Politechnika Warszawska | Wydział Mechaniczny Energetyki i Lotnictwa | Zakład Wytrzymałości Materiałów i Konstrukcji

Metoda elementów skończonych (MES1)

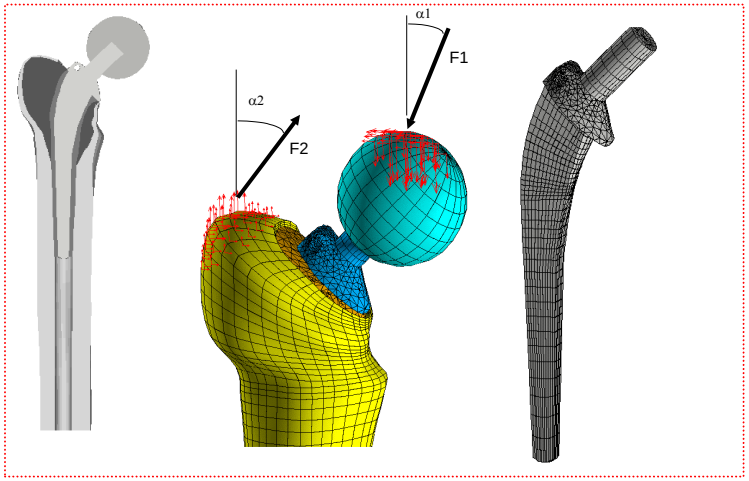
Wykład 2B. Przykłady analiz MES

03.2022

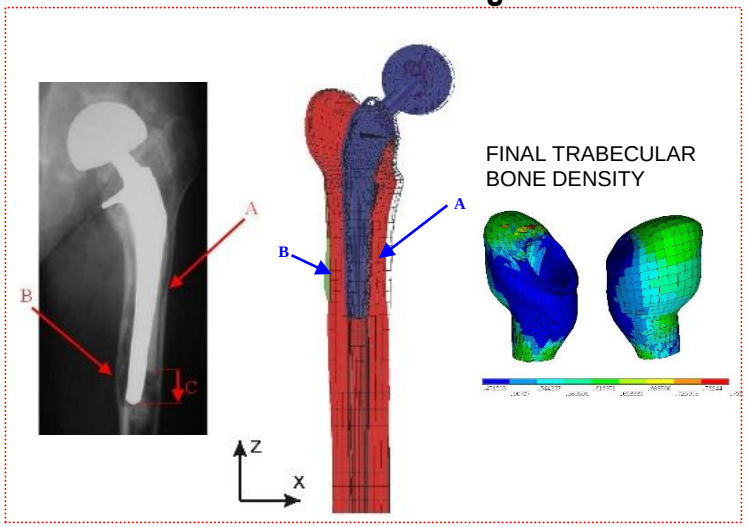
Biomechanics

- **IMPLANTS AND BONE REMODELING (SPINAL DISC IMPLANTS, HIP IMPLANTS)**

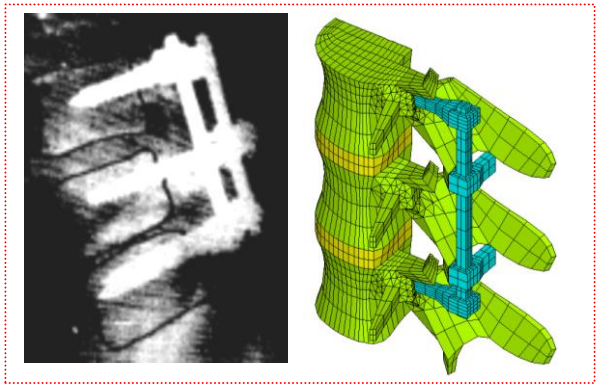
Hip implants



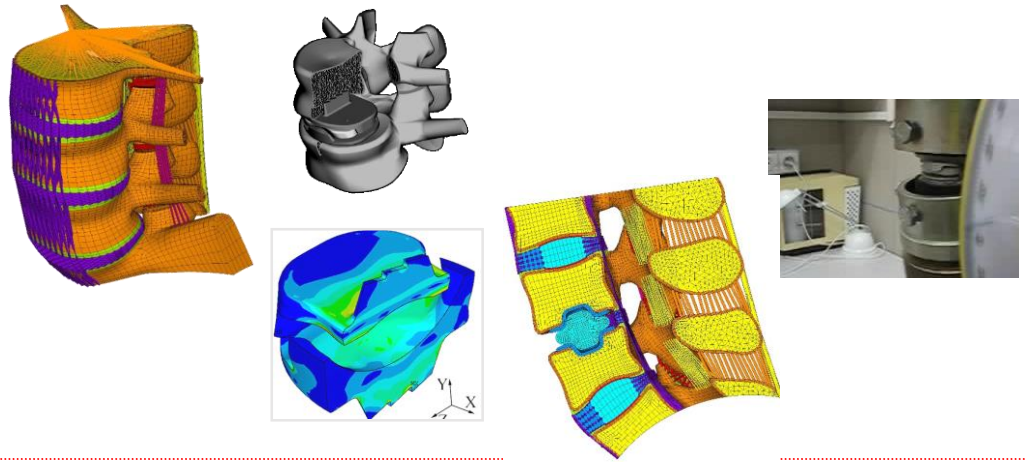
Bone remodeling



Spine stabilization

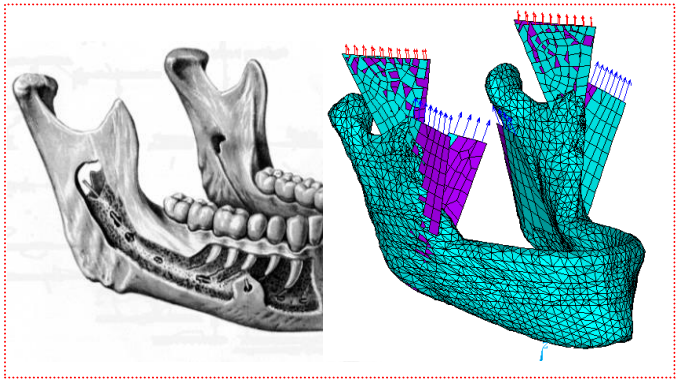


Disc implants (NCBiR, 2010 – 2013)



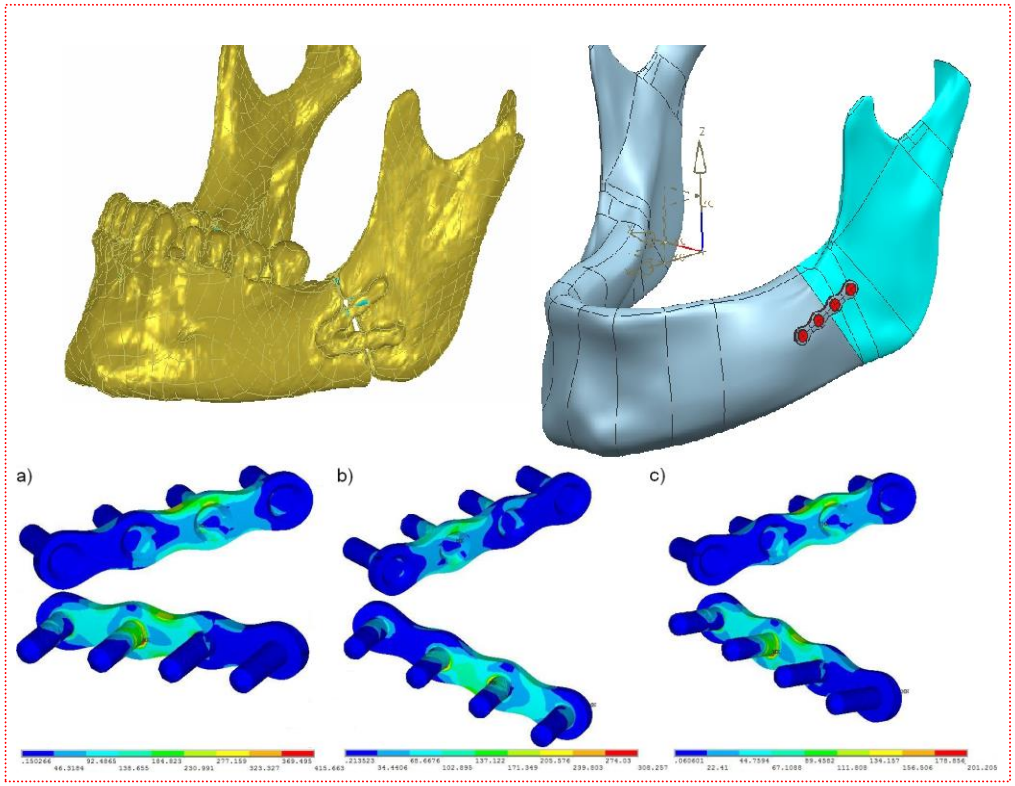
Biomechanics

- **IMPLANTS AND BONE REMODELLING (DENTAL IMPLANTS)**



- **FINITE ELEMENT MODELS FOR NUMERICAL SIMULATION OF PLATE STABILIZATION OF MANDIBLE FRACTURE**

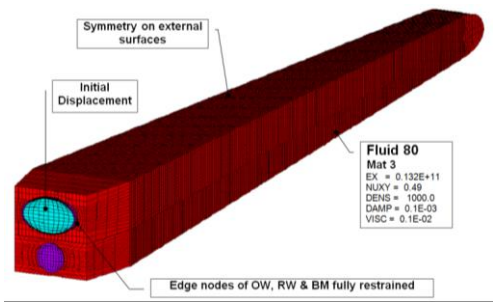
  - Optimization of the stabilization technique and procedure
  - Simulation of the behaviour of the bone tissue during healing period
  - Cooperation with Medical Univeristy of Warsaw

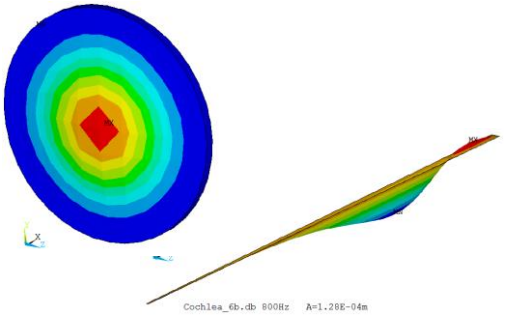


Biomechanics

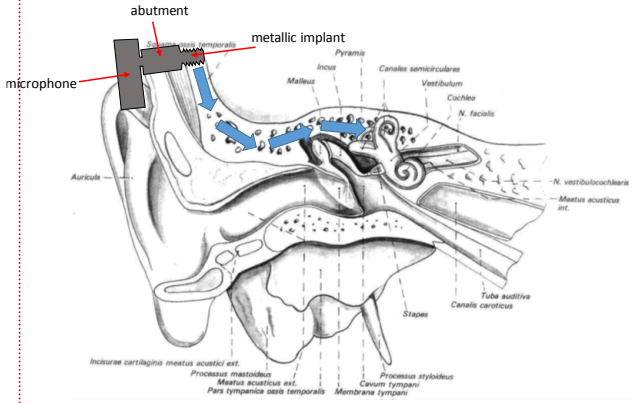
- **INNER EAR BIOMECHANICS AND BONE CONDUCTION IMPLANTS**

Biomechanics of Stapedotomy Surgery – Model and Experiment (2013-2016)

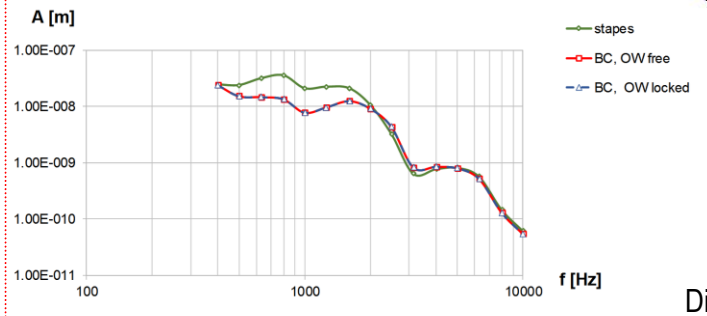


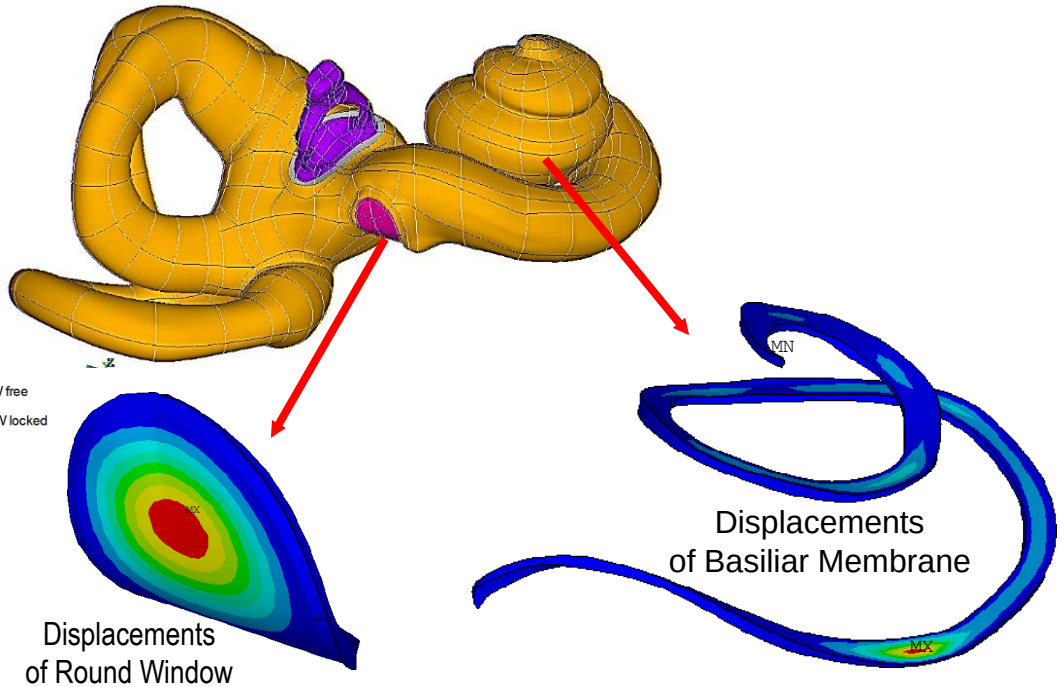


A new innovative method for direct stimulation of inner ear structures via bone conduction (2015-2018)



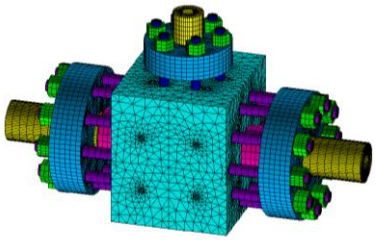
[Bochenek A., Anatomia człowieka]

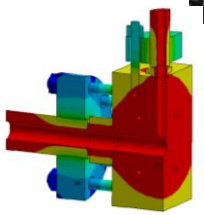


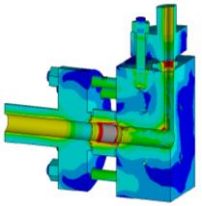


Power engineering

- **FE ANALYSIS OF A HIGH PRESSURE T-CONNECTION**

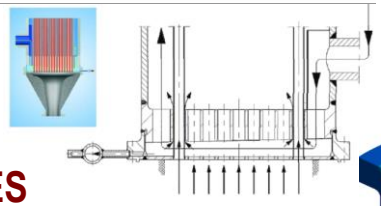


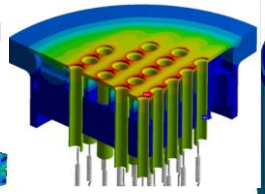


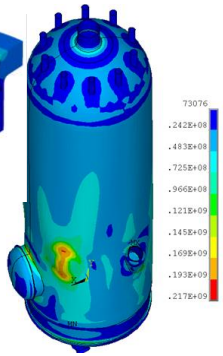


- **FATIGUE LIFE DEVICES IN CONDITIONS OF CYCLIC PRESSURE CHANGES** (HOG -ORLEN S.A.)

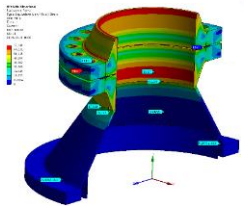
- **LOW CYCLE FATIGUE PROBLEM FOR DOUBLE TUBESHEET OF QUENCH HEAT EXCHANGERS FOR ETHYLENE CRACKING FURNACES** (Olefins II PKN ORLEN S.A.)

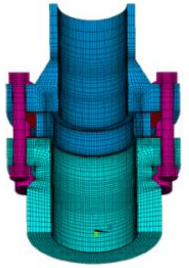




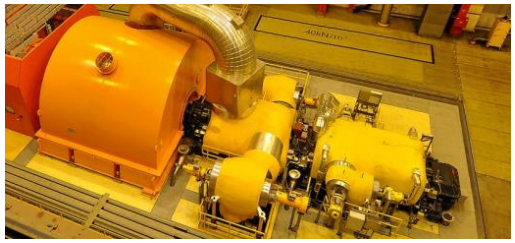


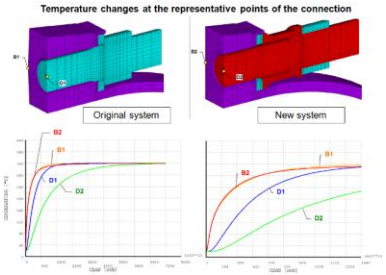
- **TIGHTNESS ANALYSIS FOR QUENCH HEAT EXCHANGERS FOR ETHYLENE CKRACKING FURNACES** (PKN ORLEN S.A)

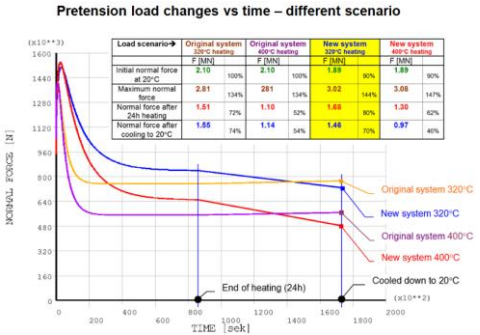




- **ANALYSIS OF FLANGE CONNECTIONS UNDER VARYING THERMAL CONDITIONS**
- **ANALYSIS OF STEAM LEAKAGE IN THE FUSELAGE OF WP TURBINE** (ALSTOM)

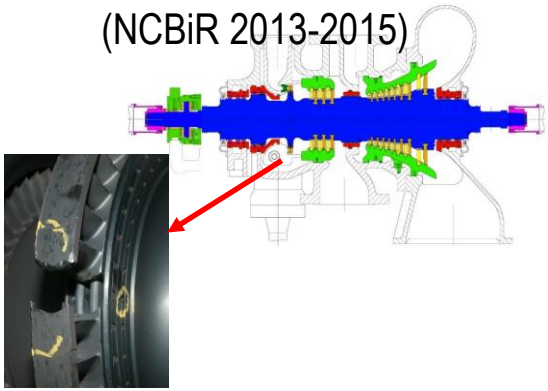


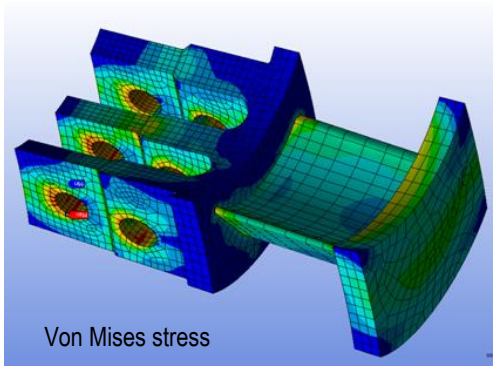


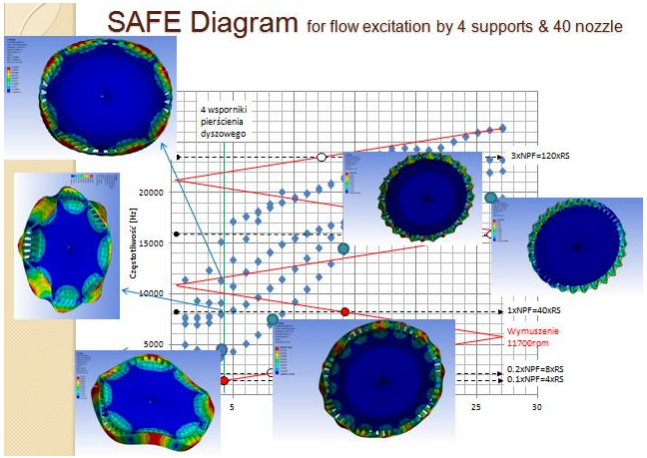


Power engineering

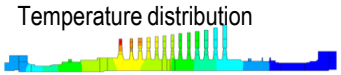
- **PROBLEMS OF STRENGTH OF ROTATING TURBOMACHINERY** (NCBiR 2013-2015)

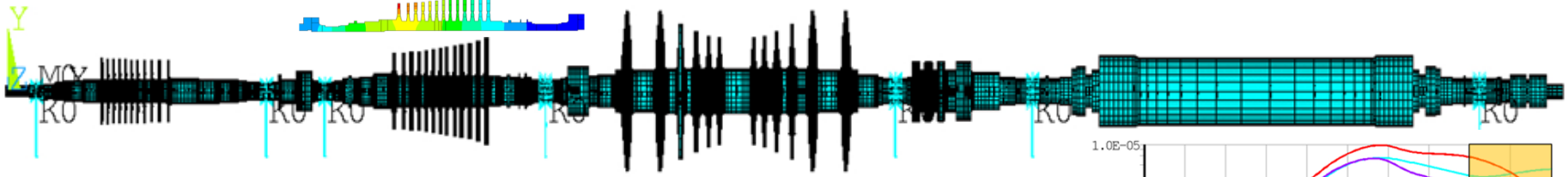


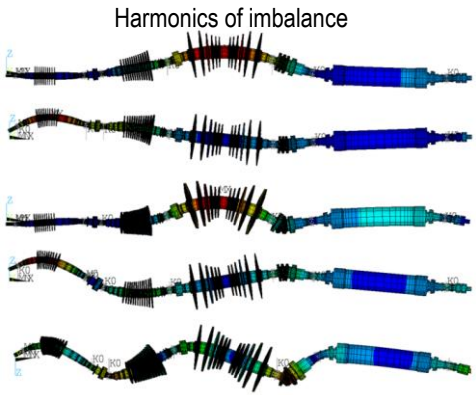


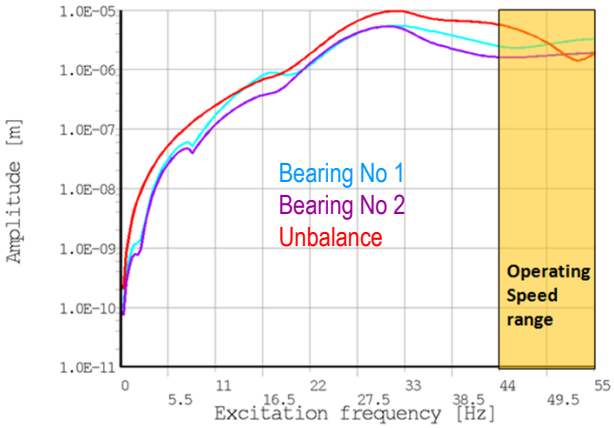


- **ANALYSIS OF THE DYNAMICS AND STRENGTH OF THE ROTORS** (NCBiR 2013-2015)



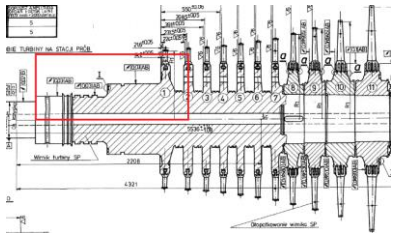
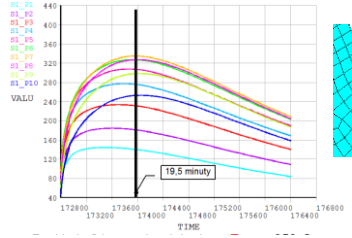


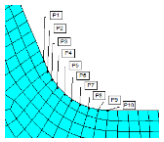
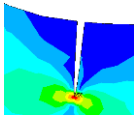
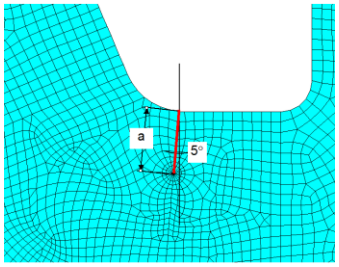


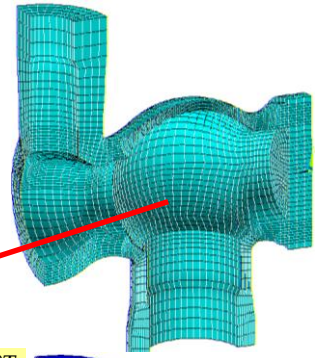
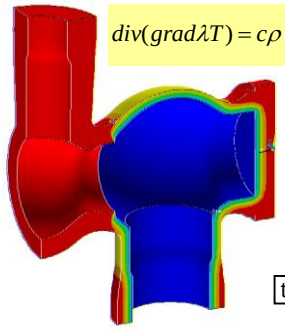
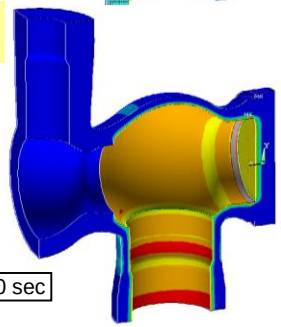


Power engineering

- **FINITE ELEMENT MODELING OF MATERIAL FATIGUE AND CRACKING PROBLEMS FOR STEAM POWER SYSTEM HP DEVICES EXPOSED TO THERMAL SHOCKS** (2014-2015)

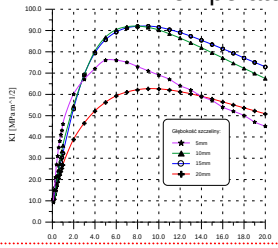




$$div(grad\lambda T) = c\rho\frac{\partial T}{\partial t}$$

Temperature

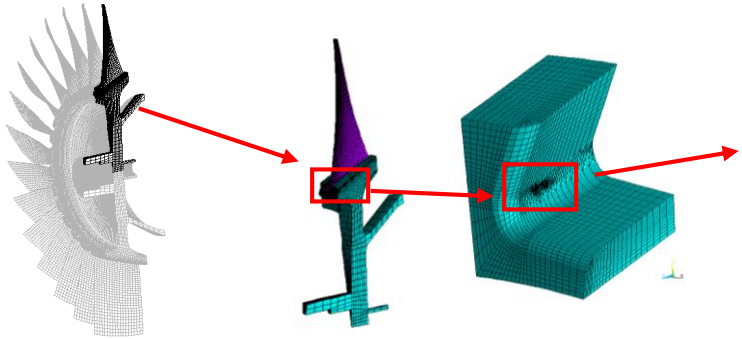
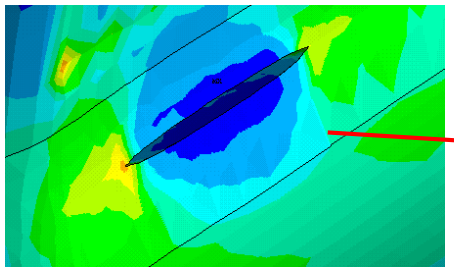
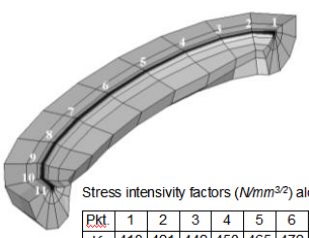
Plastic strain ε_{pl}^{max}=8‰



Low cyclic fatigue:

Cracking: $\frac{da}{dN} = C_e N^k \Delta\varepsilon_{pl}$=C

- **FE ANALYSIS OF THE TURBINE BLADE LOCKING PIECE DEFECTS**

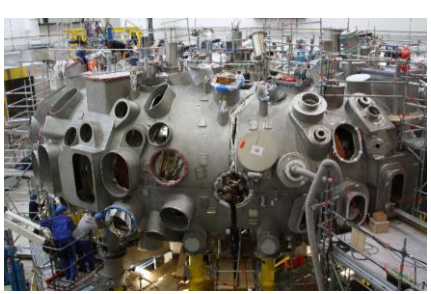
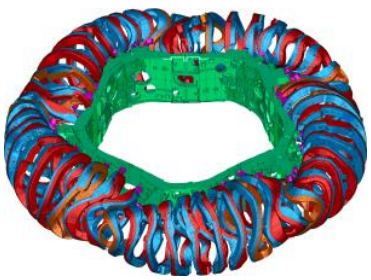
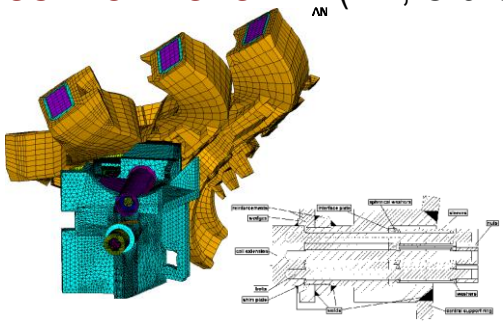
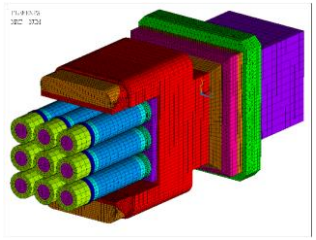
Stress intensivity factors ($N/mm^{3/2}$) along the front of the crack

Pkt.	1	2	3	4	5	6	7	8	9	10	11
K_I	410	421	442	453	465	472	476	462	455	455	450
K_{II}	81	59	38	8	12	28	44	50	52	66	76
K_{III}	30	42	64	73	78	78	72	62	48	29	25

Power engineering

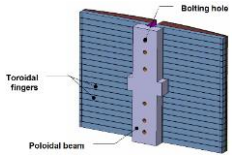
IPP Max-Planck-Institut für Plasmaphysik

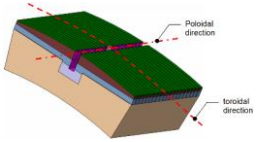
- **FINITE ELEMENT ANALYSIS OF CRITICAL CENTRAL CONNECTION ELEMENTS OF W7-X STELLATOR COIL SUPPORT SYSTEM** (IPP, Greifswald, 2005-2011)

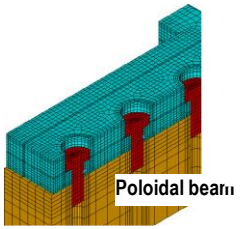





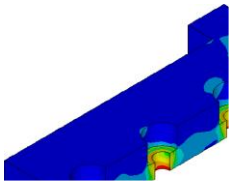
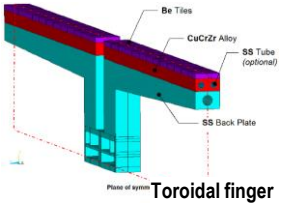
iter china eu india japan korea russia usa

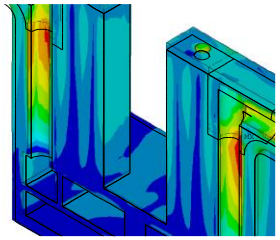
- **FE MODELLING OF THE MECHANICAL BEHAVIOUR OF SEPARABLE FIRST WALL ELEMENTS FOR ITER** (IPP, Garching, 2008)



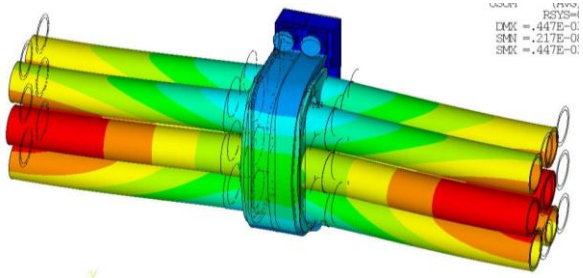
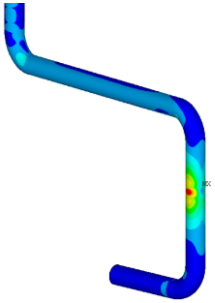
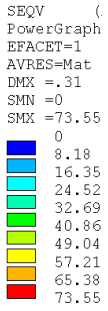


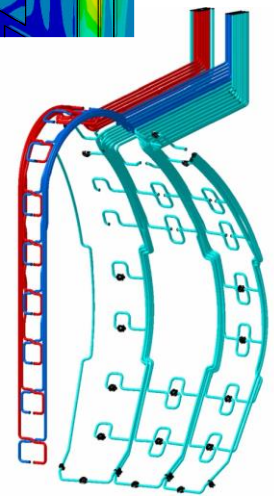




- **PRELIMINARY MECHANICAL ANALYSIS OF BLANKET MANIFOLD CONCEPT FOR ITER REACTOR** (IPP, Garching, 2008)

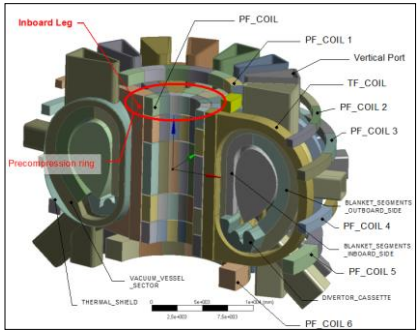


Power engineering

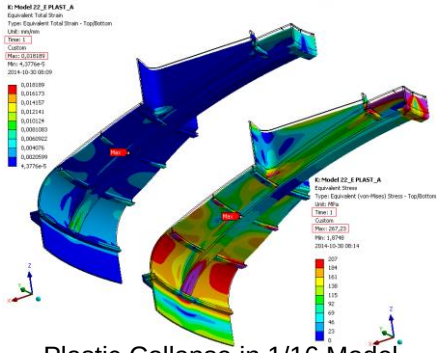
EUROfusion

POWER PLANT PHYSICS & TECHNOLOGY DEPARTMENT

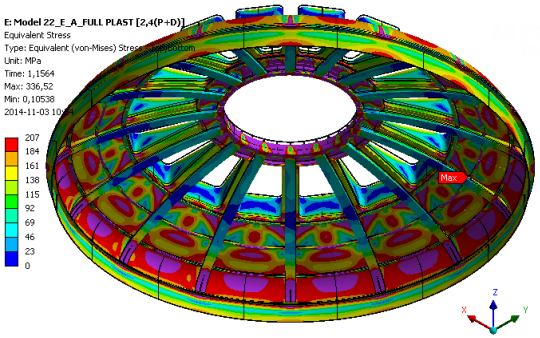
Structures of DEMO fusion reactor (2014-2018)



- **DESIGN INVESTIGATIONS OF CRYOSTAT TOP LID FOR DEMO** (2014)

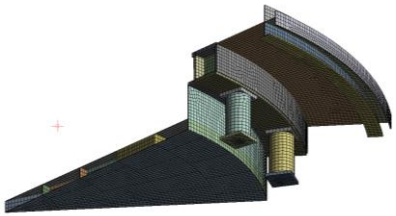


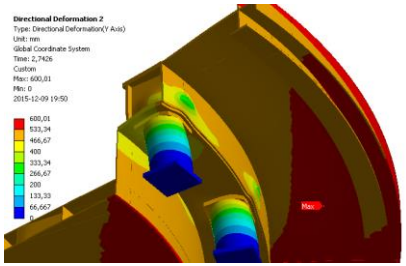
Plastic Collapse in 1/16 Model



Plastic Collapse in FULL Model

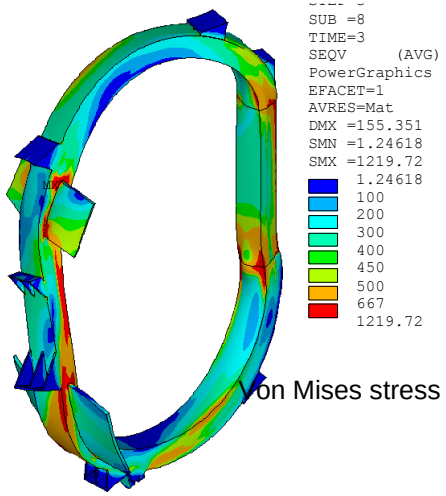
- **CRYOSTAT PEDESTAL RING DESIGN ASSESSMENT** (2015)





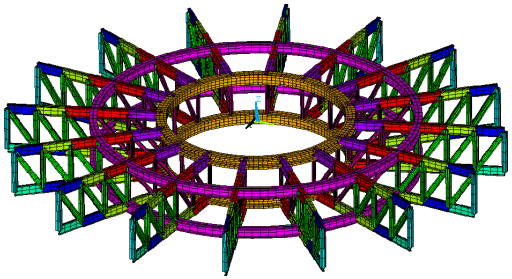
UY displacements (LF=2.7426)

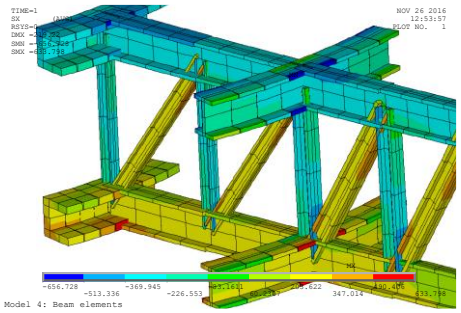
- **STRUCTURAL ANALYSES OF VARIOUS TF COIL CONFIGURATIONS** (2016)



Von Mises stress

- **DESIGN AND ANALYSIS OF BIOSHIELD ROOF** (2016)

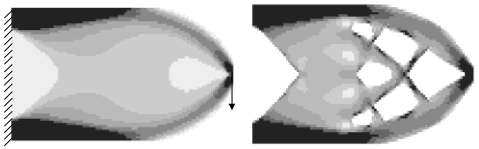


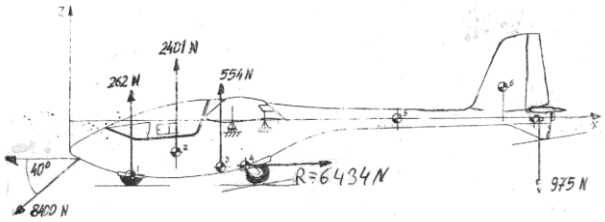


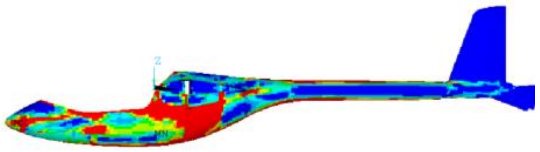
Composites, cellular solids, smart and intelligent materials

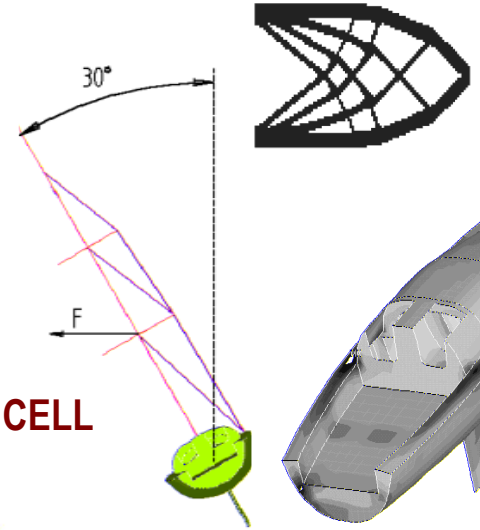
- **Structural Optimization** :

  THE PREDICTION OF OPTIMAL MATERIAL LAYOUT AND PROPERTIES FOR ELASTIC CONTINUM STRUCTURE USING WEIGHTED RESOURCE CONSTRAINT (UoM- PW 1997-2008)





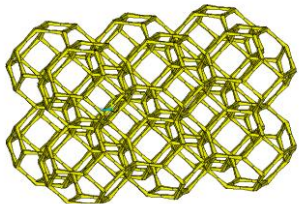


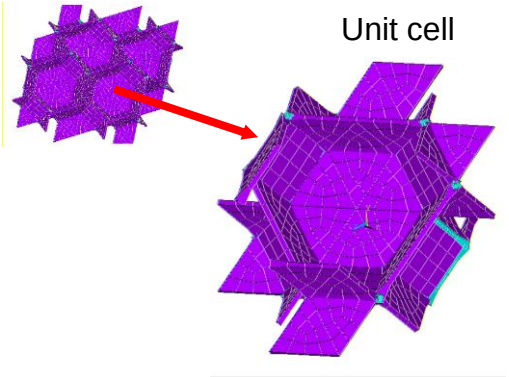


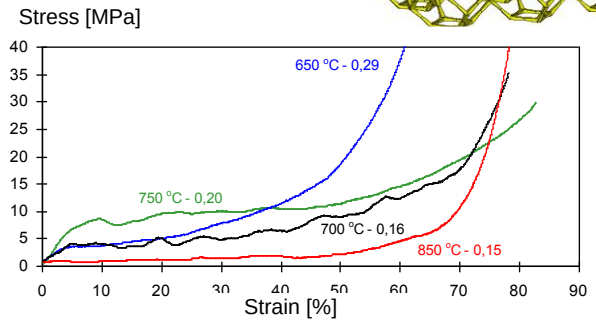
- **Mechanics of Cellular Solids**:

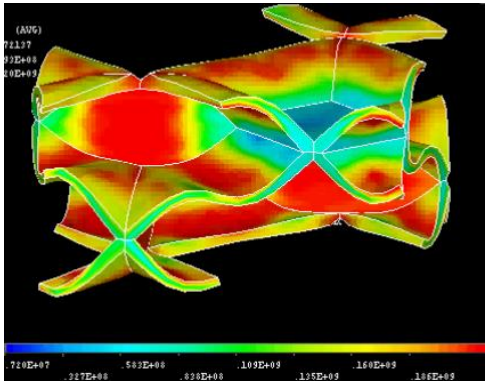
  MECHANICAL PROPERTIES OF LOW DENSITY OPEN & CLOSED CELL FOAMS BASED ON TETRAKAIDECAHEDRONAL MODEL OF MICROSTRUCTURE Aluminium Foam (AlSi12Mg1)

  (UoM PW MEiL +WIM - 1997-2017)



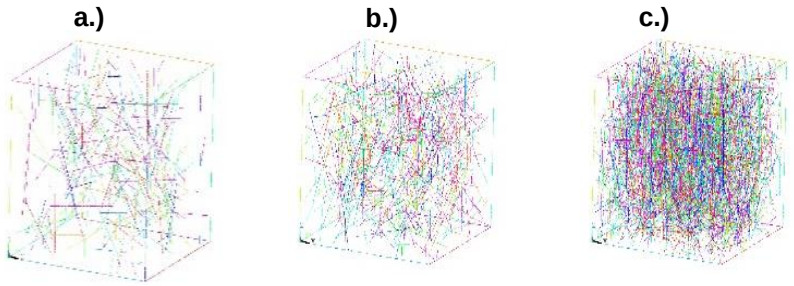




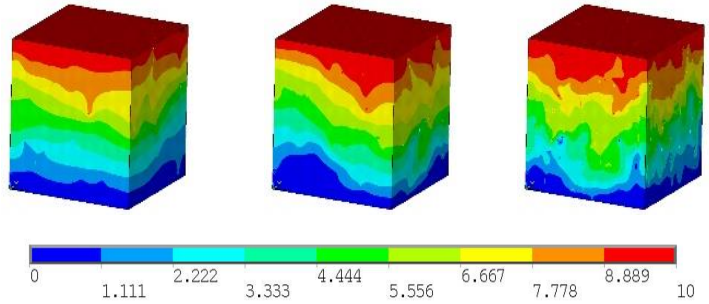


Composites, cellular solids, smart and intelligent materials

- **NANOCOMPOSITES: PARAMETRIC FE MODELLING OF MECHANICAL, ELECTRICAL AND THERMAL PROPERTIES OF NANOCOMPOSITE**

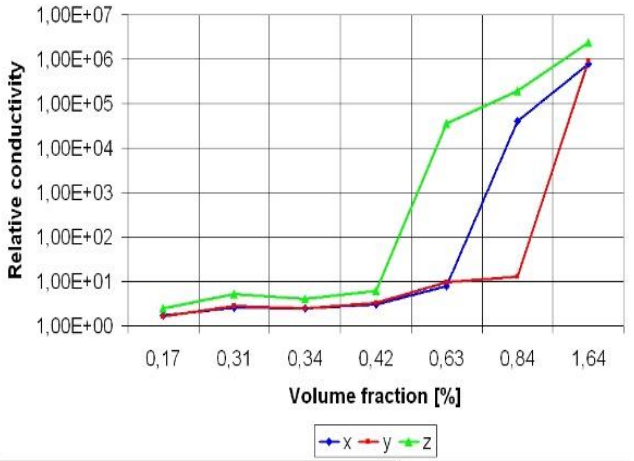


Models with different number of CNTs: a.) 200, b.) 500, c.) 2000.



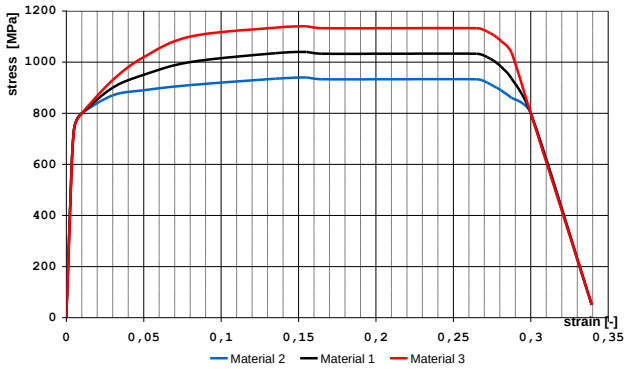
Potential [V] distribution for different number of CNTs.

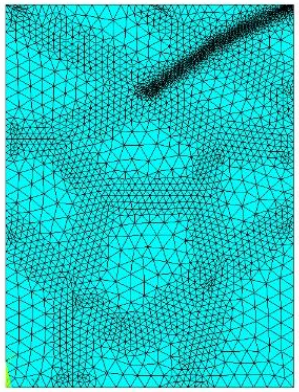
Percolation effect

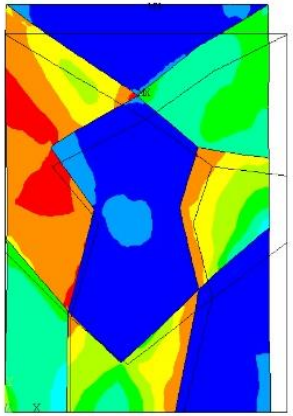


Mechanics of solids

- **FE MODELING OF MICROSCALE STRUCTURES WITH NON-UNIFORM MATERIAL DISTRIBUTION - CRYSTALLITES (NON-LINEAR MATERIAL PROPERTIES, LARGE DEFORMATION AND STRAIN)**

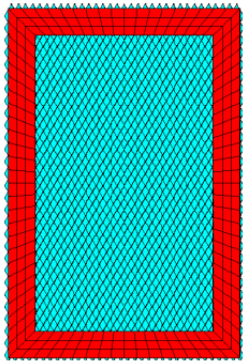


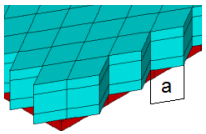


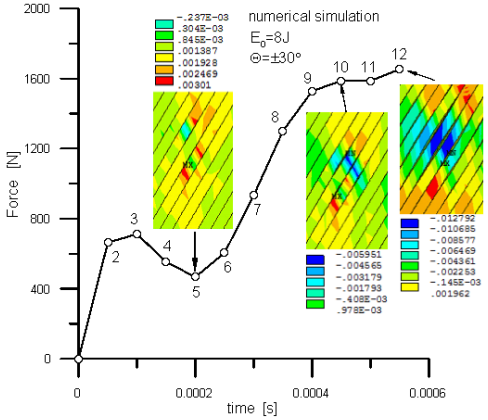


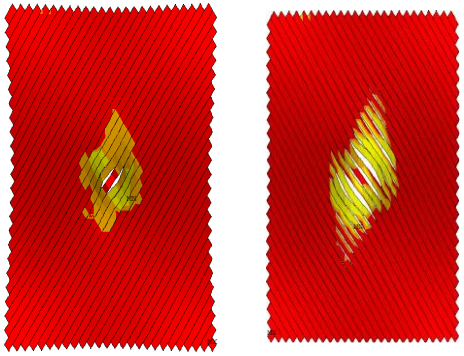
Equivalent stress distribution for 4.6% of total elongation

- **SEQUENCE OF DAMAGE EVENTS (DELAMINATION) OCCURRING IN THE COURSE OF LOW ENERGY IMPACT OF CARBON FIBRE COMPOSITES**









Final intra and interlaminar damage