



UNIVERSITÀ DEGLI STUDI
DI GENOVA

EMship

Advanced Design



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VIBRATIONS ANALYSIS 40M ICE CLASS MOTOR YACHT

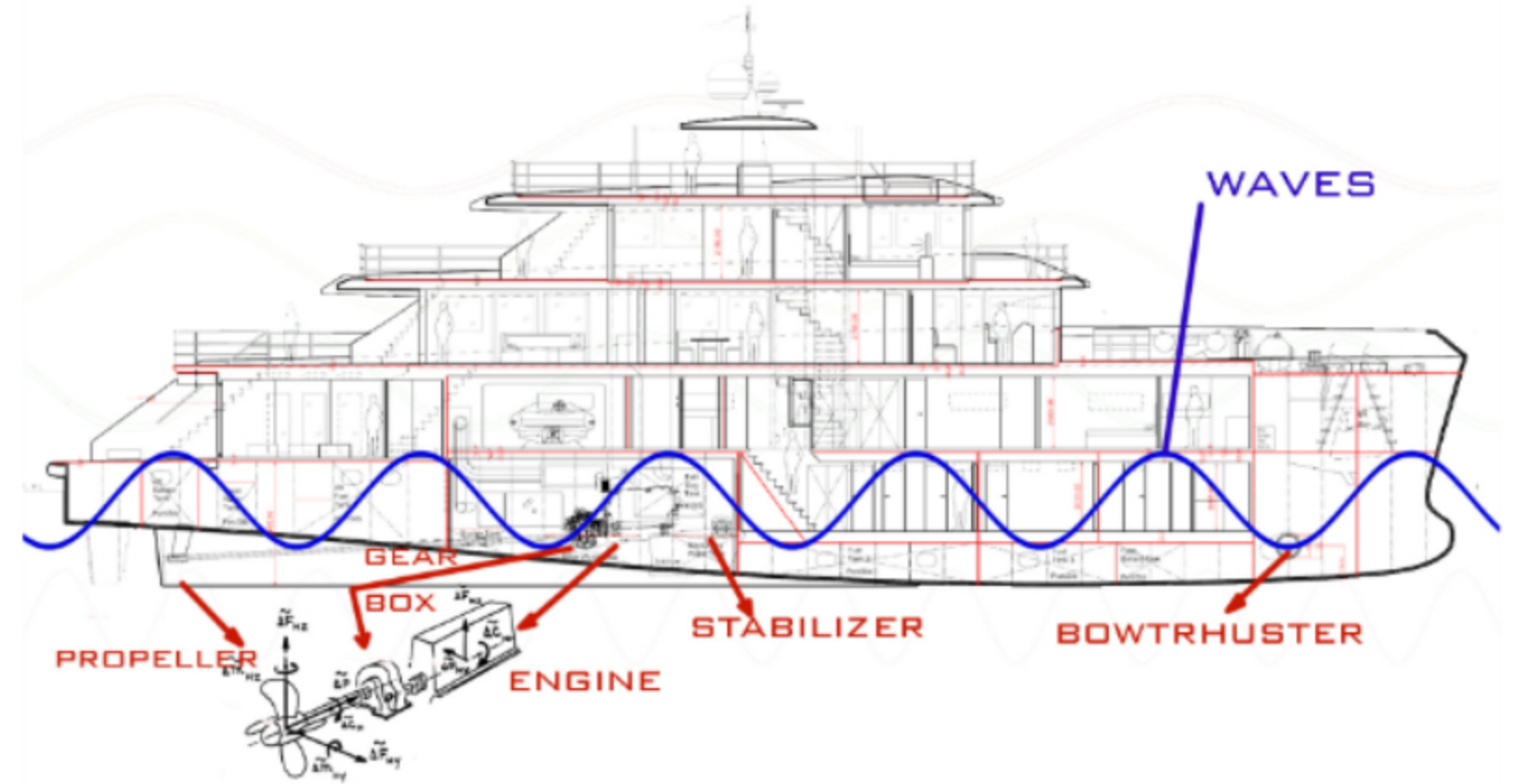
COMPARISON BETWEEN
FINITE ELEMENTS ANALYSIS AND
EXPERIMENTAL MEASUREMENTS

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REVIEWER: ZBIGNIEW SEKULSKI (ZUT)

MARIA SOL MASSERA

SOURCES OF VIBRATIONS ON A YACHT



EFFECTS ON THE YACHT

FATIGUE AND STRUCTURE RUPTURE

- SHAFT LINE SUPPORTS
- BASEMENTS

DYSFUNCTION

- ON BOARD ELECTRONICS
- RADAR MASTS
- SHAFT LINES

DISTURBANCE

- OWNER REQUIREMENTS
- COMFORT CLASS
- CLASIFICATION SOCIETIES

ICE CLASS YACHT

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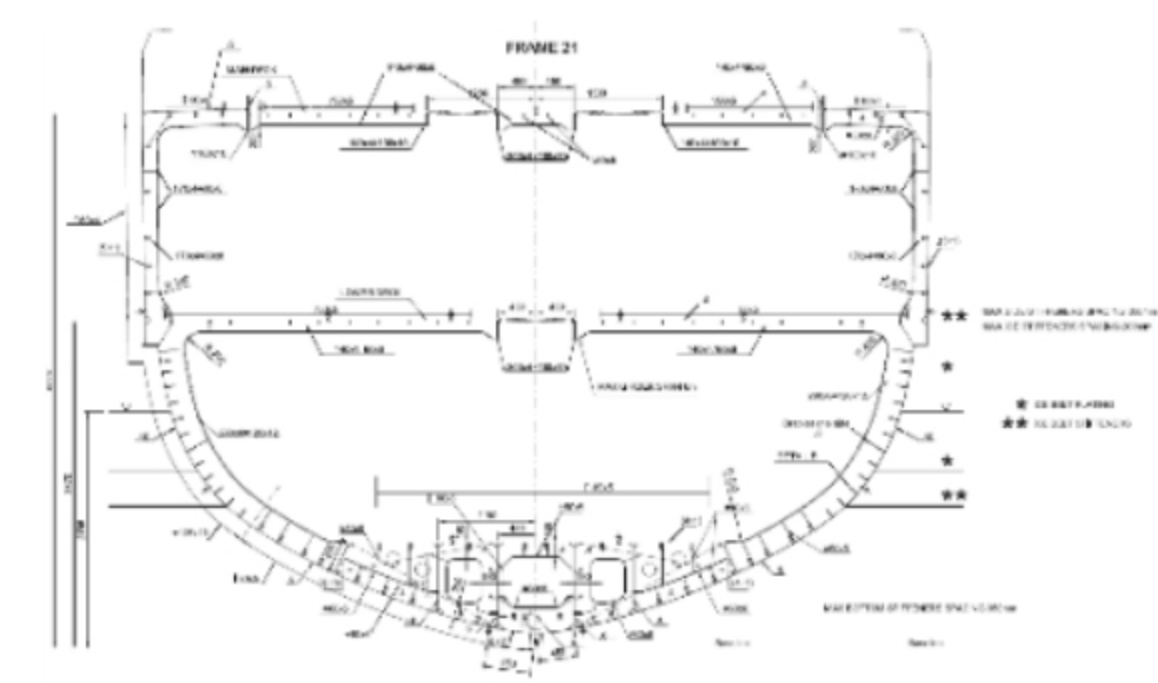
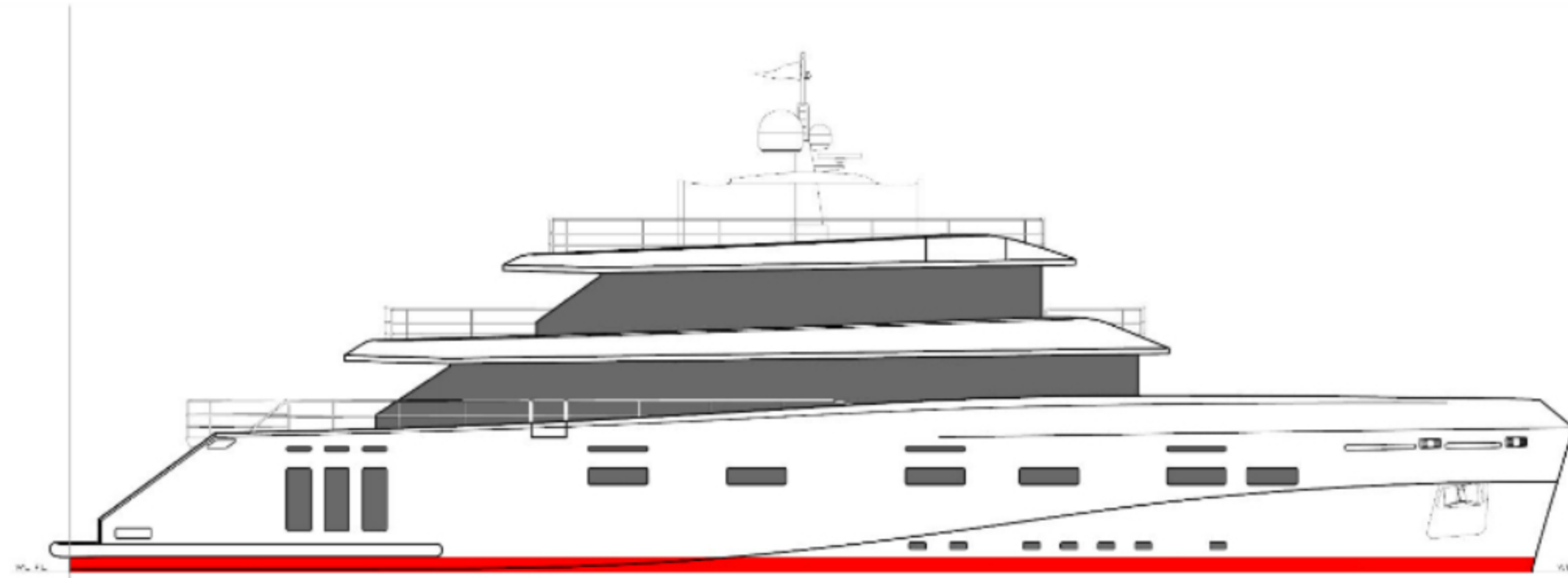
VIBRATION APPROACHES

FEM MODEL

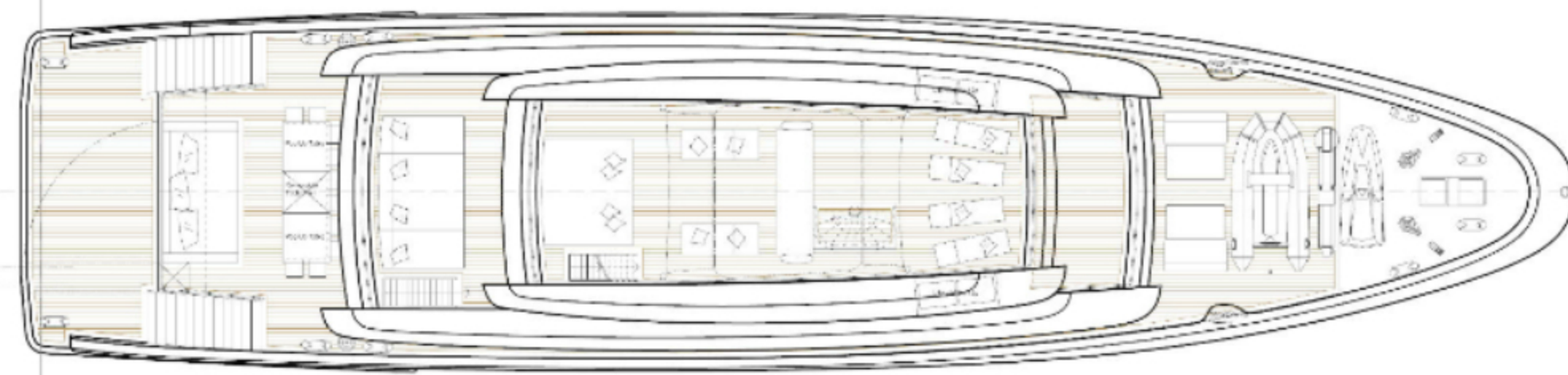
MEASUREMENT

COMPARISON

CONCLUSIONS



BASE LINE



SUN DECK

Technical Data	Value	Unit
Length Over All - LOA	40.8	m
Length waterline - LWL	39.2	m
Beam max	9.40	m
Draft	2.79	m
Depth	6.3	m
Full load Displacement	438	tons
V max	16	kn



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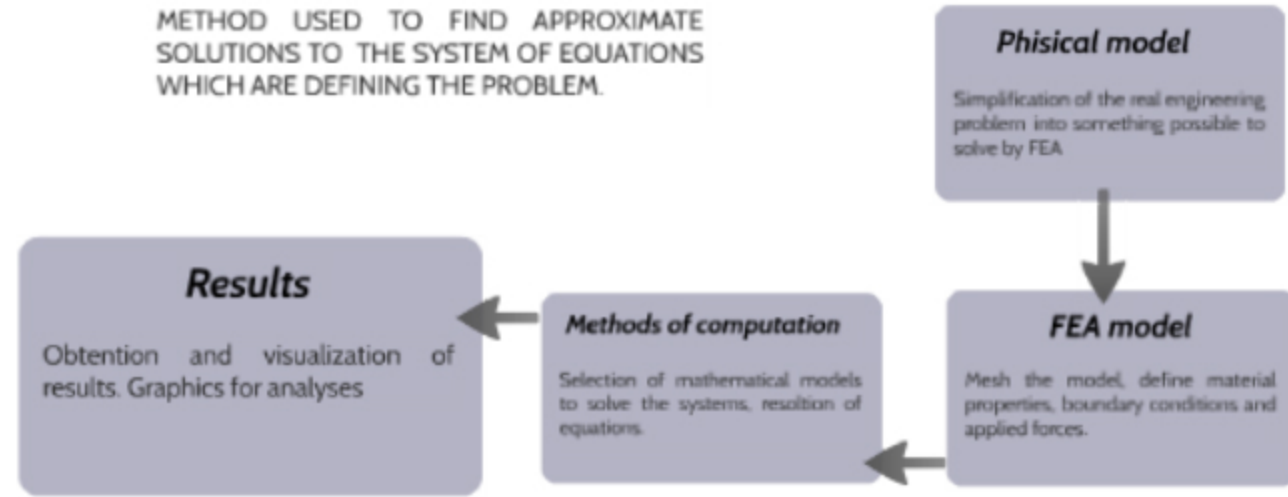
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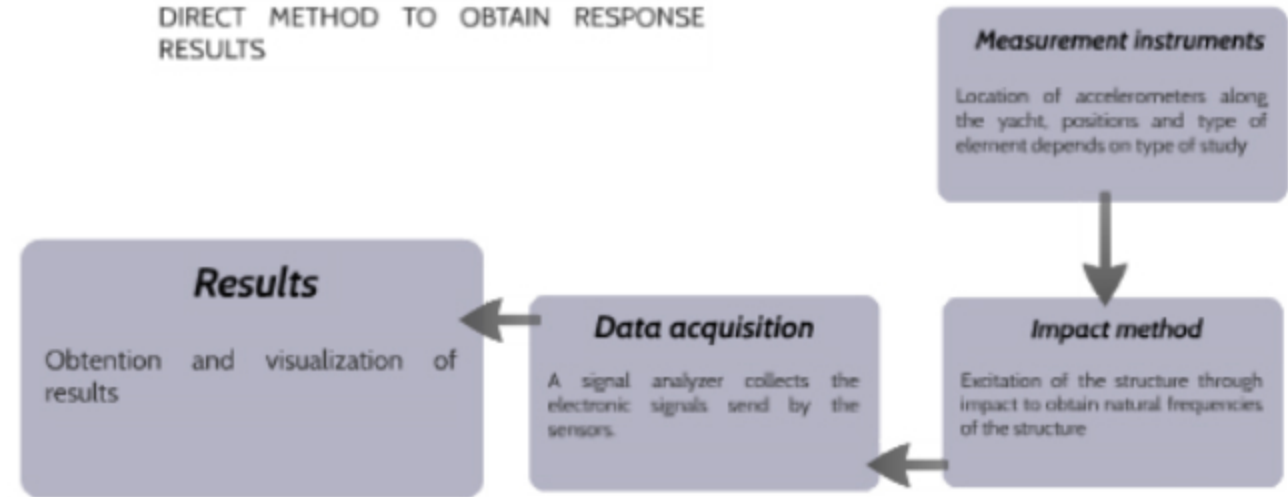
FINIT ELEMENT MODEL

METHOD USED TO FIND APPROXIMATE SOLUTIONS TO THE SYSTEM OF EQUATIONS WHICH ARE DEFINING THE PROBLEM.



EXPERIMENTAL MEASUREMENTS

DIRECT METHOD TO OBTAIN RESPONSE RESULTS



EXPERIMENTAL MEASUREMENTS

DIRECT METHOD TO OBTAIN RESPONSE RESULTS

Measurement instruments

Location of accelerometers along the yacht, positions and type of element depends on type of study

Impact method

Excitation of the structure through impact to obtain natural frequencies of the structure

Data acquisition

A signal analyzer collects the electronic signals send by the sensors.

Results

Obtention and visualization of results

FINIT ELEMENT MODEL

METHOD USED TO FIND APPROXIMATE SOLUTIONS TO THE SYSTEM OF EQUATIONS WHICH ARE DEFINING THE PROBLEM.

Physical model

Simplification of the real engineering problem into something possible to solve by FEA

FEA model

Mesh the model, define material properties, boundary conditions and applied forces.

Methods of computation

Selection of mathematical models to solve the systems, resolution of equations.

Results

Obtention and visualization of results. Graphics for analyses

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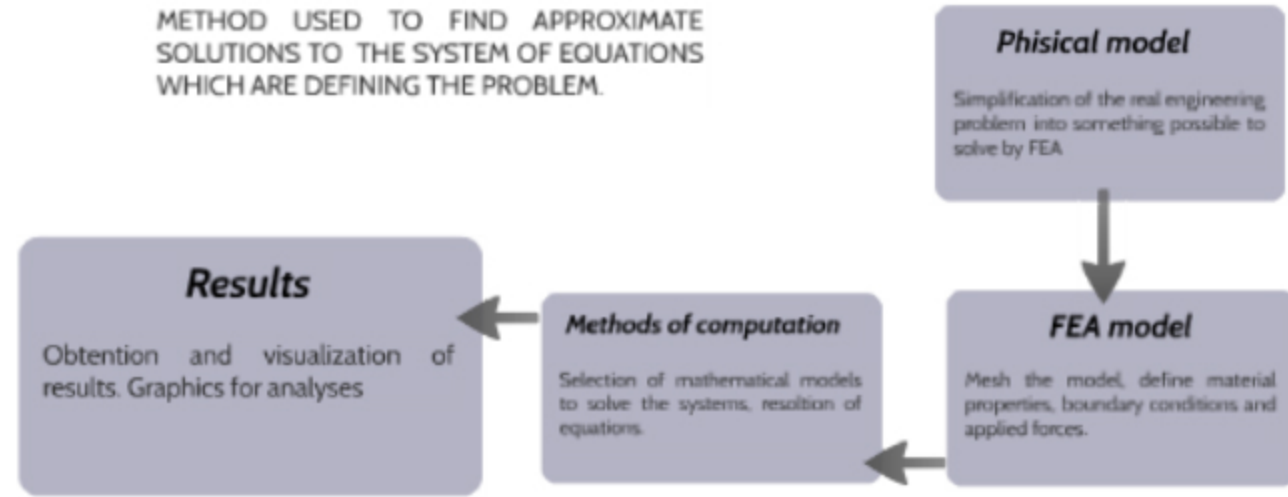
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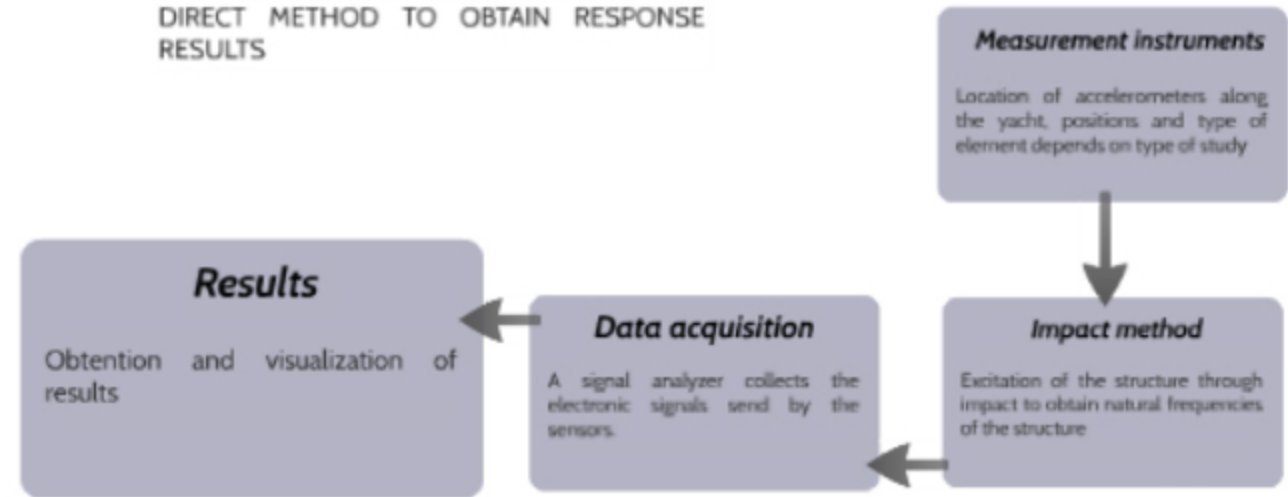
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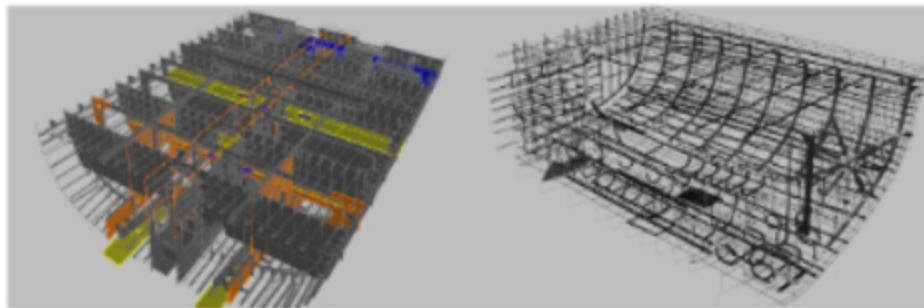
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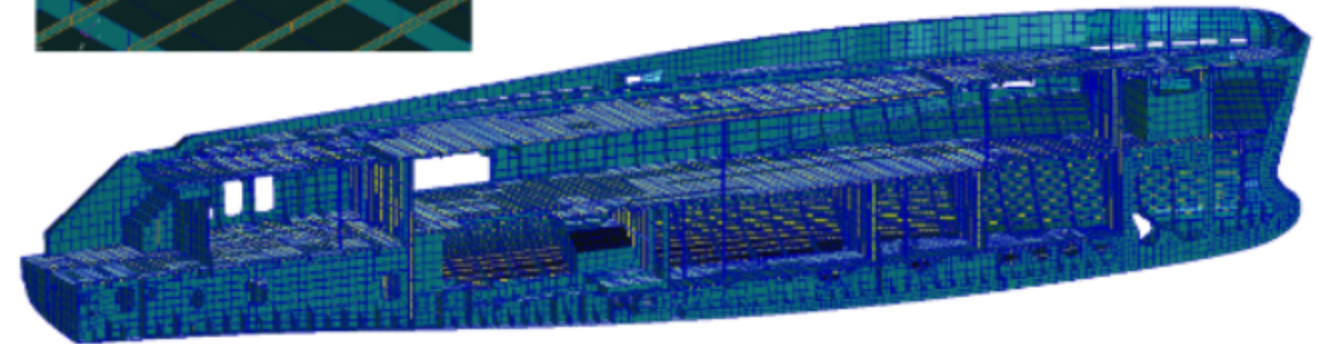
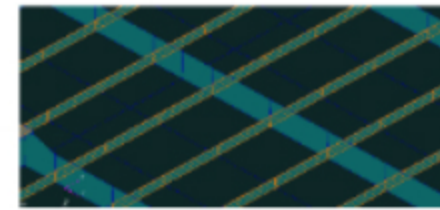
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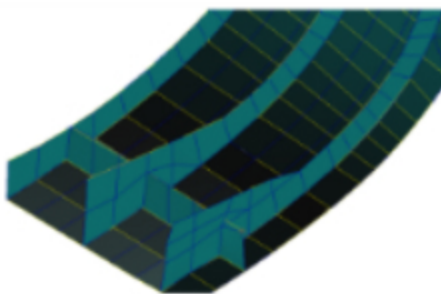
3D MODEL



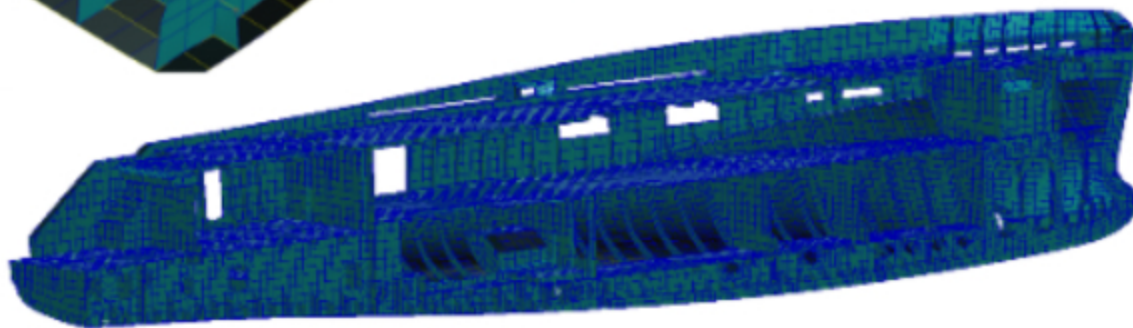
ELEMENTS PROPERTIES



ELEMENTS MODELING

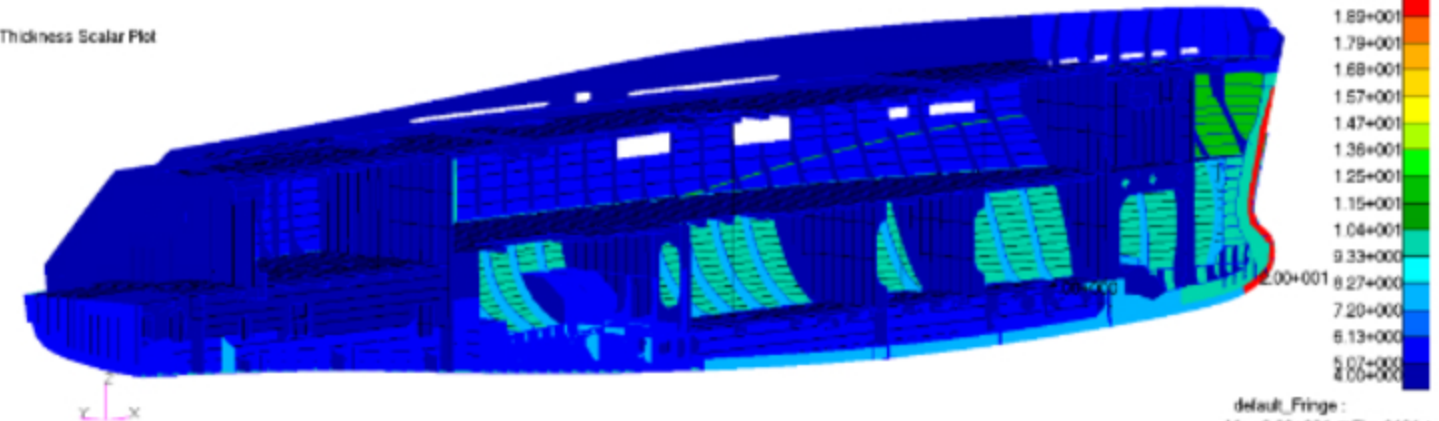


PRIMARY STRUCTURE



THICKNESS OF FINAL MODEL

Thickness Scalar Plot

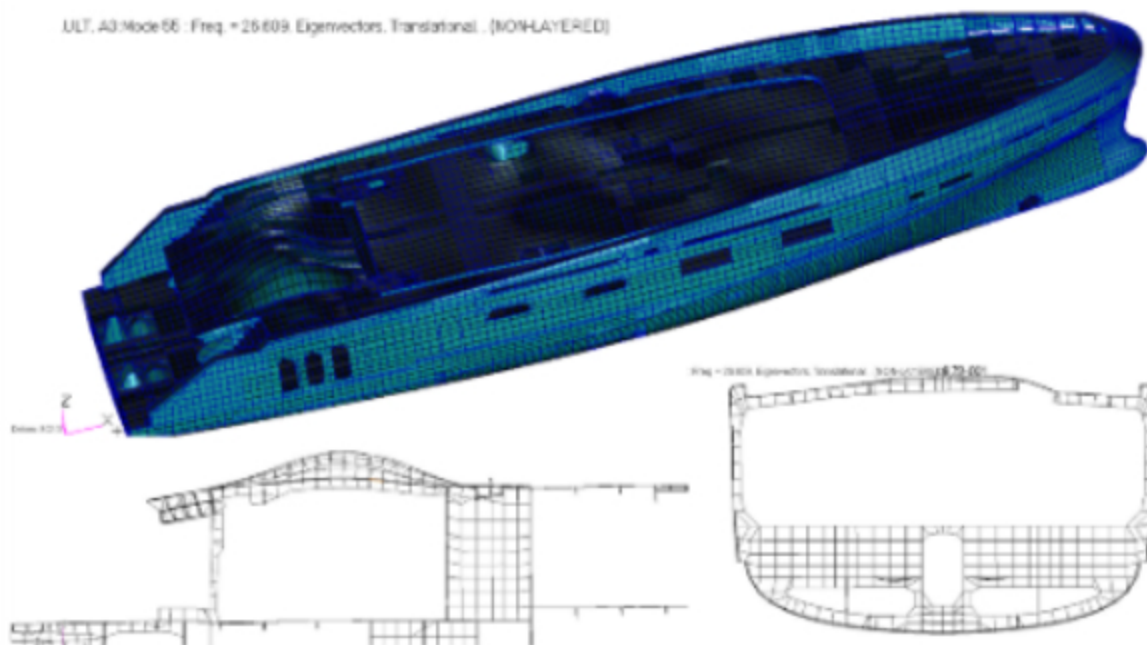


FEM ANALYSIS

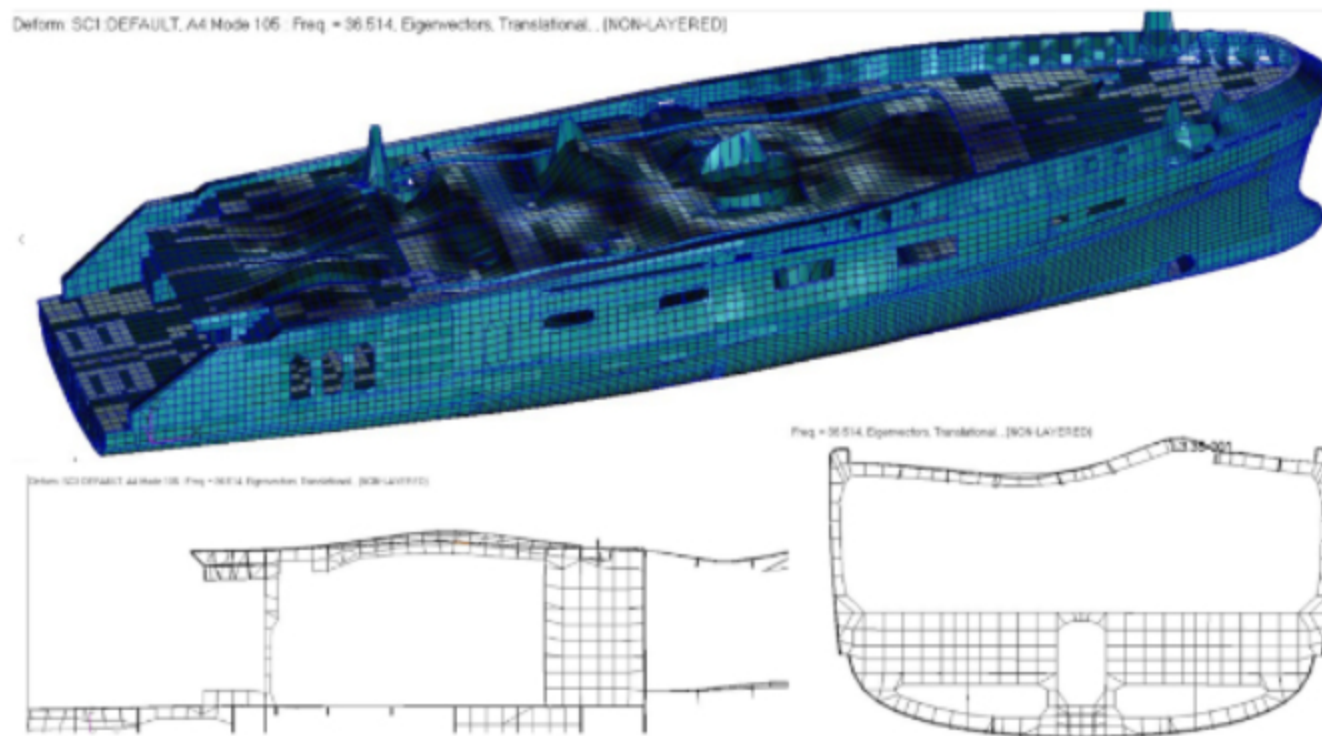
NATURAL FREQUENCIES ON THE MODEL

SubcaseId= 9 : SC1:DEFAULT, A3:Mode 9 : Freq. = 8.6233; MSC.NASTRAN JOB CREATED C
SubcaseId= 10 : SC1:DEFAULT, A3:Mode 10 : Freq. = 9.5713; MSC.NASTRAN JOB CREATED C
SubcaseId= 11 : SC1:DEFAULT, A3:Mode 11 : Freq. = 10.285; MSC.NASTRAN JOB CREATED C
SubcaseId= 12 : SC1:DEFAULT, A3:Mode 12 : Freq. = 10.581; MSC.NASTRAN JOB CREATED C
SubcaseId= 13 : SC1:DEFAULT, A3:Mode 13 : Freq. = 12.159; MSC.NASTRAN JOB CREATED C

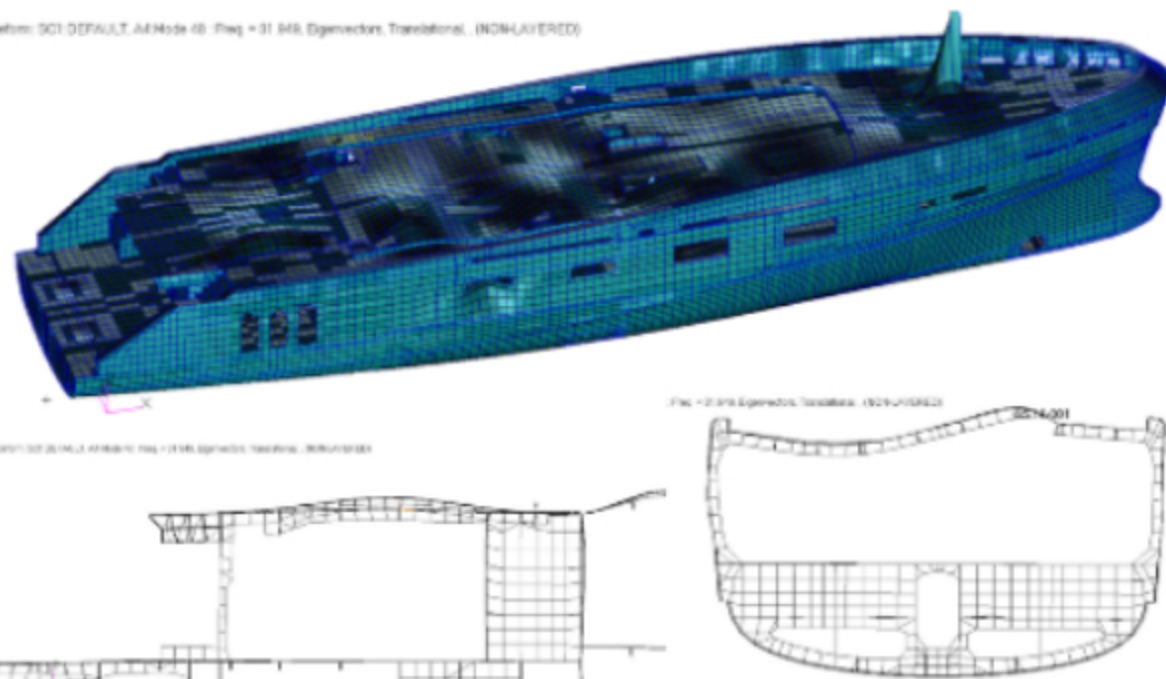
ULT, A3:Mode 66 : Freq. = 25.609; Eigenvalues, Translational, (NON-LAYERED)



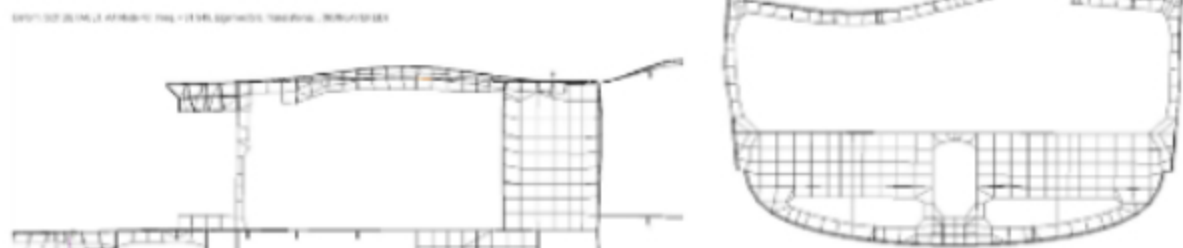
Defor: SC1:DEFAULT, A4:Mode 105 : Freq. = 36.514; Eigenvalues, Translational, (NON-LAYERED)



Defor: SC1:DEFAULT, A4:Mode 65 : Freq. = 31.548; Eigenvalues, Translational, (NON-LAYERED)



Defor: SC1:DEFAULT, A4:Mode 106 : Freq. = 32.074; Eigenvalues, Translational, (NON-LAYERED)



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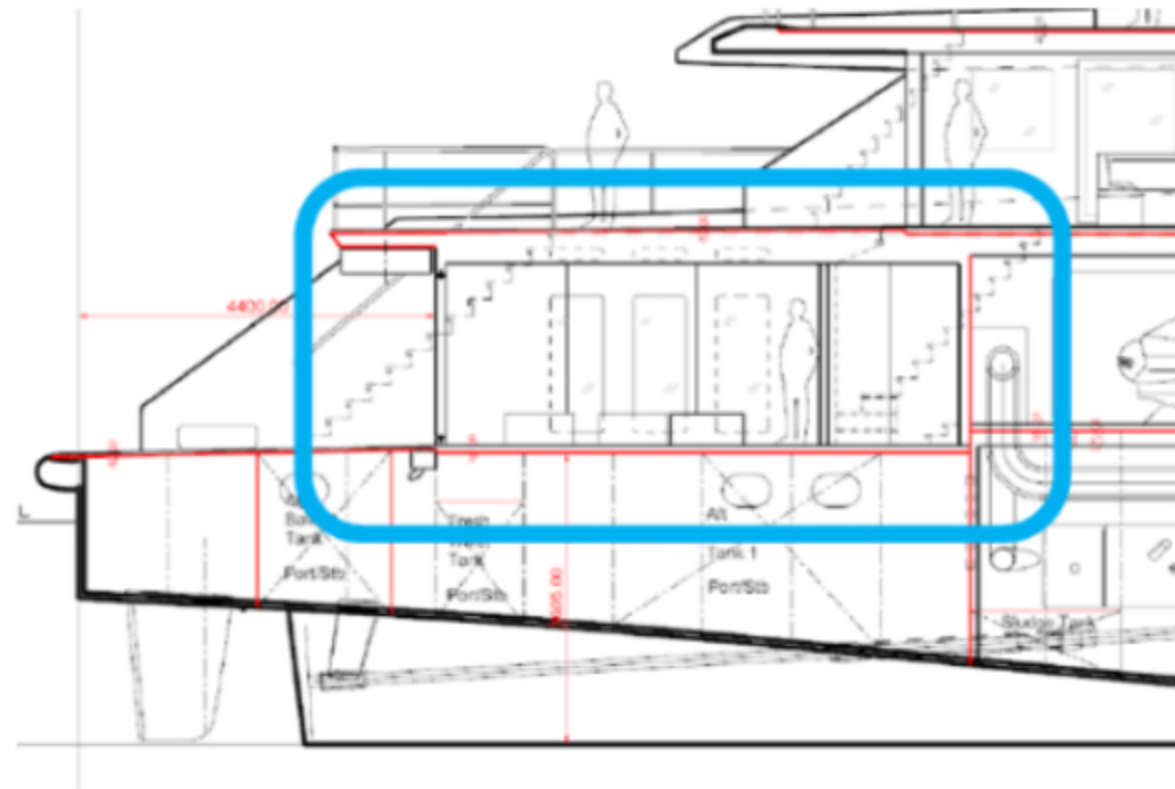
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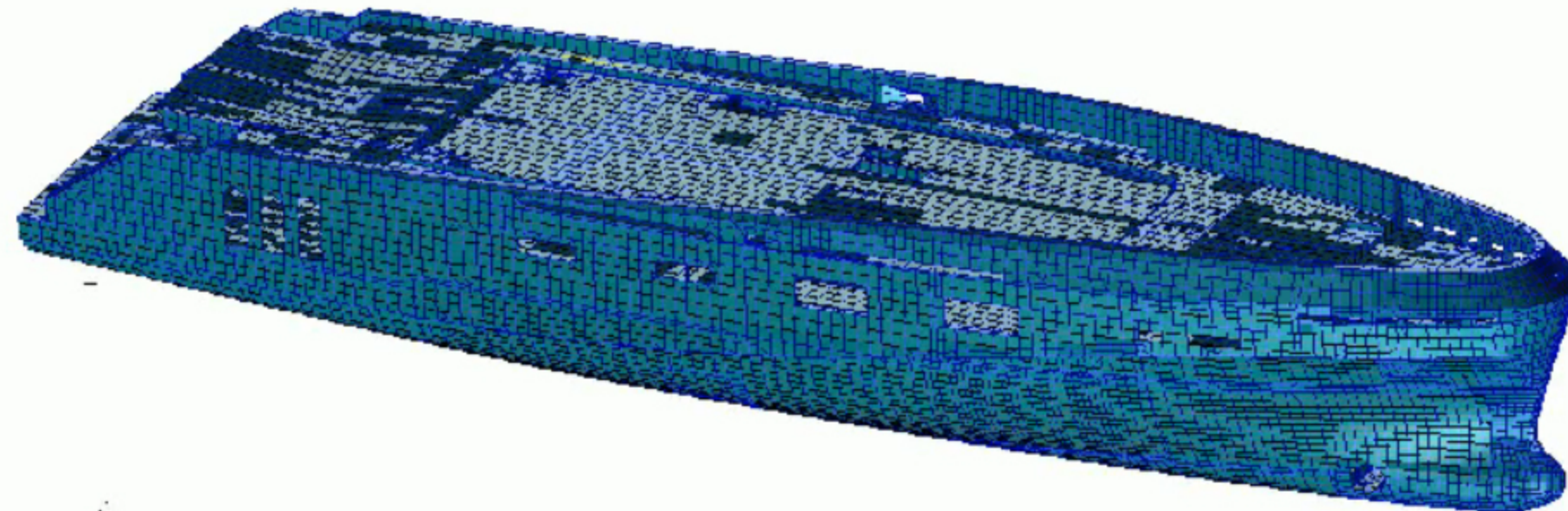
COMPARISON

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YACHT CINEMA



De cmi 301.31A0L - A3, Mode ob, rec. = 28.300, Legnecoris, Transalond, (HDM-LAY LRLD)

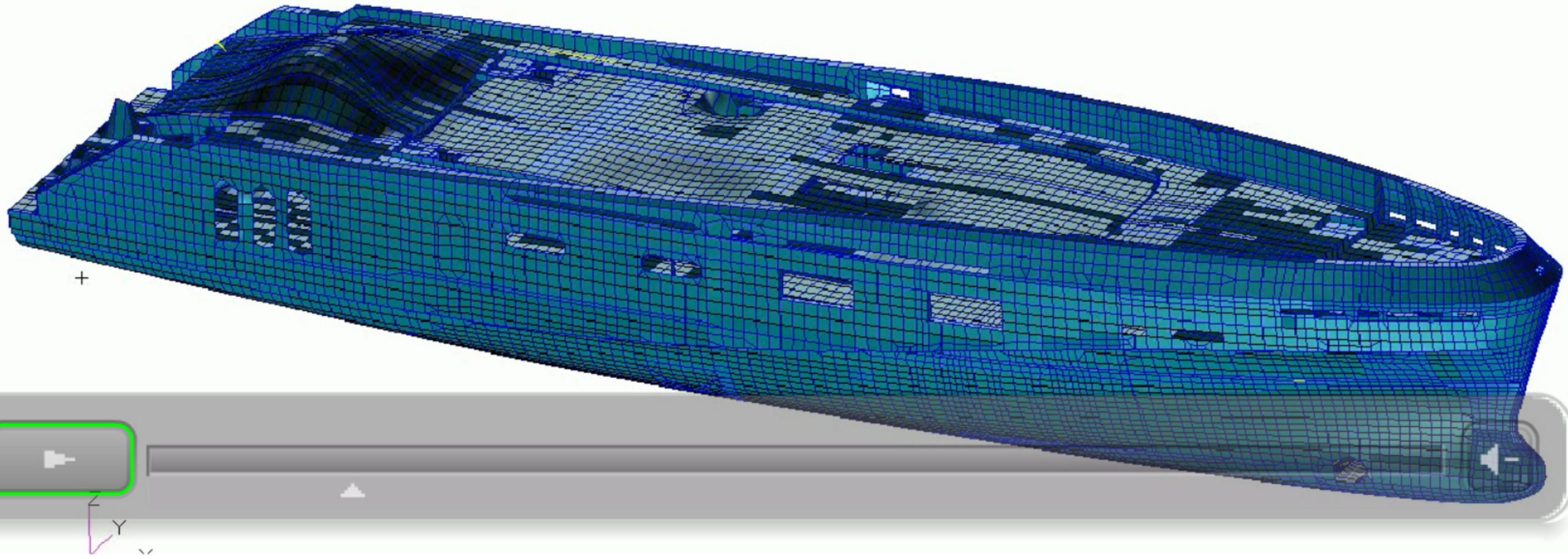


Ex.

ezi



Deform: SC1:DEFAULT, A3:Mode 55 : Freq. = 26.609, Eigenvectors, Translational, , (NON-LAYERED)



MEASUREMENTS

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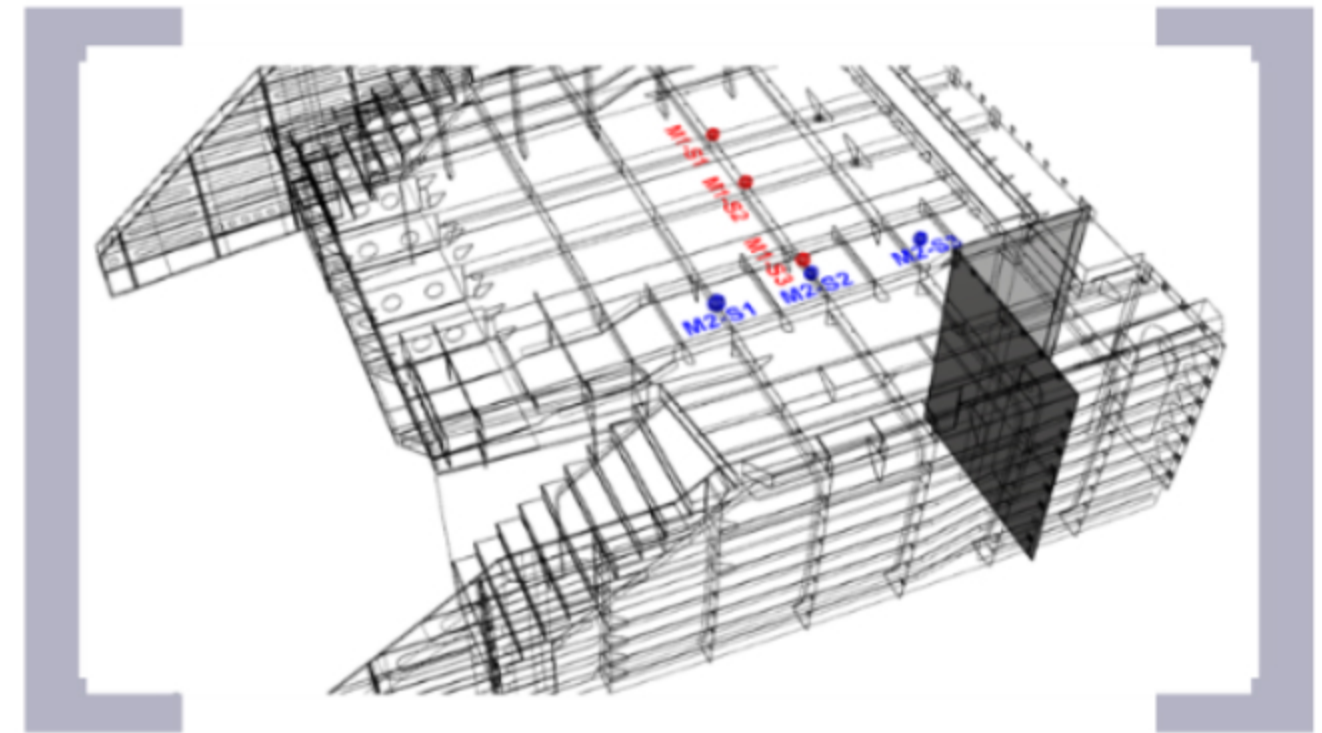
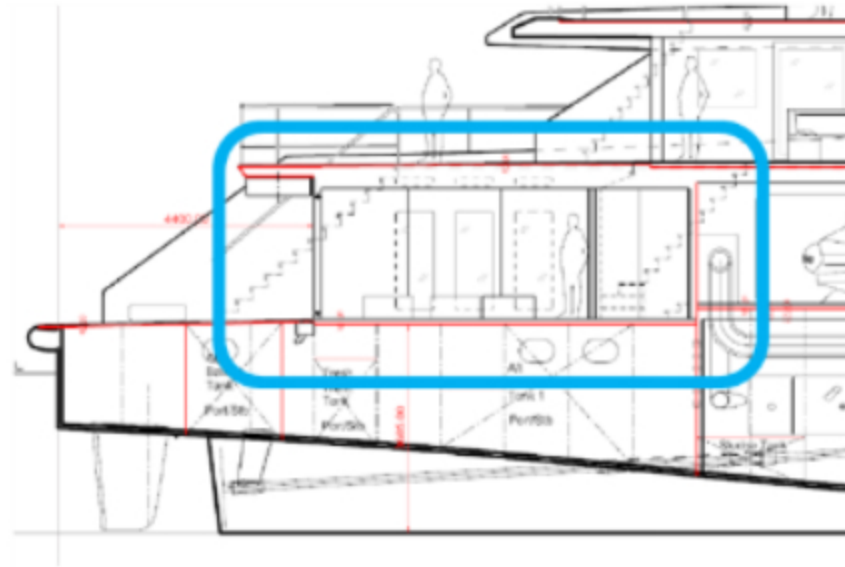
FEM MODEL

MEASUREMENT

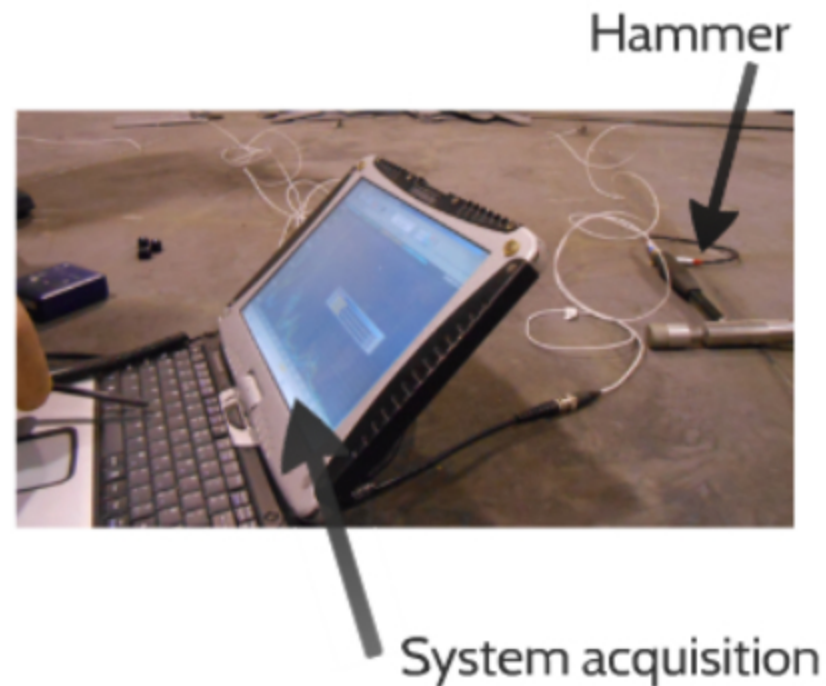
COMPARISON

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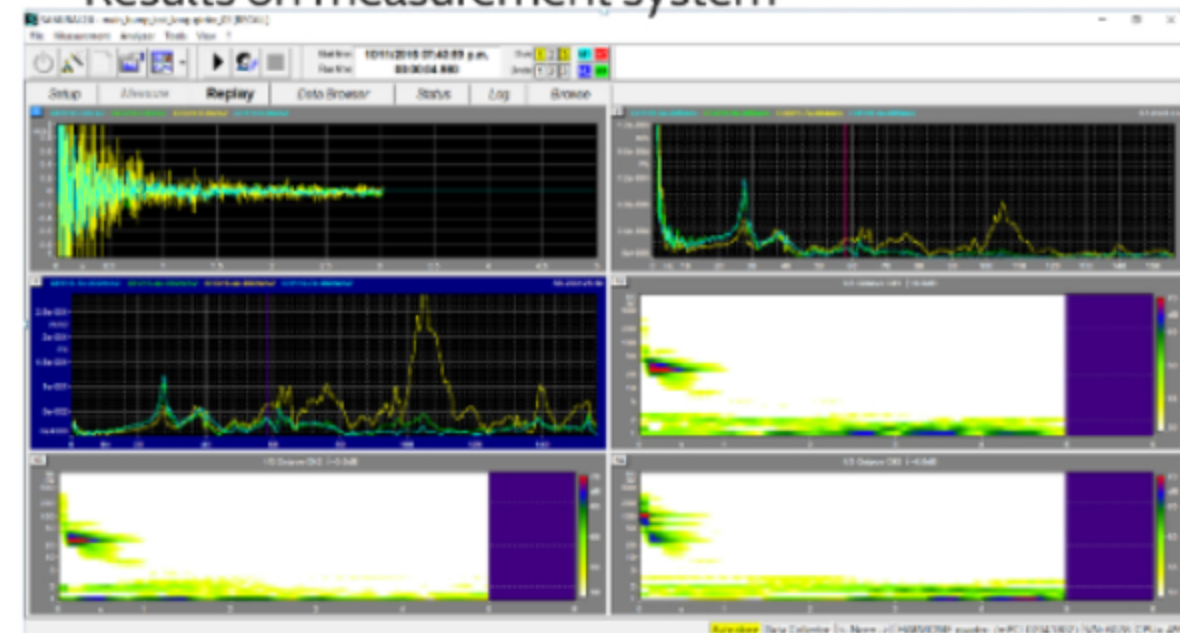
SENSORS LOCATION



IMPACT TEST

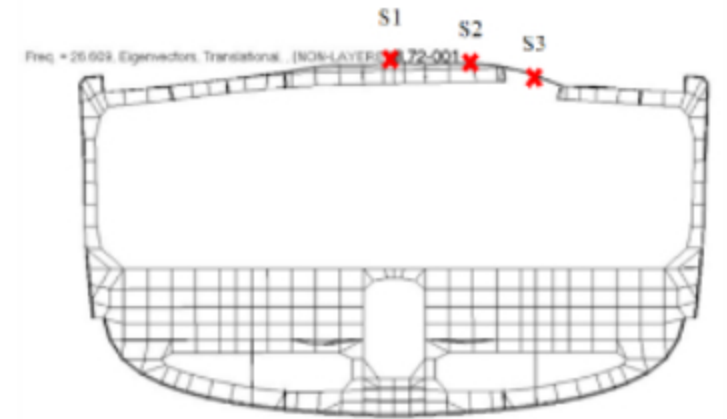
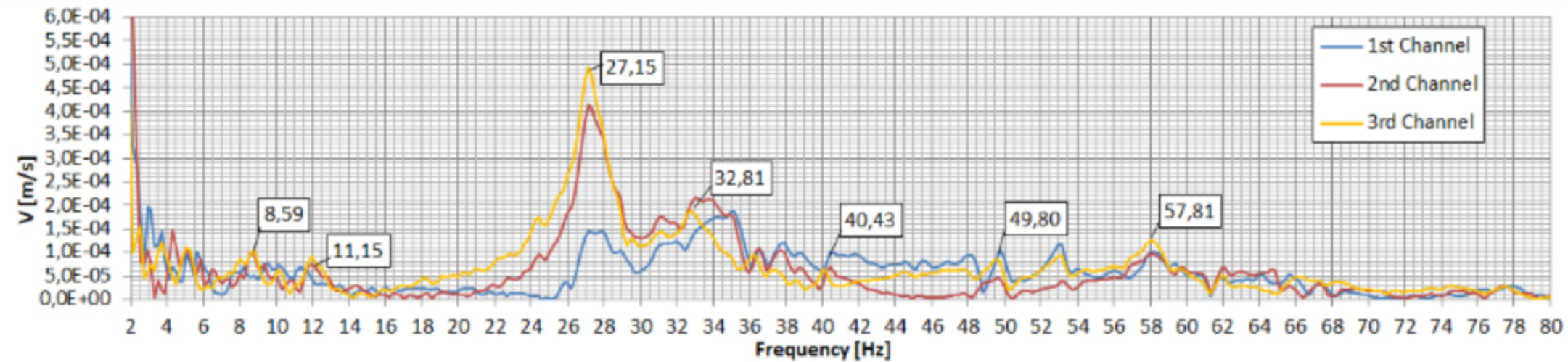


Results on measurement system

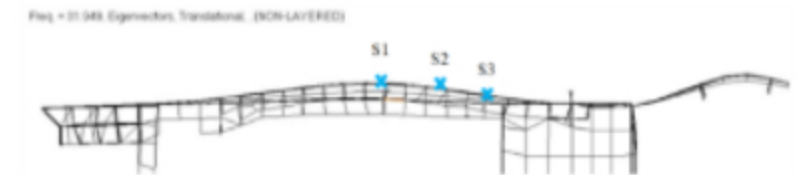
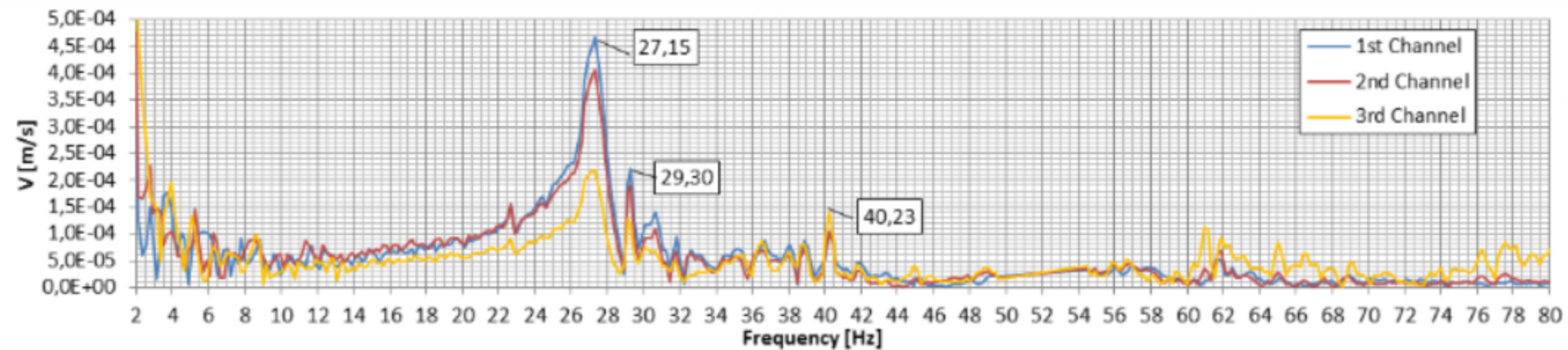


MEASUREMENTS RESULTS

TRANSVERSAL RESULTS



LONGITUDINAL RESULTS



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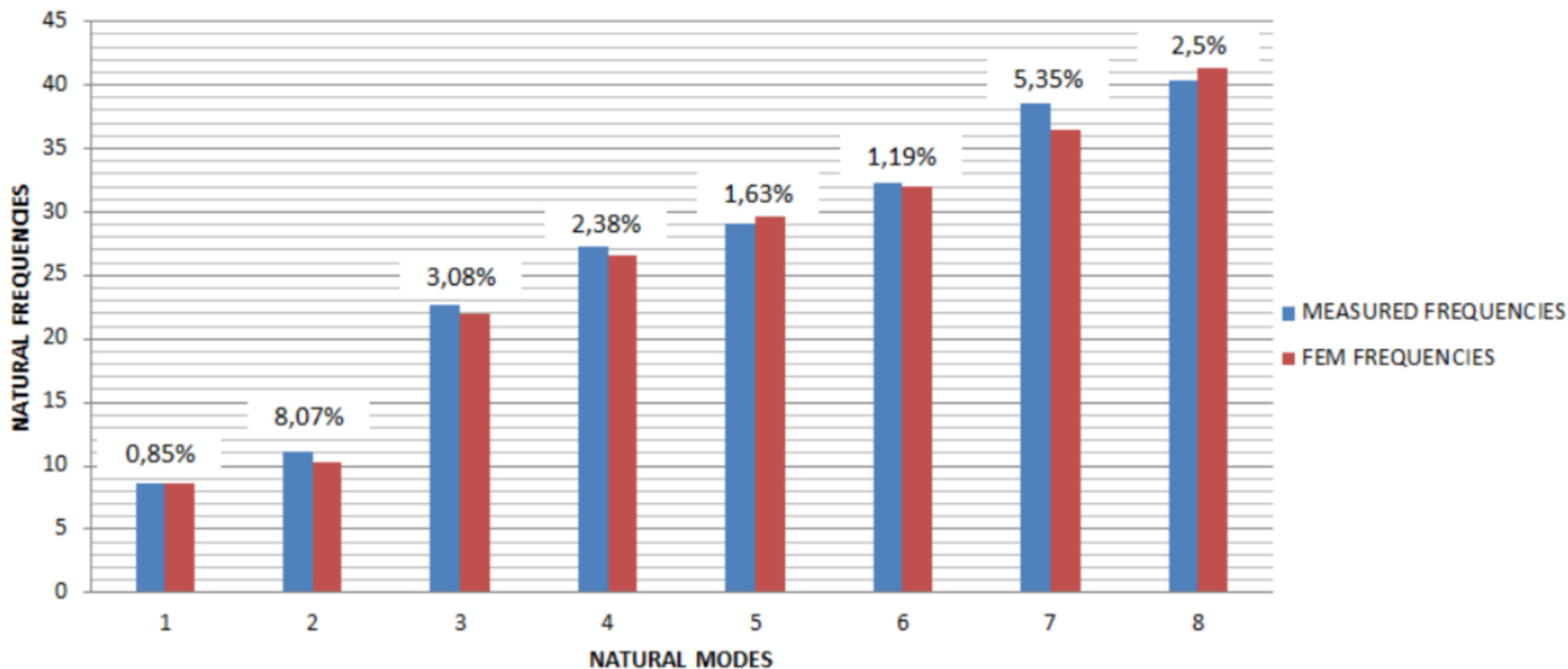
FEM MODEL

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RESULTS COMPARISON



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CONCLUSIONS

- The actual FEM model gives trustful results, with errors below 5%, it is recommended to use it for further analyses.
- Supports of the yacht are not highly influencing the results of main response on deck
- Errors could be due to extra weights onboard of the yacht at the time of measurements not considered in FEM model.
- Further analyses considering added masses and weight distribution on the yacht must be performed to obtain more information about the vibrations behaviour

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THANKS FOR YOUR
ATTENTION

MARIA SOL MASSERA