

## CURRENT STATUS OF CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT IN VIETNAM: CHALLENGES AND OPPORTUNITIES

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**ABSTRACT:** With rapid urbanization and economic growth on all fronts, much construction is conducted everywhere in Vietnam, especially in big cities such as Hanoi, Haiphong, and Ho Chi Minh. All these activities, new construction, renovation, and demolition of buildings and structures, generate huge amounts of waste, called construction and demolition waste (CDW). According to the State of the Environment report of 2011 on solid waste management issued by Ministry of Natural Resources and Environment, the total municipal solid waste generation was about 60 thousand tons/day on average, of which the CDW waste accounts for 10–12% of total solid waste. In order to maximize the potential positive impacts but at the same time to minimize the negative effects of modernization and industrialization in Vietnam, it is necessary to take immediate measures to protect the environment. This paper describes the current condition of CDW management in Vietnam and presents the challenges and opportunities of CDW recycling. The end solution intended will be to propose suitable CDW management and recycling strategies that suit these conditions with proven benefits for all stakeholders.

*Keywords: Construction and demolition waste (CDW), Solid waste management, Recycling, Reuse, Vietnam*

### 1. INTRODUCTION

Vietnam is the easternmost country on the Indochina Peninsula in Southeast Asia. It is bordered by China to the north, Laos to the northwest, Cambodia to the southwest, and the South China Sea to the east. The area of Vietnam is approximately 330,000 km<sup>2</sup> and it is ranked as the 65th largest nation in the world. Currently, the national economy relies heavily on the extraction and use of natural resources. As of July 2016, the population was approximately 91.7 million, making Vietnam the 14<sup>th</sup> most densely inhabited country in the world and 8<sup>th</sup> in the Asian region, which imposes a constant and long-lasting pressure on the country's natural resources.

Huge amounts of construction and demolition waste (CDW) are being generated in big cities in Vietnam such as Hanoi and Ho Chi Minh due to active construction activities including new construction, renovation, and demolition of buildings. It is reported [1] that the total municipal solid waste generation was about 60,000 tons/day on average, in which the CDW waste accounts for 10–12% of total solid waste.

It is important to minimize CDW generation and maximize reuse/recycling because the construction

industry is a consumer of tremendous amounts of natural resources and energy as well as an emitter of greenhouse gases. Establishment of effective strategies and enactment of laws and regulations are essential to achieving this. In addition, provision for some incentives to users of the recycled products seems to be necessary to promote their use. In most developed countries, for example, “Green Procurement” for new construction projects led by governments, i.e., enhancing the use of recycled materials for constructing buildings and infrastructure, have been actively introduced. It is essential to assess the life cycle of CDW as it provides a quantitative tool to assess the environmental impact of CDW reuse/recycling [2]. In the move toward a green or sustainable environment, Vietnam has to benchmark developed nations like Japan and EU countries in handling construction waste issues.

This paper presents the current state of CDW management in Vietnam and describes the challenges and opportunities for sound CDW management and recycling. The end solution intended will be to propose suitable CDW management and recycling strategies suited to these conditions with proven benefits to all stakeholders.

## 2. CURRENT SITUATION OF CDW MANAGEMENT IN VIETNAM

### 2.1 Definition of CDW in Vietnam

The Law on Construction (2014) [3] stipulates that construction contractors are responsible for CDW management. The Law on Environmental Protection (2014) [4] stipulates that CDW shall be collected and treated in an adequate way, and the Decree on Management of Investment Projects on the Construction of Works (2009) [5] stipulates that construction contractors shall transport and dispose of CDW and take it to designated places.

The definition of CDW appeared first in TCVN 6705 Ordinary Solid Waste – Classification in 2009 [6]. In Article 2 of TCVN 6705, CDW (or Construction Solid Waste) is defined as “Waste discarded in dismantling or renovating old construction works, or in the process of construction of new works (house, bridge, road, etc.) such as mortar, broken brick, concrete, ceramic water pipeline, roof, gypsum, and other materials”.

In Article 50 of Decree on Management of Waste and Discarded Materials (2015) [7], the categorization of CDW and its applicable handling methods are described as:

- “Soil, sludge” from excavation, dredging topsoil, and digging foundation piles shall be used to cultivate croplands or suitable land areas;
- “Gravelly soil, solid waste from construction materials (brick, tile, grout, concrete, adhesive materials)” shall be recycled as construction materials or reused as backfill materials for the buildings or buried in construction solid waste landfills;
- “Recyclable solid waste” such as glass, steel, wood, paper, and plastics shall be recycled and reused.

In addition, Article 50 of the Decree on Management of Waste and Discarded Materials (2015) stipulates that the Minister of Construction shall take charge and cooperate with the Minister of Natural Resources and Environment to specify the classification, collection, reuse and recycling, and treatment methods of CDW.

### 2.2 CDW Generation in Vietnam

In Vietnam, more solid waste is being generated in urban areas. As reported by MONRE in 2011 [1], the amount of municipal solid waste generated was about 12.802 million tons in 2008 and estimated to be 22.352 million tons in 2015. CDW is around 10–15% of total solid waste. Approximately 2,200 apartment buildings (about 6 million m<sup>2</sup>) were built in 1970–80, of which approximately 90% are now seriously degraded. In 2007, the Vietnamese

Government issued Resolution 34/2007/NQ-CP [8] on a number of solutions for the amelioration and reconstruction of damaged or degraded condominiums by 2015. Thus, in the coming years, a huge amount of CDW will be discharged in the large cities and urban areas.

CDW generation in some major cities in Vietnam is shown in Fig. 1. Currently, the daily generation of CDW in Hanoi (Fig. 1a) and Ho Chi Minh (Fig. 1b) exceeds 3,000 tons/day. For other large cities such as Hai Phong (Fig. 1c) and Da Nang, the daily generation of CDW becomes more than 500 tons/day.

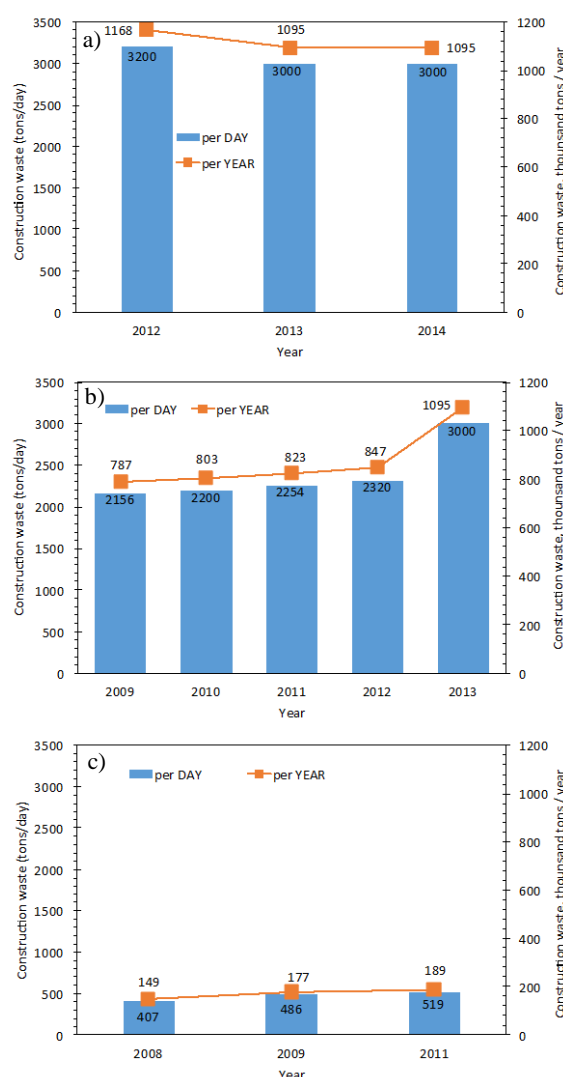


Fig. 1 Current CDW generation in (a) Hanoi, (b) Ho Chi Minh, and (c) Hai Phong (Source: Hanoi URENCO, Ho Chi Minh URENCO and DONRE, and Hai Phong DONRE)

Furthermore, according to the master plan on solid waste disposal in Hanoi [8], the major components of CDW are “Soil, Sand, & Gravel”, “Brick & Building block”, and “Concrete”, and others including metal, plastic, and wood, as shown in Fig. 2.

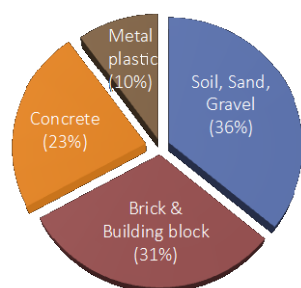


Fig. 2 Typical CDW compositions in Vietnam

### 2.3 Responsible Stakeholders in CDW Management in Vietnam

There are several Ministries directly involved in waste management in Vietnam [9] [10]. The main Ministry responsible for environmental management, monitoring and assessment of solid waste management is MONRE. On the other hand, the prime responsibility on CDW management belongs to the Ministry of Construction (MOC) [7], and MOC will guide the planning of building of solid waste disposal works and reuse of grounds of solid waste disposal facilities and appurtenances after those facilities and works terminate their operation according to Decree on Solid Waste Management (2007) [11]. Article 10 of the Decree also stipulates that MOC shall assume the prime responsibility for organizing the elaboration of regional, inter-provincial or inter-municipal solid waste management planning.

Under the proposal of the JICA Vietnam Waste Project (2014-2018) [12], a new Circular No. 08/2017/TT-BXD on Construction Solid Waste Management was formulated and enacted in 2017 [13]. The new Circular consists of the definition of terms (Chapter I, Article 2), general regulations on CDW management including separation, storage, collection, transportation, reuse and recycling, and disposal (Chapters II & III), and clarifies the responsibility of stakeholders such as generators, treatment owners, investors, provincial people's committee (PCs) of the Department of Construction (DOC) in Chapter IV. The Circular introduces first a system for reporting CDW in Vietnam, i.e., construction companies, treatment companies, and landfill sites report CDW management plans and treatment data to relevant agencies such as PCs and DOC. Furthermore, DOC is to develop and manage a database on CDW management in the provinces/cities and report to the Ministry of Construction annually. The new Circular has just become operative, and it can be expected that responsible stakeholders will face many difficulties due to a lack of experience and technical skills. Technical cooperation with professional experts

and guidelines to support the implementation are highly demanded.

### 2.4 CDW Management in Vietnam

The most common method of CDW treatment at present in Vietnam is indiscriminate dumping, and a mixed waste of concrete, bricks, and soil from construction and demolitions sites are disposed of in landfills. For example, around 40–56% of daily generated CDW is brought to CDW landfills in Hanoi [8]. Typical controlled CDW landfills in Hanoi are shown in Fig. 3. On the other hand, most marketable materials, such as steel, metals, wood, and plastics, are separated on site and sold to recyclers.

Except for collected CDW sent to controlled CDW landfills and marketable materials, other generated CDW is liable to be dumped illegally. The reduction of illegal dumping of CDW is a big challenge to every stakeholder involved, and effective countermeasures to suppress the illegal dumping of CDW in Vietnam are necessary. CDW has great value in reuse and recycling, but recycling of CDW is not yet fully developed in Vietnam.



(a) Van Noi landfill in Dong Anh District



(b) Vinh Quynh landfill in Thanh Tri District

Fig. 3 Typical controlled CDW landfills in Hanoi

There are several problems caused by insufficient CDW management in Vietnam. Major problems are 1) illegal dumping, 2) hazardous waste, and 3) depletion of natural resources.

### 1) Illegal dumping

The illegal dumping of CDW can cause risks to human health and environment, including transportation obstacles (i.e., CDW on roadsides and pavements) leading to accidents, impact on the urban landscape, air pollution (due to dust), soil and groundwater contamination, degraded infrastructure (i.e., blocking sewers and canals), and waste of land. Especially, the illegal dumping of CDW on streets causes countless accidents. The dumped CDW in the canals damages the urban drainage system, becoming a factor in flooding under heavy rainfall.



(a) Dumped CDW on the roadside



(b) Dumped CDW on drainage canal [12]

Fig. 4 Illegal dumping of CDW in Hanoi

### 2) Hazardous waste

At most demolition sites, only marketable materials are sorted. Hazardous materials are not separated at sources but dumped illegally together with other CDW. The improper management of hazardous materials like asbestos, waste containing coal tar, and mercury increases the potential risk to human health. The issue of illegal dumping of hazardous waste is mainly due to the cost and lack of treatment facilities.



Fig. 5 Illegal dumping of hazardous waste [12]

### 3) Depletion of natural resources

Major components of CDW such as soil, bricks, and concrete can be recycled and reused after proper treatment and management and can be utilized for other construction sites. The use of recycled materials contributes directly to saving natural resources, e.g., natural/virgin soil for producing clay bricks, and natural/virgin gravel and aggregates for roadbed materials and concrete manufacturing. In addition, the recycling of CDW contributes to the reduction of landfill space at CDW landfill sites.

## 3. CHALLENGES AND OPPORTUNITIES FOR SOUND CDW MANAGEMENT AND RECYCLING IN VIETNAM

### 3.1 National Strategies for Promoting Sound CDW Management and Recycling in Vietnam

In the past two decades, the Vietnam Government has put in place a sound legal framework for environmental protection that addresses guidelines for the management and disposal of all waste streams [9]. This framework is supported by many national strategies and directives that apply to solid waste management. Typical strategies are:

- i) Strategy for the Management of Solid Waste in Vietnam Cities and Industrial Parks (1999) [14]
- ii) National Strategy on Environmental Protection up to the year 2010 and Vision to 2020. (2003) [15].
- iii) Directive No. 23/2005/CT-TTg on Enhancing the Management of Solid Wastes in Urban Centres and Industrial Parks (2005) [16]
- iv) National Strategy for Integrated Management of Solid Waste up to 2025 and Vision towards 2050 (2009) [17].
- v) National Strategy on Environmental Protection up to the Year 2020 and Vision to 2030 (2012) [18].

In the National Strategy for solid waste management [17], it is expected that by 2050, all kinds of solid waste will be collected, reused, recycled and comprehensively treated by advanced, environmentally-friendly technologies, suitable to each locality, thereby limiting the amount of solid waste that needs to be landfilled (Table 3).

Together with national strategies, there have been relevant laws and policy documents such as decrees, circulars, joint circular and technical standards that have been issued to support:

[Laws]

- i) Law on Construction (2014) [3]
- ii) Law on Environmental Protection (2014) [4].
- iii) Law on Urban Planning (2009) [19]
- iv) Law on Public Investment (2014) [20]

[Decrees]

- i) Decree on Solid Waste Management (2007) [11].
- ii) Decree on Management of Investment Projects on the Construction of Works (2009) [5]
- iii) Decree on Management of Waste and Discarded Materials (2015) [7]
- iv) Decree on Construction Project Management (2015) [21]

[Circulars]

- i) Circular on Promulgating the Regulations of Environmental Protection Applied for the Construction Sector (1999) [22].
- ii) Circular on Guiding the Elaboration of Reports on the Assessment of Environmental Impacts for Construction Planning Projects (2000) [23]
- iii) Circular on Guiding the Strategic Environmental Assessment in Construction and Urban Plans (2011) [24]
- iv) Circular on Regulation on Construction Solid Waste Management (2017) [13]
- v) Joint Circular on Guiding the Regulations on Environmental Protection for the Selection of Location for, the Construction and Operation of, Solid Waste Burial Sites (2001) [25].

[TCVN]

- i) TCVN 6705: Ordinary Solid Waste – Classification (2009) [6]
- ii) TCVN 6706: Hazardous Solid Waste – Classification (2009) [26]
- iii) TCVN 6707: Prevention and Warning Signs for Hazardous Waste (2009) [27]
- iv) TCVN 6696: Requirements for Environmental Protection for Sanitary Landfills (2009) [28]

The importance of research and development for the disposal and recycling of waste is especially emphasized in the newly revised Law on Environment Protection (2014) [4]: Article 6.6 encourages builders to “conduct scientific research on technology transfer, and apply the technology for the disposal and recycling of wastes and environment-friendly technologies”. Along with the National Strategy for solid waste management [17], the Prime Minister-issued Decision No.

609/QĐ-TTg approving the planning for treatment of solid wastes in the capital Hanoi to 2030, with a vision for 2050 [8], in which the city will be divided into three zones for solid waste collection and treatment.

Despite several national strategies and decisions, detailed technical instructions for promoting treatment and recycling of CDW are not fully available in Vietnam. Besides, necessary standards and criteria for recycled materials from CDW and guidelines on the use of recycling materials (e.g., roadbed materials, concrete aggregate) have not yet been fully regulated in Vietnam (Fig. 6).

Table 3 National strategy for management of solid waste up to the year 2025 [17]

Targets	2020	2025
The ratio of cities that have solid waste recycling system (%)	70	100
% Reduction of plastic bags compared to 2010	65	85
% Collection / % Recycled	Urban house SW	90/85 /90
	Construction and Demolition Waste	80/50 90/60
	Urban sludge	50/30 100 /50
	Non-hazardous Industrial SW	90/75 100 /100
	Hazardous Industrial SW	70/0 100/0



Fig. 6 Material recycled for land reclamation. Crushed brick and concrete are utilized as is (no quality control).

### 3.2 Challenges and Opportunities for Sound CDW Management and Recycling in Vietnam

Right now, like other developing countries in Asia, Vietnam is facing a shortage of laws and enforcement in CDW management, as mentioned above. The priority in current solid waste management is for organic waste management and hazardous waste management (health waste and hazardous industrial waste). CDW, which is a non-hazardous solid waste, is considered mostly on the

research scale, and no big investment has been made so far. At present, a priority policy or investment policy for research, manufacture, and business investment in the recycling and management of CDW has not been promulgated. The recycle policy is only mentioned for general solid waste management in National Strategy on Environmental Protection up to the year 2020 and Vision to 2030 as approved by Decision No.2149/QĐ-TTg in 2009 [17]. In this legal document, one of the big tasks is to increase the reuse and recycling of solid waste by increasingly reusing solid waste, building and developing the waste market and economy, developing the recycling industry, promoting the purchase of recycled products, elaborating and applying incentive policies for recycling activities, and forming recycling funds.

Furthermore, at present, public awareness of and attitudes towards the waste generated from construction and demolition sites is limited. This must be changed, at first possibly in the industrial practice. It is required to sensitize not only engineers but all stakeholders, including regulatory authorities in the construction industry. This also requires a full understanding of the reuse potential of CDW and existing practices in implementation and enforcement for achieving the objectives of the national strategy.

Till now, many donor-oriented projects have been done in Vietnam to support solid waste management. Among them, the Japan International Cooperation Agency (JICA) is one of the leading donors and has carried out following projects on solid waste management:

- i) 2006-2009: 3R Initiative Project in Hanoi City.
- ii) 2005-2013: Haiphong Environmental Improvement Project.
- iii) 2014-2018: Project for Capacity Development on Integrated Management of Municipal Solid Waste.

In addition, some solid waste management and promotion of recycling projects have been done under the support of Ministry of Environment in Japan (e.g., Ichikawa Kankyo Engineering CDM Project on SW Composting in 2009, Ichikawa Kankyo Engineering D-Waste Recycling Project in 2014).

Several projects have also been conducted in related Vietnamese Ministries. However, most of these projects on the recycling of CDW were mainly on the research scale.

- i) "Investment of CDW recycle line to produce construction materials project" by the Ministry of Construction in 2010-2012.
- ii) "Treatment and recycling of solid waste in the construction of road infrastructure project by the Ministry of Transportation in 2010-2014.

- iii) "Investigation of the management system of CDW in urban areas" by Vietnam Urban Environment and Industrial Zone Association in 2008-2010.

In 2018, a new cooperative project between Vietnam and Japan institutional links began called "*Establishment of Environmentally Sound Management of Construction and Demolition Waste and Its Wise Utilization for Environmental Pollution Control and for New Recycled Construction Materials in Vietnam*" (the so-called JST-JICA SATREPS project) [29]. The project proposes promoting the recycling of CDW in Vietnam and aims 1) to establish guidelines necessary for environmentally sound CDW management, 2) to develop quality standards for recycled materials produced from CDW, 3) to develop new technologies utilizing recycled materials produced from CDW, and 4) to propose strategic business models designed to promote CDW recycling in Vietnam and examine their effectiveness and feasibility through on-site pilot projects. The final goal of this project is to contribute to the achievement of a CDW recycling rate of 60%, which meets the Vietnam national strategy for management of solid waste up to the year 2025, through the application of developed technologies and business models to a practical recycling business.

In Vietnam, the biggest problem with current research and development (R&D) projects is their limited application. R&D manufacture lines often stopped when the project was finished because the input material and output were not sustainable. Based on the past lessons and experiences, effective R&D activities that fully consider practical applications are highly needed to develop sustainable and environmentally sound CDW in Vietnam.

#### 4. CONCLUSIONS

Taking all facts presented here into account, it is obvious that CDW management and recycling is one of the most critical engineering issues that need immediate intervention in Vietnam. Though there have been some initiatives in the past to address this issue, none has been successful, mainly due to the multiplicity of the problem. Therefore, a more holistic approach addressing all technical, social, institutional, and economic issues is vital to achieving a sustainable solution.

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