

# Automatic Flooring Machine

[<sup>1</sup>] Durai.J, [<sup>2</sup>] Sumit Nande, [<sup>3</sup>] Faruk, [<sup>4</sup>] Patil Saurabh, [<sup>5</sup>] Sangappa

[<sup>1</sup>] Assistant professor, [<sup>2</sup>][<sup>3</sup>][<sup>4</sup>][<sup>5</sup>] UG Scholar

Department Of Mechanical Engineering

Sri Sai Ram College of Engineering, Anekal, Bengaluru

**Abstract:** -- Floor tile laying process is a finishing job usually done manually. This process is described in detail including the tile laying work flow, thinset thickness, tiles pattern, tools, tiles installation defects, costs and work rate. A cost analysis of tile laying process was made based on data obtained in one of the construction project in Langkawi in 2005. The labor cost was RM 1.50 per feet square of tiles. The material costs however vary with the quality and design of tiles. A field study was carried out to measure the work rate of manual tile installation where the average rate was 19.2seconds per tile of 300mm x 300mm. The existing research and robot technology is discussed in this research including the various configurations considered by the researchers. Based on these, important elements of floor tile laying automation were identified as lacks of data on tile laying work itself, manipulator design and costs effectiveness. We are here with new mechanized unit which can be more suitable for automation.

## I. INTRODUCTION

Construction is one of the many industries important to developing country like India. There are many challenges and difficulties faced by the industry. There are four serious problems in the construction industry today; low labor efficiency, increasing accident rate at construction sites, poor finishing or workmanship and insufficient supply of skilled workers. In India, construction companies usually employ immigrant workers due to their lower salaries compared to local workforce. In India, one of the finishes normally required in new buildings are the tile. Due to the lack of understanding of the Characteristics and improper use of material, inappropriateness of various systems, Poor workmanship, lack of ISO standard and the demands on construction time. Currently, the tile installation process is done manually which require skilled workers

### 1.2.Problem Identification and Definition

The flow chart of the activities in the tile laying process. The chart shows the activities starting from mortar bed setup up to finishing installation and can be categorized into three main phases. These are preparation phase, tile setting phase and grouting phase. The preparation phase involves mortar bed setup, mortar bed leveling, tiles planning and tile preparation. Mortar bed is a mixture of portland cement, sand and water. The purpose of mortar bed is to create an even and level before laying the tiles. In tile planning, the dimensions of the room are measured and the numbers of tiles needed are determined together with the tiles pattern. The tiles preparation is where the tiles are soaked in water to remove dust or unexpected materials at the back of tiles which can prevent good adhesion.

### Preparation

Mortar Bed Setup

Mortar Bed Leveling

Tile Planning

Tile Preparation

### Tile Setting

Spreading Thinset

Tile Setting

Tile Leveling

### Grouting

Grouting

Removing excess filler

Tile laying processes are labor intensive involving repetitive activities, time consuming and requiring skilled workers. To overcome the skilled worker shortage, low productivity, and time consuming the process should be mechanized. The new tile laying machine will be designed and developed to carry out these jobs. The machine can be operated by the unskilled worker.

### 1.4 Research Objective

The main objectives of the research are;

- i. To gather the technical data for development of product on tile laying process. This includes physical properties, optimum parameters of the process and the working rate of existing technique of tile laying process.
- ii. To develop a design approach to mechanize and subsequently automate the manual tile laying process.
- iii. To design and develop an automatic floor tile laying machine that can complete the task faster than manual process.

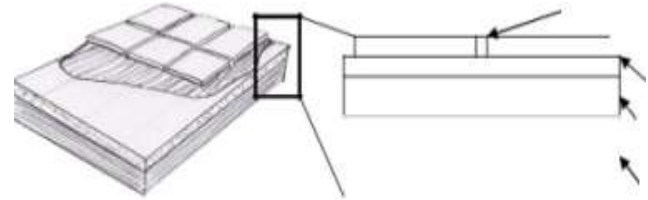
#### **Construction automation**

Constructions robot can be divided into four main groups. It is exterior handling robot, horizontal finisher, vertical finisher and interior finisher. Exterior handling robots have configurations like mobile cranes and its function is to handle large loads such as steel bars, prefabricated elements and concrete buckets. Floor surface treatment such as smoothing and trowelling is a task which can be grouped as horizontal finisher robot. Painting or inspecting exterior walls can be categorized as a part of vertical finisher. Interior finishers usually have an anthropomorphic configuration to do a task inside the building such as painting and masonry.

The automation of construction has increased the productivity in construction. Construction Industry Institute (2005) claimed that the application of the automation construction can increase the quality of finishing, improved ability, shorter time required and decrease hazardous faced by workers at construction site.

#### **2.3. Tile Laying Tools and Material**

Mortar bed is normally prepared before laying tiles to obtain a level surface of the floor. The thickness of mortar bed is between 25mm and 50mm. Mortar bed mixture usually consists of 1 part of Portland cement, 5 parts of damp sand and an adequate amount of water (Tile Doctor, 2005). A thinner layer of mortar bed of 18mm can be used depending on the unevenness of the concrete slab (Warmboard, 2005). Figure 2.2 shows mortar bed located on top of a concrete slab and the thin set mortar applied on the mortar bed.



Typical commercial tile installation

1)Grout 2)Tiles 3)Thinset mortar 4)Mortar bed 5)Concrete slab.

#### **2.4. Tile Laying and Related Automation – State of the art**

Currently, tile installation process is done manually and highly dependant on human skills. Until now, there is no commercially available machine or robot to carry out this task but there are already attempts made by researchers to automate this process.



**Technion Autonomous Multipurpose Interior Robot**

The robot process included movement from the previous to the next tile, acquire and process images to determine fine position offset, position tile in contact with ground, lay it down and lastly acquire and process image to ascertain tiles installation quality. They have configured a four wheel vehicle with omni directional motion with stereo camera based sensing to locate tile edges and seams on the floor. Tiles for the robot are fed from a hopper system from the opposite end of the vehicle and supplied via contact friction belts. In order to check the tiles accuracy, robot position and tile pattern, a laser based retroreflective target positioning system was used. Figure 2.10 below shows a conceptual design of mobile robot for automatic tile installation.



*Design of robot for automatic tile installation*

A technology which has an almost similar function with the tiles installation work and has been developed for commercial construction industry use is mobile bricklaying robot. This robot was developed in German and the task of this robot on the construction site are picking bricks or blocks from prepared pallets, apply bonding material to the bricks and placing the bricks with high accuracy and quality. The robot was fully autonomous on the construction site. The prototype called BRONCO (Bricklaying Robot for Use on the Construction Site) has been successfully tested. The tasks include picking a brick from prepared pallet, dropping and calibrating position of bricks, spreading the thinset mortar and placing the bricks with high accuracy position.