03 CONSTRUCTION AND DEMOLITION WASTE

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The construction industry in India is booming. Already at 10 per cent of the GDP, it has been growing at an annual rate of 10 per cent over the last 10 years as against the world average of 5.5 per cent per annum. Almost 70 per cent of the building stock in India is yet to come up. The built-up area is expected to swell almost five times from 21 billion sq ft in 2005 to approximately 104 billion sq ft by 2030.

This immense surge will have fallouts. Buildings are at the core of all our demands water, energy and material — but they also create waste. This waste, generated in the construction, maintenance and disposal phases of a building, is called construction and demolition (C&D) waste. This includes waste from demolished structures, renovations in the real estate sector and construction and repair of roads, flyovers, bridges, etc. To this is added the enormous debris that follows disasters such as during the Uttarakhand floods in 2013 (*see Flow chart: Types of C&D waste*).

Globally, cities generate about 1.3 billion tonne of solid waste per year. This volume is expected to increase to 2.2 billion tonne by 2025, says a 2012 report by the World Bank. Building materials account for about half of all materials used and about half the solid waste generated worldwide.

But C&D waste can be an invaluable source of building material. In fact, the recent controversy in India over sand mining has put the spotlight on the need to recycle, reuse and substitute naturally sourced building material (such as sand).

C&D waste generation in India: gross underestimation?

The Union ministry of forests and environment(MoEF) has confessed there is no systematic database on C&D waste. As per the estimates of Centre for Science and Environment (CSE), since 2005, India has newly constructed 5.75 billion sq m of additional floor space with almost one billion sq m in 2013 itself. If (according to the Technology Information, Forecasting and Assessment Council's, or TIFAC's, thumb rule) a new construction generates 40-60 kg of C&D waste per sq m, then taking an average of 50 kg per sq m, India must have generated 50 million tonne(MT) of C&D waste in 2013. Over the last eight years, it would have produced 287 MT of this waste.

This estimate only accounts for new construction. Demolition and renovation/repair-related waste of the older stock generates additional waste. The waste produced per sq m of demolition is 10 times that generated during construction: as per TIFAC, 300-500 kg of waste per sq m. If it is assumed that five per cent of the existing building stock gets demolished and rebuilt completely annually, then about 288 MT more of C&D waste would have been generated in 2013 alone because of demolitions.

TIFAC also says building repair produces 40-50 kg per sq m of waste. Assuming that one-third of the existing building stock underwent some sort of repair or renovation in 2013, India must have generated an average of 193 MT of C&D waste just from repair and renovation in that year.

Thus, the total C&D waste generated in India just by buildings in one year — 2013 — amounts to a humungous 530 MT, 44 times higher than the official estimate. Imagine the scenario if the waste generated by infrastructure projects such as roads and dams is added. Not surprisingly, in India, if C&D waste is quantified, it will be more than all the other types of solid waste put together.

Where is all this C&D waste going? A lot of it is being used by land sharks to illegally fill up waterbodies and wetlands around urban centres for real estate development. The rest is just being dumped into rivers and open spaces.

No reuse in India

Construction agencies like CPWD say that Indian laws permit the use of only naturally sourced building material. The IS: 323-1970 Indian standard specification related to aggregates for concrete, laid down by the Bureau of Indian Standards (BIS), stipulates that concrete can be made only with naturally accessed materials. Construction agencies cite this rule to avoid using recycled C&D waste.

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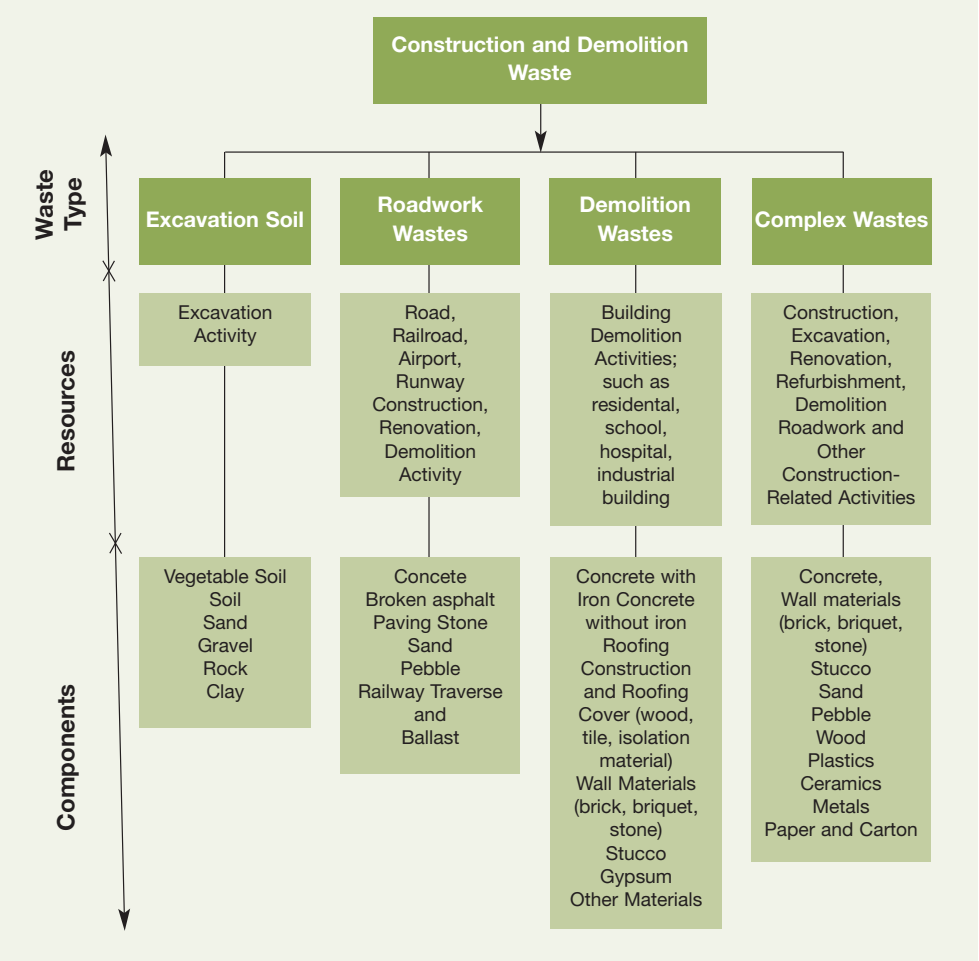
Types of C&D waste



C&D waste finds a brief mention in Schedule III of the rule for separate collection, in the Municipal Solid Waste (Management and Handling) (MSWM) Rules, 2000. Additionally, the Union ministry of urban development(MoUD) has a 2000 publication titled the *Manual on Municipal Solid Waste Management* that includes a chapter on C&D waste; the chapter provides some basic guidelines on its handling, but these are not binding.

In 2010, the Working Group on Solid Waste was constituted by the MoEF to evolve a roadmap for managing solid waste. Under the working group, the Sub-Group on C&D waste suggested that it is necessary to generate data on C&D waste. It also recommended segregation of the waste at source, development of institutional mechanisms for waste collection, reuse and reprocessing, imposition of charges on C&D waste generators, formulation of standards, and amendments to the MSWM Rules, 2000 for ensuring collection, utilisation and safe disposal of C&D waste. However, these recommendations were not included in the draft Municipal Solid Waste Management Rules of 2013 by the MoEF.

Though a number of innovative cost-effective recycled building materials, components and construction techniques have been developed and are available, Indian housing and building agencies have not adopted them in their construction practices. Lack of standardisation, not listing these techniques and material in the Indian Standard Codes and/or the Schedule of Rates (SOR), poor policy push and lack of awareness are the key barriers.

A CSE analysis, however, suggests that it is possible to reuse C&D waste within the ambit of current laws. The IS: 323-1970 is not the only standard dealing with aggregates. Sunil Soni, director general, BIS says the Bureau permits use of aggregates other than natural aggregates in plain concrete under IS: 456-2000. Soni adds that the BIS does not forbid the use of any new material. Any authority can take the initiative and permit the use of recycled material, he points out; standards will follow in due course.

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Building material crisis and environmental concern

Indiscriminate mining of sand and other minor minerals has caused extensive damage to the environment, scarred rivers, made many areas susceptible to floods, and destroyed the crucial recharge zones.

In 2012, the Supreme Court had asked state governments to amend the rules to regulate mining of minor minerals and ensure environmental management. On August 5, 2013, the National Green Tribunal (NGT) declared sand mining without environmental clearance illegal. However, the concern for a deteriorating nvironment is being seen in the context of a growing shortage of these materials. The Union ministry of housing and urban poverty alleviation had told the Rajya Sabha in 2012 about the shortage of building material, especially for aggregates and concrete owing to mining bans/restrictions on environmental grounds. The shortage has been so severe that several civic projects in India are facing delays. This is aggravating the housing crisis and affecting the construction of roads, bridges, canals, etc.

If sand mining and other naturally sourced materials have to be restricted and regulated, other strategies must be put in place to reduce demand.

Technically and legally, therefore, there does not seem to be any roadblocks in using recycled C&D waste as building material; the problem is of bureaucratic red tape and lack of political will. The BIS has already set a precedent: it has introduced exception clauses for flyash usage in the manufacturing of building materials. There are other avenues as well. The Building Material and Technology Promotion council (BMTPC), an apex body that promotes development and use of innovative building materials and technologies, has a scheme called Performance Appraisal Certification Scheme (PACS). New products manufactured by using recycled waste in fact, any new product, system or technique not covered so far by the BIS — can be certified under this scheme after evaluation. It has been used to certify new construction material (such as bamboo).

Global best practices show the way

Globally, cities have employed the legal process to maximise reuse of C&D waste in construction.

- **Hong Kong**, which has serious land constraints and therefore cannot afford landfills, has very stringent controls over C&D waste. It imposes a construction waste charge on developers. The system has lowered the quantity of C&D waste needing disposal at landfills by 60 per cent. Also, rates have been structured to incentivise on-site recycling and reuse — 100 per cent waste utilisation is charged at HKD $27 per tonne while more than 50 per cent waste needing landfill disposal is charged at HKD $125 per tonne. Revenue generated is used to maintain and subsidise C&D waste recycling centres. This has created incentives for reuse and also for very efficient construction practices that minimise the generation of construction debris. Instead of demolishing structures, Hong Kong dismantles systematically. It also offers tax concessions to C&D recycling centres.
- **Singapore**, yet another land constrained country, recycles 98 per cent of its C&D waste.
- **South Korea** has one of the most extensive and the oldest recycling policies for C&D waste. C&D waste management is part of its low carbon green growth strategy. The country has a law on Acceleration of C&D Waste Reuse/Recycling 2005 that provides for step-by-step demolition, and utilisation of recycled aggregates. It has adopted separate building codes for recycled asphalt concrete aggregates, recycled concrete aggregates, and road pavements. The Architectural Institute of Korea's Standard Building Construction Specifications recommend increased use of recycled C&D material. The effective recycling rate in Korea is 36 per cent, with a target of increasing this to 45 per cent by 2016.
- In the **European Union,** there are clear rules regarding the use of recycled material in buildings. The EU 2004 regulations in the form of European Standards for Aggregates explicitly provide for aggregates from natural, recycled, and manufactured material. They focus on fitness of use and do not discriminate between resources. While C&D waste is not used in the structural and foundation frames in the EU, it is extensively used in non-structural frameworks. Some member countries have reported that over 20 per cent of their national consumption is from recycled material.
- In the **United Kingdom**, the Northern Ireland Environment Agency has published *The Quality*

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Protocol for the Production of Aggregates from Inert Waste in 2004. This has helped promote use of recycled and secondary aggregates. Almost 280 MT of aggregates are used every year, which is 28 per cent of the total C&D waste generated.

- In the **US**, New York has stringent measures for C&D waste as it is land-locked and has limited space for disposal. Its disposal practices are more efficient than the rest of the US. It forces the developers to segregate waste at site, dismantle and not demolish, in addition to other measures.

A 2010 review of global best practices by an MoEF-appointed committee shows that in **Scotland**, about 63 per cent of waste was recycled in the year 2000. **Denmark** and the **Netherlands** have an aggressive strategy to reuse C&D waste; the Netherlands has found that 80 per cent of its C&D waste is bricks and concrete that can be recycled to minimise pressure on land. In **Japan**, way back in 2000, about 95 per cent of waste concrete was crushed and reused as roadbed and backfilling material, while 98 per cent of asphalt and concrete and 35 per cent of sludge was recycled.

Creative steps in India

Even though legal reform is taking a long time in India, several architects have already taken steps to reuse waste in their buildings. There is the example of a school building in Rajkot designed by Ahmedabad-based architect Surya Kakani that has been built from the debris of Bhuj earthquake. The Institute of Rural Research and Development (IRRAD) building in Gurgaon has innovatively recycled and utilised its own construction waste in the building itself. But these are limited steps and they will have to be encouraged with policy and fiscal support.

This is particularly relevant for the infrastructure necessary for development such as roads, flyovers, pavements, etc. In fact, the attempt to use recycled material from the Burari centre in New Delhi (*see box*: Delhi initiative) during the Commonwealth Games faced opposition as these materials are not backed by standards as yet. This mindset will have to change urgently. Globally, the strength of these materials has been proven; they are being used extensively. There is no reason why India cannot follow suit.

The way forward

India needs urgent intervention to protect its land, water, public space and envirironment from the egrerious construction expected to explode with the urban boom. Policy delay is no longer an option

- **Fast track formation of BIS code on recycled material**: There is a need to have a paid code for recycled material. The precedent has already been set by induction of exception clauses for flyash use into the manufacturing of building materials. There is a lot of research going on in this area; this research should be leveraged quickly to formulate standards and hasten the process.
- **Promote alternative material in buildings**: Devise innovative schemes that allows new products, systems or techniques related to housing/building not covered so far by BIS, to be certified after detailed evaluation. Construction agencies or authorities may include a material in their schedule of rates if backed by a test study based on BIS criteria. Promote alternative material for non-structural use as an interim measure till the time standards are in place.
- **Revise CPWD SOR to include products made out of recycled C&D waste**: Using publicly available scientific studies done by institutes like the National Council for Cement and Building Material, the CPWD should revise its SOR to allow use of products like paver blocks and flooring tiles made out of recycled C&D waste. This will ensure market development for the recycled products making them economically viable for recyclers and reduce subsidy burden on civic bodies.
- **Include explicit provision on collection, disposal, and reuse of C&D waste in the draft Municipal Solid Waste and Management Rules of 2013:** Also, set up a system and infrastructure for collection and disposal of C&D waste and recycling centres with appropriate technologies.
- **Promote efficient construction management practices to minimise waste**: National regulations and municipal rules need to push for optimal use of building space and materials, waste prevention, use of recycled content, on-site segregation, and collection and disposal system. The BIS is currently developing the Indian Standard Guidelines for Construction Project Management.
- **Promote use of alternative material in other infrastructure**: Experiments by the Central Road Research Institute, Delhi have shown that it is possible to use C&D waste for building road, embankments and pavements. This must be included in the roadmap of all infrastructure construction agencies.
- **Introduce tax policies to minimise waste generation and prevent unsafe disposal:** Introduce taxation to create incentive for waste minimisation.

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Delhi initiative

Delhi estimates generation of about 3000 to 4000 tons per day (TPD) of C&D waste. The primary responsibility of disposal of C&D waste is on the generator of the waste.

Municipal Corporation of Delhi (MCD) is responsible for the transportation and disposal of unclaimed waste (Delhi Municipal Corporation Act, 1957). The total quantity of C&D waste collected and disposed by MCD is significantly less than the quantity of C&D waste generated in the city. Considerable amount of C&D waste is completely unaccounted for and is dumped illegally in desolate areas like the Delhi Ridge and Yamuna flood plains. Moreover, there is no scientific method followed at the disposal sites, where waste is disposed without any processing. In addition to the ad hoc nature of the system, constraints of space for storage of the C&D waste, and lack of space for landfill are also important
areas of concern.

In collaboration with MCD, a pilot project has been developed by IL&FS Environmental Infrastructure & Services Ltd (IEISL) to demonstrate the potential of a scientifically managed process in relation to the collection and recycling of C&D waste in Delhi. The pilot project envisages an appropriate collection mechanism for C&D waste generated in the city, its transportation to the designated processing site, processing of the waste and reclaiming of the land by filling up, leveling and compaction. Being the first such project of organized management of C&D waste in the country, it will set an example, which can be replicated by other cities in India. Hence the learning from this pilot project is of great importance.

The project has been set up on a PPP basis at Burari on approximately seven acres of land provided by the MCD for a period of 10 years. The PPP model created for addressing the collection, processing and disposal of C&D waste is successful as it serves the dual purpose of saving of landfill space on the one hand, and also developing a market for C&D waste recyclables.

The collection and transportation of C&D waste started on 24 Jul 2009 and processing at the plant commenced on 29 Dec 2009.In the processing facility, IEISL is collecting 500 tonne per day (TPD) of C&D waste from three designated zones of the Delhi i.e. Karolbagh, Sadar - Paharganj and City. The C&D waste is thereafter being recycled into aggregates at the waste management facility, which is in turn converted to Ready Mix Concrete (RMC), pavement blocks, kerb stones and concrete bricks. The products have been tested in various laboratories and found to be suitable for the specific purposes. These products are actually being sold in the market.

As this is the first project of its kind in the country, the selection of processing equipment and methodology adopted for processing has had to undergo a number of improvements.

There was a considered decision to design the project strictly as an indigenous project, with locally available plant and equipment. Thereafter, efforts were made continuously to improve the system and the plant. Due to the heterogeneous nature of the incoming C&D waste, IEISL had to constantly fine tune the production process as well as the technology adopted for recycling.

Three years down the line IEISL is now faced with crisis of economic sustenance. The products manufactured by the recycling plant are finding no takers as there is lack of information and road-block of confusion over the Indian Standards.