Nº521 - BUILDING ROADS USING WASTES – A MAJOR APPROACH TOWARDS SUSTAINABILITY
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Sustainable development:

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:
- the concept of needs, in particular the essential needs of the world’s poor, to which overriding priority should be given;
- and the idea of limitations imposed by the state of technology and social organization on the environment’s ability to meet present and future needs."

Our Common Future (Brundtland Report), 1987
There is not a definition for Sustainability, but for Sustainable Development.

Three axis or dimensions involved: environmental, social and financial.

Sustainability not limited to environmental protection.

Sometimes environmental approach is a good starting point.

Environmental Aspects: resources consumption, emissions, water, waste generation.

Construction stage: wastes

- Minimize
- Re-use
- Recycle
- Valorize
- Send to dump
¿Is it possible to construct with wastes (properly recycled)?

- Steel produced in Electric Arc Steel Plants $\rightarrow$ > 80% waste recycled
- Silica Fume for High Performance Concrete $\rightarrow$ 100% waste recycled
- Bitumen for Asphalt Pavements $\rightarrow$ > 90% waste recycled
- Portland Cement $\rightarrow$ 0% - 30% waste recycled

¿What is more sustainable? $\rightarrow$ Comparison in terms of Sustainability

- Housing and Building $\rightarrow$ LEED, GBC, VERDE (highly developed)
- Civil Works, Highways and Roads $\rightarrow$ Multi Criteria Analysis, MIVES (early stage)

$\rightarrow$Non quantifiable evaluation & comparison through real cases in XXI century:

- Complete sections in Projects
- Test Sections (R+D Projects)
Construction and Demolition Waste in upper layer (coronation) of embankments in motorway

Demolition of former highway (hydraulic hammers)

In situ treatment through portable mills

Extension and compaction
Experimental section in Soil Cement made with recycled ballast made from Construction and Demolition Waste

 Aggregate from CDW (commercial)

 Extension of recycled ballast

 In situ cement addition and mixing
Artificial recycled ballast made from Construction and Demolition Waste of Former Structures

 ← Aggregate from CDW (commercial)

 ← In situ treatment through portable mills

 Recycled Ballast →
Stabilized soil with cement and paper sludge CDEM ash (exp.)

Ballast layer obtained from Municipal Solid Waste (MSW) ash

Asphaltic Surface layer using Electric Arc Furnace (EAF)
Concrete pavement in harbour using dredging material as corrective sand (exp.)
Two layer concrete pavement with base layer including recycled CDW aggregates (study)

Other accepted by standards examples: Reclaimed Asphalt Pavement, Scrap Tires in modified bitumen or asphalt (dry or wet way), Marginal soils or rocks treated with lime or cement.
CONCEPTION EMISSIONS

Environmental Road’s Performance

- Conception
- Design
- Construction
- Operation

CONSTRUCTION PHASE SUSTAINABILITY

MATERIAL’S TRANSPORT REDUCTION

- Less fuel consumption
- Less CO2 emissions
- Less acoustic emissions
- Less highway’s network damage

RAW MATERIALS CONSUMPTION REDUCTION

- Longer life for existing quarries
- No need for new quarries
- Use of former wastes/by products
- Save in transport of materials

EMISSIONS

- Sustainability
- Sustainability & Wastes
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IN SITU TREATMENTS vs PLANT TREATMENTS

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Sustainability - environmental dimension:

- **Use of natural resources**: existing quarries increase their operational life because a part of raw materials are replaced by by-products, formerly wastes.
- **Generation of wastes**: it is neutral if wastes are not generated in the project (external wastes) and favourable if they come from the same project. But considering a bigger scenario the use of external wastes results in reduction of generation of wastes in the industry where they come from.
- **Land arrangement in terms of urban environment**: while reducing the amount of raw materials land occupation is lower and landscape is less affected.
- **Emissions to the atmosphere**: favouring the use of recycled product reduces emissions in terms of CO2 because of less energy consumption supposed that a part of the entire process (extraction, first treatment) is avoided. But
- **Environmental accidents**: If properly done, this item is neutral
- **Generation of noise and vibration**: use of internal wastes reduces noises and vibration generated by transportation and dump management
Sustainability - financial dimension:

- **Price:** The price to be paid for a pavement unity including wastes has to be similar to the standard one. → Increased prices for recycled (scrap tyres).
- **Cost:** Cost of external wastes is not always similar or lower to the raw materials (cost of transportation, internalisation of environmental costs included in waste management)
- **Market:** A depressed market favours huge reductions of price to maintain business volume. It is desirable a stable situation to promote serious research on the use of wastes because the risk of accidents becomes higher when improvisation takes place.
- **Taxes:** Policies authentically environmentalist can help in spreading the use of waste through new taxes o reduction of taxes.
- **Legal security:** Attention must be paid on legal (penal) risks when using certain wastes as by products.
Sustainability - social dimension:

- Health and safety: If properly done, the use of wastes in road and highways construction has no effect.
- Self realisation: A society that is capable of recovering from his mistakes compensating of former episodes of dumping feels more satisfied.
- Psychological, Spiritual happiness: It’s a similar
- Capacity of developing skills: Sustainability is a challenge that walks together with human progress.
- Education: A more educated society promotes use of wastes. Using wastes educates in austerity, and prepares to difficult situations.
- Sense of transcendence: When being capable of thinking in future generations, human person reach the real sense of living and understand transcendence.
Conclusions

✓ Using wastes in road’s construction is clearly favorable in terms of sustainability. Environmental benefits run together with social and, frequently, economic ones
✓ Re use, recycling and new treatments require technical knowledge and transversal points of view. Non serious projects or test sections have negative effects
✓ R+D+i, projects are essentials, particularly innovation in transversal policies
✓ Zero Waste objective need to consider highways as industries suitable for using wastes from construction or other activities
✓ Sustainable Construction Models (common in building and housing) have to be extended to Highway’s Industry, including minimizing, re use, recycling and transport reduction
✓ Change of unlimited raw materials philosophy to best available techniques one.
✓ Inclusion of waste’s recycling programs in Environmental Impact Declaration & Studies.

→ Each Project must include an Integrated Waste and Non Profitable Materials Plan
Thank you for your kind attention.