

## SAVE A LIFE: TRAUMA HOSPITAL AND REHABILITATION CENTER

Sara M. Bakhsh<sup>1</sup>, Mohammed Fekry<sup>2</sup>

<sup>1,2</sup>College of Architecture and Design, Effat University, Qasr Khuzam St., Kilo.2, Old Mecca Road. P.O.BOX 34689, Jeddah 21478, Saudi Arabia

E-mail: [1smbakhsh@effatuniversity.edu.sa](mailto:1smbakhsh@effatuniversity.edu.sa), [2mfekry@effatuniversity.edu.sa](mailto:2mfekry@effatuniversity.edu.sa)

Received: 12.04.2020

Revised: 11.05.2020

Accepted: 08.06.2020

### Abstract

A new approach of medical system in Saudi Arabia called trauma system. Due to the high proportion of trauma cases currently occurring in Saudi Arabia, the application of the traumatic system in Saudi Arabia will improve the health of injured patients. Most of patients with traumatic injuries need a physical or psychological rehabilitation; some patients need both treatment and rehabilitation. The proposed project will contain trauma hospital and rehabilitation center that will serve the need of traumatic injuries patients. The considered zones for the space program are in-patients function, out-patients function, diagnostic and treatment function, emergency function, services function and educational function. The project will location will be outside Jeddah city towards north side. Site evaluation based on several criteria was conducted and the suggested site is located at Alswari District, Jeddah. This project increase the number of trauma centers in Saudi Arabia that will improve the emergency status. Also, allow the trauma center independent from the general hospital, which will enhance the capability of the general hospital.

**Keywords**--Medical System, Trauma Hospital, Rehabilitation Center, Traumatic Injuries

© 2020 by Advance Scientific Research. This is an open-access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>)  
DOI: <http://dx.doi.org/10.31838/jcr.07.08.73>

### INTRODUCTION

Trauma considers as a major reason of death and immobility around the world [1]. That influences the productivity of the individual. Thus would affect the social and economic status of the city. According to the medical dictionary trauma means any injury infects the physiological or psychological status of the individual [2]. For example, trauma can be caused by a car accident. The golden hour is "The first hour after injury will largely determine a critically injured person's chances for survival" [3, 4]. That quote supports the international code the distance between each health care center in highways is 100km. Accidents can be cause of many factors the most common one is car & motorcycle accidents. On the other hand, gunshot and stabbing take the minimum cause of trauma in around the world.

Trauma system is defined by a system that cares of all injured patients from different ways medical and geographical [5-7]. In addition, trauma center is hospital that occupied and designs to provide an advance level of emergency services for patients suffering from traumatic injuries. That it can be part of a hospital or independent center. Trauma center is classified into 5 levels [8]. Level 1 is the most comprehensive level that provides care for critical traumatic injuries patients. Level 5 provides the initial care for injuries. The variation of trauma center levels can directly show if the patient needs to transfer to a higher level or not. Moreover most of traumatic injuries classified under those specialties which are orthopaedic, neurosurgery, emergency medicine, internal medicine, paediatric-surgery and general surgery. Therefore, the proposed project, trauma center aims to serves the urgent cases.

### CASE STUDIES

The selected case studies improve the care of traumatic injuries by providing advanced health care facilities and excellent architectural space. The selected case studies are:

- Pars Hospital, Rasht, Gilan Province, Iran
- International Medical Center, Jeddah, Saudi Arabia
- East Jeddah General Hospital, Jeddah, Saudi Arabia
- National Intrepid Center of Excellence, Bethesda, Maryland, United States

### Pars Hospital, Rasht, Gilan Province, Iran

Pars Hospital located at Rasht, Gilan Province, Iran is designed by Azin Babakhanlou, Maryam Ayoubi, and Ainaz Rastegar (Figure 1) [9]. The pars hospital is a general hospital that includes 160 beds including intensive care unit. It include various departments laboratories, accident and emergency, acute care services, obstetrics and gynaecology theatre and IVF,ICU,CCU, specialized clinics, paediatric and E.N.T wards, operating theatre, Heli-pad and etc. In addition the hospital will provide an advanced medical treatment for patients and will a healthy environment for the workers [9].

The project is trying to not only present responds to physical planning requirement and client's demands, but also approach to a unify form and leaves effective influence on this region of the city. Composing several blocks in three different heights built on the basis of concrete structure features a comprehensive medical infrastructure. Moreover, the hospital being integrated via a transitive atrium that pervades and provides natural light accessibility in different departments, while porches create a subtle and interactive visual communication between inside and surrounding environment.

### International Medical Center, Jeddah, Saudi Arabia

Sami Engawi Consultation office is the designer of International Medical Center (Figure 2) [10]. The international medical hospital it contains two towers that is separated by a courtyard in the middle. The first tower used for OPD, Physical therapy, occupational therapy and specialized centers. The second tower used for operation theatre and inpatients ward. In addition the hospital consider to be is a multi-disciplinary that contain many specialties with providing a well advanced treatments level. These specialties are oncology, cardio, orthopaedics, OB-Gyne and women's health and children health. Their main aim is to create a trusted healthcare institute in Saudi Arabia through creating a well healthy environment for the patients.

The IMC Concept was driven from the Islamic architecture, such as the integration between indoor spaces with outdoor spaces. In addition the project was applying another concept which is healing by design. The project characterized by a famous Islamic

fountain and courtyard. These elements were major elements in the Islamic architecture in history.

**East Jeddah General Hospital, Jeddah, Saudi Arabia**

The east Jeddah general hospital is a multi-disciplinary hospital that provides an advanced level of treatments for many specialties. Their main aim is to create a clear circulation. The east Jeddah general hospital concept was to achieve clear circulation by creating two main axis intersecting in a point. Those two axis are also create a four major zone for the hospital (Figure 3) [11].

**National Intrepid Center of Excellence, Bethesda, Maryland, United States**

National Intrepid Center of Excellence is a rehabilitation center for traumatic brain injury patients designed by Smith Group (Figure 4) [12]. The national intrepid center of excellence is designed to provide advanced level of treatment, education and research in traumatic brain injury and psychological health. Create L-Shaped plan like the left side of the brain that will allow having a multiple space accommodate with diffident functions treatment, diagnostic and sport space. In addition by creating the free form spaces, is giving the feeling of hope and confidence.



Figure 4. National Intrepid Center of Excellence [12]

As a summary for the case study, the Pars Hospital does create atrium that gives feeling of connecting to nature, also it provide the heliport gives the hospital receiving traumatic patients. Secondly, the International Medical Center signified the architect designed the courtyard as element to separate between the two towers. The design involved the integration between natural environment and the building functions. Next, the East Jeddah General Hospital shows a very clear axis that separates the plan into 4 main quarters and makes the entrance of OPD independent from other entrances. Lastly, the National Intrepid Center of Excellence has outlined the integration between the educational and physiological department.



Figure 1. Pars Hospital [9]

**SPACE PROGRAM**

An architect has to understand the basics functions to formulate the space program of a hospital. The design of a hospital should depend on complex functional requirements. The hospital design from layout to building form has to meet some criteria such as segregation of work flow, clear circulation, separation of emergency routes, patients and staff safety, patients' privacy, and employee privacy. The basics form of hospitals is based on its function, which are in-patients function, out-patients function, diagnostic and treatment function, emergency function, services function and educational function. The space program of the hospital function and services are tabulated in Table 1.



Figure 2. International Medical Center [10]



Figure 3. East Jeddah General Hospital [11]

Table 1. Space program of the Trauma Hospital

Types	Department	Total Area (m <sup>2</sup> )
Hospital Function	Main Entrance	716
	In-patient ward (Adult)	23376
	In-patient ward (Paediatric)	6396
	Intensive care unit	2356
	Emergency department	2232.1
	Operation theatre	3812.4
	Obstetrics unit	1223.5
	Radiology department	1510
	Laboratory department	1005
	Educational unit	1130
	Administration department	670
	Medical records department	770
	<b>Total</b>	
Services	Central sterile services department	785.5
	Laundry department	518
	Pharmacy department	790
	Morgue department	248
	Catering department	1037
	Housekeeping and cleaning unit	81.4
	Waste management unit	580
	General storage unit	1300
Maintenance and workshop	200	
<b>Total</b>		<b>5539.9</b>

The design of a rehabilitation center focused either on patient’s physical, psychological status or both. The functional relationships take an important design consideration. Most of the rehabilitation center main focusing on the healing garden. Mainly the main consideration on rehabilitation design is type of treatments. The types of treatment are physiotherapy, hydrotherapy, occupational therapy, and psychological therapy. The space program of the rehabilitation center is demonstrated in Table 2.

**Table 2.** Space program the rehabilitation center

Zones	Net Area (m <sup>2</sup> )	Circulation (m <sup>2</sup> )	GFA (m <sup>2</sup> )
Main Entrance	323.1	32.1	353.1
Physiotherapy	485.6	146.6	604.6
Hydrotherapy	496.2	99.2	595.2
Occupational and psychological Therapy	326	65.2	391.2
Healing Garden	1108.8	110.8	1218.8
<b>Total</b>	<b>2739.7</b>	<b>453.9</b>	<b>3162.9</b>

**SITE SELECTION AND ANALYSIS**

Trauma center should be in dense area or inside the city. The site of trauma center differs according to the levels of the trauma center. Trauma center level 1 should cover a certain area that doesn’t exceed one hour from accident area. Moreover, for level two to level 5 it should associate with the location of trauma center level. Figure 5 shows site 1 location in North West Jeddah, in front of King Abdullah medical Complex and the site area is about 25000 m<sup>2</sup>. Figure 6 shows site 2 located in North East Jeddah, in Alswari District, King Saud Road and the site area is about 25000 m<sup>2</sup>.



Figure 5. Site 1[13]



Figure 6. Site 2 [14]

In order to select the most location that achieves the high sufficient factors to increase the survival rate for the traumatic patients. From the selected sites, each criterion will be given a Weighting Factor (WF) from 1 to 5, which will be used to evaluate each site by giving each factor a score according to its priority. WF of 1 is not very important and 5 is very important. The site evaluation result is tabulated in Table 3.

**Table 3.** Site Evaluation

Site Criteria	Weighting factor	Site 1	Site 2
Site capacity	3	15	15
Covered area	4	20	20
Accessibility	5	20	25
Noise level	2	8	10
Dense area	3	12	9
Distinctive stand alone	5	5	25
High level of accidents	3	12	15
Street design	2	10	4
Near to the highway	3	12	15
Shape/ proportional	2	8	10
Image/ visual quality	2	8	4
Surroundings	3	15	9
Site context	3	15	9
Demographic pattern	1	5	5
<b>Total</b>		<b>165</b>	<b>175</b>

The site evaluation result in Table 2 reveals that site 2 marks the highest score and considered as the project site location. Figure 7 shows there are several accesses to the site, which are King Saud Road, Aabir Al-Qarat Street, and Al-Madinah Road. The site located in the middle from flag roundabout and Thuwal city at 47km, near to King Abdullah Medical Complex.

The site covered from flag roundabout until Thuwal and Al-Jumum city. Also, the site surrounded by the major and minor streets that make accessibility easier. The highest noise level comes from the east side and north side of the site is free from noise. Figure 8 demonstrates the climate analysis of the selected site. The site experiences cold wind from Northwest direction and warm wind from Southeast region.



Figure 7. Site traffic analysis

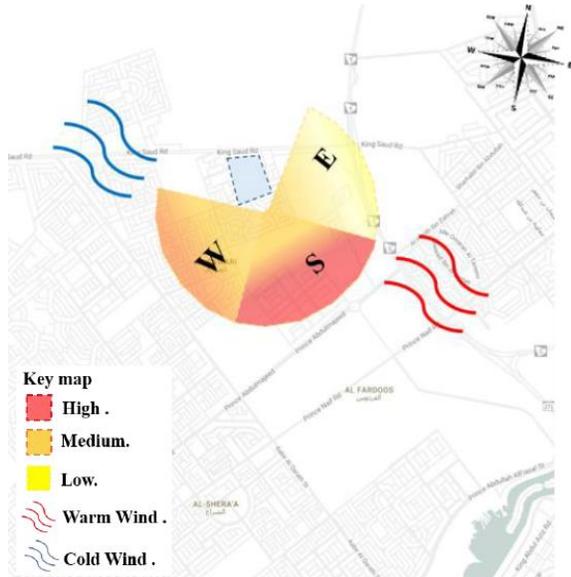


Figure 8. Site climate analysis

**ZONING AND PROJECT DESIGN**

Most of the hospitals are only focusing on patients not on employee and the visitors. The concept of this project is to give everyone their rights and put priorities, and to produce wellbeing, safe and productive hospital environment in Saudi Arabia. The hospital design and facilities will provide a high infection control especially at emergency department. Figure 9 demonstrates the site final zoning of the project.

The project will have many principles of Biophilic design principles, such as provide a good ventilation system to have increased the level of infection control, natural lights and natural view to reduce healing time for the patients and using material that absorb the noise. Use the Golden Hour theory to allocate the trauma centers on the highways. Moreover, it will be used in creating the main zoning of the project. Because traumatic injuries are very sensitive to each minutes. Thus, using the golden hour theory will help in increasing the survival level of the patients. Figure 10 and Figure 11 show the external view and interior design of the project. The main perspective view of the project is demonstrated in Figure 12.

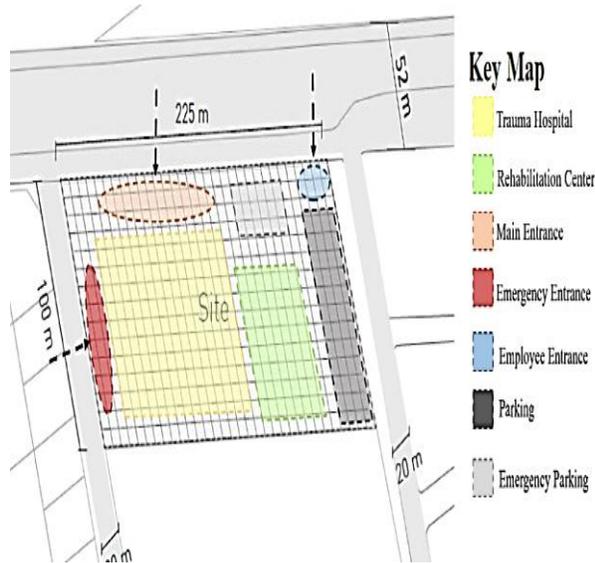


Figure 9. Site final zoning diagram



Figure 10. External view



Figure 11. Interior design



Figure 12. Main perspective view of the project

**CONCLUSION**

The proposed project provides a safe environment with high infection control to decrease the period of healing, also increase the productivity and awareness of the individual. The suggested space program of the project covered the primary zone of in-patients function, out-patients function, diagnostic and treatment function, emergency function, services function and educational function. The selected site location for this project is located at Alswari District, Jeddah based on the evaluation of site capacity, covered area, accessibility, noise level, dense area, distinctive stand alone, high level of accidents, street design, near to the

highway, shape/ proportional, image/ visual quality, surroundings, site context, and demographic pattern. This project expected to lift up the health status mainly the trauma cases in Saudi Arabia through implementation of trauma system.

#### REFERENCES

1. Spinella P. Zero preventable deaths after traumatic injury. *Journal of Trauma and Acute Care Surgery*. 2017;82:S2-S8.
2. trauma [Internet]. TheFreeDictionary.com. [cited 19 July 2019]. Available from: <https://medical-dictionary.thefreedictionary.com/trauma>
3. Rogers F, Rittenhouse K, Gross B. The golden hour in trauma: Dogma or medical folklore?. *Injury*. 2015;46(4):525-527.
4. Eastridge B, Holcomb J, Shackelford S. Outcomes of traumatic hemorrhagic shock and the epidemiology of preventable death from injury. *Transfusion*. 2019;59(S2):1423-1428.
5. Mullins R. A Historical Perspective of Trauma System Development in the United States. *The Journal of Trauma: Injury, Infection, and Critical Care*. 1999;47(SUPPLEMENT):S8-S14.
6. Eastman A. Trauma Systems. *Parkland Trauma Handbook*. 2009;:5-10.
7. Lundy D, Harvey E, Jahangir A, Leighton R. Trauma systems in North America. *OTA International*. 2019;2:e013.
8. Trauma Center Levels Explained [Internet]. Air Medical Net. [cited 19 July 2019]. Available from: <http://airmedical.net/resource/trauma-center-levels-explained/>
9. Pars Hospital / New Wave Architecture [Internet]. ArchDaily. 2016 [cited 19 July 2019]. Available from: <https://www.archdaily.com/795981/pars-hospital-new-wave-architecture>
10. SkyWatch: Jeddah's International Medical Center [Internet]. Susieofarabia.blogspot.com. 2017 [cited 19 July 2019]. Available from: <https://susieofarabia.blogspot.com/2017/01/skywatch-jeddahs-international-medical.html>
11. The first procedure to remove a tumor in the spinal cord in East Jeddah Hospital [Internet]. Scbnews.com. 2017 [cited 19 July 2019]. Available from: <http://scbnews.com/192952/>
12. National Intrepid Center of Excellence (NICoE) [Internet]. SmithGroup. [cited 19 July 2019]. Available from: <https://www.smithgroup.com/projects/national-intrepid-center-of-excellence-nicoe>
13. Google Maps [Internet]. Google Maps. 2019 [cited 9 July 2019]. Available from: <https://www.google.com/maps/place/21%C2%B046'06.5%22N+39%C2%B005'53.7%22E/@21.768474,39.0960603,692m/data=!3m2!1e3!4b1!4m6!3m5!1s0x0:0x0!7e2!8m2!3d21.7684691!4d39.0982491>
14. Google Maps [Internet]. Google Maps. 2019 [cited 9 July 2019]. Available from: <https://www.google.com/maps/place/21%C2%B048'34.6%22N+39%C2%B006'10.2%22E/@21.809608,39.1006463,692m/data=!3m2!1e3!4b1!4m6!3m5!1s0x0:0x0!7e2!8m2!3d21.8096026!4d39.1028353>