Research on Intensive Development Mechanism of Land Use in Small and Medium-sized Cities in Western China Based on "the Yangtze River Conservation" Strategy

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Abstract
As a crucial national strategy of China's national ecological civilization construction, "the Yangtze River Conservation" aims to achieve the overall planning and balance of ecological protection and urban spatial development at the macro-scale of the entire river basin. In practice, there are significant differences among cities along the Yangtze River. Different from the central large cities which have concentrated resources, technology and human resources, small and medium-sized cities are limited by their resources, location and underdeveloped economic level. Therefore, differentiated and intensive urban spatial structure and land use mechanisms will be of great significance to sustainable urban construction in the future. In this research, eight small and medium-sized waterfront cities in Chongqing were detailed investigated, revealing the dynamic spatial-temporal relationship between urban space, water and citizen life in history, which can be summarized into four types of urban spatial structure evolution models. Based on this, a five-part intensive land use framework consisting of evaluation, accounting, grading, resilience, and collaboration is proposed for architectural design. Firstly, the ecological sensitivity of built-up areas is evaluated as the basis. Secondly, functional indicators are accounted for and construction capacity is readjusted to avoid extensive land expansion. Then, the construction proposal is graded in terms of efficiency of use, which will be gradually realized in multiple stages to improve risk resistance. Finally, a land information platform is established before construction sharing between neighboring blocks to achieve resource complementarity.

Keywords: Intensive Development, Land Use Mechanism, Western China, Small and Medium-Sized City, The Yangtze River Conservation

Introduction

China has experienced rapid urbanization in the last three decades, and the results of the seventh national census in 2021 show that the current urbanization level in China has jumped from 17.92% in 1987 to 63.89%, and the total population living in urban areas has also broken through from 170 million to 900 million, with the number of mega-cities and super-cities increasing to 7 and 14 respectively, making considerable achievements in urbanization construction. And these results are particularly prominent in the development history of cities in western China.

From the end of the 20th century to the present, the development of western Chinese cities has gone through several periods in which it has been closely related to the introduction and implementation of several national policies or strategies. The cities in western China are widely distributed and numerous, including 12 provinces, municipalities or autonomous regions, accounting for 71.4% of the country's area and 27.12% of the population in 2020, and it is difficult to analyze them one by one, so Chongqing, which plays an important role in several national policies and strategies, is selected as the regional boundary for this study.

Chongqing is located in the southwest region of China, and as a provincial administrative unit, is the youngest of the four major municipalities in China. After becoming a municipality in 1997, it has been constantly present in China's national development strategies. In "China's Western Development Drive" strategy, which started in 2000 and continues to this day, Chongqing is one of the important development pivots connecting the more economically developed coastal areas in the east and the vast areas in the less developed west. In 2013, the "One Belt, One Road" cross-border cooperation began, and Chongqing gradually formed a "diamond-shaped" interaction with Chengdu in the west, Kunming in the south and Xi'an in the north, becoming an important economic opening node together and making great progress in the construction of western cities. In 2016, "the Yangtze River Conservation" strategy was proposed to develop the Yangtze River Economic Belt, which aims to "step up stronger conservation and stop its overdevelopment", so the balance between economic development and ecological conservation is further emphasized. As can be seen from the map, Chongqing is an important urban node in the upper reaches of the Yangtze River and has a key role in controlling water quality, coordinating transportation and protecting the ecosystem of the river basin.

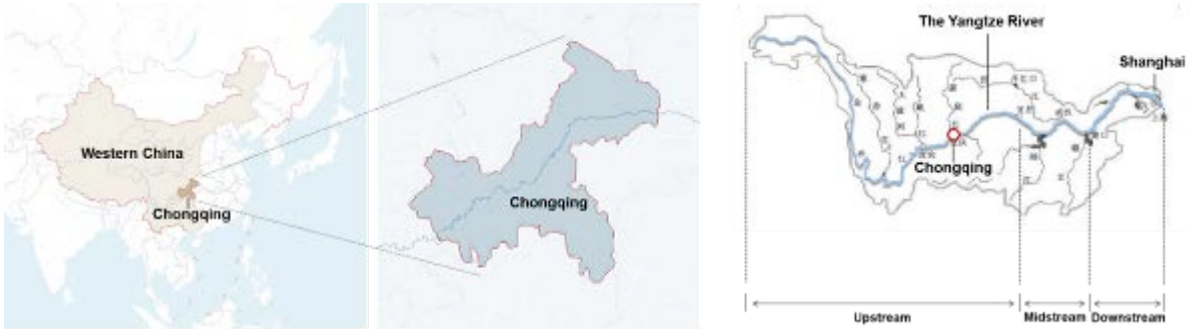

Figure 1: Chongqing in Western China and the Yangtze River Basin

After the implementation of this series of initiatives in recent years, western cities, including Chongqing, have made great progress in economy, living standards and urban construction. However, in the process of rapid urban spatial expansion, various problems and challenges have gradually emerged and can be sorted into three main aspects in terms of urban land use.

The first is about ecological pressure: The Yangtze River conservation strategy puts higher demands on economic development based on environmental protection. Secondly, the development goal of China has transformed from a single pursuit of speed to high-quality sustainable development, so intensive use of urban land is imperative. The third aspect is how to face imbalance. The Yangtze River Economic Zone spans 11 provincial-level administrative regions, and the geographical climate, economic level and development status vary significantly between different regions. In addition to the well-known economic development gap between eastern and western cities, the uneven development between western cities, especially between large central cities and small or medium-sized cities, is further intensifying, and this is often downplayed in the formulation of urban development and land use plans.

These imbalances can be clearly reflected in the population growth data for each part of Chongqing. From 2010 to 2020, the population of large central cities continues to gather, with a rise of nearly 30%, yet most small and medium-sized cities lose population severely, ranging from about -1% to -10%. In terms of urban spatial perception, the contrast between the two is even stronger. Decaying old streets, broken old city spaces, and halted construction projects in new development zones reflect the current situation of spatial structure fragmentation and extensive development of land resources in small and medium-sized cities.

Figure 2: Contrasts between Large Central City and Small or Medium-sized Cities

In summary, discussing intensive land use mechanisms in western Chinese cities in the current context is an important research proposition, and this study attempts to discuss spatial development of small and medium-sized cities along the Yangtze River in Chongqing from two clues: parallel comparison between cases and the spatial evolution of a typical city in history.

Parallel Analysis: Eight City Cases

China's city size classification standard is based on urban resident population, and cities are divided into five major categories with seven subcategories: mega-city, super-city, type I large city, type Ⅱ large city, medium-sized city, type I small city and type Ⅱ small city. On this basis, we conducted an overall sorting of cities in Chongqing using the 2020 statistics of Chongqing and divided cities in Chongqing into one mega-city, one large city, seven medium-sized cities and several small cities. Considering the comparability between city sizes and the time constraints of the research, medium-sized cities and type I small cities were extracted from them. Then, we filtered out these cities along the Yangtze River, a total of eight, as the main initial targets for investigation. Their fall in the map shows that the eight cities are widely distributed from east to west along the Yangtze River, which helps us to get a comprehensive picture of the differences between the different cities.

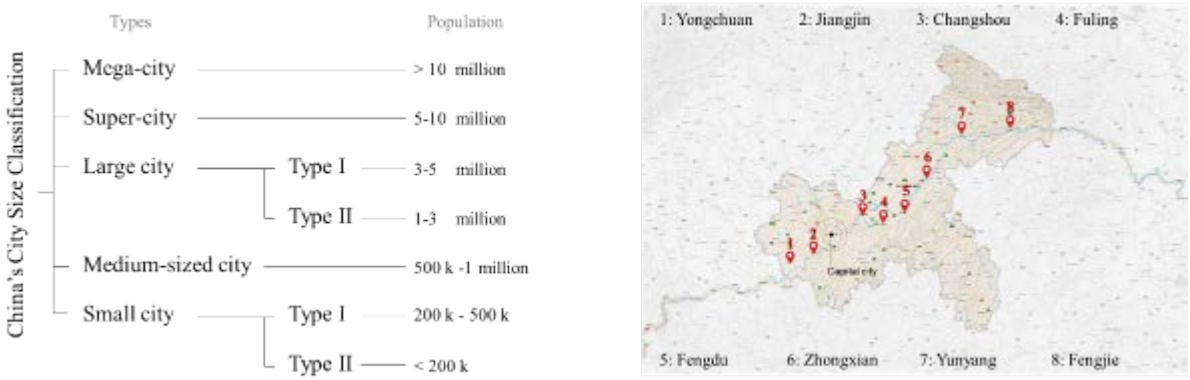

Figure 3: China's City Size Classification Standard and Eight City Cases in Chongqing

The population data and annual new completed floor space data were extracted for these eight cities from 2011 to 2020, and except for three medium-sized cities with a small increase, the population of the remaining five small cities is decreasing year by year. The new construction area completed in each city remains at a high value, with commercialized buildings accounting for about 50% of the total. Even in the medium-sized cities with population growth, the completed new floor space per capita is significantly higher than the previous floor space per capita. The population and construction data show a large contradiction, which is prominent in Changshou. While the population is declining by 20,000-30,000 per year, the new floor space completed keeps climbing, which is somewhat confirmed by our field research. As the photos show, there are many blocks in the new city area where construction is halted and a large number of new commercialized buildings are left unsold or unused.

Figure 4: Contradiction between Population and Construction

A 10 km by 10 km satellite map was intercepted for each city. From the spatial layout, it is obvious that there are old and new city areas with distinct differences in street texture and scale in all eight cities, and then the distances were calculated between them. Using the center of old and new areas as endpoints, the traffic distances of the two connected main roads were calculated. As we can see, the distance values range from 3 to 10 km and can be divided into three classes: the first is about 3 km; the second is about 6 km; the third is more than 9 km. The different classes of distances between the old and new urban areas bring different levels of fragmentation in land use: the imbalance between occupational and residential, traffic congestion and aging population.

Fuling has developed a new city area 9.5km away. Although the two are connected by tunnels and expressways through the mountains and provide more employment, most residents still live mainly in the old city, which has lower prices, abundant commerce and

convenient facilities, and only travels to the new city for work during the day. The old city area, which is brightly lit at night, contrasts with the new city, which is vacant at night. With the distance narrowed to 5.5km, the old and new areas of Yongchuan get a better balance of development between them, achieving differentiated complementarity in terms of industry, housing prices and spatial experience, but with the frequent interaction between the two areas, traffic pressure has increased dramatically. Although new connecting roads are being added every year, the situation of traffic jams at important traffic nodes has not been significantly improved. The distance of 3.6km blurs the boundary between the old and new areas of Changshou, as its connection is very tight and smooth. A large number of people in the old city, especially young people, migrate to the new area. During the field visit, about 70% of the people in the civic square of the old city were over 60 years old, and different corners were occupied by various activities of old people. The extreme distribution of different age groups in the two areas is an aspect of spatial fragmentation that is difficult to reflect in the satellite map.

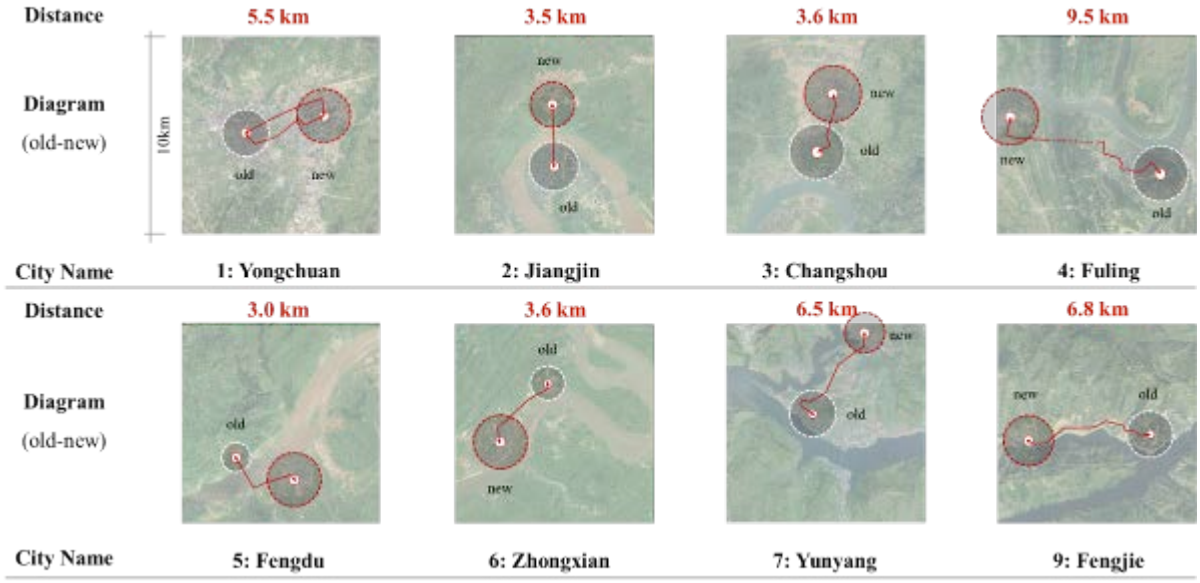

Figure 5: Distance Brings Fragmentation between New and Old Area

Such urban spatial fragmentation can be attributed mainly to the geographical conditions in which the cities are located. In order to discuss the urban spatial structure and land use more comprehensively, land use maps in urban planning and design since 2000 were collected from government departments of each city. It can be seen that the urban space is formed by the combination of multiple scattered clusters in a process of continuous growth.

Extracting four types of elements of each city: mountain, river, old and new city areas for abstract diagrams, it can be clearly seen that new construction lands cross mountains and rivers, finding relatively flat areas in steep slopes for the expansion of urban space, forming their own distinct structural characteristics.

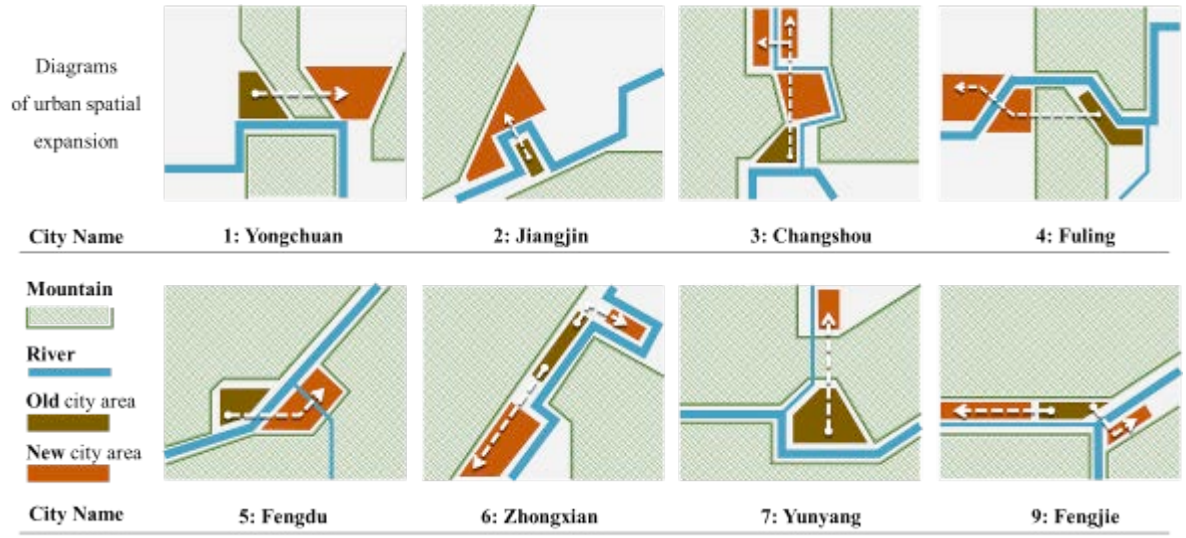

Figure 6: Distance Brings Fragmentation Between New and Old Area

The urban spatial structure of these cities can be summarized into four types. Type 1: Leapfrog development cross mountain. Land development area and resources are sufficient, but it is easy to cause tidal flow of people, and extensive land use management causes an imbalance between occupation and housing. Type 2: Coordinated development across the Yangtze River. It is helpful to the resource balance of different spatial clusters, but it strongly relies on bridge construction and has a long development cycle. Type 3: Longitudinal development along a tributary. The clusters are closely connected and communicate smoothly, but the population of old city areas is relatively aged, and the age structure of different clusters is easily imbalanced. Type 4: Linear development along the Yangtze River. Spatial development is limited by the land resources, but the efficiency of land use is relatively high, with high resilience and flexibility.

Figure 7: Distance Brings Fragmentation between New and Old Area

Historical Analysis: An Exemplary City

In addition to the important role played by geographical conditions, from a longer historical perspective of urban construction, the expansion of construction land and formation of spatial structure in eight cities are closely related to the history of changes in transportation modes. Before 1990, river transportation along the Yangtze River and its tributaries was the main transportation mode for transporting people, goods and commodities between these cities, and the areas around the river terminals became the earliest areas for urban construction. From 1990 to 2010, with the completion of the intercity highway network, land construction in the areas near the highway interchanges gradually accelerated. Urban space started to expand in this direction, and new areas continued to develop. After 2010, China entered the era of high-speed train, and railway stations led to the construction of a large amount of land around them, gradually becoming new population gathering centers, which have been developing until today.

The history of urban construction and land use in Changshou fully demonstrated this process and became an exemplary city selected in historical analysis. In the field investigation and visit, we took the relocation of a high school as a clue hoping to reveal the differences and common problems of land development and construction mechanisms in different historical periods.

During the river transport era, the urban space of Changshou could be divided into two clusters, the upper half and the lower half of the city. The lower half is the riverfront area at the estuary of the tributary into the Yangtze River. Major commercial and entertainment facilities and factories gathered here and developed a ribbon of residential areas. The upper half of the city is an inner terrace with an elevation of nearly 200 meters above the river surface, including cultural, educational, medical and sports land and corresponding residential areas. The two areas are distinctly different and interconnected in function. Important public services, including schools, are located at the junction of two areas and connected to each other by long, narrow stairways. People bought and sold goods on the road and shared facilities, making them the busiest commercial streets at that time. Nowadays, although the buildings have been vacated and people have left, these places have become important memories that linger in the local people.

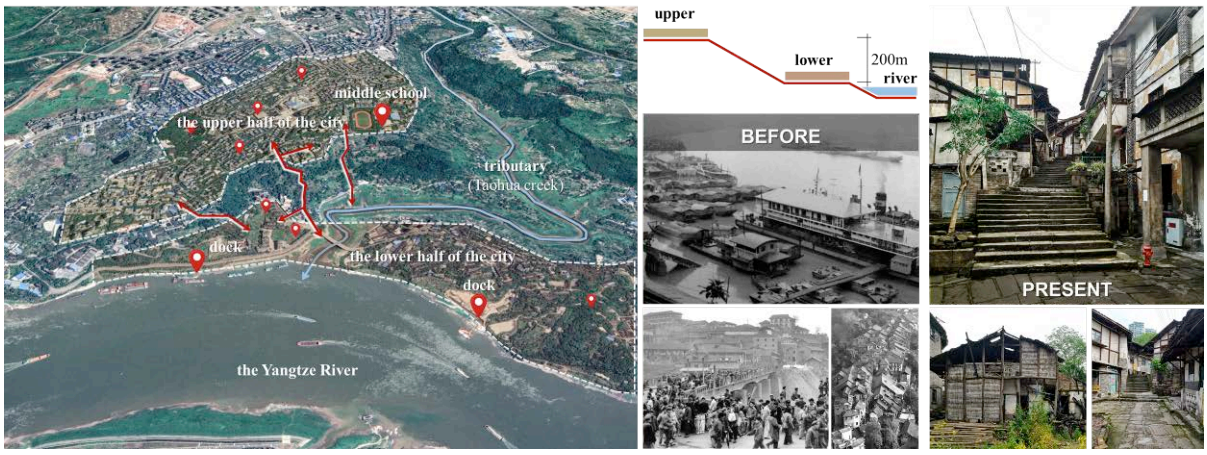

Figure 8: Land Construction During River Transport Era in Changshou (Before 1990)

Entering the highway era after 1990, the land construction in new city areas relied heavily on the development of commercial buildings. Some of the blocks near highway entrances and

exits were zoned for public services in the city planning maps and were first built in the new city around 2000. So a series of institutions, including middle and high schools, implemented a rapid relocation process. With the relocation of these institutions, the construction rate of surrounding land and housing prices were rapidly climbing. The new city areas are gradually entering a phase of rapid development and expansion relying on land and population dividends. Land auction prices and construction rates rose year by year during this period, but blind optimism about population and economic growth led to frequent incidents of long-term unused land and unfinished commercialized housings. On the one hand, it has caused great damage to the environment, and the water quality in downstream of the tributary has deteriorated to almost no flow. On the other hand, the development of the old city is completely ignored, and the urban spatial structure is seriously imbalanced.

Figure 9: Land Construction in Highway Era in Changshou (1990-2010)

After 2010, the problems of the previous phase of land development were taken into account. The planning map below shows that the previous rapid expansion by a single center had been transformed to the intensive development of multiple clusters, while schools were not relocated again, but placed in multiple smaller clusters in the form of branch campuses. Instead of focusing solely on economic development data and land development volumes, policies from the government encouraged different communities to plan flexible land use targets to create higher-quality urban spaces. At the same time, the water quality of the tributary and its surrounding ecosystem were strongly protected, transforming the abandoned riverside into an ecological city park and reintegrating it into a whole urban spatial structure.

Figure 10: Land Construction in High-Speed Railway Era in Changshou (2010-Present)

Conclusions

Based on the previous research and analysis, we summarize a five-part framework for intensive land use for architectural design. As shown in the Figureure, it consists of five parts: evaluation, accounting, grading, resilience, and collaboration. Specifically, we first study the site and its surrounding geographic, hydrological and climatic conditions and conduct an evaluation for ecological sensitivity. Based on this, the functional indicators given in the plan are accounted for and the construction capacity is readjusted. The construction plan is graded in terms of efficiency of use, which will be gradually realized in multiple stages to improve risk resistance. Establish a land information sharing platform before construction, so that neighboring blocks can be easily compared with each other and a multi-party cooperation mechanism can be formed.

Finally, this framework has tried to be used in practice for an architectural design project by us. We analyzed the geographical conditions of the site and the area where the new city is located, extracting information on daylight, rainfall, wind environment and topography to restore the real environment in different seasons. Using field visits with digital analysis, we assessed different ecological elements and determined the scope of construction. Based on this, we discussed with government departments about the modification of the previous plan to reduce the development capacity and increase the proportion of multi-functional space, forming a spatial structure based on respect for the ecosystem. For the different ecological and functional requirements in the whole site, a typology of multi-level spatial modules was sorted out and a multi-stage construction plan from 2025 to 2045 was set. Finally, the land construction plan and pipeline network information were summarized in a shared platform to facilitate overall regulation and control by the competent authorities.

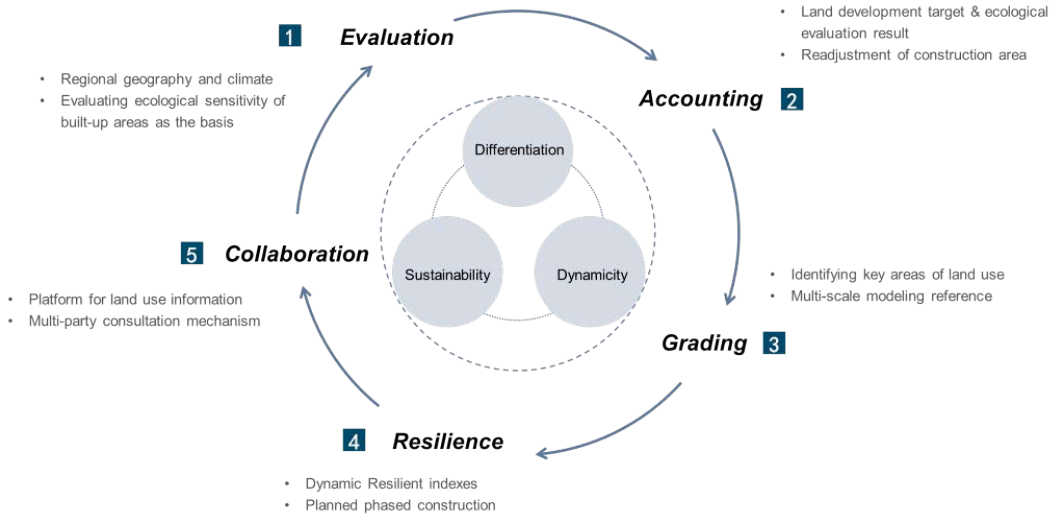

Figure 11: Intensive Development Framework for Architectural Design with Five Parts

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