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Post Syrian-War Material Recovery, Reuse and Transformation in the Old City of Aleppo

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Abstract

Purpose — Eight years of civil war in Syria severely impacted the historic core of Aleppo, with about 30 % of its buildings completely destroyed and huge amounts of debris generated. This paper proposes recovery strategies for some of the most badly damaged sites in the city through material reuse and transformation, one of the goals of which is to ensure the continuity of the city's urban cultural heritage. This process presents not only risks but opportunities with respect to the integration of technologies to support recovery and reconstruction.

Design/methodology/approach —The paper analyzes the current situation in the Old City of Aleppo by identifying the most seriously damaged sites, namely those that have sustained damage to between 80 to 100 % of the site. It reviews comparable international post-disaster examples and investigates appropriate options for dealing with the damage caused by the war and the management of debris, with consideration given to minimal intervention, the retention of structural integrity, technology and the integration of historic materials within new components and buildings. The methodology has relied on research through field work, including interviews with stakeholders in Aleppo.

Findings—The paper proposes two strategies to guide post-war rebuilding and conservation efforts in the Old City of Aleppo through: 1) the creation of new multi-purpose, public open spaces and 2) the use of debris in the repair of buildings and construction of new components and buildings, including infrastructure for solar panels within the new public spaces.

Originality/value —This paper contributes to the development of a post-civil-war

sustainable material recovery approach for the Old City of Aleppo and for Syria more generally, where a disaster waste management strategy is still in development.

Keywords: Cultural heritage, the Old City of Aleppo, Destruction, Demolition waste, Recovery, Public spaces, Reclamation, Reuse, Recycling

1. Introduction

Due to the ongoing wars and conflicts in the region, the urban cultural heritage of the Middle East is being exposed to extensive destruction. While history, collective memory and identity are being lost, huge amounts of demolition waste are being generated, which the recovery and reconstruction process must address. This requires special care when dealing with the Old City of Aleppo, one of the oldest continuously inhabited cities in the world and has been inscribed on UNESCO's World Heritage List in 1986 based on two criteria: (iii) (as) a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared; e.g. the Old City of Aleppo reflects rich and varied cultures and bears the influence of many periods of history in its architectural fabric; and (iv) (as) an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history; e.g. the Old City of Aleppo is a prominent example of a 12th century Ayyubid city (United Nations Educational et al., 2004, Directorate General of Antiquities and Museums, Ministry of Culture, 2013). The concepts beyond these criteria like authenticity, the layout of the old city in relation to the dominant Citadel has remained basically unchanged. Also integrity, the remaining coherence of the urban fabric and the vulnerabilities of fabric and archaeological remains needs to be respected.

Although the reuse of debris has not yet begun in Syria, except in some recently initiated pilot projects, the reuse of building elements and recycling materials are not new ideas. From the earliest days of large-scale masonry construction in ancient Egypt, Greece and Rome, stone has been reused many times as buildings were destroyed by earthquakes or in war, or simply fell into disrepair. The manpower needed and the cost of reusing stone was much less than using new stone from distant quarries (Bill and Addis, 2006; Aleppo City Council, 2007). Using salvaged building material in place of new material can be an effective means of conserving natural resources and reducing the amount of energy required, in addition to having tangible economic benefits (Kernen, 2002). Moreover, material reuse may serve as a means of sustaining heritage value inherent in the buildings to the materials reclaimed from them (Ross and Carleton University, 2018). It can enable something of value to be recovered from the waste stream (Gorgolewski, 2017).

In Greater Aleppo, the millions of tons of debris pose a major threat to the environment by increasing the demand for newly quarried materials and decreasing the area available for landfill sites, which are in themselves difficult to deal with. There is a need to identify more sustainable solutions in line with the 2030 Agenda for Sustainable Development, particularly with Goal 11 to "make cities and human settlements inclusive, safe, resilient and sustainable". Solutions are also needed to ensure the protection of cultural heritage and people, for waste, and for disaster management (United Nations, General Assembly, 2015).

Building conservation can be a crucial contributor to sustainability, because it can fulfill the interrelated economic, cultural, social and environmental principles of

sustainable development. The reuse of rubble has also proven to be effective as a means of reducing waste and landfill use associated with demolition (United Nations Educational, Scientific and Cultural Organization, 2005).

The United Nations (UN) Joint Environmental Unit (JEU) has prepared draft disaster waste management (DWM) guidelines specifically for developing countries with the aim of supporting the full cycle of disaster waste management (JEU, 2010). The disaster waste management framework can be divided into four phases; (1) 0-72 hours immediate and short-term action; emergency, (2) medium term action; early recovery, (3) long-term action; recovery and (4) contingency planning (Berg *et al.*, 2013). This paper addresses the second phase in the DWM framework, addressing key issues such as the location of a disposal site for the different types of waste, streamlining logistics for waste collection, transportation and reuse/recycling activities. The required actions normally include assessments, operations, planning and communication and reporting.

Temporary sites for waste processing are important, in that they provide the time to appropriately sort, recycle and dispose of the waste (Brown *et al.*, 2011). Effective waste management programs do not even exist in peace time and are a low priority in developing countries like Syria. As a result, the United Nations (UN) Joint Environmental Unit (JEU) has defined general guidelines for developing temporary storage sites: (1) they should be located in or near the affected area and away from potable water wells and rivers etc., (2) they should be on public land because approval for this use is generally easier to obtain, (3) the stored material should not threaten public health and safety, and (4) they should be appropriate relative to the scale of the debris. (Berg *et al.*, 2013).

Demolition can be considered as a normal process in the regeneration of building stocks over longer periods of time. Partial demolition begins with maintenance and refurbishment work, which could in theory continue until the whole building is replaced (one or more times) in a piecemeal manner. Until a century ago, small-scale 'organic' processes of renewal and transformation were the normal way in which buildings and towns were redeveloped (Thomsen *et al.*, 2011).

Based on his experience since the early 1980s with demolition contracts and consulting engineering services around the world, Lauritzen(2018) has proposed various scenarios of construction and demolition waste management and recycling (CDW). These are classified as: (1) transformation of old buildings into reused buildings; partial demolition and reconstruction of existing buildings, (2) transformation of old buildings into new buildings; demolition of buildings after end-of-life, recycling of materials and construction of new buildings, and (3) transformation of individual buildings from old city to new city. Urban development and renewal are also addressed, including the repair or reconstruction of existing buildings and infrastructures, demolition of existing buildings and infrastructures, recycling and the local use of recycled materials. According to Lauritzen, the assessment of the potential of material from existing buildings for reuse in new buildings and opportunities for recycling materials locally should be considered.

With respect to the urban fabric of the Old City of Aleppo, reconstruction must take into consideration the distribution of the mass, the courtyard area and the properties of traditional building materials (Aleppo City Council, 2007).

Due to the Syrian civil war, both electric power substations in the Old City of Aleppo out of service (General Electricity Company of Aleppo, 2018). If the Old City of Aleppo is to use alternative sources of energy, those likely to be introduced in the immediate future

will be solar energy sources (Windelberg and Kelzieh, 2001). In addition, the recommendation of official bodies is to focus on solar energy investment (UNESCO and Aleppo University, 2017).

This paper proposes two scenarios for dealing with demolition waste in the Old City of Aleppo, and argues that the recovered building material (stones, timber and metal) should be stored, classified, and reused for the restoration of historic buildings and construction of new components and buildings, including infrastructure for a new solar energy grid. This would significantly enhance the sustainability of the rebuilding process, while protecting the architectural character of Ancient Aleppo and providing a sense of familiarity with respect to the appearance of the built environment. This could help support social continuity after the disaster and accelerate the return of residents to their homes. In addition, it would safeguard the environment by reducing energy requirements, the use of virgin materials and the consumption of land.

2. Current situation and data collection strategy

The research described in this article is part of a PhD study with the aim of understanding the city's residential neighborhoods, in order to restore heritage sites while improving living conditions. The study began with a damage and waste assessment, based on local information, government legislation and policies, and UNESCO reports and norms related to the current situation in the Old City of Aleppo, as well as information drawn from a range of media. The data collection included a reconnaissance survey (field observation), as well as interviews with key personnel for the purpose of understanding the existing problems and issues. Interviews were carried out with Aleppo city managers and related government officers [Municipality, Directorate of the Old City, Directorate General of Antiquities and Museums (DGAM)], the General Company for Technical Studies and Consultations and the Directorate of Electricity during visits to the Old City of Aleppo in December 2016, as soon the military operations in the Old City stopped, and in August 2017 and July 2018. In June 2019, video interviews were carried out with local authorities. The visits and interviews revealed that a total of 210 archaeological sites have been evaluated by the DGAM at the request of UNESCO and conducted by local employees. In parallel, the General Company for Technical Studies and Consultations engaged the Ministry of Local Administration to undertake damage assessment, which records the extent of damage on three levels.

In addition, Shop and house owners who have started to return are receiving restoration permits from the Municipality (Directorate of the Old City), in compliance with the building code of the Old City. On the initiative of local NGOs and students of Aleppo University, conservation and restoration work, debris removal and sorting of historic stone are being carried out on a voluntary basis.

3. Damage assessment

Aleppo is located in the north-western region of Syria. Its historic center is one of the oldest continuously inhabited cities in the world and consists of about 16,000 buildings, mainly introverted courtyard houses (Windelberg and Kelzieh, 2001). These are connected together on more than 350 ha. The contemporary city has witnessed many wars throughout its history, exacerbated by the massive destruction caused by the earthquakes in 1138 and 1822 (Fischer et al., 2012). Nonetheless, the Old City still exists, and it is possible to read the character of its multi-cultural historical urban fabric despite the

notable transformations within its interior (Petrucchioli and Sarro, 2001). Between the 1950s and the 1970s, 10% of the old urban fabric was demolished with the aim of implementing a series of master plans.

In the summer of 2012, the Syrian civil war escalated in Aleppo. Militants were blockaded in its old neighborhoods, and although their leaders stressed that humans were more important than stone, the result was the killing of more people and the collapse of stonework under the shelling, bombing and clashes. This made it one of the most heavily damaged cities in the Syrian civil war, and resulted in the city being placed on the List of World Heritage in Danger in 2013 (Hinz et al., 2013).

Following the cessation of military operations in the Old City of Aleppo, in December 2016, damage assessment of the buildings has been conducted since 2017 by the General Company for Technical Studies and Consultations in Aleppo. The approximately 15,410 buildings were divided into three categories: 3,154 buildings have been destroyed, 9,049 buildings have suffered severe structural damage and 3,207 buildings have not suffered any structural damage. Each category in turn is divided into five sub-categories based on the percentage of destruction (Figure 1).



FIGURE 1: Level of destruction in the Old City of Aleppo //very damaged-damaged-untouched; (left to right). Source: author – field work with General Company for Technical Studies and Consultations, 2017.

4. Quantification and components of Syrian civil war debris

According to the World Bank Group and local authorities in Syria, about 14.9 million tons of debris were produced during the Syrian civil war in the entire city of Aleppo (Onder and Hayati, 2017). This has only been partly removed and may require massive clean-up efforts entailing huge transportation costs. It could take about six years of continuous work and 26 million "truck-kilometres" to clear the debris from Aleppo (Onder and Hayati, 2017) (Figure 2). There is, however, no accurate estimate of the amount of Syrian civil war debris generated in the Old City of Aleppo. An estimate of its volume can be made based on the fact that in the historic city center alone about 30% of the structures were completely destroyed and 60% severely damaged, thus producing thousands of tons of debris.

Considering the massive structure of the traditional buildings in Aleppo (Osou, 2013), most of the debris that has accumulated in the Old City of Aleppo will be stone, wood, and metal, as well as soil, which was used as insulation and filler between walls and in

roofs. (Figure 3).

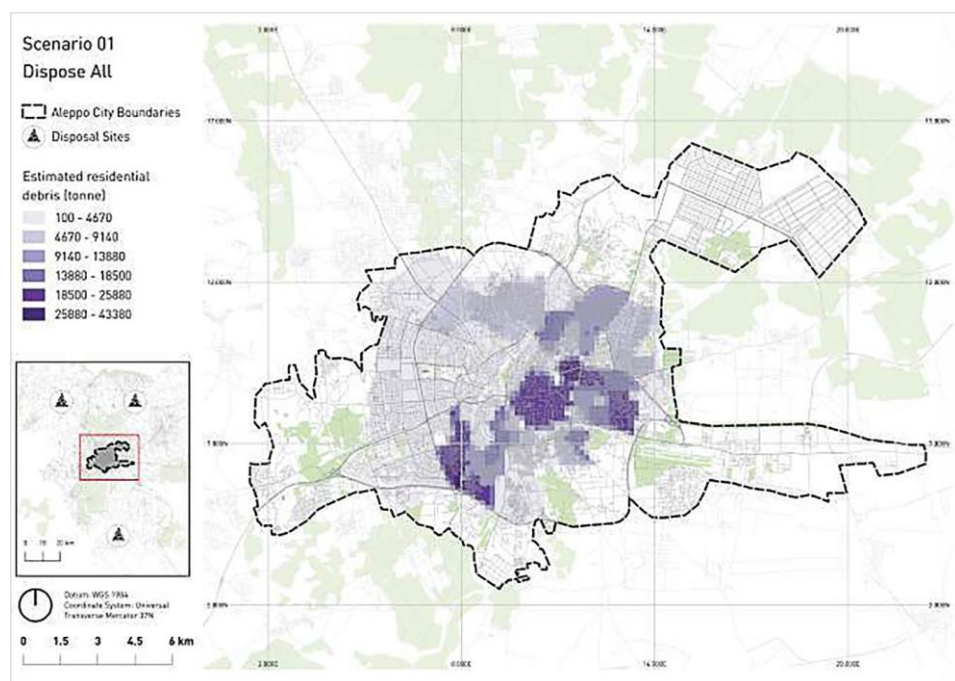


FIGURE 2: Calculated accumulation of debris. Source: Onder and Hayati, 2017.



FIGURE 3: Accumulation of debris in the Old City of Aleppo. Source: author – field work, July 2018

5. Heritage preservation between regulation and implementation in the Old City of Aleppo

Even though a cessation of hostilities came into effect in the Old City of Aleppo in December 2016, authorities have not yet developed a specific post-disaster concept for managing waste and debris. The only exception is legislation related to the removal of debris, notably Law No. 3 of 2018, which provides for “removing the debris of buildings damaged as a result of natural or unnatural causes or subject to demolition law.” This law, which has not yet been implemented, includes 14 articles regulating the process of clearing and benefiting from the debris, in preparation for its disposal and determining the fate of millions of damaged buildings in Syria, whether by renovating, reinforcing or demolishing them. According to the Syrian Antiquities Law issued by Legislative Decree No. 222; amended in 1999 and again in 2012, in order to be regarded as historic legacies subject to protection, construction materials must be at least 200 years old (Syrian Law of

Antiquities, 1963).

Additionally, the 1999 Guidelines for Restoration provide a set of detailed standards based on international standards, such as the Venice Charter and World Heritage Convention.

In the Old City of Aleppo, activities to support the preservation of debris and urban historic fabric are still limited to emergency measures for the early recovery phase. In parallel with damage assessment, debris removal is being carried out in four contractual sub-phases: debris is taken to landfill in the southern countryside of Aleppo, with the green line as the first stage, and the blue line as the second stage. Other contracts are still under ratification - the yellow and purple lines show the third and fourth stages respectively. However, the red line shows that there are still many streets blocked by debris, with the directorate of the Old City reporting 250,000 cubic meters of debris in the Old City of Aleppo. (Figures 4 and 5) (Shadi Halwi and Director of the Old City of Aleppo, 2017).



FIGURE 4: Removal of the debris from Old Jail street - one of the wide and modern streets in the Old City of Aleppo. Source: author – field work, July 2018.

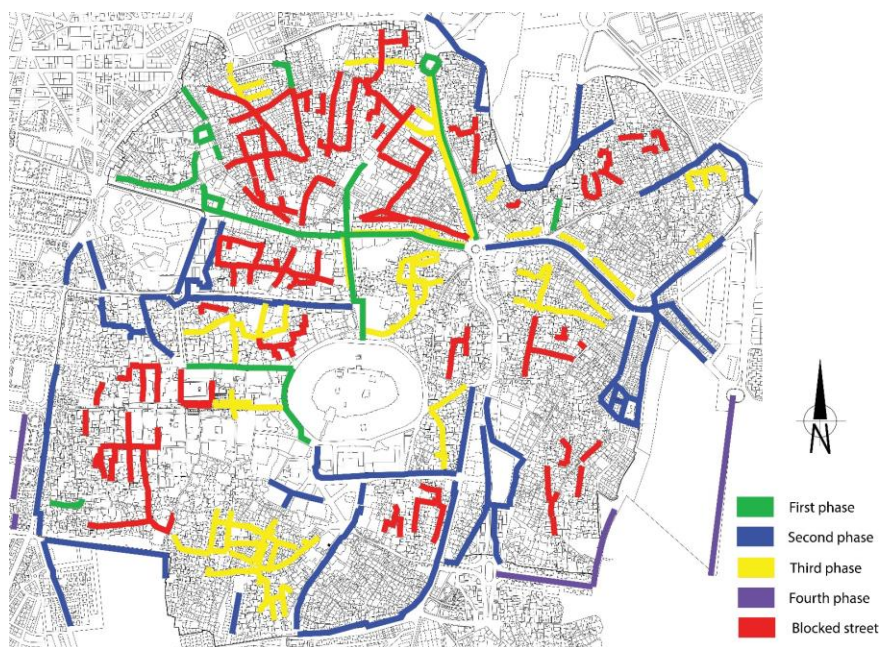


FIGURE 5: Project for the removal of debris in the Old City. First phase: contract /38/ +

second phase: contract /66/ + third phase + fourth phase under ratification. Source: Shadi Halwi and Director of the Old City of Aleppo, 2017, redrawn by author.

Most stone has been kept in place with the aim of recovering and reconstructing all the buildings in the historic city center using historic material, in order to preserve the city's architectural and cultural heritage.

In contrast, in Aleppo the strategy of debris preservation has already begun, though it is largely limited to one iconic historic building, where a buffer zone has been imposed around it that cannot be bypassed. This means that building debris cannot be tampered with, and original building material can be extracted from the debris. Local authorities started to restore the Great Umayyad Mosque thanks to 16 million USD funding. It is one of the most important religious and archaeological sites in the city and being rebuilt using "anastylosis" as a reconstruction technique, which is an archaeological term for a reconstruction technique in which a ruined building or monument is restored using the original architectural elements to the greatest degree possible. The stones of its minaret have been accumulated on the site (Figure 6).



FIGURE 6: The debris of the minaret of the Umayyad Mosque, which was built in the 8th century AD, and then renewed in the 13th century. Source: author – field work, December 2016.

Special attention has been paid to the collection of the debris debris on site. Each stone has been marked with a number and identifier (Figure 7) and measurements are being taken using a high-precision device to determine the strength of the stones and to what extent they are suitable for reuse. Usable stones will be identified, including some that are cracked. Some could be consolidated using metal bars, while others have been completely shattered. The wooden doors of the mosque are burnt and cannot be reused. All procedures are carried out under the supervision of the General Directorate of Antiquities in Syria, and the Syrian Ministry of Awqaf (Religious Endowments) has agreed with its Chechnya counterpart to finance part of the reconstruction of the mosque.

A comparable reconstruction technique employing original and non-original materials was employed in the rebuilding of Dresden's Frauenkirche in Germany fifty years after the end of the Second World War, where 44% of the stone used in the reconstruction was recovered from the ruins of the original church. (Frenzel *et al.*, 2001) and for St. Andrew's Church in Venzone in Italy, rebuilt forty years after the Italian earthquakes in 1976. In Venzone, a huge amount of recycled material was employed in river protection works, while stone recovered from the historic buildings in the town center

was stored, classified, and reused for building restoration (Faleschini *et al.*, 2017).



FIGURE 7: Classification and storage of archaeological stones on site. Source: Halwi, 2019.

Although clearing the debris is a complex task because of its volume, the lack of legislation and limited accessibility, the strategy for debris preservation should be conducted at the level of the entire historic core of Aleppo by clearing the buildings and streets of debris, taking it to temporary sites inside or close to the Old City, segregating each type and collecting the usable building material at an assembly point so it is ready for reuse, reclamation or recycling. Addressing the effects of destruction is an important factor in enabling people to return to their homes, which in turn plays an important role in ensuring a sense of security, belonging, stability and identity, especially if these homes are traditional houses with a local character.

In Haiti after the earthquake of 2010, one of the biggest obstacles preventing residents from returning home was a failure to remove debris across city, although debris had been cleared from houses and deposited in the streets (The Aleppo Project and Center for Conflict Negotiation and Recovery School of Public Policy, 2015). This is what is currently happening in the Old City of Aleppo, where the responsibility for individual houses usually lies with the owner, who is allowed to move debris into the street for collection by local authorities or a third party.

6. Post-civil war demolition waste treatment options

Collecting salvaged material for reuse requires that material be accumulated at specified points and separated according to type and reusability. After the earthquake of 2015 in Nepal, lack of coordination among the authorities reduced the opportunities of using original materials to rebuild the ancient heritage sites, within the surrounding area of Nandikeswor Bagaincha in Kathmandu, a site of considerable cultural and historical significance, the central area was left open for multi-purpose use, including a playground and disaster waste management. Lit by solar lamps, it was one of the first spaces of its kind to be used as an emergency rescue space during a disaster (Upadhyay and Ranjitkar, 2015).

In such projects, sustainable approaches to material reuse should be followed. Reusing

materials can not only minimize the generation of waste, but also reduces the cost of transporting, recycling and disposing of the waste. Only the waste materials that cannot be reused will be recycled for use in new construction. Minimum processing and energy use are achieved by reuse of the debris on site (Gems, 2015). Recycling the debris on or near the site is a common process in large construction projects. This also cuts project costs, in that it is about 40-50% cheaper than reconstruction using new materials.

In this context, this study proposes temporary open-space sites in the Old City of Aleppo, in order to store material until it can be recycled and reused for old and new buildings and infrastructure. It will also enable treatments to be studied involving minimal intervention, retaining structural integrity and integrating new objects and technology.

6.1. Scenario 1: Transformation of destroyed sites into multi-purpose public spaces

Most areas in the Old City of Aleppo cannot be easily reached by heavy equipment and the debris cannot be rapidly removed since the city layout is characterized by narrow alleys. The debris contains materials that can be reused without reprocessing or with only basic processing. In other words, objects are being put back into use, either for their original purpose or a different purpose, without major reprocessing and avoiding the waste stream. While it does not include reprocessing, it might involve some reconditioning. Utilization of demolition waste is therefore divided into reuse, reclamation and recycling.

Scenario 1 proposes that some destroyed areas should be left empty, in order to create multi-purpose public spaces to serve as disaster risk management zones and parks. These proposed sites should be chosen based on the level of destruction, the historic value of the location, and former land use, amongst other considerations.

It must be noted that public green areas in the Old City of Aleppo are very rare. Their total surface area does not exceed 3 hectares, which is about 1% of the total surface area of the Old City. The largest green area is in the Safsafah quarter. Some small sites also exist to the south of the Citadel, which are typically associated with service buildings. Overall, the amount of open space outside the courtyards is below the national standard.

This is why in this paper proposes a temporary main site within the buffer zone of the Old City of Aleppo, identified by Resolution No. 300/a (Directorate General of Antiquities and Museums, Ministry of Culture, 2002). The aim is to protect the Old City by creating a transition area between the Old City of Aleppo and the urban fabric of the modern city. The buildings located within these areas are subject to detailed studies, resulting in a special urban system that takes into account the mass, and architectural and visual harmony of the urban fabric of the Old City in terms of the form of openings, facades, cladding materials and heights etc. In addition, as part of land use development within the urban fabric, proposed public spaces have been permitted in the Old City of Aleppo for the purpose of creating public parks, small sports grounds and playgrounds for children etc. (Windelberg and Kelzieh, 2001).

There is a study of a public park in Tallet al Soudah near Action Area 1 (AA1), formerly referred to as Pilot Project Area Bab Qinnasreen, awaiting implementation, which can inform this scenario. The neighborhood of Tallet Alsauda (Figure 8 marked with

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a blue circle, Figure 9, Figure 10) is an old quarter inside the wall of the Old City of Aleppo, located on its south-western border. With an area of 13.3 hectares (Qudsi, 2017), it is identified in this study as a "temporary" disaster risk management zone. This residential area has been classified as a "disaster zone" since 2002, due to the collapse of a number of buildings, which in turn claimed many victims. Since 2004, the population has been partially evacuated and buildings threatened with collapse have been partially demolished, with the plan of transforming the entire area into "Bab Qinnasrine Park" and relocating residents to shelters. Due to previous collapses and the Syrian civil war, this area is now completely destroyed and is one of the 100 % damaged zones. It does not contain important historical buildings and is owned by the Awqaf (Religious Endowments).

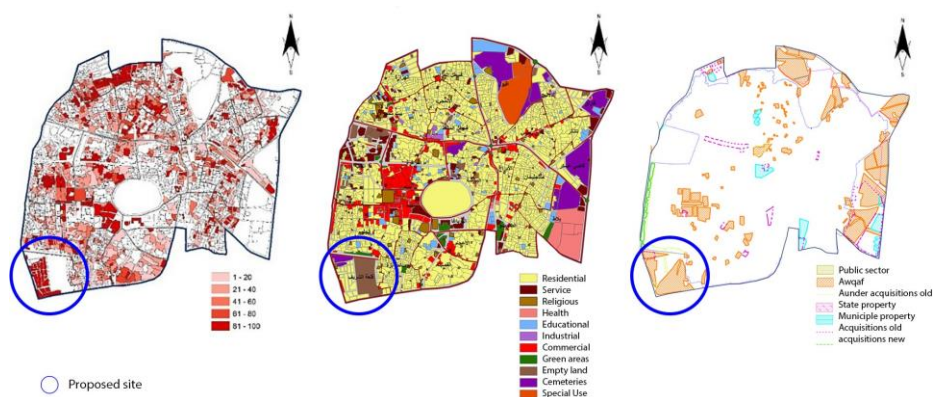


FIGURE 8: Level of destruction in the Old City of Aleppo — very damaged, land use, and property and acquisition; (left to right). Source: author - field work with the General Company for Technical Studies and Consultations, 2017.

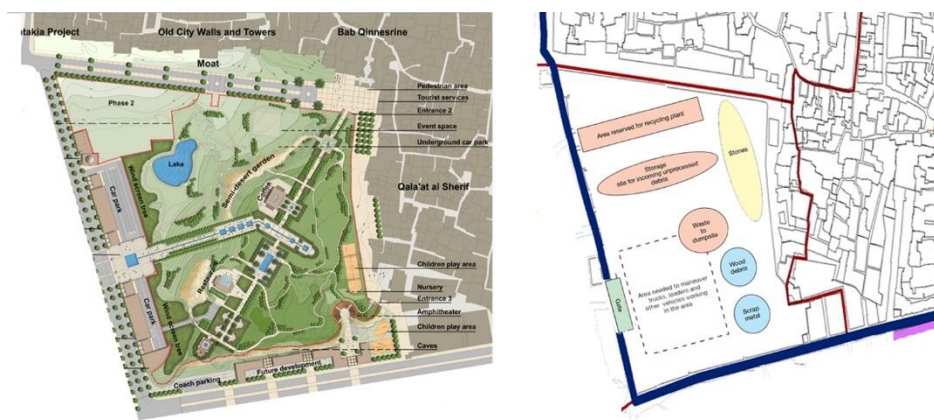


FIGURE 9: The Bab Qinnasrine Park rehabilitation project as outlined by the Agha Khan Trust for Culture (left) and suggested layout for a temporary disposal site (right); Sources: AKTC Syria (left); author, based on the United Nations (UN) Joint Environmental Unit (JEU) general suggested layout (right)).

6.2. *Scenario 2: Transformation of components of destroyed historic buildings into new components and buildings*

Scenario 2 proposed that stone be directly reused in new components and buildings, after being separated from the building waste and having attached mortar removed. The vision of UNESCO and the local authority is to rebuild the Old City of Aleppo exactly as it was before the war and with the same stones if possible, an effort that would ultimately rely on local efforts. This would require a staggering amount of new building material — seven times the annual output of all quarries in Syria (Bjerregaard, 2017) (Short, 2017). Stone from destroyed buildings could, however, serve as a quarry for the repair and construction of buildings. Particular focus would be on rebuilding the exterior stone facades, which express the identity of the old city, taking into account the fact that there are detailed plans for mosques, markets, baths and the historic castle from a previous restoration scheme which would enable careful reconstruction. But even though this applies to the region's most important historic buildings, entire neighborhoods whose alleyways and traditional houses do not have the same historical value, although they are part of the identity of the old city, have now become debris.



FIGURE 10: Accumulation of debris in Tallet Alsauda, sorting stones in Al-Hatab Square, sorting stones on-site; (left to right). Source: Totol Real Estate Title & Development in Aleppo, 2019

Taking advantage of the opportunity to reuse items and demolition material on site would reduce the cost of waste removal and landfill as well as the cost of buying new goods and materials, and would minimize the environmental impact of the transport. This reuse scenario saves on resources, waste disposal, and energy use during material processing, as well as energy use during component manufacture and transport. In addition, the identity and collective memory of the city could be preserved through the use of reclaimed materials.

For powering services and providing public lighting, the plan would be to use reclaimed metal to build sub-structures for the solar panels in specific small-scale public spaces, further reducing building costs. These structures would be embedded within the urban fabric, effectively processing material from damaged and destroyed buildings into memorial aggregate, usable in new structures.

It is worth noting that all renewable energy supply systems were reviewed in relation to the situation in the Old City of Aleppo, with a solar energy supply system identified chosen for the following reasons:

- greater potential to use the solar energy provided by PV modules,
- a good match with the buildings,

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- one of the most common and successful systems in the historical context.

Similarly, with the aim of rebuilding the city from within (LafargeHolcim Foundation, 2017), recycling operations on or as close as possible to the relevant site, sorting stations and places of use, as well as small mobile recycling plants could be set up at these proposed sites. They would process the demolition waste of the Old City of Aleppo and transform it into usable material. They would also ensure local job opportunities, while providing a platform for creating awareness among inhabitants regarding the importance of their engagement and for preserving the identity of this city. The debris from residential houses and private properties is owned by the local residents, who have the right to benefit from this material. However, no local-level guidelines exist regarding the collection of debris from private buildings.

7. Conclusion

This paper has argued that in historically important environments such as the Old City of Aleppo, the clearance of debris should be carefully managed, so as to enable the reuse of historic materials in the repair of existing buildings and in new construction. It has also proposed the reuse of some of the destroyed sites as multi-purpose public spaces, including disaster waste management zones and parks, which would provide a dynamic public space that fosters socio-cultural interaction and promotes the involvement of residents in preserving the cultural heritage, while meeting the need for playgrounds and recreational areas.

The reuse of building waste does not require complex technology or equipment. It merely requires manual labour or simple tools. As such, reuse is the simplest and most effective way of restoring historical buildings. Moreover, the use of salvaged materials in new construction not only saves money, but also protects land resources and transfers valued attributes of historic buildings to the new ones. At present, one of the principal obstacles to a robust waste management program in the Old City of Aleppo is the lack of waste recycling equipment.

In rebuilding damaged location, the recent destruction should itself be considered as an historic event worth remembering. It should not be the aim of post-war reconstruction to obliterate all evidence of that traumatic event. This study recommends that future researchers could focus on further work in this area.

References

- Aleppo City Council (2007), "Construction code of the Old City of Aleppo", Aleppo.
- Berg, P., Bjerregaard, M. and Jönsson, L. (2013), "Disaster Waste Management Guidelines", UNEP/OCHA Environment Unit, Switzerland.
- Bill, A. and Addis, W. (2006), "Building with Reclaimed Components and Materials: A Design Handbook for Reuse and Recycling", Routledge, UK and USA.
- Bjerregaard, M. (2017), "Urban Resilience Platform", URL <https://www.bbc.co.uk/news/resources/idx-d7bc8641-9c98-46e7-9154-9dd6c5fe925e>.
- Brown, C., Milke, M. and Seville, E. (2011), "Disaster waste management: A review article", *Waste Management*, Vol. 31, pp. 1085–1098.
- Directorate General of Antiquities and museums, Ministry of Culture (2002), "Resolution No. 300/a", Syria.
- Directorate General of Antiquities and museums, Ministry of Culture (2013), "The Old City of Aleppo", Syria, URL <http://www.dgam.gov.sy/index.php?d=307&id=678>.
- Faleschini, F., Zanini, M.A., Hofer, L., Zampieri, P., Pellegrino, C. and International Journal of Disaster Risk Reduction (2017), "Sustainable management of demolition waste in post-quake recovery processes: The Italian experience", Vol. 24, pp. 172–182.
- Fischer, M., Gangler, A. and Aleppo City Council and (GIZ) (2012), "The Aleppo Archive: A Place for the Memory of Urban History", Syria.
- Frenzel, C., Horner, M. and Ulrich, K.H. (2001), "Memento Frauenkirche", Ipro, Dresden.
- Gems, E. (2015), *Built Environment and Property Management: A Focus on China and Hong Kong*, Emerald Group Publishing Limited, Bingley, 1st edition.
- General Company for Technical Studies and Consultations, Ministry of Public Works and Housing (2017), Syria.
- General Electricity Company of Aleppo, Ministry of Electricity (2018), Syria.
- Gorgolewski, M. (2017), "Resource Salvation: The Architecture of Reuse", John Wiley & Sons, United States.
- Halwi, S. (2019), "Here is Aleppo", URL https://www.imgrumweb.com/hashtag/%D9%87%D9%86%D8%A7_%D8%AD%D9%84%D8%A8.
- Hinz, H.M., Richard, A. and UNESCO and ICOM (2013), "Emergency Red List of Syrian Antiquities at Risk", New York.
- Kernen, P. (2002), "Old to New, Design Guide, Salvaged Building Materials in New Construction", Greater Vancouver Regional District, Policy & Planning Department, Vancouver.
- Lauritzen, E.K. (2018), "Construction, Demolition and Disaster Waste Management An

- Integrated and Sustainable Approach”, Taylor and Francis, Boca Raton.
- LafargeHolcim Foundation (2017), “Recovering Aleppo in Syria. Rubble recycling units, Prize Winning Projects in Sustainable Construction”, URL <https://www.lafargeholcim-foundation.org/projects/recovering-aleppo>.
- Maad El Madlaji and Press Office of Aleppo City Council (2019), “Project of storing and recycling of rubble in Aleppo”, Aleppo.
- Onder, H. and Hayati, F. (2017), “The Toll of War: The economic and Social Consequence of The Conflict in Syria”, The World Bank Group.
- Osou, R. (2013), “Rehabilitation of Traditional Houses in The Old City of Aleppo Selection of Study Samples”, Master Thesis, Aleppo.
- Petrucchioli, A. and Sarro, A. (2001), “Beyond the Wall. Notes on Multicultural Mediterranean Landscapes”, Italy.
- Qudsi, J. (2017), “Rebuilding Old Aleppo Postwar Sustainable Recovery and Urban Refugee Resettlement, Master Thesis”, New York.
- Rodeyna, A. and Hamed, F.A. (2012), “Reality and prospects of wind power in Syria”, *Energy Procedia*.
- Ross, S. and Carleton University (2018), “Heritage in Reverse: Material Values, Waste and Deconstruction”, Canada.
- Shadi Halwi and Director of the Old City of Aleppo (2017), “Here is Aleppo Program”, Syria.
- Short, A. (2017), “Disaster Waste Recovery”, URL <https://www.bbc.co.uk/news/resources/idx-d7bc8641-9c98-46e7-9154-9dd6c5fe925e>.
- Syrian Law of Antiquities, Syrian Arab Republic (1963), Syria.
- The Aleppo Project and Center for Conflict Negotiation and Recovery School of Public Policy (2015), “Cleaning Rubble”, Budapest.
- Thomsen, A., Schultmann, F. and Kohler, N. (2011), “Deconstruction, demolition and destruction”, *Building Research and Information*, Vol. 39 No. 4, pp. 327–332.
- Total Real Estate Title & Development in Aleppo (2019).
- UNESCO and Aleppo University (2017).
- JEU. (2010), “Joint Environmental Unit Disaster Waste Management Guidelines, Final Draft ed”, Switzerland.
- United Nations Educational, S., Organization, C. and UNESCO (2017), “UNESCO reports on extensive damage in first emergency assessment mission to Aleppo”, Aleppo.
- United Nations Educational, S., Organization, C. and UNESCO (2018), “Decision 42 COM 7A.36 on the World Heritage properties of the Syrian Arab Republic”, General Decision on the World Heritage properties of the Syrian Arab Republic, URL

<https://whc.unesco.org/en/decisions/7209/>.

United Nations Educational, S., Organization, C. and UNESCO (2018), "Decision: 43 COM 7A.31", Ancient City of Aleppo (Syrian Arab Republic) (C 21), URL <https://whc.unesco.org/en/decisions/7525>.

United Nations Educational, S., Organization, C. and UNESCO (2004), "The Criteria for Selection", URL <https://whc.unesco.org/en/criteria/>.

United Nations Educational, Scientific and Cultural Organization (2005), "UN Convention on the Protection and Promotion of the Diversity of Cultural Expressions", Paris.

United Nations, General Assembly (2015), "Transforming our world: the 2030 Agenda for Sustainable Development", URL https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E.

Upadhyay, S. and Ranjitkar, M.G. (2015), "Post-Earthquake Debris Management: Challenges and Opportunities in Nepal", *A Journal on Rural Infrastructure Development*, Vol. 6 No. 6.

Windelberg, J. and Kelzieh, T. (2001), "Development Plan: Rehabilitation of the Old City of Aleppo", Municipality of Aleppo / GTZ, Aleppo