

## Vortex Shedding for Slender Vertical Vessel (CSA S6)

[Review Report](#)

### Information of Segment

$i =$    $L_i =$   mm  $D_i =$   mm    
 $NP_i =$    $t_i =$   mm  $MA_i =$   kg

$i$	$L_i$ (mm)	$D_i$ (mm)	$t_i$ (mm)	$NP_i$	$MA_i$ (kg)
3	5000	500	8	5	0
2	9000	800	8	9	0
1	8000	1000	10	8	0

Sketch:

Table:

### General Information

$D_0 =$   mm  $q_0 =$   kPa

Cross Section:

Location:

Terrain Topology:

Mode Shape:

Steel

Concrete

### Reference:

**Canadian Highway Bridge Design Code, CSA S6 2006**

**Dynamics of Structures, Anil K. Chopra, Prentice Hall**

**Finite Element Procedures, K. J. Bathe, Prentice Hall**

**Vortex Shedding Induced Loads on Free Standing Structures I. Giosan**

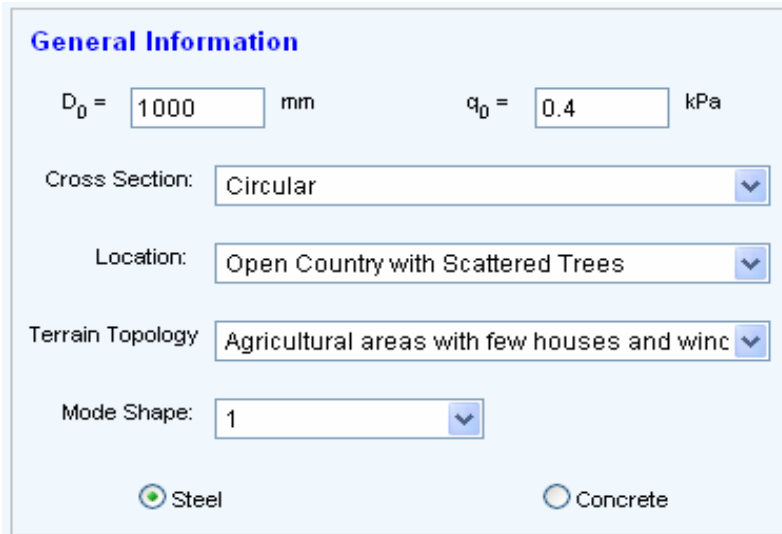
**Features:**

1. for structures with variable cross sections along the shaft
2. Considering several vibrating frequencies and mode shapes
3. with inverse iteration of finite element method, three mode shapes are available

$$[K] \cdot [\phi] = \omega^2 \cdot [M] [\phi]$$

**Instruction:**

**1. Input of General Information**



**General Information**

$D_0 =$   mm       $q_0 =$   kPa

Cross Section:

Location:

Terrain Topology

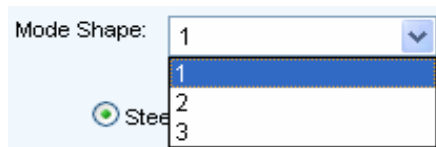
Mode Shape:

Steel       Concrete

$D_0$  - diameter at the base

$q_0$  - basic wind pressure

Mode Shape:



Mode Shape:

- 1
- 2
- 3

Steel

Three mode shapes are available

## 2. Input of Segments

**Information of Segment**

$i =$     $L_i =$   mm  $D_i =$   mm

$NP_i =$    $t_i =$   mm  $MA_i =$   kg

$i$	$L_i$ (mm)	$D_i$ (mm)	$t_i$ (mm)	$NP_i$	$MA_i$ (kg)
3	5000	500	8	5	0
2	9000	800	8	9	0
1	8000	1000	10	8	0

$L_i$  - length of the segment

$D_i$  - diameter at the top of the segment

$NP_i$  - additional points inside the segment, with these points, you can get accurate profile of mode shape  
(assume: points at equal spaces)

$t_i$  - thickness of the segment

$MA_i$  - additional mass at the top of the segment

### Add One Segment

**Information of Segment**

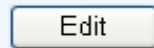
$i =$     $L_i =$   mm  $D_i =$   mm

$NP_i =$

$t_i =$   mm  $MA_i =$   kg

- 1). Select item 4 as added
- 2). Select "Add" from the list

3). Click button "Edit"



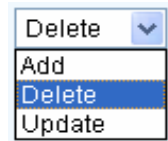
item 4 is added

### Delete Existing Segment

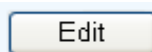
**Information of Segment**

i =

- 1). Select item 2 as deleted
- 2). Select "Delete" from the list



3). Click button "Edit"



item 2 is deleted

### Update Existing Segment

**Information of Segment**

i =

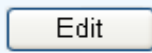
$L_i$  =  mm     $D_i$  =  mm

$NP_i$  =      $t_i$  =  mm     $MA_i$  =  kg   

- 1). Select item 1 as updated
- 2). Select "Update" from the list



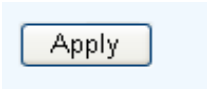
3). Click button "Edit"



item 1 is updated

### 3. Review Report

Click button "Apply"



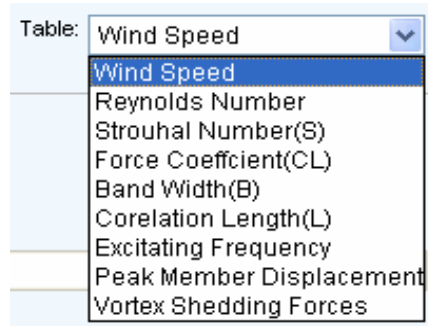
click link "Review Report"

[Review Report](#)

### 4. Review Tables

Tables at the lower part of the page are internal reports for your review and checking

You can select one from the following list

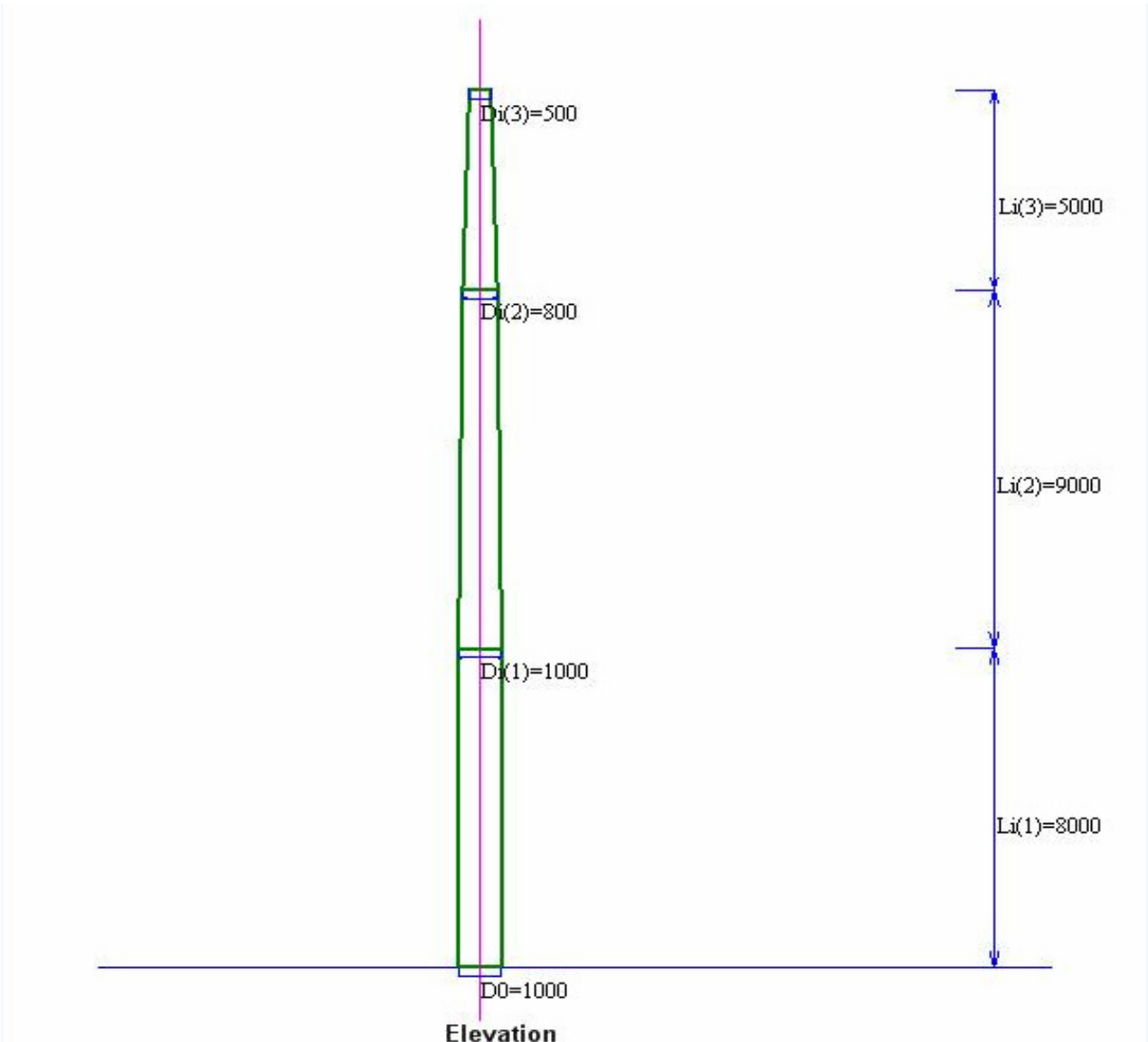


Elevation (m)	D(k) (m)	Frequency (Hz)																								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
22.0	0.5	0.36	0.72	1.08	1.44	1.8	2.16	2.52	2.88	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11	11.5	12	12.5
21.17	0.55	0.32	0.65	0.97	1.3	1.62	1.94	2.27	2.59	4.05	4.5	4.95	5.4	5.85	6.3	6.75	7.2	7.65	8.1	8.55	9	9.45	9.9	10.35	10.8	11.25
20.33	0.6	0.28	0.56	0.88	1.18	1.47	1.76	2.06	2.27	3.07	4.08	4.49	4.9	5.31	5.72	6.12	6.53	6.94	7.35	7.76	8.17	8.57	8.98	9.39	9.8	10.21
19.5	0.65	0.27	0.53	0.8	1.06	1.33	1.6	1.86	2.05	3.32	3.69	4.06	4.43	4.8	5.17	5.54	5.91	6.28	6.65	7.02	7.39	7.75	8.12	8.49	8.86	9.23
18.67	0.7	0.24	0.46	0.73	0.98	1.22	1.47	2.38	2.71	3.05	3.39	3.73	4.07	4.41	4.75	5.09	5.43	5.77	6.11	6.45	6.79	7.13	7.46	7.8	8.14	8.48
17.83	0.75	0.23	0.45	0.68	0.9	1.13	1.35	2.10	2.51	2.82	3.13	3.45	3.78	4.07	4.39	4.7	5.01	5.33	5.64	5.95	6.27	6.58	6.89	7.21	7.52	7.83
17.0	0.8	0.21	0.42	0.63	0.84	1.05	1.26	2.03	2.33	2.62	2.91	3.2	3.49	3.78	4.07	4.36	4.65	4.94	5.23	5.52	5.81	6.1	6.39	6.68	6.97	7.27
16.1	0.82	0.2	0.4	0.6	0.8	1	1.2	1.94	2.22	2.6	2.77	3.05	3.33	3.61	3.89	4.16	4.44	4.72	4.99	5.27	5.55	5.83	6.11	6.38	6.66	6.94
15.2	0.84	0.19	0.38	0.58	0.77	0.96	1.16	1.88	2.14	2.41	2.68	2.95	3.21	3.48	3.75	4.02	4.29	4.55	4.82	5.09	5.36	5.62	5.89	6.16	6.43	6.7
14.3	0.86	0.18	0.37	0.56	0.74	0.92	1.13	1.79	2.05	2.3	2.56	2.81	3.07	3.33	3.58	3.84	4.09	4.35	4.6	4.86	5.12	5.37	5.63	5.88	6.14	6.4
13.4	0.88	0.18	0.36	0.53	0.71	0.89	1.08	1.73	1.98	2.22	2.47	2.72	2.97	3.21	3.46	3.71	3.95	4.2	4.45	4.7	4.94	5.19	5.44	5.69	5.93	6.18
12.5	0.9	0.17	0.34	0.52	0.69	0.88	1.03	1.57	1.81	2.15	2.39	2.63	2.87	3.11	3.34	3.58	3.82	4.06	4.3	4.54	4.78	5.02	5.26	5.49	5.73	5.97
11.6	0.92	0.16	0.33	0.49	0.66	0.82	1.37	1.6	1.83	2.05	2.28	2.51	2.74	2.97	3.2	3.42	3.65	3.88	4.11	4.34	4.57	4.79	5.02	5.25	5.48	5.71
10.7	0.94	0.16	0.32	0.48	0.64	0.79	1.32	1.55	1.77	1.99	2.21	2.43	2.65	2.87	3.09	3.31	3.53	3.75	3.97	4.19	4.41	4.64	4.86	5.08	5.3	5.52
9.8	0.95	0.15	0.31	0.46	0.62	0.77	1.28	1.49	1.71	1.92	2.14	2.35	2.56	2.78	2.99	3.2	3.42	3.63	3.84	4.06	4.27	4.48	4.7	4.91	5.13	5.34
8.9	0.96	0.15	0.29	0.43	0.59	0.73	1.22	1.43	1.63	1.84	2.04	2.24	2.45	2.65	2.85	3.06	3.27	3.47	3.67	3.88	4.08	4.29	4.49	4.69	4.9	5.1
8.0	1.0	0.14	0.28	0.43	0.57	0.71	1.18	1.38	1.56	1.78	1.98	2.17	2.37	2.57	2.77	2.96	3.16	3.36	3.56	3.75	3.95	4.15	4.34	4.54	4.74	4.94
7.11	1.0	0.14	0.28	0.42	0.56	0.7	1.17	1.37	1.56	1.75	1.95	2.14	2.34	2.54	2.73	2.92	3.12	3.32	3.51	3.7	3.9	4.09	4.29	4.49	4.68	4.88
6.22	1.0	0.14	0.27	0.41	0.55	0.68	1.14	1.33	1.52	1.71	1.9	2.09	2.28	2.47	2.66	2.85	3.04	3.23	3.42	3.61	3.8	3.99	4.18	4.37	4.56	4.75
5.33	1.0	0.14	0.27	0.41	0.54	0.67	1.13	1.32	1.51	1.69	1.88	2.06	2.25	2.44	2.63	2.81	3	3.19	3.38	3.56	3.75	3.94	4.13	4.31	4.5	4.69
4.44	1.0	0.13	0.27	0.4	0.53	0.67	0.8	1.29	1.48	1.66	1.85	2.04	2.22	2.4	2.59	2.78	2.96	3.14	3.33	3.52	3.7	3.88	4.07	4.26	4.44	4.63
3.56	1.0	0.13	0.26	0.39	0.52	0.65	0.78	1.26	1.44	1.62	1.8	1.98	2.16	2.34	2.52	2.7	2.88	3.06	3.24	3.42	3.6	3.78	3.96	4.14	4.32	4.5
2.67	1.0	0.13	0.26	0.38	0.51	0.64	0.77	1.24	1.42	1.6	1.77	1.95	2.13	2.31	2.49	2.66	2.84	3.02	3.19	3.37	3.55	3.73	3.9	4.08	4.26	4.44
1.78	1.0	0.13	0.25	0.38	0.5	0.63	0.76	1.23	1.4	1.58	1.75	1.92	2.1	2.28	2.45	2.63	2.8	2.97	3.15	3.33	3.5	3.67	3.85	4.03	4.2	4.38
0.89	1.0	0.12	0.25	0.37	0.49	0.61	0.73	1.19	1.36	1.53	1.7	1.87	2.04	2.21	2.38	2.55	2.72	2.89	3.06	3.23	3.4	3.57	3.74	3.91	4.08	4.25
0	1.0	0.12	0.24	0.36	0.48	0.6	0.72	1.17	1.34	1.51	1.67	1.84	2.01	2.18	2.35	2.51	2.68	2.85	3.02	3.18	3.35	3.52	3.69	3.85	4.02	4.19

5. Review Sketches

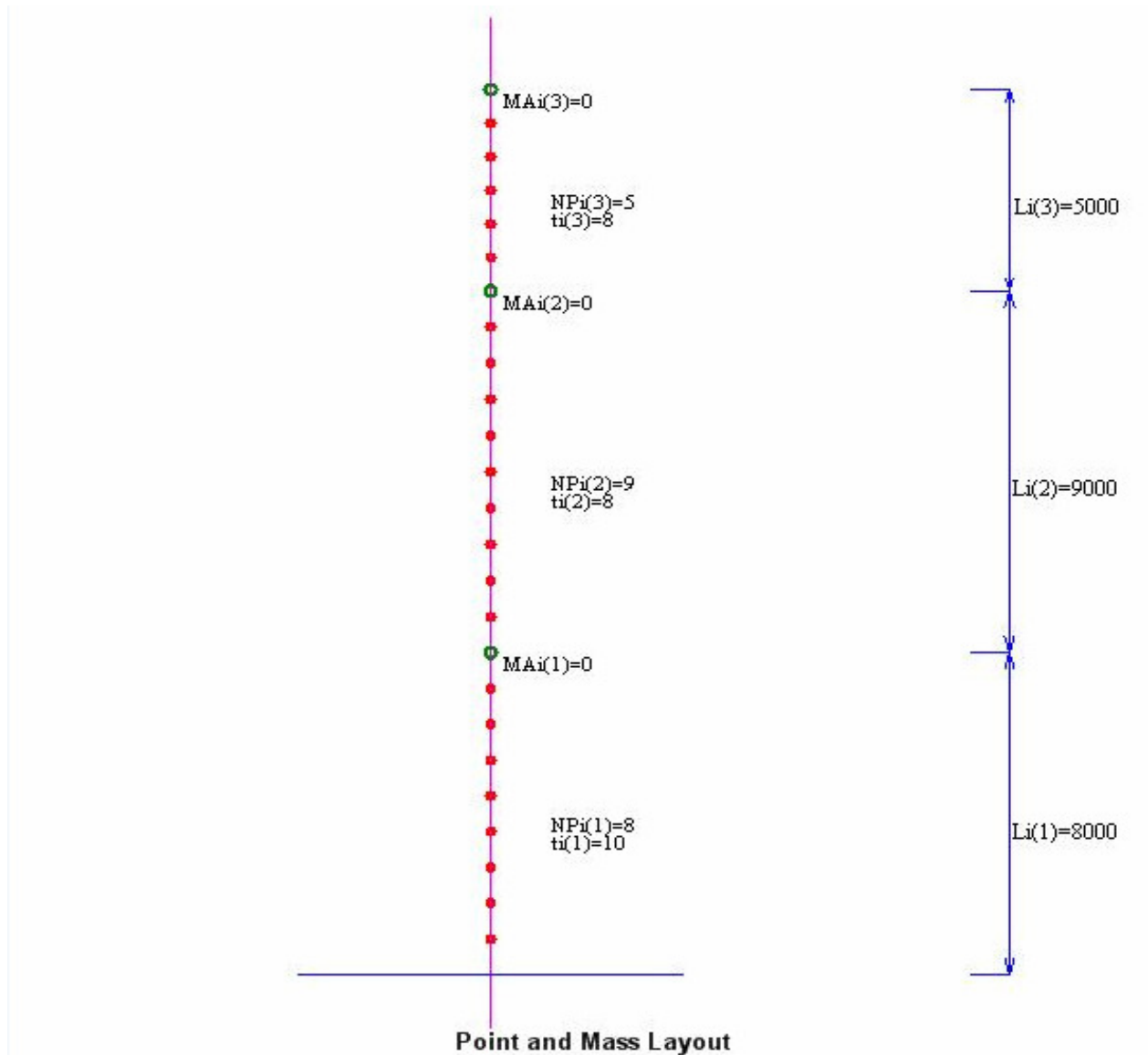
- Sketch: Elevation
- Elevation**
- Point & Mass Layout
- Final Mass Layout
- Mode Shape
- Max. Base Shear
- Max. Base Moment

1). Elevation



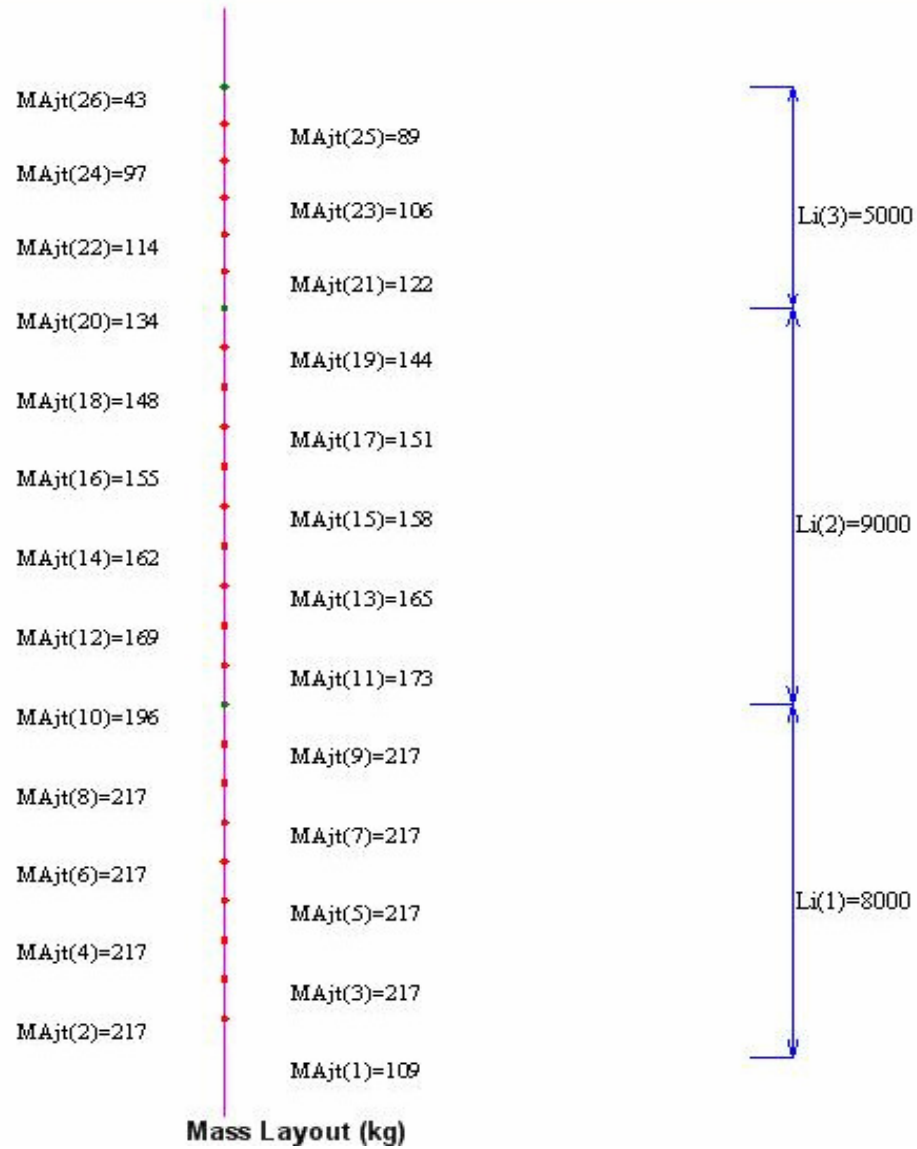
## 2). Point and Mass Layout

*additional points and additional mass layout*



### 3). Final Mass Layout

*Mass Layout at all points*

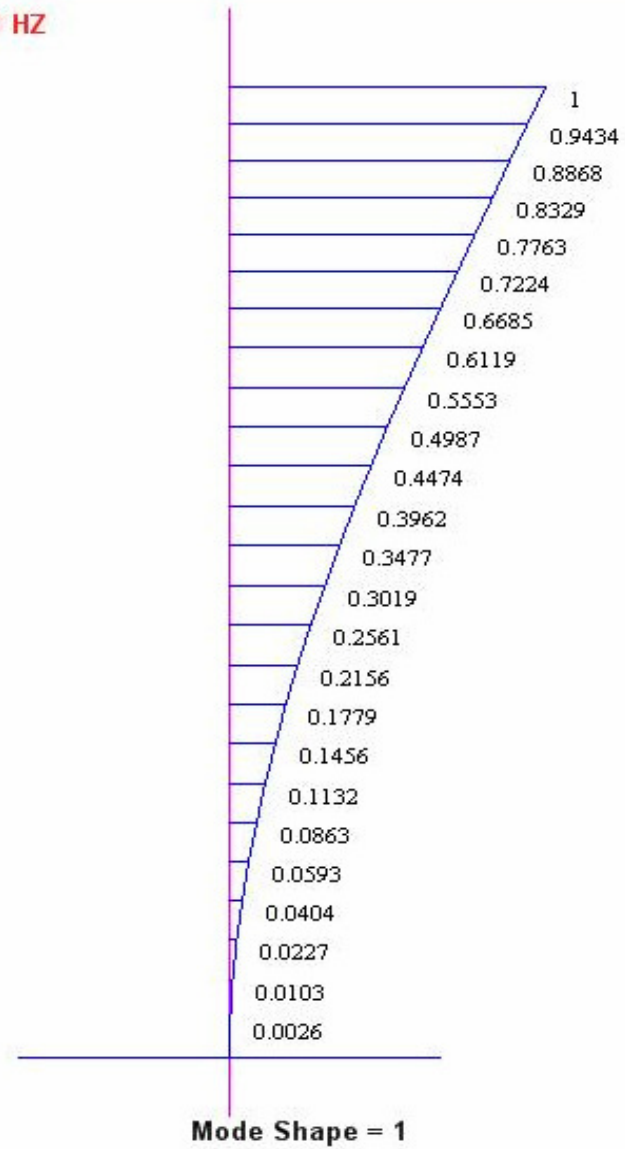




#### 4). Mode Shape

Vibrating frequency and normalized mode shape

Frequency:  $f(1) = 2.61$  HZ



**5). Maximum Base Shear**

*Maximum base shear and corresponding lateral loading profile*

**Max Base Shear = 1.5 kN**



**Lateral Loading Layout for Max. Base Shear**

**6). Maximum Base Moment**

*Maximum base moment and corresponding lateral loading profile*

**Max Base Moment = 27.6 kN.m**

