GEBZE TECHNICAL UNIVERSITY

OPERATIONAL MODAL ANALYSIS

CASE STUDY

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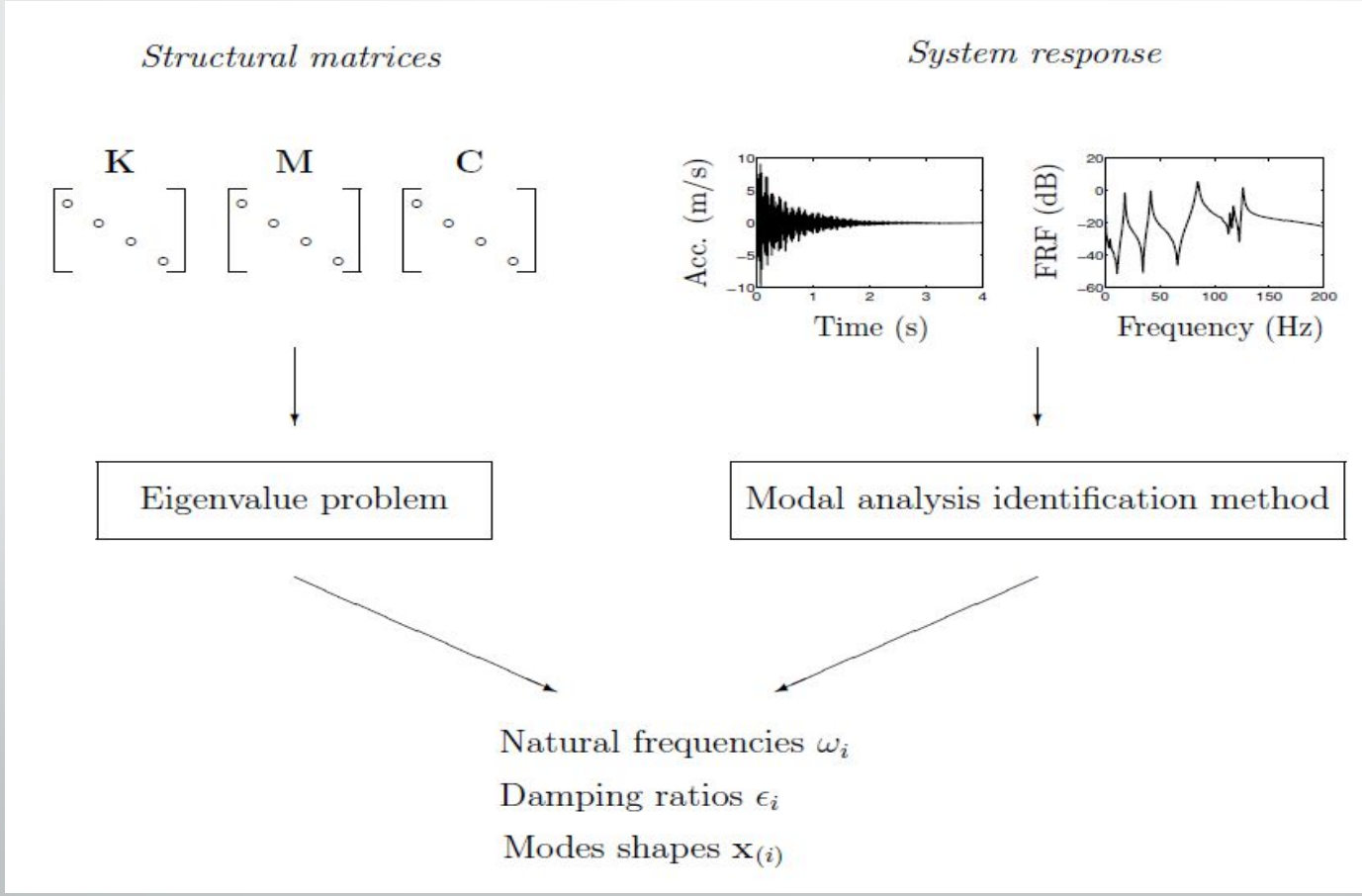
Earthquake and Structural Engineering-DYB692

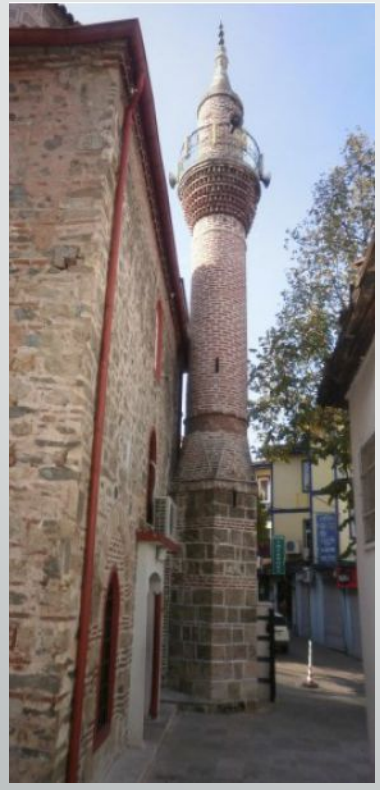
MODAL ANALYSIS

Modal analysis is used to determine a structure's vibration characteristics — natural frequencies and mode shapes.



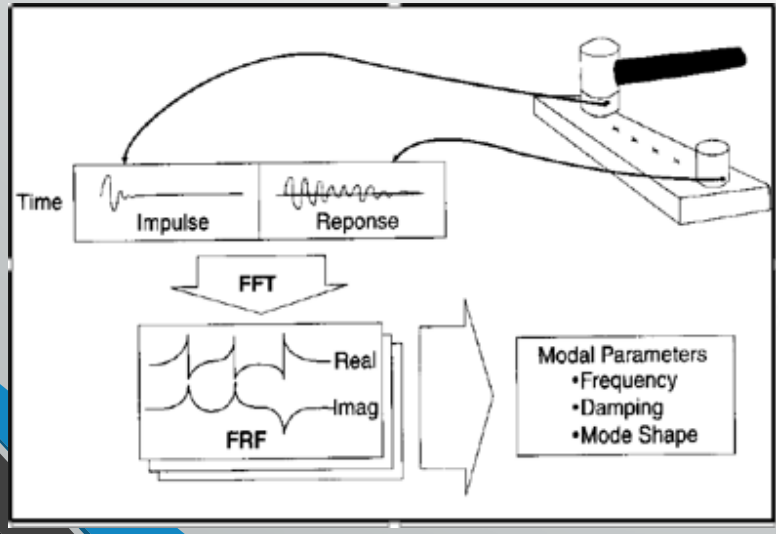
EXPERIMENTAL MODAL ANALYSIS USAGE AREA

Modal analysis plays an important role in most of the industries and applications. It has been utilized in design, optimization, health monitoring, vibration control and damage detection in structures, bridges, buildings, etc.



1-EXPERIMENTAL MODAL ANALYSIS

Experimental modal analysis (EMA) identifies the dynamic response from measurements of the applied force and the vibration response.
It is a classic input-output method where input need to be applied, controlled and measured.



Hammer Testing

- Impact Hammer 'taps'...serial or parallel measurements
- Excites wide frequency range quickly
- Most commonly used technique

Shaker Testing

- Modal Exciter 'shakes' product...serial or parallel measurements
- Many types of excitation techniques
- Often used in more complex structures

2-OPERATIONAL MODAL ANALYSIS

OMA is defined as the modal testing procedure that allows the eexperimental estimation of the modal parameters of the structure from measurements of the vibration response only.

- NEXT METHOD
- SSI METHOD (STOCHASTIC SUBSPACE IDENTIFICATIONMETHOD)
- FDD METHOD (FREQUENCY DOMAIN DECOMPOSITION)
- ARMA METHOD (AUTO-REGRESSION MOVING AVERAGE)
- STOCHASTIC REALIZATION METHOD

Difference between EMA and OMA

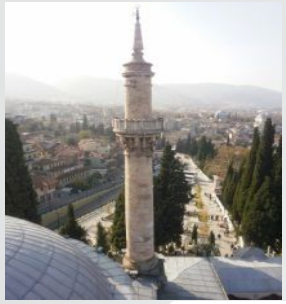
OMA has some advantages over EMA;

-cheap
-no need for artificial force
-less equipment
-structure can be used

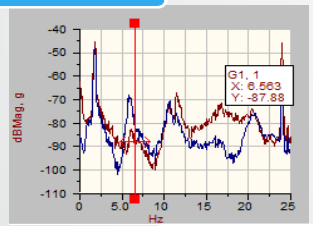
Although there are some disadvantages;

-Unscaled modal model
-Frequency range
-Long time histories

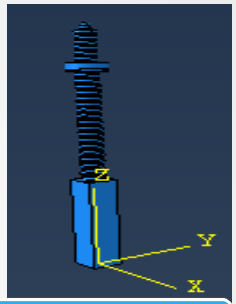
A Case study-METHODOLOGY



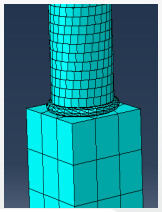
Measurement



OMA-EMA



Numerıcal Model



FEA

Dynamic Parameters

DIF<%10

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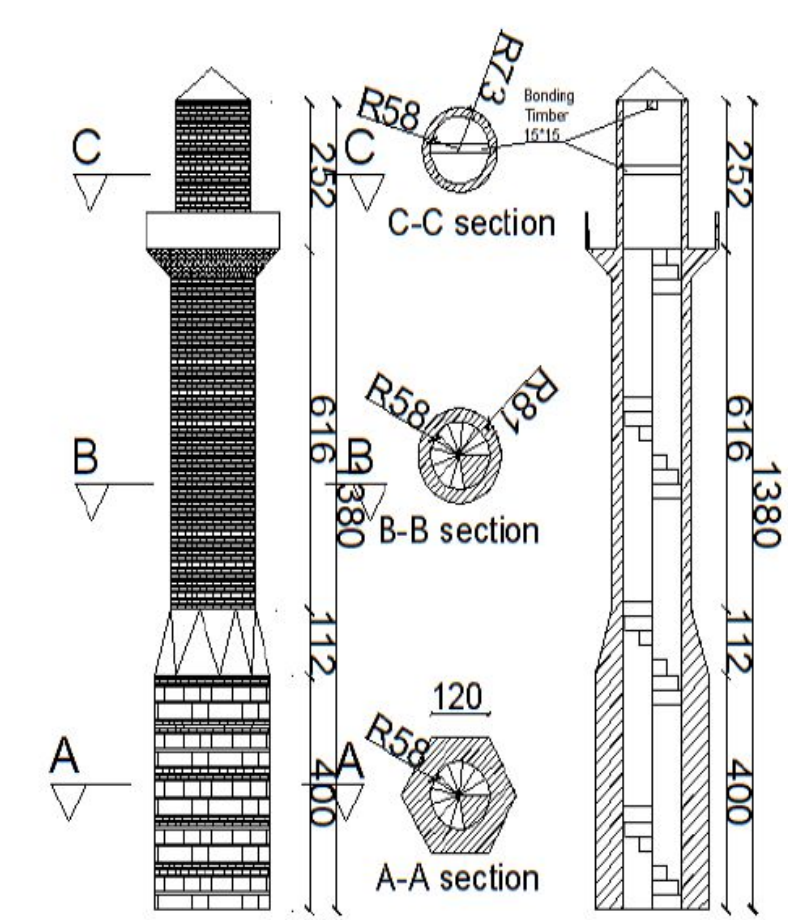
OK

REVISION

MINARET OF HOCA TABIP MOSQUE



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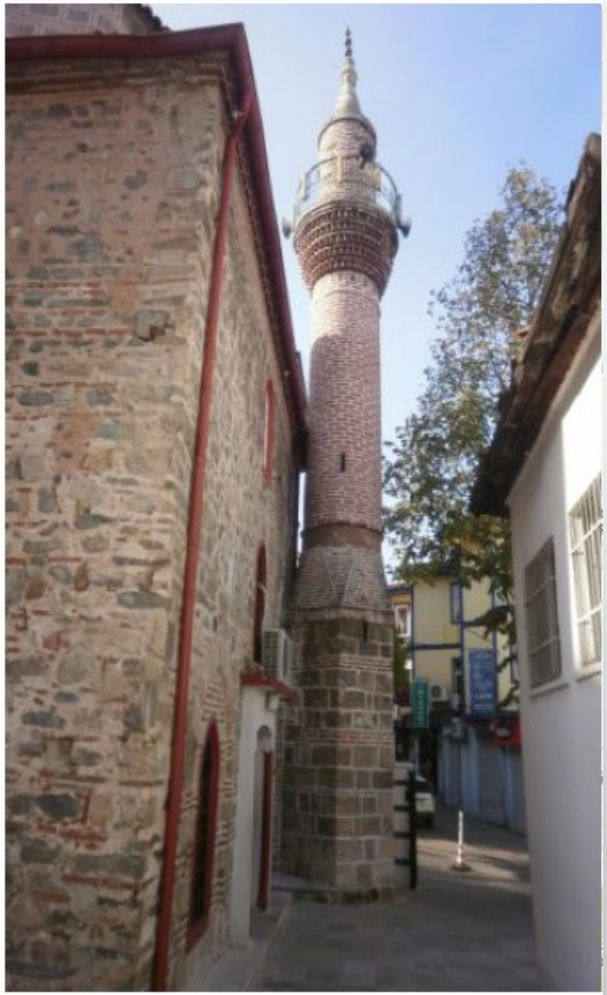
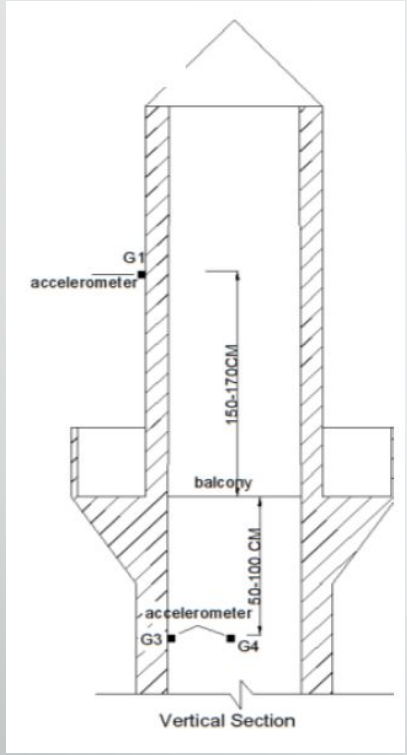
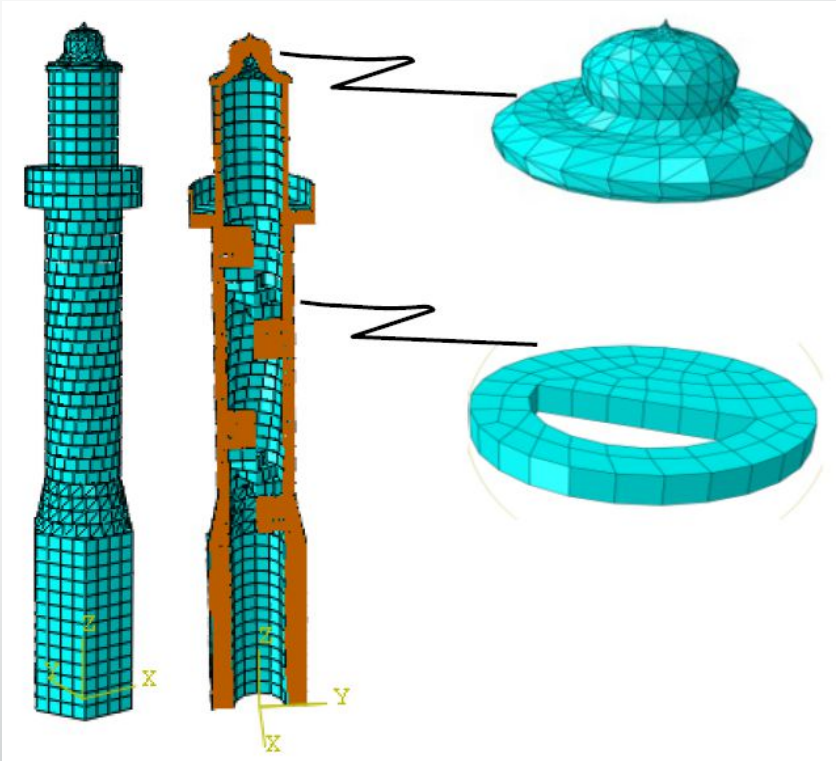
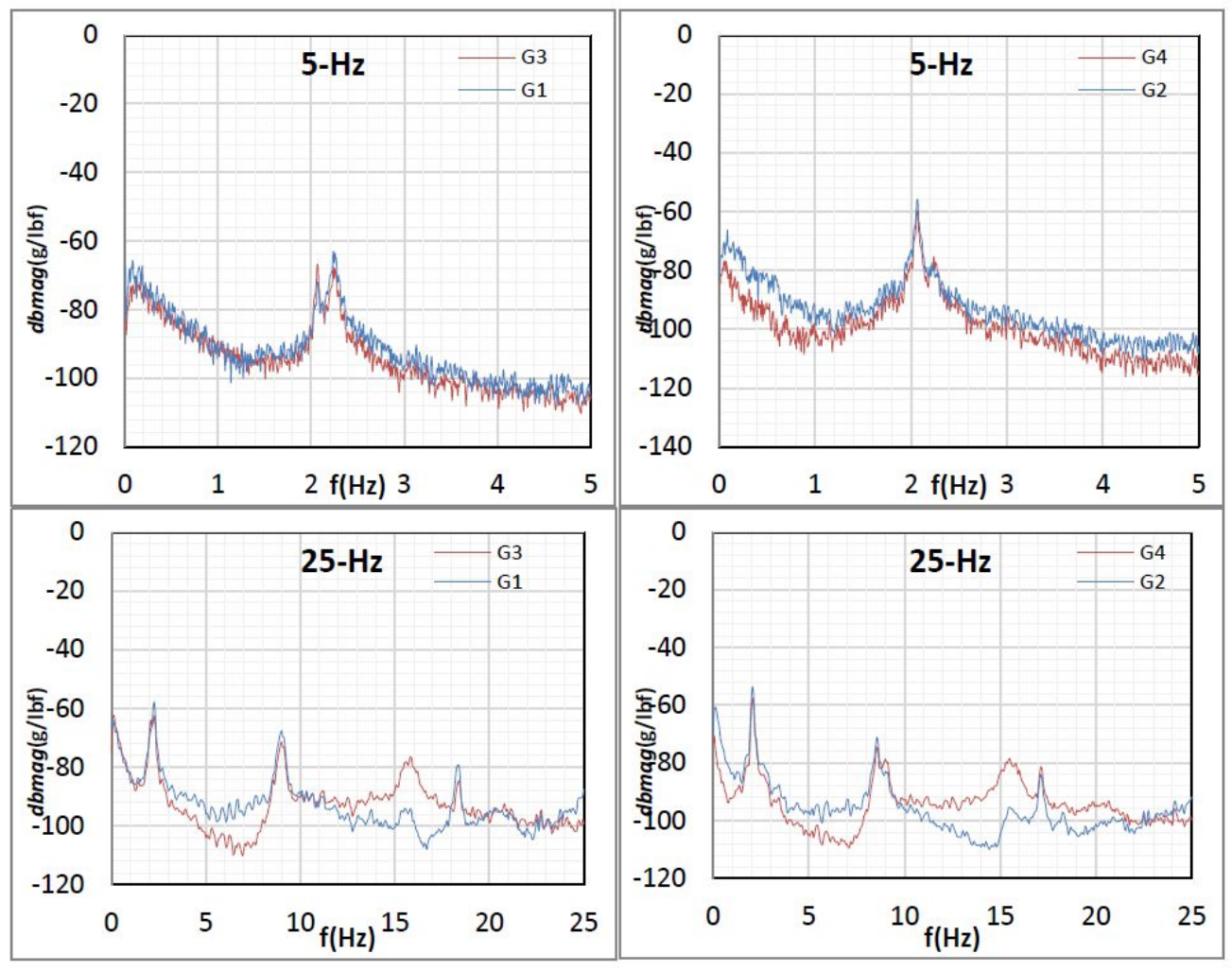


TESTING AND MODELLING



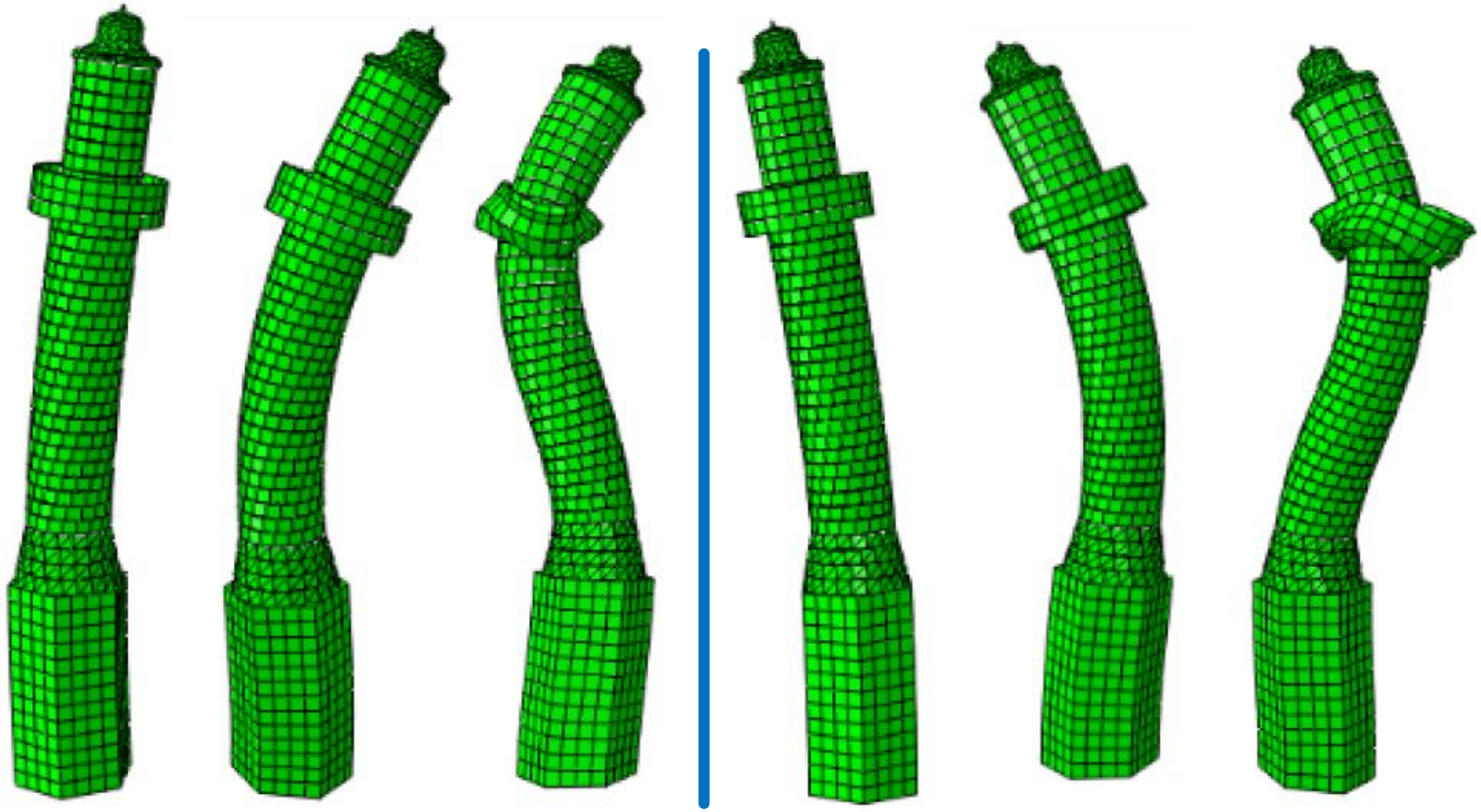


ANALYSIS



	Mode	Ambient Vibration Test (Hz)
X mode	1	2,25
	2	9,08
	3	18,38
Y mode	1	2,07
	2	8,6
	3	17,13

ANALYSIS



1.mode (x)
f=2,29 Hz
KF = X-%35,49
Y-%18,8

2.mode (x)
f=9,54 Hz
KF = X-%28,74
Y-%3,09

3.mode (x)
f=19,75 Hz
KF = X-%13,07
Y-%0,65

1.mode (y)
f=2,3 Hz
KF = X-%35,43
Y-%18,81

2.mode (y)
f=9,55 Hz
KF = X-%28,8
Y-%3,12

3.mode (y)
f=19,99 Hz
KF = X-%12,9
Y-%0,73

CONCLUSION

	Mode	Finite Element Method (Hz)	Mass Participation Factor %		Ambient Vibration Test (Hz)	Difference (%)
			X	Y		
X mode	1	2,29	35,49	18,8	2,25	-1,78
	2	9,54	28,74	3,09	9,08	-5,07
	3	19,75	13,07	0,65	18,38	-7,45
Y mode	1	2,3	35,43	18,81	2,07	-11,11
	2	9,55	28,8	3,12	8,6	-11,05
	3	19,99	12,9	0,73	17,13	-16,70

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THANKS...

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