

Visibility Analysis of the Capital District in the 2030 Master Plan of Abu Dhabi

Rim Meziani

(Assistant Professor Rim Meziani, Abu Dhabi University, Po.Box 59911, Khalifa city, Abu Dhabi, UAE, rim.meziani@adu.ac.ae)

1 ABSTRACT

The 2030 master plan of Abu Dhabi describes the new zones of urban development in Abu Dhabi city: The Central Business District (CBD), The Capital District, the Grand Mosque District and the LULU Island District. It highlights the new vision of the UAE via its political capital: Abu Dhabi.

In this paper, the author is interested in the Capital District as the core of the city that has a variety of land use from low to high rise residential buildings, to institutional and commercial buildings to offices/retails, Governmental buildings, etc., besides the landmarks and great open spaces planned in order to highlight the image of Abu Dhabi city as the Capital of UAE.

A newly introduced mean of public transportation: the metro is expected to increase the pedestrian flow from and to these buildings. In order to optimize mobility and to raise the pedestrian movement growth to open public spaces in particular and to provide a lively, easy and pleasant walkways with high visibility and good accessibility to landmarks, natural settings, national symbols, monuments, neighborhood facilities, open spaces, etc. In this paper the author using the visibility analysis, mainly axial lines and segments maps. The urban structure framework, the land use, streets hierarchy, cycling and walking maps proposed in the Abu Dhabi 2030 master plan will be taken in account. Climatic factor and environmental Leadership will be the aim of a further study.

The methodology we followed consists of applying space syntax and GIS to analyze both the visibility and accessibility of open spaces (gardens, plaza, etc), pedestrian pathways, landmarks, facilities and important buildings.

The outcomes of this research will be combined with the study of the climate comfort in further research to translate the sustainable directions to specific recommendations and designs and try to refine the vision and themes represented in the 2030 plan ,which is subjected to detailed evaluation and confirmation in further planning and design.

2 INTRODUCTION

This paper presents a small part of a research that tries to cross three factors: 1) visibility of important buildings, open spaces, roads of the capital district, 2) buildings forms and arrangement and 3) the micro-climate, in order to propose kind of guidelines or orientations for land use, transportation planning, urban forms, etc which provides: 1) livable and pleasing walk paths in an optimum time to the city functions, 2) climatic comfort for pedestrian's walk, mainly shaded and ventilated streets and open spaces and 3) high visibility to landmarks, natural settings, national symbols and monuments, etc.

In this research the author has chosen Abu Dhabi 2030 master plan as a study case, in particular the capital district for its importance. Though it is a proposed plan and a practical research on site cannot be conducted, the author finds this interesting since finding of the research may help in orienting/ guiding future development and design based on simulation and analysis in a small areas, that the master plan did not cover because of the scope.

The author used Depthmap and axial line as many research have been recently made about walkability and accessibility by using axial lines and segment map analysis, together with the using of Geographical Information System (GIS). We found the this computer programs are suitable for this research as by the capabilities of these tools in representation and analysis demonstrated in many papers.

This paper presents first the study case then the methodology and ends with a conclusion that summarizes the findings and presents the limitations of the this research, which will be developed in further work.

3 PRESENTATION OF THE STUDY CASE

3.1 Abu Dhabi city

The United Arab Emirates (UAE) is a country situated in the southeast of the Arabian Peninsula in Western Asia on the Persian Gulf, bordering Oman, and Saudi Arabia, and sharing sea borders with Iraq, Kuwait, Bahrain, Qatar, and Iran (according to Wikipedia) (Figure 1).



Figure 1: Geographical location of the United Arab Emirates. Source: <http://geography.about.com/library/cia/blcuae.htm>

The city of Abu Dhabi, which is currently the capital city of UAE with less than one million people, was established in the middle of the 18th century based on hunting and pearling activities. It has grown economically in the middle of 20th century with the discovery of oil and later politically to become the capital city of the United Arab Emirates after the Union of the 7 Emirates: Abu Dhabi, Dubai, Fujairah, Ras al-Khaimah, Sharjah, and Umm al-Quwain in 1971 to form one country (1).

3.2 Abu Dhabi 2030 Master plan

Abu Dhabi 2030 master plan was designed and implemented in 2007 in order to plan, manage and describe the future growth of the city. The continued expansion of the economy, the rapid population growth, the liberalized real estate law, the significant foreign investment and the construction projects of unprecedented influenced the birth of this master plan. The challenges that the master plan 2030 faces are: the creation of a sustainable livable urban environment and guarantee a balance between the mixed cultures existing in the cities with the preservation of the cultural character and traditions of Abu Dhabi as an Emirati and Arab city (1).

Hence, the urban structure framework plan was produced to make Abu Dhabi match its current financial and social capital to become the “Urban capital” with an expected population of 2 million residents and 4.9 million annual tourist in 2020 and 3.1 million residents with 7.9 million of annual tourists in 2030 and up to 5 million residents after a continues growth (1).

It is important to note here the urban structure framework plan was not geographically limited by the administrative boundaries of the city, but included its urban region and furthermore its natural boundaries (2), as for the Lulu island which is one of the new zones of urban development: The Central Business District (CBD), The Capital District, the Grand Mosque District and the Lulu District (Figure 2).



Figure 2. The location of the new zones of urban development. Source: The Abu Dhabi Urban Planning Council, 2007

These districts belong to the two major parts of the Abu Dhabi 2030 plan, which are connected by a developed transportation infrastructure based on the transit system. The first core is situated in the northeast of Abu Dhabi island and includes the historic center and the expanded Central Business District (CBD). The second one contains the new capital district located in the south of Abu Dhabi Island and will represent the second downtown of the city which will be designed to reflect the role and image of Abu Dhabi city as the capital of the federal government and a modern, sustainable Arab city (figure 3). Hence we are interested to take the capital district as a study case in this research.



Figure 4: The 3D model of the main square in the capital district. Source: Source: The Abu Dhabi Urban Planning Council, 2007

3.3 Capital District

That capital district is planned on 45km² of land for a population of 367,253 residents and 813,650 of daytime population and will provide 100,000 jobs (1). It is well connected to the first part of the city through highways, trams and metro networks. Its urban structure and urban forms are designed in way to orient its visual axes to the CBD and to end with the Federal Precinct that represent landmarks and important buildings not only at the level of the city, but also the nation (Figure 4).

Its planned sustainable compact mixed uses distributed in different heights and densities makes from the Capital city a good place for integration between Emirati people and other ethnic groups, between different working classes in the society and a perfect mix of different cultures. From one hand low rise buildings of universities, research centers, mosques, community neighborhood with all the necessary facilities, sports and conference venues, embassy neighborhood, and from other hand high rise buildings of offices and commerce, national governmental house and buildings (Figure 5). They are distributed in the 2030 master plan to six major precincts: Federal Precinct, City Center Precinct (CBD, Souk District, North Spine District, Federal Mosque District), Emirati Neighborhood, Sport Hub Precinct, South Spine Precinct and Palace Precinct, based on land use distribution, location to transit infrastructure, density, urban form and open space (2) (Figure 6).

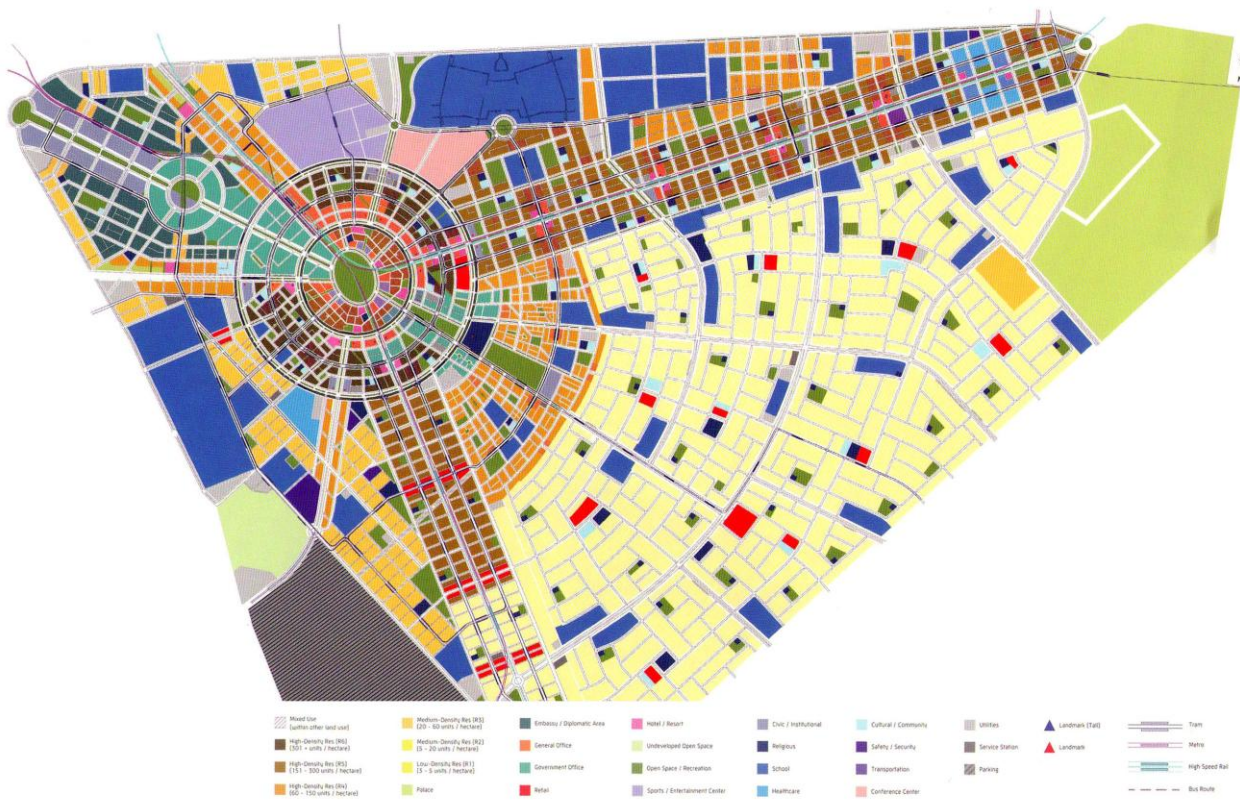


Figure 5: land use map of the Capital district- Abu Dhabi 2030 Master Plan. Source: The Abu Dhabi Urban Planning council, 2007

4 METHODOLOGY

The software applied in this research is Depthmap by UCL and the map we used is the urban spatial structure of the capital district designed by the Abu Dhabi Urban Planning Council. We used Axial map in order to check the integration and accessibility related to visibility of open spaces and roads within the whole urban system of the capital district.

The author first created automatically the axial map from the drawing file of the urban spatial structure of the capital district (Figure 7). A segment graph was generated from the axial map in order to conduct a detailed analysis through a segment analysis smaller scale: streets. The resulting graph was after that analyzed according to the connectivity, Integration, total depth, choice, node count, etc (8). Later on an analysis using metric type of radius was run.

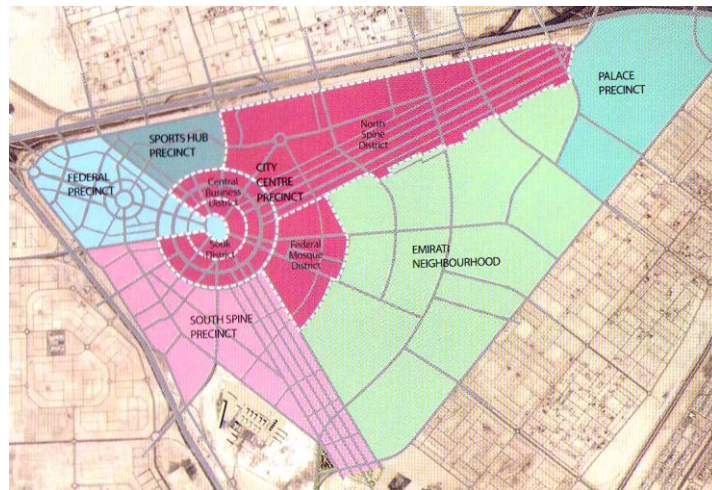


Figure 6: The six major precincts of the Capital District. Source: The Abu Dhabi Urban Planning Council

The author chose 5mn, 10mn and 15mn of walking, which is equivalent to walk 400m, 800m, 1200m and cycling 7.5 minutes and compare it with the walking and cycling map, which represents the tram and metro stops and the related 5mn walking distance from them, the streets hierarchy and the land use maps in order to identify which area from the capital district is well integrated in the whole system of the urban structure and more accessible and also to check if the walking distances proposed in the plan is enough to reach comfortably in an optimum time different destinations: open spaces and facilities, land marks, etc, especially in the hot climate of UAE.

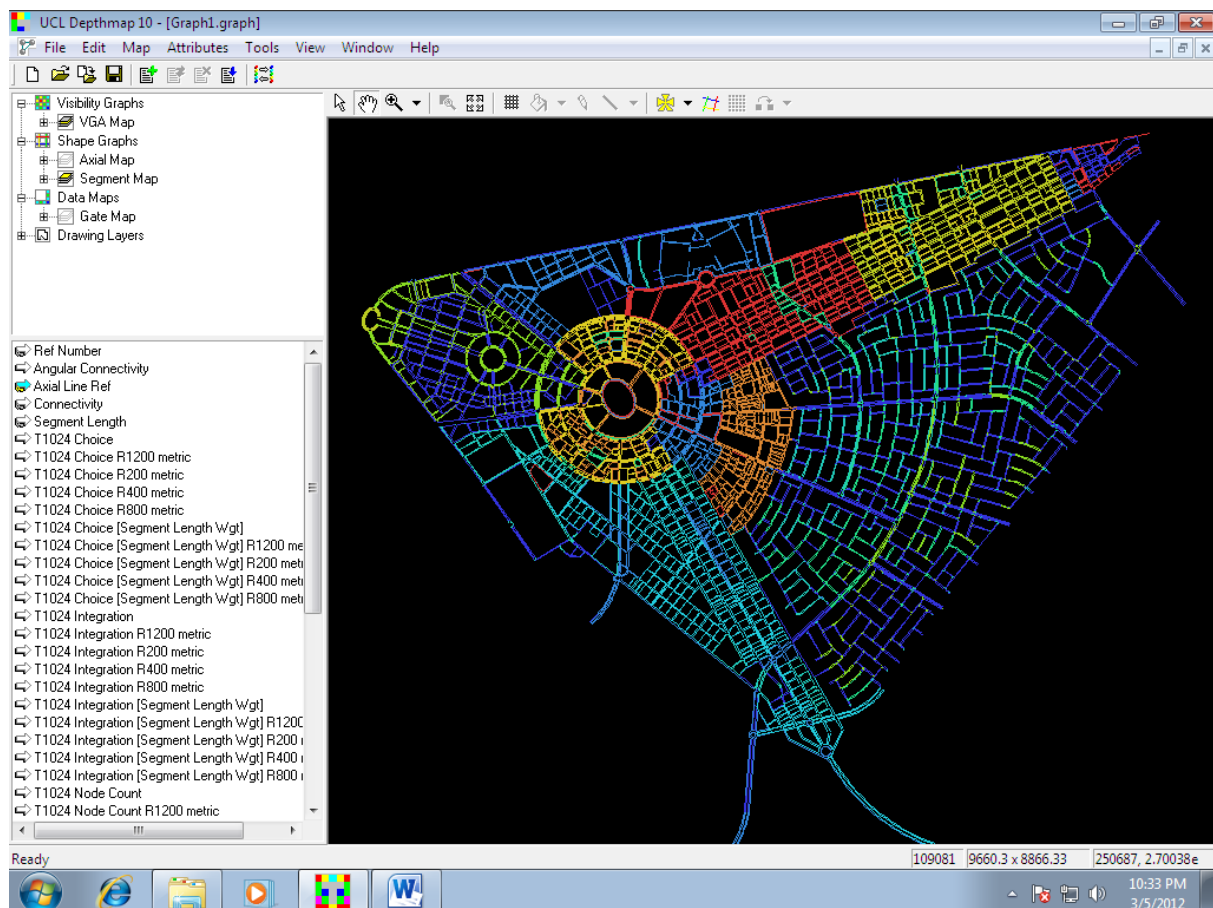


Figure 7: Axial lines references. Source: Rim Meziani, 2012

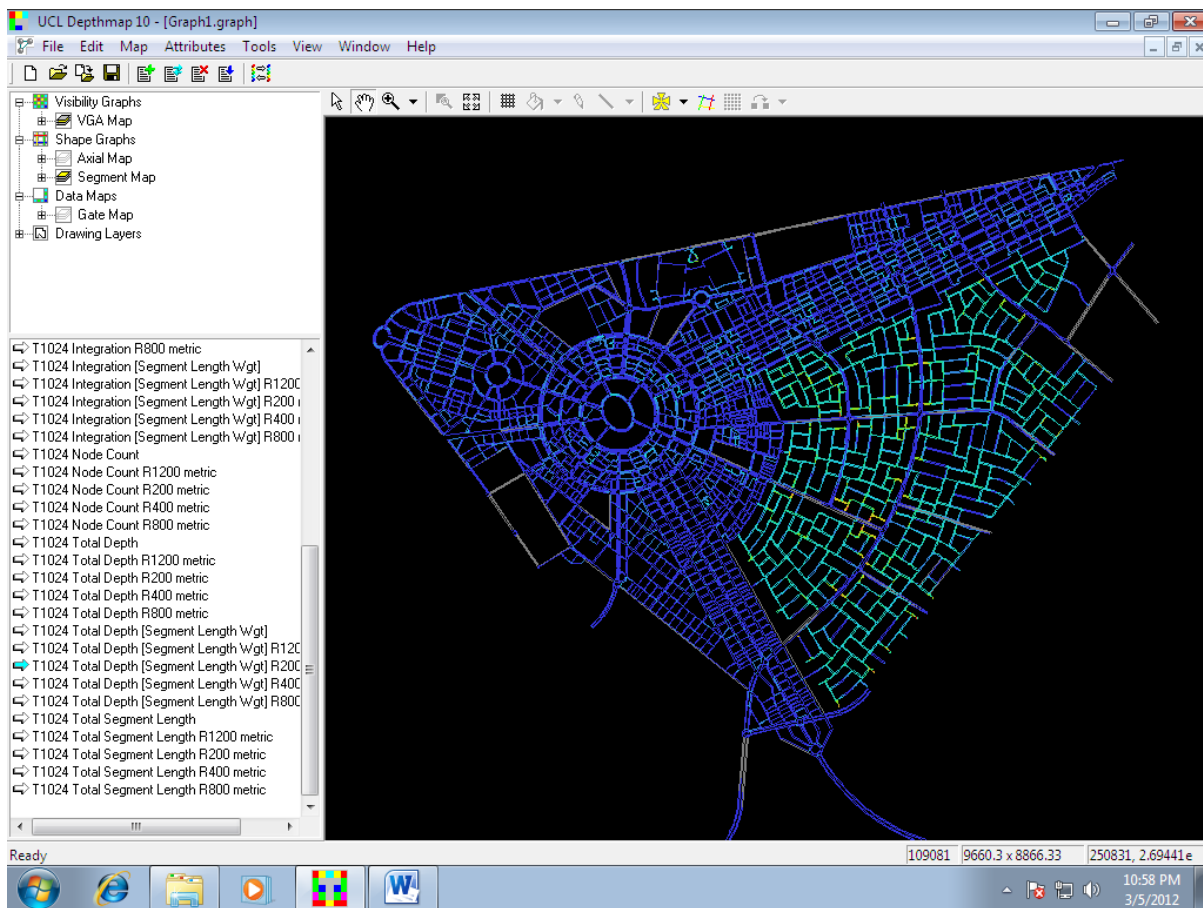


Figure 8 :Total depth -Segment length weight- R200 (5mn walk). Source: Rim Meziani, 2012

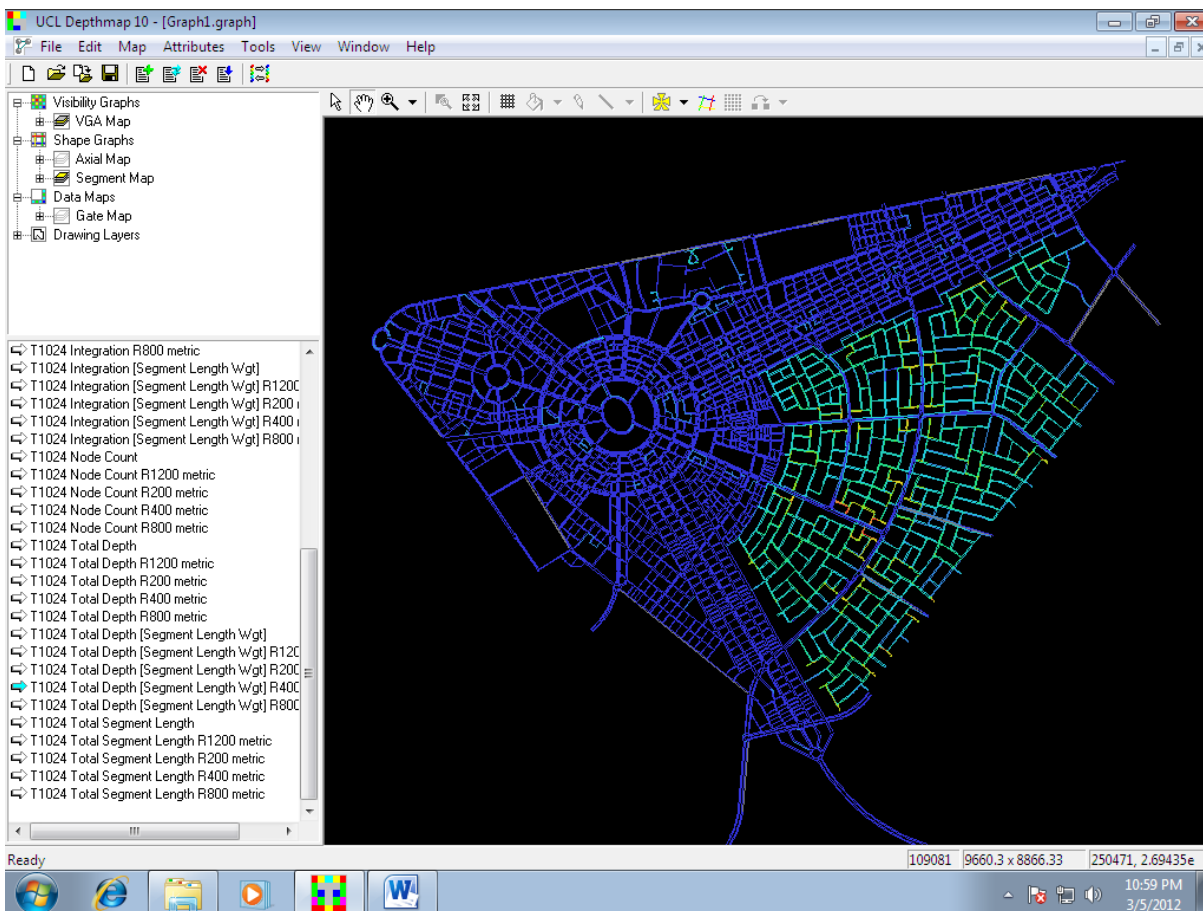


Figure 9: Total depth -Segment length weight- R400 (10mn walk). Source: Rim meziani, 2012

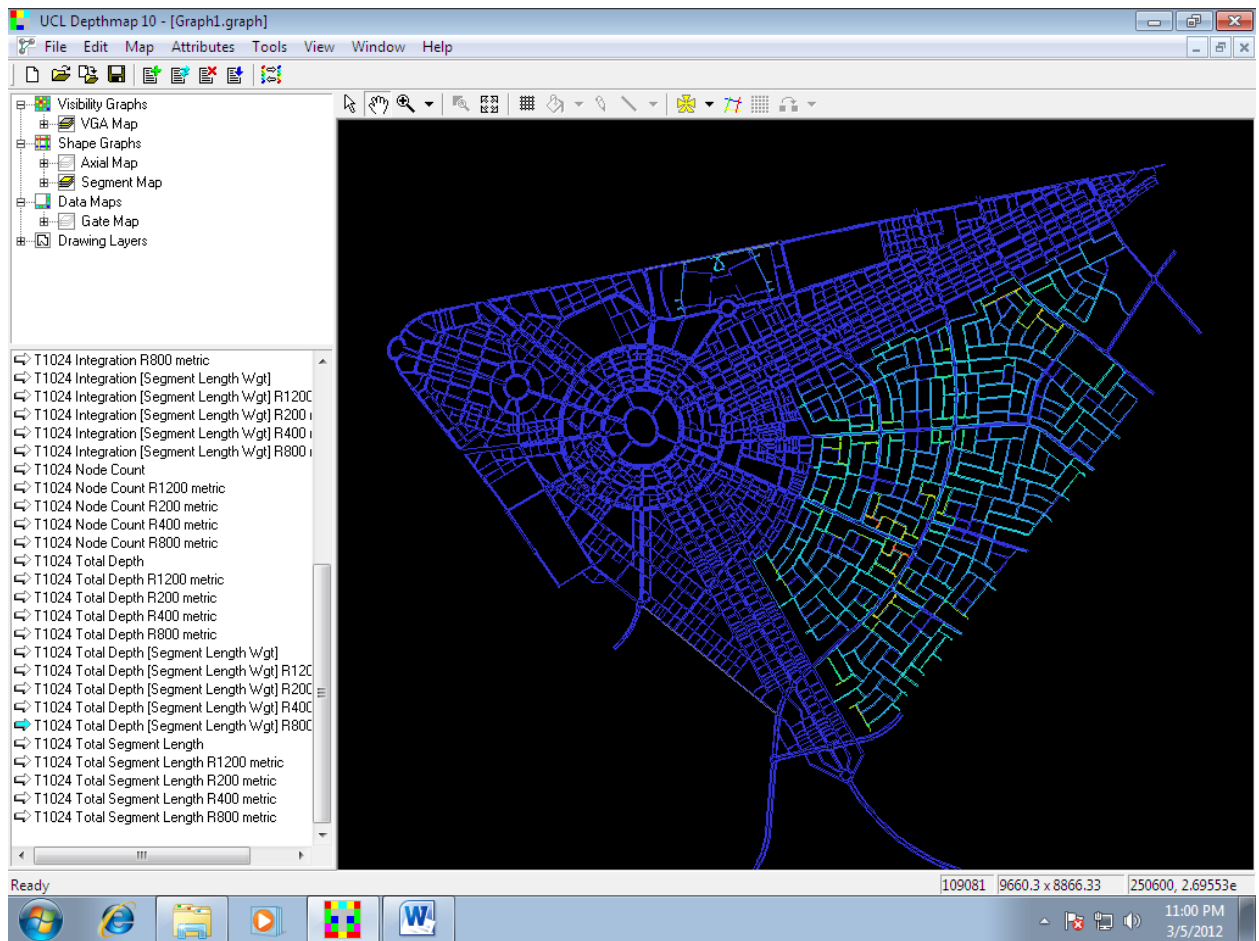


Figure 10: Total depth -Segment length weight- R800 (15mn walk). Source: Rim Meziani, 2012

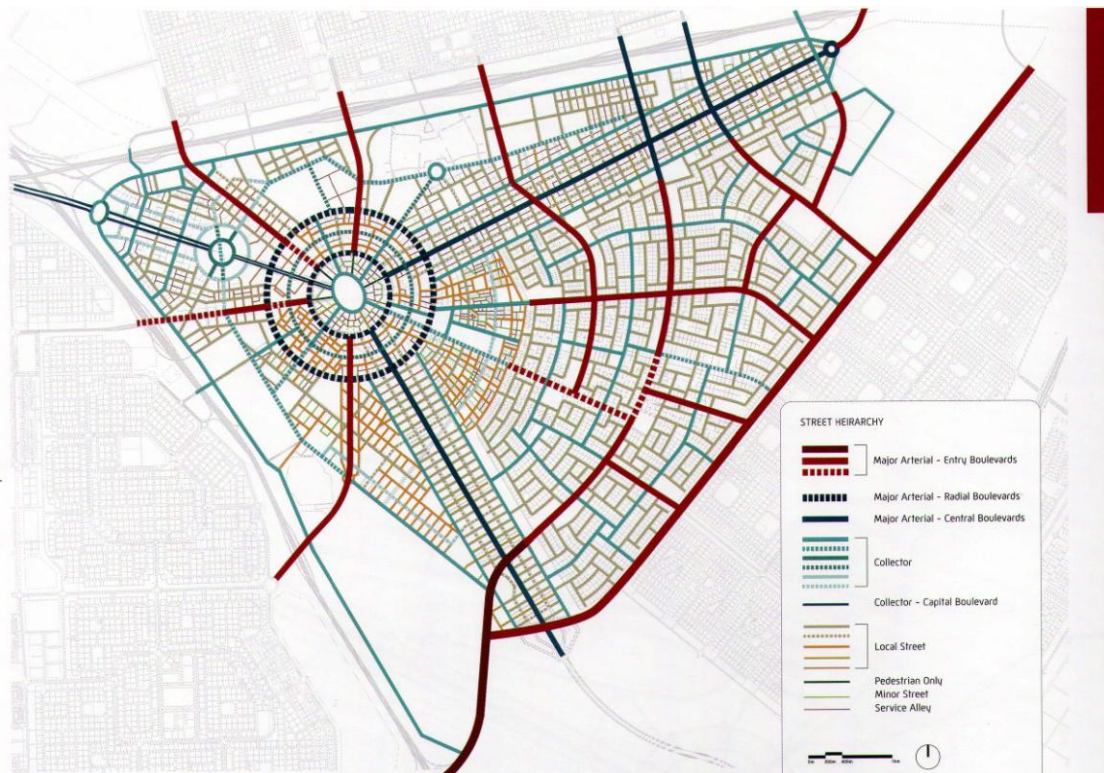


Figure 11 : Street hierarchy of the Capital District. Source: The Abu Dhabi Urban Planning council, 2007

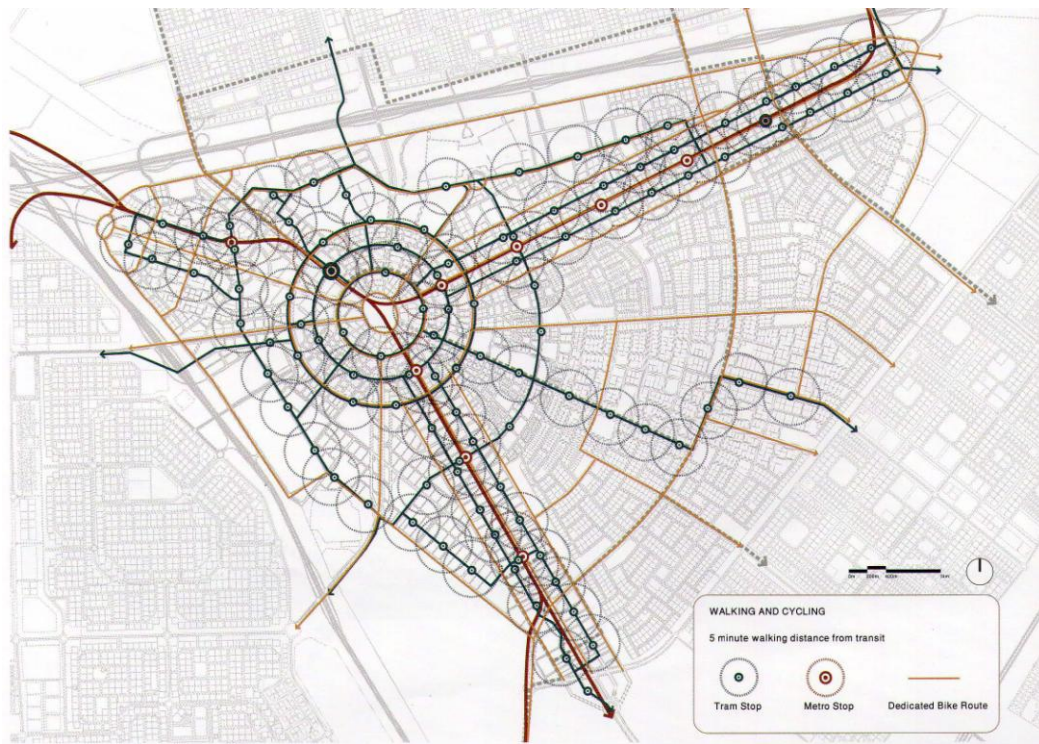


Figure12 : Walking and cycling map of the Capital District. Source; Abu Dhabi Planning council, 2007

5 RESULTS ANALYSIS AND FINDING

Before starting the analyze it is important to understand the meaning of the total depth. Turner (9) defined the total angular depth as: *The cumulative total of the shortest angular path to the segments.*

The total depth values are represented in the graph by a gradation of color by default from blue: Lowest value to green, to red: highest value. The total depth graph generated for the Capital district area (figure8) indicates that both collectors and local streets in the Emirati neighborhood (Figure11) has high value than the major arterial, which means that a large number of shortest path are connected to them.

Where comparing the total depth graphs (segment Analysis) for a radius of 200m, 400m and 800 meters that is equivalent to 5mn, 10mn and 15mn of walk (figure 8, 9, 10) , and the land use, the streets hierarchy maps with the walking and cycling map (figure 12) we found out that:

(1) The segments in the graphs with 200m, 400m and 800m radius (figure 8, 9, 10) related to the neighborhood area that represent the cycling routes and the major bus routes in the urban structure of the capital district have less total depth values (blue) that means that they have a small number of shortest angular paths connected within the walking distance mentioned above.

(2) The non residential land use planned in the neighborhood such as facilities for example: schools, mosques, healthcare, and open spaces are not always located near the public transportation stops. Knowing that riding bikes by the women is not popular because of a cultural issue, plus the hot climate represent constraints for cycling long distances.

(3) Only one major arterial entry boulevard and one collector have tram stops, which leave people with a long distance of walking. Furthermore, dedicated bike routes that are connected to the major arterial-entry boulevards, radial boulevards, central boulevards from one hand and to collector and collector-capital boulevard are the one with low value of total depth, which means that people will need more time to reach their destination, since they will take their bikes near by the trams and metro stations, and have to take a longer route. This does not promote the transit oriented model, at the contrary encourages the use of cars.

It is important to note here that 115.677 of the total expected daytime population and the 69.728 of the total residential population in the neighborhood precinct of the capital district (2) will circulate in and out in the neighborhood area. Hence, cycling routes have to be reconsidered and public transportations have to be integrated more in the neighborhood, in particular stations have to be planned near by the facilities at a optimum walking distance that is 5mn to 10mn. In this case, bus as a transportation mean will be a good

solution if extending trams and metro lines inside the neighborhood area is not possible for an economical or physical factors for example.

6 CONCLUSION

Depthmap by UCL was applied in this research and axial lines with an analysis of segment maps of the neighborhood area within the capital district, one of the most important district of the future development of Abu Dhabi was used together with land use maps, streets hierarchy and walking and cycling maps proposed in the 2030 master plan of Abu Dhabi of the urban spatial structure of the capital district designed by the Abu Dhabi Urban Planning Council in 2007. We used Axial map in order to check the integration and accessibility related to visibility of open spaces, facilities and roads within the whole urban system of the capital district and used the segment graphs for a detailed analysis at the level of streets.

We found out that that the proposed cycling and major bus routes and are planned far away from the facilities and open spaces that represent the major attraction points to the daytime population of the neighborhood which is planned as more than 100.000. The graphs showed that these routes have a small number of shortest path even walking 15mn, which does not help having a comfortable walk to optimize mobility and to raise the pedestrian movement growth all over the year and influence the livability of the city that is one of the goals of the future development of the city. Hence this part shall be reconsidered accordingly.

Encouraging walking and cycling under a hard climate such in the UAE cannot be made without providing climatic comfort, like cooling and shading through specific urban forms, good arrangement of buildings and open spaces, etc, and also urban scale street designs.

This paper presents a small part of a research that tries to cross three factors: 1) visibility of important buildings, open spaces, roads of the capital district, 2) buildings forms and arrangement and 3) the micro-climate, in order to propose kind of guidelines or orientations for land use, transportation planning, urban forms, etc which provides: 1) livable and pleasing walk paths in an optimum time to the city functions, 2) climatic comfort for pedestrian's walk, mainly shaded and ventilated streets and open spaces and 3) high visibility to landmarks, natural settings, national symbols and monuments, etc.

Even though this work focused on the neighborhood area of the capital district of the 2030 Abu Dhabi master plan due to lack of time, our target in further research is to conduct an analysis on the whole district including its 6 parts in order to study their interrelation and their integration in the whole system of the proposed urban structure of the capital district.

7 ACKNOWLEDGMENT

The author presents her thanks to Abu Dhabi Urban Planning Council which provided her with the data necessary to conduct this research and also to the Abu Dhabi University which funded this research and the author's participation to the REAL CORP 2012 conference.

8 REFERENCES

- (1) ABU DHABI URBAN PLANNING COUNCIL: Plan Abu Dhabi 2030- Urban Structure Framework Plan, Abu Dhabi, UAE, 2007.
- (2) ABU DHABI URBAN PLANNING COUNCIL: Capital District. Abu Dhabi 2030 Vision, Abu Dhabi, UAE, 2007.
- (3) ALAN PENN: Space Syntax and Spatial Cognition- or, Why the Axial line? 3rd International Space Syntax Symposium, Atlanta, USA, 2001.
- (4) AYSE KUBAT, Samia Rab, Yasmin Ince Guney, Ozlem Ozer, Serdar Kaya: Application of Space Syntax in Developing A Regeneration Framework for Sharjah's Heritage Area. 8th International Space Syntax Symposium, Santiago De Chile, 2012.
- (5) BILL HILLIER: The Art of Place And The Science of Space. In : "World Architecture", Special Issue on Space Syntax, pp.96-102, Beijing, 2005.
- (6) JAKE DESYLLAS, Elspeth Duxbury: Axial Maps and Visibility Graph Analysis- A Comparison of their methodology and Use in models of Urban Pedestrian Movement. 3rd International Space Syntax Symposium, Atlanta, USA, 2001.
- (7) RIM MEZIANI, Toshiyuki Kaneda: Toward Further Application of Visibility Analysis in the Case of Ghardaia. 10th International Conference on: Computers in Urban Planning and Urban Management (CUPUM), Iguassu falls, Brazil, 2007.
- (8) TURNER ALASDAIR: Depthmap: A Researcher's Handbook. Bartlett School of Graduate Studies, UCL, London, 2004.
- (9) TURNER ALASDAIR: Angular Analysis. 3rd International Space Syntax Symposium, Atlanta, USA, 2001.
- (10) Wikipedia
- (11) <http://geography.about.com/library/cia/blcuae.htm>