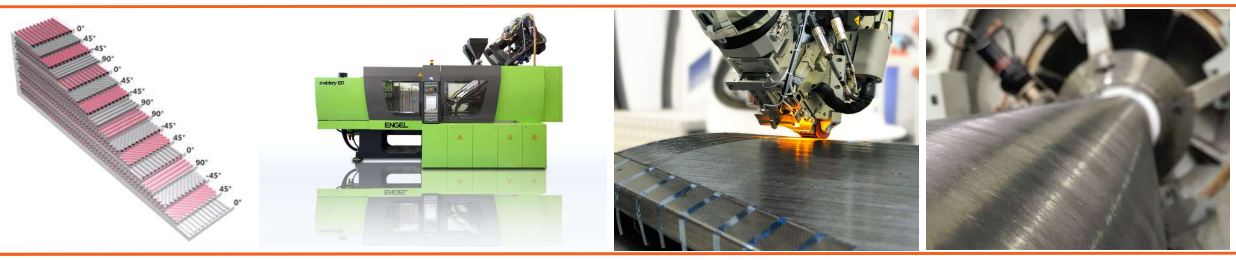
Introduction to Boat Design and Manufacturing



Instructor

Dr. Srikanth Pilla
Department of Automotive Engineering
Department of Materials Science and Engineering
Clemson University

Mentor Scope

Your Role	Mentor's Role
Propose a Boat Design	Provide feedback regarding the manufacturing of the design
	Propose what materials can be used in to manufacture mutually agreed upon design
Scout for materials that fit within project budget	Will order the materials
Manufacturing of the Boat	Provide assistance in selecting and implementing manufacturing process

Project Budget $ 50

Team Assignments

Student Name	Group	Programming	Arduino	Undergrad	Gender	Mentor
Ravikumar, Shreejith	G1	Yes (EG)	No	Mechanical		Ashokkumar, Srivishnu sashokk@clemson.edu
Sivarkar, Radhheya P		Yes (B)	No	Mechanical		
Manur, Gautham G		No	No	Mechanical		
Deshmukh, Nayan Prashant	G2	No	No	Mechanical		Baskaran, Sidharth sidharb@clemson.edu
Nair, Sohan		Yes	Yes	Automobile		
Iqbal, Mokarram		No	No	Mechanical		
Harper, Kevin		No	No	Mechanical		
Gupta, Ashish	G3	No	No	Mechanical		Gulanikar, Ajinkya Aajinkyg@clemson.edu
Garimella, Ravi Shankar		No	No	Mechanical		
Bulsara, Ardashir Hormuz		Yes (B)	Yes	Mechanical		
Kamarajugadda, Srivatsav	G4	Yes	No	Mechanical		Ashokkumar, Srivishnu sashokk@clemson.edu
Ghodekar, Madhuri K		Yes (B)	No	Mechanical	F	
Thangaraj, SriRagesh		No	No	Mechnanical		
Joshi, Akshat		Yes	Yes	Mechanical		
Adams, Maxwell	G5	No	No	Mechanical		Baskaran, Sidharth sidharb@clemson.edu
Acharya, Bharadwaj		Yes (B)	Yes	Mechanical		
Khade, Vinayak		Yes	No	Mechanical		
Mudrageda, Ram Charan		No	No	Mechanical		
Joshi, Gouri A	G6	Yes	No	Mechanical	F	Jagadeesan, Nithinsiranjeev njagade@clemson.edu
Su, Haotian		Yes	No	Automobile		
Shah, Harsh Sanjay		No	No	Mechanical		
Manoharan, Nithinkumar		No	No	Economics		
Kaushik, Karan	G7	Yes (B)	No	Mechanical		Nithyanand, Gouthaman gnithya@clemson.edu
Gopinath, Aditya		Yes	Yes	Automobile		
Linden, R Jeffrey		No	No	Economics		
Sarvaiya, Shraddha		No	No	Electrical	F	

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Team Assignments

Gupta, Ayush	G8	Yes	No	Mechanical		Jagadeesan, Nithinsiranjeev njagade@clemson.edu
Nemali-Vikram-Murthy, Ashwin		No	No	Mechanical		
Singh, Arvinder		Yes (B)	No	Mechnatronics		
Hiltenbrand, Carl A		Yes	No	Mechanical		
Sadiq, Mohammad Hasan	G9	No	No	Mechanical		Nithyanand, Gouthaman gnithya@clemson.edu
Girade, Piyush Prakash		No	No			
Taylor, Alfred		Yes (B)	No	Mechanical		
Basu, Shouvik		Yes	No	Mechanical		
Aggarwal, Deepak	G10	Yes	No	Mechanical		Ramesh, Senthil Raj senthil@clemson.edu
Sutton, Lindsey		Yes	No	Mechanical	F	
Motwani, Rahul Virbhan		Yes	Yes	Mechanical		
Ratnam Narasimhan, Hara		Yes (B)	Yes	Mechanical		
PARNERKAR, Amit Anil	G11	Yes (B)	No	Mechanical		Vedant, Rishabh rvedant@clemson.edu
Mittal, Nipun		Yes (B)	No	Mechanical		
Pundlikrao Bhagat, Aditya		Yes	No	Mechanical		
Shrivastava, Siddhant G		Yes (B)	No	Mechanical		
Vennelakanti, Goutham	G12	Yes	No	Mechanical		Ramesh, Senthil Raj senthil@clemson.edu
Kadam, Harshada Yashwant		Yes	No	Mechanical	F	
BAPAT, AKSHAY Surendra		Yes (EG)	Yes	Electronics		
Griffin, Sean		No	No	Mechanical		
Kannadasan, Gopinath	G13	No	No	Materials		Vedant, Rishabh rvedant@clemson.edu
Baburaj, Adithya		No	No	Automobile		
Khurana, Sunny		Yes	No	Mechanical		
Smriti, Aakanksha		Yes (B)	No	Mechanical	F	
Dossaji, Huzefa Z	G14	Yes (EG)	Yes	Two BSs - E and CS		Yelne, Akash ayelne@clemson.edu
Bhat, Prathamesh G		Yes (B)	Yes	Mechanical		
RAVIKUMAR, AVINASH		No	No	Mechanical		
Panda, Pritish		Yes (B)	No	Automobile		

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Team Assignments

Paul, Sumit S	G15	Yes (B)	Yes	Automobile		
Bhide, Shubham Shirish		No	No	Mechanical		
Augustine, Ajay Jeeves		No	No	Mechanical		Gulanikar, Ajinkya
Ala, Pardha Sai Krishna		Yes	No	Mechanical		Aajinkyg@clemson.edu
Rathi, Rishabh Rakeshkumar	G16	No	No	Mechanical		
Thomas, Gian St.Clair Enoch		Yes	Yes	Electrical		
Shakeel Ahamed, Faiz Ahamed		Yes (B)	Yes	Mechanical		Yelne, Akash
Uma Maheswaran, Sachin Ganesh		Yes (B)	No	Mechanical		ayelne@clemson.edu
Patheria, Akil	G17	No	No	Mechanical		
Bachuwar, Sanket Milind		Yes (B)	No	Mechanical		
He, Yong		Yes (B)	No	Mechanical		James Sternburg
Tilve, Kaushik M		Yes (EG)	Yes (EG)	Electronics		sternbe@g.clemson.edu

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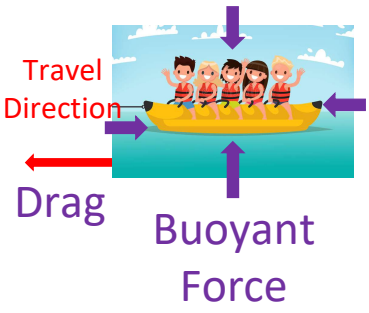
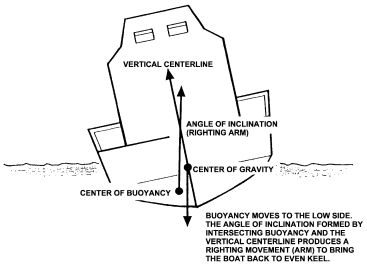
Factors to Consider for Design

Estimate the weight of all your electronics that go into making you boat autonomous

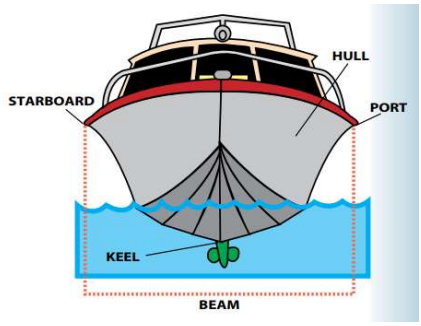


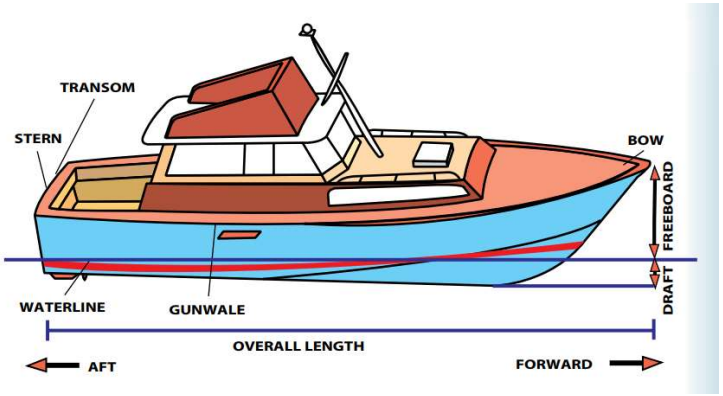
Calculate Forces Acting on Boat



Keep in Mind
Center of gravity and center of buoyancy

Parts of a Boat





Types of Boat Hull

Hull: The main body of the boat (link)

Hull	Shape	Type	Advantage	Disadvantage
Flat-Bottom		Planing	Has a shallow draft Good for fishing in small lakes & rivers	Ride roughly in choppy waters
V-shaped		Planing	Has a smoother ride than flat-bottom	Takes more power to move May roll in sharp turns
Round-Bottom		Displacement	Moves easily even at slow speeds	Tends to roll (needs deep keel of stabilizer)
Multi-Hull		Displacement	High stability because of wide beam	Needs large area when turning

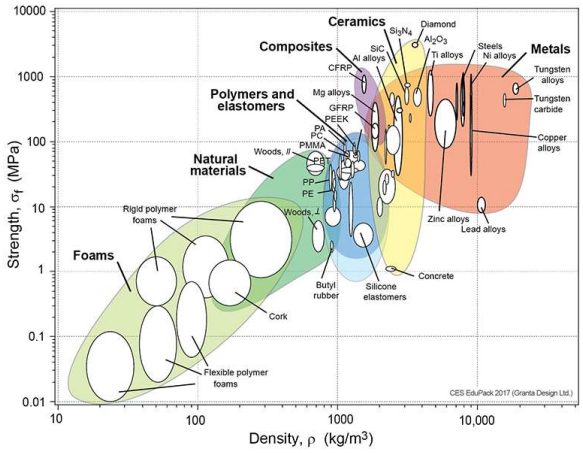
Boat Plans

See some boat plans and building instructions:

1. Toy Making Plans (link)
2. Boat Plans & Tutorial (link)
3. Tug Boat (link)
4. Stitch & Glue Boatbuilding (link)
5. Lewis Boat Work (link)
6. Simplicity Boats (link)

Popular Materials for Boat Building

Material Selection



Select your material with Care !!!

Wood

- Traditional boatbuilding material, widely popular
- Widely available
- Reasonable price
- Relatively light for its strength
- Widely available designs
- Basic skills only required (easy to learn)
- Simplest tools required for DIY boatbuilding
- Easy to shape as required
- Absorbs moisture; rots at 20% moisture
- Has to be protected by painting/varnishing
- Easy to repair (with basic skills)

Wood

GRP (Glass-Reinforced Plastic)

- Fiberglass and resins such as polyester and vinylester
- High price
- Heavy material; requires substantial thickness for higher strength
- Basic skills easy to learn
- Very easy to shape into any form
- No painting required
- Minimal maintenance for as long as the gelcoat is intact
- Easy to patch; Main problem cracked gelcoat
- Color included in the gelcoat
- Lifespan typically 10-15 years

GRP (Glass-Reinforced Plastic)

Aluminum

- Marine grade aluminum (6063) is mainly used in the hull
- Relative high price
- Light and strong
- Specialized metal-working skills and welding equipment required
- No painting required for protection
- Minimal to no maintenance required
- Relatively easy to patch or change any part
- Main problem electrolysis damage (needs protection; sacrificial anode)

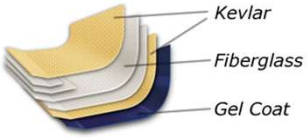
Aluminum

Steel

- Largely available (not as much as wood) with reasonable price (much lower than aluminum)
- Most basic metal-working and welding skills required
- Easy to shape into any form
- Surface preparation and high quality painting essential
- Regular periodic paint renewal required
- Main problem rust
- Because of its heavy weight, typically used for large boats
- Lifespan forever, for as long as rust is kept away

Composites

- Plastics reinforced with fibers (rather than glass)
- Fiber cloth includes Kevlar, carbon fiber, Dynel, etc.
- Resin includes epoxy, polyester, vinylester
- High strength-to-weight ratio
- Perfect for lightweight hulls with complex shape
- Less specialized tools and skills than metallic boats



Composites (Kevlar)

Composites (Carbon Fiber)

Possible Resources

McMASTER-CARR

HOBBY LOBBY

Fibre Glast Developments Corporation

amazon

MetalsDepot

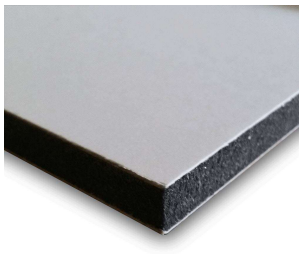
THE HOME DEPOT

Gary Mathis

There is always Scrap !

Possible Resources

Suggested Materials



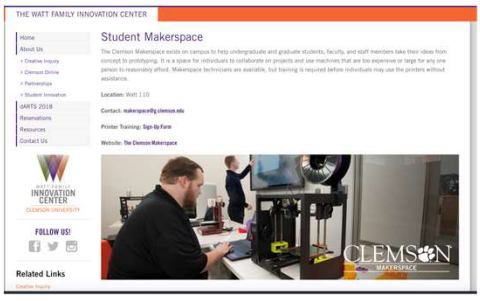
Styrene Faced Foam Board

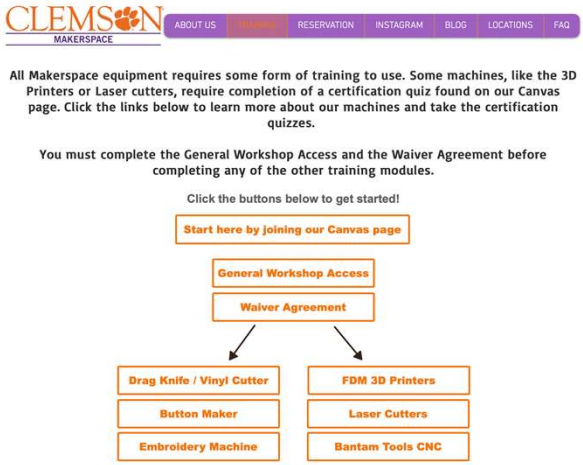
Foam board sandwiched between two thin plywood sheets

Pool Noodles

Possible Resources

3 D Printing





Possible Resources

When all else Fails !