

Steel Structures Usage and Steel Production: A Case Study in Afghanistan

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Gul Rahman Abdulrahimzai
Haroon Rasheed Safi
Asil Ahmad Halimyar

Abstract

Concrete structures dominant in the construction sector and the lack of steel structure usage is a propagating problem in Afghanistan. This problem not only affects the steel production industry and market but also the construction industry. To determine factors contributing to this problem and their extent, a series of surveys and interviews were conducted with steel traders, wholesalers, steel production companies, construction companies, and engineers. The collected data was analyzed by SPSS (Software package for the Social Sciences) program. After a thorough investigation of the results, it was concluded that, the low investment in steel sector has created a shortage in steel products' market. Therefore, traders import steel products legally and illegally, which in turn weakens the domestic production industry on basis of unfair competition. Moreover, a serious shortage of skilled labor, design professionals, and quality materials has shifted more attention towards the concrete structure. To address these concerns, this paper has attempted to suggest solutions that can help improve the market condition and shift attention towards building steel structures. The outcome suggests that training professionals in the steel sector, importing steel production and erection technologies, increasing tariffs on steel imports, controlling illegal imports, exploring mines and iron reserves for raw materials, and making productive investments in the steel sector are likely to contribute to the reduction of the present problems.

Keywords: Steel Structure's Usage, Steel Production Industry and Market, SPSS, Steel Imports, Investment.

Mr. Gul Rahman Abdulrahimzai, Teaching Assistant, Dept. of Civil Engineering, Kardan University, Kabul Afghanistan. <agulrahman@gmail.com>

Mr. Haroon Rasheed Safi and Mr. Asil Ahmad Halimyar, are Graduated Student, Dept. of Civil Engineering, Kardan University, Kabul Afghanistan.

Introduction

Steel's use as a construction material roughly follows the same timeline as steel innovation in general as railroads became a popular mode of transport [1]. In the 1800s, there were three forms of "ferrous metals" in use: wrought iron, cast iron, and steel. Wrought iron was very familiar to blacksmiths who had been working with the material for years. While we now think of it as mostly decorative, in the Victorian era, it was also commonly used as a building material. Cast iron, strong but brittle were more widely used for cooking and farming but was not very appropriate for the building. Steel was expensive to produce and was used for higher-end items like watches, swords, and scythes. [1]. Steel has become one of the most significant materials in construction industry. It is often seen as an extremely important component of modern buildings and housing [2]. With more than 1,869.9 million tons produced in 2019, It's become viable for any kind of project and offers several benefits, which many building plans rely on for structural safety [3]. Due to factors such as weight, availability, strength, and sustainability [4]. However, unlike other countries, construction in Afghanistan heavily relies on concrete structures and steel is seldom used for construction. Concrete dominance over market can be a grave problem since it creates a monopoly on the steel industry and creates hurdles in way of steel resources exploitation and new company commencements. Moreover, construction industry is changing and new trends are emerging [5]; since Steel plays an important role in these trends, Its applications will increase substantially in future. Therefore, Afghanistan needs to address these problems and adapt with the fast-evolving industry. Consequently, this paper aims to investigate steel usage and the problems in its way in construction sector in Afghanistan. Furthermore, it will attempt to suggest potential solutions to the existing problems.

1.1. An Overview of Steel Construction in Afghanistan

Afghanistan is a country blessed with natural resources. It has 3 trillion mineral reserves from which iron consists of 2.3 million tons [6],[7]. However, despite being so rich in resources, mines are still untapped. The steel industry uses metal scraps, which are mostly the remaining parts of tanks and other weaponries from the decades-long war. During this long unrest, Afghanistan has completely lost its infrastructure. There were very few opportunities for investments and many sectors completely shut down. Many Industries including steel industry had to start all over again after the establishment of new government in 2001. Despite vigorous damages to the steel industry, there is a strong political will and numerous efforts have been made to revive it. Large investments have been done in this sector. For

instance, Maihan and Khan steel companies started their operations in 20 million US dollars with an investment of about 100 and 10 million dollars respectively. Whereas there were no domestic products a few years ago, 65% of the market is now occupied by domestic products. This shows that Afghanistan is now able to somewhat compete with the regional product and is going towards self-sufficiency in steel sector.

1.2. Problem Statement

Although steel is an important component in developing infrastructures and construction industry, it is barely utilized in construction sector in Afghanistan. Currently the market is dominated by concrete structures because of the following problems: first, there is low level of investment in steel sector and companies are unable to fulfill market demands. Therefore, imported products from other countries dominate the market. Secondly, even though Afghanistan has a very high potential for steel production, none of its mines has been explored and producers only use scrap metals. Furthermore, there is a serious shortage of professionals and skilled labor involved in this sector. Overall costs increase substantially and projects face hurdles when steel structures are intended to be used. These problems will be discussed separately here.

1.3. Objectives

The purpose of this research paper is to investigate the barriers and challenges in way of steel usage in constructional sector in Afghanistan. It will suggest possible solutions to some of the most persistent problems causing the lack of interest and investment in building steel structures in Afghanistan.

- Challenges in way of steel production.
- Barriers in way of steel utilization in construction industry.
- Market problems.
- Solutions to abovementioned challenges.

1.4. Scopes and Limitations

This study is limited to the study of causes that creates hurdles in way of steel structures construction in Afghanistan. The study consists of the market condition, steel production, availability, imports, skills and expertise.

Primary data is collected from Kabul, Mazar-e- Sharif, Jalal Abad and Khoust.

A survey is conducted from various parties including steel product traders, steel production companies, construction companies, and engineers. This survey is only conducted in Kabul province.

2. Literature Review

Currently investment in the Afghan construction market is dominated by concrete for there is an overall shortage of steel products. If a steel structure is intended to be built, the company is ought to order all the required products from foreign countries which increases the costs notably. Moreover, there is a dearth of domestic products availability in market. steel products are not preferred by dealer and end users. Moreover, due to lack of government concentration and open borders regional monopoly players are trying to fail the industry. This makes it very challenging for new companies to enter market.

2.1. Raw Materials

Although Afghanistan is very rich in natural resources and has an estimated 2.3 billion tons of iron reserves, none of its mines are extracted yet. Steel production companies use metal scraps as raw material. A portion of these scraps are imported from other countries which has its effect on product's prices.

No	Province	Location	Reserve/ton
1	Badakhshan	Saijar	45,000,000
2	Badakhshan	Farmara	35,000,000
3	Baghlan	Zirak	20,000,000
4	Bamyan	Khysh	117,000,000
5	Bamyan	Haji Gak	2,070,000,000

Source: Ministry of Mines report

Table 1: List of Afghanistan Iron Reserves

2.2. Skill and Expertise

Due to the 4 decades long war, Afghanistan has lost a high number of its intellects and skilled labor. With the establishment of new government, considerable efforts have been made in education sector. A number of highly qualified experts returned to the country. However, there is still a considerable shortage in the involvement of professional engineers and skilled labor in Afghanistan [8]. Moreover, the absence of skilled labor in country appears to be having negative effect on business, industries and it is affecting investment in the country. [9] [10]Therefore, to cut expenses construction most often prefer concrete rather than steel for construction.

2.3. Technology

Another contributing factor to the preference of concrete structure instead of steel structures is the lack technology and machines availability in Afghanistan. Many steel sections cannot be produced inside the country and have to be ordered from abroad. This limits the implementation of many

steel structure designs and it is a burden on engineers and construction companies in terms of project cost and desired materials availability.

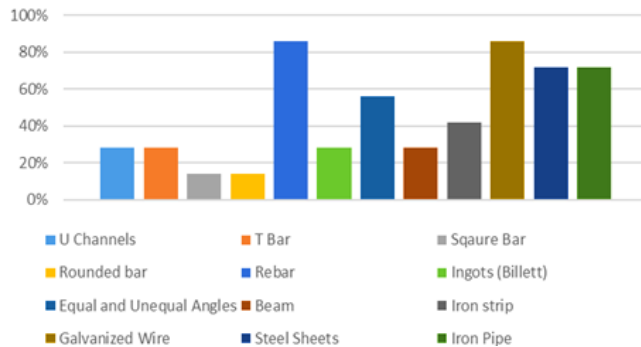


Chart 1: Available Steel Products in Afghanistan Market

3. Methodology

This research is based on three types of questioners for primary, secondary and tertiary data collection. Different questioners were sent and interviews were conducted with steel product dealers, steel production companies, construction companies and engineers. Quantitative research method was used to collect the data about production, capacity, and investment. Qualitative research method was used to collect the data about customers, strategies, available products, customer choices and behavior and barriers.

The collected data was then analyzed using SPSS (Software package for the Social Sciences) software. SPSS statistics is a statistical software platform which delivers a specific set of feature which lets users extract insights from data [11-16].

- Analyze and understand your data, and solve complex research problems [17-18].
- Understand large and complex data sets with statistical procedures [19-20].

3.1. Primary Data

Primary data on market is collected from steel wholesale dealers of Kabul and different provinces of Afghanistan.

3.2. Secondary Data

Secondary data is collected from Afghanistan's steel industries.

Further data is collected from construction companies, and engineers working in the construction sector in Afghanistan.

The government and businesses should invest in steel production companies to increase their production capacity. This will eliminate the need

for importing steel products and lessen the competition with regional monopoly players.

4. Results and Discussion

Concrete dominance over construction market is a grave problem for it creates a monopoly on the industry. There are various reasons to this problem. From materials availability to the required technologies, skills, expertise, labor, and raw materials there are a number of factor that has created this problem. Thus, many engineers and construction companies prefer concrete structures over steel structures in Afghanistan.

To investigate the extent of these issues this paper results of a survey conducted in different parties involved in the construction sector in Afghanistan.

4.1. Primary Data on Market

The first target of the survey is the construction steel market to determine which products are available. According to conducted survey, Afghanistan steel market is composed of domestic and imported products. During the survey it was determined that the market is dominated by imported steel products. While there is no major difference in the quality of domestic and imported products, a considerable portion of customers prefer imported products because of the unawareness about domestic products. Furthermore, weak marketing strategy of domestic producers and illegal tax, tariff free imports have created an unfair competition in the market.

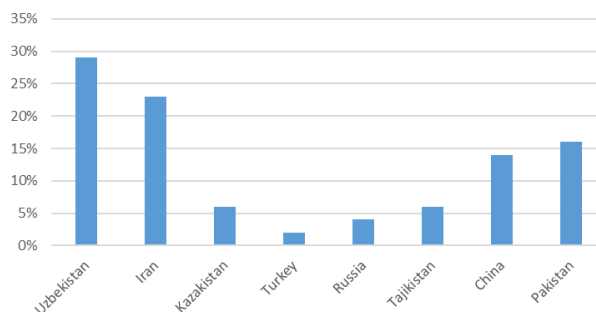


Chart 2: Steel Products Imported from Different Countries Shown in Percentages

4.1.1. Investments

Afghanistan’s steel industry is not able to fulfill the market demand due to lack of sufficient productive investment in this sector. Afghan government needs to take serious steps to medicate risk to the investment. For example, other illegal imports and the illegal imports of steel goods is an alarming

danger for domestic steel industry. An increase of tariff on imports of steel and controlling illegal imports can Support the domestic production.

4.1.2. Available Products in the Market

The conducted survey mainly focused on construction steel products in market. It was found that the following products were available in market.

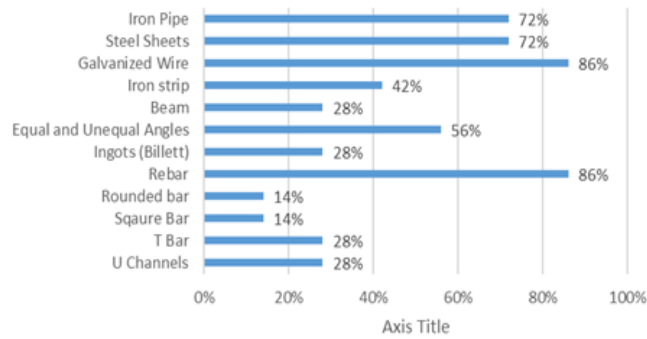


Chart 3: Available Imported Steel Products in Afghanistan

4.1.3. Domestic Products in the Market

The conducted survey found out the following steel products were produced and available in the market.

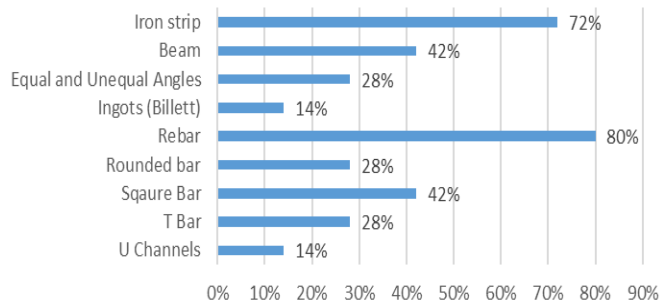


Chart 4: Domestic Steel Products Availability in the Market

It could be seen that a number of products are not produced in Afghanistan and must be imported from foreign countries. This creates an idea that domestic products are of lesser quality. Additionally, an engineer must order required product from other countries if he intends to design and build a steel structure. This will increment the overall costs substantially.

4.1.4. Primary Customers

Most customers that buy steel products private buyers and end users.

From the chart below it can be determined that steel products are mostly bought for individual uses and are not preferred by construction companies and the government as the concrete is dominant.

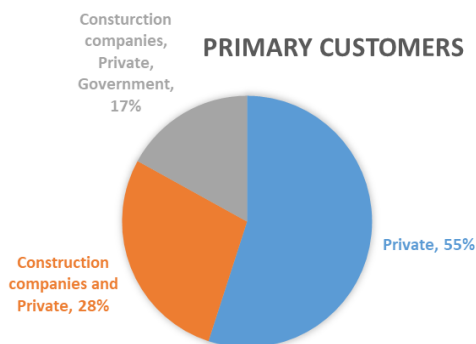


Chart 5: Categories that Make the Primary Customers of Steel Products

4.1.5. Product Preference

As shown in the 52% of customers prefer imported products while 28% prefer domestic steel products. The high extent of imported products preference negatively affects steel industry progress in Afghanistan. The remaining 20% of the customers prefer both products whichever is available and economical.

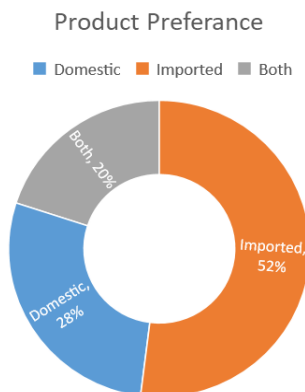


Chart 6: Product Preference

4.1.6. Domestic Product Availability

Over 60% of traders and whole sellers have domestic products. However, 40% do not have domestic products. Steel production companies, therefore, must adopt new strategies to cover the remaining 40% of the market. product availability in market will undoubtedly make it easier for buyers and companies to access domestic products and in turn support domestic companies back.

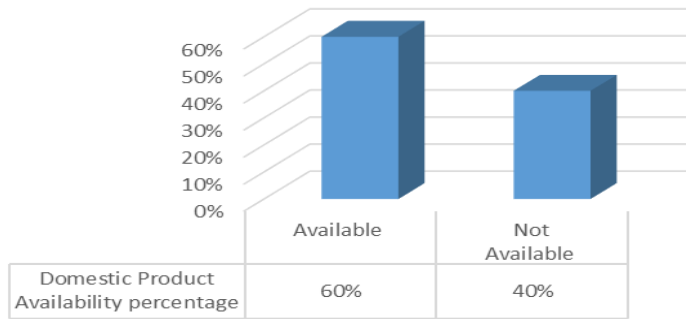


Chart 7: Domestic Products Availability Percentage by Wholesalers

4.2. Production Companies

Afghanistan has deep roots in steel production. However, the steel industry faced a grave decline during wars. Since 2003 this sector began to emerge and made a notable progress despite the strategies of regional countries to flap it. If the government take serious steps steel industry will undoubtedly become self-sufficient.

This research has collected data from 7 steel production companies on their initial investments, the source of their raw materials, used technology, production rate, cost affecting factors, mission, market competition, and the barriers they face.

4.2.1. Investments

Some steel production companies have entered the market with an initial investment as low as 0.1 million dollars. However recently 2 companies have invested 30 million and 50 million dollars. This significant change that can lead Afghanistan towards self-sufficiency in this sector.

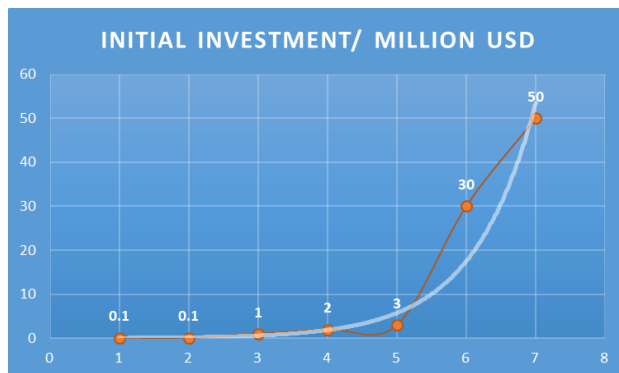


Chart 8: Initial Investments Made by Steel Production Companies

As charted above a number of notable investments have been made in steel sector which will change the market markedly for future. Yet the government and businesses should take steps to ensure steel production companies are adequately supported.

4.2.2. Raw Materials

Most of raw materials used by companies are iron scrapes which are collected, melted and reformed and converted into various products. These scrapes are found inside the country however some of them is imported from Pakistan.

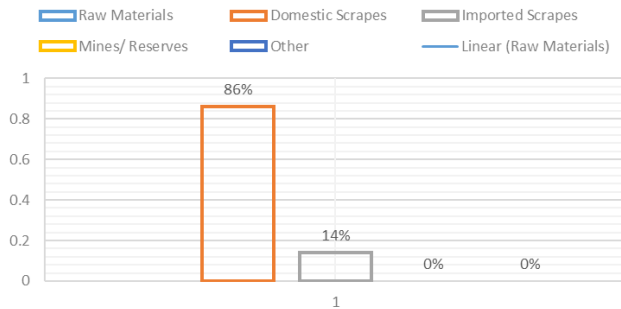


Chart 9: Raw Materials taken as Primary Products in Afghanistan by Steel Industry

Nonetheless, Afghanistan has yet not explored its rich mines and all the iron reserves remain untapped. Though iron scrapes are a good source of raw materials for companies, eventually they will run out. Therefore, iron mines should be studied and extracted.

4.2.3. Applied Modern Technology

Based on the data collected 57% of the surveyed companies uses modern technology and 43% do not have electrical machines and modern equipment.

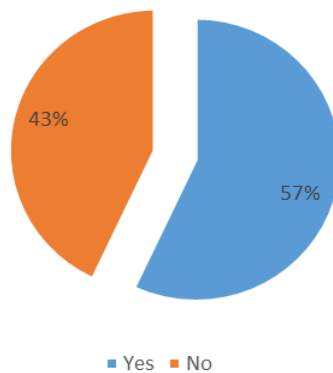


Chart 10: Modern Technology put is use by Steel Production Companies

One of the reasons that domestic companies cannot produce custom ordered products is because of the lack of modern machinery. Therefore, importing modern machinery can solve this problem and shift attention towards building steel structures.

4.2.4. Production Capacity

It was found out that the sampled firm have a variety of production rates, from a minimum of 20 metric tons per day to a maximum of 700 tons per day. Moreover, the annual production of these firm was determined to be from 7300 to 260,000 metric tons.

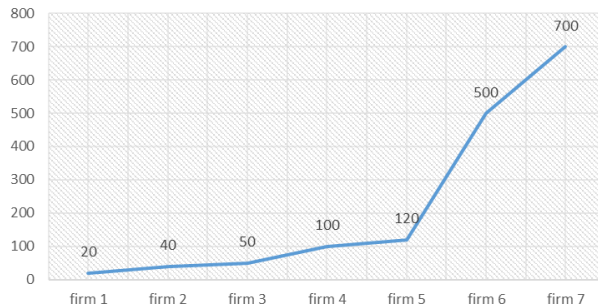


Chart 11: Steel Production Rate Per Day

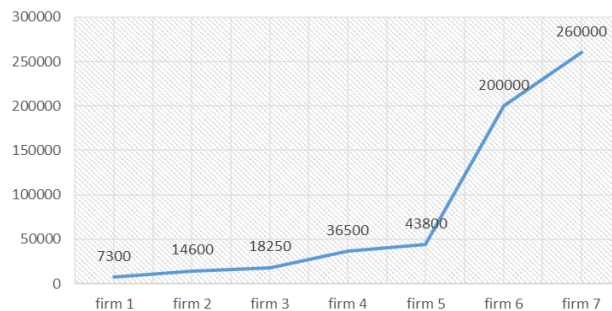


Chart 12: Annual Steel Production Rate

Currently about 80% of the annual steel needs of Afghanistan (650,000-700000) are produced by domestic companies. This is a huge progress for steel industry in Afghanistan. Nevertheless, the main challenge is the limited variety of products that are produced. Most often steel structures and engineers are limited by this inadequate variety of steel products. Therefore, many projects are not likely to be implement using only domestic products.

Steel production companies should expand their capacity by producing more varieties of steel products so that the need for importing custom ordered products is eliminated.

4.2.5. Cost Affecting Factors

Based on the answers received from the respondents, the final price is set based on the total investments plus profit. Some important factor that affects the overall prices of the steel products are raw materials, electricity, labor, transportation, and taxes.

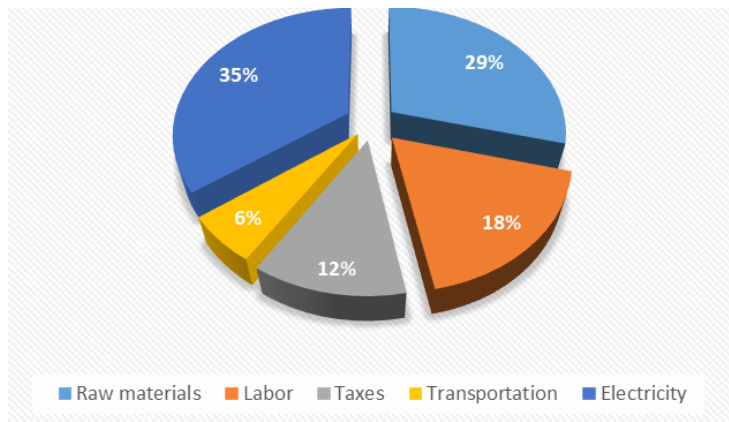


Chart 13: Factors Caused Cost Rise of Domestic Products

Since raw materials and electricity play significant role in steel product prices, exploring mines and providing low-priced electricity will bring a notable change in domestic products prices. Therefore, enabling better competition with regional countries.

4.2.6. Market Competition

Steel producers consider legal and illegal imports from regional countries as their biggest competitor. 86% of industries believe that regional countries are their competitors whereas 14% say they don't have any competition.

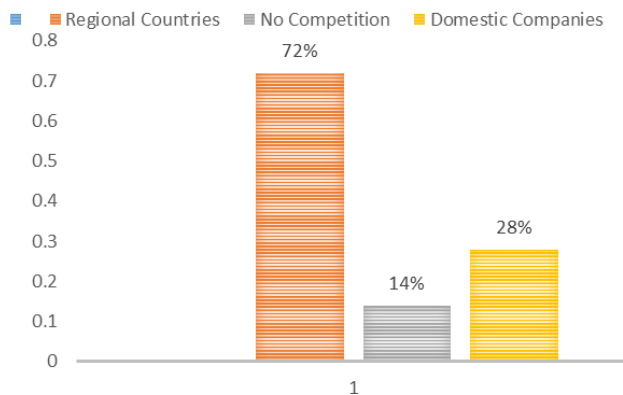


Chart 14: Market Competitors

Since the emergence of steel industry in Afghanistan (,) regional competitors have used techniques like dumping and price reduction to flap the industry and keep control of it. Therefore, it is crucial for afghan industry to become self-sufficient in order to survive in the market and be able to compete.

4.2.7. Barriers

The conducted survey asked industrialists about the barriers and challenges they face. They respondents pointed out factors such security, electricity, raw materials, investments and so on. The collected answers are shown below:

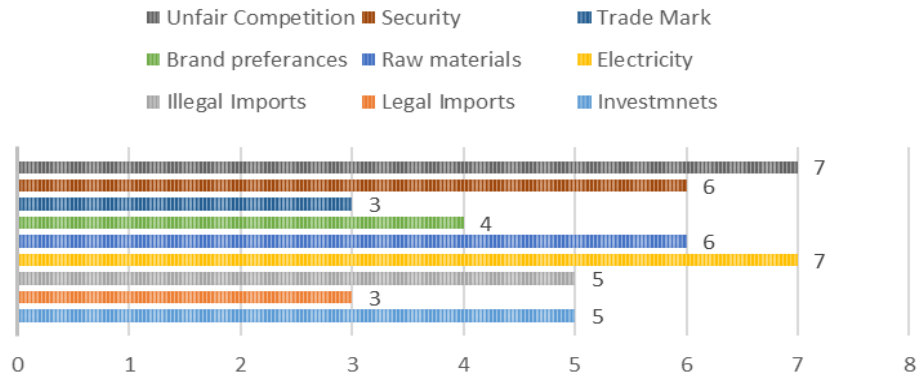


Chart 15: Obstructions in the Steel Industry in its Production

It can be seen that unfair competition, electricity, and raw materials are the most persistent problems. To address these problems some serious steps must be taken. For instance, illegal trades should be controlled, electricity should be provided for companies and as mentioned before, mines should be exploited to provide quality raw materials.

5.3. Construction Companies and Engineers

Afghanistan has an enormous reserves of Iron mines. Therefore, it is an ideal country for producing and utilizing steel products. However, most of construction companies and engineer prefer using concrete instead of steel. In order to discover the reason for this preference a survey was conducted in 5 construction companies and 16 engineers were interviewed, too.

5.3.1. Preference

First, question was about their preference and the reasons for it. Results of the survey and interviews depicted that 81% of the of engineer and all construction companies preferred concrete over steel. Majority of the reasons are provided here:

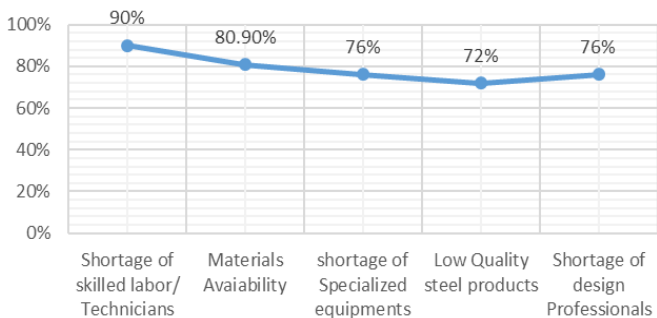


Chart 16: Reasons for Preferring Concrete Rather than Steel

To answer these concerns, more technicians and engineers should be trained in training centers and universities. As Afghan Korea vocational Training center is calling upon the government to boost capacity so that more students can benefit of such centers [21].

Furthermore, investments should be done to import specialized steel erection equipment and technologies so that high quality materials could be produced inside the country. Opportunities should be provided for students to study abroad and use their expertise in construction and steel industry to overcome the problem of professional’s shortage.

Moreover, this chart demonstrates a summary of reasons that were provided by companies and engineers on the comparison of steel and concrete.

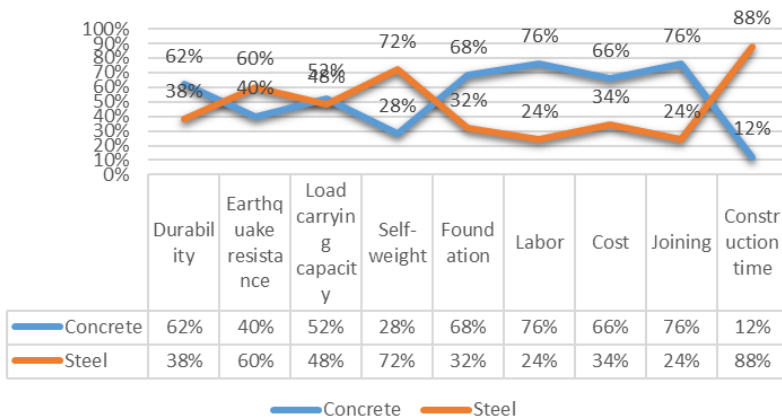


Chart 17: Property Comparison of Steel and Concrete

5.3.2. Demand

One of the reasons concretes is used by construction companies and engineers is that most of the times its customers demand. 95% of customers prefer concrete structure rather than steel structures.

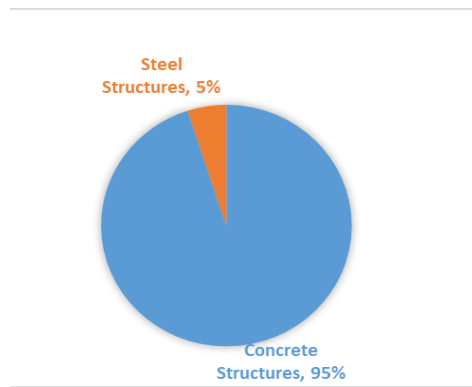


Chart 18: Demand Comparison of Steel Structure and Concrete Structure

The main reason is that people are not aware of the benefits of steel structures. They believe that concrete structures is longer lasting and durable. Therefore, to solve this issue people's awareness should be increased about steel structures. Construction companies should conduct seminars and information sessions to provide more information on steel structures and their benefits.

6. Data Obtained from SPSS

To put high precision, the data we gained as a result of numerous surveys and interviews about (steel productions, imports, domestic products availability, its preference by different stakeholders "wholesalers, construction companies and steel production companies", and barriers in steel production in Afghanistan) were then analyzed with the help of SPSS software by inputting a number of variables such as: imported products availability, domestic products availability. And the outputs of the analysis by software are tabulated as below.

	Shape type	Responses	Percent of Cases
Product Availability	U Channels	2	28.6%
	T Bar	2	28.6%
	Square Bar	1	14.3%
	Rounded Bar	1	14.3%
	Rebar	6	85.7%
	Ingots	2	28.6%
	Equal and Unequal Angles	4	57.1%
	Beam	2	28.6%
	Iron Strip	3	42.9%
	Galvanized Wire	6	85.7%
	Steel Sheets	5	71.4%
	Iron Pipe	5	71.4%

Table 2: Percentage of Available Steel Products that are Imported

	Shape type	Responses	Percent of Cases
Domestic Products Availability	U channels	1	14.3%
	T Bars	2	28.6%
	Square Bar	3	42.9%
	Rounded Bar	2	28.6%
	Rebar	5	71.4%
	Ingots	1	14.3%
	Equal and Unequal Angles	2	28.6%
	Beam	3	42.9%
	Iron Strip	5	71.4%

Table 3: Percentage of Available Domestic Steel Products

Nos. of companies	Initial investments (Millions \$)	Percent
2	0.1	28.6
1	1	14.3
1	2	14.3
1	3	14.3
1	30	14.3
1	50	14.3
7	Total	100.0

Table 4: Initial Investments Made by Steel Production Companies in Afghanistan

	Reasons	Responses	Percent of
		Nos	Cases
Reasons for Concrete Preference	Shortage of steel skilled labor	18	90.0%
	Materials availability (Concrete Structures)	16	80.0%
	Shortage of specialized equipment for steel construction	15	75.0%
	Low quality steel products	14	70.0%
	Shortage of steel structure design professionals	15	75.0%

Table 5: List of Reasons for Concrete Preference Over Steel

	Barriers	Responses	Percent of
		Nos.	Cases
Barriers	Unfair Competition	7	100.0%
	Brand Preference	4	57.1%
	Illegal Imports	5	71.4%
	Security	6	85.7%
	Raw Materials	6	85.7%
	Legal Imports	3	42.9%
	Trade Mark	3	42.9%

Electricity	7	100.0%
Investments	5	71.4%

Table 6: Barriers on way of steel production in Afghanistan Market

7. Conclusion

Afghanistan has had a remarkable progress in the steel sector in last two decades. However, there is a general tendency towards building concrete structures rather than steel structures. There are a number of reasons that caused this propagating problem ranging from the market conditions to domestic production, construction companies' preferences and public demand. This paper investigates the results of a series of surveys and interviews conducted from steel traders and whole sellers, steel production companies, construction companies and engineers to determine the underlying reasons for the tendency towards building concrete structures rather than steel structures.

First, whole sellers and steel traders were surveyed to find out the current market conditions, available products, prices and demand. It was found out that Afghanistan's steel industry is not able to fulfill the market demand due to lack of sufficient productive investment in this sector. Afghan government needs to take serious steps to mediate risk to the investment. For example, illegal imports and illegal imports of steel goods are an alarming danger for domestic steel industry. An increase of tariff on imports of steel and controlling illegal imports can Support of domestic production. Moreover, it was determined that there are both domestic and imported products are present in the market but majority of buyers prefer imported products because either their needed products are not produced in the country and has to be imported or they are not aware of the domestic products at all. Steel production companies, therefore, must adopt new strategies to cover the market, increase awareness of domestic products and attract buyers. Additionally, expanding capacity and producing more varieties of products will undoubtedly make it easier for buyers and companies to access domestic products that they require and in turn support domestic companies back.

Secondly, steel production companies were surveyed to discover the current production capacity, product types, investments, raw materials, technology, price affecting factors, market competition but faced challenges. After a thorough analysis of the data it was concluded that although a number of notable investments have been made since 2015, unfair market competition, electricity, and shortage of raw materials have created barriers for steel production companies in Afghanistan. These

factors affect the production capacity, product types and product cost substantially.

To address these problems, mines should be explored to provide access to a huge source of raw materials. Electricity must be provided so that production companies could expand their capacity. Moreover, increasing tariffs on imports will make it easier for new companies to enter the market and it will lessen the unfair competition with regional countries.

Additionally, 5 construction companies were surveyed and about 16 engineers were interviewed to determine the reasons why they prefer building concrete structures rather than steel structures. The main reasons provided were shortage of design professionals, skilled labor and specialized equipment. Moreover, 95% of the customers, demand concrete structures because they are not aware of the benefits of steel structures. To answer these concerns, investments should be done to import specialized steel erection equipment and technologies so that high quality materials could be produced inside the country. Opportunities should be provided for students to study abroad so that they may use their expertise in construction and steel industry to overcome the problem of shortage of professional's. Additionally, people's awareness should be increased about steel structures so that more demand is created in the market.

In conclusion, the data obtained from the surveys and analyzed by SPSS indicates that Afghanistan has a huge potential and market for building steel structures. however, there are some problems that need to be addressed by the government, steel production companies, construction companies and engineers.

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