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# URBAN PATHS TRANSFORMATION IN SURAKARTA: FROM ROYAL CITY TO MODERN CITY

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*ABSTRACT*

*Paths, including roads and rivers, are the main elements determining urban form. The understanding of the urban paths' typologies could explain the urban form transformations. Surakarta as case study, is a Javanese city has experienced the urban function change from royal city into modern city. This research aims to understand the paths typologies influence towards the urban form transformations relating to the urban function change. The data gathered from study documents including cartographies, photographs and historical documents, and also field observations utilizing google streets views. The data is composed through the periodization from 19th Century to recent era. It relates to the government authorities in Indonesia including kingdom era, colonial era, and Indonesian government era. The data sources are explored by the descriptive qualitative method and the spatial analysis method. The research revealed that the transformations of urban paths forms have been occurred, and these transformations are in conjunction with the urban function change. The essential factors influencing those transformations are transportation system modernization, flood risk reduction, and urban expansion. This research enhanced the comprehension of the urban function change being correlated to urban form transformation occurring in Indonesian cities.*

## 1. INTRODUCTION

Kevin Lynch stated five elements of city image including path, edge, district, node, landmark, and path is the predominant city elements such as streets, walkways, transit lines, canals, railroads, along which the observer customarily, occasionally, or potentially moves (Lynch, 1960). Path is a linier urban element which can be functioned as channel for moving or flowing in city. Edge is a linear urban element and it is not used for a path, but a barrier in city or one city with another cities. District is an area being situated inside of city having some common characteristics which are different with the characteristics of another area. Node is a point which is an area having strategic values being situated inside of city. Landmark is a point reference for signage in city area or district. The researchers argued also that urban paths are most influence than other urban elements determining the image of city (Liu et al, 2016; Filomena et al, 2019; Pauzi et al, 2018). Urban path can be transformed as urban edge or urban district. An urban edge is an urban path limiting among city areas or cities. The urban district is urban path determining an area indicating some common characteristics of location.

The street, as an urban path, is considered as the principal element forming the urban path and form (Zeka & Yüzer, 2014; Araldi & Fusco, 2016; Ibrahim & Alattar, 2016). Streets (roads) is a dominant element triggering the extension and intensification of urban space. The image of city is very influenced by the existence of streets (roads) forms in city. A metropolitan tends to have many wide streets (roads), in contrary a small city tends to have many narrow streets (roads).

The other urban path having also the fundamental role in city is urban river (Ospina-Tascón et al, 2019; Ikemoto et al, 2021). One side, it is functioned as urban ecology such as hydrological system and water ressources for life of society, and other side it can be utilized for urban activities such as space for transportation, and urban view. In case of urban morphology, the existence of urban rivers emerges various urban forms because of its unique patterns. Furthermore, the existence of railways inside a city as a path gives influence toward the urban form (Yaqub, 2019; Sacré, 2019). The development of

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railways changes the image of city. It indicates the city modernization being supported by the proper urban transportation. In the context of urban form, it can divide the urban spaces giving a consequence of urban form transformation.

The several urban paths types are the dominant elements influencing the urban expansion and transformation. The compositions of streets (roads), river, and railway influences the dynamics of urban morphology. The study of urban morphology, frequently referred to urban form, urban landscape, and townscape, has an extensive literature in three genres (Xiao, 2017). It is the science that studies the physical form of cities, as well as the main agents and processes shaping it over time (Oliveira, 2018). It concerns the size, shape and physical structure of urban settlements (D'Acci, 2019). It is related to the assessment of urban physical form and its transformation. The main approach in urban morphological analysis is to evaluate the morphogenetic process (Mohamed and Harun, 2020). It is related to analyze the urban tissue and its growth. The urban tissue is the combination of streets, plots and buildings seen as a composite (Kropf, 2017). The comprehensive understanding of urban morphology is needed for supporting the proper urban planning which is aimed for the achieving of sustainable city.

This paper is aimed to explore the path transformations influencing the evolution of Surakarta urban morphology. It is related to the urban fabric and its transformations from the royal city to the modern city. To achieve the research aim, it has 2 (two) objectives including the categorizations of urban paths changes, and the analysis of urban morphology transformations been influenced by the urban paths' changes. The first objective concerns the pattern and structure changes of urban paths, including streets (roads) and rivers, during several phases of urban historical periods. Meanwhile the second objective focuses on the influence of urban paths changes towards the urban morphology transformations.

Surakarta is an Indonesian city having the historical background with the Javanese Kingdom and culture. It relates to the existence of Mataram Kingdom in Java Island in particular Sunanate of Surakarta. The beginning of this city was correlated to the characteristics of Javanese cities having large open space called *alun-alun*, and the settlements of courtiers around the palace or the place of central authority. In the colonial era in Indonesia, this city had the dualism of urban governance that is between the Sunanate of Surakarta and Dutch government. But however, the city was experiencing the beginning of modernization process, and it is still continuing until nowadays. This situation ignites the interrogation of the urban transformations have taken place in Surakarta.

Several research have been carried out concerning the morphology analysis of Surakarta City in various urban scales. The morphology of Surakarta town (initial city) has been explored through several research (Setyaningsih et al, 2016; Purwani, 2017; Zaida & Arifin, 2010; Pratomo et al, 2006; Urfan et al, 2021; Marlina, 2018). It indicates the existence of kingdom produced the Javanese urban pattern and it remains exist in town until recently. Furthermore, several research revealed the architectural form transformations of traditional houses and buildings in town (Lestari, 2012; Muqoffa & Setyawan, 2013; Cahyono et al, 2017). The study of urban morphology and its growth in the context of urban scale have been carried out by several researchers (Djumiko, 2016; Prayitno & Qomarun, 2007; Qomarun & Ikaputra, 2007). These research demonstrated the urban growth of Surakarta. But however, our research focuses on the influence of urban path transformations including roads and rivers into the growth of urban morphology. It examines the urban path transformations influencing the changes of city function from the royal city into the modern city.

## 2. METHOD

The research uses qualitative research method to underpin an explorative understanding of the urban fabrication and transformation processes that composed the morphology of Surakarta City. It is supported also by the historical research method that serves to scientifically determine the ideas and historical facts to group them into an explanatory scientific system (Albulescu, 2018). It uses certain historical time periodization to elaborate the research analysis, and explores several historical maps being compared to the recent maps. This research is supported by the historical and recent photographs.

The historical time periods are categorized into 4 (four) periodization of urban transformation including from the 19$^{th}$ Century to the beginning of 20$^{th}$ Century, the mid-20$^{th}$ Century, the end of 20$^{th}$ Century, and the recent era. The periodization is based on the data availabilities from the official institutions including local authority, and libraries providing manuscripts, or online data. The periodization from the 19$^{th}$ Century to the beginning of 20$^{th}$ Century, and the periodization in the mid-20$^{th}$ Century are covered by the historical documents and maps that made by the Dutch government during the colonial era. Meanwhile the period of the end of 20$^{th}$ Century and the recent era are underpinned by the documents and maps being provided by local authority.

The data collection method in this research entails study documents, and field observations. The study documents collected from various data sources including cartographies (maps), photographs, and related historical documents. The exploration of recent photographs utilizes the indirect way retrieving form the images of google street view.

The research focuses on the path patterns forming the urban morphology. In morphological terms, and in a temporal perspective, streets are the most stable element of urban form (Oliveira, 2016). The comprehensive understanding of urban path transformation can explicate the process of urban expansion and transformation.

All related data are assessed by the descriptive analysis method and the spatial analysis method to explore the changes of urban paths influencing the transformation and expansion of urban morphology. The spatial analysis method in particular the overlay technique is realized and it is supported by the utilization of Quantum GIS which is the open-source software.

First phase of morphology analysis is the urban paths changes are categorized based on its patterns and structures. Second phase of morphology analysis is the assessment concerning the influences of

urban paths changes toward the urban morphology transformation. This assessment focuses on the patterns and structures of streets (roads), railways, and rivers that were transformed and these transformations influenced the urban morphology evolution during several historical periods.

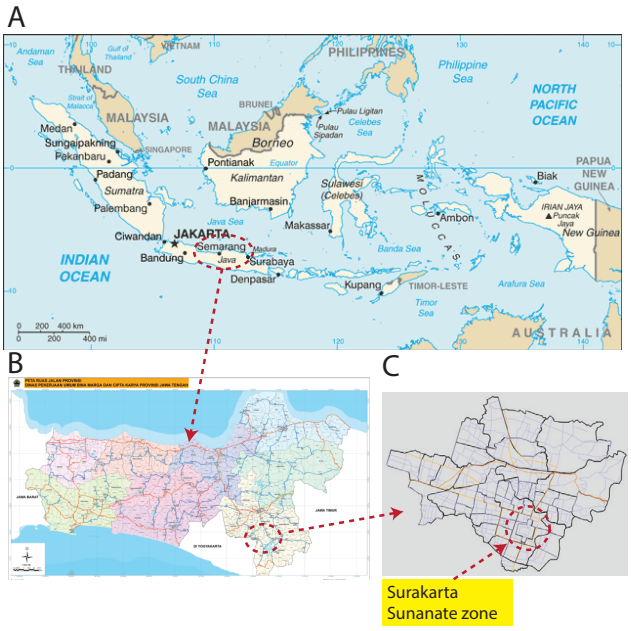
The urban path analysis in this research is based on the path typologies including structure and pattern. The path structure is classified into regular and irregular forms. The path pattern is categorized as linier, grid, radial, circular, and organic forms.

***Table 1**: Path typologies*

| Pattern | Linier | Grid | Radial | Circular | Organic |
|---|---|---|---|---|---|
| **Structure** | √ | √ | √ | √ | √ |
| Regular | √ | √ | √ | √ | √ |
| Irregular | √ | √ | √ | √ | √ |

## 3. STUDY AREA: SURAKARTA

This research is a case study. It is a type of qualitative research in which in-depth data are gathered relative to a single individual, program, or event for the purpose of learning more about an unknown or poorly understood situation (Leedy & Ormrod, 2021). The comprehensive knowledge of Surakarta Morphology in particular the pattern and structure of urban paths is poorly understood in recent era, and this research seeks to add the understanding of that issue. The case of Surakarta City has the interesting view relating to its urban history. It is a Javanese city having an important role in the history of Indonesian cities. The existence of Javanese Kingdom in Surakarta since 18th Century indicates this city has become the growth center since a long time ago. This city has passed several periods of government including empire era, colonial era, and Indonesian government era. The periodization of government certainly implies to the dynamics of city growth. This characteristic distinguishes Surakarta with other cities in Java, except Yogyakarta having also a Javanese kingdom in its region. Historically, Mataram Kingdom in Surakarta, as a big Javanese empire, was divided into 2 (two) kingdoms in 1755 including Sunanate of Surakarta, and Sultanate of Yogyakarta. However, the urban history of Surakarta is longer than that of Yogyakarta. Before the Mataram kingdom developed the palace in Surakarta, its area was only dominated by the space of a traditional settlements that was concentrated around Bengawan Solo which is a big river being located in eastern part of recent city. In recent era, Surakarta is one of Indonesian cities being located in Java Island having the highest population compared to the other islands in Indonesia. It is situated in *Jawa Tengah* (Central Java) Province, and it is the second most populous city after Semarang City as the capital of that province. The population is about 522.364 persons in 2020 (Statistics Agency of Jawa Tengah Province, 2021). Meanwhile the area of Surakarta City is approximately 4404 Hectares (Surakarta Statistics Agency, 2021). The history of the Surakarta Sunanate correlates to the initial urban growth of Surakarta. This situation is shown by the existence of urban center area, including commercial zone and city authority offices, is situated around the area of palace. However, the unit of analysis in this research is not only the urban center area, but a whole of city in order to clarify the comprehensive understanding of urban transformation occurring in Surakarta.




A : Indonesia; B : Jawa Tengah Province; C : Surakarta City

***Figure 1**: Location of Surakarta City*
*Source: modification from https://www.worldometers.info/, https://dpubinmarcipka.jatengprov.go.id/, https://intip.surakarta.go.id/*

## 4. MORPHOLOGICAL ANALYSIS: PATH FORM AND GROWTH

### 4.1. The growth of initial settlement centre

The history of Surakarta City reveals that the existence of rivers has an important role for the initial settlement growth. The settlement was growing around the rivers including Bengawan Solo River, and Pepe River. It was situated in the surrounding area of the conjunction between Pepe River and Bengawan Solo River. Pepe River is a river splitting the city, while Bengawan Solo River is a large river passing the eastern part of city. It was located also around of the small rivers, such as Jenes River, and Tanggul River. The rivers were needed for the human activities in that period. The existence of Pepe River was utilized as water resource for daily life, while the existence of Bengawan Solo River was the route of trading connecting between indigenous people with foreign traders. This situation indicates that the existence of rivers is a principal factor influencing the growth of initial settlement. The embryo of city is located around the 3 (three) mountains in Java including Merapi and Merbabu being located in western region, and Lawu in eastern region, and also 2 (two) highlands including Sewu in southern region, and Kendeng in northern region. The cosmology of Javanese empire relates to the choice of location for the palace and its kingdom is around the mountain or highland areas. One of the reasons is about the defense of kingdom. At that era, several other kingdoms were existed in Java or other islands in Indonesia. Furthermore, it is situated in the plain area. One side, it supports to the development of build-up areas such as settlements, but other side, the existence of main rivers being combined with the plain area trigger the flood risks.

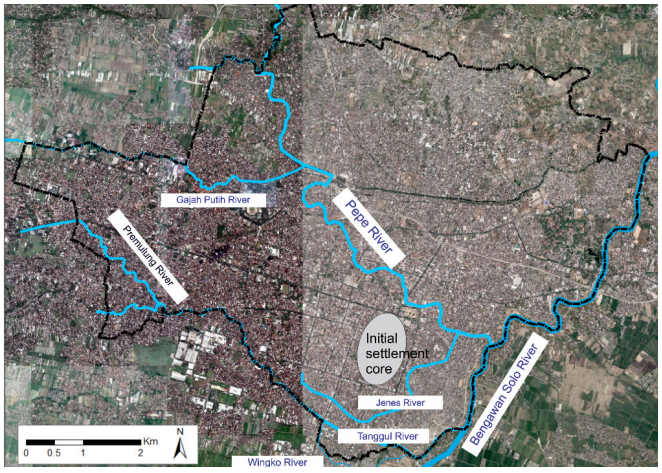
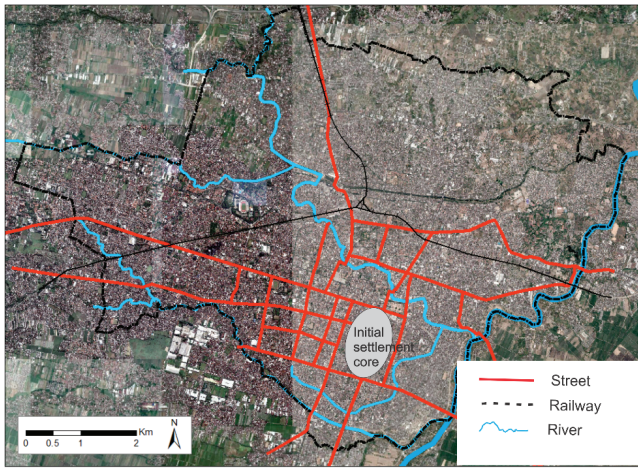



***Figure 2**: Initial settlement core and its surrounding rivers*
*Source: Modification of Google Earth, 2021*

### 4.2. Initial urban pattern from 19th Century to beginning 20th Century

The initial settlement was growing in conjunction with the appearance of Mataram Kingdom. At that time, this kingdom was located in Kartasura, an area situated in the west of Surakarta City. In 1746, the palace zone was moved from Kartasura to Surakarta due to the destruction of palace related to the rebellion. The Mataram Kingdom, and traditional (initial) settlement were growing around Pepe River, and it became the Javanese traditional settlement. The settlement was composed around of palace zone, and it was inhabited by courtiers. It was growing in the surrounding areas in particular western area, northern area, and southern area. Meanwhile eastern area of palace zone was still dominated by dry land and agricultural land.

During this period, the Dutch government had a good relation with the Mataram Kingdom, especially Surakarta Sunanate. The Dutch government could construct the railways passing Surakarta City in the late of 19th Century. It transported the agricultural products in particular cane. The railways divided the city into 3 (three) parts including southern part, western north part, and eastern north part. The railways existence in northern part of the initial city describes the northern boundary of city in that period. The southern part of city was growing as the Javanese Settlements being influenced by the existence of kingdom. It was growing around the palace, and expanded into the western part of palace zone. The main streets have been formed as grid pattern, and were principal ways into the palace zone. The southern part of city was growing as the grid patterned settlements, and nowadays it is a city center area. The traditional market as the activity center was located around the palace. The Dutch government constructed the buildings with the western building models such as offices, and housings along the Slamet Riyadi Street (Straatbeeld). Nowadays, several buildings are maintained and it is the part of Surakarta urban heritage. Furthermore, the Dutch government also built a fortress where was situated in northern area of Sunanate palace. All of streets in residential areas and urban core were properly developed and those were connected. The western modeled houses and Javanese traditional houses were built along these streets. From 19th century until to beginning 20th Century, the urban governance between Surakarta sunanate and Dutch government were well cooperated. The town was determined based on the regular grid linier forms and the urban land use was well arranged.



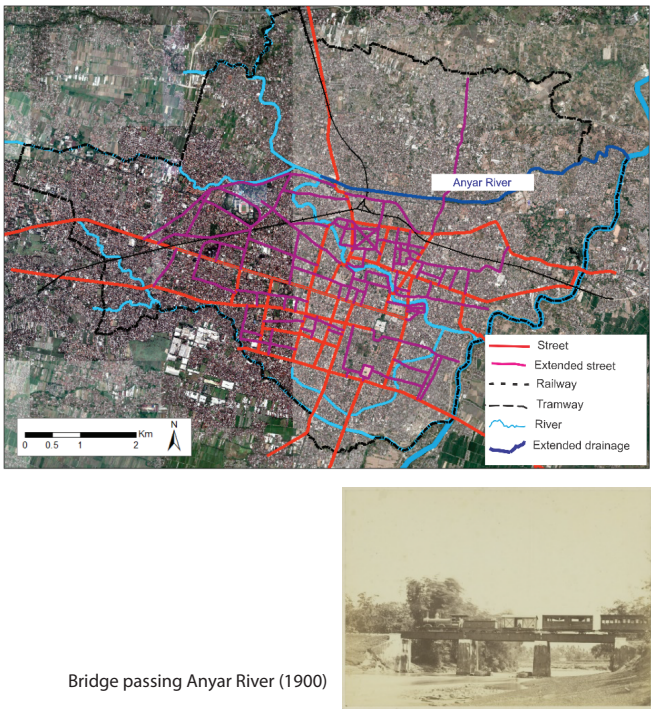

Slamet Riyadi Street (Straatbeeld) as the main street in Surakarta Town (1915)

***Figure 3** : Urban pattern in the beginning 20th Century*
*Source: Modification of Google Earth, 2021, Leiden University Libraries Digital Collections: Maps (KITLV) DE 47,7 and KITLV 34178, accessed online: 1 November 2021*

### 4.3. Urban morphology in the mid-20th Century

The second phase is the period from the beginning 20th century to the end of colonial era in Indonesia (1945). The Dutch Government had a dominant authority in Indonesia during this period. The Dutch government stimulated the city modernization. From 1900 to 1945, various urban utilities have been built, such as electricity network, clean water network, development of railways system, and developments of bridges connecting Surakarta and surrounding areas passing Bengawan Solo (Prayitno & Qomarun, 2007).

The city has experienced the urban extension in the beginning 20th Century. In southern part of city, the collector (secondary) streets have been developed, and those are formed as grid pattern. The extended linier streets took place also in the northern part of city that was limited by the Anyar River (see Figure 4). This river is an artificial drainage that has been built for the flood risk reduction in Surakarta Town. It splits Pepe River, so that the water can flow directly to Bengawan Solo without it passes the town area. The tramway has been built in town area, and it was developed along main street (Slamet Riyadi Street) connecting the Surakarta Town and other cities, such as Semarang and Yogyakarta. These situations describe that the city modernization accelerated the extension of grid patterned city, and it became the initial urban morphology (see Figure 5).






Bridge passing Anyar River (1900)

***Figure 4**: Initial urban morphology in the mid-20th Century*
*Source: Modification of Google Earth, 2021, Leiden University Libraries Digital Collections: Maps (KITLV) DE 49,2 and KITLV 26306, accessed online: 1 November 2021*

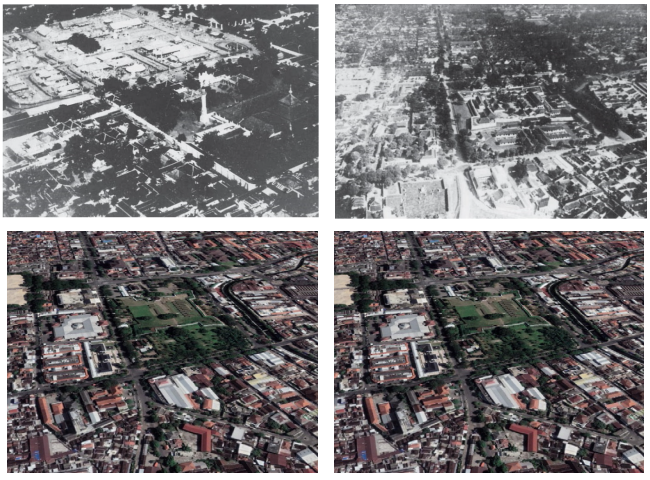


***Figure 5** : Urban Images of Surakarta in 1930 and in 2021*
*Source: Modification of Google Earth, 2021, The National Archives of Indonesia, 2014*

### 4.4. Urban expansion in the end of 20th Century

The third phase is the period from the mid-20th Century to the end of 20th Century. In this period, the Indonesian Government has held the full authority to manage its territory including cities, regencies, and provinces. Surakarta City has become a part of Central Java Province since the Indonesian Government Era. In this period, the city took place the urban expansion to the northern area. The land transformation occurs from the non-build-up area, such as paddy field, and dry land, to the build-up area in particular settlements. The extension of main roads in northern area followed the road structures in the initial city (town). The secondary (collector) roads were growing based on the needs of housing and settlements. Nevertheless, the urban growth in northern area is more slowly than that in southern area (initial city) (see Figure 6).

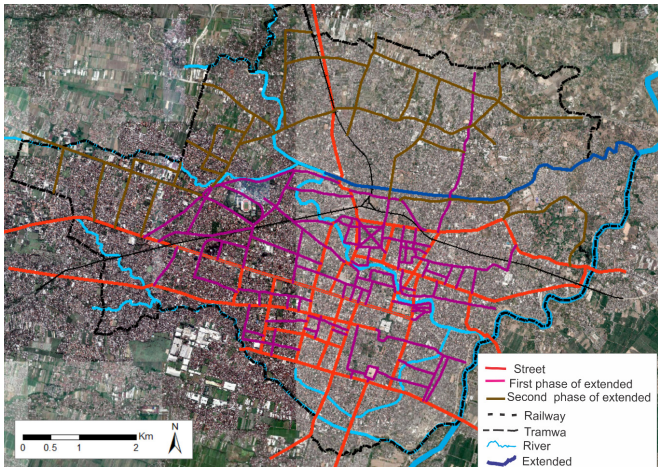



***Figure 6**: Urban expansion in northern part of city in the end of 20th Century*
*Source: Modification of Google Earth, 2021; Surakarta Spatial Planning for 1993-2013*

The constraints of the northern area growth are topography is relatively gradient and hilly area, and the water resource is limited. It is different with the southern area where the build-up zone of initial city was denser. The building coverage of Surakarta City in 2000 has achieved about 79 percent (Surakarta Statistics Agency, 2000). The increasing of building coverage is correlated to the population growth. The population of Surakarta in 1880 was about 124.041 persons (https://www.retrobibliothek.de/), while that in 1980 was 469.532, and that in 2000 was about 490.214 (Mardiansjah et al, 2018). It indicates that the population was increasing significantly for a century, and consequently it needs the development of build-up area to support human activities.

### 4.5. Urban form in the recent era

The fourth phase is from year 2000 to year 2021. In this phase, the Surakarta urban form is relatively not changed than that in previous phase. The high density of build-up area (settlement) and city centres are still concentrated into the southern part of city. The settlement in northern part of Surakarta City has been growing. The building coverage of Surakarta City in 2016 was about 82,8 percent (Surakarta Statistics Agency, 2016). It means that the build-up area of Surakarta City is denser in recent area. Furthermore, the growth of population indicates that it is correlated to the need of settlements in city. Indeed, the increasing of population was only about 32.150 persons or 6.5 percent during two decades, but however it has the consequence for the need of build-up areas.

The expansion of urban roads was limited during the last two decades. The new road took place only the east northern part of city, exactly the Mojo Street. It bridges between Ring Road and Ki Hajar

Dewantara Road, and it passes Anyar River. The existence of this road increases the accessibility between southern area and northern area in the city (see Figure 7).

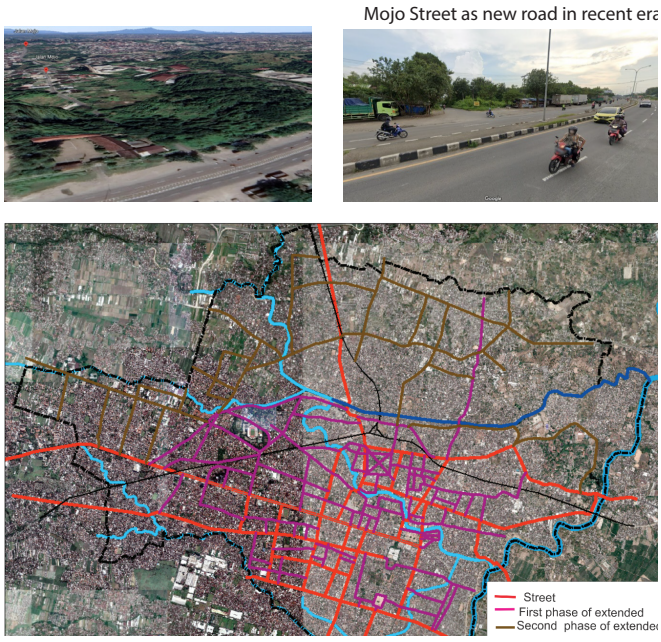



***Figure 7**: Existing urban paths pattern*
*Source: Modification of Google Earth, 2021; Surakarta Spatial Planning for 2011-2031*

## 5. RESULTS AND DISCUSSION

The findings obtained from the morphological analysis explained that the dominant factor influencing the urban form transformation is path typologies. It is proven by the transformations of path elements including rivers and streets. Rivers, including Pepe River and Bengawan Solo River, are the main elements composing the town form and the initial city form. The town has grown around the intersection of those rivers. In addition, Pepe River and Anyar River was influencing the city are divided into 2 (two) parts: southern and northern in general. Those rivers became the boundary of initial city being situated in southern area. In addition, Bengawan Solo River underlines the edge of Surakarta City from the east direction. These situations indicate that river, as linier path, is a principal path element for the morphology of Surakarta City (see Figure 8). In other side, the streets typologies, including pattern and structure, very influence the urban form of Surakarta (see Figure 9). The town was determined by the regular grid street forms until the end of 19$^{th}$ Century.

The traditional city tends to have the regular grid streets form. The main purpose of this form was to serve as thoroughfares for carrying people and goods from one place to another in a quick, safe and reliable way (Rifaat et al., 2012). The royal city as a form of traditional city, tends to have that street form. This situation took place in Surakarta during the period of royal city. It correlates to the authority of empire could easily manage the society in the town. The regular grid streets form produces the effective accessibility and connectivity for people in town. In addition, the existence of rivers had the meaningful urban path element in the royal city era. The location of palace tends to close the water resources such as river. The existence of Bengawan Solo River and Pepe River became the main water resources for the life of society. This phenomenon occurs in many ancient or royal cities in the past time (de Kleijn, 2001; Xu et al, 2018; Scarborough, V. L. et al., 2012). Furthermore, the existence of port, was located around Bengawan Solo River, became the interaction space between indigenous people and foreign traders, and also the water transportation took place through that river. Those situations reveal that the urban paths having the dominant influence to determine the urban form at the period of the royal city.

The urban modernization has taken place since the colonial era and it signs the first transformation of city. It was an initial city, and that transformation occurs until the mid-20$^{th}$ Century. It has grown based on the regular grid-linier street forms. The linier from was based on the development of railways system. It underlined the boundary of the initial city that remains located in southern area where the town is situated. Meanwhile the grid form was still determined as the intensification of initial urban space. It demonstrates the city was planned properly being intervened by Dutch government and Surakarta Kingdom. The emergence of other activity centres and the growth of neighbourhood units in conjunction with the emergence and expansion of urban streets. The neighbourhood unit concept indicates the emergence of new towns (Omer & Goldblatt, 2015). In context of Surakarta, the new town is described as the urban expansion. It indicates the first phase of Surakarta as modern city occurs since that period.

The finding reveals also the essential occurrences influencing the urban path transformations producing the urban change from royal city into modern city are the effort of flood risk reduction, the modernization of transportation, and the need of urban expansion. The effort of flood risk reduction produced the river form transformation in particular the emergence of Anyar River. The modernization of transportation accelerated the existence of railway system indicating the way transformation in Surakarta. Furthermore, the need of urban expansion influenced the streets (roads) form transformation particularly in the northern area of city.

From the mid-20$^{th}$ Century to the end of 20$^{th}$ Century extending the recent era, the urban form of northern area was growing significantly. The urban expansion was based on the urban paths which patterned radial and structured irregular. The radial pattern was the extension of the main streets in town. The development of secondary (collector) streets in northern area of city intersected the main streets, and those streets were growing by the radial-organic patterns. The organic patterns are related to the topography in the northern area of city. The situations above reveal that the urban transformation is based on the change of street typologies that is from regular grid-linear form to irregular radial-organic form. This situation describes the emergence of urban sprawl. It tends to less regular in compactness and more irregular in complexity (Rojas et al., 2013). The urban sprawl indicates the modernization of city (Cartone et al, 2021; Czamanski et al, 2008). It reveals that Surakarta has experienced the second phase of urban transformation relating to the growth of modern city.

In recent era, the insignificant transformation of urban paths typology occurs, and the urban form has been relative stagnant. This situation describes that the irregular radial-organic form of urban paths is still

dominant in recent urban form. However, Surakarta City has passed the urban sprawl process and the majority of city space has the high build-up area. Surakarta spatial planning for 2011-2031, the city is planned to have the open space and urban greenery to only 5% in 2031 (Miladan & Permana, 2020). Furthermore, the majority of urban streets can be easily accessed by the public transportations such as bus, minibus, and taxi-motors. Surakarta urban form as modern city has been determined relatively stable at the recent era.

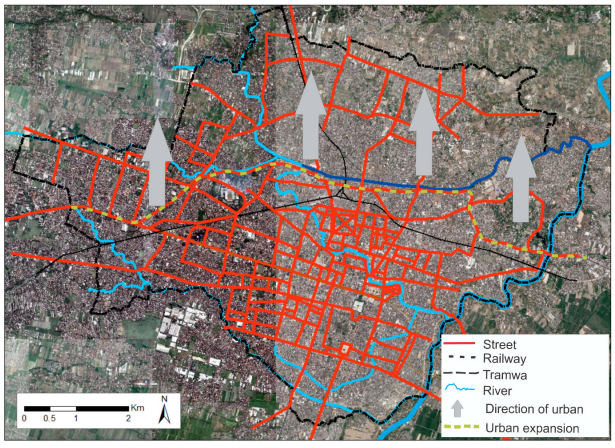



***Figure 8:*** *Urban paths elements and its expansion*

*Source: Modification of Google Earth, 2021*

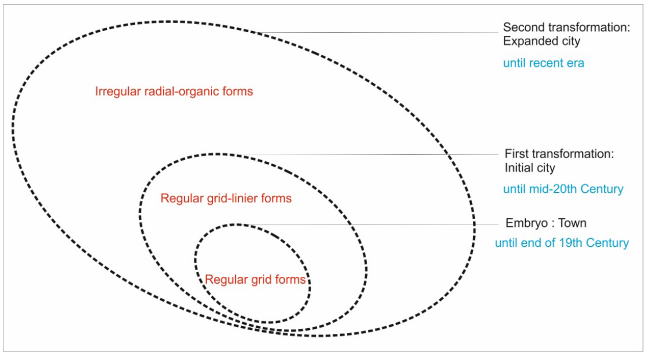



***Figure 9:*** *Urban streets typologies of Surakarta*

## 6. CONCLUSION

This research has revealed the influence of urban path transformations into the urban form of Surakarta. The transformation processes can be analysed through the assessments of the urban path elements in certain periodization including 19th Century period, the beginning of 20th Century period, the mid-20th Century period, and the recent era period. This study explains that rivers are the dominant urban paths influencing the formation of town. Until recent era, the existences of Pepe River, Anyar River, and Bengawan Solo River as the main urban rivers become the edges of Surakarta City which is divided into 2 (two) main areas: southern and northern. In other side, the existence of railway system underlines the boundaries of urban form transformations in Surakarta in particular the initial city and the expanded city. Furthermore, this research justifies that the streets patterns and structures have been transformed intensively and extensively. It changes from the grid-linier forms into the radial-organic forms. This situation indicates that Surakarta morphological forms have changed in accordance with the modernization and the need of urban expansion. The city has been transformed from the Javanese royal city into the modern city. The initial city tends to have the urban paths being determined regular and grid-linier urban forms. It indicates the existence of a traditional (ancient) city that is the royal city in case of Surakarta. The expanded city indicates there was the extensification and intensification of urban paths having the radial-organic urban forms. This form triggered the urban sprawl in Surakarta area. The urban sprawl process is an indicator of city modernization emerging new urban activities centres. In recent era, the high density of build-up area, and the accessible streets (roads) for connectivity in city reveal Surakarta has experienced the modernization in the context of its urban morphology. From this understanding, it can be key point for the direction of Surakarta urban spatial planning in order to support the sustainable city process through the restructuration of urban paths elements such as river and street.

## *ACKNOWLEDGEMENTS*

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