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Problems Related to Construction and Building Materials in Libya

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Abstract: ***The broad aim of this paper is to provide a detailed understanding of the post-war problems associated with materials for reconstruction in Libya, and to identify key problems and obstructions. Theoretical and empirical studies are being conducted in Libya. The theoretical study focuses on materials for construction and the key issues such as sources, transport and storage of materials, as well as their impact on the national economy, the nation's socio-economic development and the environment. This empirical study employed questionnaires, observations and a series of interviews with researchers, academics, suppliers and manufacturers, supported by the researcher's three decades of experience of working in the construction industry and its associated processes and operations. The empirical study illustrated that materials for post-disaster reconstruction in Libya suffer from external problems related to policies and decision-making in terms of availability of materials, fluctuation of prices of materials, specifications, building codes, legislation and regulations, and internal problems related to the construction and building material's key players: construction companies, consultancy firms, manufacturers and suppliers.***

Keywords: The Libya construction industry, Construction and Building Materials, Procurement of Construction and Building Materials, Shortage of Materials in the Libyan Construction Industry

I. INTRODUCTION

Procurement of construction and building materials is a very onerous task. It requires successful policies, planning, and human and natural resources. The construction industry, which spends more than half of its costs on materials (Hellman and Gadde, 1996), plays a significant role in nations' social and economic development. Libya, as a developing country, suffered an acute shortage of appropriate infrastructure and buildings in almost all sectors before the 2011 war. In addition, reconstruction resulting from this war has been estimated at over L.D 400 billion (£200 billion) (Libyan Cabinet, 2011); more than half of this amount will be spent on materials such as concrete (cement, steel, aggregates and sand), blocks, glass, timber, metals and finishing materials.

The decision to examine the current status of construction and building materials in Libya was reached because there are few studies and limited research undertaken despite its importance. The lack of appropriate infrastructure and buildings in almost all sectors has become more pronounced than at any other time. For instance, the consequences of the 2011 war are population expansion, urban migration and falling standards of living, meaning that successful development plans for a comprehensive urban renaissance are required, including a greater number of new buildings than at any comparable time in the past. The supply of factory-made building materials has to be expanded to cope with recent and future demand, and all the evidence suggests that the gap between potential demand and supply after the war is getting larger (see Figuer2).

II. FACTORS INFLUENCING MATERIALS FOR RECONSTRUCTION IN LIBYA

Libyan geographical, political and economic factors have a significant influence on construction activities, particularly in terms of manufacturing, transport, technical specifications and environmental circumstances relating to materials. These factors can be divided into the following categories:

2.1 Geographical Factors

Libya, geographically, is located in the centre of the hot, dry region in North Africa. Up to ninety per cent of Libya's total area is classified as arid and semi-arid lands (UNCCD, 2001; Doxiadis, 1964). In 1922, the highest ever recorded temperature, 57.5 degrees centigrade, was registered in El-Assisia, near Tripoli (Ngab, 2007), and more than ninety-seven per cent of the country's water supply is obtained from underground resources (GCP, 2000). Therefore, the proportion of desert and scarcity of water are essential challenges to Libyan development and to construction work in particular. Geographical factors can be categorised as follows:

- The vast majority of the Libyan population is concentrated in the north along the southern coast of the Mediterranean Sea (1,770 km), particularly in the Tripoli region. Consequently, social and economic activities, as well as construction resources, are concentrated in the Tripoli region. "Around seventy-nine per cent of the total fertile agricultural lands is concentrated in this region and it produces sixty per

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cent of the country's agricultural products" (Rasheed, 2004).

- The Libyan geographical area (1,759,540 sq. km) is very large, and the distances between cities and towns are very long. Combined with inadequate transport and communication systems, these factors have led to rising construction costs. "Most of the Libyan Islamic cities are separated from each other by a few hundred miles as on the coast, and more than this distance in the desert" (Elmahmudi, 1996).

- The extreme weather in Libya causes technical problems in construction operations and materials, particularly concrete. "The geographical problems, such as few sources of water and the extreme climate, were influential in pushing the people into the desert" (Elmahmudi, 1996).

- Scarcity of water in Libya is considered to be the most essential factor affecting construction operations, which depend on it for the processing of raw materials, and for the manufacturing, transport and assembly of materials and components, as well as for the curing of concrete, washing of construction equipment and consumption by personnel. In this context, it can be said that water in Libya is the most important construction resource.

2.2 Political and Economic Factors

In Libya's history, the Italians supplanted the Ottoman Turks in the area around Tripoli in 1911 and did not relinquish their hold until 1943, when defeated in World War II. Libya then passed to UN administration and achieved independence in 1951(Waniss and Erling, 2007). Since then, the state has played a dominant role in political, social and economic affairs (Libyan Government, 1969; GCP, 2000). During the last four decades 1970-2010, dramatic changes and major transformations have accrued in Libyan political, social, economic and administrative affairs. The state has had a highly centralised role, and the central government has been dominant in managing and controlling the economy and social and economic development plans.

In 1977, a new political and economic system was adopted in Libya (Libyan Government, Law No. 343/1977); based on that, a major change in the ownership structure of the construction sector occurred in 1978, when the government and public sector monopolised the management and operation of all economic sectors. Consequently, contracting in the construction sector was limited to only public and international companies. Moreover, the Cabinet and Ministry of Housing issued a series of laws and regulations to prevent private construction companies from carrying out their activities (Ministry of Housing, 1982). Implementation of the new economic system affected construction activities and building materials, with the construction sector adopting the partnership and cooperative system as the main legal framework to form and run firms. In this context, Joffe and McLachlan (1982) argued that there were few places in the Middle East and North Africa that suffered as badly as Libya from a dearth of academic literature concerning social, political and economic changes.

According to Law No. 4/1978, concerning the proprietorship of real estate, any Libyan citizen has the right to build and own only one house (Ministry of Housing, 1985). As a result, private investment in housing production for selling and renting was prevented. Since 1978, the rental of houses for Libyan citizens has been forbidden. Moreover, Law No. 4/1984 has many on-going negative effects, economically and socially. This law gave tenants the rights and support to become owners of the houses that they rented (Libyan Government, 1984). As result of these policies and regulations, private investment in housing and the operation of the construction industry has been effected in terms of housing production. Consequently, Libya has suffered an acute shortage in the residential sector, which was estimated at one million housing units (NOUP, 2006).

Hence, political and economic circumstances have had a massive impact on Libyan construction activities and building materials in terms of availability, affordability and their contribution to the national economy. According to Ngab (2007), the current capacity of the Libyan construction industry is unable to meet national housing supply needs as a result of construction policies over recent decades and a lack of managerial, financial and technical capabilities. New demands for rapid social, economic, political and technological changes will further strain the fragile industry, and new policies, and the restructuring of the building industry, are required in order to meet current and future needs.

Despite the country suffering a lack of infrastructures and buildings, "the gross domestic product (GDP) of Libya is estimated to reach $68 billion annually, and the per capita income (close to $11,630), makes the country one of the wealthiest in the region" (Ngab 2007). At the time, Ngab (2007) wrote that "more than 500,000 housing units are planned for the next ten years", giving an indication of the acute shortage of infrastructure and buildings as a result of these policies.

2.3 Historical Background

Gruneberg and Ive (2000) stated that the organisation of the construction industry itself is a consequence of historical, legal and financial development. A review of the literature shows that the use of cement and concrete in Libyan construction was started after the early 1950s. Cement and its related products, such as concrete, bricks and other materials, became the dominant basic construction materials in Libya's construction market. As a result, the country's consumption of cement increased from 60,000 tons in 1958 to 5.8 million tons in 2003

(GCP, 2003). For example, only two per cent of residential buildings in Libya in 1964 were constructed with cement and concrete (Doxiadis, 1964); however, in 2003, more than 96.7 per cent of buildings were constructed with cement and its products (RCBMC, 2000). There are many reasons behind this dramatic change, the most important being the need to modernise the country's built environment and to increase construction productivity and output, and as result of the export of oil from Libya in the early 1960s.

The literature review shows that during the period of Italian colonialism (1911-1943) and the British and French administration (1943-1951), new regulations, standards, specifications, building codes, construction materials and technologies were introduced to the Libyan construction market. Consequently, construction activities have transformed from indigenous activities to trade and formal professional activities.

III. MATERIALS FOR RECONSTRUCTION

Many studies carried out in developing countries have shown the extent to which materials and their associated issues have an influence on construction projects (see Table 1). In Malaysia, for example, lack of materials ranked first among eight external factors and delays in materials delivery ranked first among twelve contractor's responsibility factors (Al-Aghbari et al., 2007). In Nigeria, difficulties in obtaining construction materials ranked seventh among nine factors (Aibinu and Jagboro, 2002). In Thailand, materials procurement ranked first among ten factors (Ogunlana and Promkuntong, 1996). In Indonesia, materials shortages ranked seventh among ten factors (Kaming et al., 1998). In Kuwait, contractor and materials problems ranked fourth among four factors (Al-Tabtabai and Hashem, 2002). In Ghana, materials procurement ranked second among four factors (Frimpong et al., 2003), while in Iran, lack of materials and machinery ranked second among three factors. (Asnaashari et al. 2009)

In Libya, despite the importance of materials, there are few studies in this field. For example, Grifa (2008) observed that there were shortages or irregular supplies of steel in the construction market. He added that more than half of the respondents from construction firms relied on black market channels for obtaining steel. In addition, many Libyan researchers have carried out studies and papers about the Libyan construction industry but with little attention given to materials: for example, Ngab (2007), Grifa (2008), Tumi et al., (2009) and Shebob (2012). A review of these studies shows that the researchers were focused on the construction industry in terms of a general analysis of the industry, its environment, and its risk management. Based on this, it can be said that there are few previous studies relevant to construction and building materials in Libya.

For the present research, respondents from construction companies were asked about their sources for basic types of construction and building materials (Portland cement, steel reinforcement, blocks and finishing materials) and components. The purpose of this question was to understand the companies' ways of obtaining materials and identifying sources. The empirical findings (see Table 2 and Figure 1) show the sources of materials used in the Libyan construction industry.

TABLE I
INFLUENCE OF MATERIALS ON THE CONSTRUCTION INDUSTRY.

Studies carried out in Developing countries	Problems related to materials
1. Malaysia. Al-Aghbari et al.(2007)	1/8. Lack of materials. 1/12. Delays in materials delivery
2. Nigeria. Aibinu and Jagboro(2002)	7/9. Difficulties in obtaining construction materials
3. Thailand. Ogunlana and Promkuntong (1996)	1/10. Materials procurement
4. Indonesia. Kaming et al. (1998)	7/10. Materials shortages
5. Kuwait. Al-Tabtabai and Hashem(2002)	4/4. Contractor and material problems
6. Ghana. Frimpong et al. (2003)	2/4. Material procurement
7. Iran. Asnaashari et al. (2009)	2/3. Lack of materials and machinery

TABLE II
SOURCES OF MATERIALS IN LIBYA.

Sources	Cement	Rein. Steel	Blocks	Finishing mat.
State factories	47.4%	49.1%	15.8%	22.8%
Private factories	-	-	73.7%	19.3%
Private shops	78.9%	70.2%	15.8%	80.7%
Importation	43.8%	10.5%	16.3%	35.1%

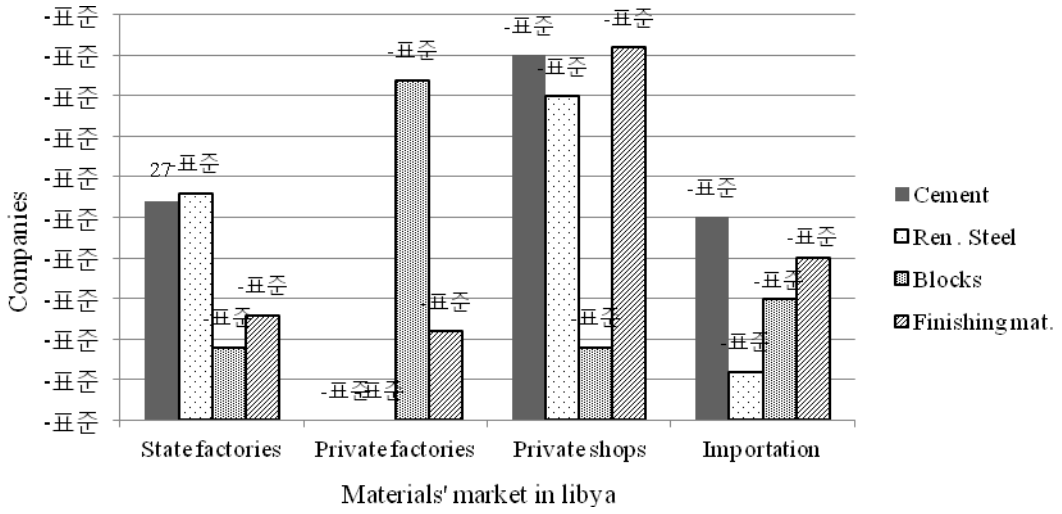

FIGURE I
SOURCES OF MATERIALS IN LIBYA.

IV. DEMAND FOR MATERIALS

Most developing countries are facing an acute shortage of appropriate infrastructure and buildings, and Libya is no exception. The empirical study, as well as recent statistics and reports from many government departments, have emphasised that almost all sectors are suffering a scarcity of buildings and infrastructure. For example, according to NOUP (2006), Libya needs to build one million housing units in the period of 2010-2025 to fill the gap in the housing sector. In addition, maintenance works are one of the major challenges for the state: for instance, of 50 sewage treatment plants, only a few are functioning; as a result, sewage collected from the other plants is being dumped in the Mediterranean Sea (GAEP, 2010). In attempting to reduce the scarcity of buildings and infrastructure, the Libyan government started the construction and maintenance of a considerable number of buildings and infrastructure in the late 2000s, in almost all sectors; the cost of these projects was estimated at over L.D 140 billion (£70 billion) (Libyan Cabinet, 2009), but because of the 2011 war these projects have been totally suspended. Now, completion of the suspended projects and reconstruction resulting from the 2011 war requires a great amount of materials; however, according to this study and the reports from many government departments, Libya has very limited potential in this regard.

For the materials to be appropriate to the needs of developing countries, they must be indigenous, locally available in abundance, and with low energy input in terms of production, maintenance and transportation costs (Harrison, S. and Sinha, 1995). Based on the survey conducted, and moreover on a census of experts' opinions and discussions on a set of developmental policies and strategies, it can be said that the Libyan construction industry has a negative effect on society, economy and the environment. Socially, a great number of people live in poor shelters (Ministry of Housing, 2010); economically, the sector only contributes 3.9% of national GDP (Ministry of Planning, 2006); and environmentally, the industry is considered one of the main sources of pollution (GAEP, 2010). These reports illustrate the current poor shape of the construction sector, where demand for materials is derived from the construction sector only.

V. THE CURRENT PRODUCTION OF CONSTRUCTION AND BUILDING MATERIALS

Currently there are seven state-owned cement plants producing an average of 5.6 million tonnes per year (GPCPBC, 1998; ACC, 2004), while construction activities consumed about 5.8 million tonnes in 2009. The demand for cement has been estimated at 13 million tonnes by 2025; this estimation was carried out before the 2011 war when the demand for cement increased sharply (see Figure 2). Libya produces 423,000 tonnes of reinforcement steel and consumes about 700,000 tonnes per year. In addition, in 2010, the production of blocks was estimated at 520,000 tonnes of clay blocks and 1,200,000 cubic metres of cement blocks, while the demand was estimated at 1,724,000 and 2,100,000 respectively.

A key factor constraining construction activities is the scarcity of key building materials, and basic materials in particular. Libya has a serious problem in not producing the materials and components needed by the construction industry, and many are sourced from outside the country. Data and information obtained from this study, supported by Libyan government organisations and agencies, indicate that despite the availability of raw materials, the country is suffering from an acute shortage of local materials.

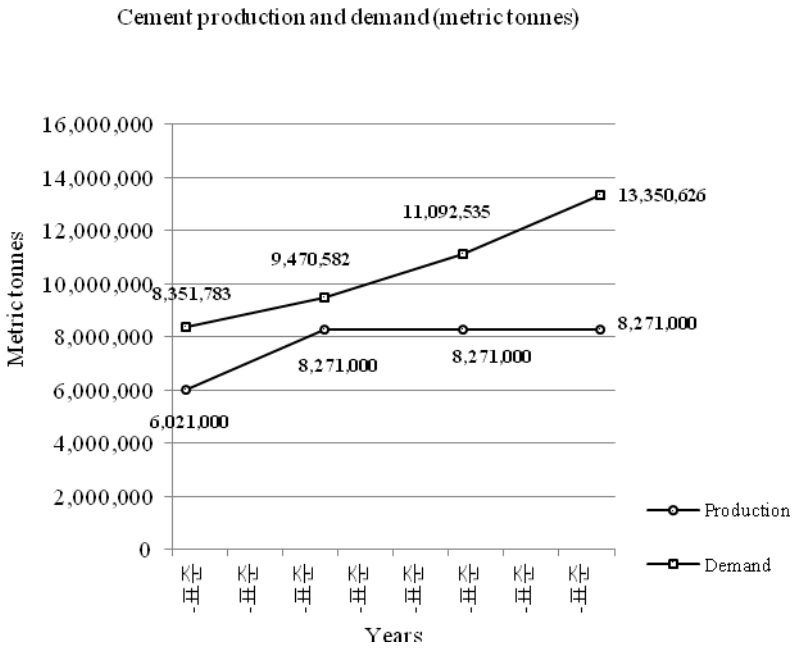

FIGURE II
Production and import of cement and the supply/demand gap, 2010-2025.
SOURCE: INDUSTRIAL RESEARCH CENTRE

VI. METHODOLOGY OF THE STUDY

Sharp et al. (2002) stated that research can be conducted by one or a combination of research approaches. Robertson and McLaughlin (1996) stated that the data collection phase of any research exercise should provide the researcher with a large amount of relevant and illuminating information, such as quantitative data generated from a questionnaire and qualitative data emanating from interviews. The method of data collection is an essential factor to ensure the quality of data, and to avoid survey bias. The methodology of this study involves the following phases:

- *Identification of issues and aspects*
  The identification of issues and aspects of construction and building materials was investigated. This was done through a literature review, and from the experience of the current researcher in the construction industry.
- *Place of study*
  The study was carried out as part of research work for the award of the degree of Doctor of Philosophy (PhD). The study took place in and around the capital city of Tripoli (Tripoli, Zawia, Surman and Subrata), in the North West State of the country. This region is inhabited by more than half of the total population of Libya; as a result, most of the country's construction activity is carried out in this region.
- *Data collection*
  According to Neuman (2009), survey research is a process of asking many people the same questions and examining their answers. In order to collect data and information, 37 questionnaires were answered by consultancy firms and 57 were answered by construction companies. In addition, a number of meetings were conducted with decision-makers in government departments and organisations. The observation method of collecting information (Robertson and McLaughlin, 1996) was employed to support the questionnaire technique, in order to gather as much data as possible about materials for construction and buildings in Libya. A considerable amount of data and information was collected through informal interviews, a visual and physical survey, analysis of documents of construction projects, and visits to consultancy firms, construction companies, and local material producers and suppliers. Visual data, such as photographs, were also collected, for use as a documentation and descriptive tool (Plummer, 2004).

A random sample method was selected to gather the data, information and evidence, and an additional snowball method was used to ensure the sampling rate was achieved. In this method, the selection was based on choosing eight civil and architectural engineers in different positions and workplaces as a starting point and then asking them to recommend other suitable respondents (Robertson and McLaughlin, 1996). This enabled the researcher to focus on those individuals who had considerable experience or a close interest in the research area. In order to test the reliability and validity of the questionnaire, a set was distributed as a sample. Iarossi, (2006) stated that the three basic goals of the pre-test are to evaluate the competency of the questionnaire, to estimate the length or completion time of the survey, and to determine the quality of the survey; the questions were then amended according to the results of the samples.

VII. ANALYSIS OF DATA

In order to present the study's findings and to compare the responses and opinions of construction companies and consultancy firms, the collected data and information were reviewed coded and analysed using Excel and SPSS software. Furthermore, in order to measure the reliability of the data, standard deviation and Cronbach's Alpha were calculated. Analysis of variance at the five per cent significance level was undertaken to test the findings and identify whether the respondent groups' opinions and views regarding some variables and aspects of the materials were similar. The output generated from data analysis showed that:

- 65 per cent of construction companies and 65 per cent of consultancy firms did not have a department concerned with materials.
- 53 per cent of construction companies and 54 per cent of consultancy firms did not use computer technology in materials management.
- 72 per cent of construction companies and 68 per cent of consultancy firms admitted that materials were not readily available in the local market.
- 90 per cent of construction companies and 86 per cent of consultancy firms admitted that sanitary and electrical fittings were not locally made, while steel, cement, blocks and tiles did not fully cope with the demand.
- 95 per cent of construction companies and 96 per cent of consultancy firms admitted that materials transport increased construction costs by between 10 and more than 50% (see Figure 3).
- Considerable amounts of materials were not tested during the construction process. Table 3 contains eight basic construction and building materials divided into three categories: materials tested before use; materials used based on the manufacturing specifications; and materials not tested.

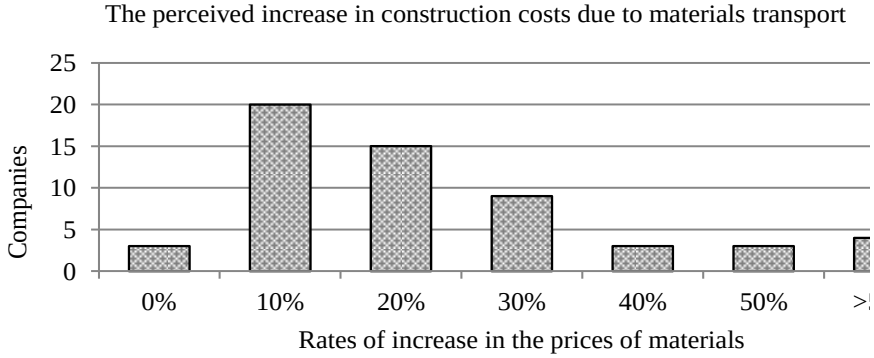

FIGURE III
The increase in construction costs due to materials transport

TABLE III
Testing of materials.

Material	Tested before use		Manufacturing specifications		Not tested	
	Contractors	Consultants	Contractors	Consultants	Contractors	Consultants
Concrete	91%	86%	7%	14%	2%	-
Cement	24%	28%	74%	67%	2%	5%
Aggregates	44%	46%	14%	11%	42%	43%
Sand	44%	51%	10%	11%	46%	38%
Steel	21%	16%	65%	73%	14%	11%
Bricks	42%	38%	12%	35%	46%	27%
Tiles and ceramic tiles	26%	22%	55%	75%	19%	3%
Pipes	14%	11%	75%	54%	11%	35%

- The experience, visual survey and observations have confirmed that materials do not live up to the required standards in terms of production, storage and transport (see Figures 4, 5, 6 and 7).

FIGURE IV
Manufacturing of cement blocks, 02.2013. Source: author.

FIGURE V
Production of limestone blocks, 02.2013. Source: author.

FIGURE VI
Transportation of blocks, 02.2013. Source: author.

FIGURE VII
Storage of cement, 02.2013. Source: author.

VII. CONCLUSION

This study has attempted to identify and address the major factors and personnel responsible for causing problems related to materials for reconstruction in Libya.

8.1 Internal problems

These problems are related to the operation of the construction and materials industries. A lack of departments concerned with materials in construction companies, consultancy firms, manufacturers and suppliers, gives an indication that materials – which are estimated at about half of any construction's cost – are not given enough attention, despite their importance. The experience, visual survey and observations have confirmed that materials do not live up to the required standards in terms of production, storage and transport. Furthermore, the lack of use of computer technology in materials management – with a high percentage of construction companies and consultancy firms not using it – adversely affects the execution of projects in terms of time, cost, effort and quality. The lack of materials testing is also considered an issue; particularly in small and medium projects. In these sizes of project, it was also observed that less attention was given to the curing and testing of concrete, despite the significance of these aspects.

8.2 External problems

These problems are related to policies and decision-making in terms of the materials industry, materials specification, building codes, legislation and regulations. Based on a review of recently developed specifications, and through many interviews in the Centre of Specifications and Standards, it was observed that deficiencies related particularly to the production, storage and transport of materials. In addition, it was also confirmed that the Libyan construction industry suffers from the absence of building codes. Shortages of materials in the Libyan market cause price fluctuations and construction delays, and adversely impact on the quality of construction output. The high cost of materials transportation, due to the geographical factors in Libya, also raises the cost of construction, as does the high percentage of construction and building materials waste. The construction sector's dependency on labour-intensive methods rather than equipment – despite the low population of Libya – causes a lack of socio-economic development, and results in a construction industry that displays limited development and modernity. Indeed, the construction industry in Libya has been suffering, for decades, from the absence of qualified technical firms and research centres, as well as from the fragmentation of its organisations and associated operations. Furthermore, the Libyan construction industry suffers from a lack of materials specification, building codes, legislation and

regulations, and legislation concerned with disasters.

Economically, the Libyan construction industry plays an insignificant role in the national economy; it is estimated at 3.9 per cent of GDP, reflecting the poor situation regarding materials procurement. For example, before the 2011 war, Libya had an acute shortage of infrastructure and buildings. During the war it suffered massive destruction in many cities, and L.D 140 billion (£70 billion) will need to be spent on materials for reconstruction.

Based on the above, and owing to the scarcity of water in Libya, it can be argued that it is essential to adopt new materials in the Libyan construction market: namely, materials that do not rely on water in the execution of projects. This can be achieved through the mutual efforts of key actors in the Libyan construction industry, including policy- and decision-makers, researchers and academics, as well as manufacturers and suppliers of materials.

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