Welcome to you all

In the event of Team Based Online Project (TOP)

An initiation of Comtel Consultants & Infraprojects Pvt. Ltd.

Project Title

Design of a multi-functional machine to assist the building floor tiling

Investigated & Presented by

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Let us know first what is building floor tiling

The picture clearly shows a floor that has been decorated with floor tiles

Little more insight – floor tiling process

- It is simply, how to decorate the floor with tiles
- The entire process of floor tiling involves a few systematic approaches

- Preparation of mortar (Mixture of cement, sand & water)
- Uniform spreading of mortar throughout the floor in small grooving pattern
- Placing the tiles on the mortar filled floor & fixing the tiles with little pressure
- Cutting of the tiles in proper shape to cover up the entire floor space with tiles

Visualization is always helpful in understanding

Preparation cement mortar

Uniform spreading of mortar with small grooving

Placing of tiles with little pressure

Cutting of tiles

Motivation behind the project work

- It has been found that till date the process of floor tiling is totally manual.
- This manual process introduces the following problems:
  - Many labors are needed – significant labor charge is required
  - Unavailability of all labors at a time lead to pause the work for uncertain period of time
  - The process is time consuming – gives rise to the overall expenditure
- That is why we have come up with a project, as a solution to these problems

What the project is all about

- Here, we have designed a multi-functional machine that will assist the floor tiling process.

- The designed machine will be able to perform the following tasks systematically:

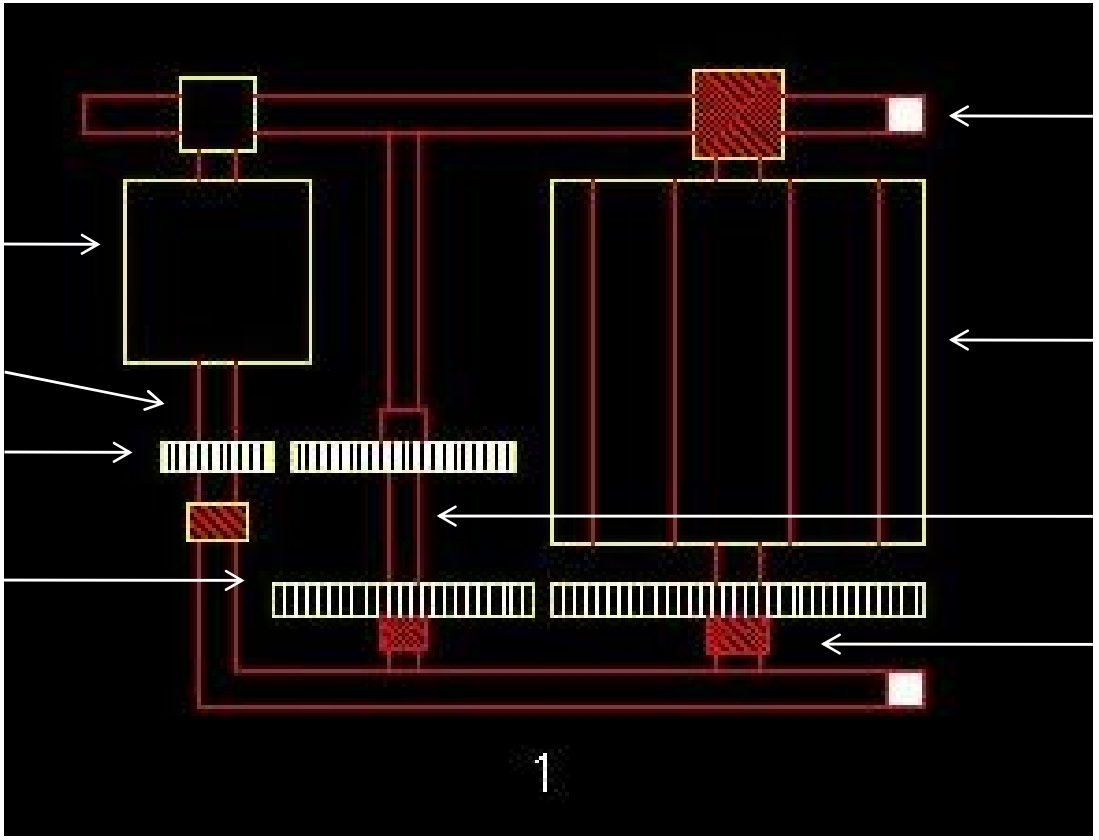
  - Pouring of mortar in the floor
  - Uniform spreading of mortar over the floor
  - Leveling of spread mortar
  - Grooving on the leveled mortar
  - Picking & placing of the tiles in desired mortar filled place
  - Cutting of the tiles according to the requirement

Multi-functional floor tiling machine

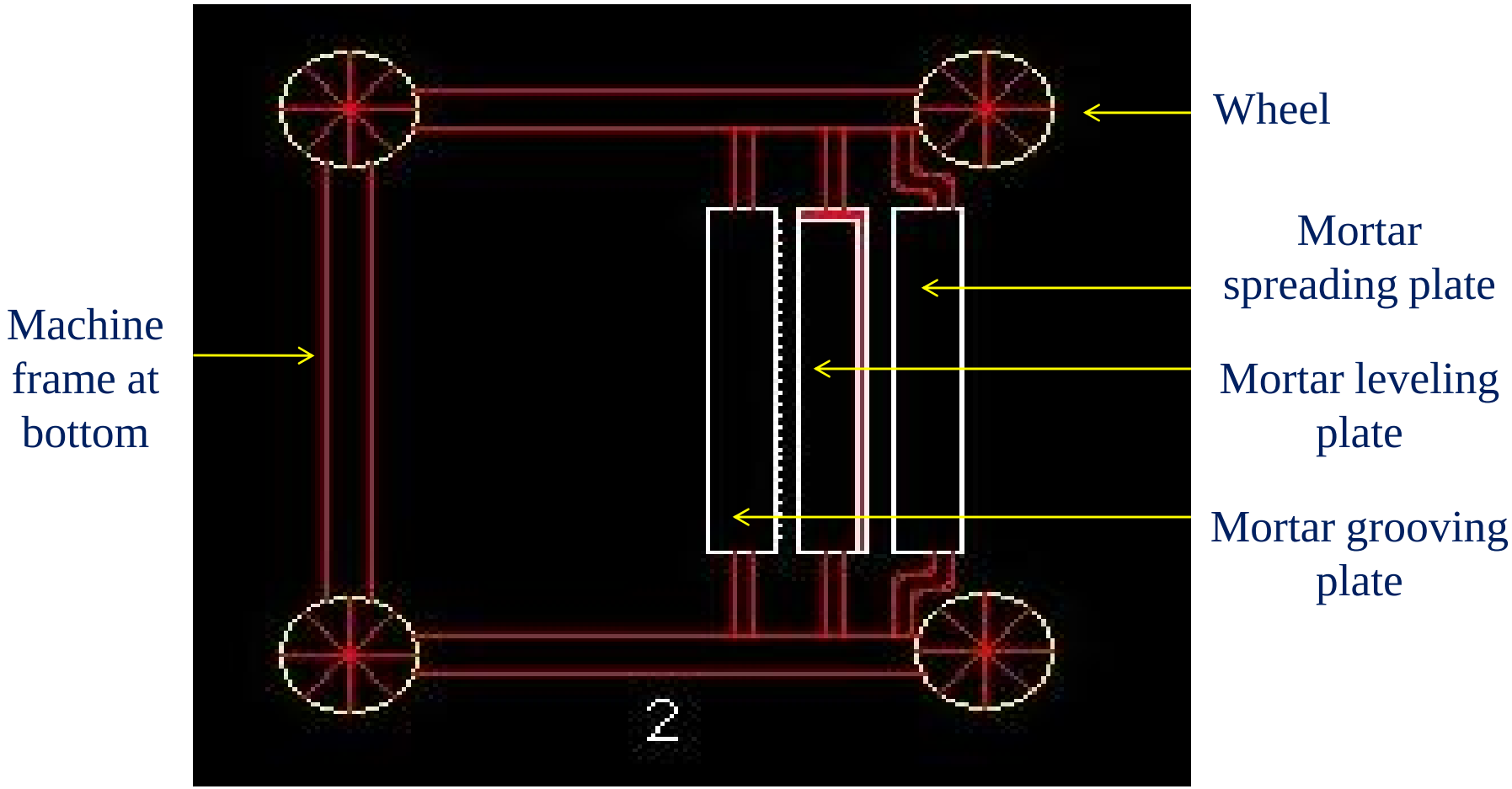
Basic components required:

- 1 DC motor – 230 V, 1 HP, 500 rpm, 1 DC motor – 850 W, 11000 rpm
- Stainless steel mortar container
- 1 set of gear (1:4 ratio), 1 set of gear (1:2.5 ratio)
- Gear shafts (2.5 cm diameter, 10 cm diameter)
- 6 Journal bearings
- 3 stainless steel plates
- 20 metallic net trays
- Rack & pinion gear
- Cast iron crank & handle
- Stainless steel/fiber frame for tiles picking
- Cast iron machine frame
- 4 wheels, 8 vacuum cups, 3 hellical coil spring

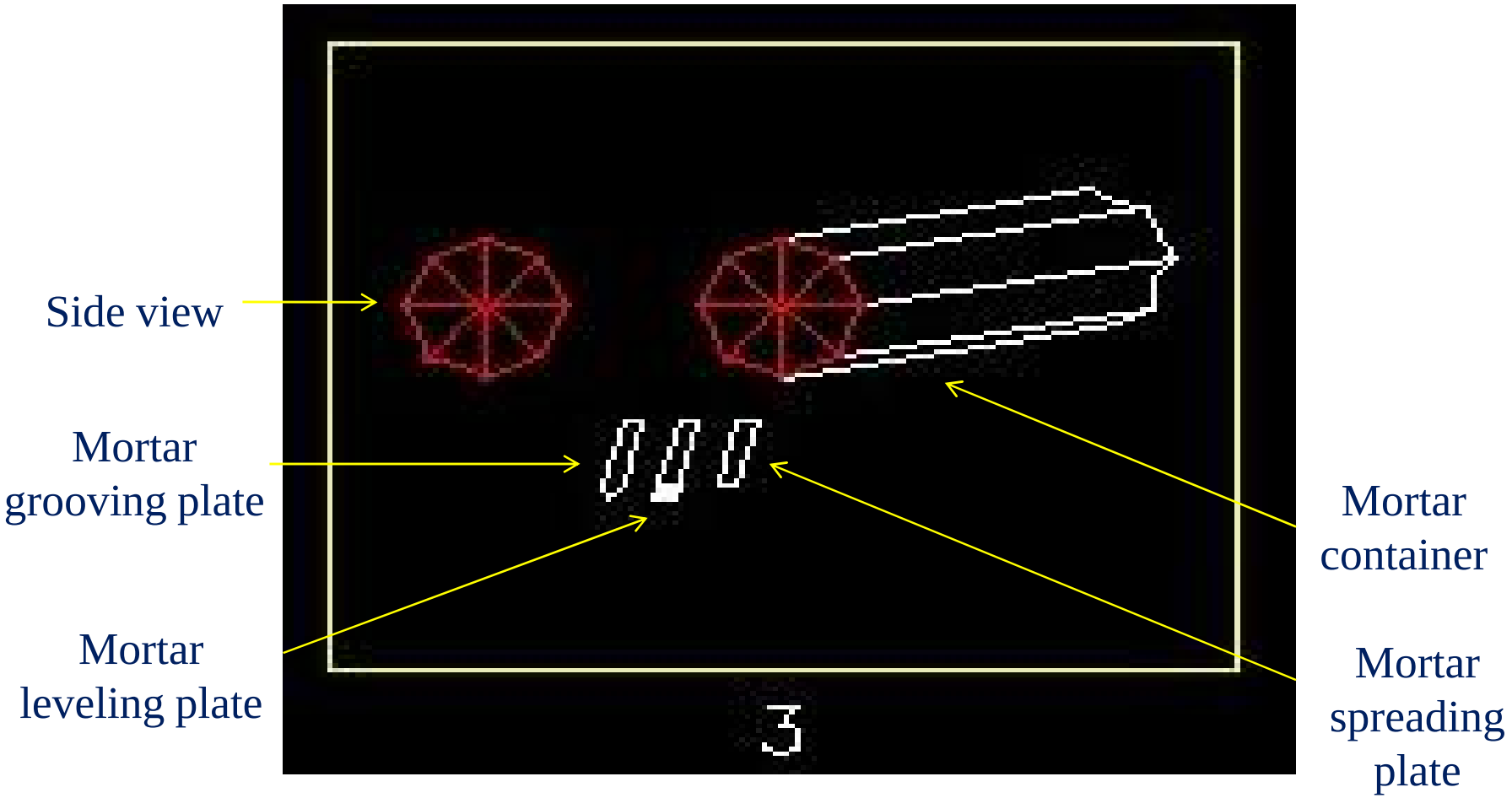
Let us start with the arrangement of these components inside the machine



Top view of the upper side of the machine

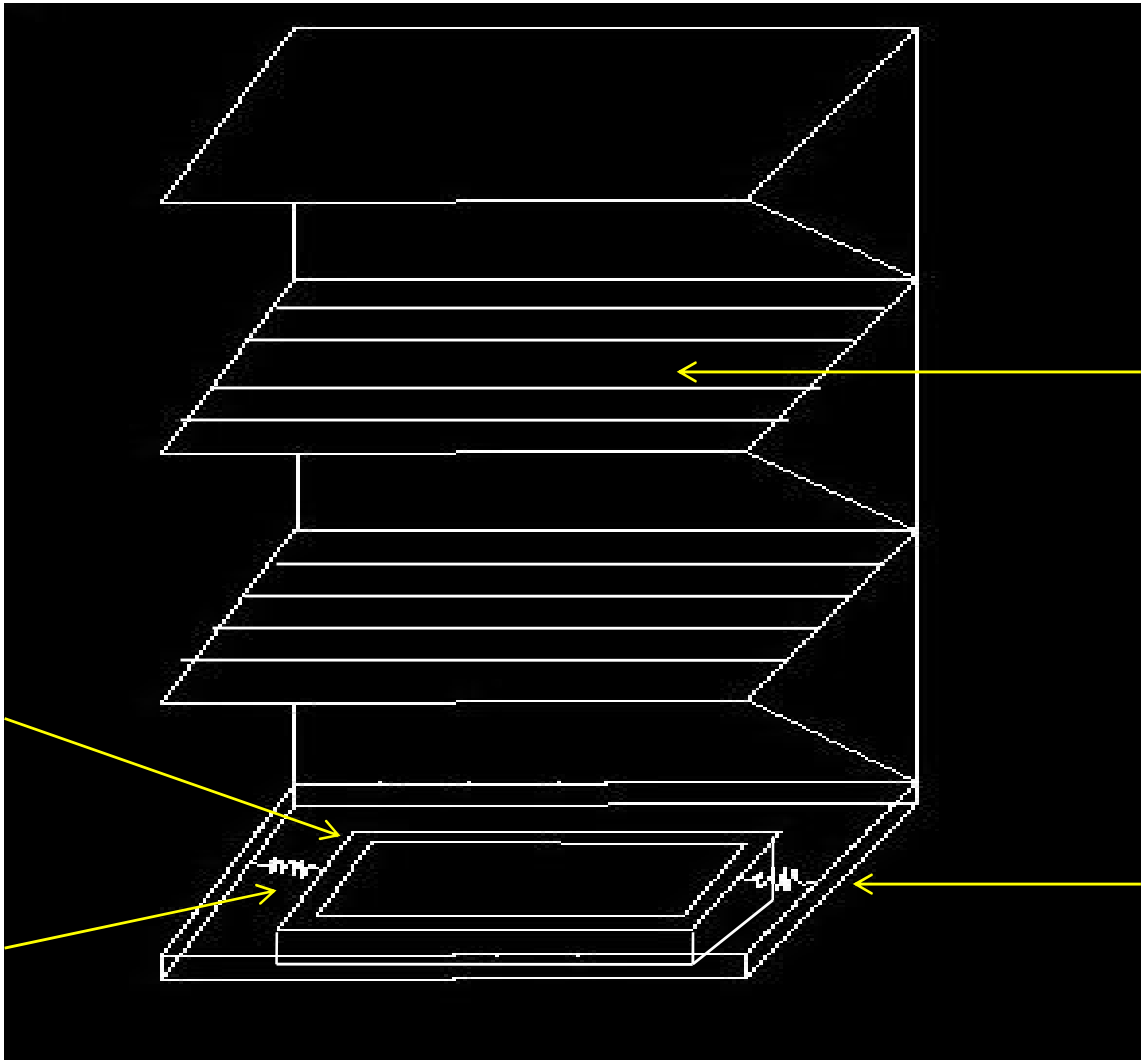


Top view of the lower side of the machine



3 dimensional view of mortar container & side view of mortar placing angular plates

3 dimensional view of tiles holding tray



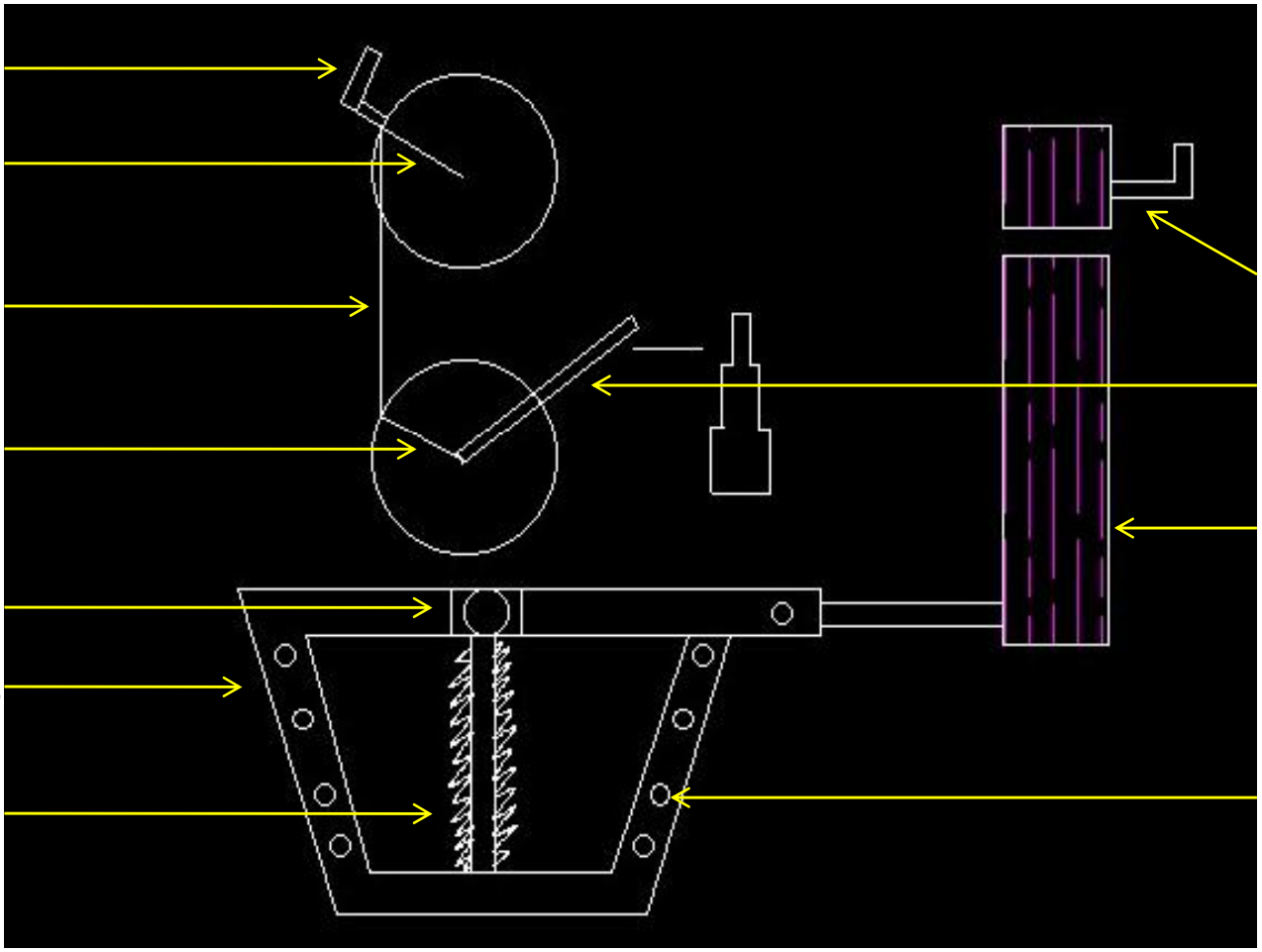
Common tray for keeping tile

Tile cutting table

Spring

Bottom tray holds tile with spring force for cutting purpose

Tile picking & placing mechanism



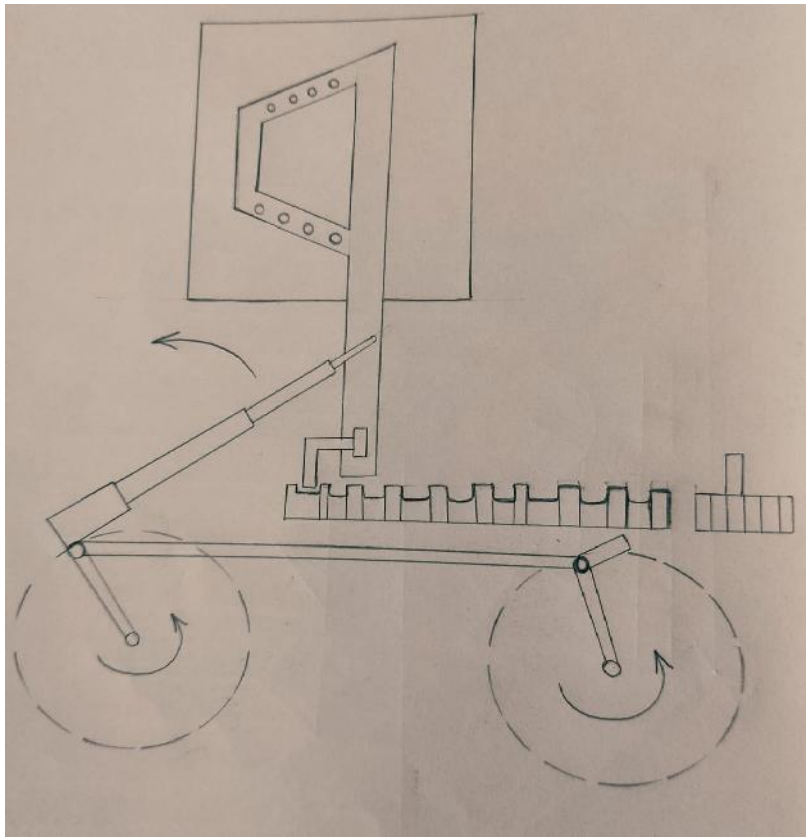
Elements of the mechanism

Adjustable crank

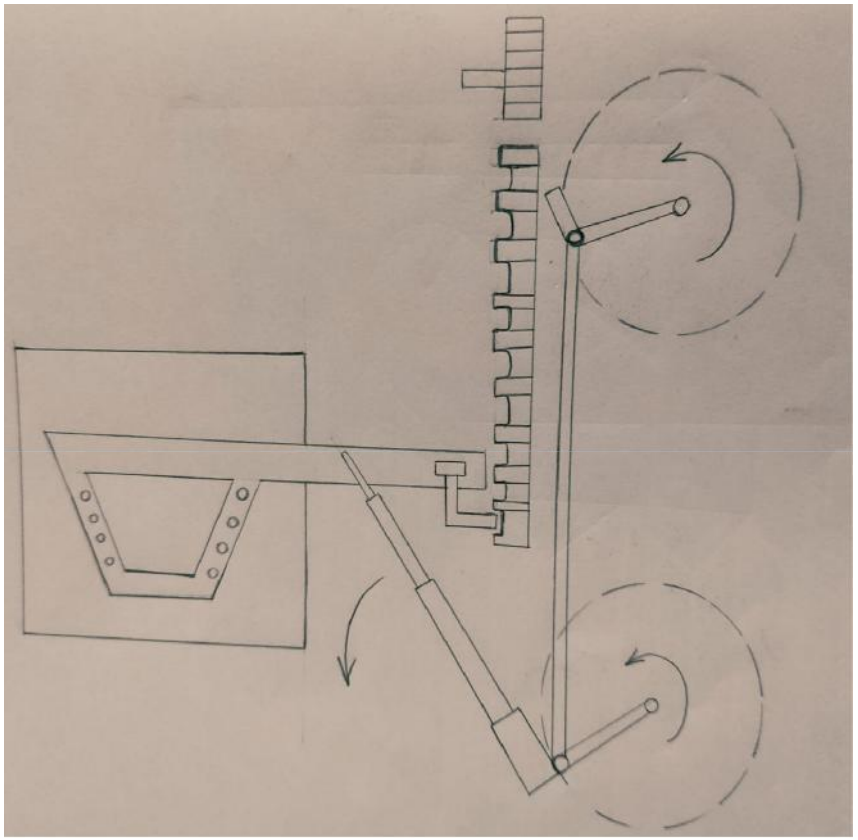
Rack & pinion gear

Vacuum cups

Functioning of Tile picking & placing mechanism

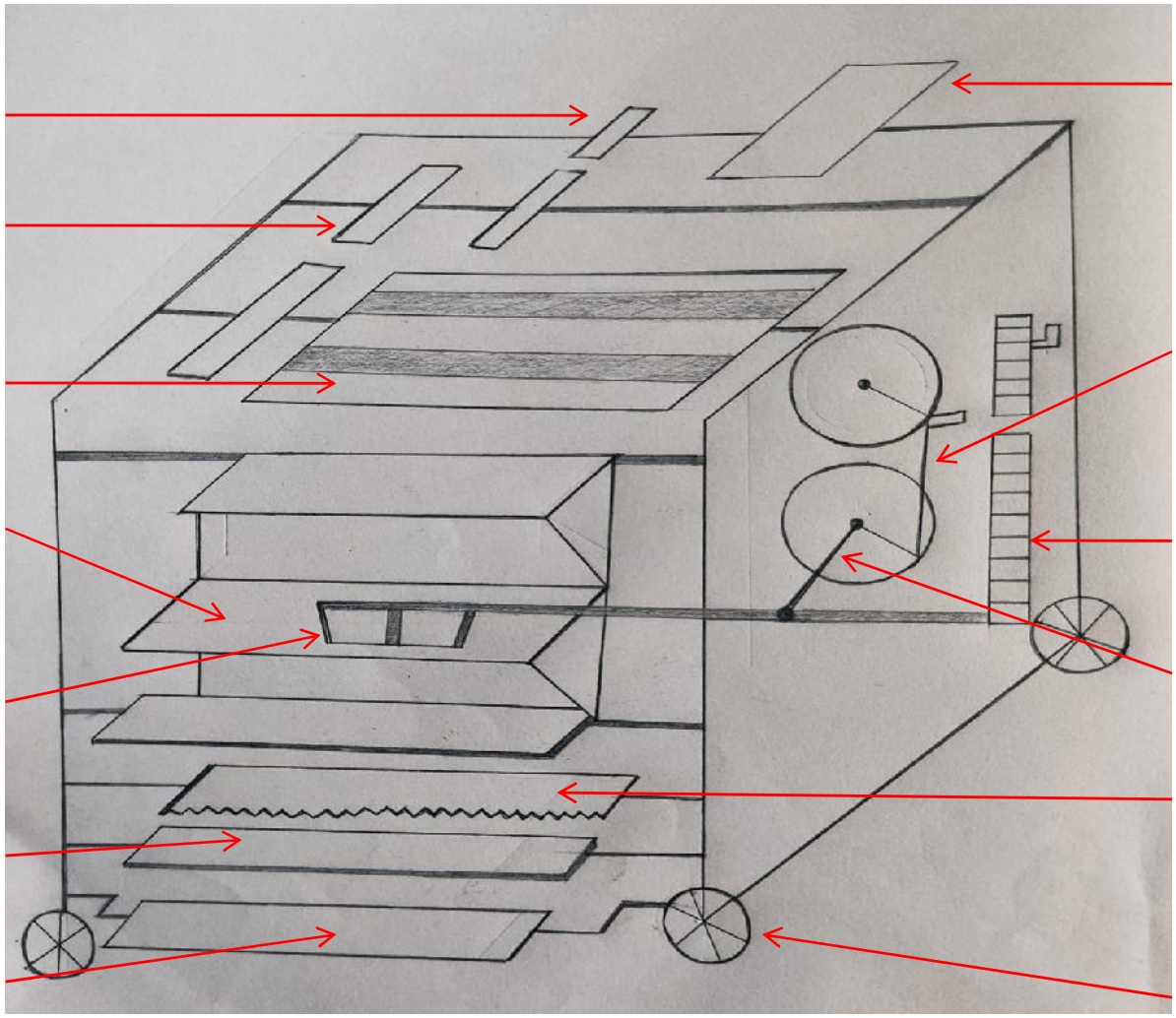


Tiles picking & placing using
double crank mechanism
connected with adjustable crank



Height adjustment of tile
gripping frame using adjustable
crank & rack & pinion gear

3 dimensional layout of complete machine assembly



Working of the complete machine

- Initially the motor runs at 500 rpm
- This speed is reduced to 125 rpm via 1st reduction gear
- On the gear shaft, the driving gear speed again reduced to 100 rpm by increasing the diameter of driving gear
- This speed is reduced to 40 rpm via 2nd reduction gear
- Thus the speed of the mortar container is restricted to 40 rpm, which is attached to the driven gear of 2nd gear set

- The mortar container is divided to 10 segments, in which the upper 5 segments is filled with the mortar. Thus, when the machine will move forward, the mortar will fall on the ground segment wise. In this way, step by step certain amount of mortar will fall on the floor.

- Once the mortar is poured on the ground, the mortar spreading – leveling – grooving can be done automatically by the plates attached to the bottom of the machine as the machine moves forward. The plates are attached to the machine bottom frame with a certain inclination to facilitate these functions.

- Once the mortar is properly placed on the floor, the motor is stopped.

- 20 tiles are kept on the tiles keeping tray one by one vertically.

- Now, the tile gripping frame is used pick & place the tiles one after another by moving the machine properly. 4 revolving wheels has been attached to the bottom frame of the machine. So that, the machine can be moved at different locations with ease.

Revolving wheel

- 8 vacuum cups are placed on the gripping frame, that are used to grip the tiles.

- The picking & placing activity is done by using a double crank and an adjustable crank mechanism.

- The height of the gripping frame according to the tiles kept at different tray, is adjusted by using a rack & pinion gear attached to the extended handle of gripping tray.

- The bottom tray is used for tiles cutting purpose. Tile is kept on the cutting table inside a frame. This frame firmly holds the tile by spring attached to both sides of the frame.

- A slider is attached to the tiles gripping frame. A motor is placed inside the slider and the longitudinal cutter is attached to the slider.

- The uncovered floor space can be measured manually using the slider along with the cutter.

- After measuring, the same gripping frame is brought back to the cutting table. The measured portion of tile is cut by rotating the slider motor.

Design specification & calculation

- Motor speed = 500 rpm
- 1st gear ratio = 1 : 4 ⟶ Driven shaft speed will be reduced to 125 rpm
- Gear ratio on gear shaft = 1 : 1.25 ⟶ Driving gear speed will be reduced to 100 rpm
- 2nd gear ratio = 1 : 2.5 ⟶ Driven shaft speed will be reduced to 40 rpm
- Motor shaft diameter = 2.5 cm, Gear shaft diameter = 10 cm
- Mortar container length (l) = 4 feet (121.92 cm), Diameter (d) = 20 cm

  Container volume = $\Pi \times r^2 \times l$ = 38300 cm^3 (Approximate)

  Container divided with 10 segments

  Each segment volume = 3830 cm^3

- Stainless steel plates,

  Spreading plate: Length = 122 cm, width = 12 cm, ground clearance = 4 cm

  Levelling plate: Length = 122 cm, width = 16 cm, ground clearance = 2 cm

  Grooving plate: Length = 122 cm, width = 16 cm, ground clearance = 2 cm

  (Here, 1 cm clearance adjusted due to plate angle)

  Thickness for all the plates = 5 mm

- Metallic trays,

  Net tray Length = 65 cm, Net tray width = 65 cm, Net tray thickness = 1 cm

  Tray material: Stainless steel

  Total no. of net trays = 20

  Bottom tray Length = 65 cm, Bottom tray width = 65 cm,

  Bottom tray thickness = 1 cm

  Total no. of trays = 20 (net trays) + 1 (bottom tray) = 21

  Clearance between each tray = 5 cm, Clearance between bottom & above tray = 10 cm

  Overall height of the tray assembly = (19 × 5) + 10 + 21 = 126 cm

- Tiles cutting table,

  Length = 63 cm, width = 63 cm, Height = 5 cm
- Metallic trays,

  Net tray Length = 65 cm, Net tray width = 65 cm, Net tray thickness = 1 cm

  Tray material: Stainless steel

  Total no. of net trays = 20

  Bottom tray Length = 65 cm, Bottom tray width = 65 cm,

  Bottom tray thickness = 1 cm

  Total no. of trays = 20 (net trays) + 1 (bottom tray) = 21

  Clearance between each tray = 5 cm

  Overall height of the tray assembly = (19 × 5) + 10 +21 = 126 cm
- Machine dimensions:

  Length = 150 cm, Width = 120 cm, Height = 150 cm

Conclusion

- A few detailing has not been given this presentation. Those will be discussed in the final presentation.

- Any missing point will be demonstrated during final presentation.

Thank You