सत्यमेव जयते
Ministry of Housing and Urban Affairs
Government of India

Sustainable Construction and Demolition Waste Management

TRAINING MANUAL

ClimateSmart Cities Assessment Framework

Waste Management

Climate Centre for Cities

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Supported by:
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
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Responsible
Ms. Vaishali Nandan
Project Head - Climate Smart Cities
Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH
B-5/2, Safdarjung Enclave
New Delhi 110029

T + 91 4949 5353
F + 91 4949 5391E vaishali.nandan@giz.de

I www.giz.de

Authors
National Institute of Urban Affairs (NIUA)

Ms Uditi Agrarwal, Mr Anand Iyer

German Institute of Urban Affairs (Difu)
Ms Corinna Altenburg, Ms Finya Eichhorst, Mr Michael Brown,

Consultant: Mr Klaus Hoppe

GIZ

Mr Liju Mathew, Mr Felix Knopf

Reviewers
GIZ
Ms Irina Riehle
GIZ is responsible for the content of this publication.
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Table of Contents

List of Abbreviations

AEP	Amdavad Enviro Projects Private Limited
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
BIS	Bureau of Indian Standards
BMTPC	Building Materials and Technology Promotion Council
BMU	German Federal Ministry for the Environment, Nature Conser vationand Nuclear Safety
BOT	Build-Operate-Transfer
CDW	Construction and Demolition Waste
CDWM	Construction and Demolition Waste Management
CE	Circular Economy
CPCB	Central Pollution Control Board
CPWD	Central Public Works Department
CSC	Climate Smart Cities
CSCAF	ClimateSmartCities Assessment Framework
DBOFT	Design Build Operate Finance and Transfer
DBOO	Design Build Own Operate
DIFU	German Institute of Urban Affairs
DMC	Delhi Municipal Corporation
EDMC	East Delhi Municipal Corporation
EU-REI	European Union's Resource Efficiency Initiative
GBCI	Green Business Certification Incorporation
GHG	Green House Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GRIHA	Green Rating for Integrated Habitat Assessment
IEC	Information, Education, and Communication
IGBC	Indian Green Building Council
IL&FS	Infrastructure Leasing and Financial Services Limited

IKI	International Climate Initiative
INR	Indian Rupee
IRC	Indian Roads Congress
ISWM	Integrated Solid Waste Management
KG	Kilogram
LA	Local Authority
MC	Material Circularity
MSW	Municipal Solid Waste
MSWM	Municipal solid waste management
MT	Metric ton
	MoEFCC Ministry of Environment, Forest and Climate Change
MoUD	Ministry of Urban Development
MoHUA	Ministry of Housing and Urban Affairs
MoRD	Ministry of Rural Development
NBC	National Building Code
NDC	Nationally Determined Contributions
NDMC	New Delhi Municipal Corporation
NIUA	National Institute of Urban Affairs
OBPAS	Online Building Plan Approval Systems
PCC	Plain Concrete Cement
PPP	Public Private Partnership
RA	Recycle Aggregate
RCA	Recycle Concrete Aggregate
RCC	Reinforced Concrete Cement
RE	Resource Efficiency
SDG	Sustainable Development Goals
SPCB	State Pollution Control Board
SQM	Square meter
SWM	Solid Waste Management
TPD	Tonnes per day
TU Berlin	Technical University of Berlin
TUV	Technical Inspection Association
ULB	Urban Local Bodies

List of Figures

Introduction to the Training Course

"Construction & Demolition (CD) waste is a useful resource and can't be termed no longer as CD waste, but to be redefined as CD material."
Dr. Shailesh Kr. Agrawal, Executive Director, BMTPC[1]

Objective

The intent of this training manual on Sustainable Construction and Demolition Waste Management is to inform about the relevance of the environmental impacts, the current national policies and guidelines and the implementation of measures and actions on the local level to handle Construction and Demoli-tion Waste (CDW).

Based on this information, the objective is to educate and train experts from local governments in a stepwise approach to plan, structure and organise Construction and Demolition Waste Management (CDWM) in their own jurisdiction, city or town.

Furthermore, the manual outlines the damages on the environment due to improper treatment of CDW, as it is still the case in India. However, Urban Local Bodies (ULB) and the environment will equally benefit if CDWM is im-plemented in a thorough way, with options for the use of recycled materials.

The training aims at educating experts from local govern-ments to successfully plan and organise CDWM in their own jurisdictions.

[1]*Utilisation of Recycled Produce of Construction & Demolition Waste - A Ready Reckoner, Ban-galore Metropolitan Transport Corporation, BMTPC, 2018*

About the Project – Climate Smart Cities

The training on CDWM is facilitated within the framework of the Climate Smart Cities (CSC) project (2018-2022). CSC is part of the German International Climate Initiative (IKI), funded by the German Ministry of Environment, Nature Conservation and Nuclear Safety (BMU) in cooperation with German Ministry of Interiors Building and Community (BMI) and coordinated by Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ) India. Implementing project partners are the German Institute of Urban Affairs (Difu), the National Institute of Urban Affairs (NIUA) and the Technical University of Berlin (TU Berlin). The CSC project attempts to anchor climate-friendly solutions within the Smart Cities Mission.

The project contributes to the achievement of the Nationally Determined Contributions (NDCs) to the Climate Goals as well as the Sustainable Development Goals (SDG). It acts as a facilitator inpromoting cooperation between national and subnational actors by technically supporting international advisory and exchange formats and by supporting the implementation of measures.

The project works with the three Indian Smart Cities of Bhubaneshwar, Coim-batore, Kochi and their respective state governments of Odisha, Tamil Nadu and Kerala, in the planning and implementation of smart and climate-friendly measures for infrastructure and area-based development, as well as the measuring and monitoring of their Green House Gas (GHG) emissions.

> The Climate Smart Cities project seeks to anchor climate-friendly solutions within the Smart Cities Mission.

ClimateSmart Cities Assessment Framework

The Smart Cities Mission under the Ministry of Housing and Urban Affairs (MoHUA) launched “ClimateSmart Cities Assessment Framework” (CSCAF) in February 2019. The CSCAFserves as a tool for cities to assess their present situation and provides a roadmap for cities to adopt and implement relevant climate actions. It is the first city assessment framework on climate relevant parameters in India.

The CSCAFconsists of 30 indicators across five categories namely; (i) Energy and Green Building, (ii) Urban Planning, Green Cover and Biodiversity, (iii) Mobility and Air Quality, (iv) Water Resource Management and (v) Waste Management. The framework provides assessment of both, mitigation and adaptation measures. The indicators are progressive in nature to support cities in assessing where they stand and encourage them to adopt appropriate actions enabling them to improve their score in the future and consequently build climate resilience.

One of the indicators under the Waste Management sector is utilization of "Recycled Aggregates (RA) and Recycled Concrete Aggregates (RCA) derived from City Construction and Demolition (C&D) waste" (see figure 1).

This training manual links directly with the above indicator in the CSCAF and provides assistance to cities on how to perform on the indicator and progressively move forward- in turn helping the city move up in its ClimateSmart City performance. Similar trainings will be provided subsequently which will link to other indicators on the CSCAF.

Figure 1: Description of Indicator 3, Source: ClimateSMART Cities Assessment Framework, MoHUA; 2019, p68,https://smartnet.niua.org/csc/assets/pdf/key-documents/Climate-Smart-Cities-booklet.pdf

Indicator 3: Recycled Aggregates (RA) and Recycled Concrete Aggregates (RCA) derived from City Construction and Demolition (C&D) waste are utilised.

Rationale: The indicator addresses the Greenhouse Gases (GHG) mitigation aspects due to Construction and Demolition Waste recycling and utilisation. The indicator intends that C&D Waste Management facilities are available and operational in cities as per C&D Waste Management Rules, 2016

Description: The Construction and Demolition (C&O) waste is a major component of all the waste generated by the construction boom. To reduce the pressure on the exploitation of natural resources, cities need to focus on finding greener ways to produce concrete, encouraging the reuse of recycled materials to rep lace virgin materials. Scientific evidence exists about reduction of GHG by reuse of recycled materials. "ClimateSmart Cities" encourages scientific processing of C&D waste as per Rules and BIS Standard IS 383. 1000/0 utilisation of Recycled Aggregates (RA) and Recycled Concrete Aggregates (RCA) can be achieved through State/city level policies.

Content of the Manual

The manual is designed for the training of operative staff in the field of local waste management as well as decision makers at ULB level. The methodology of the training and modules focuses on practice-oriented and interactive learning. Integrated exercises build upon each other and are incorporated in most modules. They help to reflect the content and, whenever possible,deepen the learnings. Helpful links and literature tips are added at the bottom of each module and provide additional and specific information.

The modules are divided into sections. Eachmodulestarts with a general de-scription andbackground information. Accompanying exercise reflect the contenttoincrease the participants' knowledge and experience. Lastly, further reading suggestions are provided to complement the information of each module. Further, a site visit is part of the overall training, providing practical insight to the topic at hand.

> The training combines practice-oriented and interactive learning.

MODULE

1

Inaugural – Introduction

Key content:

- Need and purpose of the training
- Introduction of participants and expectation management

Learning goals:

- Gain a general understanding of the topic and the aim of the workshop
- Share expectations with the Trainers

1.1 Purpose of the training on Construction and Demolition Waste Management for Indian Urban Local Governments

Due to rapid urbanisation, India's construction sector is projected to grow at a rate of 7-8% over the next 10 years and is likely to become the world's third largest by the middle of the next decade. It is estimated that almost 70% of buildings that will exist by 2030 are yet to be built. The total quantum of waste from the construction industry in India is estimated to be 100 million tons per annum in 2018.

Total waste from the construction industry in India is estimated to be 100 million tons per annum in 2018.

Such massive construction relies heavily on raw materials such as sand (for concrete and mortar), soil (for clay bricks), stone (for aggregates) and limestone (for cement); the extraction and production of which have significant ecological impacts. Some of these materials, especially sand, are already facing supply constraints (often due to environmental bans and restrictions), and thus affecting the sector.

Only 5% of CDW is recovered in India. The existing practice is to dispose the waste in landfills or illegally dump it in rivers and water bodies affecting the land and water resources. While disposal of CDW is a challenge, there is an acute shortage of naturally available aggregates, limestone and other construction materials like sand and soil. At the current growth rate, the current limestone reserves may run out by 2060.

The extraction of soil, especially for brick making decreases agricultural productivity, which in turn increases food security concerns. Reduction of this demand is possible by utilizing construction waste to produce bricks, paver blocks and construction aggregates. There is an opportunity to develop and establish standards and guidelines that create transparency and legitimacy in the reuse of CDW[1].

Only about 5% of CDW is currently recovered in India.

Moreover, and despite

- CDWM Rules (2016) with detailed duties and responsibilities,
- CDWM Rules´ templates to support ULB,
- Guidelines and advisories from different agencies,
- Rather uncomplicated processing compared to solid waste management (SWM), and
- Quality of recycled products tested and proved economical,

CDWM in India has not progressed as necessary and the implementation rate is low[2]. This training – in combination with a "Training of Trainers" – aims to add to the Indian Government's efforts[3] for the dissemination of CDWM. It is designed to support ULBs in

[1] Resource Efficiency & Circular Economy – Current status and way forward, NITI Aayog; 2019, p16
[2] Resource Efficiency & Circular Economy – Current status and way forward, NITI Aayog; 2019, p7
[3] Resource Efficiency & Circular Economy – Current status and way forward, NITI Aayog; 2019, p29ff

developing and implementing sustainable CDWM strategies on the local level. It also aims to fulfil the requirements of the CDWM related indicator under the ClimateSmart Cities Assessment Framework of the MoHUA.

1.2 Expectation Assessment

To start the training, it is helpful to assess the expectations of the participants with the content and intentions of the program. This helps to identify specific questions of the participants that can be considered during the workshop. At the end of the workshop, we will assess if and how expectations have been met.

Please note down your expectations for the training and share them with fellow participants. The expectations are not limited to technical aspects of CDWM but could also include management or environmental issues, to mention a few.

What are the topics you are most interested to learn about? Why is this important for you or your ULB?


PLANNERER

MODULE

2

Thematic Background

Key content:

- Introduction of concepts to waste management
- Construction and Demolition Waste – an overview

Learning goals:

- Gain theoretic background knowledge on the scope of the topic, the aims and benefits of sustainable CDWM, and the climate relevance of the constructions sector
- Understand the benefits and challenges of CDWM
- Awareness of the state of local CDWM, the relevant stakeholders, and understand possible need for action in their city in general

2.1 Introduction of concepts to waste management

There are worldwide "general strategies/principles" being deployed to tackle the challenges of climate change and environmental degradation. The most important strategies in CDW are:

- Circular Economy (CE)
- Resource Efficiency (RE)
- Integrated Solid Waste Management (ISWM)

The following sections will briefly outline the key points of each principle or strategy and link them to their implications for the management of CDW.

Short introduction to SDG and Waste – WasteAid[1] and new Urban Agenda: United Nations, 2017[2]

2.1.1 Circular Economy

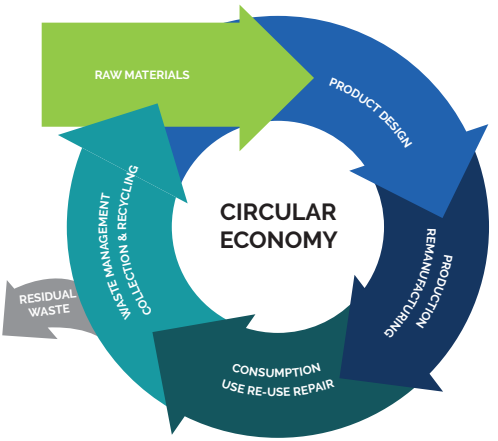
An urban circular economy (CE) is one in which cities keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of their life (see fig. 2). It is a more efficient and environmentally sound approach than the traditional linear economy in which we make, use and dispose of resources3. A transition to a CE is both a necessity and an opportunity with the potential to offer long-lasting economic, environmental and social benefits.

In summary, the CE is directly applicable to CDW. CE is about how things can be made smarter, cheaper and more resource efficient. In this sense, sustainable CDWM does not begins at the "waste" stage, but the decision-making stage about raw materials for building material and product design, i.e. the way new houses and buildings are built.

Implementing a circular econ-omy is linked to the UN`s SDG 12 "Responsible Consumption and Production and SDG 13 "Climate Action".

[1]https://wasteaid.org/waste-sustainable-development-goals/
[2]http://habitat3.org/wp-content/uploads/NUA-English.pdf
[3]Municipality-led circular economy case studies, Climate KIC ed; 2018, p2

Figure 2: Pathways to a circular economy in cities and regions, Interreg Europe; 2016, p4



Source: Graphic based on COM(2015) 614 final

Circular Economy in India – Rethinking Growth for Long Term Prosperity".[4] With a horizon of India in 2050, the publication includes a chapter on Cities and Construction.

2.1.2 Resource Efficiency and Material Circularity

A large portion of the world's urban areas will be developed during the next two decades. This period presents a window of opportunity for preserving natural resources and reducing the ecological footprint of buildings and infrastructure. The whole value chain, from extraction to use, deconstruction and recycling can be reimagined

Using secondary raw materials in construction can reduce the need for sand and gravel and reduce the quantities of CDW in landfills with limited capacities. However, an important prerequisite is to couple the deconstruction of buildings and infrastructure with the most effective separation of recyclables at source. For this purpose, reusability should be considered as a criterion when designing and selecting materials for new buildings. All materials should be evaluated for its recyclability at the end of life.

Material Circularity

Material Circularity (MC) refers to maximizing value of used materials for next level usage with ensured avoidance of virgin resource use (see fig. 3). MC in the construction sector is also referred to as circular construction. Circular construction is a valuable concept to devise an adaptive/mitigative approach for the management of critical construction materials.

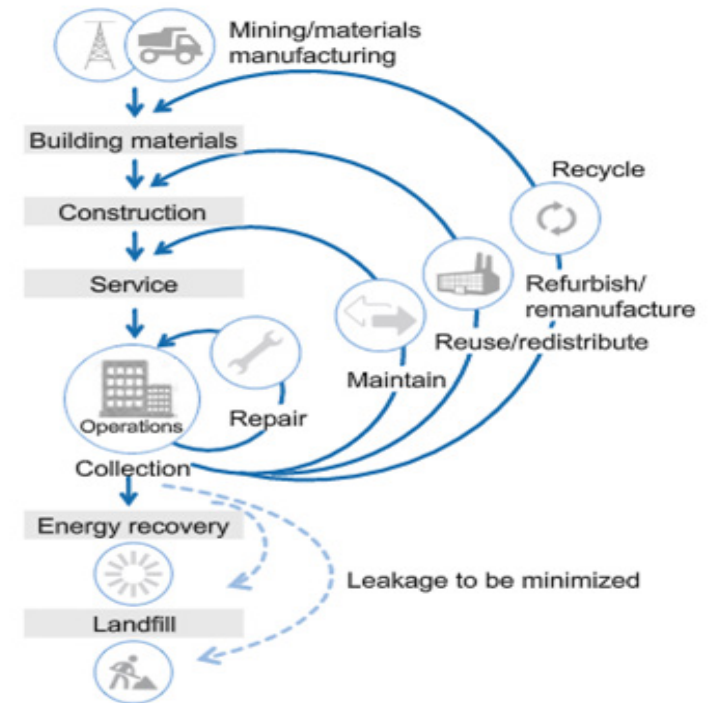
[4] https://smartnet.niua.org/sites/default/files/resources/circular-economy-in-india_5-dec_2016_0.pdf

Circular construction can be applied more effectively in redevelopment/refurbishment construction activities and with green building concepts. The MC concept is a proven approach for achieving maximised recycling of CDW stream components through the formation of new intermediate recycled products.

These products may be formed through a mix of any CDW streams with other waste such as Fly-Ash, Inert and segregated non- recyclable fraction of Municipal Solid Waste (MSW) and Industrial waste.

The concept of material circularity can be embedded in an integrated CDWM plan for any city. The adoption of a MC approach leads to a comprehensive assessment of the availability of various materials and to the exploration of synergies between different waste streams. The ultimate objective is to achieve sustainability in utilization and conservation of local natural resources. Localized circularity-based usage also helps to achieve cost optimization of resources and reduce GHG emissions due to transport.

Figure 3: Circular Economy Principles in the Construction Value Chain; adapted from the Ellen MacArthur Foundation; Braungart & McDonough; 2014, p15



Source: Ellen MacArthur Foundation; World Economic Forum; The Boston Consulting Group

2.1.3 Integrated Solid Waste Management

Integrated Municipal Solid Waste Management is based mainly on the so-called 3R-approach (reduce, reuse, and recycle). Its aim is to optimise waste management in all waste-generation sectors, including CDW (see next section). Adopting the 3R concept helps to minimise the amount of waste to be handled by the municipal authority, minimising the public health and environmental risks associated with it.[5]

The development of a Municipal Solid Waste Management (MSWM) plan is the focus of the MSWM manual, provided by the Ministry of Urban Development (MoUD) in 2016.

Figure 4 shows how the hierarchy for SWM can be adapted to CDWM.

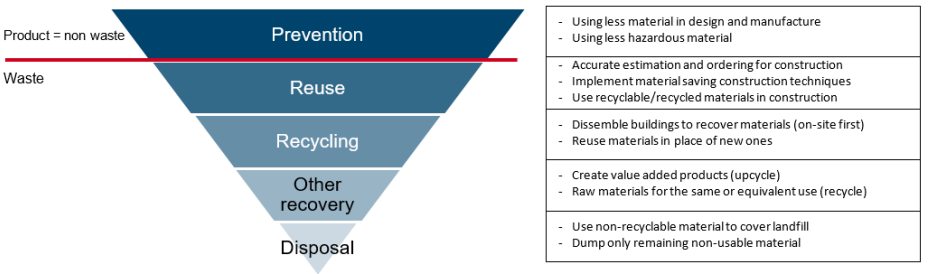


Figure 4: Hierarchy of Solid Waste Management adapted to CDWM; based on https://zerowasteeurope.eu/2019/05/a-zero-waste-hierarchy-for-Europe; 2019

In the context of the Climate Smart Cities Initiative, MSWM and CDWM are related to climate change in several ways:

(i) MSWM reduces the emissions of Green House Gases (GHGs, mainly methane) resulting from MSW and contributing to climate change. Waste minimisation, waste recycling, waste to energy strategies, and landfill gas capture and use are reduction strategies for GHGs, either directly (landfill gas capture) or by better use of energy and resources inherent in products and materials (climate footprint).

(ii) MSWM should also reflect needs for adaptation to future impacts of climate change. For example, site selection and design of landfills should reflect changing groundwater tables or rainfall patterns[6].

2.1.4 Exercise on existing module:

Participants are invited to reflect upon current Waste Management procedures in their ULB and discuss potential lessons learnt for CDW. Please share your experiences among your fellow participants. Guiding questions can be the following.

[5] Municipal Solid Waste Management Manual – Part I, MoUD; 2016, p9
[6] Municipal Solid Waste Management Manual – Part I, MoUD; 2016, p10

Guiding questions:	Notes:
Are there specific concepts such as Integrated Municipal Waste Management used in your ULB?	
What are the responsible departments?	
What are lessons learnt of existing strategies which could be relevant for CDW?	

2.2 Construction and Demolition Waste Management

CDWM is not just a sub-task of SWM in the sphere of a local government's responsibility. Solid waste in the country constitutes about one third CDW hence the objective of SWM cannot be achieved without managing CDW7. The following paragraphs introduce the topic of CDWM in brief and provide links to existing guidelines for CDWM in India for a deeper study.

Short Definition of CDW

"Waste comprising of building material, debris and rubble resulting from construction, remodelling, repair or demolition of any civil structure"

Source: CDWM rules 2016 definition

2.2.2 Sources and Composition of CDW

CDW includes all the building construction elements and all the waste from construction process itself. Structures include buildings, dams, water reservoirs, canals, and man-made river fronts, systems for providing services like water supply, sewerage, telephone/ broadband, electricity supply, and more for civilian and non-civilian purpose.

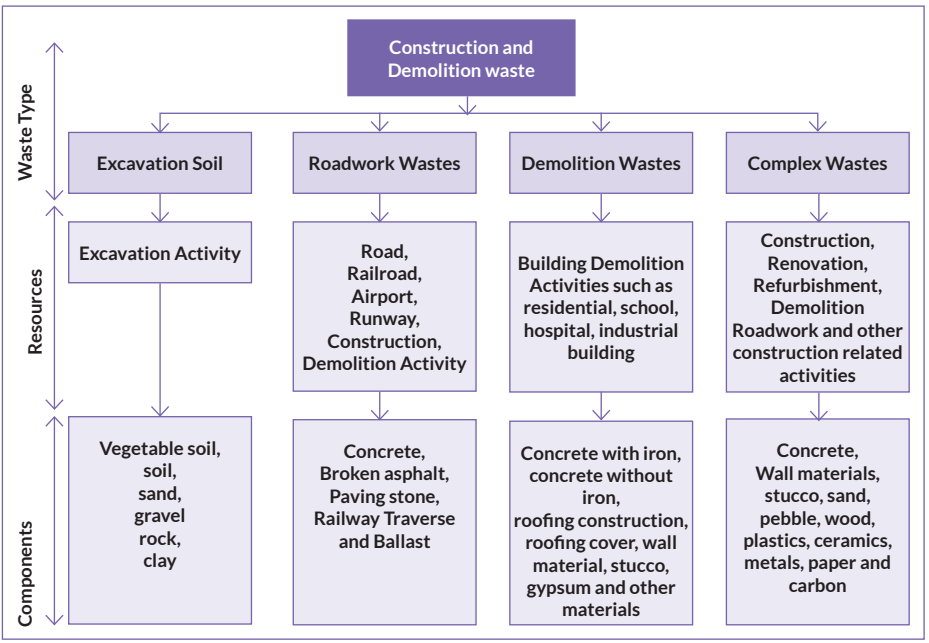
CDWM in the road sector may also be accorded equal importance as in case of on-site construction related to urban infrastructure. On an average, the CDW generated in road construction is recycled to an extent of more than 80%. But still some portions of CDW generated during re-carpeting of old roads generate asphalt shingles. In some cases, these asphalts laden sub-base is not used as re-consolidation base material. This waste requires special attention and dedicated efforts to ensure that it does not create any local pollution.

CDW comprises building material, debris and rubble resulting from construction, remodelling, repair or demolition of any civil structure.

[7]CDW, Technical Textiles & fly Ash in Construction, CPWD; 2018, p1

The different types of waste, resources and major components of CDW are listed in figure 5.

Figure 5: Composition of CDW, Technical Textiles & Fly Ash in Construction, CPWD; 2019, p18



Gardening and landscaping	Eearth work	Civil engineering	Structural engineering
• Drainage material • Layer in sport fields • Improvement of soil characteristics • Improvement of bearing capacity e.g. below garden walls	• Filling of line ditches and working spaces • Noise protection dams • Anti-freeze sublayers below buildings • Soil exchanges • Improvement of bearing capacity of earth/soil • Construction of temporary streets	Unbouded: • Gravel base layer and anti-freeze base layer • Combined gravel and anti-freeze base layer • Upper layer • Improvement of bearing capacity of plane and ground • Road pavement and flagging Bounded: • Bituminous bounded base layer • Hydraulically bounded base layer • Concrete base layer	As input in concrete: • Mix-in-situ concrete • Ready mixed concrete • Structural elements out of concrete • Concrete goods • As input in other construction materials • Mortar • Stones, such as burned bricks, sand-lime bricks or lightweight concrete

2.2.3 CDW processing and products

Guidelines highlight the importance and provide examples of existing applications. However, one of the most challenging tasks is promoting the use of processed material made of CDW. It is important to integrate the marketing and use of recycled products as main pillars in a local CDWM plan and strategy.

The table below (see fig. 6) lists products from CDW recycling and their possible usage. Figure 6: Strategy on resource efficiency in construction and demolition sector, MoHUA; 2019, p16

Ready Reckoner for Utilization of Recycled Produce of CDW – MoHUA. This guide facilitates understanding and implementation of "CDWM Rules 2016" towards 100% utilization of CDW as envisaged under Swachh Bharat Mission.

2.2.4 Economic, environmental and social impact of CDW and CDWM

CDW, if treated or not treated at all, impacts the city in different ways. Benefits and challenges are two sides of the same coin. From the environmental perspective, unauthorized dumping in storm water drains leads to further flooding, whereas the correct disposal keeps the storm water system well in function. From the economic perspective, cost savings can be achieved when drains are kept permeable, reducing the efforts to clean them up. Socially, flooding – worsened by blocked drains, mostly hurts the social disadvantaged.

Figure 7 lists impacts of CDW according to their economic, environmental and social impacts. The list includes only the most obvious impacts and does not claim completeness.

Figure 7: Economic, Environmental and Social impact of CDWM; own compilation

Impact	Explanation
Economic	**Saving expenses of solid waste management** by having generators to pay for disposal. This is as per the MSWM 2016 and Swachh Bharat Mission. Large contribution to this is the sheer weight of CDW, which leads to reduction of tipping fees paid for SWM.
	Recycled products from CDW creates an alternative construction material supply (that now has Bureau of Indian Standards (BIS) standards and other certification), and in effect create value in form of recycled resources, if it is for self-consumption or genuine financial resources if marketed.
	Reduction or removal of CDWM from SWM reduces the amount of waste that needs to be dumped on landfills significantly (until today, CDW is often treated as a part of SWM only). It reduces the weight, impacting tipping fees, and trips and costs of SWM transport as CDW is of high density, weight and of considerable size (as debris can be in all shapes).

Impact	Explanation
Environmental	**Prevention of unauthorized dumping of CDW** in drains, waterways and un-monitored public spaces. This is the prime cause for flooding and the disruption of hydrologic and associated eco-systems.
	Prevention of air and water pollution from CDW. Loose piles or materials crushed by traffic leads to particulate matter pollution (PM 2.5 and PM 10). Hazardous residues leach out and contaminate soil and ground water after rain events.
	Reduction of GHG emissions can be achieved in the construction phase, e.g. using environmentally friendly building materials. In the demolition process, benefits are achieved through on-site waste recycling and separation, reduction of transporting distances through a system of collection points, and through recycling of CDW for new construction purposes (buildings, roads etc.). Concrete plays an important role, as the energy incurred in making concrete peaks during the construction phase.
	Usage of local CDW as resource reduces the extraction of raw material and protects river areas from degradation (sand excavation). Unfortunately, purchasing raw material from long distances is more convenient, although regional or local recycled material in the same quality is available. The ULB should act as role model, making use of recycled material in own projects, provide incentives and generally promote the use of processed material. A good example of this approach is producing stabilized earth blocks from local mud or earth with appropriate stabilization using simple human press machines with a minor amount of cement/lime as binder. This approach replaces the need to buy newly burnt-clay bricks from other areas that also degrade those areas. The above example relates to the additional perspective of raw materials being banned by the authorities due to negative impacts in other systems. For example, the banning of mining of river-sand, tree-cutting or mining stone using explosives.
Social	**Generate low-skilled local employment.** Considering a worker friendly framework, every step of the CDWM process should be evaluated towards the creation of jobs for low-skilled employees (see Section 2.2.5).
	Save public open spaces and improve aesthetics in the city by restricting unauthorized dumping. This avoids nuisance and safety issues, especially for children, aged and special-abled, and makes for better views.

2.2.5 Informal Sector and traditional Recycling in India – An integrative part of CDWM

The informal sector plays an important role in India, especially in SWM and consequently CDWM. It is crucial to incorporate the informal sector in CDWM strategies, as its contribution to re-use of CDW should not be underestimated. It can support solutions at source at construction sites. At the lower end of the economic class, informal recycling is the norm. It reduces the need to purchase new materials among other purchasing priorities.

Figure 8: CDW Waste Recycling, separating concrete and bricks from concrete reinforcements

Source: Klaus Hoppe

"Similar to their role in MSW recycling, the informal sector also carries out a significant portion of the recycling activity of C&D waste. They collect commodities like wood and steel either for their own use or for selling them in the secondary market. ULBs have so far are not able to provide proper collection, disposal and management systems for C&D waste in most cities. Informal sector waste dealers contribute significantly to waste management by collecting, sorting and segregating the waste at site. They remove valuable commodities either for their own use or for selling in the secondary market. These activities are a source of income to this sector."

Resource Efficiency in the Indian Construction Sector – Market Evaluation of the Use of Secondary Raw Materials from CDW, GIZ; 2015, p31f

2.3 Exercise Module 2

Exercise Module 2: Further Impacts of CDW in your City	
Based on the list of economic, environmental and social impacts: Please note down important impacts of CDW in your city. Think about the role that the informal sector plays and might play in the future related to CDWM. What are challenges and benefits when involving this sector in a structured way? Explain and discuss impacts of CDWM and your additional findings with your fellow participants.	
Economic Impact	
Environmental Impact	
Social Impact	
Informal Sector Involvement	

Further Reading

Objective	Literature
Circular Economy	Pathways to a circular economy in cities and regions; Interreg Europe; 2016
Resource Efficiency	Fostering Resource Efficiency in the Indian Building and Construction Sector; EU-REI; 2018 Material Consumption Patterns in India - A Baseline Study of the Automotive and Construction Sectors; GIZ; 2016 Resource Efficiency in the Indian Construction Sector - Market Evaluation of the Use of Secondary Raw Materials from CDW; GIZ, 2015
Solid Waste Management	Municipal Solid Waste Management Manual – Part I-III; MoUD; 2016 (includes informal sector integration, at source minimisation in part I 26,27))
Construction and Demolition Waste – Overall Process	Training Manual on Construction and Demolition Waste Management in India for Cities and Towns; GIZ; 2017 Guidelines on Environmental Management of Construction & Demolition Wastes; CPCB; 2017
Composition of CDW Waste and GHG Emissions	Material Consumption Patterns in India – Executive Summary; GIZ; 2016
Recovery of CDW Waste	Manual for Deconstruction Towards Recovery and Utilisation of Construction and Demolition Waste; GIZ; 2017

MODULE

3

Legal Background

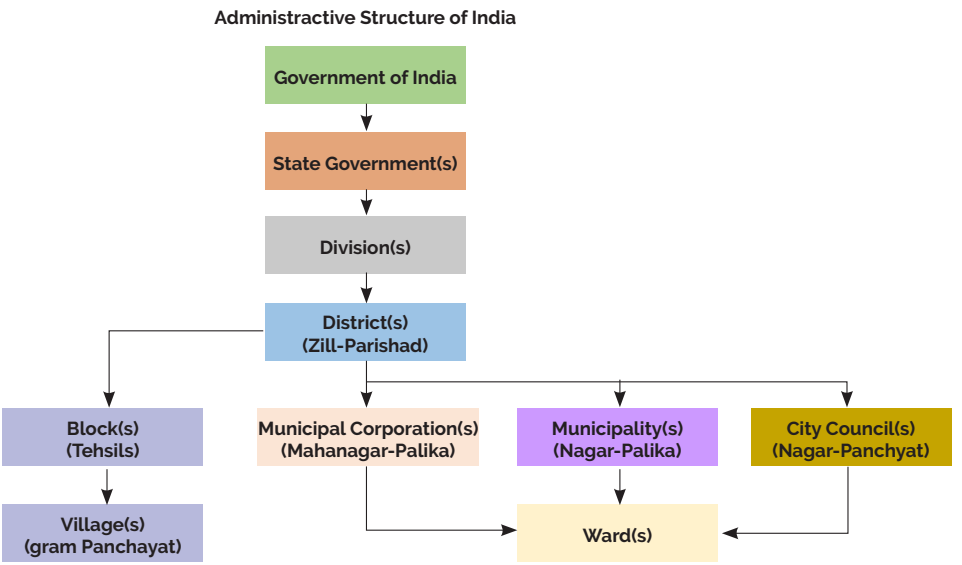
Key content:
- Administrative System of India
- Rules and Regulations of CDWM in India
- Responsibilities of different stakeholders

Learning goals:
- Improve knowledge of national law on CDWM
- Identify the necessary legal tasks for CDWM in your jurisdiction
- Understand regulatory and capacity challenges

3.1 Administrative Structure of India

Within the administrative structure of India, the Urban Local Bodies (ULB), such as the Municipal Corporations and Municipalities, form administrative units under the districts within the various divisions of the States (see fig. 9).

Figure 9: Administrative Structure of India from Central Government to ULB;

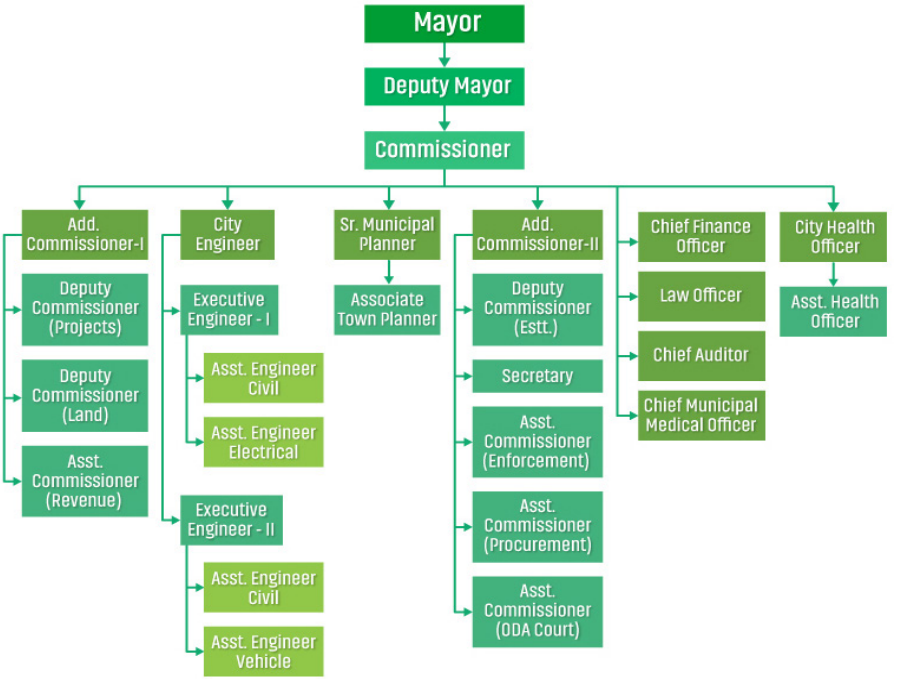


Source: Administrative structureofIndia, V Prajkumar

The rules, such as the CDWM rules of 2016, are framed at the Central Government level, and need to be adapted and implemented by the states and ULB's.

The Municipal Corporations have their own structures with various departments working independently under the leadership of the Commissioner and the Mayor. The figure below gives the example of Bhubaneswar Municipal Corporation.

Figure 10: Bhubaneswar Municipal Cooperation Organigram;



Source:BMC; 2019, https://www.bmc.gov.in/

In Bhubaneswar, SWM comes under the purview of the City Health Officer who oversees all kinds of waste generated in the city. CDW is managed by the City Health Officer as well.

3.2 Rules and regulations of CDWM in India

3.2.1 Construction and Demolition Waste Regulation before Construction and Demolition Waste Management Rules 2016

CDW is briefly mentioned in Schedule III of the Municipal Solid Waste (Management and Handling) Rules in 2000. The "Manual on Municipal Solid Waste Management" of the Ministry of Urban Development (MoUD), includes a chapter on CDW which establishes basic guidelines on its handling (2000). MoUD, in its circular dated 28th June 2012, declared all states to set up CDW recycling facilities in all cities with a population of over 1 million.

The Ministry of Housing and Urban Affairs (MoHUA) circulated a notification by **CPWD mandating use of recycled portions of CDW in construction activities**, if the same is available within 100 km of the construction site. It also specified that coarse and fine

varieties of Recycled Concrete Aggregate (RCA) derived from CDW are to be used in Lean Concrete, Plain Concrete Cement (PCC), and Reinforced Concrete Cement (RCC) used in construction.[1]

> According to the MoHUA, recyclable CDW must be used in construction activities, provided that it is available within 100km on the construc-tion site.

3.2.2 General Aspects of the CDWM Rules, 2016

The CDWM Rules 2016 were enacted by MoEF&CC to address the growing problem of CDW by establishing a uniformed approach to standardise the random and separate actions being taken by each state (vid Gazette notification G.S.R. 317(E) Part-II, Section-3, Sub-section (ii)).

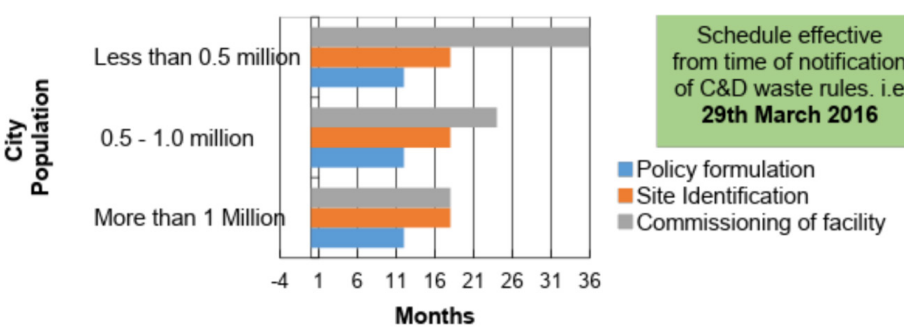
Unlike rules addressing various kinds of urban waste such as MSW and plastic waste, the CDWM Rules 2016 are NEW rules that were notified on 29th March 2016 by the Ministry of Environment, Forest and Climate Change (MoEF&CC).

The guiding principle of the rules is to recover, recycle and reuse (3R's) the waste generated through construction and demolition (see Module 2). Segregating CDW and depositing it to the collection centres for processing is the responsibility of every waste generator.

Based on the size of the city, the rules specify the timeline for implementation of the three mains stages in CDWM:

1. Policy formulation,
2. Site identification, and
3. Commission of facility based on the size of the city.

Figure 11:Strategy for Promoting Processing of CDW and Utilisation of Recycled Products



Source: CDWM Rules; 2016

[1]Notification of MoHUA on CDW; source:MoHUA; 2016, www.mohua.gov.in

Monitoring shall be made by State Pollution Control Boards (SPCBs) three times a year i.e. once in four months for cities having population more than one million. Cities with population of 0.5-1 million and less than 0.5 million shall be monitored by SPCBs two times a year i.e. once in six months (Rule - 13).

"Permission for construction will be given only when the complete construc-tion and demolition waste management plan is presented." Large generators of waste will have to pay relevant charges for collection, transportation, proc-essing and disposal, as notified by the concerned authorities.

The CDW Rules' Appendix included a collection of form templates including an application template for authorisation of CDW processing facility and an annual report template. These templates were provided to support the responsible stakeholders and to simplify implementation processes.

The rules also incorporate compliance criteria for setting up and operating a CDW processing facility (see CDWM rules,Schedules I and II) including environmental protection aspects:

- Minimum life of processing facility to be 20-25 years,
- Buffer for fivetons per day on facility grounds,
- Facility to be away from habitation, forest areas, national parks, water bodies etc.,
- Facility to be fenced including a vegetation boundary around the premises,
- Gate to monitor vehicles, weigh bridge and fire protection are mandatory,
- De-watering, sewage treatment and noise reduction of machines, and
- Measuring of air and noise quality.

In addition to the legal framework, the 2016 CDWM Rules of India also pro-vided material to guide the responsible stakeholder in implementing CDWM plans and strategies.

CDWM Rules 2016: Training Manual on Construction and Demolition Waste Management in India for Cities and Towns; GIZ; 2017, p11 + Annex-1

The CDWM Rules 2016 by MOEF&CC provide a uniform set of rules to deal with CDW and develop own strategies and guidelines.

3.2.3 CDWM rules important duties for involved parties

This section highlights the tasks and duties of stakeholders involved in the process of CDWM. According to the rules, the most important stakeholders are waste generators, service providers and contractors and the different administrative units from state to local governments. The following figure 12 summarizes the duties of these stakeholders.

Figure 12: Duties of different stakeholders

Duties of waste generators (Rule – 4)

- Every waste generator shall segregate CDW and deposit at a collection centre or transfer it to the authorized processing facilities.
- Shall ensure that there is no littering or deposition to prevent obstruction to the traffic or the public drains.
- Large generators (who generate more than 20 tons or more in one day or 300 tons per project in a month) shall submit waste management plan with appropriate approvals from the local authority before starting construction or demolition or remodelling work.
- Large generators shall have an environment management plan to address potential environmental issues from construction, demolition, storage, transportation process and disposal/reuse of CDW.
- Large generators shall segregate the waste into streams such as concrete, soil, steel, wood and plastics, bricks and mortar.
- Large generators shall pay relevant charges for collection, transportation, processing and disposal as notified by the concerned authorities

Duties of Service Providers and Contractors (Rule –5)

- The service providers shall prepare a comprehensive waste management plan for waste generated within their jurisdiction, within six months from the date of notification of these rules.
- Shall remove all CDW in consultation with the concerned local authority or through any agency.
- Accidents during the process shall be immediately reported to local authority (FormV)(Rule 14)

Duties of State Government and Local Authorities (Rule –6 & 9)

- The Secretary of Urban Development Department in the state government shall prepare state's policy with respect to the management of CDW within one year from the date of final notification of these rules.
- The concerned department in the state government dealing with land shall provide suitable sites to establish facilities to store, process, and recycle CDW with one-and-a-half years from date of final notification of these rules.
- The town and country planning department shall incorporate the site in the approved land use plan so that there is no disturbance to the processing facility on a long-term basis.
- Shall procure and utilize 10-20% materials made from CDW in municipal and government contracts.
- Local Authority (LA) shall place appropriate containers for collection of waste, removal at regular intervals, transportation to appropriate sites for processing and disposal.
- LA shall seek a detailed plan or undertaking from large generators of CDW and sanction the waste management plan.
- Seek assistance from concerned authorities for safe disposal of CDW con-taminated with industrial hazardous or toxic material or nuclear waste if any.
- LA shall give appropriate incentives to generator for salvaging, processing and or recycling preferably in-situ.
- LA shall establish a data base and update once in a year.
- Million plus cities (based on the 2011 census of India) shall commission the processing and disposal facility within one-and-a-half years from date of final notification of these rules
- 0.5 to 1 million cities shall commission the processing and disposal facility within two years from date of final notification of these rules.
- For other cities with less than0.5 million populations shall commission the processing and disposal facility within three years from date of final notifi-cation of these rules.

Shall review and issue instructions to the in- charge of the facility in case if any accidents reported by in charge of the processing facility (Rule – 14).

Duties of Central Pollution Control Board (CPCB), SPCB or Pollution Control Committee (Rule –8 & 10)
· The Central Pollution Control Board shall prepare operational guidelines related to environmental management of CDW. · SPCB shall grant authorization to CDW processing facility, (Form-III) · Monitor the implementation of these rules by the concerned local bodies, and · Submit annual report to Central Pollution Control Board and the State Government, (Form IV)
Standards for products of construction and demolition waste (Rule –11)
· The Bureau of Indian Standards shall prepare a code of practices and stan-dards for products of CDW · Indian Roads Congress (IRC) shall prepare standards and practices pertain-ing to products of CDW in roads construction
Duties of Central Ministries (Rule –12)
· The Ministry of Urban Development, and the Ministry of Rural Development, Ministry of Panchayat Raj, shall facilitate local bodies in the compli-ance of these rules, · The Ministry of Environment, Forest and Climate Change shall review the implementation of these rules as required.
Duties of processing / recycling facility (Rule –7)
· The operator of the facility shall obtain authorization from State Pollution Control Board or Pollution Control Committee. (Form-I) · The processing / recycling site shall be away from habitation clusters, forest areas, water bodies, monuments, national parks, wetlands and places of important cultural, historical or religious interest. (Schedule-I) · The processing/recycling facility exceeding five tonnes per day capacity, shall maintain a buffer zone of no development around the facility. · The operator of the facility shall submit the annual report to the State Pollution Control Board. (Form II)

Source: "CDWM Rules; 2016"

3.3 Supplementary codes, standards, city initiatives and urban missions related to CDWM

The *National Building Code* (NBC- CED 46) of India 2005: Part 11 of NBC 2005) states in chapter 11, "Approach to Sustainability" that

- Recycled Coarse Aggregate may be used in concrete for bulk fills, bank protection, base/fill of drainage structures, pavements, sidewalks, kerbs and gutters, etc.
- Up to 30 percent of natural crushed coarse aggregate can be replaced by the recycled concrete aggregate. This percentage can be increased up to 50 percent for pavements and other areas which are under pure compression specific to the standards and practices pertaining to the construction of roads.

A standard issued by the *Bureau of India Standards* (IS 383, Specification 2016) specifies the extent of utilization of coarse and fine aggregates for concrete and the percentage and quality of CDW that can be utilized. These aggregates from recycled material are of two types:

1. Recycled Aggregate (RA) made from CDW which may comprise concrete, brick, tiles, stone, etc.
2. Recycled Concrete Aggregate (RCA) derived from concrete after requisite processing.

The standard for coarse and fine aggregates for use in concrete was revised in January 2016. The revision permitsthe use of recycled aggregates up to 25% in plain concrete, 20% in reinforced concrete of M-25 or lower grade and up to 100% in lean concretes of grade less than M-15.

Delhi Public Works Department issued an advisory to all Delhi Government Departments in 2015 mandating 2-10% use of recycled CDW products in build-ing construction and road works. The advisory was reissued in 2018. This up-dated advisory mandates the use of CDW product. It also advises the installation of more small capacity CDW recycling plants (i.e. 500 TPD) at different locations in the city, including at least one for each major stakeholder of the government. The advisory also notes that North Delhi Municipal Corporation has made seven dumping locations available for CDW generated from individ-ual houses.

Several Urban Missions by the Indian Government are related to CDWM and arebriefly described in the following figure.

Congruence with Urban Missions

- **Climate Smart Cities Assessment Framework (CSCAF)**: MoHUA launched the CSCAF for all 100 Smart Cities in February 2019, to assess the state of climate action in the cities and provide a road map for the future. One of the 30 indicators of the framework is linked to sustainable recycling and reuse of CDW in the city. This ranged from collection of waste to processing of waste through setting up of facilities.
- **Swachh Bharat Mission**: Flagship programme of Government of India for improving waste management and resource recovery; CDW management falls squarely within its objectives. Cities must demonstrate improvements in cleanliness and waste management in comprehensive annual surveys, which should serve as an incentive to municipal bodies. The Swachh Bharat Mission (under MoUD) envisages the processing of 100% solid waste generated in cities / towns by 2nd October 2019 as a key objective, which includes CDW streams.
- **Atal Mission for Rejuvenation and Urban Transformation (AMRUT)**: for urban infrastructure improvement with an emphasis on pedestrian zones in 500 ULBs. Recycled products made from CDW (e.g., paver blocks) can be used beneficially for pedestrian zones.
- **Smart Cities Mission:** envisions transformative projects in cities with an emphasis on innovation. CDW processing as well as utilisation of recycled products can be included in such projects.
- **Housing for All (Pradhan Mantri Awas Yojana)**: to address severe housing shortages by constructing 1.2 crores affordable housing units by 2022. Incorporation of "sustainable green materials" is encouraged by the mission, and recycled products from CDW can find utilisation.

3.3 Exercise Module 3

Exercise Module 3: Compliance with Construction and Demolition Waste Management 2016 Rules	
Thisexercise intends to verify legal action already taken in your city including challenges that relate to the legal requirements of the CDWM rules. Please answer the following and discuss with your fellow participants. • Identify possible solutions to overcome existing restraints – on a national, state and local level. • What are the first steps to get started, if no or few steps have been taken? • Who should take the lead in your ULB?	
Question	**Answer**
Is any legal action already taken in your city?	
Are (further) steps towards legal implementation planned in the near future? Which ones?	
What are general challenges for legal action related to CDWM and rules in your administration?	
What are the capacity challenges related to CDWM in your city?	

Secondly, this part of the exercise relates explicitly to the ULB duties as outlined above in Section 3.2.3. You are invited to reflect for each requirement how far the existing system in your city is already in line with the Rules by indicating 'compliance gaps'. You can work city-wise or in sub-groups and document your findings in the Matrix.

Requirement	Compliance gaps	How to overcome gaps?
The town and country planning department shall incorporate the site in the approved land use plan so that there is no disturbance to the processing facility on a long-term basis.		
The town and country planning department shall procure and utilize 10-20% materials made from construction and demolition waste in municipal and government contracts.		
Local Authority (LA) shall place appropriate containers for collection of waste, removal at regular intervals, transportation to appropriate sites for processing and disposal.		
LA shall seek a detailed plan or undertaking from large generators of construction and demolition waste and sanction the waste management plan.		
LA shall seek assistance from concerned authorities for safe disposal of construction and demolition waste contaminated with industrial hazardous or toxic material or nuclear waste if any.		
LA shall give appropriate incentives to generators for salvaging, processing and or recycling preferably in-situ.		
LA shall establish a data base and update once in a year.		
• Million plus cities (based on the 2011 census of India), shall commission the processing and disposal facility within 1 ½ years • 0.5 to 1 million cities within 2 years • Cities with less than 0.5 million inhabitants within three years. (date of final rules notification)		
LA shall review and issue instructions to the in- charge of the facility if any accidents reported by in charge of the processing facility (Rule - 14).		

Further reading

Objective	Literature
CDWM Rules 2016	Utilisation of Recycled Produce of Construction & Demolition Waste - A Ready Reckoner; BMTPC; 2018 Guidelines of Environmental Management of CDWs. New Delhi, CPCB; 2017 Guidelines for Sustainable Habitat. India, CPWD, 2014
To aid the stakeholders to comprehend their roles in implementing the rules.	Toolkit on Construction and Demolition Waste Management Rules 2016- Capacity Building Programme by CPCB, MoEFCC and MoHUA
To provide a framework of implementation of the CDWM Rules, 2016	Strategy for Promoting Processing of Construction and Demolition Waste and Utilisation of Recycled Products, by MoHUA and Niti Aayog (Draft)
To address the considerable shortage of conventional and traditional building materials in India based on high demand of building materials by 2021-2022	Building Materials and Technology Promotion Council (BMTPC) in 2016 released the 'Guidelines for Utilization of Construction & Demolition Waste in Construction of Dwelling Units and Related Infrastructure in Housing Schemes of the Government'
To promote the use of recycled products from CDW	Green building rating schemes such as GRIHA, source: https://www.grihaindia.org/griha-rating
To outline what kind of materials from recycled CDW and in what proportion, may be safely used for specific road construction/repair applications.	Guidelines for Use of CDW in Road Sector; The Indian Roads Congress (IRC) IRC-121:2017
CDWM in building and planning processes	IS 383: 2016 Indian Standard; National Building Code (NBC- CED 46) of India 2005

MODULE

4

Site Visit

Key content:

- Overall management of a processing site: Segregation of CDW and usage of products
- Processing site initiation and management and maintenance
- Processing site technical requirements (responsibilities, data, recycling products, etc.):

Learning goals:

- Understand components of an overall CDWM strategy on local level
- Gain motivation and knowledge about different ways to implement a sustainable CDWM system
- Understand challenges and pros and cons of the components and overall system
- Identify the necessary legal tasks for CDWM in your jurisdiction
- Understand regulatory and capacity challenges

4.1 Context for site visits

Site visits and "real case" examples play a valuable role within trainings. They help to better understand and deepen the theoretical input and learn about potentials and challenges. They allow participants to benefitfrom the experience of the responsible staff on sites. They also give the opportunity totour physical facilities and conduct interviews toask immediate and concrete questions related toan individual'sobservations.

A reflection round after the site visithelps to frame the experiences of the visit and providesan opportunity for a "reality check" of the concept or component.

The content of sitevisits will vary according to the options available at the concrete training city and venue.

Figure 13: Visit of Burari Processing Site, Delhi

Source: Felix Knopf, GIZ

However, if no processing site is available you might:

- visit CDW collection sites,
- visit construction site with or without separation of CDW,
- visit a landfill or dumping site for CDW,
- visit examples of illegal dumping of CDW, or
- watch a video about one of the best practices in India, the Burari CDW facility in New Delhi (details see Module 5).

4.2 Exercise Module 4

Exercise Module 4: Site visit observation and reflection

1. The site visits will be split into small groups with specific tasks of observation during the site visit.

For the visit of a processing facility, this could include:

- technical equipment,
- efficiency of the plant/site,
- environmental protection measures,
- quality and marketing of processed products,
- overall maintenance,
- health and safety issues, or
- economic aspects etc.

Each small group shall briefly present their findings and discuss together with all other participants.

2. Please reflect on the below questions for each participant/group. Identify the strengths and weaknesses of your observations.

Question	Observation
What was interesting and helpful? What inspired you?	
What surprised you?	
What was different than expected?	
Where do you need further information?	
What is/is not transferable and why?	
Challenges recognised?	

Thirdly, assess the following statements on a scale from 1-10 (one = very low; ten: very high):

- Quality of site visit in general (topic, conduct)
- Personal benefit and knowledge improvement
- Helpfulness for your city´s approach towards CDW
- Relation to workshop and training program

MODULE

5

Best Practice Examples

Key content:

- Indian Best Practice for CDWM
- International best practice for CDWM (Germany)

Learning goals:

- Learn about Indian and German approaches to implement CDWM or treatment facilities
- Increase motivation to implement a sustainable CDWM system in their own city
- Gain better understanding of the complexity of CDWM

The best practice examples ofCDWM in this module complement the experi-ences of the site visit. The examplesprovideadditional information and broaden the background knowledge.

Best practice examples are the most suitable solutions worked out through trial and error. Theyare found to be the most sensible way to act or proceed.

We will highlight anIndian and German example in this module. However, you should use your own experience and critical judgement to evaluate and adapt the best practice solutions to your own field of work and city.

5.1 Indian best practice examples

As mentioned in introduction, the implementation of CDW Rules in India isbe-hind schedule. Few cities have already developed a CDWM strategy, plan and processing facility.However, thosecities show that CDWM in India can be im-plemented according

to the CDWM rules of 2016. The examples of Delhi, Ah-medabad, Indore and Chandigarh processing sites and collection structure provide a variety of approaches as each city developed their strategy upon its own framework.

Delhi

Delhi Municipal Corporation (DMC) is the pioneer in India in terms of initiating the first CDWM system in the country. The recycling facility in Burari, northern Delhi is installed, operated and maintained on a Public Private Partnership (PPP) basis between the Delhi Municipal Corporation and Infrastructure Leas-ing and Financial Services Limited (IL&FS) Environment.

The processing plant, currently operating at 2,000 TPD capacity was commis-sioned in 2010 for only 500 TPD on a pilot basis. The total project cost for the site was$3.32 million with a capital investment of $1.18 million1.

The following figure shows the operating capacity of the pilot phase. It is obvious that more than 50% of the material input was expected to be loose soil.

The plant has been running successfully and is an excellent case study for business models that could be adopted across India. Under the PPP agreement, the DMC pays IL&FS a fee for collection and transportation. DMC has designated 168 intermediate collection points across the city from which waste is transported to theprocessing facility.

[1]India's first CD Recycling Plant at Burari, source: IL&FS; 2014

Figure 14: Operation Capacity for Burari Facility

Recoverables	Tons	Percent
Loose soil	290	58
Brick powder / pozzolana	10	2
Brick sub-base	70	14
Granular sub-base	25	5
Sand / Dust	20	4
Fine aggregates	35	7
Grits	40	8
CD rejects	10	2
CDW total amount	**500**	**100**

Source: Report: India's first C&D Recycling Plant at Burari, IL&FS; 2014

The processing technology includes both dry and wet processing. Approximately 95% of the incoming CDW is recycled and processed into aggregates and M-sand.

Utilising the recycled materials, the unit produces finished products such as kerb stones, paver blocks, concrete bricks and pre-cast reinforced cement concrete structures like drain slabs, roofing structures, etc. The materials have been tested and meet BIS codes for usage in construction applications. The Delhi government has also recommended preferential procurement of recycled products by public agencies.

Figure 15: Paver Bricks from recycled material at Burari Site

Source: GIZ, Felix Knopf

To minimise transportation distances and associated costs, Delhi planned to have a distributed network of processing facilities in different zones of the city. Two smaller plants (500 TPD and 150 TPD respectively) have recently come online (2017-18) with planning for more under way.

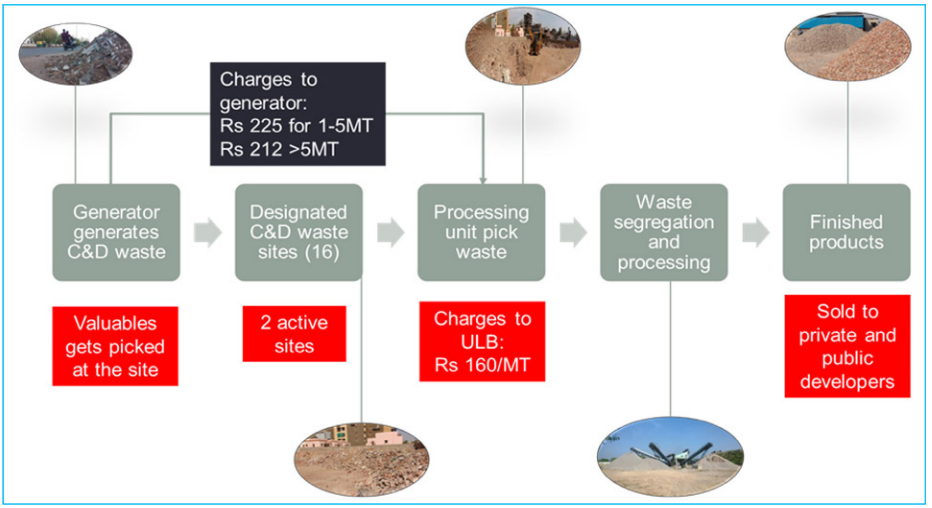
FilmBurari link; Literature:India's first C&D Waste Recycling Plant at Burari, IL&FS; 2014 can be found at http://swachhbharaturban.gov.in/ under the tab "Capacity Building"

Ahmedabad

Ahmedabad was the second city in India to implement CDW processing. It adopted a similar PPP model as that in Delhi. A 300 TPD processing facility was launched in 2014. Its capacity was increased to 600 TPD in 2016. The capacity isnow 1,000 TPD following an additional increase in 2018.Ahmedabad followed the Design Build Operate Finance and Transfer (DBOFT) model with the following steps:

1. The Municipal Corporation contracted a private party as the authorised agency responsible for both transportation and processing of the CDW. It alsodeveloped the infrastructure with its own financing.
2. The Municipal Corporation offered land to the contracted party for estab-lishing the processing facility. It also designated a series of intermediate collection points at favourable locations throughout the city.
3. The authorised agency collects CDW from the designated collection points as well as from unauthorised dumps, as directed by the urban authority. The waste is then transported to the processing facility.
4. The Municipal Corporation pays the agency an agreed fee per tonne of waste that is collected and transported.
5. The agency may also collect fees directly from large generators (such as Metro Rail) for waste collection. If generators bring waste to the processing facility at their own expense, the agency accepts it without charge.
6. The private partner has two sources of revenue – the "tipping fee" from the ULB and the sale of recycled products made from CDW. However, market uptake of recycled products made from CDW remains an ongoing challenge. The structure is shown in figure 16.

Figure 16: Revenue Scheme for Ahmedabad CDW Processing



Source: Market Study on C&D Waste Utilization in Ahmedabad, GIZ; 2016

Amdavad Enviro Projects collects CDW from 16 designated points across Ahmedabad and charges tipping fee of ₹ 160/Ton. The waste is also collected directly from generators at charges as shown in figure 17:

Figure 17: Rates for CDW in Ahmedabad

Weight	Per metric ton rate	Per trip (Minimum rate)
Less than 1 MT waste	-	₹ 220/-
For 1-5 MT waste (minimum quantity)	₹ 225/-	₹ 675/-
More than 5 MT waste (large quantity)	₹ 212/-	₹ 1700/-

Source: *Market Study on CDW Utilization in Ahmedabad, GIZ; 2016*

Market Study on CDW Utilization in Ahmedabad, GIZ; 2016

A short first summary compares the cases of Delhi and Ahmedabad in the table below:

Key Features	Delhi	Ahmedabad
Year established	2010	2014
Model	Public Private Partnership betweenDelhi Municipal Corporation (New Delhi Municipal Corporation – NDMC and East Delhi Municipal Corporation- EDMC) and IL&FS Environmental Infrastructure & Services Limited	Public Private Partnership between Ahmedabad Municipal Corporation and Amdavad Enviro Projects Private Limited (AEP)
Number of processing plants	3 in operation	1 in operation

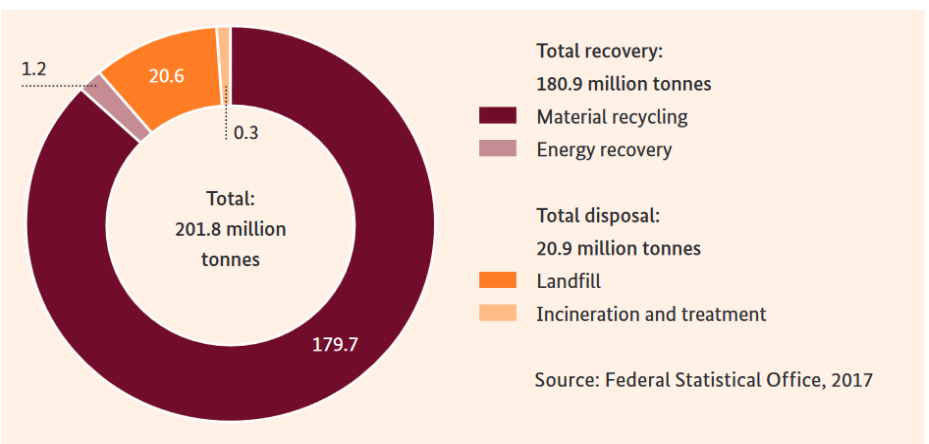
Key Features	Delhi	Ahmedabad
Capacity	First plant: 2,000 TPD; Second plant: 500 TPD; Third plant: 150 TPD	300 TPD (increased capacity to 1000 TPD)
Tipping Fee (INR per ton)	For NDMC Service Area: 147/ton (with annual escalation of 5%) For EDMC Service Area: 375/ton (with annual escalation of 3%)	178/tonne
Products	Recycled aggregates, manufactured sand, paver blocks, curb stones, tiles, hollow blocks/bricks	Paver blocks, tiles, hollow blocks/bricks, prefabricated structures like frames, manhole covers, benches, etc.

Figure 18: Comparison of Delhi and Ahmedabad CWM processing; source: Strategy on Resource Efficiency in Construction and Demolition Sector, MoHUA and NITI Aayog; 2019

5.2 International Best Practice – A German Example

CDW has the largest generation share in Germany. In 2015, 59.5% of all waste, including hazardous waste, was CDW. This totals 201.8 million tons of CDW per year. On the one hand, the recycling rate in Germany is very high: almost 90% of mineral CDW is recycled or reused in the circular economy (see fig. 19). Although this numberpoints to a successful recycling strategy, unfortunately most of the material is "only" used as low-quality material for street fillings or construction for landfills ("Material recycling"). The share of use of recycledmaterials, such as concrete in new developments, however, is still low. This needs to be increased in the future to save basic resources.

Figure 19: Total recovery and disposal of CDW in Germany 2015



Source: Waste Management in Germany 2018 – Facts, data, diagrams, BMU; 2018

Despite these good overall recycling rates, Germany faces the challenge that dumping capacities are limited, whereas the amount of CDW is constantly increasing due to a booming construction sector. Germanylacks economic incentives, proper enforcement and an overall national regulatory framework that urges constructionsector to use higher shares ofrecycled material.

The following example from a CDW recycling plant showcases innovative solutions for increasing resource efficiency and decreasing GHG emissions in the CDW sector.

CDW Recycling Plant, Heinrich Feess GmbH & Co. KG, Germany

Feess, a family-run company, plays a leading role in CDW recycling with the aim to maximize returns of recyclable materials to the economic cycle. The company's focus is earth engineering, demolition and recycling. It has 200 employees, 45 trucks and 60 construction machinery. They offer about 40 recycled products in their recycling plants.

The process of recycling starts on the construction site. With chain-mobile crushing and sieving plants, the company sortsthe raw materials at the point of production, typicallystony, gravelly building site excavated materials. This procedure saves raw materials, landfill space and transport costs. Therefore, this operation is ecologically and economically sensible. After being sorted, the materials are cleaned in an elaborate washing process. The extracted materials result in new quality building materials, e.g. R-concrete, that can be used as construction materialsin the region.

5.3 Exercise Module 5

Exercise Module 5: Best practice examples reflection	
Based on the experience of the site visit and information presented inthe best practice examples, please reflect the information and answer the following questions on your own:	
Question	Observation
What was interesting and helpful in general?	
What are the similarities of the twoIndian examples?	
What is different between the two Indian examples?	
What is different or similar between Indian and German examples?	

Question	Observation
What is/ is not transferableand why for your city? Techniques, management.	
What further information would be helpful?	
Please answer the questions below and discuss your findings with your fellow participants. Which example(s) would fit the best for your city and why? What is helpful for your city´s approach towards CDW? What do you think would not work in your city? What kind of support do you need?	

Figure 20: Wet classification plant, RC-parc Kirchheim

Source: Heinrich Feess GmbH & Co. KG; 2019

Further reading

Objective	Literature
Indian Best Practice	Solid Waste Management - Field Visit Manual 2018 – Chapter IV; NIUA 2018; Chapter 4.1 Solid Waste Management Initiatives in Urban India – A Compendium; NIUA 2019 (SWM including CDW)
International Best Practice	Construction and Demolition Waste management in Germany; Deloitte; 2015 Waste Management in Germany 2018 – Facts, data, diagrams; BMU 2018

MODULE

6

Main Steps of CDWM

6.1 Integrated Approach of Construction and Demolition Waste Man-agement

Key content:

- Overall approach of CDWM in the Indian framework
- Integrated steps of a CDWM plan/strategy

Learning goals:

- Elaborate on CDWM steps based on the previous modules
- Gain clear understanding about CDWM steps

Building upon the general background of CDW (Module 2), the legal frame-work (Module 3), the site visit (Module 4) and the presentation of Indian and German best practice examples (Module 5), the next Modules 6, 7, and 8 integrate additional information to apply to individual CDWM plans.

This module will elaborate on the steps to be taken towards a CDWM. Module 7 will elaborate on the stakeholders. Finally, Module 8 will guide the development of first steps towards project management and roadmap to achieve ULB CDWM.

CDW – as solid waste – needs an integrated andholistic approach towards its management withthe development of (integrated) plans or strategies. Here, integrated means that a responsible local body needs to considerthe different aspects of CDW comprehensively by identifying the overall context and the interrelation of its parts. This should occur in the early planning stages.

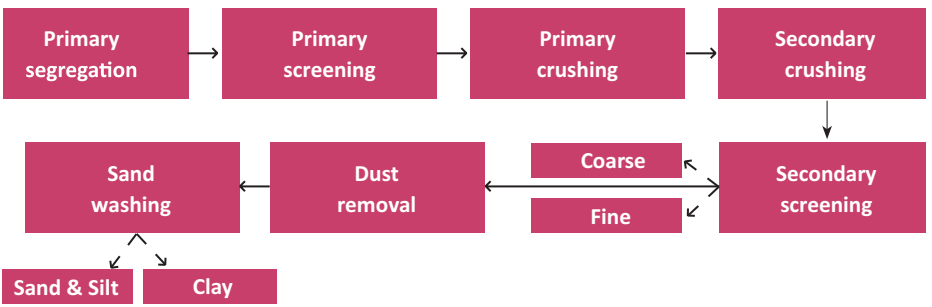
As introduced in Module 2, CDWM can be regarded from:

- a technical perspective (from on-site separation, collection, processing andfinal use of output material and products or disposal of CDW) or
- a management perspective (from first intention and decision to im-plementation of a CDWM strategy, implementation and accompanying monitoring and control.

A CDWM strategy or plan should integrate these technical and management steps.

Figure 21 shows the main technical steps of CDWM from primary segregation to final outputs.

Figure 21: Processing Steps and Outputs of CDWM



Source: Strategy on resource efficiency in construction and demolition sector, MoHUA; 2019, p12

The management process includes the overall planning and implementation of CDWM as a strategic undertaking. The MoUD SWM Manual summarises the process as follows:

"In consultation with expert institutions, the ULBs shall plan for appropriate management of CDW including processing facility and further plan to use the recycled products in the best possible manner. These institutions can also suggest ways to introduce "deconstruction" activity from the construction planning stage and provide assistance in

this matter. Municipal authorities should make by-laws as well as special arrangements for storage, transportation, processing, and disposal of CDW as per the revised rules. ULBs should monitor and record generation of CDW within its jurisdiction"1.

Furthermore, ULBs should make arrangements for the placement of appropriate containers (skips or other containers) and their removal at regular intervals or when they are filled. This can be accomplished through their own resources or by appointing private operators. The collected waste should be transported to appropriate site(s) for further processing and disposal. ULBs should monitor and record the generation of CDW within its jurisdiction2.

However, the process is not strictly sequentialwith one step following the other. Some basic steps are crucial, such as the initial decision to develop the strategyby the local government responsible or the assignment of human resources and responsibilities. The remaining steps happens partially in parallelto each other and therefore needs careful preparation and steering. For example, the steps required for CDWcan be grouped in a set of distinct activity heads, most of which can be conducted in parallel. These are in general:

- Strategic decision regarding managing CDW at city level,
- Status quo: Check laws, regulations and systemsalready in place (na-tional, state, city level),
- Estimation of the waste quantity that is to be handled,
- Broad ideas about its collecting, interim depositing and proposal,
- Communication withand involvement of stakeholders,
- Tendering and Implementation of technical parts of CDWM plan, and
- Approvals, monitoring and reporting of the regular activities.

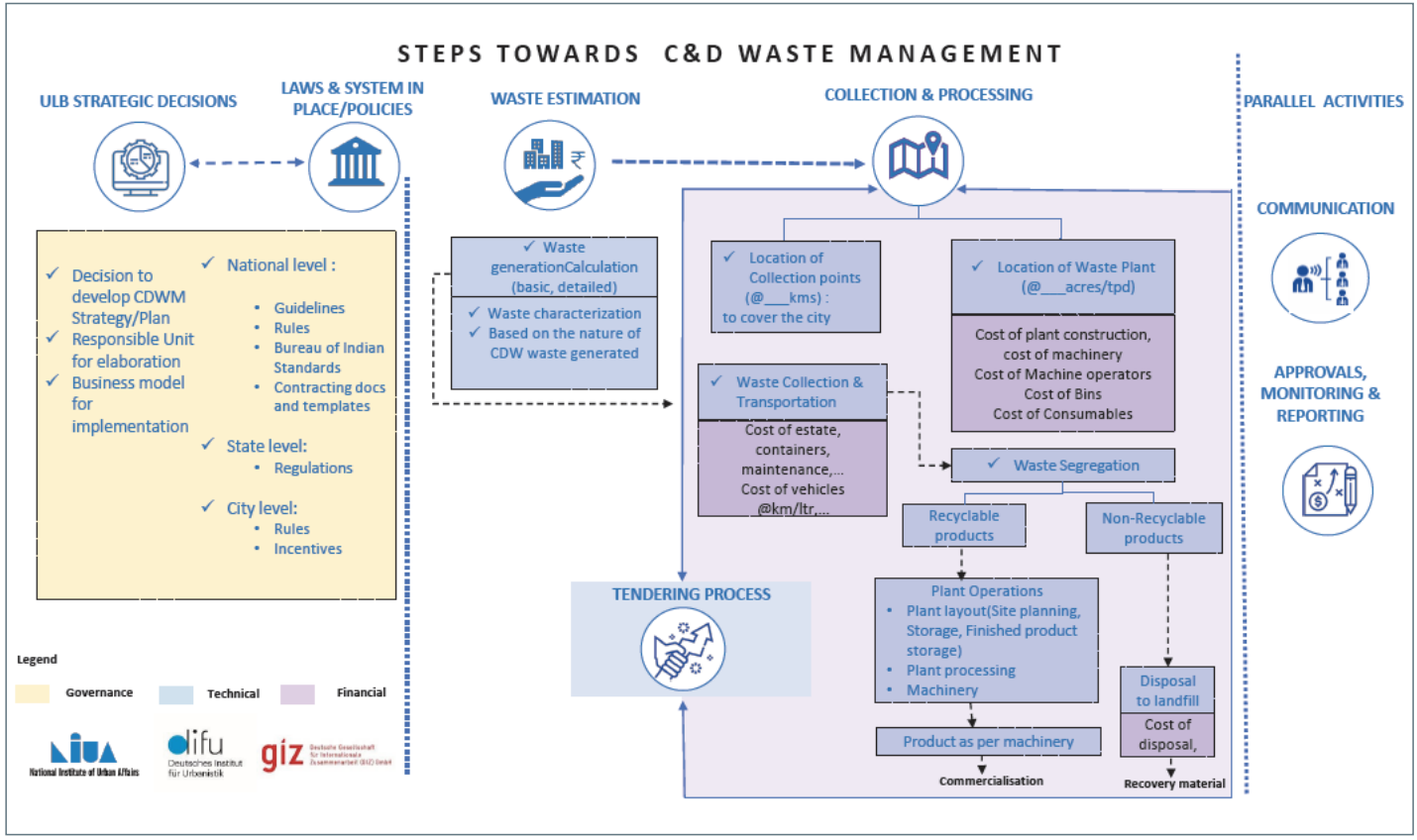
Tendering Processes of CDWM

To fulfil the tasks in CDWM, ULB shall invite tenders from eligible bidders. The specifics of the invitation will depend upon which parts of CDWM are decided to be outsourced to private companies: Collection, Transportation, Storage, Processing and Recycling.
A deeper elaboration of the important topic of tendering would go beyond the scope and time of this workshop. Literature containing supporting information about the tendering process is listed below:

Training Manual on Construction and Demolition Waste Management in India for Cities and Towns; GIZ; 2017, p37

The general aspects and steps above are summarized with tasks in figure 22.

[1]Municipal Solid Waste Management Manual – Part I, MoUD; 2016, p47f
[2]Municipal Solid Waste Management Manual – Part I, MoUD; 2016, p47f


STEPS TOWARDS C&D WASTE MANAGEMENT
ULB STRATEGIC DECISIONS
LAWS & SYSTEM IN PLACE/POLICIES
WASTE ESTIMATION
COLLECTION & PROCESSING
PARALLEL ACTIVITIES
COMMUNICATION
APPROVALS, MONITORING & REPORTING
✓ Decision to develop CDWM Strategy/Plan
✓ Responsible Unit for elaboration
✓ Business model for implementation
✓ National level :
• Guidelines
• Rules
• Bureau of Indian Standards
• Contracting docs and templates
✓ State level:
• Regulations
✓ City level:
• Rules
• Incentives
✓ Waste generationCalculation (basic, detailed)
✓ Waste characterization
✓ Based on the nature of CDW waste generated
✓ Location of Collection points (@___kms) : to cover the city
✓ Location of Waste Plant (@___acres/tpd)
Cost of plant construction, cost of machinery
Cost of Machine operators
Cost of Bins
Cost of Consumables
✓ Waste Collection & Transportation
Cost of estate, containers, maintenance,...
Cost of vehicles @km/ltr,...
✓ Waste Segregation
Recyclable products
Non-Recyclable products
TENDERING PROCESS
Plant Operations
• Plant layout(Site planning, Storage, Finished product storage)
• Plant processing
• Machinery
Disposal to landfill
Cost of disposal,
Product as per machinery
Commercialisation
Recovery material
Legend
Governance
Technical
Financial
National Institute of Urban Affairs
difu Deutsches Institut für Urbanistik
giz

Exercise Module 6: Main Steps of CDWM
1. The task and intention of this exercise is to develop main steps of CDWM based on the information of the previous modules and learnings so far. 2. By using one coloured moderation cards, identify important aspects from your point of view that need to be part of a CDWM strategy (Brainstorming) and put them on a pin board. 3. Mergementions with same content and then cluster related aspects. Find a meaningful headline for each cluster. Sometimes aspects fit into different clusters. Then you should agree on where it fits best for the time being or copy it, if the aspect is important. 4. Agree on which tasks are preparatory or basics tasks.Define an overall order of steps. 5. The trainer will explain the "Steps towards CDWM" graphic, shown in figure 21. 6. Compare your elaborated result with the trainer's presentation: • Look for similarities and differences! • Have a dialogue on differences: how could your outcome or the trainer's version be adapted or improved? • Check if anything is missing? Agree on a joint basic version, including city specifics if reasonable.

The outcome and understanding of the overall process builds the basis for the following steps of this module. Those steps contain the assessment of the basic strategy and technical situation.

Further reading

Objective	Literature
Main Steps of CDWM (Inventarisation, Collection, Transport, Disposal, Processing, Monitoring)	Training Manual on Construction and Demolition Waste Man-agement in India for Cities and Towns; GIZ; 2017, p26 Strategy on Resource Efficiency in India; MoHUA/Niti Aayog; 2018; p26 Guidelines on Sustainable Habitat - Part-IVGuidelines on Reuse & Recycling of Construction & Demolition Waste; CPWD; 2014
Processing Facility and use of products	Utilisation of Recycled Produce of Construction & Demolition Waste - A Ready Reckoner; 2018

6.2 Basic Assessments for the CDWM strategy/plan

Key content:
- Strategic Assessment of CDWM
- Technical assessment: waste estimation, collection and transportation evaluation
- Plant level Calculations

Learning goals:
- Understand needs at governance level to ensure implementation (responsibility)
- How to calculate CDW amounts?
- Aspects of locating collection points and processing unit

This sectionbuilds upon the initial status quo evaluation of CDWM in your city in Module 2.Secondly, and related to Section 6.1, it will outline and describe the assessment ofstrategic management and technical aspects relevant for a CDWM strategy.

6.2.1 Strategic Assessment

Management Structures and Capacities
You need to determine whether there is a separate unit for CDWM or does it continue to be under the SWM Department of Buildings Department. While it is ideal to have a separate cell / unit for CDWM, it is generallyimportant to locate the responsibility of CDWM within the city administration in the first place (see Module 3). CDWM must be distinctlyassigned in the rules of office, with a nodal or responsible officer, and others to support in their relevant areas. This particular CDWM unit must have the opportunity to improve its knowledge of all aspects around CDW through further trainings.

CDWM Strategy Development
The above-mentioned unit or responsible staffoverseesthe elaboration of the **CDWM Strategy / Plan for the city**. Like all plans, the CDWM Plan should have a clear vision, mission and objectives with set timelines, responsibilities and budgets. The related units should also obtain allnecessary notifications required to set the plan into reality, such as executive orders and framing the necessary regulations and rules.

- **Legal Situation (see Module 3)**
  It is therefore necessary to assess, if there are any state level policies or regulations that have already been notified with respect to CDWM. Because land is a state subject, it is necessary that all extant regulations of that particular state are understood and followed. The State Urban Development Department (or Municipal Administration or Local Self Government, as may be relevant) and the State Environment Department including the SPCBs should have a corresponding notification following the Central guidelines

- **Financial Budget and Costs**
  Depending on the size of the city and scale of construction and demolition activity, there can be a separate budget line for CDWM in the Municipal Budget for basic administrative work.
  The Plan should consider the current costs and impacts of CDW being a part of the MSW, and the implications of separating the two to treat CDW independently.

- **Inhouse operation or Outsourcing**
  It is important for a city to decide to what extent **CDWM cycle will be handled inhouse or outsourced**. This can vary from state to state based on approaches and existing capabilities. This may also differ from city to city. One ULB can decide that the collection & transportation of CDW will continue to be its own responsibility, while the processing and plant dynamics are left to an outsourced vendor / plant operator; while another can decide that the entire cycle including collection & transportation of CDW will be given to an outsourced vendor / plant operator; while yet another can indeed decide that the entire cycle is done in-house without an outsourced plant operator. This should be evolved in consultation with stakeholders and discussed for pro-con analysis (see as wellModule 7 stakeholder involvement).

However, based on case-studies and general pattern in India, the basic pro-pensities (only as observed) lead to the following conclusions:

- A city with strong labour force may decide to own, operate and consume the entire value chain.
- Smaller towns in which the quantities of CDW are lesser and ample land available with the ULB may consider collecting, transport and process the waste all by itself using only procurement of a plant or build-operate-transfer (BOT) basis.
- A small/medium city may decide a mid-way path based on the quantities and availability of land to outsource the plant operations on a design-build-own-operate basis (DBOO), while
- A large city / metro may decide to outsource most of the CDWM cycle to one or more entities by tender and share the costs or profits accordingly.

Build-Operate-Transfer (BOT) is a form of project financing, wherein a private entity receives a concession from the private or public sector to finance, design, construct, own, and operate a facility stated in the concession contract. This enables the pro-ject proponent to recover its investment, operating and maintenance expenses in the project.
A Design-Build-Own-Operate (DBOO)contract is a project delivery model in which a single contractor is appointed to design and build a project and then to oper-ate it for a period of time.

The following figure summarises the above-mentioned conclusions:

Figure 23: Inhouse or Outsourcing?

	Inhouse Solution	Inhouse/Outsourcing	Outsourcing
Size of City	Smallww	medium	big
Amount of CDW	Low	Medium	High
Labour force	Strong	Medium	Low
…			

Source: own compilation

- **Incentives and Fines**
  The rules must include the necessary incentives for re-use / re-cycling (for the waste producers), fines for transporting or dumping CDW illegally, and rates for legal CDW collection, transportation, etc. The processing aspects of CDWM are to be considered separately, since they have different dynamics, and can be treated as a project. However,the city needs to have a business-model approach to CDWMincluding a cost-benefit analysis of the entire CDWM cycle and not just of the CDW processing plant.It should also deposit current and projected (over next few years) costs against the savings / gains of CDWM

6.2.2 Technical Assessment

Besides the strategic and management aspects of CDWM it is very important to know how much CDW is "generated" within the borders of a city or city region.Only with such an evaluation of current CDW and its extrapolation in the future, a reliable collection, transportation, processing and disposalplan can be developed.

Waste estimation and methods

In the absence of full monitoring of debris removal & dumping, it is difficult to accuratelyestimate the exact quantity of CDW of a city. But there are methods of estimation based on known data. Hence, it is possible to adopt rule of thumb methods for an initial waste estimation based on the number of new constructions and demolitions (due to reconstruction) in a given city.

The current amount of CDW can be estimated at a given point based **on the rate of growth in the permits** given over the past few years for new construc-tion and reconstruction. This is best known through online building plan ap-proval systems (OBPAS) already mandated through the AMRUT scheme. With accurate hard-copy records of all permits issued over the years, a valid estimate shall be possible.However, there are a few disclaimers to this estimation:

1. The **number of authorized constructions** (i.e. as per permits issued officially) would only be a proportion of the overall construction and demolition activity in the city. This

proportion always depends on stringencies of implementation of construction permits and surveillance and penalties for unauthorized con-struction. Hence, the proportion between legally issued permits and total construction may vary considerably.

2. The **rate of construction activity** in any city is always a feature of economic growth parameters or indicators. While for practical purposes, it may be safely assumed that a larger city will be undergoing more construction as compared to a smaller city, the rate of construction may vary based on **growth parameters of the city**. Sometimes, smaller cities with new growth impetus have significant construction activity (e.g. new industries, township policies, migration, government moves like capital relocation etc.).
3. Just as there is regional variation in characterization of CDW as mentioned earlier, there would also be **regional variation in CDW disposal** due to tra-ditional practices of in-situ re-cycling (e.g. intact bricks, doors, etc.) and sal-vaging by the informal sector (metals, glass, etc.).

A. Waste Estimation:
Data of construction, demolition and renovation is available

If the amount of construction, demolition and renovation (in terms of built up area in sqm) **is known** from the number of permits issued, then the following thumb rules may be used to estimate the CDW generation, these are:
50 kg of CDW produced per sqm of new construction,
400 kg of CDW produced per sqm of demolition and
45 kg of CDW produced per sqm of renovation

It is important to note that the waste produced per sqm of demolition is significantly higher (naturally) than for new construction. Hence, even in permits issued, there **MUST be a distinction between permits issued for demolition and permits issued for new construction.**

Applying the above estimation methods, one can arrive at the net rate in kilograms produced in the city. The time during which this waste is produced is as per the number of permits given within particular time duration.

Example:
If the construction permits issued in a given city are:

- 50,000 sqm per month for new construction and
- 5000 sqm per month for dsqm
- emolition*

Then as per the thumb rule above:

- 50000 sqm of the construction will lead to 2500000 kg/per month = 2500 tons per month = 83.33 tons/day and
- 5000 sqm of demolition will lead to 2000000 kgs/month = 2000 tons per month = 66.67 tons per day

Therefore, the net CDW is equal to 150 tons per day.

B. Waste estimation:
Data of construction, demolition and renovation is not available

If the amount of construction, demolition and renovation (in terms of built up area in sqm) is not known,then it is difficult to estimate CDW generation. Not only is there an 8 times higher difference in the waste produced per sqm of demolition than for new construction, but there are also significant variations between co-relations of any other parameter (e.g. area of a city or population) and the daily CDW generation, in studies conducted across Indian cities.
Figure 23 shows the data of selected cities.

Figure 24: CDW generation in Indian Cities

City	Population (Census 2011)	Daily CDW generation (tonnes/day)	Annual CDW generation (million tonnes/a)
Mumbai	12,442,373	2,500	0,75
Delhi	16,787,941	4,600	1,38
Bengaluru	8,443,675	875	0,26
Chennai	6,500,000	2,500	0,75
Kolkata	4,496,694	1,600	0,48
Jaipur	3,471,847	200	0,06
Patna	2,514,590	250	0,08
Ahmedabad	6,063,047	700	0,21
Bhopal	1,917,051	50	0,02
Coimbatore	2,618,940	92	0,03

Source: NITI Aayog Strategy for Promoting Processing of C&D Waste and Utilisation of Recycled Products, 2018

There are significant variations between any co-relations of population and daily CDW generation:

- From 2.61 tons per day CDW generation per every lakh of population for Bhopal.
- To 38.5 tons per day CDW generation per every lakh of population for Chennai.

As there are considerable unknowns in the data for the above-mentioned cities (quality of data basis, building activity etc.), similar size cannot justify adapting numbers from another city.

To get a reliable data basis, cities are advised to

- conduct a thorough CDW estimation by an experienced service pro-vider
- implement anOnline Building Plan Approval Systems(OBPAS)to get an accurate idea of permits issued separately for construction & demoli-tion, and closely monitor all demolition / debris removal activity, in or-der to estimate CDW generation.

- **Waste transportation**

  The overall estimation of CDW for transportationincludesthe calculating of the costs related tocollection and transportation from the construction (& demolition) sites to the collection points as well as from collection points to the CDWM Plant location. Hence, and besides the re-use of material on the construction site to reduce waste in the first place, two aspects become cru-cial:strategic location of collection points and transportation/storage costs.

Location: For smaller cities or smaller CDW quantities, it is merely a matter of calculating the tonnage of CDW and costs related to transport to a single loca-tion. For larger cities, it is important to place the collection points in order to limit transportation and related costs. Land cost are an issue especially in highly urbanisedcities and its concurrence of usage.

The location of the collection points should be decided by the city according to land availability, CDW "production", variation of density, development areas and distance to the processing facility, using e.g. the existing master plan map. It is recommended to look for synergies with locations already in use for SWM.

Costs:Both transportation aspects (to collection point – to processing plant) asmentioned above have the same data points of calculation:

1. Labour / machinery hiring costs for final breakage and loading,
2. Transportation costs - either net contracts to an agency, or separately, but inclusive of
   - transport vehicle capital costs amortised over its life, taken per month
   - transport vehicle operational costs (fuel over net trips, etc.)
   - transport labour (driver, helper, etc.)
   - transport vehicle cleaning and maintenance costs, taken per month

3. Labour / machinery hiring costs for final breakage and loading.
   Usually, the transport costs from the waste generation points to the collection points, are loaded on to the contractors / builders of the sites. Yet, in several cities CDW removal is the responsibility of the city authority, in addition to the collection of debris removal charges.

- **CDW Processing Plant calculation**

In this workshop it is not possible to dig deep into the cost calculation for CDW processing. However, the following points are key parts of a plant calculation:

- The land cost (if applicable, i.e. not assumed free for city authority),
- Site layout and plant layouts including input inventory storage, plant process, toolshed, people activities and output storage,
- Costs associated with developing the site,
- Capital costs of the exact plant / machinery that is selected,
- The machinery erection /setup costs,
- Operational aspects of the plants (Labour and related, Consumables, Maintenance, etc.),
- Monitoring, Reporting and other administrative aspects, and
- The revenues from the end products that are produced at the plant.

The listed aspects can vary highly from city to city depending on the exact plant / machinery that is selected, depending on the amount of CDW that will finally be treated and possible marketing of end products.

Utilisation of Recycled Produce of Construction & Demolition Waste: A Ready Reckoner, BMTPC (MoHUA), 2018

6.3 Exercise Module 6

Exercise Module 6: General Situation in your Municipality	
Please describe the general situation of CDW in your City using the matrix below. In case, you cannot answer questions on your own, try to contact a responsible colleague via phone. If data or information is not available at all, please note accordingly. After you finished the questionnaire, on a scale from 1-10, if ten, then CDWM is working properly and one, then nothing implemented, please rate CDWM in your own city.	
Topic	**Explanation**
Quantity of Waste	
Solid Waste generated (t/a)	
CDW generated (t/a)	
CDW collected (t/a)	
CDW recycled (t/a)	
Transport and Treatment	
Organisation of Collection	
Segregation of CDW; Collection points?	
Processing Facility in operation? – TPD?	
Facility Output (recycled material?)	
Disposal site(s)	

MODULE

7

Involving Stakeholders

6.1 Integrated Approach of Construction and Demolition Waste Man-agement

Key content:
- Role and functions of stakeholders in the CDWM process
- Challenges and agendas of potential stakeholders

Learning goals:
- Identify and cluster of relevant stakeholders for CDWM
- Understand stakeholders` interaction and collaboration with each other

CDWM is a complex process that cannot be achieved by a single group or au-thority including the ULB. Identification and necessary involvement of the different stakeholders is important for all stages of CDWM on local level. A strategic approach helps to keep overview and provide opportunities for the variousgroups to participate (authorities, institutions, private sector, and citizens).

If the municipality initiatesthe process of CDWM, it is important to organise the participation process within the ULB (e.g. in form of a core team) and external stakeholders (e.g. in form of a consultation committee).

Stakeholders have different roles and importance.Their involvement will varyaccording to different phases of CDWM establishment:

- Get informed (citizens)
- Get consulted (technical experts)

- Collaborate (Builders, Constructors)
- Co-decide (authorities)
- Control implementation (responsible units in ULB)

7.1 Stakeholders in CDWM

The tasks and duties of the responsible actors are summarized below in Figure 24. These duties are set forth in the existing legal and administrative framework for India.

Stakeholder	Specification	Duties and Responsibilities
Waste generators	Owners / Builders of individual properties Contractors Transporters Builders Association Green Building - IGBC / GBCI / GRIHA Recycling Units (formal & Informal) Crushing unit owners / operators Equipment Manufacturers Product certification agencies (BIS, TUV, etc.) Marketing for Re-cycled products	Properly collect and store waste within their premises ensuring no spill over or mixing with MSW. Deposit waste in designated locations as notified by local authority. Submit waste management plan and get approval before starting construction/ demolition work. Pay relevant charges for collection and disposal as notified by local authority.
Utility service providers and their contractors		Prepare a comprehensive waste management plan. Collect and store waste securely by avoiding local disruption or pollution. Arrange with urban local authority for disposal paying the relevant charges.
Others	WA / Co-operative Societies / Community bodies Ward Sabhas / Committees CSOs, NGOs, Advocacy Groups, Entrepreneurs News Media (Print & AV)	Producers of waste Active in local action against CDW dumping Information agents

Stakeholder	Specification	Duties and Responsibilities
Governance		
Urban Local Bodies (ULB)	Municipal Corporation* Urban Development Authority Roads & Building Dept. / PWD District Collectorate	Main actor responsible for waste management. May contract third party but still responsible for oversight and outcome. Should do a feasibility study before finalizing management plan. Pass by-laws mandating CDWM and fix relevant charges and penalties. Designate intermediate collection points and a site for processing facility, if needed in collaboration with state agencies. Examine and approve a waste management plan of generators and collect relevant fees. Make arrangements for collection, transportation and processing, in contract with a private party. Establish a CDW generation database through linking waste management permits and monitor compliance. Carry out sustained Information, Education, and Communication (IEC) activities for all stakeholders. Create incentives for use of recycled products including through preferential purchase agreements in municipal contracts.
State Government	State Pollution Control Board/ Committee (SPCBs)	Monitor implementation of the Rules by local authority. Authorise CDW processing facility as per criteria and monitor environmental compliance. Prepare annual reports for CPCB.
State Government	State Urban Development Department	Monitor implementation of the Rules by local authority. Authorise CDW processing facility as per criteria and monitor environmental compliance. Prepare annual reports for CPCB.
CPCB		Prepare guidelines for CDWM. Analyse data collected by SPCBs and prepare the annual compliance report for central government.
BIS/Indian Roads Congress		Prepare standards for suitable utilisation of recycled products from CDW in construction and in roads.
Central Government		Compliance facilitation by MoHUA, MoRD. Review of implementation by MoEFCC.

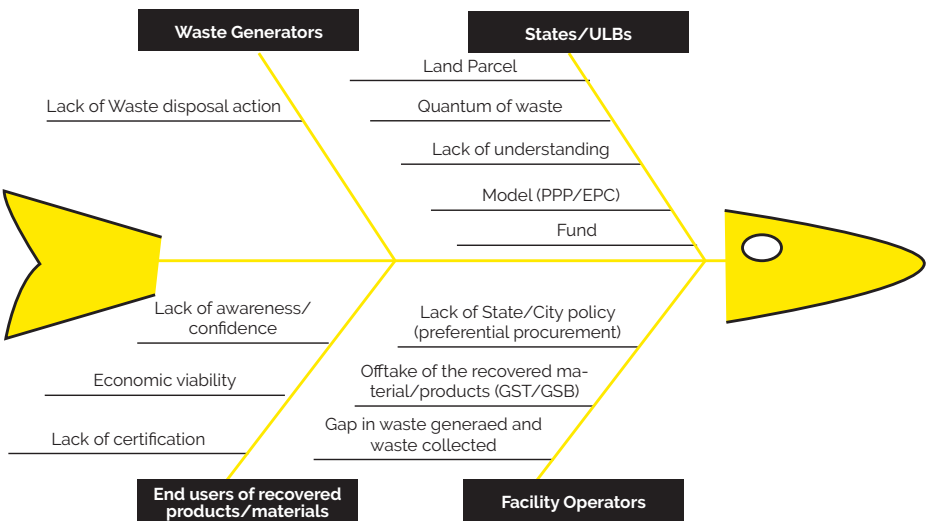
Figure 25: Strategy on resource efficiency in construction and demolition sector, source: adapted from MoHUA; 2019, p18f

The ULB is the administrative body that is most empowered, capable and responsible to implement CDWM. The actual designations may vary among different types of ULBs but responsibilities to implement a CDWM can be identified. The general roles include the Mayor, Standing Committee, the Municipal Commissioner / Chief Officer, the Chief Engineer (or corresponding for Solid Waste or Building Permits) and other relevant officers.

7.2. Challenges for Stakeholders

Different stakeholders in the field of CDWM face different challenges. The next graphic (see fig. 26) summarizes the main challenges of key stakeholders:

Figure 26: Typical challenges of stakeholders

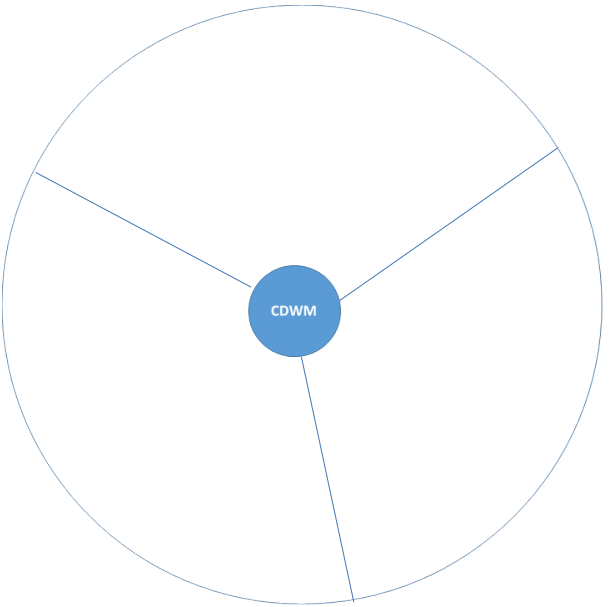


Source: Presentation on CDW by Mr. Pandya, EY; Training Workshop onCDWM (by GIZNIUA-DIFU) on 4.12.2019 at India Habitat Cen-tre, New Delhi

7.3 Exercise Module 7

Exercise Module 7: Stakeholder Identification and Assessment		
The involvement of stakeholders in the CDWM process is important and re-quires a thorough approach. You are invited to follow this process stepwise.		
In a first step, please brainstorm and identify all stakeholders in your city that are relevant from your point of view. List them below.		
List of Stakeholders		
In a second step, please group them in the suggested three fields below. Feel free to further subdivide the grouping if necessary.		
Relevant Stakeholder Collection Matrix		
Governance **Local, regional, state etc.**	**Waste Generators** **Builders, constructors, transporters, processors**	**Others** **Supporters, multipliers e.g. residential groups etc.**
In a third step, please integrate the stakeholders in the circle provided below. Divide the circle according to the groups you created in the second step. Next, rate the stakeholders according to their importance. The more important stakeholders should be placed nearer to the centre e.g. because of his decision taking tasks. Use bold letters or underline the most important stakeholders in each sector. Finally, use the exclamation mark (!) for stakeholders with the ability to "veto" CDWM elaboration and implementation.		

Exercise Module 7: Stakeholder Identification and Assessment



In a fourth step, please use the following arrows to highlight the relationship between different stakeholders:

Strong relation

Weak relation

Conflicting relation

In a fifth step, please present your results to the other participants and discuss differences and similarities, opportunities and threats of involving different kind of stakeholders.

This exercise gives a first overview of the importance and relationships of stakeholders in your city. Module 8 will include this analysis with the discus-sion of project management and roadmap.

Handbook for Stakeholder Engagement, UNEP, Nairobi; 20181

[1] https://www.unenvironment.org/resources/publication/stakeholder-engagement-handbook

MODULE

8

Project Management and Roadmap

6.1 Integrated Approach of Construction and Demolition Waste Man-agement

Key content:

- Task Identification from status quo to CDWM implementation
- Identification of Stakeholders responsible for each of the next steps
- Timeframe for actions to ensure CDWM implementation success

Learning goals:

- Develop a CDW flowchart for the city (material and responsibility flow)
- Develop a roadmap (next steps and responsibilities) jointly, using the learnings of the training workshop so far
- Present CDWM elaborated solution to superior/senior

8.1 Project Management Set-up for CDWM

- This module invites you to initiate, adjust, or improve existing approaches to CDWM project management and roadmap for your city. Ideas for CDWM strategy/plan was produced in previous exercise of this training: Status quo analysis (Module 2)
- Rules and regulatory aspects (Module 3)
- Practical experience from site visit (Module 4)
- Best practice examples (Module 5)
- Main steps towards CDWM and flow chart (Module 6)
- Stakeholder involvement (Module 7).

Exercise Module 8 will guide the compilation of the above work towards practical next steps to organise the process (project management) and to elaborate concrete next steps that might be taken (roadmap). A well-structured project management and related roadmap (time-schedule, responsibilities, and project supervision) are prerequisite for a successful implementation of a CDWM plan or strategy.

8.2 Exercise Module 8

Exercise Module 8: Project Management and Roadmap Development
The following matrix combines the project management and roadmap devel-opment in one document. The document will guide you through the different aspects and steps of CDWM. The exercise is divided by the main steps and phases of the CDWM process (see flow chart in Module 6) including sub-sections: 1. Preparation phase 2. Regulation and Rules 3. Contracting/Tendering process 4. Technical aspects 5. Supporting Mechanisms
1. Project Management (Task identification and Challenges)=In a first step*, please discuss and fill in the "project management columns": a. What needs to be done to achieve the topics intention or goal? b. What are the principal challenges in doing so?
2. Roadmap (Responsibilities and Time schedule) **In a second step*,** please discuss and fill in the "roadmap columns": · Who is the person in the city responsible for addressing the task? (see Module 7) · What is the timeline for the person/team to start and for completing the actions (start date and end date, e.g. if you imagine to begin as of now)?

Exercise Module 8: Project Management and Roadmap Development
3. Designing CDW Strategy Design a "CDW strategy core team" for your city. Use the learnings and results of the stakeholder assessment of Module 7. The following questions are intended to support you: · Who takes/has the lead? (Chair) · Who is supporting him (Team, Department) · Whom does he report to? · Which departments are involved? · Who advices the core team? · Which external stakeholders need to be involved, how and when?
· CDWM Management Core Team
Presentation and Discussion Finally, we ask you to present and share you results of your group work. 1. Each group presents their Project Management and Roadmap 2. Furthermore, each group should mention the three most important steps to be taken immediately for their city, responsibility and challenges. 3. Each group should briefly report striking and controversial aspects during group work

* Practical advice: Develop project management and roadmap in parallel for each topic or aspect of CDWM.

Concluding, the exercises in Module 8 integrate all aspects of the training and provide you with a first idea and support to structure and start or improve the process of CDWM in your city.

Module 8 – Exercise Matrix Project Management and Roadmap Development

	CDWM Process: Two steps elaboration	Option B: Step one - Module 8a – Project Management		Option B: Step 2 - Module 8b – Roadmap	
	CDWM process: One step elaboration	Option A: Module 8 – Project Management & Roadmap (Joint Elaboration)			
No	Topic	What needs to be done to achieve the topic?	Challeng-es?	Who? (Re-sponsible/ Involved)?	Starts When? Completed by when?
1	**Preparation**				**Concrete dates (month/year)**
	Is there a formal decision to develop CDWM strategy or plan?				
	Is a responsible unit assigned for elaboration and project responsibility?				
	Has a preliminary assessment of CDW / Inventory/ Characterisation been carried out?				
	Has there been a preliminary assessment of circularity (on-site reuse, reuse for local purposes)?				
	Have preliminary locations of Collection points been identified? (with land requirement – availability)				
	Has a preliminary location of processing plant been identified? (Land requirement – availability)				
	Has there been a full stakeholder identification and Assessment?				
2	**Regulation/Rules**				
	Have the national rules including templates been studied?				

	CDWM Process: Two steps elaboration	Option B: Step one - Module 8a – Project Management		Option B: Step 2 - Module 8b – Roadmap	
	CDWM process: One step elaboration	Option A: Module 8 – Project Management & Roadmap (Joint Elaboration)			
No	Topic	What needs to be done to achieve the topic?	Challeng-es?	Who? (Re-sponsible/ Involved)?	Starts When? Completed by when?
	Are necessary state regulations or General Development Control Regulations in place for CDWM as per SWM Rules 2016?				
	Are there clear specifications & rules for the handling of CDW in construction permits?				
	Are debris collection charges specified and is there corresponding usage of the same?				
	Is the responsibility for debris collection and segregation specified?				
3	**Contracting and Tendering**				
	Is there a separate cost estimation for CDWM currently? (Not only as part of overall SWM costs)				
	Has a business model for implementation of CDWM been arrived at? What is the model (Cost-plus, Profit-share, etc.)?				
	Has the tendering process for CDWM or processing plant been carried out?				
4	**Technical Aspects**				

	CDWM Process: Two steps elaboration	Option B: Step one - Module 8a – Project Management		Option B: Step 2 - Module 8b – Roadmap	
	CDWM process: One step elaboration	Option A: Module 8 – Project Management & Roadmap (Joint Elaboration)			
No	Topic	What needs to be done to achieve the topic?	Challeng-es?	Who? (Re-sponsible/ Involved)?	Starts When? Completed by when?
	What are existing circularity measures in place (to reduce CDW in general and high value resources?				
	Is segregation on-site stipulated and being checked?				
	What is the plan for collection and transport of CDW?				
	What is the plan for segregation of CDW at collection points or processing plant?				
	Has the procurement of treatment machinery (up to full plant operations) been done?				
	What are the categories for waste for processing into recycling or re-purposing?				
	Is there a list of recycling products decided as per the waste characterisation of the city?				
	Are there measures in places for disposal of the unusable waste (hazardous and otherwise?)				
	Is there an adequate monitoring and reporting system in place for CDWM?				

MODULE

9

Reflection, Feedback and Outlook

6.1 Integrated Approach of Construction and Demolition Waste Man-agement

Key content:

- Expectation reflection
- Feedback and outlook

Learning goals:

- Assess expectations and identify next steps to implement CDWM in their communities.

The final module of this training deals with an overall reflection of the learning achievements and an assessment of the next steps as a result of the training. This training course aims at providing basic information about the relevance of CDWM in urban agglomerations. The goal is also to enable participants to plan, organise and implement a sustainable CDWM in their respective cities.

Key steps for CDWM procedures and implementation were covered during the previous mod-ules.Modules focused on legal aspects, process management including goals development, best practice examples and lastly roadmap development.

The element of reflection is important to transport new knowledge and content into the day-to-day activities of the participants.

Exercise Module 9:	
Participants are invited to reflect on the past training modules. Feel free to note your thoughts first and then share it with your fellow participants.	
What are the lessons-learned from this training and the site visit?	
Which new insights could be implemented in your daily work routines?	
What and who could help you to monitor future process in setting up a CDWM system?	
Which actors and stakeholders and/ or other ULBs can assist in keeping “on track” for a sustainable CDWM system?	
Which kind of support will be needed in the future?	

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Ministry of Housing and Urban Affairs
Government of India