MODULE 4

AGE-FRIENDLY BUILT ENVIRONMENT – INTERIOR

UNIT 3

ECOLOGICAL APPROACHES TO THE BUILT ENVIRONMENT

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DESIRE

DESIGN FOR ALL METHODS TO CREATE AGE-FRIENDLY HOUSING

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DESIRE will provide professionals in the building industry and home furnishings sector with the tools and skills to apply Design4All methods as an integral part of the design process, with the aim to create or adapt age friendly housing as a solution for the wellbeing, comfort and autonomy of the older adults or dependents at home.

The DESIRE training platform consists of six modules and 21 units.

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IN A NUTSHELL

¾ of the product life service is decided already by its design. Universal design and design for all, and human-centred design is the way how to prevent many ecological problems. All used materials used in the interior should be demonstrated by the producer, to have something like a passport that declares the structure/content of used materials, their additives, and their origin.

Considering sustainability is a key issue also in the age-friendly environment, especially nowadays when the global civilisation faces an environmental crisis that is caused also by human behaviour, housing connected with building activities and consumption. That is why it is necessary to raise awareness of environmental issues in design and architecture, especially the environmental impact in the whole life cycle of each product or service.

So, the unit will provide an overview of principles and recommendations in the application of ecological approaches in architecture, interior and product design with the aim to prevent ecological problems and to give awareness the sustainability issues, in relation to an age-friendly environment.

Sustainability with many ecological innovations has also social impact- social added value in the age-friendly environment, where some projects can be designed and constructed together through participatory design that gives the possibility to express self through common issues, to be part of the creative process and to experience engagement, being involved, care, attachment to places and things. This helps to build community and get social networks from different social groups.

3.1 ENVIRONMENTAL PROBLEMS CONNECTED WITH BUILT ENVIRONMENT AND HOUSING

We can conclude then with these bullets:

- exhausting of resources that are not renewable and bad management of renewable resources, using of solutions with high carbon (CO_2) footprint[1] and using solutions for materials and products with no ecological awareness
- energy waste, especially by heating
- producing waste by new buildings and reconstructions of the old ones that are hard to recycle or diminished without releasing pollutants and toxins into the environment
- low quality of the outputs in general that cause rapid moral and physical obsolesce.

[1] A carbon footprint is the total amount of greenhouse gases (including carbon dioxide and methane) that are generated by our actions.

WASTE

Due to demanding reconstructions to create accessible and adaptable housing, there is created a big volume of waste of ceramic, plastic and metal origin often fixed together in a way that it is hard to provide upgrading of the waste into the new construction materials and prefabricates, but only the downgrading (e. g using of rubble in the foundations of buildings). The opposite is the waste created from a wood structure with a smart disassembly, where many elements can be returned into the life cycle in some new construction materials.

Especially upholstery furniture is often first exchanged in households due to early obsolescence, which creates a problem by the end of its use and removal, thus many different materials are fixed to each other with no solution to dissemble and further recycle

Figure 4.3.1 Upholstery furniture creates a big ecological problem with its standard construction principle which is joining together materials in a fixed way which causes the problem to dismount the product by recycling/reusing.

3.2 BASIC PRINCIPLES SUPPORT THE PROTECTION OF THE ENVIRONMENT AND REDUCING THE IMPACT OF CLIMATIC CHANGE, APPLICATION OF LIFE CYCLE MANAGEMENT

In a civilised society, there are used materials, products and spatial solutions that were developed with low or no ecological awareness. To be consequential, it is necessary to consider and evaluation of products during their whole life cycle or life span and it is:

Pre-production/production of materials and prefabricates by processing row materials, the renewability of the resources and the fewer pollutants together with saving energy are here crucial

Production/manufacturing/production of the final products, including transport to the final user where saving of energy, fewer emissions (e.g., VOCs), production waste separation at the working place and smart planning that is directly influenced by design (shape and construction principles, e.g., flat pack concepts have many ecological and economic benefits)

Using/life period when the product is by the final user, here is the strong connection to the health and wellbeing of users by using materials that need fewer additives which means fewer emissions during use. The physical and moral life span during use is also directly influenced by design.

Recycling/removing/at the end of the life span, it is decided if the product will be recycled or removed and it is already by the designing of the product or service if the product can be dismounted and its single parts

Considering the whole life cycle by developing new products and services it is convenient to support a circular economy that can spur growth, reduce costs, and build resilience.

Green/ecological concepts can be accessed by different approaches that can be combined.

There are complex evaluation systems at the building market, that are issuing certificates

like BREEAM, LEED, DGNB, BREEAM, LEED, WELL, ESG, EPD or system Living Building Challenge (Figure 4.3.2) serve for orientation if the buildings were designed and are used according to the sustainability philosophy. Also, carbon neutrality is a parameter that can be calculated and serve for ecological feedback.

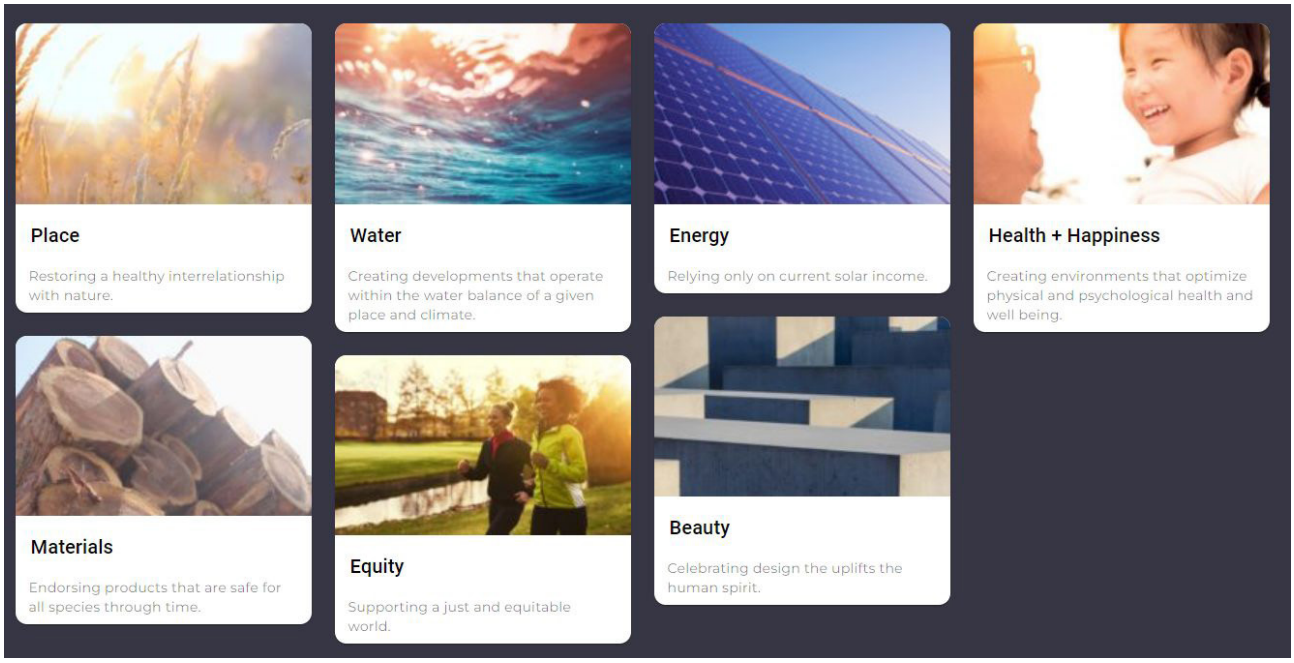

Figure 4.3.2 Living Building Challenge is organised into seven performance areas (International Living Future Institute)

For some orientation in the ecological profile of product serves different certificates and ISO norms such as ISO 9001 (if you want to know more, read Module 6) LCA: life cycle assessment of products.

Important is to consider the ecological aspects early before the building and manufacturing process, thus ¾ of the product life service is decided already by its design.

In an age-friendly environment is important to work with universal principles, to avoid demanding reconstructions (with a negative impact on the environment and the finances as well) and update the furnishings, it is convenient to work with universal principles, adaptable housing concepts by the spatial organisation, with human centred design by choice of furnishings objects that should have a timeless design and trend neutrality.

Figure 4.3.3 Öko control is a certificate that is issued by the European Association of ecological furniture showrooms (one of the members is furniture seller Eckhard Bald, Munster, Germany), their criteria are related mostly to the choice of materials that must be as solid as possible, with little additives, e.g., Austrian company specialised in solid wood furniture – Team 7 own this certificate, bed Paso (ÖkoControl)

3.3 ECOLOGICAL APPROACHES TO THE CONSTRUCTION OF PRODUCTS

In addition to the known and traditionally used design principles, it is necessary to additionally consider ecological aspects, i.e., oriented to environmental protection and recycling.

Known aspects to consider are:

- technical requirements, functionality, safety requirements, optimal production processes or good user properties, (if you want to know more, read Module 5)
- economic requirements, such as low production costs, and low user costs.

Here comes the principal moment of decision between differentiation and integration design principles (Brinkmann, 1995, in: Kotradyová, 2004).

INTEGRATED CONSTRUCTION PRINCIPLE

The term integrative construction principle means the merging (summarization) of several individual parts made of the same material without using some joints.

Advantages

- acceptable construction for later recycling (product made of one material), condition: the material must be recyclable! (e.g., plastic furniture without joints – welds; or fibrous moulded parts, chip moulded parts)
- the cost of disassembling the overall product during removal is negligible, or at least significantly less than with a differential design principle,
- economic benefits for many pieces.

Disadvantages

- high costs for forming moulds and for changes (a high number of pieces is a prerequisite for cost-effective production, otherwise it is wasteful production),
- based on differentiated demands on the product (different stress on the product), the optimal use of materials is not possible in every case! (e.g., the connection of the back wall and the structural bottom),
- from the point of view of orientation towards the appropriate use of material, it can cause a more expensive construction (result: increase in the weight of the entire product, increase in the burden on the environment when using the product).

Figure 4.3.4 Hemp chair, design: Werner Eislinger, a chair made of hemp fibre composite, an example of the integration construction principle (Designboom)

DIFFERENTIAL CONSTRUCTION PRINCIPLE

It is the breakdown of one part into more technically advantageously produced work-pieces, which require a suitable method of joining.

Advantages

- use of material appropriate to the load and requirements,
- the possibility of multiple uses of a part for another construction (principle of a children's kit),
- use of a light type of construction, thus energy-friendly production.

Disadvantages

- high production and assembly costs based on several individual parts (in part),
- higher costs for disassembly when disassembling into individual construction parts, or materials (e.g., composite materials

such as coated particle boards should be separated from solid wood or block boards etc.).

A prerequisite for ecological construction is that the differentiated parts in the summation (as a whole) are assembled in such a way that they are acceptable for the environment and further usable (Brinkmann, Ehrenstein, Steinhilper 1995, in: Kotradyová, 2004).

Chair Picto, German company Wikhahn, 1992 (Fig. 4.3.5) was the first ecological office chair, it is a good example of the differentiation construction principle, where all the parts made of metals (aluminium) and plastics are made by different specialised producers with eco audits and after finishing of the life span it is possible to disassemble and recycle them. Company Wilkhahn has set its whole philosophy, technology, and corporate identity on sustainability, including its production facilities which are experimental wood structures. As a manufacturer, they consider it as a duty to minimize any negative and maximize any positive impact on the environment and society.

Figure 4.3.5 Chair Picto, German company Wikhahn, 1992 was the first ecological office chair, company catalogue, 1998, it is a good example of the differentiation construction principle (Wilkhahn)

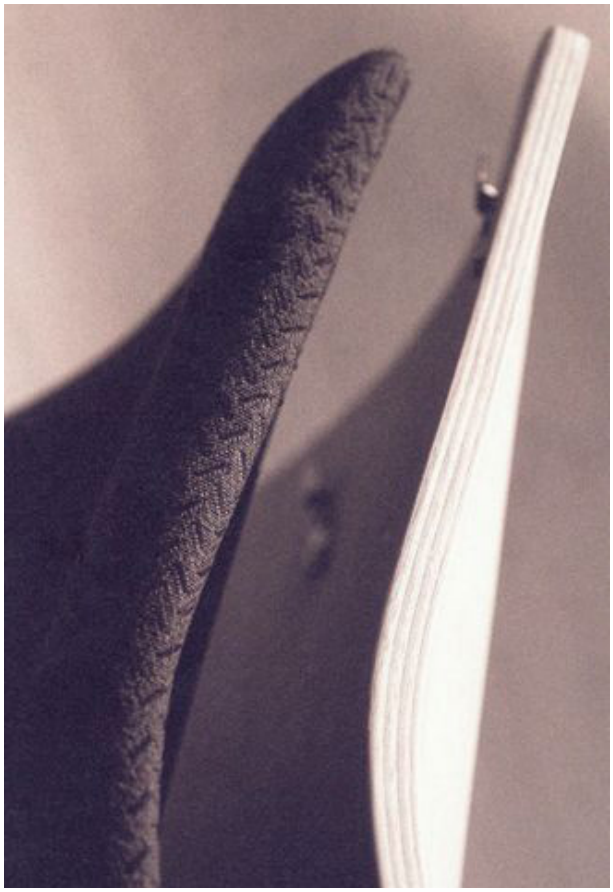

Figure 4.3.6 Exchangeability of the covers or whole upholstery prefabricates can prolong the moral and physical life span and to prevent obsolesce, left exchangeable and washable upholstery cover (Kotradyová); right upholstered shell removable from the sitting shell made of plywood enable exchange whole upholstery element in case it is already worn out, a solution developed by Becker Brackel, a German producer of moulded elements, (Becker Brackel, Formholzbrieffe, 1998)

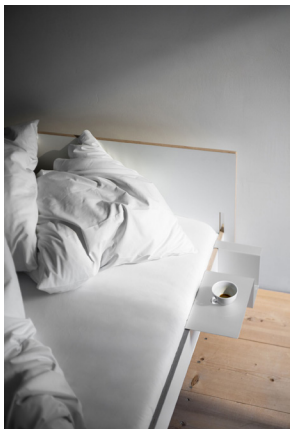

Figure 4.3.7 Flat pack system that is applied on the bed Siebenschläffer, from company Moorman möbel, made of plywood with openings made by CNC machines enabling disassembly, instead of traditional metal joints (Moorman Möbel)

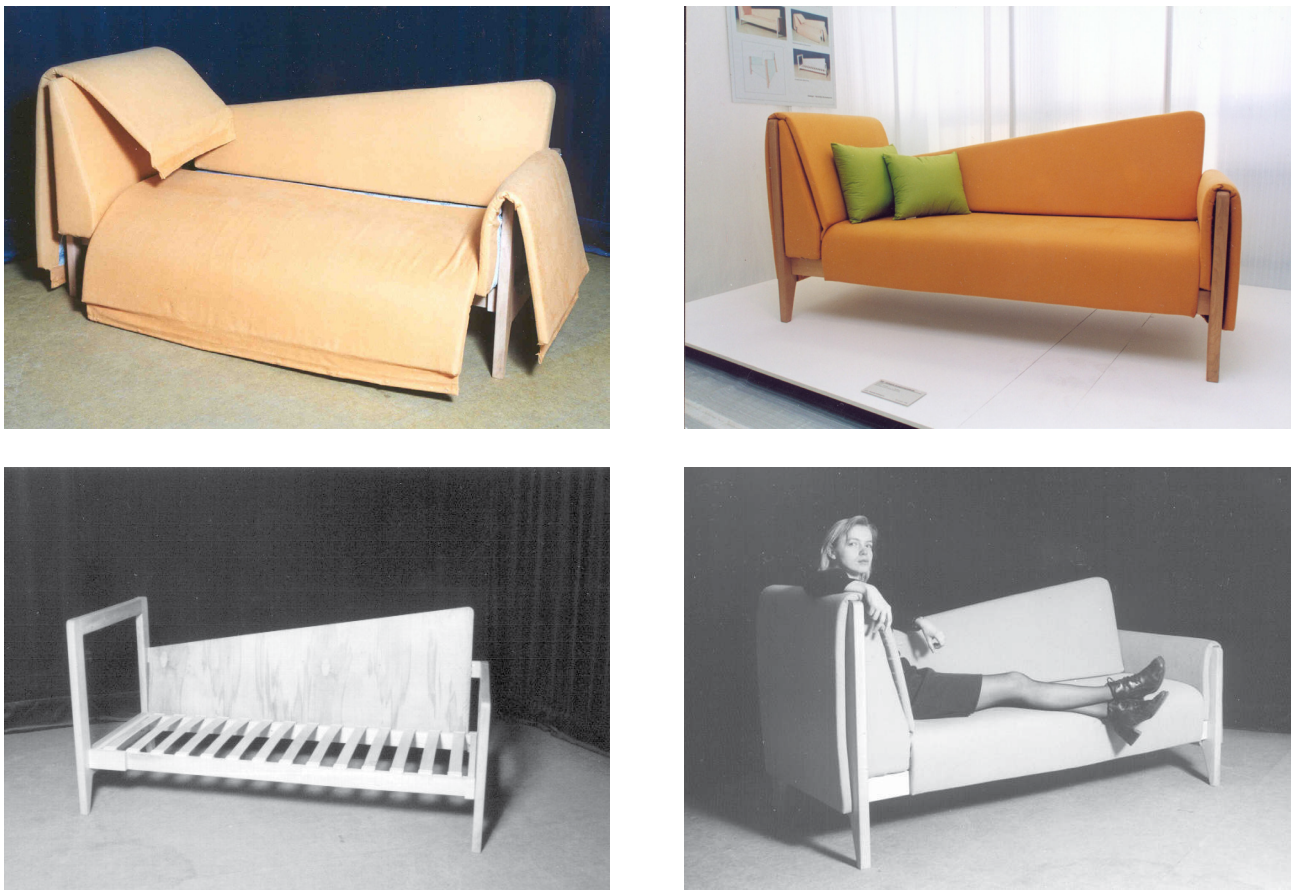

Figure 4.3.8 Sofa Teo is an example of ecological construction of upholstery furniture, it is completely dismountable, design: Veronika Kotradyová (archive of author)

Figure 4.3.9 Stand Aladar is completely foldable, its skeleton is made of durable and flexible ash and oak wood and the textile or leather (of local origin) connectors are fixed to it through dismountable joints, project Kusok dreva, design: V. Kotradyová, (Knap)

Fig. 4.3.6 – 4.3.9 are examples of the products that have applied the differentiation principle and are easy to fold or disassemble that have an advantage by manufacturing (easy to sort the waste and to organize production process – to delegate the manufacturing to specialised producers) optimize the logistics – transport within production cycle and to end consumers/ customers thus they need less volume by transport; and in the phase of using they offer high variability, adaptability and performance comfort.

3.4 ENVIRONMENTAL AWARENESS IN THE CHOICE OF MATERIALS

Choosing local renewable materials by building, reconstructing, and furnishing, using wood, clay, straw, wool, flax etc. using local human resources that support also the local economy
The first choice is **using natural/renewable raw materials** that have not only an incredibly low CO_2 footprint but especially in their authentic form have also a direct positive impact on the microclimate of an indoor environment, with health benefits and a direct impact on the wellbeing of users.

To be consequent by using renewable raw materials, they should originate from plants coming from sustainable agriculture and forestry. For a rough orientation can serve certificates like PEFC (Programme for the Endorsement of Forest Certification) and FCS certificate (Forest Stewardship Council) that are issued to the producers of biomaterials, especially wood products and services providers.

PEFC cooperates with local organisations and provides forest owners, from the large to the small, with a tool to demonstrate their responsible practices, while empowering consumers and companies to buy sustainably.

Using wood in the building and furniture industry reduces the carbon footprint of buildings in two key ways—through carbon storage and avoiding greenhouse gas emissions. As trees grow, they absorb carbon dioxide (CO_2) from the atmosphere, release oxygen (O_2), and incorporate the carbon into their wood, leaves or needles, roots, and surrounding soil. **Wood** products typically require less energy to manufacture than other building materials, substituting wood for fossil fuel-intensive materials is a way of avoiding greenhouse gas emissions[2]. The condition is that it must originate from sustainable forestry management.

[2] http://www.woodworks.org/why-wood/carbon-footprint/

Here also the purity of the sort in one material or prefabricate is a high value, this means no mixture of varied materials that is not possible to recycle once more, into one composite.
This means that e.g., furniture, floors and the whole structures should originate from forest management or agriculture that respect environmental issues.

Big advantage of using local renewable materials is a quick construction works and less energy and emissions by raw material to prefabricate, it's finishing and using.

Nowadays very actual is choosing for new built structures or by reconstruction passive or active houses solution, from ecological and economic reasons. Passive houses made of natural renewable materials (wood, straw, clay, flax oil), save energy for heating and production, thus have a low carbon footprint, have quick assembly/construction works and offer a healthy indoor microclimate, including a high level of well-being for users, are suitable as a concept for day care centres for elderly or for all kind of housing (Fig. 4.3.10).

UPHOLSTERY AND HOME TEXTILES

By the upholstery fabrics, carpets, and household textiles it is hard to use only renewable materials only (e.g., domestic wool, flax, hemp or imported bamboo, organic cotton etc.) thus they are less durable[3], have more demanding cleaning and maintainability, so they are mostly mixed with synthetic fibres. Filling materials are also the domain of synthetic foams (PUR- foam), but there are also alternatives that are less available such as gummy-coconut fibres, sheep's fleece, cotton fleece, straw, horse hairs, kapok, African grass etc.) But textiles made of natural and local yarns have not only a low carbon footprint, but also give special warmth and cosiness that are so important for the age-friendly environment (Fig. 4.3.11, 4.3.12).

[3] really durable cover fabric has more then 25 000 Martindale

Figure 4.3.10 Self-bearing Straw bale dome made in passive standard, in Hrubý Šúr, Slovakia, is the headquarter of the architecture studio Createrra, made of natural renewable materials: straw bales as the main construction material, wood structure, with using of green roof on the top, clay floor finished with flax oil varnish, walls covered by clay plaster (Createrra)

Using wool or flax with their natural surfaces are contributing massively to the wellbeing and warm, cosy atmosphere in age friendly environment, whereas the tactility and contact comfort of wool or flax is depending on the length and thickness of their fibres. Another added value is the local origin; traditional craft with a positive impact to the social sustainability in the economically less developed regions.

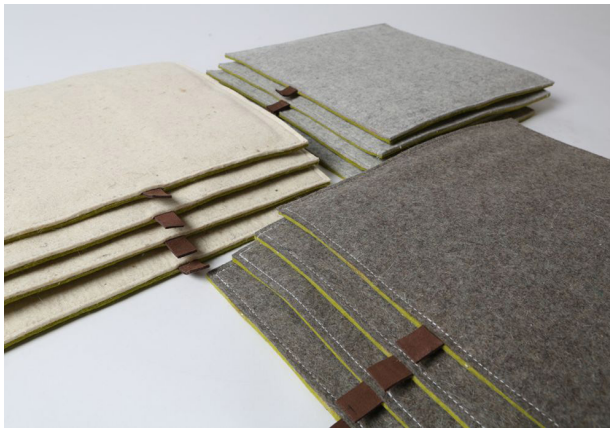

Figure 4.3.11 Wool felt seat padding, softened with a layer of cotton fleece, Samsara, design: V. Kotradyová (N. Knap)

Figure 4.3.12 Traditional wool rug/“guba”/made of local sheep fleece is hand-made with traditional weaving on looms by one of the last craftsman “gubár” Jan Fotta, region Malohont, Slovakia(Knap)

RECYCLATES AND COMPOSITES

From the sustainability point of view, on another level are new plastics – recyclates and bioplastics or biocomposites instead of fossil and mineral raw materials, where the purity of sort is very questionable, thus these are often already composites that later after finishing this life cycle has to be removed by burning/waste incineration. There are cases of recyclates – composite that are made by technology that does not need strong chemicals as joining medium to create the new material and thus it is possible to return them into the life cycle as it is by textile recyclates from company SK-tex (Fig. 4.3.13), or by company Kuruc that produce panels made of recycled Tetra packs useful as an acoustic isolation or construction board as a substitution of plasterboards (Fig.4.3.14)[4].

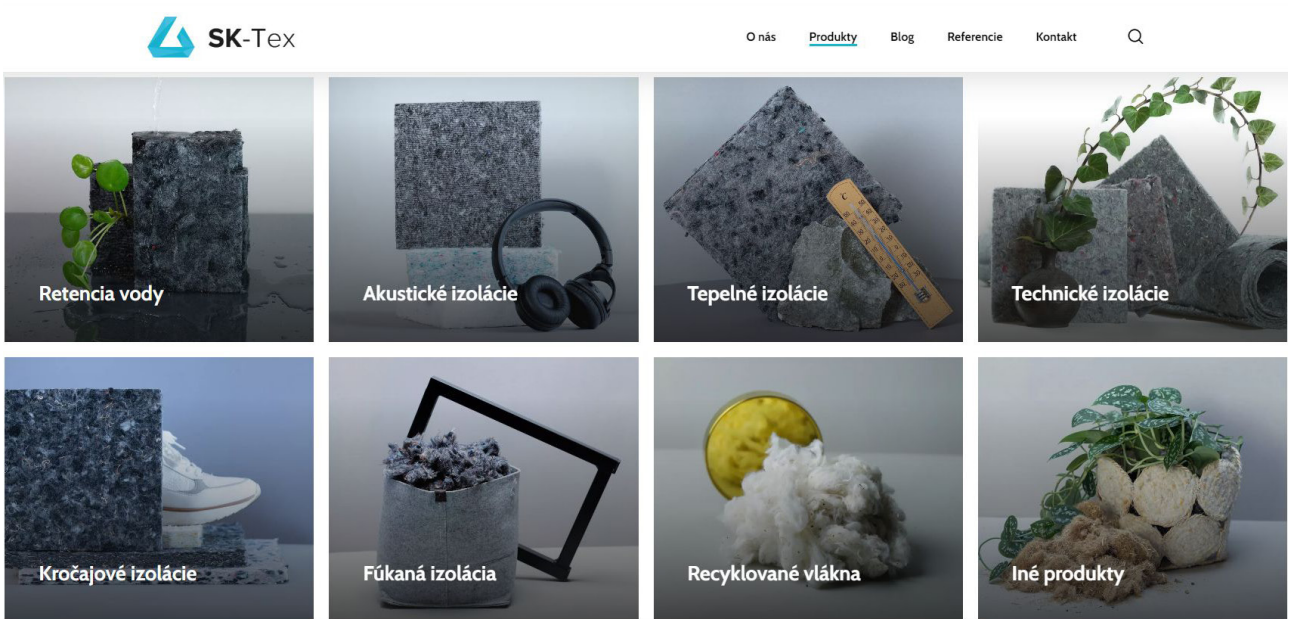

Figure 4.3.13 Recycled textiles from Slovak company SK-Tex processed into isolation and upholstery materials are using old textiles, they can be returned into the life cycle back (SK-TEX)

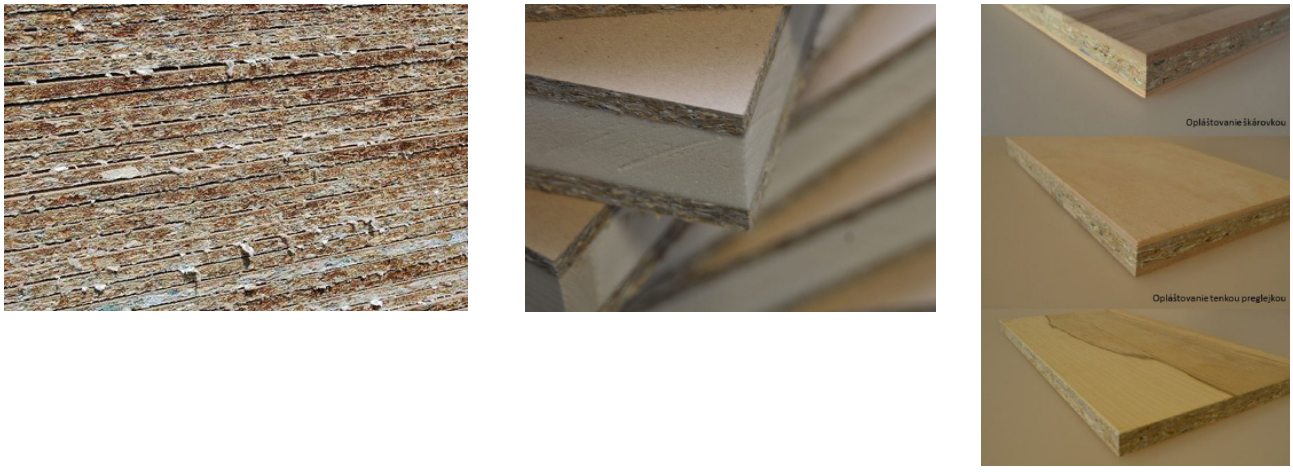

Figure 4.3.14 Tetra K, a material made of tetra pack recyclates, technology using no additives, then enabling returning into the life cycle again (Kuruc), right is the construction sandwich panel TETRA WOOD, applicable for building furniture, project: Interaction of man and wood (BCDlab)

[4] In the project Interaction of man and wood we did an experiment with this material and used it into the sandwich panel as a construction (tetra wood), and test it, if it is possible to join it with regular furniture joints and also if it is suitable outdoor.

METALS, GLASS, AND PLASTIC

Concerning industrial materials like glass and metals (steel, aluminium, cuprum), standard plastics (like PVC, ABS, polystyrene, polypropylene, polyurethane that are nowadays used in buildings and by the manufacturing of furnishings (furniture, lights, accessories), their prefabrication is extremely energy consuming and is responsible for a lot of emissions, but they are durable and can be recycled perfectly. Important here is the application of the differentiation construction principle by the final products in a way that the single elements can be then separated and recycled.

SUMMARY

- using of local renewable materials, recyclates,
- by using of industrial materials like metals, glass, and plastics, using the products, prefabricates and services from producers with ecological certificates,
- energy and pollution-saving concepts in all life cycle phases: prefabrication, manufacturing, using, and removing/ recycling,
- using of assembly-friendly construction principles (differentiation construction principle) or integration into the solid monolithic or moulded elements with a purity of sort, fewer additives, where are combined raw materials that compatible with each other,
- by an ecological concept also thinking of social innovations and sustainability-participatory design, supporting of craft and hand works, inclusiveness of marginalized social groups,
- ¾ of the product life service is decided already by its design.
- Universal design and adaptable housing can prevent ecological and economic problems.

EXERCISE:

1. Work in groups and find in your classroom any products, make an investigation or estimation of what are they from and how they are made (material that are they made of) and try to guess what their carbon is footprint.
2. Motivate students to discuss, what they do at home to contribute the sustainability. What can they do more in this field?

DESIGN

- TREND NEUTRALITY – TIMELESS DESIGN
- VARIABILITY
- POSITIVE IMPACT TO COMPLEX COMFORT/WELLBEING USERS
- TECHNICAL ADVANCE AND EXCELLENT FUNCTION
- USING OF SHAPES CONSIDERING MATERIAL AND TECHNOLOGY

CONSTRUCTION

CHOICE OF MATERIALS

- USING MATERIALS FROM GROWTH OR RECYCLATES
- CHOICE OF MATERIALS FROM PRODUCERS WITH ECOLOGICAL CONCEPTION
- MINIMAL DIVERSITY OF MATERIALS
- USING MATERIALS THAT ARE ACCEPTABLE TO EACH OTHER BY RECYCLING (PURITY OF SORT)
- USING OF MATERIALS WITHOUT HARMFUL ADDITIVES

DIMENSIONING

- MAINTAINING TECHNICAL PARAMETERS
- STRENGTH OF CONSTRUCTION
- UNIFICATION OF DIMENSIONS
- MINIMAL CONSUMPTION OF MATERIAL (LESS MASS)

JOINING TOHETHER

- EXCELLENT CONSTRUCTION SOLUTION
- SOLUTION FRIENDLY FOR DISMOUNTING (IMPACT ON RECYCLING, REPAIRS, OPTIMISATION OF TRANSPORT)

TECHNOLOGY

- CONSEQUENT PRODUCTION PREPARATION
- CHOICE OF TECHNOLOGY FRIENDLY TO THE SOIL, WATER, AND AIR BY PRODUCTION
- CHOICE OF TECHNOLOGY THAT IS ENERGY SAVING
- CHOICE OF TECHNOLOGY THAT CREATES A FRIENDLY WORKING ENVIRONMENT
- CHOICE OF TECHNOLOGY THAT WITH BETTER MATERIAL CONSUMPTION

Figure 4.3.15 Recommendations for rough orientation by designing sustainable products are divided into 3 categories: design, construction, and technology (Kotradyová)

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Figure 4.3.10 Self-bearing Straw bale dome made in passive standard, in Hrubý Šúr, Slovakia, is the headquarter of the architecture studio Createrra, made of natural renewable materials: straw bales as the main construction material, wood structure, with using of green roof on the top, clay floor finished with flax oil varnish, walls covered by clay plaster, Resource: https://www.createrra.sk/page/16/nasa-kancelaria.html, visited, December 8, 2022

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