Folded Cardboard Sandwiches for Load-bearing Architectural Components

Experimental research on paper-like building components
MATERIAL
Characteristics of corrugated cardboard panels:

• highly developed
• produced worldwide
• cheap to manufacture
• light in weight
• easy to recycle
• very sustainable
• foldable after preparation

Credit: VDW Germany, 2017
Corrugated Cardboard Production in billions of m²

Europe / Worldwide 2005 - 2015

Output by Country

Source: Statista, 2017
SWAP Panel: Laminated and un laminated corrugated cardboard panels
Thickness: from 5 to 100mm
FOLDING
Advantages of folded elements:

- Increased stability compared to flat elements
- Easy assembling of several parts by plugging or gluing
- Substitute for wooden parts
- Material saving due to additive construction
- Adaptability to the building geometry
- Free design possibilities
Normal folding with compressed surface

Folding after removing of a stripe-like part of the inner surface
Normal folding with compressed surface

Folding after removing of a stripe-like part of the inner surface
GEOMETRY
Geometrical connections

The paper removal (l) corresponds to the arc length (a)
Length of surface removal = $\pi \times$ material thickness $\times$ quotient of $\beta$ and 180°
Schematic folding process of a triangular element

a) Flat sandwich plate with areas of surface removal
Example of a triangular component and its segments
PROTOTYPES
Section model of a folded load-bearing element with triangular shape
Variations based on a triangular shape (hybrid with inlaid wooden element)
Section model of a folded load-bearing element with rectangular shape
Variations based on a rectangular shape (hybrid with inlaid wooden element)
PILLARS AND BEAMS
Pillars: Single and combined hollow profiles

Pillars: Double material profiles with different axes (material in force direction)
Walls: Single faced element, double faced sandwich, curved sandwich

Walls: Single and double curved elements
CEILINGS
Ceilings: Single horizontal beams and continuous ribbed slab

Ceilings: Sandwiches with sheet pile design and triangulated core
EXPERIMENTAL BUILDING
1. Load-bearing frames made of folded cardboard panels
2. Cardboard panels for isolation and cladding of a ventilated facade
3. Two-component sealing as protection against rain
Frame corner with wooden connector

Frames on construction site
Finished building with two-component sealing on the facade

West elevation with window made of prestressed ETFE foil
Interior

Structural system
THANK YOU!