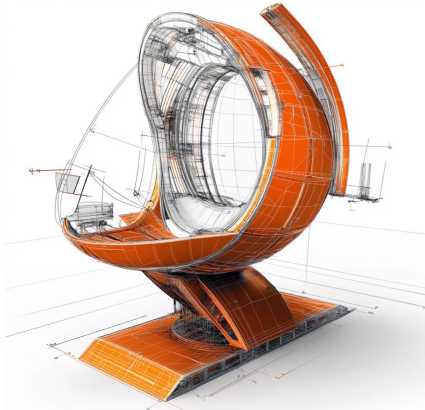# Introduction to CAD (Computer-Aided Design)

&

Parametric Design - Design for Manufacturing

A Tool for Engineering and Design

How To Make (Almost) Anything
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What is CAD?

How To Make (Almost) Anything
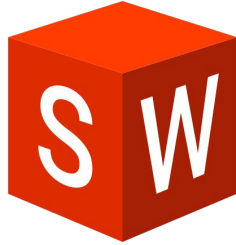
What is CAD?

Definition: CAD, or Computer-Aided Design, is software used to create detailed 2D or 3D models of physical objects or systems.

Applications: Architecture, mechanical engineering, product design.

What is CAD?

What is Parametric Design?

How To Make (Almost) Anything

What is Parametric Design?

Definition: Parametric design is a design process where relationships between elements are governed by parameters, allowing for dynamic updates and flexibility when changes are made.

- **Dynamic relationships**: Changes to one parameter automatically adjust related components, maintaining design integrity.
- **Efficient design process**: Allows rapid iteration and updates, improving flexibility and speed.
- **Complex geometries**: Ideal for designing complex shapes and structures that would be difficult or time-consuming to modify manually.
- **Optimization**: Facilitates exploring multiple design variations and optimizing for factors like material usage, aesthetics, or performance.
- **Used in various fields**: Commonly applied in architecture, product design, and engineering.

How To Make (Almost) Anything

From Concept to 3D Modeling

How To Make (Almost) Anything

From Concept to 3D Modeling: Tips for Beginners

- **Start with a clear idea**: Visualize the object in your head, considering its purpose, shape, and functionality.
- **Sketch on paper**: Begin by drawing rough 2D sketches from different angles to help define the proportions and key features.
- **Break the design into basic shapes**: Simplify the concept into geometric forms like cubes, spheres, cylinders, etc., to make it easier to model.
- **Choose the right CAD software**: Start with beginner-friendly tools like Fusion 360 or Tinkercad, which have intuitive interfaces.

- **Use parametric modeling**: Define dimensions and constraints early, so you can easily modify the design later.
- **Start with 2D sketches in CAD**: Create basic 2D sketches on different planes (front, side, top) to form the base for 3D features.
- **Extrude or revolve the sketches**: Use the extrude or revolve tools to turn your 2D shapes into 3D objects.
- **Add details gradually**: Incorporate smaller design features like holes, chamfers, fillets, and curves once the basic shape is ready.
- **Constantly check proportions and dimensions**: Regularly review your model to ensure it aligns with the original concept and practical measurements.

Keep your material in mind!

DO **NOT** SET THE LASER CUTTER ON FIRE!

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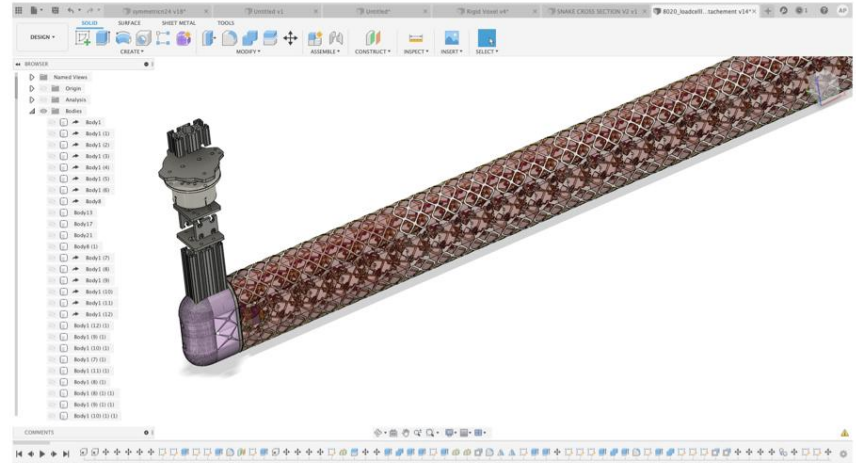
Getting Started with Fusion   360
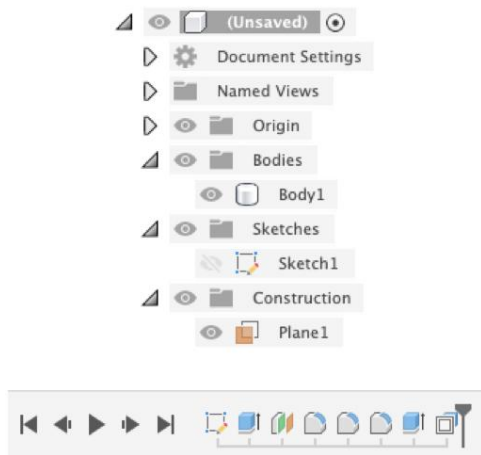
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Why Fusion 360

- Its free for students

- Its a friendly first CAD experience

- Available literature

- Cloud storage, share files

- Nice CAE, render, drawing interaction
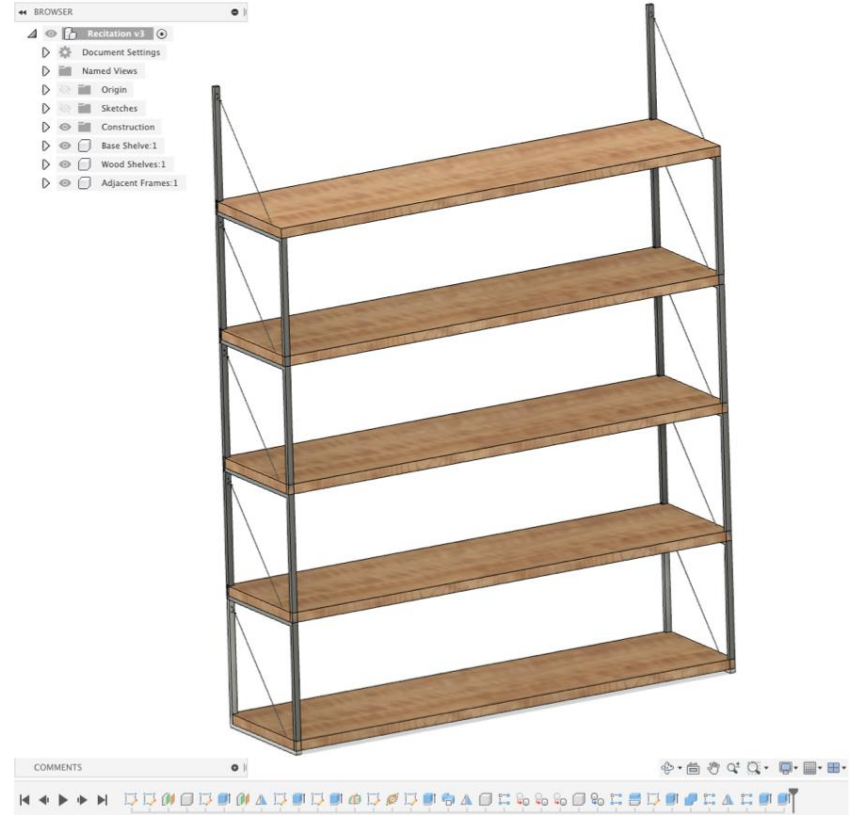
AUTODESK®
FUSION 360™

Tree Structure and Timeline

- **General Spatial Sense of the Canvas**

  - 2d zones

  - 3d environment

- **Timeline**

  - Record of the actions done

  - Can go back in time!

- **Tree**

  - Personal organisation of the elements generated

Parametrize almost anything!

- What do we call a parameter

- Learning curve of designing

- Flexibility

- Iteration
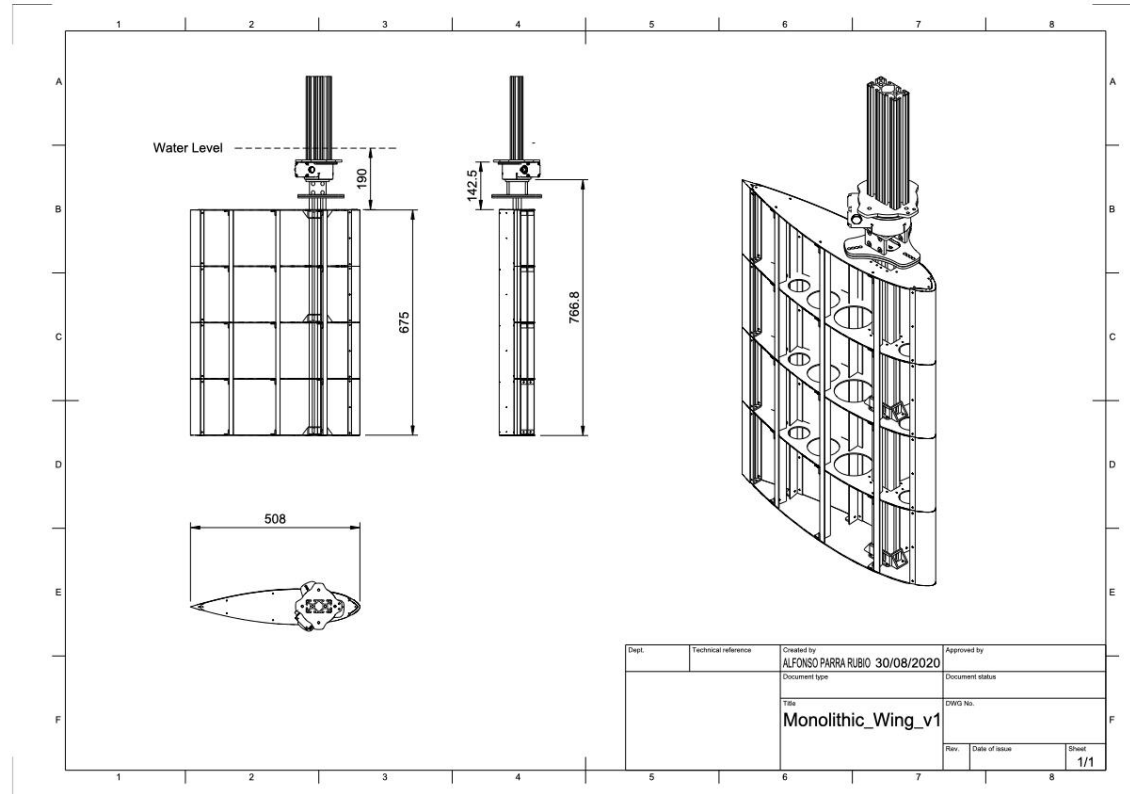
- Do not waste your time later

Sketches, Solids, and Surfaces

- Space allocation model. 3D perception

- Everything starts with a sketch

- When to use solids. Solids 101

- When to use surfaces. Surfaces 101

- Transform surfaces into volumes?

- Splitting Solids with surfaces

Drawings

- Technical Documentation

- Any View in your active part

Importing and exporting stuff

- Internal importing. So convenient. Can be tricky

- External importing. STEP, DXF and STL.

- Make your design to take away. Exporting STL, STEP and DXF.

- McMaster

DEMO :)

Some recommended resources:

Fusion 360 tutorial:
https://www.youtube.com/watch?v=WKb3mRkgTwg&list=PLrZ2zKOtC_-C4rWfapgngoe9o2-ng8ZBr

Alfonso's 2023 page (includes instructions for activating Autodesk Student account):
https://alfonso.pages.cba.mit.edu/recitations/parametric_design.html

And 2023 zoom recording:
https://mit.zoom.us/rec/share/naNtj0jNP_LRUCg4DdoYADzZCT97NhLnjEqwzm4mxlRJI7psBYL8o50hOjIrEumm.3crQ9w0PDVe1ONPG

FYI, since we're not recording recitations this year, you can find prior year's recitation videos under "Prior years": https://fab.cba.mit.edu/classes/863.24/file/prior.html, 2023 has all recitation videos recorded, 2020 has both lectures and recitations recorded.