DOI: https://doi.org/10.38027/ICCAUA2024EN0155

Visual Impact of High-Rise Buildings on the Surrounding Environment: A Case Study in Northern Cyprus

* [1] **Monzer Jaghlit ,** [2] Assoc. Prof. Dr. **Ayten Özsavaş-Akçay,** [3] Assist.Prof.Dr. **Mustafa Eyyamoğlu**
[1 & 2] *Department of Architecture, Faculty of Architecture 99138, Near East University, North Cyprus, Mersin 10 Turkey.*
[2] *Department of Architecture and Industrial Design, University of Campania, Italy*
E-mail [1]: udmitsirel@yahoo.com , E-mail [2]: aysessirel@aydin.edu.tr , E-mail [3]: bxuraktursoy@gmail.com

Abstract
High-rise buildings represent modernity and economic power. Nevertheless, their abnormal scale and presence can alter and define the identity of the city. On the island of Cyprus, with its unique history and modern aspirations, low-rise buildings are considered the predominant type of construction due to the country's social and cultural nature. Therefore, the existence of those buildings puts the city at a disadvantage in having new high-rise buildings, which can change the country's identity and culture. The construction of multiple high-rise buildings can be observed in different parts of Nicosia. Through this study, we will focus on one particular building. We will analyse how that building affects the skyline of the city, its visual impact, and shadow casting. The results showed a clear impact on the city's image and visibility across different locations in the city. Due to the location of the building, the shadow impact is limited to a few areas near the building.
Keywords: Urban Identity, High-rise Impact, City Skylines, visual impact, Shadow Casting.

1. Introduction

The rapidly developing construction industry's global impact on social, environmental and economic sustainability is also increasing at the same rate. Accordingly, many problems arise regarding environmental impacts such as the use of limited fossil fuel resources, supply difficulties, depletion of energy resources, emission problems, global warming and climate change. Accordingly high rise buildings spends high amount of of energy than other buildings which are low rise pr traditional. besides of this reduction on non-renewable energy sources in the world is one of the important problems of world.

The image of the city and how we perceive that context are determined by its architecture, style, and type. High-rise buildings present a challenge, especially in historical and low-rise cities. High-rise buildings are quite important in a city's perspective because of their qualities. Their height, top, and color are some of their most notable characteristics; these are also some of the elements that determine how successful they are. (Samavatekbatan et al., 2016). And how they can affect the city image and identity, and how taking those factors into account can contribute to a better urban environment. According to Samavatekbatan et al. (2016), the findings indicate that the height of tall buildings has the most visual impact, followed by the complexity of the buildings' tops, (Amen & Nia, 2020; Aziz Amen, 2022; Gün, 2023; Odunlade & Abegunde, 2023) and the color of the buildings has the least impact(Zau el all, 2021)(Ali et all2004). In fragile contexts, a small alteration in the architecture can have a profound impact and might change how we perceive this environment. As a result, changing the image of that context In a developing nation with monuments, striking a balance between the preservation of historic buildings and urban development during the urbanization process is a crucial issue that merits investigation. (Bu et al., 2022). It is crucial to preserve this picture in order to preserve history and culture. Policymakers and architects alike should take into account a more comprehensive understanding of this conundrum. Particularly in situations that are deemed sensitive, like northern Cyprus. For example, when a structure is situated in a key location, such as the city center or entryway to the city, the skyline is negatively impacted by tall buildings located in the middle of cities and outside of tall building clusters because of increased building visibility, which is a negative element. As per Karimimoshaver and Winkemann (2018), this results in a damaged skyline and disturbance of the city image(Ross, 2004.).

Through this study, it aims to investigate the effects of such buildings on the context of northern Cyprus, analyzing how a high-rise building can affect a city such as Nicosia that is considered a low-rise majority. Can such buildings change our perception of the city, a city like Nicossia that is known for its heritage and history? Using 3D modeling techniques, arcgis softwaers, and environmental simulations, aimed to get an overview of those effects and a glimpse of the scale of impact a building like this can have on its environment.

2. High-Rise Buildings Effects On Their Contexts

The rapid increase in high-rise buildings since the 20th century, the need for controlled growth of cities, transportation, increasing access to city centers Factors such as demand, global competition and prestige were effective.Especially with the rapid increase in urbanization, high-rise buildings are required for cities to grow compactly. This situation brings to the agenda the impact of the increasing number of high-rise buildings on the environment. In this context, the effects of high-rise buildings on the environment can be examined as positive and negative, as well as from environmental, social and economic perspectives (Nancy et all,2021).

The rapidly increasing number of high-rise buildings today can significantly change the appearance and identity of cities in terms of urban texture and aesthetics.
It is clear that the visual effects of tall buildings on the city play a critical role in determining the identity and aesthetic value of the city. The design, layout and harmony of high-rise buildings with their surroundings must be carefully planned. Therefore, tall buildings in terms of planning and design contribute to making cities look modern, innovative and aesthetically richness(Lau et all, 2021). On the other hand, poorly planned buildings can create visual pollution and disharmony.
For this reason, high-rise building designs should be considered within the scope of sustainable and aesthetic solutions, taking into account the visual effects they will create in the city. Tall buildings, which create positive and negative effects from different perspectives, leave their mark on developing cities (Samavatekbatan et all, 2016)(Ozmehmet el-t all, 2018). On the other hand, it creates negative effects in various aspects. The negative effects caused by tall buildings can be listed as follows;
-Planning is one of the basic requirements of urban development. Therefore, if high-rise buildings are not planned well, they can create instability in the cityscape and cause visual pollution.
-High-rise buildings that are incompatible with the existing environment or have low aesthetic concern may cause deterioration in the general appearance and texture of the city.
-Depending on their height, they create shadows around them, which can be effective for both those living in the building and the areas around them. In addition, they may cause obstruction of vision.
-Wind tunnels are formed due to the narrow passages formed between tall buildings. This situation negatively affects the wind speed by increasing/decreasing it.
Although tall buildings stimulate economic growth in cities, they also increase density. In addition, while they contribute to the architectural character of cities, they also reveal benefits in terms of environmental sustainability, socio-cultural dynamics and aesthetics.
In this context, it should be said that the effects of high-rise buildings on an urban scale are multifaceted.

3. Material and Methods

The method used in this research involves two approaches. The first is using ArcGIS Pro spatial software analysis and on-site observation methods. The methodology outlined by Schwab (2022) serves as its foundation. With the use of the software's Viewshed and Sun Shadow Volume tools, for the Viewshed analysis, view points have been added to the highest points of the building in each direction (north, south, east,and west). In order to get results, the sun shadow volume used on the building to analyze the cast shadows the building has throughout the seasons, a muiltptach shape of the shadows was created for each hour of the day in each of the four selected dates. In addition To gain a more comprehensive understanding of this case, observations were made regarding visibility and the skyline from various locations and points of view.Combining those two methods, hoped to gain deeper insight into the effects that tall structures have on their surroundings.
Due to the lack of building data about northern Cyprus, models of the context and the building weren't available. As a result, building footprints were obtained and observation of the buildings was made. A 3D model was made using SketchUp software, and that model was imported into ArcGIS Pro. Figure 1 shows the method's steps.

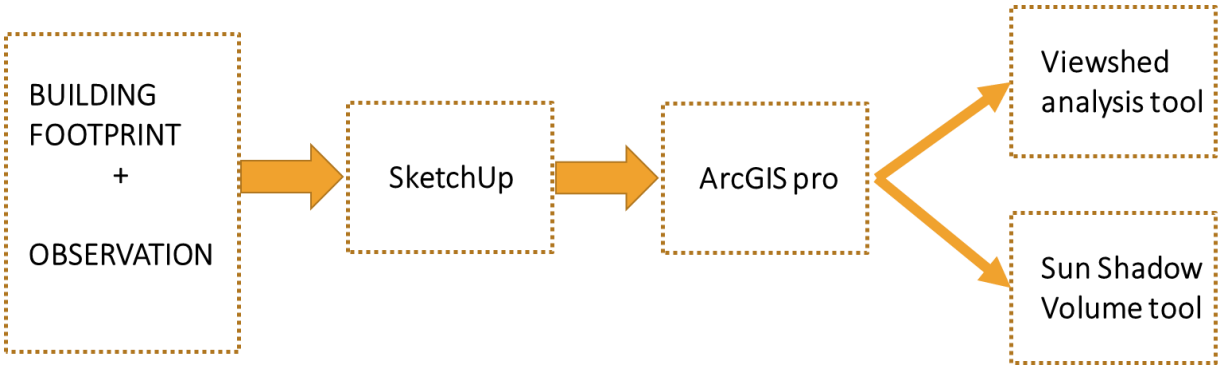

Figure 1: steps followed in the procedure to analyze the data using ArcGIS Pro

4. Results

The building's northern regions had enormous visibility throughout the region, all the way to the Kyrenia Mountains, according to the results of the visibility analysis conducted using the viewshed tool. The terrain of the area and the sparse population of buildings are responsible for the visibility.
As a result, there is high visibility along the main highway connecting Nicosia and Kyrenia as well as the near east university campus located to the east side of the road. Low visbility in some area can be contributed to changes in topography levels which my result in low elevation areas.

Due to the location of the building in a important node in the city and where the keyrian highway meet this node, users coming from the highway have a high visibility of the building.

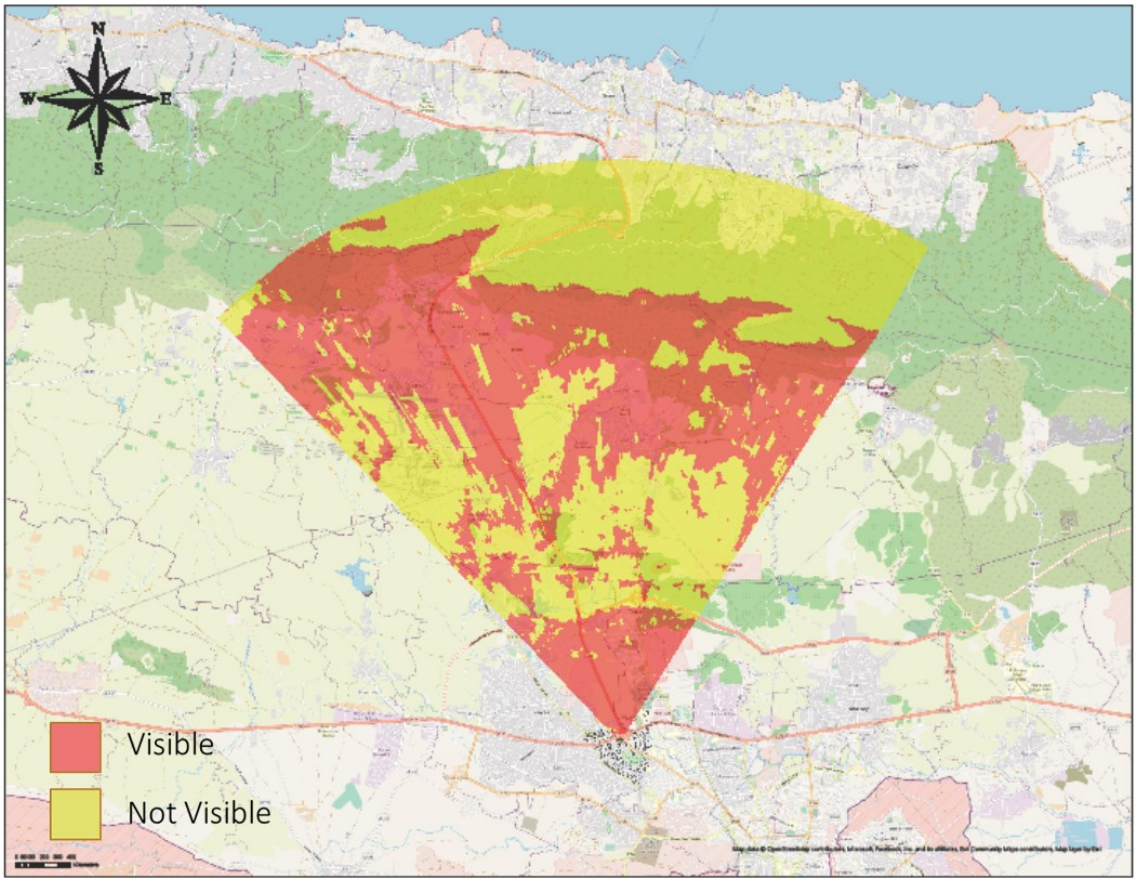

Figure 2: the result of the Viewshed analysis for the northern areas

Observation results for The skyline observation from near East University, At a distance of 1.7 kilometers, the Concorde hotel can be seen prominently dominant in the city skyline of Nicossia. The building can be visible in various distant regions, such as near East University and beyond.

Figure 3: Nicosia city skyline as seen from near east university at a 1.7 km distance

The Viewshed study for the Concorde Tower's south region, the Yenikent region the region can be described as largely low-rise structures with only a few exceptions of high apartment buildings.
Because of the connection between the building and its surroundings, the results reveal considerable visibility in some regions close to the builign, nevertheless high visbility can be seen in the two main highways that connect to the roundabout.

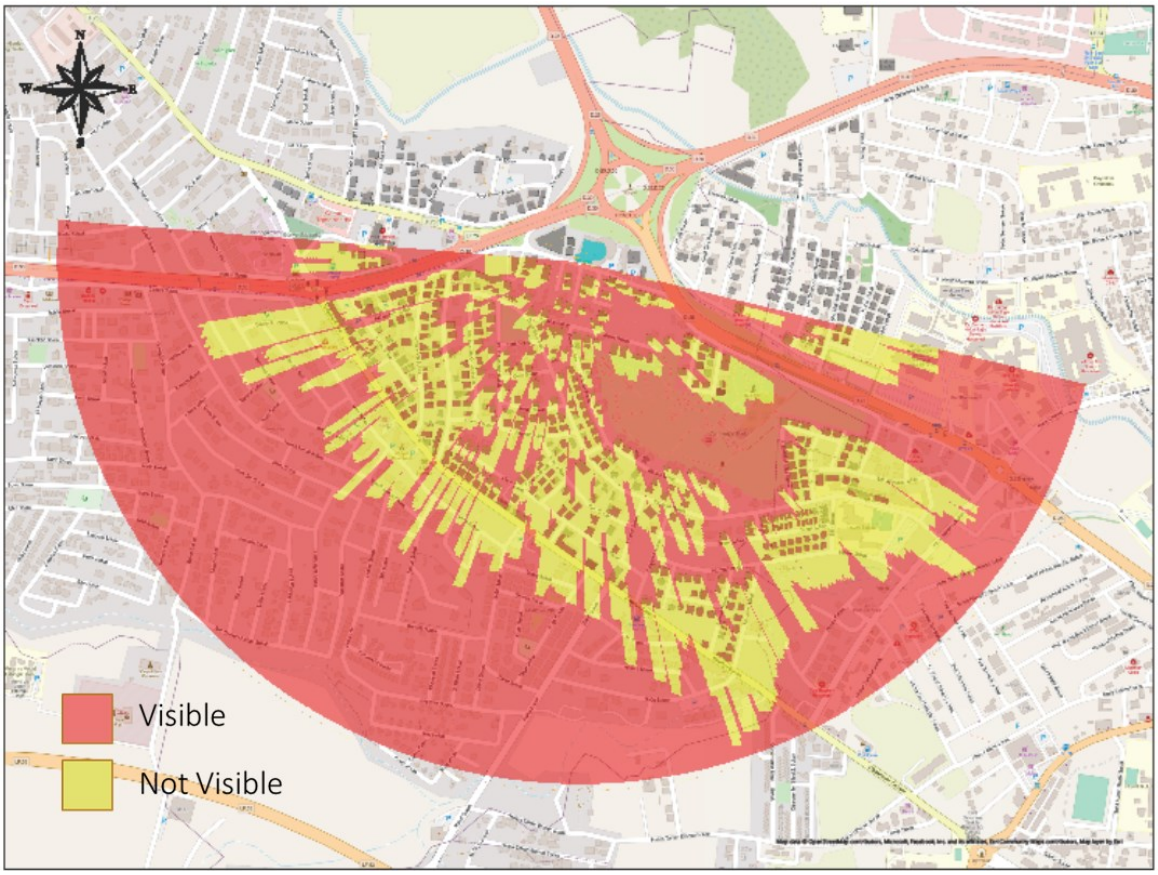

Figure 4: the result of the Viewshed analysis for the southern areas.

The east side visibility analysis display similar results as the south side with moderate visibility frot the buidligns near the rouddabout and high visibility in the two roads that conncet to the roundabout.

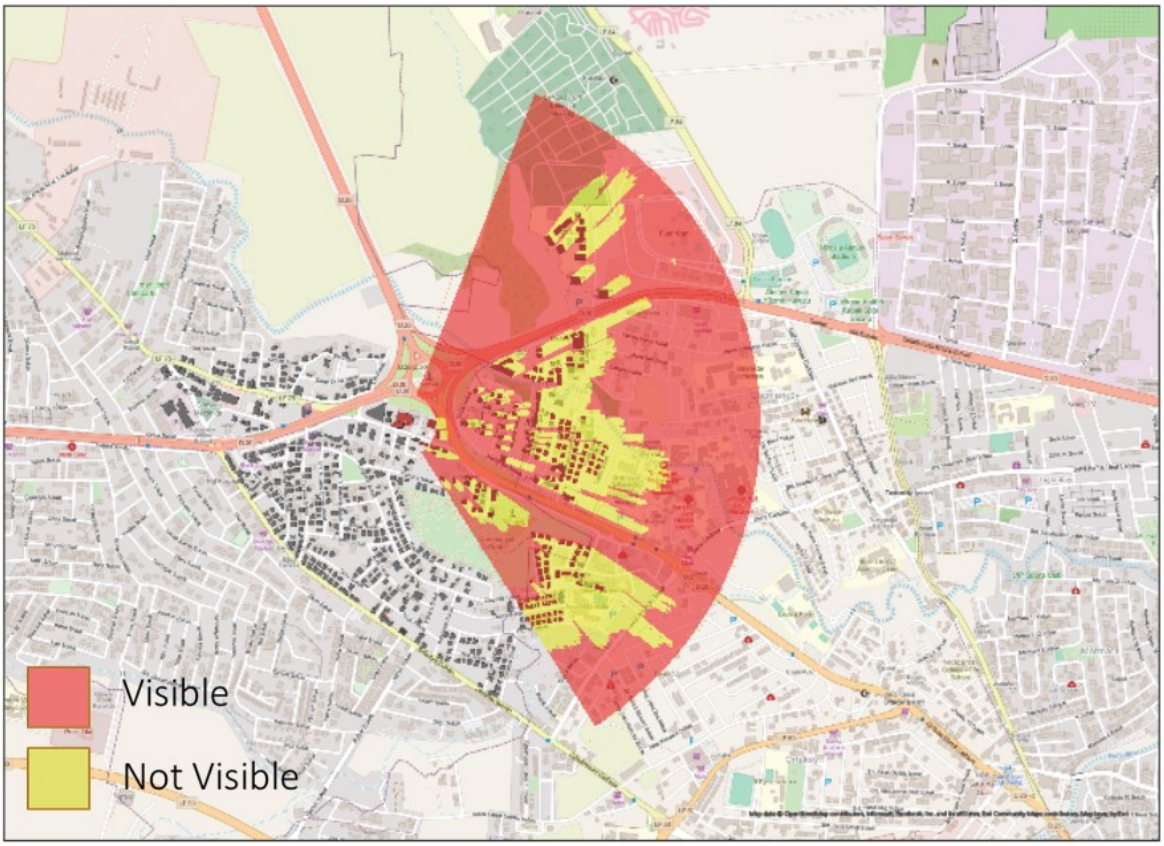

Figure 5: Viewshed analysis results for the east Göçmenköy district.

The west side visiblilyt results shows high amout of visibility along the road and lower levels in the buidligns areas The location of the building and its height effect in tremindsly in the high levels of nisibliyt espeisially in the roads that ends in the roundabout.

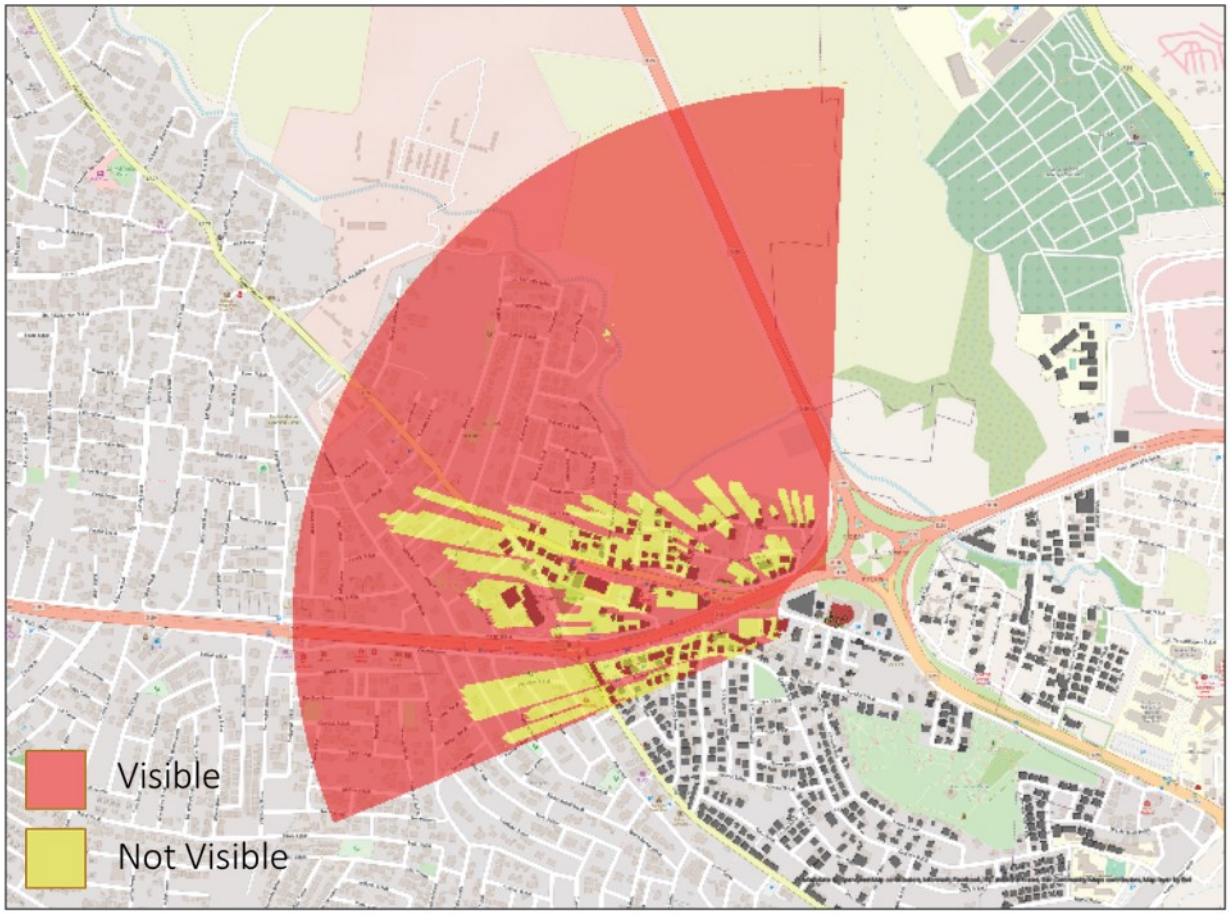

Figure 6: Viewshed analysis results for the West Gonyeli District.

The observation results for the building visibility in the surroudnings areas in 5 difrent locations with various distances the building can be seen domination its surrounding with its massive height and scale.

Figure 7: 5 Views from different locations surrounding the hotel (openstreetmap)

Figure 8: The Concorde Hotel as senn from 5 different locations.

The Concorde Hotel's visibility as seen from an apartment building in the Yenikent area of the of the southern region is highly visible, dominating the skyline of the Yenikent neighborhood.
This result give us an insight of the levels of visibilyt the building can have on a low-rise context.

Figure 9: The Concorde Hotel, as seen from an apartment building in the south Yenikent area.

The tower, as seen from 1.6 km in vacant lands south of Yenikent area, is seen to control the skyline of the region. The tower's dominant size and results of observation show the high level of visibility the tower has on the region.

Figure 10: The Concorde Hotel, as seen from a road at 1.6 km distance.

Figure 11: The Concorde Hotel, as seen from a building in a southeast direction at a distance of 1.1 km.

Figure 12: The Concorde Hotel, as seen from a building in a southeast direction at a distance of 1.1 km.

The solar shadow volume tool's shadow-casting analysis results demonstrate that large shadows are cast across a wide area. During the spring and fall equinoxes, the shadows produce similar phenomena.
These shadows cover a wide range of places, with surrounding structures receiving the most coverage at several hours; also, the west and east streets.

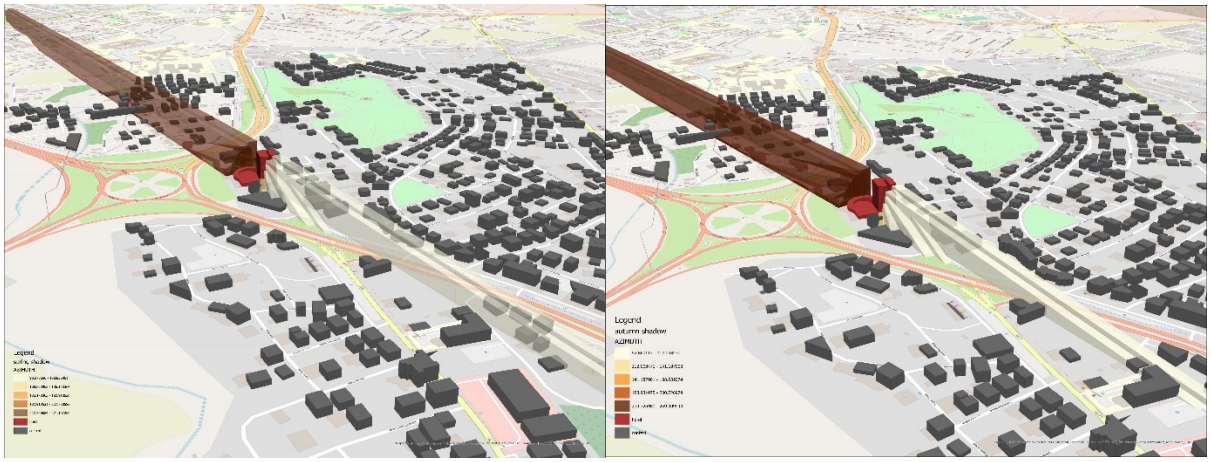

Figure 11: the shadow casting analysis results for autum and spring season

Summer shadow results The shadows seem to have a minimum impact on the adjacent buildings; other surrounding buildings are impacted. No shadows are cast on the west road; in contrast, the east road is affected.

Figure 12: the shadow casting analysis results for summer season

Direct shadows during the winter season affect the empty area in front of the tower, reaching the roads and the roundabout during many hours of the day. with the shortest shadows and the lowest effect on the surrounding.

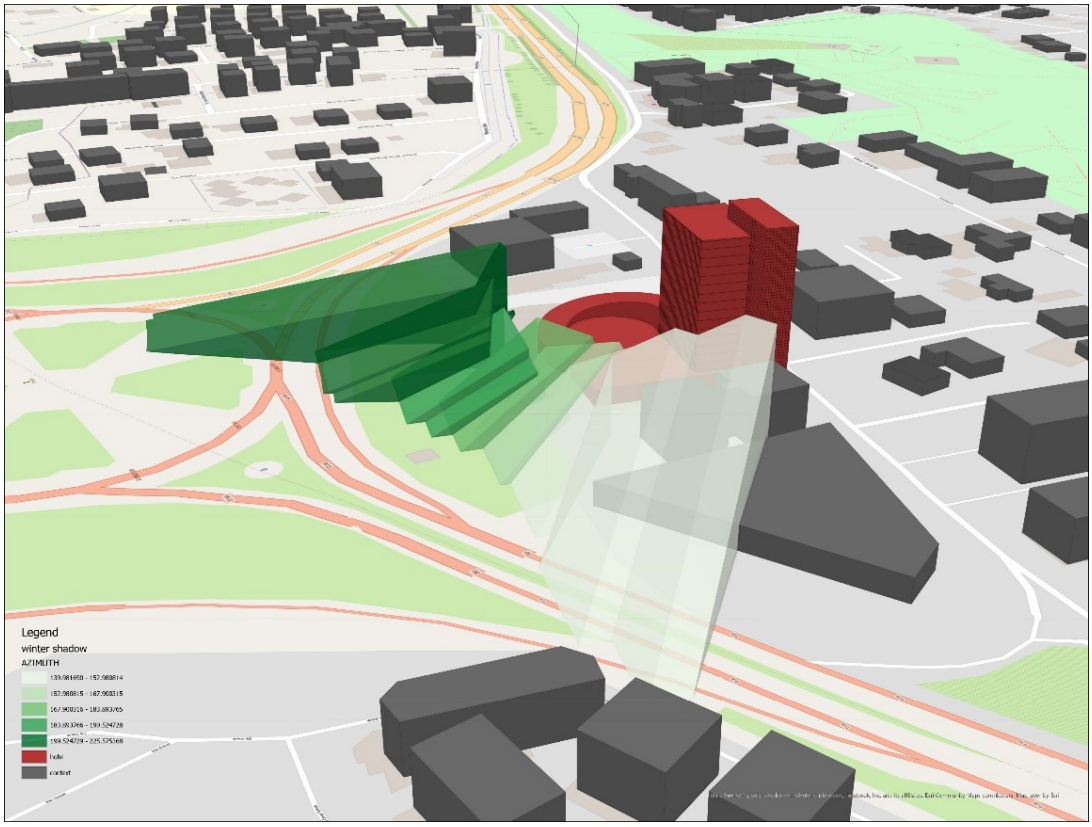

Figure 13: shadow analysis results for autumn season

4. Discussions

The findings of the study highlight the significant visibility impact of high-rise buildings on the surrounding environment, particularly in predominantly low-rise cities like Nicosia. The Concorde Tower is a clear example of how such a building can alter the city's visual dynamics and urban identity.

The visibility analysis results displayed the Concorde Tower as highly visible from various parts of the city, especially from Majour roads and from remote distances.

This level of high visibility can be attributed to the building's extensive scale and its strategic location on a focal roundabout where several important roads join. This dominance of such buildings on the city skyline should raise questions about the construction of high-rise buildings in low-rise contexts.

The building's wide range of visibility from different locations, such as near East University, at approximately 1.7 kilometers away, draws attention to the powerful and dominating presence of the tower. This kind of visibility suggests that high-rise buildings can significantly modify the visual character of any city, potentially overshadowing the historical and cultural landmarks that contribute to the city's unique identity.

The shadow analysis results across different seasons revealed extensive shadows, especially during spring, summer, and fall. Those outcomes emphasize the need for a careful integration and placement of high-rise buildings into the urban fabric. keynotes regarding this case are made:

1. Context-Sensitive Design for high-rise buildigns, high-rises should be designed and implanted to complement and enrich the urban fabric not to dominate and control the city image, this includes considerations of the building height, style and placement.
2. Architects and desingers should assess the visibility of high-rise building from different points of the city, in order to make sure that those new buildings do not dominate or minimize their surroundungs.
3. shadow reduction stratagies should be considered during the design process to minimize the shadow effect of high-rise buildings on their surrounding, this may includes adjecment to the building orentaion, adding setbacks and greenery.

5.Conclusions

In conclusion this study provide us with an insight into how high-rise buildings can effect their surrounding environment, with the results of the concorde tower reveling that high-rise buildings can profoundly effect the visiual landscape and image of the city in a predomnanlty low-rise fabric.

• The building is visible from a great distance, particularly in the northern sections of the road connecting Keyrina and Nicosia, due to the topography and lack of a built-up area. It is situated in the largest roundabout in Nicosia City and at a crucial intersection where four major roads converge.

• The Concorde Tower appears to have a significant impact on the city's skyline, but the historic old city is largely unaffected by this due to their great distance from one another.
• Because of its placement in an area that is regarded as the city's entrance and central hub, the building may be viewed as a landmark. This has the potential to change our perception of and thoughts about Nicosia.
• The shadow study reveals large shadows created in the spring, summer, and fall. Little shadows are cast on the roundabout and the empty space in front of the building throughout the winter.

The tower visibility and shadow effects highlight the need for a nuanced understanding about the placement of high-rise buildings into the urban environment.

Achnologing the context and the landscahpe in the deisgn process of high-rise building and the importance of the involvement of regulations and policymakers in that process.

Effective urban planning and context-sensitive design are essential to mitigate negative impacts on the skyline and public spaces, ensuring that new developments enhance the city's aesthetic and historical character. Balancing modern architectural advancements with the preservation of cultural heritage is crucial for maintaining a harmonious and vibrant urban environment in Nicosia.

References

Samavatekbatan, A., Gholami, S., & Karimimoshaver, M. (2016). Assessing the visual impact of physical features of tall buildings: Height, top, color. Environmental Impact Assessment Review, 57, 53-62.

Amen, M. A., & Nia, H. A. (2020). The effect of centrality values in urban gentrification development: A case study of erbil city. Civil Engineering and Architecture, 8(5), 916–928. https://doi.org/10.13189/cea.2020.080519

Aziz Amen, M. (2022). The effects of buildings' physical characteristics on urban network centrality. Ain Shams Engineering Journal, 13(6), 101765. https://doi.org/10.1016/j.asej.2022.101765

Gün, A. (2023). Urban Design Evolved: The Impact of Computational Tools and Data-Driven Approaches on Urban Design Practices and Civic Participation. Journal of Contemporary Urban Affairs, 7(1). https://doi.org/10.25034/ijcua.2023.v7n1-16

Odunlade, O., & Abegunde, A. A. (2023). Territoriality in Post-conflict Neighbourhoods: Unravelling the Dynamics of Territorial Marks in Ile-Ife, Nigeria. Journal of Contemporary Urban Affairs, 7(1), 69–85. https://doi.org/10.25034/ijcua.2023.v7n1-5

Babazadeh-Asbagh, N, & Uluca-Tümer, E. (2021). Cultural Heritage Interpretation: Proposals for Medieval Churches in Famagusta Walled City, North Cyprus. *Conservation and Management of Archaeological Sites*, 23(1-2), 61-101. https://doi.org/10.1080/13505033.2022.2147681

Bu, X., Chen, X., Wang, S., Yuan, Y., & Han, C. (2022). The influence of newly built high-rise buildings on visual impact assessment of historic urban landscapes: a case study of Xi'an Bell Tower. Journal of Asian Architecture and Building Engineering, 21(4), 1304-1319.

Schwab, V. (2022). Assessing the potential impacts of tall buildings on a predominantly low-rise built urban environment: A case study from Västerås, Sweden.

Danese, M., Nolè, G., & Murgante, B. (2009). Visual impact assessment in urban planning. Geocomputation and Urban Planning, 133-146.

Karimimoshaver, M., & Winkemann, P. (2018). A framework for assessing tall buildings' impact on the city skyline: Aesthetic, visibility, and meaning dimensions. Environmental Impact Assessment Review, 73, 164-176.

Lau, Z. Y., Tan, X. Y., Arab, Y., Hassan, A. S., Dumrongchai, P., and Rakhmatulloh, A. R. (2021). A Study on Kevin Lynch's Urban Design Elements with a Case Study at Taman Seri Juru in Simpang Ampat Town of Penang. International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies, 12(6), 12A6A, 1-13. DOI: 10.14456/ITJEMAST.2021.106

Ross, D.E. (2004). HVAC Design Guide for Tall Commercial Buildings Atlanta. GA: American Society of Heating, Refrigerating and Air-Conditioning Engineers.

Nancy Y. Nugroho , Sugeng Triyadi , Surjamanto Wonorahardjo (2021), Effect of high-rise buildings on the surrounding thermal environment, Building Environment, Volume 207, Part A, January 2022, 108393, https://doi.org/10.1016/j.buildenv.2021.108393

Ali M., & Armstrong P.J. (2008), Overview of Sustaniable Design Factors in High Rise Buildings, pp. 2 – 9

Ozmehmet, E., & Yuksel, Z. (2018, July). Evaluation of High Rise Building Sustainability Performance. In International Joint conference on Industrial Engineering and Operations Management (pp. 127-137). Springer, Cham.