

Reflections on the High-Quality Development of Geosynthetic Materials Engineering Testing

Fei Fei^{1,2,3*}^a and Weile Xiang^{1,2,3} ^b

¹Guangzhou Harbour Engineering Quality Examination Co., Ltd., Guangzhou 510230, China

²CCCC Fourth Harbour Engineering Institute Co., Ltd., Guangzhou 510230, China

³Key Laboratory of Environment and Safety Technology of Transportation Infrastructure Engineering, CCCC, Guangzhou 510230, China

Keywords: Soil Composite Materials, Inspection Work, High-Quality Development, Status Quo, Suggestions.

Abstract: At present, Chinese inspection and testing market is undergoing a process of gradual opening up, and the penetration and competition among testing institutions is extremely fierce. In this fierce market competition, testing agencies can improve market competitiveness only by achieving high-quality development. Through studying the current situation and problems of geosynthetic materials testing, this paper puts forward suggestions from the aspects of people, equipment, quality system and information construction, in order to provide reference for the new management and operation mode of testing institutions.

1 INTRODUCTION

Material testing is an important link to provide quality assurance for engineering, and plays an important role in engineering quality control. As an entity serving the society, testing institutions are technical organizations that provide testing services for the trade (Zhao, 2013), and the accuracy and scientificity of testing data and results are the ultimate embodiment of service quality. In the testing work, the service quality of testing institutions is often affected by factors such as the level of testing personnel, the accuracy of instruments and equipment, and the perfection of the laboratory quality management system (Mo, 2023). Nowadays, traditional testing institutions have problems such as low personnel quality, backward equipment, inadequate supervision, and difficult quality control, which have a certain impact on the quality of project construction.

In order to solve the problems faced by traditional testing institutions, improving service quality, enhancing competitiveness, promoting industrial upgrading, and promoting high-quality development of testing institutions have become the only way. In

accordance with the requirements of CMA and CNAS quality certification and accreditation management, starting from the aspects of testing personnel, equipment, supporting software, site and environment, the information technology is combined with laboratory management to establish a digital and intelligent test and inspection platform. A new information management model featuring business process optimization, scientific resource allocation, reliable quality control, accurate risk management and control, and scientific and accurate data has been formed (Wang et al., 2023).

2 SIGNIFICANCE OF HIGH-QUALITY DEVELOPMENT

The testing industry is a high-tech service industry, productive service industry and scientific and technological service industry supported by the state (Jiang et al., 2012). At present, China has formed the world's fastest growing, largest and most potential testing market (Jiang et al., 2015). With the continuous development of Chinese foreign trade and

^a <https://orcid.org/0009-0006-1119-9504>

^b <https://orcid.org/0009-0005-2517-9339>

the relaxation of testing market access restrictions by governments at all levels, the development momentum of testing institutions has become more and more strong, and the competition among various institutions has become more intense. In this fierce market competition, only by achieving high-quality development can testing institutions have stronger innovation ability and market adaptability, seize market opportunities, obtain more benefits, and promote the sustained and healthy development of the testing market. At the same time, the high-quality development of testing institutions also plays a leading role in maintaining quality and safety, accelerating technological innovation, and promoting industrial progress.

The report to the 20th National Congress of the Communist Party of China pointed out that high-quality development is the primary task of comprehensively building a modern socialist country. In the future, continuing to promote high-quality development will always be the main melody of China's economic construction. As an important part of the national quality infrastructure (You et al., 2019), the realization of high-quality development is the embodiment of a positive response to national policies, which not only can obtain a better development environment and policy support to enhance the development space and potential of enterprises, but also the key to ensuring the safety of people's lives and property and social stability and unity. At the same time, in the context of the complex and severe global economic situation, the high-quality development of testing institutions plays an important role in promoting the high-quality development of the economy and society, and also provides for the recovery of the global economy.

3 TESTING WORK STATUS AND PROBLEMS

Geosynthetic materials are the general term for all synthetic materials used in civil engineering (Huo, 2022). The production and application of domestic geosynthetic materials started in the 1980s (Liu, 2016), and after more than 30 years of development,

the product types have been continuously enriched, and are widely used in road, railway, water conservancy, electric power construction, seaport, airport, military industry, environmental protection and other engineering fields (Liu et al., 2019). Although geosynthetic materials have a lot of applications in engineering construction, and have solved many technical problems for engineering construction, there are still some problems to be solved.

(1) Backward equipment

Instruments and equipment are the basic components of testing work, and the performance and reliability of testing instruments directly affect the accuracy of testing results and the quality of the entire construction project (Zhang, 2021). At present, the national government continues to support the application of geosynthetic materials in various industries and the research and development and manufacturing of new products. With the breakthrough of new technologies and the continuous construction of domestic and foreign infrastructure (Zhou et al., 2020), the geosynthetic materials testing industry will usher in more market space. However, the traditional test equipment does not have the intelligent function, has the characteristics of time consuming, labor consuming and low efficiency. For example, the traditional cutting work of geotextile is completed by manual use of templates and scissors, which has large cutting errors, low fabric utilization, high labor intensity and low efficiency (Figure 1). The equipment of geotextile tensile test is mostly simplex, which can only complete the detection of one sample at a time, and the efficiency is extremely low. At present, there are already devices on the market that can speed up the cutting rate and detection rate of geotextiles (Figure 2), but these devices are mostly for geotextiles, and other categories of soil composite materials are difficult to use. It can be seen that the update speed of instruments lags behind the development of geosynthetic new materials, which seriously affects the effective development of testing work and is not conducive to the expansion of the domestic market, and causes the market competitiveness of testing institutions to weaken.

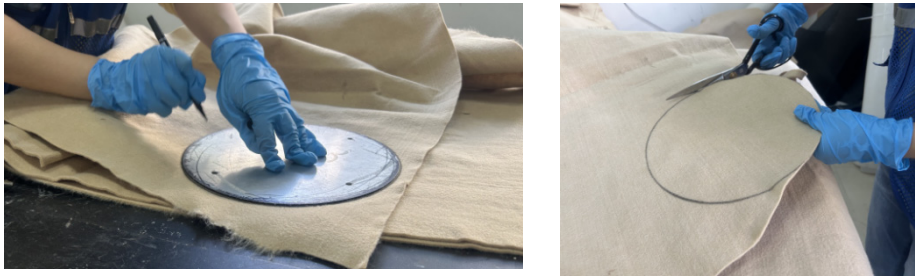
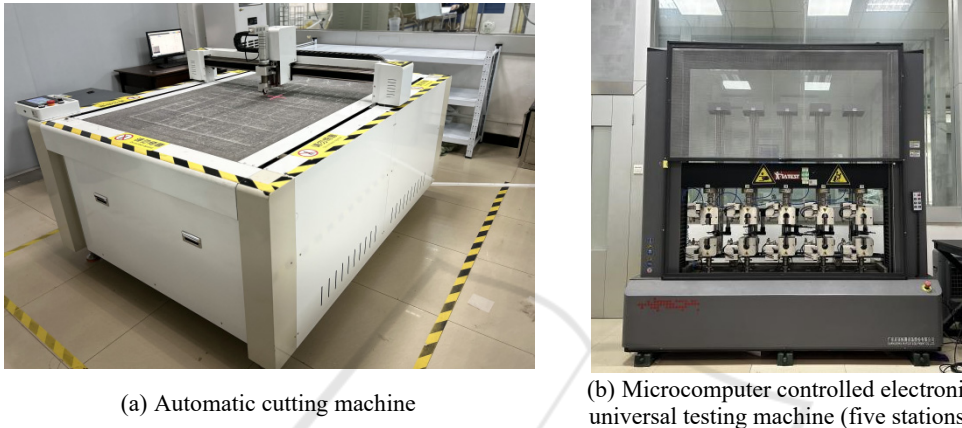


Figure 1: Traditional cutting work.



(a) Automatic cutting machine

(b) Microcomputer controlled electronic universal testing machine (five stations)

Figure 2: Geotextile equipment. (Note 1: Automatic cutting machine has the characteristics of simple operation, fast cutting speed, low labor intensity, mass production, high efficiency, high precision and fabric saving; The problem of property damage of geosynthetic materials is avoided by cold processing. Note 2: The Microcomputer controlled electronic universal testing machine can not only carry out the detection of five samples at the same time, but also reduce the labor intensity of the detection personnel, so as to achieve the goal of high efficiency and high output.)

(2) Technical personnel shortage

In the testing work, the inspection personnel is the most important component, which determines the quality of the inspection work. With the development of geosynthetic materials industry, new materials and testing equipment continue to emerge, and the continuous construction of intelligent and information platforms, testing institutions need professional and highly qualified testing technical personnel. At present, testing personnel lack excellent professional knowledge and rich work experience, weak sense of responsibility, which seriously hinders the high-quality development of testing institutions, and will lead to quality problems in testing work and cause hidden dangers.

(3) Non-uniform test standard

The test specification of geosynthetic materials in China includes two categories: national standard and industry standard. National standards are equivalent to or modified according to international

standards. Industry standards involve the Ministry of Water Resources, the Ministry of Transport, the Ministry of Ecology and Environment, the Ministry of Housing and Urban-Rural Development and other sectors, and have formulated corresponding industry product standards and application technical specifications based on international standards, national standards and some national standards (Xie et al., 2012). It can be seen that there are many norms in our country and there are differences among them. In the testing work, customers will formulate test specifications according to the nature of engineering and design requirements. Some customers choose national standards while others choose industry standards. The selected testing specifications are inconsistent and the test conditions are different, which will have different degrees of impact on the test results, as shown in Table 1. At the same time, the industry standard update is relatively slow, can not keep up with the development of new materials, which also has a non-negligible impact on the development of testing work.

Table 1: Test results under different test standard (Xie et al., 2012).

Item	Standard		Difference ratio (②-①)/①
	National standard	Ministry of transportation standard	
Test ambient temperature and humidity	20°C±2°C 65%±4%	20°C±2°C 65%±5%	/
Adjustment time of sample status/h	24	24	/
Tear strength of woven geotextile/N	707	785	+11.0
Tear strength f geotextile/N	338	345	+2.0

(4) Underexploited international markets

Infrastructure construction plays an important role in driving economic growth and is also a hot spot in international cooperation (Liu et al., 2019). At present, the global infrastructure development needs are strong, and the gap is still huge. With the continuous update and development of geosynthetic materials, its role in infrastructure construction will continue to improve. The operation mode of traditional testing institutions in China is faced with such problems as backward equipment, low working efficiency and difficult quality control. For example, the maximum gripping force of the mainstream pneumatic fixture is only 20kN, while the strength of the geotextile applied in engineering is basically between 50 and 100kN, and some special ones even reach 1000kN, obviously the detection conditions do not match the detection needs. In the face of the opportunities brought by domestic and foreign civil engineering construction, the strength of domestic testing institutions is weak and the facilities are backward, and the allocation of resources cannot be in line with international demand, which will lead to the failure to open up the international market and the loss of market opportunities.

4 RECOMMENDATIONS FOR HIGH-QUALITY DEVELOPMENT

(1) Attach importance to the construction of talents

The high-quality development of enterprises needs to form innovative development momentum, and the essence of innovation-driven is talent-driven, so the key to high-quality development lies in people. Only people with high-quality development ability can promote the high-quality development of enterprises. Testing personnel are an important part

of testing institutions, and training versatile talents has become the key to solve the shortage of personnel and weak technical strength (Hou et al., 2023). First, strengthen the construction of high-level and high-level first-class talents, introduce highly educated talents, and drive the overall development of the test group. The second is to strengthen the training of employees, formulate and improve the training plan of employees, and establish the training mechanism of employees. The third is to hold skills competition regularly to stimulate the potential of employees and encourage employees to improve their skills.

(2) Construction of quality control system

The construction of quality control system can ensure the scientific and rational work of testing institutions, reduce the operational errors of testing personnel, and then obtain accurate and true inspection reports to provide support for the quality of construction projects (Yang and Liang, 2023). The establishment and improvement of the quality system can control equipment, personnel, management and other factors that affect the test quality, which is conducive to forming an organic whole with clear division of labor, coordinated responsibilities and mutual promotion (Zhu, 2014). The first is to establish a systematic and comprehensive quality control system to achieve full coverage of elements according to the Measures for the Management of the Qualification of Inspection and Testing Institutions, the Criteria for the Evaluation of the Qualification of Inspection and Testing Institutions, the Criteria for the Accreditation of Testing and Calibration experimental capabilities and other documents. The second is to establish a suitable quality control system according to the work scope, work type and workload to provide support for the accuracy of the test report. The third is to document the organizational structure, procedures and process elements of the quality control system to form a management system document.

(3) Improve quality supervision and control

Establishing an effective quality supervision and control system can further reduce the risk and improve the quality of testing. Through improving the internal supervision system, to restrict the behavior of inspection personnel, to ensure that the whole process of inspection work is real and effective. For example, the inspection institution installs a camera in the test operation room to retain the image data of the detection process to ensure the authenticity, effectiveness and traceability of the detection process, which greatly improves the quality of supervision and reduces the labor intensity of manual supervision. At the same time, a corresponding reward and punishment system should be set up to reward employees with outstanding work, remind employees with average performance, and change employees with poor performance through post transfer or conversation, so as to stimulate employees' sense of responsibility.

(4) Construction of laboratory informatization

Introducing modern information technology into quality inspection is of great significance, on the one hand, it can speed up the development process of enterprises, on the other hand, it can comprehensively improve the quality and overall efficiency of inspection work. First, the application of information technology in testing work, quality management system and internal supervision and control can not only speed up the efficiency of testing work, but also improve the overall level of testing institutions. At the same time, testing institutions need to invest a lot of funds to introduce, update and upgrade testing equipment, build intelligent and information-based test platforms, and continue to improve testing capabilities and market competitiveness.

5 CONCLUSION

With the progress of The Times, new materials continue to emerge, and people's quality concepts are gradually improved, which has higher requirements for geosynthetic materials detection work, we must pay attention to the development of geosynthetic materials detection work. In view of the current status and existing problems of geosynthetic materials testing in China, this paper closely follows the national pace and conforms to the policy, reflects on how to practice high-quality development, and puts forward relevant suggestions, which has reference

significance for improving the comprehensive strength of testing institutions.

REFERENCES

- Zhao, G. 2013. Discussion on Improving the Operation Effectiveness of Laboratory Quality Management System. *Mechanical and Electrical Components*, 33(02): 52-55.
- Mo, L. 2023. Problems existing in the management of construction engineering quality inspection institutions and their solutions. *Chinese Architectural Decoration*, (14): 140-142..
- Wang, B., Yang, J., He, Y., et al. 2023. Understanding and practice of digital transformation in oilfield enterprise laboratories. *Petroleum Science and Technology Forum*, 42(03): 79-85..
- Jiang, E., Cao, Y., Li, J. 2012. Reservoir sediment resource utilization and River health. In *Technical Progress in Reservoir Dam Construction and Management: Proceedings of the 2012 Annual Conference of China Dam Association*. Yellow River Water Conservancy Press, Zhengzhou. Pages 47-53.
- Jiang, E., Cao, Y., Dong, Q., et al. 2015. Long-term effects of sediment resources utilization in the Yellow River. *Yellow River*, 37(2): 1-5, 12.
- You, L., Li, H., Li, K., et al. 2019. Analysis of sediment deposition characteristics of Zipingpu Reservoir since its operation. *Yellow River*, 43(11).
- Huo, J. 2022. Practical application of geosynthetic materials in civil engineering. *Aging and Application of Synthetic Materials*, 51(01): 110-112+138.
- Liu, X. 2016. Application of geosynthetic materials in highway engineering. *Transportation World*, (19): 54-55.
- Liu, K., Zhao, Y., Zhang, N. 2019. Development status and trend outlook of geosynthetic materials. *Textile Review*, (S1): 6-28.
- Zhang, Z. 2021. Study on Influencing Factors of construction inspection quality. *Urban Housing*, 28(S1): 225-226.
- Zhou, D., Zhang, P., Xie, S. 2020. Current situation analysis and development countermeasures of geosynthetic materials industry in China (2020). *Plastic Additives*, (03): 6-9.
- Xie, R., Dong, Z., Guo, W., et al. 2012. Common problems and their influence in geosynthetic materials inspection technology. *China Harbor Construction*, (06): 17-20.
- Hou, X., Zhang, K., Zhao, Q. 2023. Exploration and practice of standardization management in grass-roots inspection and testing institutions. *Standardization in China*, (14): 133-135.
- Yang, Z., Liang, B. 2023. Discussion on the Quality Management System of Construction Engineering Test and Inspection Institutions. *Urban Construction Theory Research (Electronic Edition)*, (25): 49-51.
- Zhu, M. 2014. Research on quality improvement method of indoor soil test. *Science and Technology Information*, 12(22): 64-65.