

# Research on Construction Quality Control of Expansion joint in Road and Bridge Engineering

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**Abstract:** *The construction technology of Expansion joint is a key link in the construction of highway bridges, which has a great impact on the overall quality of the bridge, so it is very important to strengthen the control of its construction technology. In the future construction of Expansion joint of highway bridges, attention should be paid to the construction operation and the management of construction personnel, so as to effectively ensure the safety of highway traffic and extend the service life of the highway.*

**Keywords:** roads and bridges; Expansion joint; Construction technology; quality control.

## 1. INTRODUCTION

In China's transportation network system, road and bridge engineering is an extremely crucial component, serving as a link between cities and promoting rapid regional economic growth. The quality of municipal road and bridge engineering will have a direct impact on economic development. In the specific construction process, the application of Expansion joint construction technology is the key point, which not only ensures the quality of the entire Roadworks, improves the use performance, but also makes people travel more safely. Therefore, in the construction of municipal roads and bridges, we should attach great importance to the construction technology of Expansion joint, improve the technical content and level, ensure that it is consistent with the requirements of the industry regulations, meet the quality standards, and promote the long-term development of the construction industry while greatly improving the construction quality and efficiency.

Roads and bridges are key components in the process of urban development and construction, and are important prerequisites for the normal operation of cities. The current urbanization development strategy is constantly advancing, causing certain pressure on urban roads and bridges. As for current road and bridge projects, their quality must be guaranteed. Only road and bridge projects that provide safety guarantees for the travel of Chinese citizens are qualified projects. Road and bridge projects need to be further improved in quality to meet the current travel needs of the people. Generally, the bridge is built in the outdoor scene, which is prone to displacement. The use of Expansion joint technology can effectively alleviate this problem. In the bridge construction, the treatment of Expansion joint is the key, which is the focus of attention, mainly because it is closely related to people's life. When there are problems in the treatment of Expansion joint, the quality of the whole bridge is difficult to guarantee. The treatment of Expansion joint is not an independent construction link, which is closely related to roads and bridges. When there are problems in the treatment of Expansion joint, the project does not meet the requirements, and the quality is difficult to guarantee. Therefore, the construction of Expansion joint should be highly valued in municipal road and bridge engineering.

## 2. COMMON TYPES OF EXPANSION JOINT

The deep integration of digital technology and lifelong learning has opened up a whole new field of learning for all mankind. First of all, digital technology has broken through the time and space limitations of traditional learning, making it possible to learn anytime, anywhere, as long as there is an Internet and equipment, greatly facilitating the public's learning activities and enhancing the efficiency of learning. Secondly, digital technology provides more abundant learning resources and more flexible learning methods for lifelong learning. Through digital technology, rapid sharing and wide dissemination of learning resources can be realized, breaking geographical boundaries and enhancing the utilization of educational resources and the fairness of learning. At the same time, the use of digital technology can also meet the personalized learning needs of different learners, and enhance the

interest and effectiveness of learning. Once again, digital technology has also changed the relationship between teaching and learning, realizing the innovation of learning mode. With the help of artificial intelligence and other advanced technologies, interactive learning between teachers and students and between students and students can be realized, as well as intelligent guidance and evaluation of the learning process, providing learners with more accurate and effective learning assistance. Finally, the introduction of digital technology provides a new path for the evaluation of lifelong learning. In the past, learning evaluation often stayed at a simple level such as examination results, while the use of digital technology can realize the all-round tracking and recording of the learning process and provide more comprehensive and accurate feedback on the learning effect, thus providing a basis for the further advancement of lifelong learning. Therefore, the deep integration of digital technology and lifelong learning not only brings new possibilities for the construction of lifelong learning system, but also provides new ideas for the evaluation of lifelong learning effects[1].

**Table 1:** China's soybean import and export volume from 2015 to 2022 (unit: RMB 100 million)

Year	Total export-	Import value	Import growth rate	Outport value	outport growth
2015	2166.16	2158.41		7.75	
2016	2253.61	2246.47	4.079855	7.14	-7.87097
2017	2693.83	2687.64	19.63837	6.19	-13.3053
2018	2509.87	2503.33	-6.85769	6.54	5.654281
2019	2443.8	2437.46	-2.6313	6.34	-3.0581
2020	2748.41	2743.48	12.55487	4.93	-22.2397
2021	3457.85	3452.36	25.83872	5.49	11.35903
2022	4094.25	4084.89	18.32167	9.36	70.4918

<sup>a</sup> Data are obtained from General Administration of Customs of the People's Republic of China database.

### 2.1 Seamless Expansion joint

The seamless Expansion joint technology is relatively special, and the materials used are generally viscoelastic materials. Made with the help of this technology and materials. The Expansion joint has excellent elastic-plastic deformation capacity, can adapt to different types of deformation, and has excellent absorption capacity for the load vibration caused by vehicle driving. Overall, this technology is widely used in southern China because it is extremely sensitive to seasonal temperature changes and is not suitable for climate conditions with significant seasonal differences in the north.

### 2.2 Plugged type Expansion joint

The internal structure of the filled type Expansion joint is mainly composed of asphalt and asphalt felt, and its biggest advantage is its relatively low cost. However, due to the limitations of its own characteristics, its defect is that it is unable to apply asphalt Expansion joint for a long time, and its service life is relatively short. The construction of this Expansion joint is also very simple [1], but its heat resistance is low. If the temperature is too high, the filler will be squeezed out. In addition, due to the poor functionality of its shape change, the filling material cannot be backfilled in after being cold, resulting in a large amount of impurities appearing in the surrounding area, which has a negative impact on the overall structural stability of the bridge.

### 2.3 Steel plate Expansion joint

The operation method of steel plate Expansion joint construction technology is very simple and convenient, so there is no need to invest too much cost in the construction process, which makes steel plate Expansion joint construction technology used in many projects. At the same time, the pressure bearing capacity of this Expansion joint construction technology is also very strong. The application of this construction technology in highway bridges ensures the corresponding project quality, thus providing safety guarantee for traffic operation [2]. However, the service life of the steel plate used in the steel plate Expansion joint construction technology is limited. When the steel plate is subjected to violent impact, the highway bridge will be damaged. Therefore, the highway

bridge using the steel plate Expansion joint construction technology cannot bear heavy vehicles.

#### **2.4 Plate type rubber Expansion joint**

The application of plate rubber expansion technology in highway bridge engineering projects is very extensive. Because the technology's own Expansion joint capacity is extremely excellent, which can bear relatively large loads and vibration, the highway bridge has excellent vibration resistance after being put into use, which ensures the safety of highway bridge application, and can also effectively extend the service life of highway bridges. Not only that, this type of Expansion joint technology has relatively excellent adsorption capacity, relatively low noise and relatively little environmental pollution.

#### **2.5 Yield**

Since the beginning of 2017, Brazil's soybean planting area has surpassed that of the United States, becoming the country with the highest cultivated soybean area in the world, with a total sown area of more than 33.3 million hectares, followed by the United States and Argentina. However, in terms of soybean production, the United States is still the world's highest yield, which is also related to the degree of modernization and mechanization of their agriculture, so Argentina and Brazil have little difference in unit yield with the United States. Although China's soybean planting area is showing an overall trend of gradual decline, but China is very different from the top three countries, only two-thirds of the United States. In general, due to the impact of climate, geographical conditions and other factors, coupled with the differences in soybean varieties themselves, the differences between the United States, Brazil and Argentina are not outstanding in terms of yield per unit area, and the competition between the two major countries in recent years has been more fierce in the field of soybean planting and export, especially after Brazil's soybean planting area exceeded the United States for the first time in 2017. Brazil's soybean exports appear to have become a political bargaining chip with the world's main consumer of soybeans.

#### **2.6 Consumption**

In 2017, the world soybean consumption growth rate was 4.25%, China's soybean consumption growth rate was 7.78%, and the United States soybean consumption growth rate was 2.88%. Although the proportion of China's soybean consumption in the total global soybean consumption shows a gradually increasing trend, although China's soybean consumption growth rate will continue to exceed the world soybean consumption growth rate and the United States soybean consumption growth rate, but China's soybean planting area is gradually reduced, domestic production is far less than the growth of demand, can only rely on imports. The United States soybean consumption growth rate is relatively low, but the total output is very high, so the United States and China on the contrary, their soybeans are mainly used to export to earn foreign exchange, which is also in line with the current international soybean trend, China's annual soybean imports accounted for more than half of the total exports of soybeans in the United States, and the United States annual soybean exports accounted for one-third of the total imports of soybeans in China. Therefore, the export volume of the world's major soybean exporting countries and related export policies will have a greater impact on China's soybean market.

### **3. CONSTRUCTION TECHNOLOGY ANALYSIS OF EXPANSION JOINT IN ROAD AND BRIDGE ENGINEERING**

In sociology, "small groups" are also known as peer groups or peer groups. A social group generally composed of people of the same age group, with similar or similar hobbies, interests, attitudes and values towards life, and social status. Its members generally have similar values, experiences, hobbies, and behavioral patterns. It is not difficult to find that "kindergarten" and "small groups" are the core concepts, expanding around two keywords to include peer relationships and peer communication. "Social network", "social participation", and "case studies" are also frequently mentioned. It can be seen that most of the literature is prominent in terms of social research. Most researchers conduct specific research around case studies. Regarding the concept of small groups for young children, Lu Xuanqian believes that Due to the fact that young children's peer groups belong to informal groups, which are spontaneously generated by young children, they are different from peer friendship relationships. Peer friendship is a two-way relationship, and the two are equal. Peer groups are groups of three or more people, with certain levels and structures among their members. However, they are also interconnected. Some peer groups are formed based on friendship, and the formation and development of groups also consolidate young children's relationships Friendship brings emotional support to young children.

In daily life, young children spontaneously gather together based on different needs such as interests, common interests, and abilities, forming a "small group" of two or three or four people. The group has common goals, behavioral norms, and each member of the group assumes their own roles. The emergence of the phenomenon of small groups in young children is a need for their social development, which is reflected in various aspects of their daily life. Compared with peer groups in other age groups, it exhibits significant variability. Young children's group interactions also have a certain emotional color, and some groups may also have obvious exclusivity. The characteristics of the phenomenon of small groups in young children are: "Temporality and stability coexist. Individual participation, independence, and crossover coexist." Studies have shown that children aged 5-6 have a high ability to pick up ideas, consider the differences between others' opinions and their own, and can converse and interact with peers in a more appropriate way. When young children meet during activities, they can decide whether this is a temporary collaboration or a relatively stable, long-term relationship through interaction. Gradually form your own small group.

### 3.1 Slotting construction of Expansion joint

In the process of Expansion joint slotting construction of municipal road and bridge works, the technology involved is whether the quality is qualified upon acceptance after the completion of bridge deck pavement, and whether it is based on the design requirements of the drawings, such as determining the width and whether the setting out is accurate. The key point to pay attention to is to determine the area and complete the marking, cover the plastic cloth to avoid damage to the road surface outside the line, and tightly seal each position with tape. In addition, the saw joint should be kept flat and tidy, and the paving should be thorough to avoid affecting the outside of the saw joint during excavation. When excavating with wind, the depth should be designed at least 12cm, and the excavation should be done to a hard point. At the same time, some asphalt concrete should be laid in the groove to clean loose cement [3]. The debris floating on the surface can be thoroughly cleaned using tools such as high-power hair dryers and high-pressure water guns. In order to ensure that the asphalt concrete pavement in the trench is not damaged during the excavation process, some eye-catching warning signs and roadblocks can be placed on site, prohibiting vehicles and personnel from passing through. Based on similarity. Young children spend most of their time in class activities and games with their peers, and children with similar personalities or class status are prone to forming groups. Children in small groups need to learn social skills such as acceptance, understanding, negotiation, concession, and cooperation in order to coexist with team members in a friendly manner. Based on this, they need to develop self-awareness such as self-esteem, confidence, and autonomy. Secondly, each child carries their own characteristics to join a "small group", and its normal operation requires all members to establish and abide by basic behavioral norms and common action goals, in order to constrain their own behavior, and can also distinguish their own group from others' groups based on this, establishing a stable sense of belonging or group identity. Finally, peer learning is an important learning method for young children. Different levels of intellectual development can provide children with reference for learning and life. Direct interaction with "role models" also practices the concept of children experiencing and gaining experience firsthand, which is more conducive to the establishment of a learning community for young children.

### 3.2 Joint cutting construction technology

Before the joint cutting construction of municipal road and bridge engineering, the specific width of the cutting surface should be calculated based on the apparent flatness of the road and bridge, to achieve precise measurement and ensure that the entire road surface is more even. After cutting the bridge surface, if the cutting surface is widened and still does not comply with the relevant provisions on the flatness of Expansion joint, the pavement needs to be resurfaced to improve the flatness and ensure that the construction of Expansion joint is completed efficiently. When the flatness of the road surface is consistent with the standard, the grooving shall be carried out based on the specific requirements of the construction design of Expansion joint. This step requires the sample to be accurately placed in the specified position and the width to be determined. Use a cutting machine to carry out saw joint construction along the asphalt pavement. During the operation, ensure that the saw joint and saw joint line are neat and uniform, without any deviation. At the same time, clean the surface of the road and bridge, and cover it with plastic cloth. After completing the cut joint work, thoroughly clean the construction site. Based on shared interests and activities. Shared interests and hobbies can easily inspire young children to form groups. For example, if girls like dolls and play with families, they will spontaneously play together. Based on parental support. Parents, as important factors in peer communication among young children, have played a certain role in promoting social groups outside of class life. Based on the power of the leader. The formation and maintenance of small groups cannot be separated from a core force "leader". Members within the group are willing to actively follow, obey orders, and listen to arrangements.

### 3.3 Installation and Welding

Before installation work, it is necessary to check whether the reserved slot is cautious enough to meet the requirements. Although cleaning is important during the slotting process, the pollutants and dust generated by the groove cannot be ignored. Before installing the section steel, it is necessary to ensure the cleanliness of the groove, and there should be no irrelevant debris in the bridge support area. Before actual dark turning, a high-pressure water gun should be used to clean it. During the installation of Expansion joint, the pavement on both sides is its elevation. With the help of lifting equipment, place the Expansion joint into the notch so that its top surface can be level with the pavement elevation. In case of nonconformity with relevant requirements during installation, the seam width shall be adjusted in time. First, the locking plate shall be released. After certain adjustment of the seam width, new locks shall be applied to the relevant sections that meet the requirements, and the operation shall be repeated so that the Expansion joint can Agree on the gap width.

## 4. CONSTRUCTION QUALITY CONTROL MEASURES FOR EXPANSION JOINT OF ROAD AND BRIDGE WORKS

In recent years, the demand for soybeans in the Chinese market has increased rapidly, but the soybean production is far from meeting the domestic soybean market demand, resulting in China having to import a large number of soybeans from the international market. Based on China's soybean trade data from 2012 to 2022, this paper systematically analyzes the current situation of China's soybean trade from the aspects of trade scale, production and consumption, and explores the existing problems in China's soybean trade. The results show that China's soybean supply and demand imbalance, domestic soybean enterprises are monopolized by foreign capital, China's soybean over-dependence on imports, lack of bargaining power in the international market, and the current international situation is tense. Therefore, the transformation and upgrading of China's soybean industry is imminent. This paper puts forward corresponding solutions to these existing trade security problems: first, increase the investment in soybean research and development, improve the management of domestic and foreign soybean trading markets, and support the planting of soybeans. Second, Diversified soybean import channels and actively sought soybean substitutes. Third, optimize the soybean industry structure, establish domestic non-GMO soybean national brand. Fourth, try to sign more international trade agreements and improve our trade status. In order to provide security for China's soybean trade, but also hope to bring greater opportunities.

### 4.1 Preparation work in the early stage of construction

In order to ensure the accuracy of Expansion joint construction technology application, sufficient preparations should be made before formal construction. Firstly, conduct on-site review of the construction design plan and drawings to ensure consistency between the construction design and the actual needs of road and bridge construction. Construction management personnel should be familiar with the design content and carry out overall construction planning in accordance with the relevant construction specifications and standards of municipal roads and bridges; Secondly, the procurement of construction materials is directly related to the quality of construction. Before construction, it is necessary to clarify the specifications and performance requirements of the purchased materials, as well as to inspect the quality of the materials before they enter the construction site to ensure that all material indicators are completely consistent with the design requirements; Third, organize construction, provide technical training for construction personnel in the early stage of construction, clarify the construction standards of Expansion joint [3], implement the job responsibilities of construction related personnel, and do a good job in scheduling construction machinery and equipment, so as to prepare for the formal construction of Expansion joint.

### 4.2 Control Material Quality

When selecting construction materials, it is important to strictly follow relevant regulations to avoid affecting the overall construction quality of road and bridge engineering. In general, the main materials used in road and bridge construction include canvas and steel plates. Before construction, relevant personnel should familiarize themselves with and master the specific construction techniques proposed in the construction design drawings, and select construction materials based on the construction techniques. After the materials enter the site, they should be properly stored to avoid damage to the materials due to external environmental factors.

### 4.3 Concrete construction control

During the concrete construction of Expansion joint, the concrete shall be prefabricated according to the mix proportion required by the design. In order to improve the performance of the concrete, a certain amount of

antifreeze and anti crack agent can be added to ensure the tightness of the concrete body after setting. When pouring and vibrating, the vibrating position shall be set at both sides of the concrete structure. When there is no bubble, the vibration can be completed, and finally the concrete surface shall be leveled, And maintain a height difference of within 2mm from the road surface [4]. If steel fiber concrete is used in construction, the fluidity, cohesiveness, and water retention of the concrete should be checked at regular intervals during the mixing process. Any problems found should be promptly reported to avoid quality problems after construction.

#### 4.4 Slotting and Installation

The premise of Expansion joint construction is the slotting process, which controls the slotting depth and width to improve the installation quality of Expansion joint. According to the design standard, fully investigate and consider the spacing of Expansion joint to determine the depth and width of the slot. On the basis of consistent width of Expansion joint and slot, clean up the sundries in the slot. Adjust the cleanness and flatness of Expansion joint groove, select blower or wire brush according to actual needs, and cover the upper layer with steel plate or canvas after grooving. Arrange the embedded parts of Expansion joint, derust the structure, and check whether the quality of Expansion joint meets the requirements. If insufficient steel bars are found, they should be repaired and leveled in a timely manner. Positioning and welding treatment of profile steel can make the profile steel firm and tight, and avoid deformation and displacement of Expansion joint [5]. After welding, check the quality, adjust the elevation and straightness in time, repair the position of quality defects in time, and avoid Expansion joint deviation or leakage.

#### 4.5 Maintenance technology of Expansion joint after construction

After the pouring operation, a comprehensive cleaning work should be carried out on the construction site, and then maintenance work should be carried out on the poured concrete. If the weather temperature is high, appropriate watering can be carried out. If the weather temperature is low, grass mats can be covered on the surface of the concrete for insulation. During the maintenance of Expansion joint, the impurities in Expansion joint shall be cleaned regularly, and the connection position between Expansion joint and pavement shall be noted. This position is prone to damage and crack problems. When problems are found, epoxy resin mixed with amine curing agent can be used for repair.

### 5. CONCLUSION

In summary, municipal roads and bridges require long-term and reliable operation. The construction unit should design the construction plan for municipal roads with a long-term development perspective, and the construction personnel should follow the requirements of the plan and control the various aspects of construction. The accurate application of various construction techniques in each link, especially to reduce external interference and avoid the occurrence of construction quality problems. The construction technology of Expansion joint is greatly affected by the construction environment temperature, and the construction of Expansion joint is also related to the operation safety of municipal roads. Therefore, in the actual construction of Expansion joint, it is necessary to make various preparations before construction, accurately apply the joint cutting and slotting technology, attach importance to the calibration of profile steel deformation, and do a good job in the maintenance and management of Expansion joint in the later period, so as to improve the construction quality of Expansion joint.

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