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General Article

SEMI-FLOATING TOWER BASED ON THE MAGNETIC MATERIALS AND POTENTIALS

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ABSTRACT
Today, towers are the fastest growing buildings in the world. Design of tower has specific characteristics that must be considered by designers and engineers. On the other hand, because of the Earth's recent conditions and appearance of new technologies, the trends are going toward new generation of towers with consideration of cost, sustainability, performance, resistance and flexibility. Therefore, magnet as potential material can be used as design and engineering element in towers. Magnetic tower base, magnetic floor slabs, and magnetic double skin facade with the help of light concrete and light metal material (Titanium), can make semi-floating tower that not only has strong flexibility against earthquake and wind, but its double skin provides sustainability potentials.

INTRODUCTION
This article is written by professor and student of architecture department of Islamic Azad University (UAE Branch), as today consideration of tower design. The article introduces the new structure for towers to solve the problems of these days and talks about how we can have semi-floating tower and the elements which I used for new structure of tower. This new structure is combined with magnetic elements, which it helps to having more flexible tower.

Magnet
"Magnet is a piece of iron or other material which has its component atoms so ordered that the material exhibits properties of magnetism, such as attracting other iron-containing objects or aligning itself in an external magnetic field". (oxforddictionaries, 2015) "Magnet is a body, as a piece of iron or steel that possesses the property of attracting certain substances, as iron." (dictionary.reference, 2015) A *magnet* is a material that can apply a noticeable force on other materials without actually contacting them. This is a magnetic force and may either attract or repulse. All materials apply some magnetic force but most of them have so small magnetic force and cannot be considered. However, there are some materials with noticeable magnetic force which are called magnets. The Earth itself is a huge magnet (madehow, 2015).
Magnetism is learned by ancient people from *lodestones* which is natural magnetized pieces of iron ore. These natural magnets attract pieces of iron. The word *magnet* in Greek meant "stone from Magnesia", as a part of ancient Greece where lodestones were found (languagehat, 2015). The earliest known surviving descriptions of magnets and their properties are from Greece, India, and China around 2500 years ago (Vowles, 1932).
Permanent magnets apply a force on objects without any outside influence. One of these magnets is the iron ore magnetite, which is known as lodestone and it is a natural permanent magnet. Other kinds of permanent magnets can be made by exposing specific materials to a magnetic force. These materials will keep their specific magnetic characteristics after the force is removed. These magnetic properties may change over time or at high temperatures, but still are considered to be permanently magnetized. Electromagnets are other kinds of magnets. They are made by surrounding certain materials with a coil of wire. When an electric current is passed through the coil, these materials apply a magnetic force. When the current is shut off, the magnetic force of these materials drops to nearly zero. Electromagnet materials retain little, if any, magnetic properties without a flow of electric current in the coil. Some metals are *ferromagnetic* in their natural form Because of the way their regular crystalline atomic structure causes their spins to interact, such as ores, cobalt and nickel. Ceramic magnets are made of a composite of iron oxide and barium or *strontium* carbonate. These materials are desirable kinds of permanent magnets because of their availability and lower cost than other types. Ceramic magnets are made using pressing and sintering (Brady, 1986).

Building Structure

Structure of any kind of building is one of the most important parts of them because of its sensitive influences on architecture, people, and especially safety. The relationship between the structural and the non-structural parts of a building may vary widely. The walls, floors and roof as space-enclosing elements in some buildings, are also structural elements, with the ability of resisting and conducting load. In some other buildings with large glazing areas on the exterior walls, there can be entirely separate structure from the space-enclosing elements. The visual solution of structure can be related to different things. The structural system of a building can be considered more and be designed to form an important part of the architectural character. The main forms of loading which buildings are received, are gravitational loads, wind pressure loads and inertial loads caused by seismic activity. Gravitational loads which act vertically downwards, are caused by the weight of the building itself and of its contents; wind and seismic loads have major horizontal components but can also act vertically. As Satisfactory condition, the structure must be able to achieve a stable state of static equilibrium in response to all of mentioned loads, from any direction. Equilibrium happens when the reactions at the foundations of a structure exactly balance and deactivate the applied load; if it were not in equilibrium, the structure would change its position in response to the load. Stability is concerned with the ability of a structural arrangement which is in equilibrium, to accommodate small disturbances without getting a major change of shape (Macdonald, 1997).

High-Rise Structure

It will more important when we talk about towers or high-rise buildings. The structure of these buildings is the key point of their design and it is the most important consideration of today living. High-rise structures in the future will have great potentials for making our urban centers better places to live. More than single purpose towers, multi-purpose towers are now under consideration because of the new needs for responsive urban architecture and design. Single towers with multiple functions like shops, living house, and offices, will have great advantages for people because of their less needs to daily transport for major needs of people. In this case, we will have less fragmentation of urban spaces and less use of cars and more pedestrian healthy ways (Zaknic, 1998).

The Possibility and desirability of high-rise structures depends on the available materials, technology and condition of services developments. Therefore always there are various advancements in this field to support new ideas for structure design. There are many architectural and design features which gradually have influenced the form and design of high-rise structures. These issues include kinds of walls and their loading systems, the core of building, the design and planning of each floor, and needed materials for the main structure. Sometimes we need more column-free spaces, open large lobbies, independent facade or external walls, and separated utility section. In most of tall buildings, the structural arrangement depends on the architectural arrangement of spaces and its aesthetics so the structure design cannot be idealized. The columns and main walls are the key elements in this discussion which need more consideration in order to resist the vertical, horizontal and lateral forces (Smith, 1991).

Magnetic Tower

In this proposal and research, we consider different ideas together to solve today problems of towers or high-rise buildings. This tower can be named magnetic tower. Its structure is combined with magnetic elements. Using of magnet provides more flexibility and stability for towers in different conditions and climate. These elements are includes magnetic foundation, magnetic slab and magnetic double skin façade. We used magnetic foundation for tower which is important to make it stable. The characteristics of magnet help the foundation to keep the building floated and in the same time, flexible in different situations like earthquake. We used magnetic plate slab for all floors of the tower. It includes magnetic plate and light concrete on top of them. This system helps each floor to have free movements in time of earthquake and windy situations. We used magnetic double skin facade for tower to not only give more freedom to the forced movements and architectural features but to provide potentials for building sustainability regarding air circulation and control of heat and coldness of internal spaces. This system is

working by two separate magnetic plates with same poles to repel each other but with specific controlled distances (Figure 1).

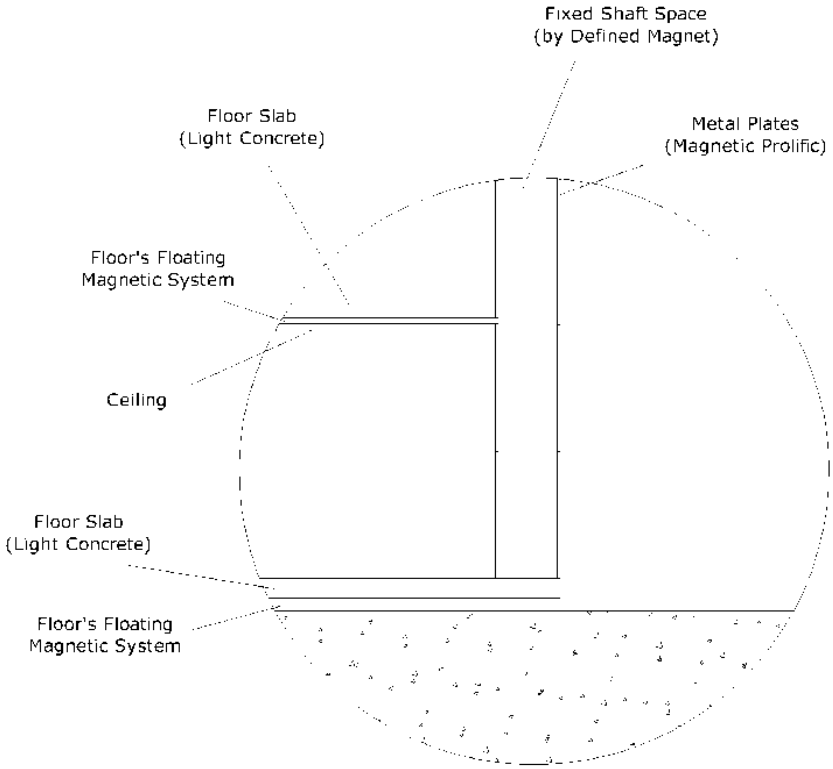

Figure 1: Details of Different Parts of Proposed Magnetic Tower Structure

This specific distance can be controlled and determined by two different formulas. These formulas are result of a research in physics and analysis of other related formulas.

$$F = \frac{B^2 A}{2\mu_0} \text{- mg}$$

$$F = \frac{4\pi B^2 R^4}{4\mu_0}\left\{\frac{1}{x^2} + \frac{x^2}{(x+2L)^2} - \frac{2}{(x+L)^2}\right\} - mg$$

Towers and design of them are one of the important issues today. This is because of their problems by lateral forces or vertical forces and lack of suitable structural system. In this research we propose new structural system by using of magnet to give more freedom to whole tower. In deep, we can design this kind of tower by using magnetic plates or ceramics and control them by keep them in specific distance, so the building in different situations and climates, can acts easily and freely, and also reduces damages and collapse.

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