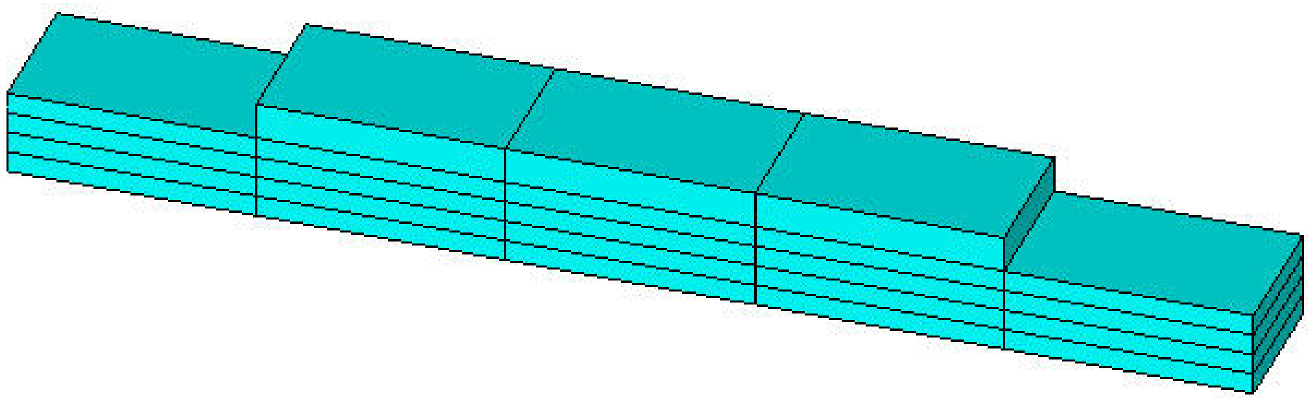
STUDY OF EFFECT OF EXPANSION JOINT ON STRESS LEVELS IN SUPERSTRUCTURE ON A BARGE STRUCTURE



TOPICS

- ✔ THE PROBLEM DEFINITION
- ✔ FE MODEL FOR NUMERICAL ANALYSIS
- ✔ LOADS & BOUNDARY CONDITIONS
- ✔ RESULTS & DISCUSSION

PROBLEM DEFINITION

THE PRESENT STUDY WAS CONDUCTED ON AN EQUIVALENT BARGE OF THE FOLLOWING DIMENSION RATIOS

	Dimension of barge (m)	Ratio	Barge	P-28
L	10	L/B	8.33	7.69
B	1.2	L/D	14.28	11.76
D	0.7	B/D	1.71	1.5
Ls	6	Ls/L	0.6	0.57

BARGE STRUCTURE

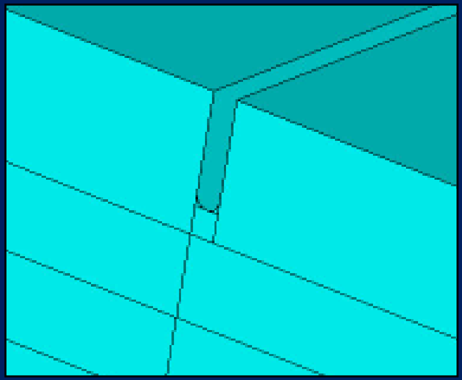
- THREE ISLAND SUPERSTRUCTURES SEPARATED BY EXPANSION JOINTS
- DEPTH OF THE SUPERSTRUCTURE - 0.3 M
- RATIO OF SUPERSTRUCTURE LENGTH TO BARGE LENGTH – 0.6
  - THE LOADING PROFILE ON THE BARGE WAS TO SIMULATE A HOGGING WAVE PROFILE
- TWO CONFIGURATIONS OF THE EXPANSION JOINTS HAVE BEEN STUDIED

FINITE ELEMENT MODEL

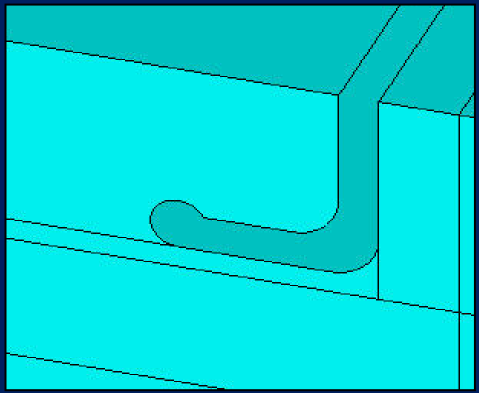
THE FINITE ELEMENT MODEL OF THE BARGE WAS CREATED IN A GENERAL PURPOSE FE PACKAGE ANSYS USING SHELL63 (ELASTIC SHELL ELEMENT) AVAILABLE IN THE ANSYS MULTIPHYSICS SOLVER.

THE THREE CONFIGURATIONS ANALYZED WERE :-

- CASE 1 - WITHOUT EXPANSION JOINT
- CASE 2 - WITH STRAIGHT CUT EXPANSION JOINT (FIG. A)
- CASE 3 - WITH CURVED EXPANSION JOINT (FIG. B)



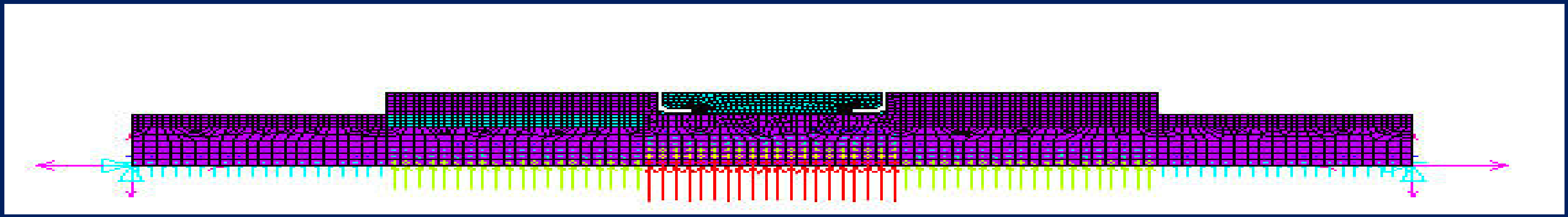
(FIG. A)

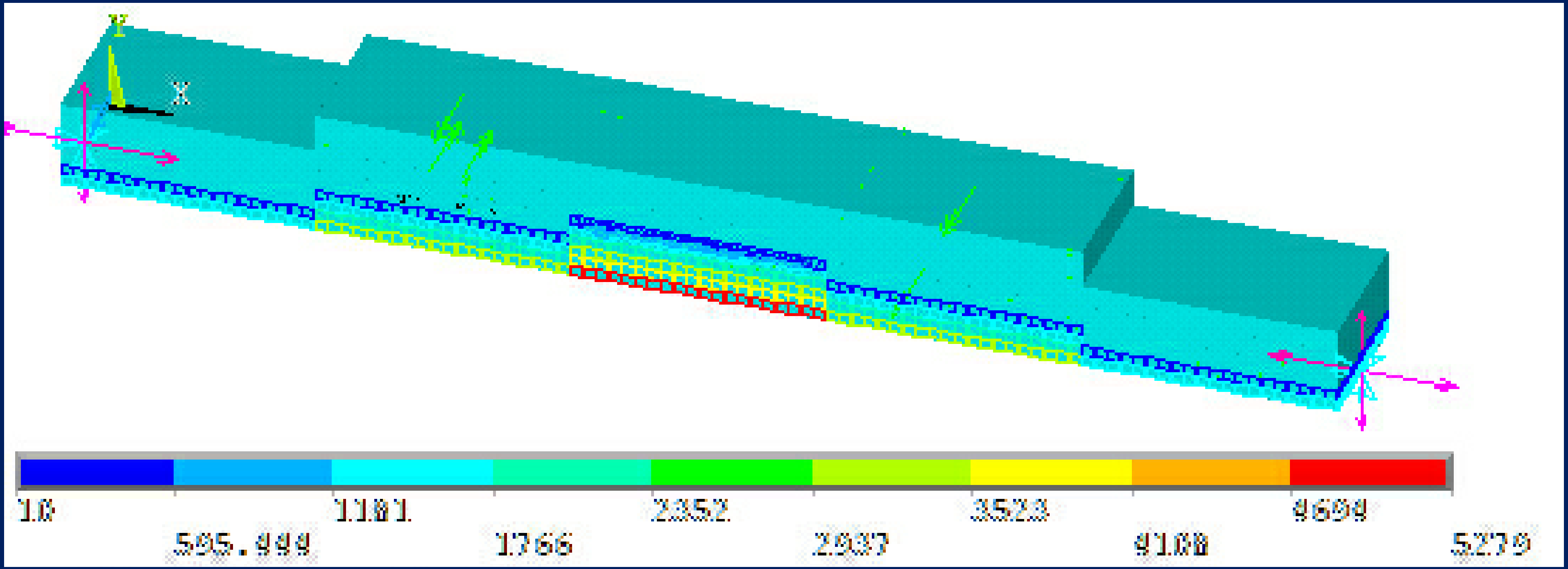


(FIG. B)

LOADS & BOUNDARY CONDITIONS

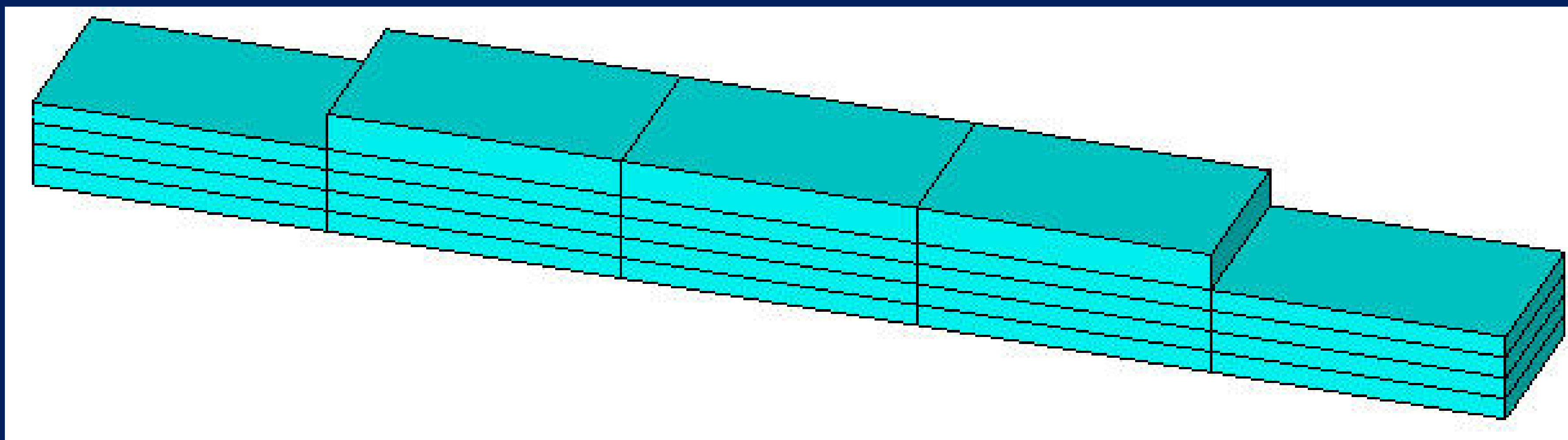
THE LOADING PROFILE ON THE BARGE WAS TO SIMULATE A HOGGING WAVE PROFILE





RESULTS & DISCUSSION

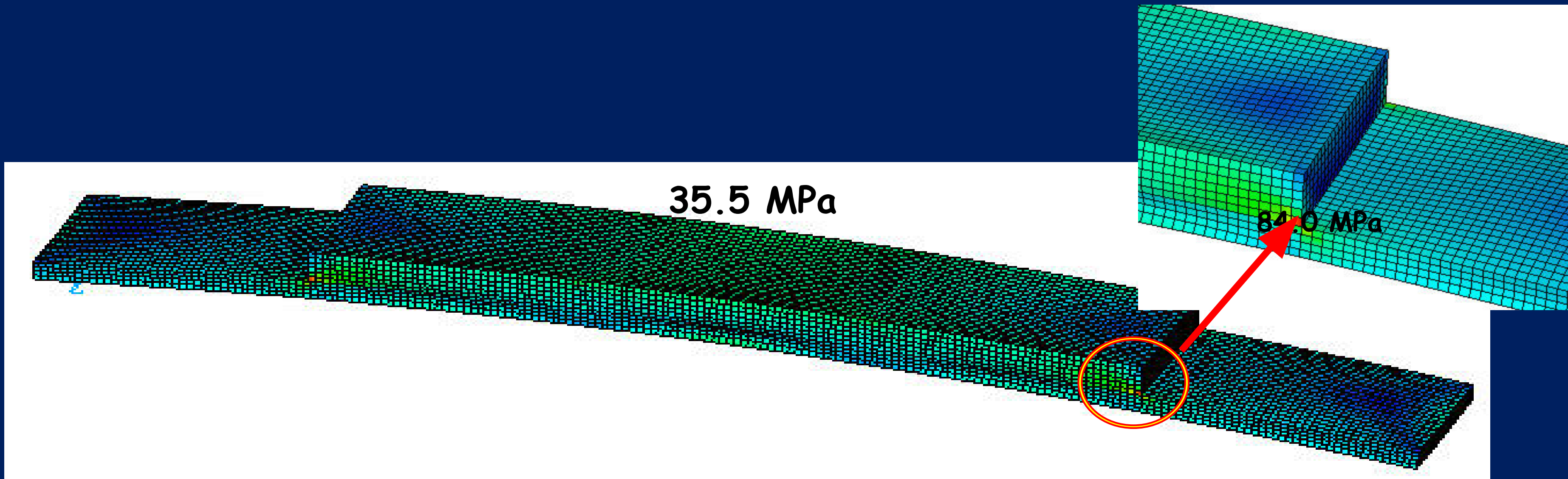
CASE – 1 : BARGE STRUCTURE WITH OUT EXPANSION JOINT



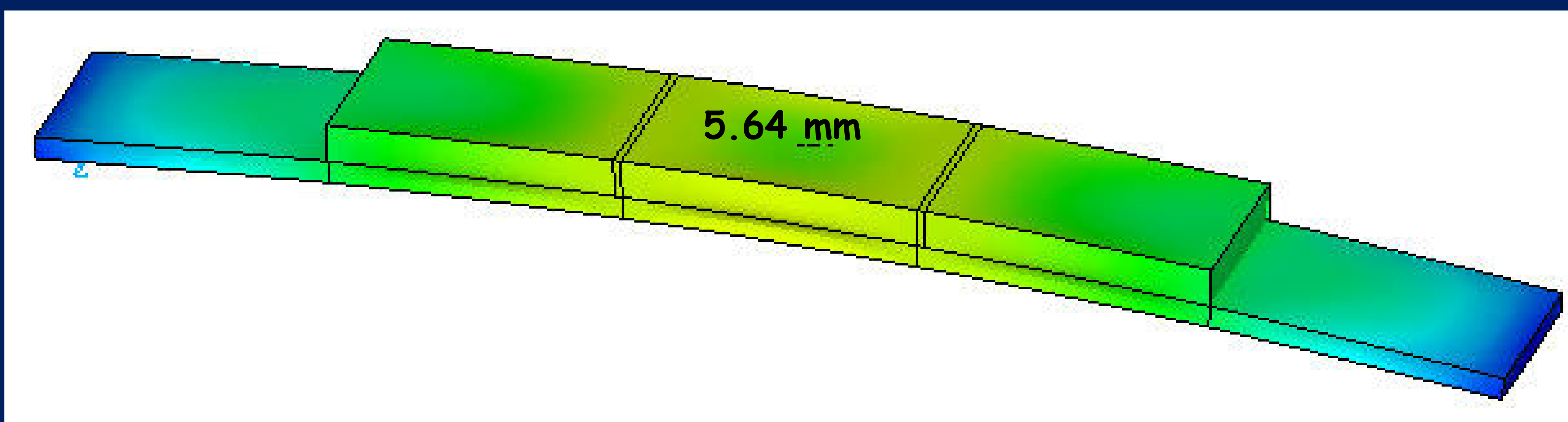
MATERIAL MODEL :-

YOUNGS MODULUS - 210 GPA
POISSONS RATIO - 0.3
DENSITY - 7800 KG/M^3

CASE – 1 : STRESS & DEFECTION PLOTS



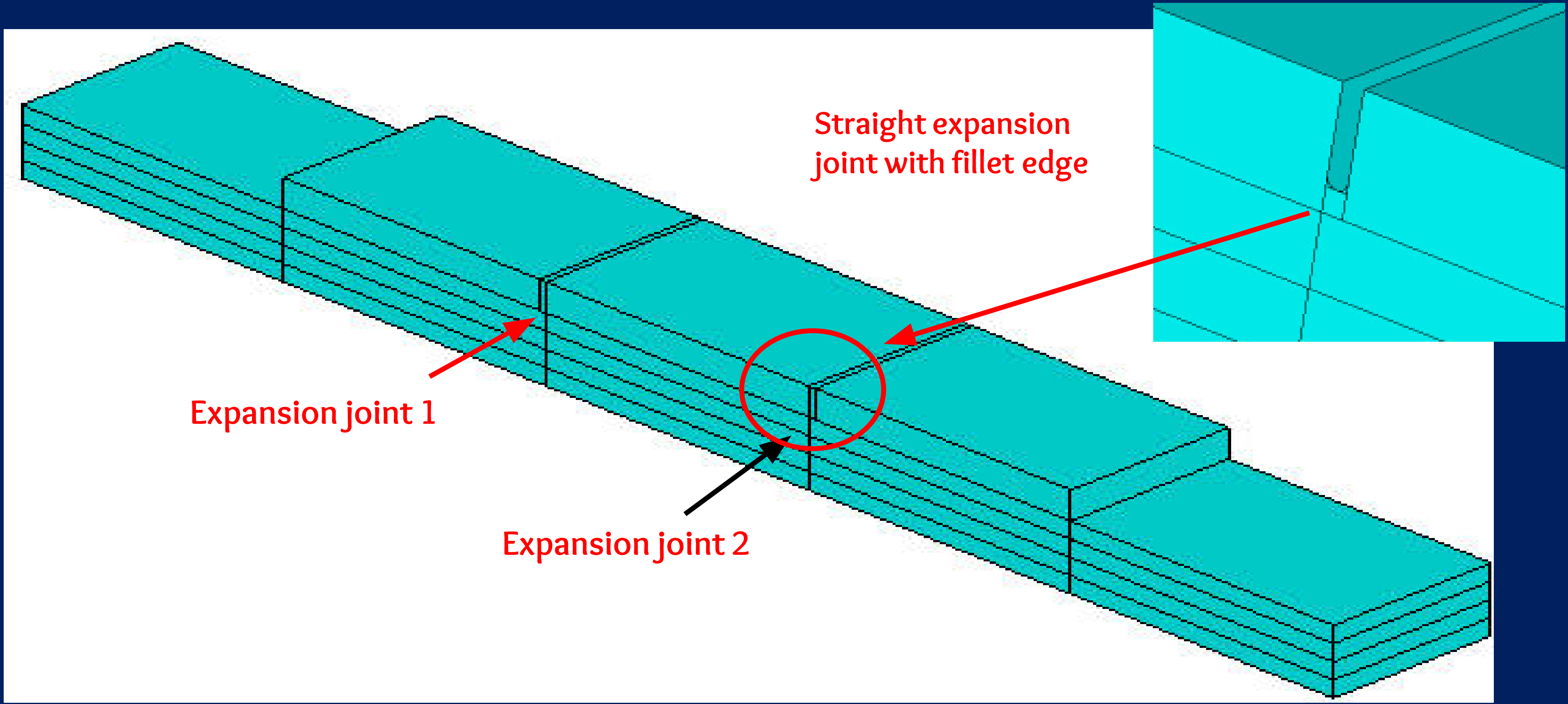
STRESS PLOT OF SUPERSTRUCTURE AND ONE DECK BELOW



DEFLECTION PLOT WITHOUT EXPANSION JOINTS

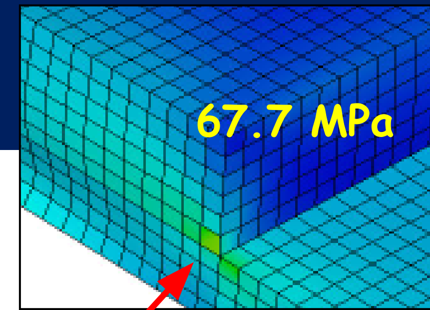
RESULTS & DISCUSSION

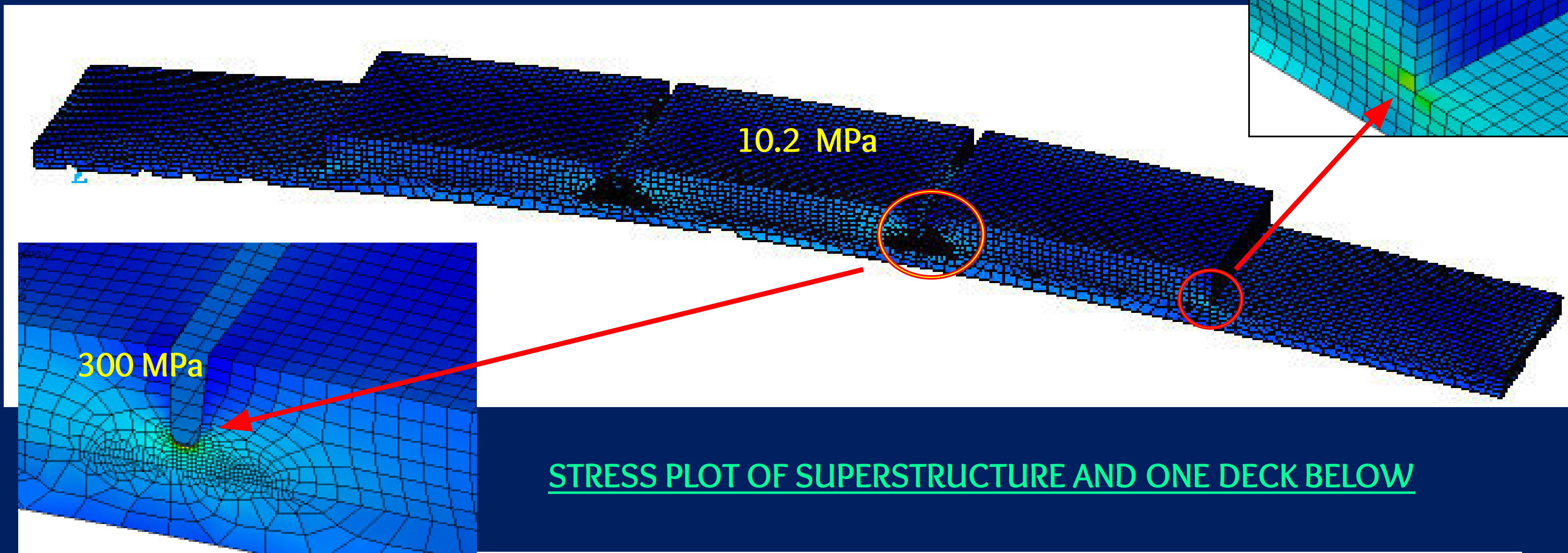
CASE – 2 : BARGE STRUCTURE WITH STRAIGHT CUT EXPANSION JOINT



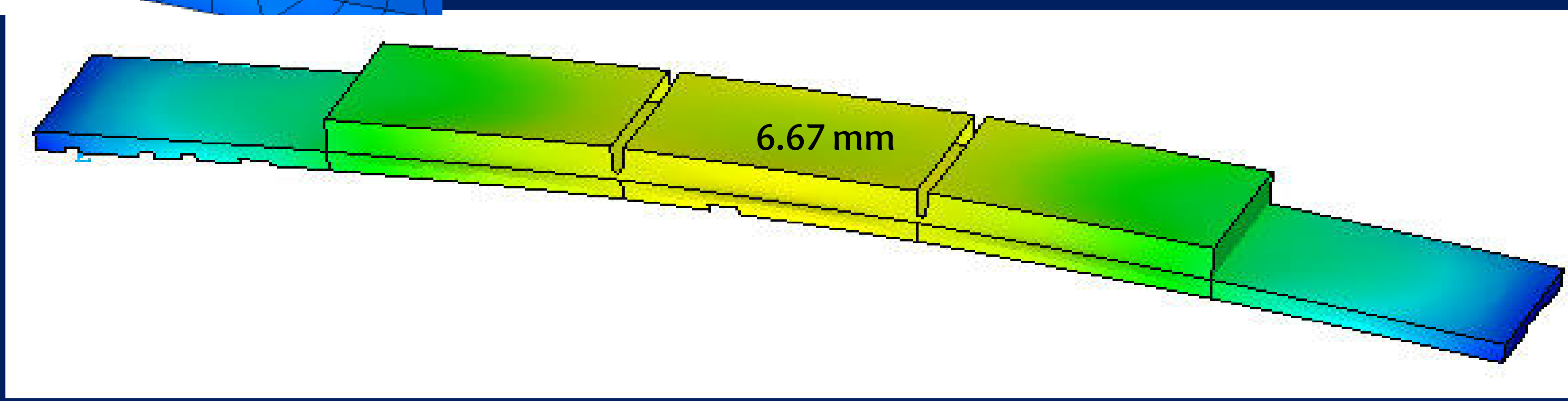
EXPANSION JOINTS OF WIDTH EQUAL TO ONE ELEMENT WIDTH WAS PROVIDED AT BOTH THE LOCATIONS

CASE – 2 : STRESS & DEFECTION PLOTS





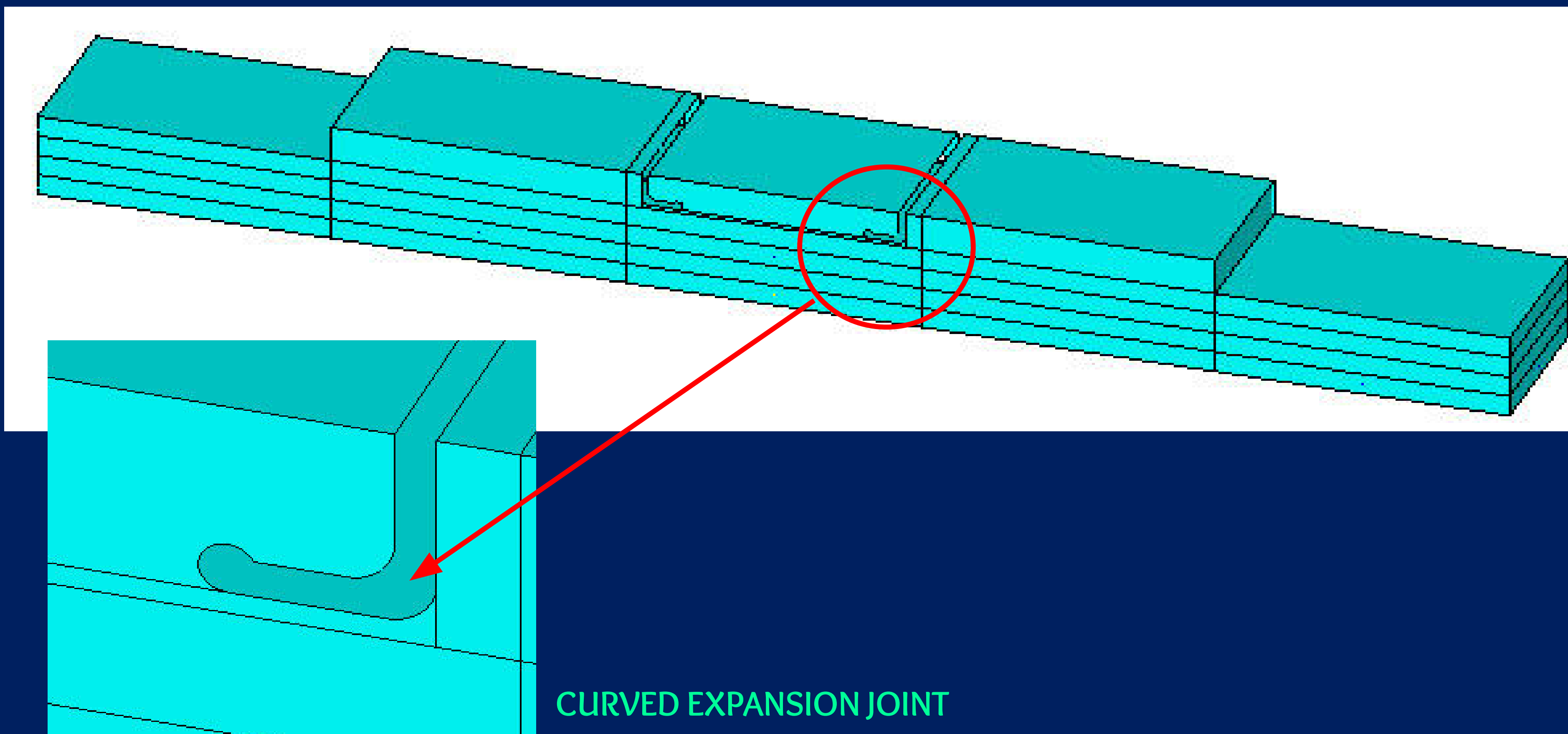
STRESS PLOT OF SUPERSTRUCTURE AND ONE DECK BELOW



DEFLECTION PLOT WITH STRAIGHT CUT EXPANSION JOINTS

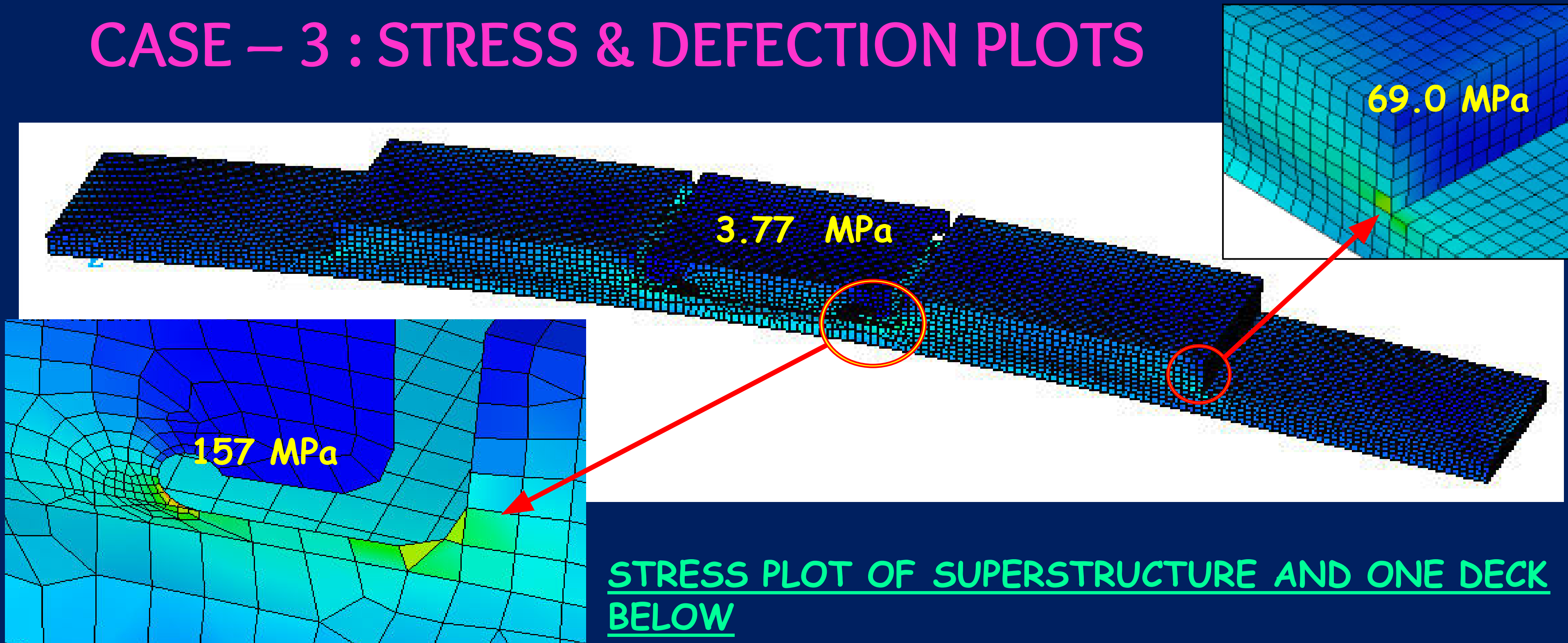
RESULTS & DISCUSSION

CASE – 3 : BARGE STRUCTURE WITH CURVED EXPANSION JOINT

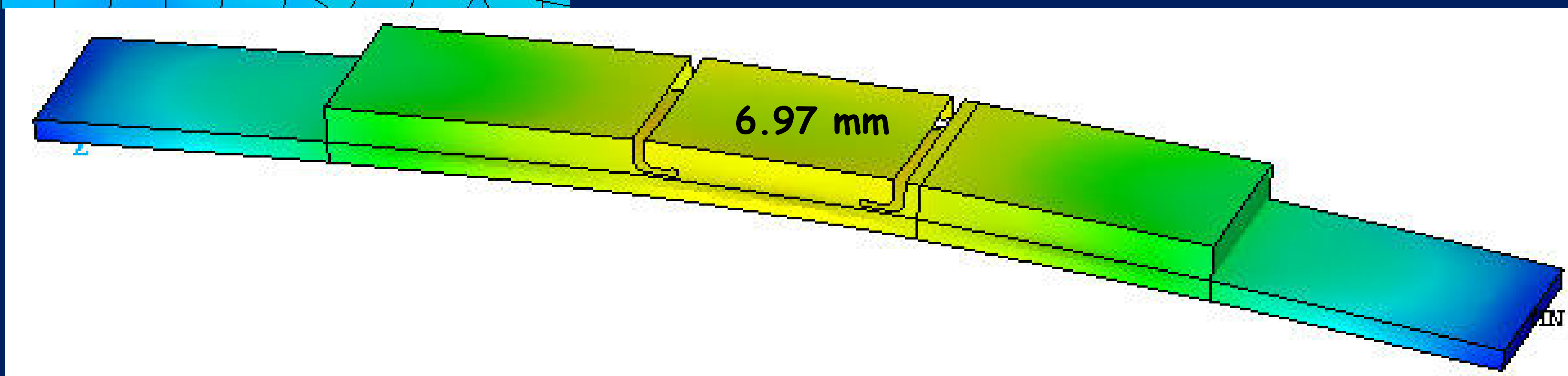


CURVED EXPANSION JOINT

CASE – 3 : STRESS & DEFECTION PLOTS



STRESS PLOT OF SUPERSTRUCTURE AND ONE DECK BELOW

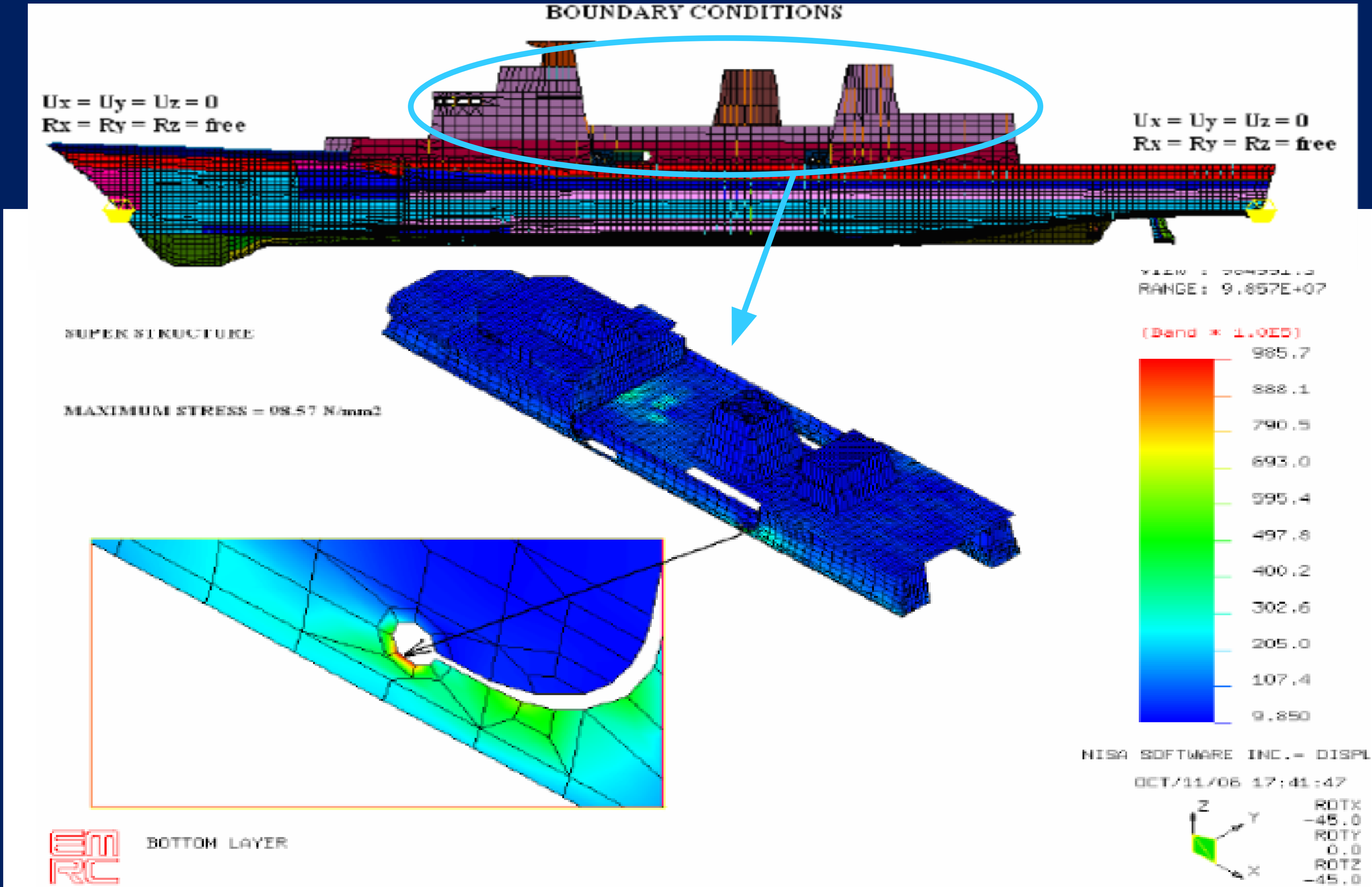


DEFLECTION PLOT WITH CURVED EXPANSION JOINTS

RESULTS & DISCUSSION

SUMMARY

Case	Global average stress (MPa)	% reduction in Global avg stress	Stress at expansion joint tip (MPa)	Stress at junction b/w SS & Dk below (MPa)	% reduction in corner stress (MPa)	Maximum deflection (mm)
No expansion joint	35.5	--	--	84.0	--	5.64
Straight cut expansion joint	10.2	71.26 %	300	67.7	19.40%	6.67
Curved expansion joint	3.77	89.38 %	157	69.0	17.85%	6.97

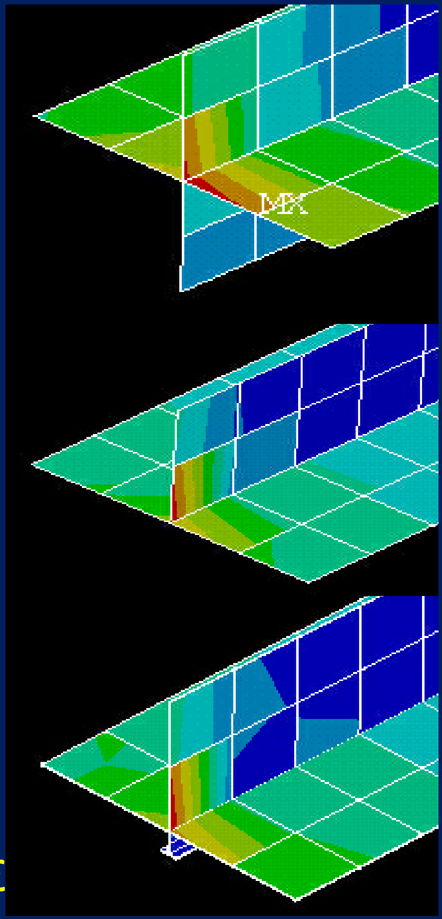


BOUNDARY CONDITIONS
Ux = Uy = Uz = 0
Rx = Ry = Rz = free
Ux = Uy = Uz = 0
Rx = Ry = Rz = free
RANGE: 9.857E+07
SUPER STRUCTURE
MAXIMUM STRESS = 98.57 N/mm2
985.7
888.1
790.5
693.0
595.4
497.8
400.2
302.6
205.0
107.4
9.850
NISA SOFTWARE INC.- DISPL
OCT/11/06 17:41:47
Z
Y
X
ROTX
-45.0
ROTY
0.0
ROTZ
-45.0
BOTTOM LAYER

RESULTS & DISCUSSION contd..

COMPARISON OF STRESS VALUES IN TOP DECK AT THE JUNCTION OF SUPERSTRUCTURE WITH THE DECK, DUE TO THE INFLUENCE OF THE BULKHEAD AT THE ENDING OF THE SUPERSTRUCTURE

Case	Stress in deck	Stress in super structure bulkhead
With bulk head at the end of super structure	57 MPa	57 MPa
Without bulk head at the super structure end	58 MPa	75 MPa
Without bulk head at the super structure end, but with a “T” beam at the same location	56 MPa	68 MPa



IT CAN BE CONCLUDED THAT THE STRESS LEVELS IN THE SUPERSTRUCTURE BULKHEAD ARE LOW IF THE SUPERSTRUCTURE ENDS ON A BULKHEAD

RESULTS & DISCUSSION contd..

FROM THE TABULATED RESULTS :

- A GLOBAL REDUCTION IN STRESS IS SEEN WHEN A CURVED CONFIGURATION OF THE EXPANSION JOINT IS USED.
- THE REDUCED STRESS LEVELS HAS A DIRECT IMPLICATION OF LIGHTER TOPSIDE AND A LOW WEIGHT OF SCANTLING IN THE SUPERSTRUCTURE HENCE IMPROVED STABILITY.
- INTRODUCTION OF EXPANSION JOINTS HAVE REDUCED THE STRESS LEVELS AT THE JUNCTION OF THE SUPERSTRUCTURE AND THE DECK BELOW BY 19.4%.

INFERENCE

IT IS RECOMMENDED THAT CURVED EXPANSION JOINT TO BE USED IN PLACE OF STRAIGHT CUT JOINT AS JUSTIFIED BY THE ABOVE STUDY AND DISCUSSION