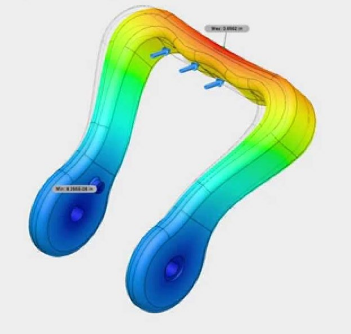
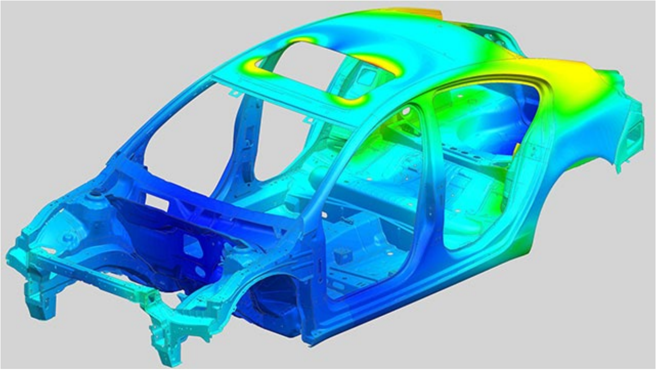
MATRICOMP

Why Simulate / Calculate Strength?

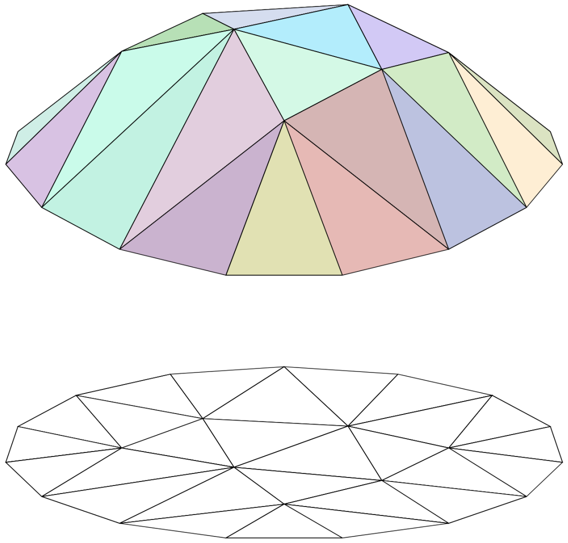
- Strength calculation gives information of strength, elasticity, mass and dimensions of the structure before it is created in real life.
- It is like virtual testing of the product / structure.
- Main benefits are to save time, money and environment during the development process.
- Sometimes physical testing is quicker and cheaper alternative. Strength calculation is not allways the best way to go!

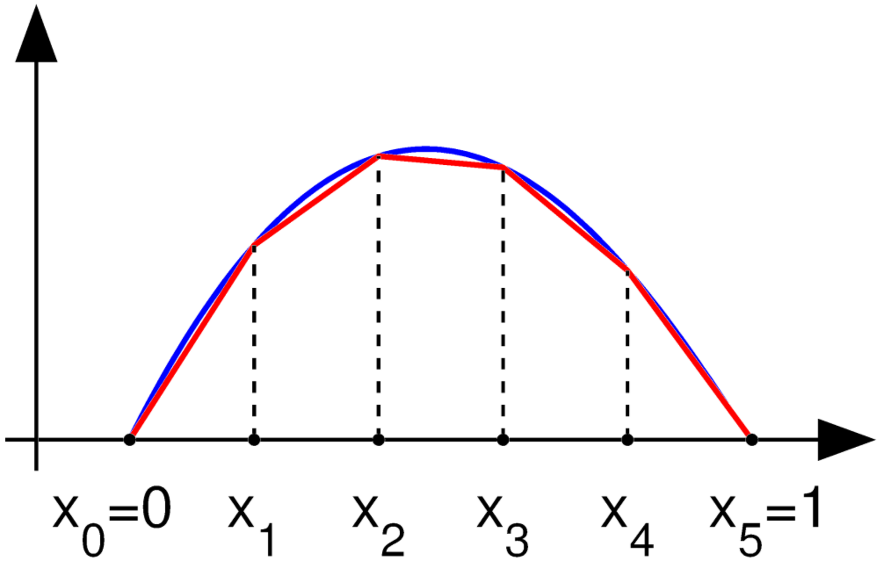


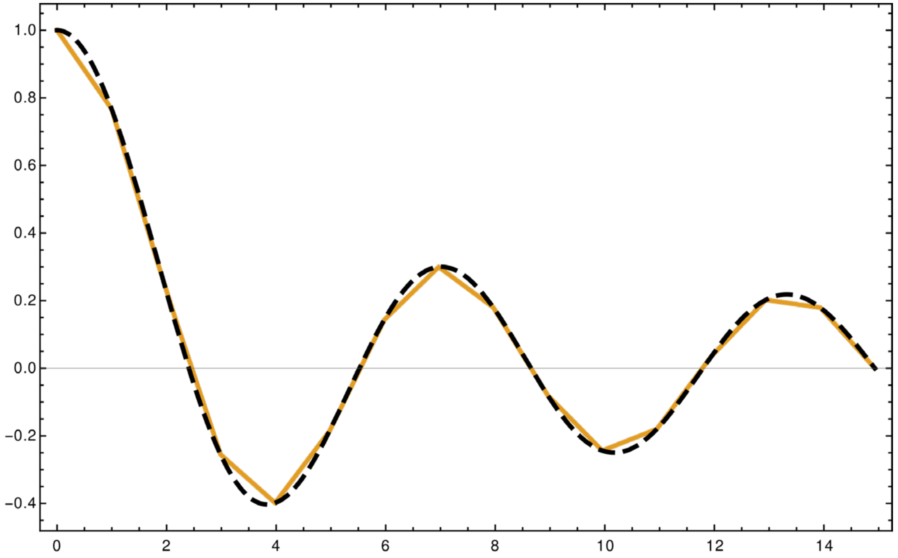


FEA = Finite Element Analysis
FEM = Finite Element Method

Type of computational calculation / analysis: The FEA is a general numerical method for solving problem by subdividing a large system into smaller, simpler parts that are called finite elements

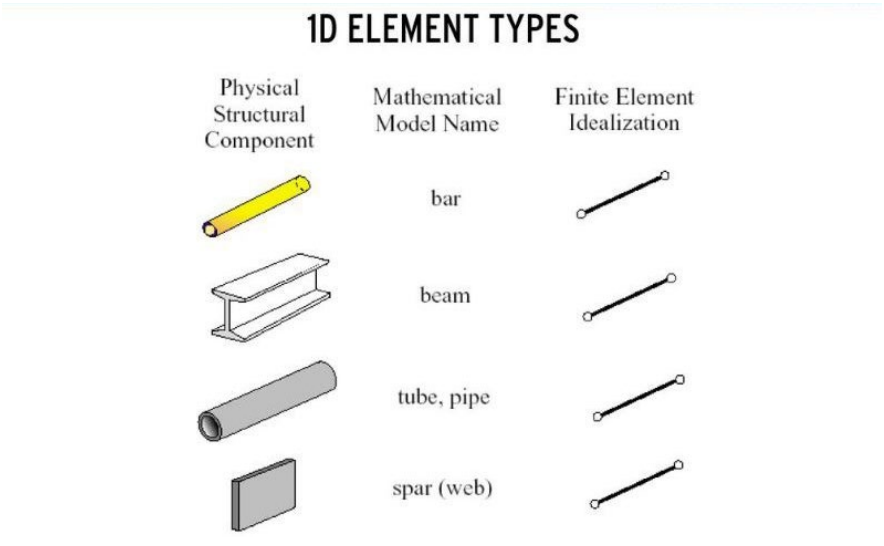


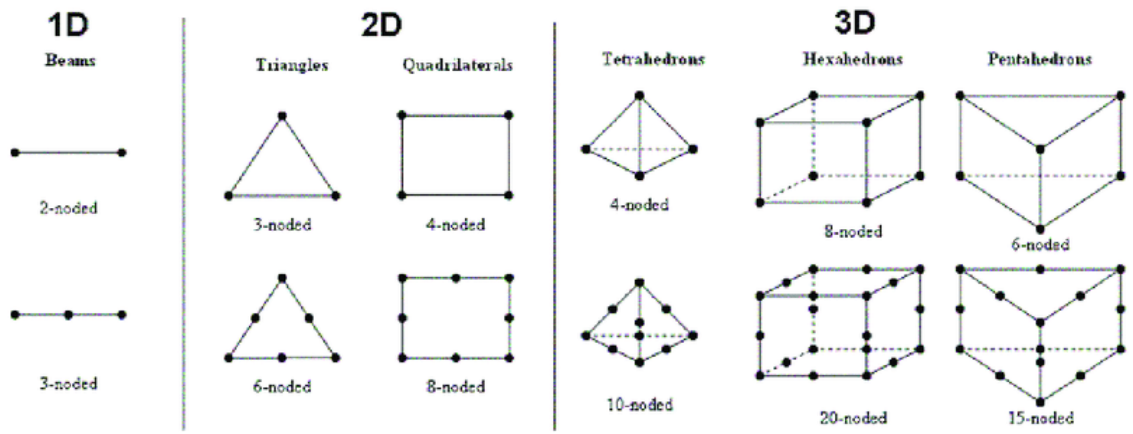


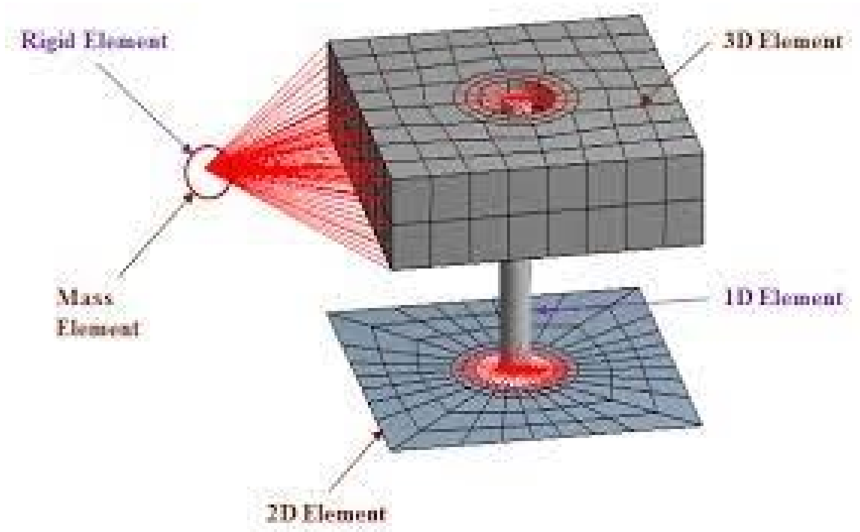


Different types of Finite Elements

- 1D, 2D and 3D elements
- 1D Line Elements: beam, bar, tube, pipe, cable…
- 2D Shell Elements: triangles, quadrilaterals
- 3D Solid Elements: tetrahedrons, hexahedrons, pentahedrons (prisms)
- Mass, rigid, spring elements







How to use FEA for composites?

- Composites are mostly anisotropic
- Laminates consists of layers of different materials and orientations
- 1D, 2D and 3D layered elements can be used to model these kind of materials.
- Directions of material global and local coordinate systems must be determined
- Experience on manufacturing method is important: Material properties + possible structures / orientations

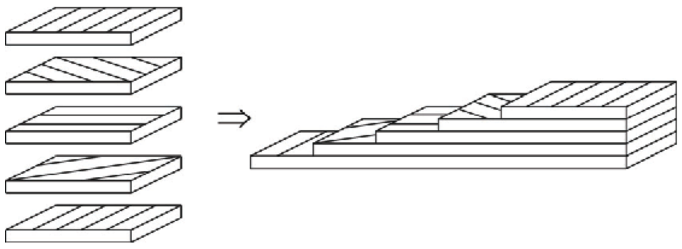
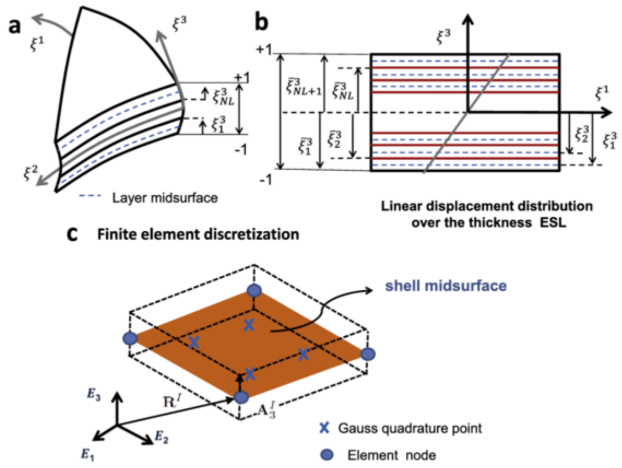
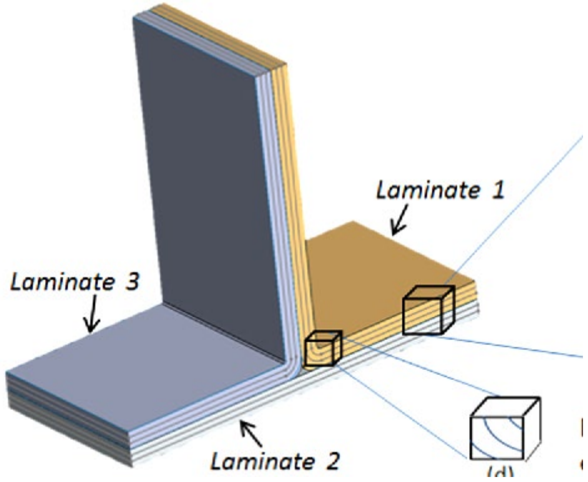


Fig. 1 Fiber-reinforced composite laminate





What is needed to know in order to perform FEA?

- Geometry
- Loads + Constraints
- Material properties →
- Requirements / standards to follow

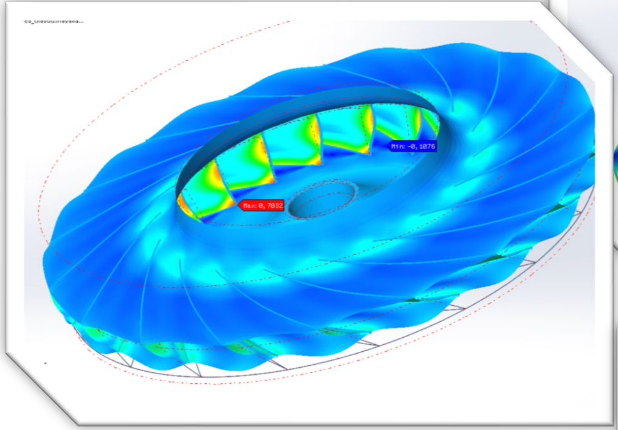
Properties of Outline Row 11: Epoxy Carbon Woven (230 GPa) Wet

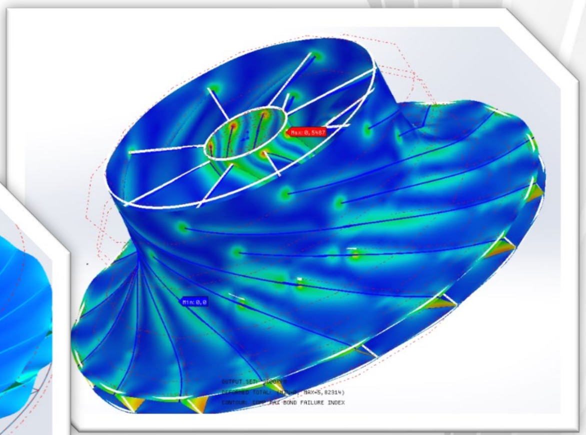
	A	B	C
1	Property	Value	Unit
2	Density	1451	kg m^-3
3	Orthotropic Secant Coefficient of Thermal Expansion		
4	Coefficient of Thermal Expansion		
5	Coefficient of Thermal Expansion X direction	2,2E-06	C^-1
6	Coefficient of Thermal Expansion Y direction	2,2E-06	C^-1
7	Coefficient of Thermal Expansion Z direction	1E-05	C^-1
8	Orthotropic Elasticity		
9	Young's Modulus X direction	5,916E+10	Pa
10	Young's Modulus Y direction	5,916E+10	Pa
11	Young's Modulus Z direction	7,5E+09	Pa
12	Poisson's Ratio XY	0,04	
13	Poisson's Ratio YZ	0,3	
14	Poisson's Ratio XZ	0,3	
15	Shear Modulus XY	3,3E+09	Pa
16	Shear Modulus YZ	2,7E+09	Pa
17	Shear Modulus XZ	2,7E+09	Pa
18	Orthotropic Stress Limits		
19	Tensile X direction	5,13E+08	Pa
20	Tensile Y direction	5,13E+08	Pa
21	Tensile Z direction	5E+07	Pa
22	Compressive X direction	-4,37E+08	Pa
23	Compressive Y direction	-4,37E+08	Pa
24	Compressive Z direction	-1,5E+08	Pa
25	Shear XY	1,2E+08	Pa
26	Shear YZ	5,5E+07	Pa
27	Shear XZ	5,5E+07	Pa
28	Orthotropic Strain Limits		
38	Tsai-Wu Constants		

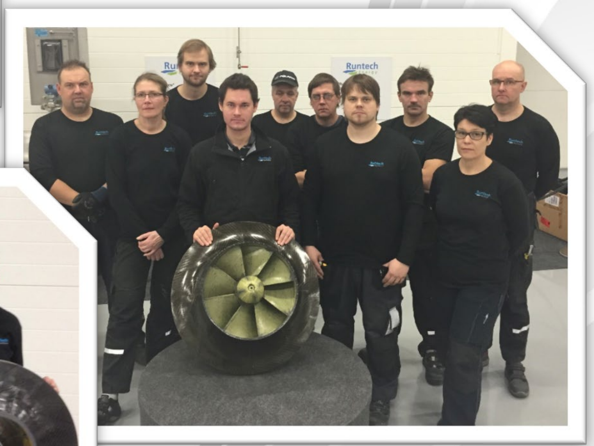
Comprehensive expertise in composites

Composite impellers for vacuum compressor
Very demanding strength and manufacturing challenge

- ✓ Mechanical design
- ✓ Carbon fiber composite structure design
- ✓ Design for manufacturing
- ✓ Orthotropic FEM-analysis
- ✓ Design of molds and tools







Runtech
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