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Training Manual on Construction and Demolition Waste Management in India for Cities and Towns

Implemented by:

giz Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH



Federal Ministry for the
Environment, Nature Conservation,
Building and Nuclear Safety

of the Federal Republic of Germany

Imprint

Published by

DEUTSCHE GESELLSCHAFT FÜR
INTERNATIONALE ZUSAMMENARBEIT (GIZ) GMBH

Registered offices: Bonn and Eschborn, Germany

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of Secondary Raw Materials

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New Delhi, India

March 2017

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TRAINING MANUAL
ON
C&D WASTE MANAGEMENT IN INDIA
FOR
CITIES AND TOWNS

January 2017

1. Introduction

Objective

The objective of the training manual is to educate and inform the participants on the severity of problem caused by Construction and Demolition (C&D) waste on the environment and serve as a reference manual providing detailed information towards management of C&D waste in an environmentally sustainable manner. It is intended that the manual be used for the purpose of training various stakeholders involved in the management of C&D waste in cities and towns. The sections of the training manual can be formed as training modules for providing necessary knowledge that an individual stakeholder will require to effectively and efficiently perform their respective duties with regards to implementation of C & D waste management rules (2016). In addition, the manual also provides some key information and benefits for businesses intended in recycling of C&D waste.

Project Background

“Fostering Resource Efficiency and Sustainable Management of Secondary Raw Materials in India” is a project being implemented to achieve an improved understanding of resource challenges and resource efficiency with focus on Construction and Demolition (C&D) waste and its potential for reuse as a secondary material in the construction sector in India.

The German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), under its International Climate Initiative, has launched a bilateral cooperation project with the Indian Ministry of Environment, Forests and Climate Change (MoEF&CC) titled Resource Efficiency and Sustainable Management of Secondary Raw Materials (in short “Resource Efficiency”). The project is being implemented by GIZ-India, in cooperation with German and Indian knowledge partners. The project aims to enable Indian key institutions responsible for the formulation of environment, climate, industry and resource policy to aid and establish institutional frameworks that improve resource efficiency

Basic Course Structure

The training for regulating authorities of cities and towns will be conducted as a three day course. The sections of the training manual can be found below:

1. Introduction
2. Background on Construction and Demolition (C&D) waste
3. C&D waste Management Rules, 2016
4. Inventorisation of C&D waste in the city
5. Collection, Transportation and Disposal of C&D waste
6. Processing and Utilisation of C&D waste
7. Elements of Tendering
8. Monitoring and Supportive Policies
9. Best Practices in India

2. Background on Construction and Demolition (C&D) Waste

Objective of the section

Management of Construction and Demolition waste is a relatively new term in India and so is the need for it. The urbanizing trend leading to lack of availability of land and resource shortage in construction sector has led to the notice, importance of C&D waste management in India which has brought about policy changes which specifies that all local governing bodies manage their C&D waste and also all polluters are responsible for the waste they generate.

Upon successful completion of the session, the participants should:

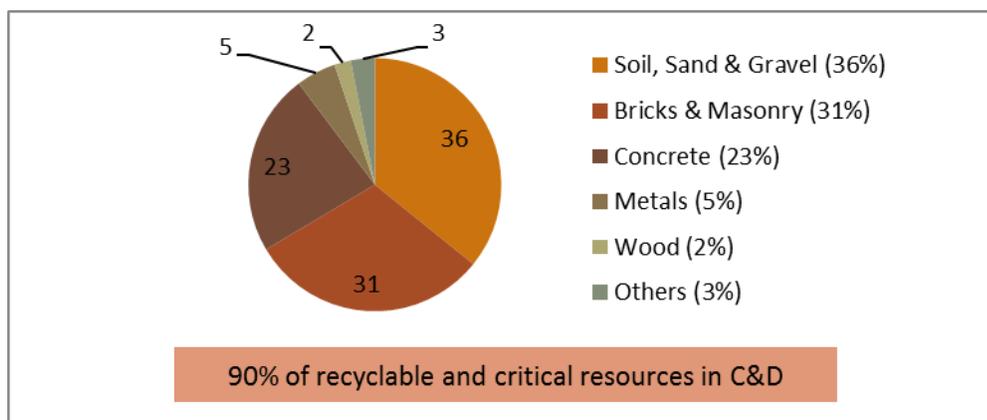
- Have an insight on what is C&D waste and what is it composed of
- Knowledge on estimation of C&D waste quantities in Indian cities
- Understanding on the flow of C&D waste in India
- What C&D waste can be recycled / reused for?
- Be familiar with the process of collection and transport of C&D waste

What is C&D waste?

Construction and demolition (C&D) waste is generated from construction, renovation, repair, and demolition of houses, large building structures, roads, bridges and dams.

C&D waste is made up of:

- Concrete
- Soil
- Steel, Wood and Plastics
- Other materials – bricks and mortar



Typical composition of C&D waste (Source : TIFAC, 2001)



Waste generated from construction, renovation, repair, and demolition of houses, large building structures, roads, bridges and dams

C&D waste consists of



Concrete



Soil



Steel & wood



Other materials

Why does C&D waste needs to be managed?

The importance of C&D waste management is not lost among the stakeholders especially in large cities, where impacts have already been felt. But still effective management of C&D waste is hampered by several challenges and implementation is far from ideal.

The improperly managed waste heaps impacts the system and the environment in multiple aspects which could broadly be classified into the following aspects

Social

- Huge heaps of C&D waste on footpaths, carriageways, alleys and all is a common scene in Indian cities turning the surrounding unaesthetic.
- The C&D debris usually could not be removed by normal street sweeping or household waste collection staff as they usually do not carry the equipment neither enough capacity in the collection vehicle nor enough manpower.
- Usually the polluters tend to dump other municipal solid waste on the heap making it a mix of waste further creating an unsanitary situation.
- The C&D waste is also stealthily dumped in open drains, water channels, and even riverbeds. The debris clog the drains and create water logging. Reports of water logging of drains turning to source for spread of epidemics is common in India
- Clearing drain silts is a major challenging activity for local governing bodies and a major percentage is consisted of by C&D.

- The C&D waste also consists of several kinds of materials which include sharps, broken glasses, boulders, broken wooden logs, rusted metal, broken ceramics etc which create a hazardous environment when dumped on unfenced open places.



Environmental

- C&D waste is also a source of environmental pollution :The C&D debris over course of time forms fine dust creating air pollution, and reducing visibility.
- The leachate and fine chemical particles degrade the soil leading to land pollution and in addition materials like paints, oil and asbestos sheets are common components of C&D waste which are bio-hazardous in nature having potential to endanger health of workers handling the waste, civilians and any living organism
- Formation of silt deposits when dumped in wetlands and water bodies damaging the water ecosystem

Economic

- C&D waste usually gets mixed up with other municipal solid waste also during the process of transfer or at the collection site.
- C&D waste is very difficult to segregate. Separate labor has to be employed for manual segregation or it has to be performed using earth moving machine, in addition the processing efficiency also get reduced due to the presence of C&D waste which is mostly inert.
- The huge mass and volume of C&D waste results in occupying a large volume of landfills and dump-yards resulting in governing bodies to find alternate space and creation of more landfills, again leading to economic inefficiency in the system.



Resource shortage - India is witnessing a boom in construction industry due to the urbanization which leads to over exploitation of primary resource to match the demands. For instance almost 100% in case of cement and bricks, 40-60% of steel, 85% of paint and 70% of glass produced in India goes into the construction sector. The anticipated growth of the sector in the near future exert added pressure on limited stocks of resources especially sand, soil, stone and limestone which have been identified as most critical resources. Therefore use of

Secondary Raw Material

A secondary raw material can be raw material waste from another industry or an alternate building material available in nature that can be used in place of critical primary resources. The material could partially or completely be replaced in a product

secondary materials need to be promoted to supplement the use of primary materials and recycled C&D waste is one of the best available option available as secondary raw material.

C&D waste management Rules in India

The Ministry for Environment and Forests notified Construction & Demolition waste management rules in 2016 to regulate the handling of C&D waste being generated. According to the new rules, the various stakeholders involved in C&D waste management have been assigned a specific role to be played in the process. Salient features of Construction & Demolition Waste Management Rules, 2016 are covered in detail as separate chapters.

Estimation of C&D waste across Indian cities

Management of C&D waste is a global concern and has not been managed or tracked properly by most countries. Even proper quantification of waste is not regularly maintained and only intermitted studies and data is available. Although many countries in the developed world have initiated proper management of C&D waste and has converted it from a waste management process to an income generating business.

Table 1. C&D waste generation data of cities

ULB	POPULATION (CENSUS 2011)	C&D WASTE GENERATION (MILLION TONNES/ANNUM)	C&D WASTE GENERATION (TONNES PER DAY)
Municipal Corporation of Greater Mumbai	12,442,373	0.750	2,500
<i>www.mcgm.gov.in</i>			
Delhi Municipal Corporation (DMC, 2005)	16,787,941	1.380	4,600
Greater Bengaluru Municipal Corporation (BBMP) (TIFAC, 2001)*	8,443,675	0.263	875
Chennai Municipal Corporation As per discussions with IIT-Madras	6,500,000	0.750	2,500
Kolkata Municipal Corporation As per discussions with KMC	4,496,694	0.480	1,600
Jaipur Municipal Corporation (TIFAC, 2001)*	3,471,847	0.060	200
Patna Municipal Corporation (TIFAC, 2001)*	2,514,590	0.075	250
Ahmedabad Municipal Corporation As per discussions with AMC officials	6,063,047	0.210	700
Bhopal Municipal Corporation (TIFAC, 2001)*	1,917,051	0.015	50
Coimbatore City Municipal Corporation (CCMC, 2015)	2,618,940	0.028	92

How to implement a proper C&D waste management system?

A cradle to grave approach has to be adopted for proper management of C&D waste according to the national standards (C&D Waste Management Rules, 2016) where a properly implemented system exists. The system should contain proper collection of segregated C&D waste from the polluter, proper transportation of waste, storage of waste occurs at designated transfer stations or collection points followed by proper processing of waste into recycled or reusable products that have market value and where minimal rejects are produced which get deposited in designated landfills. A properly implemented management system also needs to contain proper quantification and classification system for C&D waste at different stages of handling and a properly implemented monitoring system with a neat documentation process.

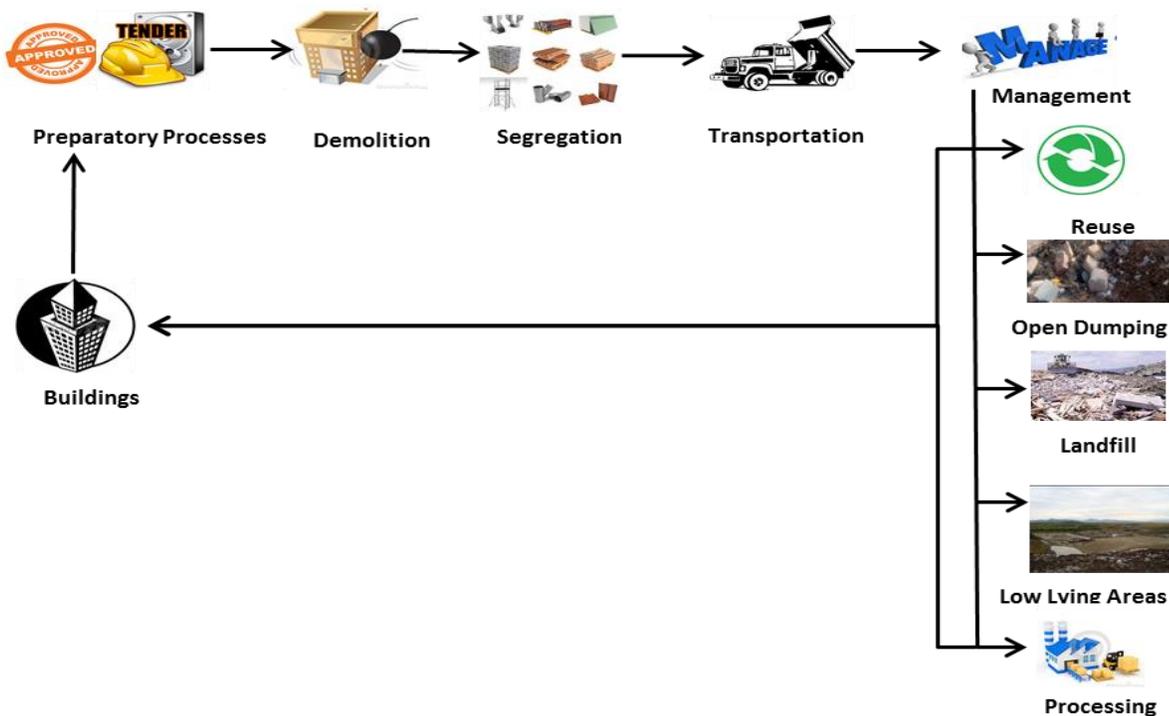


Figure1. Schematic of Current C&D Waste Management Processes in India

What can C&D waste be recycled / reused for?

C&D waste could be recycled and reused for multiple purposes depending on the composition and characteristics of the waste. The major applications of C&D waste which is practiced is listed below

- **Granular Sub Base (GSB)** – Crushed C&D waste could be used as GSB layer for road constructions, regardless of the type of construction. The granular sub-base layer is formed by piling and compacting C&D aggregates of different sizes one over the other directly below the pavement surface. This acts as the load bearing and strengthening component of the pavement structure, in addition it provides drainage for the pavement structure and protects the structure from frost.

- **Recycled Concrete Aggregates (RCA)** – Concrete waste could be recycled to make aggregates of different standard sizes to replace natural aggregates in construction processes. According to Indian standards RCA could be used in any kind of structural and non-structural applications
- **Recycled Aggregates (RA)** – Crushed aggregates of standard size made from a mix of different C&D waste materials is termed as Recycled Aggregates. RA could be used for partial replacement of natural aggregates for construction of non-load bearing structures. According to Indian standards, it could replace 20% in plain cement concrete and upto 30% replacement in road construction but only if backed up by proven laboratory test results. RA could also be used for construction of prefabricated molded structures like paver blocks, kerb stones, concrete pots and RCC Sculptures.

Table 2: C&D waste and its potential use

Material	Process	End Use
Plain Concrete	Crushed	Aggregate
Fresh Concrete	Washed to remove cement & recover aggregate	Aggregate
Reinforced Concrete	Crushed & Steel bars removed Steel recycled	Crushed Concrete reused as aggregate
Clay bricks & roof tiles	Cleaned Crushed Pulverized	Masonry Aggregate Building Materials
Brick	Cleaned & Crushed	Aggregate & Filling material

- **Manufactured Sand (M-Sand)** – Manufactured sand is also produced by crushing of C&D waste, but is much finer materials which could replace natural sand in construction activities of non-load bearing structures. According to Indian standards only materials of sieve size between 0.075mm – 4.750mm is considered classified as M-sand and much finer particles are classified as dust particles, suitable only for daily cover for MSW.
- **Smelting** – Scrap metal is melted through smelting process and is thus recycled to make more products. Almost all metal waste from C&D waste is reused or recycled through smelting

- **Backfilling** – The most common reuse practice for C&D waste in India is as a backfilling material. The C&D was as such can be dumped in pits, trenches etc and compacted for backfilling or used to increase elevation or to make top layer of surface even for construction
- **Reusing** – Materials of reuse value like wood, unbroken bricks and ceramics are being used and could be used in secondary market for construction of temporary structures or if treated properly could be used for permanent structures as well
- **Other applications** – C&D waste is also applicable in other minor applications like carrier material in preparing fertilizers, filler material in roofing constructions, wall decorative chips etc.

Table 3: Demand for soil and sand and potential generation from C&D waste

Soil	Stone (Aggregates)
Demand for soil in brick making - 884 million tonnes/annum	Demand for stone as coarse aggregates in concrete – 1.1 billion tonnes/annum Demand for stone as coarse aggregates in roads – 5 million tonnes/annum
Soil waste generated from C&D waste - 213 million tonnes/annum	Aggregates generated from C&D waste - 254 million tonnes

3. Construction and Demolition Waste Management Rules, 2016

1. Why separate rules for Construction and Demolition (C&D)

Government of India in the erstwhile Ministry of Environment and Forest published Municipal Solid Wastes (Management and Handling) rules, 2000 which was amended from time to time. However the central government after reviewing the existing rules considered it necessary to make separate rules for management of construction and demolition waste due following reasons,

- To give thrust to segregation, recovery, reuse and recycle
- To emphasis roles and accountability of waste generators and other stakeholders related to waste management

2. Objectives of this section

At the end of this section the reader should

- Understand the definitions provided in the rules
- Understand their responsibilities and duties to implement the rules
- Understand their responsibilities and duties of other stakeholders mentioned in the rules
- Understand the challenges in implementing the rules

3. Overview of this section

- Applicability of other regulations for management of C&D waste
- Definitions in the rules
- Schedules and forms in the rules
- Duties of stakeholders
- Challenges for Local bodies Implement the rules

4. Reference to other policies and regulations for management of C&D waste

- Environmental (Protection) Act, 1986 (39 of 1986), Section 6 and 25
- National Environmental Policy 2006, Section 4 and 5.4
- Municipal Solid Waste Management Rules, 2016

5. Definitions in the Rules

The rules specifically define terms relevant to implementation of its implementation. The important elements of the definitions are highlighted for better understanding of the reader.

Construction

Process of erecting or alterations of **building or built facility or other structure, or building of infrastructure**

Construction and Demolition Waste

Waste comprising of **building materials, debris and rubble** resulting from construction, re-modeling, repair and demolition of any civil structure

De-construction

Planned selective demolition in which salvage, re-use and recycling of the demolished structure is maximized

Demolition

Breaking down or tearing down buildings and other structures either manually or using mechanical force (by various equipment) or by implosion using explosives

Local Authority

Urban local authority such as **municipal corporation, municipality, nagar palika, nagar nigam, nagar panchayat, municipal council including notified area committee, gram panchayats**

Service Provider

Authorities who provide services like water, sewerage, electricity, telephone, roads, drainage etc.

Waste Generator

Person or association of persons or institution, residential and commercial establishments including Indian Railways, Airport, Port and Harbour and Defence establishments who undertakes construction or demolition

Important stakeholders mentioned in the definitions:

Heading
**Municipal Corporation,
Municipality, Nagar Palika,
Nagar Nigam, Nagar
Panchayat, Municipal Council
including notified area
committee, Gram Panchayats**

**Local service providing
agencies such as PWD,
Telephone exchange etc.**

**Indian Railways, Airport, Port
and Harbor and Defense
establishments , Residential
and commercial
establishments and
individuals and group of
individuals**

6. Forms and Schedules in the rules

Forms:

The rules prescribes five forms with fixed formats for the purpose of,

- ✓ Obtaining authorisation for processing facilities
- ✓ Annual reports
- ✓ Accident reporting

The forms prescribed in the rules are meant for,

- C&D waste processing facility
- State pollution control board
- Local authority

Table 4: Summary of all the forms attached to the rules

S no	Form Name	Purpose	Responsibility	Concerned Clause in the rules	Information to be submitted
1.	Form-I	Application for obtaining authorization	Operator of the facility	Rule 7(2)	<ul style="list-style-type: none"> ✓ Detailed proposal of processing facility ✓ Plan for utilisation of recycled products ✓ Preventive plan for accident during collection, transportation, treatment and processing of C&D waste
2.	Form-II	Issue of authorization to the operator of C&D waste processing facility	Member Secretary, State Pollution Control Board	Rule 7(3)	
3.	Form-III	Annual Report submitted by Local authority to SPCB	Local Authority	Rule 8(2)	<ul style="list-style-type: none"> ✓ Quantity and composition of C&D waste generated ✓ Details of storage facilities and transportation ✓ Information of Public Private Partnership proposals made for processing C&D along with details of technologies used for processing ✓ Provisions made to check unauthorized mixing of C&D and MSW, filling of low laying areas, encroachment on river banks, wet bodies, parks,

S no	Form Name	Purpose	Responsibility	Concerned Clause in the rules	Information to be submitted
					<p>footpaths etc.</p> <ul style="list-style-type: none"> ✓ Cases registered/settled against non-compliance by appointed legal entities ✓ Vessels provided to slums for collection of C&D waste
4.	Form-IV	Annual report submitted by SPCB/SPCC to CPCB	SPCB/SPCC	Rule 8(3)	<ul style="list-style-type: none"> ✓ Number of municipal authorities in the state for managing solid waste ✓ Summary statements as per Schedule-I and III in the rules. To be attached as Annex-I and Annex-II respectively with the annual report
5.	Form-V	Accident reporting	Operation in charge of facility in local authority OR operator of facility	Rule 14	<ul style="list-style-type: none"> ✓ Type of C&D waste involved in accident ✓ Date and time of accident and sequence of events leading to accident ✓ Assessment of effects of accident ✓ Emergency measures taken ✓ Steps taken to alleviate the effects and recurrence of accident

Schedules:

There are three schedules in the rules,

Schedule-I: It defines criteria for site selection for Storage and Processing or recycling facilities of C&D waste. This schedule is applicable to rule 7(1) in the C&D waste management rules. The schedule describes administrative route through with suitable site for storage and processing of C&D waste will be selected and handed over to operators of the processing facility. It also mentions the site compliance criteria for the processing facility.

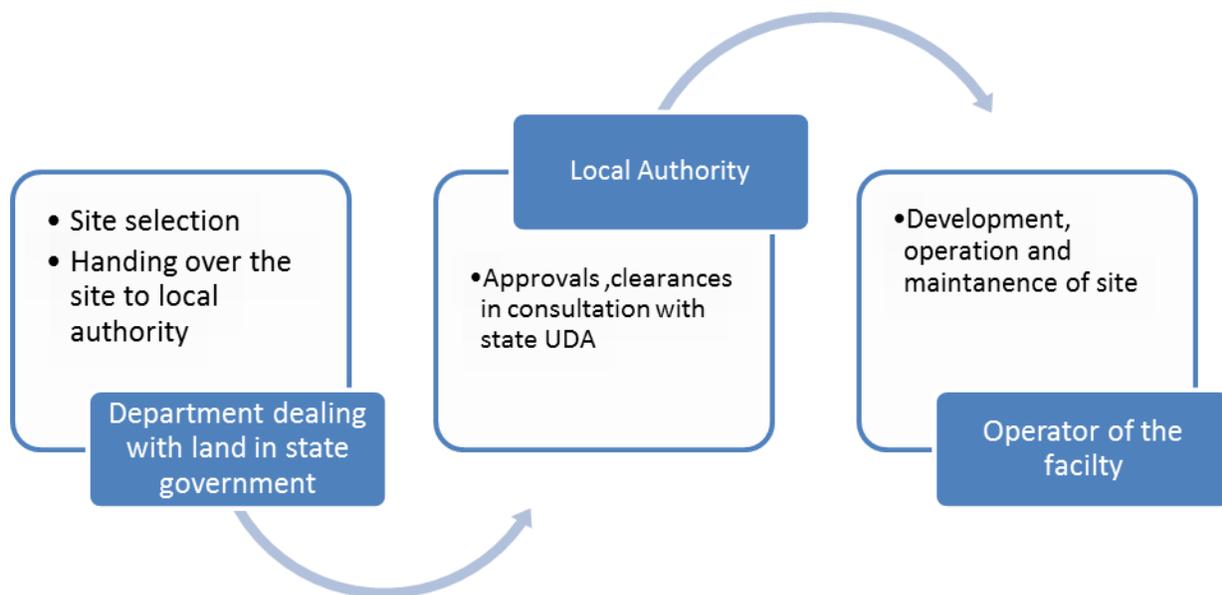


Figure 2: Administrative route for site selection and handover to operator of facility

After the land is handed over to operator of the facility it has to be developed in accordance with the compliance criteria's set in the rules. These criteria focus largely on abatement of pollution (air, water and noise) allow smooth movement of vehicles during operation of the processing facility. Figure 2 lists and summarises the criteria. It is the responsibility of local authority to monitor the compliance of these criteria in consultation with state pollution control boards.

Compliance criteria for processing facility



- Minimum life of processing facility to be 20-25 years
- Facility to be away from habitation, forest areas, national parks, water bodies, manuments, places of important cutural historical or religious interest
- For processing facilites > 5 tons per day buffer zone of no development to be maintained.
- Facility to be fenced or hedged and provide a gate to monitor vehicles
- Approach and internal roads to be concreted or paved
- Weigh bridge, fire protection equipment to be provided at the facility
- Provisionof storm water to prevent stagnation of surface water
- Prevention of noise pollution from processing plant.
- Sewage treatment facility to be provided at the facility
- Air quality to be monitored in the work zone of facility
- Noise quality to be monitored at the boundary of facility
- Vegetative boundary to be maintained around the boundry of facility

Projects utilizing at least 80% of C&D waste in-situ and have sufficient buffer area to protect surrounding habitation can be exempted from pollution norms of dust and noise

Schedule-II: Defines parameters for application and compliance criteria of materials made from C&D waste in a sanitary landfill. The schedule mentions use of processed C&D waste in three ways at a sanitary land fill,

	<p>Drainage Layer(leachate collection, Top cover system) & Capping</p> <ul style="list-style-type: none"> Crushed and graded stone or concrete material between 2mm-4.75 mm standard seive size
	<p>Daily Cover</p> <ul style="list-style-type: none"> Fines from processed C&D waste with sizes up to 2 mm Mandatory to use C&D waste if available Fresh soil except soil excavated during landfill construction shall not be used
	<p>Civil Construction</p> <ul style="list-style-type: none"> Non structural applications such as Kerb stones, paving blocks etc. made with C&D waste can be used

Schedule-III: Defines timeframe for planning and implementation of C&D rules. The time frame is effective from date of notification of the C&D waste rules i.e. 29th March 2016. The Gantt chart below provides the timelines of completion of compliance criteria mentioned in the rules.

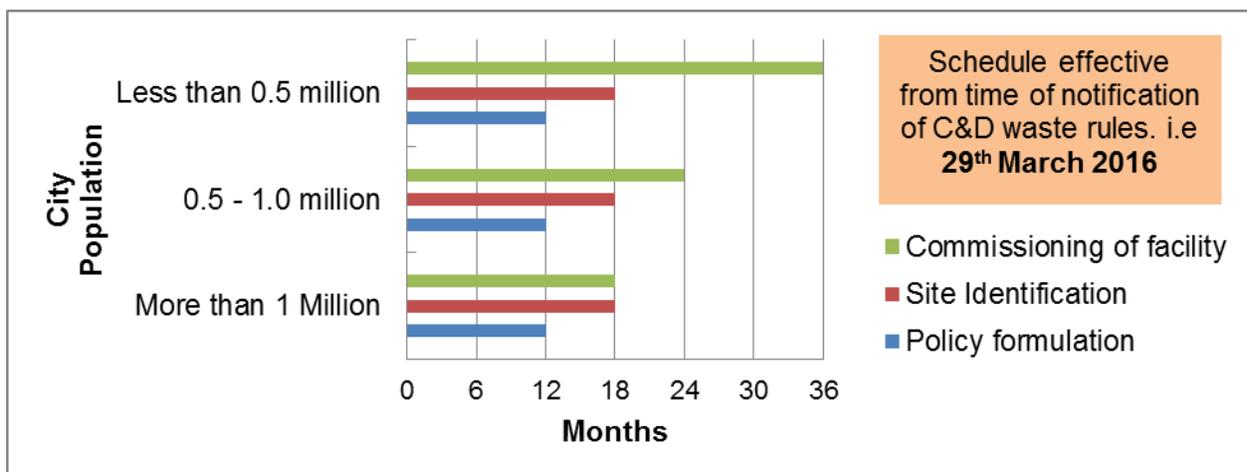


Figure3: Time line of planning and implementation of rules

7. Duties of stakeholders

Stakeholders mentioned and defined in the rules are,

- Waste Generator
- Service providers and their contractors
- Local authority
- State Pollution Control Boards or Pollution Control Committees
- State Government or Union Territory Administration
- Central Pollution Control Boards
- Bureau of Indian Standards and Indian Road Congress
- Central Government

The rules define duties each of the above mentioned stakeholders.

Duties of waste generator

- ✓ Waste generators as defined in the rules are responsible for,
 - Collection
 - Storage of C&D waste generated within their premises
- ✓ Ensure **Solid waste does not get mixed with C&D waste**
- ✓ **Deposit C&D waste to collection centres OR processing facilities** as designated and authorised by local body.
- ✓ Ensure that there is **no littering or deposition of C&D waste** to prevent obstruction of traffic, public and the drains
- ✓ Waste generators who generate **more than 20 tons per day OR 300 tons per project in a month** shall,
 - Segregate waste in to 5 streams:



1. Concrete



2. Soil



3. Steel



4. Wood and
Plastics



5. Bricks and
Mortar

- Submit **waste management plan and approval from local authority** before starting construction, demolition or remodeling work.
- **Pay relevant charges** for collection transportation, processing and disposal as notified by local authority.

Duties of service providers and their contractors

- ✓ Prepare **comprehensive C&D waste management plan** for area within their jurisdiction
- ✓ **Clean C&D waste** in the work area every day in a reasonable timeframe depending on the duration of work and quantity and type of waste generated. This should be done in consultation with local authority.
- ✓ **Tie up with authorized agencies** for cleaning of C&D waste if logistics support is not available.

Duties of local authority

- ✓ **Issue direction for management of C&D waste** as per the rules within their jurisdiction and seek detailed plan or undertaking as applicable from generator of C&D waste.
- ✓ **Chalk out stages, methodology, equipment required, material** involved in the activities required after Construction and Demolition.
- ✓ **Safely dispose C&D waste contaminated with hazardous, toxic or nuclear material** after consultation with concerned authority.
- ✓ **Make arrangement for collection of C&D waste** and ensure that clean-up is done at regular intervals.
- ✓ Get the collected C&D waste transported to appropriate sites for disposal or processing.
- ✓ **Give incentives to generator** for salvaging, processing and or recycling C&D waste preferably in-situ.
- ✓ **Examine and sanction waste management plan of generators** within one month or within date of submission and approval of building plan, whichever is earlier.
- ✓ **Establish C&D waste generation database** and update once a year.
- ✓ **Device appropriate measures for management of C&D waste and use of recycled products** in best possible manner.in consultation with expert institutions,
- ✓ **Create sustained system of IEC activities for C&D waste management** through collaboration with expert institutes and civil society organisations and also disseminate through their own website.
- ✓ **Give incentive for use of products made with recycled C&D waste** in construction activities

Duties of state pollution control boards or pollution control committee

- ✓ **Monitor implementation of the rules** by local authority.
- ✓ **Give authorization to C&D waste processing facility** in Form-III after examining the application in Form-I.
- ✓ Prepare annual report with special emphasis on implementation status of compliance of these rules and submit to CBCB before 31st July of each financial year

Duties of state government or union territory administration

- ✓ **Prepare policy document for management of C&D waste** as per the rules and within 1 year of notification of C&D waste rules. The responsibility policy making lies with Secretary in charge of development in the State government or Union territory.
- ✓ **Provide land** for storage, processing and recycling of C&D waste.
- ✓ **Inclusion of site in approved land use plan** by Town and Country planning department.
- ✓ **Make procurement of materials made with C&D waste up to a certain percentage mandatory** in municipal and government contract, subject to strict quality control

Duties of central pollution control board

- ✓ **Prepare operational guidelines** for management of C&D waste.
- ✓ **Analyse and collate the data** received from SPCB/SPCC
- ✓ Co-ordinate with SPCB/SPCC for any matter related to **development of environmental standards**
- ✓ **Submit annual compliance report to central government** before 30th of August of each financial year based on reports given by SPCB/SPCC

Duties of bureau of Indian standards and Indian road congress

- ✓ Prepare code of practices and standards for use of recycled materials and products of C&D waste in roads

Duties of central government

- ✓ Facilitation of local bodies in compliance of these rules by MoUD, MoRD and MoPR.
- ✓ Review implementation of the rules when required by MoEF&CC

8. Challenges for Local Bodies to Implement the Rules

Construction waste management is still a new area to deal for local bodies defined under the C&D waste rules. The following challenges exist for implementation of rules,

- **Tendering a PPP contract to C&D waste processing and recycling unit:** The rules have mandated local bodies to device appropriate measures for a processing facility. To fulfill this requirement a local body should be adept in drafting an appropriate tender for the waste processing unit. Limited knowledge on C&D waste logistics and management sometime leads to inappropriate tendering which prevents entrepreneurs in investing on a processing plant. This key and important challenge for local bodies will be addressed in further sections of this manual
- **Tracking C&D waste generation and dumping:** Another significant challenge for the local bodies is to track generation and dumping of C&D waste. The rules does not mentions about penalizing generators on non-compliance to the rules. It also does not specifically gives guidelines on a demolition permits at city level which will help track and document the generation of C&D waste. Local authorities can club demolition permits with the building permits for better tracking of demolition activities in the city. Investing in infrastructure such as GPS tracking of vehicles carrying C&D waste and weighing bridges at designated C&D waste dumping sites will help in transparent and efficient tracking and documenting C&D waste. Local bodies should either generate funds or be provided with some percentage of money required to install and manage this infrastructure from state or center.

3. Inventorisation of C&D waste in the city

1. Why to do inventorisation of C&D waste?

Inventorisation of C&D waste is crucial for following purposes:

- ✓ Decision making on capacity and technology of C&D waste processing plant that should be installed
- ✓ Decision making on products that can be made from C&D waste
- ✓ Decision making on amount of funds that need to allocated for management of C&D waste
- ✓ Decision making on management practices to be adopted for C&D waste

2. Objectives of this section

At the end of this section reader will be,

- Knowledgeable on ways of C&D waste inventorisation
- Able to understand current challenges and gaps of C&D waste Inventorisation
- Able to assess a C&D waste inventorisation approach

3. Overview of this section

- Scope of Inventorisation
- How to conduct inventorisation of C&D waste in your city?
- Challenges in Inventorisation

How to estimate the generation of C&D waste in the city

The first step towards management of Construction and Demolition (C&D) waste is to determine the quantify the amount of C&D waste generated in the city. Waste quantification models which has been utilised all over the world and other models available from literature review are presented here for better understanding and implementation for quantifying C&D waste in cities and towns. However the accurate estimation of C&D waste depends on the availability and accessibility of data in cities and towns.

Site visit method

This methodology requires investigators to visit the construction or demolition sites for a realistic survey. Measurements are conducted through weighing C&D waste directly on site where onsite interviews are conducted with professionals for fine tuning the estimated generation. Although

this method this method is very practical and suitable for measuring waste produced from all of the waste generation activities, it not appropriate for estimating the C&D waste generation at a regional level because of the high requirement of time, labour and moneyⁱ.

Per-capita multiplier

Per-capita multiplier is one of the earliest methodologies developed from methodologies that were used to quantify municipal solid waste (MSW). Per-capita multiplier is an easy way to quantify C&D waste as this method is based on population statistics of the region. This type of estimation is less reliable as it often leads to more than 10 folds variation in the quantity estimated.

Waste Generation rate model

Waste generation rate model is widely used by researchers around the world to estimate the quantity of waste generated in the city. In this method, the amount of construction and demolition activity happening in the sector has to be estimated and an appropriate activity specific waste generation rate has to be multiplied with the quantum of activity to get the total estimate. Statistical data such as number and the area of waste generation has to be collected for estimation in this model.

Estimation based on waste generation modelⁱⁱ

$$Q = \sum_{K=1}^n \sum_{j=1}^m \sum_{i=1}^l A_i * q_{jk} * p_k$$

Where

Q is the total quantity of demolition waste generated in a region (in kg);

A_i refers to the total amount of demolition activity in the ⁱth part of the region;

l is the number of parts or zones in the region;

q_{jk} is the waste generation rate of jth type of major material from Kth type of building;

m is the number of major materials

p_k refers to the propotion of the kth type of building in the region; and

n is the number of different types of building in the region

Quantification of Construction and Demolition waste is regarded as a pre-requisite for successful implementation of C&D waste management in a city. The selection of most appropriate method is recommended based on the quantification objectives and region specific conditions.

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. The waste produced per sq m of demolition is 10 times that generated during construction and for building repair/renovation TIFAC estimated that it produces 40-50 kg per sq m of waste. Therefore the estimates of waste generation can be calculated depending on the type of activity such as Construction, Demolition and renovation

4. Collection, Transportation and Disposal of C&D waste

How to Collect and transport C&D waste?

Collection

Existing Practices – C&D waste in most ULBs is not collected or transported in an orderly manner. The waste is either collected by a random transportation contractor and used for backfilling elsewhere or dumped on unfenced land which is mostly illegal. Some municipalities have designated landfills for disposal, where the polluter has to dump waste at his own arrangements which in most cases is not practiced since it is either far away on outskirts of city or the designated area is not known to the polluter due to improper communication by the ULB. Among the ULBs which have a collection yard a few have a proper tracking system by means of weigh bridges.

Weighbridge

Weighbridge is a device in form of a platform used to weigh very heavy objects like trucks. The weight of trucks is mostly weighed on a loaded and unloaded situation in order to measure the load it carried

Changes to be adopted - As per the national standards C&D waste need to be kept in the generator's compound and then transported to designated disposal site prescribed by the local governing body.

Transportation

The C&D waste need to be stored in a segregated manner and transported to the designated location on self-arrangements or through local governing bodies system, which ever exist in the ULB. Either way both the generator and the transporting body needs to maintain records of the quantum of waste transported to the dumping area. The local governing body could also provide fenced transfer stations as designated dumping units to facilitate easy transport of waste for the generator. The waste reaching the designated transfer stations of the ULB needs to be recorded and from transfer stations, the waste need to be transported by the governing body to the dumping site or processing site.

C&D waste is transported from the site by trucks or tractors to disposal sites by paying a minimal fee to the transporters. These transporters can be private or empanelled with the ULB. The ULB transports the waste to the disposal site from these points or contracts with private contractors to do so. The transport of C&D waste need to be in a covered truck (or any vehicle) to avoid dust, air pollution and spilling of debris on roads. Large scale waste quantum (more than 2 Tons) should be transported only by empanelled trucks which to be registered with the ULB and the registered trucks need to be available to the public to utilize. The trucks empanelled for transportation of generated waste can be enabled with GPS devices for tracking of waste flow from the collection points or demolishing site to the waste processing facilities.

The waste needs to be quantified at disposal or processing site also by proper weighing of trucks.

Land requirements

Establishment of dedicated disposal sites or transfer stations demand land area for improving the system of collection and transportation of C&D waste. The state government or the concerned Urban Local Body (ULB) is responsible for identification of place needed to set up transfer stations or disposal sites. A minimum of 675m² of land space is recommended for setting up collection points in high C&D waste generation zones and a minimum of 562m² of land space is recommended for medium quantities of waste generation.

Setting up of collection points is one of the key component of waste disposal practices. The presence of more than one transfer station per zone is suggested for an efficient management system. The establishment of more transfer stations will make the transportation process easier for corporation thereby reducing the distance of travel for small generators of waste. In big cities, where there is an unavailability of large lands for the use of transfer station, setting up of small transfer stations with an average size is recommended. However, having an appropriate system in place to comply with C&D waste disposal plan is crucial.

For example, Delhi has 168 C&D collection points / transfer stations and Ahmedabad has 16 designated collection points. In case of space constraints, a transfer station with a lower storage capacity can be set up in a land space of about 500 Sq.m. In such a case, it is recommended that two transfer stations be set up in a high generation zone.

The land chosen for setting up of processing facility needs to have adequate facilities such as proper access roads, compound wall, entrance gate, administration building, warehouse for storage of value added products, underground water tank (sump), IT systems, electrical connections, support structures etc. The detailed criteria for site selection for Storage and Processing or Recycling Facilities for Construction and Demolition Waste is mentioned in Schedule I of the C&D waste rules 2016. The minimum area of land required for setting up a 100 TPD processing plant is 2 acres.

For cities with higher waste generation capacity of 4000-5000 TPD, may need more than one processing facility in different zones and for cities with a generation capacity of 1000 TPD or less can have a single centralized processing facility. In small towns where the generation of C&D waste is low, using a mobile crushing unit for processing C&D waste is encouraged. Mobile crushers come in all sizes and processing capacities starting from bobcat machine sized crushers with a processing capacity of around 5 TPH and higher. Since the entire assembly line needs to be mounted on mobile units the processing capacity of these units will be comparatively limited to around 200 TPH. As the mobile crushing units have an advantage to moving around, small towns can fund and utilize this facility for processing operations. The option of having a jointly funded common facility can also be considered for a cluster of small towns. However, the maximum travel distance from generation to processing should be 30 k.m

Disposal

Existing practices – C&D waste is mostly being disposed in on plain land, but it is also used as daily cover in MSW landfills. In many Municipalities it is also filled inside MSW landfill, in which case it occupies huge spaces and reduces capacity of the landfill.

Changes to be adopted – The C&D waste that comes out as a waste product after processing need to dumped into a separate sanitary landfill and should not be mixed with other MSW waste. The hazardous C&D waste need to be dumped in a hazardous waste landfill.

C&D waste should not be allowed to be dumped in the landfills before recovering useful materials from the waste stream

Even for cities which do not have dedicated recycling facilities, the C&D waste debris should be disposed at designated dumping sites which provides an opportunity for recycling them in the future.

4. Processing and Utilisation of C&D waste

The Construction and Demolition (C&D) Waste recycling is still in its infant stage in India. However its potential to be implemented in a large scale is clearly visible due to the present and projected infrastructure developments by 2020. The construction and demolition activities spurring out as a result of the growing economic activities generates huge amount of waste each year which were seen to be often disposed in landfills. In 2015, the urban C&D waste generation in India was estimated to be 716 million tonnes and is projected to increase to 2.7 billion tonnes per annum in 2041. The sensitization of C&D waste is slowly gaining momentum in the recent years due to the rising cost of materials (Sand, stone and gravel) used for construction in addition to the labour and waste disposal costs. This scenario strongly favors the use of secondary raw materials which can be recovered from waste stream and reused in all applicable areas across the sector.

How to process C&D waste?

Existing practices – Mostly C&D waste is not processed. In a handful of ULBs in India waste is processed to form secondary raw materials which are used to make non-load bearing building materials.

Changes to be adopted – The C&D waste which does not get reused is usually consists of debris and inert. The waste could be segregated and processed into crushed aggregates of different sizes and used in variety of applications which include paver blocks, aggregates of concrete, GSB layer and many other applications depending on the characteristics of the material and the market demand

Construction and Demolition (C&D) waste processing in India

The Construction and Demolition waste occupies a major share of the total waste mass in almost all developed and developing countries. In many countries a huge portion of the C&D waste is processed and utilized as a raw material then being dumped into a landfill. In the recent times, because of stringent environmental laws being enforced and the changes being made to the MSW Management rules in the country, processing of C&D waste is also gaining popularity in Indian cities.

Technologies for C&D waste processing

Since Indian C&D waste (that reaches the landfill) basically consist of debris of concrete, mortar, bricks and tiles, the processing usually just involves crushing, downsizing the material, washing and sieving it into uniform sizes aggregate particles, that can substitute primary aggregates in the construction market. The processing method is very similar to a stone crushing process and uses the same machinery and equipments used in the stone crushing industry. C&D processing units can be basically be classified into two types, Stationary crushers and Mobile crushers.

Stationary processing unit

Stationary C&D waste processing unit is an assembly of crushing, sieving and washing machinery interconnected by conveyer belts for material movement. The machinery are housed on steel/concrete platforms on a permanent basis. The crushing units will also have dust control systems, noise control systems, magnetic separator devices and other additional devices based on the requirements. The systems are either semi-automated or completely automated units. The capacity of the processing units also varies according to the need from 50 TPD – 200TPD or even more.



Mobile crushing units for C&D waste recycling

Mobile C&D waste crushing units today, finds its use very occasionally in Indian cities but with the rapid urbanization trends, it can be seen as a successor to the stationary C&D crushing units. The technology is very similar to the stationary processing unit but all the equipment will be mounted on top of customized mobile unit/truck. The concept involves integrating all the equipments on one truck which has a customized chassis and body compared to conventional trucks. This kind of design provides the flexibility to ensure that the crushing station can be easily transported by and moved to crushing sites to enable on-site crushing without the transfer

of materials from one place to another, saving significant transportation costs given the quantity of waste to be processed is large. The feasibility of the technology also depends on the use of finished product, distance to be transported, availability of labour and nature of waste (segregated waste). Mobile crushers come in all sizes and processing capacities starting from bobcat machine sized crushers with a processing capacity of around 5 TPH and higher. Since the entire assembly line needs to be mounted on mobile units the processing capacity of these units will be comparatively limited to around 200 TPH.



5 TPH mini crusher with dust suppression technology, Red rhino mini crushers, Canada

C&D Waste Process Flow



Product Development from C&D Waste

The aggregates processed from C&D waste can be used for manufacture of secondary building materials as follows

- Precast non-structural building materials



- Precast street furniture



Products and Certification

One of the main issues faced by C&D waste processing units in India is selling of the products made with processed waste. To ensure enhanced sales of C&D waste based products there are two approaches that can be adopted,

1. Preferential buy back by government and private construction
2. Green labelling of products

The preferential procurement is dealt in a greater detail in following sections of this manual. Green labelling of product is another very effective approach in increasing uptake of these products in the market. One of the most popular green product label in India is GRIHA (Green Rating of Integrated Habitat Assessment). GRIHA has a set system green labelling of products. A product is assessed on one of the following criteria, recycled content, embodied energy, permeability and quality. Once green labelled a product is added to a 'GRIHA product catalog' which is a repository of green products in India and their manufacturer's details. Any building aspiring to attain green features or green certifications can use any of the products mentioned in the catalog and earn points for their green building certificate. Thus green labelling will provide C&D waste based products a bigger market for sale. This will help in increasing the demand for recycled products and ensure higher utilisation of C&D waste.

5.Elements of Tendering

Section 1: General Information

ULB shall invite tenders from eligible bidders for Collection, Transportation, Storage, Processing and Recycling of agreed amount of (_____ TPD) of CDW based on a Design, Finance, Build, Operate, & Transfer **(DFBOT) contract**.

Concession period should be 25 years, with review every 5 years. After 25 years, review will lead to continuation, modification or termination.

ULB shall adopt **3-stage bidding process**:

Criteria 1: Eligibility

Criteria 2: Technical Proposal

Criteria 3: Financial Proposal

Eligibility Criteria:

- Registered company. Written agreement of all members, if consortium is bidding.
- Satisfactorily completed in the last 5 years at least one project on civil engineering construction, building materials manufacture, or waste management and recycling projects worth INR _____.
- Owned or leased a minimum number of _____ trucks in good condition.
- Achieved in last two financial years a minimum financial turnover of INR _____.
- Demonstrated availability of Liquid assets and/or availability of credit facilities of no less than INR _____.
- Not have been disqualified by any government authority, or have record of poor performance.

Pre-tender queries, site visits, and tender amendment protocol shall be communicated by ULB.

Costs associated with tendering and method of payment shall be stated by ULB for bidders.

Section 2: Scope of Work

Project area: ULB shall clearly delineate project boundary, transportation routes and location of sites with clear maps.

Waste generation: ULB shall have estimated average availability of CDW in the project area from bulk generators and open spaces in TPD. Data on trends, seasonal variations, etc. to be provided by ULB. Bidder shall plan for CDW expected over next 25 years.

Minimum waste assurance: ULB shall ensure that the bidder will be the sole agency responsible for collection of CDW in the project area. The ULB shall assure the bidder a

minimum quantity of CDW on a monthly/quarterly basis to ensure financial viability of the project. If minimum guaranteed amount is not met, the ULB shall provide monetary compensation to the bidder at a rate quoted in the tender by the bidder.

Waste composition and acceptability: ULB shall communicate the typical composition of CDW in the project area along with degree of expected variation. This will help determine acceptability criteria based on non-CDW streams (more than ___ % non CDW) or presence of hazardous materials.

Collection of waste:

- The bidder shall set up a toll free helpline for CDW generators which will be advertised by the ULB and bidder.
- ULB shall share the mandatory CDW Management Plan of bulk generators within the project area with the bidder on a regular basis.
- The bidder shall be responsible for collection of CDW from bulk and small generators as well as from open spaces within the project area as notified by the ULB. Collection should take place within an agreed upon timeframe.
- The ULB shall pay the bidder for CDW waste collection and transportation at a rate quoted in the tender by the bidder.
- CDW brought to collection centres or processing facility by the ULB or private generators shall be accepted free of charge by the bidder, provided minimum acceptability criteria are met.

Transportation of waste:

- Bidder shall arrange for adequate number of vehicles that are appropriate for the proper collection and transportation of CDW.
- Vehicles used for transporting CDW should be GPS enabled.
- ULB shall provide the guidelines for the timing and routes for transportation of waste.

Collection centres:

- ULB shall identify and allot an adequate number of land parcels within the project boundary to the bidder to serve as intermediate CDW collection centres. The number and distribution of such parcels shall be determined in the ULB's CDW Management Plan. The bidder shall be responsible for maintaining and operating these sites on a DBOT basis.
- The bidder shall use these sites for inspection, sorting, and storing of CDW, pending transfer to the processing facility. The bidder may choose to develop these sites through the provision of necessary facilities at own expense.

Processing Facility:

- ULB shall identify and allot a land parcel to serve as CDW processing facility. The size of the parcel shall be determined based on the estimated amount of the CDW generation in the project area as assessed in the ULB's CDW Management Plan.

- Bidder shall be responsible for undertaking necessary site development, design and construction of equipment and infrastructure necessary for weighing, sorting, and processing of CDW and manufacture of finished products.
- Bidder shall be responsible to accurate weighing of incoming and waste and record keeping of such data.
- Bidder shall be responsible for maintenance and operation of the facility in accordance with applicable safety and environmental rules.
- Bidder shall arrange for appropriate management and disposal of any hazardous waste. Bidder shall also arrange for disposal of any unrecovered/unutilized waste to the nearest sanitary landfill.

Recycled Materials:

- Bidder shall be free to sell recovered materials and manufactured building products from the facility as market permits.
- Bidder shall ensure that such products meet applicable BIS standards and any other standards recommended for green building products.
- ULB shall help to promote procurement of such green building products in public projects.

Reporting: The concessionaire will be required to keep accurate records and report to the ULB on quantity and characteristic of incoming C&D waste, rejected waste, hazardous waste management, sale of products and disposal of unutilized residue to landfills at a frequency determined in the concession agreement.

Permission and Clearances: The concessionaire will be responsible for obtaining all required permissions and clearances from State Pollution Control Board and any other concerned government agencies.

Review: The agreement will be reviewed every 5 years. The review may lead to continuation, modification, or termination of agreement, as mutually agreed.

Section 3: Tendering Process

Document preparation and submission: All documents must be prepared in prescribed format and necessary supporting documents must be provided. Submission of all documents must be done in the accordance with the prescribed method within the stipulated deadline. Any errors, inadequacies, or delays will lead to rejection of bid.

Fees and Money Deposit: Transaction fees must be paid in prescribed format. An Earnest Money Deposit (EMD) of Rs. _____ shall be paid as a Bank Guarantee in the prescribed format. The EMD of unsuccessful bidders will be returned within 20 days of the end of tender validity. The EMD of the successful bidder will be discharged when the bidder has signed the Concession Agreement and furnished the required Performance Security Deposit.

Evaluation of Tenders: The ULB shall open all pre-qualified bids on date notified. The ULB has right to reject any bids that are incomplete or inadequate. Bids shall be scored based on technical proposal and only those meeting the ULB's threshold will have their financial proposal considered. The ULB may ask bidders for further information and/or clarification on both technical and financial proposals, if necessary. The entire process shall remain confidential.

Award Criteria: The bids will be evaluated on QCBS (Quality cum Cost Basis). Bid with the highest aggregate score comprising 80% (total weighted score based on technical proposal) + 20% (total weighted score based on financial proposal) will be the winning bid.

In the financial proposal, bidders will quote two prices as follows (for details, refer to Template document):

- a) Rate to be paid by ULB to bidder for collection and transport of C&D waste (INR/tonne with distance range), and
- b) Rate to be paid by ULB (INR/ tonnes) to bidder as compensation against minimum quantum of waste assured.

Award and Agreement: The winning bidder will be notified by the ULB in writing. The notification of the award will form the basis of the Concession Agreement subject to the furnishing of Performance Security Deposit. When this requirement is met, the ULB shall promptly notify other bidders that their bids have been unsuccessful.

Within 20 days of receipt of the award notification, the successful bidder shall deliver to the ULB a **Performance Security Deposit** for construction in the form of a bank guarantee for an amount equivalent to 5% of the accepted project set up cost. This will be refunded after 1 year of plant operation. Further, prior to commercial operations, the bidder shall provide Performance Security Deposit for operation in the form of a bank guarantee for an amount equivalent to 5% of the estimated operational cost for subsequent 5 years. This will be refunded after the project review at 5 years, and fresh bank guarantee will be required to cover the next 5 years of operation.

Upon receipt of the bank guarantee, the ULB shall prepare a detailed **Concession Agreement** between the ULB and the successful bidder. The agreement will include all the terms and conditions for operating the C&D waste management system and processing facility. Within 45 days of award notification, the successful bidder shall form a **Special Purpose Vehicle (SPV)** for execution of the Concession Agreement. The agreement will be signed between the ULB and the SPV within 60 days of award notification.

6. Monitoring and Supporting Policies

The management of C&D waste is crucial for any city, realizing this, Governments and policy makers around the world have enacted policies that induce the practices that favor reuse/recycle. In the Indian scenario, the MoEF has drafted a new set of rules in 2016 exclusive for C&D waste providing the guidelines on handling the C&D waste being generated. According to the new C&D waste management rules, the various stakeholders of the C&D waste have been assigned specific duties for management of generated waste. The strict enforcement of rules combined with regular monitoring procedures and supporting policies can serve as effective systems for the management of C&D waste.

Monitoring

A series of monitoring and inspection mechanisms should be in place for disposal practices of C&D waste in order to prevent unauthorised dumping. For example when applying for a building demolition permit, the owner or developer can be given an evaluation report by the demolishing contractor which estimates the amount of waste that is expected to be generated and based on the generation estimates, the generator needs to be pay an amount as monetary deposit. On paying the deposit, the permit for demolition/renovation is issued. Simultaneously, the contractor is informed by the developer that the waste must be handled by the designated processing facility established in the city. Once the construction work is completed, the waste processing facility gives a certificate for correct management of waste handled and on producing this certificate at the town hall, the waste delivered by the developer is verified with the waste treatment plant and the monetary deposit is refunded. This type of tracking systems involves multiple stakeholders but ensure proper disposal and handling of C&D waste. For effective monitoring, the government can make use of extensive IT systems such as GPS tracking of vehicles and centralized data entry for movement of waste streams form one place to another besides appropriate tests and inspections.

Supportive Policies

The presence of supportive policies in place to ensure sustainable waste management practices can trigger the growth of the recycling industries. A few Indian cities have already implemented or designed such policies to create an environment favorable for carrying out C&D waste recycling facilities. For example, a policy for purchasing final products from C&D waste has been adopted by the Ahmedabad Municipal Corporation (AMC) to purchase minimum 50% of tender total quantity of requirement for paver block for its own various civil works as per the Schedule of Rates.

The section below presents a set of policies, strategies and practices that could be helpful in identifying suitable policies/frameworks for cities for efficient management of C&D waste.

- Ban on land-filling
- Landfill taxes
- Need for waste management planning before commencement of project
- Mandatory onsite separation of waste streams

- Provision to use recycled aggregate in concrete in codes and specifications
- Subsidy for setting up recycling plant
- Need to maintain records of waste management at project level
- Minimum use of recycled materials in construction

7. Best Practices

Pilot initiatives in Delhi, Ahmedabad and Bengaluru have shown that C&D waste can be recycled and reused in construction. While such efforts are commendable, good practices across the world offer lessons for developing, implementing and sustaining an effective C&D waste management system. Several initiatives from across the world show the way to counteract the challenges faced by India in the management of C&D waste.

C&D waste recycling plant, Burari, Delhi

Delhi Municipal Corporation is the pioneers in India to initiate an integrated C&D waste recycling unit in a ULB level. The recycling facility in Burari, Delhi is installed, operated and maintained on a Public Private Partnership (PPP) basis between the Delhi Municipal Corporation and Infrastructure Leasing & Financial Services Private Limited (IL&FS Pvt Ltd).

The processing plant of 2000 TPD processing capacity was commissioned in 2010 and running successfully ever since, is an excellent case study for business models that could be adopted across India.

500TPD of C&D waste is collected from designated disposal sites by IL&FS. If the waste is not made available for collection, ULB has to bear the cost which has been agreed in the contract. Currently the waste is processed at a rate of 1000TPD and the processing technology includes both dry processing and wet processing. Around 95% of C&D waste is recycled and processed into aggregates and M-sand. Utilising the recycled materials the unit produces finished products including kerb stones, paver blocks, concrete bricks and precast reinforced cement concrete structures like drain slabs, roofing structures etc. The materials have tested and approved by Bureau of Indian standards (BIS) for usage in construction applications



Recycling of C&D waste has borne a multiple fruit bearing tree which solves the issues of handling the C&D waste (which under existing circumstances could not be processed with Municipal Solid Waste) and also getting an additional source of revenue by sale of recycled products. The treatment plant in Burari is the first of its kind in India but taking lessons from the initiative, several Urban Local Bodies from different parts of India are planning to process their C&D waste. Owing to their success in Burari, Delhi Municipal Corporation has commissioned 3 other recycling units of which a 500TPD processing plant has already started operation in Shastri park

C&D waste recycling plant, Ahmedabad

Following the success of DMC the Ahmedabad Municipal Corporation (AMC) has also initiated to install and operate a Construction & Demolition (C&D) Waste Recycling unit with a processing capacity of 1000TPD.

AMC has started the initiative and is running the project on PPP basis from June 2014, where C&D Waste is processed and recycled into aggregates which in-turn is used to prepare finished products including paver blocks, Curb-stones, Concrete tiles, prefabricated structures etc.



AMC is presently processing 600 TPD of waste and the finished products are mainly used in government projects. Paver blocks are used for paving footpaths for road projects and even in

other infrastructure projects, precast structures like slabs, precast toilets, precast sculptures etc are also used in other construction projects by the Urban Local Body (ULB).



The product is being sold under the trade-name Nu-Earth materials. Nu-Earth Curbstones, Nu-Earth Rubber Mould Paver Blocks, Nu-Mould Steel Mould Paver Blocks and Nu-Earth Hollow bricks are few among the many fast moving products in the market.

End notes

ⁱ Z. Wu et al. (2014), Quantifying construction and demolition waste: An analytical review, *Waste Management* 34 (2014) 1683–1692.

ⁱⁱ Construction and Demolition waste management in Chennai city (2015), IIT Madras



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