# ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

<table>
<thead>
<tr>
<th>Owner of the Declaration</th>
<th>HALFEN GmbH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programme holder</td>
<td>Institut Bauen und Umwelt e.V. (IBU)</td>
</tr>
<tr>
<td>Publisher</td>
<td>Institut Bauen und Umwelt e.V. (IBU)</td>
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<tr>
<td>Declaration number</td>
<td>EPD-HAL-20160245-IBC1-EN</td>
</tr>
<tr>
<td>Issue date</td>
<td>14.02.2017</td>
</tr>
<tr>
<td>Valid to</td>
<td>13.02.2022</td>
</tr>
</tbody>
</table>

HALFEN cast-in anchor channel systems
HTA-CE (HTA) and HZA

HALFEN GmbH

www.ibu-epd.com / https://epd-online.com
1. General Information

HALFEN GmbH

Programme holder
IBU - Institut Bauen und Umwelt e.V.
Panoramastr. 1
10178 Berlin
Germany

HALFEN cast-in anchor channel systems HTA-CE (HTA) and HZA

Owner of the Declaration
HALFEN GmbH
Liebigstraße 14
40764 Langenfeld
Germany
Europe

Declaration number
EPD-HAL-20160245-IBC1-EN

Declared product / Declared unit
The declared unit is one running metre with a weight of 2.6 kg per metre.
HALFEN cast-in anchor channel systems HTA-CE (HTA) and HZA in hot-dipped galvanized quality depicted using the example of HALFEN HTA-CE (HTA 40/22) with corresponding hook-head channel bolts type HS 40/22. HS 40/22 M12x40 mm bolts are assumed per running metre channel (4x at HTA-CE; 6.5x at HTA).

This Declaration is based on the Product Category Rules:
Thin walled profiles and profiled panels of metal, 07.2014 (PCR tested and approved by the SVR)

Issue date
14.02.2017

Valid to
13.02.2022

Scope:
This document refers to the HALFEN cast-in anchor channel systems HTA-CE (HTA) and HZA and corresponding HS and HZS channel bolts (hook-head channel bolts and hammer-head channel bolts). HALFEN cast-in anchor channels type HTA-CE and HZA are produced at HALFEN plant Langenfeld / Germany and HALFEN cast-in anchor channels type HTA and HZA are produced at HALFEN plant Windcrest / USA. Specific data from the HALFEN production facility in Langenfeld / Germany and Windcrest / USA was recorded for the LCA.

The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

Verification
The CEN Norm /EN 15804/ serves as the core PCR
Independent verification of the declaration according to /ISO 14025/

Dr. Burkhard Lehmann
(Managing Director IBU)

Matthias Kringer
(Independent verifier appointed by SVR)

2. Product

2.1 Product description
The product portfolio of HALFEN cast-in anchor channel systems compromises cast-in anchor channels type HTA-CE (HTA) and type HZA and corresponding hook-head channel bolts and hammer-head channel bolts named as HS (for HTA-CE and HTA) and HZS (for HZA).

The anchor channel comprises a C-shaped steel profile with mounted anchors on the channel back. These anchors are formed as round bolt anchors or as I-anchors. The anchors are mounted on the channel back by riveting or welding process. Hot-dipped galvanized quality was considered for this EPD.

The inner section of the anchor channel is filled with a PE foam which prevents an entry of concrete slurry during casting.

The various anchor channels differ in terms of mass in relation to running metres.

The declared reference product is the cast-in anchor channel system HTA-CE (HTA) 40/22 with HS 40/22 bolts with a weight of 2.6 kg/m.

In order to calculate the LCA results for the following cast-in anchor channel types the conversion factors listed in chapter 3.10 can be applied.
Environmental Product Declaration Halfen GmbH – HALFEN cast-in anchor channel systems HTA-CE (HTA) and HZA

2.2 Application
Cast-in anchor channels are cast in concrete. Prior to the casting process, they are positioned in the component and fastened in their position to the formwork, to the reinforcement or by appropriate auxiliary construction. Anchor channels serve towards subsequent fastening of fixtures.

Typical areas of application include curtain wall façades, fastening elevator installations in shafts, fastening of overhead wires and utility service pipes and cables in tunnel, fastening of handrails, platforms or seats as well as applications in the area of installation technology.

2.3 Technical Data
For the placing on the market in the EU/EFTA (with the exception of Switzerland) the Regulation (EU) No 305/2011 applies. The products need a Declaration of Performance taking into consideration the respective European Technical Assessment and the CE marking.

All geometrical dimensions, product-specific parameters and the static load capacities of the different cast-in anchor channel systems HTA-CE (HTA) and HZA are given in the following technical specifications:

HTA-CE (HTA) system:
- /ETA 09/0339/
- /ETA 16/0453/
- /CABR-YMC-1A-(2016) by CABR/
- /ICC-ESR 1008 by ICC-ES/

HZA system:
- /Z-21.4-145/
- /Z-21.4-1691/

Some types of cast-in anchor channels HTA-CE (HTA) and HZA are also approved for transfer of fatigue cyclic loads and for fire exposure.

Please refer to the mentioned approval documents for a detailed design of the anchor channel and other data related to the specific application condition.

2.4 Application rules
For the application and use the respective national provision apply.

HALFEN cast-in anchor channel systems (exclude HZA 41/27) are designed in accordance with:
- /AC 232/, /ACI 318/ and /ICC-ESR 1008/ or
- National technical building approvals /Z-21.4-145/ and /Z-21.4-1691/ from German Institute for Building Technology (DIBt)

2.5 Delivery status
HALFEN cast-in anchor channels and HALFEN channel bolts are packed separately and can also be ordered separately. (further information available in section 2.10).

2.6 Base materials / Ancillary materials

Name | Value | Unit
--- | --- | ---
Channel profile: galvanized steel | 82 | %
Channel anchor: galvanized steel | 6 | %
Channel bolt set: galvanized steel | 11 | %
Channel Filler: PE Foam | 1 | %

The product weight with respect to the declared unit HTA-CE (HTA) 40/22 in hot-dipped galvanized quality is ca. 2.6 kg per metre (average value).

2.7 Manufacture
The materials needed for the final assembly of the HALFEN cast-in anchor channel systems HTA-CE (HTA) and HZA are manufactured in-house or purchased from qualified vendors. The HALFEN cast-in anchor channels are made of cold-formed or hot-rolled channel profiles. The cold-formed channel profiles are produced at HALFEN plant Langenfeld / Germany.

The anchors are mounted on the channel back by riveting or welding process. HALFEN cast-in anchor channels with riveted bolt anchors are produced at HALFEN plant Langenfeld / Germany. HALFEN cast-in anchor channels are cast-in anchor channels are cast in concrete. Prior to the casting process, they are positioned in the component and fastened in their position to the formwork, to the reinforcement or by appropriate auxiliary construction. Anchor channels serve towards subsequent fastening of fixtures.

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Please refer to the mentioned approval documents for a detailed design of the anchor channel and other data related to the specific application condition.
anchor channels with welded I-anchors are produced at HALFEN plant Langenfeld / Germany and HALFEN plant Windcrest / USA. The anchor channels are hot-dipped galvanised after the mounting process of the anchors. The filler is assembled after the galvanising process at HALFEN plant Langenfeld / Germany or HALFEN plant Windcrest / USA.

2.8 Environment and health during manufacturing
The criteria for environmental and energy management and the requirements for the Health and Safety at work follow all statutory requirements and HALFEN standards.

HALFEN was certified according to /DIN EN ISO 50001/ on the 15th April 2016 for all its 18 locations inside Europe, the United States of America and China by the SWEDAC Certification Institute International GmbH. Since 1994 all HALFEN Locations are certified according to /ISO 9001/ (ISO 9001:2015) by DNV GL. The continuous production and product quality according to the product specifications and approval specifications of HALFEN cast-in anchor channel systems HTA-CE (HTA) and HZA are ensured by an in-process quality control by HALFEN and by regularly third party quality inspections by /MPA NRW/ and /IAS/ certified bodies.

All types of waste such as steel, PE foam, wood (wood pallets) and packaging materials (cardboard) that are incurred in the production of the product or remain as excess material will be separated according to type and recycled.

2.9 Product processing/Installation
The HALFEN cast-in anchor channel systems HTA-CE (HTA) and HZA are supplied as a ready to install anchor channel element. The HALFEN cast-in anchor channel is positioned in the building shell or in the precast concrete plant during or alternatively after the reinforcement installation without the use of lifting equipment. The HALFEN cast-in anchor channel is positioned in the component and fastened in position to the formwork, to the reinforcement or by appropriate auxiliary construction and secured against slippage during subsequent concreting. No special environmental protection measures need to be taken while processing HALFEN cast-in anchor channels HTA-CE (HTA) and HZA.

2.10 Packaging
The HALFEN cast-in anchor channels are delivered packed and strapped in bundles as long goods. Up to a length of 1.05 metres, the anchor channels are delivered on Euro pallets or cardboards. Depending on the size and length, HALFEN channel bolts are packed in packing Units of several sizes in cardboard boxes. The individual packaging materials should be separated according to their type and recycled.

2.11 Condition of use
After installation and casting, the foam is usually removed and disposed of. All supplied materials are protected in the installed condition against external influences and designed for the service life of the respective construction. No risks can arise to water, air and soil if the products are used as designated.

2.12 Environment and health during use
When used as designated, there is no impact on the environment or health.

2.13 Reference service life
A service life of at least 50 years confirmed by approval procedures is applicable for HALFEN cast-in anchor channel systems HTA-CE (HTA) and HZA, which are in line with the safety concepts outlined in the /Eurocode/ or /ACI/. The practical service life can however be considerably longer. A further condition for the service life is that the HALFEN cast-in anchor channel is used in accordance with the designed application. This service life refers to static design approach and not to reference service life according to /ISO 15686/.

2.14 Extraordinary effects

Fire
HALFEN cast-in anchor channel systems HTA-CE (HTA) and HZA are approved for the effects of fire in accordance with several technical building approvals (see section 2.4) and are not allocated to any building material class.

Water
The declared HALFEN cast-in anchor channel systems comprise hot-dipped galvanised steel. There are no environmental risks attributable to the effects of water.

Mechanical destruction
In the event of unintentional mechanical destruction, there is no risk for users or the environment if the product has been installed correctly.

2.15 Re-use phase
Cast-in anchor channels can not be re-used but material recycling is possible. All components of the described product can be returned and recycled into the material cycle. In view of an efficient recycling process it should be ensured that a separation of materials during decommissioning is possible.

2.16 Disposal
The disposal of non-recycled parts of HALFEN cast-in anchor channels can be disposed of at any waste disposal site with appropriate waste number /EWC/ 191001 (for steel components) or /EWC/ 170904 (other components) according to the /European Waste Code/ of the European Waste Catalogue.

2.17 Further information
www.halfen.com

3. LCA: Calculation rules
3.1 Declared Unit
The declared unit is 1 m length of cast-in anchor channel.
The calculation of the average of two production sites is based on actual production volumes.

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Declared unit</td>
<td>1</td>
<td>m</td>
</tr>
<tr>
<td>Grammage</td>
<td>2.6</td>
<td>kg/m</td>
</tr>
<tr>
<td>Conversion factor to 1 kg</td>
<td>0.385</td>
<td>-</td>
</tr>
</tbody>
</table>

3.2 System boundary
Type of the EPD: cradle-to-gate - with options.
The declaration considers the life cycle stages of production (A1-A3), including processes that provide materials (mainly steel) and energy input for the system, manufacturing (welding and riveting) and transport processes up to the factory gate, as well as waste processing. The production takes place in Germany and the USA, all main raw-materials are transported to factory in Germany and then distributed to the USA. The end of life covers the recycling of the steel parts, with impacts in module C4 and module D which covers loads and benefits beyond the system boundaries are also considered.

3.3 Estimates and assumptions
No estimates and assumptions were made.

3.4 Cut-off criteria
In this assessment all data for the production process is considered. This includes input flows with a contribution of less than 1% of mass or energy. The transport expenditure for all raw materials are considered. Impacts relating to the production of machines and facilities required during production are outside the scope of this assessment. The impacts arising from the dismantling of the products from the building structure (separating concrete, metal and other building materials) are not considered. The impacts are estimated to contribute less than 1% to the overall result.

3.5 Background data
For life cycle modelling of the considered products, the /GaBi ts Software/, developed by thinkstep AG, has been used. All relevant background datasets are taken from the /GaBi ts Software/ database. The datasets from the GaBi database are documented in the online documentation /GaBi ts Data/.

3.6 Data quality
The data quality can be described as good. The primary data collection was done thoroughly, all flows were considered. Technological, geographical and temporal representativeness is given. Primary data refers to the year 2015. Background datasets were taken from the /GaBi ts Data/ database. The last update of the database was 2016.

3.7 Period under review
The period under review is the year 2015.

3.8 Allocation
The overall production of Halfen comprises further products beside the product considered in this study. Data for thermal and electrical energy as well as auxiliary material refer to the declared product. During data collection the allocation is done via linear meter (m).
Specific information on allocation within the background data is given in the GaBi dataset documentation (http://www.gabi-software.com/international/databases/gabi-data-search/).

3.9 Comparability
Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to /EN 15804/ and the building context, respectively the product-specific characteristics of performance, are taken into account.

3.10 Factors for minimum and maximum variants
The HALFEN anchor channel is available with different lengths, widths and anchor types. In order to enable the user of this EPD to calculate the LCA results for the product types listed in chapter 2.1, the specific weight can be multiplied by the 1 kg results listed in the following table.

```
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Module</th>
<th>A1-A3</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>GWP</td>
<td>1.72E+00</td>
<td>-6.04E-01</td>
<td></td>
</tr>
<tr>
<td>ODP</td>
<td>-2.75E-10</td>
<td>2.70E-12</td>
<td></td>
</tr>
<tr>
<td>AP</td>
<td>5.00E-03</td>
<td>-2.32E-03</td>
<td></td>
</tr>
<tr>
<td>EP</td>
<td>5.00E-04</td>
<td>-1.83E-04</td>
<td></td>
</tr>
<tr>
<td>PCP</td>
<td>5.73E-04</td>
<td>-3.38E-04</td>
<td></td>
</tr>
<tr>
<td>ADPE</td>
<td>3.47E-05</td>
<td>4.96E-08</td>
<td></td>
</tr>
<tr>
<td>ADIF</td>
<td>1.88E+01</td>
<td>-5.65E+00</td>
<td></td>
</tr>
<tr>
<td>PERT</td>
<td>3.36E+00</td>
<td>2.96E-01</td>
<td></td>
</tr>
<tr>
<td>PENRT</td>
<td>2.08E+01</td>
<td>-5.42E+00</td>
<td></td>
</tr>
</tbody>
</table>
```

4. LCA: Scenarios and additional technical information
The following technical information is a basis for the declared modules or can be used for developing specific scenarios in the context of a building assessment if modules are not declared (MND).

End of life (C1-C4)

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collected as mixed construction waste</td>
<td>2.59</td>
<td>kg</td>
</tr>
<tr>
<td>Recycling</td>
<td>2.59</td>
<td>kg</td>
</tr>
</tbody>
</table>

Reuse, recovery and/or recycling potentials (D), relevant scenario information

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel scrap input volume</td>
<td>1.67</td>
<td>kg</td>
</tr>
<tr>
<td>Steel scrap EoL volume</td>
<td>2.59</td>
<td>kg</td>
</tr>
<tr>
<td>Net steel scrap volume</td>
<td>0.87</td>
<td>kg</td>
</tr>
</tbody>
</table>

The net steel scrap volume is 0.87 kg, resulting from an input steel scrap of 1.67 kg and an EoL steel scrap volume of 2.59 kg, under consideration of 5% recycling loss.
The collection rate is assumed to be 100%, the loss of recycling 5%.
5. LCA: Results

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

<table>
<thead>
<tr>
<th>PRODUCT STAGE</th>
<th>CONSTRUCTION PROCESS STAGE</th>
<th>USE STAGE</th>
<th>END OF LIFE STAGE</th>
<th>BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw material supply</td>
<td>Transport</td>
<td>Manufacturing</td>
<td>Assembly</td>
<td>Use</td>
</tr>
<tr>
<td>A1</td>
<td>A2</td>
<td>A3</td>
<td>A4</td>
<td>A5</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>MND</td>
<td>MND</td>
</tr>
</tbody>
</table>

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: cast-in anchor channel system, 1m

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>A1-A3</th>
<th>C3</th>
<th>C4</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global warming potential</td>
<td>kg CO₂-Eq.</td>
<td>4.46E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>-1.57E+0</td>
</tr>
<tr>
<td>Depletion potential of the stratospheric ozone layer</td>
<td>kg CFC11-Eq.</td>
<td>-7.16E-10</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>7.01E-12</td>
</tr>
<tr>
<td>Acidification potential of land and water</td>
<td>kg SO₂-Eq.</td>
<td>1.30E-2</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>-6.03E-3</td>
</tr>
<tr>
<td>Eutrophication potential</td>
<td>kg PO₄-Eq.</td>
<td>1.48E-3</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>-3.66E-4</td>
</tr>
<tr>
<td>Formation potential of tropospheric ozone photochemical oxidants</td>
<td>kg ethene-Eq.</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>-1.25E-7</td>
</tr>
<tr>
<td>Abiotic depletion potential for non-fossil resources</td>
<td>kg Sb-Eq.</td>
<td>1.49E-3</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>-1.47E+1</td>
</tr>
<tr>
<td>Abiotic depletion potential for fossil resources</td>
<td>MJ</td>
<td>4.90E+1</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>-1.47E+1</td>
</tr>
</tbody>
</table>

RESULTS OF THE LCA - RESOURCE USE: cast-in anchor channel system, 1m

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>A1-A3</th>
<th>C3</th>
<th>C4</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable primary energy as energy carrier</td>
<td>MJ</td>
<td>8.64E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>7.75E-1</td>
</tr>
<tr>
<td>Renewable primary energy as material utilization</td>
<td>MJ</td>
<td>9.54E-2</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>9.25E-0</td>
</tr>
<tr>
<td>Total use of renewable primary energy resources</td>
<td>MJ</td>
<td>8.73E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>7.83E-1</td>
</tr>
<tr>
<td>Non-renewable primary energy as energy carrier</td>
<td>MJ</td>
<td>5.33E+1</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>-1.41E+1</td>
</tr>
<tr>
<td>Non-renewable primary energy as material utilization</td>
<td>MJ</td>
<td>7.87E-1</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>1.41E+1</td>
</tr>
<tr>
<td>Total use of non-renewable primary energy resources</td>
<td>MJ</td>
<td>5.41E+1</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>-1.41E+1</td>
</tr>
<tr>
<td>Use of secondary material</td>
<td>kg</td>
<td>1.67E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
</tr>
<tr>
<td>Use of renewable secondary fuels</td>
<td>MJ</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
</tr>
<tr>
<td>Use of non-renewable secondary fuels</td>
<td>MJ</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
</tr>
<tr>
<td>Use of net fresh water</td>
<td>m³</td>
<td>2.42E-2</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>-1.03E-3</td>
</tr>
</tbody>
</table>

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: cast-in anchor channel system, 1m

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>A1-A3</th>
<th>C3</th>
<th>C4</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazardous waste disposed</td>
<td>kg</td>
<td>6.24E-7</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>-1.96E-8</td>
</tr>
<tr>
<td>Non-hazardous waste disposed</td>
<td>kg</td>
<td>7.53E-2</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>-2.23E-2</td>
</tr>
<tr>
<td>Radioactive waste disposed</td>
<td>kg</td>
<td>2.03E-3</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>2.54E-4</td>
</tr>
<tr>
<td>Components for re-use</td>
<td>kg</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
</tr>
<tr>
<td>Materials for recycling</td>
<td>kg</td>
<td>7.53E-2</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
</tr>
<tr>
<td>Materials for energy recovery</td>
<td>kg</td>
<td>2.03E-3</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>2.54E-4</td>
</tr>
<tr>
<td>Exported electrical energy</td>
<td>MJ</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
</tr>
<tr>
<td>Exported thermal energy</td>
<td>MJ</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
</tr>
</tbody>
</table>

6. LCA: Interpretation

The steel profile has a significant influence and dominates all impact categories with exception of ADPE (Abiotic depletion potential for non-fossil resources) and ODP (Ozone depletion potential). In all other impact categories than ADPE and ODP, the fixing material has a minor influence, all other pre-products a minor or negligible influence. Abiotic depletion of resources is dominated by the fixing material, the steel profile has a relevant influence. A special case is the impact category ODP, where a negative impact is achieved by the steel profile and steel anchor. This is due to benefits in the background system of the hot-dip galvanization of those steel parts.

7. Requisite evidence

No evidence required.

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Z-21.4-1691
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| **Publisher**                    | Institut Bauen und Umwelt e.V.  
Panoramastr. 1  
10178 Berlin  
Germany  
Tel +49 (0)30 3087748- 0  
Fax +49 (0)30 3087748- 29  
Mail info@ibu-epd.com  
Web www.ibu-epd.com |
| **Programme holder**             | Institut Bauen und Umwelt e.V.  
Panoramastr 1  
10178 Berlin  
Germany  
Tel +49 (0)30 - 3087748- 0  
Fax +49 (0)30 – 3087748 - 29  
Mail info@ibu-epd.com  
Web www.ibu-epd.com |
| **Author of the Life Cycle Assessment** | thinkstep AG  
Haupstraße 111  
70771 Leinfelden-Echterdingen  
Germany  
Tel +49 (0)711 341817-0  
Fax +49 (0)711 341817-25  
Mail info@thinkstep.com  
Web www.thinkstep.com |
| **Owner of the Declaration**     | HALFEN GmbH  
Liebigstraße 14  
40764 Langenfeld  
Germany  
Tel +49 (0)3466 3268 200  
Fax +49 (0)3466 3268 205  
Mail raimo.fuellsack-koeditz@halfen.de  
Web www.halfen.com |