

Sustainable Architecture and Urban Planning with a View to Recycling and Renewable Resource Management

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Abstract

The increased removal of mines and rivers to supply construction materials has caused environmental damages to mountainous and rivers; this has reached to the point that not only wildlife but also the lives of today's generations and future generations have been faced with challenges or even dangers. Although many efforts have been made for the recycling of mineral materials, all these efforts have not resulted in the reuse of construction's waste and this is a wakeup call for architects and engineers of building industry, in a way that if we don't think about changing our method of exploitation of limited natural resources and do not guide our architecture towards the use of local, renewable and sustainable architecture, our future generation, in addition to the problems of their age, must also endure the problems that we have caused. However, we can act like generations before us, and with deliberate decisions on sustainable architecture and urbanism create a good future for our children. Our ancestors created countless works of vernacular architecture with local materials matched with sustainable architecture without having to destroy the environment. Indeed, what is the heritage of today's architecture in terms of architecture's identity for the next generations?

Keywords: Recycling; Mining; Sustainable architecture; The environment; Concrete; Wood

Introduction

When we look at the history of Iran, we are faced with more than seven thousand years of ancient civilization. It is better to ask this question; what would have happened to us now if those civilizations and people did what we do today with the resources of gas, oil, mining, rivers, mountains and forests of this land? Would we still discover new sciences or we preferred to abandon the land and take refuge in other countries because of not having non-renewable resources? Why are we playing with the future of our next generation who are our children? Evidence of this issue can be observed in various industries ranging from automotive, agricultural and construction industry which are non-normative, non-native and anti-sustainable architecture and urbanism and cause the waste of water and mineral and fossil resources from production cycle to consumption- resulted from failure to comply with the principles of sustainable architecture with local materials. Thinking about the behavior of residential buildings of the present age which account for the largest share of the Building industry, we realize that it is not at all principled and cost-effective to have long-term and short-term constructions and maintenances which do not obey the principles of sustainable architecture and urbanism especially In today's world that its Energy and Mineral Resources are getting more limited.

The Effects of Mining on the Environment

According to the reports of the Ministry of Urban Planning, in recent years, the required materials of our country and developing countries in the building industries are achieved more through mines and riverbeds and this too much demand has caused many problems in the field of environment. We know very well that the majority of mines are in mountains and these mines which are being extracted by open pit and underground mining methods cause irreparable damage to the fields. We should know how the mountain systems work and what their impacts on Earth's ecosystems are and what damages will be faced if we disturb this ecosystem [1].

The impact of human activities on mountains' ecosystems compared to any other ecosystems, raises critical situation at a pace faster than

any other ecosystem. Destruction of protective vegetation, especially in steep areas of mountains exacerbates erosion. The characteristic of all mountain ecosystems is that they are restored poorly and their recovery - if destructed - is very difficult and sometimes impossible. Today, human societies are in need of care and protection of the mountains more than ever for their survival. Mountain ecosystems' function is very impressive in moderating the temperature; because of this feature, they cause different bioclimatic conditions in High Mountain belts [2].

In a recent survey of environmental and mountains scientists, the threats to mountain are classified into five factors; the first factor is the cleanly shaven vegetation of mountain system. Indiscriminate exploitation of mountain forests continues today with unprecedented intensity and the protective layer of mountainous areas are increasingly being reduced. Control of deforestation in mountainous areas is of special importance because the conditions make it difficult to revive its growth limits and also the non-protection of mountainous areas immediately put them at risk of erosion.

Erosion of mountains affect the production of desertification; in addition, it has the most significant role in the destruction of the mountains today even more than livestock grazing, road construction, mountain tourism. So far, the restoration after the operation, was less common; in the estimation of costs and revenues of Mining, costs of environmental restoration is not considered. The consequences of the operation of the mines is severe and its harmful effects are widespread. Destruction of vegetation, soil erosion, reducing the value of

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landscapes, damages to habitats and cultural resources, and reduction of wildlife populations, are among conventional effects of these types of activities. This kind of simple and negligence development only considers the moment profit and the long-term consequences for people, i.e. the present or future generations are not taken into account. It is dangerous to be indifferent towards water and soil, the country and the people and national values [2].

It should be noted that the architects and engineers also have an important share in this issue. Unfortunately, mine exploitation, especially without high technology and with high waste of materials and no actual survey on the real need of construction industry, the lack of Hierarchy of Needs of Housing, dropping native architecture, Make architects also be considered as one of the perpetrators of current conditions because such indiscriminate exploitations are the results of designs of architects. Unfortunately these damages are not only specific to mountains but are also observed in the destruction of water transmission areas such as river basins. One of the physical effects of river materials' exploitation on the environment can be expressed in this way; the exploitation of sand and gravel from the river can cause erosion of the bed, instability and destruction of existing structures in the river and other adverse consequences. Pitting in the riverbed, cause severe erosion in the upstream and downstream of the exploitation point. Because the pitting leads to the imbalance between the amount of sediment and their transport capacity by the river. The accumulation of sediments in the upstream bed of the cavity increases the tilt position; As a result, the water flow rate is increased and severe erosion is caused in the upper cavity. Table 1 shows the effects of sand and gravel mining of the rivers and the environment (Table 1). Also, these influences have irreparable effects on the plants of the rivers; in a way that plant communities may be destroyed physically by dredging, cutting, or sand exploitation. The researches of Brunt et al. shows that the plants located on the riverbank have been changed up to 10 to 15 meters and in some places up to 100 meters on either side of rivers faced with the exploitation of sand and gravel activities. Table 2 shows some of the effects of mining on the river's plant community (Table 2).

But sand and gravel mining can affect the environment of waterways from aspects such as supplying the food chain of aquatic plants and water populations and in the highest grade may affect the life of fish and mammals. In addition to the direct loss of habitat's quality and increase in the turbidity currents, sand and gravel exploitation may temporarily reduce light penetration in the water column. Water turbidity and deposition of silt and sludge in the lower classes and unstable river bed causes the population of aquatic plants such as algae and macrofite be reduced [3].

Now, reflecting on the fact that excessive extraction of sand from riverbeds In addition to the environmental impact and destruction of the environment and wildlife has had a negative impact on the streams of water on the planet, it is realized that In summing up the overall cost-effectiveness and economic feasibility of harvesting from natural raw materials in the long run is not achieved. That's why the researchers and practitioners in the field of environmental and industrial engineering, construction and mining have focused on the issue of recycling of materials. Because construction waste in developing countries has accounted for a large part of the city waste have undesirable consequences on the environment. The volume of construction of waste is to the extent that now not only in Iran but also in the developed and developing countries, it is considered to be a social and environmental problem. Construction debris and non-normative disposal of them has created many problems for cities the

most important of which are: Environmental problems, health issues, the need for a place to landfill, creating inappropriate land scape.

Recycling of concrete and its problems

Based on conducted researches, the highest volume of debris is caused by the concrete. A lot of researches are conducted about the possibility of using recycled concrete in new concrete, and some criteria are offered for the use of recycled concrete in new concrete. The use of recycled bricks to make brick and concrete blocks by molding, has attracted the attention of many researchers. In this regard, research centers, such as American concrete Institute (ACI) have provided guidelines for concrete demolition methods and using of it in new concrete [4].

Europe Demolition Association (EDA) released a report in 1992 in the field of recycling of construction debris in 9 countries of Europe. The report states that in European countries, recycled materials are used for road infrastructure. Studies in the UK show that in 1980, 20 million tons of building debris are disposed in the UK. This mass contains 50

Subject		Damage	The impact domain
	Sequestration of particulate matter	covering of the river bed and habitat	Fishing, Natural Resources, aquatic plants, the loss of beach's beauty
Short term	Water column's turbidity and suspended solids	Declining water quality	Biological contamination, fish migration, natural resources, aquatic plants, beautiful beaches
	The disappearance of wild and marine bottom dwellers	Food sources of fish	Removal of storage, reduction of the reproduction of species dependent on aquatic plants
	Physical pollution	Oil spills, noise, dust	Sailing, fishing activities, recreational, aesthetic and wildlife
	Destruction caused by sand and gravel exploitation from the bed	Destruction of bed	The loss of suitable habitat for spawning, threatening of the biodiversity, reduced natural reproduction, migration decrease migratory and semi-migratory fish
Long term	Bed and river bed elevation changes	Exacerbation of floods, interference of fresh and salt water, erosion and sedimentation	Tidal changes, natural resources, fish stocks, fishing, shipping, beautiful environment,

Table 1: Potential damages caused by sand and gravel mining on the environment (environmental regulations of exploitation of river materials, Publication No. 563, 2011).

Process	Impact
site preparation for the exploitation	Direct removal of vegetation due to river activities
Removal of river materials	Reduced light penetration due to the suspension of sediments, and reduced plant production due to reduced photosynthesis consequently
	Oxygen reduction in habitat
	Turmoil in the plant environment due to air pollution and dust resulting from this process
Production and transportation of materials	Destruction of vegetation cover in the direction of transport

Table 2: Examples of the effects of sand and gravel mining on river plant communities (environmental regulations of harvesting of river materials Publication No. 563, 2011).

to 55% Concrete 30% to 40% Building materials and a small percentage of other materials such as iron, glass and wood. English researchers in 1985 have estimated that if this debris is recycled as sand and gravel, the demand for natural resources will be reduced by about 10 percent [5].

The use of construction debris as raw materials in the construction industry is no easy task because:

- a) Although there are a lot of waste, but there is no technical knowledge for using them.
- b) As soon as debris are found useful, their price would increase and their advantage as cost effective raw material would somewhat disappear.
- c) All debris cannot be used as a building materials which be replaced by conventional materials.
- d) Use of debris requires special technical guidance and standards.
- e) Use of debris need its own health and safety measures.
- f) Some construction debris may harm other surrounding materials, such as plaster when being placed next to the concrete.

But despite these problems, the issue of protecting the environment and reducing pollution, as well as a commitment to future have made the researching to be inevitable [5].

A sample of comparing the recycled materials can be observed from the data in Table 3.

Yet it can be concluded that after 14 days, the compressive strength of recycled concrete made of recycled aggregates, is 27 percent less than the compressive strength of the conventional concrete. At 204 days, the average reduction in compressive strength was 34 percent. This is likely that the recycled concrete also have problems in frost. Hence it can be concluded that the use of these aggregate for concrete construction are not a good fit. The drop in materials' recycling is one of the facing challenges; in Table 4 the mixed reduction in Los Angeles test has been indicated (Table 4) [6,7].

It should be noted that the problems of recycling, are not only aggregates and declining quality of materials. Another problem of the recycling of construction waste, is the costly recycling process itself which may not be economically feasible in the short run. But the rising cost of raw materials and irreversible long-term environmental damages, makes the issue of recycling construction waste important. However, the possibility of recycling all materials is less and the recycling of waste and trash has not good quality. The high cost of recycling question the economic justification of recycled materials. It should be noted that in the long term, recycling operations have environmental impacts. Among the listed materials for recycling; concrete, bricks, plaster have the highest percentages of ingredients according to Table 5.

Wood and Sustainable Architecture

According to the above table, the majority of construction wastes consisting of mineral and mining exploration are obtained. Wood is the only building materials that is renewable and there is no environmental problems in terms of recycling and disposal of construction waste, also the timber recycling costs are far lower than minerals. This indicates that wood is the best material for the production and processing. Here the wood doesn't mean, the pristine mountains and tropical forests are

Type of concrete	Time	H	H/H	H/M	H/L	M	M/H
Ordinary concrete	14 days	49.5	37.3	33.6	33.7	23.9	16.1
	204	56.1	51.4	45.7	38.9	38.9	24.9
Type of concrete	Time	M/M	M/L	L	L/H	L/M	L/L
	14 days	17.2	19.1	8.7	5.5	4.5	6.8
	204 days	25.8	24.3	17.0	9.3	6.8	10.3

Table 3: Conventional and recycled concrete's compressive strength (MPa) (Building Research Center Page 44).

The percentage of good quality material	Drop percentage
0	48.62
25%	43.42
50%	36.91
75%	33.80

Table 4: The Drop of mixed materials in Los Angeles test.

Fine aggregate	Course aggregate					
Concrete and ricks	Bricks	Concrete	Plaster	Asphalt	Rock	Tile
49.7	23.8	13.2	1.5	4.9	4.6	2.3

Table 5: Percentage of different materials in construction waste (resistance assessment of debris recycling of constructions materials, 2010).



Figure 1: Tree farm.

not wood but its production of wood and wood breeding farms are meant and shown in Figure 1.

These fields are created through genetic modification of trees and over 10 years grow and become ready for being harvested [6].

Today the building is very suitable for the production of wood properties. Because the wooden material shows resistance against physical and chemical factors that very easily can damage building materials and cause their destruction. So the woods can be used in buildings, structures of ports and even places with extreme weather changes as well as in places that different kinds of gas are scattered. Other advantage of wood is that its increase of scale is less in the longitudinal direction due to the increase of temperature elevation. For example, coefficient of expansion of wood, iron and aluminum with a F temperature is as below.

Douglas Wood's coefficient of expansion $1/8 \times 10^{-6}$

Irons' coefficient of expansion 7×10^{-6}

Aluminum's coefficient of expansion 13×10^{-6}

As you can see, the coefficient of expansion of aluminum and iron is

four to seven times of expansion coefficient of wood in the longitudinal direction [7].

Thermal transfer of the wood also is low, the increase in woods scale happens slowly due to the temperature change. If the wooden parts of the buildings are exposed to cold winter weather or the summer, Increase or decrease of the length will be far less than the similar or not isolated metal. On the other hand, when exposed to fire, expansion of the metal and its lack of resistance, due to the temperature elevation (heat transfer capacity of iron and Aluminum is 310 and 1400 BTU) is very fast compared to wood. Wood is also a good thermal insulator and in this respect it is preferred over many ordinary building materials. These properties of wood in building design should not be underestimated because they are effective in reducing the current cost structure [8].

Of course, any material of construction has some drawbacks, and the wood is not excluded in this regard. The natural disadvantages of wood is the buds and branches in different parts of a tree's trunk or wooden beams in some of the trees may create an angle parallel to the axis of the tree. In some cases, ruptures, are the disadvantages who have the origin of changing environmental conditions in different ways. These natural disadvantages of wood, are very important in the design and construction of wooden structures [8].

But the other disadvantage of wood is in the attacking of insects and fungi. Of course there are strategies in today's industry for the solving of wood's internal and natural disadvantages through modification of the gene and impregnating the wood with non-toxic chemicals which prevent insect attack.

History of our vernacular architecture shows that the use of wood for the construction of residential buildings has a long history and one of our great local materials is wood. But unfortunately, in the last 40 years we have not used the materials of vernacular architecture and have not combined them with modern technology. The meaning of modern technology is not to import readymade materials (such as metal and aluminum plates) from the industrial countries. But we should also provide new technologies for the production of local materials. Because we can combine today's technology with the manufacturing of wood and create a wood breeding farm that contains genetically modified trees. This activity can be seen in America or Canada or Japan whose basic architecture is based on wood. If we pay attention to these countries we realize that most houses are built of wood. There are the cold climate and windy storms in these countries, in some of these countries, several earthquakes happen yearly. Also these countries have a lot of mines. They even can easily import abundant mineral materials and control their widespread use in architecture. Because, financially, they are among the richest countries of the world. But still, their architecture is based on local materials such as wood. The production of wood has the advantages of being cheaper, renewable, not having environmental pollution, sustainability convenient. The energy spent for the production of mineral materials, from the exploration and use of explosives and dangerous environment of the labor force to the use of gasoline for transport, electricity, water, gas, heating and cooling costs of the building, shows that this design and manufacture doesn't have a long life because the issue of energy in today's world is the most important issue and of human concern and the construction of buildings with mineral material in the near future not only would be considered against the environment but would be regarded as a destroyer of mountains and rivers and main arteries of human life. Also, the construction of buildings with mineral material would not

be economically affordable and countries, including developing countries whose architecture are based on minerals would be faced with a mountain of non-recyclable trash around the cities which will be released into the environment. In these countries, the economic life of buildings ends earlier than their physical life. The Mountains used for the extraction would turn into unusable deserts because of the end of mining, the withdrawal of chemicals, deepening of the location of the mine and debris removal around them Figures 2 and 3.

Mineral Resources and Their Finitudes

If the construction industries, architects and engineers don't make attitudinal change in the society and the building industries, if the government plans ignore Hierarchy of Housing Needs and if the supply of housing is not managed as the basic human need and a large share of production, we will be faced with big environmental disasters and economic and social crises in the near future. And in the long run a great and unforgivable betrayal of future generations is done by us including the digging of mountains to mine exploitation, drying the rivers for sand production, the destruction of lakes for water supply and cutting down forests to harvest materials from mines in the mountains. In this case, the judgment of history of today's generation would not at all be beautiful, selfless and courageous.



Figure 2: A mine abandoned after the completion of its minerals.



Figure 3: The destruction of a river for the exploitation of sand and gravel.

Subtitles

Hierarchy of Housing Needs is designed to manage the housing needs of families where the number of needs of single, double, triple and quadruple houses are forecasted. So the plans are designed based on household size and population. Unfortunately, the hierarchy is not taken seriously and the design of buildings has never been based on community needs and other more laws such as the size of land, etc. have determined the policies.

Conclusion

Discussion of green architecture or sustainable architecture can be useful in the creation of spaces and healthy cities and moving towards sustainable development, because it emphasizes the principles of sustainability, architecture, attention to biodiversity and the environment and conserving the natural resources. If the design with the sustainable development and its integration, it will be able to meet this need. In other countries the regulations and creation of the required conditions, have made the attitude to grow significantly and be used more frequently than the past. The fact that we design and build cities which are neither based on the principles of sustainable architecture nor the principles of modern architecture is rather surprising. For example we go to the West Azerbaijan and we see that most buildings' facades are composed of granite and then we fly to Tehran we see the granite facades again and then we fly to Chabahar and surprisingly we face with granite facades everywhere. It is surprising that the same architecture and material is used in in the most northwestern part of the country, the most central part and the most south-eastern part of the country having three different climate. Any architecture would ask this question that wither this architecture is according to sustainable or local architecture. Is Granite stable and insulated against cold weather of Orumiyeh or the heat of Chabahar? Which architectural style is correct? Nowadays in the architecture, we've lost geological materials and observe sustainable architecture only in planting grass. Unfortunately, our urbanization in recent decades is faced with confusion in terms of indigenous phenomena. Since a definition of locality is absent in the nature of architecture, it has never been successful in complying with the present era and technology. The prerequisite of sustainable architecture is in the recognition of local architecture and using it along with the modern technologies and societies' culture in the industry of construction and housing. One of the most used areas of the building industry is the issue of housing which has a shorter life nowadays due to the current state of the culture of consumerism. Because of the preference for quick changes of generations and fashions of society, the materials must be recyclable, available and have the capacity of mass production. Since the house is a twenty-four-hour building and its occupants use it constantly throughout the day, it should have the capability of energy saving and renewable materials for environmental issues. One of the materials that can be considered in sustainable architecture is wood. If architects and engineers of construction industry and agriculture do not use modern technology in the processing of wood, sustainable architecture or if they don't change the production of traditional housing with modular

factory production and continue to produce buildings with mineral materials, they will be faced with the destruction of vast mineral resources and the environmental wildlife. Negligence and indolence will cause irreparable damages to the environment, we all know we can create an abundance of forests by planting many trees, but we can never plant Mountains. Digging the mountains is similar to shooting; it can never return. So if today we do not change the production of construction materials and do not take seriously the hierarchy of housing needs, we will make the situation of construction industry and society worse and more dangerous. Missing components in the chain are not very complex and include: paying attention to serious sustainable architecture, designing a hierarchy of housing needs, changes in the design of the land and the building based on current conditions, the development of small towns according to sustainable architecture instead of high-rise buildings in big cities, production and processing of wood, establishment of construction industries and modular production, local materials' manufacturing based on sustainable architecture and modern technologies combined with new systems such as insulating walls, Double-glazed windows, green roofs, or solar panels that are in line with sustainable architecture. Also the mass production and factory in the short term, energy management and a lack of long-term adverse environmental effects, this trend will be beneficial affordable for the country and the planet.

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