Grooved Building Blocks for Concealed Utility Services

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Abstract

The article presents novel innovative design and development of grooved building blocks for concealed mechanical, electrical, and plumbing (MEP) utility services installations. These grooved blocks design is useful for concealing electrical wiring, water pipeline, and route for drain water required for different utility services on wall and floor. A wall prototype model constructed with grooved blocks of different designs such as straight horizontal, vertical, multi-way junction box, bend shape, and L-shape cut bricks with MEP system utility services installations. Comparative evaluation of the traditional concealed systems with grooved blocks were carried out. The grooved building blocks of the present invention was economical, reduces manpower, and time for concealed utility services.

Keywords : **Building blocks, concealed utility service, conduits, grooved blocks, MEP systems**

I. INTRODUCTION

The design and installation of mechanical, electrical, and plumbing (MEP) systems is a major challenge for complex buildings and industrial plants [1]. In general, MEP systems distribute electricity, gas, water distribution, and dispose of waste [2]. These MEP engineering systems represent a substantial part of a building and directly influence operating efficiency, economy and energy utilization [3], [4]. In general practice the MEP system installations is carried out in open or concealed fitting. In most of the civil engineering construction, especially in a building, it is normal practice to provide electrical wiring, water supply pipeline, and rain water drainage pipes after completion of civil construction if the provision for the service staff is not provided. Since the services are an essential part of any occupancy, the service ducts or grooved path required for laying the pipes or conduits cannot be avoided in any building. For smaller buildings where the provision of separate shaft for services is not an economical solution, the pipes are embedded in walls, ceilings or in floor, while for electrical wiring, generally conduits are used in all type of buildings. While designing a building, these stated services are prime considerations. The grooved path is required in structural elements and presently this is done by cutting channels post construction of a wall. Such tedious work can be eliminated with a novel alternative prefabricated design of grooved blocks for this MEP system installation.

Modular construction management arrangements for buildings defined as structure units fabricated in a manufacturing plant away from the job site [5], [6]. MEP module typically includes pipes, cable trays, and ventilation ducts, which contribute to 40% to 60% of the total construction cost of a building [7]. Defining the location and routing for MEP system components from remote location for actual site installation was a research

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gap of building systems. This is due to congested spaces, interferences, and to comply with diverse design and operations criteria. Therefore, the grooved blocks design and installation at site is one of the best alternatives for the MEP system installations. Few studies were reported in literature on the building blocks design and development for MEP installations.

Building Blocks are made of aggregates (such as stabilized soil, river sand, gravel, uncrushed stones/rocks, etc..) mixed with Portland cement (or lime) and water of desirable ratio for targeted strength and admixture if necessary [6]. Blocks are produced in a form which can be laid either with mortar or assembled as interlocking blocks which is rather mortarless. The former block can either be hollow or solid with good insulation design [8]. This application is directed to a system for organizing, insulating, and supporting pipes within a MEP rack. Studies were also reported on strength of hollow, solid, and grooved Autoclaved aerated concrete (AAC) blocks [9]. The superiority of grooved AAC blocks to conventional AAC blocks were analyzed both experimentally and also with analytical models. Surface groove system for building sheets invention involves a plurality of grooves indented into surface of the building sheet to provide a guide for cutting the building sheet along the grooves [10]. These building sheets must generally be sized and cut to an appropriate dimension for installation and limited applicability for utility services. Grooved retaining wall block and system with connectors used in a retaining wall and a retaining wall having grooved blocks to fit a flexible geo-synthetic material fits into a channel of a channel connector, and held in place by an elongate bar [11]. The system is confined to geo-synthetic wall applications only. With these research gaps in the building block system, a novel innovative grooved block design and installation was carried out for the concealed utility MEP services.

The main focus of this article is on grooved building blocks design and installations in engineering field, particularly in the construction industry for providing concealed utility services such as electrical conduits, water pipes and drainage pipes. The grooved blocks of the present invention can be arranged in a pattern during the construction of a building for laying different utility services such as electrical wiring, water pipeline, waste water /drainage pipes.

II. EXPERIMENTAL DETAILS

Grooved building blocks were manufactured using brick molds of size 230 mm (L)×110 mm (W)×70 mm (H). The mild steel plates of 2 mm thickness were used to fabricate the mold. Different design and shape sizes of

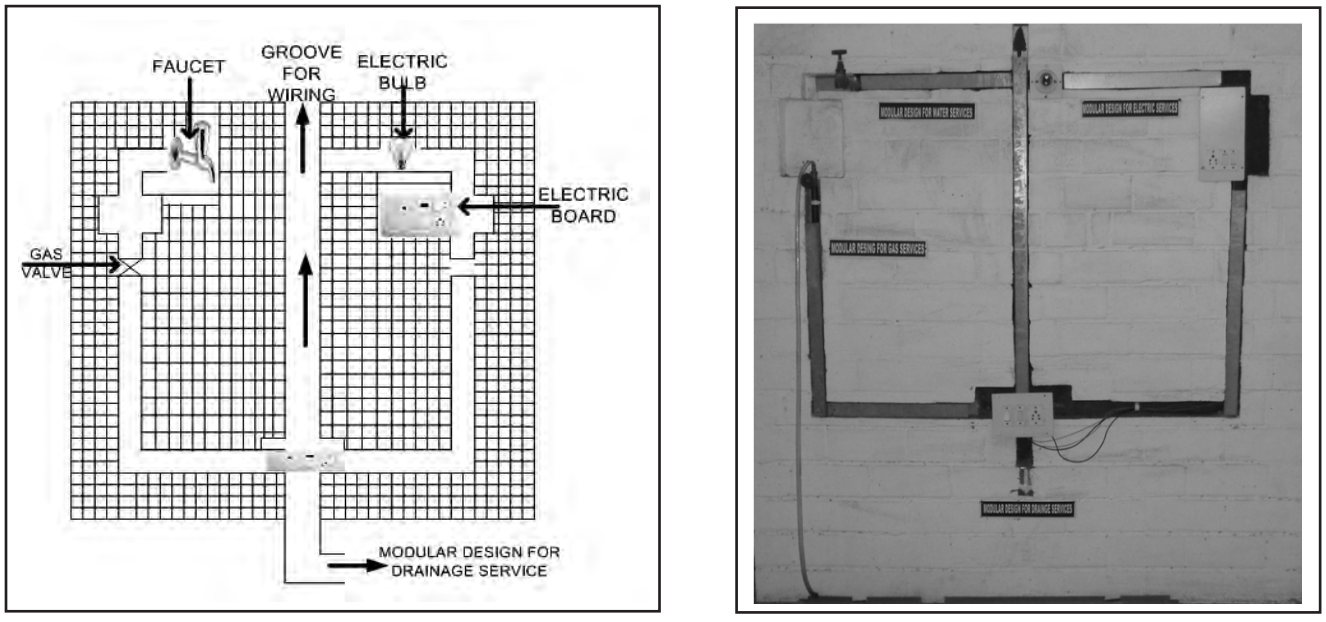
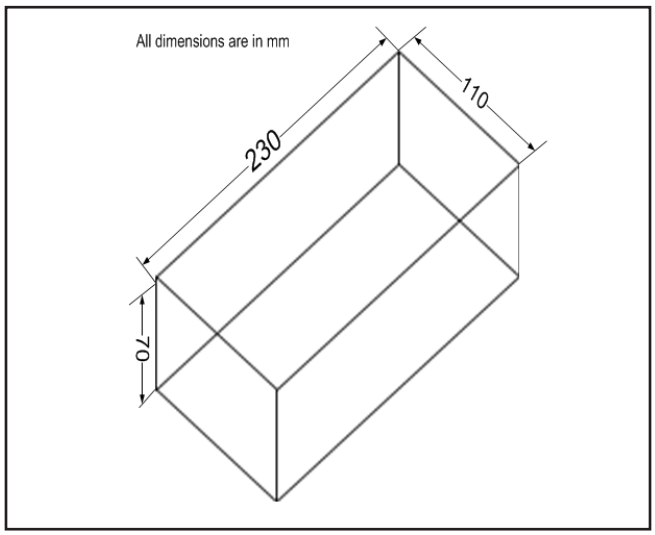
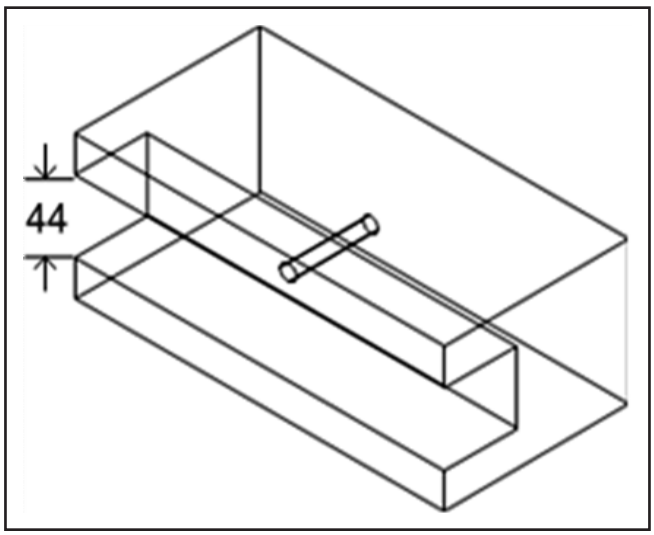


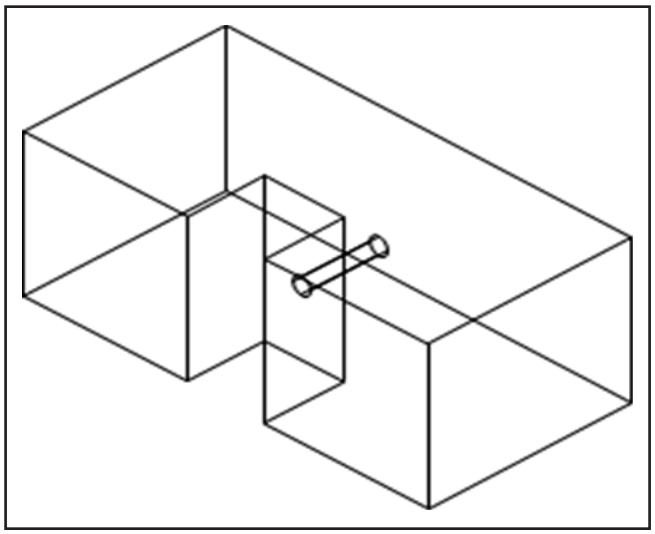
Fig. 1. Grooved Building Block (a) Design Layout (b) Photograph of Wall Prototype with Concealed MEP Services



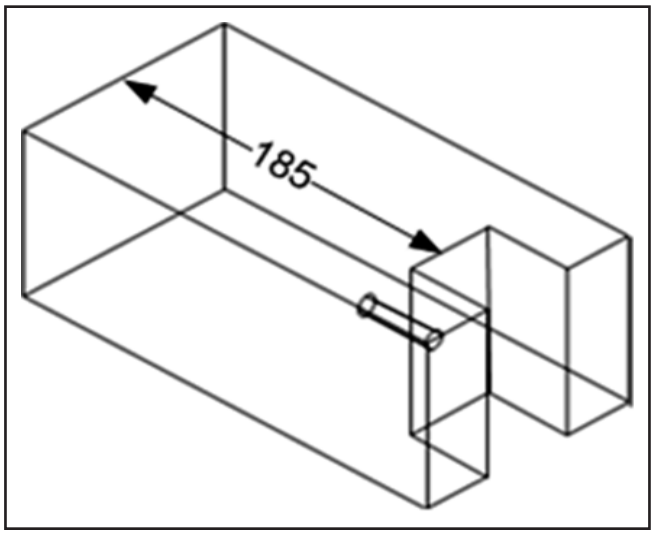
(a) Building block



(b) Horizontal groove on front face



(c) Vertical grooved block on front face

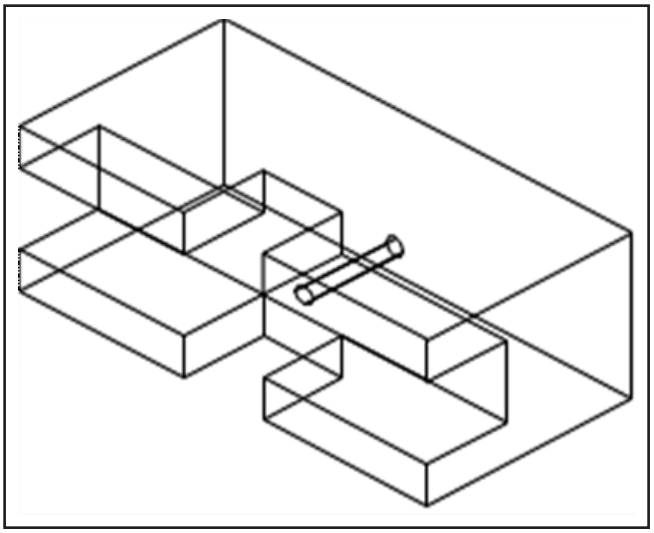


(d) Vertical grooved block on side face

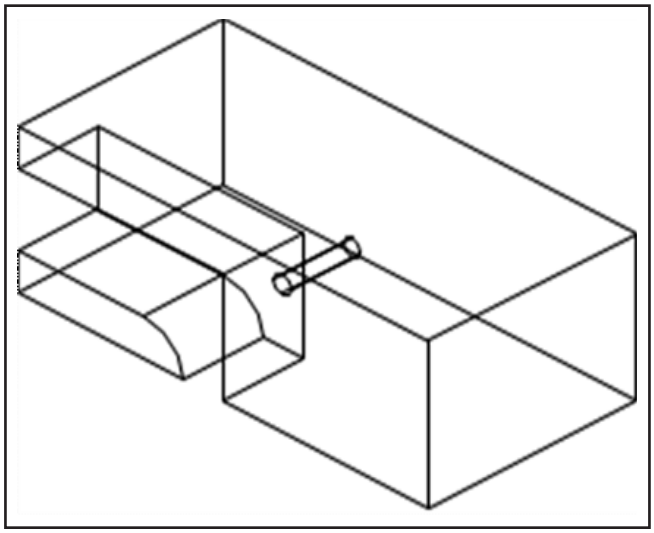
Fig. 2. Detailed Designs of the Grooved Building Block

molds were created such as rectangular, bend shape, L-shape, and box type. Cement mortar was used to produce grooved building blocks with molds. A prototype wall of size 1.6 m (L)×0.12 m (W)×1.6 m (H) was constructed with grooved building blocks at laboratory scale to achieve readymade grooves for utility services as shown in Fig.1(a) and (b). In this wall prototype electrical, plumbing, gas and drainage systems were installed for the demonstration of the concealed utility services installations.

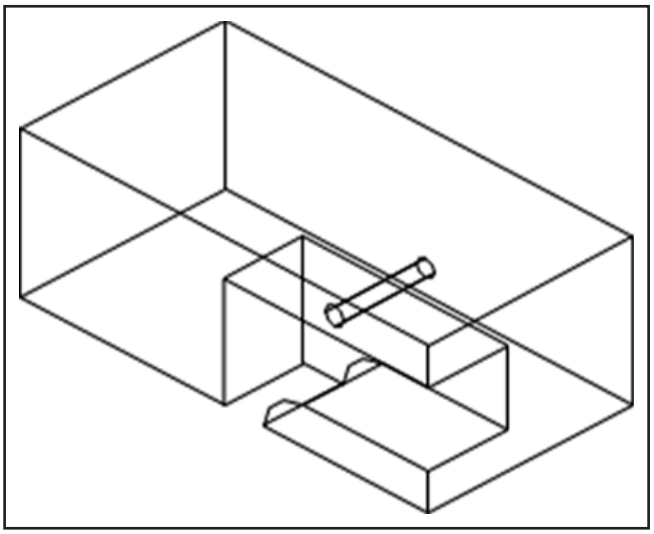
The detailed designs of the grooved building block of the present invention for concealed utility services drawings was shown in Fig. 2 (a-h). Horizontal grooved blocks on front face surface is required for installing the conduits/fittings without any bend in horizontal direction. Similarly, the vertical grooved blocks are used for installing in the vertically upward/downward requirements of MEP installations. The vertical groove design on right face is required in some typical design where the orientation of brick used with right face is exposed to ambient atmosphere. MEP installations of horizontal and vertical lines intersection can be accommodated with multi-junction grooved blocks design as shown in Fig.2(e). Regular concealed utility services installations require services at different locations in the building. The combination of horizontal



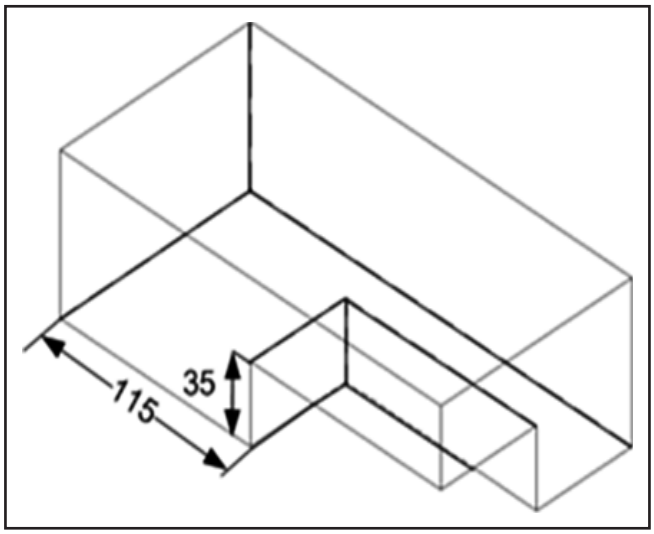
(e) Multi-junction box type grooved block



(f) Left bend shape grooved block



(g) Right bend shape grooved block



(h) L-shape building block

Fig. 2. Detailed Designs of the Grooved Building Block

and vertical grooved blocks with the left and right bend grooved blocks will meet the criteria of regular installation at different location in buildings. The electrical concealed utility services require switch boards installation on wall. With the L-shaped grooved design and installations on the wall will create the necessary space requirement for the switch board installations. The grooves of these blocks can be concealed with plaster or any suitable materials such as metal, plastic, wooden etc. as per site installation requirement.

III. ADVANTAGES OF THE PROPOSED GROOVED BUILDING BLOCK SYSTEM

The conventional concealed system has many drawbacks for MEP system installations. The grooved blocks system has the following advantageous over the conventional concealed system.

- There were no manual cutting tools required for making grooves MEP services installations.
- It is an economical, requires less man power and is a time saving method of installations.

- No condensation problems in the grooves where there is appreciable change in temperature.
- No need of threading for joints fixing.
- Fault in line is easily traceable and repairable.
- Grooves size can be altered depending on the actual load of MEP systems.
- No conduits are used in the grooved blocks and hence no short circuit problems.

IV. CONCLUSION

The present invention provides design and development of grooved building blocks for concealed utility services as is required in the construction industry. Engineering details and design and method of installations were discussed with a wall prototype model. The present invention of grooved blocks can be arranged in a pattern during the construction of a building for laying different utility services is to save the cost of conduit cutting by reducing the manpower of making grooves in walls post construction. Designed grooved blocks with inbuilt holes will help in locking the bunch of wires on the face of groove. The present invention will provide concealed utility services while designing the building by providing readymade channels for electrical wiring, water supply pipe line, and waste/rain water drainage as per the detailed drawing provided by the architect/engineer.

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PATENT INFORMATION

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