ETH zürich

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System identification of a high-rise building: a comparison between a single station measuring translations and rotations, and a traditional array approach.

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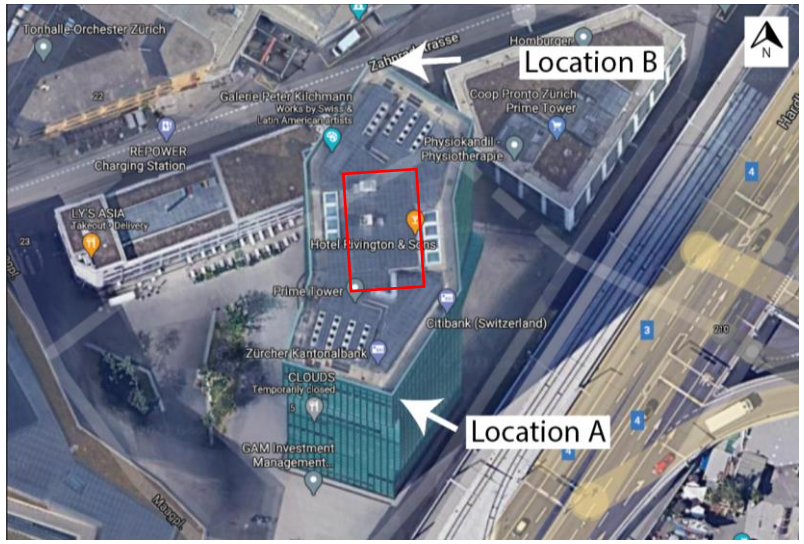
Prime Tower

- 126 m, 36 floors (3rd highest in CH)
- Large reinforced concrete core
- Pillars at edge
- Pile foundation
- Surrounded by trains, highways
- Excited by wind, EQ



Google Maps

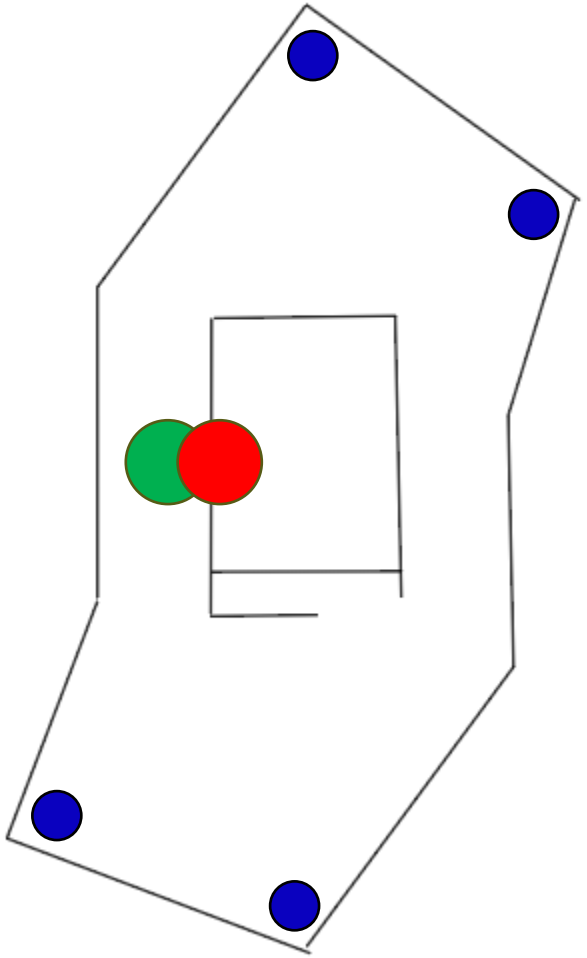
https://www.primetower.ch/en/

Prime Tower Monitoring 2021

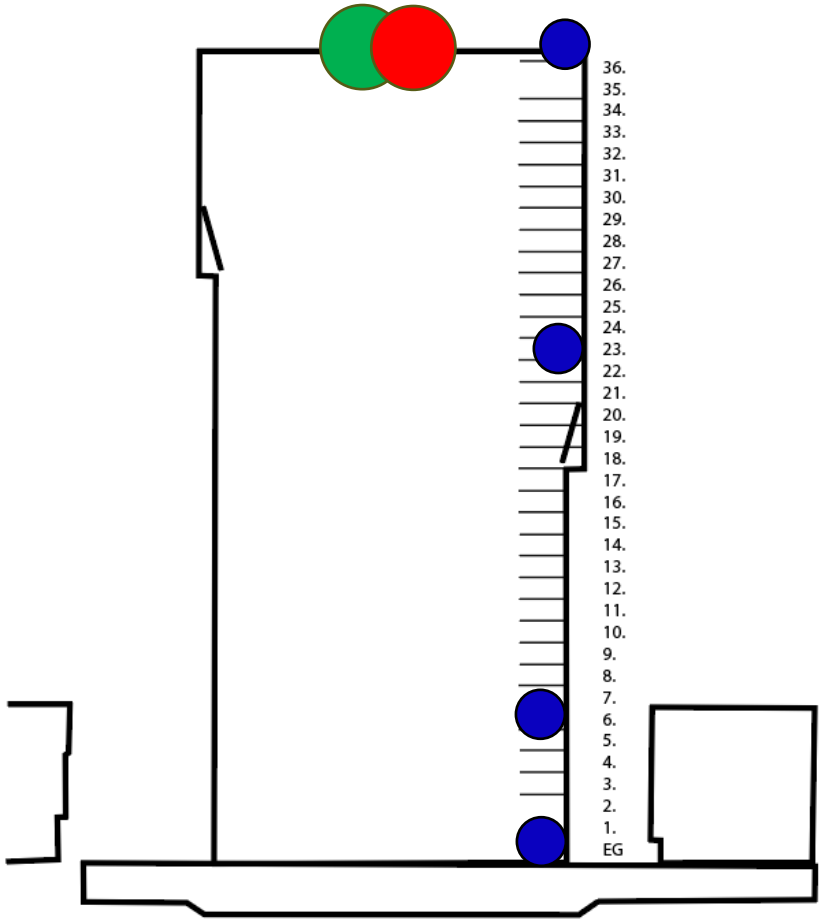
- 3C Acc (EpiSensor)
  - Fs = 250 Hz

- 3C Rot (BlueSeis)
  - FOG
  - Fs = 200 Hz

- 3C Acc
  - array



h-array



v-array

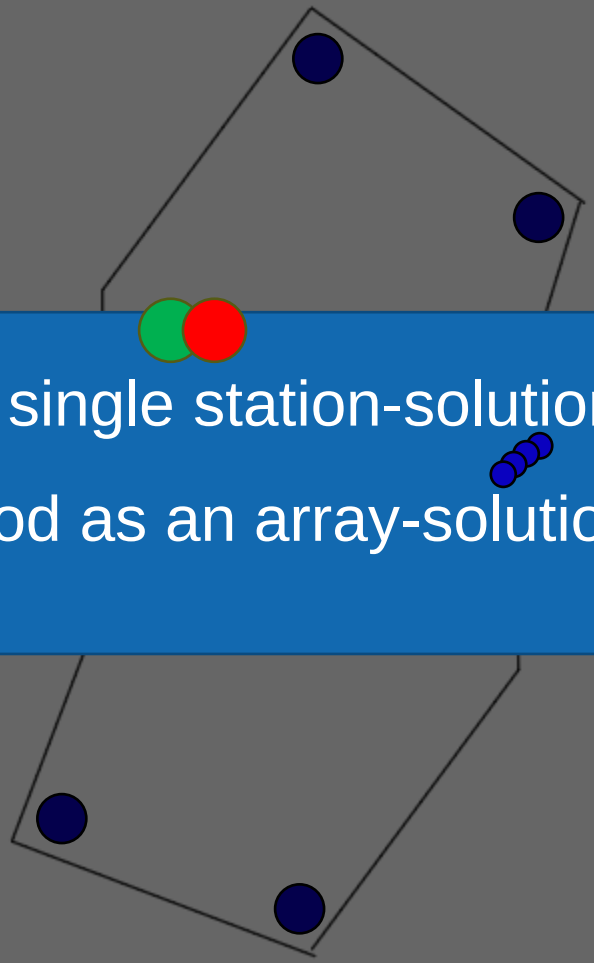
Prime Tower Monitoring 2021

- 3C Acc (EpiSensor)
  - Fs = 250 Hz

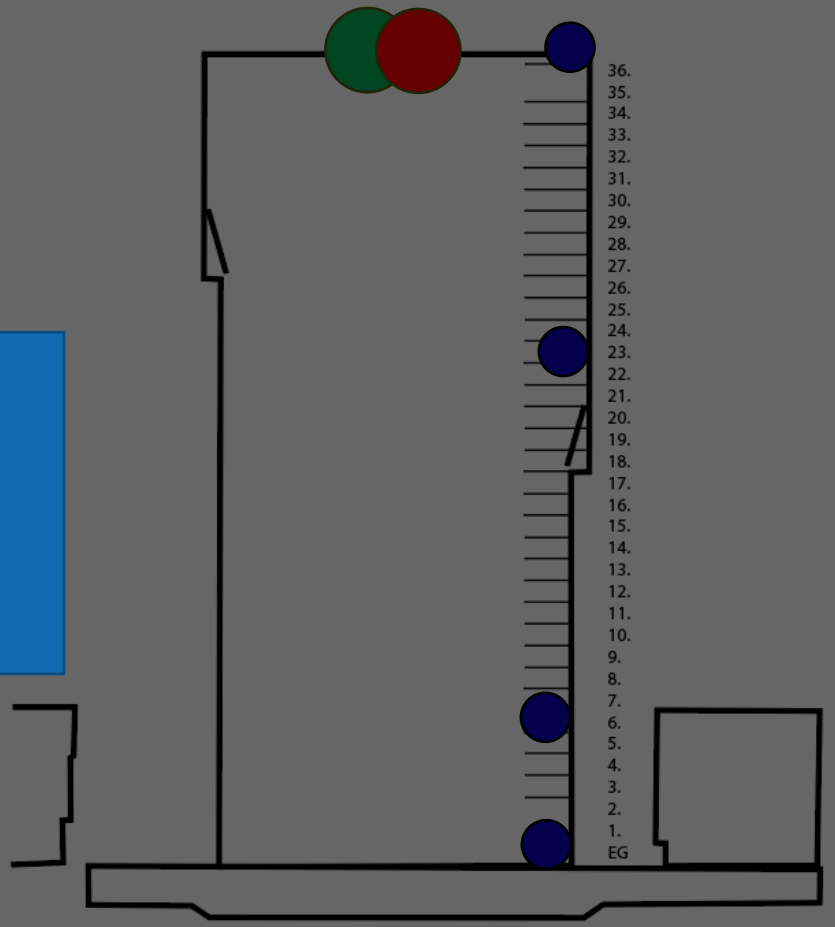
- 3C Rot (BlueSeis)
  - FOG
  - Fs = 200 Hz

- 3C Acc
  - array

Is a single station-solution as good as an array-solution?

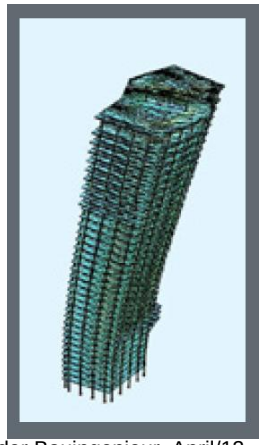


h-array



v-array

Results:
Apriori Knowledge



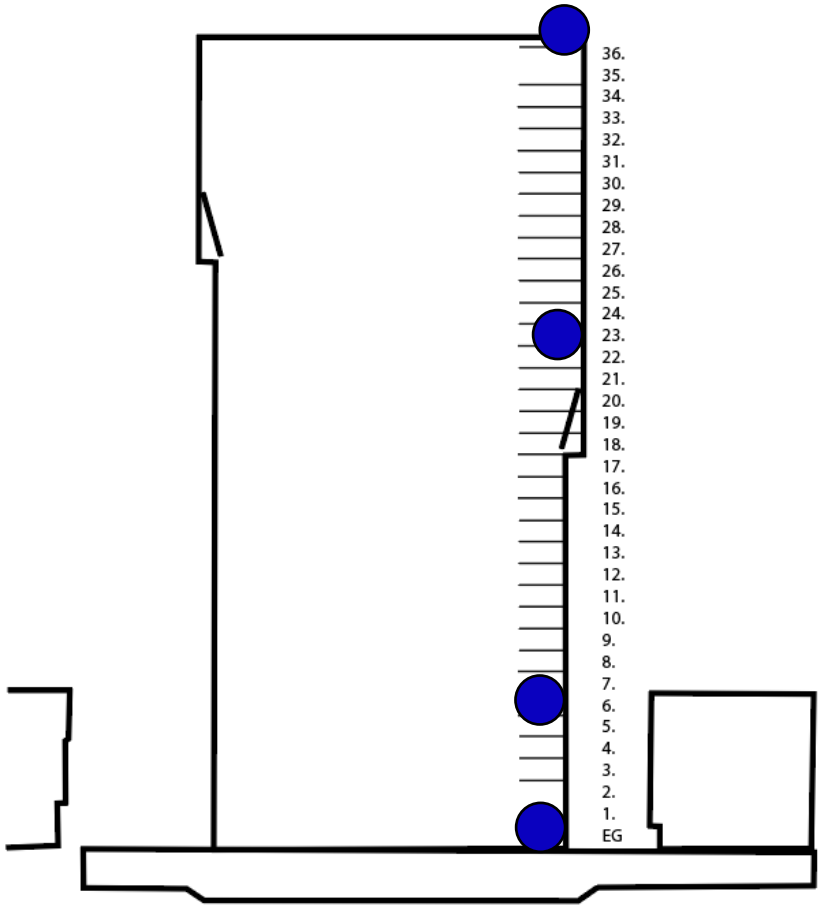
der Bauingenieur_April/12

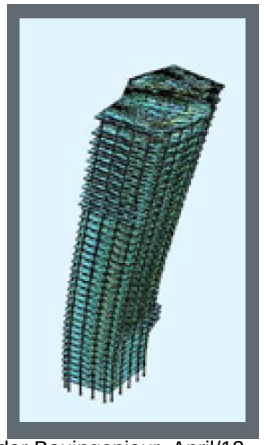
Bending EW

Torsion
Bending NS

Torsion

Results:
V-array Solution





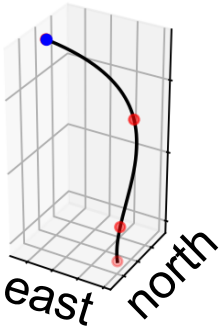
der Bauingenieur_April/12

Bending EW

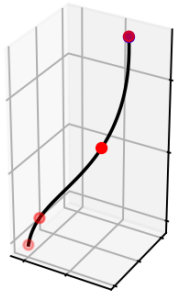
Torsion
Bending NS

Torsion

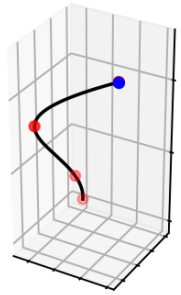
-0.36 Hz

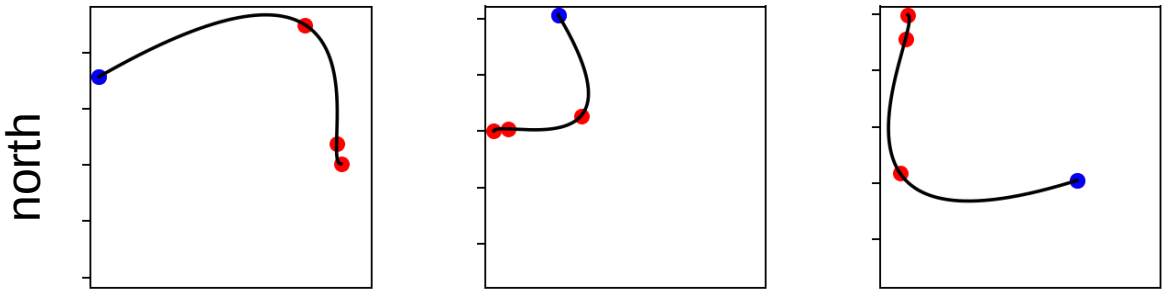


0.42 Hz



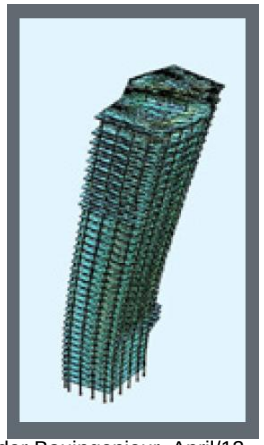
-0.54 Hz





Day 265 NE-corner

Results:
Single Station Solution vs H-array Solution

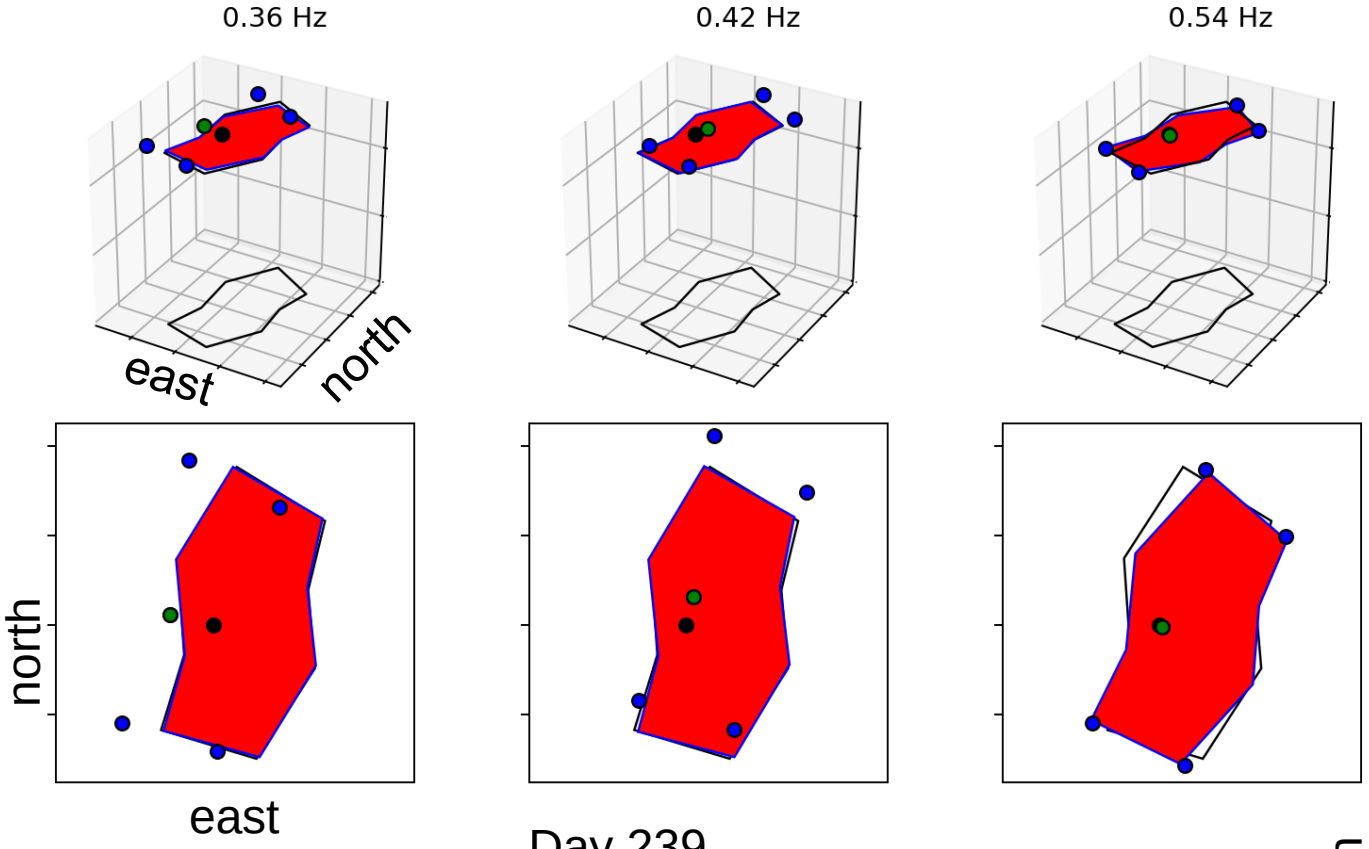


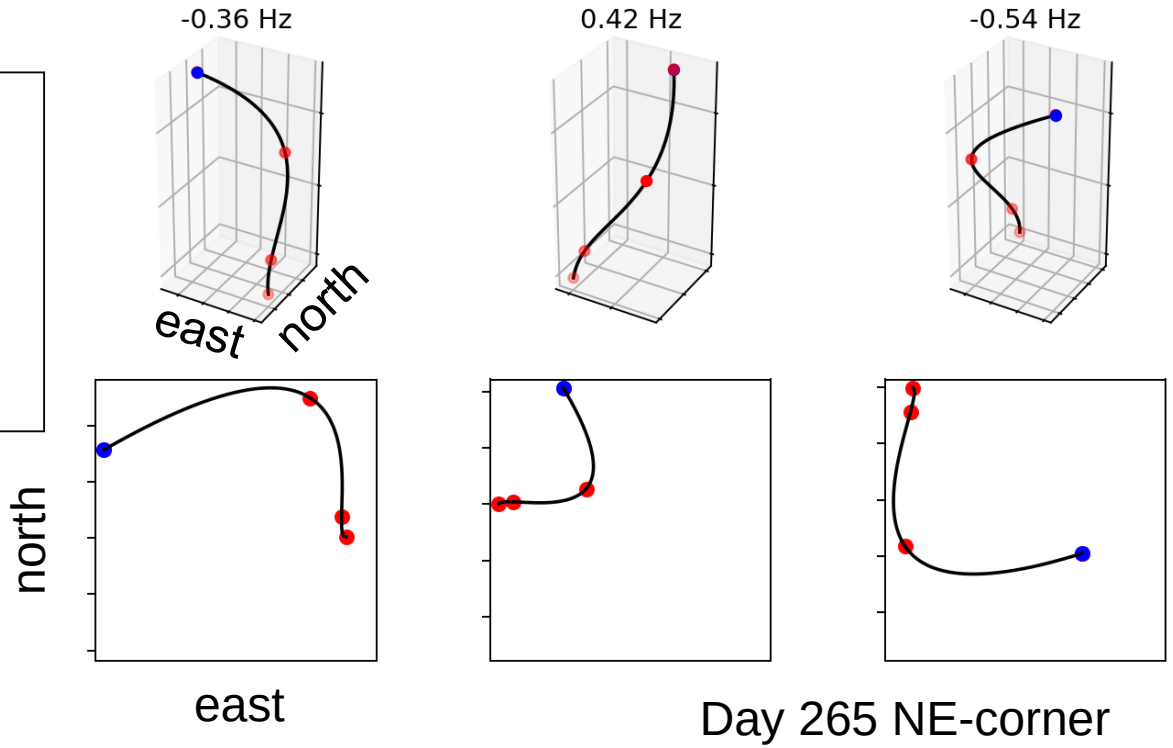
der Bauingenieur_April/12

Bending EW

Torsion
Bending NS

Torsion



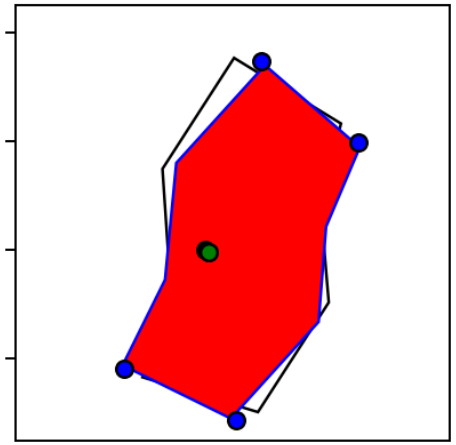


Conclusion

Single Station and H-array:

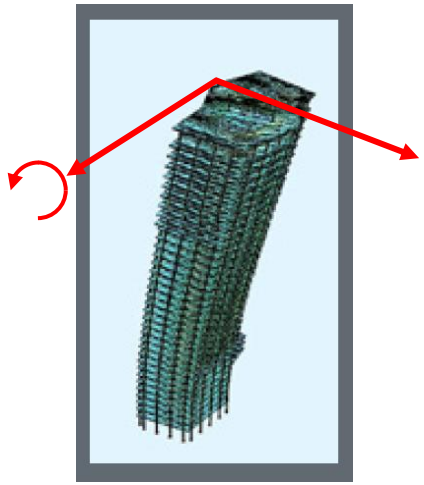
1. **eigen frequency detection**
2. **quantify the amount of torsion vs. translation**
3. **H-array can be replaced by a single station**

--> faster, simpler structural characterization possible



Outlook

1. **Vertical modeshape not yet definable with single station.**
2. **Can steepness of roof help with that?**
3. **Distinguish between bending/ shear and principal/ higher order modes?**



1. **Long term change of frequencies and modeshapes**
2. **External influences on modeshapes (EQ‘s, storm, temperature)**