COMPOSITE
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LOGOUT

1 PROJECT LEVEL   2 PAVEMENT STRUCTURE   3 SUMMARY

Home

New Design

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Help ?

Project Type: Street ➔ Concrete

TRAFFIC

Select Spectrum Type

Design Life

(Years)

User Defined Traffic Info

Trucks/Day

Traffic Growth Rate

(% per year)

Directional Distribution

(%)

Design Lane Distribution

(%)

GLOBAL

Reliability

(%)

% of Slabs Cracked at End of Design Life

(%)

CALCULATED TRAFFIC RESULTS

Avg Trucks/Day in Design Lane over the Design Life

Total Trucks in Design Lane over the Design Life

TRAFFIC SUMMARY DETAILS

Single		Tandem		Tridem	
AXLE LOAD (kips)	AXLES/ 1000 TRUCKS	AXLE LOAD (kips)	AXLES/ 1000 TRUCKS	AXLE LOAD (kips)	AXLES/ 1000 TRUCKS
24	0.07	24	0.07	24	0.07
24	1.6	24	1.6	24	1.6
22	2.6	22	2.6	22	2.6
20	6.63	20	6.63	20	6.63
18	16.61	18	16.61	18	16.61
16	23.88	16	23.88	16	23.88
14	47.76	14	47.76	14	47.76
12	116.76	12	116.76	12	116.76
10	142.7	10	142.7	10	142.7
8	233.6	8	233.6	8	233.6

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Project Type: Street ➋ Concrete

TRAFFIC

Select Spectrum Type

Design Life (Years)

Select Spectrum Type

Select a predefined distribution of axle loads and axles per thousand trucks that best characterizes the truck traffic you expect.

Custom distributions may also be entered.

More Information

GLOBAL

Reliability (%)

% of Slabs Cracked at End of Design Life (%)

TRAFFIC SUMMARY DETAILS

Single AXLE LOAD (kips)	Single AXLES/ 1000 TRUCKS	Tandem AXLE LOAD (kips)	Tandem AXLES/ 1000 TRUCKS	Tridem AXLE LOAD (kips)	Tridem AXLES/ 1000 TRUCKS
24	0.07	24	0.07	24	0.07
[illegible]	[illegible]	[illegible]	[illegible]	24	1.6
				22	2.6
				20	6.63
				18	16.61
				16	23.88
				14	47.76
				12	116.76
				10	142.7
				8	233.6

Help (Select Spectrum Type)

The four default traffic categories in the left column are each a composite of data averaged from loadometer tables representative of the facility type listed and the five default traffic categories in the right column are from the forthcoming ACI 330-18 design guide, 'Guide for Design and Construction of Concrete Parking Lots.' ACI 330R-08 describes Category A as passenger cars only, Categories B and C as composites of data averaged from several loadometer tables representing appropriate pavement facilities, and Category D as tractor semitrailer trucks with gross weights of 80 kips (360 kN). The table below gives general details for each default traffic category in the left column.

Traffic Category	Description	Traffic			Maximum Axles Loads (kips)	
		ADT	% Trucks	ADTT**	Single Axles	Tandem Axles
Residential	Residential streets, rural and secondary roads (low to medium*)	50-800	1%-3%	1-20	22	36
Collector	Collector streets, rural and secondary roads (high*), arterial streets and primary roads (low*)	700-5,000	3%-15%	40-1,000	26	44
Minor Arterial	Arterial streets and primary roads (medium*), expressways and urban and rural interstate (low to medium*)	3,000-15,000+	5%-25%	300-5,000+	30	52
Major Arterial	Arterial streets, primary roads, expressways (high*), urban and rural interstate (medium to high*)	4,000-50,000+	10%-30%	700-10,000+	34	60

*The descriptors high, medium, or low refer to the relative weights of axle loads for the type of street or road; that is, "low" for a rural Interstate would represent heavier loads than "low" for a secondary road.

** Trucks -- two-axle, four-tire trucks excluded.

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Project Type: Street ➔ Concrete

TRAFFIC

Collector

Design Life

(Years)

User Defined Traffic Info

Trucks/Day

Traffic Growth Rate

(% per year)

Directional Distribution

(%)

Design Lane Distribution

(%)

GLOBAL

Reliability

(%)

% of Slabs Cracked at End of Design Life

(%)

CALCULATED TRAFFIC RESULTS

Avg Trucks/Day in Design Lane over the Design Life

Total Trucks in Design Lane over the Design Life

TRAFFIC SUMMARY DETAILS

Single		Tandem		Tridem	
AXLE LOAD (kips)	AXLES/ 1000 TRUCKS	AXLE LOAD (kips)	AXLES/ 1000 TRUCKS	AXLE LOAD (kips)	AXLES/ 1000 TRUCKS
26	0.07	44	1.16	62	0
24	1.6	36	7.76	56	0
22	2.6	40	38.79	50	0
20	6.63	32	54.76	44	0
18	16.61	28	44.43	38	0
16	23.88	24	30.74	32	0
14	47.76	20	45	26	0
12	116.76	16	59.25	20	0
10	142.7	12	91.15	14	0
8	233.6	8	47.01	8	0

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Project Type: Street ➔ Concrete

TRAFFIC

Collector

Design Life

25 (Years)

User Defined Traffic Info

Trucks/Day

Traffic Growth Rate

(% per year)

Directional Distribution

(%)

Design Lane Distribution

(%)

GLOBAL

Reliability

(%)

% of Slabs Cracked at End of Design Life

(%)

CALCULATED TRAFFIC RESULTS

Avg Trucks/Day in Design Lane over the Design Life

Total Trucks in Design Lane over the Design Life

TRAFFIC SUMMARY DETAILS

Single AXLE LOAD (kips)	Single AXLES/ 1000 TRUCKS	Tandem AXLE LOAD (kips)	Tandem AXLES/ 1000 TRUCKS	Tridem AXLE LOAD (kips)	Tridem AXLES/ 1000 TRUCKS
26	0.07	44	1.16	62	0
24	1.6	36	7.76	56	0
22	2.6	40	38.79	50	0
20	6.63	32	54.76	44	0
18	16.61	28	44.43	38	0
16	23.88	24	30.74	32	0
14	47.76	20	45	26	0
12	116.76	16	59.25	20	0
10	142.7	12	91.15	14	0
8	233.6	8	47.01	8	0

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Project Type: Street ➔ Concrete

TRAFFIC

Collector

Design Life

25 (Years)

User Defined Traffic Info

Trucks/Day

100

Traffic Growth Rate

(% per year)

Directional Distribution

(%)

Design Lane Distribution

(%)

GLOBAL

Reliability

(%)

% of Slabs Cracked at End of Design Life

(%)

CALCULATED TRAFFIC RESULTS

Avg Trucks/Day in Design Lane over the Design Life

Total Trucks in Design Lane over the Design Life

TRAFFIC SUMMARY DETAILS

Single		Tandem		Tridem	
AXLE LOAD (kips)	AXLES/ 1000 TRUCKS	AXLE LOAD (kips)	AXLES/ 1000 TRUCKS	AXLE LOAD (kips)	AXLES/ 1000 TRUCKS
26	0.07	44	1.16	62	0
24	1.6	36	7.76	56	0
22	2.6	40	38.79	50	0
20	6.63	32	54.76	44	0
18	16.61	28	44.43	38	0
16	23.88	24	30.74	32	0
14	47.76	20	45	26	0
12	116.76	16	59.25	20	0
10	142.7	12	91.15	14	0
8	233.6	8	47.01	8	0

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TRAFFIC

Collector

Design Life

25 (Years)

User Defined Traffic Info

Trucks/Day

100

Traffic Growth Rate

1 (% per year)

Directional Distribution

(%)

Design Lane Distribution

(%)

GLOBAL

Reliability

(%)

% of Slabs Cracked at End of Design Life

(%)

CALCULATED TRAFFIC RESULTS

Avg Trucks/Day in Design Lane over the Design Life

Total Trucks in Design Lane over the Design Life

TRAFFIC SUMMARY DETAILS

Single AXLE LOAD (kips)	Single AXLES/ 1000 TRUCKS	Tandem AXLE LOAD (kips)	Tandem AXLES/ 1000 TRUCKS	Tridem AXLE LOAD (kips)	Tridem AXLES/ 1000 TRUCKS
26	0.07	44	1.16	62	0
24	1.6	36	7.76	56	0
22	2.6	40	38.79	50	0
20	6.63	32	54.76	44	0
18	16.61	28	44.43	38	0
16	23.88	24	30.74	32	0
14	47.76	20	45	26	0
12	116.76	16	59.25	20	0
10	142.7	12	91.15	14	0
8	233.6	8	47.01	8	0

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Project Type: Street ➔ Concrete

TRAFFIC

Collector

Design Life

25 (Years)

User Defined Traffic Info

Trucks/Day

100

Traffic Growth Rate

1 (% per year)

Directional Distribution

50 (%)

Design Lane Distribution

(%)

GLOBAL

Reliability

(%)

% of Slabs Cracked at End of Design Life

(%)

CALCULATED TRAFFIC RESULTS

Avg Trucks/Day in Design Lane over the Design Life

Total Trucks in Design Lane over the Design Life

TRAFFIC SUMMARY DETAILS

Single		Tandem		Tridem	
AXLE LOAD (kips)	AXLES/ 1000 TRUCKS	AXLE LOAD (kips)	AXLES/ 1000 TRUCKS	AXLE LOAD (kips)	AXLES/ 1000 TRUCKS
26	0.07	44	1.16	62	0
24	1.6	36	7.76	56	0
22	2.6	40	38.79	50	0
20	6.63	32	54.76	44	0
18	16.61	28	44.43	38	0
16	23.88	24	30.74	32	0
14	47.76	20	45	26	0
12	116.76	16	59.25	20	0
10	142.7	12	91.15	14	0
8	233.6	8	47.01	8	0

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Calculation was successful

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Project Type: Street ➔ Concrete

TRAFFIC

Collector

Design Life: 25 (Years)

User Defined Traffic Info

Trucks/Day: 100

Traffic Growth Rate: 1 (% per year)

Directional Distribution: 50 (%)

Design Lane Distribution: 100 (%)

GLOBAL

Reliability: (%)

% of Slabs Cracked at End of Design Life: (%)

CALCULATED TRAFFIC RESULTS

Avg Trucks/Day in Design Lane over the Design Life: 56

Total Trucks in Design Lane over the Design Life: 515,791

TRAFFIC SUMMARY DETAILS

Single		Tandem		Tridem	
AXLE LOAD (kips)	AXLES/ 1000 TRUCKS	AXLE LOAD (kips)	AXLES/ 1000 TRUCKS	AXLE LOAD (kips)	AXLES/ 1000 TRUCKS
26	0.07	44	1.16	62	0
24	1.6	36	7.76	56	0
22	2.6	40	38.79	50	0
20	6.63	32	54.76	44	0
18	16.61	28	44.43	38	0
16	23.88	24	30.74	32	0
14	47.76	20	45	26	0
12	116.76	16	59.25	20	0
10	142.7	12	91.15	14	0
8	233.6	8	47.01	8	0

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Project Type: Street ➔ Concrete

TRAFFIC

Collector

Design Life

25 (Years)

User Defined Traffic Info

Trucks/Day

100

Traffic Growth Rate

1 (% per year)

Directional Distribution

50 (%)

Design Lane Distribution

100 (%)

GLOBAL

Reliability

85 (%)

% of Slabs Cracked at End of Design Life

(%)

CALCULATED TRAFFIC RESULTS

Avg Trucks/Day in Design Lane over the Design Life

56

Total Trucks in Design Lane over the Design Life

515,791

TRAFFIC SUMMARY DETAILS

Single		Tandem		Tridem	
AXLE LOAD (kips)	AXLES/ 1000 TRUCKS	AXLE LOAD (kips)	AXLES/ 1000 TRUCKS	AXLE LOAD (kips)	AXLES/ 1000 TRUCKS
26	0.07	44	1.16	62	0
24	1.6	36	7.76	56	0
22	2.6	40	38.79	50	0
20	6.63	32	54.76	44	0
18	16.61	28	44.43	38	0
16	23.88	24	30.74	32	0
14	47.76	20	45	26	0
12	116.76	16	59.25	20	0
10	142.7	12	91.15	14	0
8	233.6	8	47.01	8	0

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TRAFFIC

Collector

Design Life

25 (Years)

User Defined Traffic Info

Trucks/Day

100

Traffic Growth Rate

1 (% per year)

Directional Distribution

50 (%)

Design Lane Distribution

100 (%)

GLOBAL

Reliability

85 (%)

% of Slabs Cracked at End of Design Life

15 (%)

CALCULATED TRAFFIC RESULTS

Avg Trucks/Day in Design Lane over the Design Life

56

Total Trucks in Design Lane over the Design Life

515,791

TRAFFIC SUMMARY DETAILS

Single		Tandem		Tridem	
AXLE LOAD (kips)	AXLES/ 1000 TRUCKS	AXLE LOAD (kips)	AXLES/ 1000 TRUCKS	AXLE LOAD (kips)	AXLES/ 1000 TRUCKS
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24	1.6	36	7.76	56	0
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20	6.63	32	54.76	44	0
18	16.61	28	44.43	38	0
16	23.88	24	30.74	32	0
14	47.76	20	45	26	0
12	116.76	16	59.25	20	0
10	142.7	12	91.15	14	0
8	233.6	8	47.01	8	0

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Select Pavement Design Type

Jointed-Plain Concrete Pavement (JPCP)

Roller-Compacted Concrete (RCC)

Continuously Reinforced Concrete Pavement (CRCP)

Project Level

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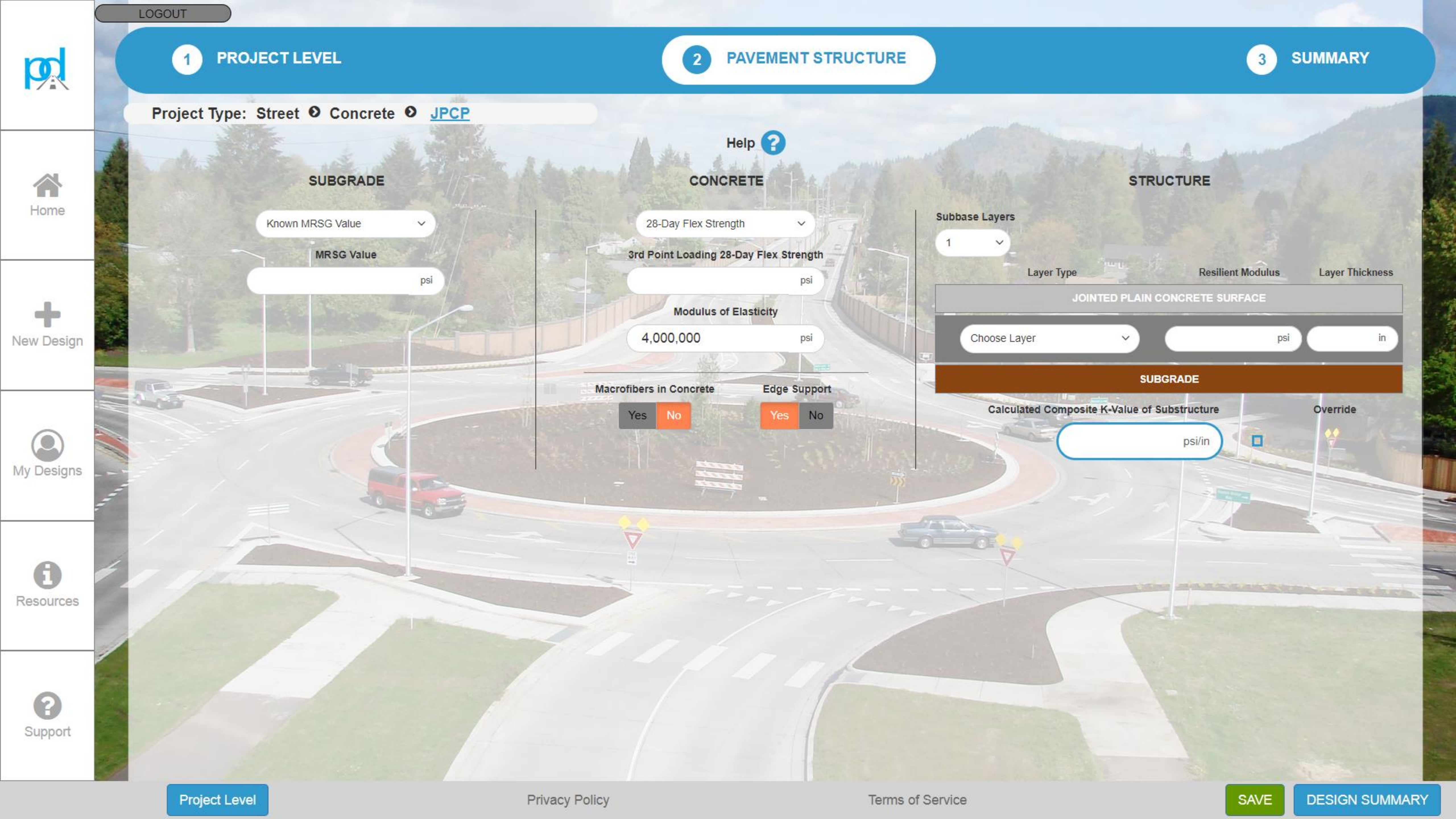
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SUBGRADE
Known MRSG Value
MRSG Value
psi
CONCRETE
28-Day Flex Strength
3rd Point Loading 28-Day Flex Strength
psi
Modulus of Elasticity
4,000,000 psi
Macrofibers in Concrete
Yes No
Edge Support
Yes No
STRUCTURE
Subbase Layers
1
Layer Type
Resilient Modulus
Layer Thickness
JOINTED PLAIN CONCRETE SURFACE
Choose Layer
psi
in
SUBGRADE
Calculated Composite K-Value of Substructure
psi/in
Override
Project Level
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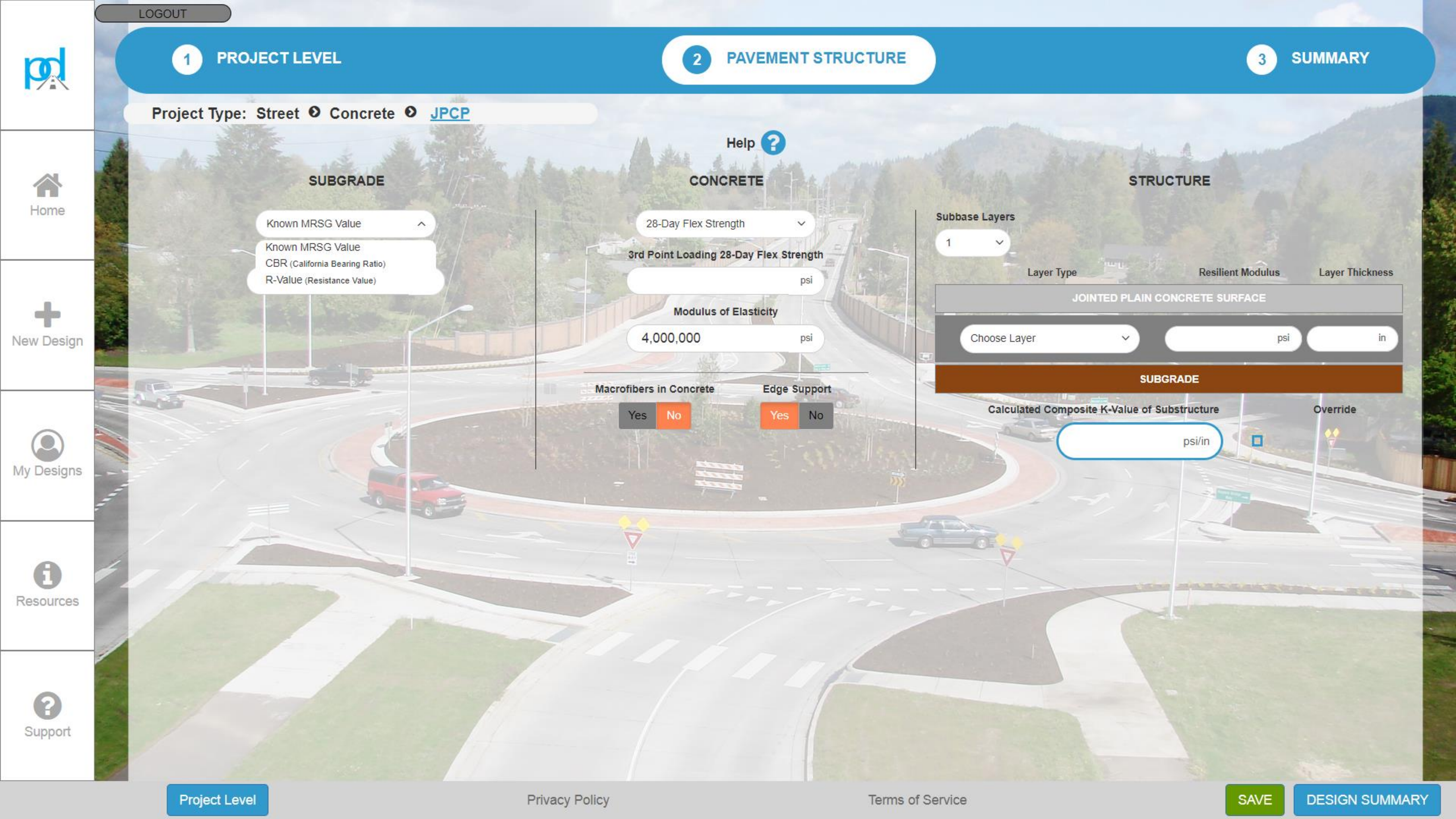
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SUBGRADE
Known MRSG Value
Known MRSG Value
CBR (California Bearing Ratio)
R-Value (Resistance Value)
CONCRETE
28-Day Flex Strength
3rd Point Loading 28-Day Flex Strength
psi
Modulus of Elasticity
4,000,000 psi
Macrofibers in Concrete
Yes No
Edge Support
Yes No
STRUCTURE
Subbase Layers
1
Layer Type
Resilient Modulus
Layer Thickness
JOINTED PLAIN CONCRETE SURFACE
Choose Layer
psi
in
SUBGRADE
Calculated Composite K-Value of Substructure
psi/in
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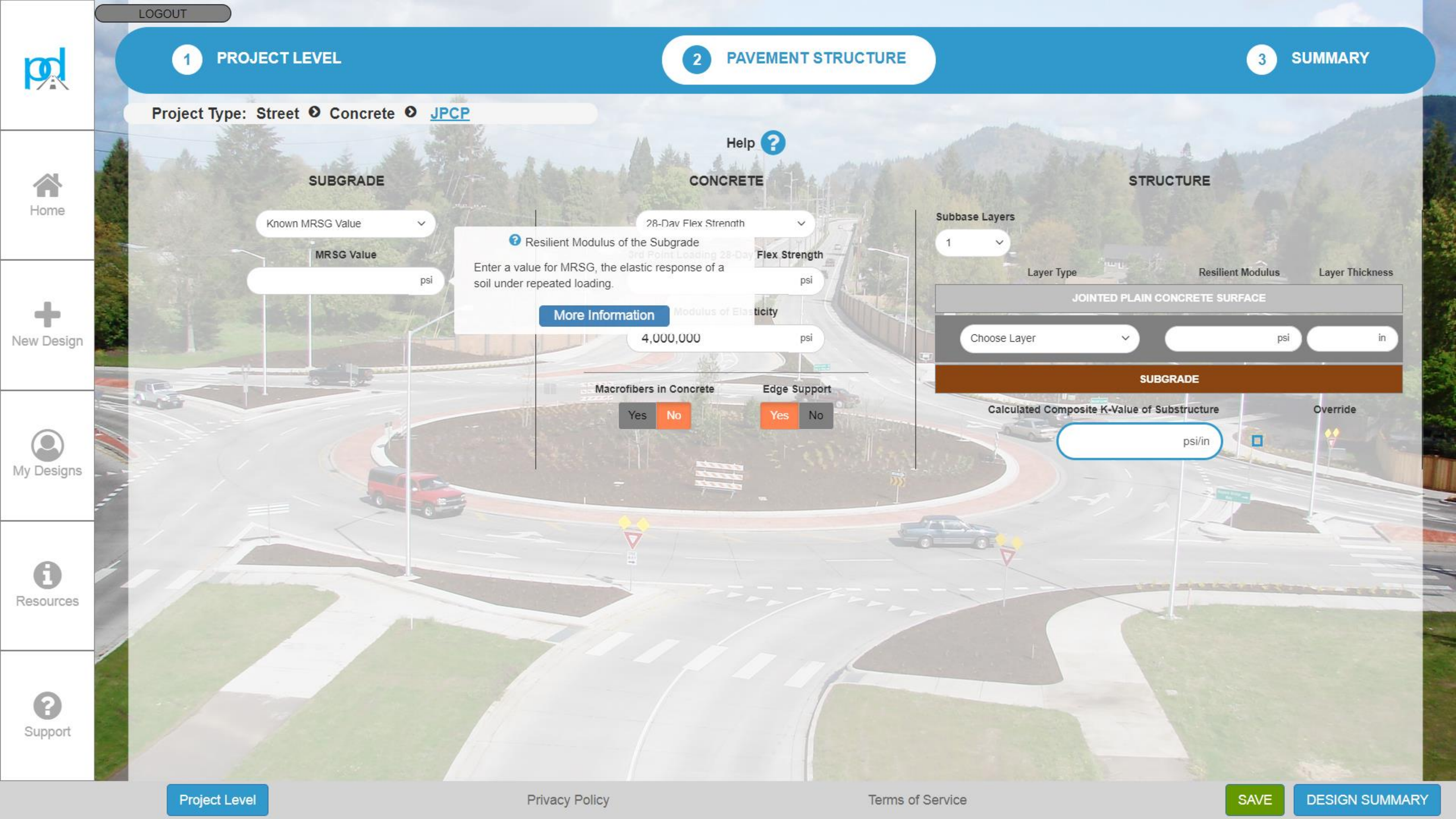
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Help
SUBGRADE
Known MRSG Value
MRSG Value
psi
CONCRETE
28-Day Flex Strength
Resilient Modulus of the Subgrade
Enter a value for MRSG, the elastic response of a soil under repeated loading.
More Information
Flex Strength
psi
4,000,000
psi
Macrofibers in Concrete
Yes No
Edge Support
Yes No
STRUCTURE
Subbase Layers
1
Layer Type
Resilient Modulus
Layer Thickness
JOINTED PLAIN CONCRETE SURFACE
Choose Layer
psi
in
SUBGRADE
Calculated Composite K-Value of Substructure
psi/in
Override
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Project Type: Street ➔ Concrete ➔ JPCP

Help ?

SUBGRADE

Known MRSG Value

MRSG Value

psi

CONCRETE

28-Day Flex Strength

3rd Point Loading 28-Day Flex Strength

psi

Modulus of Elasticity

STRUCTURE

Subbase Layers

1

Layer Type | Resilient Modulus | Layer Thickness

JOINTED PLAIN CONCRETE SURFACE

psi | in

Override

Help (Resilient Modulus of the Subgrade)

The Resilient Modulus is one of three basic subgrade soil stiffness/strength characterizations commonly used in structural design of pavements. Resilient Modulus is a measure of the elastic response of a soil (how well a soil is able to return to its original shape and size after being stressed) under repeated loading. The table below shows typical CBR and Resilient Modulus values for various common subgrade soils.

Description	AASHTO	ASTM (Unified)	CBR (%)	Resilient Modulus (psi)
Coarse-Grained Soils				
Gravel	A-1-a, well graded	GW,GP	60-80	32,000-39,000
	A-1-a, poorly graded		35-60	22,000-32,000
Coarse Sand	A-1-b	SW	20-40	15,000-25,000
Fine Sand	A-3	SP	15-25	12,000-18,000
Granular Materials with High Fines				
Silt Gravel	A-2-4, gravelly	GM	40-80	25,000-39,000
Silt Sandy Gravel	A-2-5, gravelly			
Silty Sand	A-2-4, sandy	SM	20-40	15,000-25,000
Siltly Gravelly Sand	A-2-5, sandy			
Clayey Gravel	A-2-6, gravelly	GC	20-40	15,000-25,000
Clayey Sandy Gravel	A-2-7, gravelly			
Clayey Sand	A-2-6, sandy	SC	10-20	9,000-15,000
Clayey Gravelly Sand	A-2-7, sandy			
Fine-Grained Soils				
Silt	A-4	ML, OL	4-8	5,000-8,000
Silt/Sand/Gravel Mixture			5-15	6,000-12,000
Poorly Graded Silt	A-5	MH	4-8	5,000-8,000
Plastic Clay	A-6	CL	5-15	6,000-12,000

Project Level

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Project Type: Street ➔ Concrete ➔ JPCP

Help ?

SUBGRADE

Known MRSG Value

MRSG Value

psi

CONCRETE

28-Day Flex Strength

3rd Point Loading 28-Day Flex Strength

psi

STRUCTURE

Subbase Layers

1

Layer Type Resilient Modulus Layer Thickness

JOINTED PLAIN CONCRETE SURFACE

psi in

Override

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Help (Resilient Modulus of the Subgrade)

The Resilient Modulus is one of three basic subgrade soil stiffness/strength characterizations commonly used in structural design of pavements. Resilient Modulus is a measure of the elastic response of a soil (how well a soil is able to return to its original shape and size after being stressed) under repeated loading. The table below shows typical CBR and Resilient Modulus values for various common subgrade soils.

Description	AASHTO	ASTM (Unified)	CBR (%)	Resilient Modulus (psi)
Coarse-Grained Soils				
Gravel	A-1-a, well graded	GW,GP	60-80	32,000-39,000
	A-1-a, poorly graded		35-60	22,000-32,000
Coarse Sand	A-1-b	SW	20-40	15,000-25,000
Fine Sand	A-3	SP	15-25	12,000-18,000
Granular Materials with High Fines				
Silt Gravel	A-2-4, gravelly	GM	40-80	25,000-39,000
Silt Sandy Gravel	A-2-5, gravelly			
Silty Sand	A-2-4, sandy	SM	20-40	15,000-25,000
Siltly Gravelly Sand	A-2-5, sandy			
Clayey Gravel	A-2-6, gravelly	GC	20-40	15,000-25,000
Clayey Sandy Gravel	A-2-7, gravelly			
Clayey Sand	A-2-6, sandy	SC	10-20	9,000-15,000
Clayey Gravelly Sand	A-2-7, sandy			
Fine-Grained Soils				
Silt	A-4	ML, OL	4-8	5,000-8,000
Silt/Sand/Gravel Mixture			5-15	6,000-12,000
Poorly Graded Silt	A-5	MH	4-8	5,000-8,000
Plastic Clay	A-6	CL	5-15	6,000-12,000

Project Level

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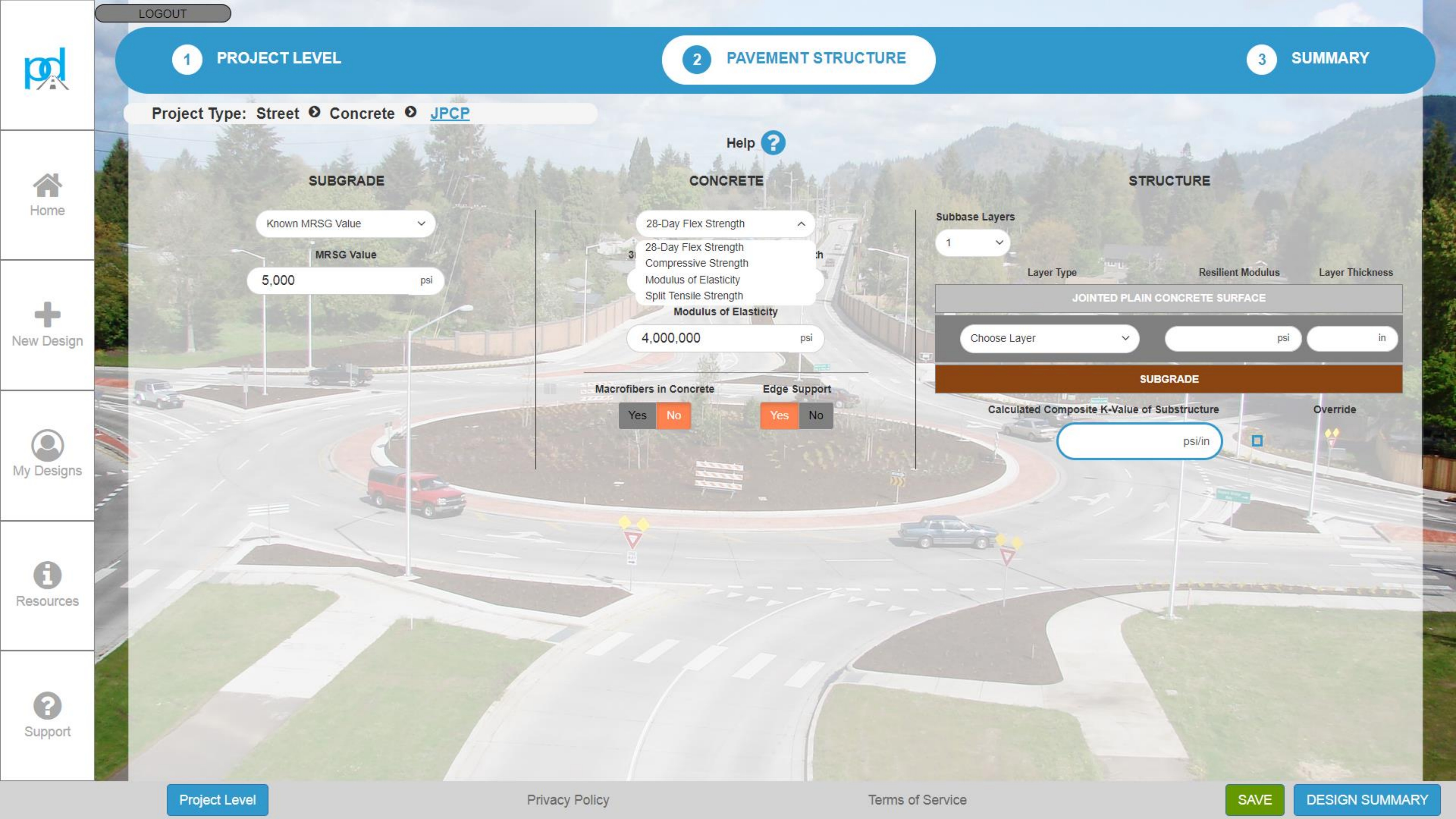
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SUBGRADE
Known MRSG Value
MRSG Value
5,000 psi
CONCRETE
28-Day Flex Strength
28-Day Flex Strength
Compressive Strength
Modulus of Elasticity
Split Tensile Strength
Modulus of Elasticity
4,000,000 psi
Macrofibers in Concrete
Yes No
Edge Support
Yes No
STRUCTURE
Subbase Layers
1
Layer Type
Resilient Modulus
Layer Thickness
JOINTED PLAIN CONCRETE SURFACE
Choose Layer
psi
in
SUBGRADE
Calculated Composite K-Value of Substructure
psi/in
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Help ?

SUBGRADE

Known MRSG Value

MRSG Value

5,000 psi

CONCRETE

28-Day Flex Strength

3rd Point Loading 28-Day Flex Strength

550 psi

Modulus of Elasticity

4,000,000 psi

Macrofibers in Concrete: Yes No

Edge Support: Yes No

STRUCTURE

Subbase Layers

1

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Choose Layer	psi	in
SUBGRADE		

Calculated Composite K-Value of Substructure

psi/in

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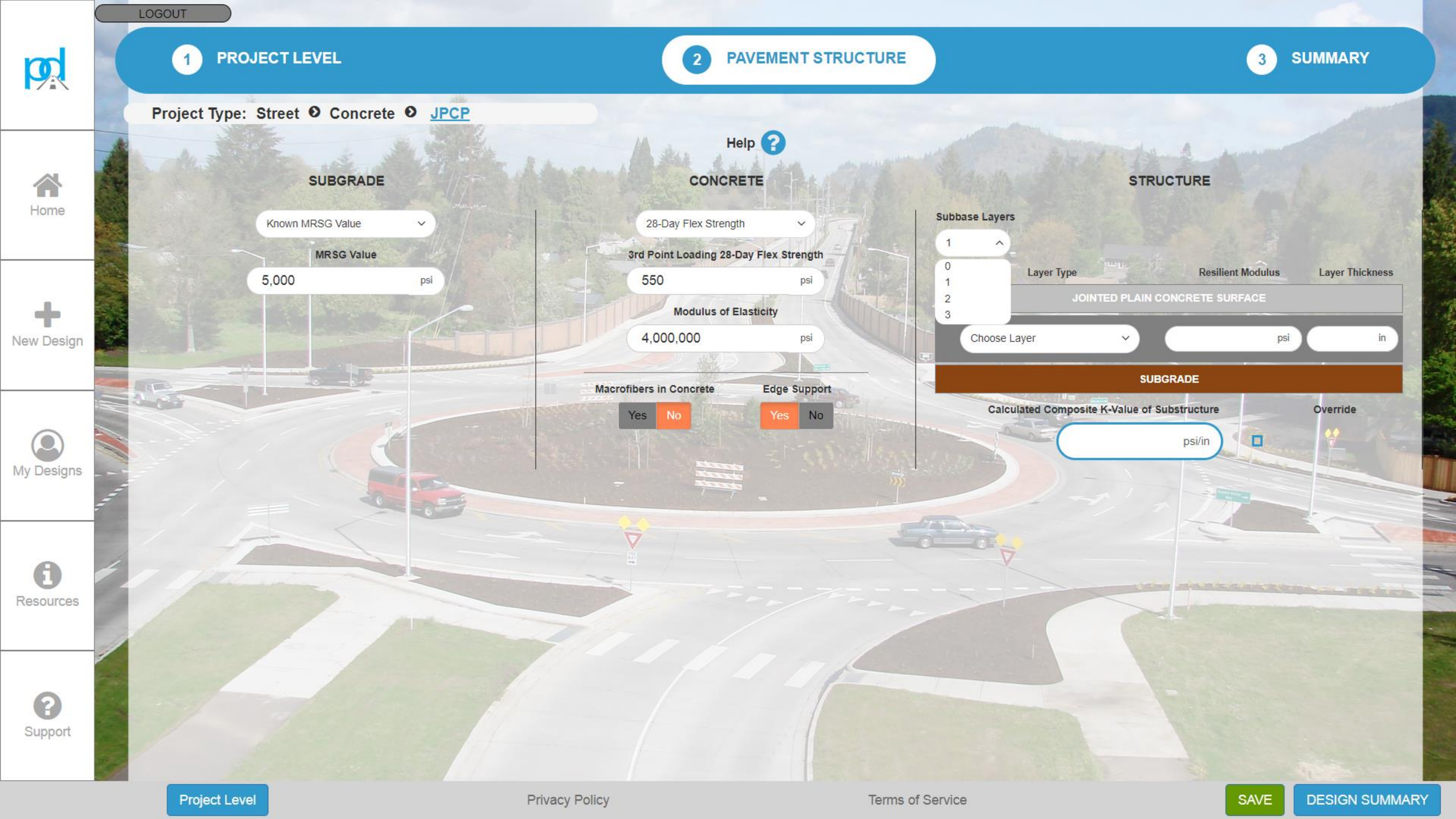
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Help
SUBGRADE
Known MRSG Value
MRSG Value
5,000 psi
CONCRETE
28-Day Flex Strength
3rd Point Loading 28-Day Flex Strength
550 psi
Modulus of Elasticity
4,000,000 psi
Macrofibers in Concrete
Yes No
Edge Support
Yes No
STRUCTURE
Subbase Layers
1
0
1
2
3
Layer Type
Resilient Modulus
Layer Thickness
JOINTED PLAIN CONCRETE SURFACE
Choose Layer
psi
in
SUBGRADE
Calculated Composite K-Value of Substructure
psi/in
Override
Project Level
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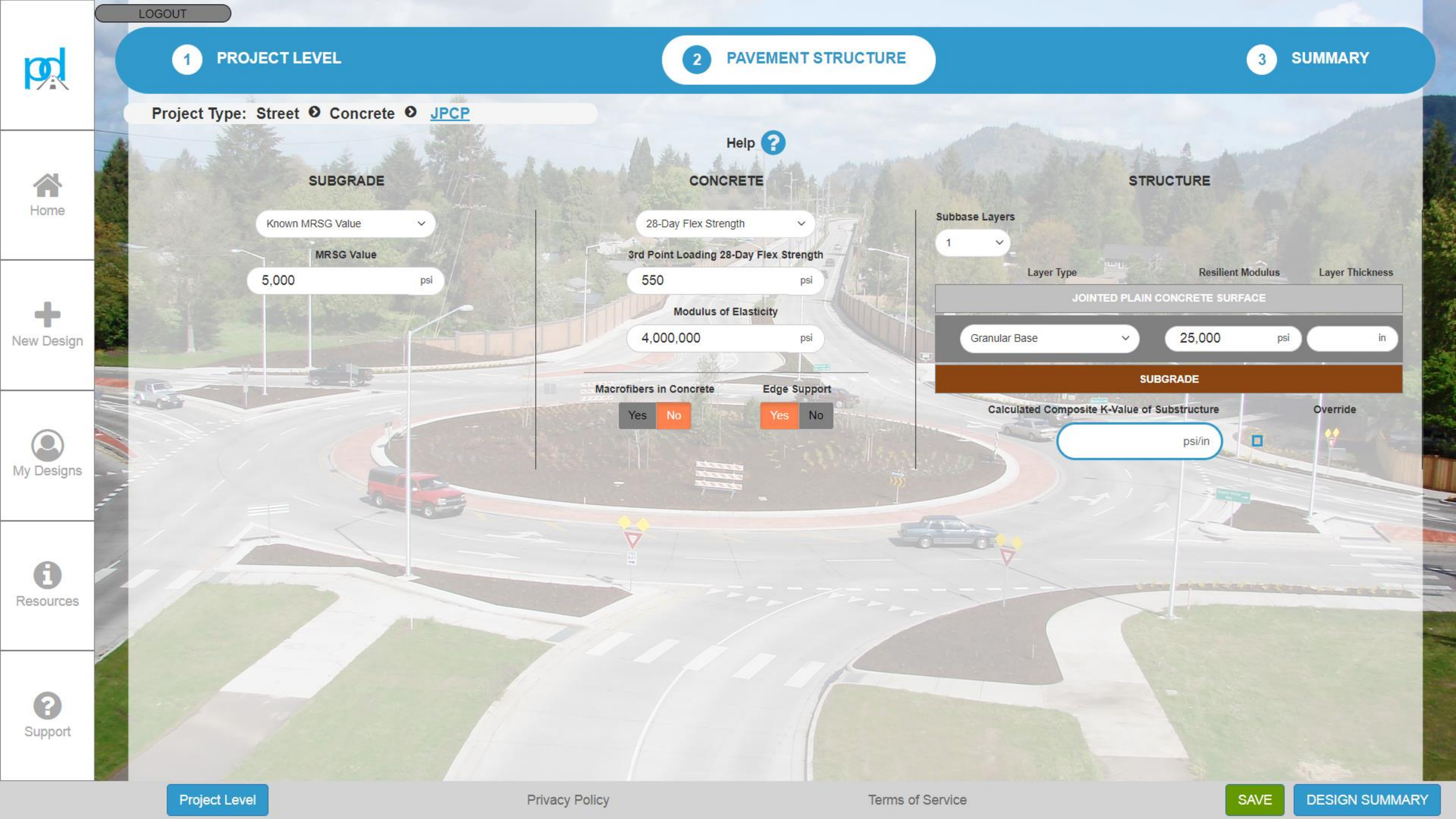
DESIGN SUMMARY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Known MRSG Value
MRSG Value
5,000 psi
CONCRETE
28-Day Flex Strength
3rd Point Loading 28-Day Flex Strength
550 psi
Modulus of Elasticity
4,000,000 psi
Macrofibers in Concrete
Yes No
Edge Support
Yes No
STRUCTURE
Subbase Layers
1
Layer Type
Resilient Modulus
Layer Thickness
JOINTED PLAIN CONCRETE SURFACE
Granular Base
25,000 psi
in
SUBGRADE
Calculated Composite K-Value of Substructure
psi/in
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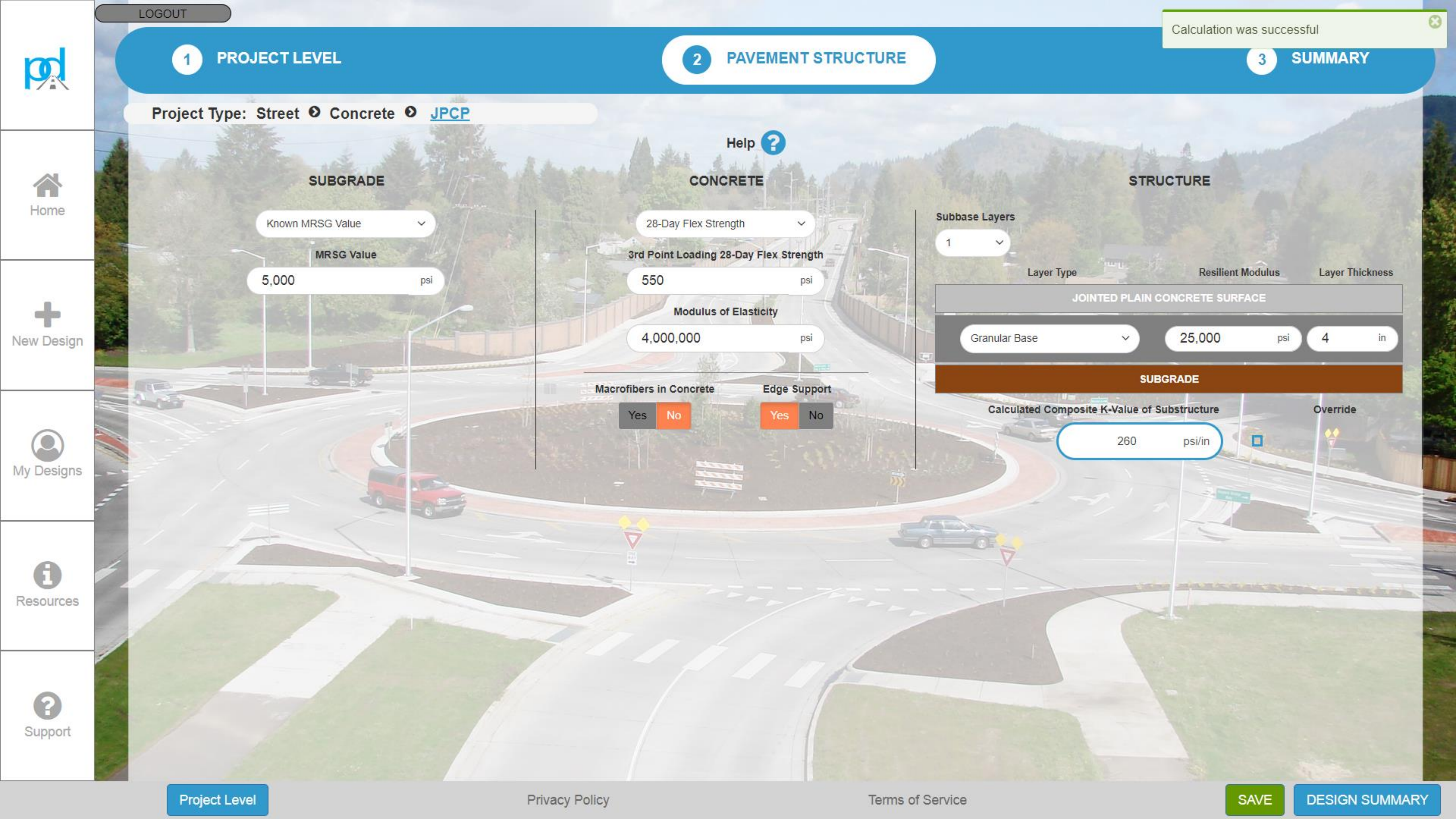
DESIGN SUMMARY



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Known MRSG Value
MRSG Value
5,000 psi
CONCRETE
28-Day Flex Strength
3rd Point Loading 28-Day Flex Strength
550 psi
Modulus of Elasticity
4,000,000 psi
Macrofibers in Concrete
Yes No
Edge Support
Yes No
STRUCTURE
Subbase Layers
1
Layer Type
Resilient Modulus
Layer Thickness
JOINTED PLAIN CONCRETE SURFACE
Granular Base
25,000 psi
4 in
SUBGRADE
Calculated Composite K-Value of Substructure
260 psi/in
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Project Type: Street › Concrete › JPCP

Calculated Minimum Thickness

Doweled	Undoweled
5.83 in	5.83 in

Recommended Design Thickness

Doweled	Undoweled
6.00 in	6.00 in

Maximum Joint Spacing

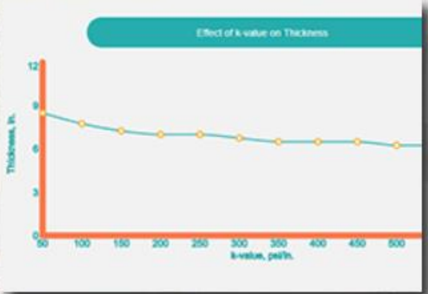
Doweled	Undoweled
11 ft	11 ft

PavementDesigner.org

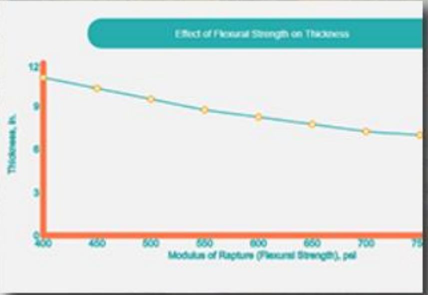
Analysis and Guidance

SENSITIVITY | CRACKING | EROSION | LOAD TRANSFER | JOINT SPACING

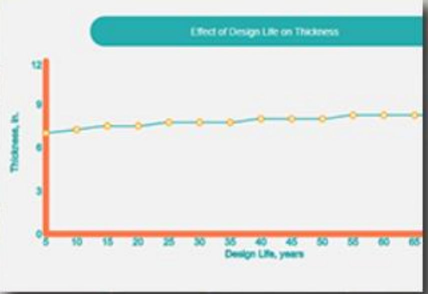
DOWELED | UNDOWELED



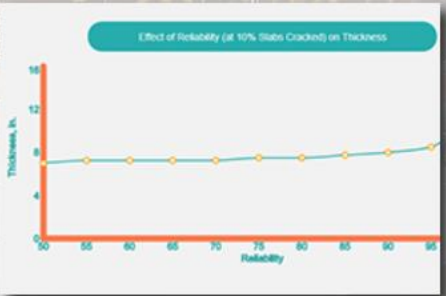
K-Value



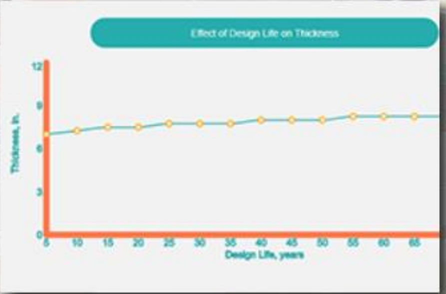
Flexural Strength



Design Life



Reliability



% Slabs Cracked

PAVEMENT STRUCTURE

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Project Type: Street ➋ Concrete ➋ JPCP

Calculated Minimum Thickness

Doweled	Undoweled
5.83 in	5.83 in

Recommended Design Thickness

Doweled	Undoweled
6.00 in	6.00 in

Maximum Joint Spacing

Doweled	Undoweled
11 ft	11 ft

PavementDesigner.org

Analysis and Guidance

SENSITIVITY | CRACKING | EROSION | LOAD TRANSFER | JOINT SPACING

DOWELED | UNDOWELED

The key to excellent long-term performance of doweled joints is adequate load transfer over the life of the pavement. Load transfer devices generally are recommended for jointed plain concrete pavements that have an initial design thickness greater than about 8 inches (200 mm) because traffic levels that require such thicknesses for fatigue resistance also are of a level that might result in pumping and faulting of the joints if load transfer devices are not included in the joints. When the initial design thickness is less than 8 inches (200 mm), load transfer devices are recommended only if faulting is the predicted cause of failure.

Although other geometries (e.g., elliptical, plate, square, etc.) and materials (e.g., stainless or microcomposite steel, zinc alloy-sleeved, etc.) can be used to transfer load across transverse joints in jointed plain concrete pavements, round and smooth steel dowel bars are the most commonly used load transfer device. Typical size recommendations for round steel dowel bars placed at 12 in. (300 mm) on-center are:

Recommended Dowel Bar Size

Concrete Design Thickness, in.	Dowel Bar Size, in.
less than 8 in. and cracking is predicated cause of failure	Dowel not recommended
less than 8 in. and faulting is predicted cause of failure	1.00 in.
between 8 in. and 10 in.	1.25 in.
greater than 10 in.	1.50 in.

Required load transfer device size and spacing can, however, vary based on load transfer technology geometry and material (see manufacturer's recommendations), and some non-uniform spacings offer opportunities to optimize/minimize steel content at the joints while causing minimal impacts on pavement responses (see ACPA's DowelCAD 2.0). Other exceptions also exist, like the lack of a need for load transfer devices in bonded concrete overlays on asphalt or composite pavements. The National Concrete Consortium (NCC) also has developed, "Recommendations for Standardized Dowel Load Transfer Systems for Jointed Concrete Pavements," which are available through the National Concrete Pavement Technology (CP Tech) Center

PAVEMENT STRUCTURE

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Project Type: Street › Concrete › JPCP

Calculated Minimum Thickness

Doweled	Undoweled
5.83 in	5.83 in

Recommended Design Thickness

Doweled	Undoweled
6.00 in	6.00 in

Maximum Joint Spacing

Doweled	Undoweled
11 ft	11 ft

PavementDesigner.org

Analysis and Guidance

SENSITIVITY | CRACKING | EROSION | LOAD TRANSFER | JOINT SPACING | DOWELED | UNDOWELED

The key to excellent long-term performance of doweled joints is adequate load transfer over the life of the pavement. Load transfer devices generally are recommended for jointed plain concrete pavements that have an initial design thickness greater than about 8 inches (200 mm) because traffic levels that require such thicknesses for fatigue ... pumping and faulting of the joints if load transfer devices are not ... thickness is less than 8 inches (200 mm), load transfer devices are ... cause of failure.

... te, square, etc.) and materials (e.g., stainless or microcomposite steel, ... er load across transverse joints in jointed plain concrete pavements, ... ost commonly used load transfer device. Typical size recommendations ... 0 mm) on-center are:

SAVE DESIGN

Design Name

Enter unique design name

Folder Name

Project Folder

+ CREATE NEW FOLDER

SAVE

..., in.	Dowel Bar Size, in.
...d cause of failure	Dowel not recommended
... cause of failure	1.00 in.
between 8 in. and 10 in.	1.25 in.
greater than 10 in.	1.50 in.

Required load transfer device size and spacing can, however, vary based on load transfer technology geometry and material (see manufacturer's recommendations), and some non-uniform spacings offer opportunities to optimize/minimize steel content at the joints while causing minimal impacts on pavement responses (see ACPA's DowelCAD 2.0). Other exceptions also exist, like the lack of a need for load transfer devices in bonded concrete overlays on asphalt or composite pavements. The National Concrete Consortium (NCC) also has developed, "Recommendations for Standardized Dowel Load Transfer Systems for Jointed Concrete Pavements," which are available through the National Concrete Pavement Technology (CP Tech) Center

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Project Type: Street ➔ Concrete ➔ JPCP

Calculated Minimum Thickness

Doweled 5.83 in
Undoweled 5.83

Recommended Design Thickness

Doweled 6.00 in
Undowele 6.00

Maximum Joint Spacing

Doweled 11 ft
Undowele 11

PavementDesigner.org

Analysis and Guidance

SENSITIVITY | CRACKING | EROSION | LOAD TRANSFER | JOINT SPACING | DOWELED | UNDOWELED

equate load transfer over the life of the pavement.
concrete pavements that have an initial design
vels that require such thicknesses for fatigue
ting of the joints if load transfer devices are not
8 inches (200 mm), load transfer devices are

materials (e.g., stainless or microcomposite steel,
verse joints in jointed plain concrete pavements,
load transfer device. Typical size recommendations
e:

	Dowel Bar Size, in.
	Dowel not recommended
	1.00 in.
	1.25 in.
	1.50 in.

Required load transfer device size and spacing can, however, vary based on load transfer technology geometry and material (see manufacturer's recommendations), and some non-uniform spacings offer opportunities to optimize/minimize steel content at the joints while causing minimal impacts on pavement responses (see ACPA's DowelCAD 2.0). Other exceptions also exist, like the lack of a need for load transfer devices in bonded concrete overlays on asphalt or composite pavements. The National Concrete Consortium (NCC) also has developed, "Recommendations for Standardized Dowel Load Transfer Systems for Jointed Concrete Pavements," which are available through the National Concrete Pavement Technology (CP Tech) Center

EDIT DESIGN DETAILS

DESIGN NAME
S&R Example 1

DESIGNERS NAME
Eric Ferrebee

ROUTE
Overland Parkway

ZIP CODE *(Project location)*

OWNER/AGENCY
ACPA

PROJECT DESCRIPTION

DOWNLOAD AND VIEW REPORT

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1 PROJECT LEVEL

3 SUMMARY

Project Type: Street › Concrete ›

Calculated Minimum Thicknes

Doweled	Undo
5.83 in	5.8

Recommended Design Thickne

Doweled	Undo
6.00 in	6.0

Maximum Joint Spacing

Doweled	Undo
11 ft	11

PavementDesigner.org

DESIGN SUMMARY REPORT FOR

JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)

DATE CREATED:

Wed Jan 30 2019 01:17:06 GMT-0600 (Central Standard Time)

Project Description

Project Name:	S&R Example 1	Owner:	ACPA	Zip Code:
Designer's Name:	Eric Ferrebee	Route:	Overland Parkway	

Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	6.00 in.	6.00 in.	Maximum Joint Spacing:	11 ft.	11 ft.
Calculated Minimum Thickness:	5.83 in.	5.83 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 260 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	25,000 psi	4 in
SUBGRADE		

CONCRETE

28-Day Flex Strength:	550 psi	Edge Support:	Yes
Modulus of Elasticity:	4000000 psi	Macrofibers in Concrete:	No

SUBGRADE

Known MRSG Value: 5,000 psi

Project Level

TRAFFIC

Spectrum Type:	Collector
Design Life:	25 years

USER DEFINED TRAFFIC

Trucks Per Day: 100

GLOBAL

Reliability:	85 %
% Slabs Cracked at End of Design Life:	15 %

Avg Trucks/Day in Design Lane Over the Design Life: 56

ING | DOWELED | UNDOWELED

...uate load transfer over the life of the pavement. ...oncrete pavements that have an initial design ...s that require such thicknesses for fatigue ...g of the joints if load transfer devices are not ...inches (200 mm), load transfer devices are

...aterials (e.g., stainless or microcomposite steel, ...se joints in jointed plain concrete pavements, ...d transfer device. Typical size recommendations

Dowel Bar Size, in.
Dowel not recommended
1.00 in.
1.25 in.
1.50 in.

...d on load transfer technology geometry and material ...s offer opportunities to optimize/minimize steel ...ses (see ACPA's DowelCAD 2.0). Other exceptions ...crete overlays on asphalt or composite pavements. ...mendations for Standardized Dowel Load Transfer ...the National Concrete Pavement Technology (CP

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DESIGN SUMMARY REPORT FOR

JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)

DATE CREATED:

Thu Oct 04 2018 15:10:11 GMT-0500 (Central Daylight Time)

Project Description

Project Name:	ARDOT - I-30 Calculator	Owner:	undefined	Zip Code:	undefined
Designer's Name:	undefined	Route:	undefined		
Project Description:	undefined				

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	8.50 in.	8.50 in.	Maximum Joint Spacing:	15 ft.	15 ft.
Calculated Minimum Thickness:	8.43 in.	8.43 in.			

Pavement Structure

SUBBASE

User-Defined Composite K-Value of Substructure: 160 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Hot-Mix or Warm-Mix Asphalt Base	450,000 psi	1 in
Cement Stabilized Subgrade	100,000 psi	6 in
SUBGRADE		

CONCRETE

28-Day Flex Strength:	630 psi	Edge Support:	Yes
Modulus of Elasticity:	3500000 psi	Macrofibers in Concrete:	No

SUBGRADE

R-Value:	20
Calculated MRSG Value	4,305 psi

Project Level

TRAFFIC

Spectrum Type:	Major Arterial
Design Life:	20 years

USER DEFINED TRAFFIC

Trucks Per Day:	7,860
Traffic Growth Rate %:	1 % per year
Directional Distribution:	50 %
Design Lane Distribution:	60 %

GLOBAL

Reliability:	90 %
% Slabs Cracked at End of Design Life:	5 %
Avg Trucks/Day in Design Lane Over the Design Life:	2,596
Total Trucks in Design Lane Over the Design Life:	18,964,076

ARDOT - I-30 and Ramps Concrete Pavement Design Analysis - Optimi

File Name: C:\Users\eferrebee.acpa\Documents\My ME Design\ARDOT - I-30 and Ramps Concrete Pavement Design Analysis - Optimized.dgpx

Design Inputs

Design Life:	20 years	Existing construction:	-	Climate Data Sources (Lat/Lon)	34.747, -92.233
Design Type:	JPCP	Pavement construction:	June, 2020		
		Traffic opening:	September, 2020		

Design Structure

Layer type	Material Type	Thickness (in)
PCC	JPCP Default	9.0
Flexible	Default asphalt concrete	1.0
Cement_Base	Cement stabilized	6.0
Subgrade	A-7-6	10.0
Subgrade	A-7-6	Semi-infinite

Joint Design:	
Joint spacing (ft)	15.0
Dowel diameter (in)	1.25
Slab width (ft)	12.0

Traffic

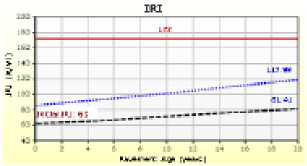
Age (year)	Heavy Trucks (cumulative)
2020 (initial)	7,860
2030 (10 years)	9,775,300
2040 (20 years)	22,134,400

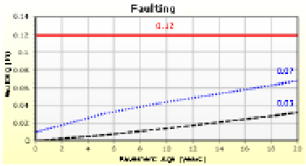
Design Outputs

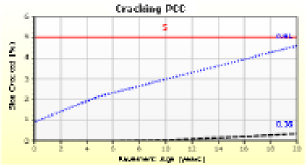
Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion Satisfied?
	Target	Predicted	Target	Achieved	
Terminal IRI (in/mile)	172.00	117.99	90.00	99.92	Pass
Mean joint faulting (in)	0.12	0.07	90.00	99.90	Pass
JPCP transverse cracking (percent slabs)	5.00	4.61	90.00	91.91	Pass

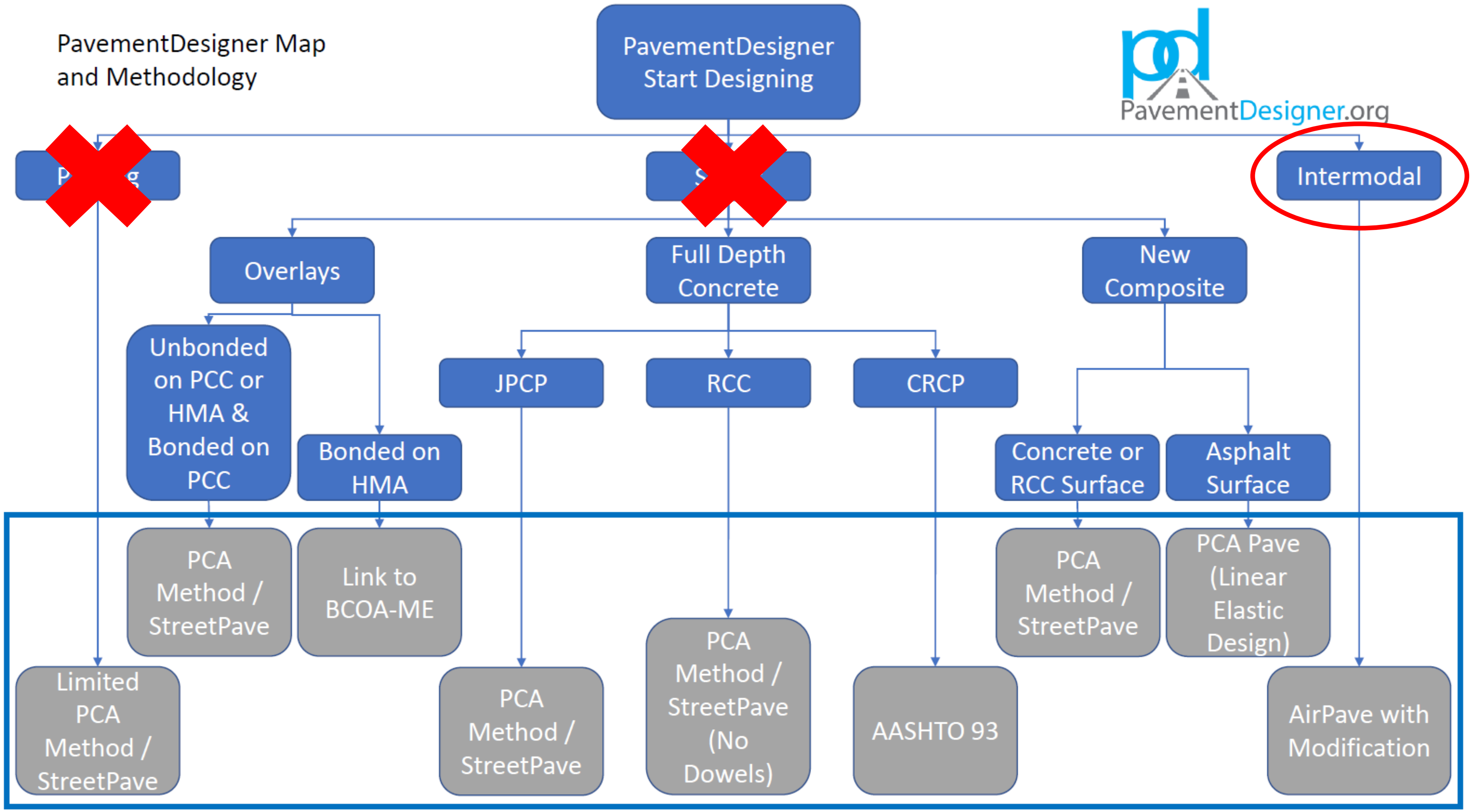
Distress Charts







Threshold Value ····· @ Specified Reliability - - - @ 50% Reliability

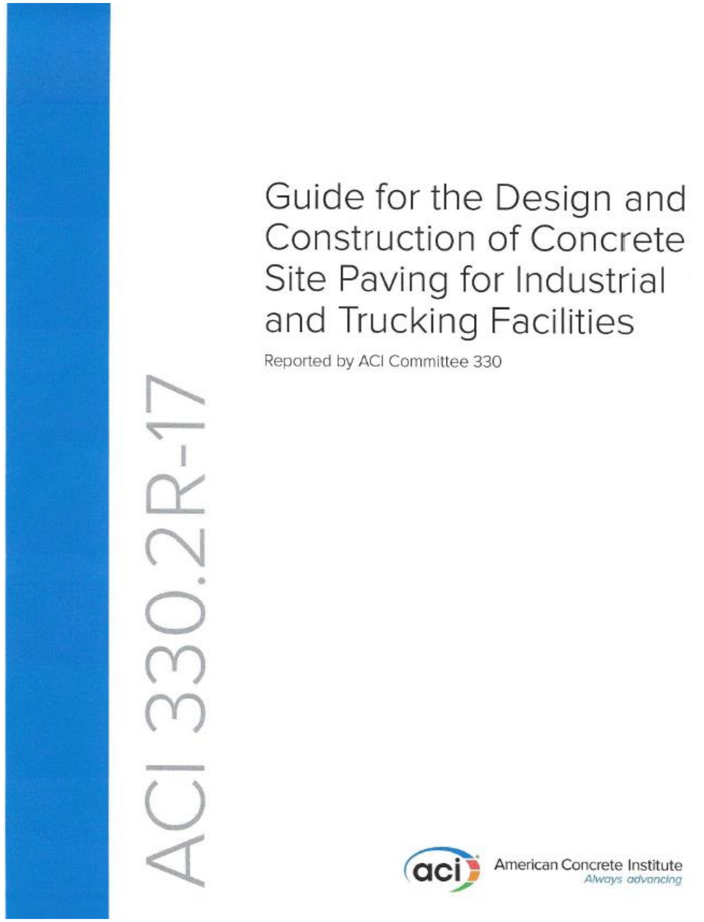


INTERMODAL DESIGN

Intermodal Design

What Designs are Available for Heavy Intermodal/Industrial Vehicles

- ACI 330.2R-17 – Guide for the Design and Construction of Concrete Site Paving for Industrial and Trucking Facilities
  - Uses design tables (Mainly for Trucks)
  - Lists additional design software:
    - ACPA StreetPave
    - Pavement ME
    - TCPavements / Optipave
    - ACPA AirPave



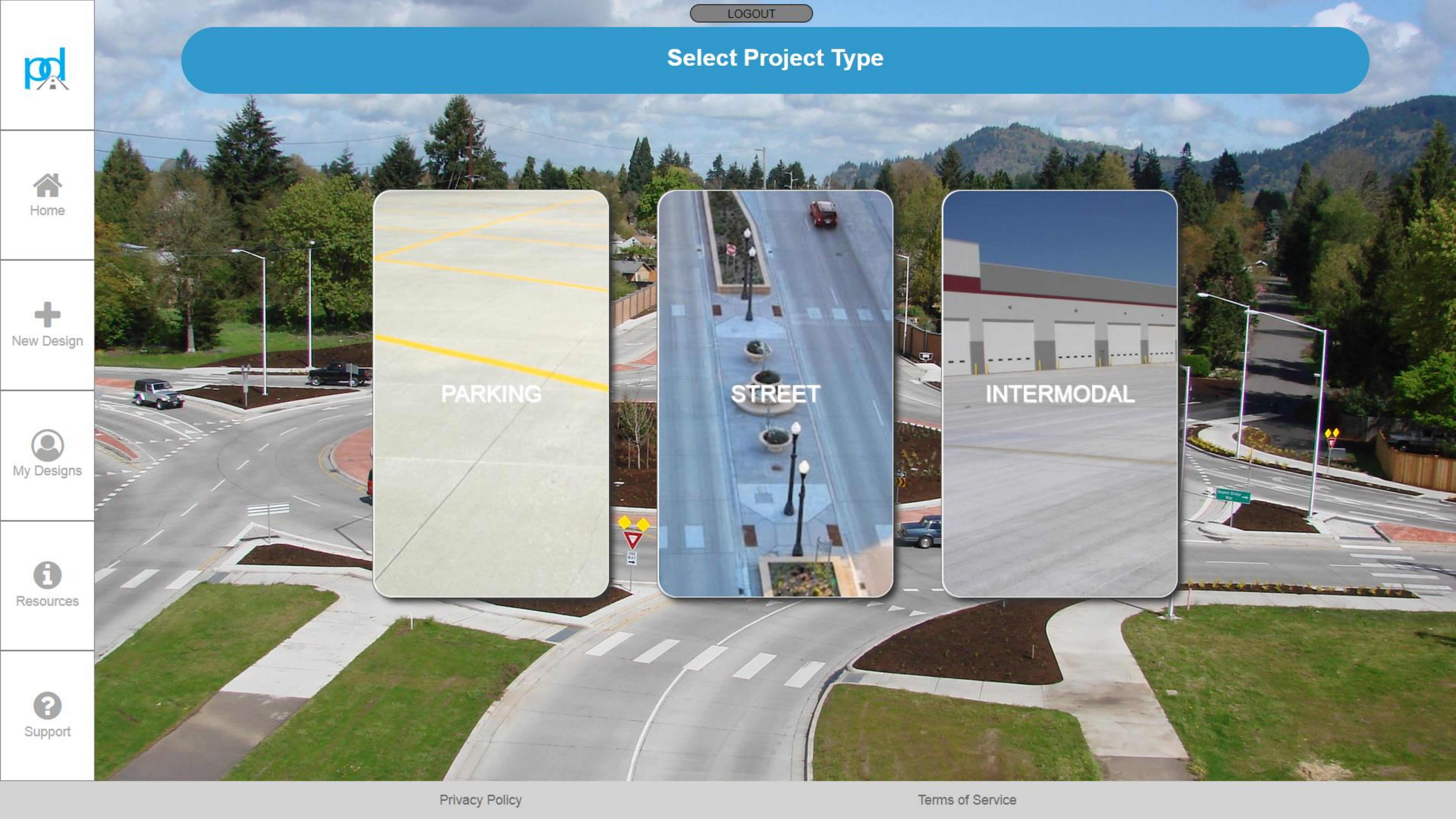
Intermodal Design with PavementDesigner

- Design for a CAT 986 Loader
  - 130,000 lb
  - Wheel base = 12.5 ft
  - Axle width = 10 ft
  - Tire Pressure = 90 psi


986H
Wheel Loader
CAT

Engine		
Engine Model	Cat® C15 ACERT™	
Gross Power – ISO 14396	329 kW	441 hp
Net Power – SAE J1349	305 kW	409 hp
Buckets		
Bucket Capacities	5-10.3 m^3	6.5-13.5 yd^3

Operating Specifications		
Rated Payload – Quarry Face	10 tonnes	11 tons
Rated Payload – Loose Material (Standard)	12.7 tonnes	14 tons
Rated Payload – Loose Material (High Lift)	11 tonnes	12.1 tons
Operating Weight	43 717 kg	96,379 lb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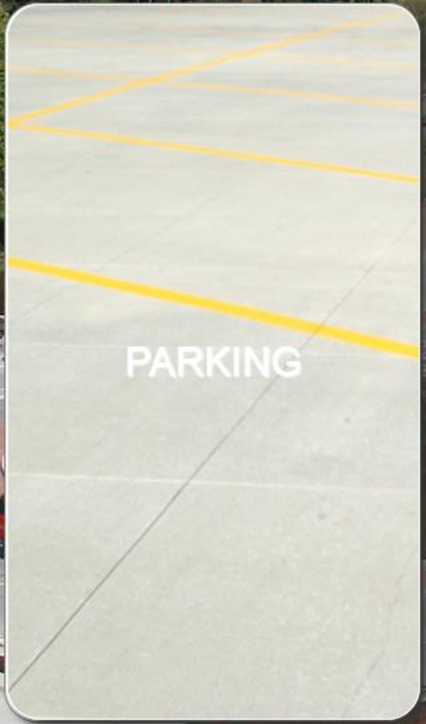

INTERMODAL

Concrete Industrial and Intermodal facilities offer a long-lasting pavement solution for non-over the road traffic. This may include forklifts, loaders, and other vehicles that use pneumatic tires and hard-rubber/plastic tires only. Facilities that have truck or bus traffic should use the parking or street design modules.

METHODOLOGY: ACPA AirPave

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1 PROJECT LEVEL 2 PAVEMENT STRUCTURE 3 SUMMARY

Project Type: Intermodal

SELECT INTERMODAL PROJECT VEHICLES

Add Custom Vehicle

Name	# of Wheels	Gross Weight (lbs)	Contact Pressure (psi)	Contact Area (in²)
Forklift - Clarklift C500/Y800CH	2	190653	80	566
Forklift - Clarklift C500/Y950 CH	2	217937	80	647
Container Handler - Kalmar LM	1	204168	130	746
Aerial Lift - Marathon Letoureau Model 2682	1	243032	80	1443
Straddle Carrier - Marathon Letoureau SST 100	1	229200	95	1146
Transtainer Crane - Paceco RT Transtainer	1	252960	124	969
Generic - Straddle Carrier	1	60211	110	260
Container Truck - Taylor TEC - 950L	2	223225	94	564
Container Truck - Taylor TEC - 155H	2	72716	110	157
Container Truck - Taylor TEC - 155L	2	71326	110	154
Container Handler - Taylor TYTC - 1100S	2	285120	108	627
Forklift - Valmet TD 1812	2	104084	80	309
Container Handler - Valmet TD 4212	2	206484	80	613
Wheel Loader - CAT 986H	4	130358	90	172

Change Design Type

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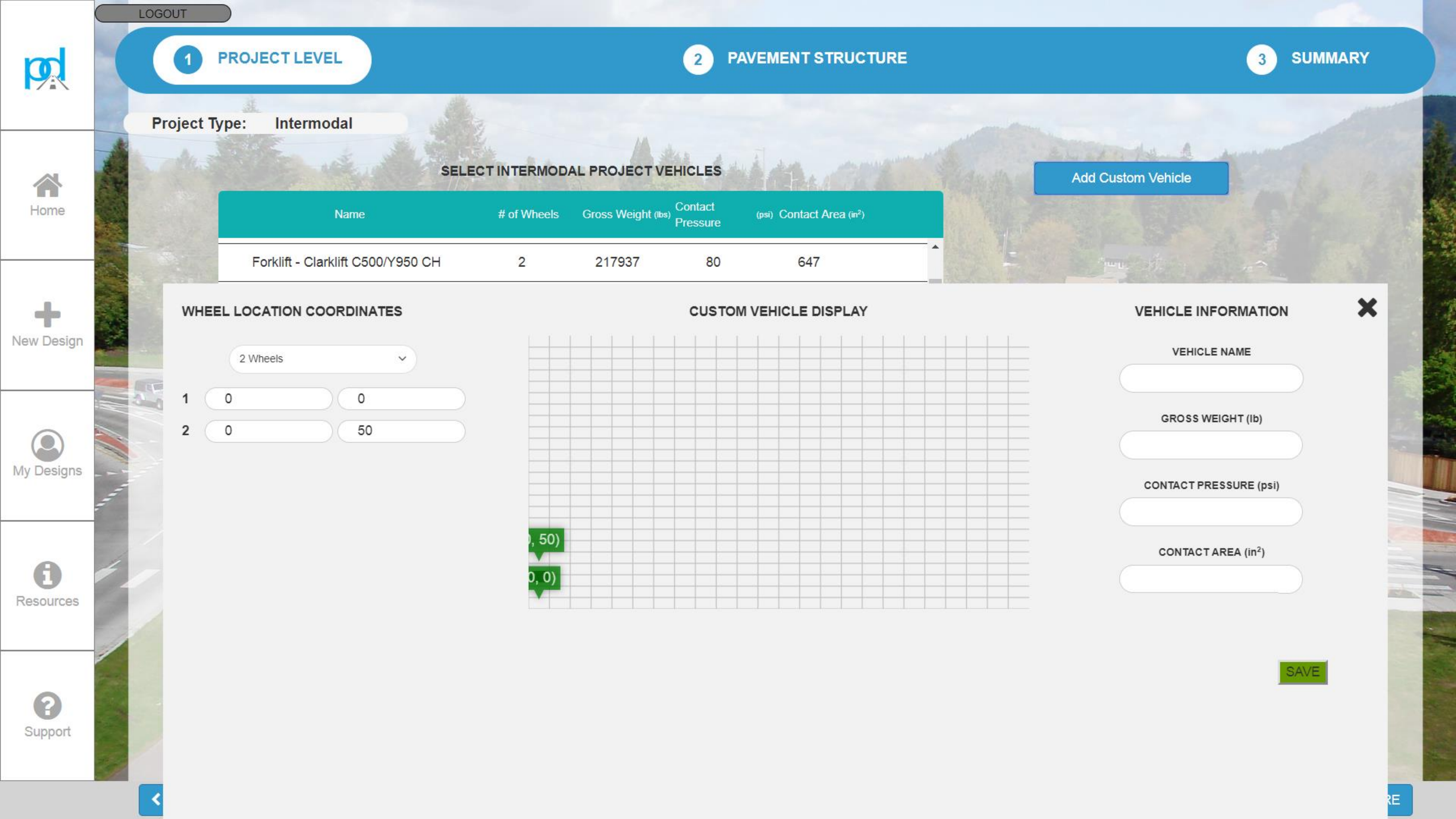
PAVEMENT STRUCTURE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Project Type: Intermodal
SELECT INTERMODAL PROJECT VEHICLES
Add Custom Vehicle
Name
# of Wheels
Gross Weight (lbs)
Contact Pressure (psi)
Contact Area (in²)
Forklift - Clarklift C500/Y950 CH
2
217937
80
647
WHEEL LOCATION COORDINATES
2 Wheels
1 0 0
2 0 50
CUSTOM VEHICLE DISPLAY
, 50)
0, 0)
VEHICLE INFORMATION
VEHICLE NAME
GROSS WEIGHT (lb)
CONTACT PRESSURE (psi)
CONTACT AREA (in²)
SAVE

LOGOUT

1 PROJECT LEVEL | 2 PAVEMENT STRUCTURE | 3 SUMMARY

Project Type: Intermodal

SELECT INTERMODAL PROJECT VEHICLES

Name	# of Wheels	Gross Weight (lbs)	Contact Pressure (psi)	Contact Area (in²)	
[illegible] 2682	1	243032	80	1443	
Straddle Carrier - Marathon Letoureau SST 100	1	229200	95	1146	
Transtainer Crane - Paceco RT Transtainer	1	252960	124	969	
Generic - Straddle Carrier	1	60211	110	260	
Container Truck - Taylor TEC - 950L	2	223225	94	564	
Container Truck - Taylor TEC - 155H	2	72716	110	157	
Container Truck - Taylor TEC - 155L	2	71326	110	154	
Container Handler - Taylor TYTC - 1100S	2	285120	108	627	
Forklift - Valmet TD 1812	2	104084	80	309	
Container Handler - Valmet TD 4212	2	206484	80	613	
Wheel Loader - CAT 986H	4	130358	90	172	
Wheel Loader - CAT 993K	4	427789	200	254	
conveyor tan x dual y	4	157080	102	385	
Example	2	100000	100	500	
MO/KS Test Vehicle	4	130000	90	360	

Add Custom Vehicle

Vehicle Name: Wheel Loader - CAT 986H

Vehicle Image

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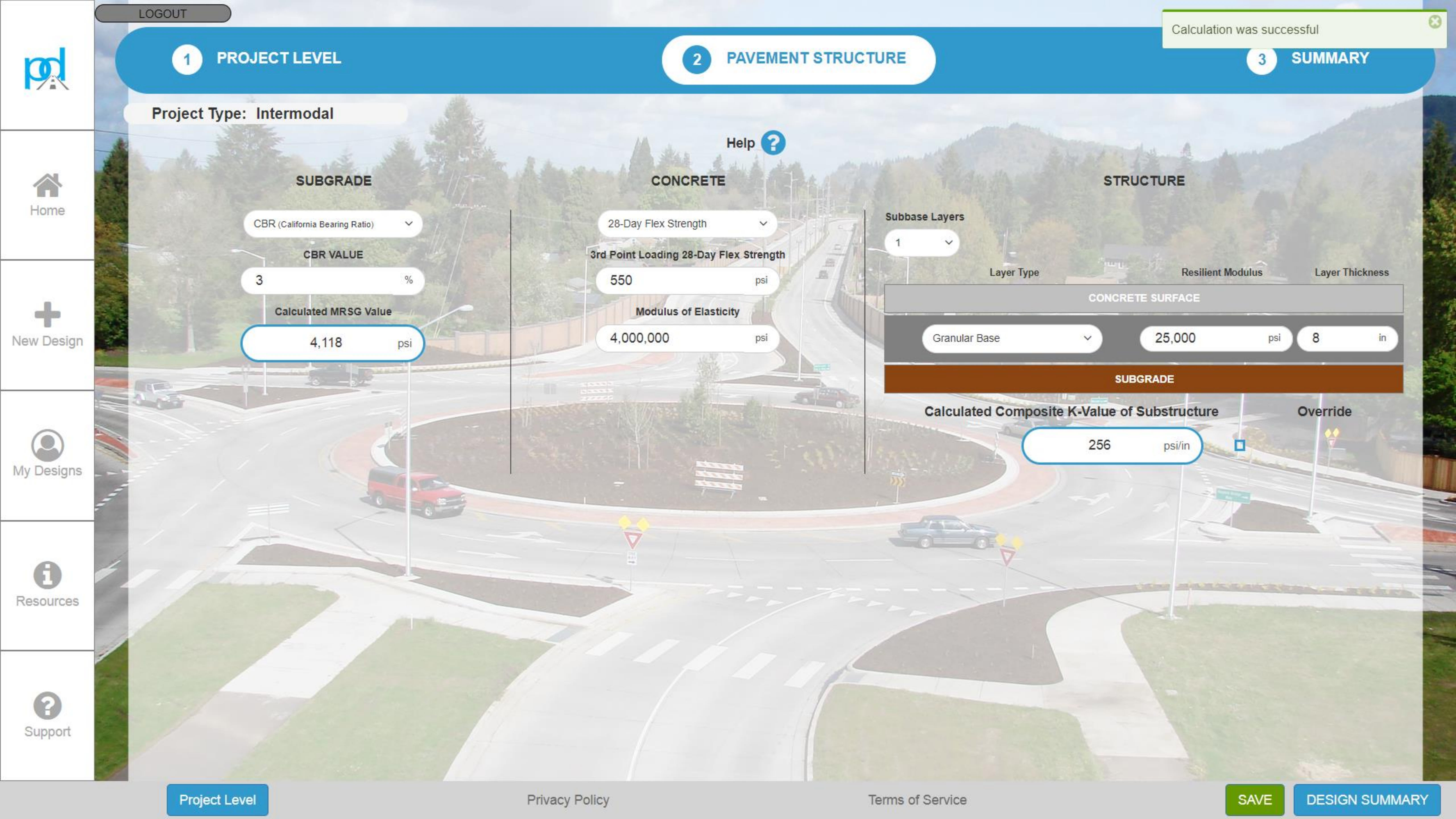
LOGOUT
Calculation was successful
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Project Type: Intermodal
Help ?
SUBGRADE
CBR (California Bearing Ratio)
CBR VALUE
3 %
Calculated MRSG Value
4,118 psi
CONCRETE
28-Day Flex Strength
3rd Point Loading 28-Day Flex Strength
550 psi
Modulus of Elasticity
4,000,000 psi
STRUCTURE
Subbase Layers
1
Layer Type
Resilient Modulus
Layer Thickness
CONCRETE SURFACE
Granular Base
25,000 psi
8 in
SUBGRADE
Calculated Composite K-Value of Substructure
256 psi/in
Override
Project Level
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DESIGN SUMMARY

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Project Type: Intermodal

Recommended Design Thickness

9.25 in

Calculated Minumim Thickness

9.20 in

Maximum Joint Spacing

14 ft

Stress Ratio

0.5 %

Results and Guidance

VEHICLE TABLE | JOINT SPACING

Vehicle Name	Maximum Angle	Maximum Stress	Allowable Total Repetitions	Thickness
Wheel Loader - CAT 986H	135.43	271.08 psi	645,434	9.2 in

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PAVEMENT STRUCTURE

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GENERATE REPORT