

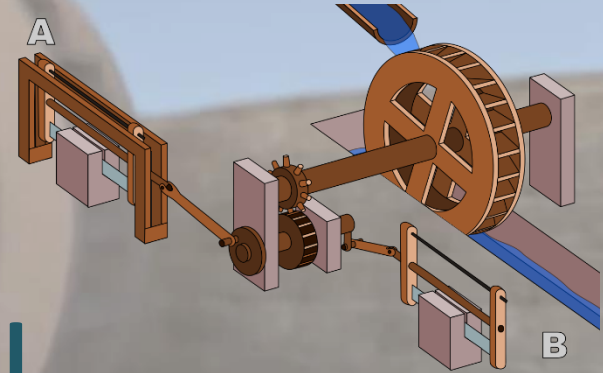


# **TA 201P- Introduction of Manufacturing Processes-I**

## **DESIGN PROJECT**

**SEC-10 GROUP-4**

## **ROMAN SAWMILL**



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# INTRODUCTION

The Roman sawmill is a sophisticated machine which consisted of a reciprocating saw powered by a waterwheel .

Dating to the 3<sup>rd</sup> century AD , the sawmill is considered the earliest known machine to combine a crank with a connecting rod to form a crank slider mechanism.

It could cut large amounts of wood or stone, which is then used in variety of industries such as furniture , thereby saving enormous amounts of efforts and labour work .

Many of the principles used in construction of Roman mills are applied to the designs of modern mills today.

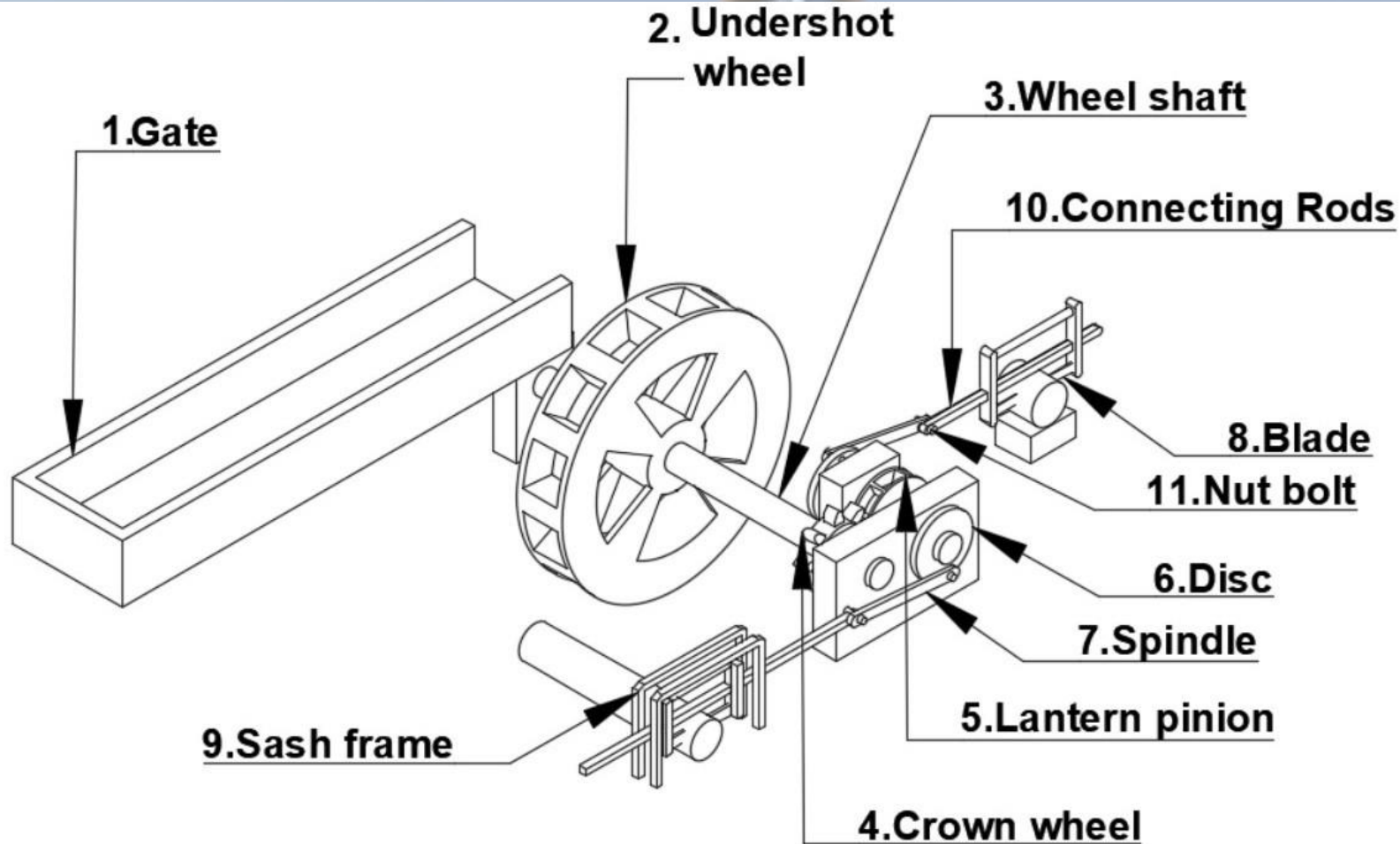
# MOTIVATION

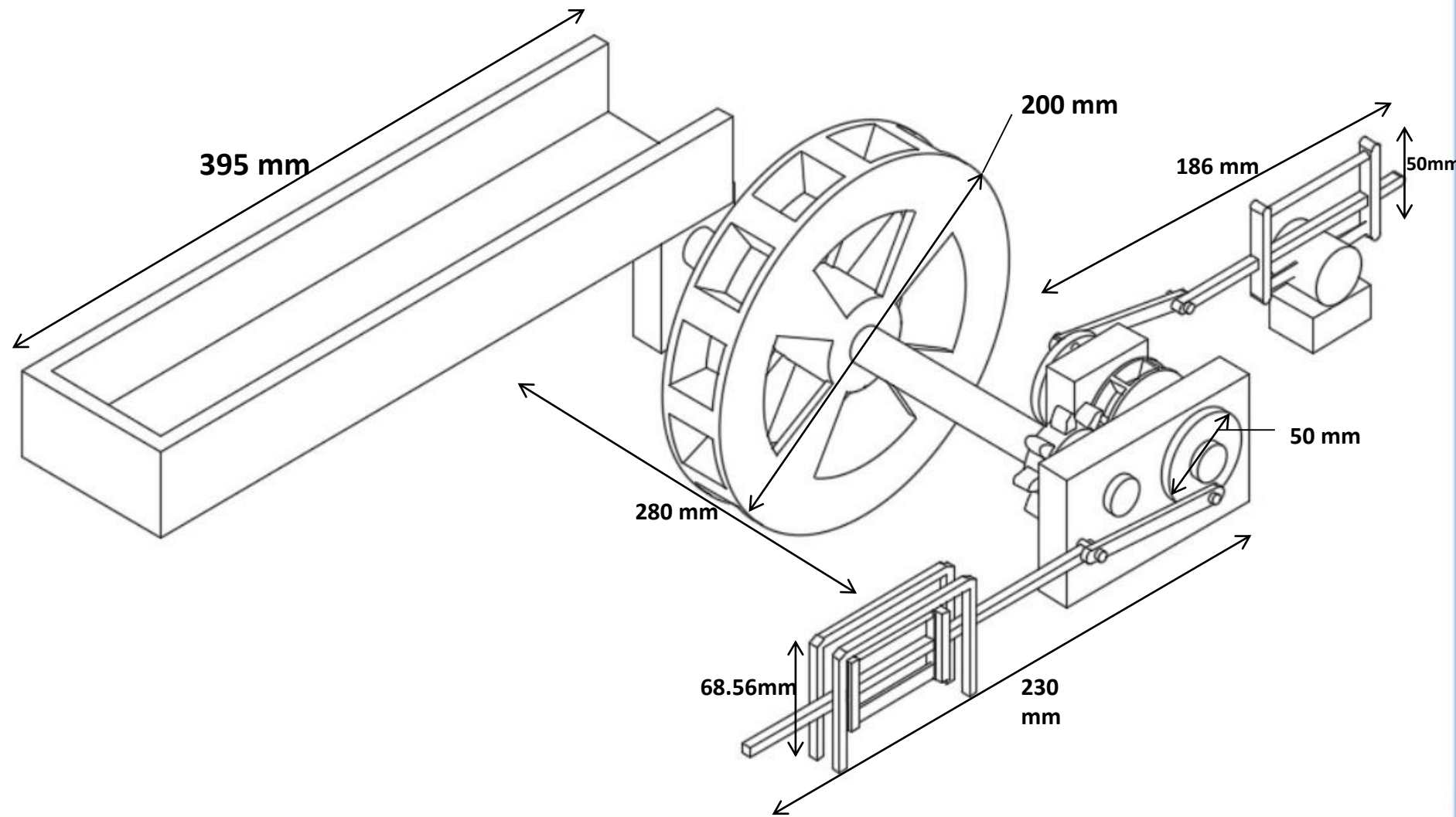
Our motivation for the project revolved around the fact that we wanted to come up with something unique and revolutionary. We looked on the internet for design ideas that fit our goals and project parameters and our search led us to one of the tools that drove the Industrial revolution and has played a huge amount of role in transforming our lives, **“ROMAN SAWMILL”**.

Wood cutting before this invention was a tremendous task which was carried in manually but with the creation of this revolutionary sawmill the process was highly simplified.

Over the years with improving technology, the functioning of this sawmill has been improved tremendously but we choose to present the earliest Roman sawmill that actually started the revolution and that what makes our project unique.

# ISOMETRIC DRAWING

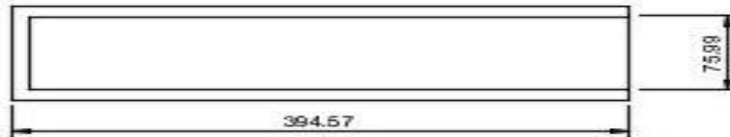
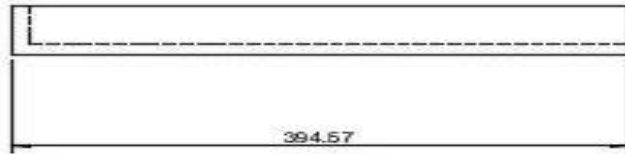






# Individual Components

## 1. Gate



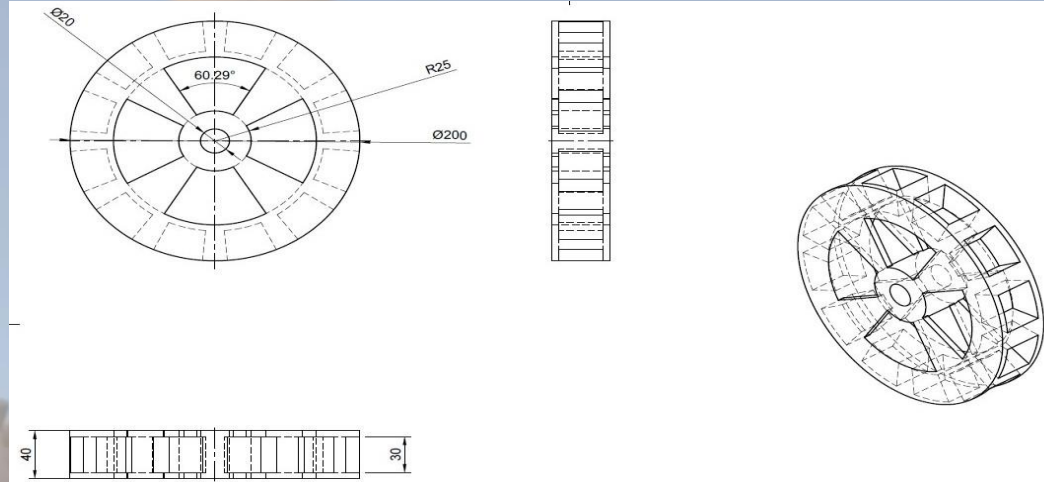
**Materials Used : Mild Steel Sheet**  
**Manufacturing process : Sheet metal cutting**  
**Joining process : Braze Welding**  
**Quantity : 1**



# Individual Components

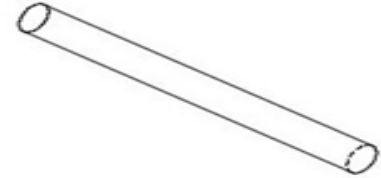
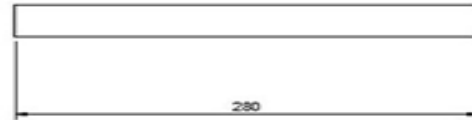
## 2. Undershot wheel

- **Material Used :** Galvanized Iron Sheet (3 ft x 8 ft x 0.35mm)
- **Manufacturing processes :** Sheet metal cutting and Bending , Drilling .
- **Joining processes :** Arc Welding
- **Quantity :** 2



## 3. Wheel Shaft

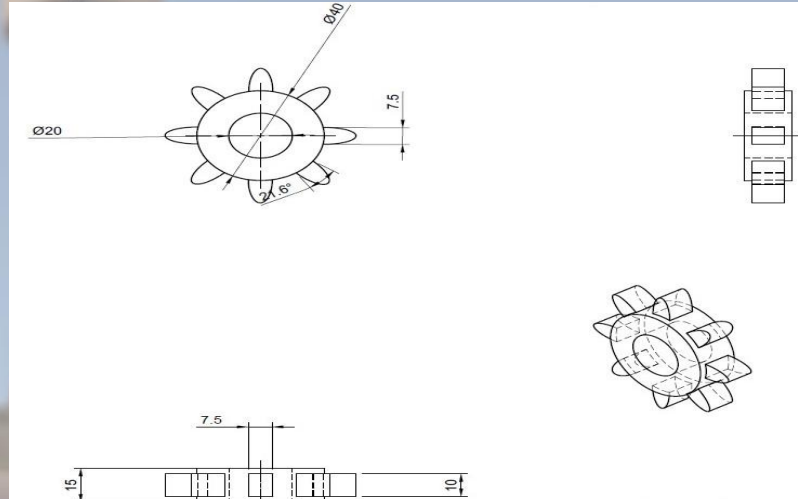
- **Materials used :** Mild Steel Round Rod (25 mm diameter)
- **Manufacturing processes :** Sheet metal cutting and Bending .
- **Joining processes :** Mechanical Fastening
- **Quantity :** 1



# Individual Components

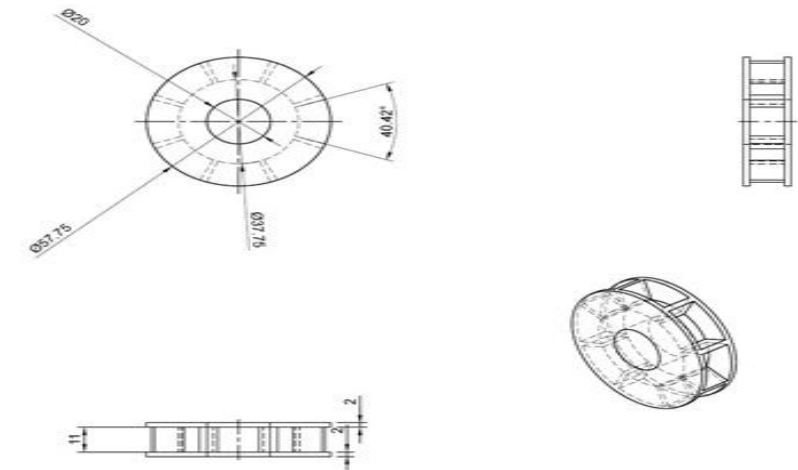
## 4. Crown wheel

- **Materials Used : Aluminum**
- **Manufacturing processes : Sand Mold Casting**
- **Joining processes : Adhesive Bonding**
- **Quantity : 1**



## 5. Lantern Pinion

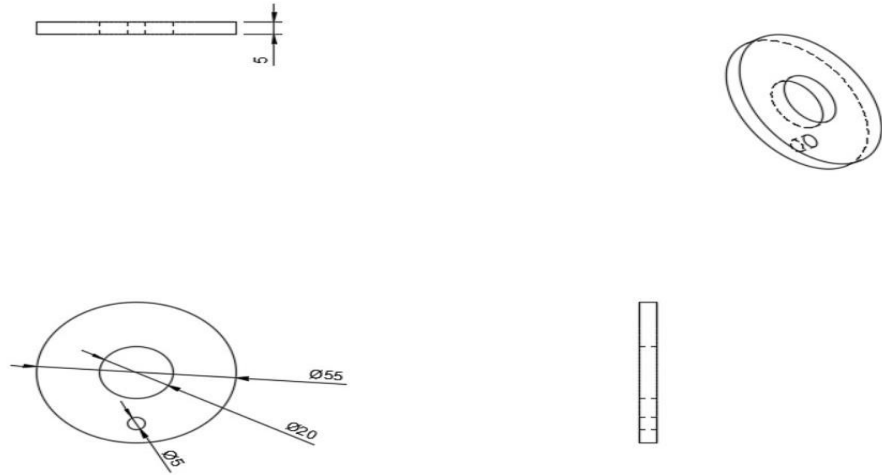
- **Materials Used : Aluminium**
- **Manufacturing Processes : Sand Mould Casting**
- **Joining Processes : Adhesive Bonding**
- **Quantity : 1**



# Individual Components

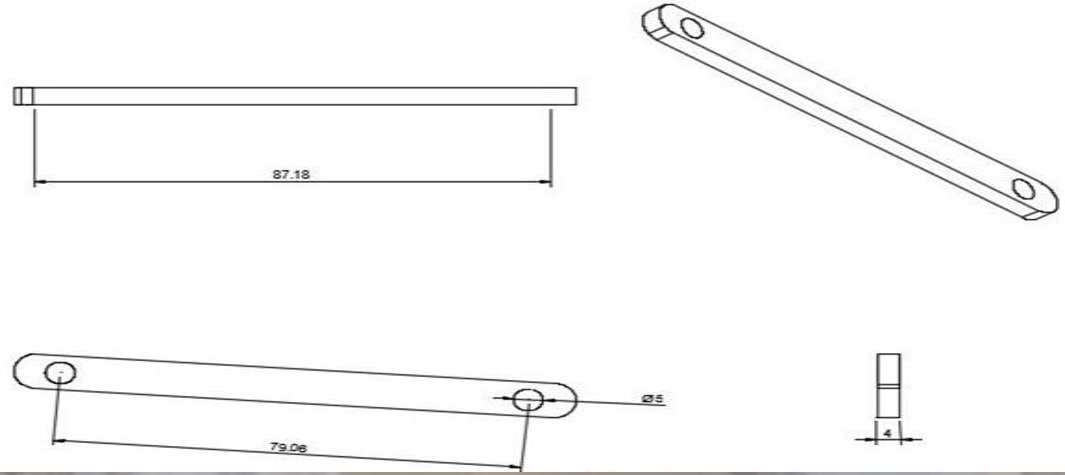
## 6 . Disc

- **Materials Used :** Mild Steel Disc (20-50 mm diameter x 5mm thick)
- **Manufacturing Processes :** Sheet metal cutting
- **Joining Process :** Arc Welding
- **Quantity :** 2



## 7. Spindle

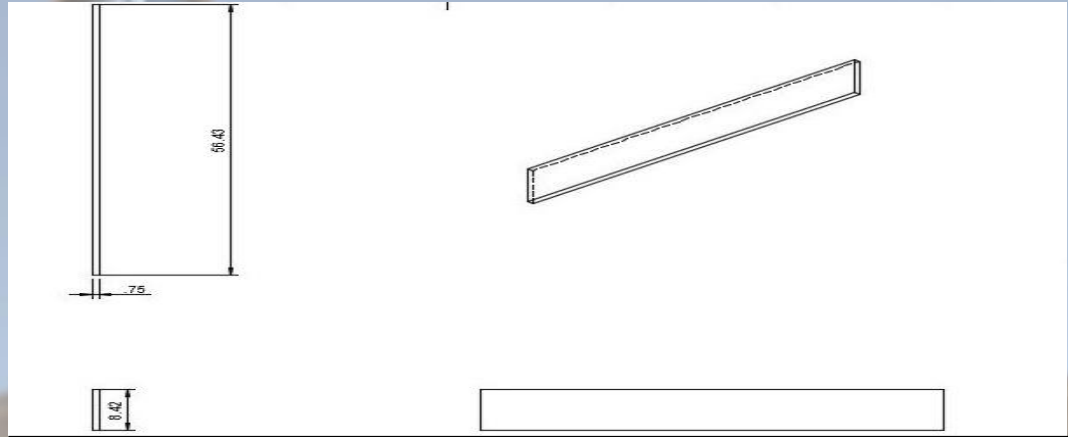
- **Materials used :** Cast iron – is a group of iron-carbon alloys with a carbon content more than 2%.
- **Manufacturing processes :** Sand  
Mold Casting
- **Joining Processes :** Mechanical  
Fastening
- **Quantity :** 2



# Individual Components

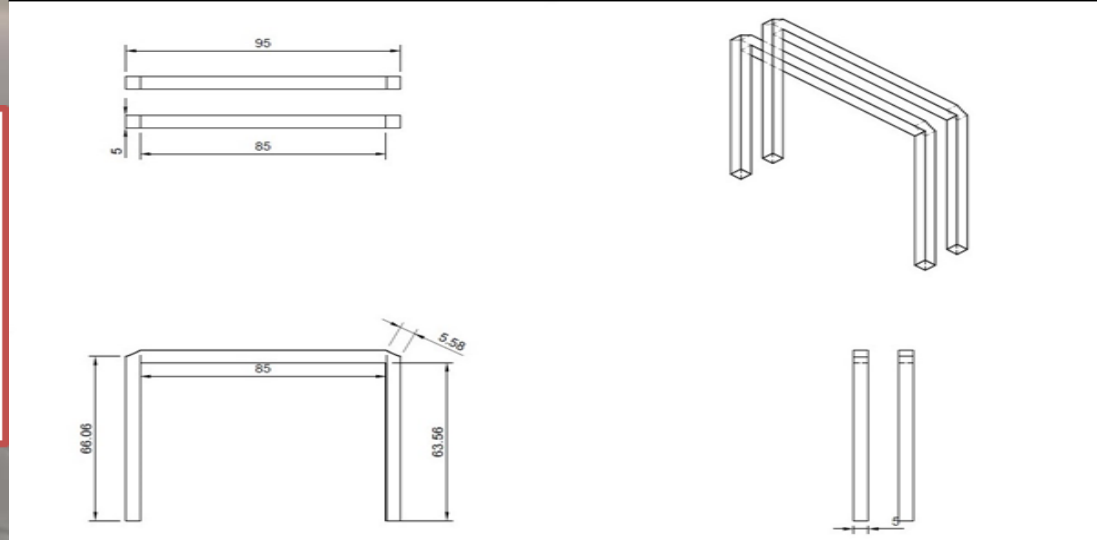
## 8 . Blade

- **Material used : Mild Steel Sheet**
- **Manufacturing Processes: Cutting and Rubbing on Whetstone**
- **Joining Processes : Braze Welding**
- **Quantity : 2**



## 9. Sash Frame

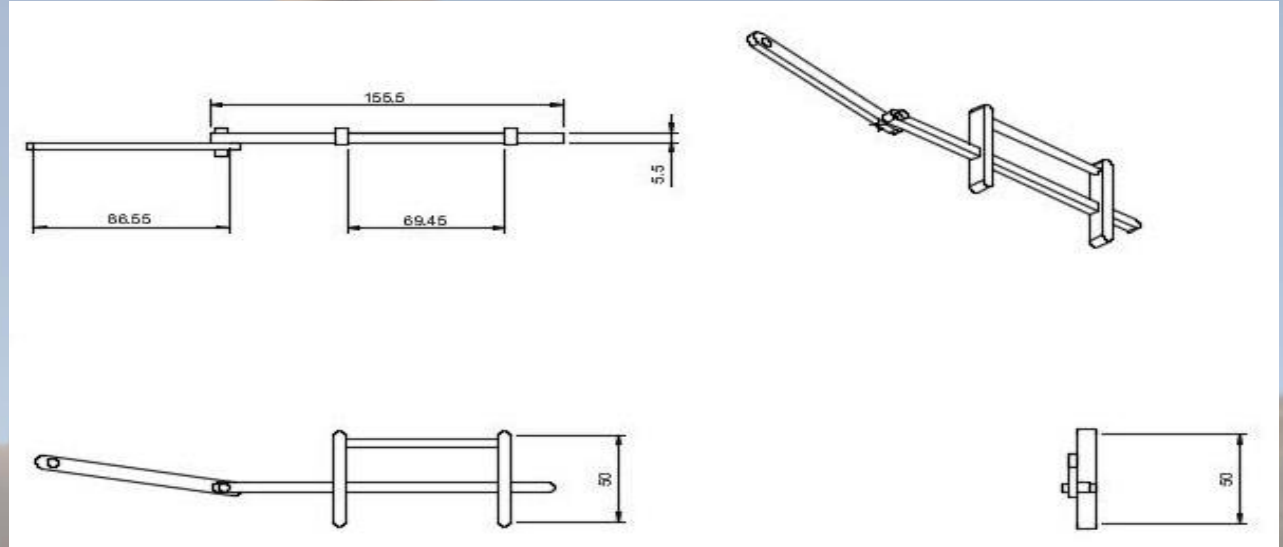
- **Materials used : Mild Steel Square Rod**
- **Manufacturing Processes : Sheet Metal Cutting and Bending**
- **Joining Processes : Arc Welding**
- **Quantity: 6**



## Individual Components

### 10. Connecting Rods

- Material Used : Mild Steel Square Rod
- Manufacturing Processes : Sheet Metal Cutting and Bending
- Joining Processes : Arc Welding
- Quantity : 5



### 11. Nut Bolt with Washer

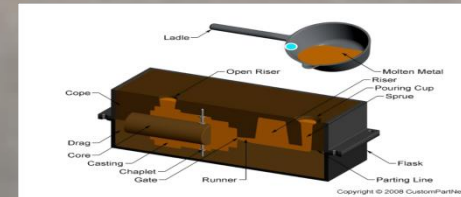
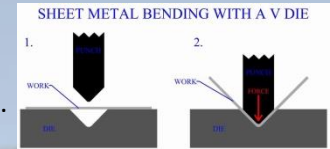
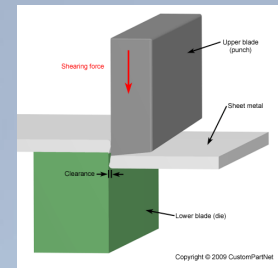
Materials Used : Nut-Bolt with Mild Steel Washer  
Manufacturing Processes : NA  
Joining Processes : Mechanical Fastening  
Quantity : 4

## Material List

- **Mild Steel**
  - It is used for different coating and cutting methods and has good weld ability. It has good physical properties and for producing frames, panels ,etc.
- **Galvanized Iron Sheet**
  - It prevents premature rust and corrosion. It is used to construct or repair steel structures. It has benefit from lower maintenance and repair costs because of its special properties.
- **Aluminum**
  - It is an extremely versatile metal. It is light weight , flexible and corrosion resistance. It is odorless , impermeable and it has recyclability.

# Manufacturing Processes

- **Sheet Metal Cutting** : # Cutting processes are those in which a piece of sheet metal is separated by applying a great enough force to cause the sheet to get separated into various parts.
  - # The most common cutting process is the shearing operation which is performed by applying a shearing force normally by cutting along a line.
  - # We have used for : Gate ,Under shot wheel ,Wheel Shaft ,Disc ,Sash frame and connecting Rods
- **Bending** : # Bending is a process by which metal can be deformed by plastically deforming the material and changing its shape.
  - # The material is stressed beyond the yield strength but below the ultimate tensile strength.
  - # The surface area of the material does not change much. Bending usually refers to deformation about one axis.
  - # We have used for : Under shot wheel, Wheel shaft , sash frame and connecting rods.
- **Sand Mold Casting** : # Sand casting, also known as sand mold casting, is a metal casting process characterized by the use of sand as the mold material.
  - # The term "sand casting" can also refer to an object produced via the sand casting process.
  - # Sand castings are produced in specialized factories called foundries.
  - # Over 60% of all metal castings are produced via sand casting process.
  - # We have used for : Crown Wheel , Lantern pinion , Spindle
- **Drilling** : # Drilling is a cutting process that uses a drill bit to cut a hole of circular cross-section in solid materials.
  - # The drill bit is usually a rotary cutting tool, often multi-point.
  - # The bit is pressed against the work piece and rotated at rates from hundreds to thousands of revolutions per minute.
  - # This forces the cutting edge against the work piece, cutting off chips from the hole as it is drilled.
  - # We have used for : Under shot Wheel

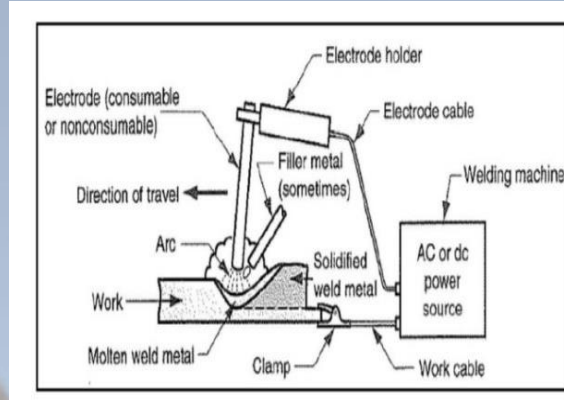




# Joining process

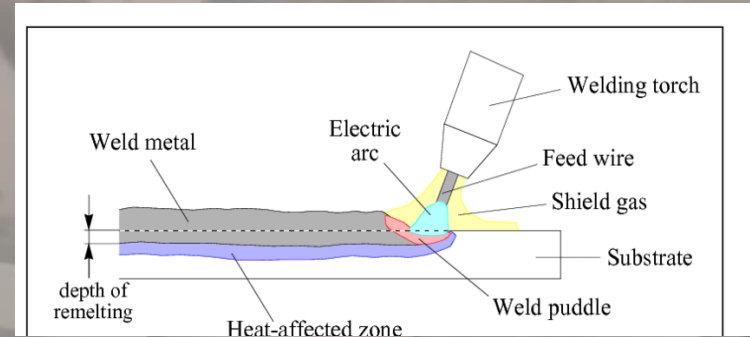
**Arc Welding :** Arc welding is a fusion welding process used to join metals. An electric arc from an AC or DC power supply creates an intense heat of around 6500°F which melts the metal at the joint between two work pieces. Once cooled, the molten metals solidify to form a metallurgical bond.

# We have used Arc Welding for : Under shot wheel , Disc , Sash frame, Connecting Rods.



**Braze Welding :** Brazing is a metal-joining process in which two or more metal items are joined together by melting and flowing a filler metal into the joint, with the filler metal having a lower melting point than the adjoining metal.

# We have used Braze Welding for : Gate , Blade



- Adhesive Bonding :**
- Adhesive bonding is a joining technique used in the manufacture and repair of a wide range of products. Along with welding and soldering, adhesive bonding is one of the basic joining processes.
  - In this technique, components are bonded together using adhesives.
  - The broad range of types of adhesives available allows numerous materials to be bonded together in products as diverse as vehicles, mobile phones, personal care products, buildings, computers and medical devices.

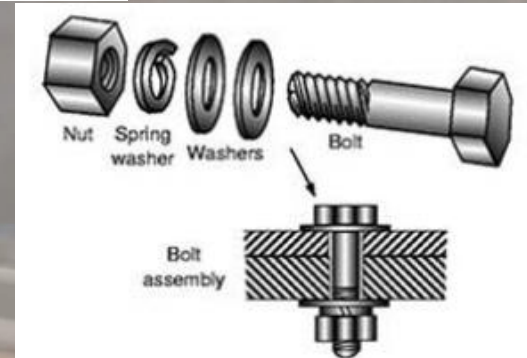
# We have used Adhesive Bonding for : Crown Wheel , Lantern pinion



**Mechanical fastening :**

Mechanical fastening is the most common method of joining many materials within the industry. Originally used for metal joining, it is also well established for joining plastics to themselves and to other materials. Screws are examples of nonpermanent fasteners since they can be removed, replaced, and reused.

# We have used Mechanical fastening for : Wheel Shaft , Spindle ,  
Nut bolt with washer



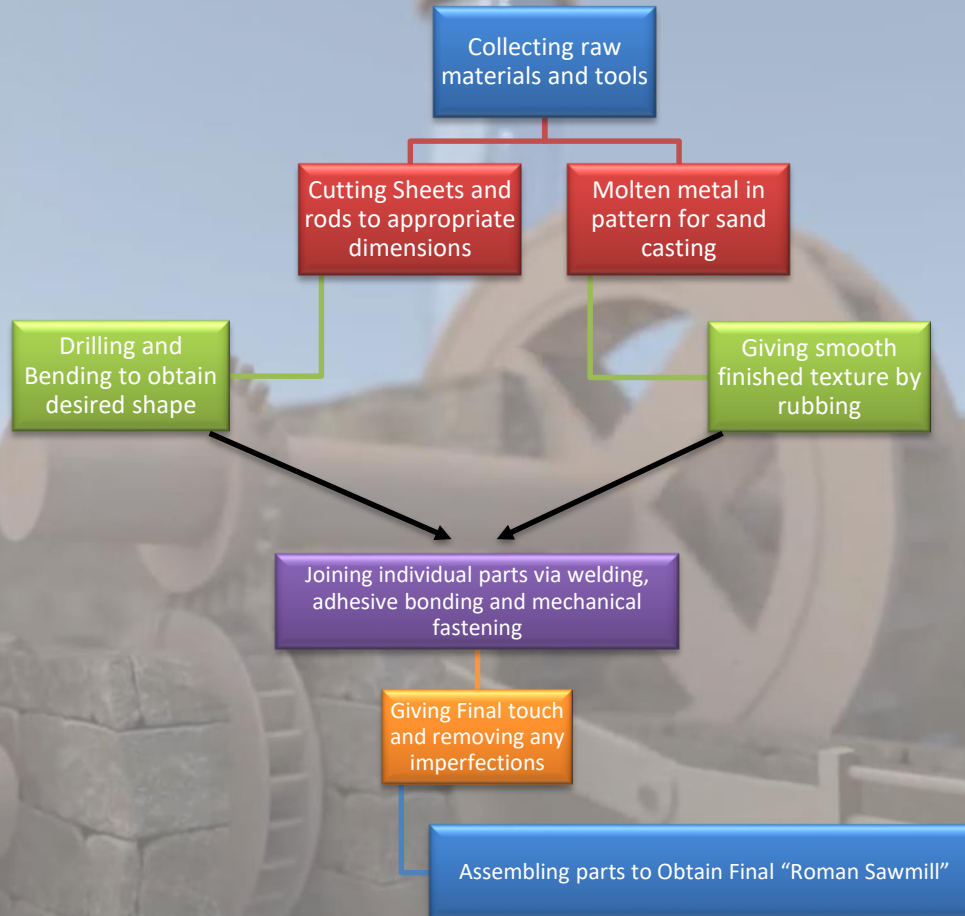
## Cost Analysis

Sr.no	Part Name	Quantity	Materials used	Rate	Dimension	Cost
1.	Gate	1	Mild Steel Sheet (0.7mm thick)	Rs.1058/sheet	(396x77)mm	Rs.839
2.	Undershot wheel	2	Galvanized Iron	Rs.756/sheet	250 x 45 mm x 0.35mm	Rs.381.7
3.	Wheel Shaft	1	Mild Steel Round Rod	Rs.65/kg	285 x 25 mm	Rs.71
4.	Crown wheel	1	Aluminum	Rs.380/kg	0.06kg	Rs.23
5.	Lantern Pinion	1	Aluminum	Rs.380/kg	0.038kg	Rs.14.5
6.	Disc	2	Mild Steel Disc	Rs.20/disc	20-50mm dia x 5mm	Rs.40
7.	Spindle	2	Cast Iron	Rs.75/kg	0.036kg	Rs.2.8
8.	Blade	2	Mild Steel Sheet	Rs.945/sheet	56.43mm x 8.42mm	Rs.5
9.	Sash Frame	6	Mild Steel Square Rod	Rs.63/kg	66 x 95mm	Rs.23
10.	Connecting Rods	5	Mild Steel Round Rod	Rs.70/kg	0.59kg	Rs.38.5
11.	Nut Bolt with washer	4	Nut-bolt with Mild steel Washer	Rs.10/pc	4	Rs.40

**Grand Total = Rs. 1,478.5 ≈ Rs 1500**

S.N O	PARTS	MANUFACTURING PROCESS	JOINING PROCESS	MATERIALS REQUIRED	COST ANALYSIS
1	GATE	Sheet Metal Cutting	Braze Welding	Mild Steel Sheet	Rs.839
2	UNDER SHOT WHEEL	Sheet Metal Cutting, Bending and Drilling	Arc Welding	Galvanized iron sheet	Rs.381.7
3	WHEEL SHAFT	Sheet metal cutting, bending	Mechanical Fastening	Mild steel round Rod	Rs.71
4	CROWN WHEEL	Sand Mold Casting	Adhesive Bonding	Aluminum	Rs.23
5	LANTERN PINION	Sand Mold Casting	Adhesive Bonding	Aluminum	Rs.14.5
6	DISC	Sheet Metal Cutting	Arc Welding	Mild Steel Disc	Rs.42
7	SPINDLE	Sand Mold Casting	Mechanical Fastening	Cast Iron	Rs.2.8
8	BLADE	Cutting and Rubbing on whetstone	Braze Welding	Mild steel sheet	Rs.5
9	SASH FRAME	Sheet Metal cutting and Bending	Arc Welding	Mild Steel Square Rod	Rs.23
10	CONNECTING RODS	Sheet Metal Cutting and Bending	Arc Welding	Mild Steel Square Rod	Rs.38.5
11	NUT BOLT		Mechanical fastening	Mild Steel Washer	Rs.40

# FLOWCHART



# SUSTAINABILITY

## 1) Mild steel sheet:-

- i) **Physical and Chemical Properties** : Mild steel has high tensile strength and impact strength. It has good ductility & weld ability. A magnetic metal due to its content, good malleability with cold forming possibilities. Mild steel contains approximately 0.15% Carbon, 0.25-0.75% Silicon, 0.03% Sulphur, 0.015-0.06% Aluminum and 0.25-0.55% Copper.
  - ii) **Recyclable** : Steel is 100% recyclable, contains up to 25% recycled steel and is the easiest packaging in the world to recycle. It never loses its compositional integrity regardless of how many times it is.
- ## 2) Aluminum :
- Aluminum is the most environmentally friendly metal. Aluminum can be recycled infinitely to make the same product; that is why it has been considered one of the most valuable items in our recycling bin and ultimately the most recyclable industrial material.
- ## 3) Arc Welding :
- The arc joint is a firm joint. Arc welding increases pressure on the manufacturing sector and wants the welding process to be sustainable. There is a need to characterize the sustainability of the arc welding process under the broad framework of sustainability.
- ## 4) Galvanized Iron :
- The sawmill machine involves parts that come in contact with water. These parts are made of galvanized iron since in the long run that will be beneficial. If we had used say for example iron, then rusting would have been inevitable.



# **ACKNOWLEDGEMENT**

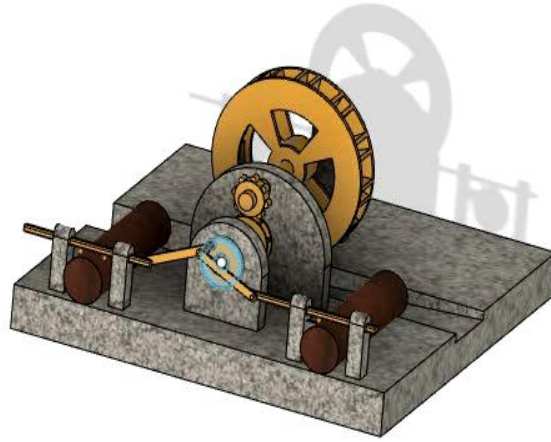
We would like to express our sincere gratitude to our tutor Mr. Tafzeelul Kamal and our lab-in-charge Mr. Indra Pal Singh who encouraged us to the highest peak and provided us the opportunity to prepare the project. Their support and direction was instrumental throughout the execution of the project. Our completion of this project could not have been accomplished without their guidance and supervision.

We would like to also thank our course instructor, Dr. Sudhanshu Shekhar Singh, for providing us with this opportunity to explore our talent and creativity through the lab manufacturing processes.



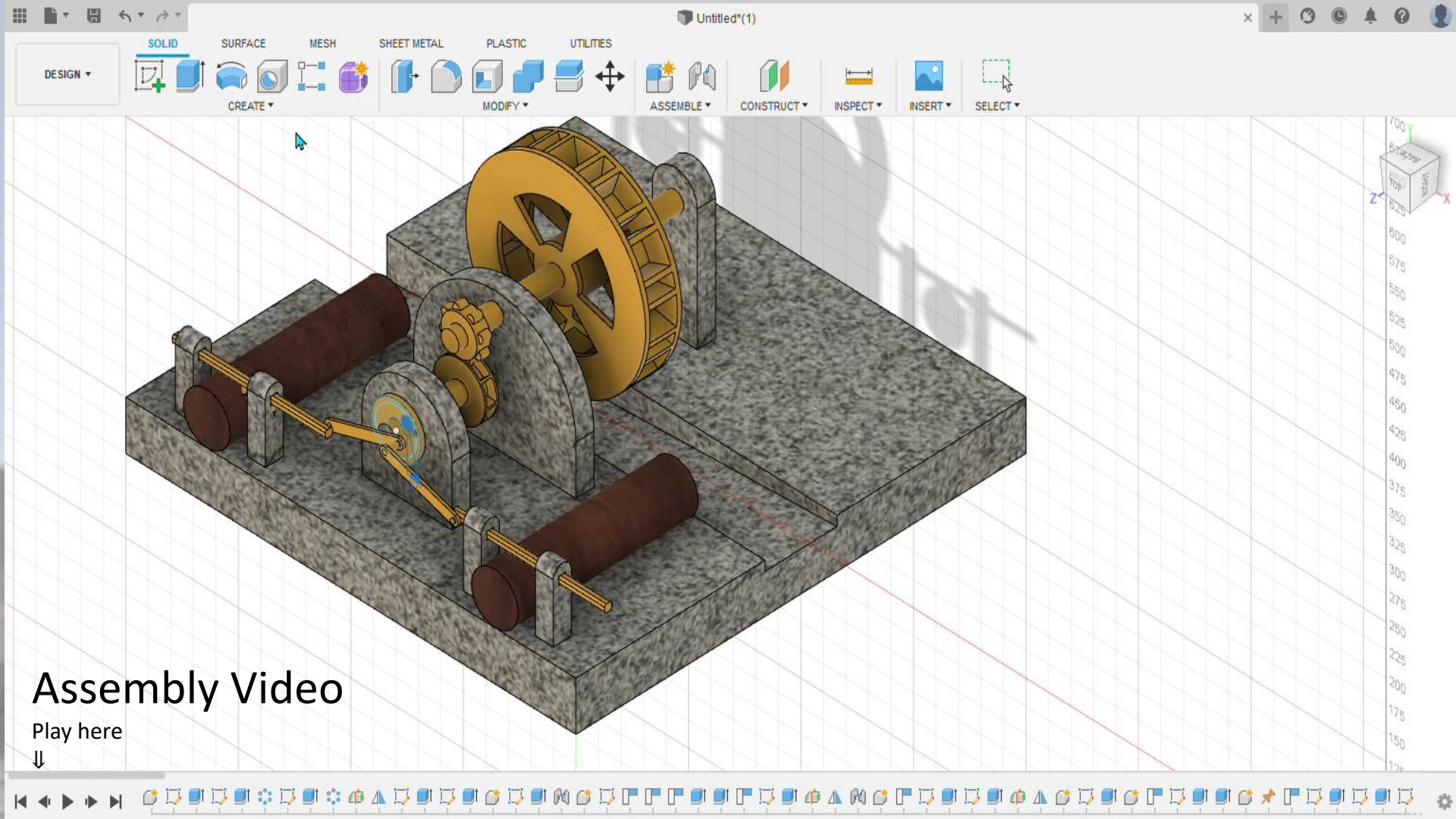
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# Final Assembly

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## Assembly Video

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