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City skyline conservation: sustaining the premier image of Kuala Lumpur

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Abstract

City skyline is a unique fingerprint and inherent abstract reflecting a city's image and identity in terms of its spatial, historical, social, cultural and economic structures over time. Acting as important components, skyscrapers intend to reflect premier image and status which have promotional and competitive benefits to a city. A rising city like Kuala Lumpur has aimed to improve its global standing through tall buildings and skyscrapers such as Petronas Towers and Kuala Lumpur Tower. The towers were designed to re-imaging the whole city and directly placed Kuala Lumpur on the world map as a world-class city. The city's skyline therefore, is instantly recognizable; distinctive assets which are important to be protected. However, due to improving technology and global city competition, many new tall buildings have been proposed with the intention to replace the iconic role of these two towers. The proposal and construction of these new buildings exceed the allowable maximum height and have given rise to the urge to re-image and re-brand the identity of this national capital city, eclipsing the iconic role of Petronas Towers and KL Tower. The study focused on how the potential impacts of new proposed tall buildings influence the existing Kuala Lumpur skylines. The aim was to investigate the quality and image of city skyline and its transformation due to new high-rise buildings. This research made use of the Geographical Information System (GIS) and its 3D modeling function to construct, assess and analyze the city silhouettes. It also showed that the effectiveness of these techniques for assessing and pre-test tall building proposals depends upon the local context of decision making.

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1. Introduction

In the fast pace of globalization process, Kuala Lumpur having experiencing rapid growth, seems to join the fray for competitiveness with other cities worldwide. The proliferation of physical development ever since Malaysia gained its independence from British occupation over more than five decades ago has never seemed to recede. Surrounded by the rapidly changing economy, based on sectors like technology-intensive production, business and financial services, and a broad range of new industries is rapidly coming to the fore. Much of the large scale urban transformation of this first national capital is greatly visible accompanying the premiership of Tun Dr Mahathir Mohamad [1], where socio-economic forces demand physical expansion from post-colonial setting to ultra-modern and sophisticated skyscrapers that change the overall city's skylines. Currently, researches in urban skyline have not received much attention in the physical planning and always been overshadowed by the need of other statutory spatial planning requirements especially in dealing with rapid growth [2].

Elsewhere in the world's major cities, especially in North America, city skyline is evidently the product of post-1960 boom in skyscrapers [3] which saw urban skyline emulated by tall building constructions that symbolized the signature of city abstraction which collectively represent cultural achievement with respect to accumulation of historical, socio-cultural and economic structure over time [4,5]. Significantly, most cities rhetorical stance embedded the concern of city regional image and identity as "world city" [5,6] with key positive impression to the tourist attraction [7]. Factors in skyline importance are ingrained in the urban function, regional image formation, site characteristic, and competing city's skyline image building capacity, urban design and centrality [3]. These 21st century urbanization trends are ramified in large cities and their surrounding regions. In fact, city-regions have now become one of the essential foundations of the new world order and phenomena of city expansion and growth [8].

In pursuit of becoming the "world city image", competing city's local authorities and mayors are becoming sensitive to plan responsibly for city growth to reflect this world premier city status as a stable global capital that balance economic gain and culture simultaneously. Impressive urban image and managed skyline consequently becoming very vital in planning and design. Many researchers in the cognitive and phenomenal paradigm in contemporary urbanization processes indicated that people share certain consensuality among their image of a certain location. Visual image relates intimately with mental image that retained in memory which in turn contributed to the environmental meanings in the evaluation of city image and sense of place [9]. This information leads to city planners and policy makers open to apparent new dimension in finding solutions to deal with the many threats and opportunities faced by cities in the current conjecture.

Experts and researchers in their seminal works in the concept of sense of place expediting intimate relationship between people and their surrounding or environmental setting [10,11,12]. Tuan [10] elaborated that the built environment is of equal importance as the natural environment in defining the character of a setting. He indicates that the Manhattan skyline symbolized and represented the city New York as a whole. Similarly, St. Louis Arch, Boston Commons, and Brooklyn Bridge are notably famous for their aesthetic dominance, but also because they respectively symbolize a gateway to the West, a sacred portion of the community, and the transition from one place to another. Tuan [10] further noted that how cities of European and Asian origin, posed a sense of mystery, the extent which visitor emotionally imagine the delight within the city center from the outside. The symbolic construction of the image of a place is commonly analyzed from two different perspectives: the insiders and the outsiders. For insiders (i.e. local residents), sense of place develops through everyday experiences in familiar settings. For outsiders, city image and sense of place are often particularly vague, abstract and simplistic. Such images are, however, important because they help people to make generalizations and finally decisions regarding, for example, their investments, residential locations or holiday destinations.

Due to the improving technology and global city competition, the dynamic growth of Kuala Lumpur city witnesses the increase in the number of high rise buildings. The urbanization of Kuala Lumpur exerts the new image and sign of the city with re-branding features such as the 452 meter Petronas Twin Towers in 1998 which stands out above all so far built by man, together with the Kuala Lumpur Tower or KL Tower (421 meter) in 1996. Petronas Towers in Kuala Lumpur City Centre and KL Tower in Bukit Nanas are two landmarks in the heart of the Golden Triangle of Kuala Lumpur; the iconic symbols that are synonymous to the city of Kuala Lumpur and Malaysia. These two landmarks located in the most strategic commercial district have been an evidently important symbol of pride and achievement. The phenomenal nuance of geometry and conical spires of Petronas Towers for instance,

representing Kuala Lumpur city skyline the wonder of global architecture molded in truly Malaysia form and soul [13]. These towers are a national landmarks denoting richness of cultural cornucopia of a corporate capital [14].

Against this backdrop, the study aimed at protecting the visual primacy and symbolic of the silhouette of these two giant landmarks. This paper also outlines the several analyses for skyline conservation and visual impact assessment of skylines in Kuala Lumpur. It illustrates the use of 3D visualization and analytical function in GIS for mapping, analysis and evaluating the prediction of newly proposed high-rise buildings' impact towards city silhouettes. The findings from the 3D model are discussed and also proposed further recommendations in the context of introducing planning criteria in order to sustain the premier image of Kuala Lumpur city skylines.

2. A glimpse of Kuala Lumpur skyline and its urban dynamism

Built heritage dated back to the mid-19th century. Evolving from a small mining town, since 1857, at the confluence of two rivers, Klang and Gombak River, Kuala Lumpur turned to a vibrant modern city. Much of the built environment owed it to the colonial powers mainly British, elaborated by 19th century buildings of Islamic heritage Mughal and pre-World War II shop houses which were the heart of retailing and other businesses. With the advantages of the economic boom and improving technology, dozens of further gigantic buildings have appeared [15], and much of the city skyline has changed with large scale urban development frames the cityscape [16]. The increase in the number of high-rise buildings in Kuala Lumpur has been dramatically altered from low and horizontal cityscape to vertical and spectacular skyline with two major iconic skyscrapers, the identical Petronas Towers and KL Tower (Fig.1). Envisioning Malaysian modernity, these two skyscrapers reflects the mood of optimism, towers of strength, fostering of a sense of world recognition of national achievement [1] and can be seen in Kuala Lumpur iconic skyline from the periphery areas.

Fig. 1.Panoramic view of Kuala Lumpur city centre [17].

However, in the wake of booming economic factors, this national capital city continues to evolve each day. The increase in land and property values, and a desire to maximise profits, associated economic revitalisation accompanied by pressure to re-image, reposition and re-brand the identity of the city have resulted in ever new taller buildings being proposed leading to growing concern about their potential impact on the city fabric and its skylines [18]. Currently, there are approximately 40 high-rise buildings been proposed and under construction from 2008 to 2013 in Kuala Lumpur city centre area [19]. This paper explores the current tall buildings phenomenon and only emphasizes on four new proposed high-rise buildings (Table 1) which seems to potentially immerse the image of two eye-catching and spectacular towers in Kuala Lumpur skyline and its visual cue. A desire by certain parties to attract new tall buildings as new tangible symbols and landmarks trigger the concern over the impact of such buildings on existing city skyline and its image and character.

Table 1. The new proposed high-rise buildings in Kuala Lumpur city centre area [19].

Name of the proposed building	Usage	Height (meter)	Number of floor	Building status	Construction start	Year of completion
Warisan Merdeka Tower	Residential/Office/Hotel	600	118	Final approval	October 2013	2015
Four Seasons Place Hotel	Hotel/Condominium	320	65	Under construction	2012	2016
Ilham Baru Tower	Office/Residential	298	62	Under construction	2010	2014
Tun Razak Tower	Office	-	40	Existing (Renovation)	2010	2014

3. Efforts in conserving Kuala Lumpur skyline

In a world where globalization has led to certain homogeneity in the appearance and character of major cities across the world, it is imperative that Kuala Lumpur seeks to define its own distinctive identity. Therefore, in 2008, the Physical Planning Department of Kuala Lumpur City Hall has initiated Draft Kuala Lumpur City Plan 2020 (DKLCP 2020) which lays a series of goals and policies to achieve economic, social and environmental development concurrently. One of the five main goals is, creating a distinctive city identity and image. Under this particular goal, as a fast developing city, it has to define its image and identity to ensure that visual heritage is conserved and all new developments within the city reflect greater awareness towards urban design excellence that shapes a local distinctiveness [16].

The department which responsible for providing, maintaining and implementing plans for Kuala Lumpur's development commenced a control plan which called KL Development Control Plan (KLDCP) as part of the provisions of the DKLCP 2020 and prepared under the provisions of Section 13 of the Federal Territory (Planning Act 1982 (Act 267) [20]. The plan has provided guidelines on how to structure and improve the city skyline such. Height Control Zone which refers to additional overlays of control on heights of new buildings that falls within the designated height control zones in Kuala Lumpur and are imposed on the areas located within Petronas Twin Towers and KL Tower view corridors, and areas located within designated historical zones. Allowable heights for all areas in are guided by General Allowable Height Plan (GAHP) which serves as guide for any new development within Kuala Lumpur with the intention of developing a city skyline and profiles that accentuate the city centre as central area and the surrounding areas as edges to the city with major landmarks buildings in the city centre being the focus of vistas and views. Fig. 2 (a) shows the overlays of GAHP on area of interest whereby the Petronas Towers act as the core, highest point and peak of the city centre. Variation in heights between several towers and podium within a development can be allowed as long as they do not exceed the allowable plot ratio and the maximum allowable heights indicated in the GAHP.

One of the new threats to GAHP ruling is a 118 storey Warisan Merdeka Tower proposed within the Heritage Height Control Zone where the allowable height must not exceed than 30 storeys (120 meters). This new tower will be the tallest structure in the country once completed, eclipsing the iconic Petronas Twin Towers and KL Tower. Many concerned citizens have denounced this proposed construction as they voiced their fears that the Warisan Merdeka project would open up a few heritage sites to commercial development in the future [21]. With this controversial project, it suggests that lack of enforcement of GAHP directly leads to negative impact on visual quality and integrity of Kuala Lumpur skyline whereby visual and identity blight.

4. Visualizing and analyzing the effects of high-rises in a GIS

This paper seek to shed light on the city as a locality or a place with distinct characters built with sense of place and the interplay with human culture for the successful and practical skyline conservation process. Firstly, in order to justify proposed intervention to promote distinctiveness through skyline conservation, it is necessary to establish the practical methodology of skyline quality measurement. The following methodology has been adopted to facilitate the conservation process of city skyline in sustaining the premier image of Kuala Lumpur city centre. A 3D city model has been specially constructed (refer to Fig. 3 for detailed processes).

Worldwide, 3D city models have been developed and used for a very wide range of applications, mainly for the visualization and exploration of cityscapes especially in urban planning and management application [22,23]. The virtual 3D representations, assist the impact estimation of planned changes at designed and proposed area in the context of the existing situation [24,25]. Based on this 3D digital city model which allow visualization from any angle, direction or zoom level, several scenes of Kuala Lumpur skyline which reflected the status quo, and with the proposed new high-rise buildings were modelled. In this virtual city model, the 3D simulation for visual impact assessment was conducted by customizing ArcGIS Desktop 10. The 3D Analyst extension was utilized in order to convert the Kuala Lumpur city centre map in 2D into 3D models. In this study, 3D visualization functions and 3D analytical tools were employed. 3D visualization, as shown in Fig. 2 (b) facilitates graphic presentation of the GAHP, such that buildings in violation can be marked. In contrast, 3D analytical tools support the visibility analysis

which can examine whether the target area is viewable from viewer observation point (i.e. line of sight analysis) and to identify the coverage of visible areas from a point of observation (i.e. viewshed investigation).

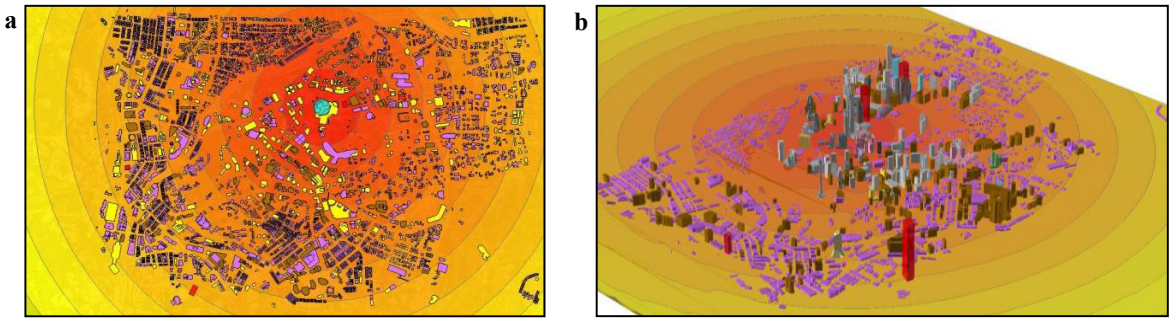


Fig. 2. General allowable height plan (a) in 2D representation map of Kuala Lumpur city centre; (b) visualization of GAHP with existing and proposed buildings in three-dimensional format.

This paper focused on the impact of new proposed high-rise buildings at Kuala Lumpur city centre which can be envisaged using 3D digital simulation and visualization. The study area was limited to the central business district at the heart of Kuala Lumpur city centre with the Petronas Towers act as the core of study area. All existing buildings located at Kuala Lumpur city centre are digitized to the actual form and height so that 3D city visualization can be performed. Depending on the view point and the viewing direction, the visualization of all proposed new buildings visual impact with existing city skyline can be systematically shown against the silhouette and visual prominence of the Petronas Towers and KL Tower.

4.1. Data collection

The most vital stage in this study was collecting the suitable 3D GIS data with sufficient location and elevation accuracy. To create 3D city model for Kuala Lumpur, both spatial and non-spatial data were used. The 3D visual representation of Kuala Lumpur city centre is a compilation of a digital terrain model with an orthophoto image and three-dimensional features i.e. buildings and towers. A series of digital orthophoto image of Kuala Lumpur dating 2010 were obtained from the Survey and National Mapping Department of Malaysia to provide a realistic setting for city skyline profiles. The data originally was derived with the 2D coordinate system of World Geodetic System (1984) and then was transformed to Malaysia Rectified Skew Orthomorphic with datum of Kertau 1948. The digital terrain model (DTM) was also acquired from the Survey and National Mapping Department in ascii file format (*.txt*) which contains 2,166,795 ground points whereby each point comprises longitude (x), latitude (y), and altitude or height (z) data. The DTM offers the most common method for extracting topographic information and provides significant information for many research activities such as, urban planning and urban design, 3D city modelling, and viewshed analysis [26]. Using these point data, the three-dimensional triangulated irregular network (TIN) was created in ArcMap and displayed in ArcScene. The TIN which own terrain elevations for ground position was used as a 3D elevation surface from this point on.

The Physical Planning Department of Kuala Lumpur City Hall (KLCH) provided the building footprint and storey height data in ‘Computer Aided Design (CAD)’ format. Although ArcGIS has a specific extension for the import of CAD data, there are some differences between GIS and CAD data structure, thus made it compulsory to customize the imported data as GIS vector data model. Apart of it, the high-rise buildings database in the study area were also derived and constructed based on Emporis, a worldwide free-to-use tall buildings database [19]. Among 3D buildings information gathered were attributes of the construction years, location, status, height, number of floors, and building usage.

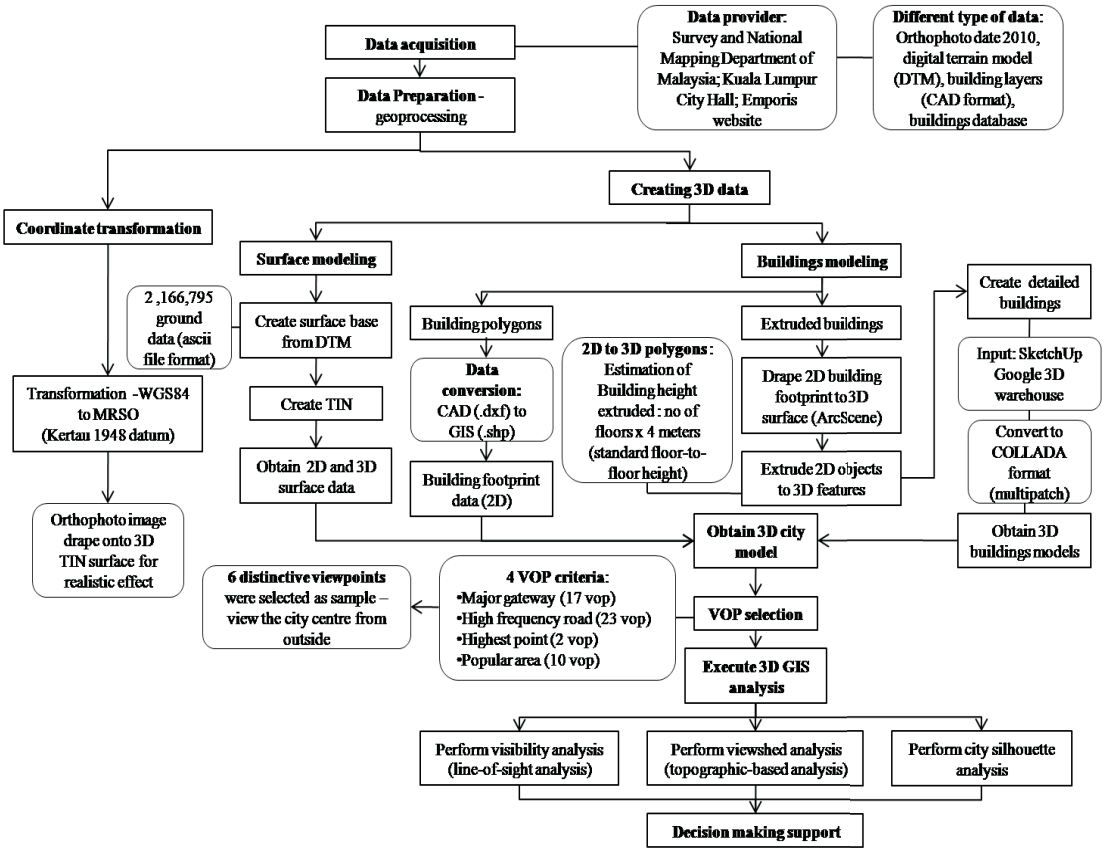


Fig.3. Methodology diagram of the Kuala Lumpur city skyline study scenario.

4.2. Data compilation and preparation of 3D cityscape

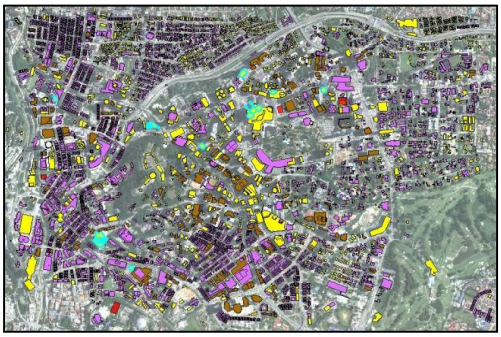
3D models of buildings were created in two different methods, in which all buildings with height less than 100 meters were generated in polygon layer and vector format, whereas the others as 'COLLAborative Design Activity (COLLADA)' model. The process of 3D city model creation started in ArcMap with overlaying a building layer (polygons) over an orthophoto image of Kuala Lumpur (Fig.4). The building layer was categorized into three different groups of building height. These structures were then shaded in different colours to mark their difference characteristic depending on building's height group; for example buildings with less than 40 meters in height are purple-coloured, 41 meters to 100 meters are brown, and more than 100 meters above ground level are yellow. The red-coloured polygons depict the proposed new buildings within Kuala Lumpur city centre. The prominent landmark buildings and towers exceeding 300 meters in height were identified because these towers and skyscrapers would be the primary features in assessing their visual prominence and impacts in the Kuala Lumpur's urban scene.

Subsequently, in ArcScene, the 2D building data layers for the area of study were added and draped onto the 3D TIN surface and Orthophoto image by defining their base height as the TIN itself. Then, the flat 2D building data were extruded to 3D objects using the building height attribute data (i.e. storey number by a standard floor-to-floor height of 4 meters) in sequence to generate the 3D data of the buildings. Since the low-rises barely change skylines of Kuala Lumpur city centre, the 3D building models in group of height less than 40 meters were removed from the 3D city model of the area of interest. To obtain the realistic effect of buildings in terms of shapes and forms, a detailed modelling approach was selected for several high-rise buildings existing in Kuala Lumpur city centre such as the Petronas Towers (452 meters), KL Tower (420 meters), and Maxis Tower (212 meters) etc. Then, the detail 3D buildings were visualized in overall silhouette with different colour based on its location. The easiest way to get the realistic 3D models of high-rise buildings was downloaded from 'Google 3D warehouse', exported as

Multipatch features, and then replaced the old geometry generated as extruded buildings with these SketchUp and COLLADA models via ArcGIS Desktop 10 software package [26]. The verification of detailed buildings' location, orientation and height has been implemented with the solid models which have been derived from KLCH and extruded the height information obtained from the Emporis database.

A 3D city models suggest a closer resemblance and visual experience of the location, represents and enhances visualization of the 3D landscape and its associated features i.e. buildings, structures, vegetation etc., and also the true simulation of reality [7,26]. 3D visualization functions were used to create a 3D urban scene of the Kuala Lumpur city centre with prominent landmark buildings i.e. Petronas Towers and KL Tower.

a



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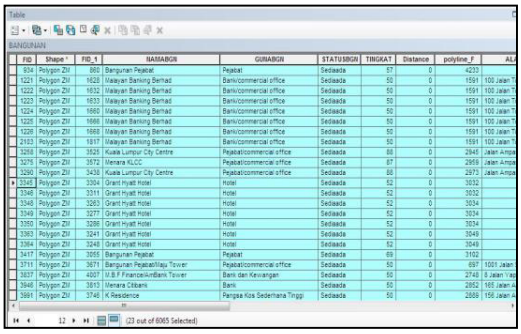

FID	Shape *	FID_1	NAMABGN	GUNABGN	STATUSBGN	TINGKAT	Distance	polyline_F	ALA
934	Polygon ZM	860	Bangunan Pejabat	Pejabat	Sediada	57	0	4233	
1221	Polygon ZM	1628	Malayan Banking Berhad	Bank/commercial office	Sediada	50	0	1591	100 Jalan T
1222	Polygon ZM	1632	Malayan Banking Berhad	Bank/commercial office	Sediada	50	0	1591	100 Jalan T
1223	Polygon ZM	1633	Malayan Banking Berhad	Bank/commercial office	Sediada	50	0	1591	100 Jalan T
1224	Polygon ZM	1660	Malayan Banking Berhad	Bank/commercial office	Sediada	50	0	1591	100 Jalan T
1225	Polygon ZM	1666	Malayan Banking Berhad	Bank/commercial office	Sediada	50	0	1591	100 Jalan T
1226	Polygon ZM	1668	Malayan Banking Berhad	Bank/commercial office	Sediada	50	0	1591	100 Jalan T
2123	Polygon ZM	1817	Malayan Banking Berhad	Bank/commercial office	Sediada	50	0	1591	100 Jalan T
3266	Polygon ZM	3525	Kuala Lumpur City Centre	Pejabat/commercial office	Sediada	88	0	2945	Jalan Ampa
3275	Polygon ZM	3572	Menara KLCC	Pejabat/commercial office	Sediada	87	0	2959	Jalan Ampa
3290	Polygon ZM	3438	Kuala Lumpur City Centre	Pejabat/commercial office	Sediada	88	0	2973	Jalan Ampa
3345	Polygon ZM	3304	Grant Hyatt Hotel	Hotel	Sediada	52	0	3032	
1346	Polygon ZM	3311	Grant Hyatt Hotel	Hotel	Sediada	52	0	3032	
3346	Polygon ZM	3263	Grant Hyatt Hotel	Hotel	Sediada	52	0	3034	
3349	Polygon ZM	3277	Grant Hyatt Hotel	Hotel	Sediada	52	0	3034	
3350	Polygon ZM	3286	Grant Hyatt Hotel	Hotel	Sediada	52	0	3034	
3363	Polygon ZM	3241	Grant Hyatt Hotel	Hotel	Sediada	52	0	3049	
3364	Polygon ZM	3248	Grant Hyatt Hotel	Hotel	Sediada	52	0	3049	
3417	Polygon ZM	3055	Bangunan Pejabat	Pejabat	Sediada	69	0	3102	
3711	Polygon ZM	3671	Bangunan Pejabat/Maju Tower	Pejabat/commercial office	Sediada	55	0	697	1001 Jalan
3837	Polygon ZM	4007	U.B.F Financial/Bank Tower	Bank dan Kewangan	Sediada	50	0	2749	8 Jalan Ia
3846	Polygon ZM	3813	Menara Citibank	Bank	Sediada	50	0	2852	165 Jalan A
3881	Polygon ZM	3746	K Residence	Pangsa Kos Sederhana Tinggi	Sediada	50	0	2869	156 Jalan A

(23 out of 6065 Selected)

Fig. 4. (a) The Kuala Lumpur city centre with three different groups of building height and landmark buildings highlighted; (b) List of buildings taller than 100 meters, extracted using GIS query function.

4.3. Viewer Observation Points

Skylines are an experience and provide knowledge for all viewers who have access to them, and the significant viewing places are location where people congregate because the viewing place must be publicly accessible, visible, easy access and have unlimited distance view [26,27]. Ideally, KLDCP recommended that visual access from to the prime elements must be identified, preserved at status quo or enhanced by providing additional view corridors. The aims are to allow visual permeability from the outer city into the inner and city centre, enhance the sense of arrival for those entering the city, as well as enabling the city appreciation. Hence, the best locations for publicly accessible of viewer observation points (VOP) have been carefully selected to show the effects of the scenario. In this study, there are 52 VOPs were determined through initial desktop study surrounding the study area that form the bases of preservation of views towards two main landmarks i.e. Petronas Towers and KL Tower. However, after ground truthing, only six were carefully selected based on four criteria in which two major landmarks is clearly visible, mainly i) major gateways; ii) high frequency road; iii) the highest point; and iv) popular area as very significant viewpoints for the purpose of this study. The scenes represent Kuala Lumpur skyline that can be viewed and compared from outside city centre in order to discover the changes in the overall silhouette before and after new proposed buildings were erected.

4.4. Analysis in 3D

ArcGIS Desktop offers several analysis tools which includes qualitative and quantitative analysis of visual impact assessment. The 3D Analyst extension in ArcMap and ArcScene is very useful in this regard. Viewshed and line of sight analysis were executed in order to study the spatial transformation and relations created due to high rise buildings. Viewshed and visibility study allows identification of visible area or target objects within its view corridors from designated viewer observation points. The visible planes have been calculated based on TIN surface and 3D building models of study area. Fig. 5 (a) shows the result of the viewshed analysis from all six VOPs which the visible areas are highlighted in green colour whereas the red depict invisible areas. The visible areas were developed based upon the average person's height which is 1.6 meter above sea level. From this analysis, the extents

of visibility of two important landmarks were well-exposed places for future possible visual value conservation and improvement.

Line of sight analysis in ArcScene calculates the visibility along the sight line from observer point to the target object. This tool can be quite efficient in marking the tall buildings if whether they obstruct any view corridors leading to a specific route, to an open space and greenery, to a waterfront, to a heritage building or hinder any wind corridors [28]. For this matter, the tool permits visibility test of each line generated from the perspective of 1.6 meter tall observer towards Petronas Towers and KL Towers which act as specific target objects for viewing. The visibility between all six viewpoints and target features is not established if one or more obstacle exists along the line of sight. Fig. 5 (b) demonstrates the result where the green lines showed that both prominent landmarks are still visible although after new proposed high-rise buildings were erected. Given the General Allowable Height Plan as explained in Fig. 2, we can also identify the existing and new proposed buildings that have violated and infringed the maximum height limit. For future planning and management, the line of sight analysis has imperative potential in recommending and enforcing building height limit as many new proposed buildings are expected to develop in city centre area.

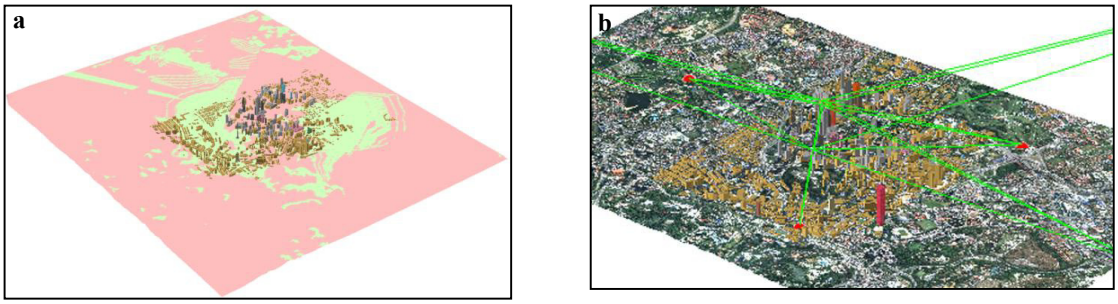

Fig. 5. (a) Viewshed analysis of Kuala Lumpur city model, (b) line of sight analysis in ArcScene.

Further analysis regarding Kuala Lumpur city profile was also conducted where the city silhouettes were extracted via 3D mapping and modeling, and visualization functions of GIS. The 3D city model supports this analysis by facilitating a perspective view of study area. As many researchers have employed this advantageous approach, the 3D city skyline visualization offers the best utilization in decision support processes due to its efficiency and effectiveness [7,26,28]. Fig. 6 (a-f) illustrates the scenarios of both existing and future of Kuala Lumpur skylines with new proposed building models (in red-colored model) from selected identical viewer observation points. Both temporal skylines were visualized and compared to determine the change in the overall silhouette. The alteration of the specific skyline due to high-rise buildings has been obtained and revealed.

Displaying the synthetic new proposed tall buildings, the skyline effect in study area and the way it alters the existing silhouette have to be examined. Hence, the intimidation towards city's skylines such as the visibility of new high-rises in Kuala Lumpur, for instance from major gateways have probability of being thwarted. The existing landmarks which had been Kuala Lumpur icons and identity for years therefore can be displayed more effectively and the visual impact of newly proposed and developed constructions can be considered to be intrusive of the Kuala Lumpur skyline. The changes and impact of proposed new building such as Warisan Merdeka Tower as illustrated in Fig. 6 (b,d,f) shows the potential of such skyscrapers to dominate and take over the role of Petronas Towers and KL Tower as new place marker and sky portal of Kuala Lumpur and Malaysia.

Fig. 6 (a,c,e) displays the view of existing Kuala Lumpur silhouettes from three viewpoints, Ampang Hill lookout, gateway from East coast Malaysia Middle Ring Road 2, and Sungai Besi North-South Highway. The two major landmarks, Petronas Towers and KL Tower were instantly recognizable as these two prominent and iconic spires sculpting and rise on Kuala Lumpur city skyline. The existence of the towers against surrounding buildings assign spiritual and civic role, as well as suggest the true character and image distinctively of this capital city of Malaysia. assign spiritual and civic role, as well as suggest the true character and image distinctively of this capital city of Malaysia.

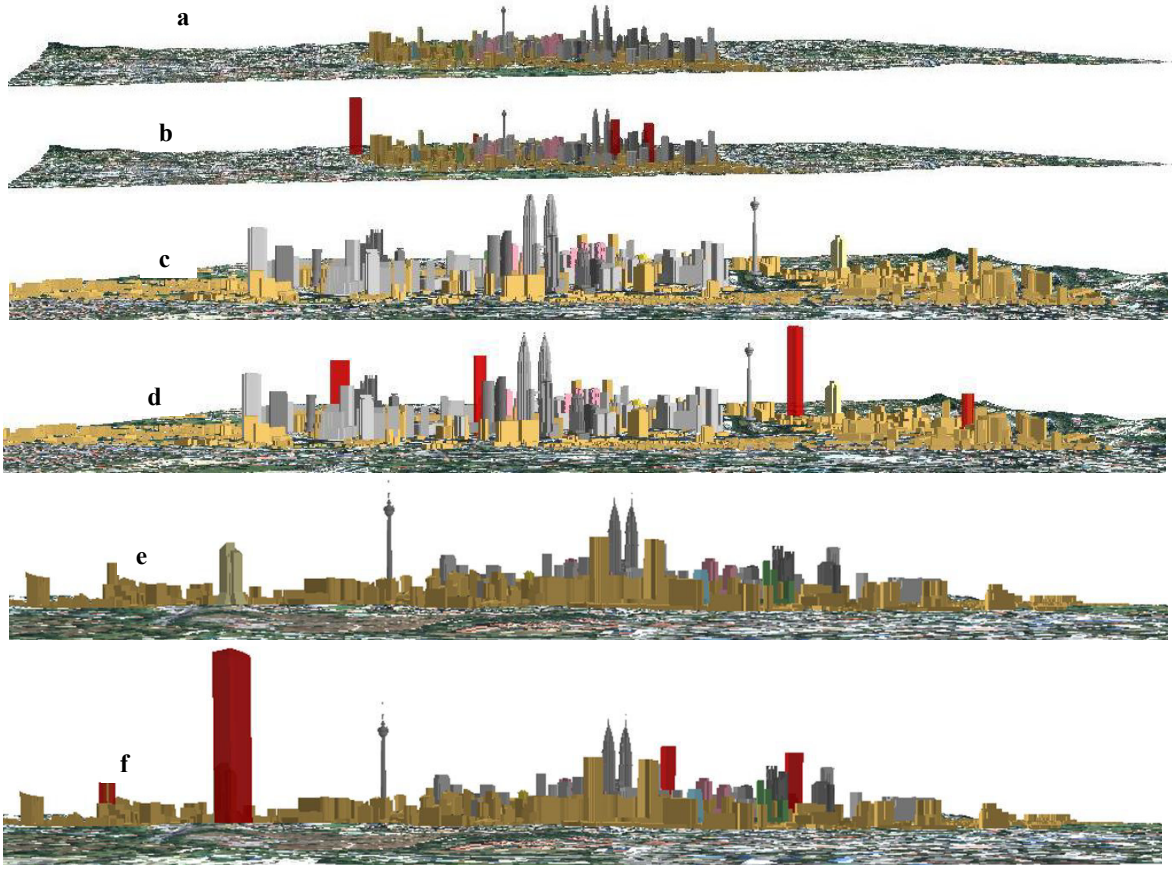

Fig. 6. Existing Kuala Lumpur skyline from the viewpoints on (a) Ampang Hill, (c) gateway from East coast Malaysia Middle Ring Road 2, (e) Sungai Besi North-South Highway; (b,d,f) Kuala Lumpur skylines with newly proposed building from identical viewpoints, respectively.

Fig. 6 (b,d,f) on the other hand highlights the newly proposed high-rise buildings in red color along with the existing city centre silhouettes. It is apparent that the newly proposed buildings are obviously obtrusive to the integrity of the existing image and character of Kuala Lumpur's skyline. These buildings would likely change people's spatial perception and mental map memory of Kuala Lumpur city centre which eventually will exert new image and concealing the existing role of Petronas Towers and KL Tower

5. Conclusion and Recommendations

This research has revealed that the need for efficient approach to preserve and sustain the premier city identity and image is vital. In assessing new development proposals especially for high-rise buildings and skyscrapers, the local authorities should utilize an array of assessment and decision support tools in their decision making processes. The application of 3D GIS explained here can be a preliminary step. The effectiveness of techniques for regulating and assessing the tall buildings proposals, for decision making and support system will aid the better urban planning in Kuala Lumpur where skyline is of primary concern. GIS technologies evidently commit as efficient paraphernalia which carry significant potentials for urban planners and decision makers in planning, mapping, managing the new high-rises that are unusual to the specific physical setting and the uniqueness of city profiles that can be developed,

tested and assessed. The analysis performed also carry imperative potentials for future stages of the research in terms of evaluation and enrichment of urban aesthetics and visualization**,** and testing of proposed new high-rises over the city silhouette. The interpretive and predictive study may be useful where any new developments can be virtually superimposed within their surrounding and exhibit them as a whole whilst being perceived from various distances. Thus, the future research will concentrate on visual threshold carrying capacity by superposing Kuala Lumpur City Plan and discuss their consequences on city silhouette using GIS.

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