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Recycling of Concrete: A Sustainable Approach towards onstruction

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ABSTRACT: Today, with increasing population and services, construction has no limit. The resources that we have are limited and hence the exploitation of these resources is a major concern in the present days. The best way to cope up through these crises is sustainable development. This type of development may be applied in various ways, may it be construction techniques, materials, sustainable designs etc. Talking of the materials that are used in construction the one used in maximum quantities is Concrete. This research paper aims at a direct sustainable approach towards construction by recycling of a building material i.e. Concrete. With the help of a few statistics and case studies, this paper will help to develop an understanding towards the ecosystem and its exploitation and also will introduce a cycle of use and reuse of concrete. The concept of stocks and flows would be explained in relation with concrete.

Keywords: Concrete: Building Material, Cement Production, Carbon Emission, Stocks and Flows, Recycling and Reuse of Concrete, Alternatives.

I. INTRODUCTION

Urbanization, today, is the major activity going around in the world. In India, large population has been moving to urban areas after the independence due to development of economy in the private sector. Also people are attracted by the idea of moving into urban areas as they provide great opportunities for jobs, education and also have proved to improve lifestyle of the people (Refer Fig. 1).

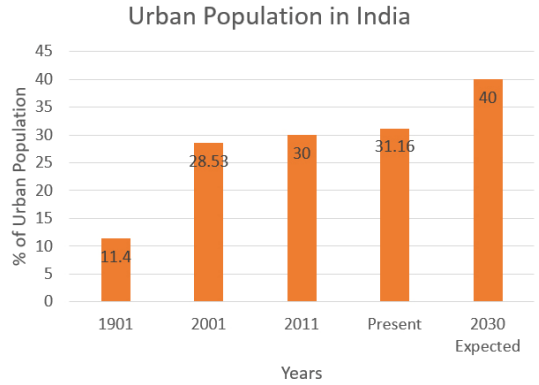

Fig. 1: Urbanisation in India, (Datta, Pranati. "Urbanisation in India", June 2012.)

With more and more people moving into urban areas, cities to be precise, there comes a great need of a fluent infrastructure. An addition to this pace of urbanization is the activity of construction and demolition. The tremendous increase in the users of urban facilities, a change in the existing infrastructure is need of the hour. This advents the process of construction and demolition. Recycling and reusing of the waste generated by demolition shall certainly make urban growth sustainable in terms of infrastructure.

II. DEMOLITION WASTE IN INDIA AND THE WORLD

The changing infrastructure produces huge amounts of demolition waste, perhaps concrete in most significant quantities. As a result of densification of core urban areas, this waste is generally moved out of the cities and dumped into landfills. Only a specific grade of this waste is presently used for new construction purposes.

City character and its relation to demolition waste.
Demolition is the result of evolution of any urban region. The history, the trajectory of development and the present day regime of cities have a substantial effect on construction and demolition. A concept of economics, “stocks and flows” would better explain the aforementioned by considering the case of Zurich.

For the year 2005, researchers from ETH Zurich have analyzed the stocks and flows of concrete precisely. They found that 676,000 tons of concrete gravel flowed into the city of Zurich and 379,000 tons of concrete material left the city. Almost half of the inflow, approximately 329,000 tons, went into new office buildings, which at the time produced with 160,000 tons, also the highest outflow. The present increase of population of Zurich is reflected in 277,000 tons of concrete flowing into the city for apartment buildings and only 39,000 tons from demolished apartment buildings leaving the city. At the same time, only 7,000 tons of concrete went into the construction of new factory buildings, while 54,000 tons of demolished factory buildings left the city. This glimpse of material flow in and out of the city shows how closely related it is to the history of the city.

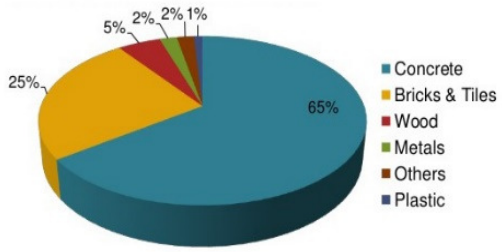

Fig. 2. Status of Demolition waste in India (Prof. S.K. Bhattacharya, Demolition Wastes as Raw Materials for Sustainable Construction Products, CSIR-CBRI News Letter, Vol-33, No-2,April-June, pp 1-2)

Present use of Demolition Waste.

With the changing infrastructure and densification of cities, it is hard for demolition waste to find its place within the core areas, and hence it has to be moved out to spill overs. This waste generally finds its place in the potential landfills, while a very little of it is reused. The real potential of demolition waste is not known to much, also the present way of its disposal has a lot of disadvantages.

Disadvantages of dumping of Demolition Waste.

i. The dumping of demolition waste in large amounts fills up the landfills minimizing their true potential.
ii. Carrying the bulk to far off urban sprawls just for dumping is a mere wastage of natural oil and gas.
iii. Dumping of this waste spoils the processing of bio-degradable and recyclable waste.

Demolition waste in India

In India, the Central Pollution Control Board has estimated current quantum of solid waste generation in India to the tune of 48 million ton per annum out of which waste from construction industry accounts from more than 25%. Management of such high quantum of waste puts enormous pressure on the solid waste management system. The breakup of demolition waste in India is depicted in Figure 2. As concrete comprises of 65% of the demolition waste, it is the best suitable for recycling. Presently, only 3-4% of this demolition waste is reused for the embankment purposes in bridges.

III. RECYCLED CONCRETE AGGREGATE (RCA)

A. Advantages of recycling demolition waste

Out of all that demolition waste comprises of concrete is the most unstructured and useless, if not recycled, but if recycled it may serve the following advantages.

i. RCA will reduce the cost of construction, so it will be a better alternative to afresh building material.
ii. Use of RCA will save time, as there will be no waiting for material availability.
iii. Less emission of carbon due to cement production and less crushing.
iv. There is no excavation for natural resources and less transportation, no harm to ecosystem.
v. Urban areas would sustain through construction and demolition process.

Properties of Recycled Concrete Aggregate

The particle shape analysis of recycled aggregate indicates similar particle shape of natural aggregate obtained from crushed rock. The recycled aggregate generally meets all the standard requirement of aggregate used in concrete (Table 1.). Use of recycled aggregate up to 30% does not affect the functional requirements of the structure as per the findings of test results.

Table 1: Physical Properties of RCA.(Use of Recycled Aggregate Concrete)

S No.	Particulars	Values	
		Natural Aggregate	**Recycled Coarse Aggregate**
1	Specific Gravity	2.4 – 3.0	2.35 – 2.58
2	Water Absorption	0.29% - 0.32%	0.3% - 0.32%
3	Bulk Density	1678.2 KN/m^2	1469.8 KN/m^2
4	Crushing Values	18.4%	36.3%
5	Impact Values	17.65%	35.2%

Source: Sonwane Tushar R

Table 2: Applications of RCA

S No.	Parameters	Compliance Criteria
3.	Civil construction in a sanitary landfill	Non-structural applications, such as kerb stones, drain covers, paving blocks in pedestrian areas.
2.	Drainage layer in leachate collection system at bottom of Sanitary Landfill Gas Collection Layer above the waste at top of Sanitary Landfill and Drainage Layer in top Cover System above Gas Collection Layer of Sanitary Landfill For capping of sanitary landfill or dumpsite, drainage layer at the top.	Only crushed and graded hard material (stone, concrete etc.) shall be used having coarse sand size graded material (2mm – 4.75mm standard sieve size). Since the coarse sand particles will be angular in shape (and not rounded as for riverbed sand), protection layers of non-woven geo-textiles may be provided, wherever required, to prevent puncturing of adjacent layers or components.
3.	Daily cover	Fines from construction and demolition processed waste having size up to 2 mm shall be used for daily cover over the fresh waste. Use of construction and demolition fines as landfill cover shall be mandatory where such material is available. Fresh soil (sweet earth) shall not be used for such places and borrow-pits shall not be allowed. Exception – soil excavated during construction of the same landfill. During hot windy days in summer months, some fugitive dust problems may arise. These can be minimized by mixing with local soil wherever available for limited period.

Source 1: Gazette of India, Part-II, Section-3, Sub-section (ii), p8

Various tests conducted on recycles aggregates and results compared with natural aggregates are satisfactory as per IS 2386.

Application of Recycled Concrete Aggregate

Recycled aggregate finds its use in very specific ways on the basis of its grading and physical properties. Table 2 mentions the best applications of RCA along with their compliance criteria.

IV. DEVELOPMENT OF METHODOLOGY

Use of RCA is a great step towards sustainable development as it focuses of recycling of waste material which prevents exploitation of existing resources. For the use of RCA to be brought into action a methodology has to be developed. Different institutions of the nation can come together for strategic planning of demolition waste.

A. Role of government and ULB's.

The governing bodies have to come up with ideas of how demolition waste can either be reduced or brought to use again. It has been experienced that government of the United States has been promoting 'deconstrution' to reduce the amounts of demolition waste. Deconstruction is strategic demolition of buildings with reuse being the main motive.

In India, the central government came up with Construction and Demolition Waste Management Rules in the year 2016, explaining the agenda of reuse of demolition waste and role of middlemen. Proper execution of these rules has to be done to get fruitful results.

Role of Public and Private Developers.

Developers shall sincerely consider and promote the use of RCA in developing infrastructure. It not only saves cost, but makes construction easy. "With a good plan during construction or demolition, it is possible to minimize waste generation by reducing wastage (reduction), followed by salvage of the materials of items like door/ window frames, shutters etc."(Sonwane Tushar R.).

V. CONCLUSION

i. Use of recycled building materials in a major step towards sustainable development, as it saves energy, cost of transportation, excavation and natural resources.
ii. Landfills would be free from huge amounts of demolition waste.
iii. Impact of waste material on the environment would be reduced.

REFERENCES

[1]. Sonwane Tushar R., Dr Pimplikar Sunil S., *Use of Recycled Concrete Aggregate*, IOSR Journal of Mechanical and Civil Engineering, ISSN: 2278-1684, PP 52-59.

[2].Gazette of India, Part-II, Section-3, Sub-section (ii).

[3].Datta, Pranati. "*Urbanisation in India"*. Infostat.sk. Retrieved 13 June 2012.

[4].Prof. Schmitt, Gerhard (2015) *Livability of Future Cities* [Online], Available at : https://courses.edx.org/courses/course-v1:ETHx+FC-02x+2T2016/courseware (Accessed October 6, 2016)