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2D and 3D GPR imaging of structural ceilings in historic and existing constructions

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GPR applications in civil engineering are to date quite diversified. With respect to civil constructions and monumental buildings, detection of voids, cavities, layering in structural elements, variation of geometry, of moisture content, of materials, areas of decay, defects, cracks have been reported in timber, concrete and masonry elements. Nonetheless, many more fields of investigation remain unexplored. This contribution gives an account of a variety of examples of structural ceilings investigation by GPR radar in reflection mode, either as 2D or 3D data acquisition and visualisation.

Ceilings have a pre-eminent role in buildings as they contribute to a good structural behaviour of the construction. Primarily, the following functions can be listed for ceilings: a) they carry vertical dead and live loads on floors and distribute such loads to the vertical walls; b) they oppose to external horizontal forces such as wind loads and earthquakes helping to transfer such forces from the loaded element to the other walls; c) they contribute to create the box skeleton and behaviour of a building, connecting the different load bearing walls and reducing the slenderness and flexural instability of such walls.

Therefore, knowing how ceilings are made in specific buildings is of paramount importance for architects and structural engineers. According to the type of building and age of construction, ceilings may present very different solutions and materials. Moreover, in existing constructions, ceilings may have been substituted, modified or strengthened due to material decay or to change of use of the building. These alterations may often go unrecorded in technical documentation or technical drawings may be unavailable. In many cases, the position, orientation and number of the load carrying elements in ceilings may be hidden or not be in sight, due for example to the presence of false ceilings or to technical plants. GPR radar can constitute a very useful tool for investigating with rapidity and high resolution, thin as well as very thick ceilings, in a non-destructive manner.

Ceilings may be made up as masonry vaults or timber/metal/concrete beams and elements laid down in one or two directions or, again, can be made as a combination of the above. A number of cases are here presented reporting on typical features to be recognised in radargrams in order to distinguish the material and possible shape of the relevant objects with the aim of providing a first small catalogue useful to the radar user and to professionals.

This abstract is of interest for COST Action TU1208.