For measuring the deformation occurring in the specimen the dial indicator is provided on the apparatus.

There are two indicators are provided on the apparatus. The first one is used for testing low strength sands (moulding sands) and the second one is used for testing high strength sands (core sands).

The same apparatus is also used for testing the tensile strength, shear strength, transverse strength, etc. of sand.

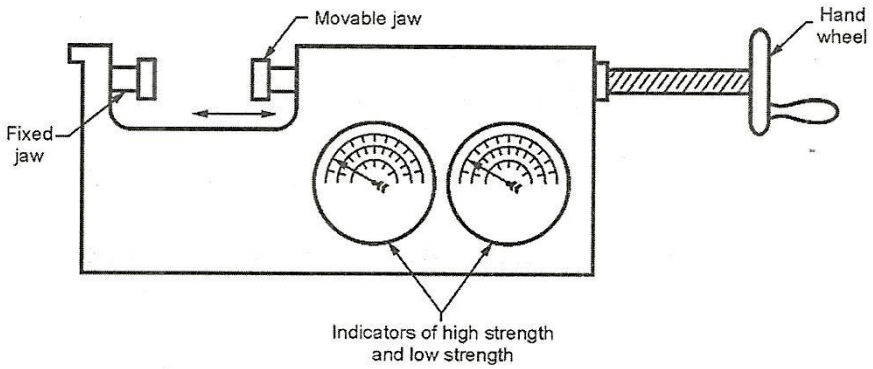


Figure 1.18 Compression Strength Testing Equipment

1.12 Core

Core is a sand shape or form which makes the contour of a casting for which no provision has been made in the pattern for moulding. Core may be made up sand, plaster, metal or ceramics. Core is an obstruction which when positioned in the mould, does not permit the molten poured metal to fill the space occupied by the core hence produce hollow casting. Cores are used as inserts in moulds to form design features which are difficult to be produced by simple moulding.

Functions of core

Core provides a means of forming the main internal cavity for hollow casting.

Core provides external undercut feature.

Cores can be inserted to obtain deep recesses in the casting.

Cores can be used to increase the strength of mould.

It can be used as a part of gating assembly.

It can form a part of green sand mould and can also be used to improve the mould surface.

Essential characteristics of core

A dry sand core must possess following properties:

It should have sufficient strength to support itself without breaking.

It should have high permeability and high refractoriness.

It should have smooth surface to ensure a smooth casting.

It should have high collapsibility, to assist the free contraction of the solidifying metal.

It should have those ingredients which does not generate mould gases.

Core applications

Core and its form increases the versatility of moulding processes and operations. In addition to recess forming and holes in the casting, cores are used as follows:

- Cores are used for mould making.
- Cores can be used as strainer, gates and pouring cups.
- Cores are used for increasing production from match plate pattern.
- Cores can be used as core mould in centrifugal casting process.
- Also it can be used as slab core for increasing casting output from one mould.

1.12.1 Core Sand and its Ingredients

Core sand is a sand mixture suitable for cores.

Core sand mixture consists of sand grains, binders for green and cured strength and other additives used for special purposes.

The commonly used core sand mixture consist of sand, 1% core oil, 1% cereal and 2.5 to 6% of water.

Core sand is almost similar to moulding sand but the main difference is that core sand has very low clay content and larger grain size.

Large grain size assures higher permeability.

Core sand ingredients

Core sand ingredients or core materials are as follows:

(a) Granular refractories:

Some of the commonly used granular refractories are:

- Dry silica sand
- Carbon
- Zircon
- Olivin
- Chamotte

(b) Core binders

A core binger is used to, Hold sand grains together. Give strength to cores. Make the cores erosion resistant. Impact adequate collapsibility to cores. Core binders are of following types:

- Organic binders (core oil, cereal, pitch, woodflour, synthetic resins, etc.)
- Inorganic binders (fire clay, bentonite, silica flour, iron oxide, etc.)
- Other binders (cement, sodium silicate, etc.)

(c) Water

In a core sand mixture, water content may vary from 3 to 7%. Binders and additives work only when moisture is present. Correct amount of water develops good green strength, edge and scratch hardness, good tensile strength, etc. Excessive amount of moisture adds difficulties in making and baking of cores.

(d) Additives

The additives used for core sand are almost similar to moulding sand, hence Refer section 1.9.4.

1.12.2 Core Making

Core making basically consists of following steps:

1. Core sand preparation
2. Core making
3. Core baking
4. Core finishing or dressing
5. Setting the cores

1. Core sand preparation :

Core sand preparation is similar to moulding sand preparation. Refer section 1.10.

2. Core making :

Small cores can be made manually in hand rammed core boxes. Cores on mass scale are rapidly produced on various core making machines which are,

- Jolt machine
- Shell core machine
- Core blower
- Sand slinger
- Core rollover machine
- Core extrusion machine

3. Core baking :

After the cores are prepared they are baked in baking furnace where the moisture is removed from the core.

In the green state, cores have round shape hence they are placed on the core plate for baking, where they tend to flatten.

The special shapes, which support the green sand cores having curved surfaces, are known as core driers.

After supporting on the core drier, they are sent to ovens for baking.

The core oven may be batch type or continuous type.

4. Finishing of cores :

After baking cores are given certain finishing operation before they are finally set in the mould.

The fins and other sand projections are removed from the sand surface of the cores by rubbing or filling, to bring them to correct dimensions and to provide a good surface finish.

The cores are also coated with refractory or protective materials to improve their refractoriness.

The surface may be coated with heat resistant paint.

Core coating materials are finely ground graphite, silica and zircon flour.

Finally core assembling is done; it means two or more parts of the core are joined together by pasting, welding or bolting before the core can be set in the mold.

5. Setting the cores

Core setting means placing cores in the mould. To obtain correct cavities in the casting, the cores should be accurately positioned in the moulds.

1.13 Types of Cores

Various types of cores of different designs and sizes are used in different ways in foundry work. A general way of classifying them is, according to their shapes and positions in the prepared moulds. Their main types are as follows:

1. Horizontal core 2. Vertical core 3. Hanging core
4. Balanced core

1. Horizontal core

A horizontal core is positioned horizontally in the mould. Refer Figure1.19.

According to the shape of the cavity required in the casting, a horizontal core may have any shape.

Uniformly sectioned horizontal cores are mostly placed at parting line.

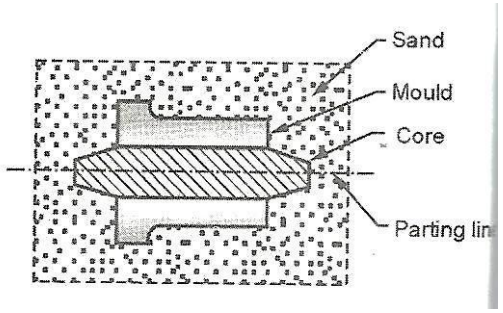


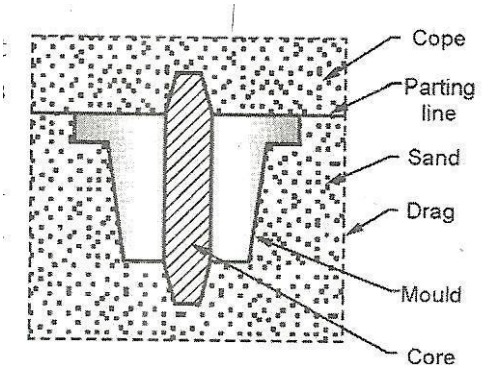
Figure 1.19 Horizontal Core

2. Vertical core

It is similar to horizontal core, except that it is fitted in the mould with its axis vertical. Refer Figure 1.20.

The top end of the core is provided with more amount of taper, to have a smooth fitting of the cope on the core.

A major portion of the vertical core generally remains in the drag.



1.20 Vertical core

3. Hanging core

Hanging core is also called as cover core as shown in figure 1.21.

It is supported from above and it hangs vertically in the mould cavity.

It has no support from the bottom. They are provided with a hole through which molten metal reaches the mould cavity.

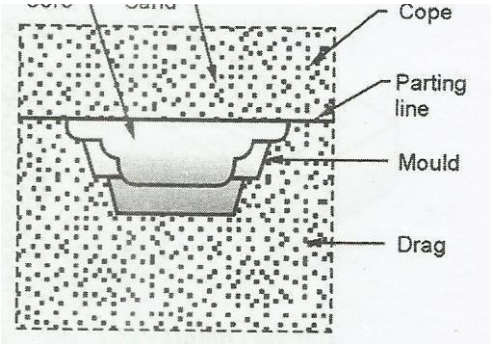


Figure 1.21 Hanging Core

4.Balanced core

Balanced core is supported and balanced from its one end only.

It requires long core seat, so that the cores does not fall into the mould cavity. Refer Figure 1.22.

It may be supported on chaplets.

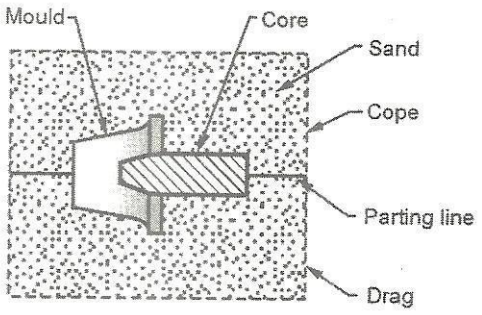


Figure 1.22 Balanced core

1.14 Core boxes

Basically, core box is a pattern for making cores. They are employed for ramming cores in them. Core boxes provide the required shape to the core sand. The commonly used types of core boxed are as follows:

1. **Half core box**

Half core box is shown in Figure 1.23 which can make cylindrical cores.

At one time, half portion of the core is made in the core box.

After producing number of half core portions, they are cemented together to make full cylindrical cores.

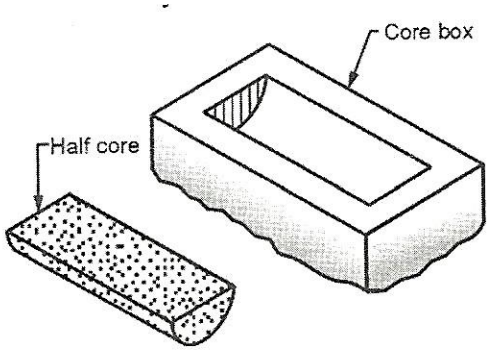


Fig. 1.23 : Half core box

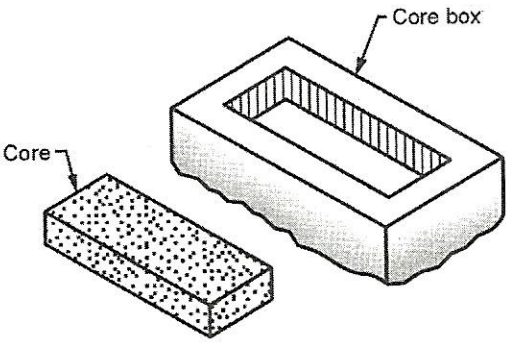


Fig. 1.24 : Dump core box

2. **Dump core box**

It is also called as slab core box.

It is similar to half core box in its construction but, it makes full core at a time, hence used to produce rectangular, square or trapezoidal cores. Refer Figure1.24.

3. **Split core box**

This type of core box moulds the entire core, but to remove the core after moulding, the box is separated in two or more parts. Refer Figure 1.25.

Two portions of the split core box can be aligned temporarily with the help of dowels.

For making the core, two portions of the split core box are joined and then sand is rammed.

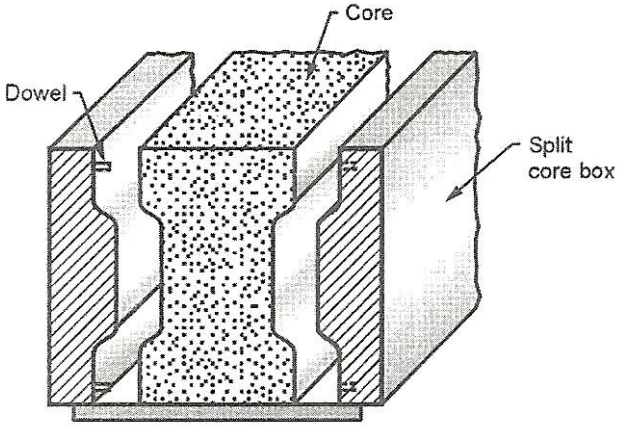


Fig. 1.25 : Split core box and rammed core

4. Strickle core box

Sand is rammed in the dump core box.

The top surface of the core in the core box is given a required shape by using strickle board cut and finished to the desired shape.

A strickle board strikes off excess sand not confirming to its shape.

A strickle board is made up of wood and in any shape, as per the requirement. Refer Figure 1.26.

This method of producing cores is less costly as compared to others.

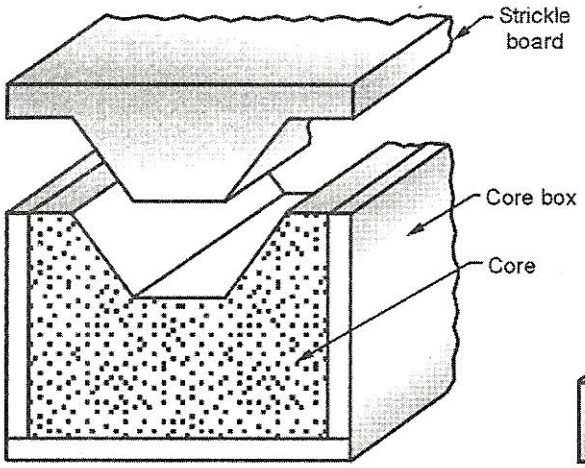


Fig. 1.26 : Strickle core boxes

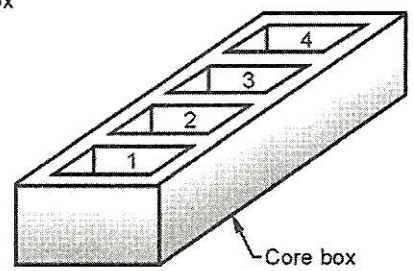


Fig. 1.27 : Gang core box

5. Gang core box

Gang core box contains a number of cavities, so that more than one core can be rammed at a time. Refer Figure 1.27.

6. Loose piece core box

It is similar to half core box.

But loose piece core box can produce two halves of a core, which may be neither identical in size nor in shape.

It is achieved by inserting loose wooden pieces in the core whenever required. Refer Figure 1.28.

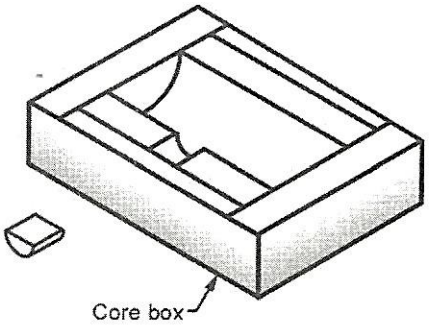


Fig. 1.28 : Loose piece core box

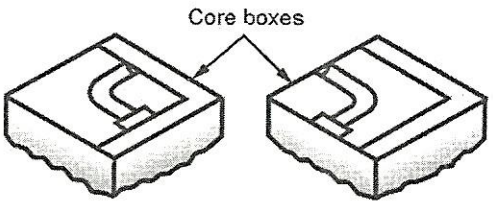


Fig. 1.29 : Left and right hand core boxes

7. Left and right hand core boxes

These core boxes are used to make cores for producing pipe bends.

Half of the pipe bend core is made in each core box.

Two halves of pipe bends are then rammed, backed and joint together to form a full core. Refer Figure 1.29.

1.14.1 Core Prints

Core prints are basically extra projections provided on the pattern. They form core seats in the mould when pattern is embedded in the sand for mould making. Core seats are provided to support all the types of cores. Though the core prints ar the part of pattern, they do not appear on the cast part. Figure 1.30 shows a core positioned in the core seat made by the core print provided on the pattern.

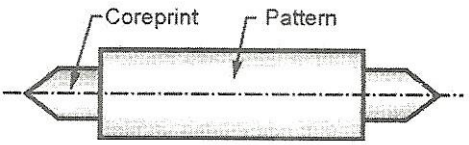


Fig. 1.30 : Core print

Core prints are of the following types:

- Horizontal core print
- Vertical core print
- Balanced core print
- Cover core print

1.14.2 Chaplets

During the casting process, if the core gets shifted from its position in the mould, it will result in a displace cavity and hence a defective casting is obtained.

Hence, a core must be firmly supported in the core seat especially to overcome vertical core movement, which is due to force exerted by poured molten metal.

For this purpose, chaplets are provided with can support the cores.

Chaplets are metal shapes which are place between the mould and core surfaces as shown in figure 1.31.

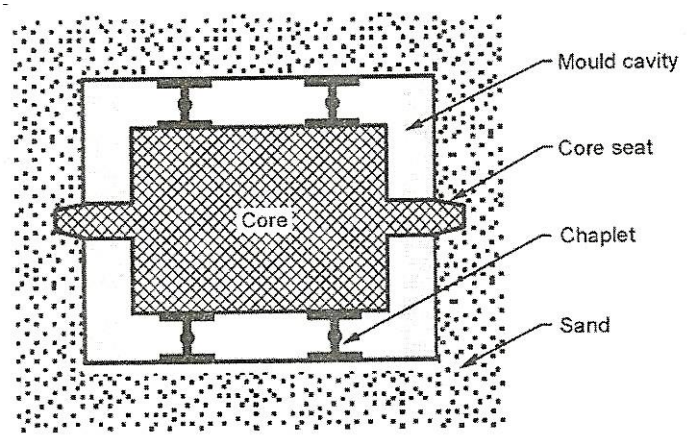


Fig. 1.31 : Cores supported between the chaplets

As the molten metal is poured, chaplet melts and becomes a part of the casting.

But the chaplets should be of the same material which is being cast.

Before use, dirty, rusty, greasy or wet chaplets are properly cleaned and dried. Figure shows a number of chaplet forms and shapes available commercially.

1.15 Moulds

Prepared moulding sand is packed rigidly around the pattern.

When the pattern is removed, a cavity corresponding to the shape of the pattern remains in the sand which is known as mould or mould cavity.

Hence, mould is a sort of container which when poured with molten metal produces a casting of the mould shape.

The process of making the mould is called as mould making.

Essential characteristics

A mould should possess following properties:

Mould should have refractoriness to bear the high heat of molten metal.

It should have strength to hold the weight of the molten metal.

Also, it should produce minimum amount of mould gases.