SUSTAINABLE ARCHITECTURE
SUSTAINABLE ARCHITECTURAL DEVELOPMENTS

SUSTAINABLE MATERIALS
2nd Part

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3. Non-Detrimental to health materials

Exposition to toxic chemicals affects inmune system

If health is affected, it will also affect the environment

Origin

- Oil products – difficulties to absorb
- Sulphurs and other toxic components (some type of wood, heavy metals)
- Biocides
- Emitting radiation – radon
- Electrostatics discharges - metals

3. Non-Detrimental to health materials

What construction materials can be dangerous to health? Why?

Read article

3. Non-Detrimental to health materials

Construction materials that can affect human health:

-Timber protection products
-Paints
-Adhesive
-Varnishes
-Waterproofing and sealing products
-Paper/card
-Lead
-Etc.

3. Non-Detrimental to health materials

Paints and varnishes

Heavy metals
Volatile organic compound (VOC) emissions – evaporate along time

Avoid polish and oil paints
Use water base
Use materials without heavy metals and/or none or low “VOC content”

3. Non-Detrimental to health materials

Asphalt, tar and bituminous products

Petroleum products
Emit toxic gases
Possibility of carcinogenic

It can cause: headache, dizzines, skin irritations, damage to liver and keadnys

3. Non-Detrimental to health materials

Plastics

Petroleum products
When burning they produce toxic gases, some of them are carcinogenic
Emissions during all useful life

- PVC releases chlorine

3. Non-Detrimental to health materials

Asbestos

Fibre cement.
When handling it emits particles that are breathed and introduced in lungs. They are carcinogenic
Asbestosis

Handled by specialised companies

3. Non-Detrimental to health materials

Metals

Conduction of electric charges
Problems with stress, insomnia y organism disfunction

Recommendations
-Not to have metalic elements or connected to energy next to the bed head end
-Not to connect structural elements and electrical installation to the same earth connection. They should be independent.

3. Non-Detrimental to health materials

Granite and other rocks with the same geological origin

They emit radon with descomposition
Radon produces radioactive particles
They stay in lungs, damage body tissues and produce cáncer
Bigger risk in smokers

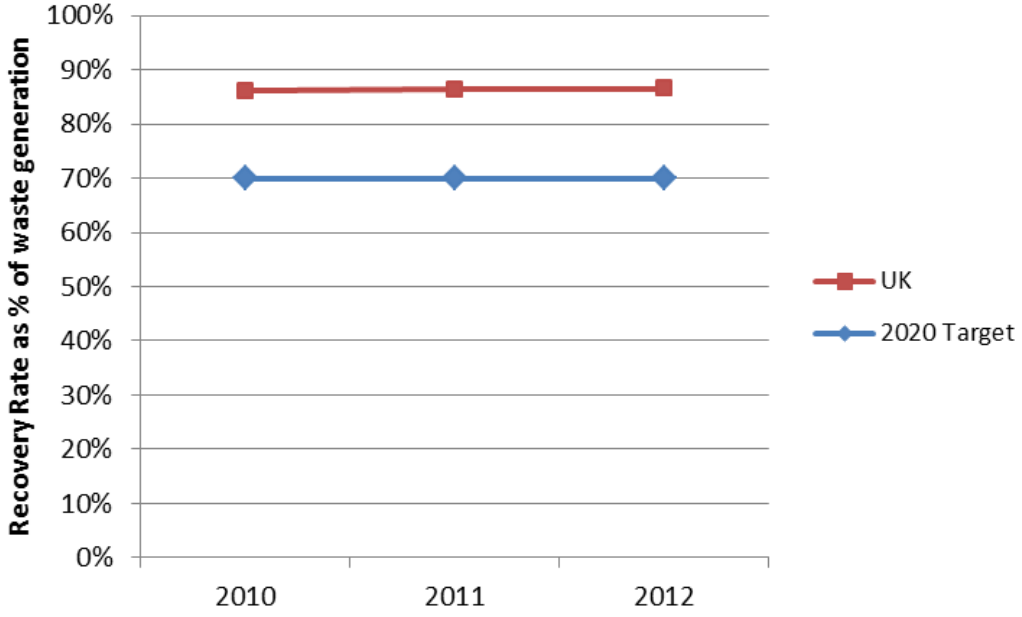
3. Non-Detrimental to health materials

PCBs

Not inflamable and good insulation properties
Present at power transformer and electrical condensers
Toxic gases are releases at more tan 350ºC (dioxines)
Affects the inmunological, nervous, reproductive and endocryne systems

Recycled and secondary materials

- Recycled:
  - Made from used construction materials
- Secondary:
  - By-products of other industrial processes



Source: UK Statistics on Waste, 2016

4. Materials recovery

Directive 2008/98/CE

Definition
"any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy"

4. Materials recovery

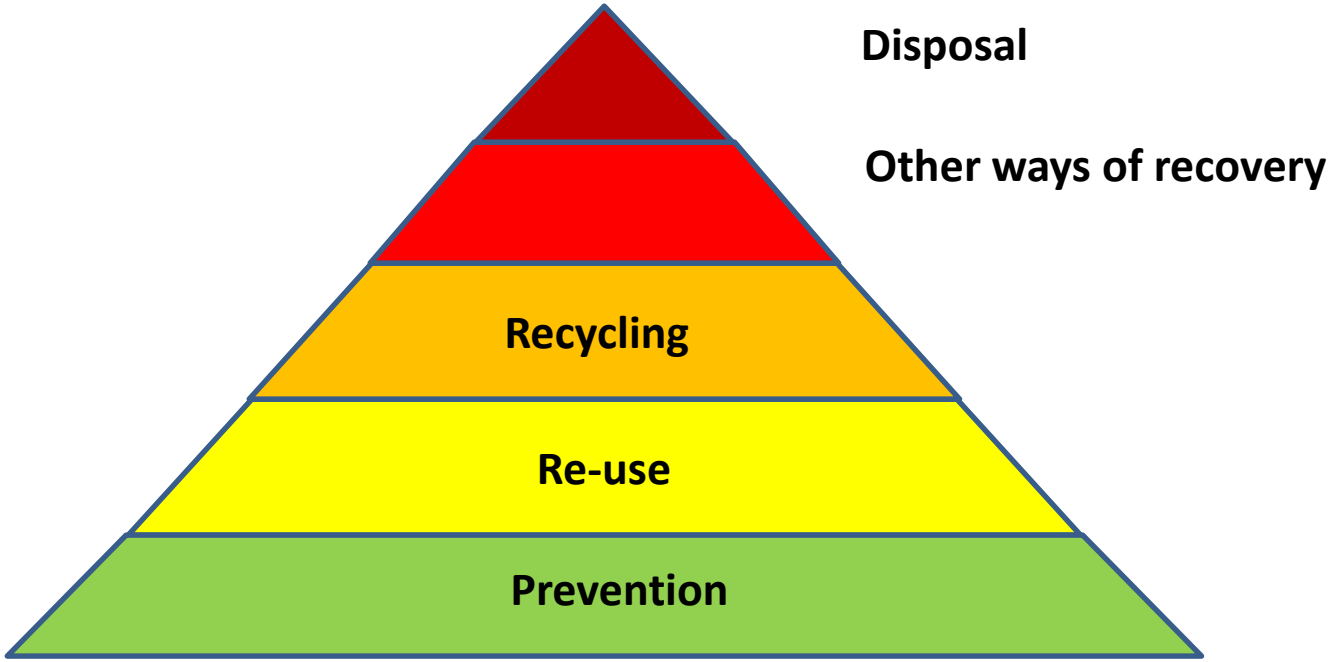
Give value to waste
Reduction of waste volume
Reduction of raw material used

Not always recovery is possible
-Apply inertisation treatments
-Store/dispose of it avoiding to contamine the Environment

VIDEO. SEPARATION OF MIXED WASTE

4. Materials recovery

Priorities for waste recovery



4. Materials recovery

Reuse

"any operation by which products or components that are not waste are used again for the same purpose for which they were conceived"

- Mainly from demolition
- Good conservation
- Easy to extract

4. Materials recovery

Reuse

Roof tiles, bricks, timber beams, metal structure frames, pavements, tiles, installations, etc.

Based in deconstruction
Construct to deconstruct

There is the need of a good Schedule for the deconstruction process

4. Materials recovery

How can we plan deconstruction?

What order of Works would you implement?

4. Materials recovery

Steps for deconstruction

1. **Dismantle of non-structural recovering elements**
   - Sanitaries
   - Cookers
   - Windows
   - Doors
   - Decorative elements
   - Etc.

4. Materials recovery

Steps for deconstruction

2. Dismantle non-structural recovering materials

- Tiles
- Pavements
- Roof tiles
- Pipes
- Prefabricated panels
- Etc.

4. Materials recovery

Steps for deconstruction

3. **Dismantle the elements that form part of the structure frame**
   - Timber frames
   - Joists
   - Trusses
   - Metalic frame
   - Etc.
4. **Massive demolition**

4. Materials recovery

Recycling

"any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations"

Recycling material: it is posible to apply any treatment to transform it

Recycled material: It comes from recycling materials

4. Materials recovery

Recycling

How do you think the market for recycled aggregates works?

4. Materials recovery

Recycling

Market for recycled materials

-Every time it is bigger and bigger
-Recycled materials can have reduced characteristics
-Innovative materials but without any or little experience in use
-Lack of legislation and standardisation, certificates, etc.
-Competing in quality and Price with origin materials

4. Materials recovery

Recycling

Recycled materials

- Recycled aggregates
- Recycled paper insulation
- Ceramic products (fireclay)
- Bricks with recycled plastics
- Metals
- New plastics
- Decorative elements
- Etc.

4. Materials recovery

Recycling material transformations. Common materials

Stony materials
Easy to recycle by crushing
Use in filling and sub-base for roads
Properties are better if mixed with other aggregates
Use in concrete depends on quality

Ceramics
Inerts and stable, easy to recycle
Ceramic construction waste can be crushed and used in filling and sub-base for roads and concrete mixes
Reused materials: old roof tiles, old tiles, sanitary.

4. Materials recovery

Recycling material transformations. Common materials

Concrete

Fresh concrete waste. Filling and use in new batches

- Mechanical seggregation
- Super-plasticizers

Hard concrete waste. Crushing. Good for fillings, sub-base and new concrete mixes

Gypsum

Contamination if mixed with other C&D waste

Plasterboard: It can be reused or recycled.

- Separation of components (plaster and card). Plaster is very easy to recycle to produce new plaster. Also used in agricultura (fertiliser).

4. Materials recovery

Recycling material transformations. Common materials

Insulation with mineral fibres (i.e. rockwool)
You can recycle and produce in material. Waste must be clean of any other adhered material (aluminium, card, plaster, etc.)

Glass
Recycling is easy by heating
Different materials depending on temperature

Timber
Easy to recycle and recover
Reuse as complete pieces, elements with big cross section and good quality
Recycling as boards or biomass. Fibreboard (aware of formaldehyde emissions)
Timber treatments are potentially dangerous for health and the environment if we incinerate it

4. Materials recovery

Recycling material transformations. Common materials

Metals

Recovery of material to transform it in new metal

Easy to separate from other elements

In many cases, it is more expensive to produce new metal from original raw materials

- Recycled steel uses 75% less energy

4. Materials recovery

Recycling material transformations. Common materials

Plastics

High lifespan

Nearly all plastics can be recycled

1º step: seggregation (PVC, PP, PET – bottles, ABS – car body, LEGO pieces, etc.)

2º paso: crushing

3º paso: different procedures

- Extruding: beams, ornamental elements
- Chemical treatment: car bodies and high strength elements
- Heat: coating

Incineration is not aceptable due to emission of dangerous pollutants

4. Materials recovery

Other ways of recovery

- The most common – energy recovery
  - -Timber
  - -Paper and card
  - -No paints or varnishes
  - -No plastics
- Pirolisis – 400ºC – hydrocarbonated gases, CO, liquid and solid carbonous hydrocarbon
- Gasification – waste is oxidised
- Digestion process– methane and compost

Targets for recycled content

- Historically…
  - Scotland – 10% minimum for major public sector projects
  - Northern Ireland – 10% minimum
  - Wales – 10% minimum for major regeneration projects
  - England – ?
  - Target set by overall project value (not per product)

Source: WRAP

4. Materials recovery

Other ways of recovery

- The most common – energy recovery
  - -Wood
  - -Paper and card
  - -No content of paints or varnishes
  - -Never incineration of plastics
- Pyrolysis – 400ºC – gases hydrocarbon gas, liquid and solid, CO
- Gasification – oxidizes waste
- Organic digestion – methane and compost

Case study – London 2012

ODA's headline waste objective:

"to optimise the reduction of waste through design, and to maximise the reuse and recycling of material arising during demolition, remediation and construction"

Towards One Planet Olympics

- Lowering the embodied carbon footprint of the Games

Source: Olympic Delivery Authority

Achievements

- Reduction in embodied carbon:
  - Stadium – 38% lower than original design
  - Aquatics – 10% lower than original design
  - Velodrome – 15% lower than original design
  - Structures, bridges, highways – 14% lower than original design
  - This also achieved cost savings

Source: Olympic Delivery Authority

Waste targets

- Demolition phase – greater than 90% reuse or recycling
- Build phase – greater than 90% reuse, recycling or recovery

Source: Olympic Delivery Authority

Achievements

- Demolition phase – 98.5% reuse or recycling
- Build phase – 99% reuse, recycling or recovery

Source: Learning Legacy, London 2012

Materials of the future?

- Newspaper wood

- Nappy roofing

- Blood bricks

- Bottle bricks

Source: www.citymetric.com

Materials of the future?

- Mushroom walls

- Plasphalt

- Wine cork panels

Source: www.citymetric.com

CONCLUSIONS

Need of promotion of sustainable materials

Innovation and industrial development

- -Reduction of consumptions and emissions
- -Waste recovery

Commitment to include recovered materials in new constructions

Promotion of more efficient materials and penalize others with big environment impact during their life cycle

Promotion of restoration and retrofitting

Ban/limit the use of dangerous materials for health

For next week

- You will each investigate the environmental impact of construction materials products
- Please prepare to discuss the above:
  - Impact of currently used materials
    - E.g. embodied carbon, footprint, extraction, waste, etc.
  - Suggest alternatives for use
    - These do not need to be too different or wacky…
    - How are the alternatives better?
- Tutorial next week

Sources of information

- UK Green Building Council (www.ukgbc.org)
- Construction Products Association (www.constructionproducts.org.uk)
- HM Government – Construction 2025
- UK Government (www.gov.uk)
- WWF (www.wwf.org)
- CityMetric (www.citymetric.com)