Postwar City: Importance of Recycling Construction and Demolition Waste

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Abstract - Wars and armed conflicts have heavy tolls on the built environment when they take place in cities. It is not only restricted to the actually fighting which destroys or damages buildings and infrastructure, but the damage and destruction inflicts its impacts way beyond the cessation of military actions. They can even have another impact through physical segregation of city quarters through walls and checkpoints that complicates, or even terminates, mobility of citizens, goods, and services in the post-war scenario. The accumulation of debris in the streets often impedes the processes of rescue, distribution of aid and services, and other forms of city life as well. Also, the amount of effort and energy needed to remove those residual materials to their final dumping sites divert a lot of urgently needed resources. In this paper, the components of construction and demolition waste found in post-war cities are to be discussed, relating each one to its origins and potential reuses. Then the issues related to the management of construction waste and demolition debris resulting from military actions are to be discussed. First, an outlook is to be given on the historical example of Berlin and how the city was severely damaged during World War II, and how the reconstruction of the city was aided in part by the reuse of demolition debris. Then two more recent examples will be given, the cities of Baghdad in Iraq, and Homs in Syria. In Baghdad, though major military actions have ceased but not all rubble is cleared out, some security structures in the form of concrete walls separate the cities into quarters and impede city life and lie around as poorly allocated resource needed for reconstruction. While in the case of Homs, and the wider Syrian context, major military operations are still raging, making more pressure on the resources needed for reconstruction. This recycling of demolition debris can bring economic and social stability through the conservation of resources, creation of jobs, and – eventually – the stabilization of the society in the midst of an atrocious war. Suggestions for relevant solutions will be given in both cities.
1. **Introduction**

1.1 **Historical Development**

War is part of human nature; the use of force to secure territories or resources went hand in hand with human settlement. However, the relationship between the two was not always straightforward [1]. Some armed conflicts dislodged populations and eradicated settlements. While in other cases - mostly victorious – communities would respond to warfare by fortifying their settlements [2]. Also, due the nature of warfare most of the actual fighting would take place in open fields and cities would be the prize at the end of it. Even with the advent of siege warfare and technology – which were developed to overcome fortifications – it was not used as an all-out assault on the built structures, but rather to allow the fighting forces access to the settlement [3]. The scale of destruction inflicted on cities and built structures in general rose gradually with each technological advancement relevant to warfare.

1.2 **World War II: Increase in Destructive Power and Military Tactics**

With time and beginning with World War I, major cosmopolitan cities like Berlin and London started to become targets for long range warfare [2]. The ability to create destruction without human encounter unleashed all potentials for dismantling the civilized way of life. This was coupled by the fact that since the industrial revolution, the means of production that would support the war effort would be concentrated in cities [1]. So, it was necessary to neutralize those production centers in order to cripple the enemy's capacity to field armies and go to war.

This became more and more in World War II. The advancement in rocketry and aviation enabled the delivery of means of destruction on a massive scale, not to mention the development of the destructive potentials of the armaments themselves, e.g., the V-1 and V-2 German rockets and the atomic bombs dropped on Hiroshima and Nagasaki by the United States. The sheer size of destruction that was inflicted during the war on both sides was massive.

2. **Destruction, Occupation, and Reconstruction: The Case of Berlin**

On the European theatre of war, and particularly Germany, intensive allied aerial bombardment – carpet bombing as it was later called - resulted in leveling 80 percent of historical centers in German cities [4]. The advance of the ground forces of the Allies from east and west was damaging too, but the gravest part of the devastation was attributed to aerial bombardment. Also, after the war and the commencement of reconstruction, additional demolitions were made for either safety reasons when buildings were deemed not restorable or to make way for new buildings altogether.

These two sources of demolition debris coupled with the dire shortage of construction materials after the war – especially in West Berlin during the Blockade enforced by the Soviets between June 1948 and May 1949 – pressed local authorities into developing a multitude of means to deal with the matter.

Demolition debris was screened for salvageable materials that could be used for reconstruction. Those would be used in building emergency housing when needed, and also to reduce the volume of waste that needed to be landfilled. The debris was a composition of bricks and other building materials like concrete and mortar made up of lime or cement. The salvaged mix would be used as aggregate in low quality concrete. Lime mortar or gypsum boards were removed when large enough and stones were recycled for use in construction. The remainder was then crushed and added to low bearing concrete mixtures in floor and ceiling slabs, as well as in hollow blocks. Specific measures were taken to avoid the inclusion of gypsum mortar or boards over a certain percentage into concrete mixtures in order to prevent the adverse effects of soluble sulphate. Also organic materials like wood were prohibited from being used in concrete mixes of higher quality [5]. Most of the work done to sift through the rubble was done manually. And due to the heavy casualties than Germany sustained at the end of the war, especially in the male population, the labor required to do the
recycling of the demolition waste was done by women who were later labeled as Rubble Women – Truemerfrauen. These women were either conscripted into this hard labor or volunteer for it, probably because the male population was decimated by casualty and captivity.

In Western Germany roughly 400 million cubic meters of debris were landfilled into mounds after sorting out anything that could be salvaged [6]. These mounds were located all around the country, and later some were merged into the surrounding landscape by covering them up with greenery. Among these artificial small mountains is Berlin's Teufelsberg [7]: it is situated in the western part of Berlin, close to the Grunewald Forest. It was created in by the disposal of 25 million cubic meters of debris on site. Due to the difficulties inflicted by the German Democratic Republic and the Soviet Union during the Cold War, all rubble from West Berlin had to be deposited within city boundaries. The site original hosted the Military Technical College during Nazi times. Allied forces tried to blow it up after capturing it but failed. The site was chosen for disposal right after the end of the Berlin Blockade and continued to receive rubble until 1972. It was used for recreational purposes for some time, like ski jumping and model plane testing [8].

The city of Berlin had to endure large scale destruction inflicted on its built structures, impediment to the reconstruction process through the blockade put in place by the Government of East Germany, and of course, the lack of sufficient manpower to carry on the process. However, with careful resource planning the city emerged after the heavy destruction of World War 2 and the partition during the Cold War as an example of good practice in urban planning.

2.1 A City under the Shadow of War: The Case of Baghdad

It is bitter irony for a city that has been known as Madinet al Salam: the City of Peace for its past glorious stories when it was the city of science, arts and music. Today, Baghdad is physically damaged by multiple checkpoints, concrete segregation walls and open sewers.

Throughout the past 30 years, there have been series of conflicts in Iraq starting from the Iran–Iraq War (1980 to 1988), Iraq's Invasion of Kuwait (1990), the Gulf War (1991), the subsequent sanctions against Iraq (1990), and finally the violence during the American-led invasion and occupation of Iraq which ended up with an ongoing Civil War resulting in the construction of the Wall of Adhamiya in Baghdad in 2007 (Figure 1). The Wall of Adhamiya

![Figure 1. Baghdad targeted districts to be gated](image_url)
is claimed to be a necessary decision to secure the capital city from the damages of the “surroundings”, while according to experts; this decision was made as an excuse to get the minority Sunni community of Adhamiya - on the eastern side of the Tigris River - completely isolated and start the preparation for a Shiite region. [6]

In 2003, the mixed Sunni-Shitte neighborhoods composed the majority of the overall distribution. The Sunni neighborhoods soon decreased to 10-15 percent in late 2009 [7]. However, the Iraqi Prime Minister - Nuri Kamal al-Maliki – ordered to take down some of the concrete walls around Baghdad's streets in October, 2009 [8]. The order did not include the walls around the Green Zone, which is a protected area for the Iraqi government buildings, the U.S. Embassy, government institutions, hotels and some private companies. Days later, an attack at the Finance and Foreign Ministries occurred killed at least 95 people, and the order was scrapped [8].

Now, with the recent wars against the so called Islamic State of Iraq and the Levant group (ISIL), in 2016, a new “security” plan is taken into consideration as the Iraqi military chiefs announced the construction of the "Baghdad Fence" to protect the city. The construction of the barrier is around 30 km (20 miles) to the west of Baghdad; to primary isolate it from Falluja, which is under control of Islamic State [9]. These so-called as security walls are being a huge hindrance to public life as well as a beacon for sectarian rift between the Sunnis and Shites.

During Saddam Hussein time in power, Iraq had to go through multilayers of economic, political and social crises, starting with the Iran-Iraq war which was a war within a war supported by the world's top military superpowers; the United States from one side, supporting Iran while the Soviet Union supported Iraq which produced no advantage for
either side during the 8 years. Moreover, the war ended with heavy human loss to both sides as there were approximately 600,000 Iranian and 400,000 Iraqis dead, as well as an economic crisis of an overall war-cost of 1.9 trillion U.S. Dollars wasted [10].

In recent decades, Iraq has been heavily dependent upon oil production as in the late 1970s, the oil production was not constrained by war or sanctions, it peaked at around 3 million bpd (barrels per day), or about 1 billion barrels per year. This constituted about half of Iraq’s GDP (Gross domestic product) that time [11]. But Iraq’s economy has declined by around 90 percent, during the 23 years of Saddam regime. The first phase of the economic decline occurred during the Iran-Iraq war which had destroyed a large part of Iraq’s capital stock, reduced oil production, and lowered much of its foreign exchange reserves. Kamran Mofid estimated that the total cost to Iraq was $450 billion (in current dollars), which amounts to about eight years of Iraq’s GDP at that time. Following up the Gulf War and the sanctions against Iraq (1991-2003) afterwards that caused more blows to Iraq’s economy [12]. The Gulf War destroyed about $230 billion of infrastructure, and caused the forced sanctions which reduced Iraq’s oil revenues by approximately six years of GDP, and the total cost to the Iraqi economy was probably even larger than that. Overall, the wars and sanctions during the Saddam regime probably cost Iraq in the order of two decades of GDP in lost output, capital, and financial resources. There are no parallels in modern history to economic devastation on that scale [12].

After the end of the 1991 Gulf War and during the struggling with economy, Saddam Hussein built dozens of palaces, which the Deserted Places blog [13] proposes to be between 80 and 100 according to different accounts across the entire country.

The U.N. documents suggests that there are eight main palaces overpowered by marble surfaces and gold and contain more than 1,000 buildings and cover an area of around 32 square kilometers (12 square miles) in total [13]. After the fall of Baghdad in 2003, some of the palaces were taken over by the British and the American troops, while others have been heavily looted. Today, the abandoned palaces are properties that belong to the Iraqi government that haven’t been fully taken care of due to its highly sensitive background. Some plans suggested having them to maintained, others repurposed, sold to developers or demolished [14]. Among many of the leading environmental, health and social tragic problems in Iraq, there’s one problem that should be addressed powerfully; which is the environmental and pollution effects of wars in Iraq. In 1991 and 2003, DU (depleted uranium) weapons were used for the first time by the American and British troops in Iraq. These weapons showed to have high destructive capability which raised harsh criticism among scientists, doctors and environmentalists.

According to the Iraqi Ministry of Environment and The Center of Radiation Protection in 2005; there are hundreds of sites contaminated with nuclear radiation [15], while experts from the United Nations Environment Program UNEP estimated that contaminated sites are thousands [16]. Although Saddam never had nuclear weapons or any well-known nuclear meltdowns, the environmental and the typical area of soil in Iraq has been vandalized by heavy pollution. Many of these harmful sites were collected around major cities like Baghdad and Basra [17].

3. **Bombed into the Stone Age: The Destroyed City of Homs**

After almost 6 years of open rebellion, the city of Homs is back under state control in Syria. The last of the armed opposition groups left their besieged stronghold in the district of Alwaer [18]. Now, the reconstruction efforts can go unimpeded. Before the onset of hostilities in 2011, the city of Homs was home to 800,000 inhabitants - the third largest city in Syria in terms of population. By 2014 however, around 50% of the built structure in the city were damaged. These impacts of this damage and the capacity to rebuild were hampered by a siege that ensued from 2011 till 2014 by the Syrian Government forces when the city was held by
the armed opposition. The city was then recaptured by the Government forces albeit for some resistance pockets that endured until May 2017.

Homs was known for its cultural diversity and unique heritage. This was evident in some of the architectural landmarks in the city like Al-Ablaq mosque which is known for its alternating white and black bricks pattern. These patterns have to be kept in consideration while planning to bring the city back to life. Even before the full withdrawal of the armed opposition, the Syrian states in collaboration with international actors like the United Nations Development program which started to rebuild the city. However, not in a manner that would appeal to the residents of the city, or for those who would be coming back after the cessation of hostilities.

According to the Syrian Ministry of Housing, the Government of the Syrian Arab Republic is gearing up its capacities towards postwar reconstruction in the areas that were recaptured by regime forces. This includes, but is not limited to, disposal of demolition waste and debris, as well as refurbishment of public buildings, facilities, and utilities. This should be made possible by the allocation of funds to acquire the needed equipment from the local as well as international markets (roughly 90 million USD). Part of this fund is to go to the procurement of a number of concrete crushing machines that are to start the recycling process. In the heart of the Syrian city of Homs lays the ancient market which was founded by the Muslim leader Saladin in the 13th century under the Ayyubid Empire and was further developed during the Mamluk era and the Ottoman period too.

The ancient Souq has fallen victim to politics as it was not only damaged by the government troops in 2014 after a two-year siege and near-daily bombardment but its Looters took everything of value, even pricing Roman-era decorative features from walls and doorframes and finally it got abandoned. Now there are members of the United Nations Development Program are working in the damaged alley of the ancient market in Homs as part of the renovation project as the majority of the souk's shops are abandoned for now, with some missing locks or doors, while the walls of others have been blackened by fire or pockmarked by shrapnel or bullets [19].

Ghassan Jansiz, a 44-year-old architect, is supervising the work being undertaken by the United Nations Development Program, and estimates the project will take around two years but so far only 13 shops have reopened out of the pre-war 4,600 retail and commercial shops. Due to the large scale of destruction that has occurred in Homs, careful and thoughtful planning for reconstruction has to take place. Upon the existence of stability that would enable the commencement of large scale reconstruction, some factors need to be included in the process. Taking the example of Berlin and its destruction during World War II, the administration of the city of Homs needs to update their building registry in order to come up with proper assessment of the damage and be able to direct the needed resources for the reconstruction process. This can be achieved by manual, door-to-door counting which will – if carefully conducted – will present more accurate results but over a long period of time. Also, during this phase, assessment and registration of building and construction materials types will give an overall idea about the resultant materials that would be found in the debris.

Salvageable materials should be accumulated in an orderly fashion that would enable their reuse. The Government at Homs has already taken some steps in this direction through the acquisition of concrete crushing equipment that would enable breaking down concrete into aggregate that can be used for paving roads for example. Also, it is very important in the process of reconstruction through construction and demolition waste recycling to estimate the size of non-salvageable materials that would be eventually landfilled. Following the example of Berlin, non-recyclable demolition debris were cleared out of cities and gathered outside them in the form of hill that could be given a green cover that would ease the incorporation of
these huge monolithic structures into the surrounding environment. Also these landfill sites need to be isolated from environmental assets like surface and ground water.

Finally, construction and demolition waste recycling will induce an economic boom in the city as it is a labor intensive industry that will provide jobs for many people and hence help achieve the peace.

4. Conclusions and Recommendations

It is the aim of the authors of this paper is to come up with policy recommendations to be followed in the postwar scenarios in cities. This was done through the discussion of three case scenarios, one from the past, one that is still on going and one that is yet to start. The cases of Berlin, Baghdad, and Homs represent different degrees in the process of postwar reconstruction and remediation of damage inflicted to cities during military actions. The case of Berlin shows the highest degree of maturity and serves as a beacon for other cases. The case of Baghdad represents a different angle to view as the damage was not only inflicted to the physical fabric of the city but also to the social one. And the case of Homs is still very nascent when it comes to reconstruction efforts and poses tangible challenges to all the involved stakeholders.

The destruction of property and buildings is an inevitable part of military operations. However, since that with the increasing tendency of urbanization worldwide and the concentration of population in urban areas, attacks made on such areas should comply with the rules of war expressed through international statutes like the Geneva conventions. Such statutes prevent the unsolicited destruction of property especially when it is undefended. This may sound almost fictional, but it is the duty of the international academic community to press ahead with demanding the cessation of destruction of civilian properties. Decreasing the destruction will naturally decrease the need for reconstruction! After the cessation of hostilities and end of military operations, the authority in charge should seek the immediate relief of any distress to the supply of necessary services and goods that would help the affected population regain their prewar way of life and the alleviation of any grievances that have hitherto been affected by.

This should start with removing any demolition debris choking the mobility of individuals, as well as goods and equipment necessary for reconstruction. It should also include the assessment of the situation of the built environment and the scale of work needed to be done. Looking for available resource in the demolition debris would serve a double purpose; it should minimize dependence on outside resources which may suffer from some delays due to political or logistical reasons. It should also help revitalize the local community through clearing the road network and creating local jobs. Creating jobs will help stabilize the local communities and pave the way for peace. The responsible authority should also make sure that the interests of the people are served rather than dictating policies from a central authority.

Finally the international community should spare no effort to engage with both the local authority and the local population of the affected regions in order to help the reconstruction process achieve its aims, which should be building a prosperous life for the people.

References

[1] F. B. Furgeson "The Birth of War," Natural History Magazine, vol. July/August, pp28-35, 2003. Retrieved on May 13th 2017 from https://goo.gl/LrmKxy.

[2] S. Graham "Cities, War, and Terrorism: Towards an Urban Geopolitics," Blackwell Publishing Ltd, pp 5-10, 2004.
[3] J. Obert "The Development of Siege Warfare in Classical Antiquity", 2013, Academia.edu, Retrieved on May 13th 2017 from https://goo.gl/rKaGZX.
[4] R. Leick, M. Shreiber and H. Sholdt "A New Look at Germany's Postwar Reconstruction", Der Spiegel Online, 2010. Retrieved from https://goo.gl/Rny8Dc.
[5] P.J. Nixon, "The use of materials from demolition in construction", Resources Policy, vol. 2 (4) pp276-283, 1976. Retrieved from https://goo.gl/R0cfDb.
[6] H. Zangana, “And how is Baghdad today?” A Baghdad security wall - and the natural response to such ugliness, 2015.
[7] G. Wessolek, A. Toland "Devil in the Sand - the Case of the Teufelsberg Berlin and Urban Soil Ecosystem Services," Researchgate.net, 2017. Retrieved on June 10th 2017 from https://goo.gl/uKzrEh
[8] Mr. Izady, “Maps and Statistics Collections”, Gulf/2000, 2003/2009.
[9] M. Dawfeq, “Baghdad to remove blast walls around neighborhoods”, CNN: Baghdad Barriers, 2009.
[10] M. Tran, “US builds Baghdad wall to keep Sunnis and Shias apart”, Gated Communities, 2007.
[11] A. Alnasrawi, “The Economy of Iraq”, Oil, Wars, Destruction of Development and Prospects, 1950-2010, Retrieved in May 2017 from https://goo.gl/HX7hYe.
[12] K. Mofid, “The Economic Consequences of the Gulf War”, Iran Economic Conditions 2, Iraq, Economic Conditions, 1990, Retrieved in May 2017 from https://goo.gl/1Ao61R.
[13] “Deserted Places. Abandoned Places and Urban Decay”, Desereted Places: Abandoned Places and Urban Decay, 2013, Retrieved in May 2017 from https://goo.gl/9WCHCi.
[14] O. Vince, “Architecture after Excess: The Palaces of Saddam’s in Baghdad”, Future Failure. Ruin& Dystopia. Space Battle, 2016.
[15] “About UNDP in Syria”, United Nations Development Programme. Retrieved in May 2017 from https://goo.gl/pkcPRZ.
[16] G. Lubin, “Forget Becoming an Oil Power, Iraq Is Actually a Toxic Nuclear Wasteland”, 2010. Retrieved on April 27th, 2017 from https://goo.gl/BwOl4K.
[17] S. Dagher, N. Malas, and S. Slobin, “Syria Shattered | Inside the Battle for Homs, Syria”, 2014. Retrieved from https://goo.gl/9WCHCi.
[18] M. Jansen, “Politics stymies reconstruction of ancient souq in Homs”, UN funding pulled from Syrian project to restore Old City and bring residents back, 2017.
[19] J. Davison "Syrian rebels leave last opposition district in Homs," Reuters. Retrieved on May 27th, 2017 from https://goo.gl/helWJp.
[20] A. Azzoz "Rebuilding Homs: how to resurrect a city after six years of conflict", The Conversation. Retrieved on May 28th, 2017 from https://goo.gl/xJ6cx0.
[21] Albaath Newspaper "Talks on the challenges of reconstruction and the challenges of meeting the demand for housing with the Minister of Public Works and Housing Arnous: an integrated vision for the next stage of construction", Albaath Newspaper. Retrieved on June 3rd 2017 from https://goo.gl/X3gXUS.