

Implementing Model Semantics and a (MB)SE Ontology in the Civil Engineering & Construction Sector

It's all about creating a common language

semantics

the meaning of words, phrases or systems

ontology

a list of concepts and categories in a subject area that shows the relationships between them

taxonomy

the scientific process of classifying things
(= arranging them into groups)

[Source: Oxford Advanced Learner's Dictionary, 8th edition]

The Danish “I” in Building Information Modelling



Photo: Copyright © Adam Mørk

by **Henrik Balslev**
Systems Engineering A/S

Sigma®

Autodesk®
Revit®
2013

AutoPLANT®

Client (1-n)

Operator (1-2)

Users (n)

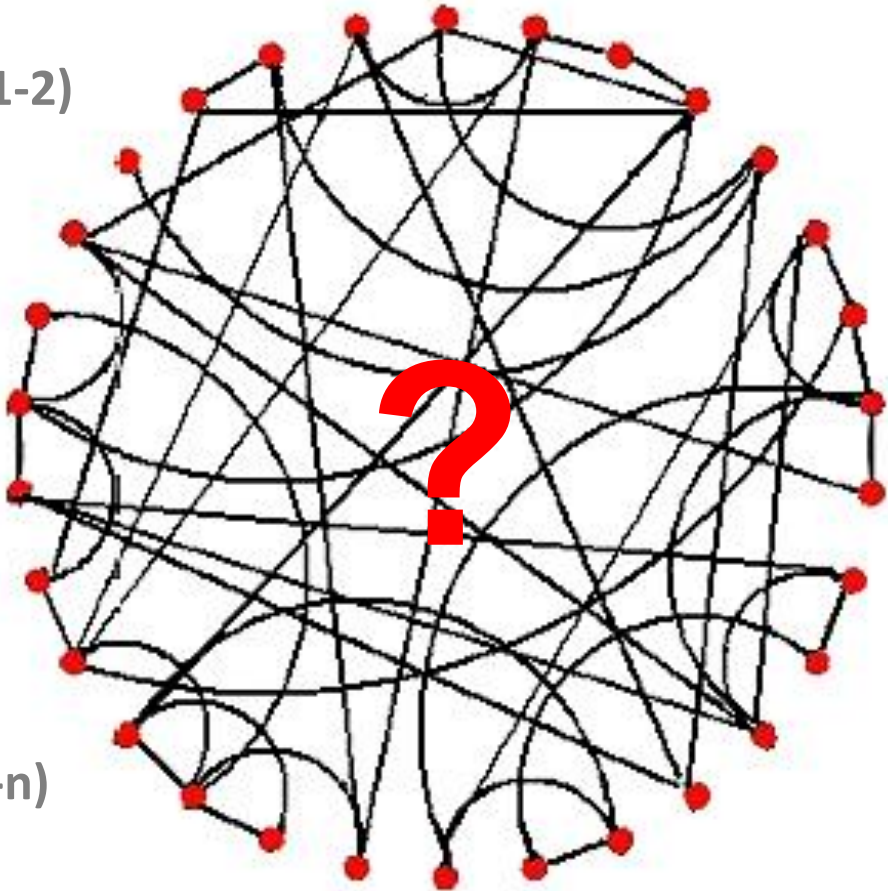
Designer (1-2)

Architect (1-2)

Engineer (5-10)

Contractor (1-n)

Supplier (n)



MicroStation

AceCad
SOFTWARE

Bentley

MagiCAD®

VIANOVA

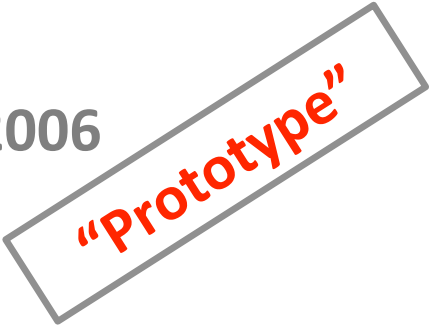
ORACLE® | PRIMAVERA®

SketchUp™

MAXWELL RENDER

The background

Danish Building Classification (DBK) from 2006
Not fully adapted and *huge* debate



“prototype”

RESTART

EU, Danish Government and Private founding -> cuneco
cuneco project running from 2011 – 2015

Central development and open commenting procedure
Valuable input from stakeholders
We are in the implementing phase – and CCS works!

ISO 12006-2 Construction entity



The mission

a new common “language”



Common language for all models

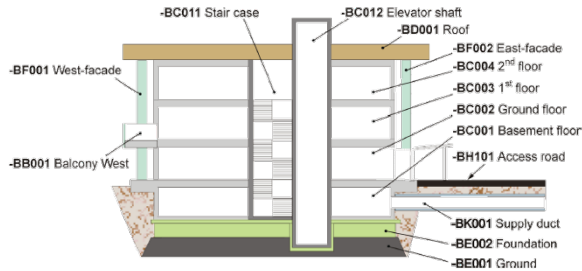
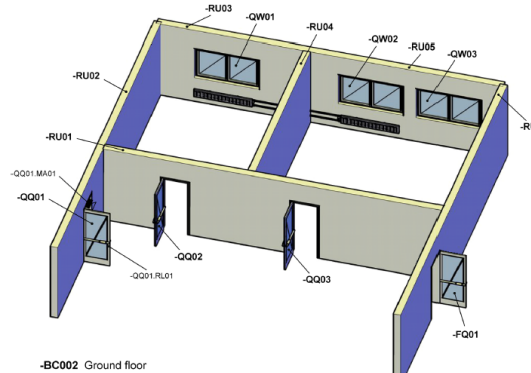


Figure B.1 — Graphical representation of construction works, example plant 1

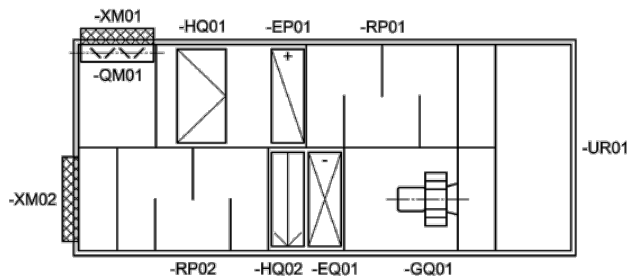
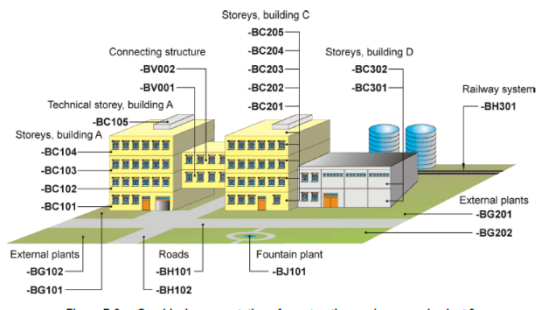


Der er i CCS valgt en klassificering, der har til formål at kunne skelne bygningsdele fra hinanden i en form for "grovsortering", fx kunne skelne mellem dør, vindue, kabel, rør etc. Dette medvirker dels til at lave en enkelt og stabil klassifikation, dels at begrænse antallet af nødvendige klasser betragteligt.

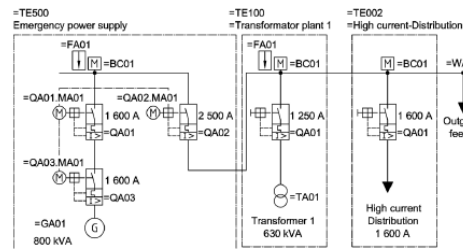
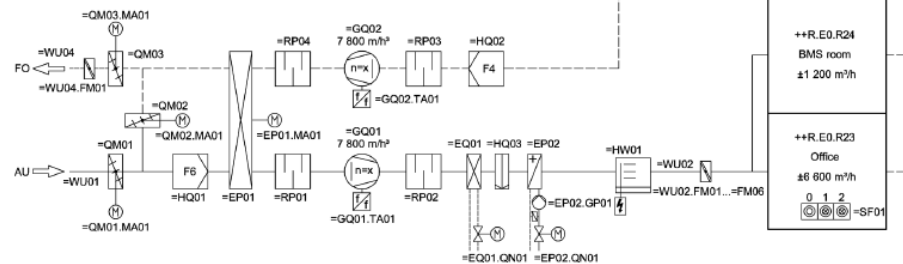
Inddelingskriteriet i CCS klassifikationen er den egenfunktion, som en given bygningsdel har "indbygget". Ved egenfunktion forstås i praksis "hvad et objekt egentlig gør, isoleret set", eller mere teknisk korrekt "objektets iboende tekniske funktion". Egenfunktionen af et objekt anses for stabil, set over livscyklus.

Øvrige egenskaber, fx type af materiale (stål, træ, beton), form ("Dannebrogsvindue", "Sadeltag", "Spidstag") etc. håndteres i CCS som selvstændige egenskaber, og medtages ikke som en del af den klassificerende kode. Det gør klassificeringen mere enkel og frem for alt stabil.

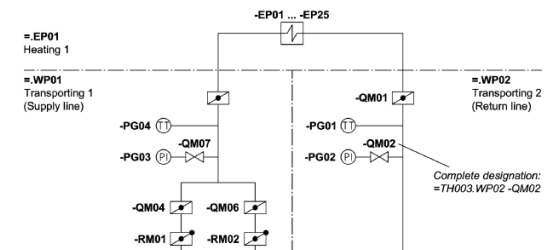
Fordelen ved en helt stabil klassifikationskode er, at koden ikke skal ændres undervejs. Det betyder i praksis, at alle objekter kan kodes på forhånd i et objektbibliotek, og at CCS objektklassen altid er kendt, når et objekt vælges og indsættes i et projekt.



=TL001
VAC system Office area



=TH003
Heating Secondary rooms



CCS – five tools for structuring building information



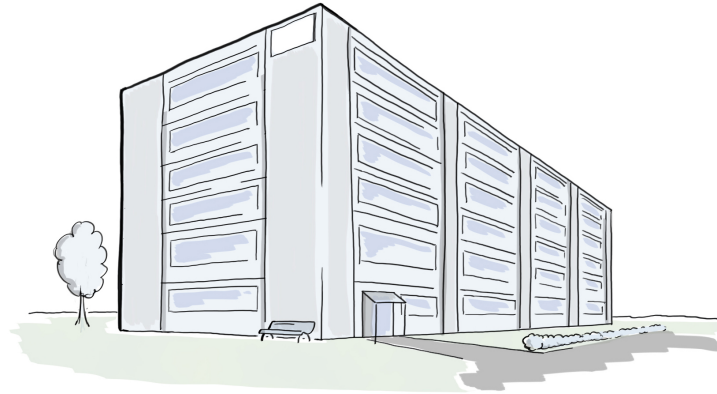
Classification

What kind of object?



Identification

Which specific object?



Level of information

Information when?



Properties

Properties of the object

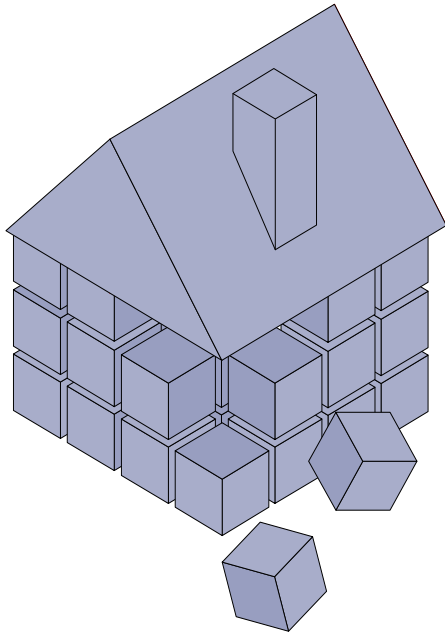


Measuring rules

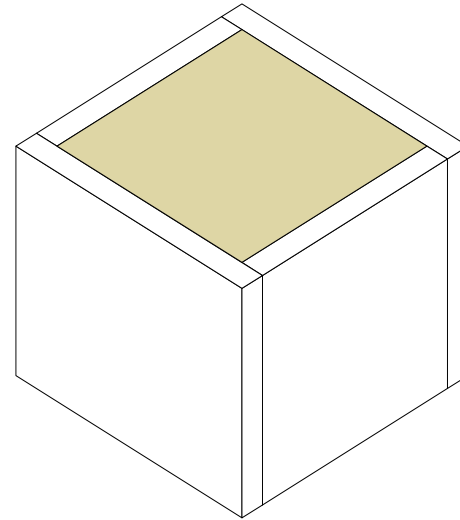
Rules for pricing



Classification



Building elements



Spaces

How others classify...

Uniformat 29

OmniClass 211

18 doors i Elements

66 doors i Products

127 doors i Work result

Uniformat Classification	Revit Category
No classification	
B - Shell	
B20 - Exterior Enclosure	
B2030 - Exterior Doors	
B2030100 - Glazed Doors & Entrances	Doors
B2030110 - Exterior Glazed Doors - Aluminum	Doors
B2030120 - Exterior Glazed Doors - Steel	Doors
B2030130 - Exterior Glazed Doors - Wood	Doors
B2030200 - Solid Exterior Doors	Doors
B2030210 - Exterior Solid Doors - Aluminum	Doors
B2030220 - Exterior Solid Doors - Steel	Doors
B2030230 - Exterior Solid Doors - Wood	Doors
B2030300 - Revolving Doors	Doors
B2030400 - Overhead Doors & Roll-up Grilles	Doors
B2030410 - Overhead Doors	Doors
B2030420 - Roll-up Grilles	Doors
B2030500 - Door Wall Opening Elements	Doors
B2030900 - Other Exterior Doors	Doors
C - Interiors	
C10 - Interior Construction	
C1020 - Interior Doors	
C1020100 - Interior Doors	Doors
C1020110 - Interior Doors - Metal	Doors
C1020120 - Interior Doors - Wood	Doors
C1020200 - Interior Door Frames	Doors
C1020210 - Interior Door Frames - Metal	Doors
C1020220 - Interior Door Frames - Wood	Doors
C1020300 - Interior Doors with Frames	Doors
C1020310 - Interior Metal Doors with Metal Frames	Doors
C1020320 - Interior Wood Doors with Metal Frames	Doors
C1020330 - Interior Wood Doors with Wood Frames	Doors
C1020400 - Interior Door Hardware	Doors
C1020410 - Door Hardware	Doors
C1020500 - Interior Door Wall Opening Elements	Doors
C1020600 - Interior Door Sidelights & Transoms	Doors
C1020700 - Interior Hatches & Access Doors	Doors

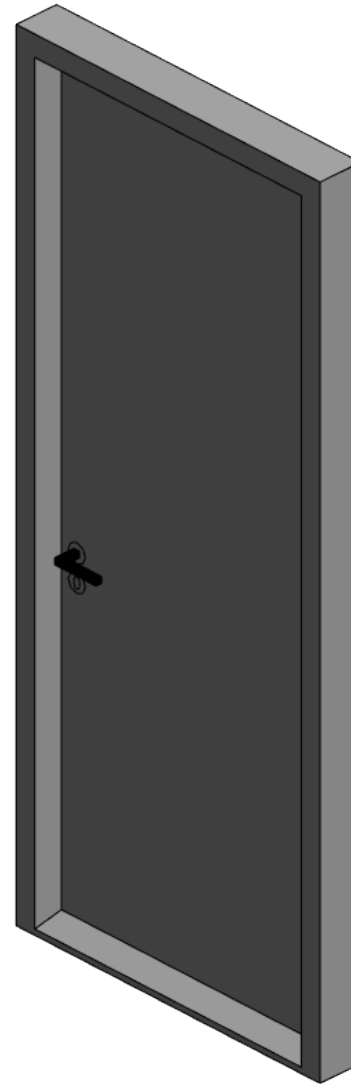


How cuneco classify ...

A door is a door!

1

... with many properties!



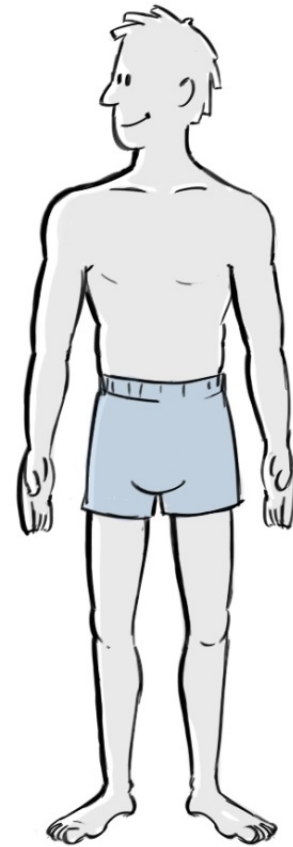
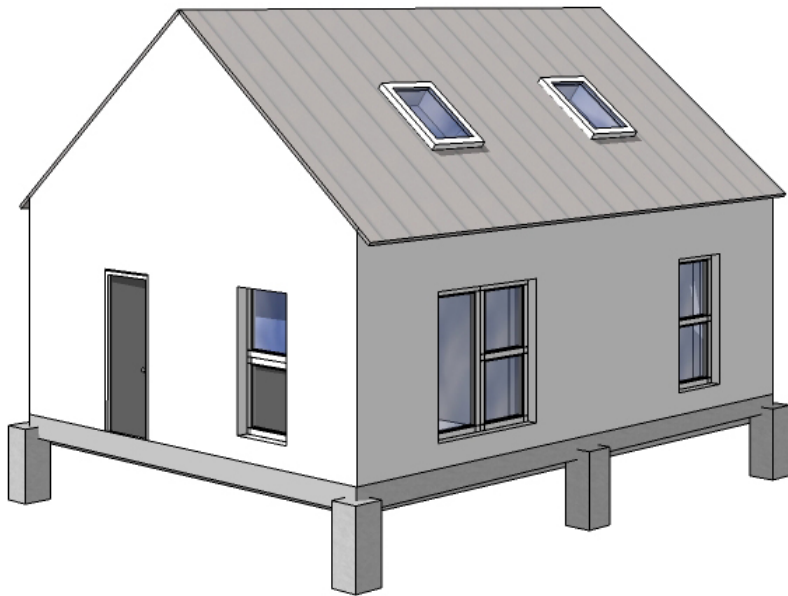
Classification by “Inherent function”

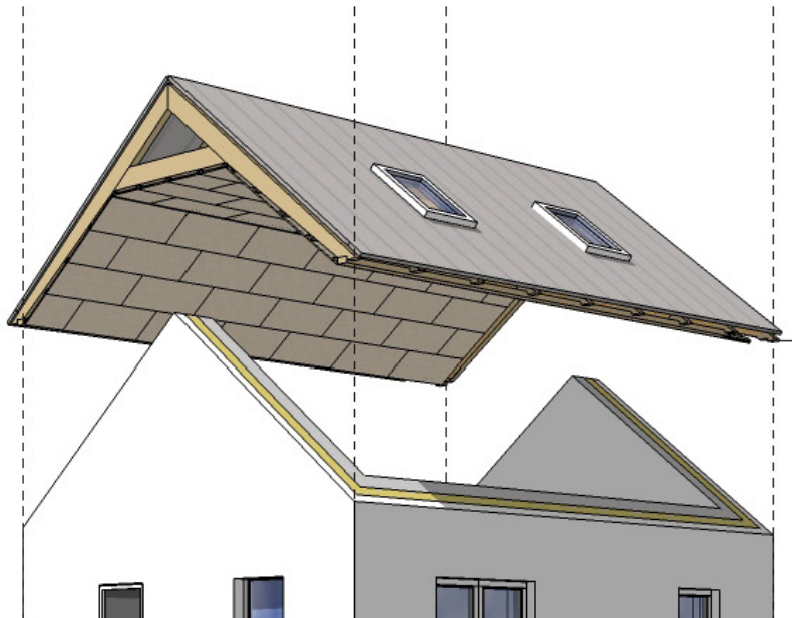


some benefits...

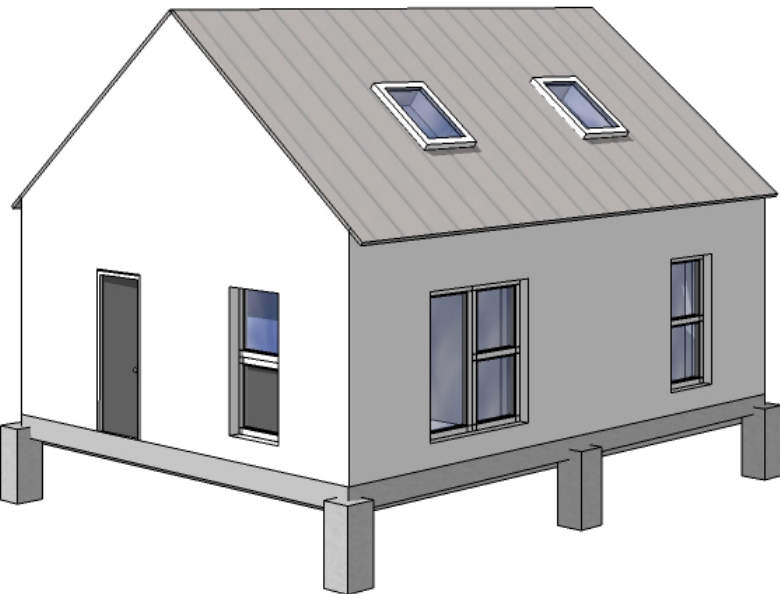
- a lifecycle stable code
- all objects can be pre-coded
- simple coding – easy for humans to recognise
- object oriented and suitable for IT

Systems





Roof system



Wall system

Slab system

Ground system

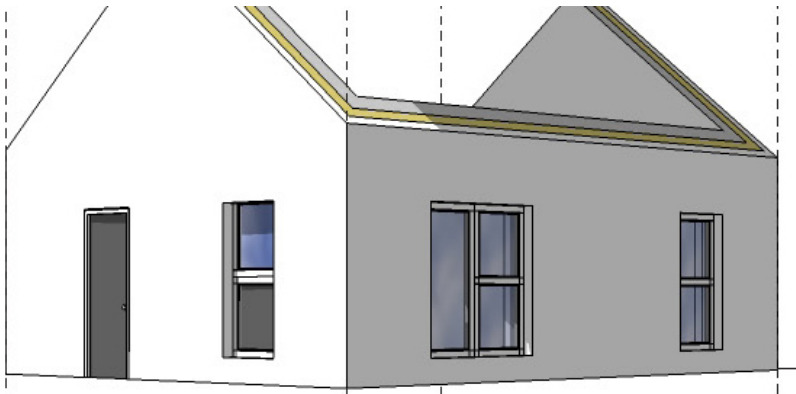
PREFERRED TERM

Wall system

CLASS

B —

DEFINITION

functional system which forms
and separates space vertically

ALTERNATIVE TERMS

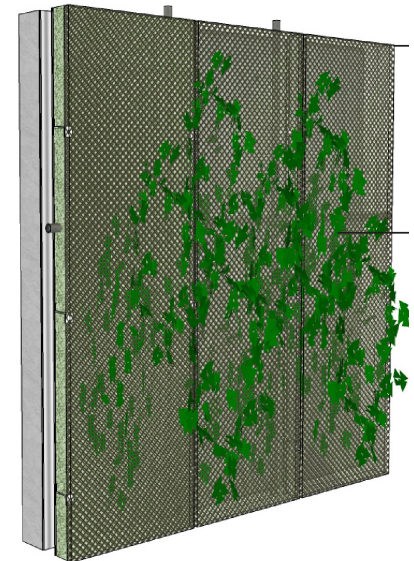
Wall

Green wall

Façade

Façade system

...



Classes of building elements



16 Functional systems X

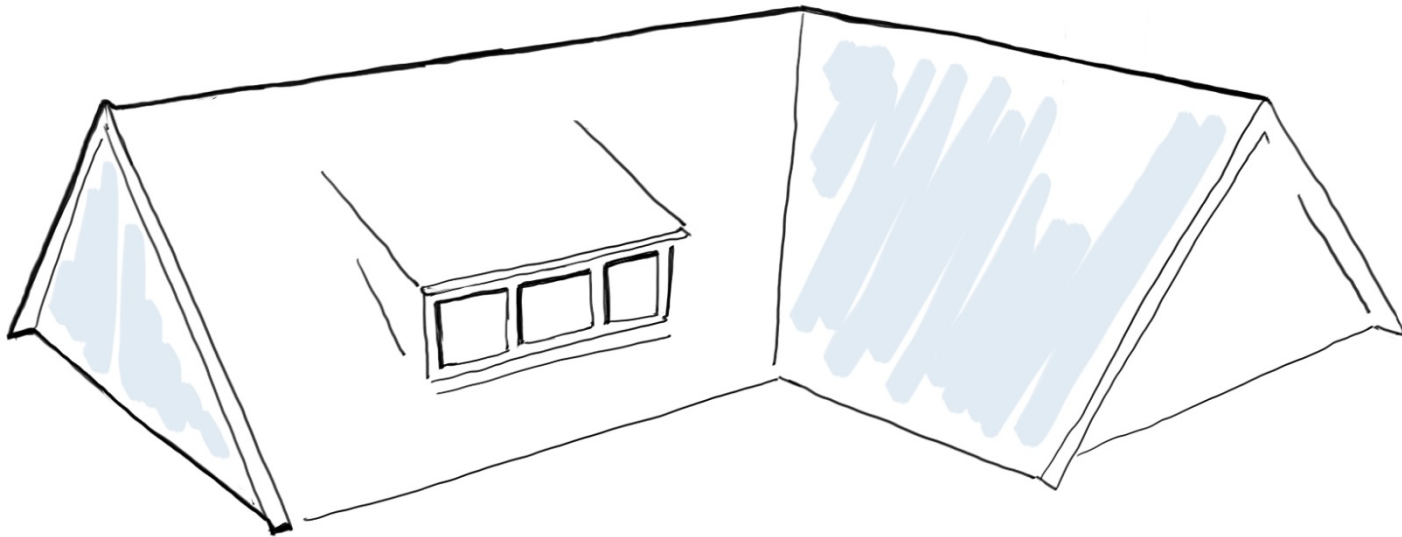
69 Technical systems XX

505 Components XXX

590



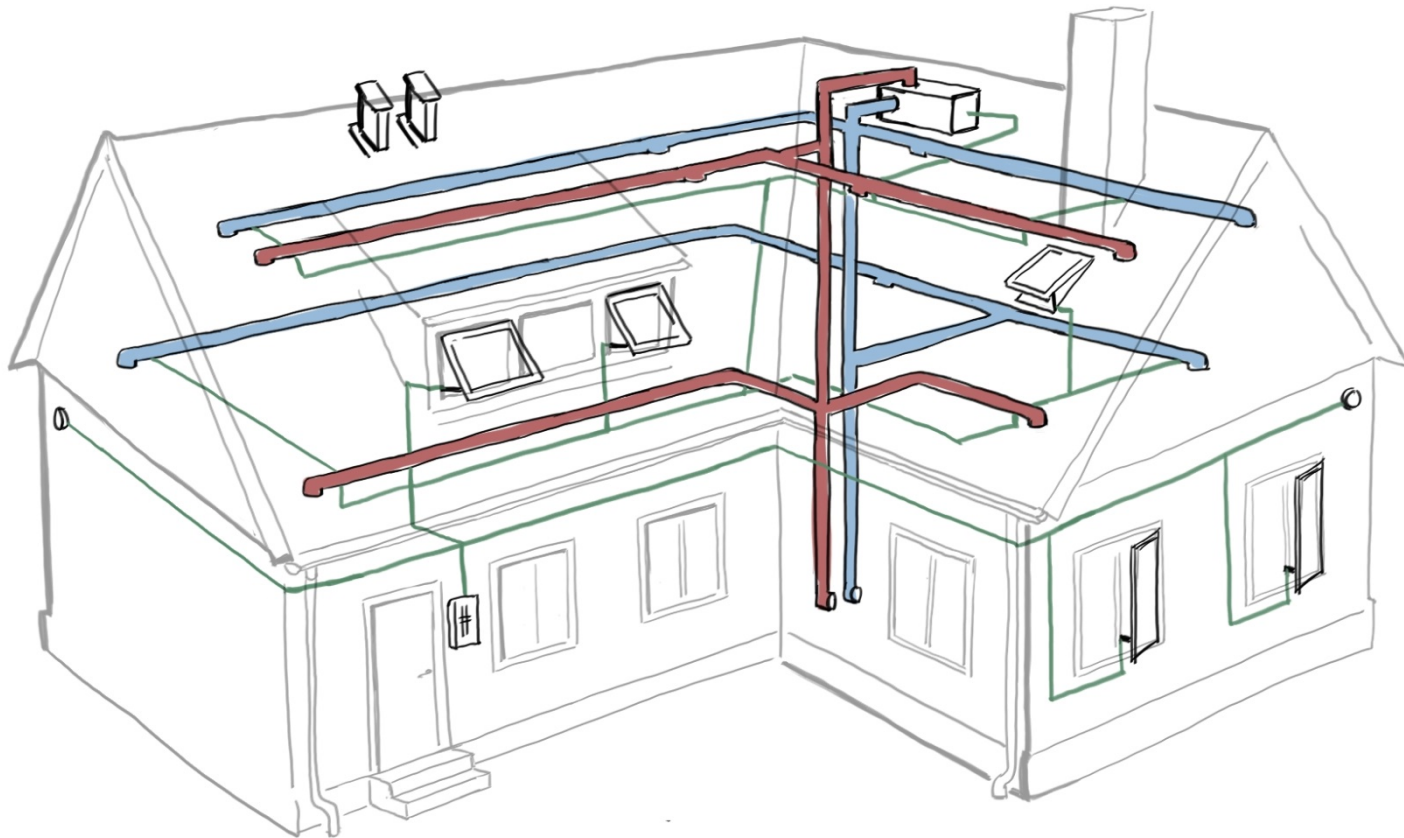
Functional system (16)



D Roof system



Functional system (16)



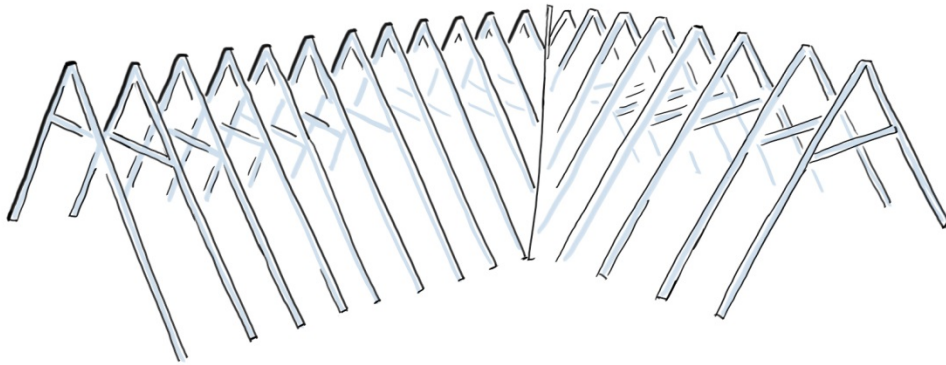
J Ventilation system



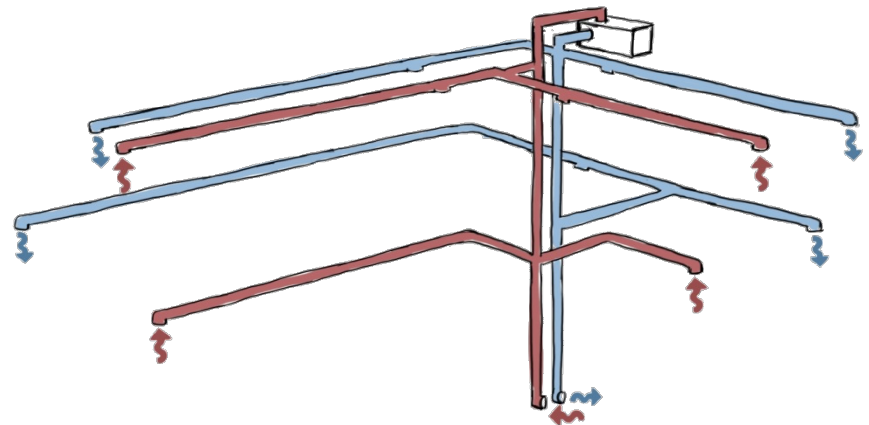
Class	Preferred term	Definition	Alternative terms
A	Ground system	functional system which terminate a construction entity by forming a part of terrain or by direct contact with terrain	Ground
B	Wall system	functional system which forms and separates space vertically	Wall, facade, facade system
C	Slab system	functional system which forms and separates space horizontally	Floor, ground floor roofing
D	Roof system	functional system which terminate a construction entity upwards	Roof , roofing
E	Gas- and air system	functional system which supply technical gases or technical air	Equipment for gas and air, gas, air
F	Water- and fluid system	functional system which supply domestic water, technical water or liquid	Water, liquid
G	Drainage- and waste system	functional system which discharge contaminated water or dispose of waste	Drainage, waste
H	Cooling- and heating system	functional system which supply cold, heat and steam	Heating, chilling
J	Ventilation system	functional system which supply air exchange	Ventilation
K	Electrical system	functional system which supply electrical energy	Electricity production plant, power supply system, electrical system, routing system



Technical system (69)



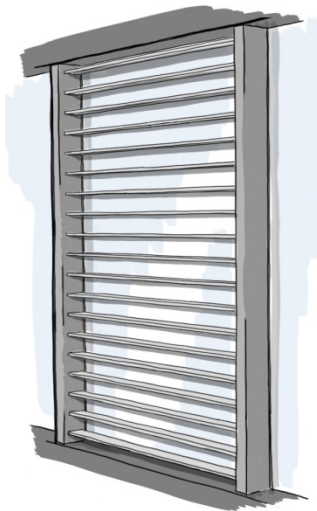
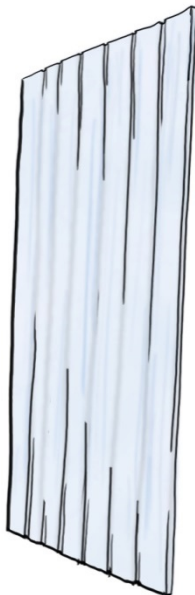
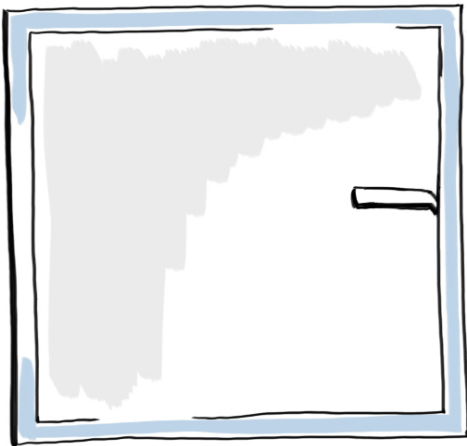
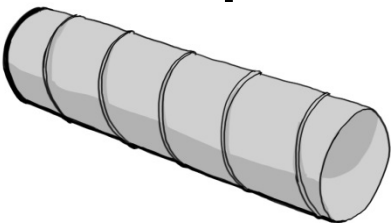
BE Roof structure



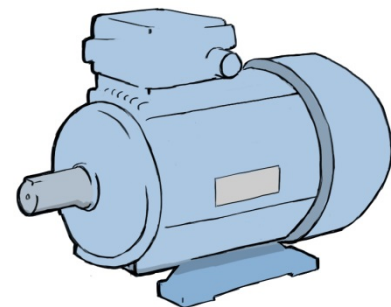
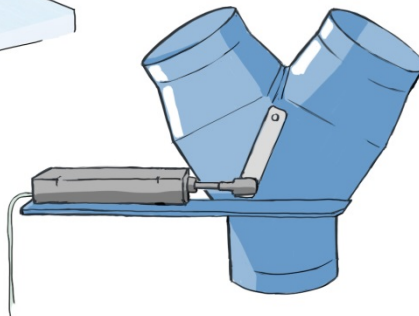
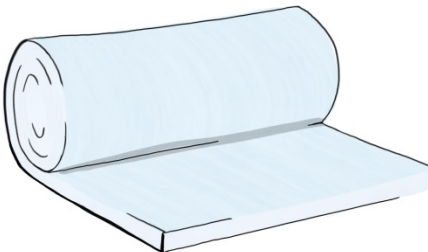
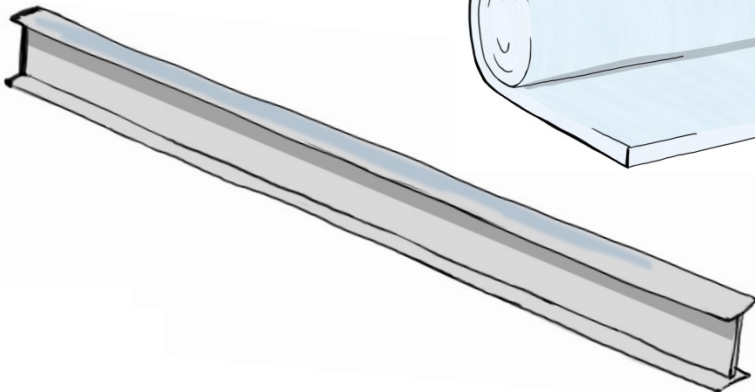
HF Ventilation plant



Component (505)



- | | |
|-----|----------------|
| MAA | Electric motor |
| QNA | Control valve |
| QQA | Window |
| RQA | Insulation |
| RQD | Screen |
| ULE | Beam |
| ULM | Wall covering |
| WPA | Pipe |

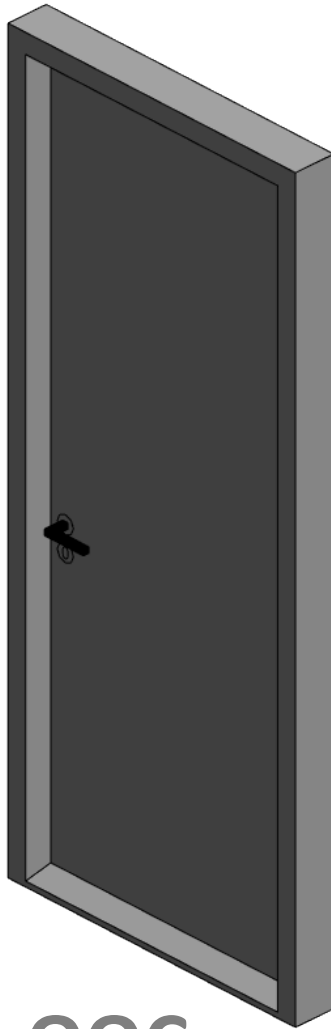




Class	QQC
Definition	space access object mainly for use by persons
Preferred term	Door
Synonyms	entrance, exit, ...
Properties	Material: Glass, wood, steel, ...



Properties



QQC

Material

Form

Dimension

Sound proofing

Thermal flow-through

Water proofnes

Strength

Fire insulation

...

Identification



GUID

{21EC2020-3AEA-1069-A2DD-08002B30309D}

Type number

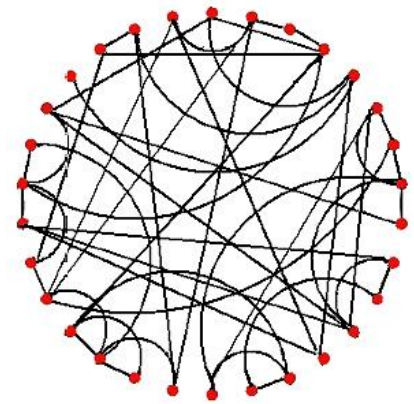
SN46T294SK

Name

“The wetroom membrane”

Common language...





RDS

Reference Designation System

ISO/IEC 81346 standard series

Designed to handle systems and their complexity

Plants – Machinery – Building construction – others

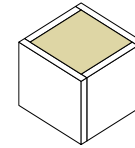
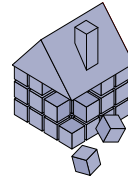
Interdisciplinary “naming convention”



Music clefs



Aspects



%

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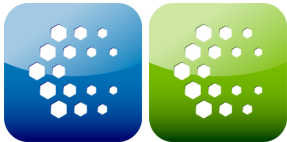
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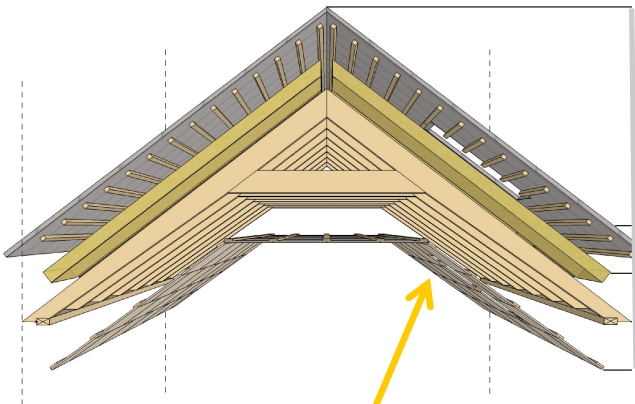
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ROOF SYSTEM 1 (D1)



ROOF CONSTRUCTION 1 (AE1)

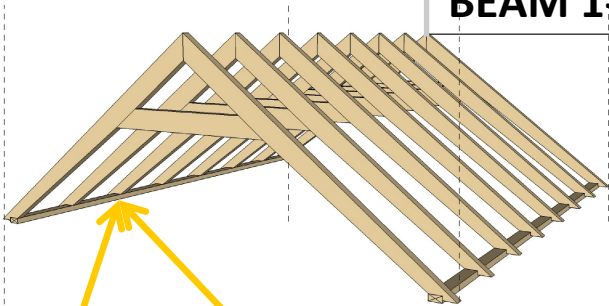


ROOFING 2 (NCE2)
INSULATION 2 (RQA2)
ROOF STRUCTURE 1 (BE1)

BEAM 1-8 (ULE1 ,..., 8)

CEILING FINISH 2 (NCD2)

-D1.AE1.NCD2



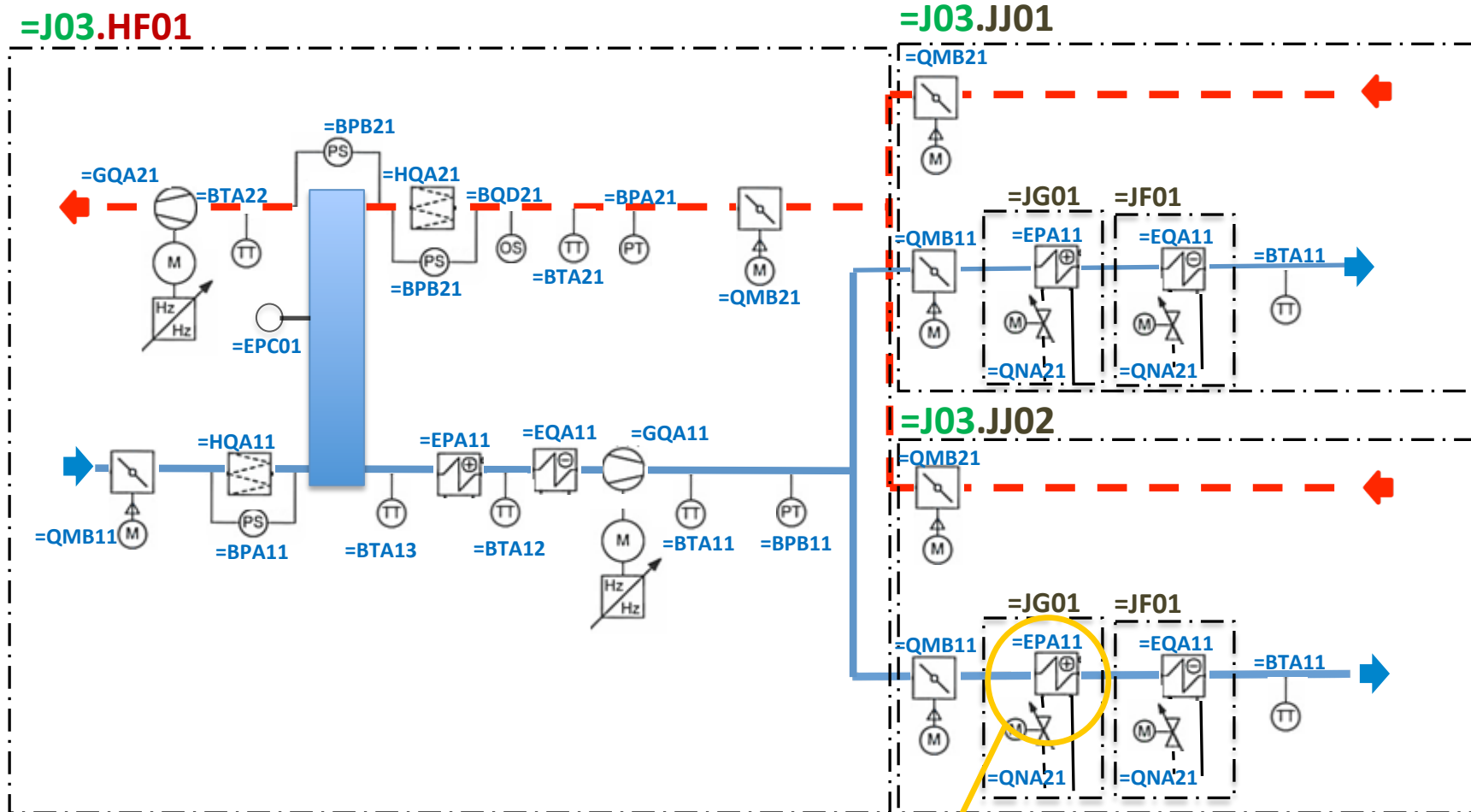
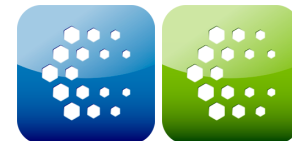
BEAM 3 (ULE3)

-D1.AE1.BE1.ULE3

BEAM 3 (ULE3)

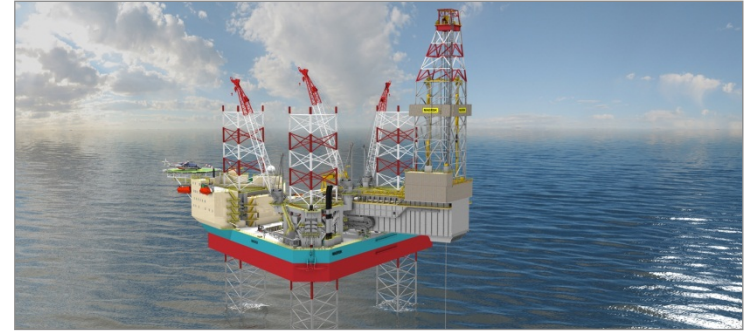
-ULE3

Ventilation system 3. Air distribution system 2.
Heating distribution system 1. Heat Surface 11.



=J03.JJ02.JG01.EPA11

RDS also applies in



Summary

RDS CLASSIFICATION

Total of 590 classes of building systems (RDS)



RDS IDENTIFICATION

Aspects & Classification & Structure (RDS)



AND

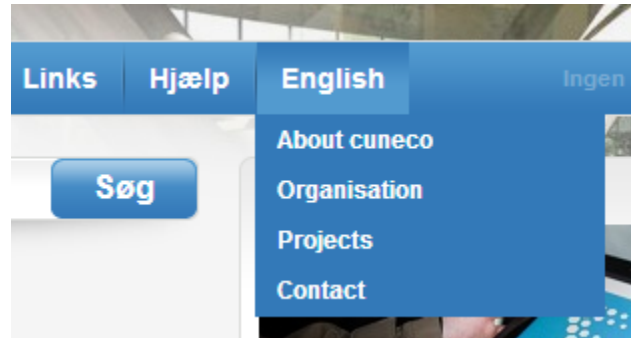
Synonyms, definitions and a lot of properties!



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Also available for Android and iOS (pad and phone)

All tables now available in English

Only complexity can reduce complexity

System theoretical rule
by Niklas Luhmann