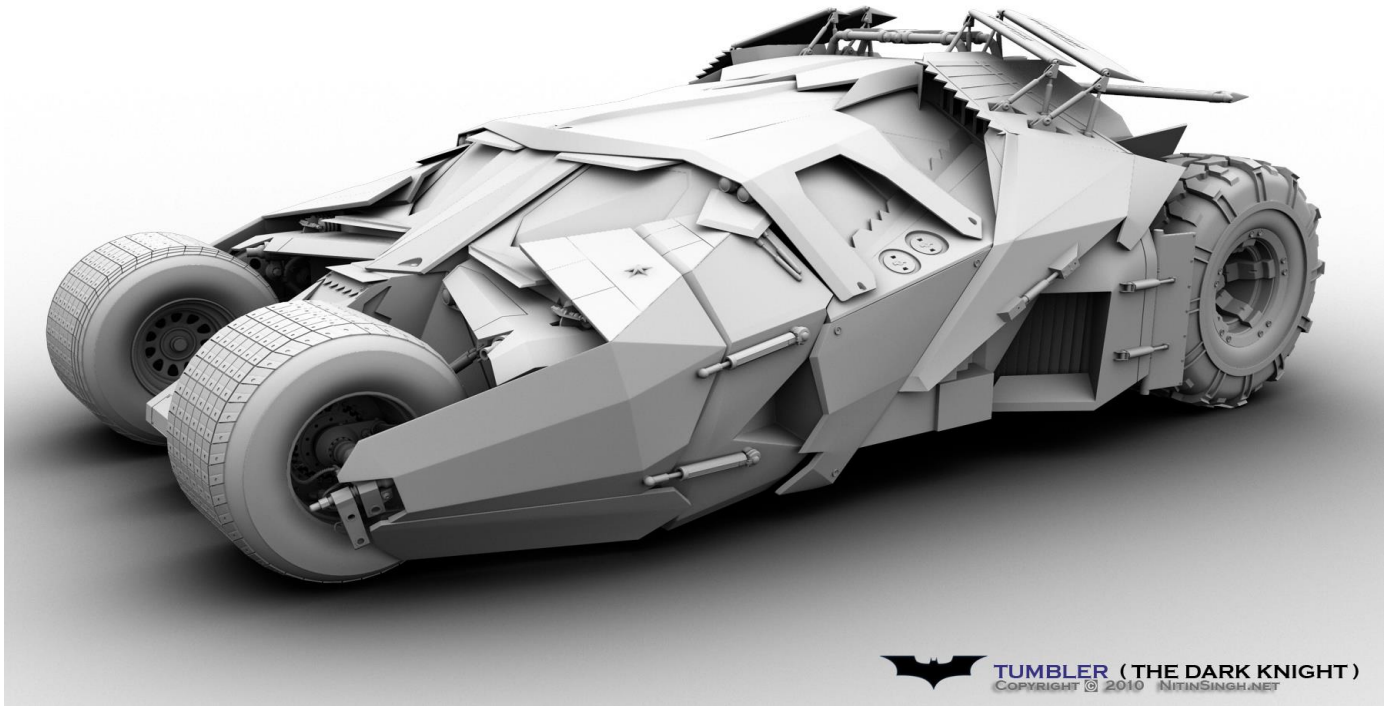
ENGINEERING METALLURGY LAB
TA201 (2015-16)



Project Name: BATMOBILE

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कर्मण्येवाधिकारस्ते मा फलेषु कदाचन।
मा कर्मफलहेतुर्भूर्मा ते सङ्गोऽस्त्वकर्मणि॥ २-४७

You have the right to work only but never to its fruits.
Let not the fruits of action be your motive, nor let your attachment be to inaction.
(Bhagvad-Gita 2:47)

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ACKNOWLEDGEMENTS

We sincerely express our gratitude towards our Tutor **Mr.Miritunjay Kumar**, Teaching Assistants **Mr. Bhupindrer Kumar Dangi** and **Mr. Mohit Sanbui,** our Engineering metallurgy Lab in-Charge **Mr. Anil Kumar Verma**, and all the other guides of the TA201 lab for their valuable support and advice in the making of this project. Without their moral and technical support we would not have been able to complete such a difficult task. We would also like to take this opportunity to thank our instructor **Dr. Anish Upadhyaya** and the institute wholeheartedly for providing us with the chance to create something creative along with gaining hands-on-laboratory experience.

GENERAL DESCRIPTION

The **Batmobile** is Batman's personal automobile and primary mode of transportation. It has appeared in almost every Batman iteration, including comics, movies, and television and has since gone on to be a part of pop culture. Kept in the Batcave accessed through a hidden entrance, the heavily armoured, gadget-laden, unmanned/remotely operated vehicle is used by Batman in his crime-fighting activities. We have pursued to make a scaled–down model of the same using the techniques learnt during the course "TA201: Manufacturing Processes I".

Motivation

After going through a lot of ideas (being science-fiction fanatics), which included rotating buildings, ironman helmet, panzer tank, etc., we finally decided to go through with our current project on 'Bat Mobile'. The main reason was that this was never attempted before and we felt we could definitely go down this road which was less travelled by and complete the job successfully. We thought this was a project that would allow us to demonstrate the skills we have picked up in our labs along with giving us enough opportunity to show our innovation.

We assumed that this project was neither too easy for our skill set and neither too hard that we end up not completing it. In hindsight, this was a correct assumption.

Innovation

We did some slight modifications in the original model to complete the project effectively using the available lab facilities and in constrained time.

- We generated a few sheet metal parts separately so that they are easier to fold and shape.
- We skipped many small parts which required precision tools to be manufactured as initially we had less idea about practicality of manufacturing methods.
- The wheel assembly was difficult to scale from the real model so we introduced our own new and simple axle and sleeve using only available hollow pipes and restricted front wheels from disconnecting by deforming the given pipe into a cone.
- We developed our own method to slide the top for entering and exiting the vehicle.

PROCEDURE

- We developed the exact geometry of our sheet development over the specified sheet material.
- Simultaneously were constructed Styrofoam (thermocol) models of the wheels and were casted.
- Next part involved cutting out the aforementioned development using Shear-Cutter followed by folding the sheet parts appropriately, as indicated on the sheet development.
- This was followed by assembling the folded sheet metal parts and joining them using soldering, riveting and brazing techniques.
- First to be made was the box-shaped chassis over which sheet-metal panel were laid.
- Next step was to join the mild-steel axles and exhaust pipe to the sheet-metal frame, by brazing or welding (as per the requirement).
- Following this, the cast iron wheels were mounted on the wheels.
- Finally we oiled the model and the project was ready.

PROCESSES

- **Sheet metal -** The main chassis is made of combination of Mild Steel sheet of 0.5mm and Galvanized Iron sheet of 0.35mm depending on strength requirement and 3 dimensional geometry.
- **Casting -** Objects that require higher precision, more skill and much strength are casted by using sand mould lost-foam casting process.
- **Brazing -** This joining process was used to join Galvanized Iron sheets and fill minor gaps (<0.1mm).
- **Welding -** MMAW and MIG were used to weld mild steel and cast iron parts.
- **Riveting -** Overlapping sheet metal parts of thickness less than 1mm are riveted over each other as it is durable, semi-permanent and economic joining method.
- **Miscellaneous -** Soldering was used to temporarily fix G.I parts with each other, Filing was done to smoothen sharp and dangerous edges to prevent damage, sprue, and riser were grinded to remove extra uneven material from the model.

COST ESTIMATION

MATERIAL USED	VOLUME/ AREA/ LENGTH USED	COST per unit (₹)	TOTAL COST (₹)
0.35mm GI sheet	2.2641 sq. ft.	20 per sq. ft.	45.282
0.5mm MS sheet	0.9754 sq. ft.	26 per sq. ft.	25.360
Cast Iron	4 kg	55 per Kg	220
MS round pipe (12.7mm dia.)	0.229 ft.	14 per ft.	3.206
MS round pipe (10mm dia.)	0.952 ft.	10 per ft.	9.520
MS round rod (8mm dia.)	0.328 ft.	16 per ft.	5.248
Rivets	10	0.12	1.20
Thermocol	0.3659 sq. ft.	12 per sq. ft.	4.3908
TOTAL MATERIAL COST OF PROJECT			314.4968

LABOUR	₹ 45 per hr.	90 hrs.	₹ 4050

TOTAL MATERIAL COST OF PROJECT	₹ 314.50
TOTAL LABOUR COST OF PROJECT	₹ 4050.00
TOTAL COST OF PROJECT	**₹ 4364.50**

DIFFICULTIES FACED

DIFFICULTIES	SOLUTIONS
Mounting the front wheels.	A thin rod of 8mm dia. was used to mount the wheels with the chassis.
Opening the Upper Gate.	We used a simple sliding mechanism to open the gate.
Inner surface of front wheels was too rough and asymmetric to roll.	We added a thin sleeve to connect the wheels properly.
Joining MS sheet with GI sheet	They are riveted together if overlapped and brazed if any other type of joint.

GALLERY