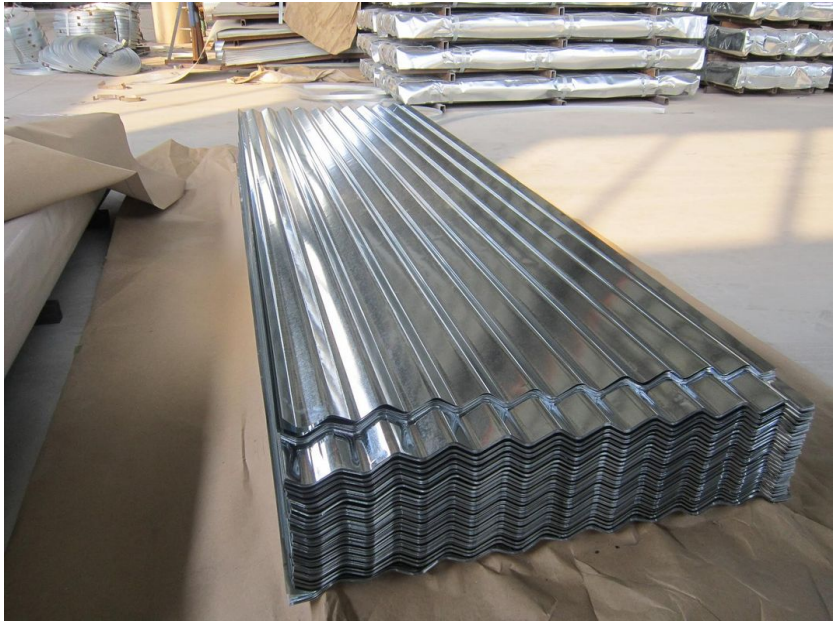
Sheet metal work

ENGINEERING WORKSHOP

Content:

Introduction to Sheet Metal Work

- The process of turning metal into thin sheets is called sheet metal. It is the most fundamental form of metal used in metal work as it can be bent, cut, pressed into our desired shape. Countless objects which we can see around us are fabricated from sheet metal work. **Sheet metal fabrication processes are those which alter a sheet's original shape to produce a drawn part of desired thickness**. It is the most basic form of metal work and it involves cutting bending and shaping sheets of metal to form a complete product. Metals commonly used for sheet metal work are: **Aluminum, Steel, Copper, GI sheet (galvanized iron sheet)**



Some tools used in sheet metal work are:

- Scriber
- Hand sear
- Mallet
- Hammer
- Center prick punch

Scriber

Hand sear

Hammer

Center Prick Punch

Try Scale

Sheet metal operation

Sheet metal operation

Measuring ,marking and laying out

- The very first step of any sheet metal process
- Tools used-scriber, steel rule, steel square

Shearing process

- Apply shearing forces to cut, or separate the material

Forming process

- Cause the metal to undergo desired shape changes without failure, excessive thinning or cracking

-This includes bending and stretching.

Finishing Process

Used to improve the final surface characteristics.

- Here are some common finishing techniques:

-Polishing: This is like shining your shoes or wiping a window until it's clear. Polishing involves smoothing the surface of the metal to make it shiny and reflective.

-Grinding: Grinding is like sanding wood to make it smooth. In sheet metal work, grinding involves using abrasive tools to remove any rough spots or imperfections from the surface of the metal.

-Coating: Coating is like painting a wall or applying a protective layer to your phone screen. In sheet metal work, coating involves applying a layer of paint, enamel, or other protective material to the surface of the metal to enhance its appearance and protect it from corrosion or other damage.

- **Measuring, marking, and laying out:**
- -First, measure the sheet metal accurately using tools like a scriber, steel rule, and steel square.
- -Then, mark the metal according to the required dimensions before proceeding with any operations.

- **Shearing process:**
- Shearing involves cutting or separating the metal along a strightline using shearing forces.
- It's like using a giant pair of scissors to cut the metal into desired shapes or sizes. Shearing process includes:

- **Punching:**
- A practical example for punching: Imagine you have a piece of paper, and you want to make holes in it to put it in a binder. You'd use a hole puncher to punch out those holes, just like how punching works in sheet metal to make holes for screws or bolts.
- Punching involves creating holes or shapes in the sheet metal using a punch and die set.
- The punch pushes through the metal, while the die provides support, resulting in a clean cut or hole.

Blanking:

- -A practical example for blanking: Think about cookie cutters!! When you use a cookie cutter to cut shapes out of dough, you're essentially blanking the dough to create individual cookies. Similarly, blanking in sheet metal is like using a cookie cutter to cut out shapes from a sheet.

- -Blanking is similar to punching but involves cutting out a flat piece of metal from a larger sheet.

- -The desired shape is cut out, leaving behind the scrap material known as a blank

- -Blanking is a manufacturing process used to cut out a flat shape from a sheet of material, typically metal. The process involves cutting the material around the perimeter of the desired shape, leaving behind the desired piece, called a blank, while the excess material, known as the scrap, is discarded. Essentially, blanking is like using a cookie cutter to cut out shapes from dough, but instead of dough, it's done with metal sheets to create specific parts or components.

- **Notching** : Notching is like making tiny cuts or grooves in the edge or corner of something, like a piece of paper or cardboard, to help it fit or function better. In sheet metal, notching means cutting small slots or grooves in the metal's edge or surface to make it easier to bend, fold, or connect with other pieces. It's like creating little tabs or slots that can interlock or hold other parts together neatly, kind of like puzzle pieces fitting together.

- **Parting**: Parting is like slicing or cutting something into smaller, separate pieces. In sheet metal, parting involves cutting a long piece of metal into shorter sections. It's similar to cutting a long rope into smaller pieces. Parting helps create individual parts or components from a larger sheet of metal, ensuring they are the right size and shape for whatever you're making.

- **Forming process**: Forming changes the shape of the metal without causing it to fail, become too thin, or crack.

Bending and stretching are common forming techniques used to shape the metal into curves, angles, or other desired shapes.

- **Bending:** This is like folding a piece of paper. It involves bending the metal along a straight line to create angles or curves.

- **Stretching:** Think of pulling and stretching a rubber band. Stretching in sheet metal involves pulling the metal to make it longer or thinner in certain areas, without tearing it.

- **Finishing**
- The finishing process is like adding the final touches to something to make it look and feel just right. In sheet metal work, finishing involves improving the surface characteristics of the metal to enhance its appearance, durability, or other properties.
- Here are some common finishing techniques:
- **Polishing:** This is like shining your shoes or wiping a window until it's clear. Polishing involves smoothing the surface of the metal to make it shiny and reflective.
- **Grinding:** Grinding is like sanding wood to make it smooth. In sheet metal work, grinding involves using abrasive tools to remove any rough spots or imperfections from the surface of the metal.
- **Coating:** Coating is like painting a wall or applying a protective layer to your phone screen. In sheet metal work, coating involves applying a layer of paint, enamel, or other protective material to the surface of the metal to enhance its appearance and protect it from corrosion or other damage.

RIVETS AND TYPES

RIVETS

- Rivets is a short cylindrical rod having a head and a tapered tail. The main body of a rivet is called shank.
- One of the earliest methods of fastening metal together and most popular choices in today's applications for it is known as the most reliable features.
- The rivets or used to make permanent fastening between the plates.

1. Solid Rivets

- These are the most widely used rivets, commonly called round rivets. They are easy to use, dependable, and have the oldest form of connecting materials.

2. Blind/Pop Rivets

- A blind rivet is a tubular rivet with a head and a mandrel through its center. You must insert the blind rivets into an already drilled hole in the parts meant to be joined. Then, use a rivet gun or unique tool to push the mandrel ivet.

3. Drive Rivets

- Drive rivets have a mandrel through their center, identical to blind rivets. However, drive rivets require using any unique tool to draw the mandrel through the rivet. It only needs a hammer and probably a backing block to get the mandrel into the rivet body and fasten the parts.

4. Self-Piercing Rivets

- These rivets do not require drilling a hole in a material before use. Self-piercing rivets can make a hole in materials using their chamfered poke or bevel drill. They pierce the material’s topmost layer, leaving the lower layer half-pierced. An upsetting die makes the rivet’s tail spread and interlocks into the base sheet, creating a low-profile button.

5. Split Rivets

- Split or bifurcated rivets are similar to self-piercing fasteners. Th are your go-to option for joining soft materials like wood, plastic and leather. As a result, they are not ideal for critical application but are suitable for home repair work.

6. Tubular Rivets

- Tubular rivets are generic tubular rivets with a head, shank, and partially hollow tube. They are of varying configurations, usually available with a head on one end and a hollow side. The hollow side passes through any piece that needs to be joined. Manufacturers join the field head to the hollow side using the cold forming technique.

7. Flush Rivets

Flush rivets are also called countersink rivets. They are best used on external surfaces to ensure an attractive appearance and avoid aerodynamic drag. It comprise countersunk heads and holes making it suitable for finished metal surfaces requiring minimal visibility. They are functional tools for aerodynamic applications due to their flush appearance.

RIVET JOINT AND TYPES

RIVET JOINT

- When two plates join by the rivets is called rivet joint.
- The rivets joint is used for joining light metals.
- Rivets joints strength is lower than bolts.
- Rivets joints are used in industry application and aircraft industry.
- Rivets joint is permanent fastener to joint the plates.

TYPES OF RIVETS JOINT

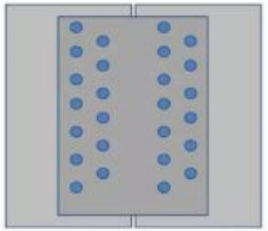
There are two types of riveting joints.

- **Lap joint**

1. Single rivet lap joint
2. Double rivet lap joint

- **Butt joint**

1. Single strap butt joint
2. Double strap butt joint

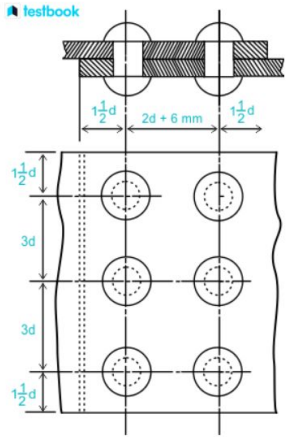


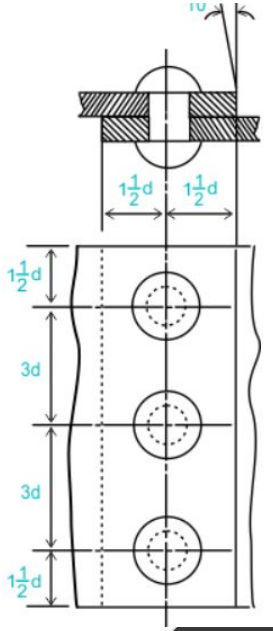
Zig-Zag Riveting Butt Joint

TYPES OF RIVETS JOINT

- **Lap joint**

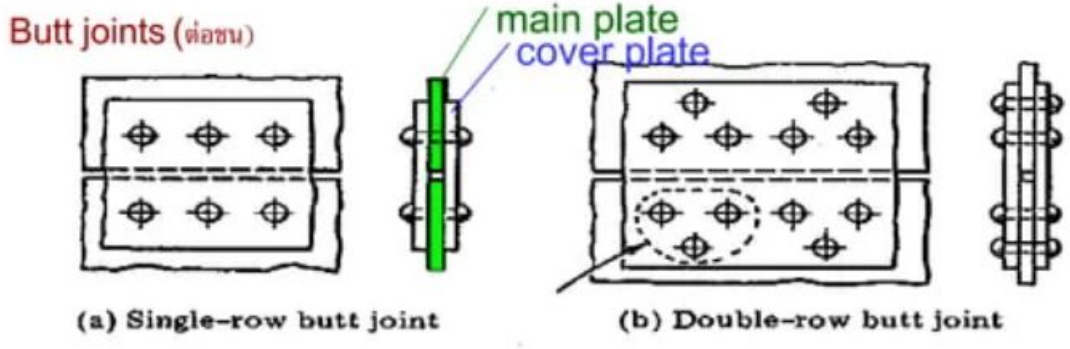
A lap joint is that in which one plates overlaps the other and two laps are riveted together.





TYPES OF RIVETS JOINT

- A butt joint is that in which the main plates are kept in alignment touching each other and cover plate is placed either one side or on both side of the main plates



Advantages of Rivets

Cost Effectiveness
Rivets are a cheap alternative to welding and metal adhesives. They save the cost of electricity that is required in large amounts for welding connections. There is no need for any special materials for the connection, unlike welding, which uses a hot metal adhesive to connect the steel members. The small size of the rivets allows transportation of larger quantities at once, thus saving the cost of transportation too.

Durability
Solid steel rivets are highly durable. They are resistant to corrosion, moisture and even chemicals. Most of the rivets used in steel construction are made out of highly resistant metals and alloys such as galvanized steel, nickel, titanium and aluminum-based alloys, which increases the tolerance to high pressures and shear load. The anti-corrosive properties also increase the life of the part being joined together.

Disadvantages of Rivets

More Work Force
Riveting requires more workforce. A total of 4 people are required to complete the process. The buck-tail of the rivet is supposed to be heated until its red hot. One person is required to stand between the riveting position and the person who is heating up the rivets. The red-hot rivets are then passed on to the people fitting the rivets. Two people are required to hold the rivet in place and hammer it with full force to deform it and seal it from both the sides. This increases the cost of manpower required.

Structural Weight
Let’s go back to the Eifel Tower. The 10,000 tons of weight is the result of 2.5 million rivets. Rivets are fully metal parts with their own weight. They surely do weigh higher than the welding joints. This adds extra weight to the structure you're building. It can be a hindrance to the efficiency of rivets as they might even sometimes get affected by the weight of other riveting joints.

Lack of Aesthetic Finish

- Welded joints have a more finished touch to their appearance. The welded area cannot be easily noticed even from a short distance. Welders grind the excess material from the joints and keep it in level with the two adjoining parts. On the other hand, rivets can be seen from far off and protrude from the steel structure. It decreases the aesthetic appeal of the structural design.

APPLICATION OF RIVETS

TRAIN ENGINE FRONT SIDE

RIVETING IN AIRCRAFTS

RIVETING USED IN EIFFEL TOWER

REVIT USED IN BUCKET

RIVET USED IN DOOR HANDLE

APPLICATIONS OF RIVETS

- **Aerospace industries**: To join sheet metals of aero plane parts and as panel fasteners in rockets.
- **Mechanical Industries**: To join two non-weldable metals like aluminum and steel (carbon or stainless steel), aluminum and copper, and titanium and steel together. Also used in the assembly of boiler shells.
- **Construction**: Assembly of the arch, truss, suspension, cable-stayed, and beam bridges. It is also used in the construction of metal-framed buildings.
- **Automobile**: Assembly of railway wagons and coaches, buses, and trucks.
- **Kitchenware:** Riveted joints are extensively used in kitchen utensils like cookers, knives, etc.

HOW DOES RIVET WORK?

- Rivets are a fundamental tool used to construct several machines and structures. The general working principle of a rivet requires drill bits to punch a hole in parts while you install the rivets in a hole and deform the tail. This process is relatively straightforward and practical.

- The preformed head of a rivet is a “factory head,” while a new head known as the “shop head” is created after inserting the rivet in the components that need joining. The rivet’s tail transforms into a shop head after you deform it with a hammer. This process is called upsetting or buckling. It expands the rear causing it to hold the rivet in place firmly.

A Stepwise Guide to the Riveting Process

- Step 1: You need to determine the suitable rivet for your parts. It would be best to consider factors such as the ideal rivet material, type, and size to do this successfully.

- Step 2: The next step is determining where to install the rivet on your parts. It will help to ensure the efficient joining of the materials or components.

- Step 3: You must drill a hole precisely 1.5 mm more than the rivet diameter you want to install.

- Step 4: Insert your rivet in the hole drilled through the materials you want to join together.

- Step 5: When you install the rivet, the tail/shank comes out at the opposite end of the part where you will deform it.

- Step 6: Once you hammer the tail, it flattens the material making the tail spread about one and a half its actual size. More importantly, ensure the rivet's bottom is identical to the workpieces to complete the riveted joint.

METHOD OF RIVETING

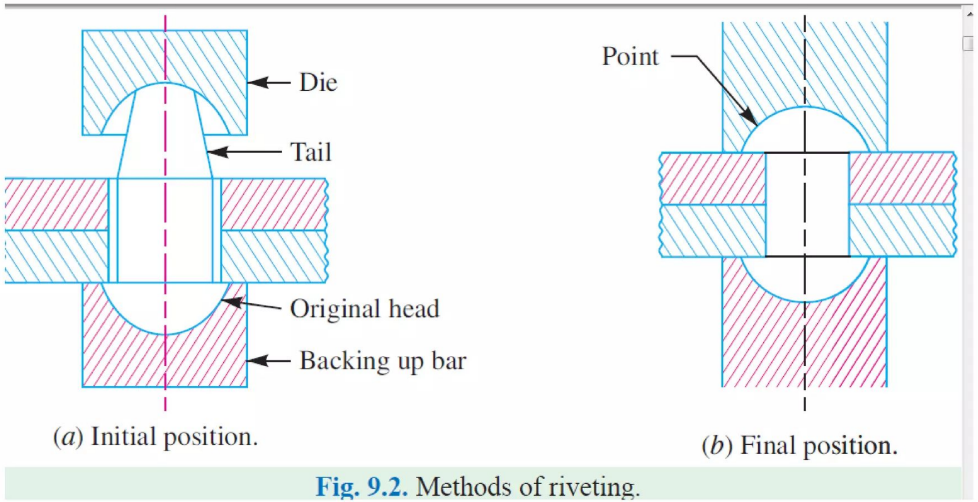


Fig. 9.2. Methods of riveting.

Types of Riveting(Temperature)

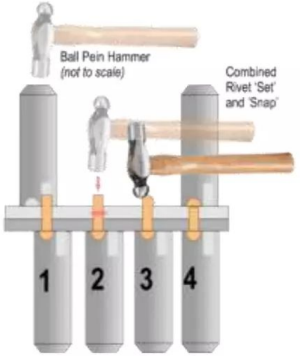
- On the basis of temperature at which protruding portion of rivets are hammered, riveting can be grouped into two categories: hot riveting and cold riveting.

- In hot riveting, the rivet end is heated by some external means (like flame heating) before hammering. Heating temperature lies around 2/3rd of melting point of the rivet material. Due to such heating, the material becomes soft and plastic and thus lower upsetting force is required. So when rivet material is hard, like stainless steel, hot riveting is preferred as lower force is required. It is also favorable for large diameter rivets, usually diameter larger than 10mm. Thermal expansion of rivet due to heating also has important role in gripping strength.

- On the contrary, cold riveting is performed at room temperature only. Here rivet is not heated and thus hammering is carried out at room temperature. So comparatively higher force is required for upsetting; however, no heat source is desired for heating rivets. Heating time is also not associated with it, so the process is comparatively faster. However, if rivet diameter is large or it is made of stronger material, then large amount of hammering force is desired. Various differences between hot riveting and cold riveting are given here in table form.

INSTALLATION –

1 .AIR HAMMER METHOD –



STEP 1 -MARK RIVET HOLES

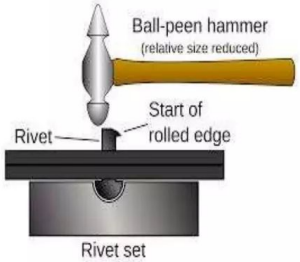
MARK HOLES WHERE THE RIVETS SHOULD GO ,THEY SHOULD BE SPACED EVERY COUPLE OF INCHES FOR THE BEST HOLDING POWER

STEP 2 - DRILL RIVET HOLES

RIVET HOLES ARE DRILLED , THE DIAMETER OF HOLES ARE MADE BIGGER THAN THE SIZE OF RIVETS

STEP 3 – INSERT RIVETS INTO HOLE

ONCE HOLES ARE DRILLED ,BEGAN TO INSERT THE RIVETS



STEP 4 – USE AIR HAMMER

ONE PERSON IS NEEDED TO HOLD THE BUCKING BAR AT END OF SOLID REVIT TO EASILY HAMMER IT ONTO THE FLAT SURFACE

Types of Riveting Methods

2. RIVET GUN METHOD

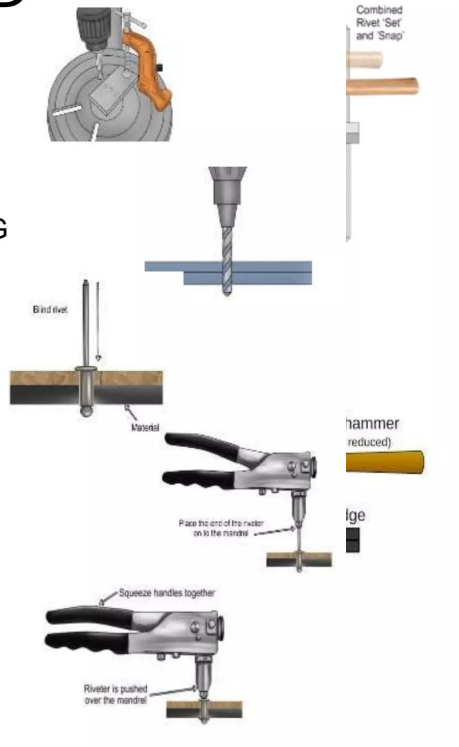
STEP 1 - CLAMPING MATERIAL
CLAMP THE PIECES OF MATERIAL TOGETHER, MAKING SURE THE THEY ARE IN LINE WITH

STEP 2 - DRILLING MATERIAL
ONCE THE MATERIAL IS CLAMPED AND IN PLACE, USING THE RIGHT SIZED DRILL BIT, DRILL THROUGH THE MATERIAL TO PRODUCE A HOLE FOR THE RIVET TO SLO THROUGH

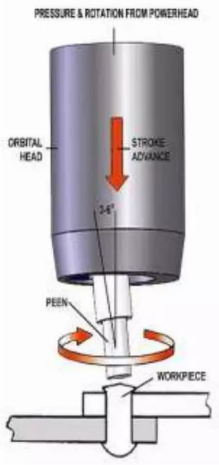
STEP 3 - PLACING RIVET
PLACE THE PIN OF THE RIVET THROUGH THE DRILLED HOLE SO THE HEAD AND MANDREL ARE UPPERMOST

STEP 4 - PLACING RIVETER
PUSH THE NOZZLE OF THE RIVETER ONTO THE MANDREL OF THE RIVET

STEP 5 - USING RIVET GUN
SQUEEZE THE HANDLES OF THE RIVETER TOGETHER. THIS WILL PULL THE HEAD OF THE MANDREL INTO THE RIVET, CAUSING THE END OF THE RIVET TO EXPAND



3.HYDRAULIC REVATING



STEP 1 – DRILLING

THE STEEL SECTION IS PIERCED BY A DRILL MACHINE TO CREATE HOLES AT A DEFINITE DISTANCE

STEP 2- HEATING OF RIVET

THE RIVET IS HEATED UPTO A TEMPERATURE OF 800- 900° C AND THEN IS PLACED IN THE PIERCED HOLE

STEP 3 – USE OF HYDRAULICS

THE RIVET IS PRESSED ON BOTH ENDS BY HYDRAULIC MACHINE WITH A HEMISPHERICAL HOLLOW WEDGE
ON BOTH ENDS DUE TO WHICH THE RIVET IS FIXED ON BOTH ENDS

Conclusion

- From this presentation we all learned what are sheet metal, how to work with sheet metal, tools required for sheet metal work, there operations, what are rivet, there types and there uses. We also learned the advantages and disadvantage of sheet metal work.

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