

## Practical Application of In-door Tested Scaled Models on Real Building structures

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### ABSTRACT

Lightning indoor testing got a very low attention of the researchers. Although lightning is impossible to create inside the laboratory however it can be presented using high voltage impulse. High voltage impulse was generated in this paper which presents the actual lightning. Selected building structures were tested under the high voltage condition. This idea was implemented practically by applying it on different real building structures. Different building with different roof tops were observed practically and it was found that this research work has a good agreement of the lightning strike points observe during the indoor activities in high voltage lab and out door activity during the field study.

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## 1. INTRODUCTION

Lightning protection system consists of Lightning Air Terminal (LAT), ground conductor and earth wire. Different standards use the convention method of lightning protection in which LAT attract lightning and diffuses it to the ground. Lightning can cause damage to the building structure and human as well as the equipment [1]. Different standards are used for the lightning protection system installation and provide all the information about building protection [2], [3].

Every year number of people are killed due to lightning in different part of the world. Malaysia is one of the high flash density countries and therefore many people get struck due to lightning [4].

This paper presents the effect of lightning on the installed air terminals during the indoor and real observation during field work.

## 2. LIGHTNING ATTACHMENT TO STRUCTURES

When a direct lightning approaches the building structure it affects the surface of a building structure and produces a high electric field on the roof top of the building structure. Similarly the height of the building, its width and length also play a key role in lightning attraction. The rod is also the key to attract lightning and protect the building structures [5], [6]. Lightning flash can be attracted by the LATs installed on the building structures with a different ratio. The placement of the LAT plays an important role in lightning attraction. However, the LATs installed on the corners have much efficiency as compared to the LAT installed in the middle of the building roof top [7]. The placement of LAT is very important on any building structure. Due to correct placement of LAT on the building structure it can attract the lightning flashes and can protect the building structures [8].

### 3. PROPOSED PROCEDURE

Indoor testing of the different geometrical structures was carried out inside the high voltage laboratory. High voltage impulse generator was used to produce the flashover for the scaled objects. The building was scaled down by considering the ratio for a single story building in accordance with the [9]. The scaled objects were tested using high voltage impulse generator as shown in Figure 1.

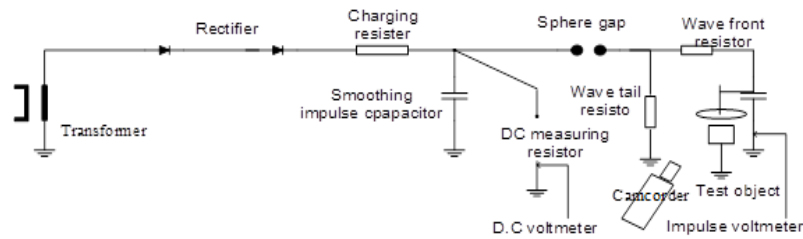


Figure 1. Schematic diagram of impulse generator

Height of the building was kept as 10 cm for each shape and impulse voltage was applied. The strike points on different shapes were observed and the field work was carried out by observing the roof tops of different building structures.

### 4. RESULTS

During the experimental process the impulse voltage was applied on the flat roof top and all the installed Lightning Air Terminals (LATs) were struck by lightning on the corner. The flashover on different air terminals of the flat roof is given in Figure 2.

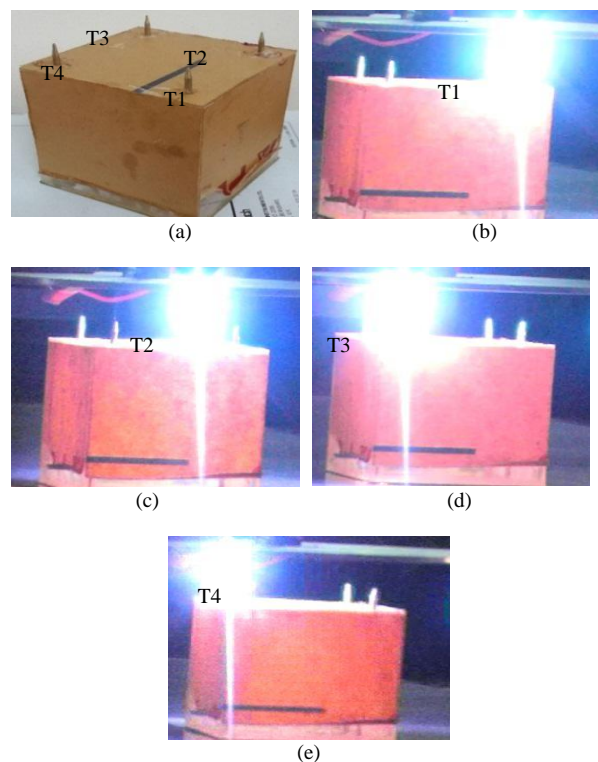


Figure 2. Flashover on the flat roof top

Similarly during the field observation it was found that the building structure were also struck by lightning on the corners. Faber towers were visited by the researchers and the strike pattern was found which has a good agreement with the experimental work done in the high voltage laboratory. Figure 3 shows the strike pattern on real building of Faber Towers.

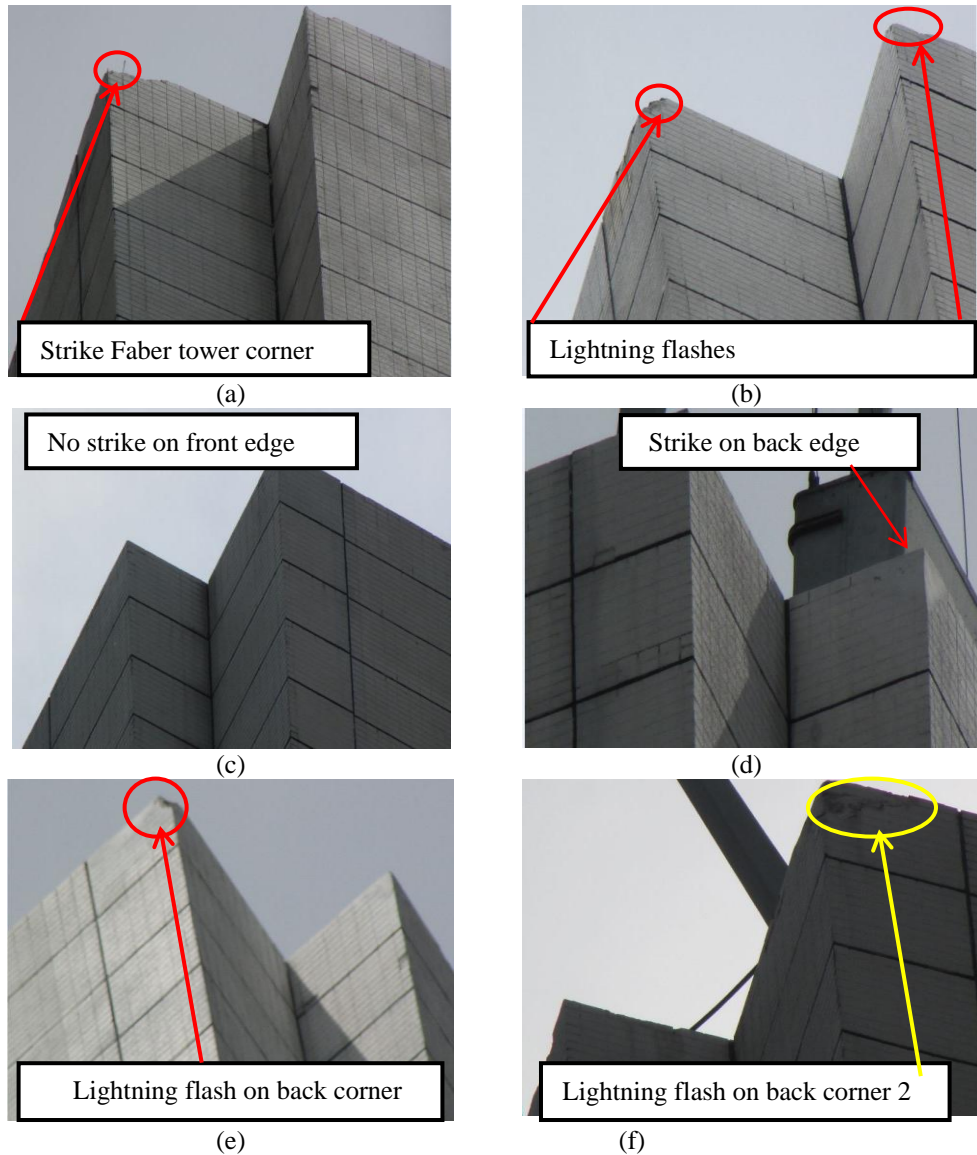


Figure 3. Lightning strike points on Faber towers

Figure 3 indicates that all the lightning flashes were struck on the corner of the real building roof top. Therefore, the indoor lightning testing can be applied to the given building installed with LAT and it can be protected from the lightning strikes.

Gable shape was also tested in high voltage laboratory which is shown in Figure 4 different air terminal is given in Figure 2.

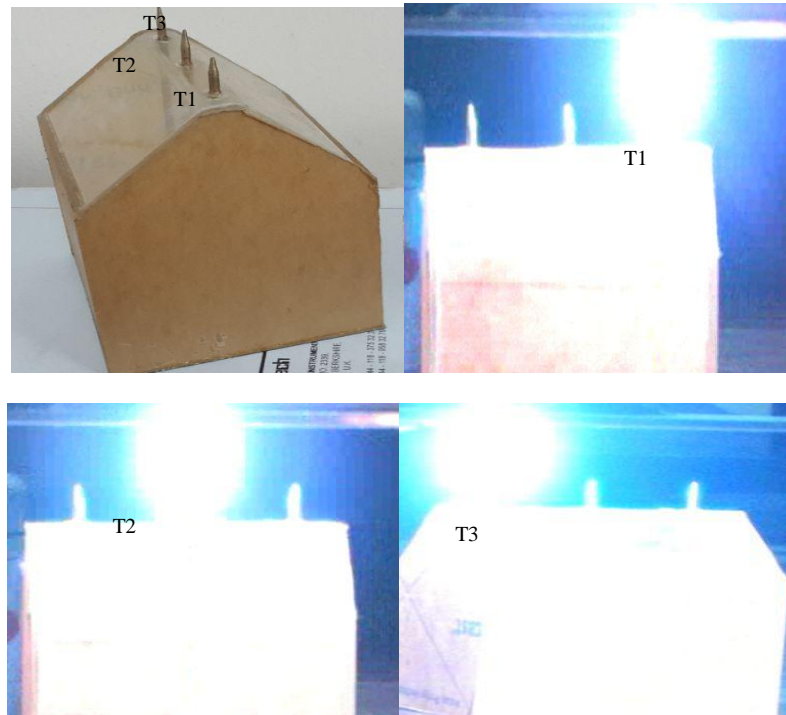


Figure 4. Flashover on Gabel shape

For the Figure 4 it can be seen all the flashes are attracted by the installed air terminals. During the field observation the incubator 1 Putrajaya was visited and the lightning strike points were found on the arc roof top.

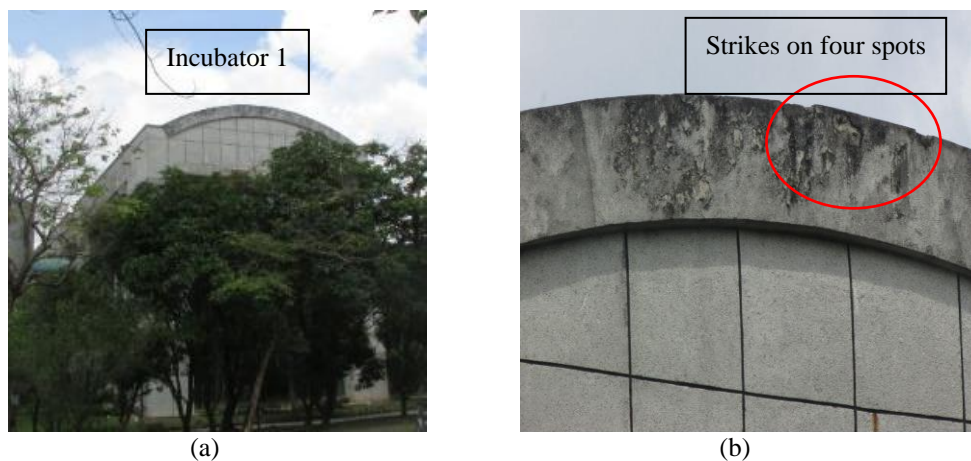


Figure 5. Strikes on the incubator 1

From the Figure 5 it can be found that the gable shape tested in indoor testing can be implemented on the building structure like incubator 1 Putrajaya.

Similarly UTH library was also taken as a case study. UTHM Library is one of the highest buildings and it is exposed to lightning and has the probability to be struck by lightning. From the library a cylindrical model was tested which can be implemented on UTHM Library. Lightning distribution on the given shape.

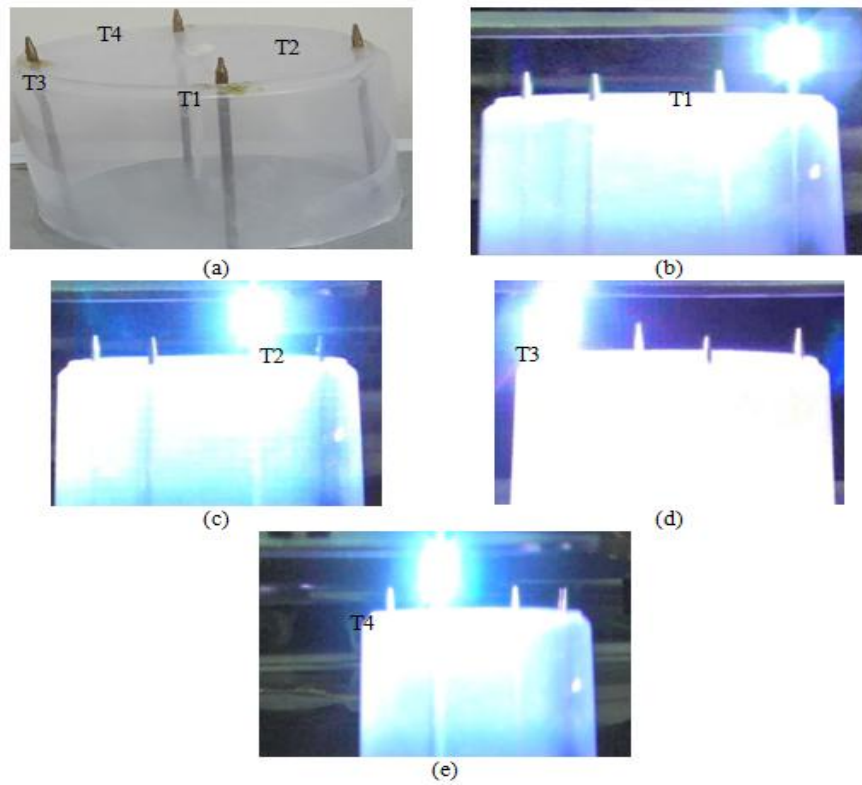


Figure 6. Cylindrical shape with flashover

The given testing can be used for UTHM Libray which is given in Figure 7. From the tested model it can be implemented for the library as it has cylindrical shape.

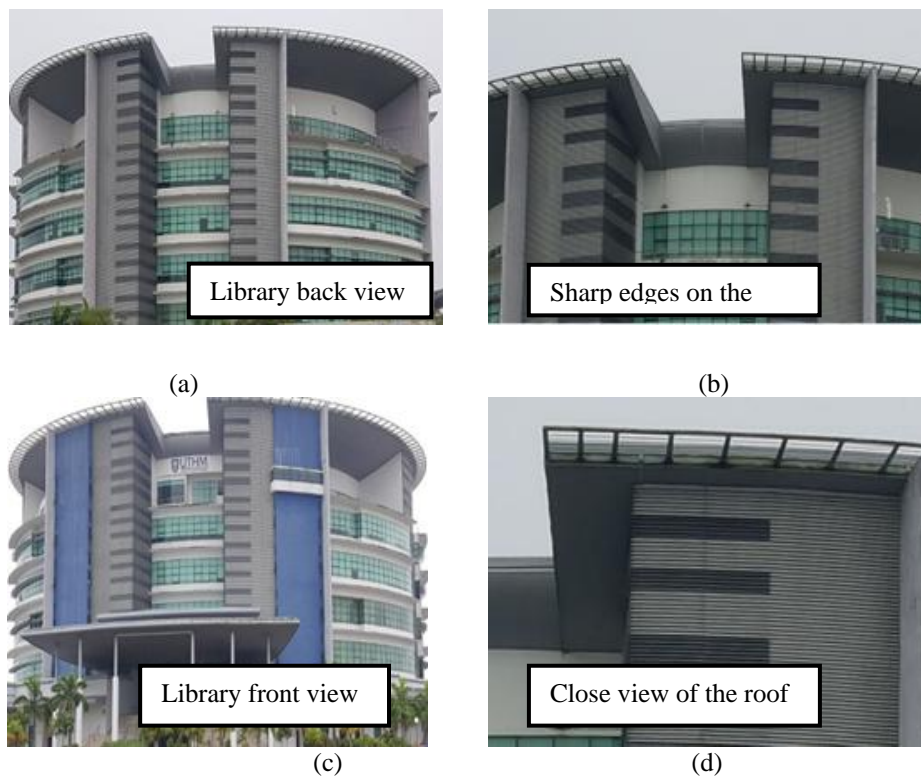


Figure 6. UTHM Library

## 5. CONCLUSION

The implementation of an indoor testing has been carried out and the different geometrical structures were selected. The shapes were tested inside the high voltage laboratory. The field observation was taken in accordance with the same shapes tested in the lab. During the field observation it was found that the geometrical shapes in real has the same characteristics of lightning attachment. Therefore, the tested model can be applied for the practical application on the observed building structures as well as the other building structures.

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