Steel Construction Industry in Sudan

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Abstract

This paper contains the results of the field survey carried on the different sectors related to construction industry of steelwork in Sudan. The paper disclosed the effect of oil exploration and production in the increasing demand of structural steel. Structural steel gained considerable grounds as structural material due to its uncountable merits. Sudan is very rich with its mineral resources. Iron can be found in many locations all over the country. Governmental support to investment in iron mining is highly required in order to face the demand of development projects.

ملخص

تحتوي هذه الورقة على نتائج المسح الذي تم على القطاعات الانتاجية المختلفة المتعلقة بصناعة وتشديد الحديد الانشائي في السودان. كما اوضحت الورقة الاثر الكبير لمشاريع استخراج النفط في السودان على زيادة الطلب على الحديد الانشائي والمباني المعدنية سواء بصورة مباشرة او غير مباشرة ودخوله كمادة انشائية ونظام انشائي منافس للخرسانة المسلحة. هناك حاجة ماسة للاهتمام بهذا القطاع لسد الفجوة وتاهيل شركات وطنية وبيوت خبرة لتقود النمو المطرد المتوقع لقطاع المنشآت الحديدية. السودان بلد غني بموارد المعدنية ويتوافر خام الحديد في العديد من مناطق السودان والمطلوب الدعم الحكومي لتشجيع الاستثمار في استخراج الحديد للاستفادة منه في مشاريع التنمية المختلفة.

1. Introduction

Sudan witnessed a remarkable increase in construction projects since the end of 1990's. This increase is linked to the oil exploration and production in the country due to high revenue of oil exportation. Our study is concerned with:

- Iron mining in Sudan.
- Effect of oil exploration and production.
- Production of structural steel elements.
- Fabrication of steelwork in Sudan.

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- Construction of steelwork.
- Prefabricated /pre engineered buildings.
- Steel construction in oil fields.

The steel industry is a very new industry in Sudan. The clear steps taken to promote this industry are linked to the oil exploration in Sudan. Oil industry accompanied with big construction projects with international firms. Most of the new factories are started after the year 2000. Alakadabi (1997), is considered as one of the first private Sudanese factories for fabrication of structural steel from imported material. Fabrication workshops were fabricating simple structural elements for construction like:

- Trusses for roof construction
- Simple small span portal frames
- Simple pre fabricated buildings
- Small size warehouses and workshops

The traditional workshops limited their work to the fabrication of doors, windows, grills, stair handrail, and furniture with special exception of some workshops specialized in the fabrication of cars chassis at Khartoum and state cities like Al Obeid. Other uses of structural sections used for roof construction were I sections and C sections which represented more than 90 % of the imported sections. They are used as main rafters, girders and columns. The most section dimension used range is 12 to 18 cm in depth.

2. Iron Mining in Sudan

Sudan is very rich of iron ore and has a very big potential resources in the following locations:

1. Red Sea hills.
2. Nuba Mountains.
3. Western Kordofan near Rigl Alfola (Abu Tulu).
4. Darfor.
5. Wadi Halfa.

The first scientific effort to assess the iron deposits in Sudan can be backdated to the year 1910 when Dunn and Grabham presented at the International Conference in Sweden a memoir entitled “The Iron ore

deposits of the Anglo-Egyptian Sudan” ⁽¹⁾, however, the real exploration works were started in the mid sixties. The Yugoslavian Company **Yugosteel** is the first international company that succeeded in producing 120,000 ton of iron from **Fodikwan – Tikranel & Grab-Dlheit** at the Red Sea Hills. In 1961 four shipments totaling 20,000 tons were delivered to Yugoslavia. The following table describes the major iron deposits and occurrences described in Sudan:

Table (1) Location & quantities of major iron deposits in Sudan

SN	Location	Estimated QTY (tons)	% Fe
1-	Red Sea Hills		
1.1	Fodikwan		
	Ore with over 50 % Fe	1,923,000	Over 50
	Ore with 20 – 50 % Fe	420,000	20 – 50
1.2	Grab Del-heit minerals	50,000,000	+60 high grade
1.3	Sofaya group – 160 km NW of Port Sudan. It includes the following areas:		
1.3.1	Ankur iron ore	7,500,000	33.3 – 66.3
1.3.2	Yaw Ikurar iron ore	4,100,000	30.6 – 64.7
1.3.3	Aderaweib iron ore	1,124,000	33.8 – 57.2
1.3.4	Mafdeib iron ore	88,400	26 - 60
1.3.5	Aguissan iron ore	220,000	Average 48.7
1.3.6	Adareim iron ore	445,700	34.6 - 64
1.3.7	Sofaya village iron ore	No significant value detected.	
1.4	Karora group iron deposits. Near Eritrean borders	4,900,000	41.1
2-	North State		
2.1	Wadi Halfa	250,000,000	60-80 Fe ₂ O ₃
2.2	Bayuda desert	43,000,000	43
3-	Kordofan		
3.1	Jebel Abu Tulu, 32 Km east Rigi Elfol	35,732,000	64.22
3.2	Nuba Mountains	2,250,000 Al Ageed 1974.	67.95 – 92.56Fe ₂ O ₃
4-	Darfour		
4.1	Jebel Kornoi, 100 Km NW of Jebel Marra	1.5 billion tons	60% of Fe and +90% of Fe ₂ O ₃

The major problems of infrastructure, power supply and technical development that hindered the investigation in the past are well improved now. The development can be seen in the following factors:

- a) The oil fields in the south and west Kordofan can solve the power supply of western Sudan and Nuba mountains iron deposits.
- b) The continuation of the construction works of the west intercontinental road (Al Ingaz AlGharbi).
- c) The ring road (Umm Ruwaba – Abassiya – Rashad – Abugibaiha – Kalogi – Talodi – Haiban – Kadogli) will connect the Nuba Mountains deposits with the Sudan railways network at Umm Ruwaba and Dibaibat.
- d) Shiryan Alshamal road and the new road that connect Dongola – Halfa.
- e) Marawi Dam that suppose to solve the power supply problem for most of the industries in the country.
- f) Oil exploration works at the South have already solved the power supply and transportation in the upper Nile areas.
- g) Exploration works of Natural Gas in the Red Sea area.
- h) The coastal road Portsudan – Suez (under construction).
- i) Portsudan – Haya – Atbara road (already completed).
- j) The new technology in aerial mapping and geophysical/geological methods and techniques.

Red sea area can be considered of strategic location due to its vicinity to the Sudan main port, which facilitates exportation and importation of material. This is in addition to the considerable amount of iron ore with high quality.

4. Effect of Oil Exploration and production

Oil exploration in Sudan started in 1970s with Chevron Company. The work at that time was limited to the exploration works only like seismic and geological/geophysical surveys. The second start of exploration works were carried in mid of 1990's accompanied with the increase of the number of concessions being awarded to the investors and the start of oil production and exportation works. The effects of this era are:

1. The nature of oil industry (big investments) necessitates rapid construction methods to ensure quick return of the initial invested money.

2. The nature of the soil in the South and South West (black cotton soil) requires light structures with special function to reduce the effect soil movement.
3. Many infrastructure works (roads, bridges) were constructed.
4. The new income of foreign currencies from oil exportation has resulted in booming in the real state sector and industries in Sudan, many towers can be noticed in Khartoum.
5. The following structures related to oil industry are of steel structures:

- Pile foundations.
- Pipe racks and tracks.
- Oil storage tanks.
- Processing facilities.
- Warehouses and workshops.
- Base camps.
- Transmission lines.
- Power plants.

Plate (1):Thar Jath Power Plant and Pipe racks at CPF

4. Steel Manufacturing

Steel manufacturing is the process by which the iron ore or steel scrap is heated to above 1200 C, processed through many operations to produce billets, blooms or slabs. Billets are then reheated in big ovens and rolled in steel mills in order to produce other products like steel bars and angles. The pioneer factory and the first of its type in the country is **Giad Factory for Steel**. The factory is founded in the year 2001/2002. It is a governmental factory and considered as one of the strategic factories that belong to **Giad Industrial City**. The factory has the only one electric furnace in the country with a capacity of 150 ton/day. This capacity is very small compared to the other factories in the area (EZ STEEL- Egypt, only one factory can produce more than 3200 ton /day).

4-1 Obstacles

The main problems facing the factory can be summarized in the following points:

- a) Unavailability of local raw material.
- b) Small size of the arc furnace (30 tons).
- c) Fluctuations of electrical supply.
- d) High cost of power.
- e) The quality of scrap is not good and needs more sorting.
- f) The suppliers of scrap are not specialized in this type of work. They need training and know – how of what is required and how to sort out the material.
- g) Lack of local training bodies because the industry is still new in the market.
- h) High taxes and customs
- i) Transportation problems.

4-2. Products:

The small quantity of billets produced in the factory is added to the imported one and reheated in an oven (more than 1000 C⁰). The molten metal is then processed through many production lines to produce reinforcing bars (8mm to 32mm diameter, tubes and angles. The capacity is 180000 ton / year.

4-3. Effect of Foreign Companies and New Development Projects:

At the start of the production, the main clients were the local contractors and building material stores. Except professionals and big companies, contractors concern about quality and specification issues is minimal. The only requirements were diameter and length. The entry of foreign companies and consultants and the expansion of the development projects all over the country, have led to the following:

- a) QA/QC is of top importance for clients.
- b) Mill certificates for the steel are required.
- c) Third party certification is asked for. The factory gives test results for every 1000 tons. The laboratories of several Sudanese universities represent the reference for third party certification for most clients.
- d) Bigger diameters are requested. The factory elongation test machine is capable of testing up to 22mm dia. The lab department already ordered one machine capable of testing up to 40mm diameter. There is a single machine capable of testing up to 1000 kN load, belongs to the Faculty of Engineering Sciences of Omdurman Islamic University.
- e) Special specifications are required. Chinese companies ask for weldable steel (of low carbon content) because they use welding instead of splicing reinforcing steel.

Plate (2) GIAD Steel Factory

5. Fabrication

The situation in the fabrication sector is better than steel making. The following fabrication workshops were visited and studied:

- a) Alakadabi For Steel
- b) Manafi for Steel
- c) Leader Technology For Steel

Alakadabi for Steel shall be studied in more details to represent other factories.

5-1 Alakadabi for Steel (an example of fabrication workshops):

The factory is a private sector factory founded in the year 1997 as small scale fabrication shop for warehouses, stores and hangers. Another line of production is added in the 2000s for prefabricated buildings. The third development is the addition of automatic welding machines as well as machines for built up sections.

5-1-1 Products: the factory is producing the following:

- a) Prefabricated buildings
- b) Portal frames for warehouses, workshops, lecture rooms and show rooms
- c) Trusses
- d) Storage steel tanks
- e) Crane girders
- f) Multi storey steel buildings
- g) Cold form sections like purlins, gutters, down spouts
- h) Corrugated iron sheeting and sandwich panels for roofs and walls
- i) Metal cladding.

5-1-2 Machinery: in this regard compared to other fabrication workshops, the factory is considered to possess the most sophisticated machines in the local market. The main machines available at Al Akadabi fabrication workshop are:

Table (5.3) Main Machines at the Fabrication Workshop

SN	Machine	Function
1-	Computer numeric cutting & drilling machine	Cutting and drilling
2-	Forming and shaping machine	C sections (160mm & 170mm)
3-	Shearing machine	Cutting of plates of 8 mm thick and smaller
4-	Shearing machine	Cutting of plates (8mm – 12mm) thick
5-	Plasma cutting machine	Cutting up to 50mm thick plates.
6-	Submerged Arc Welding machine (SAW)	Making built up sections
7-	Punching machine	Making holes
8-	Purlin machine	Making purlins of different sizes.
9-	Bending machine	For making V and U shapes. Making of chanel
10-	Sheet bending machine	Forming down spouts, gutters & cladding accessories
11-	Sheet bending & corrugating machine	Corrugated iron sheets
12-	Straightening machine	Straightening sheets and plates

Different departments are involved in the final production. The activities in each department can explained in brief in the following:

5-1-3 Sales and Contracting Office

This office is responsible for the following works:

- Sit with the client and translates his requirements into initial specifications and details
- Send the proposal to the engineering section for initial structural and architectural design
- Resubmit the proposal to the client for study and approval
- Make the contract with the client upon his approval.
- Coordinate with the engineering office for final drawings, preparation of cutting lists and fabrication works.
- Coordinate with erection department if the contract asks for that.
- Transportation of material to the site according to the contract.

5-1-4 Design/Engineering Office:

The office is composed of three sections:

- a) The architectural section for preparing the architectural drawings
- b) The civil/structural section for making the structural design and foundation details if to be included in the contract. This section is responsible also for preparing the cutting list for the workshop.
- c) The Estimation & costing section for making the material take off and cost estimates.

5-1-5 Fabrication Workshop:

The workshop is responsible for:

- a) Fabrication of the elements as per the cutting list submitted by the engineering office
- b) Sand blasting works if needed
- c) Shop painting
- d) Marking of fabricated material

5-1-6 Prefabricated Buildings Department:

This department contains many sections and production lines that are required for the production of prefabricated buildings like:

- a) Production line for foam and polystyrene with different thicknesses and densities
- b) Sheeting accessories
- c) Aluminum workshop for windows, doors, frames and accessories.
- d) Metal workshop for steel doors, windows and framing of buildings.
- e) Corrugated sheets line
- f) Sandwich panel line
- g) Electricians, carpenters, plumbers and finishing staff.

5-1-7 Multi-storey Buildings:

This section is a new section. The first buildings executed were the National Security building (three storey) building and Alakadabi Administration Building (Three stories also).

5-1-8 Comments and Remarks:

The study showed that the factory has very good resources. For better utilization the following points should be considered:

- a) QA/QC role is weak and need more improvements. It should be equipped with experienced persons.
- b) Safety measures are not properly considered especially at the workshop, painting yard and sand blasting area.
- c) The work depends on young engineers without formal training.
- d) The key positions at the engineering and workshop are occupied by foreigners.
- e) All sensitive and sophisticated machines are operated by foreigners.
- f) No clear policy for training of Sudanese engineers and technicians.
- g) High turn off of local workmanship and high rate of permissions and leaves among the local manpower.
- h) The knowledge of the local clients with steel construction is weak. Accordingly the number of requests is big while the actual number that ends with a deal is low. More effort is required to persuade clients.
- i) High taxes and duties that lead to the increase of steel prices compared with concrete where most of the ingredients are local like (cement, sand and gravel).
- j) Lack of experienced persons for erection.
- k) Low productivity of local manpower and complications for the residence permission for foreign manpower.
- l) Lack of standards, procedures and method statements

Regardless of the above mentioned points there are many indications that steel construction is going to witness remarkable progress and improvement like Marawi Dam, New steel bridges across the Nile and oil exploration works. The effect of these big projects can be seen in the following:

- a) Quantity: the work is already doubled in terms of quantity
- b) Spans: Previously, the free spans range from 10 to 20m and depend on the available I-sections in the market. According to the increased demand for large spans and more clear heights, steel factories imported machines for continuous welding and built up sections. These machines allow for the fabrication of frames capable of spanning up to 40 meters as an example:
 - The Syrian House – 30m span
 - Wathbah Company – 40m span

- Garri Free zone – 40m span.
- c) Areas: the covered areas per one building have been increased from 300m² in the past to 2000m² and 3000m².
- d) Height: the experience of high rise buildings fully fabricated locally is still new. Most of the previous buildings are one storey with or without mezzanine. Alakadabi have completed the framing of a four storey steel building. The Academy for Medical Sciences and Technology also has a library steel project under construction of 11m clear height.
- e) Increased demand: the demand for steel structures is more than the capacity of the local market. This situation gave a chance to imported materials to enter the market. The local fabricators should consider this new competition by adopting quality policies to their products.

6- Pre Engineered Buildings:

6-1 Introduction

Before 2000 there were no Sudanese pre engineered buildings companies, instead there were dealers or representatives for the known companies in the international and regional market like:

- a) Buttler
- b) Alzamil
- c) Kerby
- d) Mamouth

In addition to those companies there are considerable amount of imported pre engineered buildings from different resources like China, Egypt, India and Korea. Most of the representatives refused to give detailed data about their sales but they assured that the demand is increasing rapidly. The following data taken from Sudan Customs Headquarters show the development of this sector.

Table (2) ⁽²⁾ Imported Pre Engineered/Fabricated Build. (1997 – 2006)

SN	Year	Total Imported Pre Eng./Fab. Buildings in kg
1-	1997	166,276
2-	1998	5,257,295
3-	1999	1,391,419
4-	2000	2,681,142

5-	2001	3,923,071
6-	2002	5,659,692
7-	2003	7,846,062
8-	2004	19,640,797
9-	2005	27,475,545
10-	2006	55,244,540
	Total	129285839

The rate of increase in the imported pre engineered/fabricated buildings from 1997 to 2006 can be noticed from the above Table. The work of these dealers is summarized as follows:

- a) The client submits his request for a pre-engineered building. If he has preliminary design the same will be discussed with the technical engineer and then send to the engineering office situated in the main office for detailing and re adjustment to suit the standard designs available and cost estimate. If no drawings are available with the client, a proposal will be developed and send to the engineering office for detailing and costing.
- b) The new proposal and cost estimate will be send to the client for check and approval. Any changes or remarks shall be incorporated in the final proposal and resend to the dealer for getting the final approval of the client and contract signing.
- c) Most of the dealers have standard form of contract, technical specifications, erection procedures and brochures.

6-2 Problems:

- a) Lack of certified erectors. Some of the dealers made local training for contractors and made them familiar with their system then after nominate them as certified contractors (Alzami & Nabag).
- b) Lack of skilled manpower and technicians
- c) Some clients ask to erect by their own. In many cases they don't have the proper experience. When they face any problem always they come to the vendor.
- d) Delays at the port due to tax and administrative complications. To avoid this problem Alzamil supply the material at Port Sudan. The client has to take care for all customs, taxes, port clearances and transportation to the site.
- e) Bad roads for transportation

- f) Lack of coordination between designer, erector and civil works contractor.
- g) Long time from the client request and contract signing.
- h) No training centers for steel construction
- i) Residence complications for foreigners.
- j) The increase of the international steel prices as well as unstable prices.
- k) Design problems because design offices are located abroad
- l) Complications of the banking system in opening the letters of credit (LC).
- m) Financing problems and delay of payments.
- n) Bad roads – long transportation time & damage of material
- o) High cost of transportation – can be reduced if railways are available and functioning properly.
- p) The Private National Capital is not yet entering this type of business and the technical people lack finance capability.

6-3 Changes in the Sector

During the last five years there is a noticeable change in terms of quantity, spans and specifications. Previously the requested spans range from (30m – 35m) but now we can see spans up to 80m span portals (50m multi span at Safola Building). Quantity wise, instead of orders for 40 – 60 tons Salam Rotan Hotel has ordered (600 ton shipped into 33 containers within 45 days by Alzamil), Tuti Bridge ordered and erected over 800 tons imported from China.

6-4 QA/QC and Procedures:

- All mill certificates are provided by the supplier
- Suppliers provide erection procedures in CDs to assist in improving erection practice.
- QA/QC practice is very poor
- Method statement procedures are very poor.
- Lack of testing and calibrating devices (torque wrench calibration).

6-5 Prices:

Prices differ according to the client, as follows:

1. Exempted projects like (oil industry and big development projects Marawi Dam). These clients are well backed by the investment law.
2. Individual un-exempted clients, this category face high prices for customs and taxes.

Figure (1) Taxes and customs for prefab 1997 to 2006 ⁽²⁾

7- Steel Construction Projects:

Steel construction projects in Sudan are increasing rapidly due to the following factors:

1. The booming of the real estate investment
2. The entrance of big oil exploration companies that need big and sophisticated headquarters to manage their operations (Greater Nile Tower, White Nile Tower and Petrodar Tower).
3. The high cost of land per meter square in Khartoum encourages the vertical expansion instead of the horizontal one.
4. The new investment and tourism policy that aims at maximum utilization of the River Nile Coast in the three cities as well as relocation of the existing Ministries and governmental offices by the side of the Blue Nile (The Libyan Hotel).
5. New high rise building projects: the Gigantic Alsonut Project that developed and already started the construction works at Alsonut Area behind Hilton. The presentation shows a forest of high rise

buildings. Steel is going to take the lion share. Increase in the number of infrastructure projects can be noticed:

- a. Tuti suspension bridge
 - b. Almak Nimir steel bridge
 - c. Rubkona steel bridge – Bantiu - Unity State
 - d. 4 steel bridges under construction – Greater Nile concession area.
 - e. Marawi Dam
 - f. New free Zone at Garri
 - g. Khartoum industrial area
6. Most of the new high rise buildings/towers are of complicated, special architectural features. Due to the flexibility of steel it was chosen as the structural material as an example:
- a. The Libyan Hotel at the previous animal zoo
 - b. Greater Nile Tower at Alsonut Project (3300 ton of steel, basement, mezzanine, ground floor plus 15 typical floors and other annexed buildings/facilities).
 - c. Alsalam Rotana Hotel (600 ton).
7. The new agencies for cars and equipments that require big clear spans for cars and equipment show rooms (an example is Toyota show room near Khartoum Airport and Headquarters of Diesel Equipment near the airport also).
8. The expansion in the higher education is involved in the increasing demand in terms of quantity and size. New universities need rapid construction to accommodate the increasing number of students and big lecture rooms and labs.
9. Big laminated advertising boards are becoming familiar in Khartoum and National roads. This is in addition to the steel towers for the different telecommunication companies.
10. The expansion of the National Electricity Corporation in the field of transmission lines to cover the country with expected power supply from Marawi Dam created more demand for steel.
11. Works in Khartoum International New Airport.

7-1 Typical Projects

Two steel construction projects were visited namely:

1. Diesel Construction Headquarters located near the airport.
2. Greater Nile Petroleum Operating Company (GNPOC) at Alsonut Project.

Plate 3: GNPOC Headquarters

Plate 4: Diesel Headquarters

Diesel Construction Headquarters Building is a 6 storey building with mezzanine at the ground floor fabricated by Alzamil at their regional office (Egypt). The structural system is built up portal frames (150 tons). Although the steel structure is already completed but erection has been done with unspecialized contractor in coordination with the supplier supervisor. The main remarks are:

1. No erection procedures and no certified erector, accordingly the erection faced many problems like displaced holes and reversed order of material ordering.
2. No QC/QA procedures
3. Unavailability of erection tools.

The situation in the second building (GNPOC) is more better because the client has his own experienced engineers in addition to the International Consultant (KEO Consultants from Emirates & TECHNO consultants as local consultant). The contractor is an International Malaysian Company. The contractual, design, construction procedures, shop drawings are well considered in a professional way as seen in the contract documents and the site set up. The project started and the contractor was terminated because he encountered great losses in other projects and faced cash flow problems. The key factors for choosing steel construction are:

1. The shape factor: the building is architecturally complicated and need flexible construction material.
2. Time factor: since the building is urgently required by the client the initial estimated erection time by floor was 9 days only. This target cannot be achieved by concrete construction.
3. Foundation: the building is 15 storey building with basement and the total steel quantity is **(3300 ton)**. Steel construction reduced the size and weight of foundations.

7-2 Problems:

1. High cost of the imported structural steel although it is exempted from custom duties.
2. Logistics: The source of steel is Malaysia. Transportation was a real problem in addition; unexpected costs were encountered because the port is not big enough to receive the containers and ships that shipped long sections. As a solution the material have been off loaded at Jeddah (KSA) then reloaded in smaller ships to Port Sudan.
3. Long time is required for material inspection, handling and obtaining of customs clearances at the Port.
4. Lack of local engineers and skilled technicians especially in steel QC/QA.
5. Unavailability of local specialized contractors in this type of work. This has prolonged the choice of another contractor in lieu of the terminated one.
6. Fabricator and designer are located in different countries: coordination takes long time.

8- Reinforcing Steel and Other Products

Production of reinforcing steel shall be studied because it represents the first step towards production of heavy structural steel members. From this point of view comes the focusing on this industry. The field survey showed that most of these factories have plans to add another line of production for hot rolled section (the International Steel factory and Giad). The following factories were visited and studied:

1. The International Factory for Steel
2. Giad for Steel
3. Alasaad For Steel

4. Shawahiq for Steel

8-1 Products and Capacities

Table (3) Steel Products in Some Factories

SN	Factory	Billets	Rein. Bars	Angles	Pipes	Hot rolled
1	Giad	Yes	Yes	Yes	Yes	No
2	Alasaad	No	Yes	Yes	Yes	No
3	International Fact.	No	Yes	Yes	Yes	No
4	Shawahiq	No	Yes	Yes	Yes	No
5	Alamjad	No	Yes	Yes	Yes	No
6	Dubai	No	Yes	Yes	Yes	No
7	Alyarmook	No	Yes	Yes	Yes	No
8	The United Factory	No	Yes	Yes	Yes	No

Table (4) Approximate Capacity ton/year of some steel factories

SN	Factory	Total production
1	Giad	180,000
2	Alasaad	250,000
3	International Fact.	120,000
4	Shawahiq	120,000
5	Alamjad	150,000
6	Dubai	120,000
7	Alyarmook	110,000

8-2 Raw Material Source:

All factories depend on imported billets, flats and long products except Giad, which depend partially on imported steel because it has its own small Arc Furnace. The main source of imported steel is:

1. Turkey, which represent the first supplier for Sudan.
2. Okrania
3. Iran
4. India
5. China

8-3 Sources of Equipments and Key Technicians

The common remark for all factories is that, they bought the equipment from different countries and at the same time they made contracts with engineers/technicians from the origin of equipment. The aim is to:

1. Benefit from on job training
2. Reduce the cost of external training
3. More people will be trained with one trainer while only one person will benefit from external training.
4. Most of the factories are second hand ones. It is found to be cheaper to bring technicians who are familiar with the machines to reduce the break down and maintenance time.

8-4 Quality Control/Quality Assurance (QA/QC):

This side needs more training and equipments. All factories have departments for QA/QC but with limited equipments and experienced people. The main tests carried at the factories are:

1. Tension test
2. Chemical analysis
3. Physical testing (shape, length, dimensions, deformations.)
4. Specific density test.

Factories give test certificate for each 1000 tons and the client has the right to consult any third party lab for verification. The accepted laboratory for all factories is that of the faculties of engineering of different universities.

8-5 Problems:

1. High taxes
2. Unstable power supply
3. High cost of power
4. Skilled local manpower unavailable
5. Administrative complications at the Port.
6. Transportation and bad roads
7. Fluctuations of international prices
8. No standard specification to govern all factories. Only recently the Sudanese Standardization Authority has distributed a proposal for specifications for factories to see their remarks and input.
9. Residence problems for foreign manpower.

8-6 Proposed Solutions:

1. Reduction of taxes and customs to encourage this strategic industry.
2. Improvement of roads condition
3. Simplification of administrative procedures
4. Coordination with the Ministry of Interior affairs to facilitate residence problems
5. Encouraging the investment in the steel industry in order to provide iron ore locally.
6. Exemption of the industry inputs from taxes and custom duties.
7. Issuance of governing specifications
8. Unification of equipment source. This will make exchange of experience very easy.

9- Steel Industry, Current Situation and Expectations

The total number of steel factories in Sudan is 9. The production of each factory is ranging between 120000 ton/year to 200000 ton/year with a total production not exceeding 1800000 ton/year. The production does not cover even 25% of the local market demand. This small production is affected by the fluctuation of the international market and the increasing prices of steel billets. Another major factor is that the biggest steel companies in the world are outside the Arab World, so the global policy is determined to serve the interest of those companies

The situation of steel industry in Sudan is still not as expected. The production is far behind the demand. Collaboration of all concerned parties is required (governmental, private sector and educational institutions). The following suggestions may help pushing a head this industry:

1. Steel industry should be independent. Billets and plates should be provided locally by exploiting the iron ore available in large quantities.
2. Construction of steel sections/ sheets/plates factories
3. Encouraging of the construction of new steel mills.
4. Encouraging the formation of companies working in the exploration, production and exportation of steel billets.
5. Encouraging the existing factories to add hot rolled structural steel sections production line..
6. Preventing the exportation of the scrap. An important initiative for preventing scrap exportation taken by The President has been

published in Akhir Lahza daily newspaper on 20/06/2007 issue No. 323.

Giad Company has very promising projects that can give the steel industry important steps forward:

Project No. (1): construction of a factory for the production of steel plates, steel sheets, and steel billets. The aim is to cover the local need in the first stage.

Project No. (2): construction of a factory for hot rolled sections and built up sections.

Project No. (3): construction of a factory for special steel and spare parts products:

- Steel bridges
- Turbines
- Heavy equipment
- Steel for cars, trailers ...

Project No. (4): foundation of Material Research Center for Metals & Mining that consist of the following proposed departments:

- Metallurgy
- Mining
- Processing
- Advanced metallurgy
- Structural steel & special steel products

There are ongoing coordination between Giad Company, Ministry of Science and Technology, Sudan University for Sciences and Technology and other Sudanese experts.

The Investment Map of Sudan for The Transformation Industries shows the existing demand and production as well as the expected production and gap.

The imports data for the different steel products also give a clear picture of the increase in the Sudan imports. The market can accommodate any new investments in this sector. To understand where the location of Sudan Steel Industry is, let us have a look to the Arabic steel industry.

11. Arab Steel Industry

Arab steel industry witnessed rapid increase especially after the decision of oil producing countries to encourage non petroleum products. Sudan production is considered as nil.

Fig (2) ⁽⁴⁾ Iron production of Arab Countries

Remarks:

1. This production represents (1.32%) & (1.2%) of the international production in the years 2003 & 2004 respectively.
2. Sudan contribution is zero.

From the above table Egypt and Saudi Arabia represents the biggest Arab producers. This high increase is attributed to the fact that Algeria was able to attract direct foreign investments equal to 15 billion dollars through 2007 only for 20 projects. One of these projects is steel production factory with a total cost of 130 million dollars. In the period 2000 – 2006 the programmed projects in cooperation/joint ventures reached 601 projects with a total cost of (8 billion)U.S dollars as follows:

Table (5) ⁽³⁾ International investment in Algeria

SN	International investor	No. of Projects
1-	European Community	296
2-	Arab countries	240
3-	Asian countries	043
4-	U.S.A	019
5-	Total	698

The above show the importance of international investment in the promotion of steel industry.

Sudan has considerable quantities of iron deposits in strategic locations like red sea area. If properly utilized, it can cover the local market and compete in the Arab one ⁽⁵⁾.

12. Conclusion

1. The study showed the situation of steel construction industry in Sudan that is witnessing rapid increase in terms of quantity and type.
2. More joint venture investments in iron mining are required to provide the steel industry input.
3. Oil production represented the land mark for booming of infrastructure projects. Steel construction industry is affected positively with this booming.
4. Reduction of customs and duties as well as cost of power supply.
5. Improvement of investment policy in order to attract investors.
6. Provision of low cost power supply means.
7. Encouraging the private sector and the banking system to finance this strategic industry.

12. References:

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