INTEGRATED SOLUTION SYSTEM FOR BRIDGE AND CIVIL ENGINEERING

midas Civil For CANADA

Computational Analysis and Design In accordance with CHBDC CSA-S6-14







All-In-One Solution



Ease of Use





Reprinted April 2016. This reprint is being issued to incorporate Update No. 1 into the original 2014 Code.



\$6-14



Future

Canadian Features



World wide existence



USERS Across North America (partial list)



USERS Across North America (partial list)



midas Civil Bridge Engineering Software



What kind of bridge type can midas Civil handle?

Conventional Bridge



Culvert







Slab Bridge

Staged Segmental Bridge



Balanced Cantilever Method Bridge







Movable Scaffolding Method Bridge



Precast (Spliced) Girder Bridge



Integral Bridge



Steel Plate (Flare) Girder Bridge





Precast Segmental Method Bridge

Fill Staging Method Bridge

Cable-stayed Bridge & Suspension Bridge





Cable Stayed E Bridge

Extra-doesd Bridge



Suspension Bridge



Steel Box Girder Bridge

Few project examples - Canada

Alexandria Bridge, Hope, BC

The More Canyon Bridge, BC





Calgary West LRT, Calgary



Nelson Creek Bridge, West Vancouver



Few project examples - Canada

Long Span Steel Arch Bridge



Few project examples - USA

US 17 Wilmington By Pass in USA



Lee Roy Selmon Flyovers in FL USA



Port Access Bridge, Alaska

Galena Creek bridge in NV USA





Few project examples - USA

Innerbelt Bridge in Cleveland OH

Ironton-Russell Bridge





Pearl Harbor Memorial Bridge



Hastings Bridge



INTEGRATED SOLUTION SYSTEM FOR BRIDGE AND CIVIL ENGINEERING midas Civil for Canada

midas Civil GUI





				Civil 2015 -	IE:\Edgar Demo *] -	[Model View]				_	^
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Modeling Features

Drag & Drop



Tree Menu



Tree Menu



Integrated solution system for bridge and civil engineering Introduction to midas Civil

Analysis



Analysis

Construction Stage analysis

Moving Load Analysis

• Influence Line & Influence Surface

Modal Analysis

• Eigen Value & Ritz Vector

Dynamic Analysis

- Static Seismic Analysis
- Response Spectrum Analysis
- Time History Analysis

Buckling Analysis

Large Displacement Analysis

P - Delta Analysis

Thermal Stress Analysis

Nonlinear Analysis

- Nonlinear Geometric Analysis
- Nonlinear Material Analysis
- Pushover & Fiber Model Analysis
- Inelastic Time History Analysis
- Boundary Nonlinear Analysis

Heat of Hydration Analysis

Integral Bridge Analysis

Steel Structure CS Analysis



Prestress Analysis

PSC Bridge – Tendon Prestress Loss

	Tendon Coordinates		Elem	Part	Stress (Immediate Loss) (tonf/m²)	Elastic Deform. Loss (tonf/m²)	Stress(Elastic Loss Stress (Immediate Lo)/ ss)	Creep/Shr (tor	inkage Loss hf/m²)	Relax:	ation Loss onf/m²)		Stres Stress(In	Effe	ective Num.		
	rendon Elongadon	T	The Los:	s of ter	ndon group [Top-P 1	-1] at the stage of [CS1	5]										_	
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			71		110687.5790	-1503.1204		0.9864		-2001.5266	5	-1781.49	10			0.952	2	1.0000
	Tendon Loss		7 J	l	119519.1913	-1312.9539		0.9890		-1683.7269)	-1923.63	38			0.958	8	1.0000
			81		116158.3065	-1567.3373		0.9865		-2058.4493	}	-1897.96	22			0.952	4	2.0000
	Tendon Approximate Loss		8 J	I	120289.2121	-1437.5402		0.9880		-1728.7034	1	-1966.36	09			0.957	3	2.0000
	The deal Market		91		117096.8201	-1601.7405		0.9863		-2560.0828	}	-1954.09	97			0.947	8	4.0000
	i endon weight		9 J		120883.9961	-1269.3180		0.9895		-2170.9805)	-2018.44	93	0.9548			3	4.0000
	The deel Church Lineth Church		10 1		101609 4420	-1575.9776		0.9666		-2025.2251	1	-2021.45	59 90			0.946	2	6.0000
	Tendon Stress Limit Check		11 1		120864 1954	-1220.2173		0.3033		2084 8731	,	2001.20	78			0.9533		8.0000
				1	122359 4065	-1207 2216		0.9901		-2510 7456	;	-2100.94	99			0.943	4	8,0000
h.,	Copy		12 1		121846,7142	-1499.5523		0.9877		-3059.8470	,)	-2116.07	64			0.945	2	10.0000
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4	Fied	CHALE	13 I		122617.7621	-1456.1471		0.9881		-3117.3407	·	-2152.61	91			0.945	1	12.0000
	ring	Cuitr	13 J	1	123420.2116	-1169.5774		0.9905		-2695.1804	L .	-2167.29	01			0.951	1	12.0000
			14 I		123346.6290	-1305.2973		0.9894		-2762.0238	}	-2177.54	84			0.949	4	13.0000
	Sorting Dialog		14 J	I	123754.7978	-1091.6720		0.9912		-2380.9363	}	-2185.20	32			0.954	3	13.0000
	2 2		15 I		123689.1182	-1205.4594		0.9903		-2502.6430)	-2196.40	93			0.952	3	14.0000
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Prestress Analysis

PSC Bridge – Approximate Tendon Prestress Loss

Approximate Estimate of Time Dependent Tendon Losses	x
Design Code AASHTO-LRFD 06 AASHTO-LRFD 06 Estimation Method PCI Bridge Design Manual 04 JSCE 02 Lump Sum Estimate Method Tendon Load Load Case PS	× Add
Rational Approximate Method (AASHTO-LRFD06) Ambient Relative Humidity (0-100)	Delete
Compressive Strength of Concrete at time of Initial Loading (f'ci) 0 kips/in² Dead Load (Self Weight) Load Case Self	▼
Relaxation Loss Load Case	Add
Per Code User Defined Tendon Type Low-relaxation Strand Relayation Loss	Delete
Additional Dead Load(Superimposed Load Case Self	ad)
Load Case	Add
	Delete
Remove Approximate Estimate of Time Dependent Tendon Loss Data	Cancel

Prestress Analysis

PSC Bridge – Tendon Stress Limit Check

Tendon Coordinates					Tendon Stress		Tendon Stress Limit					
Tendon Flongation			Tendon	FDL1	FDL2	FLL	Immediately af	ter andhor set				
				(N/mm²)	(N/mm²)	(N/mm²)	At anch.	Away from anch.	At service			
Tendon Arrangement		•	Bot1	867.1222	1008.6050	1008.6050	1330.0000	1406.0000	1280.0000			
Tendon Loss			Bot2	866.9082	1008.4515	1008.4515	1330.0000	1406.0000	1280.0000			
Tandan Annualisaska La			CS01a01_I	951.7275	1086.9387	1079.3223	1330.0000	1406.0000	1280.0000			
Tendon Approximate Lo	JSS		CS01a01_r	951.9741	1087.2330	1079.6144	1330.0000	1406.0000	1280.0000			
Tendon Weight			CS01a02_I	970.9649	1098.5414	1087.4911	1330.0000	1406.0000	1280.0000			
The day Church Lineit Cha			CS01a02_r	971.2241	1098.8414	1087.7895	1330.0000	1406.0000	1280.0000			
Tendon Stress Limit Che	ЗСК		CS01a03_I	982.9584	1103.6489	1095.1710	1330.0000	1406.0000	1280.0000			
			CS01a03_r	983.2302	1103.9547	1095.4758	1330.0000	1406.0000	1280.0000			
			CS01b01_I	928.6975	1069.5204	1069.5204	1330.0000	1406.0000	1280.0000			
			1b01_r	928.8691	1069.7805	1069.7805	1330.0000	1406.0000	1280.0000			
Tendon Stress			🗶 1b02_l	946.5612	1076.5253	1069.6800	1330.0000	1406.0000	1280.0000			
		_	1b02_r	946.7449	1076.8016	1069.9516	1330.0000	1406.0000	1280.0000			
– Tendon Stress Limit ––––			11b03_l	959.7907	1079.9189	1070.4710	1330.0000	1406.0000	1280.0000			
At anch	0.7] e	11b03_r	959.9866	1080.2054	1070.7541	1330.0000	1406.0000	1280.0000			
Aconcin	0.7] rpu)2a01_l	932.7898	1071.1960	1071.1960	1330.0000	1406.0000	1280.0000			
Away from anch.	0.74	fpu	l2a01_r	932.9301	1071.3970	1071.3970	1330.0000	1406.0000	1280.0000			
		1.)2a02_l	953.0878	1079.1348	1070.7337	1330.0000	1406.0000	1280.0000			
At service	0.8	fpy	l2a02_r	953.2380	1079.3484	1070.9434	1330.0000	1406.0000	1280.0000			
			2a03_l	970.7999	1081.7421	1071.2847	1330.0000	1406.0000	1280.0000			
OK	Capital		l2a03_r	970.9601	1081.9655	1071.5031	1330.0000	1406.0000	1280.0000			
UK	Cancer)2b01_l	781.8189	990.2175	990.2175	1330.0000	1406.0000	1280.0000			
			2b01_r	782.0235	990.4289	990.4289	1330.0000	1406.0000	1280.0000			
			CS02b02_I	826.3534	1017.4450	1017.4450	1330.0000	1406.0000	1280.0000			
			CS02b02_r	826.5675	1017.6609	1017.6609	1330.0000	1406.0000	1280.0000			
			CS02b03_I	865.6381	1042.1207	1042.1207	1330.0000	1406.0000	1280.0000			
			CS02b03_r	865.8604	1042.3412	1042.3412	1330.0000	1406.0000	1280.0000			
			CS03a01_I	932.3756	1070.9447	1070.9447	1330.0000	1406.0000	1280.0000			
			CS03a01_r	932.5233	1071.1613	1071.1613	1330.0000	1406.0000	1280.0000			
	Nation 1		CS03a02_I	952.9029	1079.3094	1070.7975	1330.0000	1406.0000	1280.0000			
	100		CS03a02_r	953.0611	1079.5400	1071.0235	1330.0000	1406.0000	1280.0000			

Moving Load Analysis

Moving Load Tracer + Vehicle Load Conversion to Static Load



Moving Load Analysis

Live Analysis Control: Normal+ Concurrent Force

Moving Load Analy	sis Control D	ata	
Truck/Train Load Control	Option		
Analysis Method			
e Exact	O Pivot	0 Qi	uick
Load Point Selection			
Influence Line De	pendent Point	O Al	Points
Influence Generating P	oints		
• Number/Line Elem	ent :	3	
O Distance between	Points :	11.81102	n.
Analysis Results			
Plate	Frame		
Center	Norm	al	
Center + Nodal	 Norm 	al + Concurre	ent Force
C Stress Calculation	Comb	ined Stress C	Calculation
Calculation Filters			
Reactions			
ali 🔍	Group :		
Displacements			
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Forces/Moments			
O All	Group :		-
			Curre

	Elem	Load	Part	Axial (kips)	Shear-y (kips)	Shear-z (kips)	Torsion (in-kips)	Moment-y (in-kips)	Moment-z (in kips)
	1	moving([[1]	12.84	3.98	9.39	221.00	2154.30	215.69
-	1	moving(J[2]	12.04	3.90	9.39	221.00	1894.00	110.00
	2	moving([2]	11.70	5.59	10.09	169.48	1925.54	151.01
	2	moving(J[3]	11.70	5.59	10.09	169.48	1644.27	77.53
	3	moving([3]	10.64	8.20	10.39	200.50	1669.82	109.95
	3	moving(J[4]	8.99	8.20	10.39	200.50	1519.84	93.98
2 1	4	moving([4]	8.66	2.11	10.74	56.20	1569.47	109.85
			1000	0.00	0.44	10.71	CO.00	4577.00	04.04

Normal Envelope results



Concurrent force results for Moment-y

Rail Track Analysis Wizard

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nt Lenath	+	Var.	•	mbankment Length	
2: Deck					
40	m	Embankment	Length 300		m
•	-	Type 2			
_		© Type 4	-	-	- 11
	•		•		
I: Rail	•	Number of Tr	acks 2	2	EA .
Rail Expansion J	ointe				
Track 1	Track 2				
Position(m)	Position(m	1)			
0		0			
	I Length 2: Deck 0 1: Rall RealEpassen J Track 1 Posifion(m) 0	I I Rall Position(m) Paticipanon June Track 1 Position(m) Paticipanon June Track 1 Position(m) Paticipanon June Paticipanon June	Deck n (Deck have or Deck have or Deck have or Deck have or Deck have or Vac Deck or Type 2 Orype 4 Type 4 Type 4 Type 4 Type 4 PasiEconon, hore. Track 1 PosiEconon, hore. Track 1 PosiEconon, hore. Track 2 PosiEconon, hore. Track 1 PosiEconon, hore. Track 1 PosiEconon, hore. Track 1 PosiEconon, hore. Track 2 PosiEconon, hore. Track 1 PosiEconon, hore. Track 2 PosiEconon, hore. Track 2 Track 2 PosiEconon, hore. Track 2 PosiEconon, hore. Track 2 PosiEconon, hore. Track 1 PosiEconon, hore. Track 2 PosiEconon, hore. Track 2 PosiEconon, hore. Track 2 Track 2	Deck n Deck n Deck note Deck note	Creak no Creak Num ker Creak Num

Automated modeling for Structure and Rail Interaction

- I) Simplified Separate Analysis Auto generation
- 2) Stage Analysis or Complete Analysis model
- 3) Moving Train load Auto Geneartion



Performance Based Seismic Design

Pushover Analysis – Performance Based Seismic Design



Dynamic Analysis

Seismic Analysis Capabilities

Response Spectrum Analysis

Pushover Analysis

- 4 Basic (P, V, M & PMM) Hinges
- FEMA, Eurocode, Multi-linear type hinge
- RC, Steel, SRC, Masonry material types
- Load or Displacement Option
- Demand Spectrums and Performance Points

Boundary NL Time History Analysis

• Damper, Isolator, Gap, Hook

Inelastic Time History Analysis



Non-linear Analysis

Pushover Analysis – Capacity Curves



Dynamic Analysis

Nonlinear Matrix

Pushover Analysis

scoelastic Damper Type Nonlinear Spring near Spring in Lead Rubber Bearing Isolator Nonlinear Properties Damper Type Maxwel Model · 1099 Stiffness (k) C Kelvin(Voigt) Model Yield Strength (Fy) 15.69 C Damper-Brace Assembly Model(Maxwell+Kelvin) Post Yield Stiffness Ratio (r) 0.08917 Nonlinear Properties Damping (Cd) : 300 Hysteretic Loop Parameter (a) Hysteretic Loop Parameter (b) Reference Velocity (V0) : 0.2 |a| + |b| = 1.0Damping Exponent (s) a : alpha b : beta Bracing Stiffness (kb) : 55000 $f = c_d \cdot sign(\dot{d}_a) \cdot \left| \frac{\dot{d}_a}{v_b} \right|^s = k_b d_b$ $\mathbf{f} = \mathbf{r} \cdot \mathbf{k} \cdot \mathbf{d} + (\mathbf{l} - \mathbf{r}) \mathbf{F}_{\mathbf{x}} \cdot \mathbf{z}$ $\dot{z} = \frac{k}{E} \left[1 - |z|^2 \left\{ \alpha \cdot \text{sign} \left(\dot{d} \cdot z \right) + \beta \right\} \right] \dot{d}$ $\mathbf{d} = \mathbf{d} + \mathbf{d}$ teretic System Type Nonlinear Spring ear Spring in Friction Pend Nonlinear Propertie Nonlinear Properties : 250000 Stiffness (k) : 250000 Stiffness (k) kqf/m **Dampers & isolators** Yield Strength (Fy) : 300000 Frictional Coefficient, Slow (us) . 0.04 Post Yield Stiffness Ratio (r) : 0.1 Frictional Coefficient, Fast (uf) . 0.047 Rate Parameter (r) : 20 Yielding Exponent (s) : 2 Radius of Sliding Surface (R) vsteretic Loop Parameter (a) . 0.5 ivsteretic Loop Parameter (a) Hysteretic Loop Parameter (b) eretic Loop Parameter (b) a : alpha b : beta |a| + |b| = 1.0b : beta |a| + |b| = 1.0 Cancel $\mathbf{f} = \mathbf{r} \cdot \mathbf{k} \cdot \mathbf{d} + (1 - \mathbf{r}) \mathbf{F}_{\mathbf{x}} \cdot \mathbf{z}$ $\mathbf{f} = -\frac{\mathbf{P}}{\mathbf{P}}\mathbf{d} - \mathbf{P} \cdot \mathbf{\mu} \cdot \mathbf{z}$ $\dot{z} = \frac{k}{\left|P\right| \cdot \mu} \left[1 - \left|z\right|^2 \left\{\alpha \cdot \text{sign}\left(\dot{d} \cdot z\right) + \beta\right\}\right] \dot{d}$ $\dot{z} = \frac{k}{E} \left[1 - |z|^{5} \left\{ \alpha \cdot \text{sign} \left(\dot{d} \cdot z \right) + \beta \right\} \right] \dot{d}$ $\mu = \mu f - (\mu f - \mu s) \exp^{-rv};$ $\mathbf{v} = |\dot{\mathbf{d}}|$ <u>s=2</u> <u>s=1</u> Cancel OK OK Cancel

Boundary nonlinear analysis

Soil Structure Interaction

Non Linear spring supports for Abutment and Foundation

Nonlinear point spring support to represent the stiffness of the backfill and soil







General Link for Soil-Structure interaction (6x6 stiffness, mass, and damping matrix)



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Soil Structure Interaction

Non-linear Soil Springs for Pile



Multi-Linear Plastic Kinematic Time Forcing Function Hinge Model



Kinematic Hinge Model



Takeda Hinge Model

Soil Structure Interaction

Integral Bridge

Automatic Soil Spring generated for Soil-Structure Interaction



INTEGRATED SOLUTION SYSTEM FOR BRIDGE AND CIVIL ENGINEERING midas Civil for Canada

Design



Steel Composite Section Design Check

Steel Composite Section Design Check as per CSA-S6-14

	te Steel Girder Design Parameters		X
ode :	CSA-S6-14 Update by 0	Code	
Stren	gth Resistance Factor		
Resi	stance factor for flexure (Phi_s)	0.95	
Resis	stance factor for shear(Phi_s)	0.95	
Resis	stance factor for compression(Phi_s)	0.9	
Resis	stance factor for tension(Phi_s)	0.95	
Resis	stance factor for torsion(Phi_s)	0.9	
Resi	stance factor for reinforcement(Phi_r)	0.9	
Resi	stance factor for shear connector(Phi_sc)	0.85	
Resis	stance factor for bearing, interior(Phi_bi)	0.8	
Resi	stance factor for bearing, end(Phi_u)	0.75	
Option	n For Curved Girder neck for Horizontally Curved Girder		
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Desig Ult Ult Se Tra	heck Construction Stage Resistance n Parameters imate Limit State-Flexure imate Limit State-Shear rvice Limit State ansverse Stiffeners, Longitudinal Stiffeners, Bearing	Stiffener	



Before Composite/ After Composite
With Time dependent material behavior/modular ratio

Steel Composite Section Design Check

Steel Composite Section Design Check as per CSA-S6-14 Design Report (EXCEL compatible)

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Service Limit State

Flexure Design

Shear Resistance

PSC Design

PSC Design as per CSA-S6-14





PSC Design

PSC Design as per CSA-S6-14 Design Report (EXCEL compatible)



Shear Design

Reinforced Concrete Design

Reinforced Concrete Design as per CSA-S6 Design Report



midas GSD

General Section Design as per CSA-S6



Dynamic Report Generator





INTEGRATED SOLUTION SYSTEM FOR BRIDGE AND CIVIL ENGINEERING midas Civil for Canada

Thank you

Contact DanielLee@midasit.com Midasoft@midasit.com

