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Recycling Concrete

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Abstract— ***Concrete recycling is an increasingly common method of utilizing the demolished or renovated concrete. The process involved for recycling are crushing, pre-sizing, sorting, screening and contaminant elimination. Further cleaning is necessary to ensure the recycled concrete products is free of dirt, clay, wood, plastic and organic materials. This is done by water floatation, hand picking, air separators and electromagnetic separators. The more care that is put into the quality, the better product we will receive with sound quality control and screening. Seceral advance have made recycling more economical for all types of concrete pavements. These includes:-***

- ***development of equipment for breaking concrete be they plain, mesh and doubly continous reinforced.***
- ***Develoment of methods to remove steel that minimizes the labour.***

Use and application of crushing equipments that can accomodate steel reinforcement.

Keywords—Reduction of waste; Reduction of Transportation Cost; Reduce Disposal Cost and Employement Oppurtunities.

1 Introduction

In last 50 years, there has been extensive construction activity, which is increasing at an exponential rate. It is generally accepted and expected that a building would last for atleast 60 years. Hundreds of thousands of reinforced concrete structures are being annually constructed worldwide with a belief that they are strong durable.

Today's concrete is made using cement, coarse aggregates of stone, sand and water, chemicals called admixtures are added to the concrete mix to control its setting properties and are used primarily when placing concrete during environmental extremes, such as high or low tempoeratures, windy conditions, etc. For longevity of the buildings, as much as it is important to have good quality construction and important to have right planning and design in place. Quality assurance and quality control is important at every stages of project life cycle.

Concrete is the second most consumed material after water and is the basis for the urban environment. It can be roughly estimated that in 2006 between 21 and 31 billion tonnes of concrete (containing 2.54 billion tonnes of cement)3 were consumed globally compared to less than 2 to 2.5 billion tonnes of concrete in 1950 (200 million tonnes of cement).4 Concrete is made from coarse aggregate (stone and gravel), fi ne aggregate (sand), cement and water.5 Primary materials can be replaced by aggregates made from recycled concrete. Fly ash, slag and silica fume can be used as cementious materials reducing the cement content. These materials can be added as a last step in cement production or when the concrete is made. In the developed world most cement is made industrially into concrete and sold as ready-mix concrete. On a smaller scale, and more commonly in developing countries, concrete is made in situ on the construction site by individual users. Concrete can be recycled from: • Returned concrete which is fresh (wet) from ready-mix trucks • Production waste at a pre-cast production facility. 6 • Waste from construction and demolition. The most signifi cant source is demolition waste. 7 Other America 13% USA 3.9% CIS 3.4% Other CEMBUREAU 2.3% European Union 27 10.6%

Other Asia 13.2% Africa 4% Japan Oceania 2.7% 0.4% India 6.2% Other Europe 0.2% ASIA 69.4% CHINA 47.3% 2006 World Cement Production by Region: 2.54 billion tonnes * Regional breakdown of cement production is similar to that of concrete production.

2 Recycling Concrete : Reality

· Although concrete is not broken down into its constituent parts, it can be recovered and crushed for reuse as aggregate (for use in ready-mix concrete or other applications) or it can be recycled through the cement manufacturing process in controlled amounts, either as an alternative raw material to produce clinker or as an additional component when grinding clinker, gypsum and other additives to cement.

· It is generally accepted that about 20% (or more) of aggregate content can be replaced by recycled concrete for structural applications.

· Countries such as the Netherlands and Japan achieve near complete recovery of waste concrete.

· Current technology means that recovered concrete can be used as aggregate in new concrete but (1) new cement is always needed and (2) in most applications only a portion of recycled aggregate content can be used (regulations often limit content as do physical properties, particularly for structural concrete).

· Most greenhouse gas emissions from concrete production occur during the production of cement. Less-significant savings may be made if transportation needs for aggregates can be reduced by recycling.

· A full lifecycle assessment should be undertaken. Sometimes low-grade use is the most sustainable solution as it diverts other resources from the project and uses minimal energy in processing. That is not to say more refined uses might not also suit a situation.

· This depends on local conditions (including transportation costs)

3 Sustainable Development Principles Lifecycle thinking and Recycling Concrete

Recycling concrete is not an end in itself. An assessment of the overall sustainable development benefi ts of recycling concrete is needed. It is useful to place concrete in the context of the environmental impact of other materials. Concrete has a high environmental impact with respect to its input materials, namely in the cement production phase. Transportation and delivery at all stages of production is the second greatest source of impact.31 It is, however, extremely durable and can bring many environmental advantages during the use phase. Factors to consider when comparing recycled aggregate to virgin aggregate or other building materials include: • Transportation costs including fuel usage and CO2 emissions - C&DW is often already located in an urban area close to or on the construction site whereas virgin materials are often sourced from more distant quarries and natural areas. Conversely, transportation costs may sometimes increase when using recycled aggregate as it may not always be feasible to process aggregate on-site. • Noise, air and water pollution and the energy needs of the processing systems to recover the concrete or use natural materials - Systems for different materials can be compared - Producing coarse aggregate will have less impact than further refi ning; however, future use of the aggregate has to be considered. • Land Use Impact – Using recycled aggregate means - Less waste goes to landfi ll - Less land is disturbed as virgin alternatives can be conserved. • Environmental impacts during the use phase - Recycled aggregate has similar properties to regular virgin concrete. As such there is usually less difference in impact from this perspective during the use phase. Compared with other building materials, the thermal mass of concrete means that energy savings can usually be made during the operation of a building built with concrete as less energy is needed for heating and cooling than for many other materials. • Useful life expectations - The durability of concrete and recycled concrete means that its long useful life can be a sustainability benefi t compared with other materials.

Recycling concrete – CO2 neutral Much sustainable development discussion focuses on reducing greenhouse gas emissions. However, as already discussed, recycling concrete creates few opportunities to reduce carbon emissions. Greenhouse gas emissions reductions can be made when a high carbon footprint material or process is substituted for a lower one. Recycling concrete into aggregate tends not to produce any such savings as compared to using natural aggregate except in so far as transportation requirements can be reduced. Research indicates that over long periods concrete, particularly crushed concrete can carbonate and as such reabsorb CO2. However, there is no real practical data at this point and estimations and research are still fairly nascent.32 Cement manufacture is the target area for carbon emissions reduction efforts as it is the stage of production where the most greenhouse gas impact occurs. Signifi cant steps have been madee by the industry as a whole in recent years.

4 How Can Recyled Concrete be Used ?

- As aggregate (coarse and fi ne)
- As blocks in original or cut-down form

Use as aggregate Most recycled concrete is used as aggregate in road subbase, and most commonly in unbound form. The quality of aggregate produced depends on the quality of the original material and the degree of processing and sorting. Contamination with other materials also affects quality. More refi ned aggregate may produce a product of higher value use but may also have a greater environmental impact in production. When well cleaned, the quality of recycled coarse aggregate is generally comparable to virgin aggregate and the possibilities for use are equally comparable although some limitations as to strength may exist. Material containing plasterboard can have more limited applications.

Recycled aggregate accounts for 6% to 8% of aggregate use in Europe, with signifi cant differences between countries.70 The greatest users are the United Kingdom, the Netherlands, Belgium, Switzerland and Germany. It was estimated in 2000 that ~5% of aggregate in the US was recycled aggregate.

As coarse aggregate

For road base, sub-base and civil engineering applications

Use for road base, pavement and sub-base is widespread and the most common use. In the US its use and acceptance has been promoted by the Federal Highway Administration, which has adopted a pro-use policy and undertaken research in the area. Finnish research has found that recycled concrete specifi ed to an agreed quality and composition in the sub-base and base layers can allow the thickness of these layers to be reduced due to the good bearing properties of the material. When used as a base and sub-base the unbound cementitious material in recycled aggregate has been found to have a bonding that is superior to that from fi nes in virgin aggregate such that the strength is improved providing a very good construction base for new pavements. It can also be used bound in asphalt mixtures. Various civil engineering projects can also make use of coarse aggregate.

For concrete

A common misperception is that recycled concrete aggregate should not be used in structural concrete. Guidelines and regulations often consider the physical limitations of recycled concrete aggregate, but ideally they should also promote its use. A study by the National Ready Mixed Concrete Association (NRMCA) in the US has concluded that up to 10% recycled concrete aggregate is suitable as a substitute for virgin aggregate for most concrete applications, including structural concrete.76 UK research indicates that up to 20% of recycled concrete aggregate can be used for most applications (including structural).77 Australian guidelines state that up to 30% recycled aggregate content in structural concrete can be up to 30% without any noticeable difference in workability and strength compared with natural aggregate.78 German guidelines state that under certain circumstances recycled aggregate can be used for up to 45% of the total aggregate, depending on the exposure class of the concrete.79 As recycled concrete aggregate has cement in it, when reused in concrete it tends to have higher water absorption and can have lower strength than virgin aggregate. Sometimes more cement is needed.

5 Reuse in Original Form

Reuse of blocks in original form, or by cutting into smaller blocks, has even less environmental impact; however, only a limited market currently exists. Improved building designs that allow for slab reuse and building transformation without demolition could increase this use. Hollow core concrete slabs are easy to dismantle and the span is normally constant, making them good for reuse.

6 Economic Benefit of Recyled Concrete

In addition to the environmental benefi ts, using recycled concrete can also be economical, depending on the situation and local conditions. Factors include:

1. Proximity and quantity of available natural aggregates
2. Reliability of supply, quality and quantity of C&DW (availability of materials and capacity of recycling facility)
3. Public perceptions regarding the quality of recycled products
4. Government procurement incentives
5. Standards and regulations requiring different treatment for recycled aggregate compared to primary material
6. Taxes and levies on natural aggregates and on landfill.

The cost of sending waste to landfi ll can often be greater than the cost of sorting and selling concrete waste from a construction site to a recycler (or even paying a fee for collection), particularly when landfi ll fees exist.

The cost of using demolition materials in a new construction on the same site can also be less than that of new materials.

Depending on the recycling methods used, particularlythe extent to which materials need to be sorted and other materials removed, the costs of recycling machinery and processing may increase.

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