

## Cycle-Oriented Building Components and Constructions Made from Paper Materials

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**Abstract :** The building industry has a high demand for resources and at the same time is responsible for a significant amount of waste created worldwide. Today's building components need to contribute to the protection of natural resources without creating waste. This is defined in the product development phase and impacts the product's degree of being cycle-oriented. Paper-based materials show advantage due to their renewable origin and their ability to incorporate different functions. Besides the ecological aspects like renewable origin and recyclability the main advantages of paper materials are its light-weight but stiff structure, the optimized production processes and good insulation values. The main deficits from building technology's perspective are the material's vulnerability to humidity and water as well as inflammability. On material level, those problems can be solved by coatings or through material modification. On construction level intelligent setup and layering of a building component can improve and also solve these issues. The target of the present work is to provide an overview of developed building components and construction typologies mainly made from paper materials. The research is structured in four parts: (1) functions and requirements, (2) preselection of paper-based materials, (3) development of building components and (4) evaluation. As part of the research methodology at first the needs of the building sector are analyzed with the aim to define the main areas of application and consequently the requirements. Various paper materials are tested in order to identify to what extent the requirements are satisfied and determine potential optimizations or modifications, also in combination with other construction materials. By making use of the material's potentials and solving the deficits on material and on construction level, building components and construction typologies are developed. The evaluation and the calculation of the structural mechanics and structural principals will show that different construction typologies can be derived. Profiles like paper tubes can be used at best for skeleton constructions. Massive structures on the other hand can be formed by plate-shaped elements like solid board or honeycomb. For insulation purposes corrugated cardboard or cellulose flakes have the best properties, while layered solid board can be applied to prevent inner condensation. Enhancing these properties by material combinations for instance with mineral coatings functional constructions mainly out of paper materials were developed. In summary paper materials offer a huge variety of possible applications in the building sector. By these studies a general base of knowledge about how to build with paper was developed and is to be reinforced by further research.

**Keywords :** construction typologies, cycle-oriented construction, innovative building material, paper materials, renewable resources

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