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Application of Neural Network in Seismic Risk Survey

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Abstract: - The accuracy of inversion data is determined by the reliability of linear inversion method. Therefore, the study of nonlinear seismic inversion method is a meaningful work. This paper mainly aims at the application of nonlinear neural network inversion method in Fujian Risk Survey, the following work has been accomplished: (1) The theory and algorithm of the conventional multilayer feedforward neural network and some problems in the design of the model are analyzed and summarized. Aiming at the gradient descent function search algorithm in the BP algorithm, a method for global optimization is proposed by combining simulated annealing (global search algorithm) with Conjugate gradient method (local search algorithm) , the principle and implementation of simulated annealing and conjugate gradient algorithm are analyzed in detail. (2) Based on the analysis of conventional multilayer feedforward neural networks, the model structure and basic principle of probabilistic neural networks are studied. The object function search algorithm and its realization are analyzed. The method is applied to the risk elimination prediction for the first time, and the results are satisfactory. (3) The method and principle of inversion of reservoir parameters by using various seismic attribute information and neural network technology are discussed. In order to make full use of the effective information contained in seismic signal, the method of seismic attribute extraction and optimization is studied, the principle and implementation method of attribute optimal ranking by stepwise recursive method and selecting the most important attribute combination by interactive verification method are presented.

Keywords: Earthquake Resistance, Natural Vibration Period, Column, Beam, Foundation Type, Chemical, Dangerous, Inversion, Neural Network.

I. INTRODUCTION

The research background of this article is to conduct a comprehensive survey and evaluation of key hidden dangers in risk factors such as earthquake disasters [1], geological disasters, meteorological disasters, floods and droughts, marine disasters, and forest fires through the national comprehensive risk survey of natural disasters (hereinafter referred to as the "survey"), identify regional disaster resistance capabilities, and establish a database of comprehensive natural disaster risks and disaster reduction capabilities by type and region; The collection of seismic resistance data for different structural types of buildings, as well as the collection of geological conditions, fractures, and other aspects in Fujian Province, has played a certain role in further improving the earthquake prevention and disaster reduction capabilities of Fujian Province, especially in the chemical industry, where the chemical industry, as one of the eight evaluated buildings, poses the greatest danger. Therefore, it has played a significant role in identifying natural hazards in the chemical industry, at present, there are differences in methods both domestically and internationally. Due to the fact that foreign buildings are not as complex as in China, the types of buildings in China are quite complex, especially in terms of seismic resistance. This article mainly refers to the seismic research of buildings in the United States and Japan, especially in the field of chemical engineering. The regulatory and standard systems at home and abroad are different, including requirements for chemical management, safety production, environmental protection, and other aspects. Therefore, when conducting risk surveys, it is necessary to follow the corresponding national and regional regulations and standards. Cultural and social environmental differences both domestically and internationally can also affect the methods and priorities of risk assessment in the chemical industry. There may be differences in risk perception, risk dissemination concerns, and cultural backgrounds of risk management among different countries and regions [2]. This will affect the goals, content, and focus of risk surveys [3].

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II. CHEMICAL HAZARD ANALYSIS

Chemical Hazard analysis is a process of systematic assessment of chemical process and equipment to identify potential hazards and risks, and to take corresponding measures for prevention and control [4]. Its significance lies in the following aspects: Accident Prevention [5]: Chemical Hazard Analysis can help identify and assess the potential accident risk, including fire, explosion, leakage and so on. By analyzing the hazard, we can identify the weak links and potential causes of accidents in the system, and take corresponding measures to prevent, so as to reduce the possibility of accidents. Personnel Safety: Chemical Hazard analysis helps to assess the potential hazards of chemical processes to personnel. Through the analysis of possible accident scenarios and hazard sources, appropriate safety measures and protective facilities can be identified to protect the safety and health of staff. Environmental Protection: Chemical Hazard Analysis can assess the potential environmental impacts of chemical processes, including soil, water and air pollution. By identifying and assessing the potential environmental risks, corresponding measures can be taken for environmental protection and pollution prevention and control to reduce the adverse effects on the environment. Regulatory Requirements: chemical hazard analysis is in line with the regulatory and standard requirements of an important link. Many countries and regions require chemical enterprises to carry out risk assessment and risk management to ensure safety and environmental compliance. Through risk analysis, we can meet the legal requirements and ensure the legal operation and sustainable development of enterprises. Decision support: Chemical Risk Analysis provides a comprehensive understanding of chemical process risks and provides a scientific basis for decision-making. Based on the results of hazard analysis, Safety Management Strategy, emergency response plan and equipment maintenance plan can be formulated and optimized to minimize accident risk and loss. [6]

Risk censuses vary at home and abroad 1. Laws, regulations and standards: different countries and regions have different laws, regulations and standards for the chemical industry risk census. There are different regulations and standard systems at home and abroad, including requirements on chemicals management, safe production, environmental protection and so on. Therefore, when carrying out the risk census, we need to follow the relevant national and regional regulations and standards. 2. There may be differences in risk identification and assessment methods at home and abroad. Some countries and regions may use a combination of qualitative and quantitative methods, comprehensive consideration of the probability and impact of risk, risk assessment. Others may be more focused on Quantitative analysis and the use of risk models. 3. Cultural and social environment: Cultural and social environmental differences at home and abroad can also influence the methodology and focus of risk surveys in the chemical sector. Different countries and regions may have different perceptions of risk, concerns about risk communication and cultural backgrounds of risk management. This will affect the objectives, content and focus of the risk census 4. Data availability and reliability: there are also differences in data availability and reliability at home and abroad. A large amount of data, including accident data, chemical data, environmental data and so on, needs to be collected and analyzed in the risk survey [7]. Data collection and sharing mechanisms, data quality and reliability may differ between countries and have an impact on the accuracy and comprehensiveness of risk censuses Chemical Process Safety: Fundamentals with Applications "By Daniel A. Crowl and Joseph said. Louvar: This book covers the fundamentals and practical applications of chemical process safety, including risk assessment, safety design, accident prevention, and emergency response. Role in the chemical industry: 1 through the risk survey, chemical enterprises can conduct a comprehensive survey and analysis of all aspects of the identification of possible risk sources and risk factors. This includes the storage and treatment of raw materials, production processes, equipment and facilities, process operations, the use of dangerous goods and storage. 2. On the basis of risk survey, risk assessment is carried out, and the identified risks are qualitatively and quantitatively assessed. Through assessment, we can determine the severity, probability and impact of each risk, and provide a basis for the development of risk management strategy. 3. Risk survey can provide comprehensive safety management information for chemical enterprises. By understanding the sources and characteristics of risk, the enterprise can formulate the corresponding safety management measures and operating procedures to ensure the safety of staff and facilities. Four. Emergency Plan: Risk Census can also provide basic data for chemical enterprises' emergency plan. Through the analysis of risk source and potential accident, the corresponding emergency plan can be made, including accident response measures, emergency evacuation plan, emergency equipment and resource preparation, etc. 5. Inspection: risk survey results can be used as a basis for supervision and inspection to help the regulatory authorities to assess the safety management and risk control of chemical enterprises. According to the results of the risk survey, the regulatory authorities can take corresponding supervisory measures to ensure the compliance and safety of enterprises Destructive earthquakes have been recorded in the area of regional tectonics in Xiamen since 963 AD, with 50 m ≥4.7 earthquakes recorded in more than 1,000 years, the 1604 Quanzhou earthquake was the largest in the region. (2) The area is mainly located in the South China Earthquake Zone, the southeast corner of which spans the Western Taiwan earthquake zone. Since 1500, the seismic data of M ≥5.0 in the southeast coastal area of the region are basically complete. The Seismic Catalogue of regional seismic network can basically reflect the regional seismicity. (3) The spatial distribution of regional earthquakes is closely related to the seismic zones, and the seismicity levels in different seismic zones are significantly different. The seismicity shows an increasing trend from northwest to southeast and from inland to coast [8]. The focal depth of medium and small earthquakes in the region is concentrated in the range of 1-15km, which indicates that the medium and small earthquakes in the region belong to shallow structural earthquakes in the crust. (4) The earthquakes in the South China coastal seismic belt will be at a high level of activity in the next hundred years, and the earthquakes of magnitude 6.5 may occur. Destructive seismic activity has been very active in the western seismic belt of Taiwan, and it is estimated that there will still be magnitude 7 earthquakes in the next hundred years. (5) The basic characteristics of the regional modern tectonic stress field are represented by the NW-SW horizontal stress axis, the NW-SE near horizontal principal compressive stress axis and the near-vertical intermediate axis. (6) The target area has been affected by 7 earthquakes with earthquake intensity above VI, of which 2 earthquakes with intensity VII and 5 earthquakes with intensity VI. (7) Two destructive earthquakes were recorded in the near-field, mainly located in the northeast of the target area, and the near-field seismic activity is weak, mainly located in the southeast offshore area, and the epicenter space of the earthquake. See Figure 1, regional geological structure map of Xiamen [9].

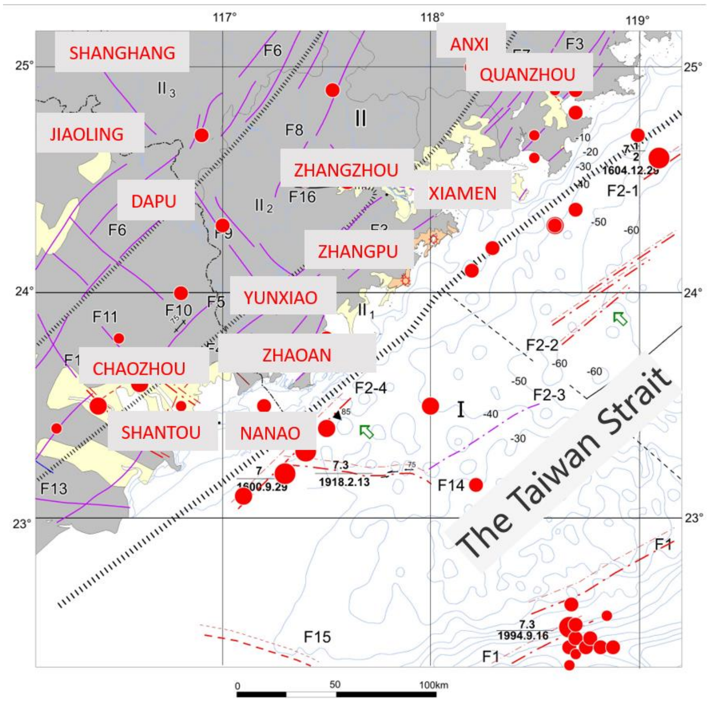

Figure 1: Regional Structural Map

III. Methods

The method of sampling and detailed investigation: a-collecting method: collecting construction drawings and related data from relevant departments or house owners. B-analogy: in the same block, with the selected object structure similar to the characteristics of the house, the collection method to complete the house inventory. C-field measurement method: the selected sample of detailed survey objects, the use of field measurements to get detailed survey data. House sampling detailed inspection should be as far as possible the collection of house detailed inspection target building, structure construction drawings and other detailed information [10], when the archives detailed inspection target drawings are incomplete or missing, data should be filled in, drawings drawn and photographs taken by analogy or field survey. The specific principles of technical method selection are as follows: 1) when the object of detailed investigation has detailed architectural, structural construction drawings or other information, data collection method should be used, and on-site verification. 2) When there is no detailed construction drawings or other data, it is better to use analogy method and carry out on-site verification. 3) When the detailed investigation object does not have the detailed building, the structure construction drawing or other data, cannot find the analogy object with the block, should use the actual survey method.

IV. RESULTS

According to the data of adjusting files and measuring, the data collection and quality inspection system of building facilities in the PC terminal was filled in the electronic questionnaire, and the detailed data input was realized5. Duration figure 2.

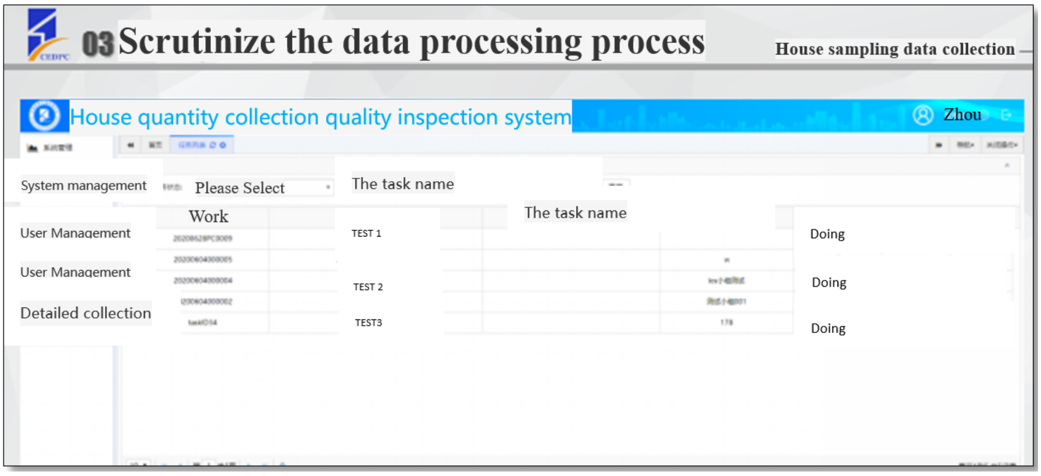

Figure 2: Input Graph

The results of the investigation on the seismic capacity of different buildings show that there are the most high-rise and multi-storeys buildings in the investigation area (Xiamen is highly urbanized [11], and the least wood-frame buildings, and most of them are used for tourism and leisure, the stone structure houses are very common (characteristic of South Fujian), and most of the houses built recently are brick-concrete structure with frame structure [12]. The following from the number of investigations, regional distribution, building years, the number of floors and other indicators for statistical analysis. (1) according to the characteristics of Xiamen housing, combined with the quantity base of various structural types, the number of industrial factory buildings is the lowest, with 33 buildings examined in detail, accounting for 7.2%, the second is wood-frame houses, 48 detailed survey, accounting for 10.5%, the largest number of "Brick and concrete structure, brick and wood structure," 76 detailed survey, accounting for 16.6%. For details, see the detailed survey quantity statistics chart in figure 3.

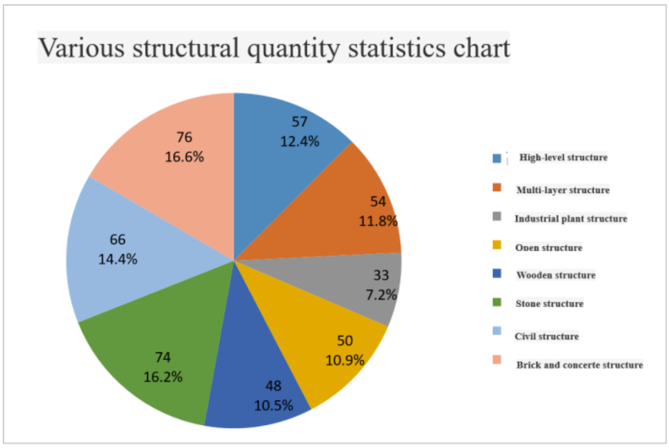

Figure 3: Comparison Chart

(2) In terms of the actual distribution of the surveyed houses, Huli district had the lowest number of surveyed houses with 37(8.1%), followed by Siming District with 54 surveyed houses with 11.8%. The district with the highest number of surveyed houses was Jimei District, detailed survey of 119 buildings, accounting for 26.0%. For details, please refer to the detailed survey quantity chart of each district in Figure 4.

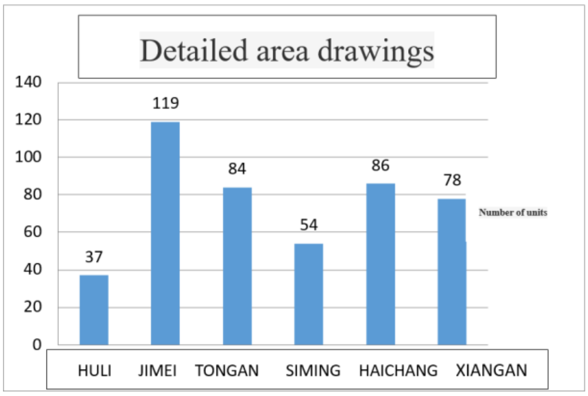

Figure 4: Area Drawing

(3) According to the year of construction, the number of houses in the 1990s was the lowest, with only 21 houses, accounting for less than 5% , accounting for only 4.6% , followed by 31 houses in the 1970s and 80s, accounting for 6.8% respectively, the largest number was in the 1910s, with 175 buildings, accounting for 38.2% . See the architectural chronology chart for details in figure 5.

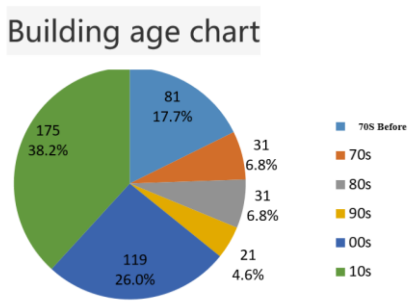

Figure 5: Building Age Chart

(4) According to the number of storeys, the buildings can be divided into four groups: 1-3 storeys, 4-7 storeys, 8- 15 storeys, 16 storeys and above. The numbers are 321, 80, 11 and 46 respectively. In terms of the number of storeys divided [13], the number of 8-11 storeys houses was the smallest, with only 11 houses, accounting for 2.4%, followed by the number of houses above 16 storeys, accounting for 46 houses, accounting for 10.0%, with the largest number of 1-3 storeys houses, accounting for 321 houses, it accounts for more than 70% (70.1%) and covers 7 types of structures other than high-rise structures. See the building floor number chart for details in figure 6. [14]

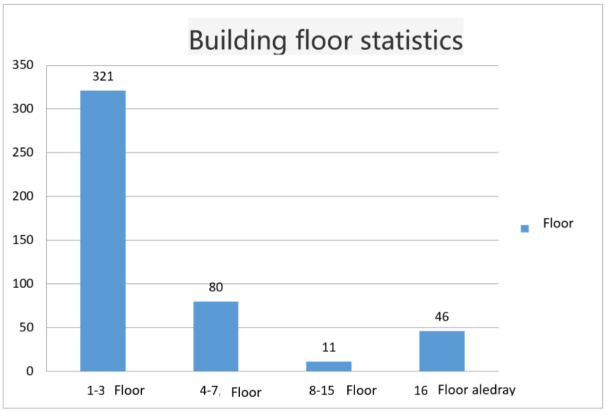

Figure 6: Floor Statistics

V. Analysis of Seismic Performance of Each Structure

Steel structure steel structure has good ductility [15], which can offset the energy consumption of seismic wave. Steel is basically isotropic material, carrying tensile, compression, carrying shear strength are very high, and has good ductility, especially steel structure with its unique high ductility to reduce the seismic response[16]. Steel structure can also be regarded as an ideal elastic-plastic structure, which can absorb and consume seismic input energy through plastic deformation of the structure, so it has a higher ability to resist strong earthquake. The steel structure is lighter than other structures, which also greatly reduces the impact of earthquake. In addition to high seismic performance, steel structure construction cycle short, high degree of industrialization, environmental performance is also significantly better than the concrete structure. Steel structure used in shopping malls, passenger stations, stadiums and other buildings, good flexibility, can absorb seismic forces, but the cost is high. 2. The seismic performance of RC structure is second only to that of steel structure, especially for frame-tube structure, shear wall structure and frame-shear wall structure. Although the reinforced concrete structure is heavy in quality, its ductility is good, and it can withstand large deformation, so its seismic performance is better than that of brick-concrete structure in earthquake. The main seismic damage characteristics of multi-storey and high-rise reinforced concrete structures are as follows: the seismic damage of the top column is more serious than that of the bottom column, the seismic damage of the corner column is more serious than that of the inner column, the seismic damage of the short column is more serious than that of the long column, the beam and column are the most easily damaged, and the infilled wall is easily cracked [17].

Brick-concrete structure, brick-wood structure brick-concrete structure because its load-bearing wall body own weight is big, is the brittleness material, its tensile strength, the shear strength, the bending strength are all low, therefore the masonry building's anti-seismic performance is relatively bad. However, the ring beam and structural column of brick-concrete structure can form hoop effect, which greatly improves the seismic performance of brick-concrete structure. In addition, because of the structural characteristics of brick-concrete buildings (low-rise, small bay, fixed layout) general residents will not easily due to decoration or other factors to destroy the structure layout. Therefore, in the “Wenchuan County 512” and other earthquake cases, the self-structure reasonable, according to the code design and construction of the brick-concrete structure shows the seismic capacity is not weaker than the frame structure. As long as the joints are not damaged, the structural structure of brick and wood is relatively small in vertical load, and the timber has good elasticity, strong tensile and shear resistance along the grain, and the spatial system formed by the vertical and horizontal bracing connection of the roof truss, can effectively play an anti-seismic role. 4 wood structure wood structure material tenacity is good, is the mortise and tenon mode connection and fixation, so the structure of the integrity is good. Moreover, the timber structure has light weight and small seismic force, and its seismic performance is better than that of unprotected brick-concrete structure. 5 stone structure stone masonry is a kind of masonry which is made of mortar connecting material stone block, and is a kind of non-uniform network structure system. There are a lot of joints in stone masonry, and there are a lot of original voids and holes in the fire, and the craftsmen's construction method is mostly artificial joint filling, so the plump degree of mortar in the ash joint is seriously insufficient, therefore, the seismic and shear-resistant performance of stone masonry is significantly reduced. 6. The main bearing walls of civil structures are adobe walls and rammed earth walls. Because of the early construction period (usually before 70S) and the self-built buildings, the seismic performance is not considered enough, and the raw soil weight is big, the material performance is bad, the wall is easy to corrode, therefore the civil structure rural residential building earthquake resistance is worst [18].

VI. Conclusions

Based on the analysis of seismic performance from low to high, the seismic performance of civil and stone structures in rural residential buildings in Xiamen city is poor. The second is the brick-concrete structure, with the construction of 6 to 10 floors of the most dangerous, because the amount of brick, brittle strong. The third is the bottom frame structure, that is, the bottom floor is the frame structure, used as street-facing commercial outlets, large bay, in order to save costs more than two floors and common for brick and concrete structure, because the two materials are rigid, top-heavy foot light, the ground is liable to collapse after an earthquake. The relatively strong aseismic frame structure is more common in buildings above 10 storeys. The frame shear wall structure has the best seismic performance, among which the pure shear wall structure has the best performance. Most of the high-rise buildings above 30 storeys are frame shear wall structures, because the shear wall is a concrete structure with high stiffness, strong horizontal seismic strength, and low damage rate in many earthquake cases. In common building structures, steel structure has the best performance in seismic performance because of its good flexibility and absorption of seismic force, but the construction cost is higher.

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