

BBf BRiCK

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Carbon footprint details of BBf BRiCK's
BRiCK-A-LIKE & BRiCK CLASSIC solutions

- *Internal calculations, based on 3. party verified EPD.*

1. BACKGROUND

In 2023, BBf BRiCK (part of the BB fiberbeton Group) launched a new brick facing cladding solution purely based on GRC – BRiCK-A-LIKE –, in addition to the existing solution which incorporates traditional brick slips – BRiCK CLASSIC.

The goal, regarding the introduction of BRiCK-A-LIKE, was to reduce to a minimum the material usage and weight, furthermore, reducing the carbon footprint of the cladding element. With BRiCK-A-LIKE, no burnt clay brick slips are used.

This memo showcases and details the carbon footprint of each BRiCK solution.

All data in this memo is based on 2 elements designed and manufactured to the same geometry, loading conditions, support system and durability:

- 1) BRiCK CLASSIC solution: 30 mm thick burnt clay brick slips at the surface.
- 2) BRiCK-A-LIKE solution: 5 mm coloured GRC “bricks” at the surface.

Any mention of GRC refers to glassfibre-reinforced concrete, sometimes also referred to as GFRC.

BRICK CLASSIC is described as follows:

In short, BRICK CLASSIC is GRC elements with embedded clay brick slips. The brick slips are embedded directly into the GRC, ensuring a strong and durable bond.

BRICK CLASSIC elements can be made in the desired size and length, with precisely the type of clay brick slips that is desired – often chosen for aesthetic reasons. Likewise, bonds and joints can be customized to fit the given project. The final element will, therefore, take on characteristics from the chosen brick slips and their texture.



BRICK-A-LIKE is described as follows:

BRICK-A-LIKE is made of pure GRC and provides the aesthetics of bricks without the need for actual clay brick slips.

BRICK-A-LIKE elements can be made in the desired size and length and grants unprecedented design freedom to influence the brick aesthetics. These elements are not limited by available clay brick slips but can freely be designed by customizing shape, colour, joint, and bond. Conventional masonry methods and stacking principles can be set aside, letting BRICK-A-LIKE offer new and exciting architectural design possibilities.



2. ELEMENTS DETAILED

The elements detailed and showcased are 4668 mm wide and 1521 mm high. Standard Danish brick geometry is applied (nominal facing geometry 228 mm x 54 mm, horizontal joints are 12.67 mm high and vertical joints are 12 mm wide).

The thickness of the brick slips is 30 mm for the BRiCK CLASSIC solution, whilst the thickness of the GRC bricks is 5 mm for the BRiCK-A-LIKE solution.

For the BRiCK CLASSIC solution, a FM5 grouting mortar is applied after demoulding with a depth of 25 mm.

The elements are designed with hollow ribs on the backside to distribute structural loads and are installed via 8 (4 top + 4 bottom) embedded stainless steel brackets. See details in appendix A.1.

Other relevant data for both solutions:

- Total number of bricks/grc-bricks: 448.5
- Total length of horizontal joints: 102.7m
- Total length of vertical joints: 29.7m
- Total element area: 7.10 m²

Drawing details for the BRiCK CLASSIC and BRiCK-A-LIKE elements are included in appendix A.2 and A.3, respectively.

3. GLOBAL WARMING POTENTIAL

The GWP_{A1-A3} for each component in the showcased and detailed elements is calculated in the following table.
GWP data for each component is presented in appendix B.

	BRICK CLASSIC		BRICK-A-LIKE	
	Amount	kg CO _{2,eq}	Amount	kg CO _{2,eq}
Facing Bricks	$448.5 \times 0.228 \times 0.054 \times 0.03 = 0.1657 \text{ m}^3$ $0.1657 \text{ m}^3 \times 1,800 \text{ kg/m}^3 = 298.26 \text{ kg}$ brick slips of type B221 GWP _{A1-A3,B221} = 0.129 kg CO _{2,eq} /kg	38.48	$448.5 \times 0.228 \times 0.054 \times 0.005 = 0.0276 \text{ m}^3$ $0.0276 \text{ m}^3 \times 1,950 \text{ kg/m}^3 = 53.82 \text{ kg}$ GRC brick slips GWP _{A1-3,GRC, grey cement} = 0.689 kg CO _{2,eq} /kg	37.08
Grouting	$102.7 + 29.7 = 132.4 \text{ m}$ of grout Grout thickness 12mm / depth 25mm → 0.0397 m ³ $0.0397 \text{ m}^3 \times 1,950 \text{ kg/m}^3 = 77.415 \text{ kg}$ grout GWP _{A1-A3,FM5} = 0.162 kg CO _{2,eq} /kg	12.54	No grouting – visible GRC from back structure	0
Glassfibre Reinforced Concrete	Ribs: 0.1416 m ³ 12 mm plate: 0.0839 m ³ Total GRC: 0.2255 m ³ $(0.2255 \text{ m}^3) \times 1,950 \text{ kg/m}^3 = 439.73 \text{ kg}$ GWP _{A1-3,GRC, grey cement} = 0.689 kg CO _{2,eq} /kg	302.97	Ribs: 0.0924 m ³ 12 mm plate: 0.0839 m ³ Total GRC: 0.1763 m ³ $(0.1763 \text{ m}^3) \times 1,950 \text{ kg/m}^3 = 343.78 \text{ kg}$ GWP _{A1-3,GRC, grey cement} = 0.689 kg CO _{2,eq} /kg	236.86
Embedded stainless steel	8 pcs of 0.763 kg = 6.104 kg GWP _{A1-A3,ST} = 3.42727 kg CO _{2,eq} /kg	20.92	8 pcs of 0.763 kg = 6.104 kg GWP _{A1-A3,ST} = 3.42727 kg CO _{2,eq} / kg	20.92

The total weight and Global Warming Potential of each of the elements is provided in the following table.

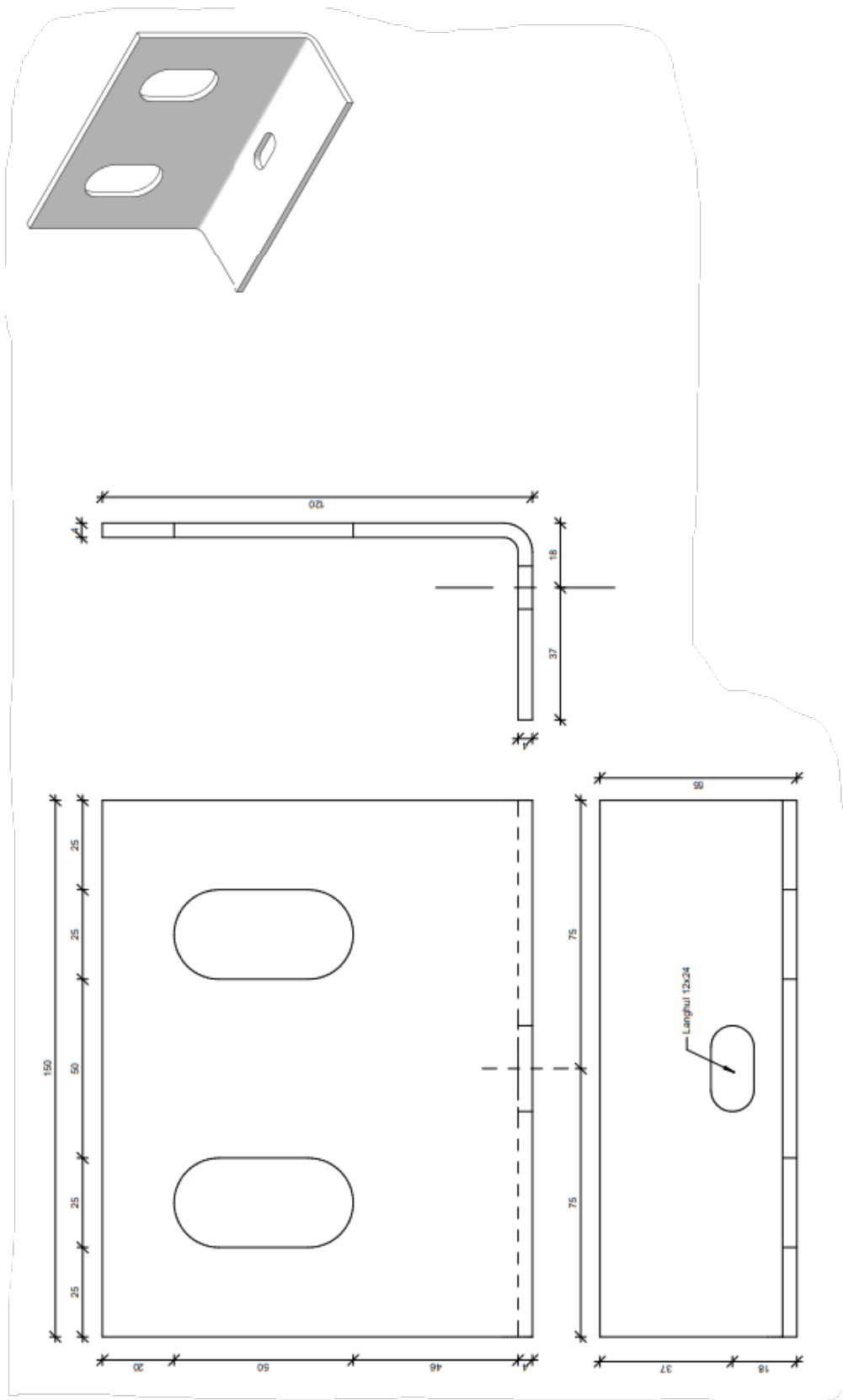
	BRICK CLASSIC	BRICK-A-LIKE
Weight of element, kg	821.5 (115.7 kg/m ²)	403.7 (56.9 kg/m ²)
GWPA1-A3, kg CO _{2,eq}	374.9 (52.8 kg/m ²)	294.9 (41.5 kg/m ²)

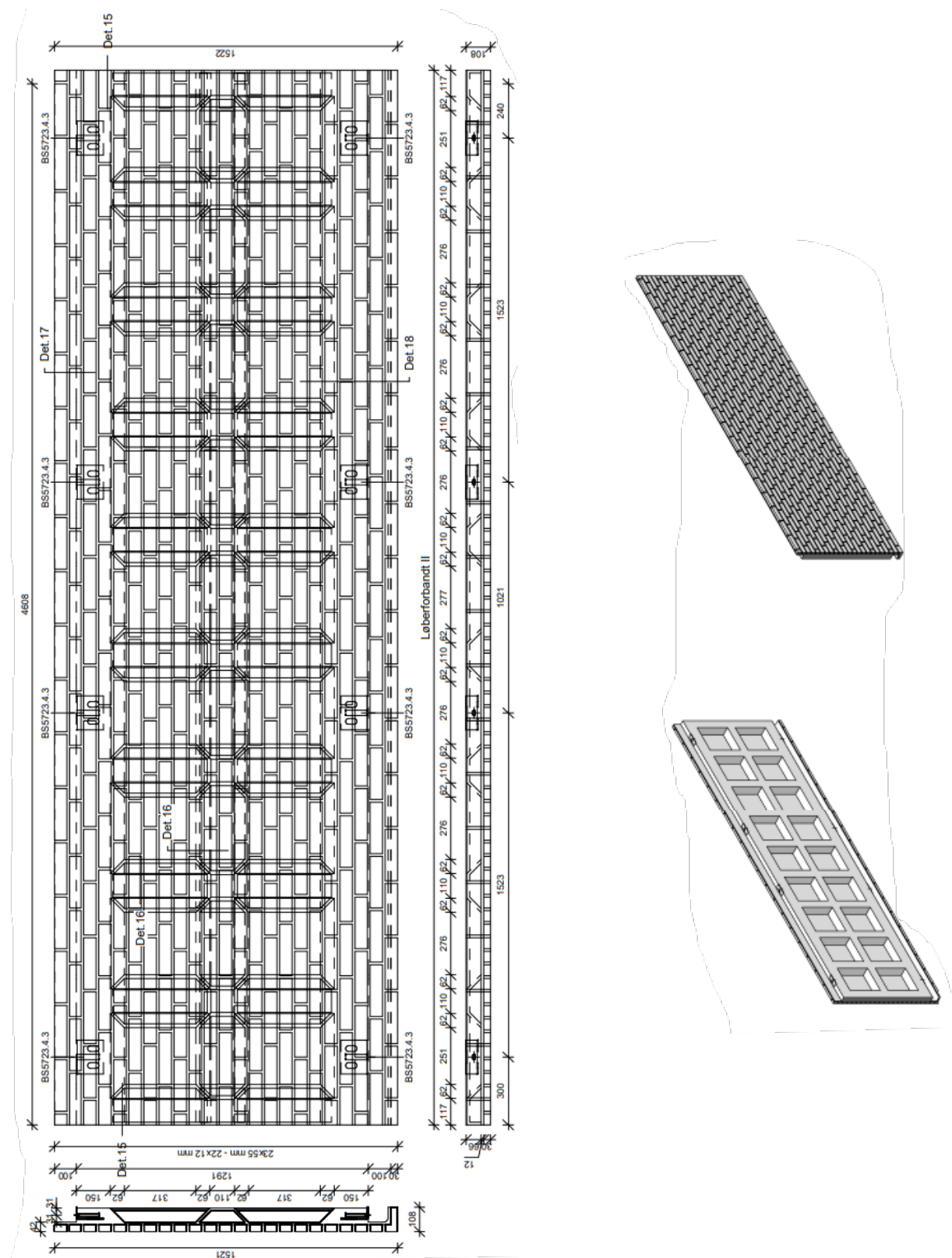
Note: For this specific case, BRICK-A-LIKE enables weight savings around 50%, whilst reducing the environmental impact (expressed as GWP) by 20%, compared to a traditional GRC solution with burnt clay brick slip (such as or similar to BRICK CLASSIC).

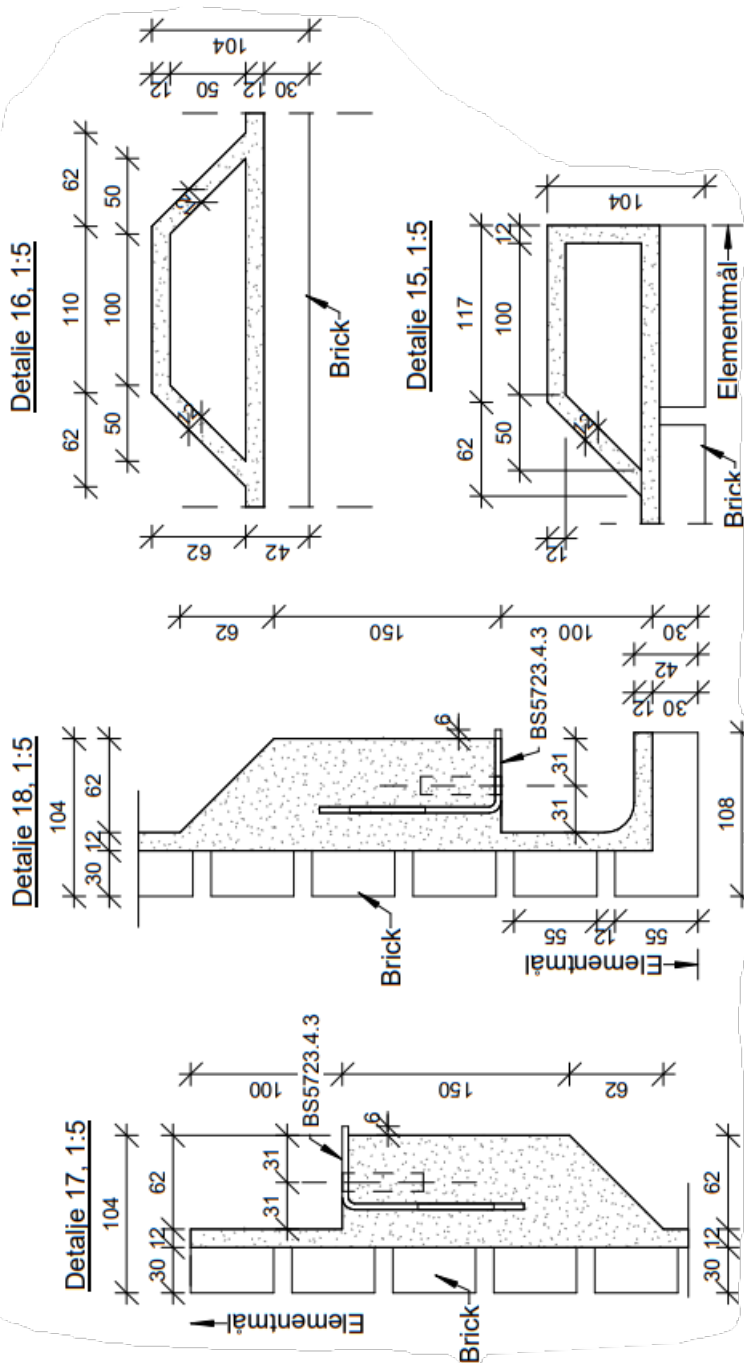
APPENDIX A: Design of the elements

A.1: Details of embedded stainless-steel brackets

Material type: A2, aisi 304 EN10028-7 / 1.4301



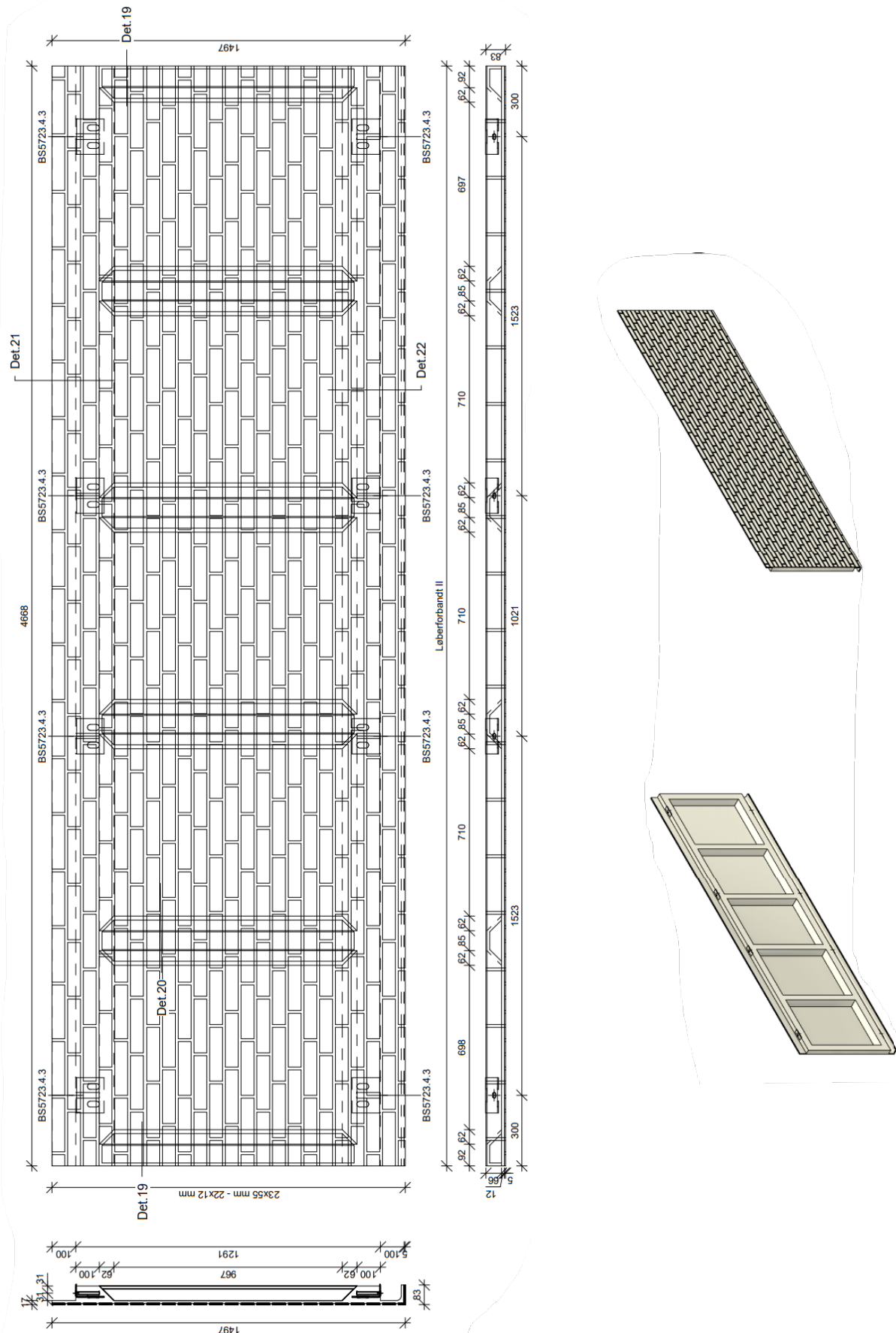


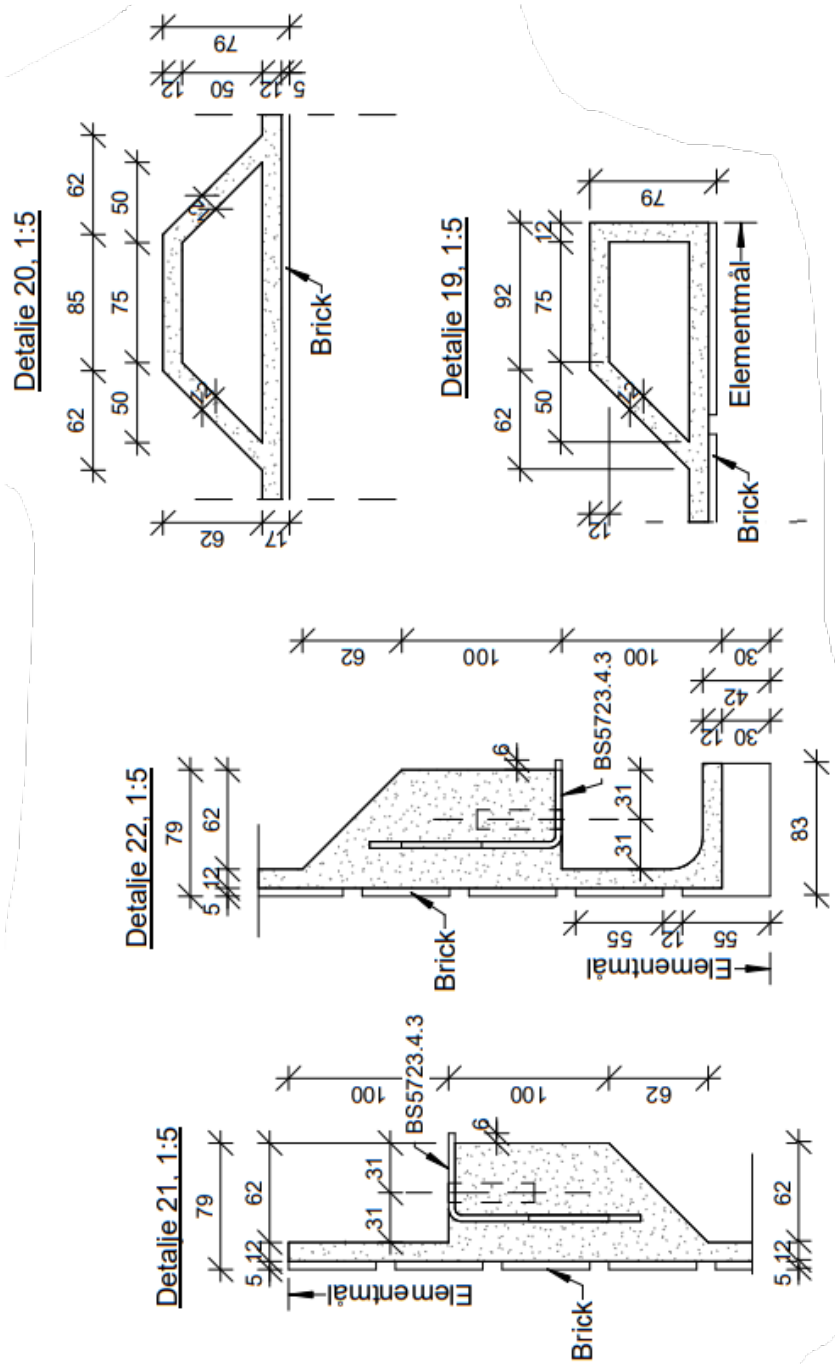


A.3: Design BRiCK-A-LIKE element

Total weight of element is 449 kg. Brick-A-LIKE slips are 5 mm thick.

Upper and lower ribs are massive, all other are hollow. Standard GRC thickness 12 mm.





APPENDIX B: Environmental Data

This appendix presents the relevant environmental data chosen for the different components taken into account for the overall carbon footprint detailing in the report. Only life cycle modules A1-A3 are included.

Glassfibre reinforced concrete

BB fiberbeton's EPD no. MD-21008-EN proves a GWP (modules A1-A3) at 0.845 kg CO_{2,eq} / kg GRC.

BBf BRiCK CLASSIC and BRiCK-A-LIKE are manufactured with grey Portland cement (Aalborg Portland BASIS cement, $GWP_{A1-A3,BASIS\text{ cement}} = 0.726 \text{ kg CO}_{2,eq} / \text{kg cement}$) instead of white Portland cement (Aalborg Portland AALBORG WHITE cement, $GWP_{A1-A3,AALBORG\ WHITE\ cement} = 1.04 \text{ kg CO}_{2,eq} / \text{kg cement}$).

Based on the LCA report prepared prior to the EPD of BB fiberbeton GRC, 61% of the total GWP originates from the manufacture and distribution of the white cement. The EPD for BB fiberbeton GRC manufactured with grey Portland cement (BASIS cement) is estimated to:

$$GWP_{A1-A3,GRC,Grey\ cement} = GWP_{A1-A3,GRC,White\ cement} \times \left(1 - 0,61 \times \left(1 - \frac{GWP_{A1-A3,BASIS\ cement}}{GWP_{A1-A3,AALBORG\ WHITE\ cement}} \right) \right)$$

$$GWP_{A1-A3,GRC,Grey\ cement} = 0.845 \times \left(1 - 0,61 \times \left(1 - \frac{726}{1.040} \right) \right)$$

$$GWP_{A1-A3,GRC,Grey\ cement} = 0.689 \text{ kg CO}_{2,eq} \text{ per kg GRC}$$

Declared unit: 1 kg, Declared density: 1,950 kg/m³.

Grouting mortar for BRiCK CLASSIC

GWP data from an FM5 mortar in "EPD Danmark, no. MD-21072-DA - VM5 ufarvet (grå)" is used.

Declared unit: 1 kg, Declared Density: 1,950 kg/m³, $GWP_{A1-A3,FM5} = 0.162 \text{ kg CO}_{2,eq} / \text{declared unit}$.

Brick slips for BRiCK CLASSIC

GWP data from a red brick B221 from Strøjer Tegl in “EPD Danmark, no. MD-21045-EN” is used.

Declared unit: 1 kg, Declared Density: 1,800 kg/m³, GWP_{A1-3,B221}= 0.129 kg CO_{2,eq} / declared unit.

Stainless Steel

The embedded stainless-steel brackets are of type A2 (aisi 304, EN10028-7 / 1.4301). GWP data is taken from the Danish Building Code BR18, appendix 2, table 7, ID #G0551.

Declared unit: 1 kg, Density: 7,860 kg/m³, GWP_{A1-A3,ST}= 3.427 kg CO_{2,eq} / declared unit.