The Influence of Ring Roads on Traffic Characteristics in Urban Cities

Hassan Abid zaid Al-Mousawi [1*], *lee* Vein Leong [2] and *Hamid* Al-Jameel [1]

[1]Civil Department, Faculty of Engineering, University of Kufa, Najaf, Iraq
[2]Universiti Sains, Malaysia

Abstract. Constructing ring roads is a traditional approach to alleviating traffic congestion in urban areas and enhancing road capacity. However, this solution is frequently inefficient in the long run. This study investigates different strategies for managing traffic congestion in urban areas and evaluates their efficacy. The text examines three situations where various methods were employed to address traffic congestion issues. These strategies are categorized into three distinct categories. The initial concept encompasses substantial engineering interventions, such as the establishment of ring roads, the creation of new roadways, and the enlargement of preexisting roads. Many cities are implementing push-and-pull strategies to optimize existing capacities and promote environmentally friendly transportation alternatives, thereby reducing car usage. These strategies include promoting public transportation, cycling, and walking, as well as modifying urban land use patterns to minimize the need for people to travel. These methods are successful in delivering long-lasting transportation solutions. Nevertheless, more than push-pull strategies are needed to adequately address traffic congestion, necessitating extensive engineering interventions to expand road capacity, particularly in cases of severe traffic in urban areas. The integration of these methods is categorized as the third principle. The utilization of ring roads also gives rise to numerous novel challenges, particularly in metropolitan areas. The predominant issue lies in the unregulated expansion of houses (urban sprawl) and inadequate public transportation. The problems identified of significant magnitude include Interconnectivity between different regions, the point where ring roads intersect, accessibility to housing, settlement amenities, and social challenges. The study determined that the third concept to tackle traffic congestion could be the most efficient approach for constructing ring roads in urban areas. To address the difficulties involved in the construction and development of circular roads, it would be beneficial to establish an organization that facilitates coordination among all stakeholders involved in the development of ring roads right from the outset. Urban Planning Directorates at the governorate level are responsible for carrying out this work in urban cities. In addition, rigorous enforcement of laws is also crucial for achieving desired goal.

1 Introduction

Dense traffic in metropolitan areas has a substantial negative impact on the natural environment and the economic system. According to the Canadian Taxpayer Alliance, the yearly cost of traffic exceeds $1.5 billion, not including the economic impacts of producing large amounts of greenhouse gases and causing severe environmental damage via pollution generated by poorly driven automobiles [1]. Studies have shown that motorists in Moscow experience an annual reduction of 127 hours due to traffic congestion [2]. In addition, traffic congestion was responsible for 20.3% of greenhouse gas emissions in Europe, with carbon dioxide (CO2) constituting 88.2% of the total emissions. The primary factors responsible for air pollution resulting from traffic congestion were nitrogen oxides (NOx), accounting for 58%; non-methane volatile organic compounds (NMVOC), contributing 18%; carbon monoxide (CO) at 30%; sulfur oxides (SOx) at 21%, delicate particulate matter with a diameter of 2.5 micrometers or less (PM2.5) at 27%, and particulate matter with a diameter of 10 micrometers or less (PM10) at 22%. The main goal of the many solutions developed worldwide to alleviate traffic congestion is to minimize the duration of time spent on the road. According to traffic experts, a strategy to reduce traffic congestion includes increasing the capacity of highways by building ring roads, extending existing roads, creating rail-over-road grade separations, constructing flyovers, improving intersections, expanding parking lots, and implementing toll road incentives. Establishing or developing ring road networks is a widely used strategy to alleviate the problem of traffic congestion. This study investigates several techniques to mitigate traffic congestion and assesses their long-term efficacy in urban regions worldwide.

* Corresponding author: hassana.almusawi@student.uokufa.edu.iq

Based on this information, the study aims to classify the various strategies employed by these cities to mitigate traffic congestion and assess their effectiveness. The objective is to determine if building a ring or bypass road would be more efficient in lowering traffic and decreasing dependence on private vehicles to ease traffic congestion in urban areas. High population density in urban areas, resulting from urbanization and natural development, greatly affects the demand for infrastructure and settlements. The study also aims to classify and address new challenges arising from the expansion of ring roads in major centers.

2 Ring Roads and their Impact on Reducing Traffic Congestion

The first circumferential routes were built around Berlin, Munich, and London in the 1930s. The construction of ring roads in Europe, in particular, was not intended to relieve congestion in the past because there were no traffic jams and congestion, and the number of vehicles at that time was different from the amount that caused the traffic problems that emerged later [3]. The primary objective of ring roads was to create impressive structures and enhance the existing spatial organization of cities [4]. Furthermore, automobile penetration rose dramatically following World War II, which encouraged the construction of oceanic highways in many prosperous countries. Ring roads provide alternative routes for vehicles destined for suburbs or transport goods to peripheral suburbs without passing through the city center, thus relieving traffic congestion in city centers by providing alternative routes for traffic and decentralizing the flow of vehicles from heavily congested main arteries. Ring roads relieve traffic congestion by diverting vehicles away from urban centers. Furthermore, ring roads redirect unfavorable traffic patterns, limiting the flow of transit goods and cross traffic to the city center, thus avoiding congestion in the central area. Moreover, when a city expands, and its urban planning extends towards the ring road or suburban areas, the ring roads greatly influence the city organization and act as a tangible constraint.Suburbanization, the process of converting rural regions into municipalities that heavily rely on automobiles, intensifies the reliance on vehicles without sufficient public transit options. Moreover, the development of ring highways and the rise in traffic in city centers have led to significant changes in the distribution of accessibility within metropolitan regions [5]. "The suburban decentralization process has mainly focused on these areas due to their high accessibility along the orbital corridors. The city center is no longer the most easily reachable point by car." [5]. According to specific authors [6], the construction of ring roads positively impacts local businesses since they function as transport hubs and contribute to the expansion of companies, the development of economic districts, and the relocation of jobs from urban centers to suburban areas. Ring roads improve the ease of reaching suburban areas, increase the value of properties, and attract additional investors [7]. Ring roads facilitate the dispersion of activity while simultaneously intensifying traffic flow between different regions, leading to a progressive congestion buildup on these roadways. The demand for more orbitals at greater distances from the city center steadily increases [7]. "According to a meta-analysis of numerous studies, increasing the number of lane miles by 10 percent leads to an immediate 4 percent increase in vehicle miles traveled. Over a few years, this increase in capacity results in a 10 percent rise in vehicle miles traveled, encompassing the entire added capacity [8]." Consequently, the expansion of ring roads may not ultimately alleviate the challenges related to traffic congestion. Instead, it will promote the utilization of new automobiles and lead to a substantial deterioration of the environment due to heightened vehicle usage at peak hours, often known as "generated traffic."

3 Impact of Ring Roads on Traffic Flow

Expanding road capacity results in two specific types of traffic: redirected traffic, which is impacted by elements such as time, route, and destination, and induced traffic, which emerges from adopting alternative means of transportation, longer journeys, and the use of new cars [9]. The phrases "the more construction occurs, the more drivers will be attracted" and "roads themselves contribute to the creation of traffic" are connected to the concept of created traffic. Hence, augmenting the lane capacity on an existing road or constructing a circular thoroughfare are two instances of enhancing a transportation system that will entice a larger populace to use the novel mode of transportation. Superficially, the new improvement improves the efficiency of traffic movement and reduces travel durations [10]. Consequently, the traffic problems may have been fixed. Over time, the newly constructed road infrastructure causes a shift in the locations where people choose to live and work, attracting more vehicles and leading to a rise in traffic volume [10]. Hence, disregarding the long-term consequences of traffic congestion seldom leads to its reduction. Specifically, the total number of journeys rose by 8% in the year after the opening of the North Sea Channel section of the Amsterdam Ring Road. Of the entire amount, 3% can be ascribed to self-generated growth, while 2% is supplied by distant work. In addition, 5% of the increase might be attributable to adding new drivers due to improved transportation infrastructure, a process known as induced demand. Out of the total 5% increase in demand, 2% can be ascribed to changes in travel plans, 1% to passengers who decided to start driving themselves, and 2% to modifications in the frequency and destination of journeys [11]. Furthermore, the inauguration of the North Sea Channel led to a significant 22% increase in the total number of trips within five years. The gain can be attributed to a 15% rise from autonomous sources and a 7% rise from induced demand from the new road infrastructure [12]. It is essential to comprehend thoroughly how drivers respond to different travel conditions. Before commencing a journey,

individuals operating vehicles often undertake the following determinations: ascertain whether to start on a trip (trip generation) and select the most suitable destination to fulfill their requirements (trip distribution). Short-term "Triple Convergence" refers to redirecting journeys from alternative routes, schedules, and transportation modes [13,14].This accounts for the majority of the generated traffic. Nevertheless, as time progresses, the proportion of traffic generated by induced travel will progressively increase. The increase in road capacity is influenced by the patterns of land use that rely on automobiles [15]. Constructing a new highway might entice businesses or people from conveniently located, varied neighbourhoods to suburban and exurban areas with higher car traffic per individual. Additionally, studies have shown that traffic congestion contributes to maintaining balance [16]. During periods of low congestion, traffic volume increases. However, as congestion on the roads intensifies, the growth rate of traffic volume decreases until it reaches a point of equilibrium, at the point where the curve reaches a state of being parallel to the x-axis. When further capacity is introduced, traffic volumes increase until a new balance is achieved. "generated traffic" describes the additional vehicle travel associated with a single link [17]. In contrast, "induced travel" refers to the total vehicle travel. It is essential to highlight that the movement along the demand curve demonstrates the short-term impact on traffic volume. Although the total demand for vehicle travel stays constant, drivers experience decreased travel costs when congestion decreases. Furthermore, the expansion that takes place as transportation patterns and spatial development become more focused on automobiles, meaning that significant car usage is necessary to reach employment, stores, and other activities, illustrates the long-term effects of induced travel. Regardless of the accuracy of the expected traffic increases, any road improvement will inevitably lead to a 10% increase in current traffic in the short term and a 20% increase in the long term [18]. Research and transportation modeling has shown that expanding road capacity is just a short-term remedy for reducing traffic congestion and addressing the environmental problems linked to traffic. Simultaneously implementing push and pull strategies to alter transportation demand and reduce automobile use is essential in conjunction with constructing more ring roads.

4 Effectiveness of the Three Concepts

A comparison analysis is performed to examine the methods used by different cities to reduce traffic congestion. The tactics implemented by each municipality are classified into three main categories. The sites now under close examination include Polegate, United Kingdom, and five bypasses around the United Kingdom. The cities of Hasselt, Belgium; Malmö, Sweden; and Oslo, Norway, are now under intensive scrutiny. Table 1 presents further case examples for each idea. These cities aim to mitigate traffic congestion in their transportation systems to enhance the environmental quality of urban and peri-urban areas. The three themes exemplify the diverse strategies that can be employed to mitigate traffic congestion: The first concept prioritizes the augmentation of additional road capacity. The second model utilizes transport demand management tactics, for instance, using strategies like push and pull measures may effectively decrease automobile traffic without increasing road capacity. Third concept integrates both Concept 1 and Concept 2. The three aforementioned principles are succinctly outlined and reinforced hrough additional instances examples, as depicted in Table 1. Given the case study's illustration of a substantial surge in traffic flow, it is evident that Concept 1 is only feasible in the short term. However, it was found that Concepts 2 and 3 effectively reduced traffic congestion by decreasing the number of vehicles.

Table 1: Examination of three distinct concepts and their effectiveness in reducing congestion.

Topic 1: Measures in Heavy Engineering	**Topic 2: Travel Demand Management Utilising Push and Pull Measures**	**Topic 3: Integration of Heavy Engineering and Travel Demand Management through Push and Pull Measures.**
The Polegate Bypass experienced a significant 76% overall rise in traffic within one year, with 27% of this increase attributed to induced traffic. After five years, the generated traffic accounted for 32% of the total growth. The user's text is "[19]".	In Hasselt, over one year, there was a 16% switch from vehicle use to bus use, a 12% switch from bicycle use to bus use, and a 9% switch from walking to bus use. In 2006, the annual ridership of free buses in Hasselt was approximately 4.6 million people, while in 1997, it was 1.5 million bus passengers. The user text is "[20]".	Stockholm introduced the Essinge bypass and traffic congestion fees (tolls) to decrease the total distance traveled by vehicles inside the city center. Consequently, the result was a 16% decline in kilometers traveled by vehicles in the inner city and a 22% drop in vehicle traffic inside the charge cordon. Additionally, the improved bus service contributed to this reduction. The user's text is "[22]".

The A500 Basford, Hough, Shavington bypass has experienced a 7.7% rise in traffic volume over five years. The A66 Stainburn & Great Clifton bypass has seen a 13.6% increase in traffic volume over seven years. The A1 Willowburn – Denwick Improvement has witnessed a 21.8% increase in traffic volume over eight years. Lastly, the A1 Bramham-Wetherby bypass has observed a 7.4% increase in traffic volume over three years. The user's text is "[19]".	In Malmö, 30% of inhabitants opt for bicycles as their mode of transportation to commute to their workplaces. From 2006 to 2011, there was a 6% decline in individual car traffic despite a 9% growth in population and a 15% increase in workers. The user's text is "[20]".	In Oslo, utilizing the Festningstunnel and the imposition of congestion charges resulted in a significant shift in travel patterns between 2005 and 2015. The proportion of public transport usage rose from 21% to 32%, while the ownership of cars declined from 45% to 34%. The user's text is "[23]".
Newbury Bypass: FYA: The actual amount of induced traffic significantly surpassed the Highways Agency's worst-case projection from 1995, which predicted that there would be no more than a 10% increase. The actual traffic level exceeded the expected number by 46% six years before the 2010 forecast [19].	In Utrecht, there has been a significant rise of about 50% in bicycle usage and car sharing, while private car usage has decreased by 14% [20]. In Hague, car ownership declined by 12% while the utilization of public transport increased from 30% to 65% [21].	Helsinki: Circular highway and electric vehicle charging regulations The critical roadways in the metropolitan area experienced a decrease in peak-period traffic congestion by 10-30% [22].
The Barnstaple Bypass experienced a 20% increase in traffic within three years. Similarly, the M62 saw a 19% increase in traffic over five years. The Severn Bypass had the highest traffic growth, with a 44% rise in just one year [23].	The closure of the motorway in the urban center of Seoul, Korea, known as Cheonggyecheon, in conjunction with the enactment of enhanced bus services, extended subway operating hours, the introduction of new bus routes encircling the downtown business district (the CBD), and increased parking fees, effectively mitigated the traffic congestion resulting from 168,000 cars per day. Between 2003 and 2008, this campaign resulted in a 15.1% rise in the number of people using buses and a 3.3 percent rise in subways [24, 25, 26].	Milan plans to expand its subterranean network and implement a charge for entering the city center. Additionally, they will introduce new bus lanes, increase the frequency of buses, implement stricter parking restrictions and higher rates, and provide park-and-ride facilities. The car traffic in the city center was reduced by 34% [27, 28].
Following its inauguration, the North Sea Channels portion of the Rotterdam Ring Road had a notable 8% surge in traffic within a year, with 5% of this rise being due to induced traffic. Following five years, there was a significant 22% rise in visits, of which 7% may be directly attributable to encouraged traffic [23].	The project at Jellicoe Street, Auckland, involved the demolition of an industrial service road and the creation of a pedestrian boulevard. The region also implemented car bans and integrated a Light Rail Transit (LRT) system with a shared-space approach. Controlled parking was introduced as well. As a result, there was a significant rise in cycling usage by 67% and bus use by 57%. Additionally, there was a substantial fall in car use by 46% [26].	In Gothenburg, implementing a congestion toll cordon, additional bus lanes, and decreased parking space limits in the city center resulted in a 12% decrease in car traffic across the cordon and a 6% decrease in the city center [29].

The A316 in London experienced a significant increase of 84% in induced traffic over eight years. Similarly, the M11 in London saw a 38% increase in generated traffic over nine years. The Leigh Bypass also experienced a 20% increase in induced traffic within one year [23].	In Paris, the closure of the Pompidou Motorway and the implementation of a car-free zone along the left bank, combined with a shared space on the right bank that includes a narrower road for automobiles and more extensive paths for walkers and cyclists, resulted in a 20% decline in private car usage over a period of 5 years [30].	Jakarta has implemented several measures to minimize car traffic in the city center, including constructing an outer ring road, implementing congestion charges, and the extension of the Great Jakarta commuter train. Additionally, the city has introduced mass rapid transit (MRT), light rail transit (LRT), and bus rapid transit (BRT) systems. These efforts have resulted in a 30% reduction in car traffic in the city core [31].
The Westway in London experienced a 50% increase in induced traffic over ten years, whereas the Manchester Ring saw a 23% increase within just one year [23].	Vauban, located in Freiburg, is a community designed to be car-free and parking-free. It is a mixed-use area with a focus on short distances. There is a convenient interchange between buses and trams, and the neighborhood operates not-for-profit. The vehicle-sharing service resulted in a 57% decrease in car usage and a 75% rise in bicycle usage [30].	The Hammersby Sjostad area in Stockholm underwent a redevelopment of a 160-hectare brownfield site, the Tvärbanan tram line was extended as part of this redevelopment, and two new bus lines were introduced. The neighborhood is situated near a congestion toll border. In addition, car-sharing and bike-sharing services and bicycle parking facilities were introduced for each building. Implementing these measures led to a significant rise in the utilization of public transportation by 52%, an increase in cycling by 27%, and a decrease in vehicle usage to just 21% [30].
Not efficacious in the long run	Efficient	Efficient

5 Identification of issues in the development of the ring road

The investigation of ring roads and the conditions of the surrounding areas provides the basis for identifying the issues associated with the development of ring roads. Data was collected with four distinct methodologies: The research used a technique that included four main components: (1) evaluating the spatial planning, (2) doing direct visual observation, (3) surveying inhabitants residing around the ring road, and (4) conducting interviews with relevant agencies and organizations. The survey undertaken across seven prominent urban centers in Indonesia, namely Medan, Palembang, Bandar Lampung, Surabaya, Makassar, Manado, and Jakarta, revealed 23 difficulties with constructing the ring road [32]. The concerns above encompass:

Challenges to the connectivity and integration of different regions and urban areas. For example, several parts remain disconnected from Manado's newly built ring road.

Concerns about the width of the ring road. An example of this is the narrowing of the road at the intersection of the Inner Ring Road in Medan and the former road.

Physical ailments or health problems. Multiple areas of Medan's inner ring road are uneven and damaged.

Issues about bottlenecks or congestion. During peak hours, traffic congestion occurs on Jakarta Ring Outer Road (JORR).

Problems arise at the junction of the ring road and another route. For example, let's examine the inadequately planned the point where the Collector Road and the Ring Road join in Manado.

The entry of the house garden was directly connected to problems with the ring road. An example would be the front yard of a house directly next to Medan's inner ring road.

The roadside roadblock is leading to traffic problems on the ring routes. An example of this is the utilization of t he roadside as a parking area on the Bandar Lampung ring road.

Challenges about public transport modes and infrastructures. For example, in Manado, no bus stop is available for residences near the ring road.

Issues related to improper alteration of land use. For example, the vicinity adjacent to Palembang's ring road has transformed from agricultural to residential land use.

Uncontrolled housing growth and sprawel problems: housing around Manado' ring road.

Challenges associated with high population density. The population density in the residential area next to the inner ring road in Medan.

Challenges about land ownership legitimacy and incarceration. For example, multiple occurrences of land being seized and subsequently freed to facilitate the construction of Makassar's ring road.

Challenges related to insufficient housing and settlement infrastructure. For example, let's analyze the many housing complexes in Bandar Lampung that still need to complete public infrastructure surrounding the ring road.

There is a need for more environmental infrastructure. For example, Palembang Ring Road needs to be improved regarding sanitation infrastructure.

Challenges related to accessibility to home from ring roads. An example of this is the difficulty of accessing a residential complex from Manado's main artery, the ring road.

Challenges related to housing in impoverished urban areas. Many instances of slum houses were built in the roadside area of Bandar.

Concerns about the deterioration of the environment. An example of this would be the implementation of a new circular thoroughfare in Manado, which would have a detrimental impact on the local ecology.

Moreover, there are problems with the acquisition of land. An obstacle to the liberation of the area allocated for Makassar's middle ring road (MRR) is the abundance of residential complexes in the city.

Alignment of matters about urban spatial planning. Manado's ring road provides examples of diverse land use rules that extend over administrative regency boundaries.

Coordination across sectors regarding matters related to local government. Many structures around the ring road were approved for demolition by the local government because of a need for more communication between the street organizers.

Challenges about the funding of development. For example, land in Makassar is purchased regularly due to a lack of money.

Disaster problems: Certain sections of Manado's ring road are susceptible to landslides.

Issues about society. Several sites along the Medan Ring road are susceptible to criminal activity throughout the night due to the absence of street illumination. as shown in Figure 1.

(a) Connectivity issues in urban and regional locations

(b) Physical condtion problems

(c) Traffic jam / congestion

(d) Intersection of the ring road with another route

(e) Housing accessibility linked to ring road

(f) Traffic-disrupting roadside barrier

(g) Uncontrolled housing growth purchase of land

(h) Challenges related to the environmental and urban amenities

(i) Inadequate provision of

Fig. 1. The most common problems of ring roads [32].

6 Typologies of issues in the ring roads

Based on the survey results for the seven cities, there are 23 emerging problems near ring roads. Difficulties can be categorized into comparable issues to create a basic taxonomy of challenges [32]. The problems that arise are categorized on the basis of urbanization, regulations, spatial planning, housing, stakeholder governance and environment. These sections facilitate the classification of ring road development difficulties for large cities in Indonesia, as shown in
Figure 2.

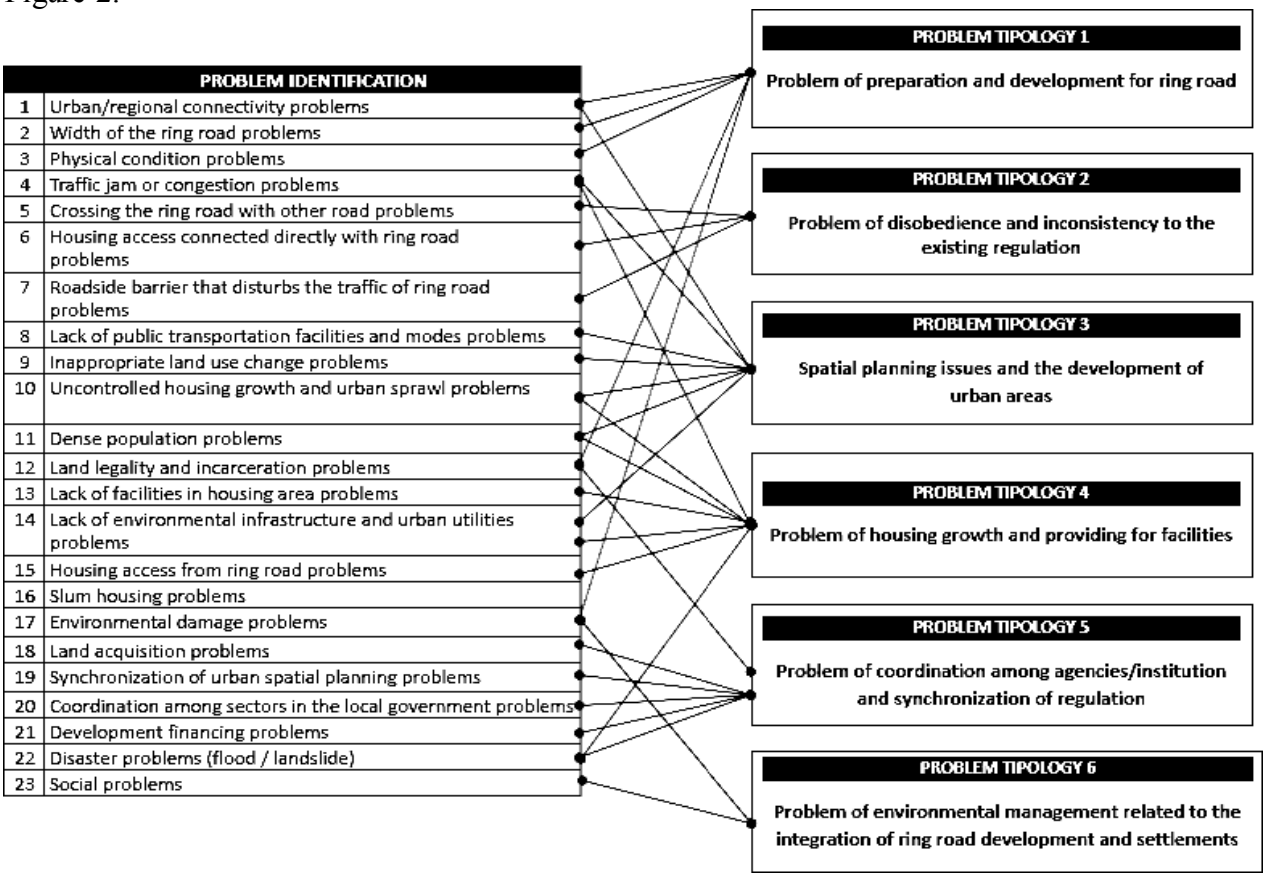

Fig. 2. Formulation of problem typologies for the creation of a ring road. [32].

The six difficulty categories associated with the development of ring roads in Indonesian metropolitan centers can be further explained as follows:

1. The matter of planning and constructing circular highways. The predominant challenge encountered in the planning and building of ring highways is the matter of procuring land. Due to the government's insufficient financial support, the land purchase process cannot be comple ted concurrently. Thus, the process co-occurs with the growth of the town. Consequently, there are still several ring road connections and construction projects that remain unfinished. An additional concern arises from developing a segme nt of the new ring road among densely inhabited regions. It is challenging to upgrade the existing routes to meet the criteria of the new ring road in this case.
2. The problem of noncompliance and irregular enforcement of regulations. Noncompliance with existing rules is the primary factor contributing to many problems on the ring road. The ring road should be built as a toll road due to its significance as the primary route, although this is not the case in most local areas. Due to its direct connection to residential complexes and villages, this toll-free circular route presents several challenges. Furthermore, the swift proliferation of housing complexes and towns will increase roadside barriers and violations of territorial boundaries.
3. The topic of urban growth and spatial planning. Suburban residential developments or settlement regions usually emerge after ring highways are installed. Occasionally, the unplanned growth of residential areas clashes with the objectives of spatial planning and local development. Many recently built residential areas are distant from The Regional Activity Centre (RAC/PKW). This might lead to increased transport rates and ultimately result in congestion on the ring road.

4. The matter of housing expansion and the provided amenities. Upon the widespread dissemination of the new ring road location plan, developers eagerly seized the opportunity to acquire land near the new ring road. This condition may have an impact on urban sprawl and unregulated housing. The absence of adequate urban planning and the unrestrained expansion of residential development have led to the ineffectiveness of public amenities. Additionally, it has been shown that several developers are required to provide public facilities as mandated by settlement regulations. Furthermore, research has shown that several residential buildings near ring roads either need more road access or have it but still need improvements.
5. The issue of achieving synchronous cooperation between institutions and rules. Lack of cooperation across organizations and entities might lead to issues in issuing construction permits. There are several ongoing problems over the construction permission for the location of the ring road at various places. Obtaining property for a circular highway is further complicated by needing a construction permit (IMB). It has been ascertained that the circle of roads intersects many administrative borders. Local authorities must collaborate in order to fulfill this obligation. It is advisable to synchronize development laws with a specific emphasis on implementing consistent space limitations in regions adjacent to the circular road.
6. An environmental management difficulty that arises from merging ring highway and development of settlements is the environmental effect. The story of ring roads and the adjacent settlements could exert adverse effects on the environment. When devising a plan for a circular route, it is imperative to consider this situation right from the beginning. Effective planning is essential for the expansion of residential areas to ensure the provision of a comfortable and conducive living environment. Occasionally, slum colonies are found encircling ring roads, which diminishes the surrounding area's appeal. Immediate action must be taken to halt the spread of slum settlements, and the surrounding vicinity should be restructured.

7 Discussion

Ring roads relieve traffic congestion in urban centres by providing alternative vehicle routes. Furthermore, ring roads redirect unwanted traffic, such as transit goods, away from the city centre to relieve congestion. Ring roads greatly influence urban planning by stimulating urban sprawl and facilitating expansion. Moreover, the ring road poses a tangible impediment to the city's growth. This study examines several methods to relieve traffic congestion in urban areas and evaluates their effectiveness.These strategies are categorized into three distinct ideas. The first idea includes methodologies for constructing ring highways, constructing new roads, and expanding pre-existing road networks. Ring roads facilitate the dispersion of activity and at the same time intensify traffic between suburban areas, leading to a gradual build-up of congestion on these roads. Consequently, this increases the need for additional roads located at a significant distance from the city core. This approach has proven ineffective in the long term due to the high volume of traffic it generates, leading to traffic congestion due to the gradual growth in demand for using these roads. The second concept includes improving current capabilities and adopting environmentally sustainable alternative modes of transportation to reduce the use of cars. This involves advocating for the use of public transit, cycling, and walking, as well as reducing people's need to travel by reshaping urban land use patterns. This concept has proven effective by offering long-term, environmentally-friendly transportation options. However, alternative modes of transportation and mitigation strategies, such as push and pull measures, may need to be reviewed to effectively address traffic congestion. In such cases, it may be necessary to enhance road capacity by implementing significant technical interventions, especially when the city faces high traffic volumes. This technology represents the third principle in traffic congestion management. Based on surveys and data analysis conducted on a selected group of cities in different parts of the world, it has been proven that building ring roads enhanced by alternative and environmentally sustainable means of transportation is the most efficient approach to addressing traffic congestion issues in urban areas. Using ring highways creates many additional challenges, especially within major cities. The prevailing problem is the unregulated expansion of residential areas (urban sprawl) and insufficient public transportation. The secondary obstacles were regional connectivity, the intersection of circular roadways, housing accessibility, settlement amenities, and social concerns. This study highlights the potential for enhancing the construction and administration of ring roads by establishing an institution that promotes effective coordination among all parties engaged in the development process from its inception. Urban planning directorates at the governorate level can carry out this work in major cities. Moreover, strict implementation of laws is also crucial for successful development.

8 Conclusions

The salient findings extracted from this study are as follows:

1. Establishing ring roads initially mitigates traffic congestion in large urban areas, but with time, their efficacy reduces due to the escalation in traffic volumes resulting from their utilization. Therefore, the third paradigm combines extensive technical and transportation demand control techniques with push and pull strategies. This strategy is especially appropriate for metropolitan regions that aim to redirect traffic

since it efficiently alleviates traffic congestion by reducing car usage and encouraging other transportation methods.

2. Ring roads play a role in determining the layout of a city by causing the urban spatial structure to shift away from the center towards the outlying districts. The ring road, a physical barrier, accompanies this city expansion. Ring roads facilitate the growth of local enterprises by serving as transit routes, promoting business expansion, fostering economic development in specific regions, and redistributing employment opportunities from urban centers to suburban areas. Ring roads improve the ease of reaching suburban municipalities, elevate the value of real estate, and enhance its appeal to investors.
3. One of the primary issues ring roads face is an unregulated expansion of residential areas (urban sprawl) and inadequate public transport. The identified issues of significant magnitude include regional connectivity, the intersection of ring roads, accessibility to housing, settlement amenities, and social challenges.
4. The analysis determined that the construction of the ring road serves two purposes: enhancing connection between cities and promoting regional growth. The ring road can serve as a means of connecting the National Activities Centre (NAC/PKN). It can adhere to the regulations and standards of a primary arterial road. Additionally, housing development surrounding the ring road should align with spatial planning and settlement planning regulations and standards. The absence of integration between these two factors will result in issues and limitations in urban growth, ultimately leading to a detrimental impact on regional development.
5. An institution can be established to facilitate coordination between all parties concerned with developing ring roads, starting from the initial stages. This would help solve most problems, alleviate difficulties, and enhance the overall efficiency of ring road projects. Urban planning directorates at the governorate level can implement this role in the context of metropolitan cities. In addition, strict law enforcement is crucial for effective development.
6. Green areas and afforestation can be used as barriers on both sides of the ring road to mitigate pollution, environmental degradation, nuisance, noise, direct connection between the entrances to residential units, and the challenges on the round highway.

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