

Architectural visions in rehabilitation of quarries and brick factories in Amman: A Case study rehabilitation of Al-Muqabalain industrial zone

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ABSTRACT

The mining and quarrying sector represented by stone sawing and bricks factories is considered as the vital industrial sector in Jordan, due to the fast economic growth, urbanization, and forced migration. However, Bricks and stone sawing resulted in environmental degradations, due to the emission of significant quantities of gaseous and particulate pollutants, besides visual pollution caused by the random distribution of these factories. Hence the importance of this paper lies in examining quarries and brick factories rehabilitation issue within Amman Metropolitan Area. The study is based on comprehensive survey for nine industrial zones, strengthening it via statistical data acquired from Greater Amman Municipality, using as a case study of Al Muqabalain industrial zone. According to survey results, the proposed solutions for the random distribution of stone saw and brick factories in Al Muqabalain area are summarized by either rehabilitation of brick factories and old quarries that are inevitable to transfer through proposed legislative policies or relocation for the factories that cannot be rehabilitated to appropriate alternative site through organized procedures, then decision-making. In this study, Wadi Al-Ish is the proposed alternative site where most of appropriate criteria were achieved. Finally, further environmental recovery studies will be needed to help the use of solid and liquid factories waste, and this is not to be without formation of a committee of stakeholders to develop an applied plan for these proposed solutions.

Keywords: Quarries, Brick factories, Industrial zone, Environmental pollution, rehabilitation.

HIGHLIGHTS

- Stone sawing and bricks manufacturing are essential industrial sectors in Jordan.
- Bricks and stone sawing result in environmental degradations.
- The proposed solutions for the randomness presence of stone and brick factories are either rehabilitation or relocation.
- National legislation frameworks for quarry rehabilitation should be developed.

INTRODUCTION

Amman is one of the oldest cities in the world; it is known as a modern and ancient city. Due to its many bright stone buildings quarried from the surrounding hills, Amman is often referred to as the white city. Architecture in Jordan uses raw materials in the natural environment (as stone, minerals, mud, etc.) and links these materials to the environmental characteristics of the city. Jordan is characterized by availability and diversity of building stone, due to the spread of the rock layers with specifications suitable for construction purposes throughout history (Tarrad et al, 2012). The industrial sector is the main incubator of employment in Jordan; industries include processing, manufacturing, assembling, and storing, with the presence of external storage for waste and materials (containing external operations) causing inconvenience and low probability of emission. The permitted uses are light industries, food industries, fuel

facilities, weaving, vocational training schools, stone sawing and bricks manufacturing, brick and tile factories, animal industries, truck repair stations, and any other similar uses. The mining and quarrying sector, which included bromine, phosphate rock, and potash production, contributes with 2.5% to Jordan's gross domestic product in 2013 (Taib, 2015). Stone sawing and bricks manufacturing are important and essential industrial sectors that have a positive influence on investment; they represent a vital sector of construction, and it is one of the most traditional crafts. Production in the sector depends upon the availability of natural resources in a country (Vintr et al., 2014). The preliminary statistics indicate that the total number of workshops related to this sector is about 1000, extending from stone sawing to marble and bricks factories, located within the industrial zones of Amman city, of which 60% are licensed, which is classified as a medium industries including processing operations, manufacturing, collection, and storing (Great Amman Municipality). The construction sector development of Amman and the horizontal architectural expansion are due to the demand for housing for about 300,000 Jordanians returning from the Gulf, also from immigration movements, which created an urgent need for proper housing that required finding of construction related industries, such as stone saws and bricks industries in and around Amman near the raw materials resources. On the other hand, the existence of a random distribution and spread of these stone and bricks small industries, some being close to residential areas, are not compatible with environmental standards. Bricks and stone sawing result in environmental degradations, due to emission of significant quantities of gaseous and particulate pollutants. Aggregate materials and ornamental stones, extracted mainly via quarrying operations, are used extensively for all construction applications and are essential for the development of any modern economy (Galetakis and Soutana, 2016). Among small scale industries, the brick kiln industry is a booming industry as the demand for bricks is increasing almost universally due to fast economic growth, urbanization, and prosperity) Skinder, 2014). During the production of these materials large quantities of fine by-products/wastes, such as the quarry dust and the marble sludge, are generated (Galetakis and Soutana, 2016). Brown haze is associated with mobile sources, particularly diesel fueled vehicles that are common in Jordan, and white haze is associated with mining and quarry activities and rock (limestone) cutting; tons of rock powder become fugitive dust carried by wind in all directions around the quarries (Abu-Allaban et al, 2006). The stockpiling and disposal of this fine by-product is one of the most important problems facing the quarry industry today (Galetakis et al, 2012). The impact of the waste that is being generated from the pre-extraction process, proper extraction processes, and post-extraction processes that would depend on some variables. These variables are dependent on the location of the quarry, that is, whether the quarry is cited in a forest, a desert, an uninhabited farm or active land, near or within a local community, or a city (Ogan et al, 2016). In January 2014, the joining of Amman to the one-hundred flexible city network was announced that is managed by the Rockefeller International Foundation, where it has been selected out of 300 cities that had participated in the second challenge to the one hundred flexible cities. This program aims to enable one hundred cities around the world to improve their ability to deal with shocks and pressures growing continuously. The flexibility of the city is defined as the ability of individuals, communities, institutions, companies, and systems to survive, adapt, and grow regardless of the constant pressure and sudden crises faced by the city. By joining the city of Amman for a network of 100 flexible city, it will be focused on the priorities of infrastructure, environmental, and social structure, as the accelerated increase in the numbers of the population, which has grown from 1.9 million in 2004 to about 4 million in 2016, led to great pressure on infrastructure of the city and on its ability to provide basic services, especially electricity, water, environmental health, and public transport services. National legislation frameworks and specific provisions for quarry rehabilitation tend to be 'dynamic', quickly changing to higher level, and consequently more demanding. It is good to establish a base-line of requirements, in the form of guidelines that could-today-be over and above the legislation for each country, but-in general terms-should cover the needs of operating for tomorrow in many countries (<http://www.wbcsd.org/Projects/Cement-Sustainability-Initiative/Resources/Guidelines-on-Quarry-Rehabilitation>, 2011, accessed 27.3.2017). Now, it is an established fact that small scale industries are one of the major contributors to atmospheric pollution in environment; therefore, the importance of this research is to maximize the advantages and minimize the harmful environmental and societal impacts of these industries to reach the desired level of perfection, by applying environment friendly and effective alternative solutions, which will help build pollution free city, through prospective policies that protect mining and quarry resources.

METHODOLOGY

Study area of this research is the eastern part of Amman, where most of quarries and brick factories are distributed, in addition to many other quarries sites scattered within the existing urban area as shown in Fig. 1. This research is based on both primary and secondary sources of data. Primary data has been collected through diverse field observation, comprehensive survey through interviews with the owners and managers of the sampled quarries and brick factories; and intensive questionnaire survey has been conducted with people who live around quarries and brick factories zone. Besides that statistical data have also been sourced from Greater Amman Municipality.



Figure.1. Geographical setting: distribution of industrial zone in Amman. Source: GAM, 2015, adapted by author

This study was performed on three phases: **phase 1**, preliminary observations for different industrial zones in Amman; **phase 2**, a detailed study of nine industrial zones using Al Muqabalain zone as a case study; and finally **phase 3**, proposed solutions comprised with proposed legislative policies were developed.

Preliminary observations on the industrial zones

A field survey has been carried out in different industrial zones distributed in Amman, where initial observations and many of photos have been taken to a different existing factories and quarries. In addition, aerial images show industrial land boundaries, including the built-up area and vacant plots for each industrial zone with the assistance of the Municipality of Amman. The objective of this phase is to define where most of quarries and brick factories are distributed, in addition to many other quarries sites scattered within existing urban area, and its environmental and visual pollution resulting consequences.

Field survey

Field survey questionnaires were distributed to nine areas of Amman (Shafabadran, Swuayleh, Wadi Al-Seer, Bader, Al Muqabalain, Al Qwaismeh, Khrabeet Al-souq, Marka, Sahab). The questionnaire contained many quantitative and qualitative questions that discussed various issues such as classification of quarries and factories, land ownership, number of factories on the land, stone and bricks workshops areas, status of buildings, vocational licenses, and the raw material resources.

A detailed study of Al Muqabalain industrial zone

Al Muqabalain is a district in Amman Governorate in north-western Jordan, where most of quarries and brick factories are distributed randomly, and scattered within existing urban area. Numerous interviews and inquiries were conducted with a number of industrialists and entrepreneurs in Al Muqabalain zone. Frequent visits to Al Muqabalain

zone were conducted to gather information about the current state of the existing industries with the help of great Amman Municipality. Detailed surveys were carried out focusing on critical points such as the places where brick, tile factories, and stone quarries aggregated in this area, the status of license, the presence of certain factories in the streets, and the possibility for rehabilitation of these factories.

The proposed solutions

Proposal planning framework comprised of the proposed legislative policies for Al Muqabalain industrial zone was planned to protect environmentally or socially significant areas by supplying necessary infrastructure.

RESULTS AND DISCUSSION

Fig .1 indicates the distribution of the main industrial zones in Amman, which are Al Muqabalain, Al Qwaismeh, khrabeetAlsouq, Bader, Marka, Sahab, Wadi Al seer, Swuaylieh, ShafaBadran.

Preliminary observations on the industrial zones

It is noted in the aerial view of the main industrial zone that some zones are completely overcrowded with large built-up areas like Al Muqabalain and Swuaylieh zones, while others are less overcrowding with the presence of acceptable vacant plots like Marka and Wadi Al seer zones; see Fig.2 a, b ,c ,d.

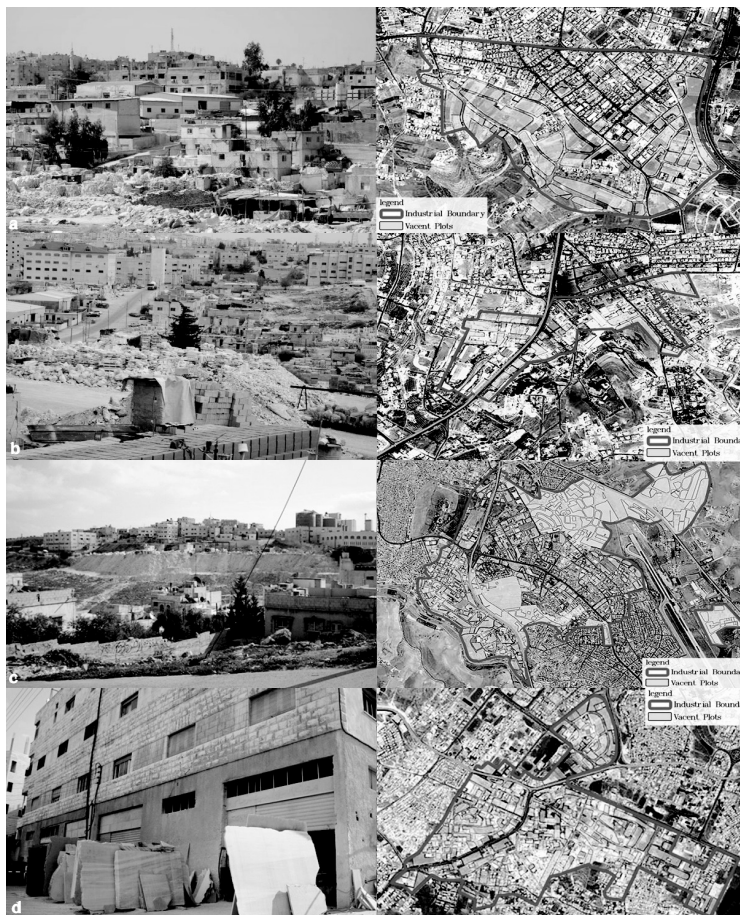


Figure.2. Sweileh industrial zone. b) Wadi Al-Seer industrial zone. c) Marka industrial zone. d) Al Muqabalain industrial zone. Source: GAM, redrawn and presented by the researcher

The existing conditions of these industrial zones did not take into account the environmental requirements; visual pollution is resulting from the dumping of stone saw waste in the surrounding environment as shown in Fig. 2b. It is clear in Fig. 2d that there is an overrun on the pavements and in some cases on the streets for the purpose of storage or display materials; in addition, land uses for these industrial zones are contrary to authorized use adopted by Great Amman Municipality plans; compatibility with the adjacent usage was not taken into account; it also shows the mixed uses of lands (Fig. 2c). Finally, the total area of these industrial zone is not sufficient and this led to overcrowding in quarries and factories (Fig. 2a), which was created temporarily as a result of an urgent need for proper housing that required finding of construction related industries near residential areas, such as stone saws and bricks factories in and around Amman due to immigration movements, in addition to being the regions of raw materials resources. This indicates that these zones are not planned as industrial cities, but it was created legacy.

Field survey results

Table.1 shows the distribution of 988 brick and tile factories in addition to stone and marble quarries in different industrial areas in Amman. Clearly, the highest presence of these factories and quarries is in Al Qwaismeh, 286 factories, followed by Sahab, Marka, and Al Muqabalain, respectively. On the other hand, Shafa Badran has the lowest presence of factories in a rate of 11, all of which are tile factories.

Table.1 Classification of quarries and factories in different industrial zone

Industrial zone	Total number	classification of quarries and factories				
		Stone quarries	Tile factories	Brick factories	Marble quarries	Mixed kilns
Al Muqabalain	129	29	13	48	6	33
Bader	18	2	1	1	8	6
Sahab	262	143	1	36	1	81
ShafaBadran	11	0	11	0	0	0
Wadi Al-Seer	27	5	1	10	10	1
Khrabeet Al-souq	17	7	0	7	1	2
Al Qwaismeh	285	91	51	117	19	7
Marka	199	24	7	121	8	39
Swuayleh	33	9	0	9	9	6
Total	981	310	85	349	62	175

Regarding quarries and factories classification, Sahab had the highest presence of stone quarries in addition to other mixed factories, while Al Qwaismeh had the highest presence of tile factories and marble quarries; finally, Marka had the highest presence of brick factories. It can be observable that brick factories had the highest presence in all industrial zones, 349 out of 988 different factories. Figure 3 highlights important information about industrial land ownership, as it seems that the number of rented stone saws and bricks factories in all industrial zones far exceeds the number of owned ones, and this is a good indicator that the possibility of relocation and rehabilitation of infringing quarries is available.

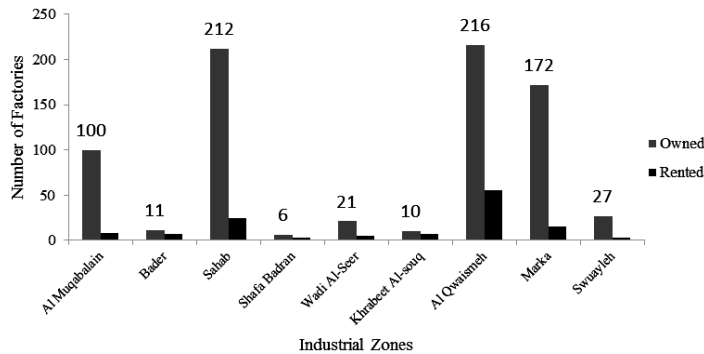


Figure 3. Industrial zones land ownership.

In figure 4, we find that 61 % of these quarries and factories distributed in Amman are licensed for a medium industrial uses, while 39 % of them are unlicensed. Table 2 shows more details.

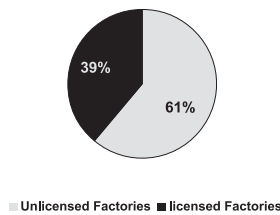


Figure (4). The proportion of licensed factories to unlicensed ones.

As shown in Table 2 115 of stone saw and brick factories in Al Muqabalain are not licensed, and we infer that from the random distribution and mix uses of lands, which has a significant impact on the environmental and visual pollution afflicting this region.

Table.2 Vocational licenses for quarries and factories on industrial zones

Industrial zone	Number of factories	
	Unlicensed	Licensed
Al Muqabalain	115	8
Bader	4	14
Sahab	90	177
ShafaBadran	10	1
Wadi Al-Seer	0	27
Khrabeet Al-souq	0	13
Al Qwaismeh	130	154
Marka	24	174
Swuayleh	4	27
Total	377	595

In Sahab 177 of stone quarries are licensed; nevertheless we note the presence of 90 other stone quarries and factories that are unlicensed, and this indicates the presence of a large number of factories that contravene licensed uses and must be closed than relocated. The largest number of unlicensed factories ever found is in Al Qwaismeh, which is almost equal to the licensed ones. There is a randomness presence in the distribution and uses, which means that these factories and their various uses are not compatible with the legislative regulation used in Amman Municipality, so there is a need for a joint effort to correct this problem. On the contrary, in Marka industrial zone we note that most quarries and factories are licensed for industrial uses and this is considered as an eligible industrial area, due to the little observable randomness in land uses and factories distribution.

The workshops areas in different industrial zone were represented in Table 3; it is clear that Sahab industrial city is known of a large spread of stone saw and brick factories, where 149 of its workshops are ranging between 500 and 1000m² and this area is not appropriate for such factories, while 105 of the workshops in Al Qwaismeh zone are ranging from 200 to 500 m² also this area is inadequate for such industries, which consequently leads to infringement on the roads and streets borders resulting in environmental and visual pollution. This can be linked to the previous table, where a large percentage of factories are not licensed in this region due to the lack of sufficient space for such factories. On the other hand, in Marka it can be observable that the number of workshops is built over an area of 1000 m², which is significantly great compared to the other industrial zones, where most of the factories and quarries are licensed for industrial uses as mentioned earlier, which is a good indicator of suitability of these areas for such industries; it is considered to be an environmentally eligible zone

Table .3 Stone and bricks workshops areas m²

Industrial zone	Stone and bricks workshops areas m ²				
	Less than 200	200-500	500-1000	1000-1500	More than 1500
Al Muqabalain	3	24	62	22	6
Bader	2	3	11	1	1
Sahab	3	8	149	43	38
ShafaBadran	0	0	2	1	6
Wadi Al-Seer	2	15	6	0	2
Khrabeet Al-souq	0	13	4	0	0
Al Qwaismeh	13	105	98	1	11
Marka	5	9	76	56	54
Swuayleh	3	9	22	0	3

We can see in Fig. 5 that most of the existing factories in industrial zone are old, 84%, while 16% of the total factories are new, and this helps us in determining quarries and factories that can be either rehabilitated or must be relocated based on their status, taking into account the need to preserve quarries with cultural heritage value.

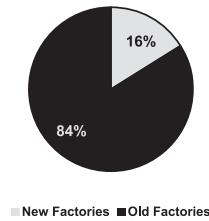


Figure .5 Status of quarries and factories.

Fig. 6 indicates the most important raw resources of stones, bricks, tile, and marble. Wadi Al Ish and Kassarat Sahab are the most important zones that provide the raw resources for all industrial cities in Amman, and also they are considered the closest areas to them. They are located within the boundaries of the entrances of Amman city near the main corridors that serve adjacent zones, while Ruwaished and Ma’an areas are considered the most important resources that supply industrial factories with the raw materials in southern Jordan.

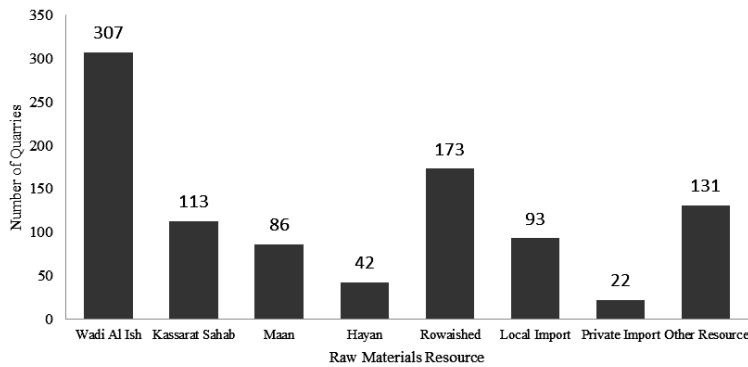


Figure .6 The raw materials resource.

A detailed study of Al Muqabalain industrial zone

After conducting numerous interviews and inquiries with a number of industrialists and owners of the industrial factories in Al Muqabalain area, they all confirm the axes of rehabilitation process of these industrial zone near populated residential areas are to give it a description of manufacturing industries so as not to affect the neighbors. Great Amman Municipality pointed out that most of industrial areas in Amman are inherited and that there are overlap between the industrial, housing and overlap between the same industries where there are food industries as well as stone and cement factories, which necessitated proposed rehabilitation studies. Rehabilitation of industrial zones lies in the process of development and reorganization of an open space alternative site just for industrial use to avoid the negative overlap between the mix uses. Great Amman Municipality emphasized the need to relocate of brick, stone and marble factories in Al Muqabalain area into an new industrial zone determined within certain criteria to be discussed later on by the fact that these factories pose environmental threat and cause a constant nuisance for the entire population, besides the fact that the location is not commensurate with the physical and demographic applied regulation for this zone.



Figure.7 Sketch map for quarries and factories distribution in Al Muqabalain zone. Source: GAM, redrawn and presented by the researcher.

As shown in Fig. 7 there is a wide spread of brick and stone saw factories near residential neighborhoods on an area of approximately 300 acres. These industrial facilities, which are centered in plot number 49 in Fig.7 at the east side of Al Muqabalain area, cause several environmental impacts such as distortion of the area aesthetic view and noise pollution due machinery and equipment. Brick factories and stone saw infringe the authorized use of the land, knowing that these lands are classified for light industries only. Another problem lies in um Qusaier area, shown in Fig. 8. The brick factories are built along the sides of main street, where infringement on the streets is evident through the dumping of waste and sand that are causing closure of some streets and routes. The following enclosed streets are Abu al FathAjlouni Street, Alsbar Street, Ali Hussein al-Omari Street, South Hashemite Street and others. Besides that, in some cases one plot of land has more than one establishment up to 24 factories and more than half of it is unlicensed or illegal.



Figure .8 Sketch map for the closed streets in um Qusaier area. Source: GAM, redrawn and presented by the researcher .

Table 4 shows a wide spread of brick factories representing up to 41% of the total quarries in Al Muqabalain zone. Knowing that most of Al Muqabalain plots are organized as light industries uses, and this means that these workshops (saws stone, brick and marble) with their mixed uses are mostly unlicensed and not compatible with the authorized uses. Brick factories and quarry areas need to be compatible to surrounding land uses and not infringe on residential, public zones.

Table .4 Classification of quarries and factories in Al Muqabalain zone

Type of Factories	Quantity	Percentage (%)
Closed	3	2
Stone Saw	19	11
Brick Factories	68	41
Tiles Factories	21	13
Marble Factories	18	11
Stone Saw and Other	11	7
Brick Factories and Other	17	10
Tiles Factories and other	10	6
Total	167	100

The total number of existing quarries and factories in AlMuqabalain zone is 167 facilities, of which 44% are authorized facility and 37% are unlicensed business establishment. As shown in Fig. 9, this high percentage of unlicensed factories return to the fact that most of these factories, which do not exceed one acre, include usually more than one establishment, and this means infringement of these factories for the regulation of land uses. This classification is considered an initial successful step taken by the government to regulate these areas to confirm the need for relocation of these factories.

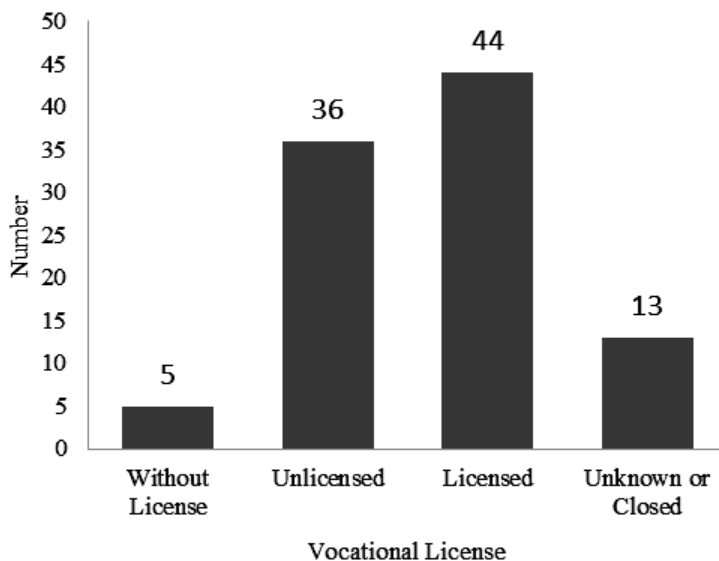


Figure.9. Vocational licenses for quarries and factories in AlMuqabalain zone.

As shown in Table 5, the survey identified quarries and factories that could be rehabilitated and reorganized without transfer them under the terms of the approved regulation and licensing by study of an environmental audit of these sites, which represent 81 % of the total factories, while 19% of the quarries and factories should be relocated, and that needs processing of an alternative sites based on environmental study, which includes preparation of infrastructure for the new vocational city, which will absorb all the saws stone, brick, and marble factories.

Table 5 Possibility of rehabilitation

Possibility of rehabilitation	Number of quarries and factories	Percentage %
Factories can be rehabilitated	135	81
Factories must be relocated	32	19
Total	67	100

Finally, the proposed solutions for the random distribution of stone, brick, and tile factories in Al Muqabalain area are summarized by either rehabilitation or relocation through organized procedures, then decision-making. In case of relocation, criteria for the appropriate site must be specified first.

A Proposed rehabilitative plan for Al Muqabalain industrial zone

A proposed rehabilitative plan should be developed by a joint effort between several concerned organizations and institutions, in order to improve aesthetic and city views and to reduce environmental impacts and related pollutions. Rehabilitation programs have received serious attention in various parts of the world in recent years due to acceleration of mining and associated land disturbance (Toy and Griffith, 2001). Quarries and industries that can be rehabilitated and reorganized should be determined without moving them under the terms of authorized regulations and licensing through environmental audit of these sites. Criteria of action plan for licensable sites should be developed and determining rehabilitation requirements and reorganization, regarding the old quarries and factories that are difficult to relocate. The most important criteria for quarries rehabilitation are as follows:

- Legislative control:
 - Encourage all quarries owner to get licensed and work according to government rules.
 - Enforce other measures such as environmental or air pollution control regulations.
 - Legislation that can protect environment from through quarries wastes in streets.
- Environmental & Air Pollution Control:
 - Propose air pollution control regulations.
 - Recycling of rock waste materials, the after-use of quarries increases public acceptance of quarrying and show that the former quarry sites are not merely degraded areas, but can give added value to the land and act as a catalyst for development of a region (Lintukangas, 2012).
 - Landscape suggestions of depleted rock area or rock exhaust area
- Economical control
 - Legally registered quarries will be tax and this would improve government revenues.
 - If quarries reduce pollution, government can reduce taxes.
- Modern Techniques
 - To raise awareness of modern quarries techniques of cutting and processing stone using water to reduce air pollutant from stone.

In Fig.10 zoning was done for the spaces where the residential buildings were integrated with each other and a green space was created to serve the area and reduce environmental pollution caused by mining and quarrying. The residential buildings were also separated from the industrial zones through the commercial buildings.

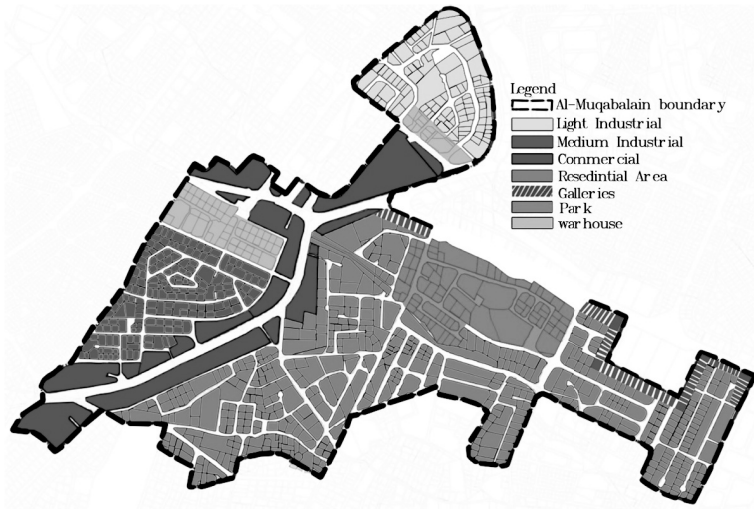


Figure.10 Proposed rehabilitative plan for Al Muqabalain industrial zone. Source: designed by the researcher

The industrial buildings have been rehabilitated; two independent zones have been established for light and medium industries. They are connected to each other by warehouses and stores far away from the residential buildings and serviced by external roads, whose design helped reach industrial zones easily without passing through residential area, in addition to setting up galleries around the main roads serving the area and adjacent zones.

Proposed alternative site for relocation

It is difficult to expand the rehabilitation and reorganization process, ideally, the transition to fitted infrastructure alternative sites as quickly as possible to the factories and quarries that are inevitable to transfer. In the case of the relocation decision, factories that cannot be rehabilitated or reorganized should be identified; their licenses must be stopped until the alternate location is determined. This procedure is followed by a relocation warning during a specified period. Criteria for the appropriate relocation site are mainly plots with large open space, close to the main roads, away from the organization or inhabited areas with suitable site topography, besides their proximity to the main raw resources. In this study, proposal alternative site for Al Muqabalain industrial zone was chosen based on the obtained results. As it is clear in fig. 11, Wade Al-Ish is the proposed alternative site where most of appropriate specifications can be achieved, of which is the presence of a large open spaces far from residential areas with proximity to the raw materials resources, since Wadi Al-Ish is considered the major resource for raw materials that supply most of industrial zones in Amman as explained in Fig. 6.



Figure.11 Proposed alternative site plane for Al Muqabalain industrial zone. Source:

GAM, redrawn and presented by the researcher

The aforesaid studies have revealed that many quarries are located near rock formations that are geologically exploitable, thus facilitating the transformation of the involved areas, very close to sites for the extraction and production of building materials, as devoted to a new urban expansion (Dal Sasso et al., 2012). More importantly, the region is served by the new main ring road that represents Amman's main corridor with quick access to all main industrial zones in Metropolitan Area. See Fig.12

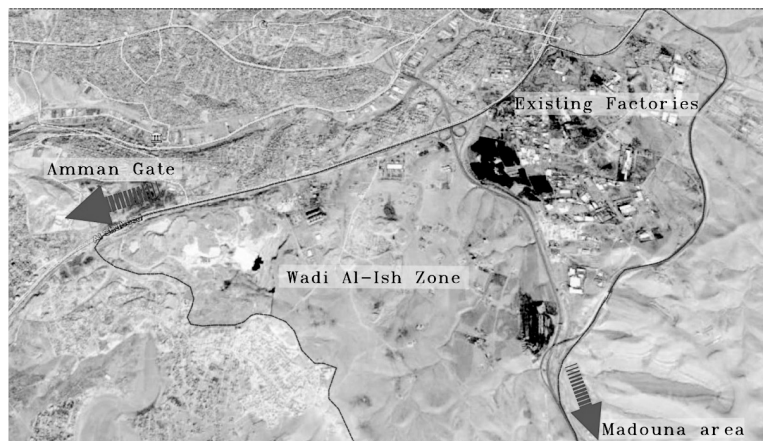


Figure.12. Aerial view of alternative site for Al Muqabalain industrial zone. Source:

GAM, redrawn and presented by the researcher.

A successful rehabilitation outcome is more likely when the organization is structured to support the process of designing and implementing the plan. An individual role with overall responsibility for both rehabilitation plan and each action plan should be identified and appropriately resourced (<http://www.wbcso.org/Projects/Cement-Sustainability-Initiative/Resources/Guidelines-on-Quarry-Rehabilitation>, 2011, accessed 27.3.2017).

Factories and institutions must provide adequate financial resources and more to ensure the dynamic application of rehabilitation plans. In addition, successful collaborative work between quarries factories and Great Amman Municipality would effectively implement rehabilitation plan objectives and regulatory rules. Among the most important collaborative aspects are adherence to properties setbacks, developing safe sidewalks, and designing a distinctive stone façade to get out of visual pollution, on the other hand as publicity sign for the factories through manufactured stone materials used on its building stone facade, as well as a green space of not less than 30%. In recent years there is an increasing demand for green areas and amenity spaces in urban centers due to recreation needs and growing environmental awareness. Green spaces provide aesthetic, ecological and economic benefits (Damigos and Kaliampakos, 2003). Fig. 13 represents an example of individual initiatives by the owner of one of the largest stone saws in Al Muqabalain zone; he suggests doing a new design for the main facade of his factory, where the researcher draws a proposal design based on owner views and suggestions by changing the architectural configuration of the building shown in Fig. 13a; the general appearance was improved through the use of basalt stone manufactured in the factory for facade design. The entrance is designed as a vault shape using brick materials and fair face to make it distinctive landmark, in addition to planting around the building to increase its aesthetic value as it clear in Fig. 13b.

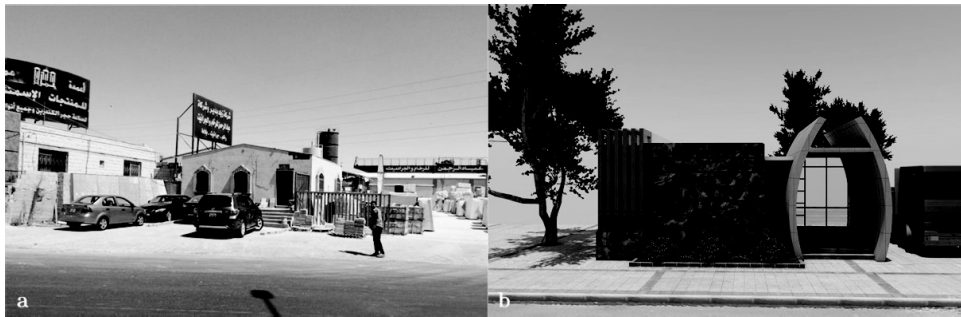


Figure.13 .The current status of the existing stone saw factory .proposal design for the stone saw factory. Source: designed by researcher.

Exploitation activities require an enforcing regulation of environmental rehabilitation of both dumps and quarrying areas: soil stripped during exploitation phases has to be separated from the waste rocks, and it should be saved for the subsequent vegetation re-establishment in the quarry area (Neri and Sanchez, 2010).

An Alternative site should be processed by environmental and sustainable study for site development and outfitted as possible with the requirements to deal with quarries and factories waste, to take advantage of them and, furthermore, encourage environmental studies that help in the use of solid and liquid waste, attempting to provide appropriate funding to them. Recovery in manufacturing in industrialized economies has increased the demand for inputs worldwide (Fugiel et al, 2016). Many previous studies have pointed out the possibility of benefiting from the remnants of quarries and factories through their use in the manufacture of other useful materials, including materials used for agriculture .Quarries and brick factories produce huge amounts of waste that has a potential for recovery. Waste from stone and aggregate quarrying industry represents a serious environmental and economic problem in view of the difficulties related to its disposal, especially of the finest fraction. Although some attempts have been made to investigate possible reuse of these materials, little is known about their potential as components of a cultivation substrate (Luodes et al, 2012). The formation of a committee of stakeholders to develop an applied plan for these proposed solutions is the first step in the implementation process.

CONCLUSION

It is clearly visible that there is a negative overlap between the industrial, housing land uses, as well as a randomness presence in the distribution and deployment of brick and stone saw factories in Amman industrial zones. The study has revealed that these industrial zones and their various uses are not compatible with the zoning regulation and land use in Amman Municipality; it is inherited due to the forced demand for housing for Jordanians returning from the Gulf and other migrations. As known, the Production of brick and stone sawing results in environmental degradation due to emissions of significant quantities of particulates and gaseous pollutants, besides visual and social pollution caused by the random distribution of these factories within residential areas, which necessitated proposed rehabilitation studies. Our study identified factories' sites that could be rehabilitated and reorganized without transferring them under the terms of the authorized regulation and licensing with the study of an environmental audit of these sites, as well as the quarries and factories that must be relocated, and their need to an alternative sites far away from residential areas, based on environmental study, which includes preparation of infrastructure for the new vocational city that will absorb all saws stone, brick, and marble factories. Finally, proposed solutions are summarized by either rehabilitation or relocation through organized procedures that need to be supported by a committee of stakeholders to develop an applied plan.

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رؤى معمارية في اعادة تأهيل محاجر ومصانع الطوب في عمان : حالة دراسية لمنطقة المقابلين الصناعية

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الخلاصة

يعتبر قطاع التعدين والمحاجر المثلثة بمصانع نشر الأحجار ومصانع الطوب القطاع الصناعي الحيوي في الأردن، وذلك بسبب النمو الاقتصادي السريع والتحضّر والهجرة القسرية. حيث نتج عن انتشار مناشير الطوب والحجارة في الأحياء السكنية إلى انحطاطات بيئية وتدهور كبير بسبب انبعاث كميات كبيرة من الملوثات الغازية والجسيمية، إلى جانب التلوث البصري الناجم عن التوزيع العشوائي لهذه المصانع. ومن هنا جاءت أهمية هذه الورقة في دراسة مسألة إعادة تأهيل المحاجر وإعادة تأهيل مصانع الطوب داخل منطقة العاصمة عمان. واستندت الدراسة إلى مسح شامل لتسع مناطق صناعية وتعزيزه من خلال البيانات الإحصائية التي تم الحصول عليها من أمانة عمان الكبرى، وذلك باستخدام دراسة حالة لمنطقة المقابلين الصناعية. ووفقاً لنتائج المسح، فإن الحلول المقترحة للتوزيع العشوائي لمناشير الحجر ومصانع الطوب في منطقة المقابلين يتم تلخيصها إما بإعادة تأهيل مصانع الطوب والمحاجر القديمة التي لا مفر منها لنقلها من خلال سياسات تشريعية مقترحة أو نقل للمصانع التي لا يمكن إعادة تأهيلها إلى موقع بديل مناسب من خلال إجراءات منظمة ثم اتخاذ القرارات. في هذه الدراسة، وادي العش هو الموقع البديل المقترح حيث تم تحقيق معظم المعايير المناسبة. وأخيراً، ستكون هناك حاجة إلى مزيد من دراسات والبحوث البيئية والمعمارية المستقبلية للمساعدة في استخدام النفايات الصلبة والسائلة المصنعة، وهذا لا يكون دون تشكيل لجنة من أصحاب المصلحة لوضع خطة تطبيقية لهذه الحلول المقترحة.