A Zero-Waste Approach in the Design of Buildings

Detail drawings

R.S. van Houten & N.A. de Lange
In this supplementary book a collective overview of all 2D drawings for the designed zero-waste facade system as described in the rapport “A Zero-Waste Approach in the Design of Buildings - Introducing a new way of approaching sustainability in buildings with a conceptual industrial building design as an illustrative example” is shown. This book is structured as follows:

Overview drawings
- Facade and roof
- Plan and section
- Foundation plan
- Enlarged sections

Element drawings
- Facade elements
- Superstructure elements
- Foundation elements

Detail drawings
- Principle details facade
- Principle details superstructure
- Principle details foundation
Overview drawings - Facade and roof
Design according to 'Zero-Waste' - Detail drawings

Plan and section

Detail number  
Author  
Scale  
Location/name

Zero-Waste Industrial building Graduation Project
Design part Structural
1:300  
R.S. van Houten
Plan & Sections
00

Plan and section
Overview drawings - Floor plan and sections
Detail drawings

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<td>1</td>
<td>R.S. van Houten</td>
<td>1:100 &amp; 1:50</td>
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Overview of all superstructure elements
Overview drawings - Overview of structural elements: superstructure
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<td>R.S. van Houten</td>
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<table>
<thead>
<tr>
<th>Element (female, short)</th>
<th>Foundation edge</th>
<th>Element (male, short)</th>
<th>Foundation edge</th>
<th>Element (female, long)</th>
<th>Foundation edge</th>
<th>Element (male, long)</th>
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Note: The diagrams depict various components of the foundation edge with dimensions and labels for each part.
Floor element middle

<table>
<thead>
<tr>
<th>Floor element corner 1</th>
<th>Floor element side 1</th>
<th>Floor element corner 2</th>
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<tr>
<td>Floor element side 4</td>
<td>Floor element middle</td>
<td>Floor element side 2</td>
</tr>
<tr>
<td>Floor element corner 4</td>
<td>Floor element side 3</td>
<td>Floor element corner 3</td>
</tr>
</tbody>
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Zero-Waste Industrial building Graduation Project
Design part: Structural
Detail number: 05
Location/name: Floor elements
Author: R.S. van Houten
Scale: 1:50 & 1:100
Principle details facade

Steel-cork-steel sandwich element
- Roof corner element
  - 1.5mm galvanised steel
  - 250mm expanded cork
  - 1.5mm galvanised steel

Utility rail
(embedded in element, folded from outer layer of element)

Height adjustable feet attached to utility rail and socket
(galvanised steel)

Utility rail
(embedded in element, folded from outer layer of element)

Cork protrusion
(exposed through triangular holes, preventing water accumulation between sandwich layers)

Internal element connection, spaced 1000mm
- M10 Bolt with lifting eye
- Galvanised steel washer
- Cork washer (high quality)
- Steel-cork-steel sandwich element
- Cork washer (high quality)
- Galvanised steel washer
- M10 Nut (recessed in utility rail)

Socket for adjustable feet (pre) attached to structural frame
(galvanised steel)

Main structural frame
(see structure design for more detail)

Façade element to façade element connection, spaced 1000mm
- Welded on M10 Bolt
- [Two overlapping element edges with 4mm steel reinforcement strip]
- Cork washer (high quality)
- Galvanised steel washer
- M10 Nut or toggle-latch

Steel-cork-steel sandwich element
(wall element)
- 1.5mm galvanised steel
- 250mm expanded cork
- 1.5mm galvanised steel

Height adjustable feet attached to utility rail and socket
(galvanised steel)
Steel-cork-steel sandwich element (wall element)
- 1.5mm galvanised steel
- 250mm expanded cork
- 1.5mm galvanised steel

Cork protrusion (exposed through triangular holes, preventing water accumulation between sandwich layers)

Utility rail (embedded in element, folded from outer layer of element)

Internal element connection, spaced at 1000mm
- M10 bolt with lifting eye
- Galvanised steel washer
- Cork washer (high quality)
- Steel-cork-steel sandwich element
- Cork washer (high quality)
- Galvanised steel washer
- M10 nut (recessed in utility rail)

Steel-cork-steel sandwich element (roof corner element)
- 1.5mm galvanised steel
- 250mm expanded cork
- 1.5mm galvanised steel

Zinc gutter, attached to utility rail (standard product)

Utility rail (embedded in element, folded from external layer of element)

Drainage slope: 16mm per meter

Radius of 500mm to allow for curve in profiled galvanised steel and to increase bending strength

Detail drawings facade - Roof corner connections
Steel-cork-steel sandwich element (door element)
-1.5mm galvanised steel
-250mm expanded cork with cut out door framing
-1.5mm galvanised steel

Aluminium foam foundation edge element (special element for door opening, see structure design for more details)

Floor elements
- Galvanised steel
- Cork
(see structure design for more details)

Sliding door
- 1.5mm galvanised steel
- 150mm expanded cork
- 1.5mm galvanised steel

Aluminium foam foundation element (see structure design for more details)

Drainpipe connected to utility rail
- Diameter 100mm
- Zinc, standard product
- Spaced at 6000mm
Design according to ‘Zero-Waste’ - Detail drawings

Element reinforcement
- Welded galvanized steel, attached to utility rail using bolts
- Internal element connection, spaced 1000mm
  - M10 Bolt (recessed in utility rail)
  - Galvanized steel washer
  - Cork washer (high quality)
  - Steel-cork-steel sandwich element
  - Cork washer (high quality)
  - Galvanized steel washer
  - M10 Nut (recessed in utility rail)

Dual glass panes
- (8mm, 4mm, 6mm)

Cork protrusion
- (exposed through triangular holes, preventing water accumulation between sandwich layers)

Detail number
- Author
- Scale
- Location/name

Zero-Waste Industrial building Graduation Project

Author: N.A. de Lange
Window detail F5
Element reinforcement
- Welded galvanised steel, attached to utility rail using bolts (only in large window element)

Internal element connection, spaced 1000mm
- M10 Bolt (recessed in utility rail)
- Galvanised steel washer
- Cork washer (high quality)
- Steel-cork-steel sandwich element
- Cork washer (high quality)
- Galvanised steel washer
- M10 Nut (recessed in utility rail)

Internal side

Façade element to façade element connection, spaced 1000mm
- M10 Bolt (recessed in utility rail)
- Galvanised steel washer
- Cork washer (high quality)
- Steel-cork-steel sandwich element
- Cork washer (high quality)
- Galvanised steel washer
- M10 Nut (recessed in utility rail)

External side

Shear studs
- Folded from partial cut-outs in the galvanised steel, spaced at ~200mm (external side), or (internal side) galvanised steel welded to outer layer, spaced at 500mm

Cork protrusion
- Exposed through triangular holes, preventing water accumulation between sandwich layers

Utility rail
- Embedded in element, folded from external layer of element

Steel-cork-steel sandwich element
- 1.5mm galvanised steel
- 250mm expanded cork
- 1.5mm galvanised steel

Cork protrusion
- Exposed through triangular holes, preventing water accumulation between sandwich layers

Detail number
- F5

Author
- N. A. de Lange

Scale
- 1:5

Location/name
- Zero-Waste Industrial building Graduation Project

Design part
- Facade

Detail drawings facade - Window and wall connections
Steel-cork-steel sandwich element (roof element)
- 1.5mm galvanized steel
- 250mm expanded cork
- 1.5mm galvanized steel

Shear studs, spaced 500mm (galvanized steel, welded to outer layer)

Façade element to façade element connection, spaced 1000mm
- Welded on M10 Bolt
- [Two overlapping element edges with 4mm steel reinforcement strip]
- Cork washer (high quality)
- Galvanized steel washer
- M10 Nut or toggle-latch

Internal element connection, spaced 1000mm
- M10 Bolt with lifting eye
- Galvanized steel washer
- Cork washer (high quality)
- Steel-cork-steel sandwich element
- Cork washer (high quality)
- Galvanized steel washer
- M10 Nut (recessed in utility rail)

Utility rail
- Embedded in element, folded from internal layer of ek

Socket for adjustable feet (pre) attached to structural frame (galvanized steel)

Height adjustable feet attached to utility rail and socket (galvanized steel)

Main structural frame (see structure design for more detail)
Drainage slope: 16mm per meter

Utility rail (embedded in element, folded from internal layer of element)

Steel-cork-steel sandwich element (roof element)
- 1.5mm galvanised steel
- 250mm expanded cork
- 1.5mm galvanised steel

Internal element connection, spaced at 1000mm
- M10 Bolt with lifting eye
- Galvanised steel washer
- Cork washer (high quality)
- Steel-cork-steel sandwich element
- Cork washer (high quality)
- Galvanised steel washer
- M10 Nut or toggle-latch

Facade element to façade element connection, spaced at 1000mm
- M10 Bolt
- Cork washer (high quality)
- Galvanised steel washer
- (two overlapping element edges)
- Cork washer (high quality)
- Galvanised steel washer
- M10 Nut or toggle-latch

Shear studs, spaced at 500mm
(galvanized steel, welded to outer layer)
Space-truss to column connection node
- 10mm galvanised steel
- Welded internal connections
- Pre-drilled holes Ø20mm

C24 timber class 300x300mm
connection piece column-truss
- pre-drilled holes Ø50mm
- pre-sawn node space 11m

Column connection node
- 10mm galvanised steel
- Welded internal connections
- pre-drilled holes Ø20mm

Timber element to node connection
- M20 steel bolt (galvanised)
- Steel washer (galvanised)

C24 timber class 300x300mm
vertical chord
- pre-drilled holes Ø50mm
- pre-sawn node space 11m
Zero-Waste Industrial building Graduation Project

Design part: Structural
Detail number: ST
Location/name: Foundation edge (male)
Author: R.S. van Houten
Scale: 1:5

**Floor element**
- 3mm galvanised steel sheet (checkered)
- Integrated steel grading (galvanised, thickness 3mm, spacing 200mm)
- Expanded cork

**Foundation edge element (male, long)**
- Closed cell aluminium foam
- Integrated aluminium sheet (7mm)

**Connection with foundation slab**
- M20 aluminium bolt
- Aluminium washer
- Cork washer (high quality)

**Foundation element top (female)**
- Integrated aluminium sheet (10mm)
- Closed cell aluminium foam

**Cork sealant strip (high quality, 10x100mm)**

**Foundation element bottom (male, end piece)**
- Closed cell aluminium foam
- Integrated aluminium sheet (10mm)

**Integrated threaded aluminium insert**
- External Ø 47mm
- Internal Ø 27mm

**Additional foundation element**
- Closed cell aluminium foam
Floor element:
- 3mm galvanized steel sheet (checked)
- Integrated steel grating (galvanized, thickness 3mm, spacing 200mm)
- Expanded cork

Connection with foundation slab:
- M27 aluminium bolt
- Aluminium washer
- Cork washer (high quality)

Foundation element top (female):
- Integrated aluminium sheet (10mm)
- Closed cell aluminium foam

Foundation element top (male):
- Integrated aluminium sheet (10mm)
- Closed cell aluminium foam

Shear studs (integrated with aluminium bars):

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**Zero-Waste Industrial building Graduation Project**

**Design part**: Structural

**Detail number**: S1

**Location/name**: Foundation slab top connection

**Author**: R.S. van Houten

**Scale**: 1:5