

# **READY-MADE GARMENTS FACTORY**

## **IN A SUB-URBAN SETTINGS**

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**Abstract**

Garments sector is the life blood of Bangladesh as the agricultural land has there been turned to a country of garments industries. Employment in the Ready-made garment sector in Bangladesh provides workers with economic benefits and some empowerment. More than 4.2 million people are working in this sector and about 5000 garments factories are scattered across the country. 78 per cent of our foreign earnings come from this sector. So it will not be an overstatement to say that, we earn our bread from garments industries. But it is a matter of great sorrow that the socio-economic condition of the Garments workers is not in a lofty stage. Amongst the workers about 80 per cent are women, who work dawn to dusk even up to late night where working conditions are not in the satisfactory level. They have no time or scope for recreation. In many cases factories don't have childcare facilities, medical centers and proper training facilities. So it is our responsibility to provide them a safe working condition where they can work without any type of discomfort.

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## **Chapter \_01**

### **BACKGROUND OF THE PROJECT**

1.1 INTRODUCTION

1.2 PROJECT BRIEF

1.3 AIMS AND OBJECTIVES OF THE PROJECT

1.4 GIVEN PROGRAMS



## 1.1 Introduction

The export-oriented readymade garments (RMG) sector in Bangladesh started its journey in late 1970s as a small non-traditional sector of export. The first garment factory opened in 1976. The industry has grown dramatically since then. The industry deserves special connotation for at least three reasons: (a) it is the single largest earner about 77 % of the yearly foreign exchange earning of the country; (b) it has been the fastest growing industry in the recent years; (c) The industry employees about 4.2 million people. Despite many difficulties faced by the sector over the past years, it continued to show robust performance, competitive strength and, of no less importance, social commitment. RMG's contribution to Bangladesh economy is well-known, well-appreciated and well-respected. In Bangladesh the industry has expanded mainly for the easy availability of labor especially of the female labor accessibility. This sector is considered as one of the main sources of employment for female workers of Bangladesh. On the other hand Garment factories in Bangladesh have been heavily criticized over the last 38 years for the working conditions in which employees must provide labor. High internal gains from artificial lighting, poor natural lighting and equipment produce an intolerably hot work environment, which exacerbates the already uncomfortable climate. Most of our Garments Factories do not consider building depth, building height, volume, equipments and number of storey which factors are very essential to make factory energy efficient. In addition, Very little industrial management is concerned to the work place environment and health of the workers. But to ensure sustainable economic and social development, the industry owners and management must take responsibility.

## 1.2 Project brief

In this current world scenario, with the energy crisis and climate change, the next step towards better work or built environment is to be sensitive about these issues and design functional spaces with hidden agendas. An agenda that primarily includes reduced energy consumption and the reuse/recycle of energy.

Garments industries are a major source of economic growth for our country, still these industries are hardly ever designed. Workers are forced to work in horrible working conditions. Lack of

safety measures, work spaces is monotonous in most cases. Proper ventilation and thermal comfort is ignored in most cases.

As Bangladesh is facing severe energy crisis recently, current and future industries need to improve their energy efficiency. The lack of sensitivity in use of space, energy, material etc, very often causes inefficiency. The situation is deteriorating progressively with time, being caused by the natural growth of the demand for power at one hand and retiring of depreciating power generation plants on the other. It should be a priority for the architects, engineers and the designers to research and recognize how they can contribute to make these energy consuming industries more sustainable.

Hence, I chose this project to understand how a garments industry can be improved in terms of day-lighting, comfort, building form and skin.

### **1.3 Aims and objective of the project**

- Creating a comfortable working environment for the workers. Ensuring more playful workspace for the workers by rethinking their sitting layout.
- incorporating green areas alongside their working areas to increase efficiency and creating a healthy workspace.
- Making the whole industry environmentally-friendly by special consideration in terms energy consumption, natural lighting & ventilation, maximum day light usage.
- Introducing water treatment and recycling at different levels. Water recycling is reusing treated wastewater for beneficial purposes such as agricultural and landscape irrigation, industrial processes, toilet flushing, and replenishing a ground water basin (referred to as ground water recharge). Water recycling offers resource and financial savings.
- Adequate usage of Solar control glass can be an attractive feature of a building whilst at the same time minimizing, or even eliminating the need for an air conditioning system, reducing running costs of the building and saving energy.

- Sensible Consideration in choosing construction materials and orientation of the form. Not only the usage of such building materials which contribute to green living but also the adaptation of such construction technique which has a minimal effect on the environment.

## **1.4 Program**

### **- Storage**

Yarn storage

Fabric storage

Finished product storage

### **- Knitting**

### **- Dyeing/washing**

Dyeing (10 machine)

Dye store

Washing ( 5 washing 5 drying)

Ironing

Laboratory ( 1 officer 2 assistants )

Toilet

WTP ( water treatment plant )

Boiler room ( 9 ton boiler )

### **- Production floors**

Cutting

Accessories store

Cutting quality office

Screen print ( manual )

Sewing (380 machines )

Supervisors office ( 1+ 8 desk )

Finishing ( ironing and packaging )

Inspection officers office

Spot removing

Toilets ( Male : 8 urinals , 8 WC, 8 Wash basins)

Wash basins. Female : 16 WC , 16 Wash basins)

- **Café seating** ( indoor )

Kitchen (store, cooking, prep )

- **Day care ( 20 children ages 0-4 )**

Sleeping area

Toilet ( including bathing & changing )

Kitchen

Dining

Playing (indoor )

Office

**- Mini clinic**

Doctors cabin

Toilet

Waiting area

Assistants desk + store

**- Administration**

MD office + toilet

4 DGM office + toilet

Secretaries

7 admin officer room

2 officer ( accounts )

3 manager room

Common toilet

Seminar room

Kitchenette

Copying and filing room

Office assistant + store

**- Services**

Generator room

ETP ( effluent treatment plant )

**- Parking**

2 types of parking required. One is for 4 trucks used for loading and unloading. The other is parking for 5 cars for the admin section.

## **Chapter \_02**

### **SITE APPRAISAL**

2.1 SITE AND LOCATION

2.2 ROAD NETWORK

2.3 ACCESS

2.4 TRAFFIC FLOW

2.5 NOISE

2.6 SURROUNDING BUILT FORM

2.7 SUNPATH & WINDFLOW

2.8 SITE PHOTOGRAPHS

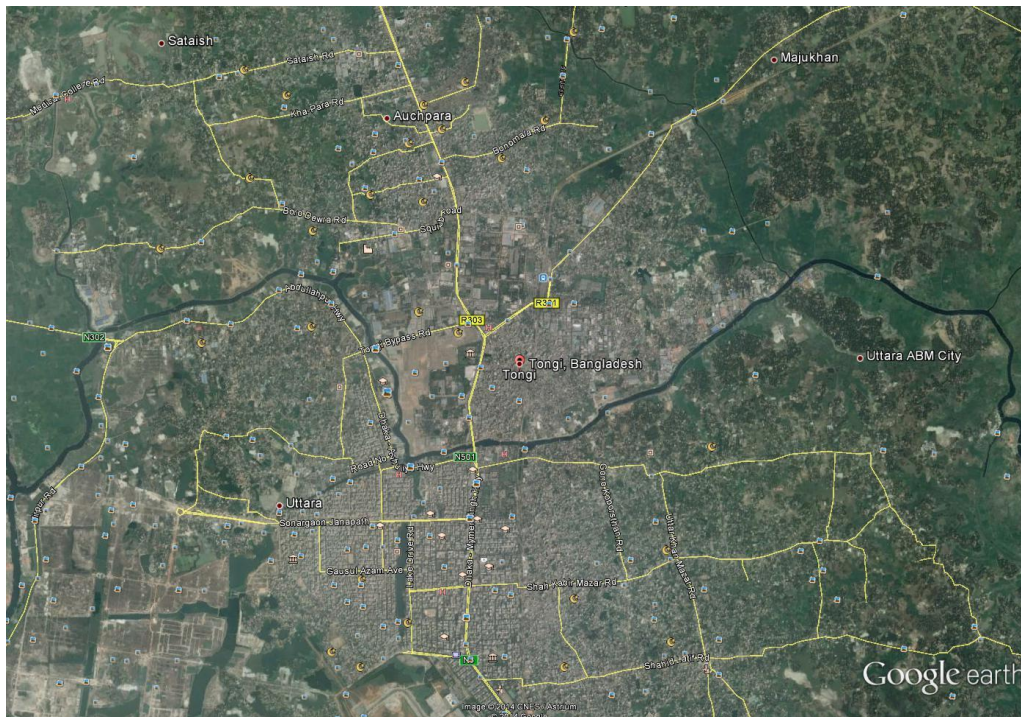
2.9 SWOT ANALYSIS

## 2.1 Site & location

### 2.1.1 Tongi

Tongi is a township in Gazipur, Bangladesh, one of the nearby town of Savar, with a population of 350,000 that hosts the Biswa Ijtema, features a BSCIC industrial area, which produces BDT 1500 crore of industrial products annually and marks the northern border of Dhaka, the capital of Bangladesh, since 1786. Tongi Shahid Memorial School compound is mass burial site of the genocide in Liberation War of Bangladesh. It lies within the jurisdiction Gazipur District, which is a part of the Dhaka Division.

Geologically, the Tongi area comprises the southern extension of the Madhupur tract, a long narrow tract of tectonically elevated area of older sediments only a few metres above the surrounding rivers the Turag. Locally, the Tract is subdivided into the Bhawal Garh terrace which is a part of an inlier, an elevated area surrounded by lowlands by very young riverine sediments occupying the surrounding valleys.



Map of Tongi , Source: Google earth



### 2.1.2 The site

6.23 acres land of Mr. Nurul Amin at Silmun, Tongi thana, Gazipur Zilla.

### 2.1.3 Location of the site



Fig :1 Location of the site, Source: Google earth



## 2.2 Road Network

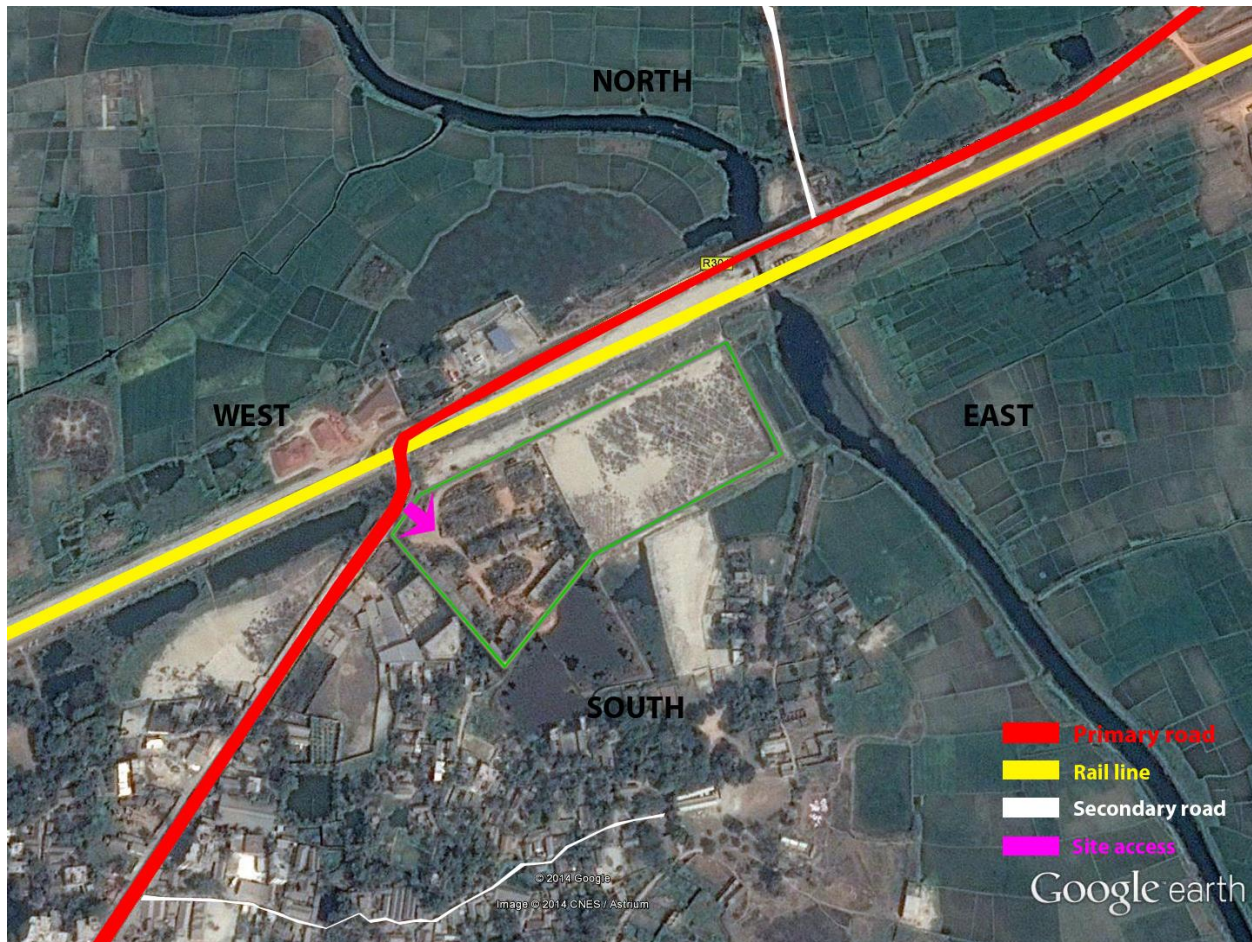


Fig :2 Road network

## 2.3 Access

At present the site is approached from the main road which is around 25 feet wide and is on the north-west corner of the site.

## 2.4 Traffic flow

Traffic or vehicles is considerable low in this area. As there are many industries in this area, vehicles including many public transport are seen on the road. Bus, truck, public van, rickshaw in somewhat frequent rate is observed.

## 2.5 Noise

Though the site is situated in an industrial location, it is surrounded by large green farmlands and water body, so noise level is considerably low. Surrounding residential areas maintain the distance from the site.

## 2.6 Surrounding built form

The site is situated in an industrial area. There are many small industries on the south-west corner of the site and lies right before the local bazar on the east side (Mazukhan bazar ). North side is marked by a petrol pump. Also large numbers of farmlands surround the site. Surrounding built forms are of various floor heights, ranging between 1-6 stories.

## 2.7 Sun path & wind flow

i) Sun: During the winter months, sun remains at a comparatively low altitude which makes possible the pleasantly winter Sundays. During hot summer the Sundays are most undesirable. Rays usually comes from the east, south, west and partly from northeast to northwest high altitude of the sun.

ii) wind direction: General wind direction varies from southwest to south in the summer and northeast to north in winter. Breeze during summer particularly in the humid season (june-september) is very pleasant.

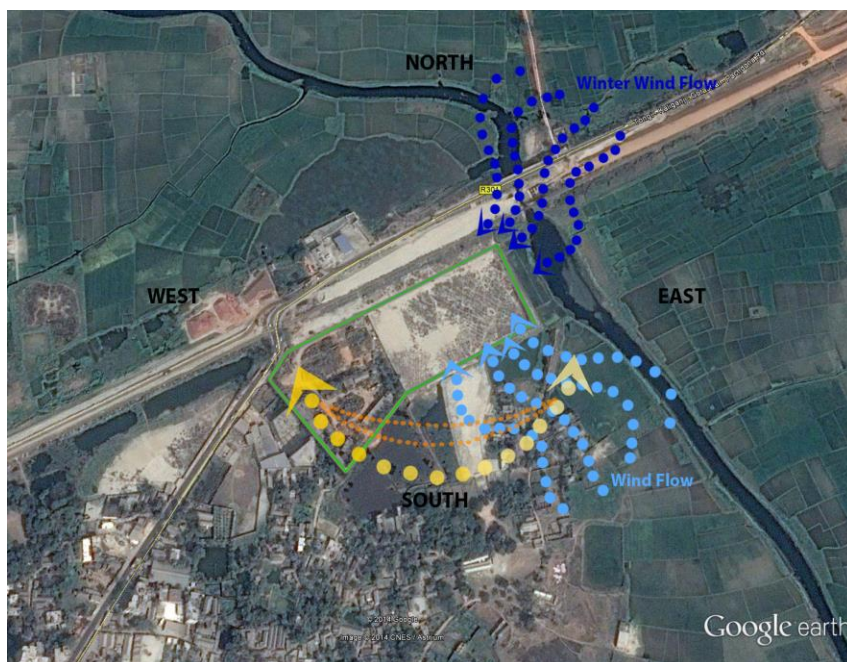


Fig :3 Sun path and wind flow



## 2.8 Site views



Fig :4 Site photos



View 01



View 02





View 03



View 04



View 05



View 06



View 07



View 08



View 08



View 09 (Source: Mahmud, 2014)

## 2.9 SWOT ANALYSIS

### Strength

- i) A rapidly developing area, not fully developed yet.
- ii) Easily accessible.
- iii) Located in lash of green.
- iv) Minimum traffic congestion.
- v) Nice lake view.

### Weakness

- i) Lots of unused spaces surrounding the site.
- ii) Rail crossing in front of the site resulting in periodical rail signals which is totally undesirable.

### OPPORTUNITY

- i) Lots of open spaces around, some of which can be designed for better which.

### Threat

- i) If not treated properly, the area might have a bad impact on the community, as possibilities are huge.
- ii) Unplanned development may spoil overall effect of the site.

## **Chapter \_03**

### **LITERATURE REVIEW**

3.1 RMG INDUSTRY IN GLOBAL CONTEXT

3.2 RMG INDUSTRY IN BANGLADESH

3.3 STRENGTH, WEAKNESS, OPPORTUNITY & THREAT

3.4 SOCIAL IMPACT OF THE RMG SECTOR

3.5 ENNERGY EFFICIENCY IN RMG

3.6 DESIGN CONSIDERATIONS

3.7 WORKPLACE EVALUATION OF A GARMENT- FACTORY

Readymade garments industry is originally a sector of the textile industry. However due to its own vastness nowadays RMG is also considered as an individual industry. While conducting the literature reviews for the origin of readymade garments industry, it was discovered that the early literatures refer to “textile industry” as a whole, rather than describing the “readymade garments industry” as a separate industry. It was during and after the industrial revolution that the readymade garments industry evolved as an individual industry.

### **3.1 Readymade Garments Industry in Global Context**

#### **3.1.1 History of the Industry**

The exact date of when people started wearing clothes is not clear. There are different estimations about when people started wearing clothes. One of the studies says that men started wearing clothes 190,000 years ago. Anthropologists believe that the earliest clothes were made from skin, vegetation etc.

Till the 17th century the textile industry was more of a cottage industry localized within certain transportable zones. The clothiers fabricated the cloth via various processing, all carried out in their courtyards. The clothiers would keep a portion of their product for the nearby market and carry most of their products on horseback to relatively distant areas for selling their products.

There are also evidences of silk being imported to Europe from China via the Silk Road. Cotton being one of the earliest clothing materials in India made its first steps in Europe only during the medieval period. Later cotton came up as the prime clothing material globally.

#### **3.1.2 Rapid Growth during the Industrial Revolution**

The textile industry experienced booming growth during the industrial revolution of the 18th and 19th century. It is one of the industries to get maximum advantage from the Watt engine. With the invention of the “flying shuttle” by John Kay in 1734 C.E mass production of yarn and cloth became a mainstream industry. The industry while getting geared up with advanced technology of those times also experienced labor protests against introduction of “flying shuttle” as the labors feared job loss. However, soon it was realized that because of the dramatic increase in



rate of production the demand also increased. James Watt's modified steam engine with separate condenser added another muscle to the industry in 1761. The industry received its biggest blessings in 1764 with the invention of "Spinning Jenny<sup>10</sup>" by James Hargreaves. This invention elevated the thread production capacity of a single labor by eightfold and subsequently much further.

### **3.1.3 Technical Aspects of the garment Industry**

Garment industry is a broad term. It has numerous wings of source materials and systems of processing and production. To keep the chapter specific and focused only cotton is referred to as the source material and its processing is described in this chapter. The garment industry as a whole begins from cotton tree and ends at the retailer shop from which the product is sold to end customer. In the long process there are numerous technical aspects involved. Six basic steps of garment industry (cotton based) are as below.

- a. Cultivation and harvesting
- b. Preparatory process
- c. Spinning
- d. Weaving
- e. Finishing
- f. Marketing

Of all the steps given above Step-a (cultivation and harvesting) occurs in cotton fields mostly under natural conditions. Steps – b, c, d and e occurs at various types of processing plants.

Marketing is the absolute business part of the chain.

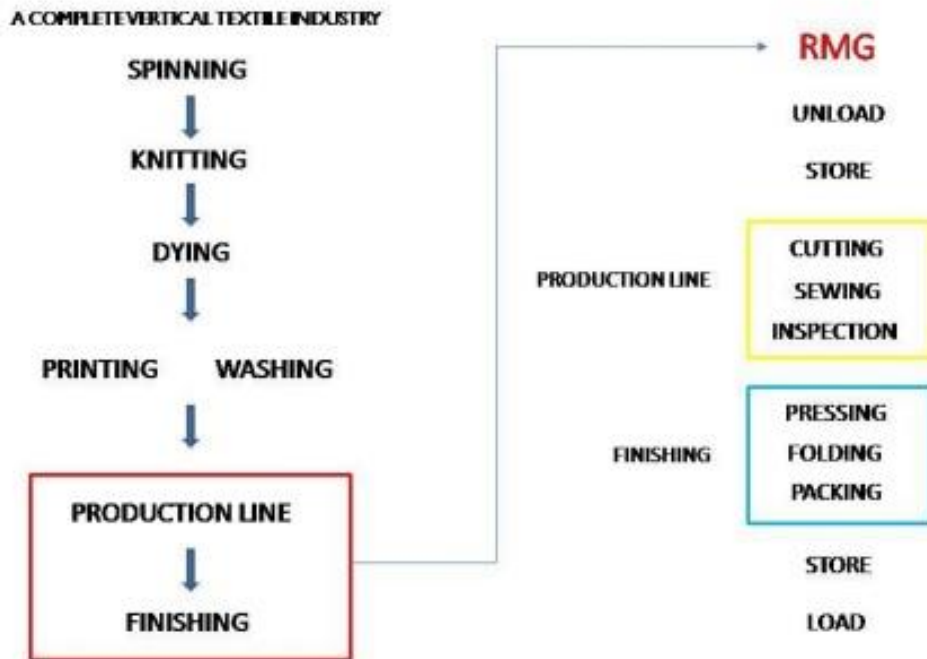


Diagram 01: Order of events in readymade garments industry

### 3.2 RMG industry in Bangladesh

During the early 1950s, labors in the Western World became highly organized; they became more aware of their rights, which resulted in formulation of trade unions. This and other changes provided workers greater rights including higher pay; which resulted in higher cost of production. Thus the Retailers started searching for cheaper markets. Developing economies like Hong Kong, Taiwan and South Korea presented themselves as good destinations for relocations because they had open economic policies and had non-unionized and highly disciplined labor force that could produce high quality products at much cheaper costs. Within a short period, Bangladeshi entrepreneurs got familiar with the world apparel markets and marketing. They acquired the expertise of mobilizing resources to export-oriented RMG industries. Foreign buyers found Bangladesh an increasingly attractive sourcing place. Till the end of 1982, there were only 47 garment manufacturing units. The breakthrough occurred in 1984-85, when the number of garment factories increased to 587. The number of RMG factories shot up to around 2,900 in 1999. Bangladesh is now one of the 12 largest apparel exporters of the world, the sixth largest supplier in the US market and the fifth largest supplier of T-shirts in the EU market. The

industry has grown during the 1990s roughly at the rate of 22%. In the past, until 1980, jute and jute goods topped the list of merchandises exported from Bangladesh and contributed more than 50% of the total export earnings. By late 1980s, RMG exports replaced jute and jute goods and became the number one in terms of exports.

### 3.2.1 An overview of the Bangladesh RMG industry

The RMG industry is the only multi-billion-dollar manufacturing and export industry in Bangladesh. Whereas the industry contributed only 0.001 per cent to the country's total export earnings in 1976, its share increased to about 75 per cent of those earnings in 2005. Bangladesh exported garments worth the equivalent of \$6.9 billion in 2005, which was about 2.5 per cent of the global total value (\$276 billion) of garment exports. The country's RMG industry grew by more than 15 per cent per annum on average during the last 15 years. The foreign exchange earnings and employment generation of the RMG sector have been increasing at double-digit rates from year to year. Some important issues related to the RMG industry of Bangladesh are noted in table 1.

| <i>Year(s)</i> | <i>Issue</i>                             |
|----------------|--|
| 1977-1980      | Early period of growth                   |
| 1982-1985      | Boom days                                |
| 1985           | Imposition of quota restrictions         |
| 1990s          | Knitwear sector developed significantly  |
| 1993-1995      | Child labour issue and its solution      |
| 2003           | Withdrawal of Canadian quota restriction |
| 2005           | Phase-out of export-quota system         |

*Source:* Compiled by the author from Quddus and Rashid (2000), Mainuddin (2000) and databases of the Bangladesh Garment Manufacturers and Exporters Association, and the Export Promotion Bureau, Bangladesh.

Table 1: Important issues related to the Bangladesh ready-made garments industry

Currently, there are more than 4,000 RMG firms in Bangladesh. More than 95 percent of those firms are locally owned with the exception of a few foreign firms located in export processing zones (Gonzales, 2002). The RMG firms are located mainly in three main cities: the capital city Dhaka, the port city Chittagong and the industrial city Narayanganj.

Ready-made garments manufactured in Bangladesh are divided mainly into two broad categories: woven and knit products. Shirts, T-shirts and trousers are the main woven products and undergarments, socks, stockings, T-shirts, sweaters and other casual and soft garments are the main knit products. Woven garment products still dominate the garment export earnings of the country. The share of knit garment products has been increasing since the early 1990s; such products currently account for more than 40 per cent of the country's total RMG export earnings (BGMEA website). Although various types of garments are manufactured in the country, only a few categories, such as shirts, T-shirts, trousers, jackets and sweaters, constitute the major production-share (BGMEA website; and Nath, 2001). Economies of scale for large-scale production and export-quota holdings in the corresponding categories are the principal reasons for such a narrow product concentration.

### **3.2.2 Size of the Garment industries of Bangladesh**

Year after year the garment industry remains the most important contributor to the country's GDP, earning around \$5 billion annually and accounting for about two thirds of all exports. Bangladesh has about 4,000 garment factories with up to 10 million livelihoods dependent on it directly or indirectly. In 2006 it provided jobs for 2.2 million people, accounted for 10.5% of the country's GDP, and contributed 40% of its manufacturing output. Exports have been growing at an impressive rate in recent years. In 2006/07 alone, they increased by 18.2% to reach US\$9.6 billion, a record level for the fifth consecutive year. The contribution to GDP increases at 13.25% in 2007.

About 80 per cent of garment workers are women in a country where they are traditionally excluded from taking part in social, political and economic activities. The Ready Made Garments sector has more potential than any other sector to contribute to the reduction of poverty. Despite the phenomenal success of the RMG sector the working conditions and wages of workers in the industry are cause for serious concern. Bangladesh's current position as a leading garments exporting nation needs to be consolidated. The economy-wide reverberations of failure would be disastrous. We believe it is in everybody's interest to sustain this industry – an industry which changed the lives of so many people, particularly women, in Bangladesh.

### 3.3 Strength, Weakness, Opportunity & Threat of Garments sector

#### Strength

- Availability of cheap labor.
- Energy at low price.
- Easily accessible infrastructure like sea road, railroad, river and air communication.
- FDI is legally permitted.
- Moderately open Economy, particularly in the Export Promotion Zones.
- GSP under EBA (Everything But Arms) for Least Developed Country applicable (Duty free to EU).
- Improved GSP advantages under Regional Cumulative.
- Looking forward to Duty Free Excess to US, talks are on, and appear to be on hopeful track.
- Investment assured under Foreign Private Investment (Promotion and Protection) Act, 1980 which secures all foreign investments in Bangladesh.
- Overseas Private Investment Corporation, USA insurance and finance agendas operable
- Bangladesh is a member of Multilateral Investment Guarantee Agency (MIGA) under which protection and safety measures are available.
- Adjudication service of the International Centre for the Settlement of Investment Dispute (ICSID) offered.
- Excellent Tele-communications network of E-mail, Internet, Fax, ISD, NWD & Cellular services.
- Weakness of currency against dollar and the condition will persist to help exporters
- Bank interest @ 7% for financing exports
- Convenience of duty free custom bonded w/house

- Readiness of new units to enhance systems and create infrastructure accordant with product growth and fast reactions to circumstances

### **Weakness**

- Lack of marketing tactics.
- Absence of easily on-hand middle management
- A small number of manufacturing methods
- Low acquiescence: there is an international pressure group to compel the local producers and the government to implement social acquiescence. The US GSP may be cancelled and purchasing from US & EU may decrease significantly
- M/c advancement is necessary. The machinery required to assess add on a garment or increase competence are missing in most industries.
- Lack of training organizations for industrial workers, supervisors and managers.
- Autocratic approach of nearly all the investors
- Fewer process units for textiles and garments
- Sluggish backward or forward blending procedure
- Incompetent ports, entry/exit complicated and loading/unloading takes much time
- Speed money culture
- Time-consuming custom clearance
- Unreliable dependability regarding Delivery/QA/Product knowledge
- Communication gap created by incomplete knowledge of English
- Subject to natural calamities

## **Opportunity**

- EU is willing to establish industry in a big way as an option to china particularly for knits, including sweaters
- Bangladesh is included in the Least Developed Countries with which US is committed to enhance export trade
- Sweaters are very economical even with china and is the prospect for Bangladesh
- If skilled technicians are available to instruct, prearranged garment is an option because labor and energy cost are inexpensive.
- Foundation garments for Ladies for the FDI promise is significant because both, the technicians and highly developed machinery are essential for better competence and output
- Japan to be observed, as conventionally they purchase handloom textiles, home furniture and garments. This section can be encouraged and expanded with continued progress in quality.

## **Threat**

The exporters have to prepare themselves to harvest the advantages offered by the opportunities.

### **3.4 Social impact of the RMG sector**

#### **Women Empowerment**

It is well recognized that women's participation in income generation activities lends them a better status within the family and provides them with considerable freedom. A job ensures equitable access to household resources (nutrition) and larger investment on female human capital (health and education). Employment opportunities draw attention to women's needs for public facilities such as transportation, communication, safety etc. and create a demand for policy response in these areas. It also has created a demand for education and health. As the income by the female member reduces dependency on male income it reduces their vulnerability. It also reduces the possibility of domestic violence against women. Expansion of

women's employment has contributed positively to the improvement of the savings behavior of the poor people since women tend to be better savers.

### **Savings**

Regular earning enables a large number of the garment workers to go for some savings. Workers investments on family pension schemes etc. create savings. A BIDS survey conducted in the early 1990s found that 21 percent of both male and female workers aged 15 years and above had their own bank accounts. A higher proportion of workers (30 percent) had bank accounts in the EPZ. Findings showed that women are on average better savers than men and save about 7.6 percent of their otherwise small income.

### **Population Control**

Employment opportunities especially for women created positive impact on family planning and population control in the country. Independent working-women are getting more conscious about the advantage of a small family, and are exposed to modern family planning methods. Working adolescent girls tend to avoid early marriage as they have their own source of income and are self-dependent. The mean age at marriage for girls working in RMG factories tend to be higher than the national average.

### **Condition of the workers of RMG**

According to BGMEA about 3 million people are employed in the RMG sector (around 80% are female). Growing apprehension is the already deprived garment workers may face further retrenchment which may worsen the existing poor working and living standard of the workers.

A "decent employment" means rising productivity and real wages by ensuring rights to work, employment, social protection, freedom of association and social dialogue in an integrated approach. The concept of decent work has significant gender implications in Bangladesh RMG sector since women constitute a vast majority of the labor force, and women and the worst victims of violations of decent work conditions.



Women workers are particularly deprived of their special legal rights (e. g. maternity benefits) and remain more exposed to exploitation within their particular spheres of work. The female workers tend to be underpaid and exposed to physical assault by both fellow colleagues and employers.

Results of a study for ILO re-confirmed us the absence of decent work in most of the RMG industries as they offer low wage, long working hours, poor health and safety protection and in most cases there is no formal contract for job security and social protection.

The national labor movements are continuously demanding for National Minimum Wage. The minimum wages rule for the garment sector, endorsed in 2006. The minimum wage is Tk 1650.

No formal appointment letter is issued to the employees' contractually defining their terms of employment. In most cases the industries do not follow proper dismissal procedure for their workers. Since the workers do not get any formal contract, the employers can hire and fire them at any time without showing any reason.

The exhaustive and prolonged work schedule of RMG industries sometimes causes occupational disease among the workers, which ultimately impacts negatively on their productivity.

The recent collapse of a garment factory building at Savar shows how insecure and vulnerable the workers are in the RMG sector. Therefore it is now urgent to improve OSH condition at workplaces for the business interest of the RMG owner in quota free market.

Bangladesh does not have any national social safety net program like contributory provident fund, medical allowances, unemployment allowances etc. Small and one time retrenchment benefits are not adequate for workers and their families in situations of massive income losses. In most cases the workers do not have their own savings and are not prepared to face any adverse situation.

Though export-oriented apparel industry is the lifeblood of Bangladesh's foreign exchange earning, the basic rights, welfare issues of garment workers are severely neglected.

The basic problem of the ordinary workers and labor movement in garments sector are low scope of operation, non-recognition of legally registered unions at the factory level, long working hours and practically no weekly holiday that left hardly anytime for workers to participate union

activities, non-compliance of existing labor laws, high occupational accidents etc. On the other hand, creation of yellow trade unions by the garments owners, imposition of self-made code of conduct, apathy to active social dialogue made ordinary workers and trade unions more vulnerable.

Closer cooperation between employers and employees are important to ensure the sustainability of an industry. However, it was evident that there is a lack of adequate communication between employees and employers and role of such social dialogue in building a healthy working relationship at factory level are always absent. It is absolutely difficult for workers to form legally registered in house union as a systematic tool to carry on social dialogue with employers at workplace.

### 3.5 Energy efficiency in RMG

Energy reduction can be achieved in Garments Factory Buildings in view of Thermal Comfort, Design approach, building envelope, planning and building services are all considered with respect to comfort level in RMG sectors. The key factors associated with the successful achievement of low energy RMG factory design have been identified and formulated into a methodology to provide a guide for designers.

#### 3.5.1 ENERGY EFFICIENCY AND THERMAL COMFORT

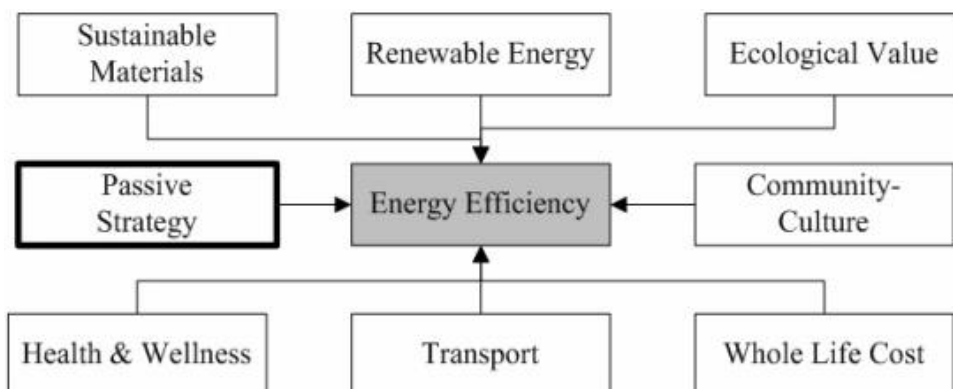


Diagram 02: Components of Energy Efficiency

It is shown that 8 components are co-related with the Energy Efficiency, among them passive design features are discussed to achieve thermal comfort level in this paper. Thermal comfort is one of the main elements of passive design features. Standard Thermal comfort level has not been yet introduced for the working (production) area of the Ready Made Garments Factory in Bangladesh which is very important to make a factory green and energy efficient. Thermal

comfort is affected by heat conduction, convection, radiation and evaporative heat loss. Thermal comfort is maintained when the heat generated by human metabolism is allowed to dissipate thus maintaining thermal equilibrium with the surroundings. Any heat gain or loss beyond this generates a sensation of discomfort. It has been long recognized that the sensation of feeling hot or cold is not just dependent on air temperature alone. Factors determining thermal comfort include: (i) Air temperature (ii) Mean radiant temperature (iii) Air movement / velocity (iv) Relative humidity (v) Isolative clothing (vi) Activity levels. The concept of thermal comfort is closely related to thermal stress.

Most of the RMG factories in Bangladesh are constructed by steel structure in the upper portion and brick plaster in the lower portion. RMG factories have no consideration about protect or restore open habitat and pest management, erosion control and landscape management plan in Bangladesh. Factories have no reflection about the ratio of open space and built space. Many of the factories have less than 30-40% open green space and no consideration about the future expansion. There no found of non-fossil fueling facility for vehicles and lack of green consideration about soft paving. Ready Made Garments factories have less reflection about the water conservation and water efficiency strategy. Most of the factories have no efficient indoor plumbing fixture and water harvesting system. There is less use of water that comes from ETP and no consideration about water efficient landscaping. By now, the building envelope serves multiple roles. It protects the occupants from changing weather conditions and it plays a key comfort needs. In Bangladesh even now there is no consideration about sustainable ventilation, lighting, building envelope etc.

The single largest operating cost of industrial buildings in the Bangladesh is lighting. It also introduces heat into the space and increase building cooling loads. Because lighting systems significantly impact a building's operating cost and energy performance, evaluate options for the lighting systems before considering strategies for a low-energy HVAC system. Also, take advantage of day lighting opportunities whenever possible. Most of our RMG factories use artificial lighting for whole day long. But they have a lot of opportunities to use natural day light.

### 3.6 Design consideration

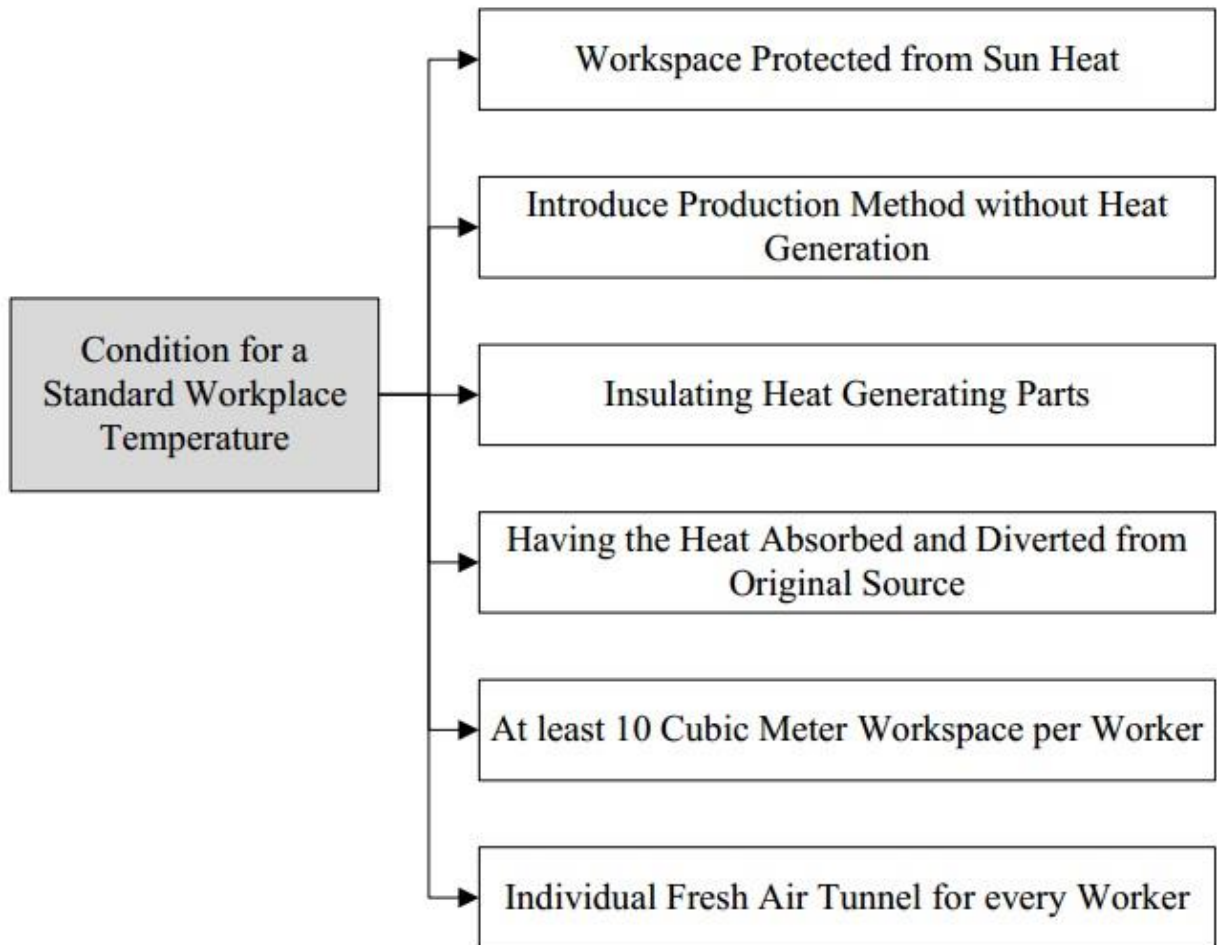


Diagram 03: Components of Energy Efficiency

According to the international labor law and WHO this six requirements are very essential for a factory building to achieve the good working environment and indoor air quality.

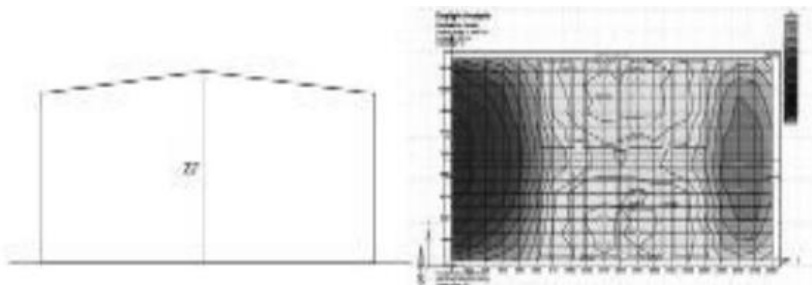


Fig :5 Factory height analysis by Eco Tect and Radiance

The floor plates and height of a RMG factory can be varied depending on the thermal levels required, occupancy and activity requirements. Based on the internal heat gain, space layout can be adjusted. It can be seen that if the height of the factory building is 6m to 8m, it will give the maximum comfort level for the production area in which 150-200 workers work at a time in a single space from 9.0 AM to 7.0PM.

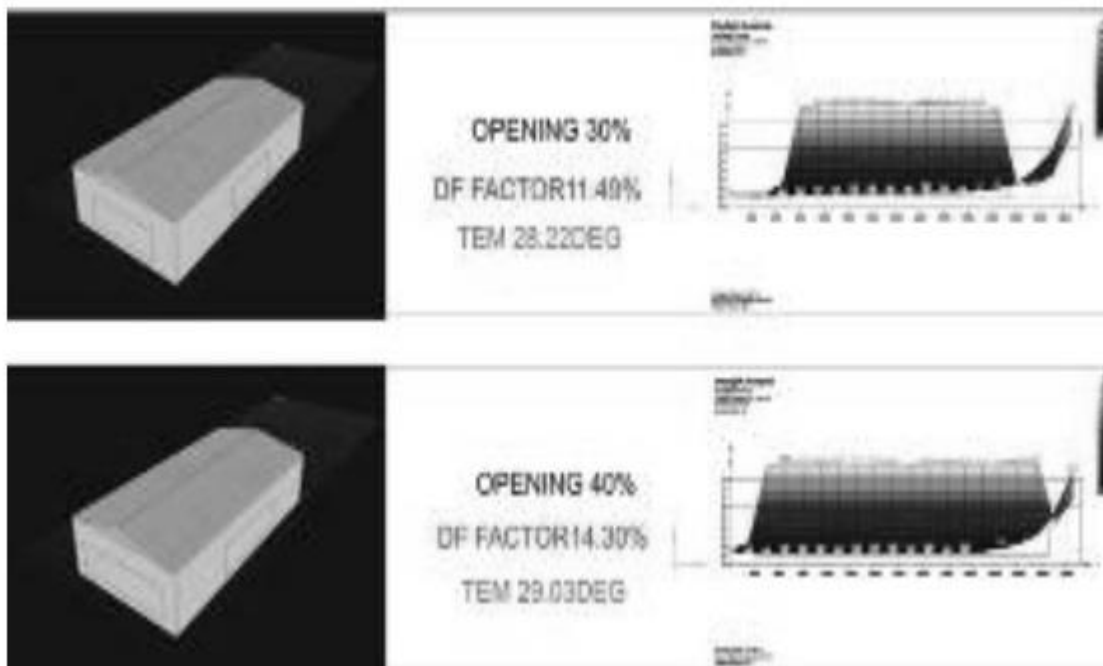


Fig: 6 Windows opening analysis by Eco-Tect and Radiance

According to the thermal comfort factors, production space temperature and comfort level are calculated with the help of Eco-Tect and Radiance software (Building Performance Software) for all types of windows openings. From the simulation result it is seen horizontal window with the shading device has achieved the good quality comfort range of temperature and the minimum percentage of openings should be 25-35% to achieve the standard thermal comfort level for production space. The floor plate of a factory building should be no longer deeper than 25-30m to assist cross ventilation opportunities. It is measured that production floor area should be come from the following equation:  $15 \times \text{no of production line} \times \text{no of machine} \times \text{sft per machine} + \text{circulation}$ . This equation gives the optimum comfort level for the production area.

In Bangladesh, most of the RMG factories have no considerations about the building finishes and external- internal color scheme which is very important to make a factory green and cost effective.

| Option  | Elements | Materials                    | degC  |
|---------|----------|------------------------------|-------|
| Model 1 | Roof     | Corrugated metal sheet       | 29.21 |
|         | Wall     | Brick plaster                |       |
|         | Floor    | Concrete slab                |       |
| Model 2 | Roof     | Corrugated metal sheet       | 25.81 |
|         | Wall     | Concrete block plaster       |       |
|         | Floor    | Concrete slab                |       |
| Model 3 | Roof     | Corrugated metal sheet       | 25.32 |
|         | Wall     | Double brick cavity plaster  |       |
|         | Floor    | Concrete slab                |       |
| Model 4 | Roof     | Corrugated metal sheet       | 24.8  |
|         | Wall     | Double brick solid plaster   |       |
|         | Floor    | Concrete slab                |       |
| Model 5 | Roof     | Corrugated metal sheet       | 24.75 |
|         | Wall     | Brick concrete block plaster |       |
|         | Floor    | Concrete slab                |       |

Table 02: Factory building materials analysis

From this Table it can be shown from the analysis, if the factory wall is constructed by brick plaster only, it creates high temperature for the indoor space than others. Standard comfort level can be achieved when the factory building’s wall is constructed by cavity or solid block because it creates heat barrier from outdoor to indoor.

### 3.7 Workplace evaluation of a Garment- Factory

A large number of establishments in the garment industries of the world are situated in the southeastern part of Asia where labor is plentiful and cheap. Recent reports and observational studies suggest that employees in this industry often work under difficult conditions that are unacceptable in industrialized countries. This paper reports the results of an ergonomic study in an export garment manufacturing plant in South East Asia to evaluate the working conditions of the plant from an ergonomics/human factors perspective and to suggest possible solutions to management for implementation. The investigation was done by a questionnaire survey and by observations and measurements in the workplace. The results indicated that the plant conditions were stressful, involving long work hours with poor safety and labor relations, and that work equipment and the physical workplace design were acceptable ergonomic practices. A low-cost solution, presented to management by the investigators, was implemented and, over a period of six months, seemed to be the dominant reason for significant improvements in throughput (14.6%), reduction in absenteeism (65 %), job satisfaction (40 %), decrease in employee turnover (75 %), and reduction in health complaints (50 %).

It is suggested that one of the worst aspects of sewing machine operations in the garment manufacturing industry is the body posture operators are forced to assume throughout the workday. Operators typically sit with a sharp forward flexed torso (Halpern and Dawson, 1996) which places them at risk to muscular-skeletal disorders (Vihma et al., 1982). Such a posture has been found to be mainly the result of the geometry of the workstation, and suggested and tested solutions have included work surface modification (Haslegrave and Corlett, 1993), the adoption of adjustable chairs (Keyserling and Chaffin, 1988; Yu et al., 1988) and various low cost workplace modifications (Chanet et al., 2002). Li et al. (1995), in a review of the literature, noted that sewing machine operators' posture improved from changes in machine and work surface inclination, and Yu et al. (1988) also observed significant posture improvements from improved seat design (Yu et al., 1988). Up to the mid-nineties there was little data and information available in the literature that suggested that these improvements, involving ergonomics principles, have been implemented in the South East Asian garment manufacturing industries (Ahsan, et al., 2000), even though these methods were well documented (Zohir et al., 1996a). To date, anecdotal evidence indicates that this situation has not improved. While the political and economic conditions of the countries concerned may be major factors in this lack of

improvement, the awareness of the importance of ergonomic interventions can transcend some of these obstacles.

In addition to the poor physical workplace and equipment design, administrative problems, such as inadequate breaks and lack of job control by workers, as observed by Ahasan and Rabiul (2002), have most likely contributed to the physical ailments mentioned above. In the Asian garment industry, the laxity of labor law enforcement seems to have produced a lack of taking responsibility by management and owners toward working conditions. Studies have shown that most of the garment factories have not followed the country's labor laws and the International Labor Organization's conventions (Bongers, et al., 2002). Management and owners seldom take responsibility for any work-place injuries or accidents, and evade responsibilities, even for accidental deaths (Khan, 1997). In Dhaka, Bangladesh, for example, there is little enforcement of a national minimum wage and, while that wage is expected to be revised every three years, its implementation is lacking especially in the garment manufacturing industry. Violation of working hours is no less severe. According to the labor laws in Dhaka, the maximum number of working hours per day should be 10, including 2 overtime hours but, in most cases, workers are forced to work longer extending to 12 to 16 hours per day.

Inadequate or absence of transportation, housing, insurance, social security or children day care facilities exacerbates already difficult working conditions. Anecdotal evidence points to congestion in people and equipment, excessive heat and humidity, poor furniture and physical workstation design.

Prolonged sitting, in unnatural postures is not uncommon and is often accompanied with seats that have no backrests. There are also cases of inadequate rest break periods. The present study is an assessment of the work conditions in a garment manufacturing plant in the export-oriented apparel manufacturing industry in Dhaka, Bangladesh. This particular plant was selected among a few that were visited mainly because of the cooperation and interest shown by its management in conducting the study. The plant is typical of those involved in the export-oriented garment industry in Bangladesh.

The objectives of the study were to enlarge the database of the working conditions in the garment manufacturing industry in South East Asia through an ergonomic evaluation of the working conditions of the workers and to suggest possible solutions to deal with observed problems.



## Methods

Workers' perceptions of their physical work conditions were solicited via a questionnaire, prepared by the study investigators and management of the plant. The questionnaire was administered in the plant to a total of 460 subjects (419 females and 41 males). The subjects were volunteers and were not promised or given any rewards for their efforts. They were engaged in work activities such as drawing, cutting, operating machines, sewing, and ironing. Questionnaire information was gathered on personal characteristics, subjective opinions about work conditions, and cumulative trauma problems associated with work in the plant. The personal and job related characteristics of the subjects (age, years at work, gender, education level and work experience) are summarized in Table 1. The investigation lasted for six months and involved management participation at all stages. However, the acquiescence of management to perform a follow-up study could not be guaranteed and was not done. Also, a control group of subjects in the investigation was not practical because of high turnover. Quantitative data were analyzed with the SPSS statistical analysis system.

| Variables              | Mean | SD   |
|------------------------|------|------|
| Age (years)            | 27   | 4.1  |
| Years at work          | 4.3  | 3.2  |
| Working hours per week | 52.5 | 5.6  |
|                        | N    | %    |
| <i>Education</i>       |      |      |
| Primary                | 210  | 45.7 |
| Secondary              | 188  | 40.9 |
| Higher secondary       | 55   | 11.2 |
| College                | 7    | 2.2  |
| <i>Marital Status</i>  |      |      |
| Married                | 173  | 37.6 |
| Not married            | 287  | 62.4 |

Table 03: personal and job-related characteristics of the workers who participated in the questionnaire survey

First a seminar lasting over an hour was conducted for the subjects to help them understand work related health problems and symptom recognition so that responses to the questionnaire would be as accurate as possible (Sarder and Ali, 1996). They were made aware of the distinction between injuries and pains caused by work activities and those caused by non-work activities. While this was always difficult to do, the aim was to make the workers aware that aches and pains felt at work might not necessarily have been caused by work activities. Workers were instructed that they should be totally honest and were advised that their individual responses would remain anonymous, protected by the study investigators who were university professors, and unavailable to company management. After the seminar, a walk-through investigation was conducted by the investigators and two of the industrial engineers from the plant, who were knowledgeable in the area of human factors/ergonomics, to gather information on work characteristics, work and workstation design and workplace environmental conditions. A checklist was used as an aid. A small sample of 10 workers (3 males and 7 females), in excellent health, were also tested for their heart rate during the work shift, while working, using a portable telemetric device (Polar Electro, made in Finland). They were a mixture of older and younger workers. They wore the device by using an adjustable band, containing the electrodes and a transmitter, around the chest area. It is assumed that this intervention caused no significant interference to the workers' work activities. The heart rate results were taken as indicative of the physiological strain of the workers. The workplace environmental variables measured were relative humidity and ambient air temperature, by means of standard instruments.

## **Results and discussion**

The subjects were relatively young, with the mean age of 27.1 years ( $n = 460$ ). About two thirds of them were below 30 years of age, with about 15 % below 20. They were relatively inexperienced, with an average duration of 4.3 years on the job. These data, which suggest rapid turnover of the workforce, are typical of most of the South East Asian apparel manufacturing industries (Zohir and Majumder, 1996b) and imply that a severe human cost was embedded in the work. In addition, working hours in this plant were lengthy by the standards of the industrialized countries. Figure 1 is a photograph depicting a typical crowded work environment in the plant that was investigated in the present study. As Figure 2 indicates, approximately 70% of the sample worked 50-60 hours per week and 65% of the sample were under 30 years of age.



Fig: 7 Working environment inside of a garments factory

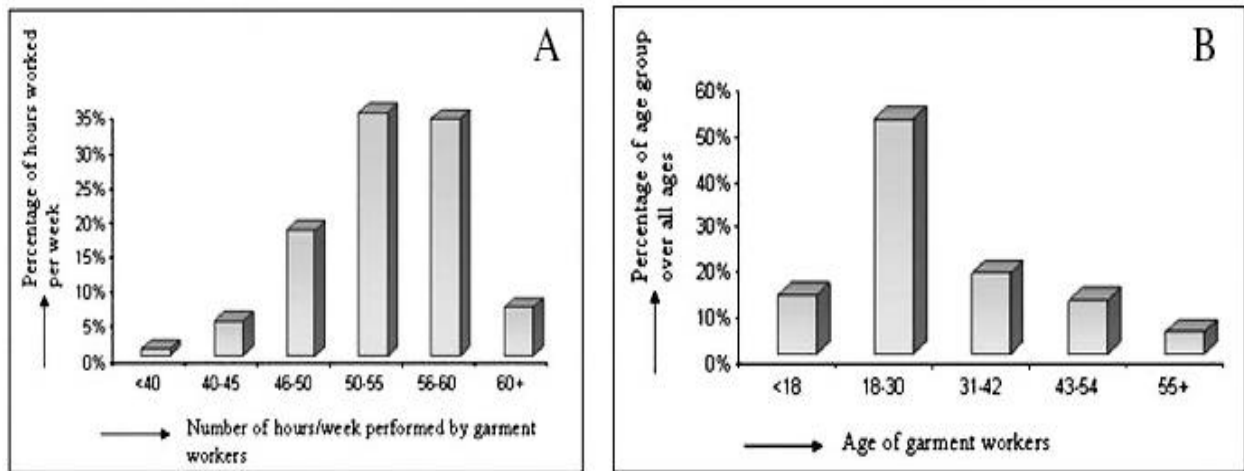


Diagram 04: frequency distribution of hours worked per week (A) and frequency distribution of age.

**The walk-through investigation yielded the following observations:**

- i. Jobs were varied with respect to products, processes, and operations, and were performed both individually and in groups.
- ii. Jobs were neither well structured nor routinely organized.
- iii. Tasks were generally repetitive and burdensome to workers.
- iv. Workspace was congested and sitting postures were typically constrained and uncomfortable. Sitting cross-legged crouched or leaning forward was common.
- v. Gripping and pinching with considerable forces and for extended durations was common.
- vi. Time schedules were tight and often required hurrying in performing tasks.
- vii. Rest pauses were few and short when taken.
- viii. Seats were devoid of a backrest (Figure), which would have allowed intermittent micro breaks for resting the upper body after stressful sessions of bending the trunk and neck.
- ix. Many seats were hard and wooden, without a cushion to prevent tissue compression at the area of the ischial tuberosity's.
- x. Sharp bending of the neck was common, combined with sharp bending of the trunk among taller workers, or moderate bending, among shorter workers.
- xi. Workspace and equipment design features that would have allowed workers to assume a more upright posture with less trunk or neck flexion, as recommended or tested by Keyserling at al.(1982), Huoviala (1984), and Wick and Drury (1985) were absent. For example, the sewing table surface was neither adjustable in height nor tiltable. Drury (1985) found that an 11° tilt of the sewing table resulted in a reduction of trunk flexion from 17° to 1° and head/neck flexion from 46° to 37°.
- xii. Equipment, including sewing machines, was generally old and inappropriately designed.
- xiii. There was a general lack of control over work.
- xiv. There was a general fear of being dismissed for reporting stressful or unsafe working conditions.

The occurrence of the various work-related disorders, reported on the questionnaire, is summarized in Table 2. As can be seen from the table, most of the reported incidences in the back, neck and shoulders are relatively high and are most likely the result of working with constrained postures, poorly designed workstations and non-ergonomic tools. The high incidence of wrist pains (26 % of the subject sample and 7.9 % of reported cases of pain or discomfort) is an indication of excessive hand work involving gripping and pinching with the arm

in constrained postures, and the high incidence of ischial tuberosity pain (29 % of the subject sample and 8.8 % of the total reported cases of pain or discomfort) is the consequence of prolonged sitting on relatively hard surfaces. Moreover, it was observed that there were poor welfare services and a lack of health, hygiene and ergonomic measures taken by the factory owners for workers’ legal protection. It is important to note that some of these reported incidences were lower than those reported by Chan et al. (2002) in California and Herbert et al. (2001) in New York (Table 3) but may not necessarily have been due to better work conditions. The results may have been due to (i) a greater degree of tolerance and acceptance of pain and suffering at work in the Bangladesh workplace compared to the American workplace and

(ii) differences in reporting by subjects. Heart rate was found to be significantly higher for older workers (above 40 years of age) than for those below 30 years of age. In general, heart rate increased from an average of 73 beats per minute at the start of a shift up to 84.5 beats per minute, declined during the mid-shift break to 75.5 beats per minute, then increased again after the break to 85 beats per minute (Sarder and Ali, 1996). Ambient plant temperatures ranged from 34-38 °C, which was about 3 to 4 °C higher than the outside temperature, due to the lack of air conditioning in the plant (Sarder and Ali, 1996). The relative humidity was between 50-70% (Sarder and Ali, 1996). This combination of environmental variable Indicated a physiologically

| Reported work-related problems | Number of subjects | Percentage of subjects | Percentage of total reports of disorders |
|--------------------------------|--------------------|------------------------|--|
| Back pain                      | 285                | 62                     | 18.7%                                    |
| Neck pain                      | 156                | 34                     | 10.2%                                    |
| Shoulder pain                  | 160                | 35                     | 10.5%                                    |
| Wrist pains                    | 120                | 26                     | 7.9%                                     |
| Ischial tuberosity pain        | 134                | 29                     | 8.8%                                     |
| Other pains in the upper body  | 86                 | 19                     | 5.6%                                     |
| Visual discomforts             | 53                 | 12                     | 3.5%                                     |
| Dehydration                    | 47                 | 10                     | 3.1%                                     |
| Other discomforts              | 168                | 37                     | 11.0%                                    |

Table 04: occurrence of work related disorders

|                                 | Present study (in Dhaka, Bangladesh) | Herbert et al. (2001, in New York) | Chan et al. (2002, in California) |
|---------------------------------|--------------------------------------|------------------------------------|-----------------------------------|
| Diagnosis                       | Number (%) reporting pain (n=460)    | Number (%) reporting pain (n=36)   | Number (%) reporting pain (n=99)  |
| Back pain                       | 285 (18.7%)                          | -                                  | 48 (26%)                          |
| Neck pain                       | 156 (10.2%)                          | 17 (47%)                           | 33 (18%)                          |
| Right Shoulder pain             | 160 (10.5%)                          | 23 (66%)                           | 23 (13%)                          |
| Left Shoulder pain              |                                      | 13 (36%)                           |                                   |
| Carpal tunnel syndrome symptoms | 120 (7.9%)                           | 16 (46%)                           | 7 (4%)                            |
| Other discomforts               | 168 (11.0%)                          | -                                  | 8 (4%)                            |

Table 05: occurrence of work related disorders compared with other studies

Stressful work environment (Ahasan, 2002), which certainly affected the daily productivity and the long-term health of workers. A comprehensive solution to deal with the ergonomics problems found in this study was proposed to the Factory Owners and Employers Association but was deemed to be too costly (approximately US \$26,000.00). It was based on both engineering and administrative methods and also involved personal protective devices. Therefore another, less costly, alternative (US \$3,300.00) consisting of basic low technology interventions was proposed. These solutions included mainly using chairs with backrests, floor mats for standing tasks (e.g. cutting), tilting the worktables by using wooden wedges under the legs, implementing training programs with work safety awareness, and playing background music. A balance line was implemented prior to ergonomic evaluation but the productivity improvement was not as much it was thought by the management. These low technology ergonomic solutions were implemented to boost the productivity in the manufacturing process, since management was interested not merely in line balancing but with other aspects that could improve productivity. Overall the plant gained an hourly production of 6 pieces solely from the ergonomic intervention. The results of the implementation of the solutions reported by management, was a recovery of the cost of the ergonomic improvements (\$3,300) within 4.4 months, a 14.6% increase in production rate, a 65% reduction in absenteeism, a 40% increase in job satisfaction, a 75% reduction in employee turnover, and 50% reduction in the number of health related complaints.

**Chapter \_04**

**CASE STUDIES**

4.1 MOHAMMADI GROUP

4.2 POLO KNIT-COMPOSITE INDUSTRIES

4.3 AJ GARMENTS

#### 4.1 Mohammadi Group Ltd

A name well known in the Garments Family for its quality manufacturing, styling accuracy, timely delivery and competitive pricing, is one of the leading 100% exported oriented garments industry in Bangladesh. Experts set up the factory with a space of 35,000 square feet with high quality machineries from Japan, Germany, Korea and Singapore. It is located at Khilkheta, about 07 ( seven ) minutes driving distance from Zia International Airport, Dhaka and is equipped with advanced technology. A team of highly trained and experienced professionals runs the factory with proven track record for custom made services to ensure premium quality. The factory has a Quality Control team whose responsibility is to ensure proper quality standard by conducting inspections at different stages of production.

Key Facilities, which can be referred to as examples of Best Practices:

A) Time Attendance & Pay Roll: We have setup computerized software based Time Attendance & Pay Roll system for all workers and employees. This can generate Barcode ID Card, Salary Sheet, Pay Slip etc.

B) House Keeping Team: The factory has a House keeping Team for maintaining neat and tidy environment and atmosphere in accordance with the Health and Safety Act of our country.

C) Medical Facilities: The workers enjoy free health care benefits and Medicare. We have a qualified Doctor who visits our factory every working day of week. 2

D) Evacuation Plan: There are some diagram kept in the floor of the factory showing direction for all employees to run out in case of any emergency situation.

E) Emergency Exits: We have one extra exit in all the floors for use by the workers in case of any emergency in the factory.

F) Fire Drills: We have Fire Fighting Equipment in the factory as per Factory Act and in order to use them effectively as and when required we have a Fire Fighting Team who are specially trained to deal with any fire emergency. We have arrangement for Fire Drills on regular basis i.e., once every month so that the team can perform their duty effectively when required.



G) First Aid Boxes: For every 150 workers we have a person trained in First Aid and Medicare. We keep certain quantity of medicine of different types in a First Aid Box in each floor for employees to use as First Aid.

#### **4.1.2 Floor Layout**

**Ground Floor** : Child Care, Doctor's Room, Fabric and Acc Go down, Generator Room, Security Room.

**3rd Floor** : Six Sewing Lines, Cutting Section, Sample Section

**4th Floor** : Finishing Section, Proposed finishing and finish carton warehouse (Will be completed with in Sept'05.)

**Number of Line** : 06 ( Six ) lines.

#### **Factory setup :**

- a) Quality Control Section
- b) Pattern & Sample Section
- c) Cutting Section
- d) Sewing Section
- e) Finishing Section
- f) Packing & cartooning Section.

**Product Range** : Men's & Boys Dress and Casual Shirts.

**Production capacity** : 180,000 pcs per month

**Special Features** : Vacuum ironing table, Feed of the Arm, Placket Fusing machine, Collar forming machine, Cuff Forming machine, Kansai Special, Fabric Inspection machine, Maximum sewing machines Are auto trimming and vertical trimmer.

### 4.1.3 Factory views



Front view



Fire exit plan



Cutting section



Sewing floor



Spot removing area



Finishing area

Fig 08: Mohammadi Group factory views

## 4.2 POLO Knit composite industry

Hemayatpur, savar

The reason behind choosing this project is the availability of the program schedule which is similar to that of my project. Therefore, I visited this factory in order to understand the production functions, machinery and their requirements, space requirements, power consumption, workers comfort levels etc.

Production flow at polo knit composite industry:

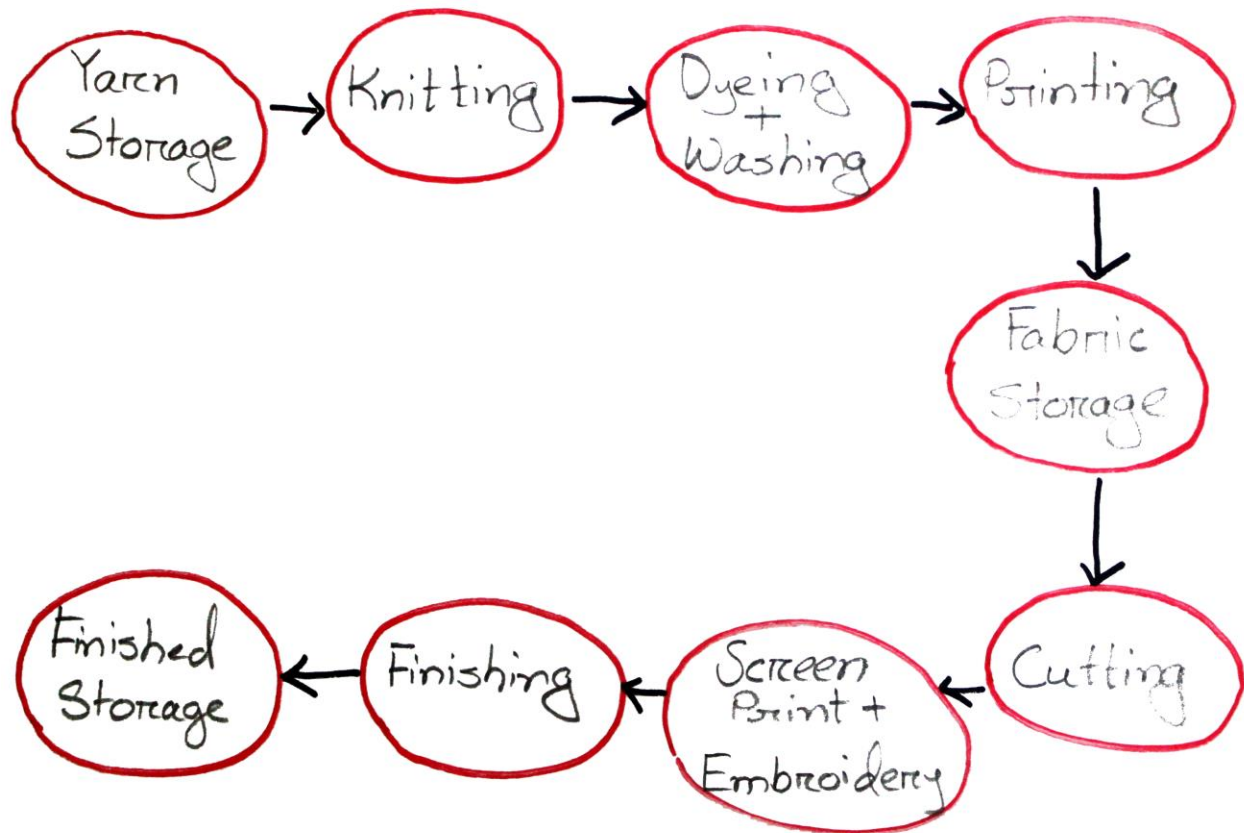


Diagram 05: Production flow of POLO Knit composite industry.

The sewing floors are particularly difficult to work in as the temperature rises considerably due to high worker density ( about 18 sqft per worker) and metabolic heat. The lighting requirement is between 800-1200 lux. So a large number of florescent lights are used so a lot of the heat is generated from the lamps.

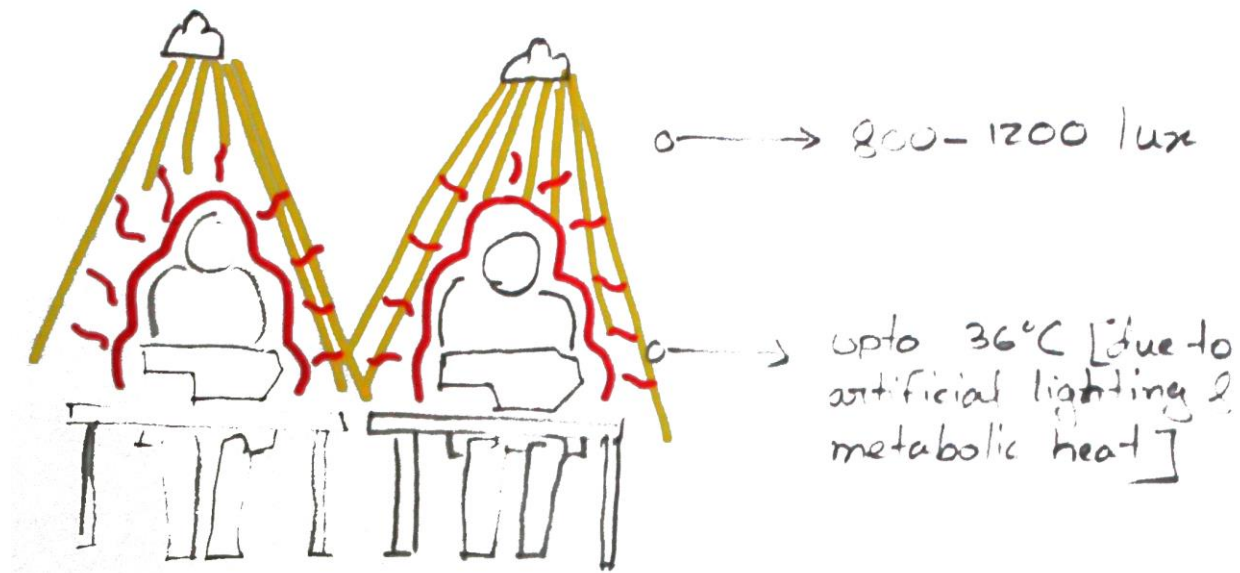


Fig 09: Condition of the sewing floor

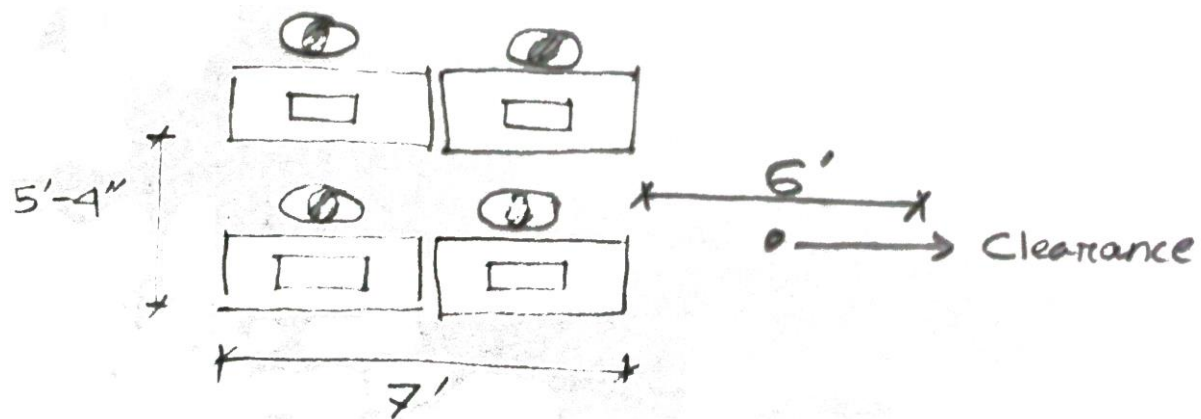


Fig 10: Area & clearance requirement for sewing lines

The finishing and packaging floor is another space which gets very uncomfortable because of the steam that is used for ironing. Hence it requires de-humidification. Similar conditions are created at the dyeing and washing sections as there are large flat-bed dryers which use steam to dry the washed and dyed fabrics. The workers in the cutting area are required to mask to cover their noses and mouths as tiny fabric particles float in the air when they cut the materials. Therefore this area also requires constant air change. The knitting section comprises of light machines which do not generate a lot of heat, and as this space has a standard floor to floor height of 15', is stays pretty comfortable. The rest of the spaces are either storage or circulation and do not have requirements that cause them to get too temperate or humid.

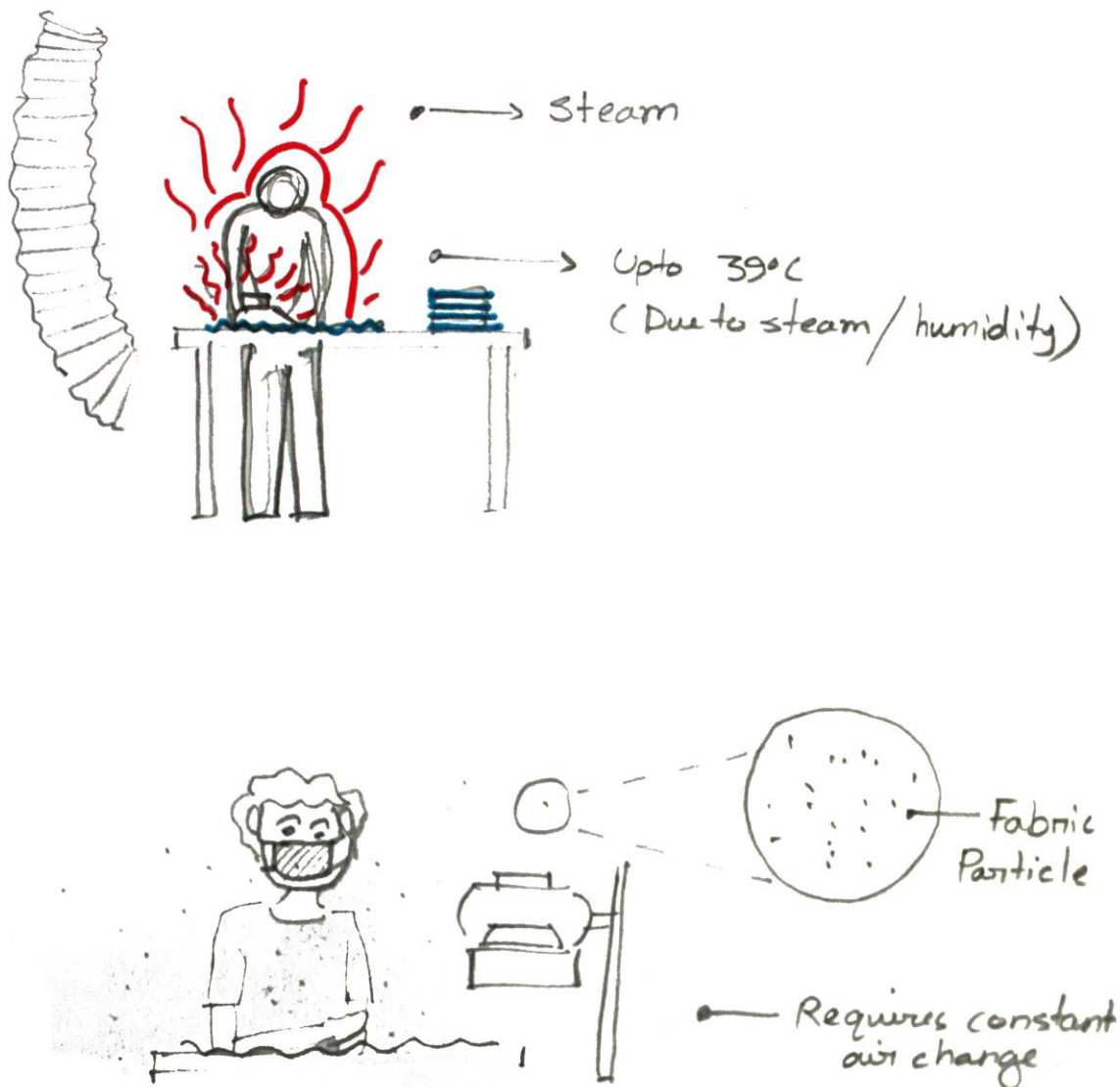


Fig 11: Condition of finishing, dyeing & cutting floors respectively



## 4.3 AJ GARMENTS LIMITED

### 4.3.1 Factory views



Fig 11: AJ factory views

### 4.3.1 Zoning

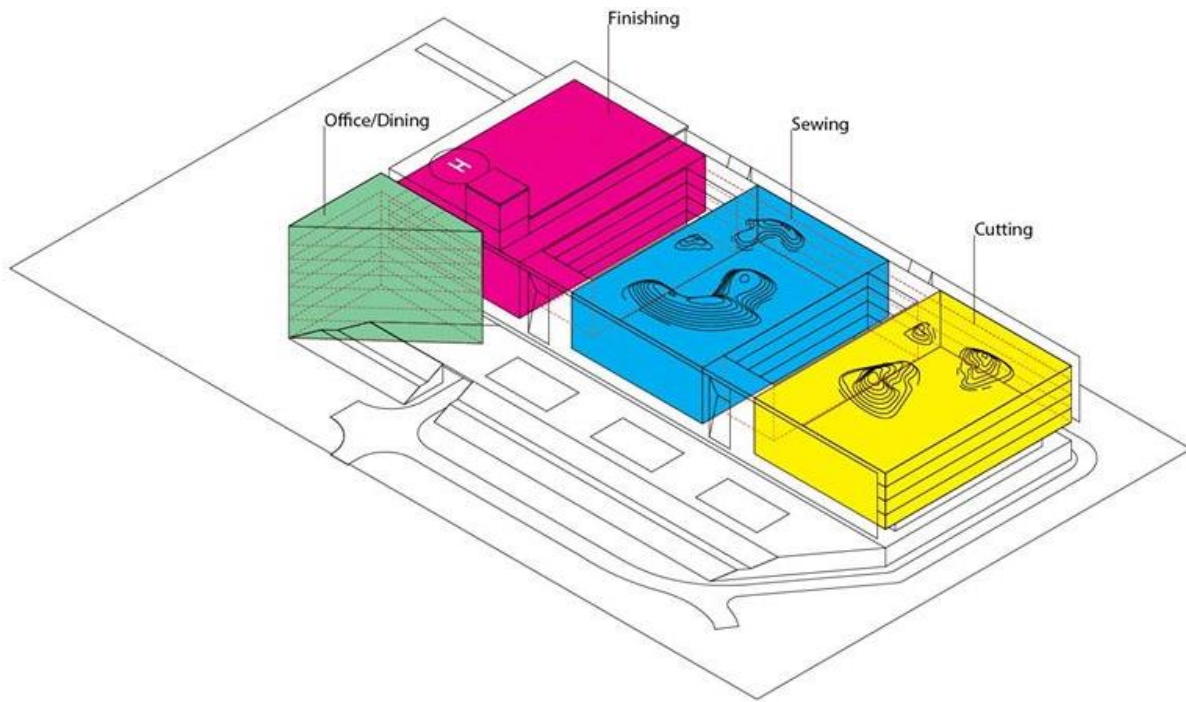


Diagram 06: zoning

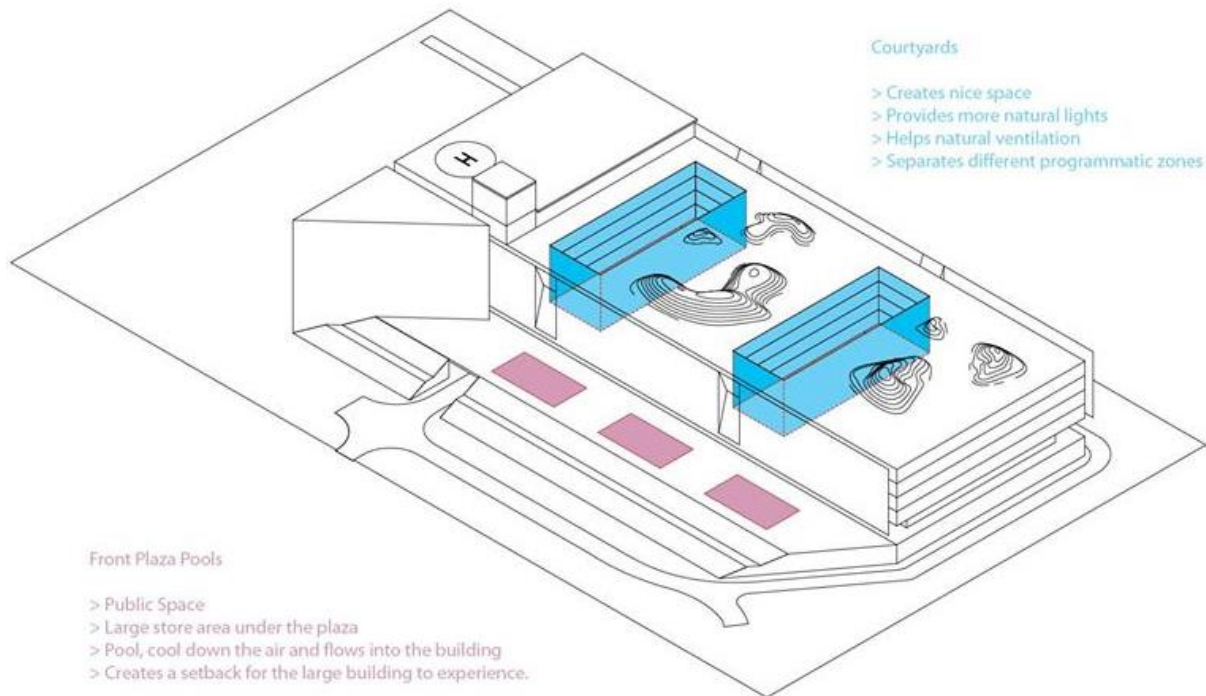


Diagram 07: courtyards and front plaza

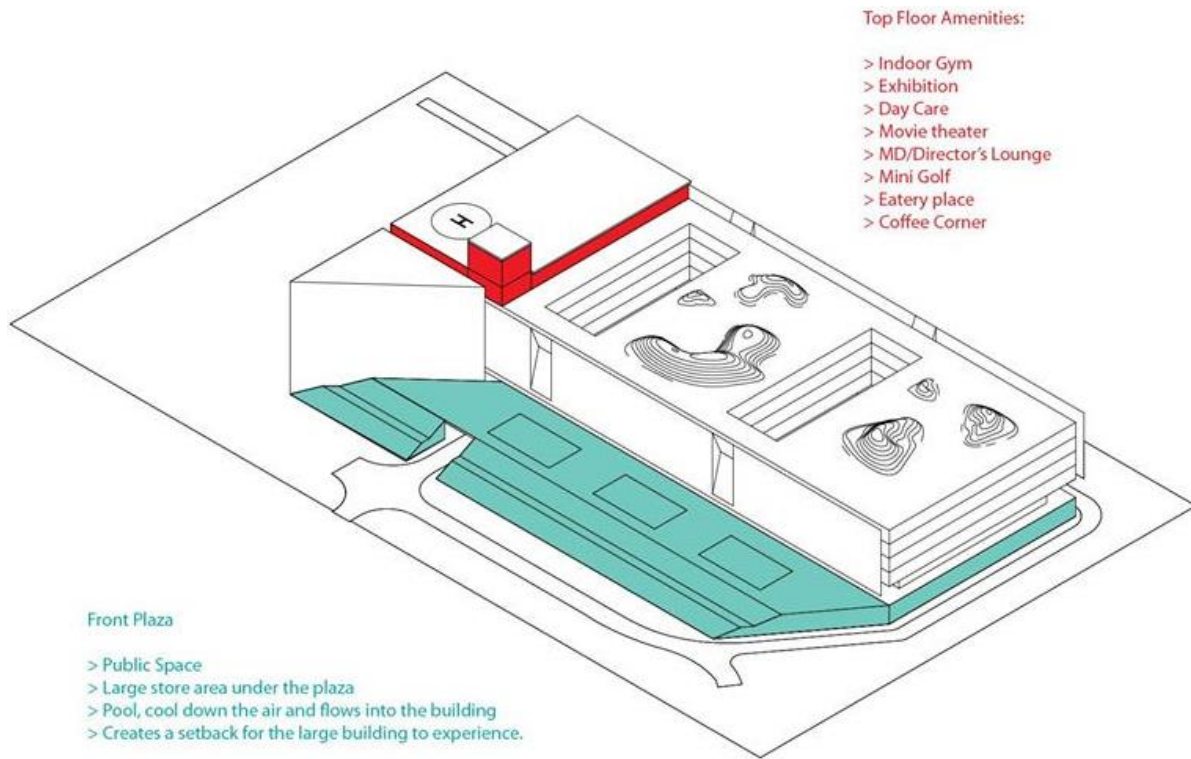


Diagram 08: Amenities & public space

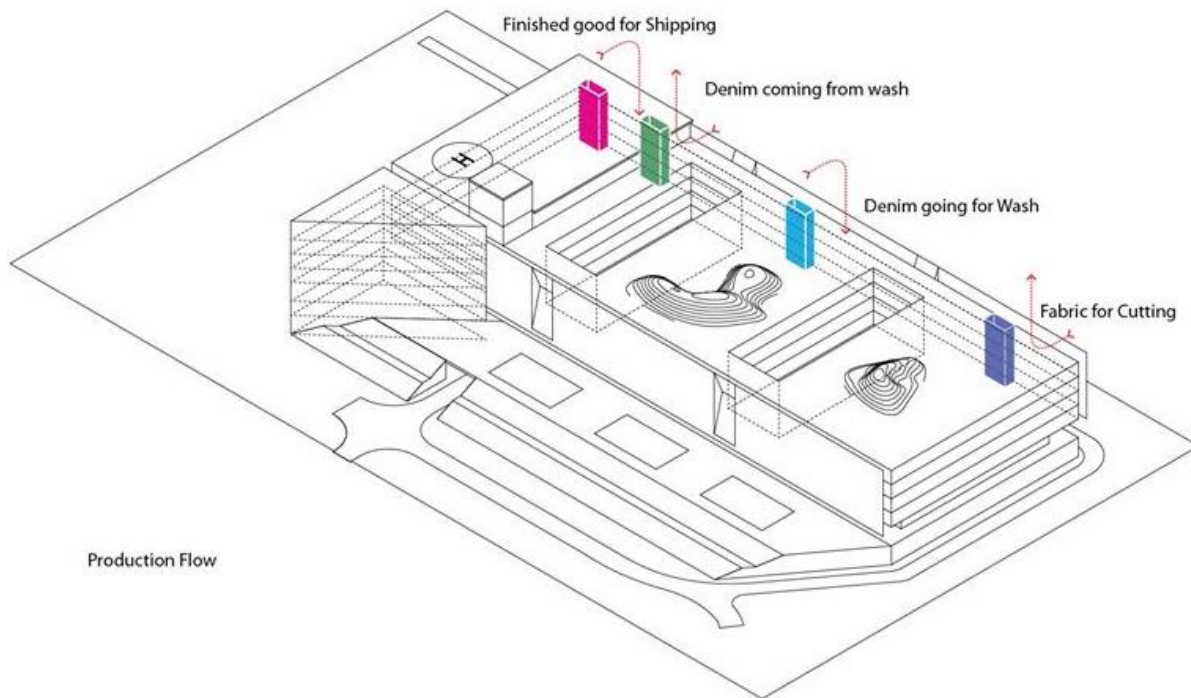


Diagram 09: production flow of AJ garments



**Chapter \_05**

**PRGRAM DEVELOPMENT AND SQUARE FEET**

## 5 Program development and square feet

|                                       |           |
|---------------------------------------|-----------|
| <b>- Storage</b>                      |           |
| Yarn storage                          | 4500 sft  |
| Fabric storage                        | 3000 sft  |
| Finished product storage              | 4000 sft  |
| <b>- Knitting</b>                     |           |
|                                       | 12000 sft |
| <b>- Dyeing/washing</b>               |           |
| Dyeing (10 machine)                   | 2700 sft  |
| Dye store                             | 500 sft   |
| Washing ( 5 washing 5 drying)         | 4200 sft  |
| Ironing                               | 2700 sft  |
| Laboratory ( 1 officer 2 assistants ) | 550 sft   |
| Toilet                                | 35 sft    |
| WTP ( water treatment plant )         | 600 sft   |
| Boiler room ( 9 ton boiler )          | 400 sft   |
| <b>- Production floors</b>            |           |
| Cutting                               | 3500 sft  |

|   |          |
|---|----------|
| Accessories store                                 | 200 sft  |
| Cutting quality office                            | 200 sft  |
| Screen print ( manual )                           | 1000 sft |
| Sewing (380 machines )                            | 8500 sft |
| Supervisors office ( 1+ 8 desk )                  | 200 sft  |
| Finishing ( ironing and packaging )               | 4500 sft |
| Inspection officers office                        | 50 sft   |
| Spot removing                                     | 150 sft  |
| Toilets ( Male : 8 urinals , 8 WC, 8 Wash basins) | 1000 sft |
| Wash basins. Female : 16 WC , 16 Wash basins)     |          |
|   |          |
| - <b>Café seating</b> ( indoor )                  | 7500 sft |
| Kitchen (store, cooking, prep )                   | 1050 sft |
|   |          |
| - <b>Day care ( 20 children ages 0-4 )</b>        |          |
| Sleeping area                                     | 400 sft  |
| Toilet ( including bathing & changing )           | 220 sft  |
| Kitchen   | 180 sft  |
| Dining  | 150 sft  |
| Playing (indoor )                                 | 1200 sft |

|                         |  |
|-------------------------|--|
| Office                  | 150 sft                                    |
|                         |  |
| <b>- Mini clinic</b>    |  |
| Doctors cabin           | 200 sft                                    |
| Toilet                  | 35 sft                                     |
| Waiting area            | 150 sft                                    |
| Assistants desk + store | 150 sft                                    |
|                         |  |
|                         |  |
| <b>- Administration</b> |  |
| MD office + toilet      | 200 + 35 sft                               |
| 4 DGM office + toilet   | $(150 \times 4) + (35 \times 4) = 740$ sft |
| Secretaries             | 200 sft                                    |
| 7 admin officer room    | 600 sft                                    |
| 2 officer ( accounts )  | 250 sft                                    |
| 3 manager room          | 300 sft                                    |
| Common toilet           | 100 sft                                    |
| Seminar room            | 300 sft                                    |
| Kitchenette             | 30 sft                                     |
| Copying and filing room | 150 sft                                    |

|   |                  |
|---|------------------|
| Office assistant + store  | 50 sft           |
|   |                  |
|   |                  |
| <b>- Services</b>   |                  |
| Generator room  | 1000 sft         |
| ETP ( effluent treatment plant )  | 3000 sft         |
|   |                  |
| <b>- Parking</b>  |                  |
| 2 types of parking required. One is for 4 trucks used for loading and unloading. The other is parking for 5 cars for the admin section. |                  |
| <b>TOTAL</b>  | <b>92825 sft</b> |

## **Chapter \_06**

### **CONCEPTUAL STAGE AND DESIGN DEVELOPMENT**

6.1 SELF REALIZATION

6.2 CONCEPTUALIZATION

6.3 DESIGN DEVELOPMENT (IDEA OF SPACES & ZONING)

6.4 PLANS, SECTIONS, RENDERS AND MODEL IMAGES

## 6.1 Self realization

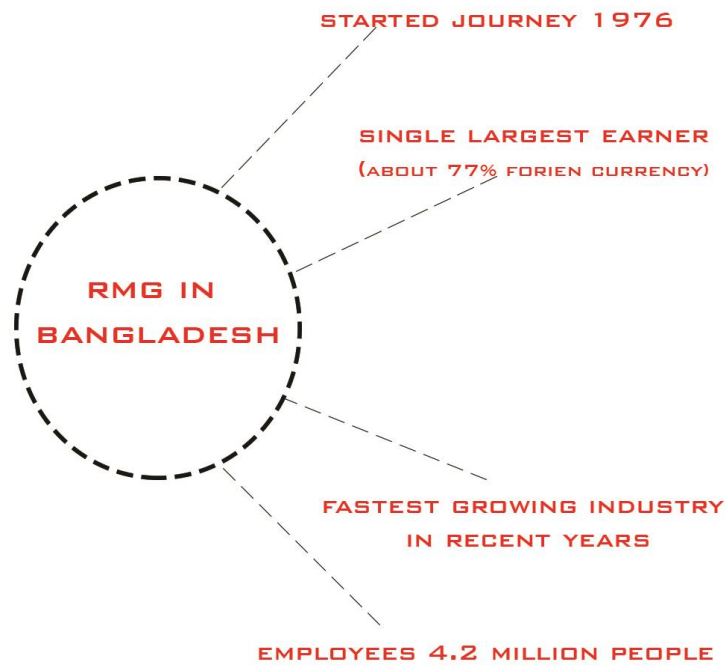


Diagram 10: Rmg in Bangladesh

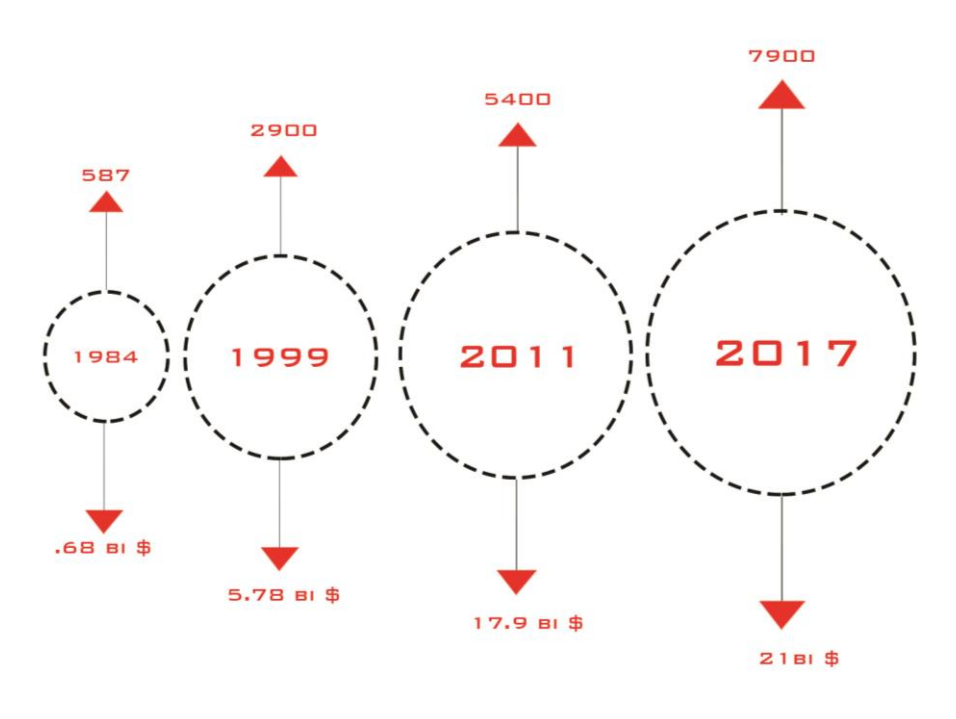


Diagram 11: growth of Rmg in Bangladesh

## Working environment in bangladeshi garmnets factories

Garment factories in Bangladesh have been heavily criticized over the last 38 years for the working conditions in which employees must provide labor.

- High internal gains from artificial lighting
- Poor natural lighting and equipment produce an intolerably hot work environment
- Unplanned building depth, building height, volume, equipments and number of storey which factors are very essential to make factory energy efficient
- Improper ventilation



Sewing requires a level of lighting between 800- 1200 lux, for 10-12 hours a day, which is met by artificial means. Within these spaces, 70% of the internal gains may be attributed to artificial lighting. The ironing space requires less light 100-300lux, and therefore less artificial lighting, however the use of steam irons results in internal temperatures as high as 39°C, resulting in a significant cooling demand.



Sewing sector



Ironing sector



In most garment factories, the **ironing space** and the **sewing space** are **adjacent**, resulting in **heat transfer** between these **two spaces**. Most buildings are made with **sand lime brick** which is **not ideal** in terms of **dissipating heat**.

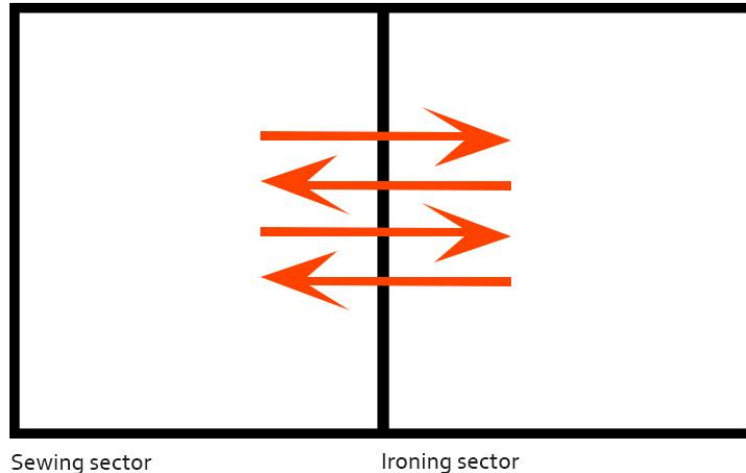


Diagram 12: heat transfer between two spaces

The **artificial lighting** and lack of **natural ventilation** is due to:

Most garments factories have **deep floor plan**  
**Small windows** which are **not correctly orientated**  
 Most windows are **not shaded** and  
 in many cases windows are shut to prevent drafts  
 Most factories have **ceiling fans** for interior **circulation**, but in many cases are **randomly placed**.  
 Often they are **turned off** to avoid creating **strong breezes** in the wrong direction, which may disrupt the work.

## Safety Problems

Safety need for the worker is mandatory to maintain in all the organization. But without the facility of this necessary product a lot of accident is occur incurred every year in most of the company. Some important cause of the accident are given below-

- ☒ Routes are blocked by storage materials
- ☒ Machine layout is often staggered
- ☒ No provision for emergency lighting
- ☒ Doors, opening along escape routes, are not fire resistant
- ☒ Factories are artificially lighted so no visibility inside the factory intimes of hazards as the electricity is disconnected for safety reasons.
- ☒ Adequate doors as well as adequate staircases are not provided to aid quick exit
- ☒ Lack of proper exit route to reach the place of safety
- ☒ Parked vehicles, goods and rubbish on the outside of the building obstruct exits to the open air



## Timeline: Deadly factory accidents in Bangladesh

**Spectrum garment factory collapse (April 11, 2005)-**  
collapsed after additional floors that had been illegally built gave way.  
The collapse **killed 64** people and **injured another 80**.

**Eurotex explosion, fire and stampede (December 3, 2010)-**  
A boiler explosion at the Eurotex factory in Dhaka started a fire, which led to a stampede that **killed 2** workers. Another **62 were injured**.

**That's It Sportswear fire (December 14, 2010)-**  
An electrical fire **killed 29** people.

**Tazreen Fashion Factory fire (November 24, 2012)-**  
At least **112 people were killed** and **200 injured** in a fire at the Tazreen Fashion Factory in Dhaka.

**Smart Export fire (January 26, 2013)-**  
A fire at the Smart Export Garment factory, **killed 7** people.

**Rana Plaza collapse (April 24, 2013)-**  
More than **1,100 people** were killed after the Rana Plaza building collapsed.

## 6.2 Conceptualization

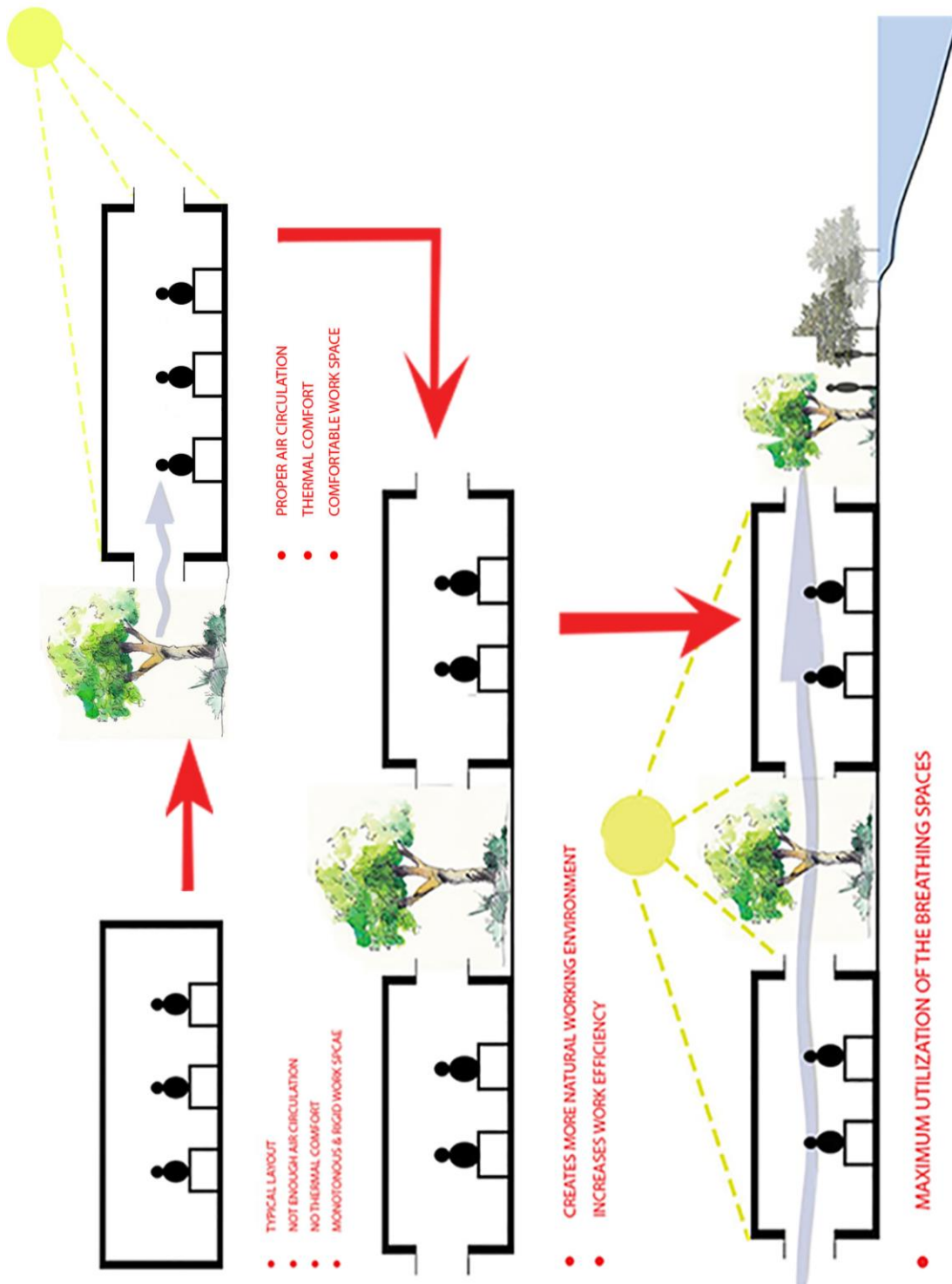


Fig 12: creating breathing spaces & there maximum utilization

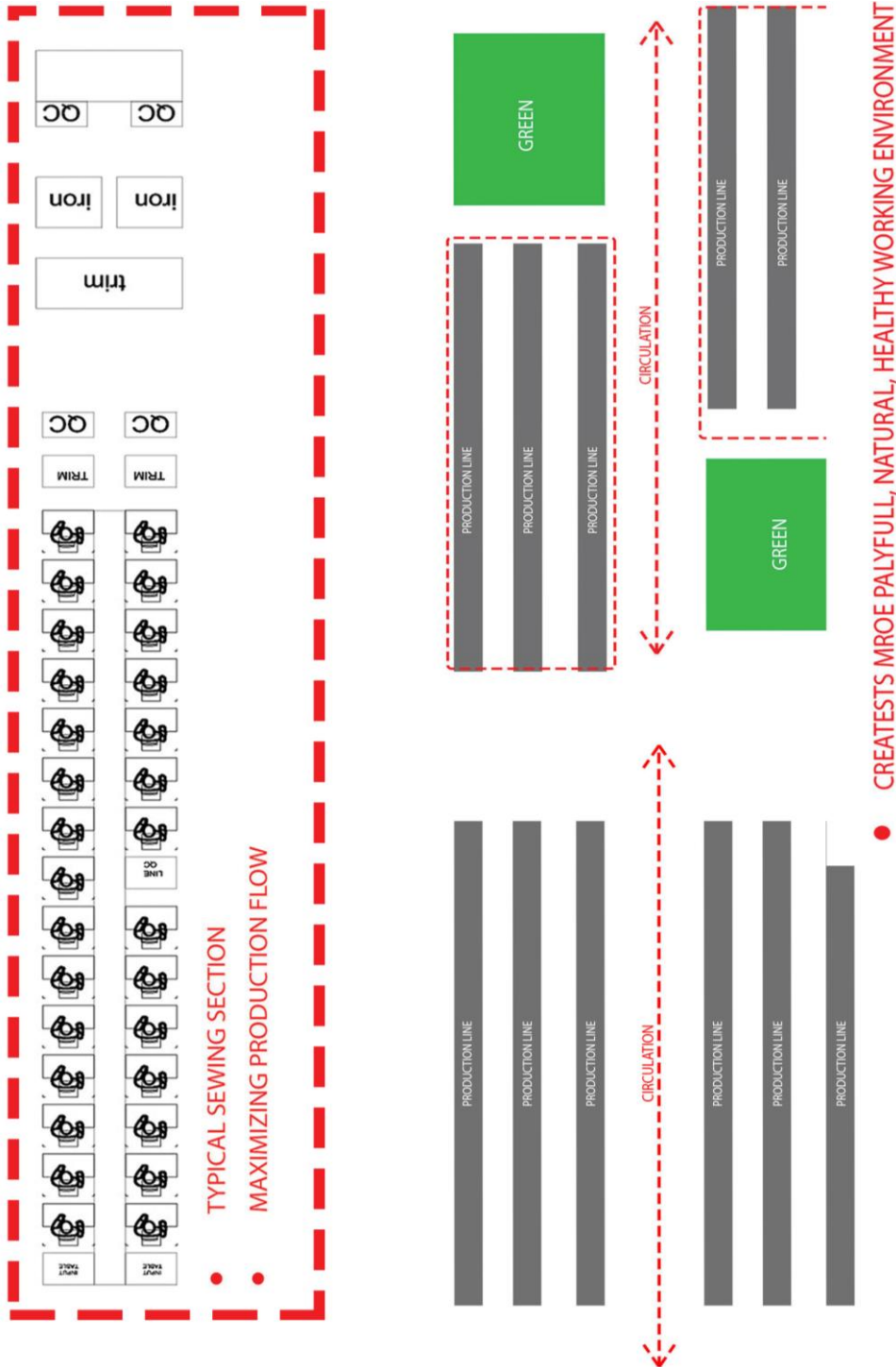


Fig 12: creating more playful, natural & healthy working environment

### 6.3 Design development (idea of spaces & zoning)

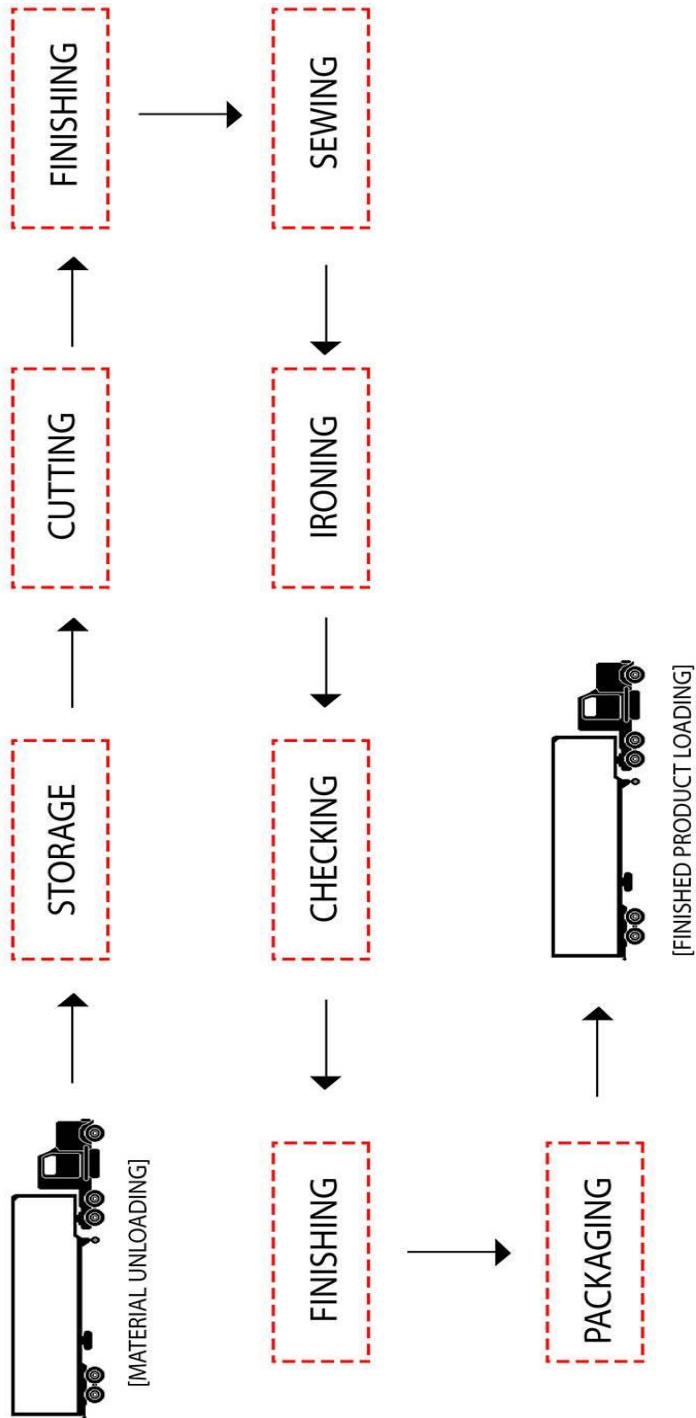
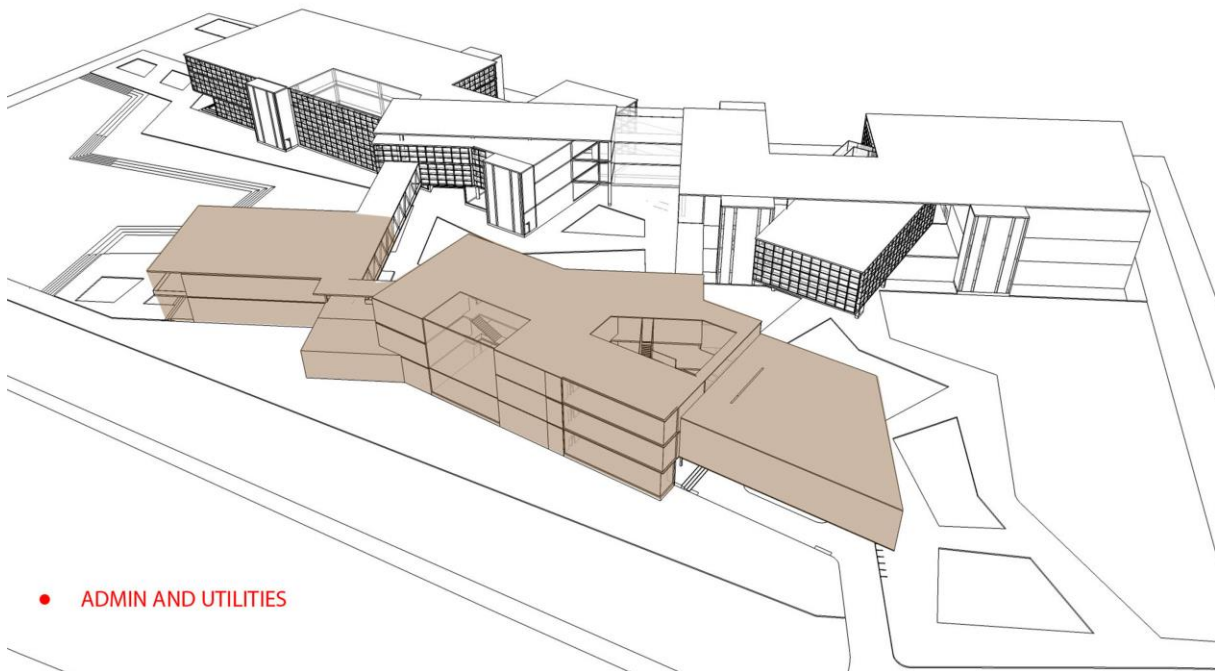
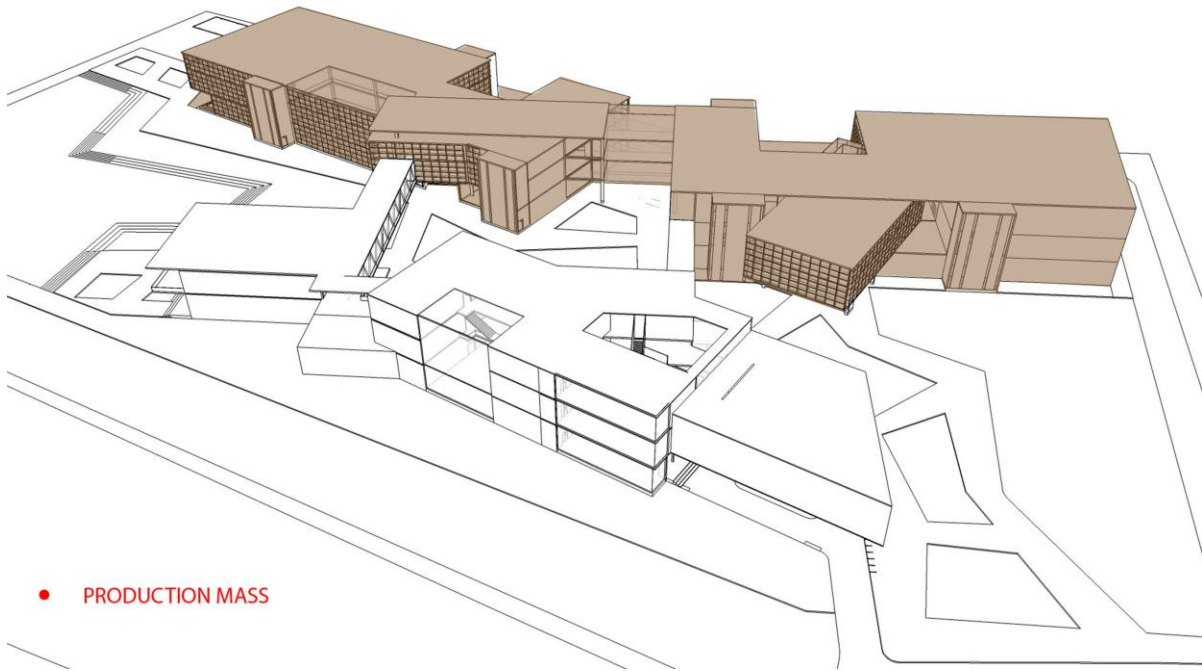
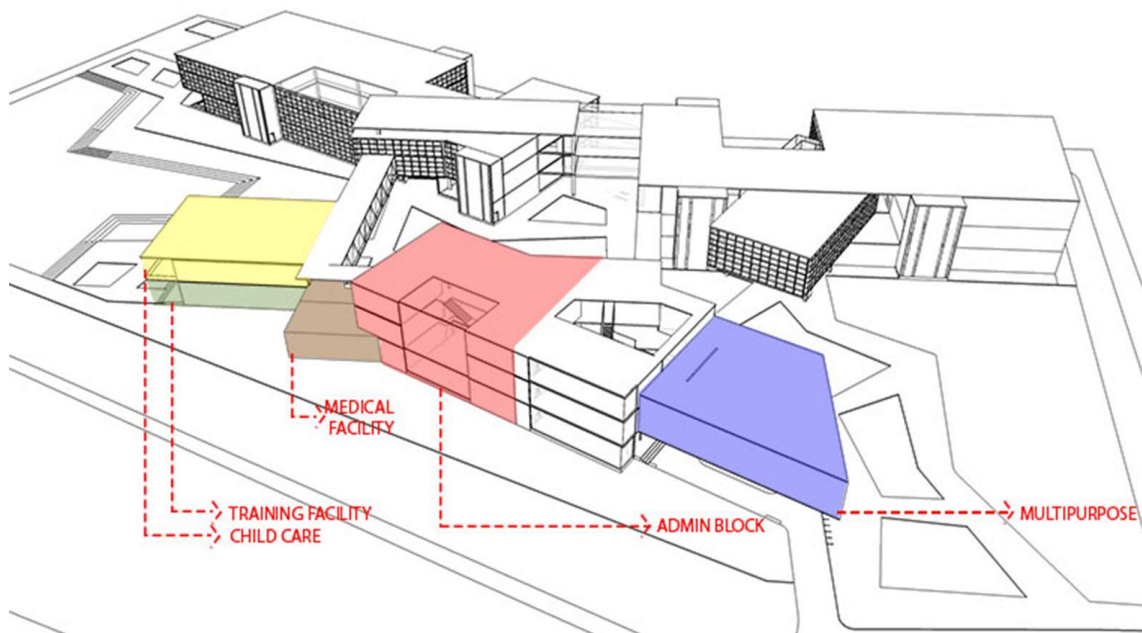
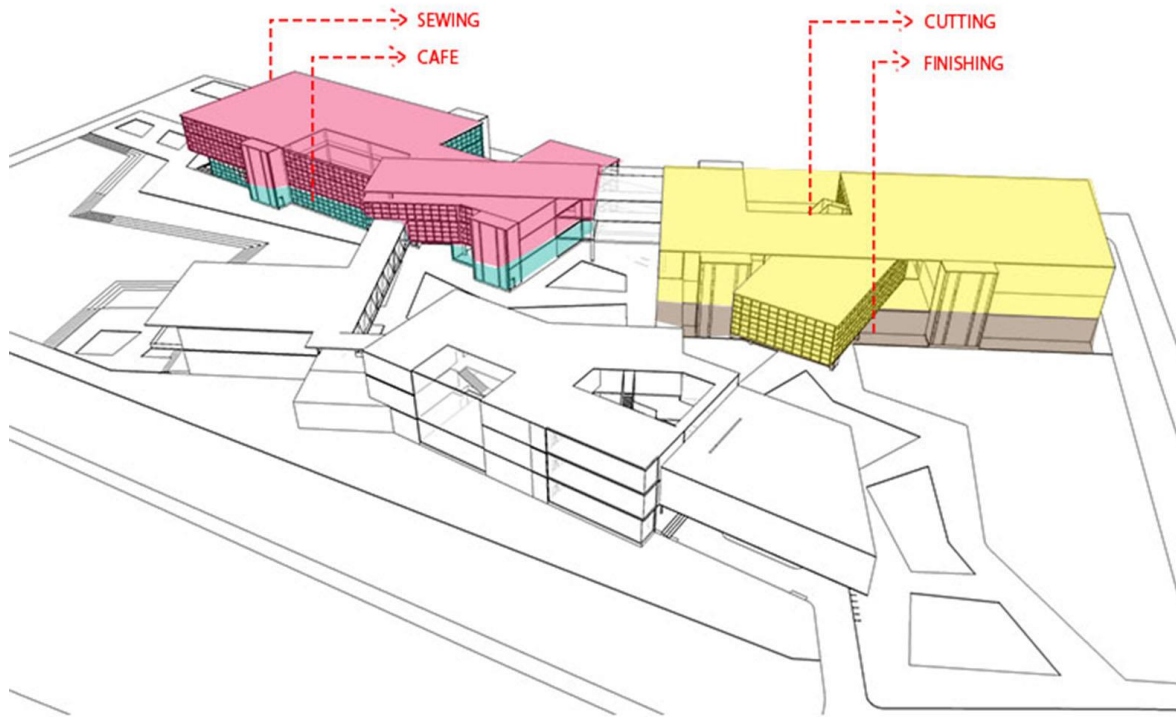


Fig 13: Production flow







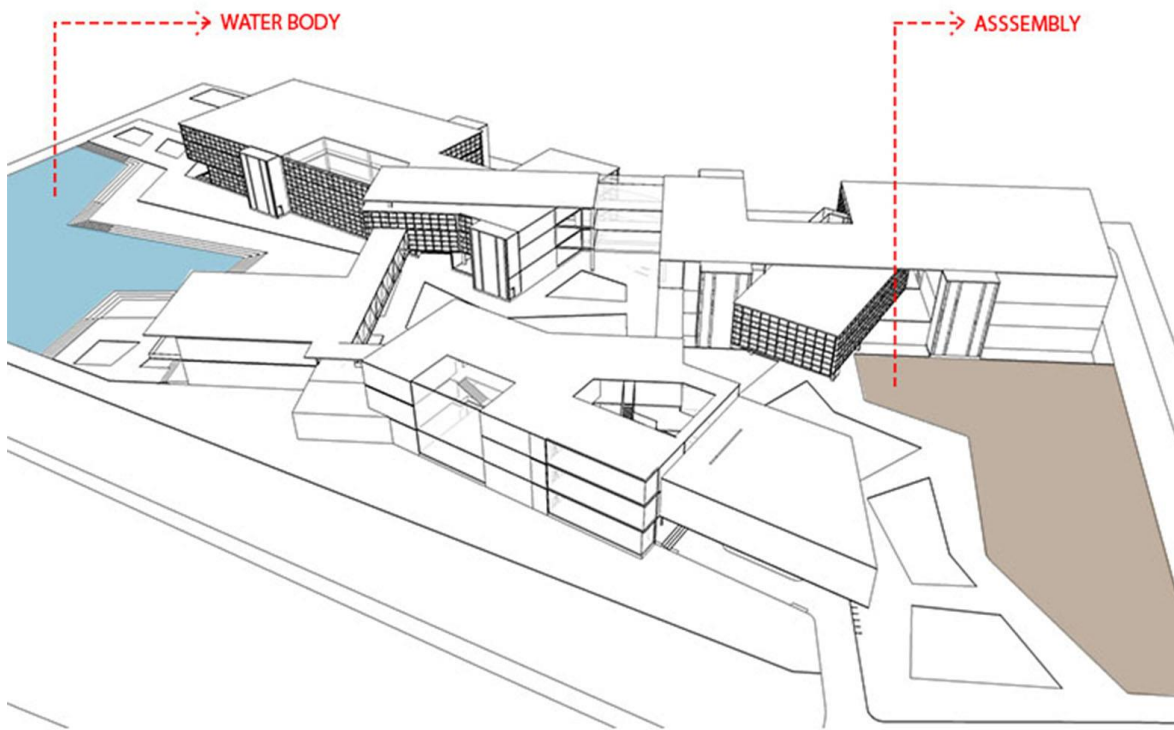
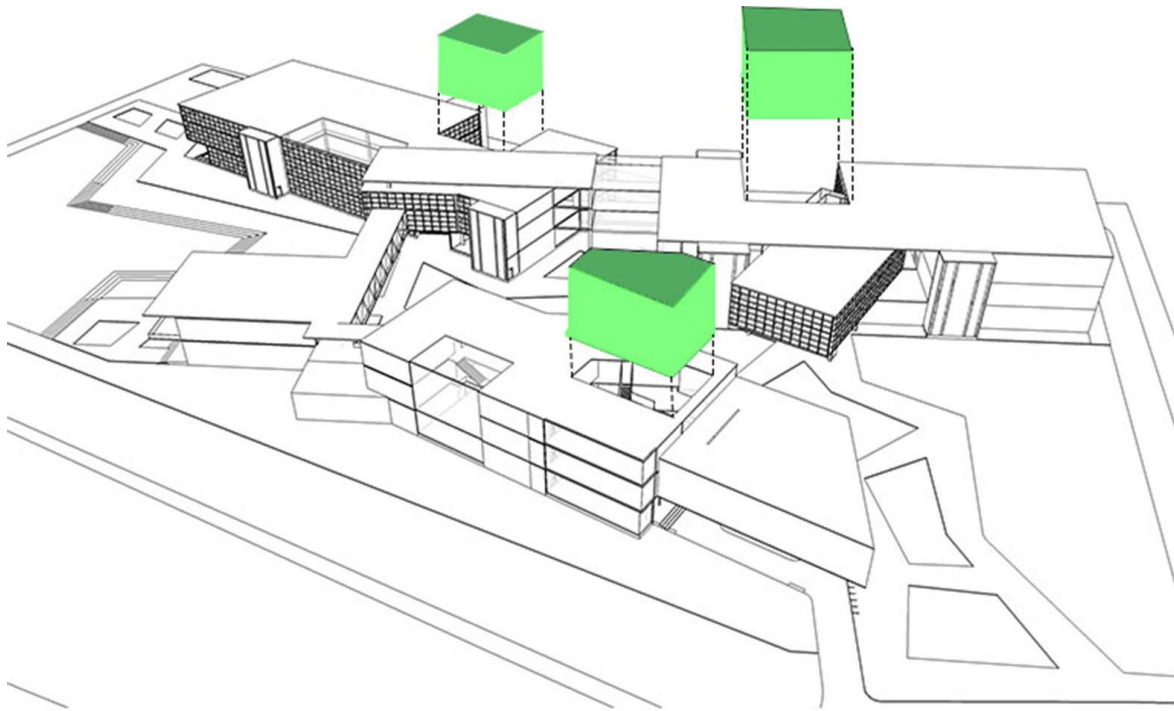


Diagram 13: zoning



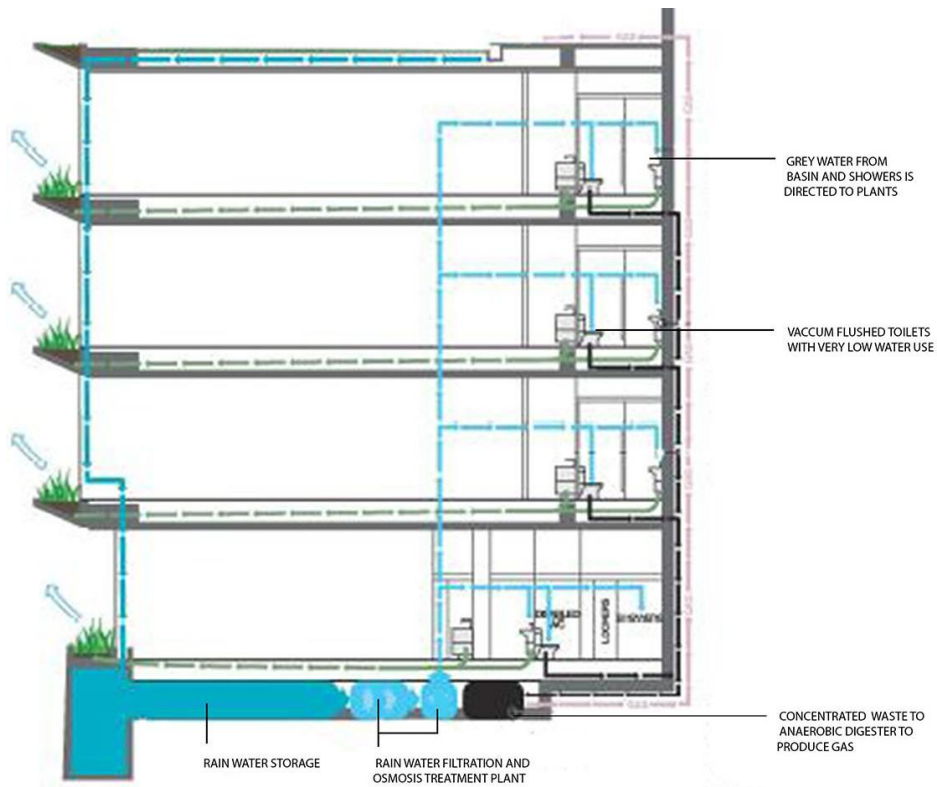


Diagram 14: rain water harvesting and water recycling

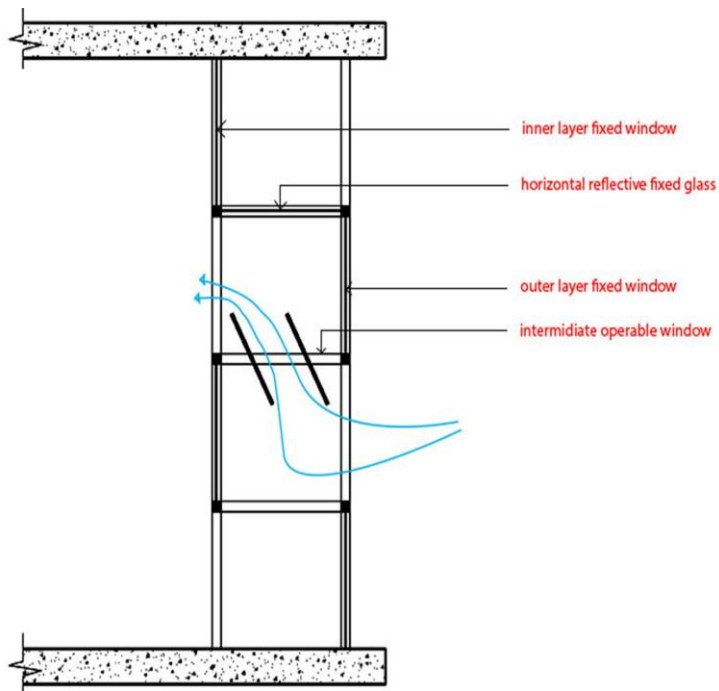


Diagram 15: fenestration detail

### 6.4 Plans, sections, renders and model images



Fig 14: Master Plan



Fig 15: Section AA'

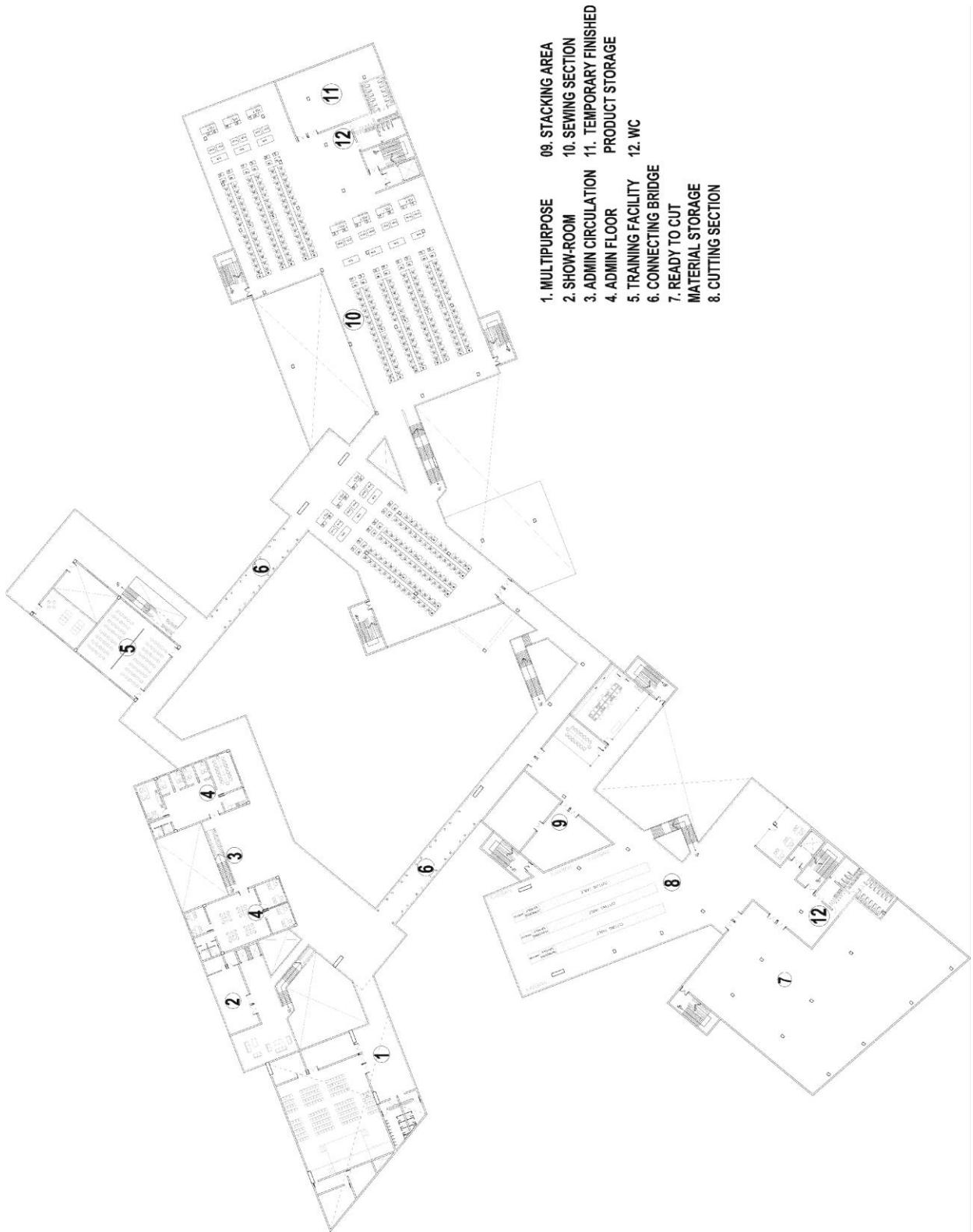


Fig 16: 1<sup>st</sup> floor plan

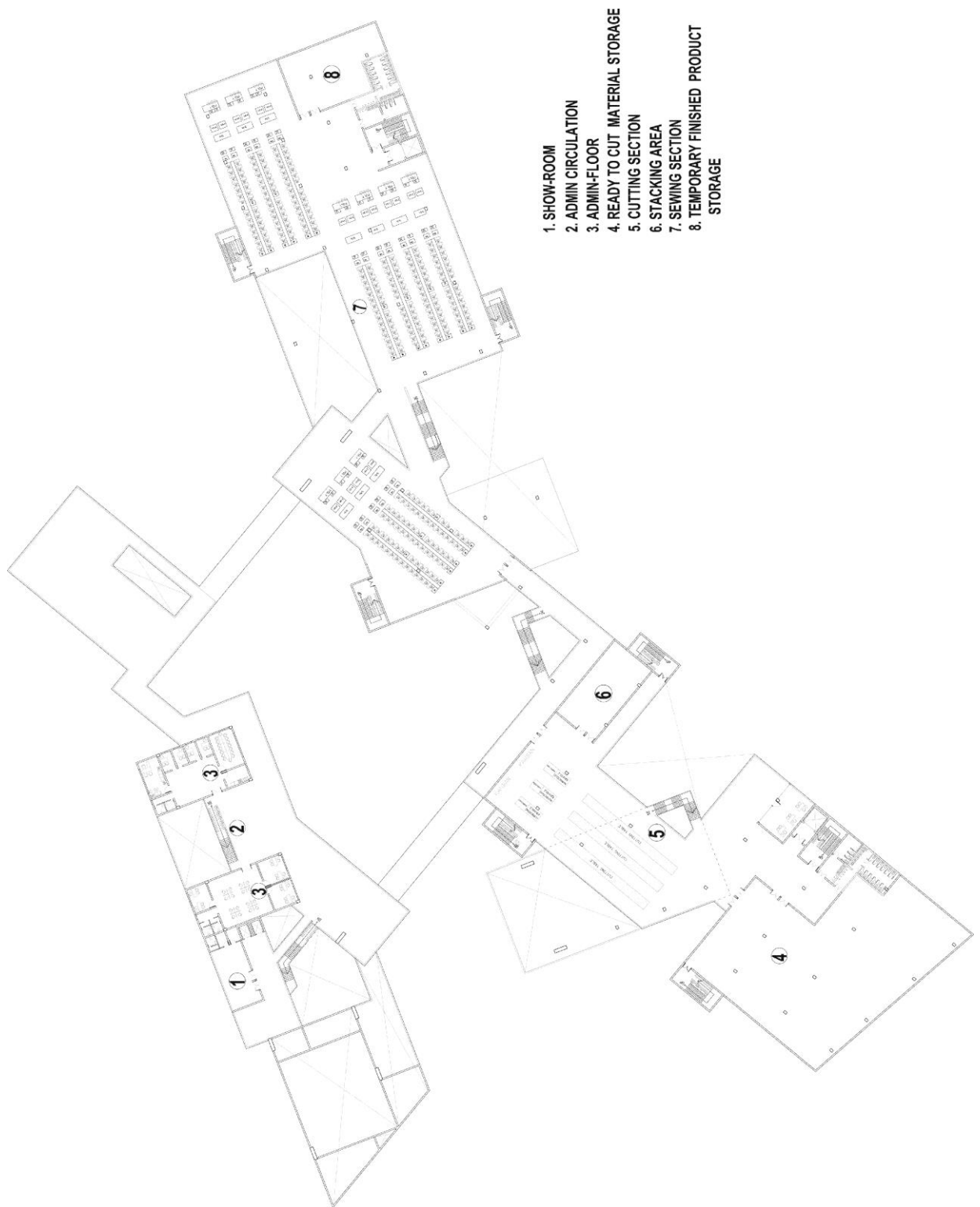


Fig 17: 2nd floor plan

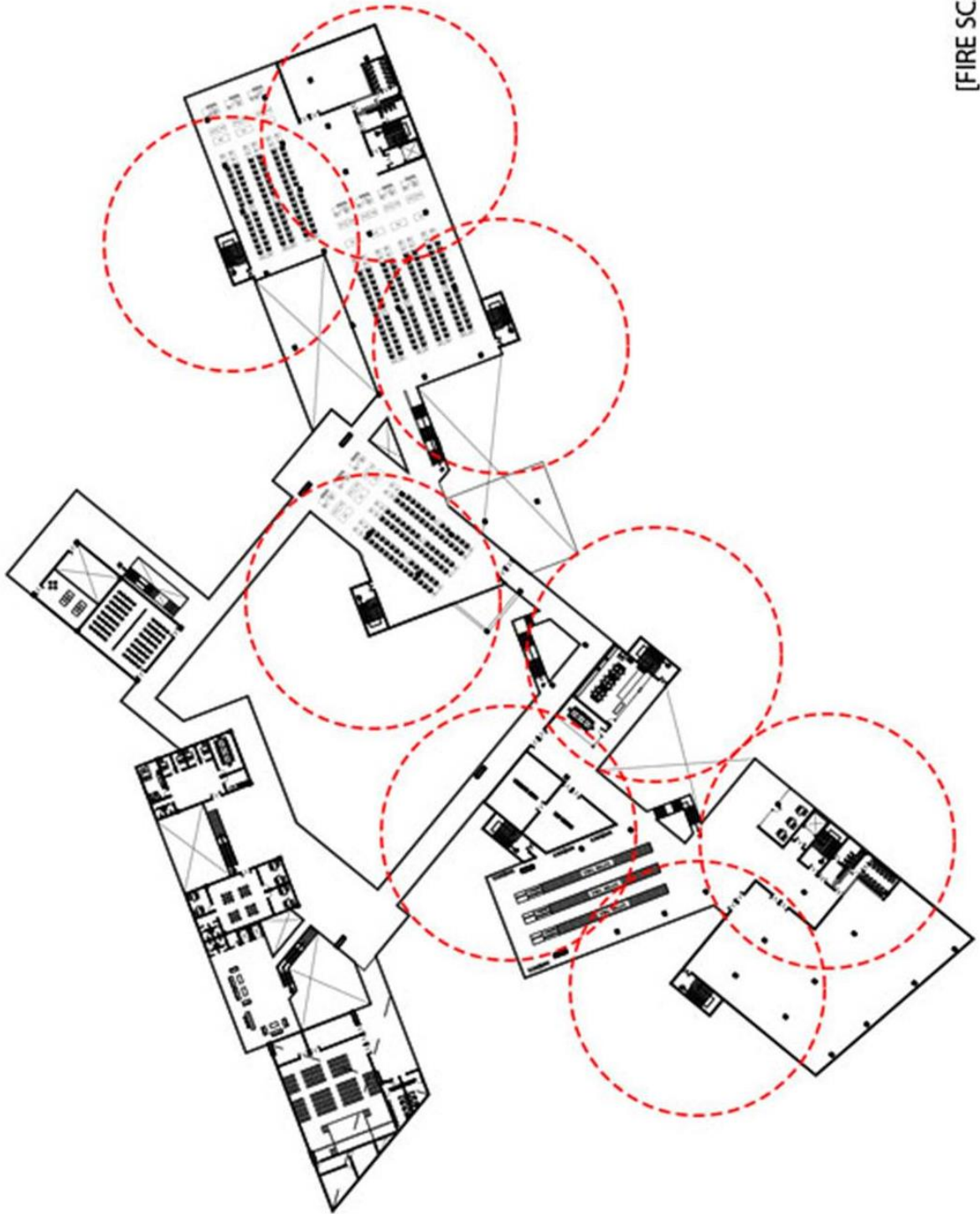


Fig 18: fire escape planning



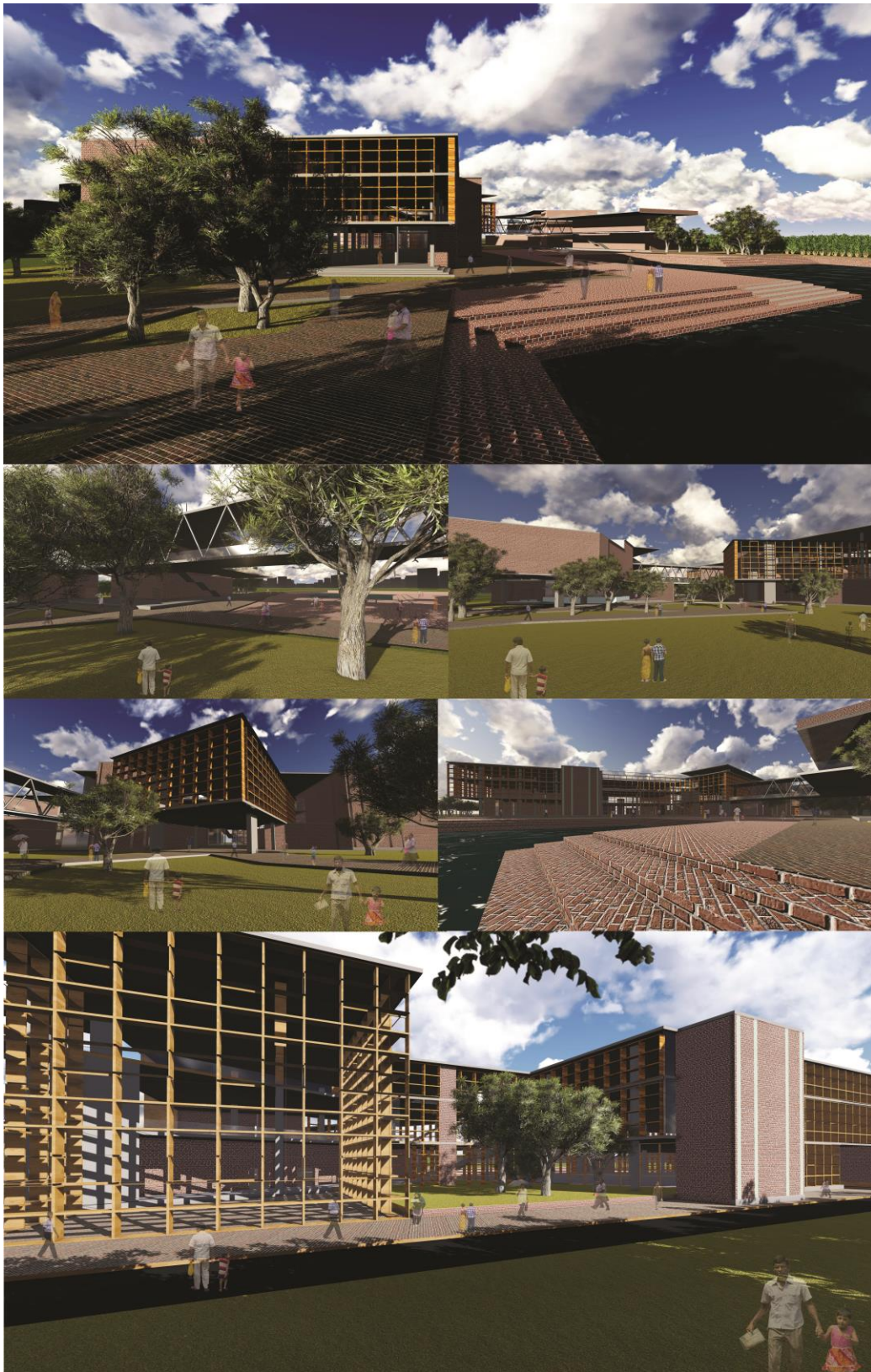


Fig 19: Renders



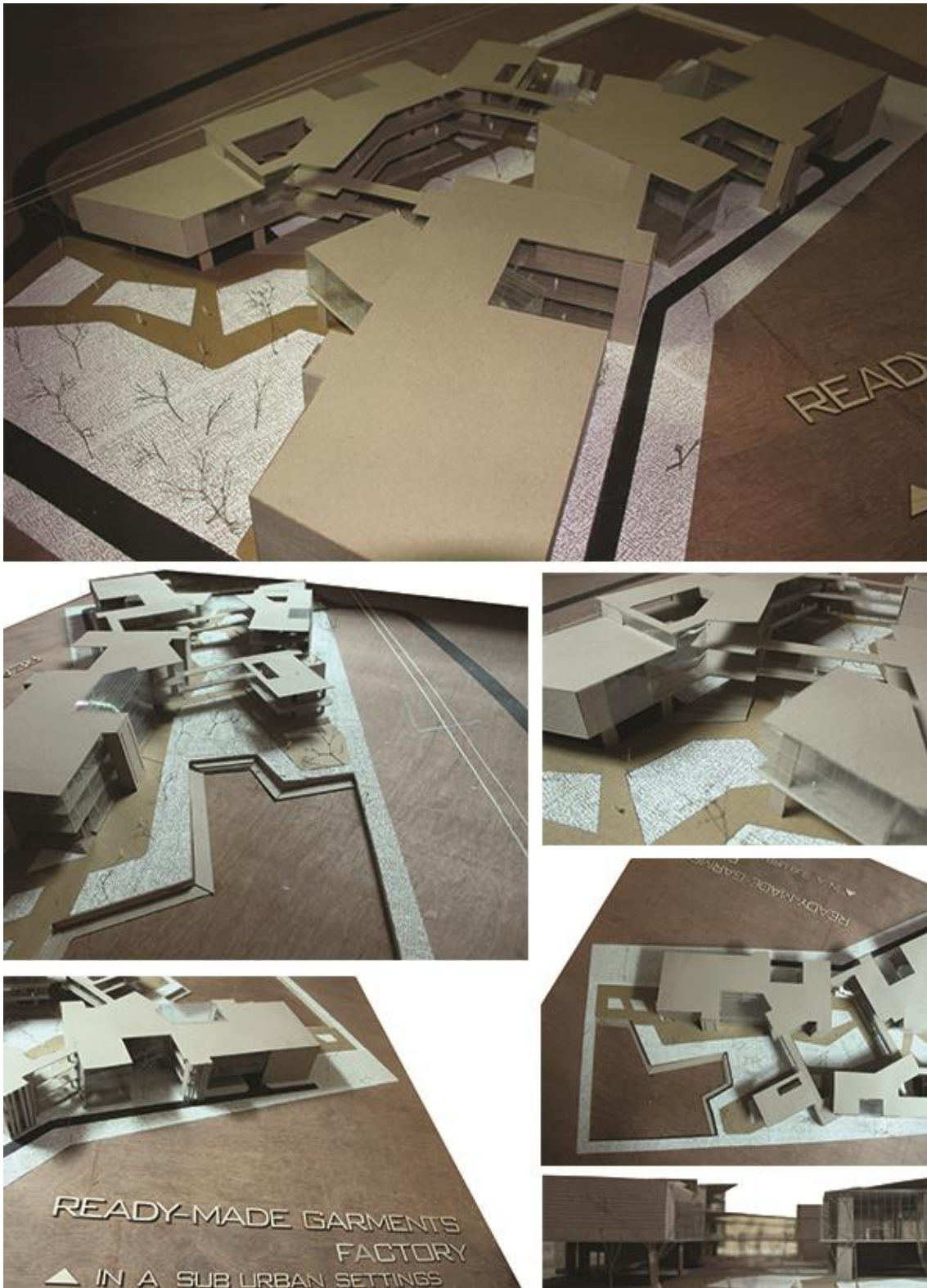


Fig 20: model images

## BIBLIOGRAPHY

1. Bazlul Khondhker, Abdur Razzaque, and Nazneen Ahmed (PDF). Exports, Employment and Working Conditions: Emerging Issues in the Post – MFARMG Industry. (Report).
2. "BGMEA Upbeat on Export Growth". Bizbangladesh.com. Retrieved 2010-10-05.
3. Fauzia Ahmed. "The Rise of the Bangladesh Garment Industry: Globalization, Women Workers, and Voice."
4. "Garment Workers in Bangladesh."
5. Naila Kabeer and Simeen Mahmud. "Rags, Riches and Women Workers: Export – oriented Garment Manufacturing in Bangladesh."
6. Garment Workers Revolt in Bangladesh.
7. BGMEA RMG Export Statistics
8. <http://www.cbsnews.com/news/bangladesh-factory-disaster-how-culpable-are-western-companies/>
9. <http://edition.cnn.com/2013/05/02/world/asia/bangladesh-us-tshirt/index.html>
10. "Avoiding the fire next year". The Economist. 4 May 2013.
11. Paul, Ruma; Quadir, Serajul (4 May 2013). "Bangladesh urges no harsh EU measures over factory deaths". Dhaka: Reuters.
12. Nur, Shah Alam (1 May 2013). "Space shortages at rented houses make RMG units non-compliant". Bangladesh: Financial Express.
13. Quddus, Munir; Rashid, Salim (2000). *Entrepreneurs and Economic Development: The Remarkable Story of Garment Exports from Bangladesh*. Dhaka: The University Press Limited.
14. Yardley, Jim (23 August 2012). "Made in Bangladesh: Export Powerhouse Feels Pangs of Labor Strife". *The New York Times* (Ishwardi, Bangladesh).
15. Ethirajan Anbarasan (25 November 2012). "Dhaka Bangladesh clothes factory fire kills more than 100". BBC. Archived from the original on 25 November 2012. Retrieved 25 November 2012.
16. Farid Ahmed (25 November 2012). "At least 117 killed in fire at Bangladeshi clothing factory". CNN. Archived from the original on 25 November 2012. Retrieved 25 November 2012.



17. Anis Ahmed and Ruma Paul (25 November 2012). "[Bangladesh's worst-ever factory blaze kills over 100](#)". Reuters. [Archived](#) from the original on 25 November 2012. Retrieved 25 November 2012.
18. Greenhouse, Steven (5 December 2012). [Documents Indicate Walmart Blocked Safety Push in Bangladesh](#). *The New York Times*. Retrieved April 27, 2013.
19. Quadir, Serajul; Paul, Ruma (9 May 2013). "[Bangladesh factory fire kills 8; collapse toll tops 900](#)". Dhaka: Reuters.
20. Damien Gayle (30 April 2013). "[Bangladesh factory death toll could reach 1,400: Primark says it will compensate families of killed and injured](#)". *Daily Mail* (London).
21. "[Disaster in Bangladesh: Rags in the ruins: A tragedy shows the need for a radical improvement of building standards](#)". Dhaka, Bangladesh and Savar, Bangladesh: [The Econom](#)