

# Analysis And Design of A Multi Storied Car Park Concrete Structure

**Using Etabs Software, A Case Study of Alsiteen St. Located At K H. Sudan.**

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**Abstract**— the main purpose of the research is to present a simple comprehension of the multi-story car parks design and the role they play which can lead for a better society. We have studied the case of increasing illegal parked vehicles which case heavy traffic. And based on our studies we recommended the multi storied car park as solution. Examined our case study through filed survey at the main intersections of the area. Determined the average number for illegal parked cars, Then we were able to determine the suggested space for those cars and the capacity we need with the manual design sheet. The paper mainly focuses on the utilities of the manual design sheets, and ETabs software for analyzing and better understanding of concrete behavior during cars loads and other loads upon the building. And also the design recommendation depending on the BS8110-1997 code of standers.

**Keywords**—Car parks structure; concrete design; multi stoery structure ; manual design; infrastructure design .

## I. INTRODUCTION

The movement of vehicles, alignment and organizing of traffic is considered to be a true reflection on the society's nature. And due to the streets traffics and the movement. We as locals and foreigners take the first impression on the country and realize the type of society that we are coming towards. So the rapid rise and increasing in illegal parks, which can be effectively avoided and solved through multi story structure near to the traffic spots .As a future vision for Sudan and Sudan urban cities, taking in account the principle of sustainability and development to provide a high quality of life for all and to create an attractive, Vibrant, and successful town centers. They are a perfect way to reduce traffic, which helps gratefully in preventing accidents. And as a new type of buildings in Sudan, car parking structures are considered one of the most important features in any building, duo to the urgent need for investment in big and crowded states such as Khartoum.

Our team's primary focus was on the crowded areas caused by illegal parking and the lack of available parking rows. As the team had a specific lot area taken in consideration to solve this dilemma, which has been a major problem in the main streets of the state of Khartoum.

The validated approach in this work combines several methods. Some of them are inspired by well-known traditional

methods. Which can give clear understanding and economical solutions. Providing adequate parking space to meet the demand of major cities which can be very challenging giving the fact that long period of time is required for construction and the annual increase of vehicles. Statistics shows that there are more than 1 billion and 200 million cars on the roads around the world , with an annual increase of 6.45% at the same time three are increase demands for an empty lands , which can be invested in malls ,compounds , stadiums , and etc..

There for the amount of parking lots is also increased stimulatively especially in urban cities.

## . LITERATURE REVIEW:-

. This project intends to demonstrate the suitability and capability of multi storied car parks in Sudan, Also giving more understanding for the structural behavior. tho dose the relation between traffic and the sustainability structures . Multi-story car parks have unique features that showcase them better than any structures. A lack of understanding and recognition of these qualities by designers and those responsible for inspection and maintenance is believed to be the major cause of many of the common problems identified in these structures (Pike et.al, 2011). Parking structures are generally classified as either "static" or "automated." The automated parking are more common in Europe while static is the most prevalent type of parking structure in the United States (Carl and Timothy, 2006).

A previous projects by a group of researchers conclude that parking problems and traffic management issues in Nigeria and other similar countries which is leading to time delays and traffic congestion are as a result of inadequate parking space, traffic signs/signals, indiscipline, encroachment of illegal activities at car parks etc (Osuba, 2012). This is why new innovations and technology need to showcase more e to help address this issue and reduce some of the constraints on traffic management system of urban centers and also help improve their parking system. One of these innovations is the introduction of the multi storey carpark structure. The ramps are located inside or outside the building and can be curved or straight. Helical ramps allow faster traffic than straight ramps. The parking access lanes must run along the parking spaces. Distances in the exit direction should be as short as possible. The ramp slope must be less than 15%, ideally below 12% (Arcelormittal, 1996).

.there are more evidence demonstrate multistoried car park as the most sustainable and educate solution in any urban cities , not just developing contraries such as Sudan . It showcase the best use of land and resources for a better city layouts and more space for initial structures.

## II. METHDOLOGY

. The first step is to estimate, using car trips from the survey, the accumulation of vehicles and the theoretical capacity for the area. Which was done through field survey mainly and data collecting. Then we determined the row parking capacity (without regulations) and the actual capacity (taking into account the regulation information) based on the same field survey. And the BS8110-1997 design code. Finally we compared the data obtained in the first two steps to determine the difference between the actual parking capacity and the theoretical capacity. To have the actual capacity storage.

The field survey was done at the intersection of Al Siteen street and Al Mashtal street at 8:00 AM and found that the number of legal parking spots that were originally designed for the street are merely enough and there are about 100 cars parked incorrectly in that area causing unnecessary traffic that can easily be avoided if there was a multi-story car park on site.

### I. Statement of the problem

Parking, a pillar in the transporting system which considered as a serious problem that confronts the urban planner and traffic engineer; because it plays a crucial role in the management and organization of traffic. Any vehicles traveling on highways will at one time or another be parked at some point for either a relatively short time or a much longer time, depending on the reason for parking. The existence of parking facilities is therefore an essential element of the highway mode of transportation.

## II. Standards and criteria of parking design

- The location of the car park must go along with the city layout. To reduce the required time of accessibility.
- Its exits and entries must be far from major or main intersections. Due to the ability of surrounding streets to contain the additional traffic.
- The maximum capacity for the transporting system around the area. . To determine the actual capacity of the structure.

. And specifically relating to transport and local plans, our research aims to Allocate new development at locations are easily accessible by sustainable transport mods , and 2-

Promote an integrated transport system that gives priority for walking, cycling and buses paths for developing country such as Sudan and increase the sustainability layouts in its future vision for a better Sudan .



Figure 1 -traffic being caused of illegal parking.



Figure 2- different view of the traffic.

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## III. Properties of building under study :-

.The area that we chose for this study is an empty land with an  $1800 m^2$  (40x45) which is perfectly suited for solving the traffic issue.

.The multi-story car park will be three floors plus the ground floor (3 Typical + Ground) .

.The maximum capacity for the entire building is 96 vehicles, the capacity can be calculated manually or using the following equation:-

$$\frac{S - [\sum_{i=1}^n (Li \times li)]}{a + \lambda} \cdot N \text{ spaces}$$

Where:- $S$  is the area of the parking area ( $m^2$ ).

$n$  is the number of aisles.

$Li$  is the length of aisle (m).

$li$  is the width of aisle (m) is the average area, occupied by a parked car ( $m^2$ ).

$\lambda$  is the necessary space around the vehicle for parking maneuvers o The average values used for  $a$  and  $a + \lambda$  in this study are  $21 m^2$  and  $25 m^2$ .

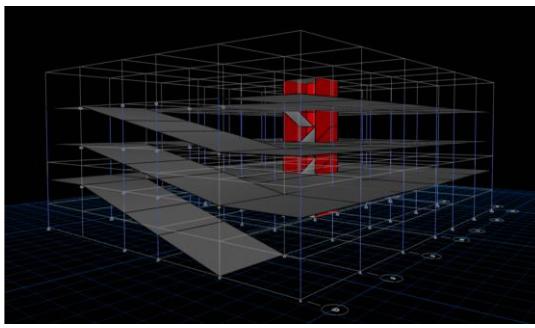


Figure 3- 3D view of the parking model.

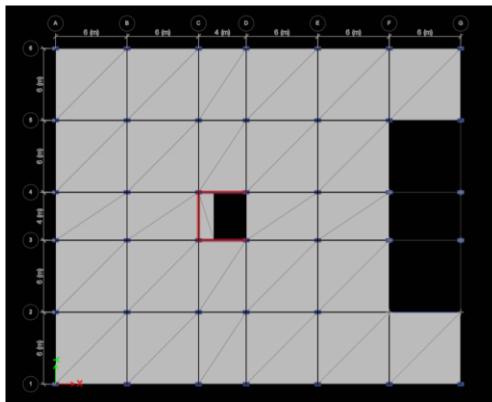


Figure 4- vertical view for the model in Etabs.

#### IV. INTRODUCTION TO ETABS SOFTWARE :-

. Extended3D Analysis of building System, which is recognized globally as the pioneering leader in structural engineering analysis and design software for structural and earthquake engineering.

##### I. Description of analysis model :-

The multi-story car park model will be (3) floors plus the ground floor (3 Typical + Ground). Which represent reinforced concrete structure. It shows the behavior of the structural elements during loading and shows the deformed shape, and what to expect from the maximum combination loads .And as shown in figure (3) it demonstrate the Ramp slope with each floor height.

##### II. REASLTS & DISCUSSION

Table 1: Structural members and their sections

Structural Members	Sections (mm)
Beams	500X250
Ramp Beam	600X200
Columns	350X550
Slab	200
Wall	200

Table 2: Load cases

Case	label	Analysis Type	Load (Kn/m <sup>2</sup> )
1	Dead	Linear Static	S.W
2	Live	Linear Static	6
3	Finishing	Linear Static	2
4	Partition	Linear Static	2

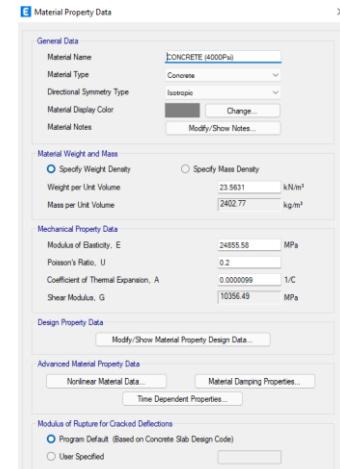


Figure 5 concrete properties and strength .

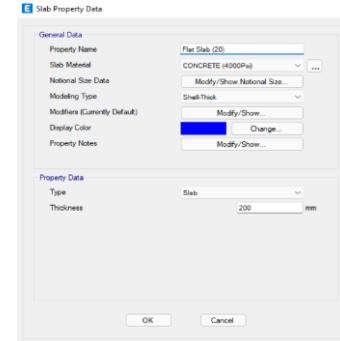


Figure 6- Flat slab properties .

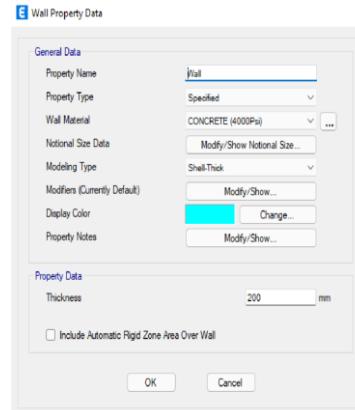


Figure 7- walls properties.



Figure 8- steel Bars & steel links properties.

Foundation type	Q all	A /m <sup>2</sup>
<b>F1</b>	<b>150</b>	<b>1.12</b>
<b>F2</b>	<b>150</b>	<b>2.67</b>
<b>F3</b>	<b>150</b>	<b>5.67</b>
<b>F4</b>	<b>150</b>	<b>7.32</b>
<b>F5</b>	<b>150</b>	<b>10.26</b>
<b>F6</b>	<b>150</b>	<b>13.21</b>

. Based on the study we made and taking in mind the early mentioned statistics about the incredible amount of vehicles on the streets we conclude that even though the multi-story car park systems have several disadvantages, it is quite possible to solve these problems and optimize the structure to be functioning perfectly with the least possible obstacles.

### III. CONCLUSION

. In this project, we have studied the case of the increasing amounts of illegally parked vehicles, and figured that one of the best solutions to this problem is the construction of a multi-storied car park. We examined our case study in which we did a field survey at the intersection of Al Mashtal and Al Siteen Street to determine the average amount of vehicles that are parked illegally in this area and thus determining the amount of parking spaces we need to reduce the problem. Which led to determine the properties of the building under study. A brief model overview of ETABS software and how we designed the model of the building and the input tables were processed. , we analyzed the results and discussed the validity of the project and its advantages

### I. RECOMMENDATION :-

.Based on this research, there are some recommendations to cover and to explore on the utilities and design of the multi-story car park structure.

- To study the behavior of concrete structures during car loads and other loads upon the building, then suggest another approach.
- To collect data from other sites as possible case-studies and compare the results with our data and analyze them.
- The ramp slope angle in any corrections on new designs must not exceed 1 degrees.
- More research is needed upon the placements of parking bays and the movement of cars inside the building exits and entrances too.

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