

**Outline**

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**Four Case Studies:**

1. Application of RSA to bridge seismic design
2. Mission Bridge – Comparison of demands from RSA and time history analyses
3. **Lake City Overpass: RSA demands and combinations**
4. Knight Street Bridge retrofit – RSA and modeling

**Lake City Overhead – Burnaby, B.C. [add bridge photo(s)]**

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Lake City Overhead – Burnaby, B.C. [add bridge photo(s)]

3



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Lake City Overhead – Burnaby, B.C. [add bridge photo(s)]

4



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**Lake City Overhead – Burnaby, B.C. - Overview**

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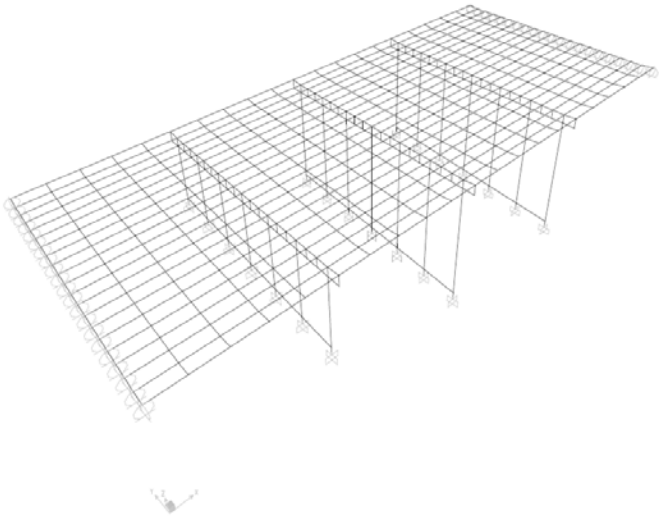
- Four span structure with simply supported box stringers, 56.2 m length
- Slight curvature to the roadway
- Three 7-column bents with 2.5 ft diameter columns and a support skew of 7°
- Variable bent column heights with Bent 1 columns shortest (clear ht for Bent 1 columns = 5.9 m; clear ht for Bent 2 and 3 columns = 10.1 m)

**Lake City Overhead – Burnaby, B.C. – RSA Modeling**

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- A 3- model of the complete structure (SAP 2000)
- The superstructure was modeled as continuous transversely: deck joints are being replaced with link slabs at piers
- The superstructure-to-abutment connection was modeled as "free"; no reliable mechanism to transfer the inertial loads
- Opted to have piers resist the seismic loads; abutment soil retrofit cost concerns
- No foundation springs were used; the footings were assumed to be completely fixed due to the presence of competent soils

**Lake City Overhead – Burnaby, B.C. SAP2000 Model** 7



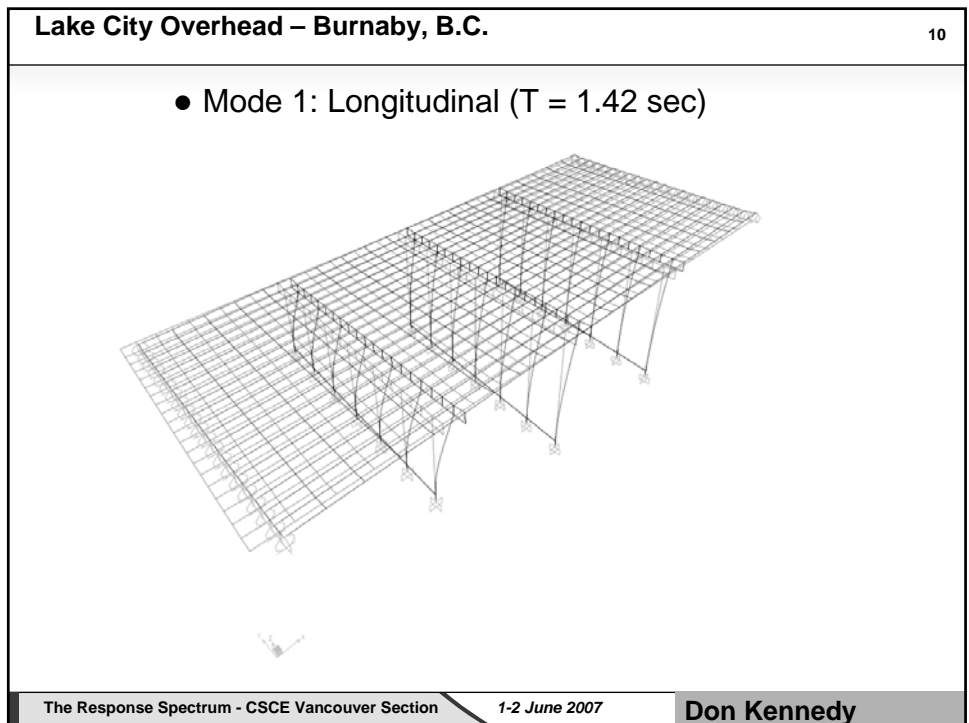
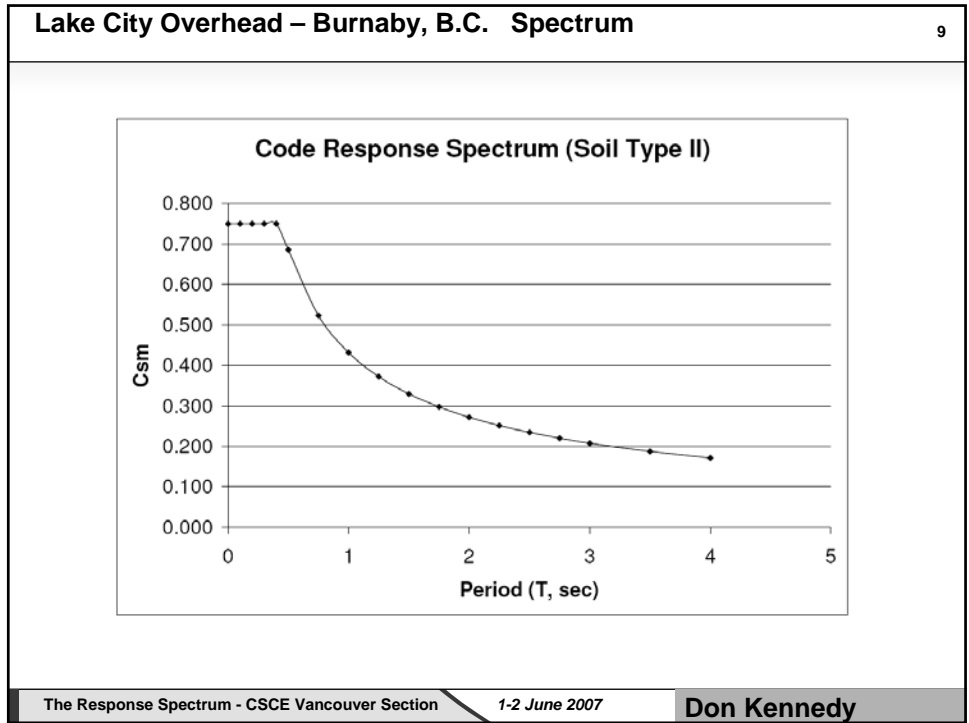
The image shows a 3D wireframe model of a bridge structure. The bridge has a long, rectangular deck supported by several vertical columns. Above the deck, there is a complex truss system consisting of numerous interconnected members, likely representing overhead power lines or a similar structure. The model is rendered in a perspective view, showing the bridge's length and width.

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**Lake City Overhead – Burnaby, B.C.** 8

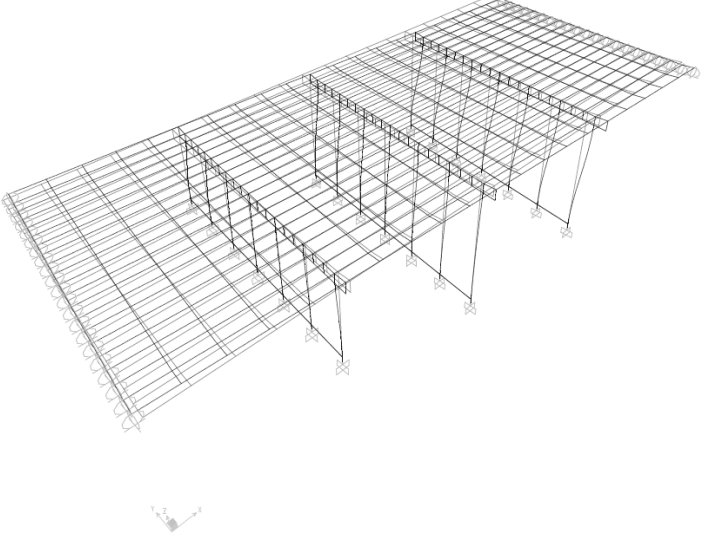
- CSA-S6-00 response spectrum was used (Cl. 4.4.7)
- Designated as an 'Emergency Route' bridge and assigned an I value of 1.5
- Soil profile type II was assumed with a site coefficient of  $S=1.2$

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Lake City Overhead – Burnaby, B.C. 11

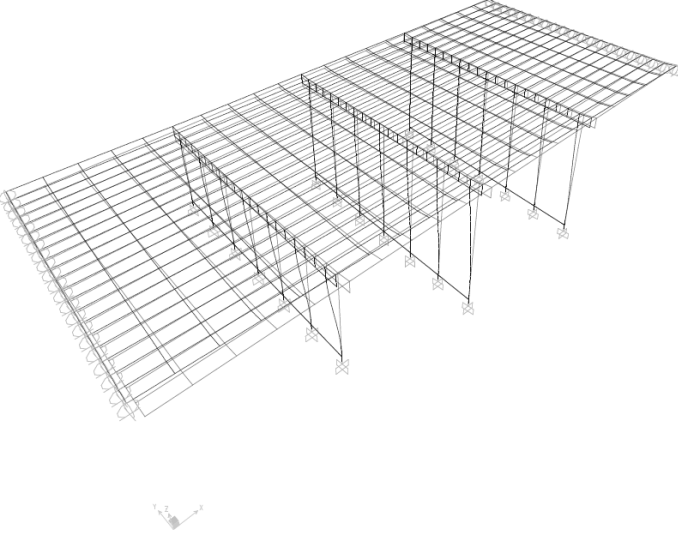
- Mode 2: Torsional ( $T = 1.34$  sec)



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- Mode 3: Transverse ( $T = 0.63$  sec)



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**Application of RSA analysis**

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- MM spectral analysis was used to determine horizontal displacement demands at the centre of the bents; forces were not extracted from this analysis
- 12 modes were found to be sufficient to capture at least 90 percent of the modal mass participation as per CSA-S6-00
- A summary of modal mass participation for each mode is shown as below

**Modal contributions**

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TABLE: Modal Participating Mass Ratios

OutputCase	StepType	StepNum	Period	UX	UY	UZ	SumUX	SumUY	SumUZ
Text	Text	Unitless	Sec	Unitless	Unitless	Unitless	Unitless	Unitless	Unitless
MODAL	Mode	1	1.419091	0.91	0.0002638	8.568E-08	0.91	0.0002638	8.568E-08
MODAL	Mode	2	1.341581	0.02991	0.33	1.094E-08	0.94	0.33	9.663E-08
MODAL	Mode	3	0.634554	0.01153	0.63	1.612E-07	0.95	0.96	2.579E-07
MODAL	Mode	4	0.170675	0.00002864	7.332E-07	0.000001338	0.95	0.96	0.000001596
MODAL	Mode	5	0.148838	0.000001549	0.000001867	0.08636	0.95	0.96	0.08636
MODAL	Mode	6	0.144702	0.000008174	0.000000619	0.0009342	0.95	0.96	0.0873
MODAL	Mode	7	0.127119	0.00008884	0.0002868	0.000553	0.95	0.96	0.08785
MODAL	Mode	8	0.126794	0.000032	0.00005848	0.0001009	0.95	0.96	0.08795
MODAL	Mode	9	0.11634	0.001085	0.0002809	0.0007313	0.95	0.96	0.08868
MODAL	Mode	10	0.115209	0.0005923	0.000003337	0.000042	0.95	0.96	0.08872
MODAL	Mode	11	0.114048	0.0003985	0.00002622	0.001164	0.95	0.96	0.08989
MODAL	Mode	12	0.110875	0.00001201	0.001142	0.00003991	0.95	0.96	0.08993

