

# Optimization Layout of Anhui Provincial Construction Engineering Quality Inspection Institutions

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## Abstract

*Construction engineering quality inspection is an important means to ensure the quality and safe use of construction engineering. On the base of analyzing the status and the main problems of Anhui provincial construction engineering quality inspection institutions, the five principles were proposed to put forward the total control, optimize the structure and increase and development ability, moderate competition and standard development. By optimizing the detection mechanism, enhancing the overall level of the testing agencies, and strengthening supervision, to achieve a basic balance and reasonable layout of supply and demand in various cities and regions. It provides reference for the research and practice of the supervision and management of construction engineering quality test institutions.*

**Keywords:** *Construction engineering; quality inspection; current situation; development layout*

## 1. Introduction

The construction industry is a pillar industry in Anhui Province, with the urbanization and the continuous improvement of people's living standard, the construction scale of Anhui province to maintain stable and rapid growth, the overall strength has been continuously enhanced. Construction engineering quality inspection is an important means to ensure the quality and safe use of construction engineering, and also is the focus of project quality supervision and inspection work. Construction engineering quality inspection is authorized third parties in accordance with the relevant national laws, regulations, construction standards and design documents, to test materials, components, equipment for the construction project, and the project entity quality, and determine the quality of the activities. Construction engineering quality inspection institutions provide scientific data, fair, accurate to the community, to provide a scientific basis for the quality of construction engineering judgment.

## 2. Current Situation and Problems

### 2.1. Current Situation

Recently in Anhui province, accelerating the development of construction industry as the center, it has made great achievements to improve the competitiveness of the construction market, to regulate market order, and to cultivate the new pillar industry, which has made an important contribution to the national economy and social development of Anhui province. According to the “guiding opinions on the promotion of the construction industry to accelerate the

transformation and upgrading development of the people's government of Anhui province" ([2013] No. 4), it is expected to 2015, the province's construction industry output value will reach 7000 billion Yuan, to 2017, the province's construction industry output value of over ten thousand billion Yuan, it will be listed into the large province ranks of construction industry, (Figure 1). With the overall progress of the construction industry, construction engineering quality inspection institutions show a thriving scene. Under these conditions, good construction quality supervision has become an extremely challenging task [1]. Construction quality supervision is an aspect of construction management and is the most complex in content [2].

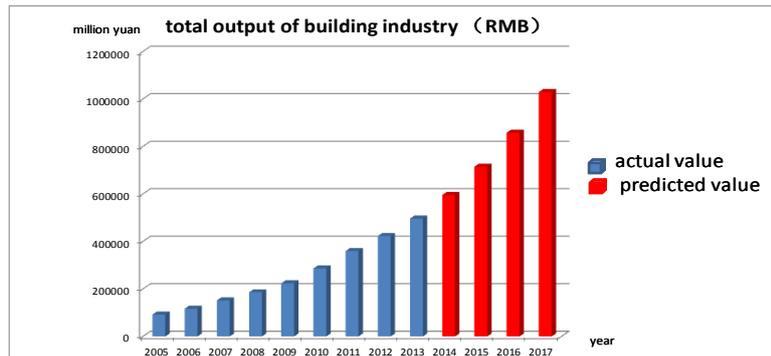


Figure 1. The Trend of Total Output Value of Construction Industry in Anhui Province

Table 1. The Basic Situation of Anhui Provincial Construction Engineering Detection Institutions \*

Area	Amount	Property				Professional detection category						
		Utilities	Enterprises		Other	WS	BS	MS	CW	ES	SS	IE
			SO	P								
Hefei	38	3	9	24	2	30	11	16	4	9	8	8
Wuhu	15	0	2	12	1	13	2	5	0	1	2	1
Bengbu	5	2	1	1	1	4	0	4	0	2	1	2
Huainan	4	1	1	2	0	3	0	2	0	1	1	1
Huaibei	4	0	0	3	1	4	0	1	0	1	0	1
Suzhou	6	2	1	2	1	6	0	4	0	2	0	0
Anqing	13	3	5	4	1	12	1	10	0	2	0	3
Lu'an	10	2	4	4	0	10	0	7	0	2	0	1
Fuyang	9	0	2	4	3	8	0	5	0	1	1	1
Chuzhou	11	1	2	4	4	11	0	6	0	1	1	1
Ma'anshan	10	0	3	6	1	10	2	5	0	3	1	2
Chizhou	6	0	2	4	0	5	0	3	0	1	0	1
Tongling	5	0	1	4	0	5	2	2	0	1	0	1
Xuancheng	9	2	3	4	0	7	0	7	0	1	1	2
Huangshan	9	0	4	4	1	9	0	3	0	1	0	0
Bozhou	4	0	1	2	1	4	0	3	0	1	0	0
Total	158	16	41	84	17	141	18	83	4	30	16	25

\* SO: State-owned; P: Private; WS: Witness sampling; BS: Basement structure; MS: Main structure; CW: Curtain wall; ES: Energy saving; SS: Steel structure; IE: Indoor environment.

In 2005, after the “No. 141” of the Ministry of construction promulgated, the construction engineering testing market of Anhui province was moderately open, and formulated a series of management system, according to the laws for approval, management and monitoring construction engineering quality test institutions. After market liberalization, various types of social capital influx detection market, a number of private capitals have joined the project quality testing agencies. Some detection institutions of construction project subjected to all levels of Government Quality Supervision Department and the quality of laboratory enterprises also have to transform the social intermediary institution, the monopoly based testing market pattern in the past was broken, and the new pattern of diversification detection market began to appear. The number of construction engineering quality test institutions has rapidly grown; non state detection institutions enhance the vitality of the detection market. At present, there has 158 construction engineering quality test institutions in Anhui province, covering the witness sampling inspection and special inspection of all projects; it has 3458 employees, including 1870 technicians (see Tables 1-2). With the expansion of the scale of construction, construction engineering quality testing workload has increased year by year, only in 2013, the province's total output value of construction engineering quality detection reached 6.85 billion Yuan.

**Table 2. The Staff Situation of Anhui Provincial Construction Engineering Detection Institutions**

Area	Amount	Professional and technical personnel	Category		
			Intermediate title	Senior professional title	Registered practitioners
Hefei	1186	558	250	110	26
Wuhu	341	175	78	26	6
Bengbu	98	53	25	1	2
Huainan	110	38	18	11	6
HuaiBei	82	35	24	6	2
Suzhou	97	70	36	4	1
Anqing	205	144	67	12	8
Lu'an	173	111	46	4	6
Fuyang	193	114	45	8	4
Chuzhou	178	91	49	5	3
Ma'anshan	287	154	87	27	11
Chizhou	73	49	26	1	0
Tongling	103	72	30	8	2
Xuancheng	172	106	46	10	5
Huangshan	83	52	31	2	1
Bozhou	77	48	22	3	1
Total	3458	1870	880	238	84

## 2.2 Problems

### 2.2.1. Small Scale and Management Norms

After the enactment of “No. 141”, according to the document, Anhui province approved the establishment of various types to meet the requirements of the detection institutions, appearing a lot of small scale of detection institutions. From the registered capital, the registered capital of more than 10 million Yuan have only

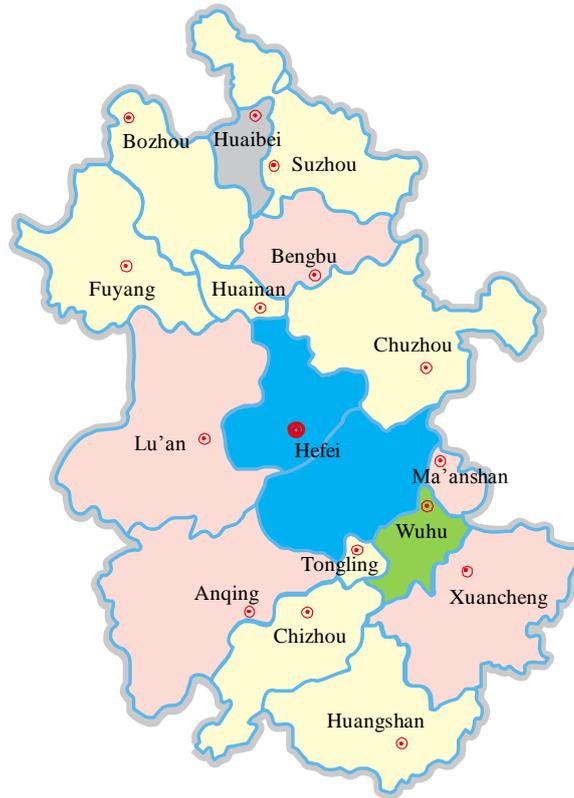
6, the registered capital of the about 88% detection institutions was below 2 million Yuan, the scale of most of the detection institutions is relatively small, single detection and technical content is low, only to witness sampling inspection or other individual testing service. Part of detection institutions due to lack of funding, testing laboratory and office space in the form of leasing, cannot guarantee the normal testing environment requirements, to detect the various aspects of management is not standardized. The professional staff number of detection institutions is shortage, poor level of testing personnel, relatively old testing equipment, which cannot deal with development needs of the construction project.

### **2.2.2. Uneven Regional Development**

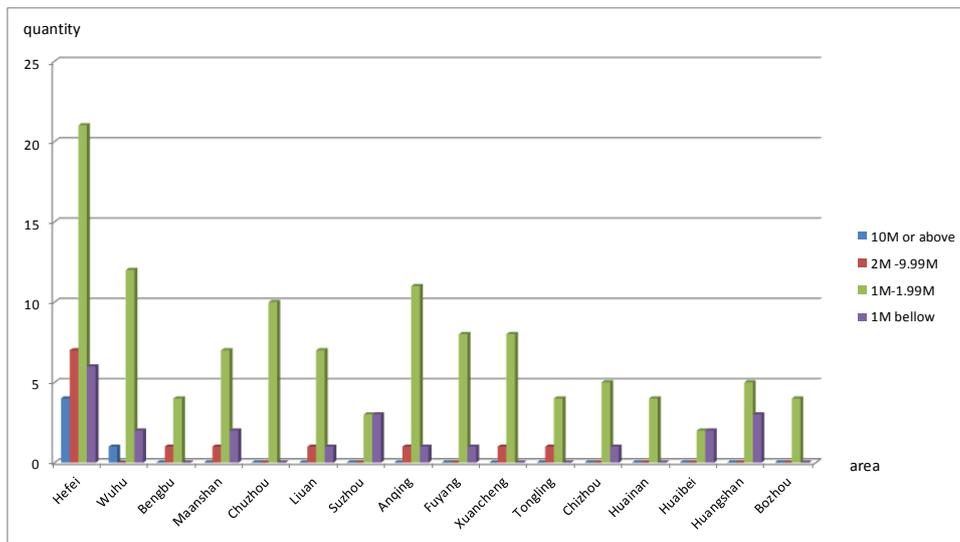
Because of the different of the construction scale and economic scale, levels of development of detection institutions are different in cities. From the registered capital distribution area of province's cities and testing agencies, the registered capital of 10 million Yuan are less in the detection institutions, there are 5 in Hefei, only 1 in Wuhu. The stronger detection institutions are mainly distributed in Hefei, Wuhu, Ma'anshan, Bengbu, Xuancheng, and Anqing (Figure 2). The registered capital of county-level detection institutions are mostly about 10 million Yuan (Figure 3). The total amount of Hefei detection institutions are most, which is related to the overall size of the larger construction area in Hefei. From the business perspective, part of the region is not engaged in steel structure; the indoor environment and other special inspection operations, curtain wall detection is mainly distributed in the Hefei area (see Table 3).

### **2.2.3 Market Environment Influence**

The relationship of current construction engineering quality test institutions and the detected unit is a kind of principal-agent, and also is the relationship of detection and being detected. Construction engineering quality test institutions as an independent third party intermediary service organization, its mission is to produce scientific data, fair, accurate to the society, for the construction of engineering quality assessment. On the other hand, the detection institutions is also facing the problem of existence, but also to undertake the business in the market, so it needs with the client to establish good relations of cooperation. Part of detection institutions for improper benefits unable to grasp their own position of fairness and justice, issued false reports serious damage to the image of the whole detection institutions, disrupting the market test.



**Figure 2. The Map of Administrative Division of Anhui Province**



**Figure 3. The Distribution of Registered Funds in Every Area of Anhui Province**

**Table 3. The Planning Land Scale of City Center and the Number and Professional Detection Category of Detection Institution✕**

Area	2010 (m <sup>2</sup> )	2020 (m <sup>2</sup> )	Number	Professional detection category						
				WS	BS	MS	CW	ES	SS	IE
Hefei	334	425	29	●	●	●	●	●	●	●
Wuhu	150	195	10	●	●	●		●	●	●
Bengbu	115	165	2	●		●		●	●	●
Huainan	118	165	3	●		●		●	●	●
Huaibei	77.1	96.2	3	●	●			●		●
Suzhou	65	73	2	●		●		●		
Anqing	100	142	4	●	●	●		●		●
Lu'an	40.5	82	4	●		●		●	●	●
Fuyang	82.8	140	4	●	●			●	●	●
Chuzhou	55	95	3	●	●			●	●	●
Ma'anshan	110	124	7	●	●	●		●	●	●
Chizhou	25.3	45	2	●	●			●		●
Tongling	63	80	3	●	●	●		●		●
Xuancheng	43	65	3	●		●		●	●	●
Huangshan	31	57	3	●		●		●		
Bozhou	50	70	1	●		●		●		

✕the data from “the overall planning of land use in Anhui province (2006-2020)”<sup>[3]</sup>

#### 2.2.4. Supervision Difficult

There is a lack of systematic understanding of the entire process of construction quality formation and not enough effort in supervising key steps<sup>[4]</sup>. Although our country in order to standardize the testing market, the introduction of all kinds of legal documents of the relevant departments, to constrain chaos of testing market, but due to the lack of legal document operation, supervision and management information system is not perfect, the control effect is not ideal, and not to ensure scientific and impartiality of engineering quality detection results. The engineering quality problems, only for the construction units, construction units, engineering supervision units' responsibility, responsibility of detection units often do not pay attention. Although the introduction of a variety of documents and measures of the construction administrative departments, a clear inspection agency shall bear the legal responsibility of the detection data, but due to the system of investigating the responsibility of the main parties involved in the test is not perfect, the lack of specific operational provision is difficult to implement. In addition, the detection process of sampling, sample preparation, testing, data processing and other links, regulatory difficult, detection results depends on the self-discipline behavior of testing personnel and institutions in the very great degree.

### 3. Layout Planning

#### 3.1. Principle

Under the guideline of scientific development, combined to play the role of market mechanism and strengthen the administrative supervision, a comprehensive upgrade of Anhui construction engineering quality testing industry, implementation of the province's total construction scale consistent with detection capability, to

further standardize the implementation of various cities and regional supply and demand balance based on the detection institutions, reasonable institutional layout, market order, the industry as a whole to enhance the level of science and technology detection, detection of institutional distribution close to the project, to meet the needs of the construction engineering quality control.

### **3.1.1. Total Control**

At present, Anhui province has 158 construction engineering detection institution, can basically meet the construction projects in provincial quality control need, the number has become saturated, and the next 3 years the number of construction projects increase modest, therefore, to maintain the existing number of invariant detection institution from the overall.

### **3.1.2. Structure Optimization**

Provincial and municipal center detection institution as a leader, can lead the development of detection industry; county-level detection institution based on solving the witness sampling and the structure detection. The arrangement and number of detection institutions should be consistence with area size and area of infrastructure, the layout of detection institutions has to be balanced.

### **3.1.3. Capacity Lifting**

With the development of the construction industry level, to strengthen the capacity of existing construction test institutional, actively promote the transformation and upgrading of the existing means of detection and the introduction of talent, improve the management level of detection institutions, and actively carry out research on methods and detection technology, to ensure the effective supervision of construction project quality control.

### **3.1.4. Moderate Competition**

Abide by the rules of the relationship between market supply and demand, it is necessary to avoid the excess of detection ability lead to vicious competition, but also to prevent the local monopoly due to the shortage of detection ability. Detection ability in the region of large scale construction is slightly higher than the actual demand, to form a moderate competition.

### **3.1.5. Specification Development**

It has to strengthen the supervision of day-to-day work of the inspection institutions. Interactive of quality supervision and testing of engineering should be implemented from the technical, remote video can supervise the detection of on-site inspection. The qualification of project quality supervision and management of institutions and personnel management together, regularly publish the credit ranking. For the detection of low credit rating agencies must focus on examination of qualification verification. Detection institutions having criticism and bad record limit the expansion of illegal, and resolutely clear out market for violation inspection personnel detection institutions.

### **3.2. Measures and Suggestions [5-7]**

#### **3.2.1. To optimize the Detection Mechanism**

According to the related document spirit of Anhui Provincial Living and Construction Office, combined with the detection ability and distribution of detection enterprise and the construction scale, it has to do layout work within 3 years of testing organizations. In principle, each county to set up 1 detection institution; according to the urban planning and construction area of city center, the establishment of 1 detection institution per 50 square kilometers, the city of not less than 2 testing organizations. The county detection institution is based on the service of testing of the main structure and witness sampling; the municipal inspection agencies should actively develop and perfect the special test, testing agencies to undertake the business of detection region. Detection methods of related industries are encouraged to research by detection institution, and actively expand the business to other industries or neighboring provinces.

#### **3.2.2 To enhance the Overall Level of the Testing Agencies**

Based on the comprehensive mapping survey of construction engineering quality test institutions, combined with good experience of neighboring provinces, actively encourage the detection institutions to enhance the detection ability and technical innovation, improve the level of development of the industry. During three years (2015-2017), the inspection agency should be in accordance with the specification and volume of business with sufficient detection test site, test environment can meet the requirements of specification, testing items testing organization 100% inspection parameters; the elimination of backward detection equipment, to reduce the interference of human factors on the test results, in order to improve the automation level of detection equipment, the key parameters automation quantity can reach more than 90%; all personnel have 100% certificates; actively introduce talents, the bachelor degree or above of personnel and testing process management accounted for more than 85%; research institutions have to carry out new techniques and methods of detection, and actively participate in scientific research project and research the formulation of testing standards.

#### **3.2.3. To strengthen Supervision of Inspection Institutions**

Fully playing the role of quality supervision institutions at all levels, there is not less than 1 times of the supervision each year for testing institutions; the quantities of annual inspection are not less than 20% of the total number of detection institutions; through the establishment of dynamic supervision model, such as the real-time data transmission for conventional material testing, real-time reporting of pile foundation detection data from the source. 100% monitoring of the raw materials of construction engineering; regularly carry out capacity verification activities, and publish the results.

### **4. Summary**

The status and present problems of Anhui provincial construction engineering quality inspection were analyzed to identify significant research associated with advanced construction test technology. With the overall progress of the construction industry, there appear some problems of construction engineering quality inspection institutions such as management norms, uneven regional development, market environment influence, and supervision difficult. The Layout planning and Some Measures and suggestions were proposed in this paper. In order to meet the diverse

needs of the construction engineering quality inspection, the following suggestions will be conducive to the healthy and sustainable development of the industry.

To encourage the existing detection institutions bigger and stronger

To strengthen the management of the detection institutions into Anhui provinces

To strengthen supervision and standardize the behavior detection

To encourage the public participation and play the association strength

To encourage technological progress of existing detection institutions

To stimulate innovation and realize more rapid progress.

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