Chapter 4
Best Practices

Form must have a content, and that content must be linked with nature.

Alvar Aalto

Abstract This chapter presents examples of innovative and sustainable use of bio-based products in building façades. Selected cases represent best practices implemented all over the world are presented from the perspective of art and innovation. Cases and examples incorporated in this chapter are indexed and summarized in a form of portfolio. Short description regarding materials, building function as well as motivation of architects to design certain objects is presented. Buildings presented here may inspire new generation of architects to successfully implement biomaterials-based solutions in their future projects.

The design of a building is an important process affecting its operational performance. Sustainable, safe, and comfortable built environment is particularly essential in present day, when a majority of people spend most of their time in offices, factories, or homes. Buildings are gradually becoming people centric. The focus on the occupant well-being and comfort as well as on flexible, collaborative, and adaptable spaces has become a concern of architects, designers, and developers (Jadhav 2016). New materials, design tools, and building technologies encourage buildings to be more responsive to their occupants and the environment. By using renewable materials in buildings and adopting sustainable design practices, we can

A. Sandak et al., *Bio-based Building Skin*, Environmental Footprints and Eco-design of Products and Processes, https://doi.org/10.1007/978-981-13-3747-5_4

contribute to human health and well-being. Nowadays, contemporary architectural practice is driven by the innovation of materials. Advanced, smart, responsive, and biologically inspired materials are gaining popularity in architectural design (Aksamija 2016). Wood and other bio-based building materials have gradually become more important, especially in the context of CO_2 neutral economy. None of the other materials can be utilized in such numerous ways as wood, as it is remarkably versatile, aesthetically charming, and, at the same time, entirely recyclable. The examples presented in this chapter display the wealth of innovative and sustainable use of bio-based products in building façades. The products used include modified wood, engineered timber products, as well as certain exploratory solutions incorporating bio-based energy harvesting systems. The function of selected buildings was not limited to the physical space they offer.

We would like to present the following case studies (Figs. 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10, 4.11, 4.12, 4.13, 4.14, 4.15, 4.16, 4.17, 4.18, 4.19, 4.20, 4.21, 4.22, 4.23, and 4.24) with the aim to demonstrate how buildings interact with the occupants and what motivated architects along the design process. The knowledge-based implementation of bio-based materials in architecture is restricted only by the imagination of designers. We sincerely hope that buildings presented here may inspire new generation of architects to successfully implement biomaterials-based solutions in their future projects.

01. Asakusa Culture Tourist Information Center

ARCHITECT:
Kengo Kuma & Associates

COMPLETION DATE:
2013

LOCATION:
Taito-ku, Tokyo (JP)

DESCRIPTION OF THE CASE-STUDY:
It's made mainly from glass and wood, and its interiors are airy and bright. The building benefits from lots of natural light, and excess sunshine is filtered by vertical wooden louvres that wrap the building´s eight stories.

REFERENCES:
https://inhabitat.com/kengo-kuma-designs-a-

Fig. 4.1 Asakusa Culture Tourist Information Center

02. Bibliothèque nationale de France

ARCHITECT:
Dominique Perrault

COMPLETION DATE:
1996

LOCATION:
Paris (F)

DESCRIPTION OF THE CASE-STUDY:
The double facade is visually complex and layered. The wooden screens protecting the books age and acquire a patina without loosing their qualities. Glass, steel and wood are combined here and provide sense of cohesion and individuality to the reading rooms.

REFERENCES:
http://www.bnf.fr/documents/dp_perrault_en.pdf

Fig. 4.2 Bibliothèque nationale de France

03. BIQ

ARCHITECT:
SPLITTERWERK, Arup GmbH, B+G Engineers, Immosolar

COMPLETION DATE:
2013

LOCATION:
Wilhelmsburg, Hamburg (DE)

DESCRIPTION OF THE CASE-STUDY:
At close range, the façades, oscillating from afar through the constantly growing algae, start to move. Bubbles forming through the supply of carbon dioxide and nitrogen, as well as the permanently essential circulation of water containing aerosol-like microalgae, seem to suggest that biomass production could be a solar-powered art installation, steadily bubbling along.

REFERENCES:
http://syndebio.com/biq-algae-house-splitterwerk/

Fig. 4.3 BIQ building

04. Cafe Birgitta

ARCHITECT:
Talli Architecture and Design

COMPLETION DATE:
2014

LOCATION:
Helsinki (FI)

DESCRIPTION OF THE CASE-STUDY:
Shou-sugi-ban, or burnt wood siding is a traditional Japanese method for charring cypress boards and to use them as cladding. It is known, to last over 80 years and is a natural protectant against fires and insects. The wood surface becomes water-proof through the carbonisation and is thus more durable. The process is quite simple and the result is bold and beautiful. In in Pyhä Birgitta Park in Helsinki cafe Birgitta with charred wood cladding is an example of architectural design that takes advantage of both traditional and new, innovative solutions.

REFERENCES:
https://binodem.wordpress.com/2015/02/17/wood-charring-machine/

Fig. 4.4 Cafe Birgitta

05. Chapelle de St-Loup

ARCHITECT:
Localarchitecture

COMPLETION DATE:
2008

LOCATION:
Pompaples (CH)

DESCRIPTION OF THE CASE-STUDY:
Localarchitecture, which has a special interest in timber construction and new structural solutions, is known of several works exploring traditional and contemporary wood building techniques. The team developed a structure using timber panels, which makes it possible to cover large areas with fine sections. The shape was generated using computer software that calculates the load-bearing structure, determines the dimensions and transmits this information to the machine that cuts out the 6-cm thick timber panels.

REFERENCES:
https://www.archdaily.com/9201/temporary-chapel-for-the-deaconesses-of-st-loup-localarchitecture

Fig. 4.5 Chapelle de St-Loup

06. European Council and Council of the EU

ARCHITECT:
SAMYN and PARTNERS

COMPLETION DATE:
2016

LOCATION:
Brussels (BE)

DESCRIPTION OF THE CASE-STUDY:
In the context of a sustainable development approach, it was decided to restore and reuse some old, though still efficient, window frames. Glazed double façade is made from an outer skin patchwork of recycled old oak windows found from demolition sites, with crystal clear single glazing, and an inner skin of crystal clear double glazing. The final design provides the necessary acoustic barrier from the traffic noise of Rue de la Loi in the European Quarter of Brussels and a first thermal insulation for the inner space.

REFERENCES:
https://www.designboom.com/architecture/philippe-samyn-and-partners-europa-building-eu-council-headquarters-belgium-04-05-2017/

Fig. 4.6 European Council and Council of the EU

07. Market Hall in Ghent

ARCHITECT:
Marie-José Van Hee
Robbrecht & Daem

COMPLETION DATE:
2012

LOCATION:
Ghent (BE)

DESCRIPTION OF THE CASE-STUDY:
The building is located in the centre of Ghent close to historic stone buildings. It is designed to encourage local residents to convene in the market square for social gatherings and public events. The building materials include concrete columns, a steel framed roof and a wooden cladding. Additionally, a glass envelope protects the wood and provides a soft shine, with the reflected sky.

REFERENCES:
https://www.dezeen.com/2013/04/19/market-hall-by-robbrecht-en-daem-architecten-and-marie-jose-van-hee-architecten/

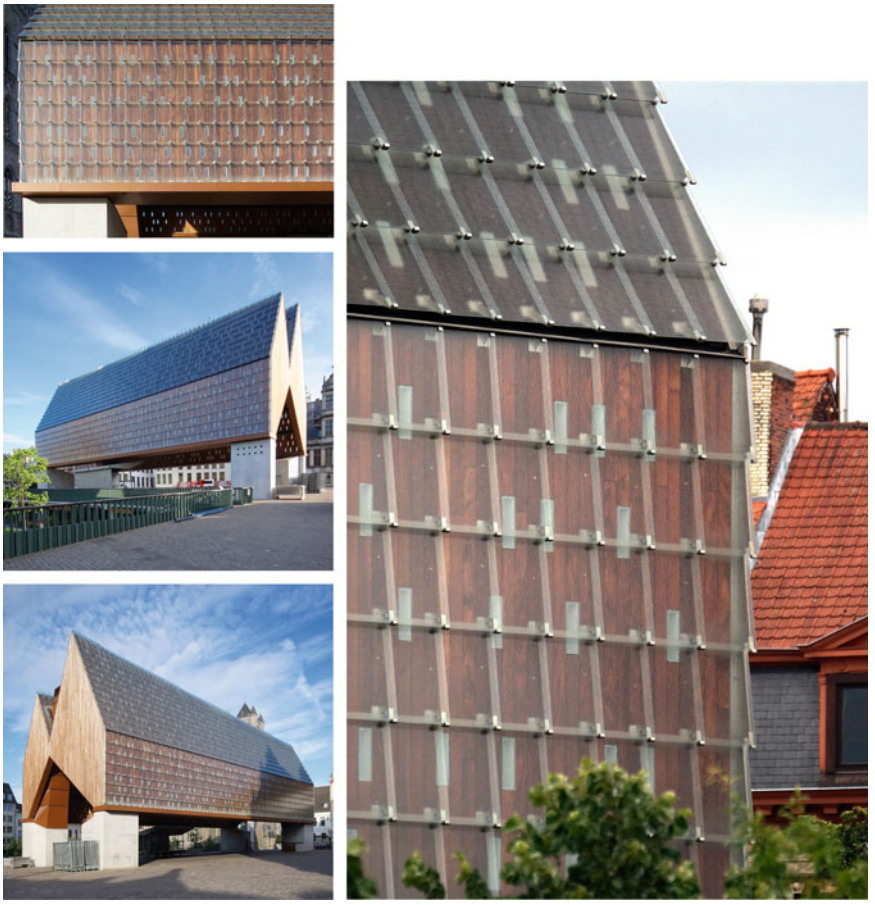

Fig. 4.7 Market Hall in Ghent

08. Parkeergarage Laakhaven

ARCHITECT:
Moke Architects

COMPLETION DATE:
2014-2017

LOCATION:
Hague (NL)

DESCRIPTION OF THE CASE-STUDY:
For the first time in history bamboo poles were used for a parking garage siding in the Netherlands, which makes this project more environmentally friendly, sustainable and innovative. The entire facade is covered with the highest quality bamboo poles (2,370 lineal meters) imported from Colombia.

REFERENCES:
https://www.bambooimport.com/en/blog/bamboo-cladding-parking-garage-the-hague
https://www.mokearchitecten.nl/portfolio/parkeergarage-laakhaven/

Fig. 4.8 Parkeergarage Laakhaven

09. Pavillon of Reflections

ARCHITECT:
Studio Tom Emerson
Manifesta 11, ETH Zurich

COMPLETION DATE:
2006

LOCATION:
Zurich (CH)

DESCRIPTION OF THE CASE-STUDY:
A timber island, arrange like a fragment of intimate urban space enclosed by six objects: a tower, a tribune, a bar, a sun deck with changing cubicles below, a central pool with cinema screen above, and three generous sets of steps that lead into the lake. Together with the tower, the volumetric roofs over the bar are built up from a distinct profile of timber lattice roofs.

REFERENCES:
http://www.bnf.fr/documents/dp_perrault_en.pdf

Fig. 4.9 Pavilion of reflections

10. Sampa Pauma House 6

ARCHITECT:
KUS Corporation

COMPLETION DATE:
2013

LOCATION:
Setagaya-ku, Tokio (JP)

DESCRIPTION OF THE CASE-STUDY:
Wood elements are used here as elements providing frame that surrounds the building. By the use of timber as "tree grass lattice" at the outer circumference of the building, architects aimed to create attractive both interior and exterior spaces.

REFERENCES:
http://www.kus.co.jp/work-shimouma.html
https://www.early-age.co.jp/detail/?sanpapa_shimouma_house

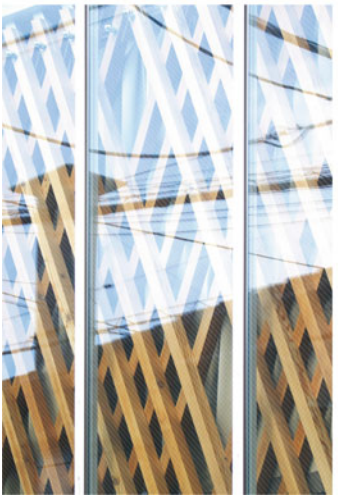

Fig. 4.10 Sampa Pauma House 6

11. SunnyHills at Minami-Aoyama

ARCHITECT:
Kengo Kuma & Associates

COMPLETION DATE:
2013

LOCATION:
Minami-Aoyama, Tokyo (JP)

DESCRIPTION OF THE CASE-STUDY:
The intricate structure takes inspiration from traditional bamboo baskets, but the angle of the wooden lattice is very unique. Unlike the conventional 90 degrees, the slats are angled at 30 and 60 degrees assembled with „no-glue-nor-screws", a technique Kuma considers „the essence of Japanese architecture".

REFERENCES:
https://inhabitat.com/kengo-kuma-wraps-tokyos-sunny-hills-cake-shop-in-a-latticed-3d-wooden-cloud/

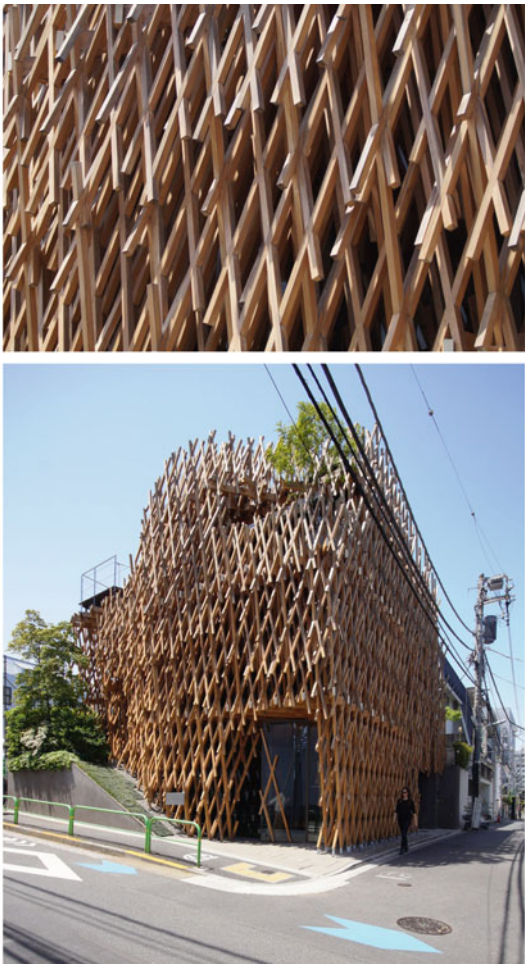

Fig. 4.11 SunnyHills at Minami-Aoyama

12. Tietgenkollegiet — Student Housing

ARCHITECT:
Lundgaard & Tranberg Architects

COMPLETION DATE:
2006

LOCATION:
Copenhagen (DK)

DESCRIPTION OF THE CASE-STUDY:
The facade is made with a unique copper alloy and features sliding partitions inspired by traditional southern Chinese Hakka house architecture. The alloy keeps the building surface clean and protected, and it will age to a rich dark tone over time, allaying restoration needs in the future. American oak and glass partitions alternate throughout the alloy wall, creating an exciting and dynamic facade that also encourages the flow of fresh air and sunlight.

REFERENCES:
https://inhabitat.com/lundgaard-and-tranbergs-tietgenkollegiet-dorm-is-the-coolest-circular-housing-on-campus/

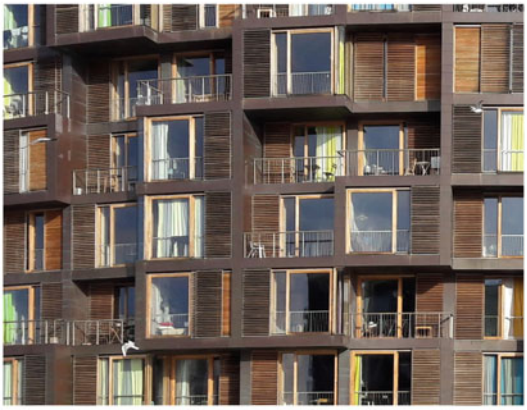

Fig. 4.12 Tietgenkollegiet—student housing

13. Wälder Haus

ARCHITECT:
Andreas Heller Architects & Designers

COMPLETION DATE:
2014

LOCATION:
Helsinki (FI)

DESCRIPTION OF THE CASE-STUDY:
Wood play here an important role in two respects. It is used as a sustainable building material in the building structure and as façade material. Moreover the WÄLDERHAUS host an exhibition that deals with the relationship between the forest, the city and its inhabitants.

The upper three storeys are made entirely of larch wood. The green roof provides habitat for plants and animals and it can be colonized by birds and insects.

REFERENCES:

https://www.iba-hamburg.de/projekte/wilhelmsburg-mitte/eingangskomplex-am-inselpark/waelderhaus/projekt/waelderhaus.html

Fig. 4.13 Wälder Haus

14. Yokohama Ferry Terminal

ARCHITECT:
Foreign Office Architects

COMPLETION DATE:
2002

LOCATION:
Yokohama (JP)

DESCRIPTION OF THE CASE-STUDY:
Throughout the project, a deliberate dynamism pervades the tectonic and material languages of the building. The abundance of non-orthogonal walls, floors, and ceilings creates a controlled sense of vertigo that is accentuated by similarly off-kilter fixtures and details. The effect is magnified by material cues, such as the shifting grains of the wooden planks on the observation deck that indicate the locations of creases, and the minimalist grey metal paneling that is revealingly worn by the structures under it.

REFERENCES:
https://www.archdaily.com/554132/ad-classics-yokohama-international-passenger-terminal-foreign-office-architects-foa

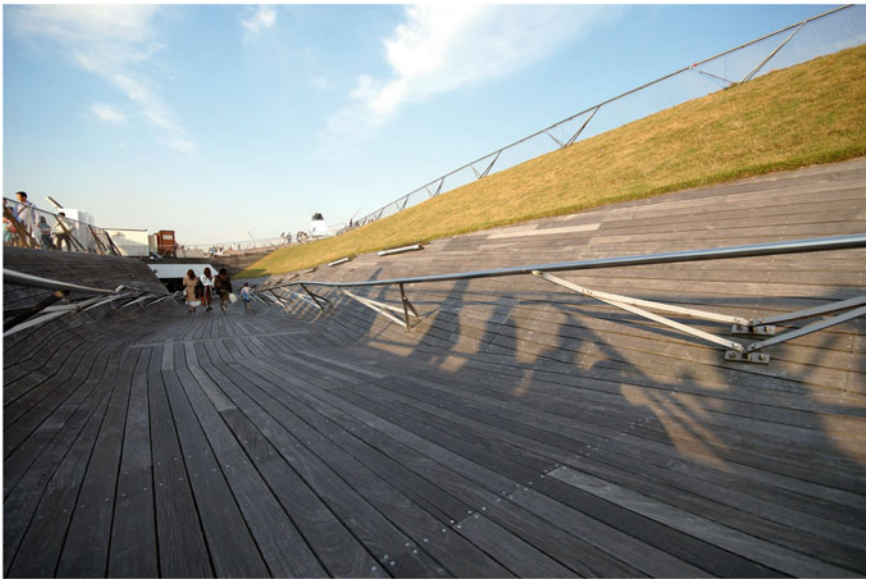

Fig. 4.14 Yokohama Ferry Terminal

15. Kreod Pavillion

ARCHITECT:
Chun Qing Li

COMPLETION DATE:
2012

LOCATION:
London (UK)

DESCRIPTION OF THE CASE-STUDY:
KREOD is an innovative architectural sculpture, organic in form, environmentally-friendly and inspired by nature. Resembling three seeds, the three 20m² pods combine through a series of interlocking hexagons to create an enclosed structure that is not only magnificently intricate but secure and weatherproof. KREOD functions beautifully both as an architectural landmark and an imaginative exhibition space – its three pods can be combined in a variety of configurations or installed as independent free-standing forms.

REFERENCES:
https://kebony.com/us/projects/kreod/

Fig. 4.15 Kreod pavilion. Photograph courtesy of Kebony

16. Rotho Blaas SRL headquarter's extension

ARCHITECT:
monovolume architecture + design

COMPLETION DATE:
2005

LOCATION:
Kurtatsch (IT)

DESCRIPTION OF THE CASE-STUDY:
The Rothoblaas office is a large scale commercial operation specializing in assembling systems and power tools for the woodworking industry. The aim of the project was to create a compact building with a high level of recognition. The building acts as corporate identity of the enterprise; contemporary, representative and innovative. This has led to a functional, compact structural shell, provided with a glass envelope. The main building material employed is wood, in order to show their own products.

REFERENCES:
https://www.archdaily.com/36359/rothoblaas-limited-company-monovolume?ad_medium=gallery

Fig. 4.16 Rotho Blaas SRL headquarters. Photograph courtesy of Paolo Grossi

17. Barangaroo House

ARCHITECT:
Collins and Turner

COMPLETION DATE:
2017

LOCATION:
Sydney Harbour (AU)

DESCRIPTION OF THE CASE-STUDY:
Barangaroo House, a free-standing, three-storey restaurant, has become one of the first projects in Sydney to utilise Accoya® wood cladding. The world-leading high performance, sustainable wood product, and the distinctive Japanese charring technique, Shou Sugi Ban has been merged here. „Utilising Shou Sugi Ban was an ideal way to create a unique, striking building form which references ancient craftsmanship and traditions in a very contemporary way"*

*Huw Turner

REFERENCES:

https://www.dezeen.com/2018/08/13/collins-and-turner-barangaroo-house-restaurant-sydney-architecture/

Fig. 4.17 Barangaroo house. Photograph courtesy of Rory Gardiner

18. 1500 West Alabama Office Building

ARCHITECT:
Dillon Kyle Architects

COMPLETION DATE:
2018

LOCATION:
Houston (US)

DESCRIPTION OF THE CASE-STUDY:
The exterior has a commercial boxy look, so the team looked for creative cladding finishes to wrap the building and provide a rainscreen. Accoya® wood boards covers the entire building. The rainscreen is made of G80 galvanized steel sheets offset from the building with the Accoya® leaf boards attached to it. An abstract leaf-like pattern is carved into 2,500 eight-foot long by eight-inches tall and 11/16-inches in depth. The leaf pattern serves as a gentle reference to the live oak trees that line the neighbourhood.

REFERENCES:
https://www.accoya.com/projects/project/dillon-kyle-architects-office-building-gives-the-wow-factor-with-accoya/

https://www.dkarc.com/dillon-kyle-architects-houston-tx.html

Fig. 4.18 1500 West Alabama office building. Photograph courtesy of Accsys

19. Misono Branch of the Hekikai Shinkin Bank

ARCHITECT:
Kengo Kuma

COMPLETION DATE:
2017

LOCATION:
Nagoya (JP)

DESCRIPTION OF THE CASE-STUDY:
The seven-story Misono branch building is located in the Naka Ward of Nagoya. The Japanese modern style design is highlighted by eye-catching Accoya® planks diagonally attached on the exterior glass walls and tall trees planted as a green-void corner feature near the base of the building. Constructed by Sekisui House, Ltd. Accoya® was selected due to its dimensional stability making it possible to achieve an elegant, slim structure having wide fixing points without risk of bending and warping.

REFERENCES:
https://www.accoya.com/projects/project/hekikai-shinkin-bank-chooses-accoya-wood-facades-asia/

https://www.designboom.com/architecture/kengo-kuma-accoya-wood-cladding-toki-shinkin-bank-misono-branch-07-06-2018/

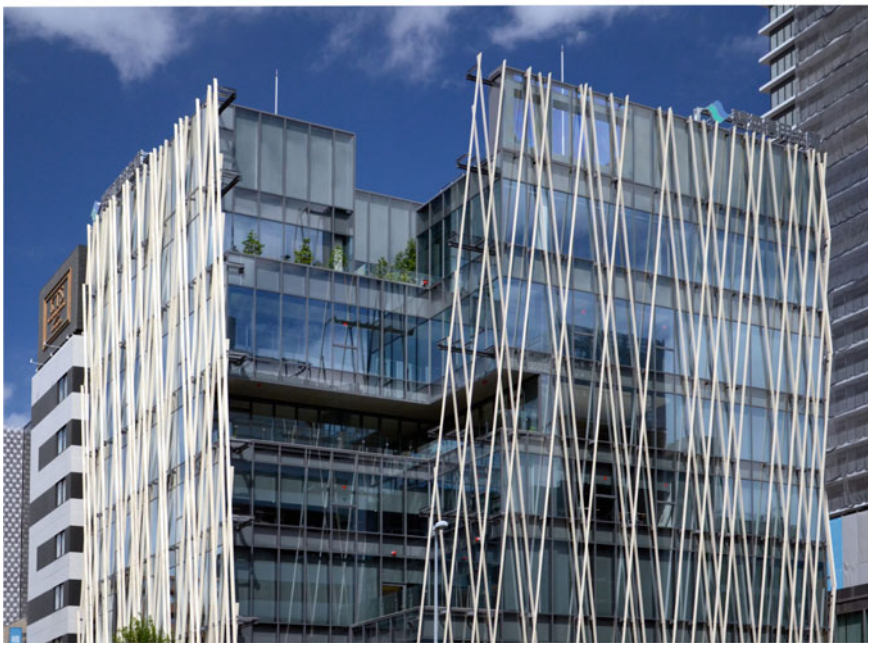

Fig. 4.19 Misono branch of the Hekikai Shinkin bank. Photograph courtesy of Accsys

20. Amsterdam Marine Base

ARCHITECT:
Architects Bureau SLA

COMPLETION DATE:
2016

LOCATION:
Amsterdam (NL)

DESCRIPTION OF THE CASE-STUDY:

Architects Bureau SLA were tasked with presenting a design accommodating new uses within the building. Additionally, the Marine Base had to be renovated in time to host the Dutch Presidency of the European Union in the first half of 2016. Located in the heart of the city, the design consists of a new layout, new services and new facades. The facades consist of large 3.5 x 3.5 meter triple glazed windows set into deep window bays. Due to its structural integrity and sustainable properties, Accoya® was used for the main windows. The pattern of the wood appears random at first glance, however, they represent an interpretation of all the European communities national flags.

REFERENCES:

https://www.accoya.com/projects/project/accoya-selected-for-the-marine-base-amsterdam-building/

Fig. 4.20 Amsterdam Marine Base. Photograph courtesy of Milad Pallesh

21. Unique Loadbearing Strawbale Dome

ARCHITECT:
Gernot Minke
and Bjorn Kierulf (Createrra)

COMPLETION DATE:
2010

LOCATION:
Hrubý Šúr (SK)

DESCRIPTION OF THE CASE-STUDY:

Unique load bearing straw bale dome is nowadays used by the architectural studio Createrra. It is built as a combination of wooden supporting structure, load bearing straw bale vaults and dome. Heat recovery ventilation, air distribution through wooden ring beam. Structure is covered with clay plaster, EPDM foil and green roof. Different clay plaster finishes and earth floor are used in the interior.

REFERENCES:

http://minke-strawbaledome.blogspot.com/2010/08/gernot-minkes-strawbale-dome.html

Fig. 4.21 Unique loadbearing strawbale dome. Photograph courtesy of Createrra

22. MAI Modulo Abitativo (Housig Module)

ARCHITECT:
DUOPUU,
Cnr-Ivalsa Wood Building Design Lab

COMPLETION DATE:
2010

LOCATION:
San Michele all'Adige (IT)

DESCRIPTION OF THE CASE-STUDY:
MAI Modulo Abitativo Ivalsa prototype was designed by DUOPUU and wood building design lab of CNR-IVALSA in collaboration with Ceii Trentino and support of Provincia Autonoma di Trento. The goal of the project were to design and build a small wooden prototype house that can be built and prefabricated, easily transported by truck to the final destination and finally assembled to form a real house in a few hours. All the construction phases in the production area have been optimised to reduce the waste of materials, control air and water pollution, and achieve a highly efficient building process with respect to the environment and the workers.

REFERENCES:
http://www.duopuu.eu/essays/2010/09/mai-modulo-abitativo-ivalsa/

Fig. 4.22 MAI housing module. Photograph courtesy of Romano Magrone

23. Duna - Bird Watching Tower

ARCHITECT:
Bergen School of Architecture, Faculty of Architecture STU Bratislava, Veronika Kotradyová

COMPLETION DATE:
2018

LOCATION:
Hrušovská zdrž, Kalinkovo (SK)

DESCRIPTION OF THE CASE-STUDY:
This student´s hands-on project with environmental added value is promoting nature watching. The structure consists of 95% wood. The beams were CNC cut and glued before being transported to the site. The dressing is made up of three crossed layers of spruce and local pine finished by pigmented oil paint. The project aims to motivate people to come and learn about the birds and nature.

REFERENCES:
https://www.archdaily.com/868106/duna-bergen-school-of-architecture-plus-slovak-university-of-technology-in-bratislava

https://archello.com/project/duna

https://arkitektur-n.no/prosjekter/duna-bird-watching#

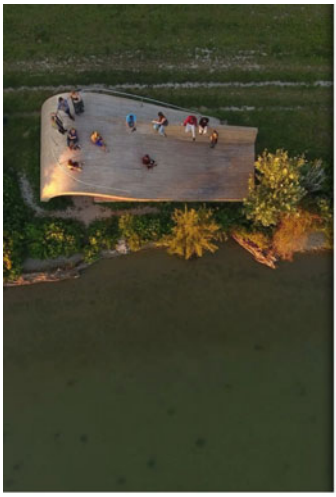

Fig. 4.23 Duna—bird watching tower. Photograph courtesy of Veronika Kotradyova

24. Observation Tree House

ARCHITECT:
Atelje Ostan Pavlin

COMPLETION DATE:
2015

LOCATION:
Celje, Bohinj (SI)

DESCRIPTION OF THE CASE-STUDY:
The Tree Observatory is a public building, which serves as a platform for pedagogical and cultural activities, exhibitions and contemplation. The structure of the house is built between six trees. The geometry of the building has six arms and intermediate terraces is connected to it. The central space is illuminated with zenith light through the "dome". The house is made of coniferous wood cut in the city forest and its equipment is modular and mobile.

REFERENCES:

http://www.piranesi.eu/atelje-ostan-pavlin-observation-tree-house-celje-city-forest-and-bicycle-trail-bohinj-slovenia/

https://www.celje.si/en/card/city-forest-tree-house

Fig. 4.24 Observation tree house. Image courtesy of Aleksander Ostan (outdoor image) and Jure Kravanja (indoor images)

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