Economic assessment of building demolition methods in Hanoi, Vietnam

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INTRODUCTION

Construction and demolition waste (CDW) has attracted growing attention in developed and developing countries alike. In Vietnam, it is estimated that roughly 0.57 tons of CDW were generated per capita in 2014; more than 80% of which were from demolition activities (Hoang et al., 2020). Two demolition approaches frequently applied there are manual demolition and hybrid demolition. In manual demolition, only human labor and light machinery are employed; whereas, in the hybrid demolition, heavy machinery is used to pull down building structures after interior parts are dissembled by demolition workers using light equipment. The reuse/recycling rate observed in demotion sites in Hanoi was as low as 10% (Hoang et al., 2020). This situation raises a need for more sustainable demolition practices such as selective demolition, which dismantles the whole buildings, by either manual labor or heavy equipment, in a systematic and thorough manner to maximize the amounts of materials reused/recycled. Even though there is an increasing number of studies on CDW in Vietnam, none of them provided comprehensive evaluations of demolition practices. This study fills this gap by scrutinizing characteristics of the two demolition techniques, i.e., manual and hybrid demolition in Hanoi, Vietnam to identify their possibilities and potential obstacles to be converted into the selective demolition approach. This study focuses on residential buildings with the Reinforced Concrete (RC) structure given its prevalence in Hanoi, Vietnam.

MATERIALS AND METHODS

Two demolition sites were selected as case studies. Site observations and interviews were conducted to identify workflow, equipment, labor, time scale and unit (technical aspects); cost breakdown (economic aspect); and waste generation amounts, reuse/recycling rates (environmental aspects).

RESULTS AND DISCUSSION

Table 1 indicates the process of building demolition in the two observed sites in Hanoi in comparison with the selective demolition procedure described in previous studies (Lund & Yost, 1997). Whilst the demolition process can be generally divided into three main stages, namely, interior removal, building structure removal, and site clearance, detailed activities vary according to the demolition approach. Both observed sites in Hanoi did not implement abatement measures for hazardous wastes even though corrugated asbestos-cement shingles were found. Rather than based on environmental concerns, the selection of interior components to be dismantled and sorted was driven merely by potential economic values. Once the interior components were considered economically unappealing, they were smashed during the structure demolition stage, contributing to a mixture of wastes generated. Even though on-site segregation after demolition was observed, this was only for collecting metals, which have high market values.

Table 1 Demolition techniques and duration

	Activity	Productivity (man h/unit)		
		Manual demolition	**Hybrid demolition**	**Selective demolition***
Interior removal	Asbestos/hazardous waste abatement	-	-	0.41/m^2
	Remove carpets	0.041/m^2	-	0.41/m^2
	Remove kitchen appliances and fixtures	-	0.33/each	0.41/each
	Remove bathroom fixtures, taps, and toilet fixtures	-	0.29/each	0.59/each
	Remove plaster	-	-	0.11/m^2
	Remove doors and windows	0.56/each	2.4/each	0.54/each
	Remove handrails	0.20/m^2	0.38/m^2	0.3/m^2
	Remove insulation, wiring, and plumbing pipes	-	-	0.016/kg
	Remove tiles	-	-	0.41/m^2
	Remove ceiling joists	0.61/m^2	0.89/m^2	0.29/m^2
Building structure removal	Remove balconies	0.50/m^2	0.39/m^2	0.15/m^2
	Remove roof	0.37/m^2	0.42/m^2	0.21/m^2
	Remove walls	0.29/m^2	0.043/m^2	0.54/m^2
	Remove stairs	0.89/m^2	0.11/m^2	0.30/m^2
	Remove floors	0.21/m^2	0.11/m^2	0.25/m^2
	Remove beams and columns	1.2/m^2	0.11/m^2	0.72/m^2
Site clearance	Separate dismantled materials	0.87/m^2	0.10/m^2	0.033/m^2
	Collect valuable items	0.28/m^2	0.10/m^2	-

**Note: Lund & Yost (1997)*

The duration of manual demolition was about quadruple that of the hybrid demolition (Figure 1). This extended timeframe of manual demolition, however, did not translate into the higher salvage value often attained, due to greater possibilities of material segregation, in selective demolition (Lund & Yost, 1997). The manual demolition (20.78 \$/ton) was about two times as expensive as the hybrid demolition (9.37 \$/ton), whereas the value collected from reused/recycled materials of the former (1.46 \$/ton) was less than half of the latter (4.24 \$/ton). This can be explained by the fact that although materials were decommissioned separately, they were mixed during the waste moving process owing to little attention paid to on-site sorting. In both sites, the reuse/recycling rates were less than 5%, much lower than 82%, the average reuse/recycling rate obtained in selective demolition (Lund & Yost, 1997).

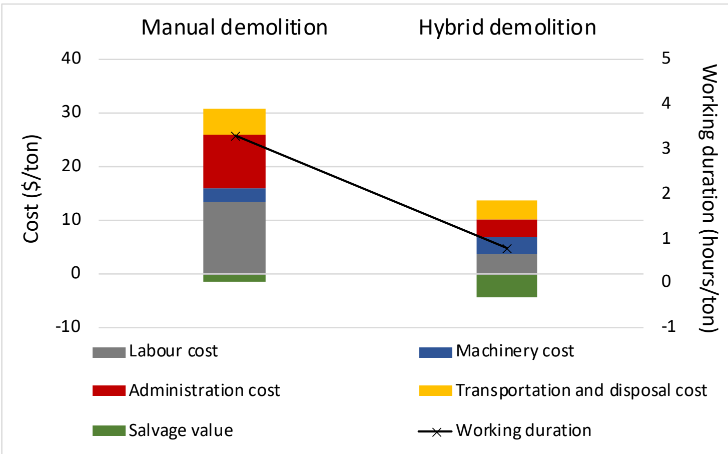

Figure 1 Cost breakdown of demolition sites in Hanoi

CONCLUSION

The preliminary results of this study confirmed the unsustainable practices of RC building demolition in Vietnam. In contrast to selective demolition, the manual demolition in Vietnam did not result in the higher reuse/recycling rate due mainly to poor on-site sorting. The results provided a prerequisite for identifying the technique and estimating the potential expense of adopting selective demolition in Vietnam.

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