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A Study of the Evolution and Physical Traits of Two Competing Street Patterns: Narrow Meandering and Wide Gridiron

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ABSTRACT

A street is a passageway for people in a built environment and is one of the essential elements of urban planning. Streets convey a city's history, urban form, and socio-cultural values of societies that shape it. Street patterns must be carefully planned to create safe environments for everyone, particularly youngsters and elders. There are two common street patterns in history: meandering and gridiron. The development of these two opposed street patterns is examined in this study using historical discourse. In this study, the deductive approach is employed to distinguish between the physical traits of the street types mentioned above. According to this study, meandering street patterns reflect more concerns to human senses, socio-cultural values and aesthetics than gridiron. This research instigates further investigation in this regard to create inclusive, safe streets for everyone.

Introduction

In the public domain, streets make up most of the urban environment. This is where We make all our trips to work, the store, and restaurants (Ewing et al., 2006). By fusing the public and private domains, streets link various parts of a city. Streets have a key role in the character and value of society because they give a pleasant, safe, and healthy environment (Brown, 2000). The worth and importance of a street in a city are summarized in the following remark from Maki (1962): "A street (Linkage) functions as the adhesive for the city. It links people together in addition to connecting space (Moughtine, 2003, p. 113). A society's character and quality are greatly enhanced by having proper streets since they create thriving, safe environments. As mentioned by Haslam (1972), streets are important in a town because they form buildings and other built structures, similar to how a dress takes on its shape from a tailor's dummy. Therefore, streets perform important socio-cultural roles in addition to acting as a means of transportation and passageways. According to Christian (1971), the Street is a small universe. It represents the society's personality for newcomers visiting that particular city (Christian, 1971, p.80). On the Street, it's possible to bump into friends and hear intriguing stories. In Trancik's opinion (1986), a decent public place cares for its users' socio-cultural values and connectivity. If it accomplishes the goal within that particular society's historical and sociological context, it serves as a place (p.98).

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There are two common patterns in history: meandering and gridiron. This research aims to understand the distinctions between street layouts to acknowledge a better plan. The streets make up the majority of the city's physical surroundings. Transforming a location into a place for leisurely strolling and casual contact not only plays a key role in urban planning but also significantly impacts how people experience and appreciate a place's design. The objective is to increase awareness and understanding of the significance of street layouts, perhaps to enhance the condition of the streets in Pakistani cities.

Before delineating the distinction between both layouts, this research explores the Evolution history of the Gridiron pattern and of winding and curvilinear streets. Physical traits of this very space are also probed to understand the safety, inclusiveness, and peacefulness, given that the primary function of the Street is to serve as a setting for walking and spontaneous connection, informal conversation an, d engagement, along with serving as connecting space between different areas. The walkable Street strengthens people's sociability. As per Jacob (2003, p.6.2-1), you might not be able to meet anyone if you cannot stroll down the Street. A lot of scholarship, i.e. (Lynch, 1964; Cullen,2012: Jacob, 1961; Alexander,1977; Appleyard,1976; Ford, 1999; Burton and Mitchell,2006; and Yaseen, 2016) towards the end of the 20th century and at the dawn of 21st century acknowledged such concerns of street space apart from going from one point to another

Methodology

The study is based on the question.

What is the difference between a meandering street and a gridiron street? This question will make it possible to inquire about the true character of the streets. The answer to this question will make it possible to establish the use of the streets. Seeing the annals of history will help to understand the evolution of these two types. This research probes many applauded perceptions and researches of numerous academicians—the investigation of the street space includes tracing its history from classical times to delineate the trajectory of both types of layouts. The research is being conducted using a qualitative methodology. A huge body of scholarship is examined for comprehending the difference between both patterns. The research uses photographs and drawings to demarcate both patterns. Since it infers the pre-established definition and theories about the street area, this study suggests a deductive way to determine the research question.

Evolution History of Gridiron and Meandering Street Pattern

Streets pattern during the classical period

The city's orthogonal planning resulted from the requirement for the geometry of the mud-brick building and an easy way to divide the area. Hippodamus laid constructed the Greek city of Miletus on a grid, with the Main Street running east-west and North-South meeting at a right angle, with secondary streets extending in between. (Broadbent, 1990, p.5).

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Figure 1. Greek city plan showing grid iron pattern for Street layout.
Source: (Broadbent, 1990)

The Romans adhered to the Greek grid. The central forum and the city's basic street layout were the two main features of the Roman city. They also incorporated the idea of major and minor streets as well as a general street layout designed for military control. The Itinera (only for pedestrians), the Actus (for the passage of one cart alone), and the Viae (for enabling the passage of two carts abreast) were the three streets that made up the streets of the town. (Morris, 1979, P. 63). This particular layout of streets is clear and well arranged, good for way finding and orientation, making it easy to monitor and clean and also the intersections make the choice easy of the route to destinations. Square planning complies with the dignity of Roman citizens (Corbusier, 1987, p.7).

Medieval Street (Narrow Meandering)

Medieval cities are characterized by organic planning with narrow winding streets around the central marketplace (Saalman, 1968, p.32). The relationship of the height of enclosing buildings with the horizontal dimension of street space was very important in medieval cities where mostly the height was 3-4 times the width of the Street. In the evolutionary process, medieval cities' main feature is meeting site conditions. Resultantly, irregular cities evolved with different street patterns but with defined proportions. The height of the buildings on both street sides was consistent with acquiring a strong sense of enclosure. The medieval city developed without conscious planning by adding different values over centuries. The beauty of these Streets was pronounced by its irregular arrangement of buildings with different heights, recesses and projections (Broadbent, 1990, p.32).

Narrow curvilinear streets themselves carried interest as the end of streets was not apparent from the beginning; converging into a spacious pedestrian space was a pleasing surprise. The street pattern is indicative of intercommunication, defence and rhythm. The medieval Street has often been considered "the finest street" for its curves. Despite his vehicle speed considerations, Le Corbusier recognized the townscape quality of curving streets (Corbusier, 1987).

Medieval Islamic city streets

Muslim raiders who successfully set up bases in Europe left behind illustrations of their ambitions for urban planning. In some of Spain's largest cities and in some of its smaller towns, winding, narrow alleyways with tall buildings hiding attractive internal courtyards can be spotted. The primary concern in Islamic culture was safeguarding against visible intrusion into the private sphere of homes. Views were appreciated when possible, but the visual corridors' obstruction into the private domain, concern for privacy, came first (Hakim, 2008).

With consideration for human senses, informal plans from Spain to India and south-east Asia

were made. There were also guidelines for how wide a street needed to be for two parallel camels to pass through while fully loaded. The meandering planning enhances the sense of security and vibrant social contact with its narrow, occasionally blind alleyways that end in private courtyards and are frequently covered. Cordoba, Marrakesh, and other Moroccan cities are a few examples. Most of the streets were curving, twisting, and turning into each other for security, privacy, defensive reasons, and the thrill of surprise. Streets were rarely straight. (Broadbent, 1990, p.11-15)(Fig 2). Hassan Fathy portrays the classic Arab city and its refined architectural style.

'To control temperature, the winding Street functions as a courtyard. Wide and straight surfaces would heat up faster. In terms of aesthetics, this arrangement generates more curiosity. Street alignment irregularities act as a catalyst for innovation and creativity (Fathy, 1973)

Figure 2. Meandering Street of Cordoba, strangers can't have a clue what is at the end of the Street, with the play of sun and shadows. Source: (Fun_Travel@live.com, 2018)

Spontaneity and freedom of living are further characteristics of mediaeval cities. When designing the Gourna village, Hassan Fathy acknowledged with "Saving the Individuality." (Fathy, 2000, p.46). Saalman (1968) describe the situation in words like, People have the option of constructing the street area to the extent of their political clout. Even in some instances, the street space was spanned due to extensive upper story extensions, and in other instances, it is on the verge of touching the building or habitation on the opposite side of the Street. (Broadbent, 1990, p.28).

Beginning of Regulations in Medieval Meandering Street

The defense was another factor in the irregular medieval cities of Europe. However rmedieval cities like Siena, Bologna, and Parma also have a pattern similar to that of the Street. To make right the previous wrong in Siena, Costituto was enacted into law in 1262. According to Costituto, street widths were determined following the hierarchy of streets. For instance, minor street width was 6 braccia[1], and major street width was 8 braccia. Because it needed to be attractive and bright, the main Street leading to the church was 10 braccia wide. It was planned to have 20 braccia outside the city wall. Height-to breadth ratio was heavily considered to increase the sense of enclosure.

Most of the time, street width was 3–4 times higher. (Broadbent, 1990, p.32)(**Fig.3)**

[1] an Italian unit of length varying between 15 and 39 inches

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Figure 3. Siena street hierarchy with concern for height to width ratio for street space. Source: (NoorMohammadi, 2017).

Renaissance Street (Introduction to gridiron)

Related constructs have influenced the principles of urban planning, architectural design, and aesthetic philosophy since the fifteenth century. One such concept is the desire for discipline and order in contrast to space's relative irregularity and dissemination. The primary Straight Street was constructed primarily to make it easier for people to move around the city, increasingly by carriage.

Most of Renaissance Urbanists' plans for the "perfect city" included representations of it. In the Renaissance, artists like Michelangelo, Leonardo da Vinci, and Raphael all depicted entire towns or portions of them. None of these theories supported Alberti(1955)'s assertion that *convenient and beautiful streets are enhanced by their undulations*. In these Renaissance cities, the streets spread outward from the central piazza rather than being laid out in a grid pattern. (as cited in Broadbent, 1990, p.37)**.**

The Renaissance was characterized by symmetry, proportion, and a desire for horizontality as opposed to the elaborate decoration of Gothic and the winding, twisting alleys of the Middle Ages. The symmetry and homogeneity of the Grid Iron pattern are in keeping with Renaissance ideals. Implementing the Grid Iron system opposed the informality and asymmetry of the Middle Ages.

Though, the city's gridiron street structure in such a way that it would make the city hot in the summer and expose it to "stormy blasts" in the winter. In contrast, the user was protected from such extreme weather conditions combined with the added benefit of security in the narrow, twisting ancient alleyways. To prevent enemies from approaching the settlement, the meandering Street would cause them to become confused. The Renaissance was characterized by symmetry, proportion, and a desire for horizontality as opposed to the elaborate decoration of Gothic and the winding, twisting alleys of the Middle Ages. (Broadbent, 1990, p.36). A lot of emphases was placed on carefully positioning large buildings or appropriately imposing statues at the end of long, straight streets to close off vistas. Buildings were combined into a single, unified architectural assembly, preferably by replicating a basic elevation design, to produce the continuous urban fabric that gave it visual solidity and the confinement of space. In the Renaissance, it was meant to create a single enclosed space. (Zucker, 2003)(Fig.4)

Figure 4. A street in Rome shows the Repetition of the same elevational details to achieve balance and symmetry. Source: (Tavani, 2022)

Baroque Street

The general layout was almost preserved when planning transitioned from Renaissance to baroque, but the width was expanded to improve traffic. Sixtus and Fontana were constructing the streets when carriages were just beginning to become widely used, according to Siegfried Giedion (1967). They needed to be more room than they were for those on foot or horses.. As Fontana says the well-known Street leading from the Santa Croce church is sufficiently wide and straight to accommodate the movement of five parallel carriages. (p.95).

Figure 5. Champs Elysee; straight, undisturbed view and flanked by regular and equal sized buildings. Source: **(TRAMUTA, 2021)**

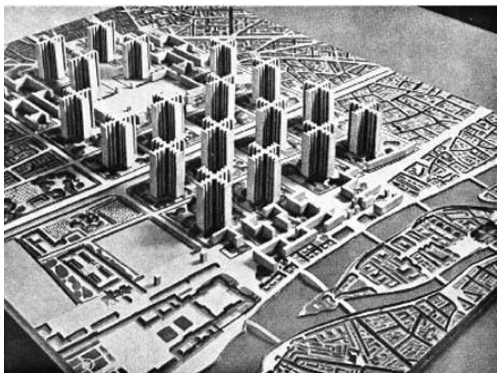
Versailles[2] is the best illustration of such a broad and straight design. This immediately impacted other cities' city designs, including Greenwich, the Mall in Washington, D.C., etc. (Broadbent, 1990, p.41). the characteristics of the Street in this time period are a street as straight as a ruler, uninterrupted views, and regular, equivalent flanking buildings.

[2] A city in north central France near Paris was capital of France from 1682 to 1789.

20th Century Modern Street

The 20th century saw a dramatic change in street design in terms of use and character due to Corbusier's belief that "Our streets no longer operate." The idea of a street is useless and outdated (Corbusier, 1987). In modern ideas, street behaviour has changed from being alive to being a component of a "system," where it is considered as a location to get from point A to point B. (Lash, 1992). When a dead space rather than a dynamic one was created instead of the interactive society architects had envisioned, it was the main cause for concern (Crosby, 1956, p.33). The need to have effective highways has overtaken the social experience and affluent street culture(Fig 5).

Figure 5. Proposed plan of the modern city with the notion of no street.
Source: (Merin, 2008-2022)



Physical Attributes of Both Patterns

A meandering or curvilinear street pattern is a type of layout characterized by multiple curves (Dale & Sharn,1995). While gridiron refers to a system made up of streets that connect at right angles and run parallel or crosswise (Dale & Sharn,1995)

The meandering Street previously served as a place in an urban neighborhood with a public space near their private locations/homes Since it served as the framework or setting for establishing social relationships. A similar claim is made by Moughtin (2003) that "the street serves not simply as a means of access but is fundamentally an arena for the social expression" (p.123). Moreover, The meandering streets are more tranquil compared to gridiron since gridiron streets lack cul de sacs. Cul de sacs restrict the through movement and make it a passage only for the resident, not for everyone(Grammenos et al, 2022).

The main characteristics of a meandering street are the user's sense of safety and security. Because they make individuals feel secure when immersed in their surroundings, regardless of passing vehicles, the public realm is also found in the city's streets, where people are allowed to assemble and kids can socialize with their peers while their elders watch after them. Children can interact with people in the public sphere that the street area provides, and they can also learn a lot from them by watching, listening, and imitating what they do. Additionally, the narrowness of meandering streets creates a sense of enclosure, making it safer for passersby to feel enclosed. Instead, a large gridiron street lacks this sense of security and gives passersby the impression that they are outside. Besides, there was great concern for privacy in meandering medieval streets, particularly medieval Islamic city streets. Winding, narrow alleyways with tall buildings hiding attractive internal courtyards, a family space.

Contrary to these arguments in favor of meandering streets, According to Grammenos et al. (2022), city dweller anticipates the same level of enjoyment from driving as they do from strolling and walking. While congested, winding and narrow streets may be appealing to pedestrians, they are frustrating to cars. Driving must flow freely, feel safe, and provide expansive, rich visual experiences to be fun. These characteristics are typically attained by extending straight stretches, separating traffic lanes, and enlarging curves (Grammenos et al., 2022).

Further, narrow Street minimizes the vehicle's speed that a driver may not like. The meandering street pattern is endorsed by "New urbanism," also referred to as "neotraditional" planning (Ford, 1999) and is a new trend in the planning industry. These theories' proponents contend that certain characteristics are necessary for cities and towns to be successful and long-lasting. Like Street crosswalks, a pedestrian network was created to provide a more compact pedestrian-Character that may be achieved by reducing the street width (Dale & Sharn,1995).

While, Proponents of meandering and curvilinear Street (Burtob, 2006; Alamdari & Habib, 2012) use this intrinsic quality of curve as an essential quality for the residential Street by providing safety and priority to pedestrians and kids playing in the street space instead of vehicles (see fig6)

Figure 6. a) Gently curving streets with diverse form and structures are more exciting than straight unchanging streets. Source (Burton 2006)

b. Woonerf: Basic purpose of this movement is to lower the speed that is suitable for pedestrian and cyclists. source: (Alamdari & Habib 2012)

Gridiron streets are preferred due to the prevalent misperception that the main purpose or defining characteristic of streets is transportation. Due to this misunderstanding, Today's urban streets are so unwelcoming and dangerous for pedestrians that people are frequently obliged to stay at home and commute by personal automobile. Christopher solved this problem by asserting that "the streets nowadays are solely for moving through or for transit from one point to another." It must offer a place to live. He advised "narrowing the end of a street with the bulge in the centre" to give it a cosy, residential atmosphere (Alexander, 1977, p590-591). In mediaeval streets, such a setting is already present, giving it a location to remain rather than just pass through(Fig7)

Fig 8.Bulged space in the meandering Street of the old walled city of Lahore

Source: author

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Such bulged space cuts through traffic and provides a place for walkers of the Street to chitchat and gossip.The gridiron pattern is legible and understandable, with straight streets meeting at a right angle. While the meandering Street may appear to an outsider as a maze of cul-de-sacs, it offers a reference system of thresholds and buffer zones o the residents but serves as filters to keep outsiders out. Typically, thresholds take the form of arches, doorsteps, low stone posts, or just a street's abrupt narrowing and curving. This understandability of the gridiron streets pattern makes easy arrangements for criminals and crooks after incidents (Ford,1999). Due to multiple intersections its easy for crooks to find their way. While curvilinear with culdesacs restrict the crooks and criminals due to un-understandable ways for strangers (Kunstler 1996,129), Dead ends or cul-de-sacs are another feature of a meandering narrow street. Since they were personal and private, they were secure from thieves (Kunstler, 1996: 129).

Table1

Comparison between the physical traits of meandering and gridiron streets

Meandering Street	Gridiron street
1. Narrow and Informal	1. Wide and Formal
2. inconsistent Street width	2. Consistent street width
3. less priority to vehicular traffic	3. High priority to vehicular traffic
4. usually unplanned and grow with time	4. Planning based on systematic deliberations
5. Picturesque: Developed through use and time under layers of history. Usually have concerns to human senses	5. Banal: Developed before use and predictable
6. Exciting, since the scene changes after a few steps	6. Unexciting since the scene remains the same under deliberate planning
7. It serves as a platform for social interaction beyond the function of movement.	7. It serves to facilitate traffic, and the resultant space becomes unsociable
8. Fit for slow traffic, thus, prioritizing the pedestrian	8. Fit for fast speed, thus prioritizing the vehicle
9. Narrowness adds a feeling of enclosure	9. No feeling of enclosure on broad and wide gridiron street
10. The narrow street functions courtyard to normalize the temperature	10. Straight and wide surfaces would heat up more quickly in summers, and no protection from a gust of cold wins in winter
11. Respect for privacy, particularly in medieval Islamic city streets where the doors of one house were not kept in exact opposite to the other house	11. In gridiron streets usually door open in front of other's house
12. Usually, end at cul de sacs that add to privacy and safety from strangers by blocking it as a thoroughfare	12. Devoid of cul de sacs making is less private and minimum safe due to serving as a thoroughfare
13. The defence of the user/ resident was the reason of many medieval Street	13. Practising authority and control by the government was one of the reasons of gridiron

Table 1 shows the comparison of physical traits of both patterns. It is explicit that meandering streets reflect more concerns for human senses and socio-cultural values than gridiron.

Based on this comparison, it is recommended that

— Meandering street patterns and gridiron are distinguished from each other. Where meandering Streets have excellent features, therefore should be considered at least as an option before deciding on the gridiron pattern.

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— It is found that the meandering street pattern is based on the human dimension where human acquaintances and daily experience are important. Particularly, the models of Medieval Islamic streets may be more helpful with privacy and safety concerns.
— It is further found that gridiron is less suited to walkability and sociability than the medieval meandering street pattern.

Conclusion

The townscape and identity of the city are distinguished by its streets, which are the fundamental components of the urban structure. The Street connects buildings on the Street and throughout the entire town. In Street design there had always been a great concern for travel and transportation along with social and psychological impacts. Widths of streets always cater for the ways of transportation, whatever the means for movement were used in those times. For instance, in the Islamic period, street width was defined regarding the width and area required by laden Camels, and even the necessity to make straight streets felt to facilitate the Carriages. Social and defensive concerns are also evident, for instance, the concept of cul de sac. The medieval city, developed without conscious planning, by adding different values over the course of centuries. Walking in curved medieval streets is a sequence of continuous blend of mystery and surprise. Several examples in the history are apparent showing the concern for designing a street as 'place' for public rather than mere path.

The street space, before Renaissances, was a setting for diverse events and activities according to climatic conditions and socio-cultural values. Starting from Primary Street, concerns for symmetry, regularity and undisturbed views dominated the socio-cultural values during renaissance time. At the turn of twentieth century, deliberations for the vehicle speed and progress undermined all the historical concerns for the design of street layout. As a result, the gridiron became the norm for street layout. It is concluded that Gridiron pattern is not the only choice, particularly in all planned cities of Pakistan. The need of transportation cannot be ignored in the existing situation. But taking care of one issue, transportation, on the cost of many physical attributes is not a solution. Owing to the importance of this very space in society's character building, it is necessary to learn the lessons from medieval meandering Street.

This research opens avenues for further deliberations in Street designing to find a street pattern that considers human dimensions and the need for progress and speed.

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