

The debris generated during the construction, renovation, and demolition of buildings, roads, and bridges is called construction and demolition wastes (C&D waste). They include: concrete, wood, asphalt, gypsum, metals, bricks, glass, plastics, building components like doors, windows, and plumbing fixtures, trees, stumps, earth, and rock from clearing sites.

# USE OF RECYCLED CONCRETE IN CONSTRUCTION IN LUXEMBOURG

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Construction and demolition waste constitutes a major portion of total waste production in the world, and most of it is used in landfills.

The re-use of concrete rubble collected from demolished structures is an important issue. After crushing and screening, there is the possibility of appropriately treating and reusing such waste as aggregate in new concrete, especially in lower level applications.

Different aspects of the topic beginning with a brief review of the European initiatives and definition in terms of C&D waste generated and recycled aggregates produced from C&D waste are given. Along with a brief overview of C&D waste, a summary of the situation in Luxembourg in use of recycled aggregate is discussed.

This writing concludes by identifying some of the major barriers in more use of recycled aggregate concrete, including lack of awareness, lack of knowledge, barriers of specifications/codes for reusing these aggregates in new concrete.

## Introduction:

### Circular economy

A circular economy is a system that is restorative or regenerative by intention and design. It replaces the 'end-of-life' concept with restoration, reuse and recycling. In the context of concrete, a circular system can be achieved by transforming waste to a new raw material. This brings a double benefit to environment: Waste is eliminated and waste as a resource is used in an efficient and sustainable way.

\_Source: Towards the circular economy - Reports - World Economic Forum

Using natural resources and converting, transforming them into goods is one of the principal economy foundation of our and earlier generations. And of course it will be an essential part of the future wealth. However statistics show that the quantity of our current resource use is at such a rate that the facility of future generations and the developing countries to access to their appropriate share of decreasing resources are endangered.

Knowing this, it is clear that the conception of resource efficiency has gained huge significance in all over the world, especially in Europe.

Europe is dependent on the rest of the world for many resources, such as fuel and raw materials, which are part of products imported from outside the European Union.

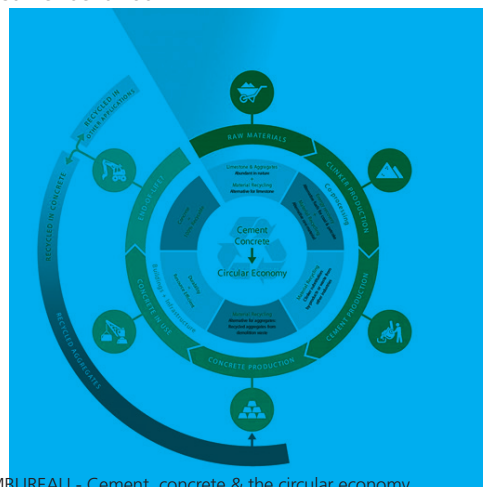
Our dependence on oil, gas and coal makes consumers

and businesses vulnerable to damaging and costly price fluctuation. Shortage of resources and unpredictable product prices brings instability to the European economy which threatens our economic security.

Therefore several strategies and campaigns like 'The Roadmap to a Resource Efficient Europe (COM (2011) 571)', 'Europe 2020 Strategy' and others, have been launched by the European Union and its partner countries in order to diminish this dependency and to build a resource efficient Europe.

Statistics and trends show that in order to achieve these goals, the improvement of the European waste management has to be stimulated and promoted.

The major plan is to turn waste into a resource so that we get a circular economy. Therefore objectives and goals are set in European policies and legislation in order to improve waste management, stimulate improvement and innovation in recycling, limit the use of landfilling, and initiate change consumer behaviour.



CEMBUREAU - Cement, concrete & the circular economy

### Construction and demolition waste

The European Commission has identified construction and demolition (C&D) waste as a priority stream because of the large quantities that are generated and the high potential for reuse and recycling enclosed in these materials.

More precisely, statistics show that there is application of the huge quantity of products made of concrete in the construction sector and that its properties make it the most consumed material worldwide and the second most

consumed resource worldwide. So concrete has the highest potential to be recycled.

Generally, recycling concrete means reusing or recycling of demolished concrete for the purpose to use it as a secondary raw material for different fields of application: road construction, foundation, substructure, structural concrete, etc.

Recycled concrete aggregate is basically produced in two stages: Firstly, crushing of demolished concrete, and secondly, filtering and removal of contaminations and unwanted by-products such as reinforcement, paper, wood, plastics and gypsum. Concrete made with such recycled concrete aggregate is called recycled aggregate concrete.

In general, in Europe, when we speak about recycling of concrete, we speak about downcycling because a pure recycling of concrete for higher class raw material is economically unviable at the moment.

Down cycling describes the process of converting waste materials or useless products into a new, lower-value material or product. Downcycling aims to reduce waste and the consumption of new raw materials, energy usage, air pollution and water pollution.



Vishojit B. Thapa - RECYMA S.A. - C&D Waste

### Situation in Luxembourg

The current situation of waste management considering concrete recycling and its application in Luxembourg is simple to scrutinize.

In comparison with the European average, Luxembourg generates the second highest share of the EU-28 considering mass per inhabitant. The high ranking is due to the high percentage of excavation material, like soils and rocks, which is included in the definition of C&D waste. This is largely responsible for the high amount of waste generated in Luxembourg.

For example, in 2010, the numbers about Luxembourg consolidates the overall European tendency, 8.6 million tons out of 10.4 million tons of total waste, was generated by the construction sector as construction and demolition waste.

From the total amount of eliminated and recycled inert waste in Luxembourg (2010):

\_Inert waste

Consists of:

Eliminated inert waste (landfilling, earth and stone): 70%

Recycled inert waste: 30%

\_From this recycled inert waste: 30%

Consists of:

Regional recycling centres: 21%

Other backfills: 1 %

Exported inert waste: 8 %

According to experts, among all the materials, concrete represents approximately 178 thousand tons (178 000 tons). This amount of tons is the quantity of recyclable concrete for 2010.

Additionally, experts estimate that currently in Luxembourg, for concrete waste, there is a high tendency of downcycling of concrete waste for use in road construction, foundation and substructure construction.

Luxembourg already fulfils by the requirement for concrete

of the Waste Framework Directive which in general requires Member States to take any necessary measures to achieve a minimum target of 70 % (by weight) of construction and demolition waste by 2020 for preparation for reuse, recycling and material recovery, including operations using non-hazardous construction and demolition waste to substitute other materials.

The national network consists of 12 regional landfill sites exploiting inert waste. The quality of the recycled concrete aggregates generated in Luxembourg depends on several factors.

In Luxembourg, its origin is mainly from demolition of buildings, thus already the initial material is not pure concrete demolition and it has a considerable rate of contamination. Its minor constituents are bricks, tiles, ceramics, soils, gypsum, insulating material, timber, metals, etc. Considering these constraints, we can say that the recycled concrete in Luxembourg has an average quality.

In Luxembourg, there are two important documents which have to be consulted and followed while using recycled aggregates for concrete production:

\_Combined document 'concrete', EN 206-1: Concrete - Specification, performance, production and conformity, completed by the national application DNA EN 206-1:2000

Original title: DOCUMENT COMBINÉ « BÉTON » constitué de la NORME EN 206-1: BETON, Partie 1: Spécification, performances, production et conformité, modifiée et complétée par le Document National d'Application luxembourgeois de l'EN 206-1: 2000

\_Specification sheet: Aggregates

Original title: PONTS ET CHAUSSEES, CAHIER DES CHARGES: 'GRANULATS' (CDC-GRA08)

Additional to these national documents the following European Standard has high importance:

\_EN 12620: Aggregates for concrete is most relevant for aggregates for structural concrete

According to these documents, the normal-weight aggregates have to be certified conforming to 'EN 12620: Aggregates for concrete' and the national specification sheet 'CDC-GRA Granulats et sables'.

The aggregates need a valid certification delivered by 'Laboratoire d'Essais des Matériaux des Ponts et Chaussées du Luxembourg' or need to be proved by the producer to have passed all the controls prescribed by the regulations in order to get a certification as aggregates and sand.

The recycled concrete aggregate have to submit a certification of adequacy delivered by an organisation approved in the framework of the directive 'Beton mit rezykliertem Zuschlag' from DAfStb (Deutscher Ausschuss für Stahlbetonbau; engl. German Committee for Structural Concrete).

In general, the following are the fields of application for recycled concrete aggregates in Luxembourg:

\_Huge quantities are used in road constructions and foundation and substructure construction.

\_Slight, minor quantities are used for the base or fill for drainage structures or piping systems. They are used to replace sand and gravel for the levelled assembly of extern piping of various systems.

As a conclusion, we can say that in Luxembourg recycled aggregates are mostly used in road construction and as sub-layer in foundation construction, but barely used in concrete production. In fact there are no statistics or accounting of its use as second raw material in concrete production in Luxembourg and it is difficult to find further information of their use in structural construction because this potential still hasn't gained ground in Luxembourg.

There are different reasons for this lack of use of recycled concrete aggregates for concrete production in Luxembourg. One important reason is the average quality of the recycled concrete aggregates, which makes the material unpredictable for concrete production.


As the material comes from construction sites, there is

always a certain degree of impurity of the material which changes from one construction site to another. This is also due to the strong scattering of the source material, which requires a separate and individual inspection

Furthermore, improved sorting and washing seems to be material-intensive and cost-intensive which leads to the inefficiency of the recycling process. There is a very low profit margin with the present processes. Besides, the limited quantities of material available in Luxembourg make it difficult to improve the processes and stimulate research in this field.

Finally, in the last centuries, Luxembourg's growth and wealth was driven by the steel industry and large reserves of blast-furnace slag, which are by-products from the steel production processes, had been made.

In the last decades, Luxembourg profited from these reserves for use in road and railway construction, but they are almost entirely spent. Therefore, the recycled concrete aggregates are used as slag replacement in road and foundation construction, drainage system, etc.

 Das Bildelement mit der Beziehungs-ID r1d11 wurde in der Datei nicht gefunden.

Workshop "Les bétons recyclés" - Chaux de Contern

## Situation in neighbouring countries

### Belgium

In general, the situation in Belgium is slightly different from other countries. The geological context mainly influences the development of recycled concrete aggregates.

Belgium is divided in two main administrative regions which also represent two different geological regions, the Dutch-speaking region of Flanders in the north and the French-speaking southern region of Wallonia. The administrative region of Brussel plays a minor role on geological level.

In the region of Flanders, there are very low amounts of stone pits and quarries which explain its huge ambition in retrieval alternative aggregates accessible in short distances. So in general, the region of Flanders highly promotes the research and utilization of recycled concrete aggregates for numerous applications.

The region of Wallonia counts several sandstone quarries. This high occurrence of natural aggregates explains the high frequency of quarries in the southern regions. Additionally, the lobby of the quarries owner try to suppress the research and use of recycled aggregates to maintain their predominance and authority in the aggregates market. So, in the southern region there is the presence of a brake for the development of recycled aggregates.

Like it is general practice in the Greater Region, also in Belgium, the use of recycled aggregates is limited for application in sub foundations and road constructions. There are some construction projects consequently using recycled concrete in Belgium, but these are all individual and singular cases.

### Germany

According to German experts, the utilisation of recycled concrete aggregates for recycled concrete production is possible and feasible, but in Germany there exist many restrictions.

Additionally, the stand of processes for recycled concrete is not efficiently practicable, therefore there is minor to no use in practice in Germany.

There are construction projects using only recycled concrete, but the number is very small comparing to overall construction projects and the motivation often comes from the environmental awareness of a small group of persons.

Additionally, high portions for the remote use of recycled concrete are the different additional requirements in German Standard which restrict the use of recycled concrete to very limited applications.

### France

According to French experts, France has a slight backorder to other countries in the development of detailed and extensive procedures and requirements for the use of recycled concrete aggregates.

Therefore, the French government has launched a national project for research and development called RECYBETON. The aim of this project is to change the trend by re-using all the materials of deconstructed concrete, as components of new concrete or hydraulic binders, including the fine particles.

### Summary

In general, valuable work has been done in several European countries in implementing research, development, pilot and demonstration projects, and in documenting best practice in fields such as selective demolition, the operation of recycling centres, and material-by-material processes.

The construction industry should therefore be encouraged to use alternative methods of managing material performance risks, including contract- or sector-specific specifications, or by the external verification of quality certification of recycled materials. It should not be necessary to wait for nationally or internationally agreed specifications.

Research plays a key role in deciding how quickly the sites are cleared and redeveloped, and this in turn strongly influences the extent to which selective demolition and the use of recycled concrete aggregates is practical.

Especially in Luxembourg, the awareness and importance about promoting new technologies and projects concerning recycling of concrete has not yet reached like, for example, in the neighbouring countries.

Luxembourg's government and construction companies have always been independent, efficient and sustainable in the aggregates and resource market. In the future, the competition and the well-known resource depletion will be more visible effects in the market. Therefore in Luxembourg, future plans and investments in recycling improvement have to take place on time.

 Das Bildelement mit der Beziehungs-ID r1d11 wurde in der Datei nicht gefunden.

Workshop "Rezyklierter Beton" - Université de la Grande Région

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RECYMA - Hosingen: Romain Coos, Director-General

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