

Case study on rail transit: Chongqing rail transit line 2

I . Basic information about Chongqing rail transit line 2

This project adopts the system of straddle-type monorail, reaching a length of 31 kilometers, with 25 stations (22 elevated stations included). It crosses three districts, radiates to 9 areas and connects 6 districts. It is the first urban rail transit in western China and also the first straddle type monorail transit in the country. Since July 2005, Chongqing rail transit line 2 has been operated safely and stably for over a decade.

The straddle-type monorail system that this project adopts is the first middle-volume rubber-wheeled light rail system in China, with smaller radius of turning circle, stronger gradeability, extremely lower running noise, better adaptation to the mountainous Chongqing.

II. Features match with SDGs

1. Features match with Goal 3: ensure healthy lives and promote well-being for all at all ages.

1) Improve citizens' travel conditions

With a 30 thousand one-way person-time and 300 million annual passenger capacities, this line has made great contribution to ease the traffic pressure, improve citizens' travel conditions and improve convenience of obtaining public services for related communities.

2) Well-adapted to the topography

The trains of this line adopted rubber tires and special bogies with no strict requirements on the terrain and strong adaptability for steep slopes and sharp bend. The train has relatively strong climbing ability (with the maximum slope of up to 100 ‰), and can pass through relatively smaller bend (with the curve radius of up to 30m). It can be well-adapted to the city's varied terrain, geomorphology and complicated geographical environment, it can also avoid existing buildings to shorten unnecessary demolition, which makes it easier to select lines in the city and endows it incomparable adaptivity in the planning and selection of lines.

2. Features match with Goal 8: promote inclusive and sustainable economic growth, employment and decent work for all

The operation of the line has greatly promoted the development of the districts alongside and has played a leading role for the development of the main urban area of southern Chongqing, which

greatly supports economic development of Dadukou District and Banan District. One of the most prominent contributions is that it promotes and stimulates the real estate, shopping, malls, and entertainment along the line. With the Line promoting the economy of the whole area, monorail economic zone has been formed, and the development for commercial, real estate and other industries has been sped up.

3. Features match with Goal 9: build resilient infrastructure, promote sustainable industrialization and foster innovation

Supported by the construction of Monorail Traffic Project Line 2 and in combination of national sci-tech support plan project of *Equipment Research and Development for Straddle-type Monorail Transportation* project, Chongqing organized relevant domestic enterprises, universities, and scientific research institute successively, have completed research and development of key technologies and industrialized technology breakthroughs like straddle-type monorail transportation equipment system integration and straddle-type monorail whole vehicle integration, have achieved technical leaps like the first place in the regenerative braking energy absorption device technology and the smallest construction investment, filling the gaps in the field of technology of China and reaching the overall the international advanced level. Among them, some core technologies have reached the leading level in the world, including vehicle traction, disc brake, new type on board ATP, and sliding switch technologies, etc. Through the unremitting efforts, Chongqing has formed the world's largest manufacturing industry base for straddle-type monorail transportation equipment, as well as straddle-type monorail transportation industry chain for being the largest international scale most integral structure in aspects of design, research and development, vehicle and system equipment manufacturing integration, engineering construction, operation and maintenance and so on, creating a large number of employment opportunities.

4. Features match with Goal 11: make cities inclusive, safe, resilient and sustainable

1) Economic sustainability

Less demolish demand. From riverside to mountaintop, the line crosses areas with different altitudes, from 180 to 430 meters and a relative height difference of 250 meters. The gradient and slope length of twisted roads are seldom seen in plain cities. With a gradeability of 6 – 8% for a maximum slope length of 400 meters, a minimum radius of turning circle of 100 meters, the

monorail system can fully adapt to the lineament of Chongqing. The regular steel-wheel rail system, with gradient of 3% and radius of turning circle of 300 meters, will lengthen the underground line and increases the burial depth of stations to 80-100 meters.

Less construction cost. The adoption of modular structure and standardized track beam facilitates plant prefabrication and on-site assembly, which can ensure the accuracy and convenience for construction, thus shortening the duration. At the same time, the project cost is relatively low, which accounts only 1/2 to 1/3 of the subway cost, far lower than other urban rail transit system. It can effectively reduce the burden on the government and reduce the payback period, achieving sustainable development economically.

2) Environmental sustainability

During the construction of the project, citizens paid high attention to the influence of the system on their lives and the environment. According to environmental impact assessment report and relevant environmental protection regulations, the Environmental Monitoring Center of Chongqing provided monitoring report that shows that the running noise value is 64.0 db (up going) and 57.8 db (down going) at 12 meters of the line, that the comprehensive electric field intensity and magnetic field intensity meet the requirements of Regulations on Electromagnetic Radiation Protection, that the sewage discharge reaches up to the first level discharge of national standard, and that environmental vibration also meets the national standards.

By the monitoring on the environment and citizens surveys in the trial operation which lasted for half a year, it turned out that all environmental indexes meet up with relevant requirements and no environmental damage was made.

The regenerative braking ground absorption technologies were improved in the subsequent operations and retroact the surplus energy of regenerative braking to low voltage power lighting system for the first time in China. The recycled energy accounts for about 10-20% of the total consumption of pulling energy and greatly contributed to energy conservation and environment protection. Owing to its outstanding environmental performance, the project was rated as “National Environmentally Friendly Project” in 2007. In addition, the railway track was laid along the central green belt or roadside green belt with small-sized pier stud and elevated structure. The line is mainly made up of elevated line, forming a flyover crossing with urban ground traffic with smaller interference.

3) Less impact on landscape.

Restrained by geographical conditions, the original roads of the city are very narrow. The monorail system takes full advantage of medial strips and its upper space and has no influence on roads. The 0.85-meter-wide track beams has better landscape efficacy. The wheel-track system requires flat-plate-type elevated track bed on original road in elevated track section and noise-proof facilities along flat-plate-type elevated track bed, which would make great damage to landscape.

4) Made itself a scenery line of the city

Landscape effect is a vital factor requiring careful consideration of urban rail transit planning, construction and operation. Targeting at minimizing the impact on the city landscape, Line 2 adopted optimized design in the line planning phase by taking advantage of existing road central separation zone for the viaduct layout program. At the same time, according to the characteristics of the landscape city, it was designed to run along the Binjing Road of Jialing River and to pass through the City Forest Park, featuring with unique viewing characteristics. The cultural landscapes form a unique scenery line, including the 36 Sichuan arid Chongqing historical story wall, oldies exhibition of LiZiba station, photography exhibition of Huanghuayuan station and other cultural landscapes. In addition, due to its superior complicated geographical environment adaptability, it has successfully preserved more than 30 historical and cultural landscapes and culture heritages along the line, thus passengers can view the Jialing River scenery as well as explore the memory of Chongqing. The vertical afforesting and nightscape lighting along the line has also made it a scenery line of the city.

4. Features match with Goal 17: reinforce the means of implementation and revitalize the global partnership for sustainable development

With the above advantages, the industry in Chongqing is working as a group, and going out to the word.