TOPOLOGY OPTIMIZATION OF JCB ARM LINK

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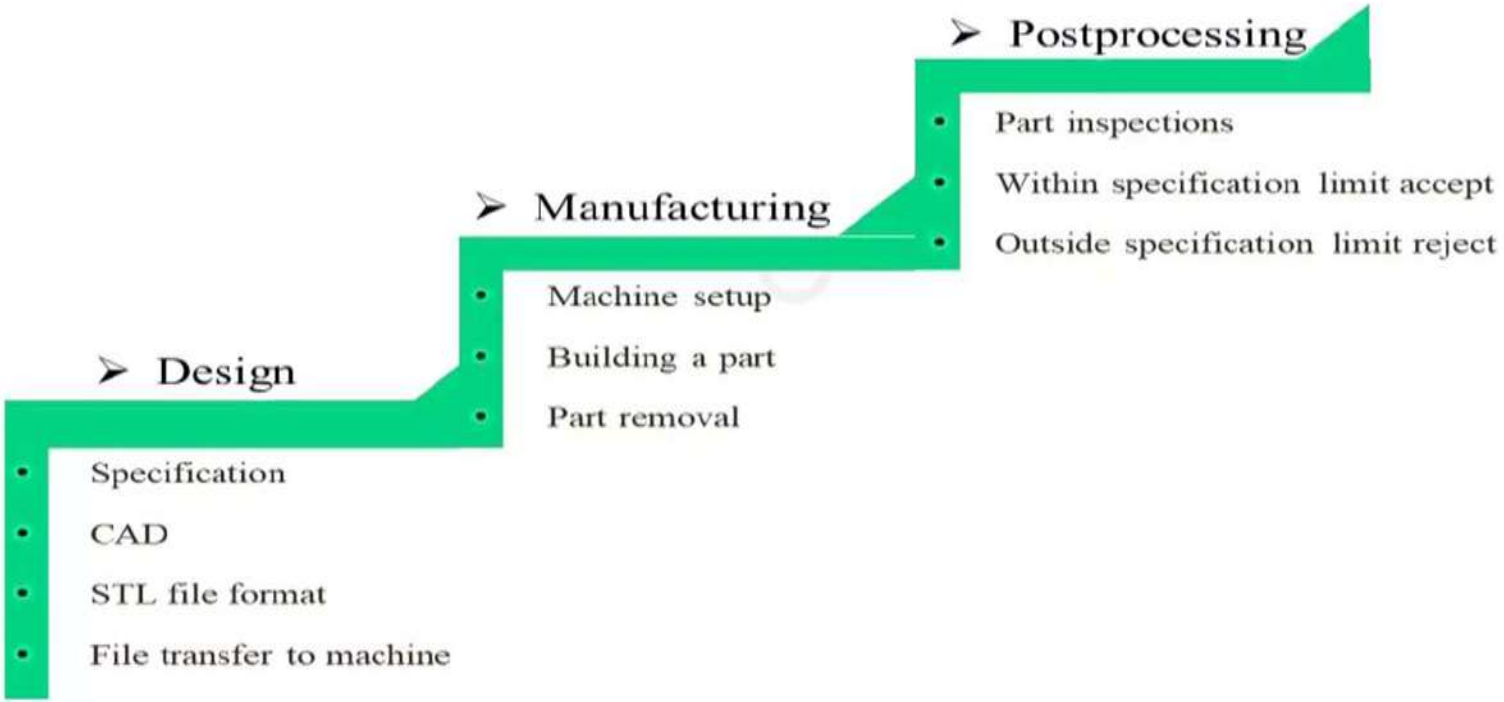
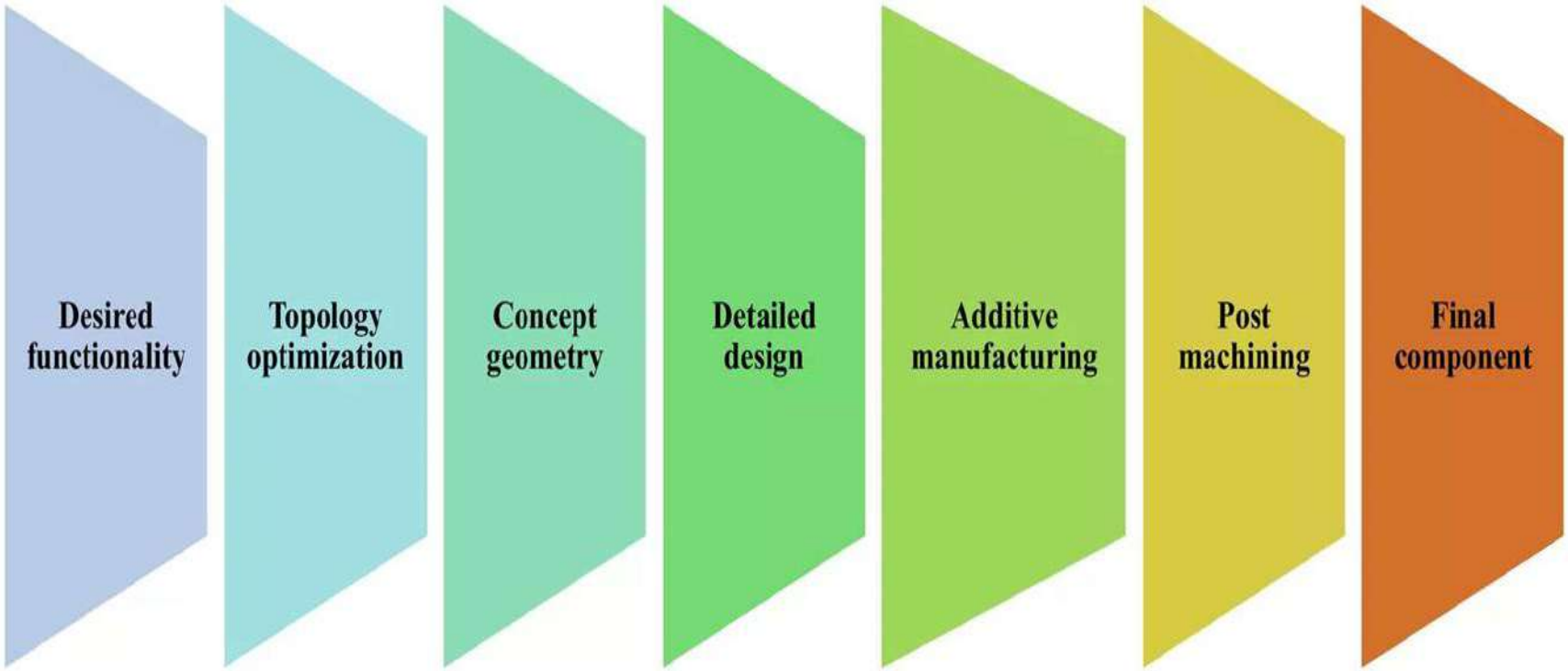
CONTENT

1.1 ADDITIVE MANUFACTURING

- The term 'additive manufacturing' was given by the ASTM F42 committee.
- Additive Manufacturing (AM) is the process of making 3D objects from computer model data by joining materials layer by layer under computer control using a 3D printer.



1.2 DESIGN FOR MANUFACTURING



1.3 Topology optimization

- Topology optimization (TO) is a mathematical method that optimizes material layout within a given design space, for a given set of loads, boundary conditions and constraints with the goal of maximizing the performance of the system.
- TO is different from shape optimization and sizing optimization in the sense that the design can attain any shape within the design space, instead of dealing with predefined configurations. The conventional TO formulation uses a finite element method finite (FEM) to evaluate the design performance.

1.4 Topology optimization: formulation

- Definition of a design domain that contains the structure.
- Discretization of the domain into Finite Elements to evaluate the mechanical or physical responses
- Applications of boundary conditions and load cases
- Discretization of the material distribution: constant density per element) = the design variables
- Optimization algorithm to solve the maximization problem: prediction of new improved design characterized by a set of density variable map

1.5 ADVANTAGES

Topology Optimization

- **Design freedom:** part performance not limited by imagination of designer
- **Time to market**: fast, nearly automated design process
- **Customization:** tailored designs for specific requirements

Additive Manufacturing

- **Design freedom:** relatively few shape restrictions, complexity for free
- **Time to market:** no tooling needed, on-demand production
- **Customization:** produce many different part at once

1.6 Ansys software

- Topology Optimization technology, Ansys Mechanical gives you the tools you need to design durable , lightweight components for any application.
- You can define objectives easily and apply controls to ensure that manufacturing requirements are met, minimum material thicknesses are set and exclusion areas are defined.
- Topology optimization lets you specify where supports and loads are located on a volume of material and lets the software find the best shape.
- You can now easily perform light weighting of structures, extract CAD shapes and quickly verify the optimized design.
- You can also simulate spatially dependent materials like composite parts, 3D printed components, and bones and tissues for more accurate results.

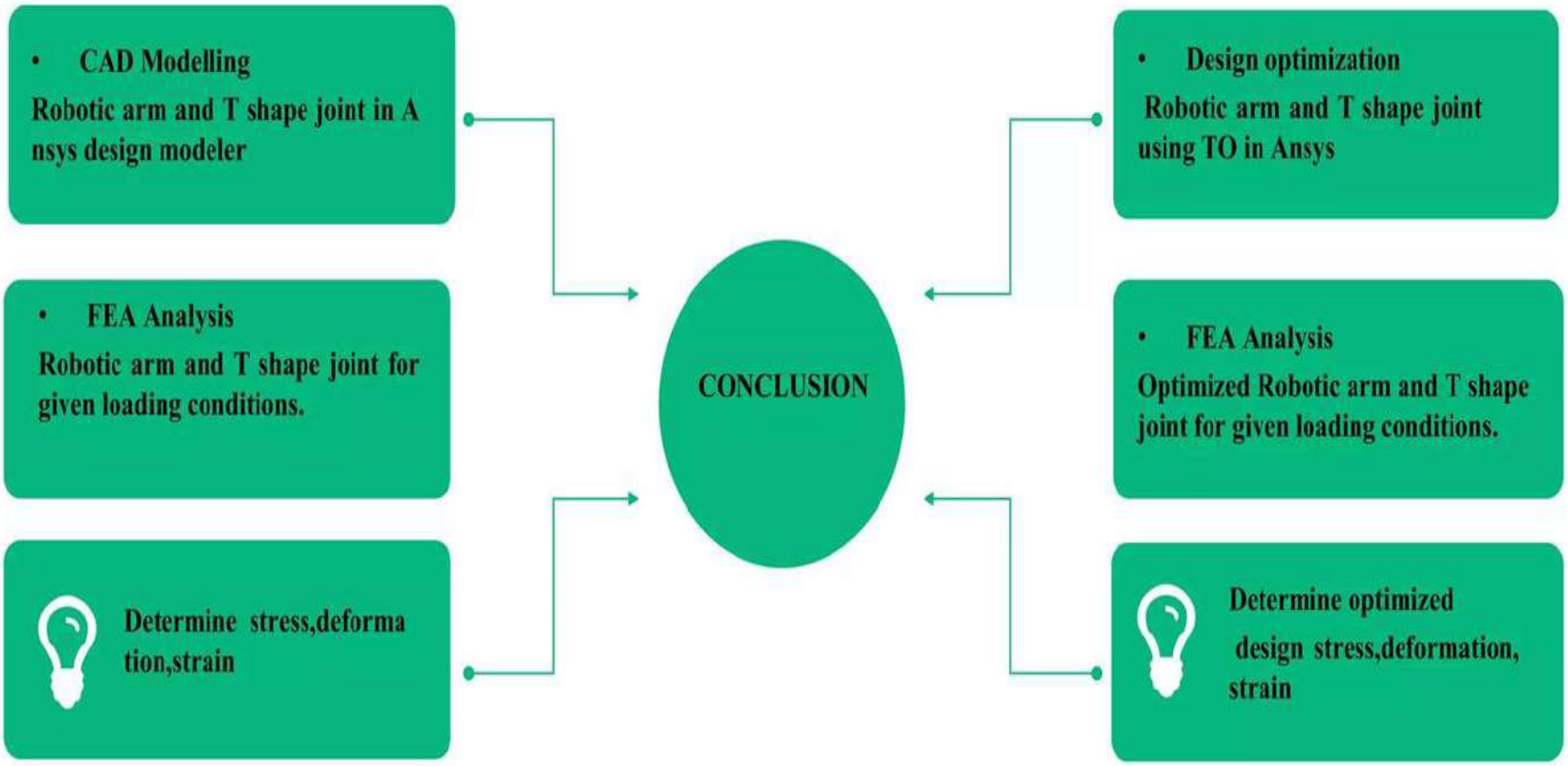
1.7 ANSYS SOFTWARE

Topology optimization in Ansys allows you to:-

- Take into account multiple static loads combined with optimizing for natural frequencies (modal analysis)
- Satisfy requirements for minimum material thickness
- Observe rules around feature direction (for machining operations for example)
- Have scope for both cyclic and planar symmetry
- Easily validate results

METHODS

3.1 Flow chart



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RESULTS AND DISCUSSION

- ✓ The FEA simulation is solved using sparse matrix solver.
- ✓ The matrix is formulated for elements and assembled to form global stiffness matrix.
- ✓ Various matrix operations are carried out like inversions, multiplication to get the results at nodes and are interpolated to get results for entire element edge length.
- ✓ The most popular integral formulation, based on the variational calculus of Euler, is the P rinciple of Minimum Total Potential Energy.


THANK YOU