

ELECTROMAGNETIC FIELD RADIATED BY THE LIGHTNING CHANNEL AND ITS IMPACTS ON A TYPICAL BUILDING

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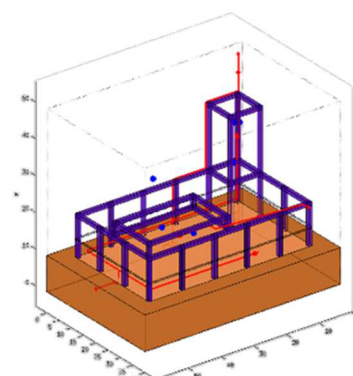
This paper deals with the failure of internal systems due to the Lightning Electromagnetic impulse (LEMP) generated by the lightning discharge.

Indeed, nowadays, the structure are equipped with electronic system more and more sensitive to external field. After a lightning strike on a structure, or near a structure, the LEMP generated can perturb even destroy the sensitive equipment.

The LEMP is composed of the direct effects of lightning by conduction, and of the inductive effects of the magnetic field.

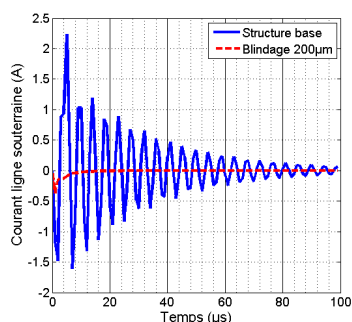
The characterization of the installation studied is realized through a rigorous electromagnetic modelling based on the FDTD (Finite Difference Time Domain) method. The modelling tool used is the free software TEMSI-FD developed by the XLIM laboratory [1]

The chosen structure for the paper is a building with large dimension (50m x 30m x 12m) and with a tower of 30m high. The building can be protected by air-terminals and surge arresters. The building is located on a soil which can be less or more conductive. Moreover, the building is connected to two services (aerial one for communication and buried one for energy).



Some Perfect Match Layers (PML) [2] have been implemented around the calculation volume, and are like if the case studied was located in an infinite space. Indeed, the PML avoid reflections, and side effect of the calculation volume.

The lightning current is generated via a quasi perfect current source. It is modeled with a voltage source associated with a high value resistance. This source is positioned in various points of the calculation volume. Those points are considered to be preferred impact points of the lightning discharge.



The lightning current applied only modelize the first strike. The mathematic formula used is one of a bi-exponential waveform with time parameters of 10/350μs, and a peak current of 200kA.

In this paper, the effects of the radiated field due to a lightning discharge on the structure are studied with respect to the impact point, and according to various configurations of the building. The various studied cases enable to analyse the effect of the electromagnetic radiated fields on the structure and on the services, the importance of the earthing system, the need of equipotentiality, and as well as the relevance of protections and shielding.

For that purpose, the electromagnetic radiated fields, the current flowing in the soil, the parasite currents induced on the services are evaluated with the FDTD method.

References

[1] C. Guiffaut, "Guide de l'utilisateur TEMSI", 2007.

[2] J. Berenger (1994). "A perfectly matched layer for the absorption of electromagnetic waves". Journal of Computational Physics 114 (2): 185–200. Bibcode 1994JCoPh.114..185B