MIDAS Civil 2016 v2.1
Release Webinar

PSC Composite Design Check / Load rating

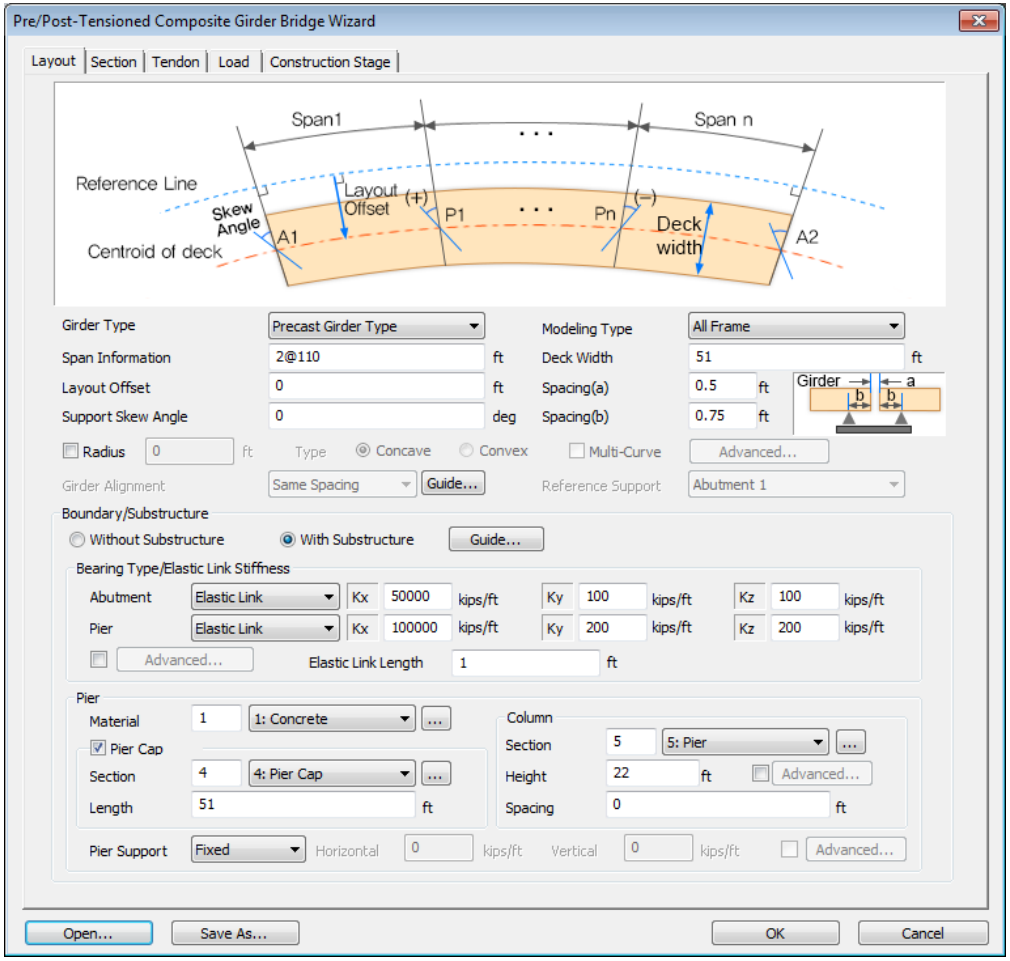
MIDAS

What is Composite Girder Module?

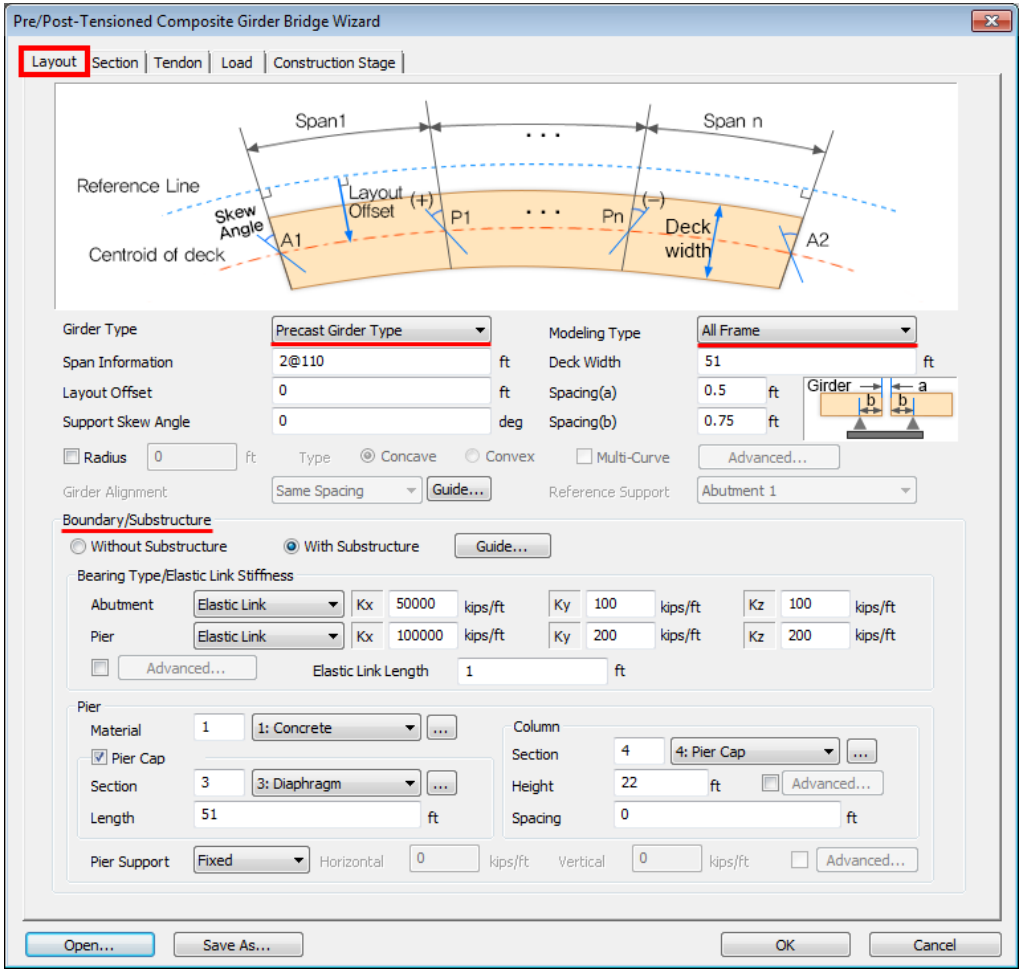
- Wizard-modeling
  - Steel Composite Bridge
  - PSC Composite Bridge

- Report Generation for Design & Load Rating Check
  - AASHTO
    - Steel Composite
    - PSC Composite
    - RC Pier
    - Cross-frames
  - Canada Code (Will be updated in August 2016)
    - Steel Composite
    - PSC Composite

PSC Composite Wizard

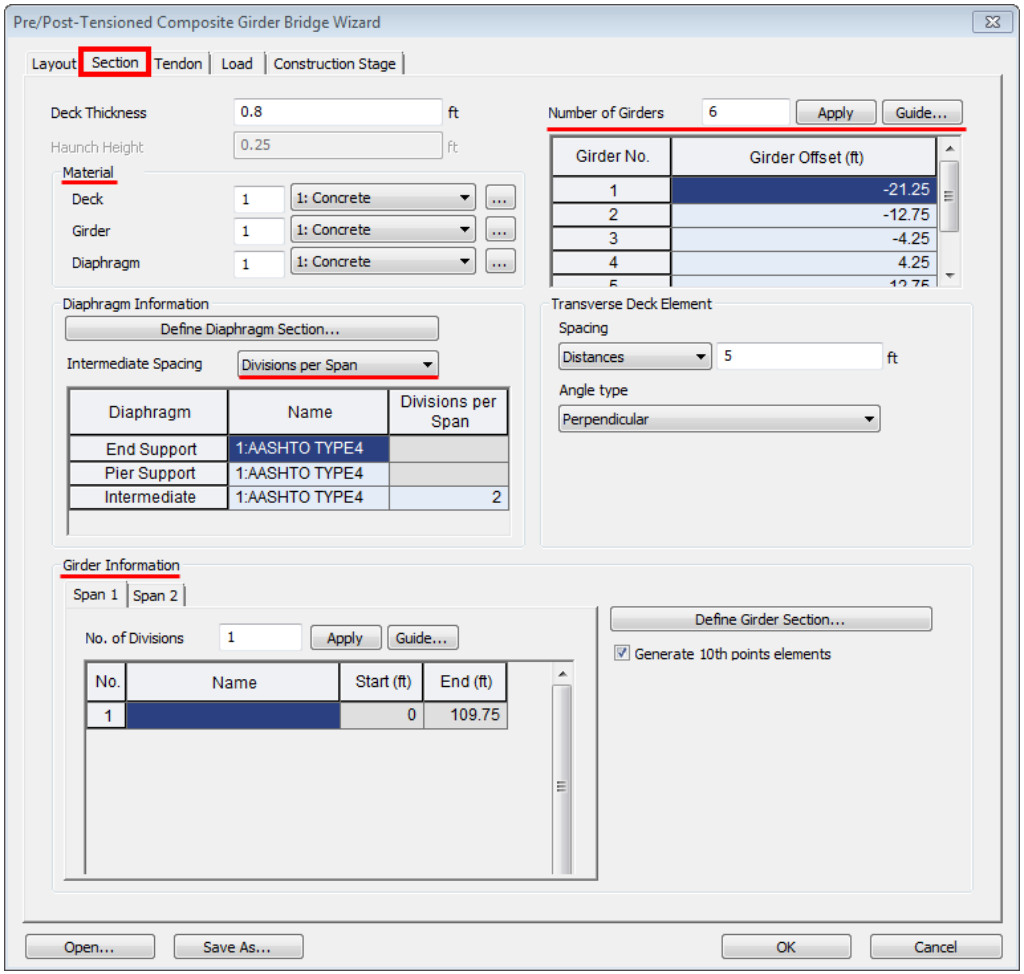


Wizard : Layout



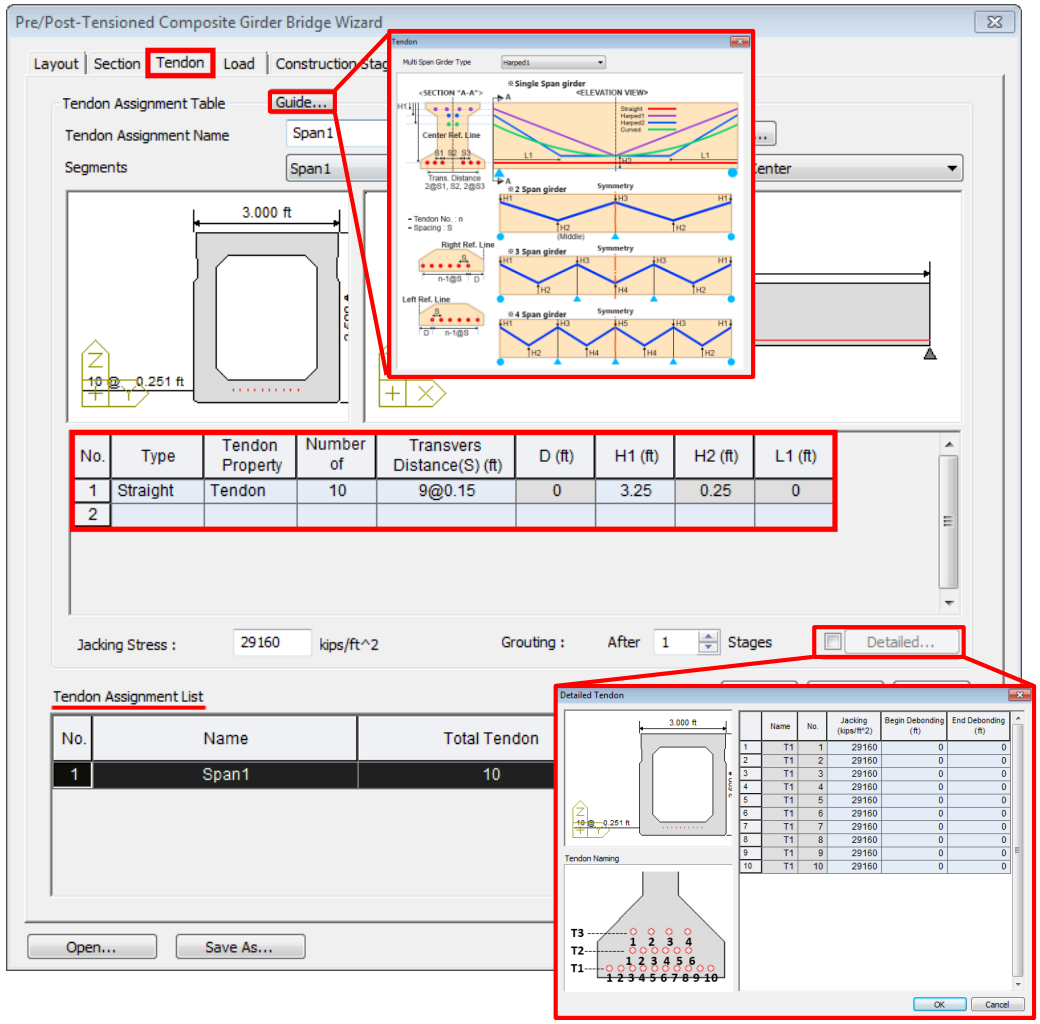
- **Girder Type**
  - Precast / Splice
- **Modeling Type**
  - All Frame
  - Girder as frame, Deck as plate
- **Bridge dimension input**
  - Span length, curvature gap spacing
  - Girder alignment options
    - Same spacing
    - Offset spacing
- **Bridge dimension input**
  - Sub-structure definition

Wizard : Section



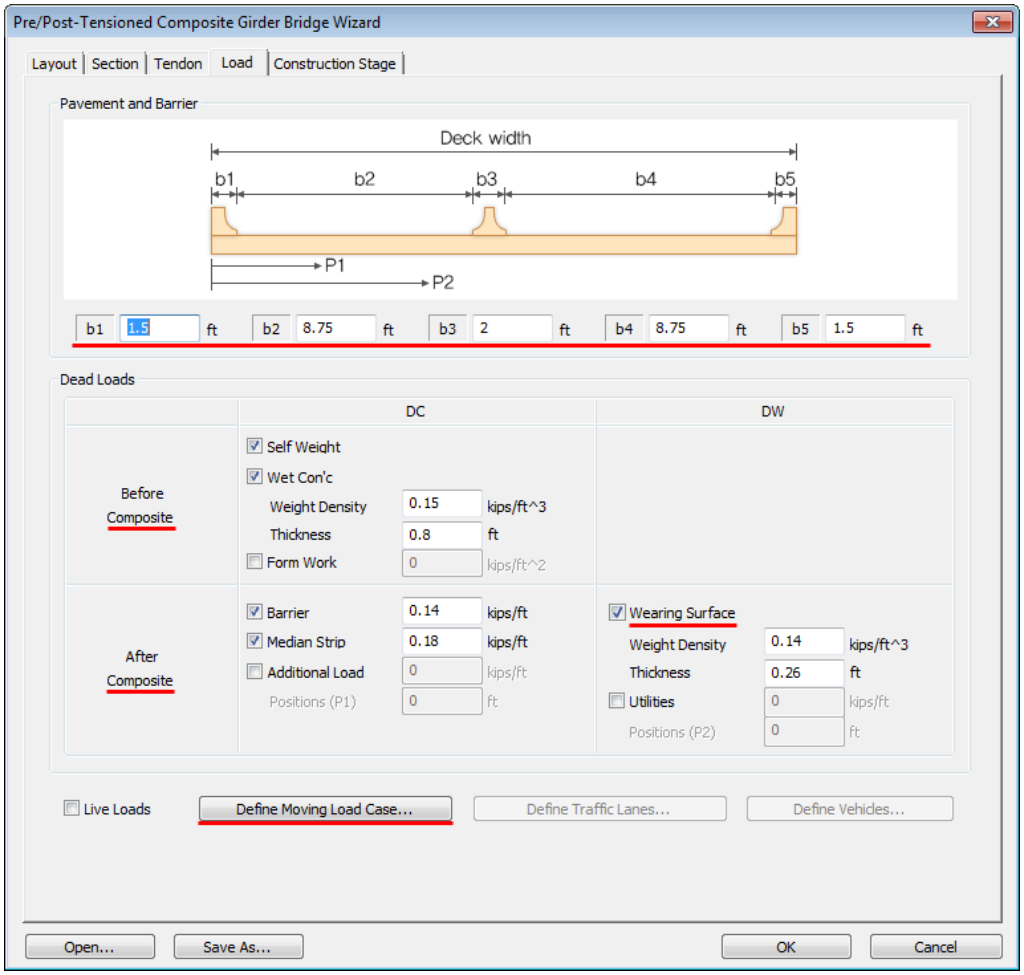
- **Girder information**
  - Number of girder
  - Section assignment per girders
- **Design material selection**
  - Deck / Girder / Diaphragm
- **Diaphragm distribution options**
  - Distance
  - Division per Span

Wizard : Tendon



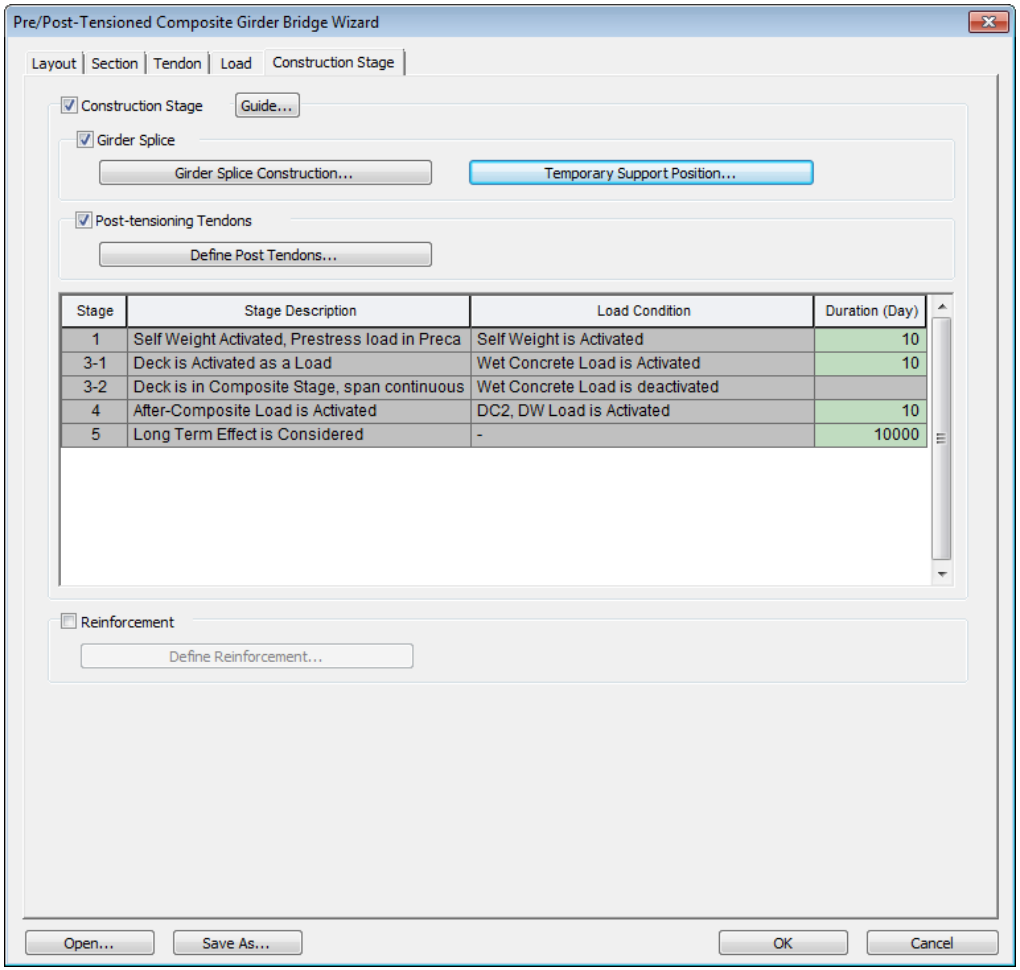
- **Tendon type**
  - Straight
  - Harped 1 & 2
  - Curved
- **Tendon definition table**
  - Number of tendons
  - Distribution distance
  - Vertical displacement
- **Tendon Assignment List**
  - Different tendon assignment per spans
  - As many assignment as user wants
- **Detailed tendon table**

Wizard : Load



- Pavement and Barrier
- Composite load cases
  - Pre-composite load cases (DC 1-1)
  - Post-composite load case (DC 1-2)
  - Wearing surface & additional (DC 2)
- Moving load analysis
  - Moving load code selection
  - Lane definition
  - Vehicle selection

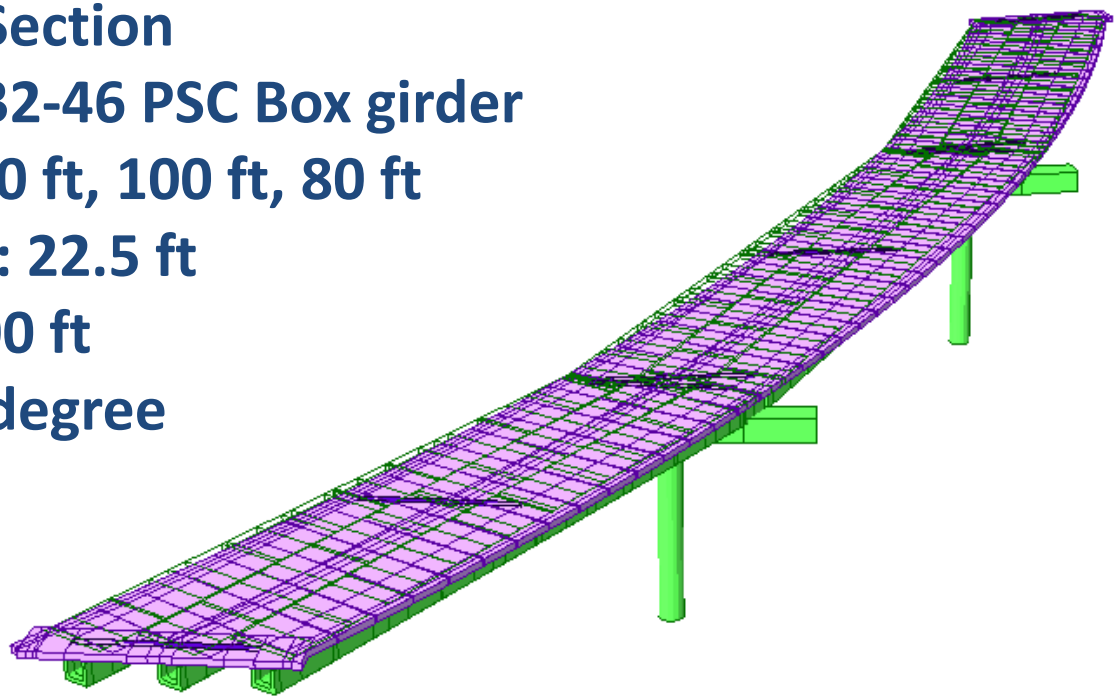
Wizard : Construction Stage



- Visual guide for construction sequence
- Concrete pouring sequence
  - Splice girder pouring sequence
  - Temporary support position
- Stage duration input
- Girder reinforcement definition

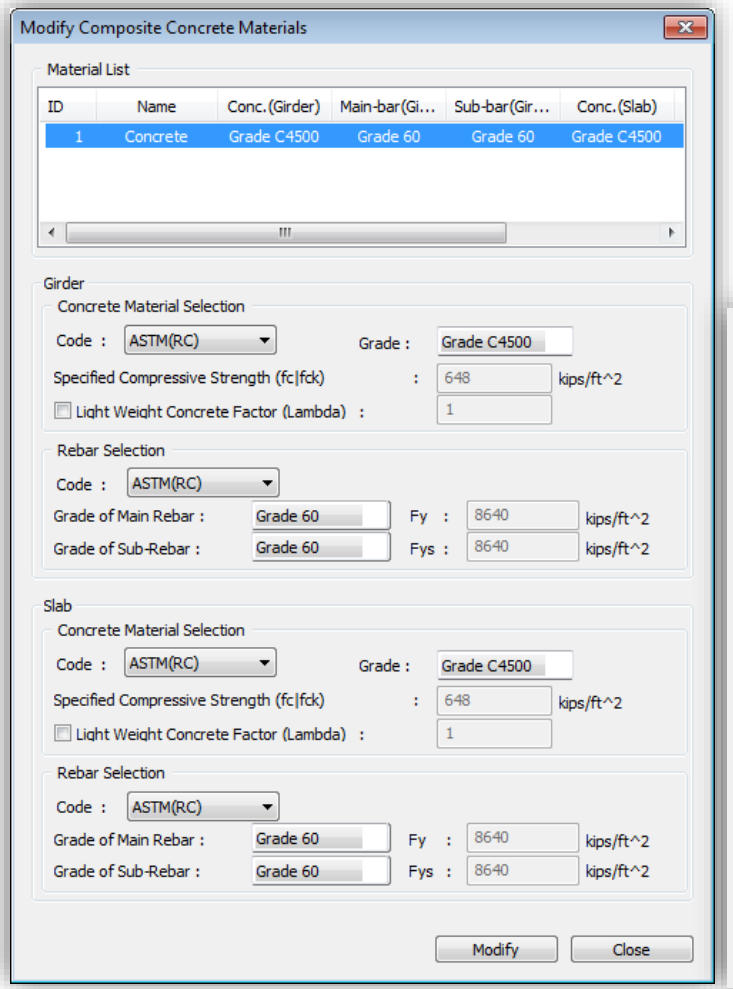
PSC Composite Wizard Demonstration

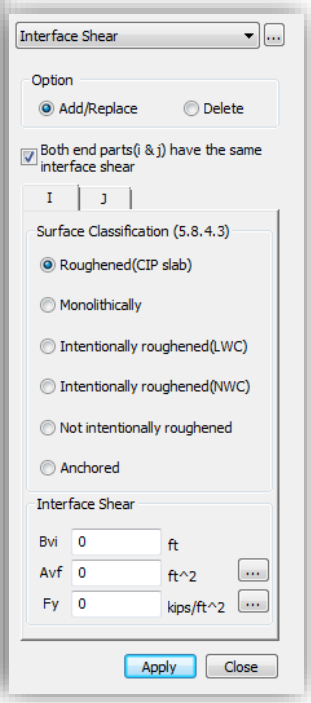
- Bridge Summary
  - PSC composite Section
    - Ohio DOT B32-46 PSC Box girder
  - 3 span bridge: 80 ft, 100 ft, 80 ft
  - Total slab width: 22.5 ft
  - Curve radius: 500 ft
  - Skew angle: 30 degree



PSC Composite Design Check & Load Rating

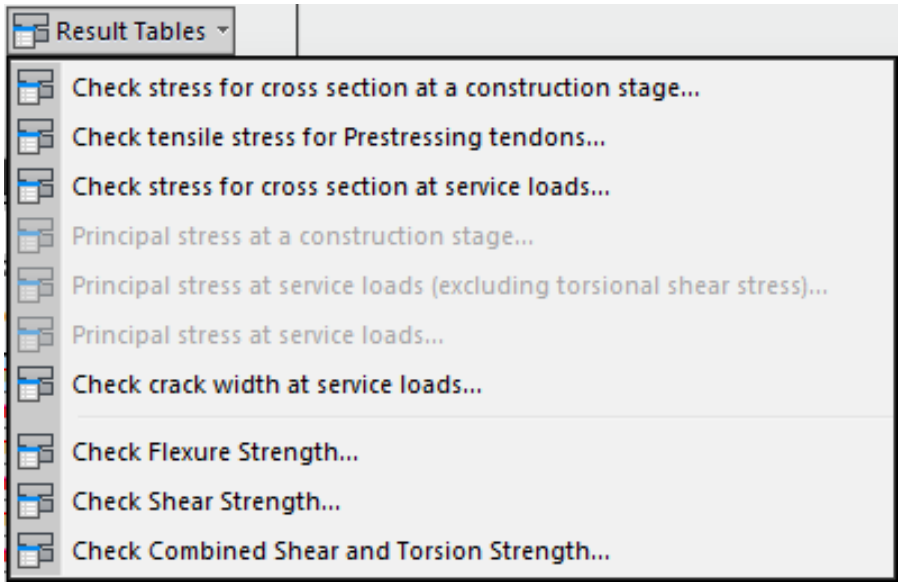
PSC Composite Design Check





- **Material selection**
  - Separate material definition girder and slab
  - Light concrete factor
- **Interface shear consideration**
  - Surface classification by 5.8.4.3
  - Interface width & reinforcement area
  - Shear connector definition

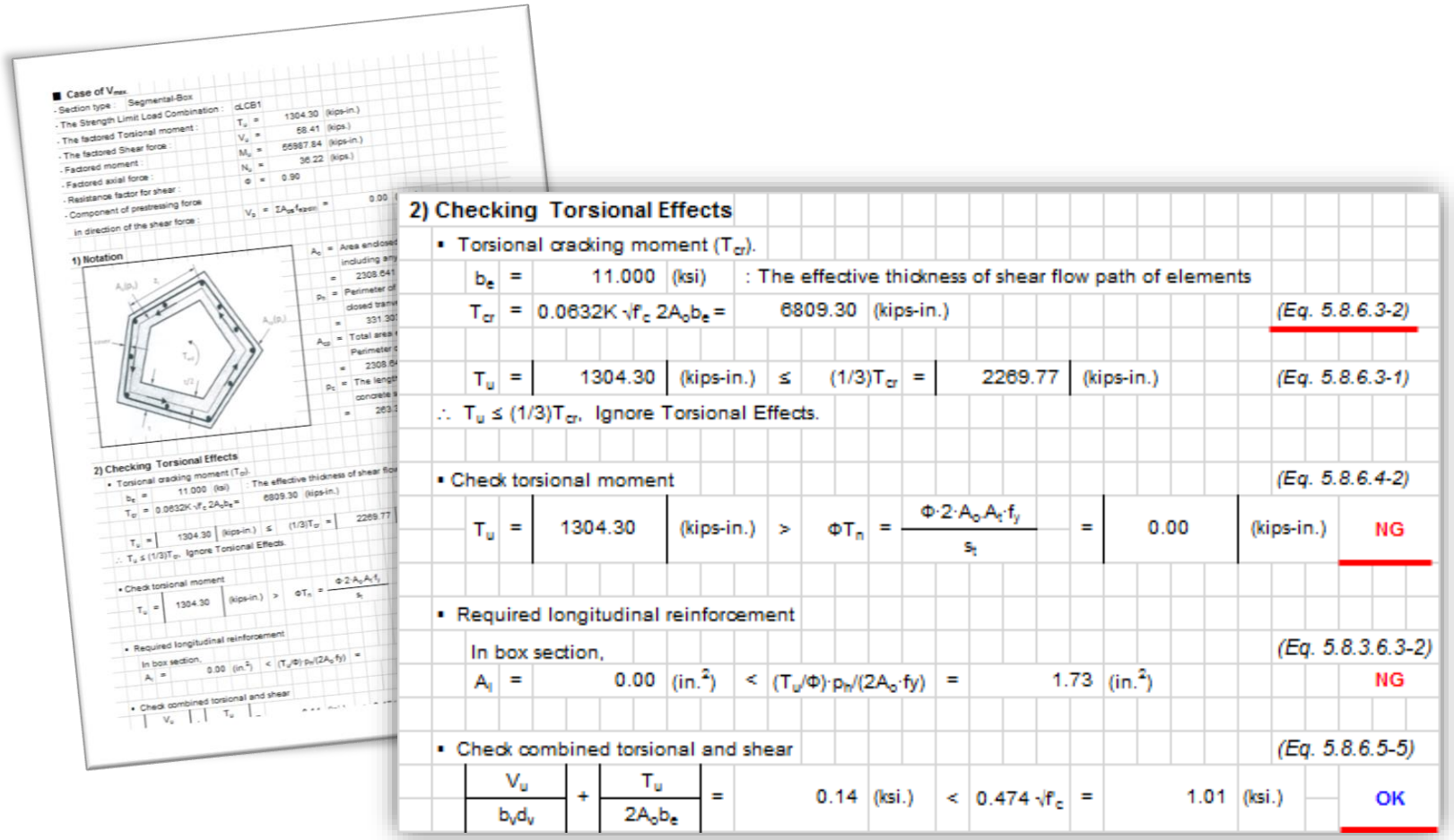
Design Result Table



- **Strength**
  - Flexure
  - Shear
  - Combined shear and Torsion
- **Stress**
  - Sectional & Principal stress
    - Per construction stage
    - Under service load case
  - Tendon tensile stress
- **Crack width under service load**

Elem	Part	Positive/ Negative	LCom Name	Type	CHK	Muy (ft*kips)	Mcr (ft*kips)	Mny (ft*kips)	PhiMny (ft*kips)	Ratio (Muy/PhiMny)	PhiMny/ min(1.33Muy,Mcr)
84	I[11]	Negative	cLCB1	FX-MIN	OK	0.0000	-2307.5010	23.9942	17.9956	0.0000	2159474.8861
84	I[11]	Positive	cLCB1	FX-MAX	OK	26.5598	12754.2249	13540.6330	13540.6330	0.0020	383.3216
84	J[534]	Negative	cLCB1	FX-MIN	OK	-11.5115	-2310.6930	23.9942	17.9956	0.6397	1.1754
84	J[534]	Positive	cLCB1	FX-MAX	OK	20.9491	12774.9135	13540.6330	13540.6330	0.0015	485.9838
85	I[534]	Negative	cLCB1	FX-MIN	OK	0.0000	-2322.7463	23.9942	17.9956	0.0000	2159474.8861
85	I[534]	Positive	cLCB1	FX-MAX	OK	58.3551	12770.0263	13540.6330	13540.6330	0.0043	174.4650
85	J[25]	Negative	cLCB1	FX-MIN	OK	0.0000	-2741.8921	23.9942	17.9956	0.0000	2159474.8861
85	J[25]	Positive	cLCB1	FX-MAX	OK	561.1422	12770.9129	13540.6330	13540.6330	0.0414	18.1432
86	I[25]	Negative	cLCB1	FX-MIN	OK	0.0000	-2741.9097	23.9942	17.9956	0.0000	2159474.8861
86	I[25]	Positive	cLCB1	FX-MAX	OK	555.7808	12770.9179	13540.6330	13540.6330	0.0410	18.3182
86	J[535]	Negative	cLCB1	FX-MIN	OK	0.0000	-3521.2853	23.9942	17.9956	0.0000	2159474.8861
86	J[535]	Positive	cLCB1	FX-MAX	OK	1376.3223	12759.6580	13540.6330	13540.6330	0.1016	7.3972

Design Result Report



2) Checking Torsional Effects

- Torsional cracking moment (T_{cr}).

b_e = 11.000 (ksi) : The effective thickness of shear flow path of elements

$T_{cr} = 0.0632K\sqrt{f_c}\,2A_o b_e$ = 6809.30 (kips-in.) *(Eq. 5.8.6.3-2)*

T_u = 1304.30 (kips-in.) ≤ $(1/3)T_{cr}$ = 2269.77 (kips-in.) *(Eq. 5.8.6.3-1)*

∴ $T_u \le (1/3)T_{cr}$, Ignore Torsional Effects.

- Check torsional moment *(Eq. 5.8.6.4-2)*

T_u = 1304.30 (kips-in.) > $\Phi T_n = \dfrac{\Phi \cdot 2 \cdot A_o \cdot A_t \cdot f_y}{s_t}$ = 0.00 (kips-in.) NG

- Required longitudinal reinforcement

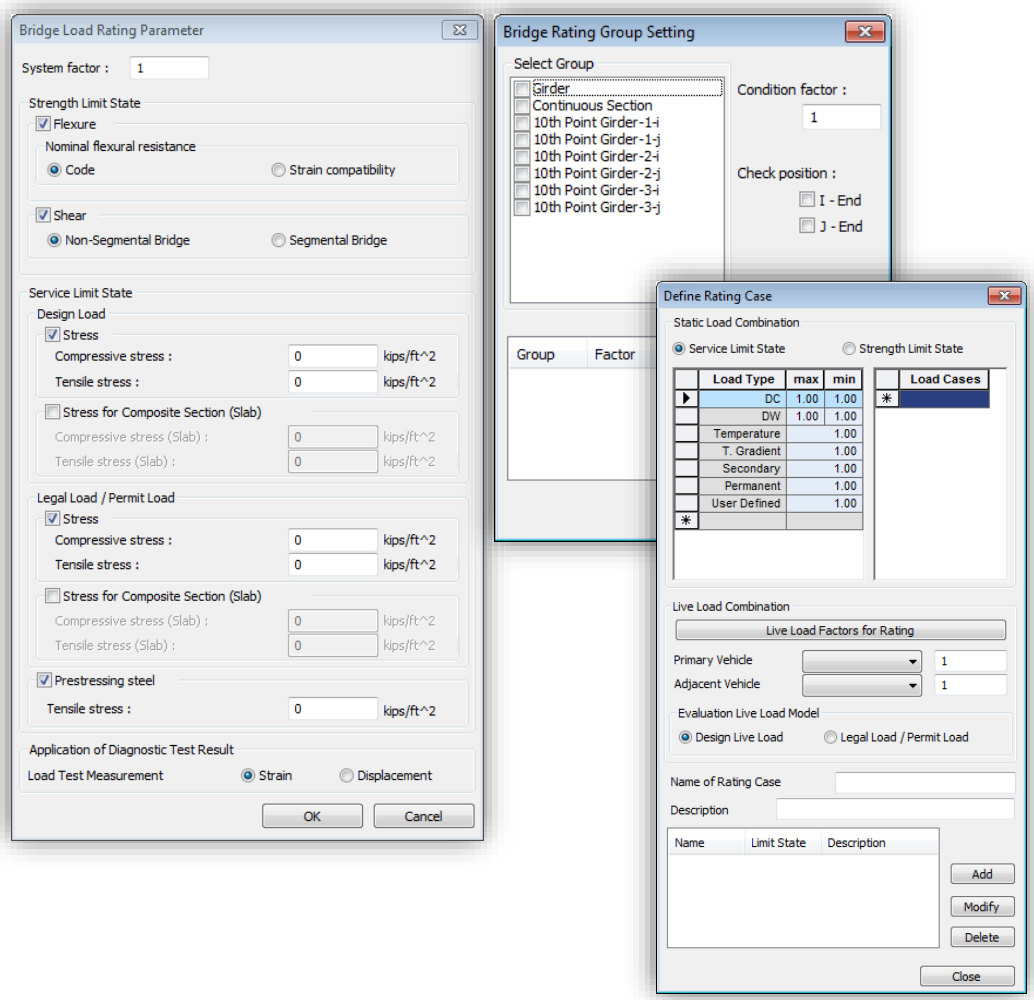
In box section, *(Eq. 5.8.3.6.3-2)*

A_l = 0.00 ($in.^2$) < $(T_u/\Phi)\cdot p_h/(2A_o \cdot fy)$ = 1.73 ($in.^2$) NG

- Check combined torsional and shear *(Eq. 5.8.6.5-5)*

$\dfrac{V_u}{b_v d_v} + \dfrac{T_u}{2A_o b_e}$ = 0.14 (ksi.) < $0.474\sqrt{f_c}$ = 1.01 (ksi.) OK

PSC Composite Load Rating



- **Rating parameters**
  - Limit state stress for Service / Fatigue / Pre-stress
- **Material selection**
- **Rating group**
  - Structure Group compatible
- **Rating case definition**
  - User friendly
  - Primary / Adjacent vehicle

Rating Result Table

- Summary table
  - Limit state stress for
  - Service limit state
  - Strength limit state
- Rating factor
  - Concrete stress
  - Pre-stressing Tension
  - Flexural & shear strength
  - Strength limit state
- Rating factor detailed table

	Group	Elem.	Part	Girder/Slab	Relative Location	Comp./ Tens.	Rating Case	Rating Factor	Check
	SG1	3	I[3]	Girder(Composite)	-	Tens.	SER_DC(MAX)_DW(MAX)_T(+)_TG(+)_A.V(Fx-Max)	1.4756	OK
	SG1	3	J[4]	Girder(Composite)	-	Comp.	SER_DC(MAX)_DW(MAX)_T(+)_TG(+)_A.V(Fx-Max)	57.0232	OK
	SG1	3	J[4]	Girder(Composite)	-	Tens.	SER_DC(MAX)_DW(MAX)_T(+)_TG(+)_A.V(Fx-Max)	0.8202	NG
	SG1	4	I[4]	Girder(Composite)	-	Comp.	SER_DC(MAX)_DW(MAX)_T(+)_TG(+)_A.V(Fx-Max)	57.0232	OK
	SG1	4	I[4]	Girder(Composite)	-	Tens.	SER_DC(MAX)_DW(MAX)_T(+)_TG(+)_A.V(Fx-Max)	0.8202	NG
	SG1	4	J[5]	Girder(Composite)	-	Comp.	SER_DC(MAX)_DW(MAX)_T(+)_TG(+)_A.V(Fx-Max)	47.4226	OK
	SG1	4	J[5]	Girder(Composite)	-	Tens.	SER_DC(MAX)_DW(MAX)_T(+)_TG(+)_A.V(Fx-Max)	0.5192	NG
	SG1	5	I[5]	Girder(Composite)	-	Comp.	SER_DC(MAX)_DW(MAX)_T(+)_TG(+)_A.V(Fx-Max)	47.4226	OK
	SG1	5	I[5]	Girder(Composite)	-	Tens.	SER_DC(MAX)_DW(MAX)_T(+)_TG(+)_A.V(Fx-Max)	0.5192	NG

Load Rating Report

AASHTO Load Rating Summary Result Table

Load Rating Summary Detail for Prestressed Concrete Girder Bridge (Strength Limit)

Level	Load Combinaion	Moving Load Case	Weight (tons)	Load Factors					Moment (Strength, kip· in)					Shear (kips)				
				LL	DC		DW		Scale Factor for Load Test	Rating Factor	Safe Load Capacity	Live Load Demand	Critical Element	Scale Factor for Load Test	Rating Factor	Safe Load Capacity	Live Load Demand	Critical Element
					max	min	max	min										
DL	STR	MVL 1	NA	1.00	1.25	0.90	1.25	0.90	1.618	-30.556	NA	603957.35	18-J	0.000	0.000	NA	-2015.01	17-I

Where,

Level Type	DL	: Design Load Rating
	LL	: Legal Load Rating
	PL	: Permit Load Rating
Load Factor Discription	LL	: Load Factor of primary vehicle load case
	DC	: Load Factor of dead load case
	DW	: Load Factor of dead load case of wearing surfaces and utilities

Load Rating Summary Detail for Prestressed Concrete Girder Bridge (Service Limit)

Level	Load Combinaion	Moving Load Case	Weight (tons)	Load Factors					Stress Girder (Service, kip/in^2)					Stress Slab(Service, kip/in^2) [Composite Section]				
				LL	DC		DW		Scale Factor for Load Test	Rating Factor	Safe Load Capacity	Live Load Demand	Critical Element	Scale Factor for Load Test	Rating Factor	Safe Load Capacity	Live Load Demand	Critical Element
					max	min	max	min										
DL	SER	MVL 1	NA	1.00	1.00	1.00	1.00	1.00	0.000	0.000	NA	0.09	17-I	0.000	0.015	NA	-0.10	17-I

Where,

Level Type	DL	: Design Load Rating
	LL	: Legal Load Rating
	PL	: Permit Load Rating
Load Factor Discription	LL	: Load Factor of primary vehicle load case
	DC	: Load Factor of dead load case
	DW	: Load Factor of dead load case of wearing surfaces and utilities

THANK YOU for Joining Today's Webinar

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