THE CONSTRUCTION OF RESOURCE-SAVING AND ENVIRONMENT-FRIENDLY RAILWAY STATION UNDER THE ECONOMY PRINCIPLE

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ABSTRACT

This paper argues that the construction of high-speed railway station must follow the idea of life-cycle cost, apply life-cycle cost technical and economic valuation to the project, and realize sustainable operation. Economy does not mean that the lowest cost of construction is the best, cost of maintenance is of the same importance as the one-time input. The technical standards selection, scale determination and amenities equipment should meet not only the short-term but the long-term development need. We should determine reasonably the scales of different railway stations and their different areas on the basis of the differentiation of ordinary-speed railway, high speed passenger dedicated railway Lines and inter-city express. Different construction decoration standards can be used to different types of station and different function areas. We should also adopt scientific Engineering Norm, standardized design and delicate management to control investment and lower the cost through craft and construction method innovation. Not only the profitability but public interest should be taken into consideration and especially social benefit should be paid much attention. We should insist energy-saving and environmental protection principle, control land use reasonably, make full use of natural lighting and ventilation, use renewable resource such as solar energy, terrestrial heat and wind energy actively, and promote technology of vacuum sewage suction and shockproof noise-reduction. The paper also introduces Beijing South Railway Station which is the supporting engineering of 2008 Olympic Games and the terminus of High Speed Shanghai-to-Beijing Rail Line and the Beijing-Tianjin Inter City High Speed Railway Line.

Key words: construction; Economy; Environment-friendly; railway station; Resource-saving

Railway transportation plays a very important role in the modern sustainable-developing transportation system of many developed countries because of its many advantages such as land- and resource-saving as well as environmental protection. According to the requirements of mid-long term railway development plan, the length of Chinese railway network can reach 120,000 km and has modernized before 2020, including 18,000 km high speed passenger dedicated railway Lines. In 2008, in order to expand the domestic demand to cope with international financial crisis, Chinese government made an important decision to speed up the railway construction, increasing the investment per year to 300 billion Yuan, and started the High Speed Shanghai-to-Beijing Rail Line. At present, the development in railway construction has dramatically stimulated the Chinese economic growth and achieved great social and economic efficiency. Building up a batch of monumental railway passenger station is a very important component of Chinese large scale railway construction. During the period of eleventh five year plan, Chinese railway will build 548 passenger stations. As far as city scale is concerned, there will be 25 large scale stations in the level of provincial capital; As far as line type is concerned, there will be 158 stations for high speed passenger dedicated railway lines and 83 stations for high-speed inter-city railway lines with the investment of 100 billion Yuan. From the standpoint of the Scientific Outlook on Development and the construction of

harmonious society, Ministry of Railway brought out the new idea that the railway station construction must insist humanism and follow the five basic principles of "function, system, advancing, culture and economy". This paper plans to explore the implementation of the economy principle on the basis of general requirements of five basic principles.

1. THE FUNDAMENTAL CONNOTATION OF THE ECONOMY PRINCIPLE

Railway passenger station is the large scale railway facility that concerning both profitability and public interest, it should be resource-saving, environment-friendly and operationally sustainable. The construction of railway station must follow the idea of life-cycle cost; pay much attention to the social benefit and conduct the construction investment and operation maintenance on the basis of economy principle.

1.1 Construction of railway passenger station

The construction of railway station must implement the principle of “reinforcing the essentials and reducing the nonessentials”, build up the economic idea that adapts to the national economy development phase, lower the construction cost as much as possible under the premises of function and system optimization, advanced techniques and culture incorporation.

1.2 Maintenance of railway station operation

Construction investment and operation maintenance costs are two factors that affect the investment efficiency. Environmental efficiency of energy consumption is manifested in the course of operation and the efficient method to lower the operation maintenance cost is to adopt advanced energy-saving and environmental protection techniques. Hence, economy does not mean that the lowest cost of construction is the best; cost of operation maintenance is of the same importance as the one-time input in the construction.

2. INVESTMENT CONTROL OF DESIGN PHASE

Design is the origin of investment control and is the key factor to the construction of resource-saving, environment-friendly and monumental railway station.

2.1 Ensuring the function and system investment needs of station

The mass transit operation of high-speed passenger dedicated railway line can shorten the waiting time for the passengers and the provision of convenient and smooth distribution service is the primary function of railway station. Design plan should provide definite, clear, short, smooth, and separate streamline organization and eye-catching guiding signals for passengers; shorten the transfer distance as much as possible. To realize the overall optimization, railway station should be connected with other methods of transportation, the different components of it should be unified and coordinated which are the necessary requirements to shorten the commute time, save social recourses and promote the competitiveness of railway itself.

2.2 Determining the size and standard of railway station reasonably

Size and standard are the main factors that affect the construction investment of railway station and should be controlled strictly. The size and standard of railway station should be determined according to the characteristics of different railway lines such as ordinary-speed railway, high speed passenger dedicated railway lines and inter-city express. The sizes of different zones of railway station should be

different, public zone should be the optimal and the best and biggest zones should be left to the passengers, the size of non-public zones should be reduced to save investment as long as the basic use conditions are ensured. The standard of key railway stations should be improved and the mid-small stations should adopt practical and simple standard.

The technical standards selection, scale determination and facilities equipment should meet not only the short-term but the long-term development needs. We should stay firmly rooted in the present while looking ahead to the future, control the size and standard of railway station according to the future developing trend, avoid the reconstruction or discard which forms the overlapping projects right after construction which is caused by scale insufficiency or standard backwardness because of limitation of initial investment.

2.3 Optimizing the style and structural form of railway station

We should select reasonably the style of railway station which can dramatically affect the construction cost and land use ratio.

Different structures such as steel structure, concrete structure, concrete structure equipped with steel roofs have varying costs and should be reasoned scientifically and selected reasonably. We should select the supporting structural component with the most economic structural height, the smallest surface area and diameter.

2.4 Selecting the applicable decoration standards

Decoration standards can affect the construction cost; we should eliminate the careless stack of high-end and luxurious decoration materials. The decoration standards of large scale station, rail border station and the stations of tourist areas can be higher, mid-small stations should adopt simple and natural decoration standards. The station decoration should merge with the local culture and adopt local decoration materials. Different decoration standards should apply to the different areas of railway station, VIP waiting room can adopt higher decoration standard, public area should be beautifully generous and bright, non-public area should be simple and practical.

2.5 Adopting energy-saving and environment protection techniques to save operation maintenance cost

We can make full use of natural lighting and ventilation by adopting transparent construction materials, roof style that suitable to the local natural environment and appropriate spatial scales, achieve the goal of saving energy by using thermal insulating materials and controlling construction size, achieve the effect of saving energy and environment protection by adopting photovoltaic, ground source heat pump techniques to use no-discharge, renewable resource such as solar energy, terrestrial heat and wind energy, promote energy-using efficiency by using technique of combined heating, cooling and power supply, lower noise pollution by setting up noise barrier, realize the integrated processing of pollutants by using devices of vacuum toilets and vacuum sewage suction to reduce the emission alongside the railway line, realize the effect of energy-saving and energy-efficient by using lighting and elevator.

2.6 Paying much attention to the investment economy of non-platform-prop canopy

Being one kind of important passenger transport facility, non-platform-prop canopy is widely used and its investment, an important component of railway construction investments, should be controlled efficiently. We should first determine the reasonable canopy spatial type; second, we should control the span and height of canopy; third, we should simplify the design of ceiling, fourth, we should realize the weight-lightening of the structure and the simplification of decoration.

3. COST CONTROL IN THE CONSTRUCTION PHASE

3.1 Design institute

Design institute should be very careful and all-around, avoiding the design modification because of unclearness of geological exploration or omission of design.

3.2 Construction unit

Enhancing the management of construction unit can assure the completion of railway construction task, construction unit should control strictly contract management, inspect the work volume and calculate pricing with discretion and assure the process is controllable. The costs of different materials and equipments are varying which are essential to the construction investment control. Construction unit should control strictly the purchase of materials and equipment, adopt public bidding, and use products that have high quality and low price under the premise of reaching the standard of techniques.

3.3 Construction enterprise

Optimizing the organization of construction and strengthening the management of construction are the effective method for saving cost and increasing income; craft and construction method innovation is the fundamental means to lower the cost and promote the efficiency.

4. ESTABLISHMENT OF NORM

4.1 Standardized design

Design universal drawing for the parts that can use standardized design can speed the progress of design, regulate construction method, increase labor productivity and lower the engineering cost effectively.

4.2 Establishment of norm

Railway station construction in new era adopts lots of new techniques, new crafts, new materials and new equipments. Designing scientific and reasonable engineering norm timely is useful for the determination of wear and tear of construction, mastering of construction cost, controlling the investment size. At present, we have added the items for the deep hole excavated for building foundation, steel structure, decoration, energy saving and environment protection, forming a set of norms applicable for railway station.

5. RAILWAY STATION OPERATION MAINTENANCE

a) Set up new idea of humanism and passenger-oriented service, promote work efficiency, reduce non-productive staffs and save labor costs
b) Enhance elevator, condoning and lighting management to save electricity
c) Optimize the energy structure and use clean and high-effect energy

6. ENGINEERING PRACTICE AND OPERATION EMPIRICAL STUDY OF BEIJING SOUTH RAILWAY STATION

Beijing South Railway Station is the important supporting engineering of 2008 Olympic Games, the terminus of High Speed Shanghai-to-Beijing Rail Line and the Beijing-Tianjin Inter City High Speed Railway Line, the classic of Large-scale integrated transport hub station. Beijing South Railway Station

went to operation in April, 2008 and has achieved good operation effect and social benefit after 8 months' test.

6.1 Resource saving and Environment-friendly

Transparent central day lighting band and glass-curtain wall realize natural lighting; wide span and high headway realize the natural ventilation; all elevated railway station saves the land resources to the utmost; solar photovoltaic power and ground source sewage heat pump techniques provide clean and renewable resource; technique of combined heating, cooling and power supply increases the energy-using efficiency; noise barrier lower the noise pollution to the surrounding environment, vacuum toilets and vacuum sewage suction systems realize the integrated processing of pollutants and reduce the pollution to the railway line. According to calculation, CRH Harmony Express consumes less than 16 KWH per capita; the Beijing-Tianjin Inter City High Speed Railway Line consumes less than 8 KWH per capita during the half hour from Beijing to Tianjin.

6.2 Smooth flow line, convenient distribution

Passenger flow enters from top and exits from below, flow line is simple and smooth, and signals are eye-catching and explicit. The two circuit lanes around the station can reach any directions of city and deliver the passengers to elevated reception platform by car; passengers can be evacuated quickly by taxi and other cars in the exchange hall of basement floor 1 or switch other transportation vehicles via exit lane; convenient switch from subway to railway can be realized in the basement floor 2 and 3; passengers from mass transit can enter elevated waiting room from ground.

6.3 Graceful design and advanced techniques

Beijing South Railway Station extracts the designing element from the Temple of Heaven of Beijing and complements the local culture. The whole building is permeable and fluent, and shows the characteristics of transportation buildings. The main station building adopts wide span steel structure; non-platform-prop canopy uses a type of pylon and large-spanned suspension beam structure system.

At present, a batch of new stations such as Hongqiao station of Shanghai, new Guangzhou station and new Wuhan station are constructing. Under the guideline of five basic principles of the Ministry of Railways, the Chinese railway constructors have enough intelligence and capacity to build a host of energy-saving, environment protection railway monumental station classics and add luster to Chinese and world railway.

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