Beyond Form And Symbol: Spatial Position and The Landmark Potential of Popular Monuments, A Visibility Graph Analysis of Tugu Maung In Bandung

Restu Minggra[1*], Try Ramadhan[2], Agara Dama Gaputra[3], Aldissain Jurizat[4], Nitih Indra Komala Dewi[5], Dian Fitria[5]

[1,3,4,5,6]Architecture Study Program, Faculty of Engineering and Industrial Education, Universitas Pendidikan Indonesia, Bandung, Indonesia
[2]Architectural Engineering Education Study Program, Faculty of Engineering and Industrial Education, Universitas Pendidikan Indonesia, Bandung, Indonesia
* Corresponding author:
Email: rminggra@upi.edu

Abstract.
Tugu Maung is a series of uniformly designed popular monuments placed on roundabouts, intersections, and traffic islands in Bandung, Indonesia, as gateway markers of the old city district. Because the design is identical across sites, spatial position becomes the distinguishing factor between them, yet the visual performance of each site has not been measured quantitatively. This study measures and compares the visual performance of twelve Tugu Maung sites (TM1–TM12) in terms of visual integration, visual connectivity, and intelligibility. A quantitative-descriptive approach with a comparative multi-case strategy was applied through field surveys and Visibility Graph Analysis (VGA) simulation in depthmapX. Values at each monument (selection) were compared with the value distribution of the entire simulation area (attribute), allowing sites with different area sizes and shapes to be compared on equal terms. The results show that eleven of the twelve sites have visual integration above the simulation-area mean, with the highest normalized ratios at TM8 and TM11, whereas TM1 and TM2 on the northern entry corridor, screened by dense vegetation, have connectivity below the area mean despite their designated gateway function. Intelligibility (R^2) ranges from 0.542 at TM5 to 0.955 at TM3 and does not always coincide with the visibility of the monument point, yielding three patterns: highly visible sites in intelligible areas, locally prominent sites in less intelligible areas, and sites with limited visibility despite intelligible surroundings. The findings indicate that the capacity of popular monuments to function as urban markers is also related to spatial position, in addition to form and symbolic meaning; for urban users, spatial position works through visibility and orientation.
Keywords: *Tugu Maung, popular monument, space syntax, visibility graph analysis, intelligibility and landmark.*

I. INTRODUCTION

Tugu Maung in Bandung was built on the initiative of the Bandung City Government in late 2017 and introduced to the public in early 2018 as a symbol of the guardian of the city [1]. Each monument carries four white maung (tiger) statues facing the four cardinal directions (Fig. 1). The same design was replicated at twelve roundabouts, intersections, and traffic islands from the Jalan Dr. Setiabudi corridor in the north to Tegalega in the south. Within the old city arrangement program, the twelve sites function as gateways to the heritage district [2, 3]. The gateway function requires each monument to be recognizable by road users approaching from various directions, whereas visual coverage and intersection configuration differ between sites. Within the framework of the production of space [4], the placement of a monument shapes how space is perceived, traversed, and interpreted through its relations to the street network, building masses, and urban movement. For the gateway function, the spatial position of the monument therefore works through visibility and orientation, the spatial-visual dimension on which the study focuses.

Beyond its gateway function, Tugu Maung belongs to a broader shift in the understanding of monuments since the early twentieth century. Riegl [5] distinguished commemorative values, comprising age value, historical value, and deliberate commemorative value, from present-day values, comprising use value and newness value. Deliberate commemorative value seeks to keep a moment perpetually present in the consciousness of future generations and therefore requires continual restoration, while newness value, expressed through unbroken form and pure color, appeals directly to the general public [5]. Huyssen [6] showed that contemporary cities intensify public memory culture, producing monuments and urban markers that intersect with popular culture, tourism, and city image making. The shift in memory culture gives rise to popular monuments, which are present in everyday urban life and articulate collective identity through easily recognized and reproduced symbols. As a recent popular monument, Tugu Maung carries deliberate

commemorative value and newness value more than age value, and the periodic repainting of the monument [3] reflects the restoration that both values require. Value-based readings, however, center on form and symbolic meaning and give less attention to the spatial position of such monuments in the city.



Fig. 1. Tugu Maung at the intersection of Jl. Pajajaran and Jl. Cicendo

The visibility and orientation dimension is grounded in the concept of the landmark. Lynch [7] defined landmarks as external reference points whose quality depends on contrast with their background and on visibility from multiple locations. Landmark quality is closely tied to wayfinding, a dynamic spatial problem-solving process in which navigators perceive environmental information, structure mental representations, and execute movement decisions [8]. Urban nodes such as roundabouts and intersections, where Tugu Maung is placed, serve as critical decision points at which landmark features anchor route choices and reduce navigational uncertainty [9, 10]; a marker at such a node supports orientation when it is visible from the spaces leading towards it. Visibility is therefore a prerequisite for the marker function and can be measured objectively through the configurational approach of space syntax.

Space syntax, developed by Hillier and Hanson [11], reads spatial configuration as the relation of each space to all other spaces in a system. Its principal measure, integration, is the mean depth of a space relative to all other spaces and is associated with natural movement [12]. Hillier [13] defined intelligibility as the correlation between connectivity, a local measure, and integration, a global measure, indicating how far the overall structure can be understood from local experience. Visibility analysis builds on the isovist, the set of points visible from a single vantage point [14], later extended into the isovist field [15]. Visibility Graph Analysis (VGA) [16] links mutually visible grid cells, so that visual connectivity, visual integration, and intelligibility can be computed at the cell scale. The visual measures represent the visual dynamics of spatial morphology [17] and are implemented in the Depthmap software [18]. Through VGA, the position of a point can be compared quantitatively with all other points within the same visual field.

Studies of urban visibility and studies of urban monuments have so far developed along separate lines. Within visibility studies, Desyllas and Duxbury [19] compared axial maps and VGA in modelling pedestrian movement in central London, Kim and Penn [20] related intelligibility to residents' cognitive maps, and Morello and Ratti [21] operationalized Lynch's imageability, including landmark visibility, through three-dimensional isovists. In Indonesia, studies of urban monuments generally adopt qualitative approaches, such as historical, semiotic, and perception studies, which explain monument meaning without addressing the relationship between spatial position and visibility [22, 23]. Previous VGA studies have generally examined a single district, plaza, or landmark, and no comparative study of a series of uniformly designed popular monuments has been found in the literature reviewed. The constant form of Tugu Maung across locations allows form to be controlled as a variable, so that differences in visual performance between sites can be associated with the spatial configuration of each location.

The study addresses four interrelated questions: how visually integrated each Tugu Maung point is relative to its simulation area, how much of the area is directly visible from the point, how intelligible the surrounding area is, and how point-level visibility and area-level intelligibility together shape the potential of each site to function as an orientation marker. The aim of the study is to measure and compare the visual performance of twelve Tugu Maung sites, defined here as the combination of visual integration, visual connectivity, and intelligibility. The methodological contribution is a normalized VGA protocol that

compares values at the monument point (selection) with the distribution of values across the entire simulation area (attribute), so that sites with different area sizes and shapes can be compared on equal terms. The conceptual contribution is to affirm that the capacity of popular monuments to work as urban markers is also related to spatial position, in addition to form and symbolic meaning.

II. METHODS

The study applied a quantitative-descriptive approach with a comparative multi-case strategy to twelve Tugu Maung sites (TM1–TM12) on roundabouts, intersections, and traffic islands in Bandung. The units of analysis are the monument point and a simulation area within a 100-meter radius of each site; the monument point lies at the center of the area, farthest from the boundary zone in which the edge effect artificially lowers VGA values [24]. Visual configuration was measured through Visibility Graph Analysis (VGA) within the space syntax framework [11, 16], a widely used method that derives visual integration and visual connectivity from a visibility graph, suits grid-based analysis of small urban areas, and yields reproducible results because it depends on spatial data only [24, 25]. The analysis followed three stages. First, the sites were located through Google Maps and observed directly to identify the components that form and limit visual coverage, namely the street network, pedestrian paths, the traffic island, and building masses, dense vegetation, and other solid elements that obstruct sight lines; the observations were documented in photographs and field notes and matched against map imagery. Second, each simulation area was redrawn as a two-dimensional plan separating open space from view-obstructing elements, with a uniform boundary at every site, and saved in DXF format. In the figure-ground plans, trees with dense canopies and continuous planting were drawn as solid masses, so vegetation was treated as a visual obstruction equivalent to building masses. Third, VGA was run in depthmapX [18] on a grid of 2 × 2 m cells, each treated as an observation point whose 360° field of view corresponds to an isovist [14, 24]. Two measures were computed: visual integration [HH], the global connectedness of each cell based on mean visual step depth, and visual connectivity, the number of cells directly visible from each cell. Values at the monument point were taken from a 2×2-cell selection grid (selection) as mean, maximum, and minimum and compared with the statistics of the entire simulation area (attribute) through the ratio of their means; a ratio above 1 indicates relatively high visibility, and a ratio below 1 a relatively segregated position [11]. The intelligibility of each area was expressed as the coefficient of determination (R^2) of the scatter plot between the visual integration and visual connectivity of all cells [13, 25].

III. RESULT AND DISCUSSION

In media documentation, Tugu Maung is recorded as Tugu Titik Gerbang Kawasan Kota Lama Bandung (Old City District Gateway Point Monument) [3]; the name derives from its four maung (Sundanese for tiger) figures. It originates from a city policy under Mayor Ridwan Kamil that required new projects in historic districts to adopt the art deco style to preserve the old city character [2], keeping large-scale development in harmony with the city's heritage [2]. By the end of 2017, three Tugu Maung had been erected under this policy, alongside portal- or gate-type markers [2]. The program was run by the Decorative Elements Section of the City Spatial Planning Office, formed in early 2017, with Tugu Maung and the city gateways as its first projects. Of the three district marker types in the program, namely street gates spanning the carriageway, pedestrian gates above the sidewalk, and island monuments [1], Tugu Maung belongs to the last, standing on an existing traffic island in the middle of an intersection. Each monument, about 10 m high and 2.4 m in diameter based on field observation, combines a pedestal, a white body with gold accents, four maung statues, stained glass and clocks on all four sides, and a pillared dome. Its art deco composition echoes the old city architecture, making the monument both a symbolic object and a marker of the heritage district boundary (Fig. 2a).

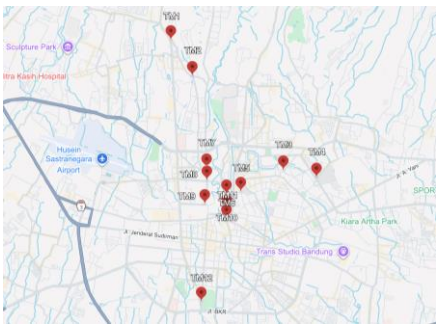
(a)  (b) 

Fig. 2. (a) Profile of Tugu Maung; (b) Locations of Tugu Maung in Bandung (Source: Author's documentation, 2026)

The twelve Tugu Maung sites are distributed along the north–south corridor of Bandung (Fig. 2b) and coded TM1–TM12 for identification. The street and subdistrict of each site are detailed in Table 1. The uniformity of form, height, and footprint across the twelve sites allows differences in visibility between sites to be read as an outcome of the surrounding spatial configuration, consistent with space syntax, which measures the extrinsic relations between spaces and leaves the intrinsic properties of objects, such as form and size, outside its scope [24]. VGA operates on a two-dimensional plane at the observer's eye level, so the vertical dimension of the monument is treated as a constant in interpreting the VGA results, which are presented in the following subsections through the visual integration [HH], visual connectivity, and intelligibility (R^2) of each simulation area.

Table 1. Locations of the Tugu Maung sites in Bandung

Code	Location	Subdistrict
TM1	Jl. Sukajadi–Jl. Dr. Setiabudi intersection	Sukasari
TM2	Jl. Cipaganti–Jl. Dr. Setiabudi intersection	Sukasari
TM3	Jl. Citarum (Istiqamah Mosque roundabout)	Bandung Wetan
TM4	Jl. WR Supratman–Jl. Brigjen Katamso intersection	Cibeunying Kaler
TM5	Jl. Sumatera (Hotel Aryaduta intersection)	Sumur Bandung
TM6	Jl. Wastukencana (Al Ukhuwwah Mosque intersection)	Sumur Bandung
TM7	Jl. Wastukencana–Jl. Cihampelas intersection	Cicendo
TM8	Jl. Pajajaran (former Kina Factory crossroads)	Cicendo
TM9	Jl. Kebon Kawung T-junction (Bandung Station)	Cicendo
TM10	Jl. Wastukencana–Jl. Braga intersection (City Hall)	Sumur Bandung
TM11	Jl. Braga	Sumur Bandung
TM12	Jl. Otto Iskandar Dinata (Tegalega)	Astanaanyar

Visual integration analysis

The visual integration [HH] values of the twelve figure-ground maps are summarized in Table 2.

Table 2. Visual integration [HH] values at the Tugu Maung points (selection) and across the entire simulation area (attribute)

Code	Visual integration [HH]						Ratio (S/A)
	Selection			Attribute			
	Mean	Max.	Min.	Mean	Max.	Min.	
TM1	6.826	7.029	6.641	7.596	12.786	2.402	0.90
TM2	8.929	9.210	8.642	8.801	12.873	1.860	1.01
TM3	21.130	21.518	20.645	12.928	23.369	1.913	1.63
TM4	21.409	23.731	19.773	17.066	28.210	3.475	1.25
TM5	7.200	7.515	7.036	4.826	8.203	1.706	1.49
TM6	11.078	11.385	10.645	6.730	13.062	2.594	1.65
TM7	11.469	11.503	11.445	7.560	11.843	2.018	1.52
TM8	12.946	13.139	12.764	7.262	13.458	3.117	1.78
TM9	12.139	12.431	11.956	8.144	12.598	2.584	1.49
TM10	16.722	17.039	16.578	13.784	18.647	2.482	1.21
TM11	9.096	9.338	8.830	5.391	9.680	1.682	1.69
TM12	7.468	7.483	7.453	5.738	9.730	2.052	1.30

Visual integration [HH] at the monument point ranges from 6.83 at TM1 to 21.41 at TM4 (Table 2). The highest absolute values were recorded at TM4 (21.41), TM3 (21.13), and TM10 (16.72), sites located in simulation areas with high mean integration (12.93–17.07). After normalization against the attribute, the

ranking shifts: the highest ratios are reached at TM8 (1.78), TM11 (1.69), TM6 (1.65), and TM3 (1.63), followed by TM7 (1.52), TM5 (1.49), TM9 (1.49), and TM12 (1.30), while TM4 and TM10 reach 1.25 and 1.21. The shift in ranking indicates that the high absolute values at TM4 and TM10 partly reflect the integration level of the surrounding area, whereas TM8, TM11, and TM6 occupy prominent positions relative to more segregated simulation areas. The distinction corresponds to strategic visibility: wayfinding is supported by the visibility of a specific, actionable element relative to its surroundings more than by the overall openness of space [26]. TM1 is the only site with a ratio below 1 (0.90), and TM2 is nearly equal to the area mean (1.01).

At TM8, TM11, and TM6, the monument occupies a node at which many sight lines converge even though the surrounding area is relatively enclosed, so the monument can potentially be found earlier by road users approaching from various directions. At TM4 and TM10, the surrounding area is relatively open, so the monument is visually accessible but not markedly more prominent than other parts of the area. At TM1, the monument is less visually accessible than the area average, so road users require more changes in viewing direction before the monument becomes visible, while TM2 has a level of visual accessibility equivalent to the area average.

Visual connectivity analysis

Visual connectivity confirms the low values at TM1 and TM2 but shifts the highest ratios towards the roundabout sites (Table 3 and Fig. 3). The number of cells directly visible from the monument point ranges from 180 cells at TM1 to 4,178 cells at TM4. The highest ratios of connectivity to the attribute mean were recorded at TM6 (2.82), TM8 (2.76), and TM7 (2.56), meaning that the visual coverage from the monument point is more than two and a half times the coverage of an average cell in the simulation area. TM1 (0.20) and TM2 (0.77) are the two sites with connectivity below the mean. At TM1, the visual coverage of the monument point is only about one fifth of the area average, which indicates that sight lines are obstructed by elements around the intersection, chiefly the surrounding vegetation described below. Both sites are located on the Jalan Dr. Setiabudi corridor in the northern part of the city, so low visibility is concentrated on the entry corridor from the north.

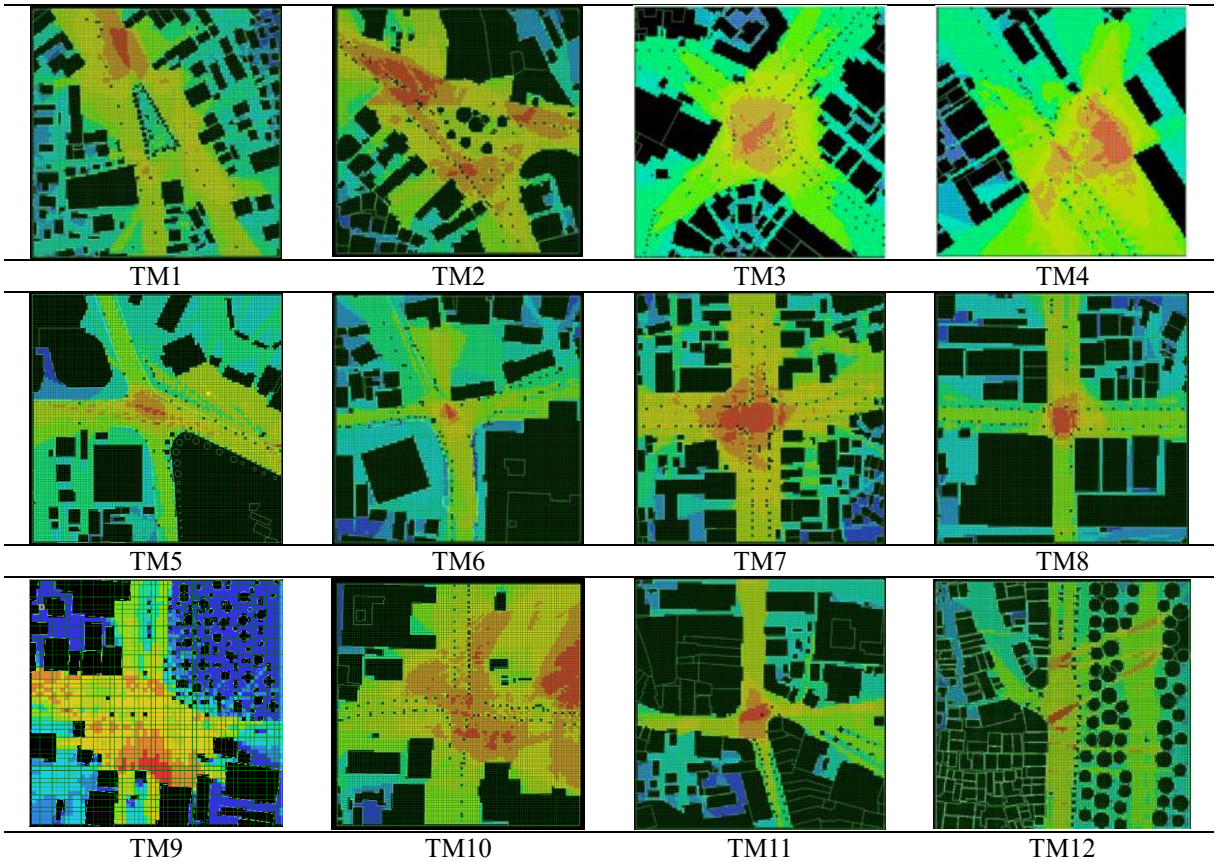


Fig. 3. Visual connectivity simulation results for the twelve Tugu Maung sites in depthmapX

At TM6, TM8, and TM7, the monument is directly visible from an area more than two and a half times the area average, so its presence is relatively easy to recognize from around the intersection. Field observation shows that the three monuments stand on roundabouts at four-way intersections with wide street corridors; each street arm opens a straight sight line towards the roundabout, so the monument can be visually captured by road users from all four directions of arrival. At TM4 and TM3, the numbers of visible cells are the largest (4,178 and 3,792 cells), but the ratios are only 1.38 and 1.88 because the surrounding areas are also relatively open. At TM1, road users can see the monument only when they are close to the intersection, and field observation shows that the low connectivity at TM1 and TM2 is related to vegetation around the monument. TM1 stands on the dividing island between Jl. Setiabudi and Jl. Sukajadi, a passive green open space surrounded by large trees with dense canopies, so sight lines towards the monument are obstructed from almost all directions of arrival. TM2 is located in an active park at the intersection of Jl. Setiabudi and Jl. Cipaganti, in the form of a plaza with more open paving, yet vegetation at the edge of the plaza still limits the field of view towards the monument, so the connectivity ratio of TM2 (0.77) is higher than that of TM1 (0.20) but remains below the area average.

Table 3. Visual connectivity values at the Tugu Maung points (selection) and across the entire simulation area (attribute)

Code	Visual connectivity						Ratio (S/A)
	Selection			Attribute			
	Mean	Max.	Min.	Mean	Max.	Min.	
TM1	180.25	203	151	903.89	2610	3	0.20
TM2	853.75	932	756	1109.21	2361	1	0.77
TM3	3792.00	3828	3762	2019.90	4083	1	1.88
TM4	4178.25	4555	3893	3035.77	4997	1	1.38
TM5	1294.50	1341	1249	544.79	1511	2	2.38
TM6	1888.00	1943	1828	669.73	2107	7	2.82
TM7	2168.75	2200	2137	847.50	2378	3	2.56
TM8	1781.25	1836	1731	645.64	1903	5	2.76
TM9	1018.75	1026	1010	432.53	1062	2	2.36
TM10	3192.25	3274	3155	2322.11	3651	11	1.37
TM11	1093.75	1199	974	446.48	1307	2	2.45
TM12	1101.75	1113	1087	593.38	1221	2	1.86

(Source: VGA simulation results, 2026)

Intelligibility analysis

Whereas visual integration and connectivity describe the position of the monument point, intelligibility describes the visual structure of each simulation area as a whole and is expressed by the coefficient of determination (R^2) between the two measures [13]. The R^2 of the simulation areas ranges from 0.542 at TM5 to 0.955 at TM3 (Table 4); Fig. 4 shows the scatter plot for TM8 as an example. Four areas have R^2 values above 0.92, namely TM3 (0.955), TM4 (0.950), TM10 (0.929), and TM8 (0.921). Four other areas fall within the range of 0.89–0.90, namely TM7, TM1, TM2, and TM9; TM11 (0.790) and TM6 (0.772) fall within an intermediate range; and TM12 (0.560) and TM5 (0.542) show the lowest intelligibility. Comparison of the point-level ratios (Tables 2 and 3) with the area-level R^2 shows that the visibility of the monument point and the intelligibility of the area do not always coincide. TM5 and TM12 have integration ratios of 1.49 and 1.30 and connectivity ratios of 2.38 and 1.86, yet are located in the areas with the lowest R^2. Conversely, TM1 is located in an area with an R^2 of 0.894, yet the monument point is relatively segregated (integration ratio 0.90; connectivity ratio 0.20).

In terms of wayfinding, intelligibility is linked to cognitive mapping and to the legibility concept of Lynch [7, 24] and describes how far road users can understand an area from what is visible around them. Where R^2 is high, locally open places are also well connected to the whole area, so a momentary view gives accurate cues about the main spaces [13]; at TM3, TM4, TM10, and TM8, the monuments can therefore be read as part of a clear area structure. Field observation indicates that TM3 lies on wide street corridors with a large intersection radius, so its long sight lines run along the most integrated routes, while TM4 has low building density and is visually continuous with Taman Persib and the field of the Infantry Weapons Center (Pusat Persenjataan Infanteri), which are directly linked to the street network. Where R^2 is low, as at TM5

and TM12, open places are not necessarily connected to the rest of the area, so road users may see the monument yet struggle to relate it to the wider street network. At TM5, the non-orthogonal morphology of the intersection breaks sight lines between street arms, so locally open spaces do not extend into the wider system. At TM12, the edge of Alun-alun Tegalega that falls within the simulation area forms an extensive, highly connected open space that large trees separate visually from the street network, lowering the correlation between connectivity and integration. Conversely, the TM1 area is relatively intelligible but its monument point is poorly visible. The following classification therefore combines point-level visibility with area-level intelligibility.

Table 4. Intelligibility (R^2) of the twelve simulation areas

Code	R^2	Code	R^2
TM1	0.894	TM7	0.896
TM2	0.891	TM8	0.921
TM3	0.955	TM9	0.891
TM4	0.950	TM10	0.929
TM5	0.542	TM11	0.790
TM6	0.772	TM12	0.560

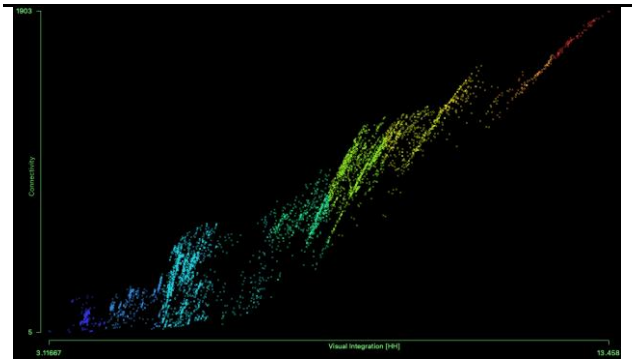


Fig. 4. Scatter plot of visual integration [HH] against visual connectivity for TM8

Synthesis of visual integration, connectivity, and intelligibility

Based on the integration ratio at the monument point and the R^2 of the surrounding area, the twelve sites can be grouped into three patterns. The first pattern comprises TM3, TM4, TM7, TM8, TM9, and TM10, sites with an integration ratio above 1.2 in areas with R^2 above 0.89; sites in the first pattern are distributed to the northeast of the city center, in the western cluster in Cicendo Subdistrict, and at the Wastukencana–Braga intersection. The second pattern comprises TM5, TM6, TM11, and TM12, sites that are locally prominent with integration ratios of 1.30–1.69 but are located in areas with intermediate to low intelligibility (R^2 0.542–0.790); three of the second-pattern sites are located in the core of the old city in Sumur Bandung Subdistrict, while TM12 is located on the southern corridor. The third pattern comprises TM1 and TM2 on the northern corridor, with integration and connectivity at or below the area mean. With reference to the landmark visibility criteria [7] and the concept of decision points [9, 10], first-pattern sites have the strongest potential to function as orientation markers because they are visible from many cells within an area whose visual structure is easy to understand. Second-pattern sites can potentially be recognized from around the intersection, but the surrounding area provides less support for reading the relationship between the monument point and the wider spatial network. Third-pattern sites have the most limited marker potential, even though TM1 and TM2 occupy the entry corridor that is programmatically designated as the gateway to the old city district. The three patterns therefore indicate that an identical monument design works differently for urban users according to the visibility and orientation conditions of each spatial position.

The marker potential described by the three patterns is a theory-based inference, because road-user perception and orientation behavior were not measured, and the two-dimensional VGA does not model the height of the monument or its visual contrast against the background, a known limitation of the two-dimensional spatial logic of space syntax with respect to height and scale [25]. The bounded simulation areas may also be subject to edge effects [24], and road users were not distinguished by familiarity with the district, although residents and visitors in historic districts rely on landmarks in different ways [27]. Testing

the inferred marker potential therefore requires behavioral wayfinding measures [28]. Within these limits, the results at TM1 and TM2 indicate, for the planning of the old city district, the need to review the placement of the monuments or the arrangement of view-obstructing elements around the intersections of the northern corridor so that the gateway function becomes more legible.

IV. CONCLUSION

The visibility graph analysis of twelve Tugu Maung sites shows that an identical monument design yields varied visual performance according to the spatial configuration of each location. In terms of visual integration, eleven of the twelve monument points exceed the mean of their simulation areas, with the highest ratios at TM8 (1.78), TM11 (1.69), and TM6 (1.65) and the only ratio below 1 at TM1 (0.90). In terms of visual connectivity, the monuments at TM6, TM8, and TM7, which stand on roundabouts at wide four-way intersections, are directly visible from an area more than two and a half times the coverage of an average cell, whereas TM1 (0.20) and TM2 (0.77), surrounded by dense vegetation on the northern entry corridor, fall below the area mean even though both sites are designated as gateways to the old city district. The intelligibility of the surrounding areas ranges from 0.542 at TM5 to 0.955 at TM3; wide, continuous street corridors and open spaces linked to the street network yield intelligible areas, whereas irregular intersection morphology and open spaces screened from the street lower intelligibility.

Combining point-level visibility with area-level intelligibility, the twelve sites form three patterns: highly visible sites in intelligible areas (TM3, TM4, TM7, TM8, TM9, and TM10), locally prominent sites in less intelligible areas (TM5, TM6, TM11, and TM12), and sites with limited visibility despite intelligible surroundings (TM1 and TM2). The findings indicate that the capacity of popular monuments to work as urban markers is also related to spatial position, in addition to form and symbolic meaning; for urban users, spatial position works through visibility and orientation. Methodologically, the normalized VGA protocol allows dispersed monuments to be compared on equal terms. For the planning of the old city district, the results at TM1 and TM2 indicate the need to review the placement of the monuments or the vegetation obstructing views on the northern entry corridor so that the gateway function becomes more legible. Further research can test the inferred marker potential through road-user perception surveys, cognitive mapping, or three-dimensional isovist analysis.

V. ACKNOWLEDGMENTS

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