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Waste Reduction in the Demolition of Concrete Structures in Highly Urbanised Cities and Its Management

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Abstract
This research focuses on strategic planning for efficient waste reduction during the demolition of concrete structures in densely populated cities and its control. It's estimated that demolition and construction account for a good percentage of all waste in the world. When it comes to demolition, it's important to think about ways to reduce, reuse, and recycle as much as possible. It's not often that an opportunity comes along to make an impactful change in how we do things. But when it comes to demolition, there's room for improvement. In this paper, we'll discuss the importance of strategic planning in demolition waste reduction and provide a brief approach. Highly Urbanised Cities have been on the rise all over the world. What used to be small towns and villages have turned into bustling metropolitan areas with populations in the millions [BigRentz, 2021]. Due to this increase in population, the demand for new structures and housing has also gone up. As a result, more and more concrete structures are being built daily. But what happens when it's time for these structures to be demolished? In this paper, we will discuss strategic planning for effective waste reduction in the demolition of concrete structures in highly urbanised cities and its management.

Key Words*:* strategic planning, demolition, highly urbanised cities, and recycling

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1. Introduction

The strategic planning approach for effective waste reduction in the demolition of concrete structures in highly urbanised cities is a new approach that has been developed in response to the increasing global concern about the environmental impact of demolition waste. The approach uses a strategic planning framework that can be applied to any demolition project to reduce waste and improve environmental performance throughout the project's life cycle. This approach can identify and implement strategic actions to reduce waste at each stage from early project conception through demolition, rehabilitation, and redevelopment. The strategic planning approach will have applications across multiple sectors, including commercial building demolition, civil infrastructure demolition, and industrial redevelopment projects.

2. Literature Review

2.1 The Need for Strategic Planning in Demolition Projects

When it comes to demolition, most people think of tearing things down. However, demolition is more than just wrecking balling your way to success. It's a complex process that requires careful planning and execution to ensure that the project is completed safely and efficiently [Pinnegar et al., 2015]. One of the most important aspects of demolition is waste reduction.

Many cities now require demolition contractors to submit waste reduction plans as part of their bid proposals. This is because municipalities realise the importance of minimising the amount of debris in landfills. But how can you make the most of demolition waste reduction? Implementing a strategic plan focusing on efficiency and safety [Xanthopoulos et al., 2012].

When you think about demolition, what comes to mind is the wrecking ball smashing through a building and the screech of metal against metal as the structure is torn apart. It's a dramatic process and one that creates a lot of waste. In fact, demolition is one of the largest sources of waste in the world. According to the EPA, the total generation of this waste in 2018 was 292.4 million tons in the United States [2018]. That's a lot of concrete, metal, plastics, and other materials going into landfills yearly. But it doesn't have to be that way. There are steps that demolition contractors can take to reduce the amount of waste created during a project. And by planning and thinking strategically, they can ensure that even the smallest demolition project leaves an as little environmental impact as possible.

Managing waste in demolition projects can be a daunting task. However, careful planning and execution can be done effectively and efficiently [Alwan et al., 2017]. One of the first steps is to develop a waste management plan. This plan should include details on how waste will be collected, sorted, and disposed of. Identifying and contacting potential waste management partners early in the process is also important. It's also important to select the right team for the job. The demolition team should be knowledgeable about and compliant with local and federal regulations governing waste management [Ferronato & Torretta, 2019]. They should also be able to properly collect, sort, and dispose of all types of demolition debris. When it comes to demolition, waste can be a huge issue [EPA, 2018]. Not only is it an eyesore, but it can also be dangerous and harmful to the environment. That's why strategic planning is essential for any demolition project - it helps ensure that waste is minimised as much as possible.

2.2 The Process of Demolition of Concrete Structures in Highly Urbanised Cities

The process of demolition of concrete structures in highly urbanised cities is a complex one that requires careful planning and execution. The first step is to identify the structures that need to be demolished. This can be done through a survey or by looking at aerial photographs of the area. Once the structures have been identified, the next step is to devise a demolition plan. This plan will consider the safety of the workers and the public, as well as the environmental impact of the demolition. The demolition will only be completed once all the necessary permits have been obtained [Ferronato & Torretta, 2019]. The demolition team will then proceed to carefully take down the structure, ensuring not to damage any adjacent buildings or infrastructure. The debris from the demolition will then be cleared and disposed of safely and promptly.

It is no secret that the world's population is increasingly shifting towards urban areas. In fact, over half of the world's population now resides in cities, and that number is only expected to grow in the years to come. As a result, housing, office spaces, and other infrastructure demand continue to rise [United Nations, 2018]. Unfortunately, this also puts a tremendous amount of stress on existing urban infrastructure, especially concrete structures. These structures are often not designed to handle the loads and stresses associated with high-density use, and as a result,

they often buckle, crack, and even collapse. This poses a serious safety threat to the people who live and work in these cities, not to mention the huge financial burden it places on society [EPA, 2018]. For this reason, it is often necessary to demolish concrete structures in highly urbanised areas. One of the most obvious benefits is that it opens up space for new development. Demolition also allows for the redevelopment of old and outdated structures, improving a city's overall look and feel [Awad, 2020]. Additionally, it can help reduce traffic congestion and improve air quality.

Demolition is a necessary step in the redevelopment process, and it's crucial to have a solid plan in place for how to handle the aftermath. With the right team in place, demolition can be a safe and successful process for everyone involved. Several methods can be used to demolish concrete structures in highly urbanised cities. The most common methods are hydraulic demolition, explosive demolition, and mechanical demolition [Awad, 2020]. Hydraulic demolition is the process of using high-pressure water to break up and demolish a structure. This method is often used for smaller structures, such as bridges and piers. Explosive demolition is the process of using explosives to demolish a structure. This method is often used for larger structures, such as buildings and dams. Mechanical demolition is the process of using machines to demolish a structure. This method is often used for larger structures, such as buildings and dams.

It is important to remember that the demolition of concrete structures in highly urbanised cities is a process that should be done with caution. While it offers several advantages, it can also lead to a number of problems if not done properly. The key to ensuring a successful demolition project is planning and clearly understanding what needs to be done [Gudienė et al., 2013]. With the right planning and execution, demolition can be a safe and efficient way to remove concrete structures from your city.

2.3 The Strategic Planning Approach to Demolition

2.3.0 The Approach

There is no one-size-fits-all answer regarding the demolition of concrete structures in highly urbanised cities. Every city presents unique challenges, and the most effective approach for each situation will vary. That being said, a few key principles always apply. Proper planning and preparation are essential, and the safety of workers and the public must always be the top priority. With the right approach, demolishing concrete structures can be a safe and efficient process that helps make cities more liveable and prosperous. Xanthopoulos et al. [2012] present that the strategic planning approach to demolition is a new way of thinking about the process of tearing down a building. Traditionally, the approach to demolition has been to bring in a wrecking ball and start smashing away simply. However, this method can be very destructive and often damage neighbouring buildings and premature wear and tear on the demolition crew. The strategic planning approach focuses on taking a more careful, methodical approach to demolition [Higashi & Isobe, 2017]. Planning and setting specific goals for the demolition project makes it possible to achieve them while minimising the amount of damage caused.

There are several ways to demolish a concrete structure. Wrecking balls are slow and can take hours or even days to bring down a large structure [Fountain, 2013]. Explosives can be dangerous and unpredictable and, depending on the surrounding buildings, can cause collateral damage. Hydraulic shears are efficient but often require heavy equipment, which can be expensive and difficult to manoeuver in a city setting [Fountain, 2013]. The strategic planning approach to demolition is a new method that addresses the drawbacks of traditional methods. It involves creating a detailed demolition plan that considers the surrounding buildings, traffic patterns, and other factors that could affect the demolition process. This approach is safe, efficient, and minimises the amount of collateral damage. The benefits of the strategic planning approach are many and varied [Alwan et al., 2017].

2.3.1 How Can This Approach Be Implemented in Highly Urbanised Cities?

Highly urbanised cities present a unique set of challenges when demolishing concrete structures. The proximity of buildings and other infrastructure often means that traditional demolition methods are not feasible and can even lead to dangerous situations [United Nations, 2018]. The strategic planning approach offers a new way to demolish concrete structures safely and efficiently. It involves careful planning and executing a demolition project, focusing on minimising disruption and inconvenience to the surrounding area.

This approach can be implemented in highly urbanised cities by working with local authorities and stakeholders to create a coordinated plan that addresses the area's specific needs. There are a few examples of successful implementations of this approach. One example is the demolition of buildings in Toronto. In this case, the planners took into account the surrounding buildings and factored them into the demolition plan [Swann, 2020]. This ensured that the demolition would not cause any collateral damage. Taking these extra precautions ensured that both buildings were safely and efficiently demolished.

2.3.2 Challenges That Need to Be Considered When Using This Approach

A demolition project can be daunting, but it can be much easier and more efficient when strategic planning approaches. Several challenges need to be considered when using this approach. The most important is ensuring that the correct permits are obtained before demolition. Another challenge is working with the surrounding community and ensuring that the project does not cause inconvenience or disruption. Finally, planning the project carefully and meticulously is important to avoid surprises or delays. By taking these challenges into account, you can ensure that your demolition project goes as smoothly as possible.

2.4 Management of the Materials

2.4.0 What Materials Are Recovered From the Demolition of Concrete Structures?

When a structure is demolished, a number of materials are recovered for recycling. Concrete is the most common material recovered from demolition, as it is used in most structures. Steel, aluminium, and timber frames are commonly recovered, as are bricks, sanitary ware, and flooring. These materials can all be recycled using different processes. Concrete can be

recycled into new concrete products, steel can be melted down and reused, aluminium can be recycled into new cans or products, and timber can be turned into new timber products.

Recycling these materials instead of sending them to landfills saves resources and helps reduce greenhouse gas emissions [EPA, 2018]. It is important to properly manage these materials so that they can be recycled and not wasted. There are a few ways to do this. First, the material should be segregated according to type. Concrete, timber, aluminium, steel frames, bricks, sanitary ware, and flooring should be separated. Second, the material should be cleaned and dried before recycling. This will help ensure that the recycled material is of the same quality as the original material. Finally, the recycler must be aware of what type of material is being recycled. Not all recyclers can recycle all types of materials.

2.4.1 What Are the Alternatives to Recycling These Materials?

You can recycle a variety of materials from demolition projects. Here are a few of the most common types:

Steel: Steel frames can be recycled and used to create historical structures.

Aluminium: Aluminium can be recycled and used in various ways, including building new products or repairing old ones.

Concrete: Concrete can be recycled and used to create new structures or paved areas.

Wood: Wood can be recycled and used to create new furniture, flooring, or other household items.

Let’s take a look at some real-world examples of how demolition can be used to improve your community. In India, there is a growing trend of demolishing old, colonial-era buildings and replacing them with new, modern structures. While this may be a necessary step for economic development, it often comes at the expense of historical landmarks and architecture. Fortunately, there are ways to reuse these old materials instead of simply throwing them away. Steel and aluminium frames can be melted down and used to create new structural components, while bricks and mortar can be recycled and used in new construction projects. By using demolition this way, India can preserve its heritage while building a brighter future for its citizens.

3. Methodology

The study sought to answer the following questions:

What is the preferred strategy for demolishing concrete structures in highly urbanised cities?

What are the benefits and limitations of the preferred strategy?

What are the possible strategies that can be adopted for the demolition of concrete structures in highly urbanised cities?

The study adopted a descriptive research design. Data were collected from both primary and secondary sources. The primary data were collected through a questionnaire survey distributed to experts in the field of demolition. A total of 101 questionnaires were distributed, and 62 were returned, yielding a response rate of 61%. The secondary data were collected from textbooks, journals, internet sources, and other published reports.

The construction and demolition waste generation rate in Indian cities has been quantified using a bottom-up material flow analysis. We collected secondary literature on demolition projects and construction activities in Indian cities to calculate C&DW generation rates. The results show that over 150 million tonnes of C&DW were generated in urban areas in India in 2016; nearly half of that waste was generated in small to medium towns.

4. Results

The study found that implosion is the preferred strategy for demolishing concrete structures in highly urbanised cities. The benefits of implosion include time savings, reduced noise and vibration levels, reduced environmental impact, and increased safety [Prakash, 2014]. The limitations of implosion include cost and lack of expertise. Possible strategies for demolishing concrete structures in highly urbanised cities include implosion, excavation, cutting, and wrecking ball.

The study also found that there are many benefits to strategic demolition planning. Perhaps the most significant benefit is that a strategic demolition plan can save money. Everyone can save time and money when all stakeholders are on board and working towards a common goal. In addition, a strategic demolition plan can help minimise environmental impact [Hussain et al., 2022]. By coordinating the demolition process, waste can be minimised, and the negative effects on the environment can be reduced. Finally, a strategic demolition plan can help ensure public safety. By planning and coordinating with relevant agencies, stakeholders can minimise the risks associated with demolishing a concrete structure.

Waste management in Indian Demolition Projects has become very important in recent times. It is estimated that nearly half of all Indian demolition projects produce C&D waste. India is not recycling more than 1% of its C&D waste. This is a shockingly low rate for a country that produces about 150 million tonnes of construction waste yearly. The government of India has advised construction and demolition agencies to install on-site recycling units for redevelopment projects. This recycling unit was installed in the Kidwai Nagar redevelopment project, which involved the demolition of 2500 residential buildings and the redevelopment of a new city. This project recycled the demolition waste into bricks, reducing transportation costs and the need for natural resources.

5. Discussion

5.0 Key Recommendations

The study provides the following key recommendations for the demolition of concrete structures in highly urbanised cities:

Review and revise the existing guidelines and regulations on the demolition of concrete structures

Adopt a strategic planning approach to the demolition of concrete structures

Establish a system for monitoring and regulating demolition contractors.

Develop a training program for demolition personnel.

5.1 Waste Management in Indian Demolition Projects

Although India has a large population, its population density and growth make the size of its C&DW generation highly disproportionate to the size of its urban population. Cities in mega and town-class cities generate around 5000 tonnes of C&DW per year, which is equivalent to 22 tonnes per day. Hence, cities in these classes account for nearly half of urban C&DW generation. In addition, waste generated in mega and town-class cities is significantly larger than in the corresponding cities in urban India. The following is a good strategic planning approach model that could be used in India [Tezeswi & MVN, 2022]. It is based on the theory of planned behavior.

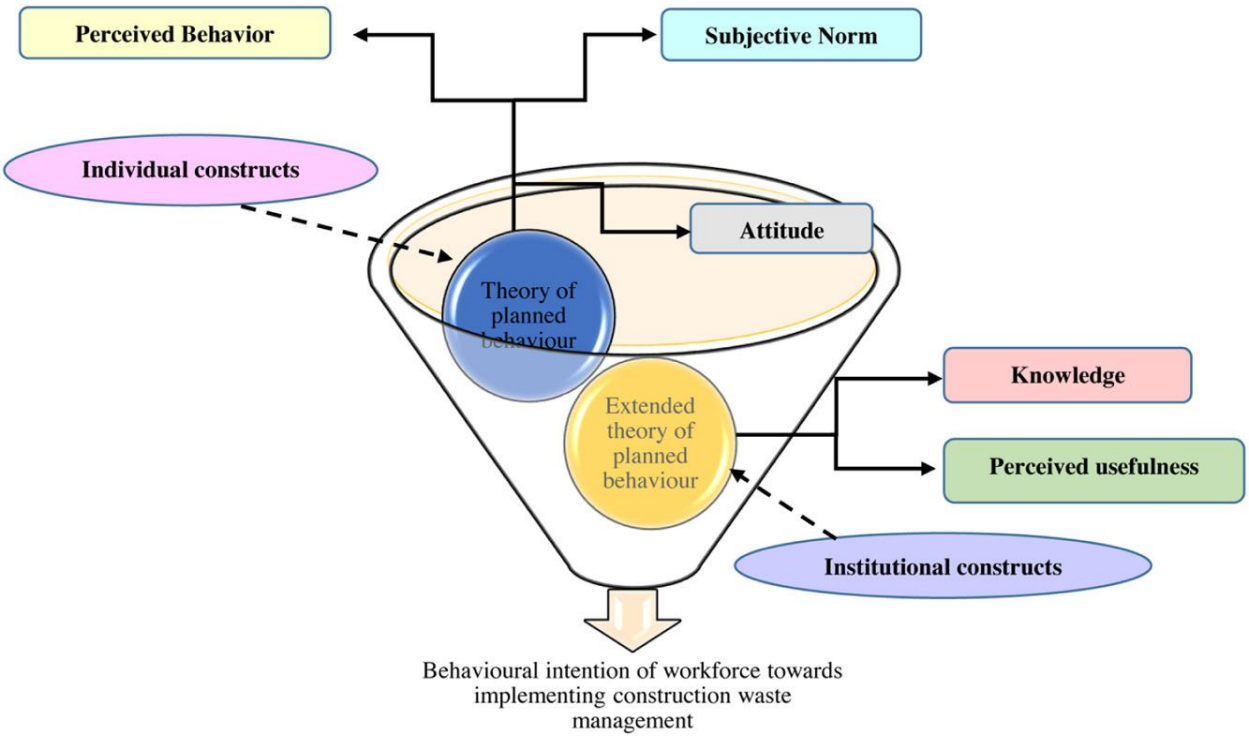

Figure 2. A strategic planning approach based on the theory of planned behaviour.

The strategic planning approach shown in Figure 2 to demolition is the most effective way to demolish a concrete structure [Gálvez-Martos et al., 2018]. Many steps are taken in order to make sure that the demolition is successful. The first step is to develop a plan. This plan should include the reason for the demolition, the steps that will be taken, and the people who will be responsible for each step. Once the plan is developed, it should be approved by all necessary parties. The next step is to secure the site. This means putting up fences and signs to keep people out of the area and ensuring that all necessary permits are in place. The next step is to

prepare the site. This includes removing any hazardous materials, such as asbestos, and demolishing any structures that are in the way. The final step is to demolish the structure. This involves using the right equipment and taking care not to damage any surrounding structures.

6. Conclusion

There are many reasons why concrete structures should be demolished using a strategic planning approach. Taking the time to develop a plan allows all aspects of the demolition process to be considered. This helps ensure that the demolition is carried out safely and efficiently, with minimal disruption to the surrounding area. In highly urbanised areas, demolition is an essential component of waste management. It is critical to properly plan and execute a demolition in order to reduce the amount of waste produced. There are a variety of factors to consider when planning a demolition, including the type of structure being demolished, the materials used in the structure, and the surrounding environment. By planning strategically, contractors can reduce the amount of waste produced by as much as 90%. Waste management is an important part of any construction project, and it is crucial to be mindful of the amount of waste produced. With careful planning, contractors can minimise the impact of demolition on the environment and ensure that the waste produced is properly handled and disposed of.

References

1. Alwan, Z., Jones, P., & Holgate, P. (2017). Strategic sustainable development in the UK construction industry, through the framework for Strategic Sustainable Development, using building information modelling. *Journal of Cleaner Production*, *140*, 349–358. https://doi.org/10.1016/j.jclepro.2015.12.085
2. Awad, A. (2020). Guidelines for Civil Structures Demolition Method selection to enhance environmental protection. *International Journal of Emerging Trends in Engineering Research*, *8*(2), 307–313. https://doi.org/10.30534/ijeter/2020/11822020
3. BigRentz. (2021, April 12). *23 Construction Waste Statistics & Tips to Reduce Landfill Debris*. BigRentz. Retrieved June 27, 2022, from https://www.bigrentz.com/blog/construction-waste-statistics
4. EPA. (2018). *National Overview: Facts and Figures on Materials, Wastes, and Recycling*. EPA. Retrieved June 27, 2022, from https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials
5. Ferronato, N., & Torretta, V. (2019). Waste mismanagement in developing countries: A Review of Global Issues. *International Journal of Environmental Research and Public Health*, *16*(6), 1060. https://doi.org/10.3390/ijerph16061060
6. Nouby M. Ghazaly, A. H. H. . (2022). A Review of Using Natural Gas in Internal Combustion Engines. International Journal on Recent Technologies in Mechanical and Electrical Engineering, 9(2), 07–12. https://doi.org/10.17762/ijrmee.v9i2.365
7. Fountain, H. (2013, June 17). *Tricky ways to pull down a skyscraper*. The New York Times. Retrieved June 27, 2022, from https://www.nytimes.com/2013/06/18/science/tricky-ways-to-pull-down-a-skyscraper.html

8. Gudienė, N., Banaitis, A., Banaitienė, N., & Lopes, J. (2013). Development of a conceptual, critical success factors model for construction projects: A case of Lithuania. *Procedia Engineering*, *57*, 392–397. https://doi.org/10.1016/j.proeng.2013.04.051
9. Gálvez-Martos, J.-L., Styles, D., Schoenberger, H., & Zeschmar-Lahl, B. (2018). Construction and demolition waste best management practice in Europe. *Resources, Conservation and Recycling*, *136*, 166–178. https://doi.org/10.1016/j.resconrec.2018.04.016
10. Higashi, K., & Isobe, D. (2017). Study on blast demolition planning of buildings for improving efficiency of demolition and safety during demolition. *The Proceedings of The Computational Mechanics Conference*, *2017.30*, 061. https://doi.org/10.1299/jsmecmd.2017.30.061
11. Kadhim, R. R., and M. Y. Kamil. "Evaluation of Machine Learning Models for Breast Cancer Diagnosis Via Histogram of Oriented Gradients Method and Histopathology Images". International Journal on Recent and Innovation Trends in Computing and Communication, vol. 10, no. 4, Apr. 2022, pp. 36-42, doi:10.17762/ijritcc.v10i4.5532.
12. Hussain, C. M., Paulraj, M. S., & Nuzhat, S. (2022). Source reduction and waste minimization in construction industry. *Source Reduction and Waste Minimization*, 111–126. https://doi.org/10.1016/b978-0-12-824320-6.00005-8
13. V. N. Patil and D. R. Ingle, "A Novel Approach for ABO Blood Group Prediction using Fingerprint through Optimized Convolutional Neural Network", Int J Intell Syst Appl Eng, vol. 10, no. 1, pp. 60–68, Mar. 2022.
14. Pinnegar, S., Randolph, B., & Freestone, R. (2015). Incremental urbanism: Characteristics and implications of residential renewal through owner-driven demolition and rebuilding. *Town Planning Review*, *86*(3), 279–301. https://doi.org/10.3828/tpr.2015.18
15. Prakash, S. (2014). *Methods of demolition of building structures*. Civil Engineering News. Retrieved June 27, 2022, from https://www.civilengineeringnews.tk/2014/07/methods-of-demolition-of-building.html
16. Swann, A. (2020, December 11). *Toronto's historic buildings are being demolished for condos*. NUVO. Retrieved June 27, 2022, from https://nuvomagazine.com/affairs/torontos-historic-buildings-are-being-demolished-for-condos
17. Tezeswi, T. P., & MVN, S. K. (2022). Implementing construction waste management in India: An extended theory of planned behavior approach. *Environmental Technology & Innovation*, *27*, 102401.
18. United Nations. (2018, May 16). *68% of the world population projected to live in urban areas by 2050, says un | UN Desa Department of Economic and Social Affairs*. United Nations. Retrieved June 27, 2022, from https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html
19. Gupta, D. J. . (2022). A Study on Various Cloud Computing Technologies, Implementation Process, Categories and Application Use in Organisation. International Journal on Future Revolution in Computer Science &Amp; Communication Engineering, 8(1), 09–12. https://doi.org/10.17762/ijfrcsce.v8i1.2064

20. Xanthopoulos, A., Aidonis, D., Vlachos, D., & Iakovou, E. (2012). A planning optimisation framework for construction and Demolition Waste Management. *International Journal of Industrial and Systems Engineering*, *10*(3), 257. https://doi.org/10.1504/ijise.2012.045675
21. Agarwal, A. . (2022). Symmetric, e-Projective Topoi of Non-Solvable, Trivially Fourier Random Variables and Selberg's Conjecture. International Journal on Recent Trends in Life Science and Mathematics, 9(1), 01–10. https://doi.org/10.17762/ijlsm.v9i1.136